PLUREL

Governance and planning strategies

Module 3

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PERI-URBAN LAND USE RELATIONSHIPS – STRATEGIES AND SUSTAINABILITY ASSESSMENT TOOLS FOR URBAN-RURAL LINKAGES, INTEGRATED PROJECT, CONTRACT NO. 036921

D3.4.5

Peri-urban prospects

Policy development with scenariomodellingfor the Manchester City-Region

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SIXTH FRAMEWORK PROGRAMME

Contents

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Partners

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Abstract

The Manchester city-region is changing rapidly. The economic and social structure is in flux, even while much of the landuse policy is set in the formal spatial planning system. The scenario method use here enables debate on topical questions: e.g. how to fund green infrastructure in an age of deficits and privatizations? Or, how can local market towns co-exist with globalized business parks?

Scenarios are a structured way to explore the future. They can help with anticipation of possible risks and opportunities, in the face of rapid and unpredictable change. The PLUREL project applies 4 main scenario storylines to explore the possible futures for peri-urban areas across Europe. This Deliverable looks at the application of these scenarios to the Manchester case study (i.e. the Manchester 'Rural Urban Region'). This includes:

- Main drivers of change and scenario issues in the Manchester city-region.
- results from the MOLAND modelling (to follow).
- implications for policy and further research (to follow).

Objectives/aims

This deliverable aims at a stakeholder driven local-regional based scenario development with both qualitative and modelling results.

The regionally specific scenarios will distinguish between general and locally specific land use relations and their impact in the urban fringe. The MOLAND model will be applied here as in all case study regions, as input to the regionally specific scenario development.

Methodology

Key parameters in spatial development were formed as inputs to the Moland Manchester model:

- housing forms, patterns, landuse density are all relevant to the growth and pattern of peri-urban development;
- Transport infrastructure may promote in- or out-migration, counter-urbanization, or re-urbanization.
- Spatial planning policy may aim to manage or contain growth in larger cities, smaller cities and towns, or smaller rural settlements.

Results / findings / conclusion

The alternative possibilities for urban and spatial development are the subject of the PLUREL – and yet they do not always link very directly to the 'driving force' scenarios. Location choices and urban form patterns are clearly the outcome of many forces, only some of which are described in the driving forces scenarios. Others are the outcome of accidents of geography or history or politics: the uncertainties of lifestyle and behaviour: or the not always rational choices of businesses or policy makers. For example under A1-Hypertech, does the new information technology enable the population to live and work in the countryside, or to commute greater distances, or to live in the middle of the city with a better quality of life? Each of these possibilities is plausible, and each is very sensitive to the future of peri-urban areas.

We have also explored **'challenges, dilemmas, contradictions and conflicts'.** These can open up new possibilities and/or opportunities, which more straight line scenarios might miss. For instance,

- Is the landscape mainly for production / leisure / nature conservation – and who are the winners or losers in these options?
- Will peri-urban areas be peripheral and dependent, or the valued 'green heart' to the cities which are both loved and hated?

Popular science description

The Manchester city-region is changing rapidly. The economic and social structure is in flux, even while much of the landuse is set in the formal spatial planning system. The scenario method enables exploration of topical questions: e.g. how to fund green infrastructure in an age of deficits and privatizations? Or, how can local market towns co-exist with globalized business parks?

Scenarios are a structured way to explore the future. They can help with anticipation of possible risks and opportunities, in the face of rapid and unpredictable change. The PLUREL project applies 4 main scenario storylines to explore the possible futures for peri-urban areas across Europe. This Deliverable looks at the application of these scenarios to the Manchester case study (i.e. the Manchester 'Rural Urban Region').

Note on status of this report

Due to delays with the implementation of the Metronamica modelling system, a previous version of this report was submitted in month 42. This version now includes the results of the landuse modelling and policy implications.

Classification of results/outputs:

For the purpose of integrating the results of this deliverable into the PLUREL Explorer dissemination platform as fact sheets and associated documentation please classify the results in relation to spatial scale; DPSIR framework; land use issues; output indicators and knowledge type.

Spatial scale for results: Regional, national, European	Regional scale (i.e. Manchester Rural Urban Region)
DPSIR framework: Driver, Pressure, State, Impact, Response	A focus on the drivers or dynamics of landuse change: plus the pressures, states and impacts which result.
Land use issues covered: Housing, Traffic, Agriculture, Natural area, Water, Tourism/recreation	All forms of landuse are covered.
Scenario sensitivity: Are the products/outputs sensitive to Module 1 scenarios?	The results (when complete will be an application of Module 1 scenarios at the local & regional scale.
Output indicators: Socio-economic & environmental external constraints; Land Use structure; RUR Metabolism; ECO-system integrity; Ecosystem Services; Socio-economic assessment Criteria; Decisions	A full range of indicators are relevant.
Knowledge type: Narrative storylines; Response functions; GIS-based maps; Tables or charts; Handbooks	A full range of knowledge type are produced (when complete).

How many fact sheets will be derived from this deliverable:	1 fact sheet is directly based on this deliverable: 'future land use change scenarios'

Introduction

The dynamics of peri-urbanization and land use change are complex and multi-level, beyond the capacity of any one technical modelling system. So it is essential to work with scenarios: these will combine technical analysis and modelling, with more qualitative issues which explore social, cultural, economic and political changes. Such scenarios are most effective when they reach beyond a purely technical format, to include a creative set of stories, models, images and visions.

Scenarios are a kind of 'story of the future'. They can help with anticipation of possible risks and opportunities, in the face of rapid and unpredictable change. They are not forecasts, rather they aim to ask 'what-if' questions (for example, *'what-if' the global credit system was to melt down?).*

Some of these questions are focused on long term trends which might be modelled or predicted (e.g. *how many people will be retired or working in 2030?)*: at the same time we need to include for 'wild cards' of high impact and low probability (at least low perceived probability before they occur): (*e.g. what if a volcanic eruption shut down the EU air travel industry?).*

The PLUREL scenario framework

PLUREL developed a scenario framework, based on the IPCC report 'SRES' (Special Report on Emissions Scenarios) (IPCC, 2001). As detailed in PLUREL Deliverable 1-3-2, this included:

- Applying the global scenarios to the EU space, up to the years 2025 and 2050.
- Exploring a series of plausible 'shocks', i.e. rapid and important changes which are relevant to the scenario and the theme.
- Focusing on the implications for urbanisation and peri-urban land use change.
- Translating the scenarios into modelling parameters, and also into policy and governance factors.

The scenarios were used in Module 1 as the basis of 'top-down' modelling work on economic, demographic, environmental and land use changes. In the study of spatial typologies and governance systems, they are applied to different urban types and governance types. In in each of the case study regions the 'top-down' scenarios are the starting point for 'bottom up' scenarios within each of the case studies. The scenario framework includes 4 main types (with references to the A/B/1/2 of the IPCC report):

- A1 – hyper-tech: rapid development in technology: rapid counter-urbanisation.
- A2 – extreme water: rapid climate change and water crisis: defence of the cities.
- B1 – peak oil: energy price shock: localisation of activity.
- B2 – fragmentation: localized communities with polarisation of cities.

Objectives of the Work Package

To develop forecasting scenarios for the case study regions following a (Module 2 provided) typology of dynamics in European urban regions and the global scenarios by

Module 1. The regionally specific scenarios will distinguish between general and locally specific land use relations and their impact in the urban fringe. The MOLAND model will be applied in all case study regions as input to the regionally specific scenario development.

Objectives of the deliverable

The PLUREL project applies 4 main scenario storylines to explore the possible futures for peri-urban areas across Europe. These were developed by Module 1 with top-down, macro-scale driving forces for economy and society. There were further inputs from Module 2 on the spatial and governance typologies. This deliverable aims at a stakeholder driven local-regional based scenario development with both qualitative and modelling results.

Structure of the deliverable

This Deliverable explores the application of these scenarios to the Manchester case study (i.e. the Manchester 'Rural Urban Region', as defined in D3.3.3.).

- First we set out the scenarios in progress: storylines and settings.
- Then the methodology for scenario development, and its applications to policy analysis.
- Third, a review of scenario issues and uncertainties in the Manchester city-region.
- Fourth, the results from the MOLAND modelling are summarized.
- Finally, the detailed implications for policy and further research.

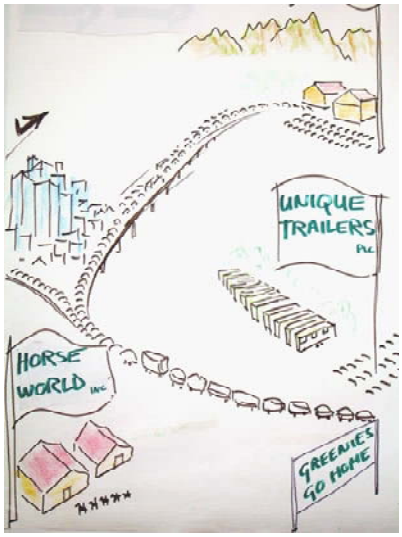
1. Manchester peri-urban scenarios

In each of these main scenarios, the *EU background is shown in italics*: **the main scenario storyline for Manchester and its area types is shown in bold**: and the implications for spatial development and policy is shown in normal type.

A1 – 'Hyper-tech' scenario

(globalizing, individual focus: high growth, technology innovation)

... a world of rapid economic growth, global population that peaks in mid-century, and the rapid spread of more efficient technologies. Investment in R&D is high and nations share knowledge and pool resources in a global research market place. Energy prices decline because supply is driven by new developments in renewable energy production and nuclear fission. The shock concerns the rapid acceleration of ICT (information & communication technology) which transforms home and work as never before.



In the Manchester city-region, the city / airport / business park system grows as a global hub, with waves of capital spinning out from the centre and the peri-urban parks. Economic growth is strong and the pressure for development is intense. This leads to value 'peaks' in popular locations, with house prices of five or ten times the average. One effect is that other locations become sinks for people not on the housing ladder, where social problems multiply, even next door to their wealthy neighbors.

Some of the population growth migrates further afield to Cheshire, Lancashire and the Pennine areas, with ever more flexible working patterns, enabled by high speed immersive video-tele-working, and rapid expansion in creative industries. These former rural areas are a combination of globalized urban culture side by side with revived traditional country crafts, such as in food, buildings, and forest products.

The peri-urban becomes segmented by carefully graded differences in value & status, which are linked to market risk & opportunity. There are contrasting trends, side by side. One is a new fascination with outdoor living as a high tech, high value activity: so, more large estates are converted to privatized country parks, for sports such as go-karting and war games. Another trend is the withdrawal of some social groups from the outdoors altogether – living in sealed buildings inside gated communities, with next generation Playstations for work and leisure. Many peri-urban environments start to resemble the Sims virtual world on which their inhabitants depend.

Implications for area types:

- The Pennine area becomes basically an eco-theme park, with tourist-based local community development (but this generates resistance).
- The Mersey Belt is used for elaborate experiments in high value eco-housing, (which means that low value communities are pushed to the side).

- Rural Cheshire and Lancashire see a growth of intensive farming, side by side with intensive outdoor leisure facilities, in privately owned country parks etc.

Implications for policy:

- **Spatial planning:** the Green Belt seems to accelerate many peri-urban problems. To counter this a next generation GB is developed which is more responsive to market needs and the return of added value to the community.
- **Local community development**: many communities are globalized migrant social groups, both high and low paid workers. So LED agenda is one of connecting the locality to global networks, alongside some efforts to pick up the pieces for excluded groups – the old / young / disabled / unskilled.
- **Green infrastructure**: the privatization of larger and larger land areas, often by global financial firms, is both problem and opportunity for GI. The question is not so much how to fund it, rather who funds it and who is denied access on the other side of a security fence?

Dilemmas and challenges:

- The high growth hi-tech future for Manchester will run out of physical room to expand – there is literally not enough space for all to live the suburban dream, without expanding into large rural areas, and thereby destroying the resources which they aspire to.
- So this could see a great restructuring in spatial patterns, where quality of place is as highly valued as quantity of space in house and plot size. The commercial logic points to gated enclaves, not just for housing, but for whole settlements, where local services, businesses and landuses are strictly controlled.
- Also the hi-tech dream of total advanced connectivity for people and enterprises, may be a myth – it turns out that people and enterprises guard their privacy. So, the roles of information filtering and knowledge inter-mediation become crucial parts of social and economic life.
- One implication of 'success' is that the huge capacity in material production and consumption does not lead to a utopia – rather to a largely bored and restless population with too much leisure time. The peri-urban zone is a likely focus for many weird and diverse activities, not all of them legal or ethical: including extremist cults based on chemical, spiritual, artistic, political or virtual alternatives.
- This also suggests a revival of the former peri-urban bad-lands and scrap-lands, this time not so much for stolen cars, but in information frontiers and 'licence free' zones, where normal rules don't apply. It can be argued that society needs such grey zones, and they could even fit into an expanded concept of 'farm diversification'. Underground spaces may be created in order to survive in areas of escalating land values.

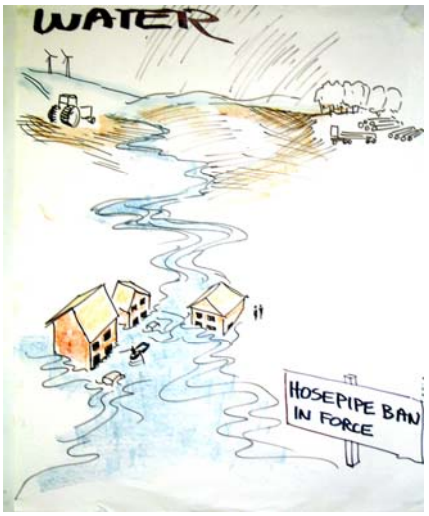
Ethnographic futures

- Define: Our landscape & society is defined by market values on a global scale
- Relate: Social relations are organized on a global market exchange basis, even within households and communities
- Connect: Advanced ICT enables virtual immersive connections: coupled with advanced high speed responsive transport modes.
- Create: Supply chains are highly organized and integrated at both global and local levels
- Consume: Materialist consumption as a status chasing activity, with the benefit of advanced technology, but with the implication of boredom and alienation.

A2 – 'Extreme water' scenario

(localizing, individual focus: low growth, bottom up)

... a more heterogeneous world, of self reliance and preservation of local identities. While the population increases, economic development is primarily regionally-oriented, and per capita economic growth and technological change more fragmented and slower than in the other storylines. The shock sees rapid increase in flooding, drought and sea level rise. A year does not go by without a major event, and in some cities and regions development is seriously constrained.



In the Manchester city-region, the climate agenda produces some awkward surprises, while arguments continue over the science, the policy responsibility, and the economic effects. Most rivers now seem to produce a 100-year flood every other year: the flood retention areas are used to capacity, displacing parkland, farmland and habitats: and the ideal of planned multi-functional land use in the peri-urban becomes very difficult.

The residential areas which are regularly flooded seem to be always in the poorest neighborhoods: this raises class and racial tensions almost to breaking point, as the rich on the hills are accused of letting stormwater roll down onto their neighbors. As public finances are very short, at a time of economic stagnation, there is little funding for flood defences, and the main growth industry is in private insurance and litigation between parties to the flooding problem.

The peri-urban area is generally fragmented, with a weak planning system, divisions between district boundaries, and reliance on a stagnant private sector for investment. Some parts are chaotic zones of hazardous land and floodplains, private appropriations and enclaves, with increasing floods & storms, while planning & investment reduces. In general Manchester's urban economy stagnates, along with the fortunes of the peri-urban retail & business parks.

Implications for area types:

- Many upland towns and neighborhoods in the Pennines manage to revive their local markets and enterprises, surrounded by small scale farming & forestry. (however there is increasing tension with commuters who are seen as taking value outside the community.
- In the Mersey Belt, there are tensions & conflicts over access to safe non-hazardous land, and green infrastructure which is shrinking and degrading (which in turn provides local business opportunities).
- Rural Cheshire and Lancashire return to their roles as regional food providers and there is a revival of mixed family farms. There is conflict between new businesses providing for urban leisure, and the large landowners with private country parks etc.

Implications for policy:

- **Spatial planning:** with a generally weak and privatized governance system, spatial planning is fighting a rearguard action, particularly in the chaotic peri-urban zones. The Green Belt is about as much as can be hoped for, and change to this is resisted more strongly – most of all by the wealthy residents who stand to lose most from change.
- **Local community development**: in the return to more local and regional private enterprise there are many opportunities for SMEs and inter-mediaries. The non-economic groups are more marginalized, and have to reconstruct local philanthropy in a reminder of pre-20th century charity.
- **Green infrastructure**: the privatization of previously public land is a challenge for GI: new schemes are devised to generate and recycle added value through community forestry for biomass and carbon storage. Much happens not by design but through informal cultivation and appropriation of woodlands and peri-urban landscapes.

Dilemmas and challenges:

- The low growth private enterprise future for Manchester is in many ways 'business as usual' – but what does this mean in a post-industrial age?
- A return to reclamation and recycling is likely, as the economy stagnates and consumers hang on to new money. The peri-urban would see a rapid growth in yards and sheds for vehicles, construction materials, consumer and specialist goods of all kinds.
- This would also encourage plot-land settlements – informal, self-organized and possibly cooperative communities, living in trailers, tepees, yurts and other portable structures. A combination of shed-lands and plot-lands could spread across the peri-urban landscape, sprouting up in the cracks of the grey infrastructure of motorways and industrial estates.
- It would be difficult for a light spatial planning system to oppose this, as it represented the main prospects for economic growth, and the possibility of greening former industrial sites, through informal local food cultivation.
- The onset of major climate change impacts will be more challenging, but we might also find that the plot-land culture breeds greater social resilience to the problems of heat, drought, storm and flood.
- However there will be tensions, and periodically wealthy residents or large landowners organize policy / vigilantes to clear the informal squatters / growers out of their area. The result could be large communities of displaced people at certain points in the urban / peri-urban structure.

