

VISUALIZING LANDSCAPE SYSTEM RELATIONSHIPS

(Juanjo Galan Vivas, Polytechnic University of Valencia)

STAFF TRAINING SEMINAR_TELOS project
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 - Urban Green Infrastructures (and DPSIR)
 - Metabolic approaches
 - Landscapes of production
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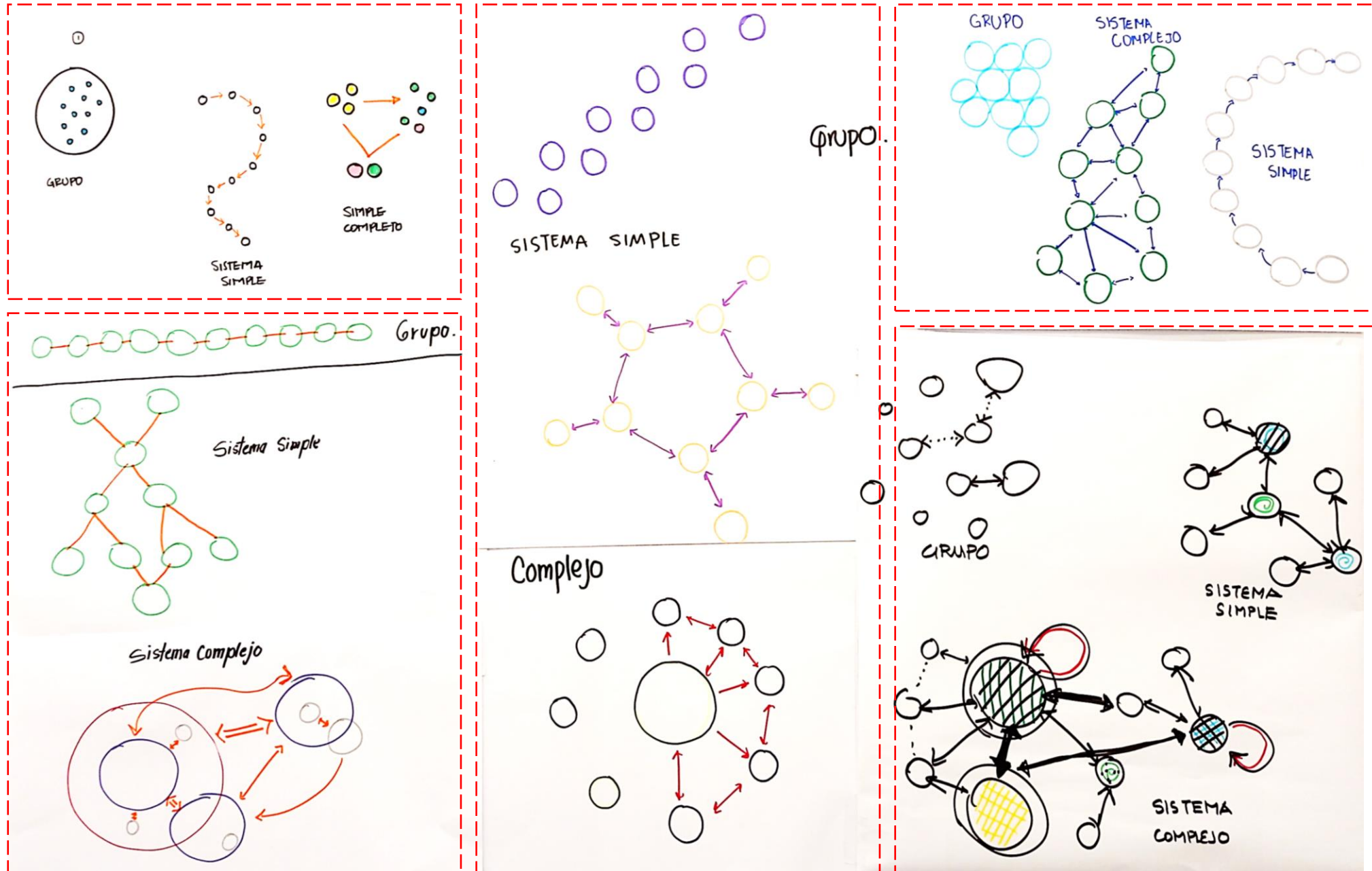
1. Systems, Models, and Systems representations

WHAT IS A SYSTEM?

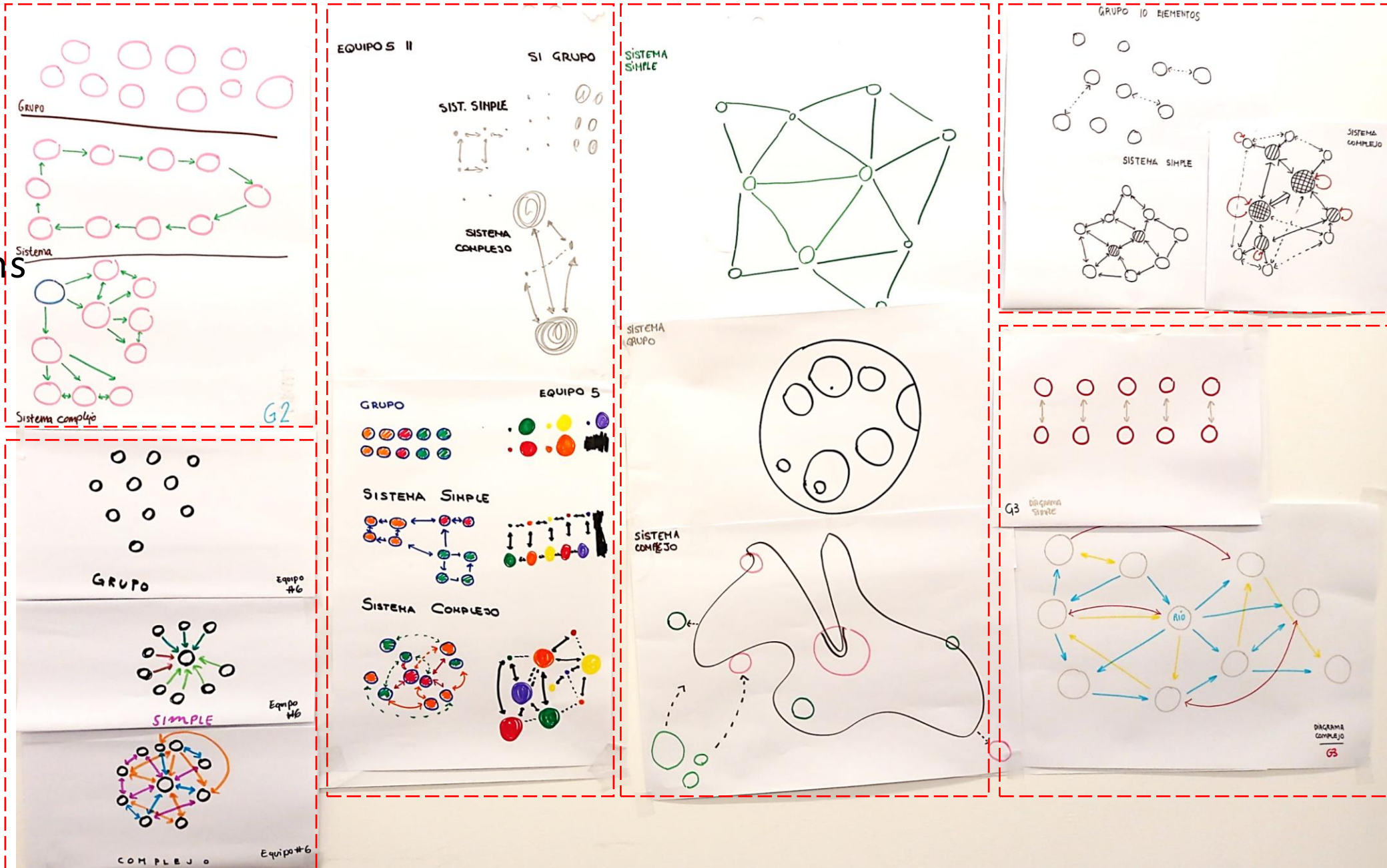
Exercise for the students (10 minutes):

- **Represent graphically a system with circles and arrows**
 - **A GROUP of 10 elements**
 - **A simple SYSTEM of 10 elements**
 - **A COMPLEX SYSTEM of 10 elements**