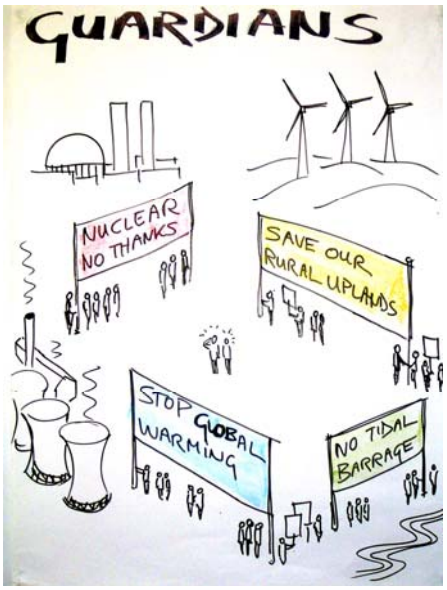
Ethnographic futures

- Define: Our landscape & society is defined by market activities at the local & regional scale:
- Relate: Social relations become more localized, but stratified by value, status, ethnicity and culture
- Connect: Both virtual & physical networks are slow and unreliable, with reduced coordination & investment.
- Create: There is a revival of small businesses, as the stagnation of the global economy makes room for local entrepreneurs
- Consume: Materialist consumption is defensive and risk-avoiding, often with yesterday's technology.

B1 – 'Peak Oil' scenario

(globalizing, collective focus)

... a future of environmental and social consciousness – a global approach to sustainable development, involving governments, businesses, media and households. Economic development is more balanced with rapid investment in resource efficiency, social equity and environmental protection. The 'shock' in this scenario is driven by the real possibility of 'peak oil', leading to rapid rises in energy prices, with many social and economic effects. For peri-urban areas, high energy prices have an enormous effect on location choices as transport costs limit commuting distances. Although tele-working is encouraged, most people attempt to return to larger cities and towns, and more remote rural areas decline.



In the Manchester city-region, the end of the fossil fuel age leads towards interesting times. The technical issues are not so difficult – electric cars become the majority choice within 15 years, with a charging network using imported solar power from Africa and biomass from Scandinavia. But there is continuing uncertainty over electric power infrastructure, and the costs of renewable energy in a privatized market. It turns out that most car drivers are not keen on the electric shift, and look for other adaptation strategies in other ways: a combination of public transport, tele-working from home or neighbourhood centres, and a reverse migration back towards large urban centres. This trend is enhanced by uncertainties on international travel, as volcanic ash continues to disrupt aviation.

In the peri-urban areas there is continuing flux of new population movements, and changes in the lives of existing residents. The implications of peak oil go much further than simply transport, to affect production and consumption chains in food and farming: construction materials: industrial manufacturing: energy, water and waste: and many logistics-based service sectors, such as tourism, catering, and retail in general. Around the conurbation the peri-urban area takes on a new importance, as the primary site for newly localized supply chains, which have to compete with the growing demand for high-quality living and working environments.

Overall the policy aspiration is to reshape the peri-urban into a model sustainable city-region: but these involves much restructuring and reshaping of landuse patterns, and so generates strong resistance and adaptation strategies. Many essential services such as vehicle recycling go underground (literally or economically): and cultural demands such as youth events move into unexpected territories.

Dilemmas and challenges:

- The global level of governance may be necessary for sustainability, and the peak oil transition may be good for climate change. But does this low carbon future enable human development in the broader sense? Some argue that strong action on climate

may not be compatible with democracy and transparency – that it may serve to exacerbate existing divisions of power, wealth and ideology.
- Will the peri-urban metro-scape be planned to the last square meter, and organized from some command and control bunker? Or are there other more responsive and effective ways to coordinate and facilitate a global sustainability agenda?
- What kind of resistance and adaptation strategies might arise? A global sustainability agenda sounds good from a distance, but when it means displacement of existing activities such as leisure on marginal land, or low value housing and businesses, then there are likely to be strong responses at the local level.
- The end of cheap fossil fuel oil is likely to diversify the technology and infrastructure. There could be conflicting agendas about landuse for bio-fuels, for leisure or for food, and between local, national or EU provision.

Ethnographic futures

- Our landscape & society is defined by public values on a top-down basis.
- Social relations are organized by EU / global values: diversity, empowerment and dematerialization.
- Virtual & physical connections are organized top-down, with large investment in public transport, and large ICT firms which are publicly owned.
- Employment is organized at global level with public-private partnership firms: supply chains are integrated & responsive to social needs.
- Personal consumption is geared to community values, with narrowing gaps between rich and poor.
- The peri-urban is carefully planned at national and regional level, with green infrastructure & multi-functional land for food, biodiversity & climate adaptation.

Implications for area types:

- The South Pennines become an international showcase for alternative lifestyles and heritage landscapes (although with strong opposition from some communities).
- The Mersey Belt is coordinated for urban growth fitted with multi-functional landscapes (with resistance from freelance farmers and foresters).
- The Cheshire rural lowlands are in a process of planned restructuring for low carbon / footprint settlements & lifestyles. There are areas of intensive farming & energy crops mixed with planned habitats and multi-functional landuse.

Implications for policy:

- **Spatial planning:** while this scenario puts governance and spatial planning back in the centre stage, there are still challenges and dilemmas. Green Belt policy is in the firing line, as it tries to build in more and more objectives, while retaining strength and transparency.
- **Local development**: economic and social development at the local town or village level is favoured in principle, but in practice is often sidelined by the more top-down policy regime. Much local activity seems to take place in spite of policy, or off-radar, or in many cases by going underground.
- **Green infrastructure**: should see a massive investment in this scenario, as an integrated city-region governance system is able to plan strategically and mobilize investments, and where necessary re-organize spatial patterns. However there are many instances where it emerges that GI was locally generated and used, and that a top-down approach pushes Manchester in the direction of Milton Keynes.

B2 – 'Fragmentation' scenario

(localizing, individual focus)

… Europe sees a fragmentation of society, in terms of age, ethnicity and international distrust. The ethnic division of cities is driven by the increased in-migration of the working-age population from outside and within the EU. Cities become more segmented as younger migrants dominate inner and central areas, and older natives populate the outskirts and enclaves outside the cities – so that peri-urban areas become 'peri-society' areas.

… then we see a human pandemic, transmitted by animals or birds, which spreads rapidly and leads to severe restrictions on the movement of people and trade. This reinforces the island mentality at the local, urban, regional and even national level.

In the Manchester city-region, the dreams of sustainability campaigners seem to be coming true, with a shift towards the local community for many kinds of social and economic life. This can generate a high quality of life for communities with good levels of housing, jobs and opportunities. But for communities who are already disadvantaged or excluded, the segmentation of the city can lead to a downward spiral.

In the peri-urban area this leads towards even more segmentation than before, so that communities have to build fences and gates (literally or institutionally). The higher value environments of the Pennine uplands and the Cheshire lowlands are protected and enhanced with a range of social and economic thresholds, such as schools, family ties, small business levies etc. Lower value communities tend to be pushed towards lower value locations, in the shadow of grey infrastructure such as motorways, heavy industry, waste management and waste water plants.

Peri-urban land in this fragmenting metro-scape is often managed and worked from nearby: community farms producing for local markets, or local schools setting up nature trails and outdoor experiences. Again there is a darker side, in that higher fences may be needed to keep 'undesirables' or 'foreigners' from stealing food, or squatting on underused corners.

Dilemmas and challenges:

- The local and communitarian is an aspiration for many in the sustainable development lobby: but what does this mean in practice? The system of advanced globalized capital is more powerful than some had recognized so far, even for basic commodities such as bread or water.
- So the localization trend could lead, not to the demise of globalization, but to a different and more segmented kind of pattern. For instance, various communities in

the Manchester city-region are linked ethnically to Pakistan: racially to China: economically to the USA: and culturally to the Caribbean.
- Other communities are likely to form more extreme cultures and sub-cultures: these could be based on extreme leisure, religious and mystical sects, augmented realities through virtual or chemical technologies.
- The policy aspiration for a 'sustainable city-region' could be more difficult in many ways: as local communities block any infrastructure improvements: housing needs cannot be met through any new development:

Ethnographic futures

- Our landscape & society is defined by community-based values and activities on a local basis
- Social relations are community based, but segmented by race, class, age, lifestyle and ethnicity.
- This society is well connected within local groups, but fragmented between communities. Web 2 & 3 is the basis for virtual & transport networks, but seems to create many divisions.
- Many firms are local cooperative or social enterprises with complex supply chains and trading systems. Low production efficiency is balanced by better fit to demand.
- Much consumption is within the household or community, with less materialism and more socio-cultural meaning.

Implications for area types:

- Manchester reverts to its history of 500 neighborhoods, while more enclaves spring up in the peri-urban zone, many of them gated communities.
- The peri-urban is the ideal space for self-contained communities to grow, with many functions of food, energy, water etc, in an 'archipelago of enclaves'.
- The Pennine communities strengthen their local self-help & resilience (with opposition from many business and landowning interests who are not local at all)
- The Mersey Belt communities tend to fragment into social and cultural types: including locals / commuters / ethnic / cultural groups.
- Rural lowland communities retreat into more self-contained village life, with social trading systems. Much rural land is used intensively for local food, energy etc, with local labour input. As much of their wealth comes from urban service sectors, there are high capacity virtual and video working centres in each village or neighbourhood.

Implications for policy:

- **Spatial planning:** Green Belt policy is appropriated by high value communities who use it to defend their amenities and way of life. Strategic planning in general will need to adapt to the fragmentation challenge above.
- **Local development**: while economic / social / ecological integrated development at the local level is a priority, the effects are very uneven, and in both rich and poor communities there is conflict over means and ends.
- **Green infrastructure**: local involvement in developing green infrastructure is very strong, and there is active investment by landowners and developers. However the fragmentation between communities means that strategic level corridors and patches are more difficult, and that regional adaptation to climate change is slowed down by endless negotiations and deliberations.

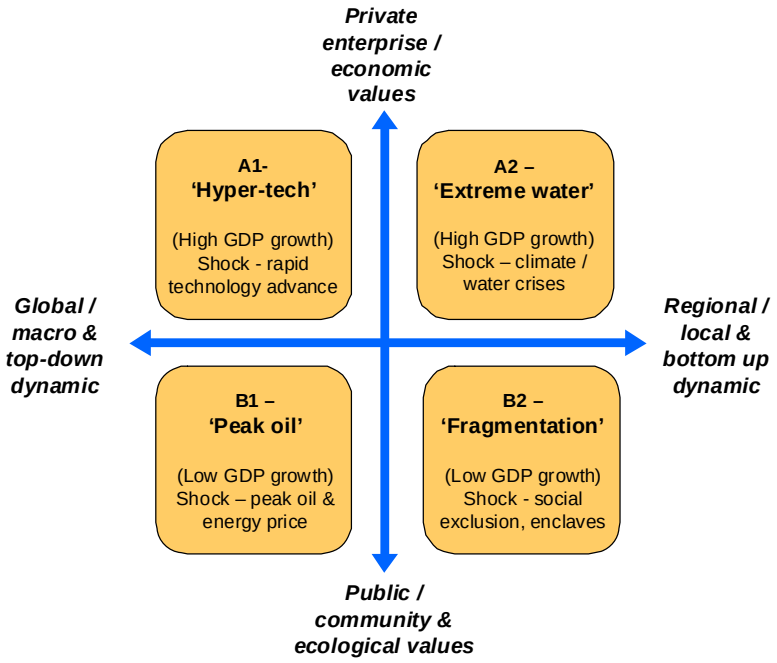
2. Methodology

Top down scenario framework

Scenarios are best organized in a framework, which provides a clear logic and structure for comparing different possibilities. Module 1 developed a framework based on the global scenarios of the IPCC (Intergovernmental Panel on Climate Change), known as SRES (Special Report on Emissions Scenarios). These were then adapted to the PLUREL agenda:

- Applying the global scenarios to the EU space, up to the years 2025 and 2050;
- Developing a series of possible and plausible 'shocks', i.e. rapid and important changes in particular sectors or themes;
- Focusing on the implications of each scenario for urbanization and peri-urban land use change.

PLUREL Scenario framework



The result is shown as a 2 x 2 framework as in the diagram above, (with code letters "A1" etc, borrowed from the IPCC scheme). The vertical axis is concerned with globalized and top-down dynamics, versus localized and bottom-up dynamics. The horizontal axis focuses on public and collective values, versus private enterprise values. The results of the shocks, with their implications for urbanization can be summarized:

- ***A1 – hyper-tech:*** rapid development in ICT: strong pressures for counter-urbanization and spread into rural areas.
- ***A2 – extreme water:*** rapid climate change and water crisis: defensive forms of urban development and infrastructure;

- ***B1 – peak oil:*** energy price shock: rapid localization of activity as transport becomes more costly.
- ***B2 – fragmentation:*** various forms of pandemic disease, combined with social polarization of communities and cities.

This framework then extends into social and economic factors which have been modeled at the EU and national scale.

The thinking behind a recent scenario project for the North West region have also been included: (NWDA, 2010). This contains a similar cross-axis (public-private): but a different vertical axis (high / low economic growth).

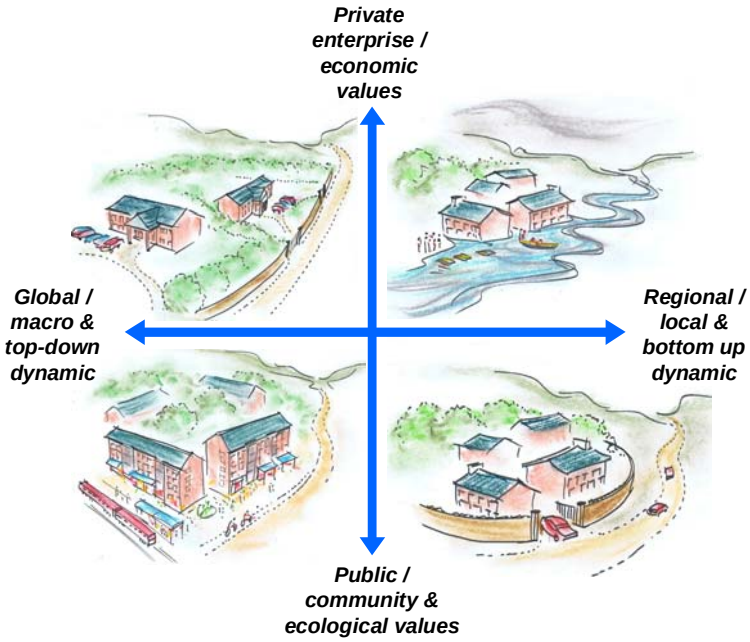
The summary results of the top down scenario modeling for Manchester are as follows:

	A1	A2	B1	B2
scenario parameters	**'Hyper-tech'**	**'Extreme water'**	**'Peak oil'**	**'Fragmentation'**
	globalizing / privatizing	localizing / privatizing	Globalizing / public	localizing / public
Population growth (EU 27)	*Medium-High*	*Medium*	*Low*	*Medium*
fertility	*medium*	*medium*	*low*	*medium*
mortality	*low*	*medium*	*high*	*medium*
migration (international)	*medium*	*medium*	*low*	*medium*
GDP growth (EU 27)	*high: 3.4%*	*high: 3.2%*	*low 2.25%*	*low 2.25%*
urban population growth (average)	*low*	*high*	*Medium*	*medium*
peri-urban / rural population growth	high	low	very low	medium
"Shock" storyline	rapid technology advance	extreme water events	peak oil	fragmentation, social exclusion

Visualization of the PLUREL framework

As a further input to the scenario mix, visualization is extremely useful in enabling wider and more creative thinking. The 'generic' visualization below shows the same typical location under four very different patterns of urban development.

- A1 – hyper-tech: large detached houses with multiple cars per household.
- A2 – extreme water: scattered adhoc development, suffering from flooding and other environmental hazards.
- B1 – peak oil: planned higher density mixed use in 'transit-oriented developments'.
- B2 – fragmentation: scattered development for gated and inward-looking communities.



Applied to the Manchester case, these represent the range of variation in the discourse and policy agenda: and likewise in the aspirations of residents. The reality of settlement patterns after 20-40 years has a large inertia, as only 20-40% of the building stock is likely to be renewed in that period. This shows up in the landuse modelling results in section 4.

Bottom up scenario framework

The 'ethnographic futures' scenario framework was developed to explore future possibilities from contrasting and cross-cutting perspectives, with a focus on the human experience side of the picture. This explores 5 overlapping fields:

- Define: the concepts, ideas and paradigms we use to define the world around us
- Relate: social structures & relationships which link people and organizations
- Connect: the technologies used to connect people, places and things
- Create: the processes and technology through which we create goods & services
- Consume: the goods & services we create, and the ways in which we aquire and use them.

VERGE as a Scanning Framework:

In a full scenario development process, this would be used as the basis for an extended collective deliberation. This may take extended periods, such as the recent experience for Natural England SCENE 2060 scenarios, of 3 sessions of 2 days each, (Natural England, 2009).

	A1	A2	B1	B2
Ethnographic parameters	**'Hyper-tech'**	**'Extreme water'**	**'Peak oil'**	**'Fragment ation'**
	globalizing / privatizing	*localizing / privatizing*	*globalizing / public*	*localizing / public*
Define	Our landscape & society is defined by market values on a global scale	Our landscape & society is defined by market activities at the local & regional scale	Our landscape & society is defined by public values on a top-down basis.	Our landscape & society is defined by community-based values and activities on a local basis
Relate	Social relations are organized on a global market exchange basis, even within households and communities	Social relations become more localized, but stratified by value, status, ethnicity and culture	Social relations are organized by EU / global values: diversity, empowerment and dematerialization.	Social relations are community based, but segmented by race, class, age, lifestyle and ethnicity.
Connect	Advanced ICT enables virtual immersive connections: coupled with advanced high speed responsive transport modes.	Both virtual & physical networks are slow and unreliable, with reduced coordination & investment.	Virtual & physical connections are organized top-down, with large investment in public transport, and large ICT firms which are publicly owned.	This society is well connected within local groups, but fragmented between communities. Web 2 & 3 is the basis for virtual & transport networks, but seems to create many divisions.
Create	Supply chains are highly organized and integrated at both global and local levels	There is a revival of small businesses, as the stagnation of the global economy makes room for local entrepreneurs	Employment is organized at global level with public-private partnership firms: supply chains are integrated & responsive to social needs.	Many firms are local cooperative or social enterprises with complex supply chains and trading systems. Low production efficiency is balanced by better fit to demand.
Consume	Materialist consumption as a status chasing activity, but with the benefit of advanced technology.	Materialist consumption is defensive and risk-avoiding, often with yesterday's technology	Personal consumption is geared to community values, with narrowing gaps between rich and poor.	Much consumption is within the household or community, with less materialism and more socio-cultural meaning.
Other: implications for the peri-urban	The peri-urban becomes segmented by carefully graded differences in value & status, coupled with risk & opportunity.	The peri-urban is a chaotic zone of hazardous areas, private appropriations and enclaves, with increasing floods & storms, while planning & investment reduces.	The peri-urban is carefully planned at national and regional level, with green infrastructure & multi-functional land for food, biodiversity & climate adaptation.	The peri-urban is the ideal space for self-contained communities to grow, with many functions of food, energy, water etc, in an archipelago of enclaves.

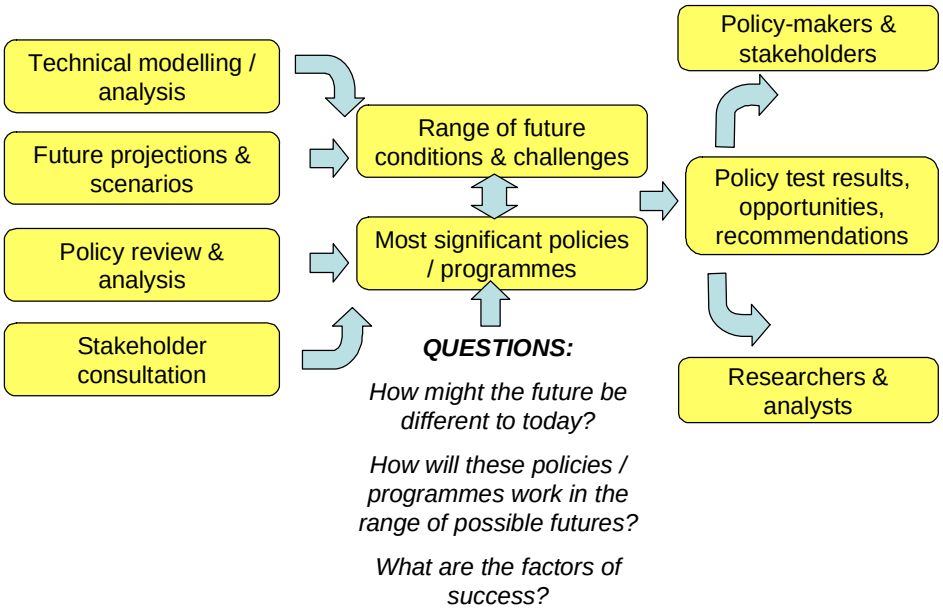
Policy-scenario testing

In the PLUREL Manchester development, there were several scenario mini-workshops, followed by a series of structured interviews. These focused on current and future agendas and policy responses, and asked the interviewee to name their view on the most

important 'key drivers and challenges' for the peri-urban agenda. These were then allocated to each of the 5 ethnographic fields, and each of the scenario types.

- Review the issues raised by stakeholders, on 3 levels: (policy / peri-urban / structural)
- Analyse from these the most significant scenario axes of change
- Fit these to the top-down PLUREL scenarios and the results for Manchester
- Extract the technical parameters for the MOLAND landuse model
- Develop scenario storylines and spatial profiles
- Explore for each scenario the policy implications and responses.

'Policy-scenario testing'



Generally we find two kinds of information in scenarios -

a) Technical and quantitative information, more suitable for technical model settings. Some of these hard factors can form inputs to the MOLAND model, which is being developed across the PLUREL project.
b) Non-technical, human and qualitative factors, more suitable for wider discussion with stakeholders and the public.
c) Experiential and multi-media is also a powerful way to explore scenarios and elicit possible responses.

The M3 scenario developments take in the general development trajectories in each city-region location - firstly with a focus on political/economic drivers:

- Governance & institutions
- Economic & employment trends
- Lifestyle and social trends
- Values and cultural trends

The outcomes are then seen in alternative trends for urbanization and land-use relationships:

- Land-use dynamics – urbanization, infrastructure, development
- Land-use patterns – spatial connectivity, contiguity etc

Each of these is over-arched by stakeholder cultural factors and worldviews: such as:

- Roles, functions and values of peri-urban / rural / natural areas (e.g., what is the purpose of rural areas?)
- Structural & paradigm change in urbanization & spatial development (e.g, does wireless tele-working change everything?)

3. Scenario issues in Manchester

Scenarios are a way to project forwards the concept of 'transition', i.e. emergent structural change, or paradigm shift at various levels of a system. While transitions can be seen on many levels - social, economic, cultural, political, technological, etc – their eventual outcome can only be seen in hindsight. Effective scenarios are basically exploring the current transitions in progress, and questioning the boundaries of the 'space of possibilities'. Where they are followed through, then the implications for present day activity can be explored as a 'space for opportunities'.

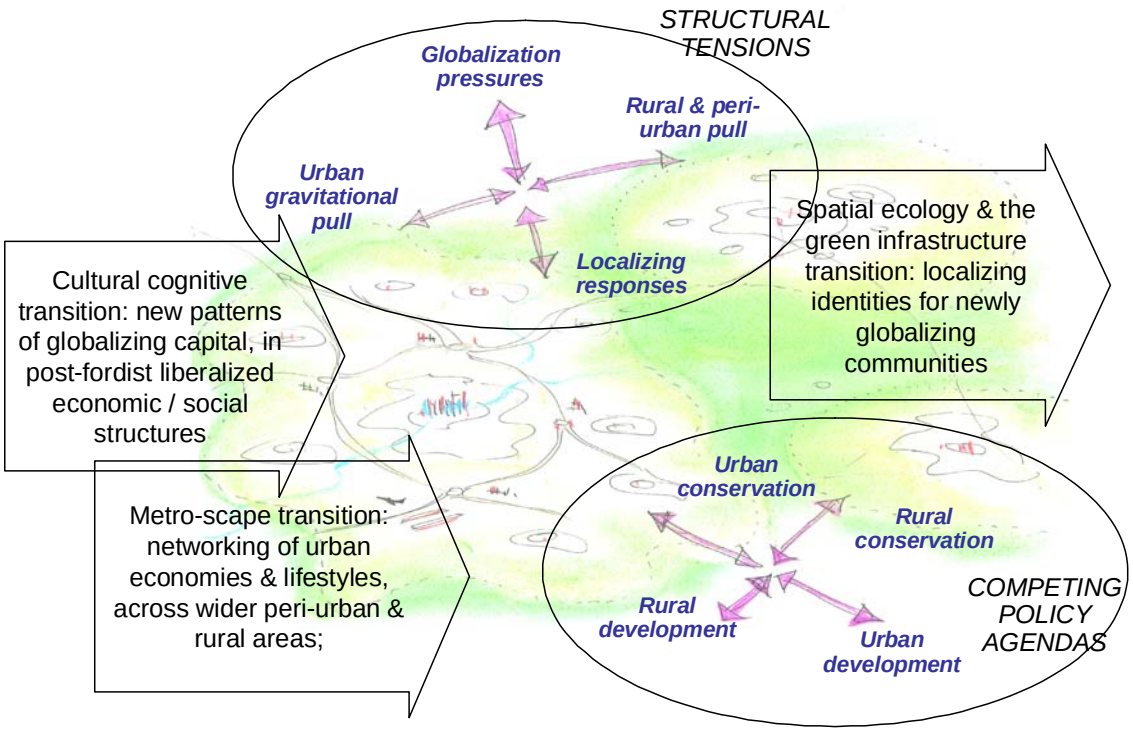
Manchester city-region in transition

Manchester was one of the world's first industrialized and global trading cities, creating notorious levels of pollution and industrial sprawl. 150 years later the peri-urban city-region is divided, with newly restored green infrastructure side by side with post-industrial wastelands. In each case there are local agendas competing with global forces, re-inventing a future role and identity in a complex metropolitan landscape or 'metro-scape'.

The PLUREL research approach aimed to look beneath the surface to explore three main peri-urban 'transitions', as in the picture:

- 'Metropol-ization': an 'urban transition' of economies and lifestyles, networked across wider peri-urban and rural areas;
- 'Cultural capitalism': a 'global transition' – new patterns of globalizing economic / social structures and activities;
- 'Spatial ecology': a 'green infrastructure' transition: new directions in localizing places and economic / social activities at a local level.

Peri-urban transitions in the Manchester city-region



In the background are new directions in the 'territorial cohesion' agenda. Greater Manchester has a fragmented governance, split between ten independent municipalities: however there are experiments in progress with new forms of partnerships and consortiums. The UK government has set up a 'City-Region Pilot' programme, and Greater Manchester now has a set of partnership Commissions on environment, economy, housing etc, and a novel Low Carbon Economic Area Initiative. There is a relatively stable spatial planning system, and long experience of urban fringe policies and programmes.

While physical development is limited by the Green Belt and similar policies, social / economic / cultural change in the peri-urban area can be rapid (depending on how it is measured). So the agenda is how to respond to new types of problems and opportunities in the peri-urban – not just physical sprawl, but the social / economic / cultural fallout from a large and messy urban system.

Overall, the Manchester city-region shows a possible future direction for older industrial metro-scapes, with lessons for other parts of the EU. There is generally positive experience in partnership agencies, multi-functional land-use, and the Green Belt spatial policy – although this is now being questioned. However there are also powerful forces, of globalization and privatization, social exclusion and fragmentation, and governance systems in continuous flux, which increase the challenge of the peri-urban agenda and the uncertainty of its future.

The transitions can also be summed up as 'issues', 'agendas', or 'discourses' which have been identified by interviewees and other respondents.

General policy issues:

- Social exclusion & deprivation: divisions of wealth & poverty
- Cultural fragmentation: generation gaps & cultural gaps
- Economic stagnation: non-competitiveness, volatile employment
- Low quality townscape & local environments
- Climate change – emissions mitigation and impacts adaptation.

Peri-urban issues:

- Derelict & underused & neglected land
- Traffic congestion & other impacts
- Urban pressures: commuting, commercial development
- Urban take-over & peri-urban dependency

Spatial and local applications

Each of the main area types in the Manchester city-region has a distinct profile and trajectory. Overlaid on these is the spatial development and spatial patterns of the city-region as a whole.

	A1	A2	B1	B2
Implications for area types	**'Hyper-tech'**	**'Extreme water'**	**'Peak oil'**	**'Fragment ation'**
	globalizing / privatizing	*localizing / privatizing*	*globalizing / public*	*localizing / public*
Spatial patterns in Manchester city-region	Manchester grows as a global hub, with waves of global capital spinning out from the centre and the peri-urban hubs.	Manchester's urban economy stagnates, along with peri-urban retail & business parks.	Manchester becomes a national / EU centre of governance, public services & social innovation.	Manchester reverts to its history of 500 neighborhoods, while more enclaves spring up in the peri-urban zone, many of them gated communities.
Implications: for peri-urban	The peri-urban becomes segmented by carefully graded differences in value & status, coupled with risk & opportunity.	The peri-urban is a chaotic zone of hazardous areas, private enclaves, & informal / illegal landuses: with increasing floods & storms, while planning & investment reduces.	The peri-urban is carefully planned at national and regional level, with green infrastructure & multi-functional land for food, biodiversity & climate adaptation.	The peri-urban is the ideal space for self-contained communities to grow, with many functions of food, energy, water etc, in an 'archipelago of enclaves'.
Implications: Pennine area	The Pennines are basically an eco-theme park with tourist-based local community development.	Pennine towns and neighborhoods revive local markets, with small farming & forestry.	The Pennines are a international showcase for alternative lifestyles and landscapes (with strong opposition from some communities).	The Pennine communities strengthen their local self-help & resilience (with opposition from some business & landowners)
Implications: Mersey Belt area	The Mersey Belt is used for elaborate experiments in high value eco-housing, (which means that low value communities are pushed to the side).	In the Mersey Belt, there are tensions & conflicts over access to non-hazardous land, and green infrastructure which is shrinking and degrading (which in turn provides local business opportunities)	The Mersey Belt is coordinated for urban growth fitted with multi-functional landscapes (with resistance from freelance farmers and foresters).	The Mersey Belt communities tend to fragment into types: including locals / commuters / ethnic / cultural groups.
Implications: rural lowlands:	Rural Cheshire and Lancashire see a few areas in intensive farming, side by side with intensive outdoor leisure facilities, in privately owned country parks etc.	Rural Cheshire and Lancashire are regional food providers with mixed family farms. (conflict between new businesses providing for urban leisure, and the large landowners with private country parks).	Rural lowlands are in planned restructuring for low carbon / footprint settlements & lifestyles. There are areas of intensive farming & energy crops mixed with planned habitats and multi-functional landuse.	Rural lowland communities retreat into more self-contained village life, with social trading systems. Much rural land is used intensively for local food, energy etc, with local labour input.

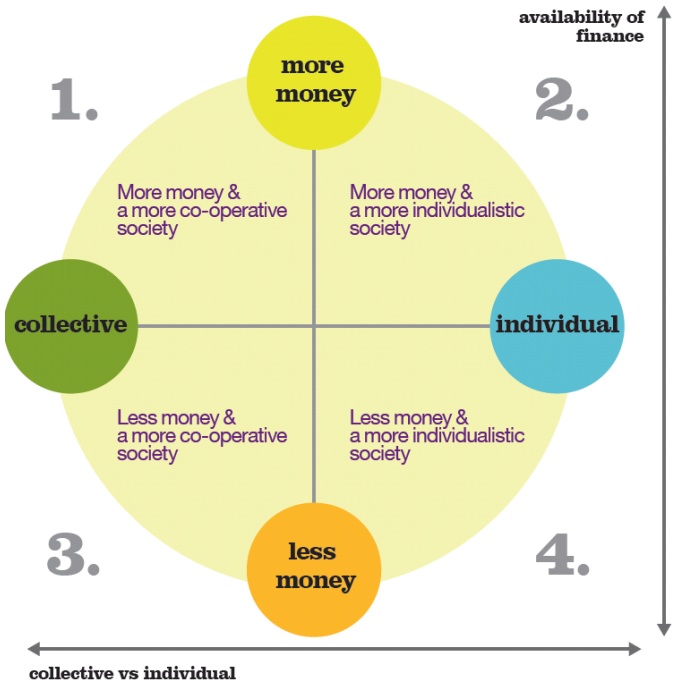
Scenario challenges & dilemmas

In particular we are interested in **'challenges, dilemmas, contradictions and conflicts'.** The above explores the most interesting 'histories of the future' for Manchester's peri-urban. These have the potential to open up new spaces of possibility and/or opportunity, which straight line scenarios might miss.

Generally, where there is a system, there will be conflicts, contradictions and internal pressures which shape it. And where that system is in transition, there will be more dilemmas and challenges which are raised for different actors involved. For every change there will be adaptation, resistance or denial: and for every policy there will be opposition, sabotage or counter-vailing forces.

For instance, in the Manchester upland areas, there are particular questions and uncertainties which have emerged through stakeholder discussions:

- *Is the landscape mainly for production / leisure / nature conservation – and who are the winners or losers in these options?*
- *Will peri-urban areas be peripheral and dependent, or the valued 'green heart' to the cities, which are both loved and hated?*
- *Will the upland areas go along with the top-down scenarios, or create local forms of resistance and opposition, which are part of their non-conformist history?*



Regional & city-region scenarios

A participative scenario programme was run by the North West Development Agency (NWDA), in order to explore the robustness or sensitivity of the Regional Spatial Strategy and the Regional Economic Strategy. Both of these important policy platforms were

abolished by the incoming Coalition government in 2010. The PLUREL scenarios have some common elements with the NWDA set, enough to generate topical discussions with stakeholders.

Scenario drivers & uncertainties

This is a review of the local & regional driving forces & uncertainties, in terms of the future of the Manchester City-region.

Demography and social issues:

- While fertility and mortality are relatively slow changing, over several decades there emerge some very different demographic profiles.
- International and inter-regional migration are more volatile, and very dependent on policy and global economic swings, and could change rapidly.
- Urban-rural in- or out-migration is also dependent on spatial policy, the state of the cities or the countryside, and transport and communications.
- Lifestyle perceptions of city or rural quality of life, leisure and tourism, also affect the trends of peri-urbanization.

Economic and employment issues:

- Economic growth in general will affect the rate of urbanization: particularly the rate of savings and capital investment will drive the expansion of the building stock and residential land-use conversion.
- Economic structures and employment patterns also affect the trends of peri-urbanization, e.g. if home-working becomes a majority for the service industries.
- Business technology will affect not only employment but supply chain logistics, the distribution of production, services and consumption, and thereby the pressures for urbanization or peri-urbanization.

Environmental issues:

- Climate change variables are well known, but the range of uncertainty in the estimates of impacts may be increasing. These include sea-level rise and fluvial flooding; extreme weather events and hazards; soil erosion and habitat change.
- One likely climate change impact is that the urban environment may become more unpleasant and hazardous, but how much and how soon is quite uncertain.
- Water resource and flood management issues will put pressure on peri-urban development, particularly in arid climates or areas vulnerable to flooding.
- Energy demands may put pressure on peri-urban areas for production of bio-mass

Urban & spatial development issues:

The alternative possibilities for urban and spatial development are the subject of the PLUREL – and yet they do not always link very directly to the 'driving force' scenarios. Location choices and urban form patterns are clearly the outcome of many forces, only

some of which are described in the driving forces scenarios. Others are the outcome of accidents of geography or history or politics: the uncertainties of lifestyle and behaviour: or the not always rational choices of businesses or policy makers. For example under A1-Hypertech, does the new information technology enable the population to live and work in the countryside, or to commute greater distances, or to live in the middle of the city with a better quality of life? Each of these possibilities is plausible, and each is very sensitive to the future of peri-urban areas.