Systems, Models, and Systems representations



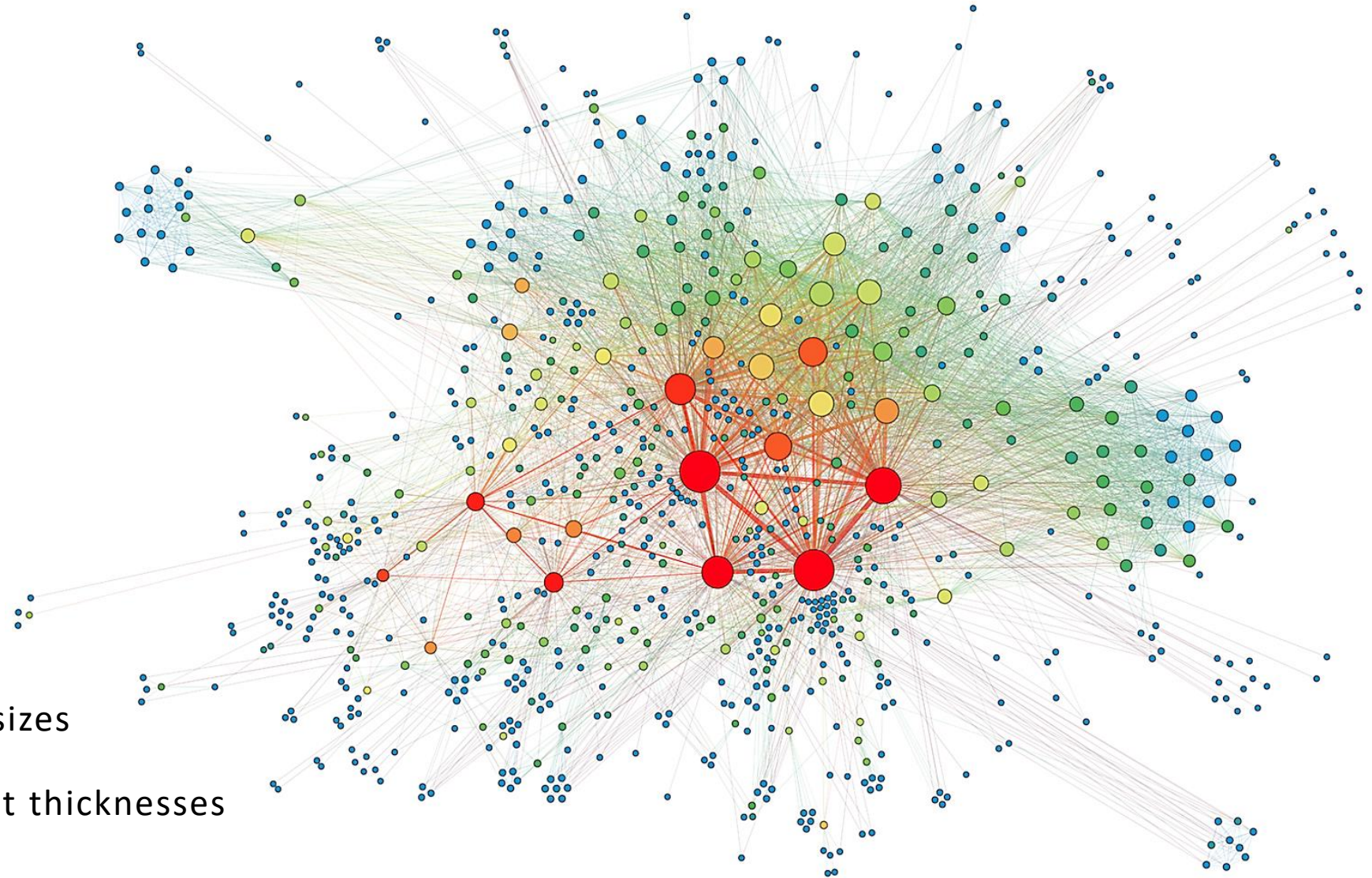
Systems, Models, and Systems representations



Systems, Models, and Systems representations

Notice:

- Elements: different colors and sizes
- Relationships (arrows): different thicknesses
- Clusters and hierarchies
- Is this a representation of a social, informational, ecological, economic system:

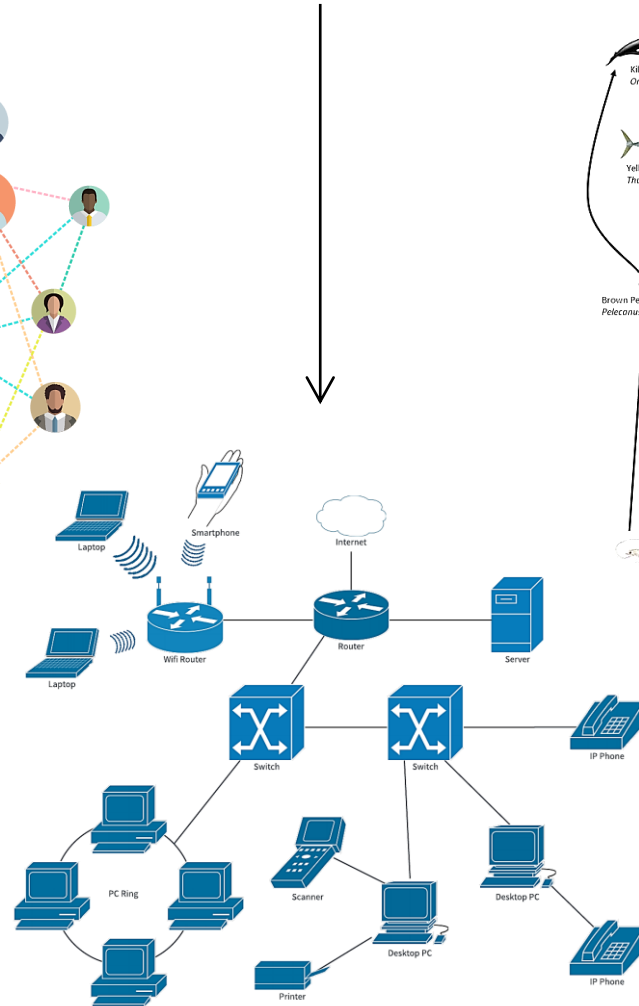


SYSTEMS THEORY and the representation of different types of systems....