The spatial scenarios are to be developed by Modules 2 and 3: for the moment we set out some of the major parameters and uncertainties.

- Housing investment: housing forms and patterns: housing and landuse density are all relevant to the growth and pattern of peri-urban development;
- Transport and communications are central to the peri-urban agenda: infrastructure development may promote in- or out-migration, counter-urbanization, or re-urbanization.
- Spatial planning policy may aim to manage or contain growth in larger cities, smaller cities and towns, or smaller rural settlements: or not at all.

The further research agenda for a 'spatial scenario framework', based on a systemic understanding of the dynamics of peri-urbanization, is explored in Section 4.

Rural development issues:

- Agriculture and particularly the CAP reforms relating to intensive or extensive production, will be the major influence on land-use change.
- Biodiversity protection is a clear policy choice, which may put large parts of the peri-urban area out of development uses.
- Rural economic development trends are dependent on the scenario type, i.e. whether localizing or globalizing forces are dominant.

In reality each of these factors, and many more, is dependent on the others, and there are many more in the complex system of peri-urban development.

4. Spatial scenario modelling

Modelling platform

The MOLAND / Metronamic system is a leading modelling platform for landuse and development modelling at the urban-regional scale (www.metronamica.nl) . The Manchester application of Metronamica started late, due to an abortive programme of work on the Agent Based Model (ABM) system. However during the last 6 months of the project, there was rapid development of a modelling system for Manchester. This aimed to translate the pan-regional scenarios and local policy issues and options, into technical settings and model inputs, and then explore the outputs.

The results can then be compared with current policies such as the North West Spatial Strategy and Housing Strategy. They can also be linked into the various levels of economic and social analysis, as above. But underneath the apparently simple landuse change scenarios, is a set of assumptions and questions to be explored: -

- In an old industrial area, such as the MCR, many landuse changes are about multi-functional use, or changes in the qualities of land.
- Many landuse changes are the result of external forces. For instance the future of the Common Agricultural Policy is likely to decide whether marginal uplands are kept in pasture, or converted to ecological sites, made available for economic development, or left untouched.
- Other policy agendas are still in formation. There is a question for instance, of how far the city-region should aim to feed itself: there could be large effects on peri-urban landuse, which at the moment is driven by the need for leisure and amenity.
- Some high growth type scenarios are easily visible, while other low growth or 'sustainability' type scenarios hardly show up on the maps.

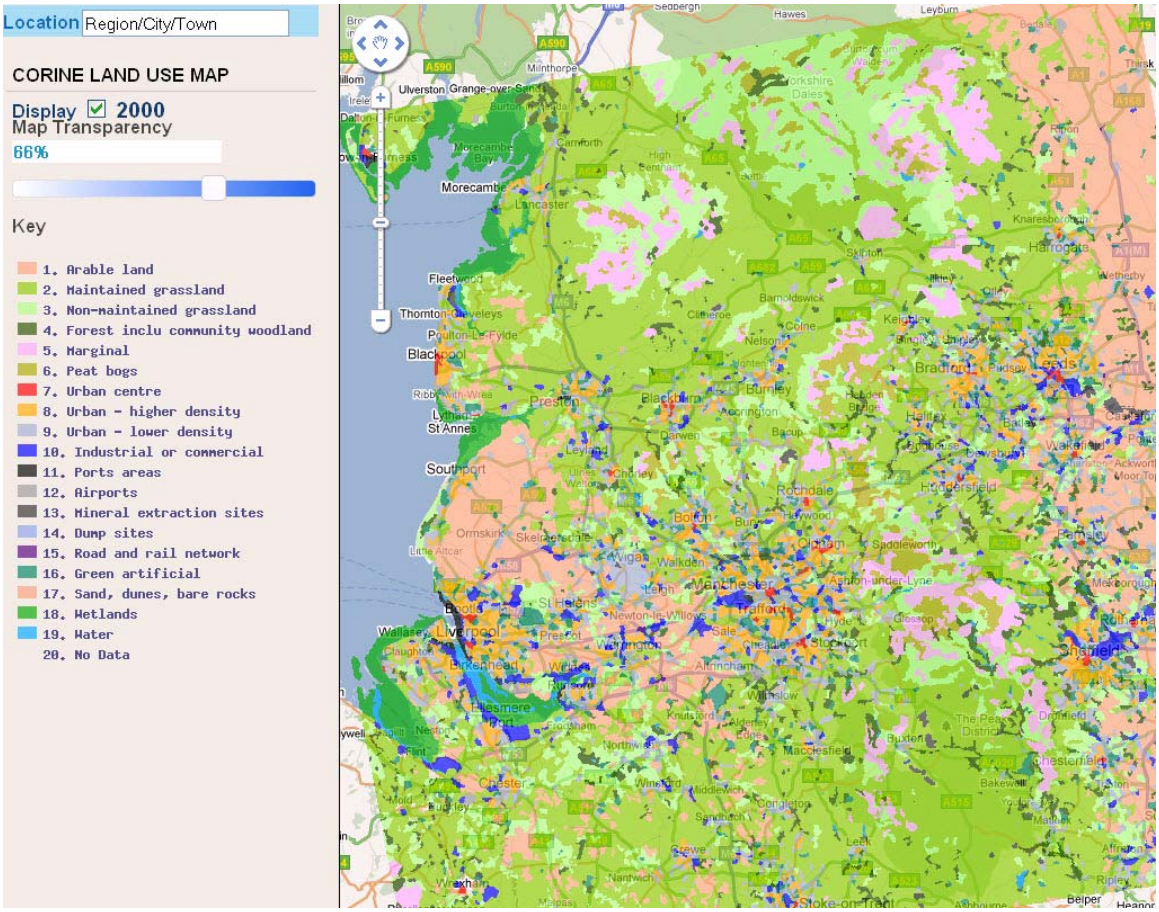
This suggests some important issues for landuse modelling. It is not often a forecast, but more a tool for focusing 'what if' type of questions, in particular the difference between policy options. It needs to be multi-scalar, so that changing patterns of fields or settlements, can be linked to higher level changes, and vice versa. It needs to be multi-actor, in helping to ask the questions on who gains or loses from landuse change, or from the policy which aims to manage it.

Further extension to Ecocities

In a demonstration of the value of PLUREL research, there is now (as of 2011) a collaboration with the Eco Cities project on climate change adaptation.

Eco Cities is a joint initiative between the University of Manchester and property company Bruntwood. The project looks at the impacts of climate change and at how we can adapt our cities to the challenges and opportunities that a changing climate presents. It is an interdisciplinary research project which draws on the expertise of Manchester Architecture Research Centre, Centre for Urban and Regional Ecology, Brooks World Poverty Institute and Manchester Business School. (www.ecocitiesproject.org.uk)

The core aim of Eco Cities is to create a climate change adaptation blueprint for Greater Manchester, by the end of 2011. The blueprint will be based on leading scientific research, will include an exploration of possible future scenarios for Manchester, and will incorporate case studies at three spatial scales: building, neighbourhood and conurbation. As a decision-aiding tool, it is hoped that the blueprint will become a key resource for planners and other relevant stakeholders in the city region as they seek to adapt to climate change.



New technology platform

The graphic here shows the technology tool for overlay of spatial data on a googlemap platform, as used in the GRABS project http://www.grabs-eu.org/

This is a powerful extension to the Metronamica tool which is otherwise fixed to its 100m grid size, as it enables zooming, overlays onto satellite or map image, with variable degrees of transparency. (This is accessible as of January 2011 on a development server at http://130.88.39.152/clc/)

Extension to social quality of life valuation

The next step to follow on the PLUREL work is to link the scenario work with public attitudes, lifestyles and values.

This draws on work done by ECA on the 'Quality of Life Simulator' (QOL). This is based on 'conjoint' surveys of public perceptions, in different parts of each case study region,

including the Manchester city-region. The software can then analyse & present the results by type of social profile, location, age and other factors (figure xxx).

- A 'baseline scenario' can be calculated from the majority of preferences under each category.
- Other alternative scenarios can be constructed, either referring to model outputs such as Moland, or by expert judgement. These can be targeted at specific locations, e.g. the peri-urban.
- The differences between one scenario and the next can be tested by examining 'tipping points' i.e. the point at which 50% of the population would try to move location, based on their reported preferences and priorities.

In the MCR there is initial data from a randomized public survey with a sample size of 765. This can be used to investigate the public preference sets, which are likely to drive people to move from one location to another. This focuses on the responses from the peri-urban location people, under each of the PLUREL scenarios. This helps to understand the social and cultural dynamics of out-migration, counter-urbanization, and social change in the peri-urban areas.

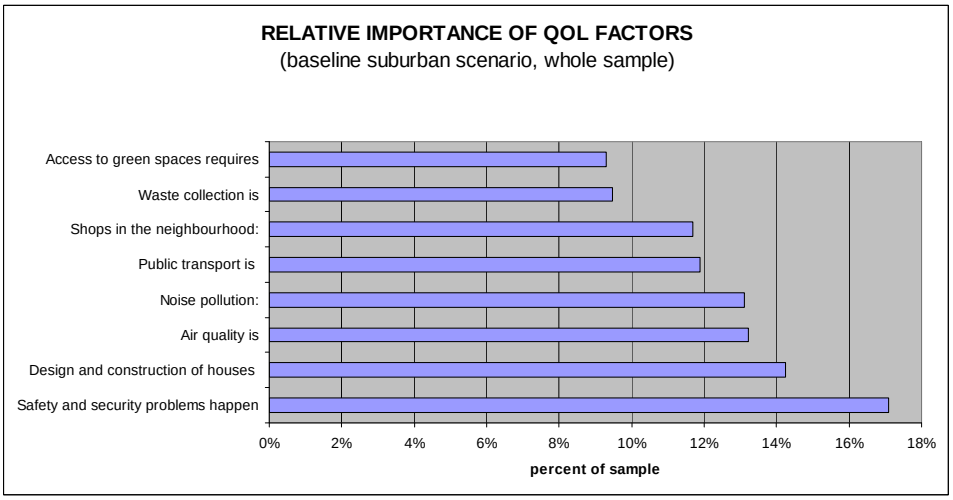


Figure xxx: quality of life survey results:
Source: Edinburgh College of Art 2010

Extension to economic scenario valuation

A further step is to link the ongoing development and debate on scenarios with the economic analysis. There are various ways of doing this. In the Manchester application there is no large scale econometric model or input-output analysis. Instead the economic study done by University of Bath focused on the valuation of green infrastructure, in particular the alternative management scenarios for peat bogs. These point to a kind of dilemma, in that conservation for long term climate stability is often a short term cost and therefore difficult to justify in policy terms.

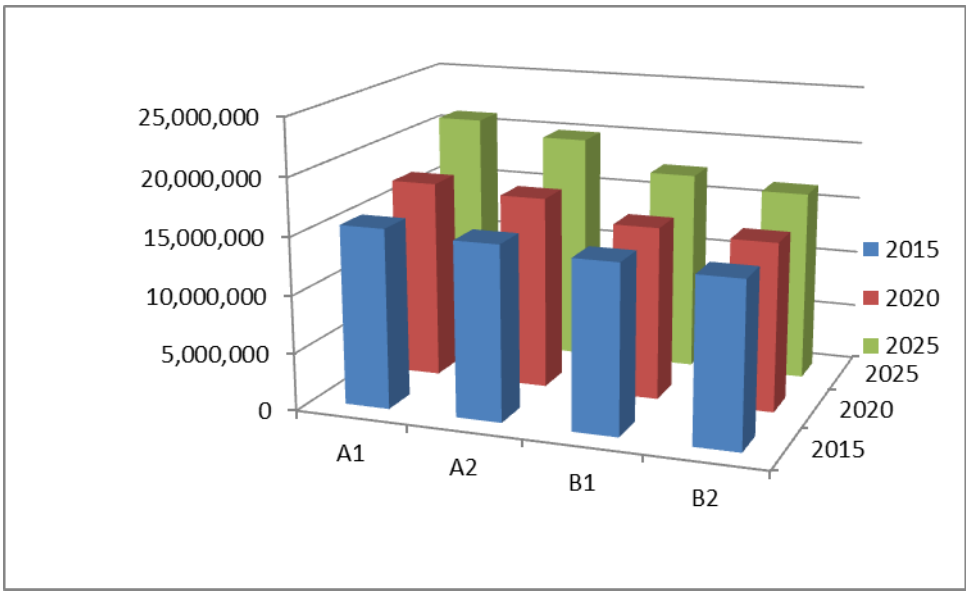
Such dilemmas point towards new concepts in environmental economy (Everard & Ravetz, 2009). An economic cost-benefit analysis is applying cost benefit analysis techniques to look at the economic case for two kinds of strategy: green infrastructure, and local economic development. In the green infrastructure study, each case in each location is unique, but we can identify costs and benefits which are more direct:

- Direct costs of land tenure, reclamation and restoration, planting, maintenance:
- Direct benefits in ecosystems services, e.g. local produce, flood risk management, soil conservation etc.

There are also costs and benefits which are more or less indirect and/or 'shadow', which are more or less measurable:

- Indirect costs, such as extensification of public services, and opportunity cost from displacement of high value landuses.
- Indirect / shadow benefits, such as property prices, public health, access to leisure, general amenity value
- Intrinsic benefits, such as bio-diversity, landscape quality and cultural heritage in its own right.

***Figure xxx: Net Benefits of Maximum Wetland Scenario over No Intervention* (£2008)**
Source: University of Bath 2010



This gets very topical when more extended chains of value added are factored in, which is often the case for local economic / community development with multi-functional landuse.

For instance, the Incredible Edible scheme described below, involves many enterprises in the public, private and social sectors: generating value which is both financial, social and environmental: and helping to recycle land which is otherwise marginal, at minimum public cost and maximum benefit. There are also many possible spin-off benefits, such as increasing climate change adaptation and resilience. If the economic analysis includes for all social and environmental benefits, this kind of project looks like a winner: so then the question is the factors of success or the barriers to action.

Key modelling parameters

The MCR landuse model application highlights the key parameters which link the technical modelling to wider policy concerns.

- Economic growth, where this is related to landuse demands for housing, industry or commerce:
- Population growth total, as a result of fertility / mortality, and of migration.
- Residential density: generally declining due to household size reduction and rising space demand: but in some cases balanced by infilling, sub-division, multiple generation families etc.
- urban / rural migration, with incentives for centre city, suburban, peri-urban or rural locations.
- Clustering of growth in the 'neighbourhood effect', where each landuse competes and attracts similar or different landuses.
- localized growth, which may follow current trends of high and low growth districts: or change from that pattern:
- Environmental policy, where related to demand for green-blue infrastructure (shown in the landuse maps as 'forest / community woodland': and 'green artificial' i.e. parks, golf courses, urban open space etc.
- Spatial planning policy: particularly the strength of restriction in the Green Belt, related zones, and ecological sites.

Patterns of peri-urbanization

One of the most significant scenario factors for this project is not only the volume, but the spatial 'pattern' of peri-urbanization. This includes a number of layers, from the surface to the underlying structures:

- Spatial pattern of urban development and settlement forms;
- Spatial pattern of green infrastructure and other forms of infrastructure;
- Spatial pattern of land ownership and land access;
- Spatial pattern of lifestyles and 'activity prisms';
- Urban development and spatial governance – spatial planning, urban regeneration, local –regional government, public services, public infrastructure etc.
- Underlying factors in spatial governance: property rights and law: public investment: space intensive / extensive paradigms:

Landuse & development modeling

Basic starting parameters are calculated at the regional scale from top-down EU level models: NEMESIS for economics: IIASA model for demographics.

- **Population growth:** this is calculated at the regional scale: including - basic parameters of demography, household size & structure
- **Economic growth:** including basic GDP, incomes, employment: also including financial investment in built environment.
- **Growth in artificial surface: t**his is the basic measure of urbanization
- **Growth in floorspace:** this can be independent of 'artificial surface', by building more multi-storey / underrground. All other things equal, there is a correlation between this and artificial surface.

- **Counter-urbanization:** this represents the outward push of larger cities, and the pull of more remote rural areas.
- **Settlement clustering:** this represents the localized gravitational field of smaller settlements, i.e. propensity to cluster around local centres for services, infrastructure etc.
- **Transport / infrastructure investment:** this shows the level of growth in roads / public transport modes. (Also would apply to energy / water in some more remote areas).
- **Spatial planning policy:** this shows the strength of planning to contain development: for positive landuses e.g. national parks & habitat sites: or for avoidance of negative landuses, i.e. proximity to industry / major infrastructure.
- **Hazard zoning policy**: particularly applies to known flood vulnerability zones (fluvial / coastal) (and other types of unstable / contaminated land)

There are other (endogenous) parameters which should emerge from model results

- Urban spatial patterning – growth, perforation, polycentricity, counter-urbanization, re-urbanization etc.
- Urban 'metropolization' – socio-economic patterns of agglomeration, poly-centric development, rural restructuring, proxies for lifestyle change.

Summary of landuse model settings

Landuse & development model parameters	**A1**	**A2**	**B1**	**B2**
	'Hyper-tech'	**'extreme water'**	**'peak oil'**	**'fragment ation'**
	globalizing / privatizing	localizing / privatizing	globalizing / public	localizing / public
Population growth:	Medium	High	Low	Medium
Economic growth:	High	Low	Medium	Medium
Growth in artificial surface:	High	Low	Medium	Low
Growth in floorspace:	High	Low	High	Medium
Counter-urbanization:	Rapid	Slow	Slow	Medium
Settlement clustering:	Medium	Weak	Strong	Medium
Transport / infra investment	Medium	Low	High	Medium
Spatial planning policy:	Medium	Weak	Strong	Medium
Hazard zoning policy.	Strong	Weak	Strong	Medium

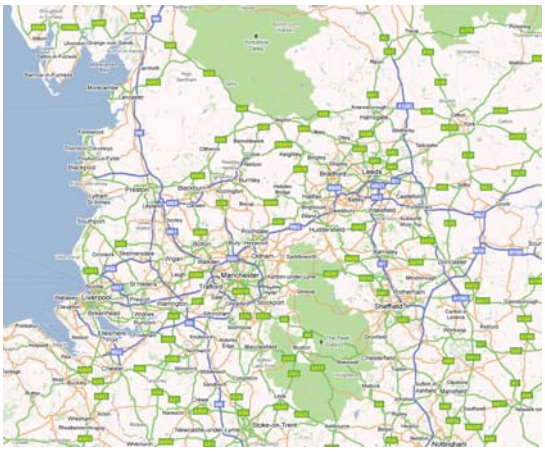
5. Landuse modelling results

Location & boundary

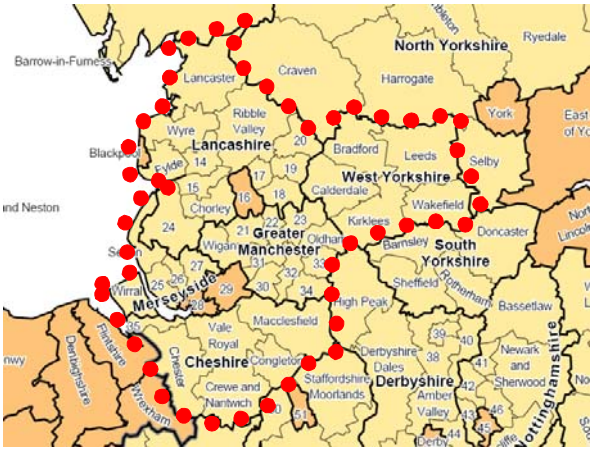
As in the D3-3-3 on the Manchester city-region, there is no single proper definition or boundary for the city-region. For the modelling effort, a boundary was selected which was larger than the previous study. This includes 4 of the 5 county areas of the Northwest region. To enable coverage of the Trans-Pennine border area, which was one of the sub-area case studies, an extension was made to the Leeds City-Region to the east, (i.e. the smaller 5-district version of the Leeds City-Region). This results in a total of 41 local authority areas.

However the Leeds City-region was not as yet able to supply important data on green belt and brownfield land

a) Road network



b) Local authority areas



Baseline landuse map

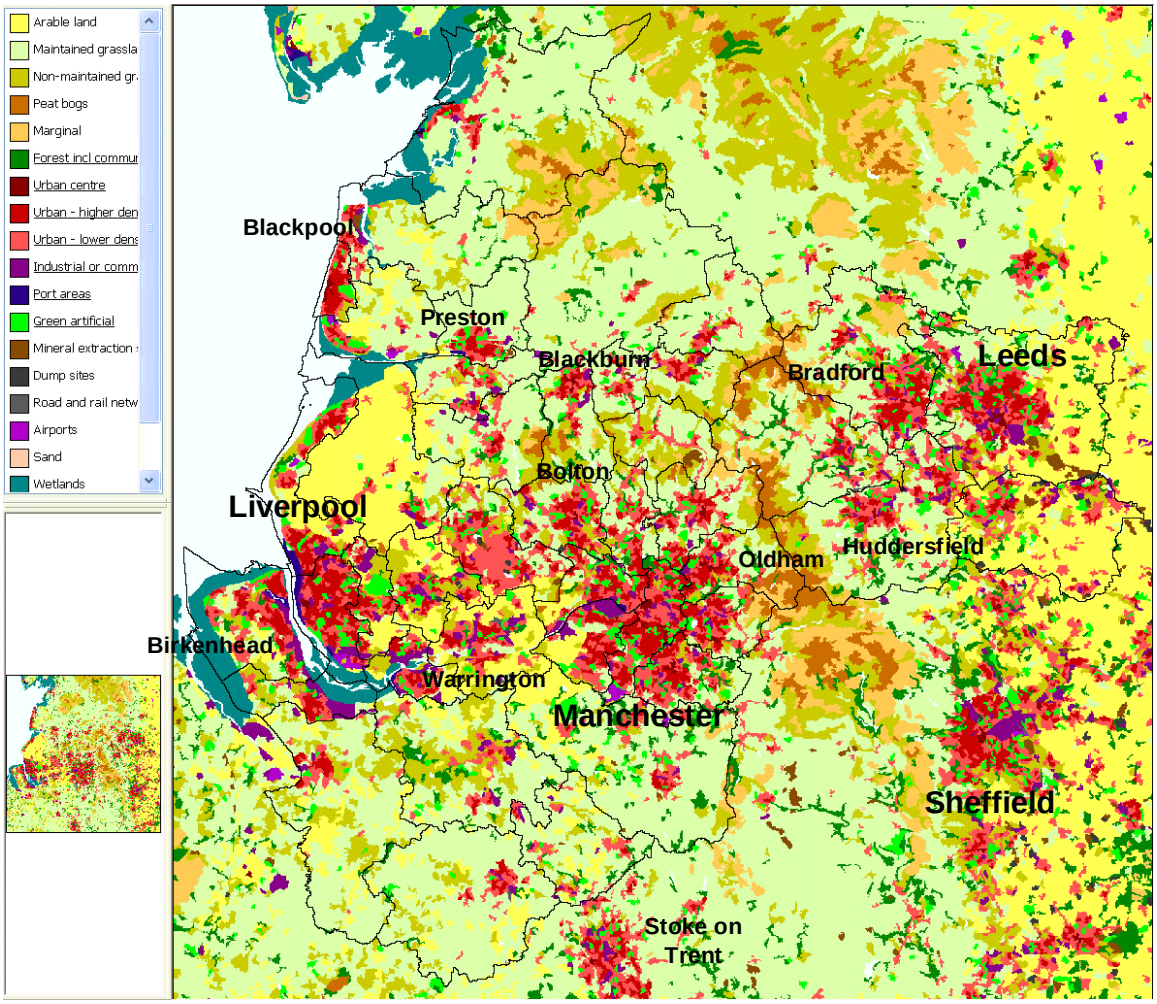
IN using the Metronamica system, much effort goes into the preparation of the baseline landuse map. Some challenges came up:

- It was decided to use the Corine Land Class (CLC) system which is common across the EU. However, unlike most EU countries, the UK did not invest in the earlier 1993 dataset. So the current 2001 data could not be properly compared and calibrated with the 1993 dataset. The updated 2006 dataset is expected sometime in 2011, this will enable the calibration of the model.
- In the Ecocities project, the decision was made to construct a custom-made landuse map of higher quality, based on the 'Urban Morphology Types', as in the next section.
- Also the CLC contained no detail on the different densities and types of 'discontinuous urban form'. By reference to the population densities from Census data at LSOA, the raster land-use map could be divided into 2 bands - higher and lower than the average density.
- The average density across all urban forms is 37 persons / hectare.

The map below shows some interesting features:

- Some city centres are surrounded by lower density urban form, rather than higher. This reflects the industrial restructuring and internal shrinkage process.
- Some outer areas are classed as 'urban centres': this reflects the history of these industrial cities, which began as a very poly-centric system of satellite towns.
- Analysis of initial landuses is below.

BASELINE – LANDUSE MAP



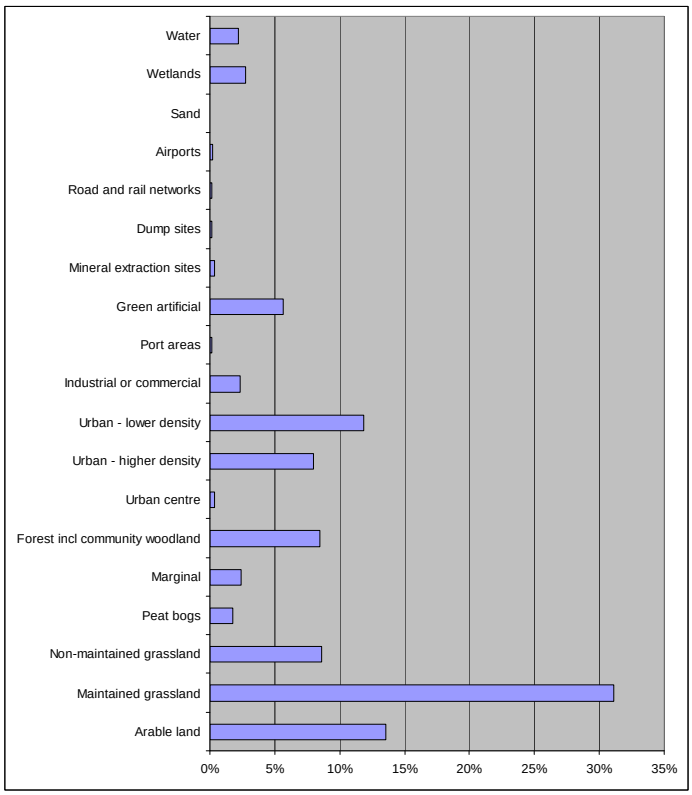


Figure 5.1: analysis of current landuses in the study area (2001)

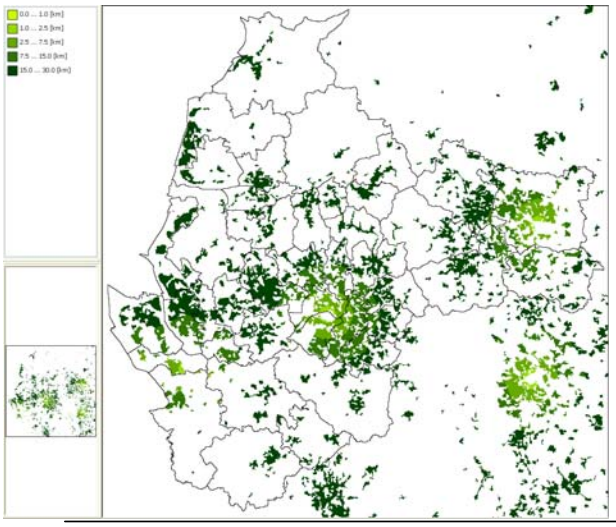
Landuse modelling factors

Below is a selection of the key input and output maps, showing the example of the B1 scenario.

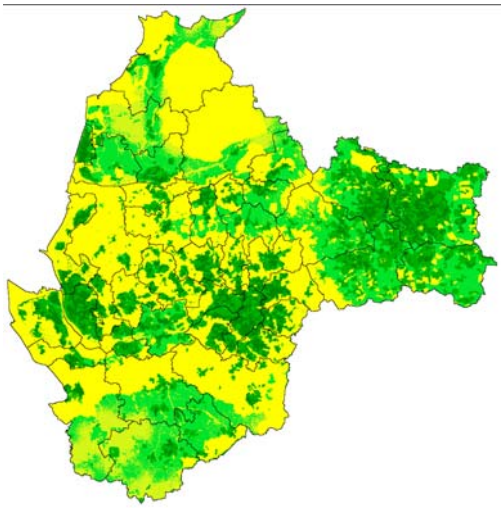
- a) Distance to work indicator: this is one of a set of indicators which show the residential distance to identifies areas of industry & commerce.
- b) Total potential – (urban high density): for this landuse type, this shows the total effect of the accessibility, zoning and neighbourhood functions
- c) Accessibility – (urban high density): this takes the combined effect of all road and rail infrastructure: and also simulates the gravity field of large cities.
- d) Total zoning – (urban high density): this combines all forms of zoning: including restrictions on national park, green belt, ecological sites and flood risk areas (100 / 1000 year floods). It also simulates positive incentives on brownfield sites and development zones.

LANDUSE MODELLING FACTORS (B1 scenario)

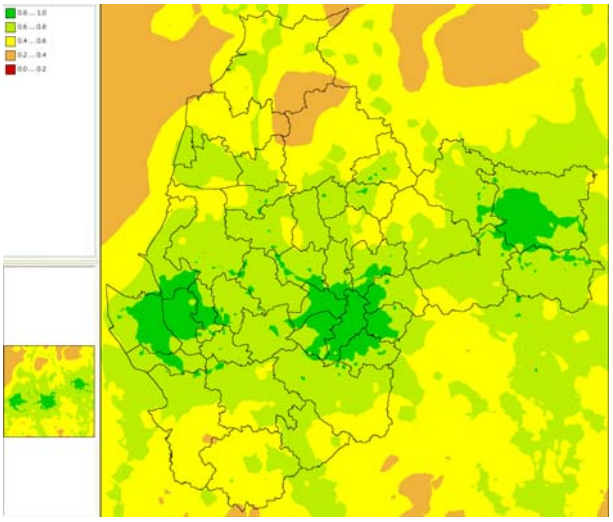
a) Distance to work indicator



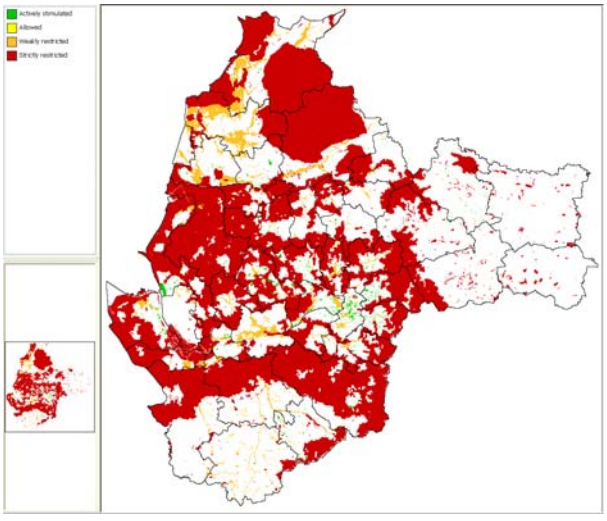
b) Total potential – (urban high density)



c) Accessibility – (urban high density)



d) Total zoning – (urban high density)



B1 scenario – 'Peak Oil'

This scenario is the most moderate growth and highly planned of all. Key inputs included:

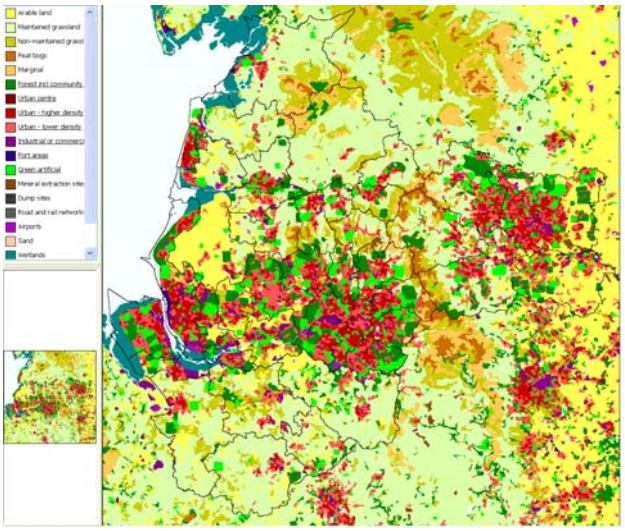
- The policy zoning restrictions and incentives were set at maximum
- The urban gravity field and attraction of public transport were high
- The 'random' factor was set low, to simulate a strong planning regime.
- The areas of forests and urban greenspace were projected to grow to a level of 10 hectares per 1000 population each (in areas currently below this level).

The results show broadly:

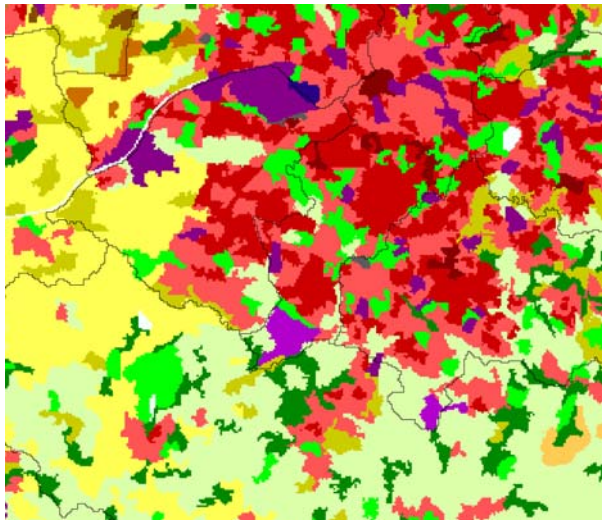
- Urban consolidation effect and maintenance of city / town centres.
- New industrial development only on brownfield land.
- Increase of forest and urban greenspace, in proximity to residential areas for social value. The comparison map c) shows how new forest areas are strategically placed to cluster for greater ecological quality.
- The comparison map (d) for 'lower density' urban growth shows the very limited areas of suburban development. As the Leeds city-region is at present without Green Belt data, the urban expansion is there shows as more peripheral, while in other areas it is more in the middle ground.