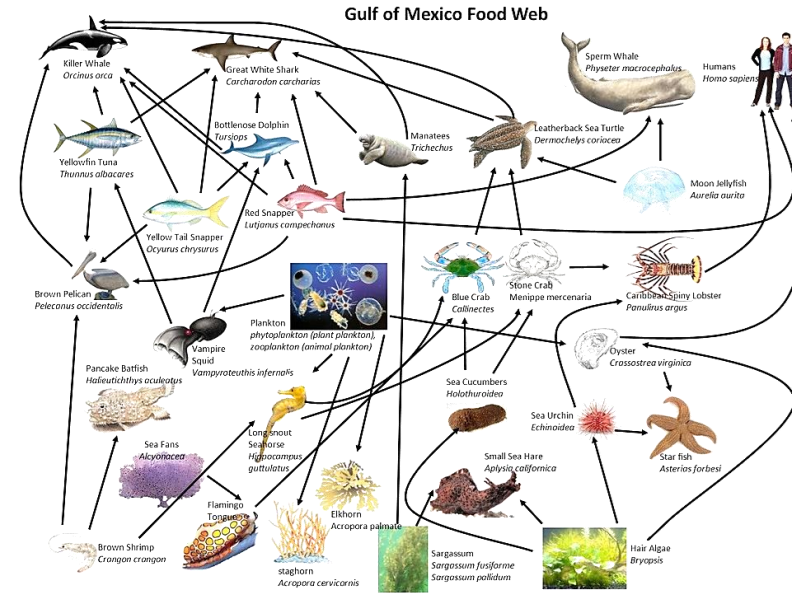
SOCIAL



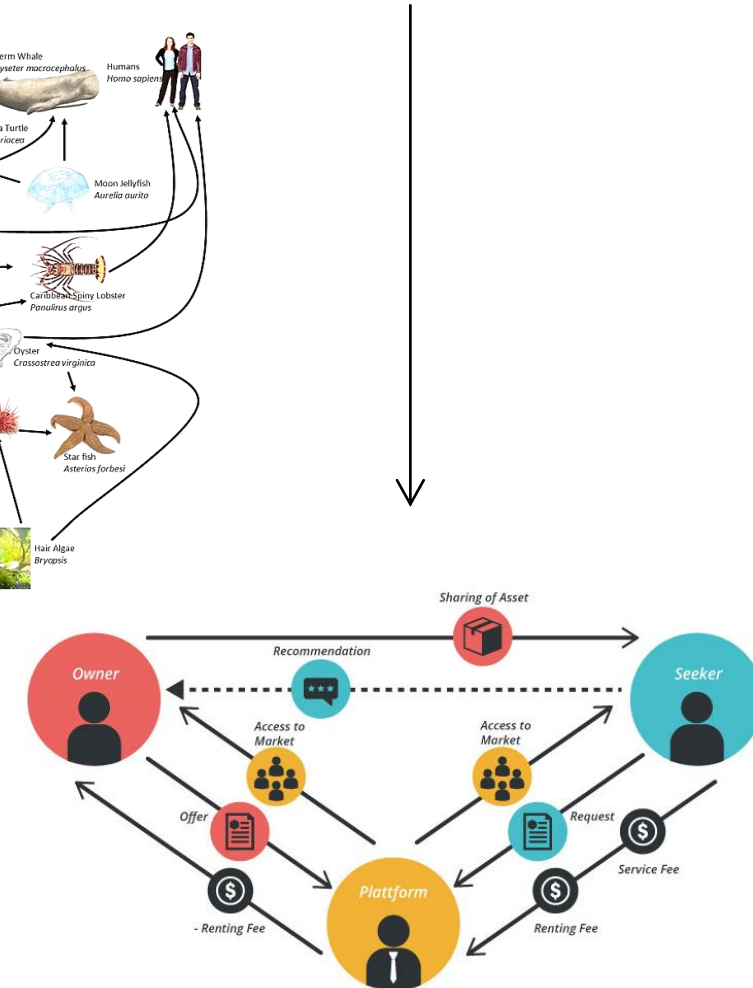
INFORMATION



ECOLOGICAL



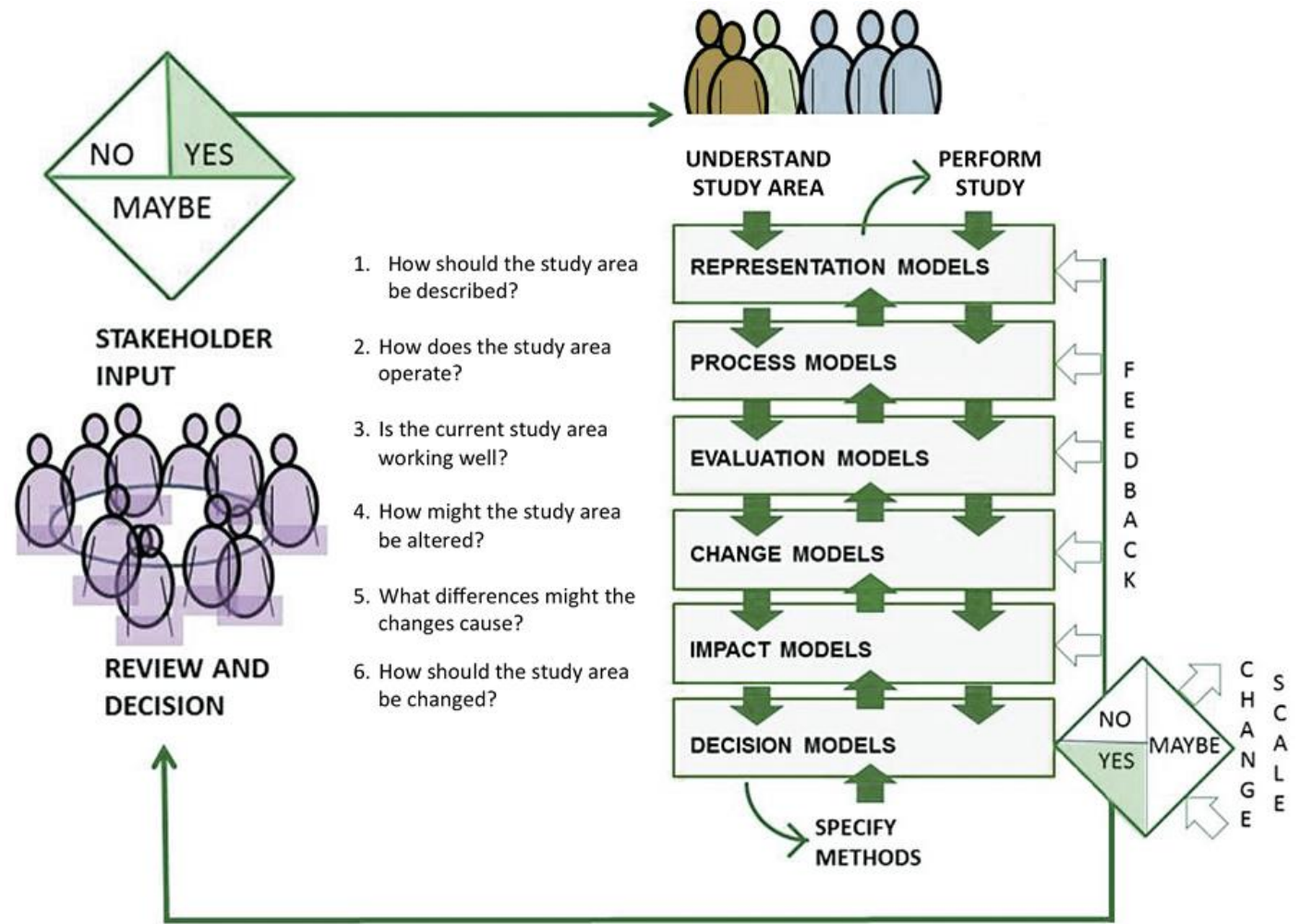
ECONOMY



A SYSTEM: a group of interacting or interrelated elements that act according to a set of rules to form a unified whole

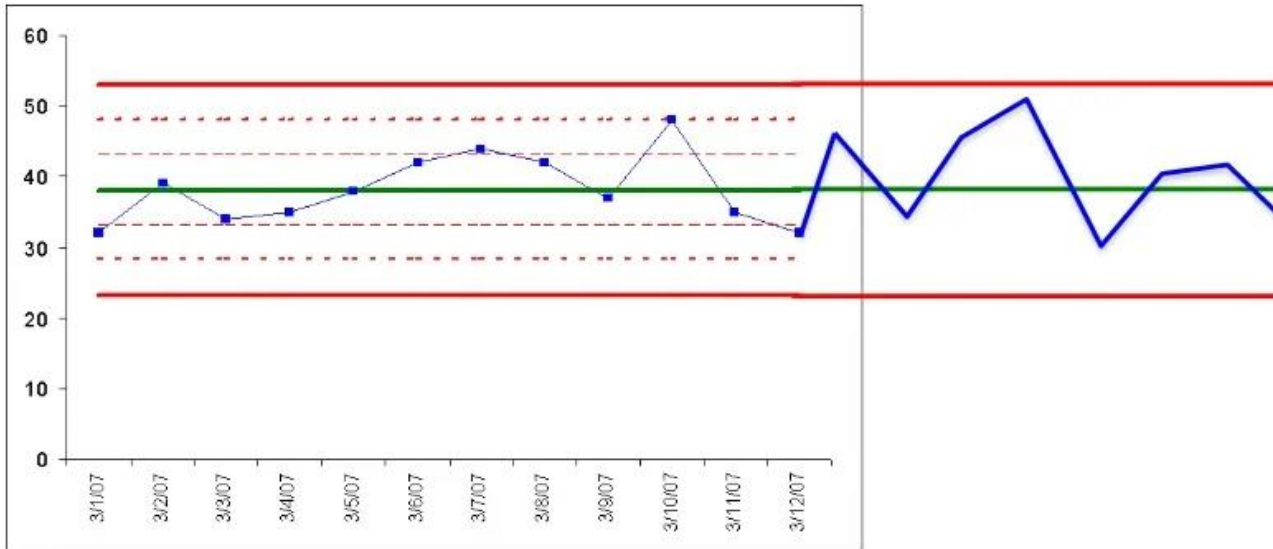
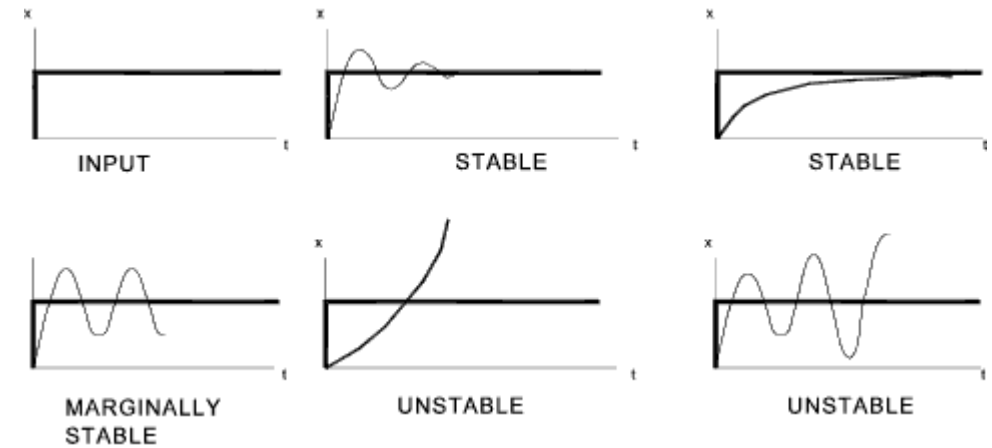
A COMPLEX SYSTEM: systems whose behavior is intrinsically difficult to model due to the dependencies, competitions, relationships, or other types of interactions between their parts or between a given system and its environment. Systems that are "complex" have distinct properties that arise from these relationships, such as nonlinearity, emergence, spontaneous order, adaptation, and feedback loops, among others