B1 SCENARIO – 'PEAK-OIL'

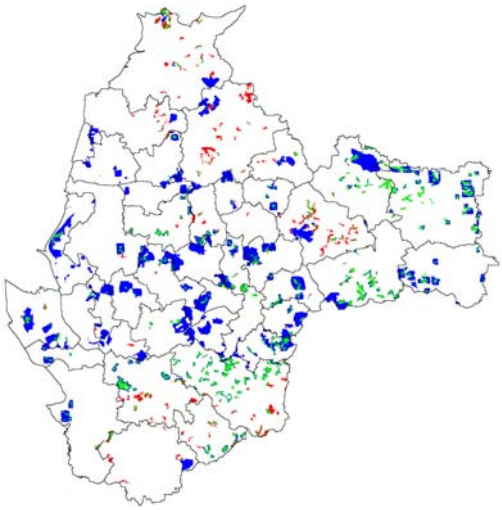
a) Landuse map 2050



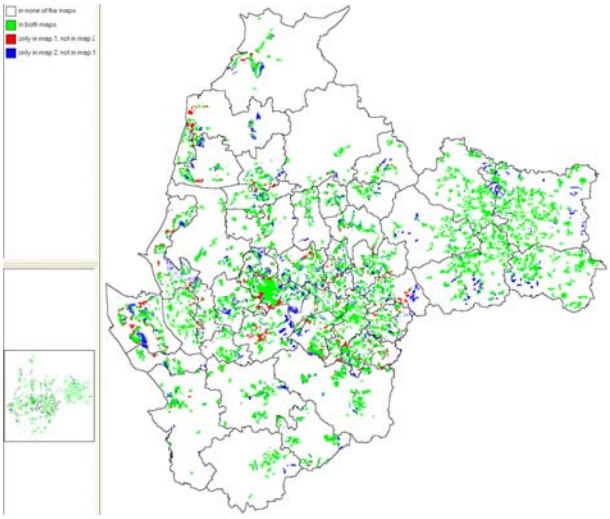
b) Landuse map 2050 - detail



c) Comparison 2000-50 - forests



d) Comparison 2000-50 – low density



B2 Scenario – 'Fragmentation'

This scenario keeps some elements of the B1, but explores the possibility that communities may prefer to move away from each other. This simulates the ageing society and a more fragmented version of society. Key inputs included:

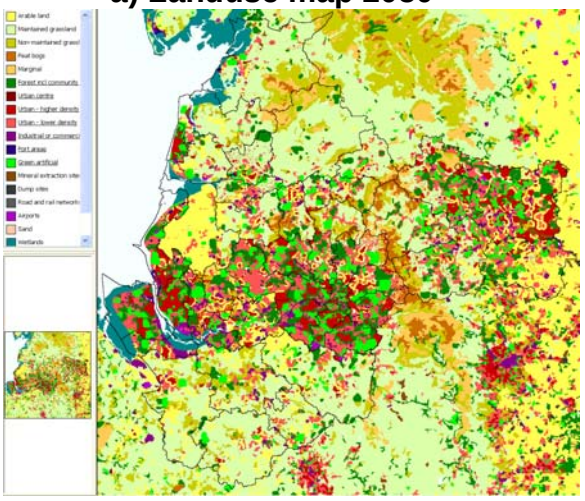
- The policy zoning restrictions and incentives were set at maximum
- The urban gravity field and attraction of public transport were set quite low
- The 'random' factor was set at medium, to simulate the possibility of self-organization by communities and landowners.
- The neighbourhood attraction splines in some cases were set at slightly negative, to simulate the pushing away effect between communities.
- As with B1, areas of forests and urban greenspace were projected to grow to a level of 10 hectares per 1000 population each (in areas currently below this level).

The result is an interesting variation on the conventional high / low growth scenario axis.

- As urban communities push away from each other, over time there is a separation of the urban fabric into distinct villages and towns (as it was until the late 20th century
- This could be achieved in practice by the consolidation of neighbourhood units into 'communities of interest', by densification of hubs, agglomeration of landholdings, conversion of under-occupied land and buildings into combined ecological / employment units.
- There is also a 'proto-community' zone in the more suitable parts of the rural area: with the landscape filling up with small (1 hectare average) clusters of houses and work units.
- This also sees expansion and agglomeration of small rural towns and their adjacent forests and greenspaces, for instance in the Pennine hills.

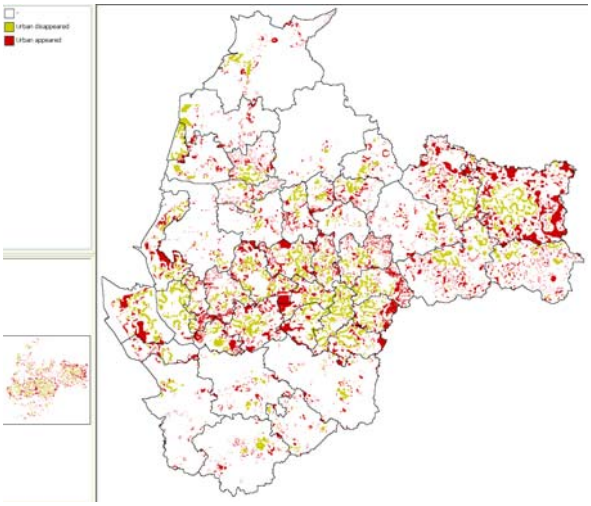
B2 SCENARIO – 'FRAGMENTATION'

a) Landuse map 2050

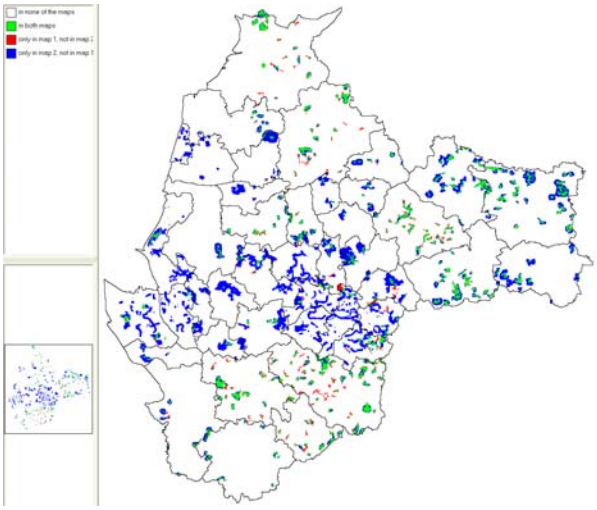


b) Landuse map 2050 - detail

c) Urban expansion 2050



d) Forest land – comparison 2000-50



A1 scenario – 'Hypertech'

The A1-'Hyper-tech' scenario is a more typical high growth, decentralized scenario. Key inputs included:

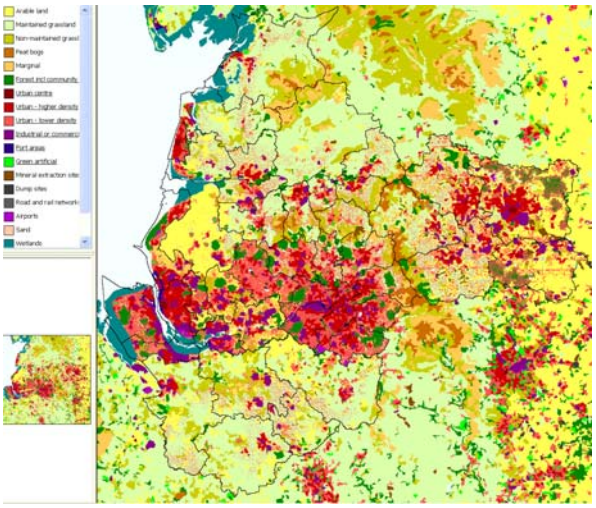
- Accessibility attraction based on road transport, with a medium urban gravity field.
- Zoning restrictions and incentives generally at moderate levels
- Neighbourhood attractions (i.e. clustering) at low levels, with a medium-high random factor.
- Demand for industrial and commercial space nearly doubles during the period, and decentralizes away from high density areas.
- Large shift to lower density urban form, reflecting the increased affluence, and the high-tech capacity to work and shop from home.

The results are in a sense predictable:

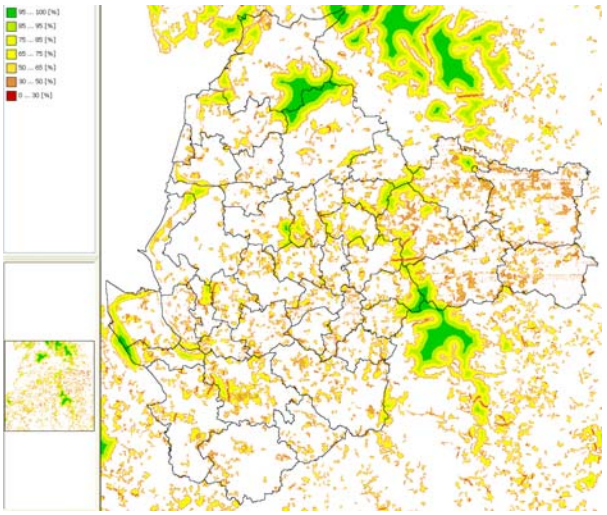
- higher density urban form shows a few increases around city centres.
- lower density urban form shows large increases in suburban areas, which are basically any location not strictly covered by Green Belt or ecological protection.
- In this scenario the Green Belt was anticipated to be 'weakly restricted ': so where conditions of proximity or accessibility are very favourable then the pressure for low density development breaks through.
- The effect on habit fragmentation (b) are very clear: only a few areas of highly connected habitat remain in the uplands and a few coastal areas. However it could be argued that the high-tech background to this scenario would find ways to compensate these impacts.

A1 SCENARIO – 'HYPER-TECH'

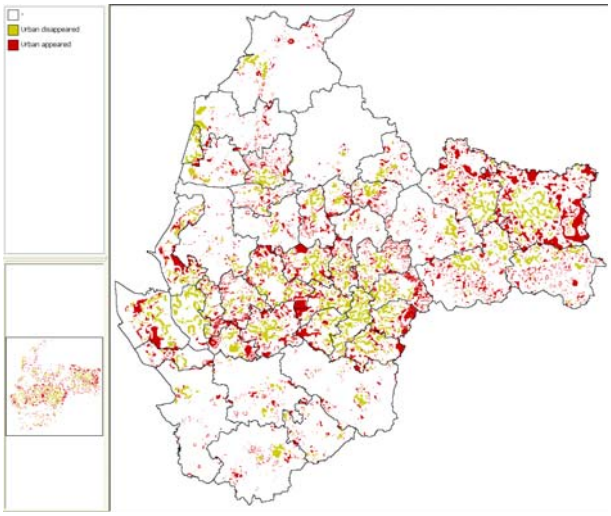
a) Landuse map 2050



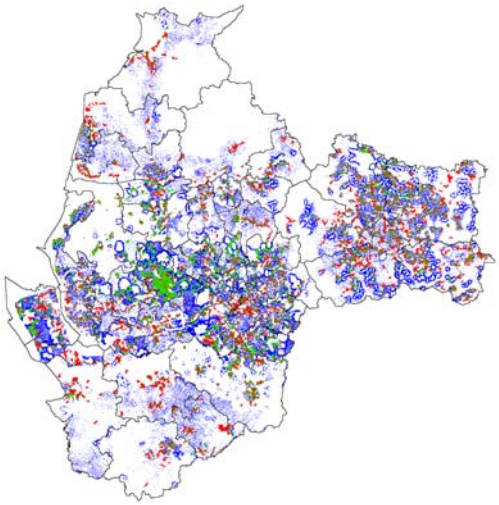
b) Habitat fragmentation 2050



c) Urban expansion



d) Comparison 2000-50: low density



A2 scenario – 'Extreme water'

This scenario projects a rather chaotic, private enterprise, weak planning, medium growth future. Key inputs included:

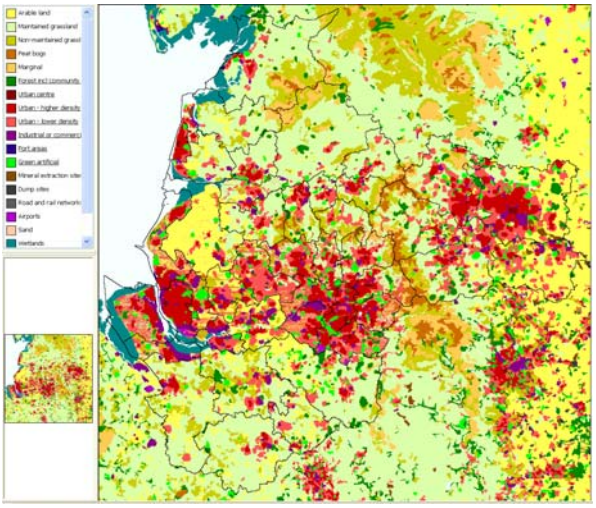
- Accessibility based on road transport, with a weak urban gravity field
- Zoning is also medium to low: there are few restrictions on building on flood risk areas, even though in this scenario extreme events are thought likely.
- Forest and greenspace grows only slightly on the land left vacant by other landuses.
- Neighbourhood attraction is generally weak
- There is a higher random factor, to simulate the 'do your own thing' approach of this scenario.

The results are an interesting variation on the conventional high-growth scenario:

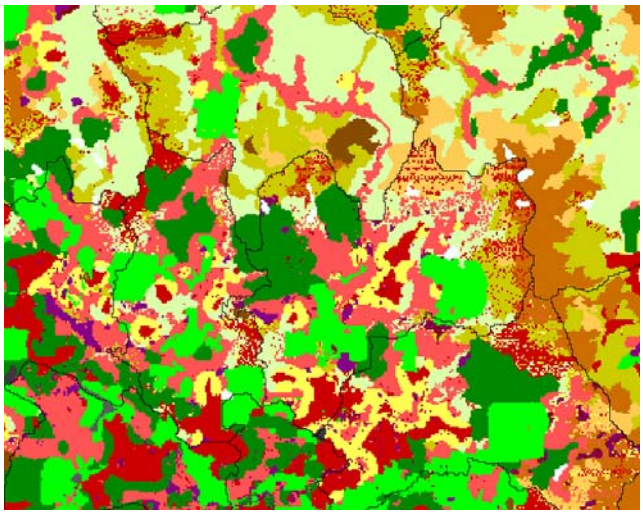
- The urban expansion map (c) shows large areas of the countryside populated with adhoc development. Existing towns and neighbourhoods show quite strange new forms.
- The distance to work indicator (d) shows that most of the new adhoc development is at larger distances from major employment centres. |

A2 SCENARIO – 'EXTREME WATER'

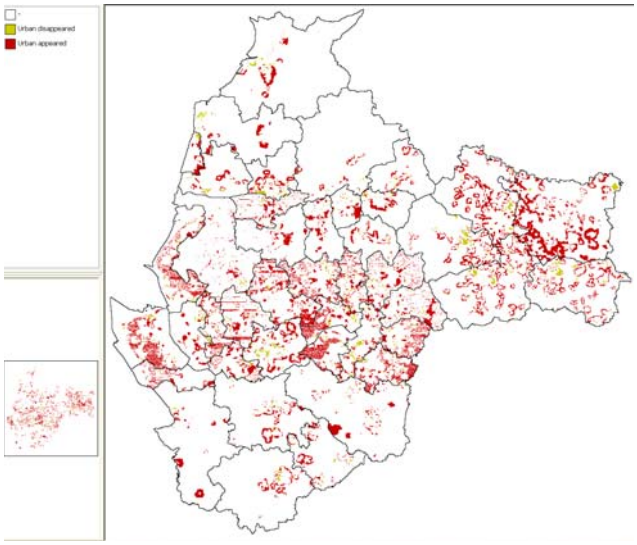
Landuse map 2050



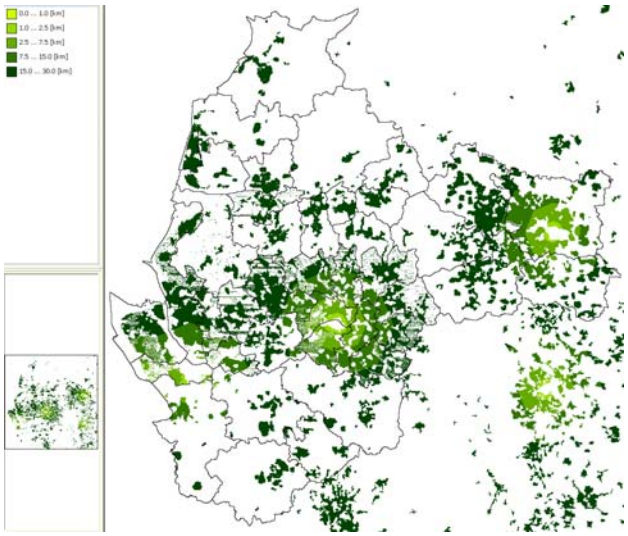
Landuse map 2050 - detail



c) Urban expansion 2050



d) Distance to work indicator 2050



6. Implications & conclusions

Overall, the lessons from the MCR case study, have wider significance. On the territorial level there are lessons particularly for more mature and post-heavy-industry city-regions. Although the direct expansion of the physical urban area is slow, the restructuring process continues, with a many forms of economic, political, technology-infrastructure, social and cultural transition, which throw up new contradictions and opportunities.

The modelling exercise described above aims to simulate some of the physical effects of this. In reality, such a simulation can only approximate to a combination of multiple driving forces:

- Economic forces in land and property markets, and the construction cycle
- Policy and governance effects on planning and urban form
- Social and cultural forces, in communities, lifestyles, public attitudes and perceptions
- Technology and infrastructure, in transport, communications and utilities
- Other agendas, such as urban sustainability: social cohesion: economic competitiveness etc.

For the spatial planning implications: currently the UK is experimenting with a highly localized and de-regulated planning system, without any form of regional strategy. Further application of the modelling system and the scenario framework aims to work directly with the local authorities in this city-region, to explore the implications of different policy mixes on the long term landuse and spatial development pattern.

For the wider policy implications: it appears that the governance of the newly emerging peri-urban areas is at least as important as the urban areas, which currently demand most of the attention and funding. What stands out is the agenda not only for ***better*** forms of governance (e.g. strategic planning authorities): but ***new*** forms of governance (building institutional capacity and collective intelligence to deal with complex problems which are multi-level, multi-agency and multi-objective. In this process a more advanced and useful concept of 'sustainable peri-urban' begins to emerge. In this way the MCR case highlights the many challenges and experiences, for others to build on.

7. Annex

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Metronamica Manchester – Scenario Parameters

These are the main scenario parameters for the PLUREL scenarios in Metronamica. It is expected that the Ecocities scenarios will be interpreted in a similar scheme, to fit the categories in Metronamica.

Firstly there is a 'general scenario context' overview. Then the summary tables follows the general structure of the MOLAND interface;

- external factors
- policy measures
- parameters – regional interaction
- parameters – landuse model
  - landuse
  - neighbourhood
  - accessibility
  - suitability
  - zoning policy
- scenarios –
- indicators
- analysis

There are updated sections on the policy layers, including brownfields and green belt data layers.

General scenario context

The MCR landuse model application highlights the key parameters which link the technical modelling to wider policy concerns.

- Economic growth, where this is related to landuse demands for housing, industry or commerce:
- Population growth total, as a result of fertility / mortality, and of migration.
- Residential density: generally declining due to household size reduction and rising space demand: but in some cases balanced by infilling, sub-division, multiple generation families etc.
- urban / rural migration, with incentives for centre city, suburban, peri-urban or rural locations.
- Clustering of growth in the 'neighbourhood effect', where each landuse competes and attracts similar or different landuses.
- localized growth, which may follow current trends of high and low growth districts: or change from that pattern:
- Environmental policy, where related to demand for green-blue infrastructure (shown in the landuse maps as 'forest / community woodland': and 'green artificial' i.e. parks, golf courses, urban open space etc.
- Spatial planning policy: particularly the strength of restriction in the Green Belt, related zones, and ecological sites.

General scenario summary

	A1	A2	B1	B2	
General demographic parameters	**'Hyper-tech'**	**'Extreme water'**	**'Peak oil'**	**'Fragmentation'**	**Notes**
	globalizing / privatizing	localizing / privatizing	Globalizing / public	localizing / public	
General PLUREL scenario	rapid technology innovation and counter-urbanisation	rapid climate change and defence of the cities.	energy price shock and retreat from the peri-urban.	communities in retreat with polarisation of cities.	
Population growth	**0.41%**	**0.30**	**0.19**	**0.30%**	Mid-estimate based on UK projections & IIASA model (note Y&H trend higher than NW)
urban / peri-urban pop. growth	Low / high	High / medium	Medium / low	Medium / medium	
GDP Growth	3.02%	2.62%	2.12%	2.01%	(EU 27 model results)
"Shock" storyline	Rapid technology advance	Extreme water & weather events	peak oil & effects on road transport	fragmentation, social exclusion	
General migration pattern	Out-migration to peri & rural areas (+ metro-lifestyles)	Stagnation & clustering towards growth areas	In-migration to larger urban centres	Fragmentation into smaller communities	
Spatial patterns in Manchester city-region	Manchester CR grows as a global hub, with waves of global capital spinning out from the centre and the peri-urban hubs.	Manchester CR urban economy stagnates, along with peri-urban retail & business parks.	Manchester MCR becomes a national / EU centre of governance, public services & social innovation.	Manchester CR reverts to 500 neighbourhoods, gated enclaves spring up in the peri-urban zone	
Implications: for peri-urban	peri-urban becomes segmented by carefully graded differences in value & status, coupled with risk & opportunity.	chaotic zone of hazardous areas, private enclaves, & informal / illegal landuses: floods & storms, while planning & investment reduces.	carefully planned at national and regional level, with green infrastructure & multi-functional land for food, biodiversity & climate adaptation.	ideal space for self-contained communities to grow, with many functions of food, energy, water etc, in an 'archipelago of enclaves'.	
district growth projections	High growth areas see more demand	No change to present	Balancing out between high & low	Low growth areas see more demand	Existing range: 1.16% (Manchester) – 0.21% (Burnley) As spreadsheet

DRIVERS: External factors

	A1	A2	B1	B2	Notes
scenario parameters	**'Hyper-tech'**	**'Extreme water'**	**'Peak oil'**	**'Fragment-ation'**	
	globalizing / privatizing	localizing / privatizing	Globalizing / public	localizing / public	
Population & area growth	(settings already input to trial version)				Set for total or for individual districts
Total population	**0.41%**	**0.30**	**0.19**	**0.30%**	Mid-estimate based on UK projections & IIASA model (note Y&H trend higher than NW)
urban centres pop	0.16%	0.30	0.39	.10	
High density urban	0.16%	0.30	0.19	.50	
Low density urban pop	0.58%	0.30	0	.10	
Forest area	*0*	*+2% p.a.*	*+5% p.a.*	*+5% p.a.*	Note high growth rates from low base
Industrial / comm. Area	*1.3%*	*0.5% p.a.*	*1% p.a.*	*0.5% p.a.*	**50% of GDP growth**
Port area	*-1%*	*-1% p.a. area*	*-1% p.a. area*	*-1% p.a. area*	General shrinkage
Green area	*0*	*+2% p.a.*	*+5% p.a.*	*+5% p.a.*	Note high growth rates from low base
District level planning scenarios (where applicable)	Continue polarization of high / low (due to deregulation)	Convergence towards medium (due to chaos & slowdown)	Planned growth (due to new forms of governance)	Restricted growth (due to NIMBY effect)	This is based on changes to 2000-2010 growth trends at district level
High Growth districts	Continue	Reduce	Reduce	Reduce	
Medium	Continue	Continue	Increase	Continue	
Low growth districts	Continue	Increase	Increase	Continue	

Policy (zoning) measures

	A1	A2	B1	B2	notes
scenario parameters	**'Hyper-tech'**	**'Extreme water'**	**'Peak oil'**	**'Fragmentation'**	
	globalizing / privatizing	localizing / privatizing	Globalizing / public	localizing / public	
ZONING FACTORS refer to urban & industrial landuses: *(forest / green landuses in italics)*					
ECOLOGICAL SITES	Weak restriction *(forest / green – allowed)*	Weak restriction *(forest / green – allowed)*	Strong restriction *(forest / green – strong restriction)*	Strong restriction *(forest / green – strong restriction)*	Includes SSSI, SBI, SAC, Ramsar etc
100 year FLOOD RISK LAND	Allowed *(forest / green – actively stimulated)*	Allowed *(forest / green – actively stimulated)*	Strong restriction *(forest / green – actively stimulated)*	Strong restriction *(forest / green – actively stimulated)*	"Allowed" due to technology advance
1000- year FLOOD RISK LAND	Allowed *(forest / green – actively stimulated)*	Allowed *(forest / green – actively stimulated)*	Strong restriction *(forest / green – actively stimulated)*	Strong restriction *(forest / green – actively stimulated)*	"Allowed" due to technology advance
GREEN BELT etc	Weak restriction *(forest / green - actively stimulated)*	Weak restriction *(forest / green - actively stimulated)*	Strong restriction *(forest / green - actively stimulated)*	Strong restriction *(forest / green - actively stimulated)*	Incl. GB, AONB & National Park: various data in NW: awaiting Leeds CR
PEAT BOG	Weak restriction (forest / green – allowed)	Weak restriction (forest / green – allowed)	Strong restriction (forest / green – strong restriction)	Strong restriction (forest / green – strong restriction)	Data direct from CLC
BROWNFIELD for HOUSING	Allowed *(forest / green - allowed)*	Allowed *(forest / green - allowed)*	Actively stimulated *(forest / green - allowed)*	Actively stimulated *(forest / green - allowed)*	Awaiting NLUD data – see method note below
BROWNFIELD for OTHER USES	Allowed	Allowed	Actively stimulated	Actively stimulated	

Also see detailed notes below.

Parameters - regional interaction

	A1	A2	B1	B2	notes
	'Hyper-tech'	**'Extreme water'**	**'Peak oil'**	**'Fragmentation'**	
Key parameters	globalizing / privatizing	localizing / privatizing	Globalizing / public	localizing / public	
"Constant growth of density" / OR area growth – (direct input)					Set for total or for individual districts
urban centres pop	+0.2% per annum density change (= densification)	+0.2% per annum density change	+0.2% per annum density change	+0.2% per annum density change	Pop. density assumed similar to high density areas (ie. mix residential & commercial)
High density pop	-0.5% p.a. density change	0	+0.5%	0	Residential density changes are based on household size change: may be balanced by sub-division & infill development
Low density pop	-0.5% p.a. density change	0	+0.5%	0	"
Forest area	0% area change	+2% p.a.	+5% p.a.	+5% p.a.	Based on strong green infrastructure policy
Ind / comm. Area	1.3% p.a. area	0.5% p.a.	0% p.a. (due to dematerialization)	0.5% p.a.	Related to GDP growth
Port area	1.3% p.a. area	0.5% p.a.	0% p.a. (due to dematerialization)	0.5% p.a.	
Green area	0% area change	+2% p.a.	+5% p.a.	+5% p.a.	Based on strong green infrastructure policy

Parameters - Land-use model

Landuse

- Initial landuse maps & change maps.
- Shows total potential maps for each landuse.

Neighbourhood

- Shows attractivities to/from each functional landuse – see chart below
- (It seems that changes to this will need to be saved as a separate project, not as sub-scenarios in one project)

BASE CASE Based on 100m cells & 800m radius	**TO – landuse**				
FROM - Landuse	**URBAN CENTRES** *(Continuous urban fabric)*	**HIGH DENSITY** *(discontinuous urban fabric)*	**LOW DENSITY** *(discontinuous urban fabric)*	**INDUSTRY**	**Forest & green artificial**
URBAN CENTRES *(Continuous urban fabric)*	Near – high Far – low	Near – low Far - medium	Near – low Far - medium	Near – negative Far - zero	Near – zero Far – zero
HIGH DENSITY *Discontinuous fabric*	Near – negative Far – medium	Near – high Far – low	Near - low Far - medium	Near – negative Far - negative	Near – high Far – medium
LOW DENSITY *Discontinuous fabric*	Near – negative Far – medium	Near - low Far - medium	Near – high Far – low	Near – negative Far - negative	Near – high Far – medium
INDUSTRY / COMMERCIAL	-	-	-	Near – high Far – low	-
Forest & green artificial	-	Near – low Far – low	Near – low Far – low	-	Near – high Far – low

Accessibility

>> Go to infrastructure layers

- A road
- B road
- Motorway
- Rail station
- "City Centre" – includes just one point at centres of each major city: i.e. Liverpool, Manchester & Leeds. This is inserted in order to provide a buffer function, which provides an approximate model, of the incentives for urban in-migration or out-migration.

	A1	**A2**	**B1**	**B2**	**notes**
scenario parameters	**'Hyper-tech'**	**'Extreme water'**	**'Peak oil'**	**'Fragmentation'**	
Accessibility gradients					
Motorway	??				Buffer only on nodes
A road	??				Linear buffer
B road	??				Linear buffer
Rail stations	??				Buffer only on nodes: (main / local stations counted same)
Urban centres	Gradient of 30km radius				Simple model of large city attraction / repulsion

A1 – distance decays	Urban centres	High den	Low den	Ind/comm	notes
Motorway	1	1	1	25	
A road	1	15	15	5	
B road	4	1	5	1	
Rail stations	16	10	5	10	
Urban centres	1	1	-30	1	

A2 – distance decays	Urban centres	High den	Low den	Ind/comm	notes
Motorway	1	1	1	25	
A road	1	15	15	5	
B road	4	1	5	1	
Rail stations	16	10	5	10	
Urban centres	1	1	-30	1	

B1 – distance decays	Urban centres	High den	Low den	Ind/comm	notes
Motorway	50	1	1	25	
A road	5	15	15	5	
B road	100	1	5	1	
Rail stations	50	10	5	10	
Urban centres	300	1	-30	1	

B2 – distance decays	Urban centres	High den	Low den	Ind/comm	notes
Motorway	1	1	1	25	
A road	1	15	15	5	
B road	4	1	5	1	
Rail stations	16	10	5	10	
Urban centres	1	1	-30	1	

Suitability

No data included in this at the moment.

- slope data – we have Eurostat data but this is not high quality.
- agricultural land quality data – we have DEFRA data but this is not included. The CLC base map should be enough.
- Flood risk areas are covered by the zoning above.

Zoning

- Sets up basic land-use / function relations for 'functional' landuses i.e. urban centres, high/low density urban, ind&comm, ports, forest & green,
- Also sets up the weightings of zoning options for each landuse: i.e. "actively stimulated (1.5): allowed (1): weakly restricted (0.5): strongly restricted (0.01).

>>>Then goes to zoning table as above.

Brownfield land & redevelopment

IN practiced much of the development potential is within urban areas, i.e. on smaller or larger vacant or derelict brownfield sites. The CLC just puts these all into the 'discontinuous' or 'ind / comm' categories.

This layer provides a set of urban / peri-urban locations, where new development is 'strongly stimulated' or at least 'allowed' (depending on the scenario). These settings simulate the likely effect of spatial planning policies together with public subsidies which may exist.

NLUD data was kindly supplied by the Homes & Communities Agency, in geo-reference and in polygon form. Unfortunately the data is not consistent across all local authorities. More than half the areas supplied only georeferences for site centroids. Over a third listed 'no information' or 'don't know' for the site uses and potentials.

The basic definition was drawn between brownfield land suitable for housing / other uses. However due to the data problems above, it was decided to run these together, i..e. to assume that any brownfield site might be suitable for housing / other uses, if the demand & incentives were there. This corresponds to the current direction of de-regulation in the UK planning & regeneration system.

There is also different evidence on the housing capacity of brownfield land (CUPS, 2010). The analysis of NLUD data and housing statistics shows that in the North West region, of all new residential development, a total of 71% was on 'brownfields' (Figure 3 below):

- 17% was on 'other previously developed uses'
- 30% was on 'vacant and derelict'
- 25% was on 'residential' (i.e. taking down old dwellings to build new ones).

Extension for climate-related policy & modelling

The EcoCities application and extension of the Metronamica modelling system into climate-related policy falls into 2 main stages.

These notes look at 2 main issues for discussion:

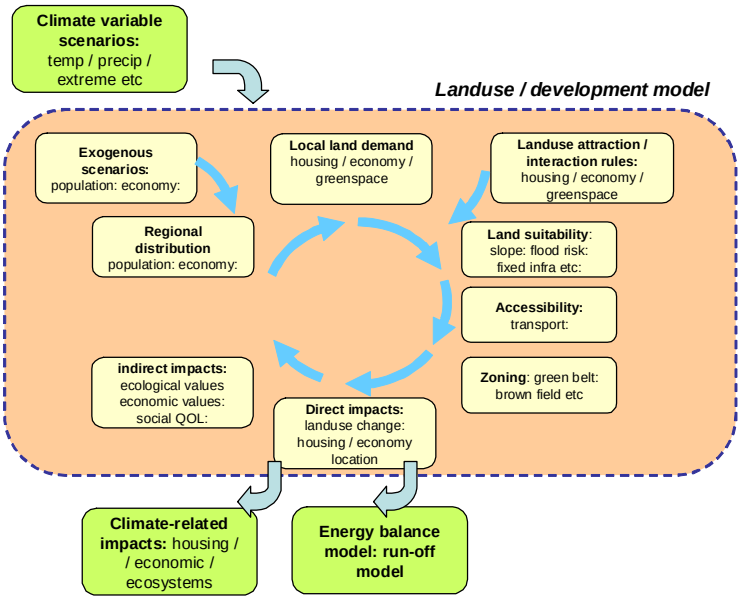
1) Extension of the Metronamica application for climate-related policy & modelling issues
2) Application of Metronamica with more detailed UMT land classification, related to climate issues.

Stage 1: landuse change >> climate variables

Utilising Metronamica to understand implications of the EcoCities scenarios for land use change in Greater Manchester. Once the scenarios have been run, and the extent of land use change assessed (this can be done in terms of area change of land use types), the outputs of the modelling exercise could potentially be applied to:

- Energy balance model to look at implications of changes in green cover on temperatures?
- Runoff model to look at the implications of future development (and increase in hard surfaces) on flood risk?
- Considering the implications of land use change on exposure to climate change impacts (i.e. spatial exposure to climate impacts e.g. increased hard surfaces and flooding, densification of urban areas and heat island impacts)
- Determining loss/gain of land cover types that provide adaptation functions (e.g. woodland, urban green space).
- General assessment of the implications of land use change on the adaptive capacity of Greater Manchester

Stage 1: Landuse change >>> climate variables

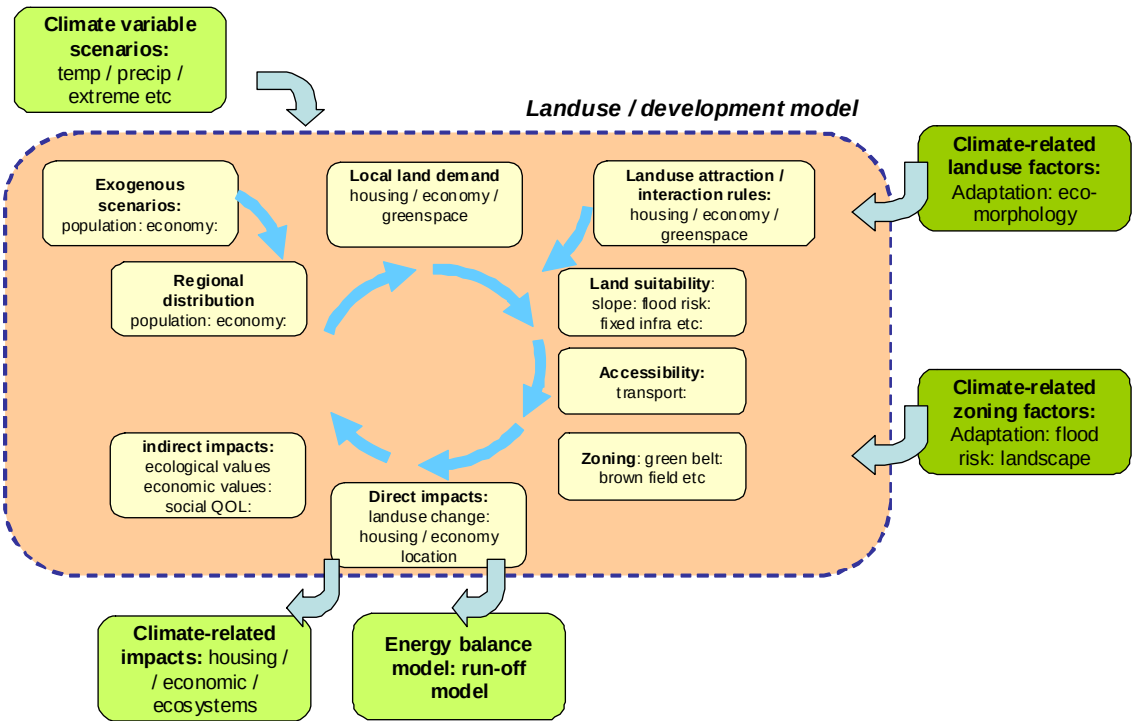


Stage 2: climate responses >> landuse change

Applying the Metronamica model to understand the land use implications of potential climate change adaptation responses in Greater Manchester.