A MODEL: a simplified description of a system or process to assist calculations and predictions. A simplified representation of reality (e.g. a complex system), usually made for specific purposes



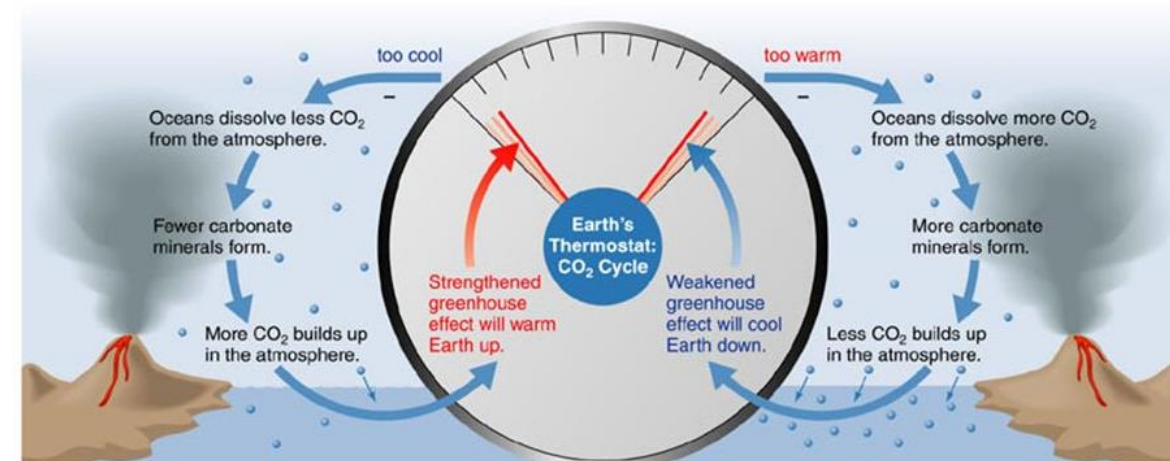
2. Stable systems and Dynamic systems

Stable systems and Dynamic systems: SYSTEMS & TIME



Source: Mark Graban Deming Red Bead 2016 SHS

Earth Homeostasis



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Stable systems and Dynamic systems: SYSTEMS & TIME

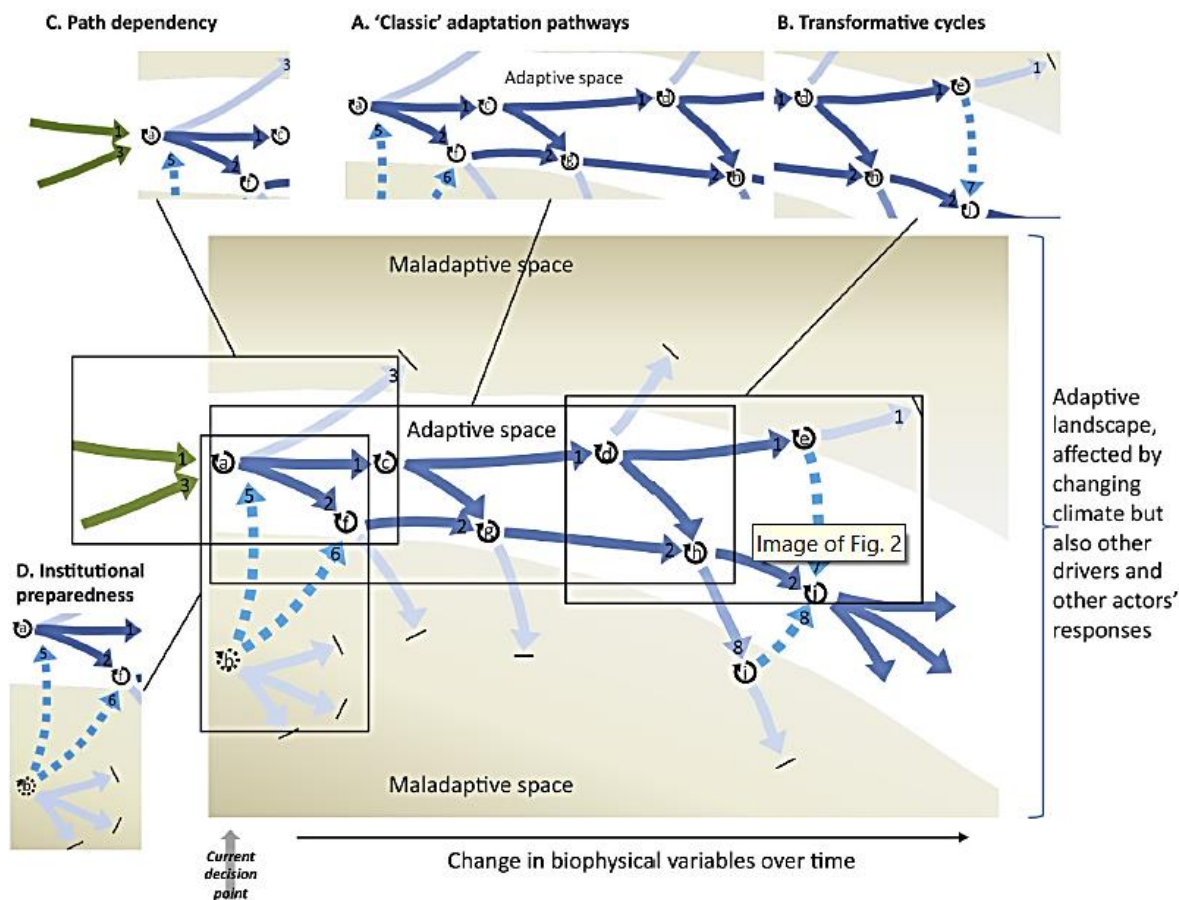
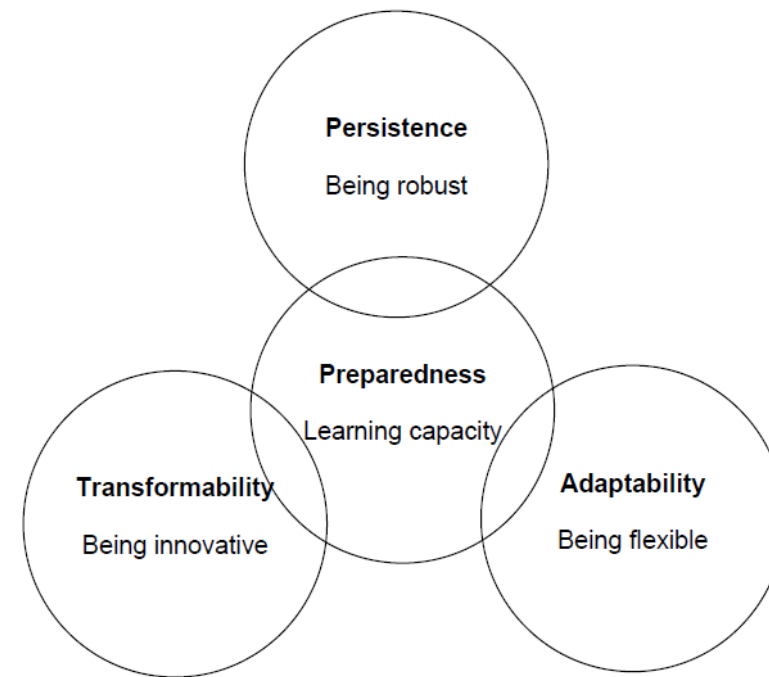


Fig. 2. One decision-making actor's adaptation pathways through an adaptive landscape, building on the metaphor of Fig. 1, where the boundaries between adaptive and maladaptive responses are changing over time, due to biophysical changes, but also due to changes in social and institutional context, including the actions of other decision-makers who may perceive different adaptation pathways. Circle arrows represent decision points, dark blue arrows represent pathways that are contemporaneously adaptive, grey arrows lead to maladaptive dead-ends; dashed blue arrows represent more-or-less transformative pathway segments, and the green arrows show antecedent pathways prior to the current decision cycle (a) faced by the decision-maker of concern. Boxes A–D highlight differences from Fig. 1 that are discussed in the text.

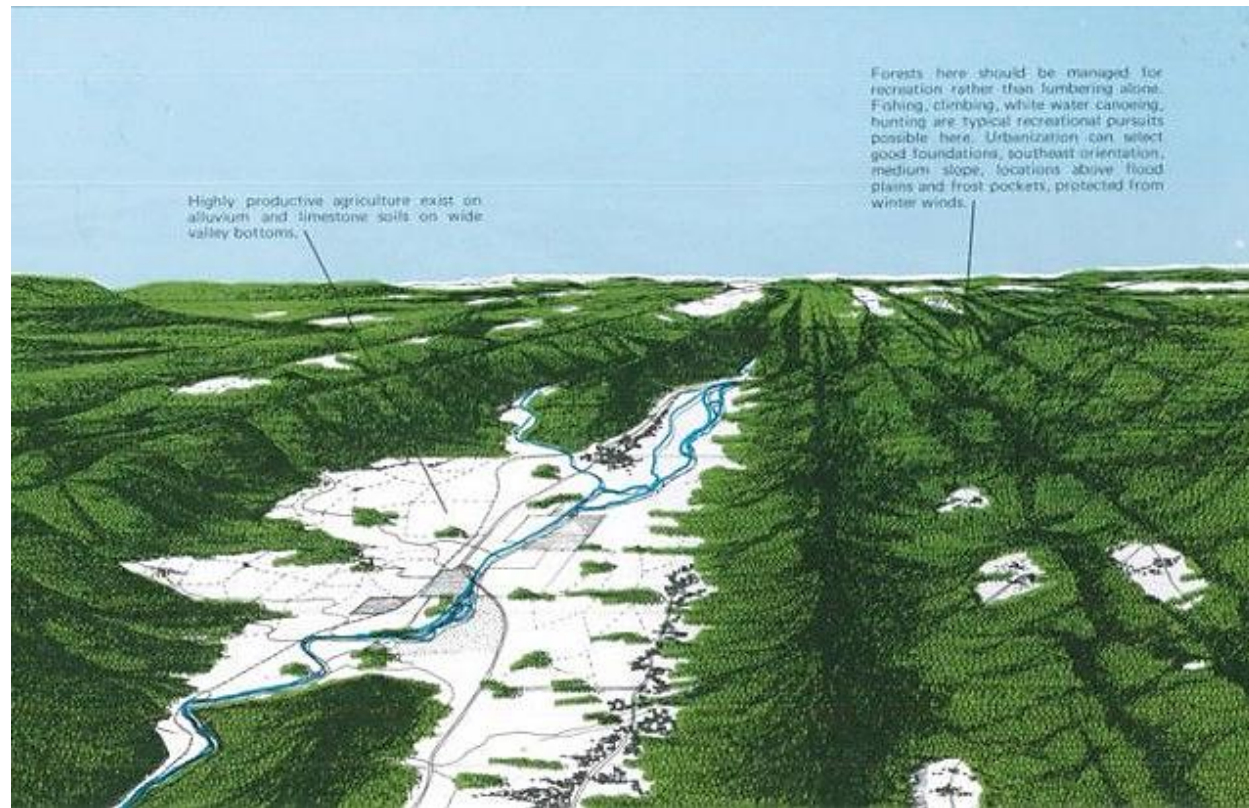


Four-dimensional framework for resilience building. *Source:* the authors.

3. Landscape Systems representations: an overview

Representing spatial systems: simplification and abstraction of a complex reality

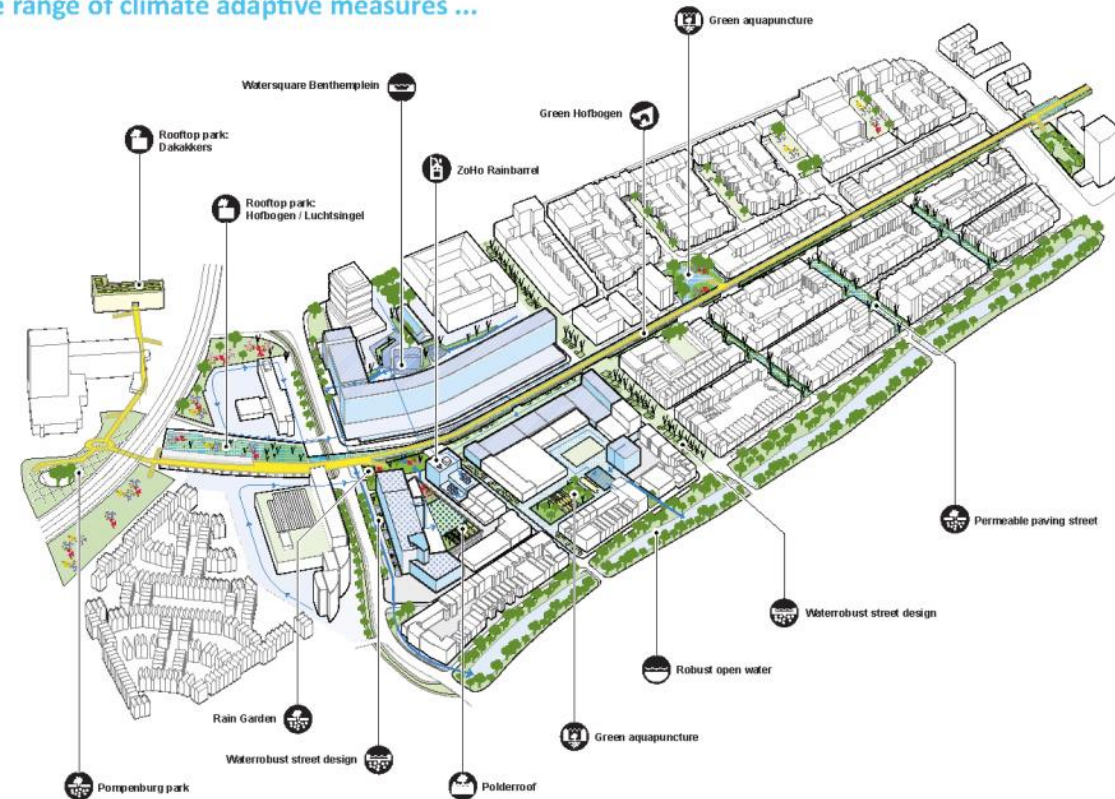
Physical and spatial structure



Source: 'Design With Nature' Ian Mc Harg, 1969

Climate perspective 2030

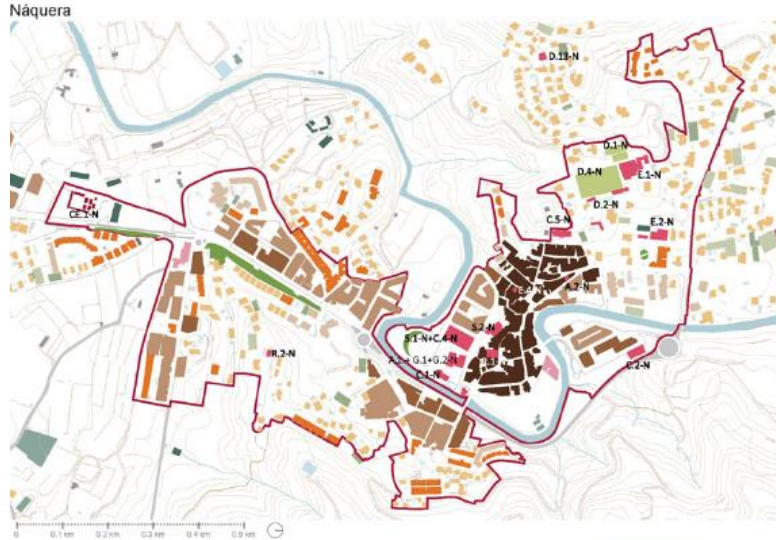
A wide range of climate adaptive measures ...