- Protection and enhancement of land uses that provide adaptation functions:
  - Development of cool air corridors
  - Protection and enhancement of high grade agricultural land
  - Protection and re-naturalisation of floodplains and water courses
  - Reducing hard surface cover
  - Protection and enhancement of urban green/blue spaces and networks
  - Increase allocation of land for outdoor recreation
- Considering the potential implications of policy interventions aimed at increasing adaptive capacity. E.g. impact of land use policy change on temperature, runoff etc
- Links to the emerging work on adaptation 'archetypes' - assessing the implications of possible policy responses within these themes. This could be explored in the context of adaptation response scenarios within identified rick-response themes e.g. different % changes in tree cover or % changes in area of green space protection and enhancement.

Stage 2: climate responses >> landuse change



Linking Metronamica with climate-related issues

This shows a summary of climate-related policy / modelling variables to be considered, within the general structure of the Metronamica parameter types.

Parameter types in Metronamica	Climate-related issues	Possible link to future modelling
regional interaction	Distribution of development between areas of growth or decline	More detailed 'regional' model
Landuse	Variation in the overall housing density / job density / areas of GBI	More detailed housing model
neighbourhood	Effect of clustering / fragmentation in development patterns	More detailed actor-based model
Accessibility	Effect & split of transport modes links to energy / climate policy. Urban effect simulates inward / outward migration of large settlements.	
suitability	Detailed factors in topography	
zoning policy	Protected areas: flood risk areas: brownfield land policy. Zoning can stimulate GBI areas & patterns	Simulation of economic effects

Summary of landuses & climate issues

This table shows the UMT categories in comparison with the CLC categories as used in the PLUREL project. Also each UMT category links to the main types of climate-related landuse modelling / policy issues

Primary land use (NLUD / LUC)	**Detailed UMT**	**CLC+ categories equivalent (used by PLUREL version)**	**Main climate-related landuse modelling / policy issues**
Farmland	Improved farmland	arable land: maintained grassland:	Potential for soil CO2 storage
	Unimproved farmland	Non-maintained grassland	Potential for soil CO2 storage
Woodland	Woodland – *function*	forest / community woodland	Adaptation of species & habitats: hydrology issues
Minerals	Mineral workings and quarries – *feature*	Minerals	Potential for major GBI
Recreation and leisure	Formal recreation – *feature*	Urban green	Potential for major GBI
	Formal open space – *function*	Urban green	Potential for major GBI
	Informal open space – *vacant*	Urban green	Potential for major GBI
	Allotments – *functions*	Urban green	Potential for local food systems
Transport	Major roads	Road & rail	Potential for ecological corridors
	Airports	Airport	Expansion or containment???
	Rail	Road & rail	Potential for ecological corridors

	River, canal	Water / port area	Potential for major GBI
Utilities and infrastructure	Energy production distribution	??	Shift to industrial ecology systems
	Water storage and treatment	??	Shift to industrial ecology systems
	Refuse disposal	Landfill etc	Shift to industrial ecology systems
	Cemeteries and crematoria	??	??
Residential	High density residential	High density DUF	Shift to adaptive built environment
	Medium density residential	Higher + lower density DUF	Shift to adaptive built environment
	Low density residential	Lower density DUF	Adaptive built environment
Community services	Schools	??	Potential for major GBI
	Hospitals	??	Potential for major GBI
Retail	Retail	Urban centres or ind/comm??	Shift to industrial ecology systems
	Town centre	Urban centres	To be protected
Industry and business	Manufacturing	Industry / commerce	Shift to industrial ecology systems
	Offices	Urban centres or Ind/comm.	Shift to adaptive built environment
	Storage and distribution	Industry / commerce: ports	Shift to industrial ecology systems
Previously developed land	Disused and derelict land	Brownfield housing / other (NLUD policy layer)	Potential for major GBI
Defence	Defence	??	Potential for major GBI
Unused land	Remnant countryside	Marginal	Potential for major GBI
OTHER TYPES		CLC	
	??	peat bogs	(contained in ecological layer)
	??	Sand, dunes, rocks	(contained in 'marginal' category?
	??	wetlands & habitat	(contained in 'marginal' category?
	??	Water	

Notes:

- GBI = green infrastructure
- DUF = 'discontinuous urban form' in the CLC system.
- the PLUREL takes the whole DUF category from CLC, and divides it into higher / lower density, according to the calculated unit density at LSOA level. The threshold is 37 persons per hectare.

Summary of climate-related landuse policy issues

The table above identifies 6 main areas of climate related landuse policy issues, each related to specific landuses / landuse changes.

- Potential for soil CO2 storage: this is regional / national issue but with local effects
- Adaptation of species & habitats: this looks directly at the GBI areas and vulnerability / resilience / adaptation to climate change effects.

- Potential for major GBI: this look at major changes & expansions of GBI areas
- Potential for ecological corridors: this focuses on the connectivity, which is more likely to use existing linear forms e.g. road, rail, water or others
- Shift to industrial ecology systems: includes the potential for renewable, recycled & low impact management of energy, water, resources
- Shift to adaptive built environment: includes a range of actions to increase the ecological diversity, connectivity, resilience within and between buildings.

The next table below then shows the links between each of these and the main types of direct landuse change: and some related climate-environment issues.

Climate issue	Direct landuse change issues	Related climate-environment issues
Potential for soil CO2 storage	Possible shift from pasture to arable farming, or marginal to pasture?	New agricultural & forestry systems: low impact / high diversity / localized production
Adaptation of species & habitats	Diversity & connectivity in urban environment	Resilient & multi-functional ecological systems.
Potential for major GBI	Expansion & connectivity of green space & forest	Feedback effects to micro-climate on a neighbourhood / urban scale
Potential for ecological corridors	Expansion of green corridors on transport & water routes	Feedback effects to urban quality of life & leisure / tourism
Shift to industrial ecology systems	Increase in ind / comm area to enable recycling / re-use economy???	Link to energy/ water / material circular systems
Shift to adaptive built environment	Re-structuring of built / green space patterns	Feedback effects to micro-climate management in & between buildings

Technical data notes

Yi Gong, January 2011

Data processing Metronamica Application Manchester

General information

```
ncols         1420
nrows         1440
xllcorner     3444000
yllcorner     3386000
cellsize      100
```

Land-use data 2000

Source: CLC 2000 raster @100 meter resolution

Continuous urban fabric appears blue or a darkish bluegrey on satellite images. Centres of urban districts can easily be identified on satellite images by reference to topographic maps.

Discontinuous urban fabric comprises **residential** areas around the edge of urban district centres, and certain urban districts in rural areas.

Industrial or commercial units located in continuous or discontinuous urban fabric are taken into account only if they are clearly distinguishable from residential areas (industrial complex with a surface area greather than 25 ha with associated spaces: car parks, storage areas, etc.). Sanatoriums, spa facilities, hospitals, rest homes, military bases, educational establishments, university sites, commercial centres bordering on or outside urban districts are associated with this category, as are associated surfaces such as car parks, sports grounds, wasteland, etc., with a surface area of less than 25 ha. The category also includes major industrial livestock rearing facilities, waste water treatment plants, cement fish farming ponds. Large greenhouse surfaces are not included under this heading.

Processing: - Construction

Processing: Reclassify according to the table below, except for Construction, which was reclassified as follows:

For all cells that are construction
Look at the predominant urban land use in the surrounding (continuous / discontinuous / industry and commerce)
Assign that land use
When there is no urban land use in the surrounding
Assign discontinuous urban as a land use

To determine the predominant land use, we used a majority filter with a circular radius of 5 cells.

Urban and Peri- urban

- LSOA population estimation 2001 used to calculated the LSOA population density (people per ha) around PLUREL area**.**
- Based on the population density, the discontinuous urban fabric area with higher than the mean density is classified into urban, and the lower value is peri-urban. Population density is based on 5518 LSOA which are within PLUREL research area. The Mim density is 0.10 and Max is 252, with mean (37, st dev 28).
- The urban center population is 5% and urban area population is 95% of urban area population.

Settings

Regions - 42 Local authorities, 43 boundary areas

ID	NAME	LABEL
0	out of modelling area	
1	Chester	13UB
2	Crewe and Nantwich	13UD
3	Vale Royal	13UH
4	Congleton	13UC
5	Macclesfield	13UG
6	West Lancashire	30UP
7	Kirklees	00CZ
8	Calderdale	00CY
9	Bradford	00CX
10	Leeds	00DA
11	Wakefield	00DB
12	Ellesmere Port & Nes	13UE
13	Wirral	00CB
14	Liverpool	00BY
15	Sefton	00CA
16	Fylde	30UF
17	Halton UA	00ET
18	Knowsley	00BX
19	St. Helens	00BZ
20	Warrington UA	00EU
21	Trafford	00BU
22	Manchester	00BN
23	Salford	00BR
24	Tameside	00BT
25	Wigan	00BW
26	Bolton	00BL

27	Bury	00BM
28	Chorley	30UE
29	South Ribble	30UN
30	Preston	30UK
31	Blackburn with Darwen UA	00EX
32	Rossendale	30UM
33	Rochdale	00BQ
34	Oldham	00BP
35	Burnley	30UD
36	Wyre	30UQ
37	Ribble Valley	30UL
38	Lancaster	30UH
39	Pendle	30UJ
40	Blackpool UA	00EY
41	Stockport	00BS
42	Hyndburn	30UG

Land use classification

Model type ID	Model type_name	Model land use type	CLC 2000_ID	CLC 2000_name
1	arable land	vacant	18	Tilled Land
~~1~~	~~Horticulture (no this type)~~	~~vacant~~	~~14~~	~~Scrub / Orchard~~
2	maintained grassland	vacant	6	Mown / Grazed Turf
3	non-maintained grassland	vacant	5	Grass Heath
			7	Meadow / Verge Meadow / Verge / Semi-natura
			8	Rough / Marsh Grass
			10	Open Shrub Moor
			23	Felled Forest
4	forest incl community woodland	vacant	9	Moorland Grass (grassland)
			15	Deciduous Woodland
			16	Coniferous Woodland
5	marginal	vacant	11	Dense Shrub Moor
			12	Bracken
			13	Dense Shrub Heath
			19	Ruderal Weed
			25	Open Shrub Heath
6	peat bogs	vacant	17	Upland Bog
			24	Lowland Bog
7	Continuous urban fabric	function	21	Continuous Urban
8	urban	function	20	Suburban / Rural Development
9	Peri-urban	function		
10	Industrial or commercial	function		
11	Port areas	function		
12	Airports	feature		
13	Mineral extraction sites	feature		
14	Dump sites	feature		
15	Road and rail networks	feature		
16	Green artificial	feature		
17	Sand, dunes, bare rocks	feature	3	Beach and Coastal Bare
			22	Inland Bare Ground
18	Wetlands, habitat sites	feature		
19	Water	feature	1	Sea / Estuary
			2	Inland Water
			4	Saltmarsh
20	NODATA	feature	0	Unclassified
	Construction sites			

FINAL land use

ID	Land use	Type
0	Arable land	Vacant
1	Maintained grassland	
2	Non-maintained grassland	
3	Peat bogs	
4	Marginal	
5	Forest incl community woodland	Function
6	Urban centre	
7	Urban – higher density	
8	Urban – lower density	
9	Industrial or commercial	
10	Port areas	
11	Green artificial	
12	Mineral extraction sites	feature
13	Dump sites	
14	Road and rail networks	
15	Airports	
16	Sand, dunes, bare rocks	
17	Wetlands, habitat sites	
18	Water	
19	NoData	

Sector:

Name	Land use (function)	Type
Urban centre population	Urban centre	population
Urban population higher density	Urban higher density	population
Urban population lower density	Urban lower density	population
Industry & commercial area	Industry & commercial	area
Port area	Port	area
Green artificial area	Green artificial	area
Forest & community area	Forest include community garden	area

Population estimation

Population: ONS LSOA population estimation 2001& 2009

Sector / Time	2000-Jan-01 00:00:00	2009-Jan-01 00:00:00	2050-Jan-01 00:00:00
Urban centre population [people]	191306.55	198902.7	233507.3833
Urban higher density population [people]	3634824.45	3779151.3	4436640.283
Urban lower density population [people]	4542160	4651520	5149715.556

	Urban centre population			Urban population higher density			Urban population lower density	
District name	2001	2009		2001	2009		2001	2009
Chester	2357.25	2572.65		44787.75	48880.35		71083	67293
Crewe and Nantwich	1964.65	2048.8		37328.35	38927.2		71936	77274
Vale Royal	1029	1309		19551	24871		101718	101056
Congleton	573.2	673.3		10890.8	12792.7		79283	78638
Macclesfield	1651.35	1557.4		31375.65	29590.6		117101	121157
West Lancashire	1139.3	1146.35		21646.7	21780.65		85694	87317
Kirklees	5730.25	6461.9		108874.75	122776.1		274375	277512
Calderdale	2536.2	2506.8		48187.8	47629.2		141655	151421
Bradford	12168.75	14112.5		231206.25	268137.5		227378	224557
Leeds	16989.95	20600.15		322809.05	391402.85		375810	375698
Wakefield	3857.2	3952.75		73286.8	75102.25		238236	244842
Ellesmere Port & Neston	2030	1880.95		38570	35738.05		41028	42954

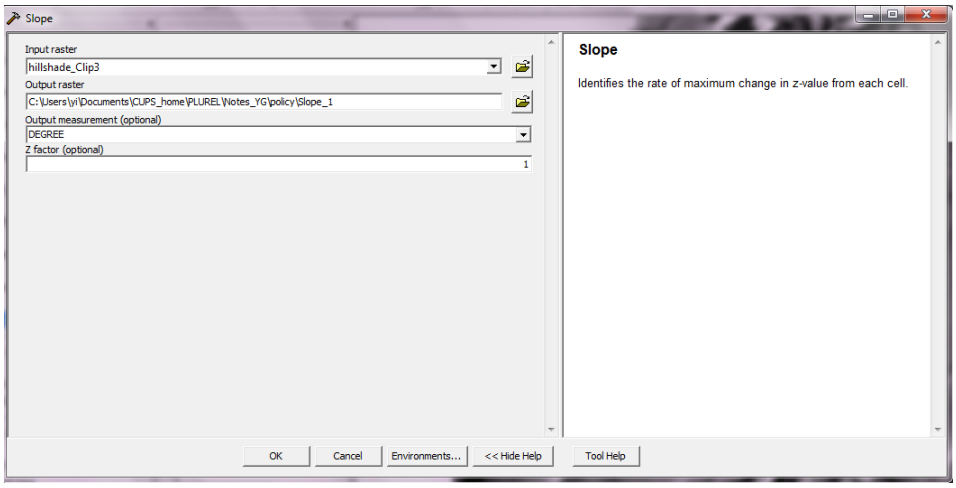
Wirral	8091.6	7681.85		153740.4	145955.15		153172	154858
Liverpool	16135.45	15891.35		306573.55	301935.65		119149	124468
Sefton	8338.85	7592.95		158438.15	144266.05		116107	121444
Fylde	707.7	786.15		13446.3	14936.85		59186	60625
Halton	2886.7	2311.45		54847.3	43917.55		60825	72478
Knowsley	4484	4294.25		85196	81590.75		61558	63476
St. Helens	3758.05	3804.9		71402.95	72293.1		101665	101025
Warrington	3693.5	3667.55		70176.5	69683.45		117332	124412
Trafford	5718	6113.75		108642	116161.25		95812	93007
Manchester	14736.75	18161.2		279998.25	345062.8		128180	120607
Salford	6428.75	6506.35		122146.25	123620.65		88403	94955
Tameside	5825.2	5892.3		110678.8	111953.7		96583	97523
Wigan	5634	5695.5		107046	108214.5		188773	192585
Bolton	6670.05	6701.8		126730.95	127334.2		127901	131077
Bury	3872.8	4099.9		73583.2	77898.1		103199	100599
Chorley	967.75	1062.05		18387.25	20178.95		81204	83544
South Ribble	1425.3	1435.95		27080.7	27283.05		75443	79447
Preston	3483.5	3375.45		66186.5	64133.55		60702	67132
Blackburn with Darwen	3589.1	3329.4		68192.9	63258.6		66671	73312
Rossendale	494.9	445		9403.1	8455		55749	58219
Rochdale	4889.45	4507.7		92899.55	85646.3		108651	114557
Oldham	6003.45	5598.7		114065.55	106375.3		98468	106792
Burnley	2191	2050.25		41629	38954.75		45701	44570
Wyre	1474.1	1414.55		28007.9	26876.45		76318	82778
Ribble Valley	217	231.95		4123	4407.05		49713	53037
Lancaster	2351.9	2669.65		44686.1	50723.35		87011	86364
Pendle	1613.55	1453.35		30657.45	27613.65		57006	60245
Blackpool	5203.5	5079.9		98866.5	96518.1		38200	38400
Stockport	6658.7	6609.5		126515.3	125580.5		151383	151464
Hyndburn	1734.85	1615.5		32962.15	30694.5		46798	48801

Neighborhood interactive rules: networks

4 networks are selected for incorporation:
0: motorways
1: regional roads; a road
2: local roads; b road
3: rail stations

Suitability : Slope data

Data Source (EEA hill
Resampling technique: Bilinear (Bilinear interpolation)



Slop value	Class name	Suitability index									
		Arable land	Maintained grassland	Non-maintained grassland	Marginal	Urban centre	Urban higher	Urban lower	Industry	Ports	
<=1	0	10	8	4	1	10	10	10	10	10	
1-2	1	8	10	8	4	8	8	8	8	8	
2-5	2	4	4	10	8	6	6	8	8	6	
>=5	3	1	1	1	10	1	1	1	1	1	
NoData	4	10	10	10	10	10	10	10	10	10	