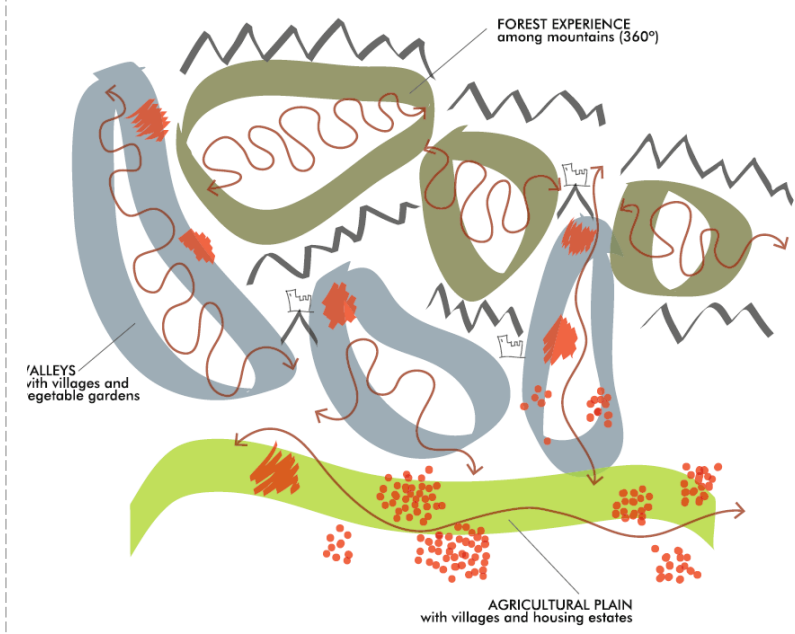
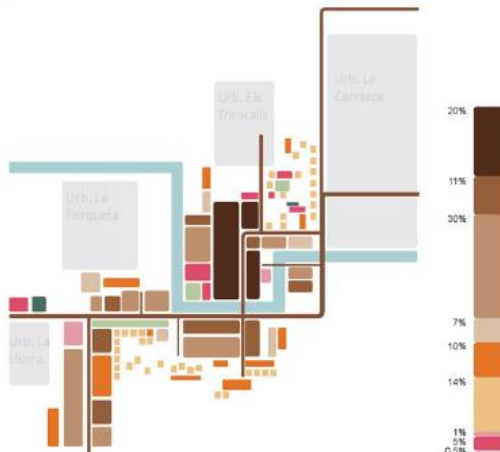
ZOHO DISTRICT (Rotterdam),(source: DeUrbanisten)

Representing spatial systems: simplification and abstraction of a complex reality

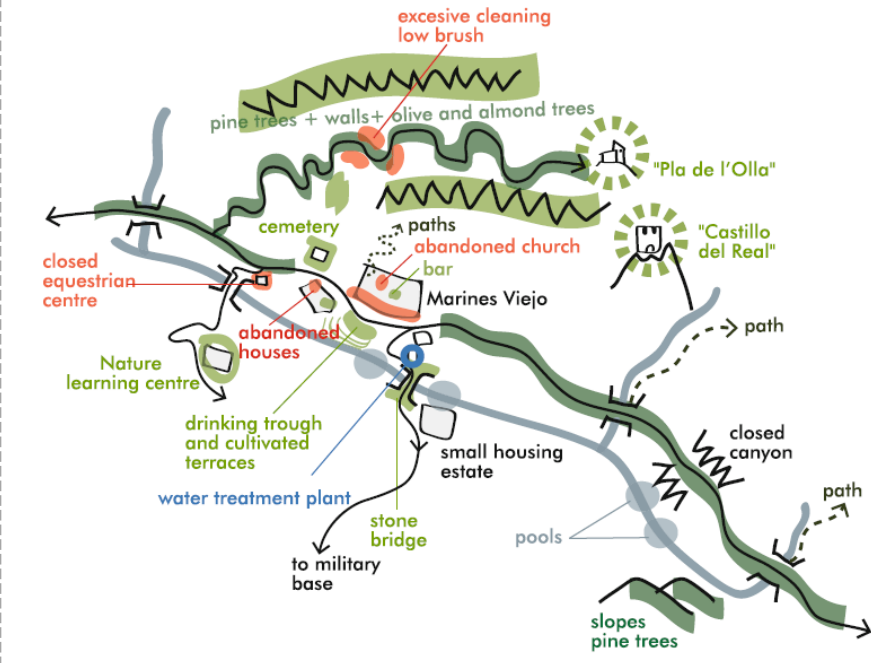
Physical and spatial structure + Abstract representation of a City, a Territory, a District... a Landscape



A town



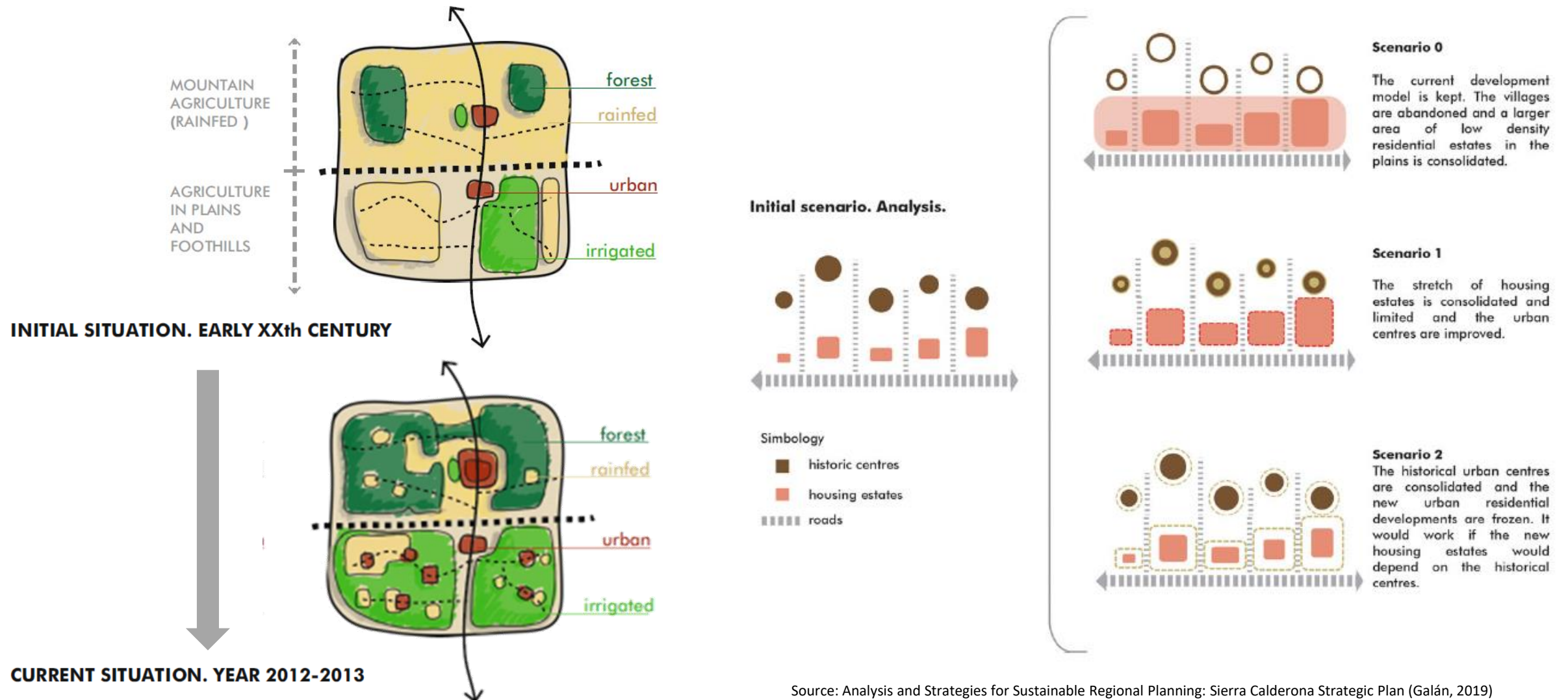
A region



The landscape from the road

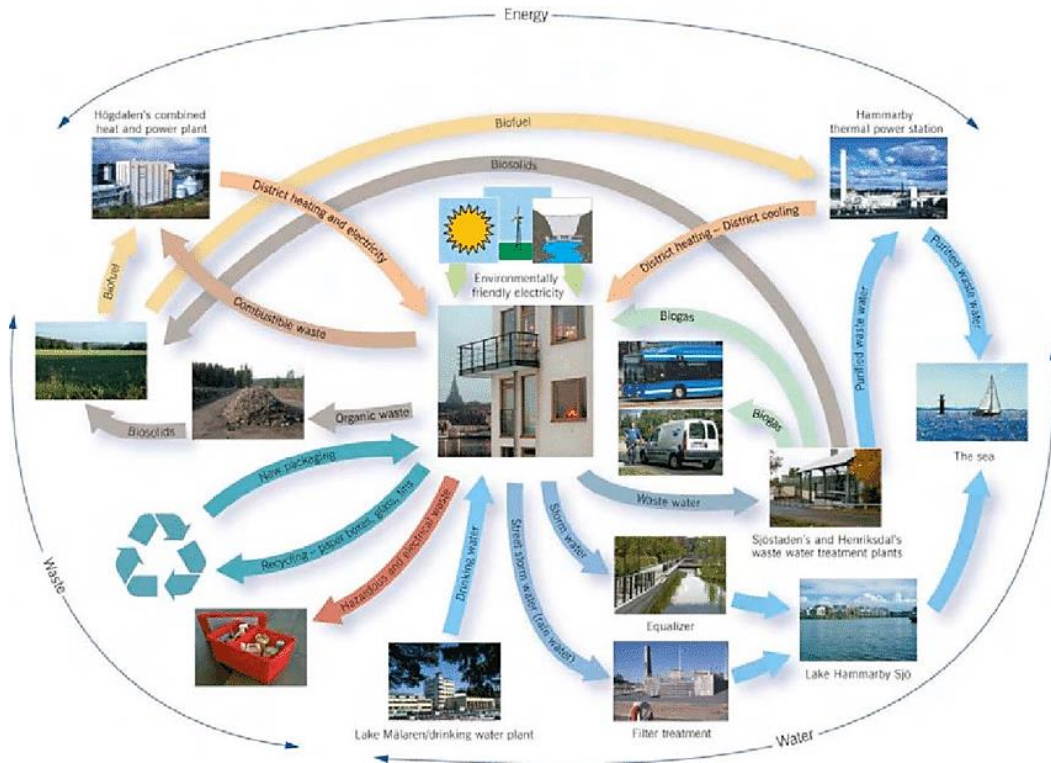
Representing spatial systems: simplification and abstraction of a complex reality

Physical and spatial structure + Abstract representation of the **EVOLUTION** of a City, a Territory... a Landscape

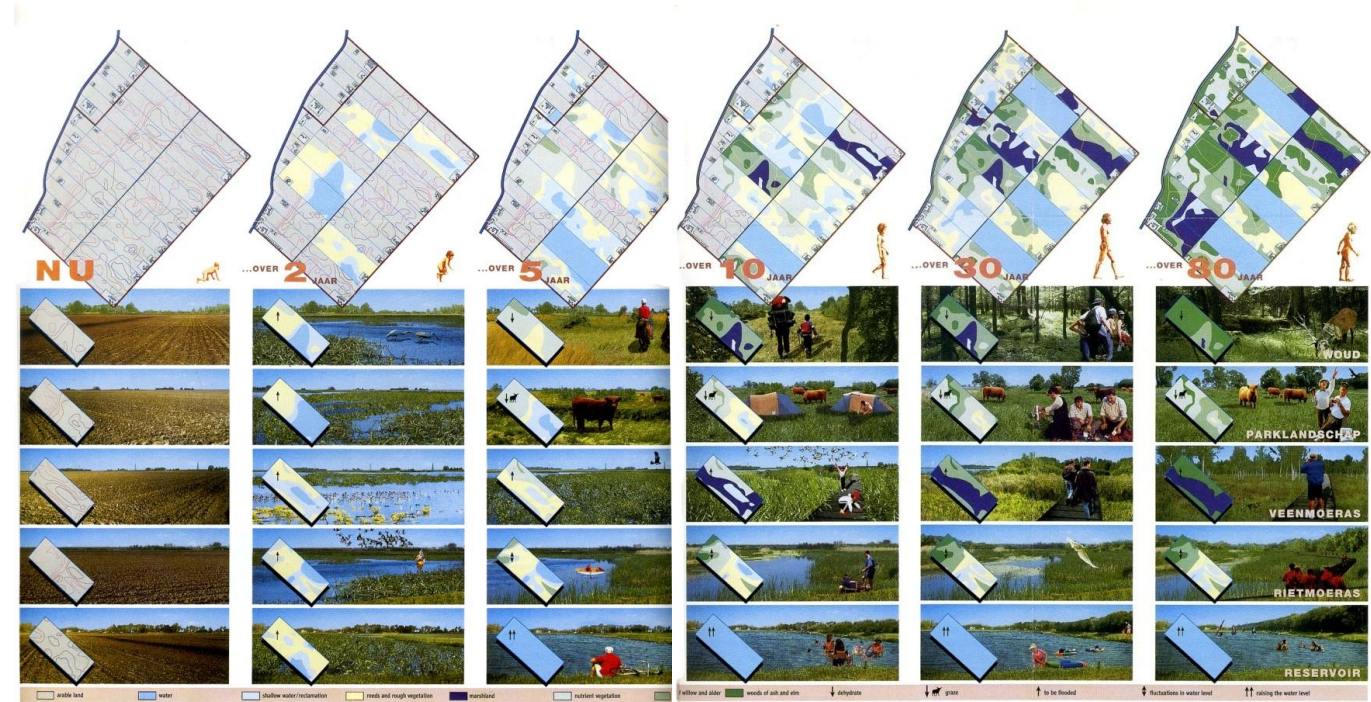


Representing spatial systems: simplification and abstraction of a complex reality

Functional structure and processes



Temporal evolution

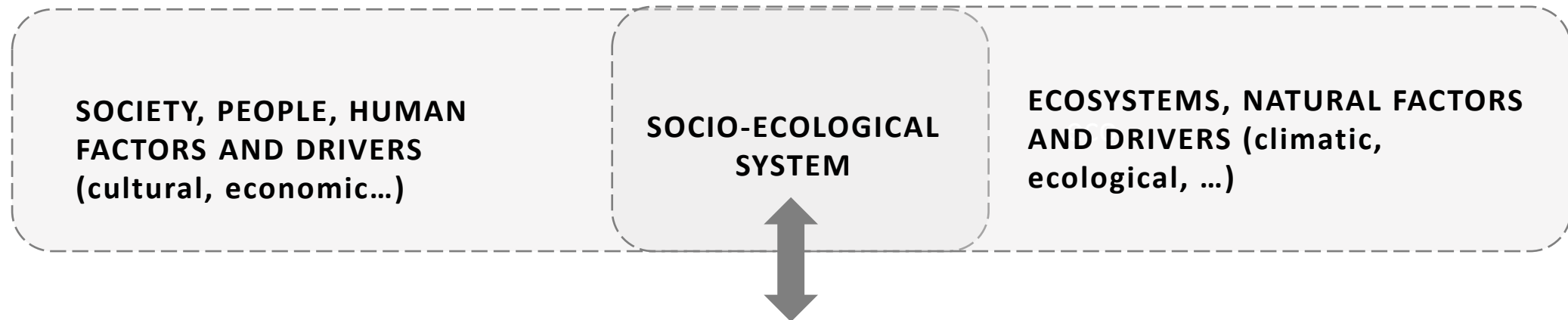


Hammarby Model (2004, sourceFortum, Stockholm Water Company, City of Stockholm)

Progressive transformation of agricultural land into natural marshes and urban areas (Haarlemmermeer, (Netherlands)), (source: VISTA office for environmental planning, landscape architecture and ecology)

Representing SOCIO-ECOLOGICAL systems:

Socio-ecological system: complex adaptive system composed of two primary subdomains highly interlocked, a human society and economy on the one hand and ecosystems on the other.



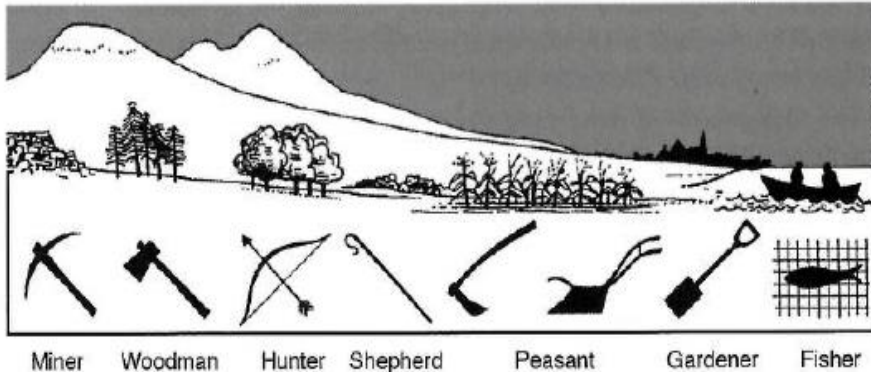
LANDSCAPE: an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors (European Landscape Convention)

↑↓
VISUALIZING LANDSCAPE SYSTEM AS SOCIO-ECOLOGICAL RELATIONSHIPS?

Representing LANDSCAPE SYSTEMS and/as SOCIO-ECOLOGICAL systems:

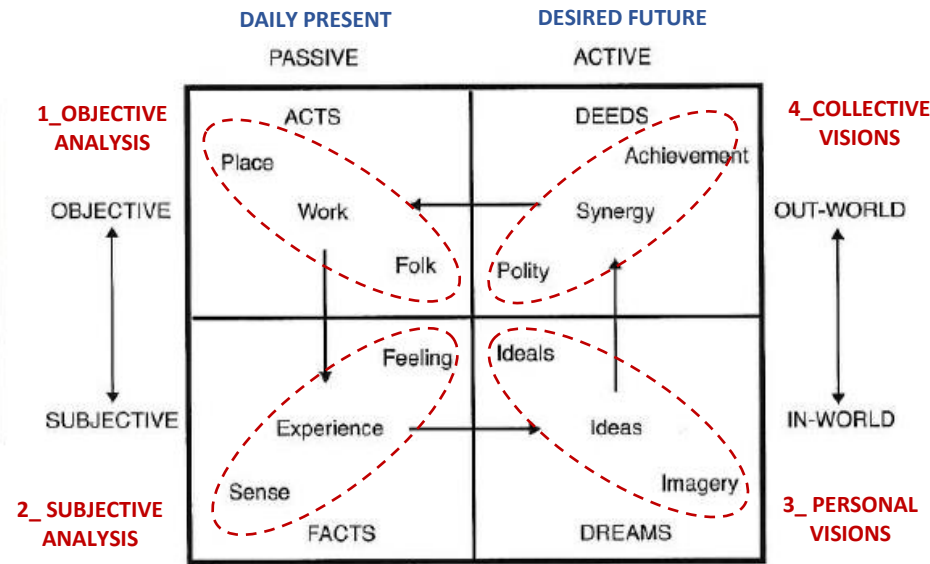
Landscape concept: ... *from being a concern of specific fields of expertise to an integrative concept encompassing both natural and cultural dimensions as well as many levels of meaning* (Clemetsen, 2016)

The landscape lends *“materiality to the... frequently incomprehensible science of models and predictions. It connects disciplines by operating as a platform at which multi-, trans- and interdisciplinary conversations might be had”* (Leyshon & Geoghegan, 2013)



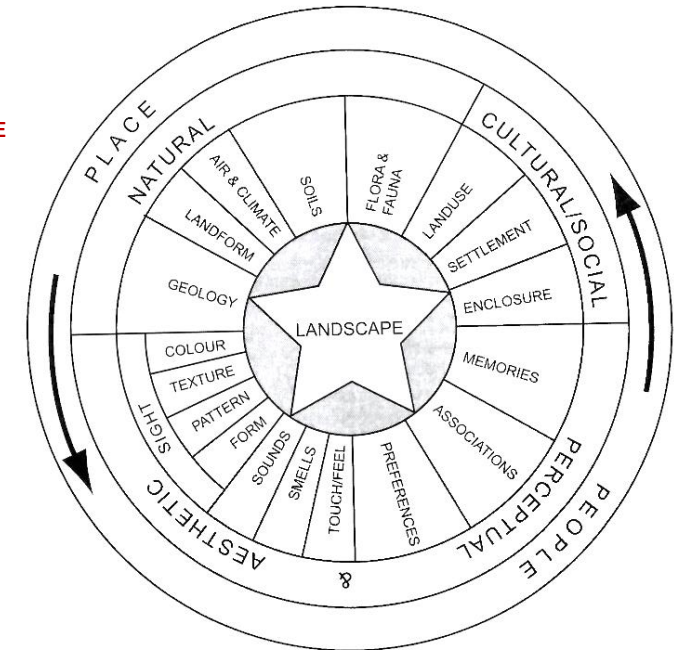
“The valley section” – a pedagogical illustration of how nature and human communities co-evolve within a regional context

The Valley Section by Partick Geddes, 1909 (in Clemetsen, 2016)



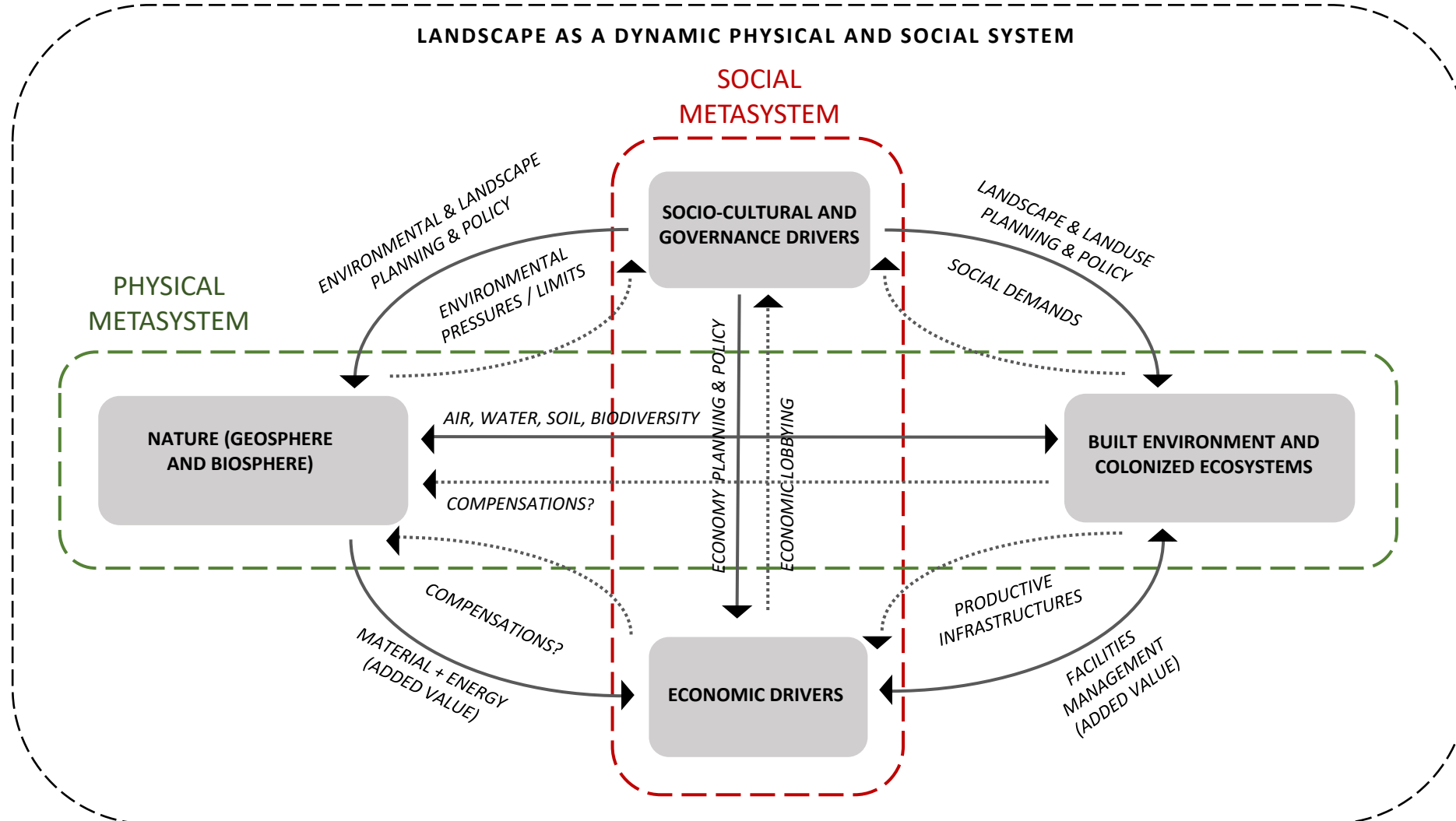
A simplified model of the Notation of Life, by Patrick Geddes (1917)

Source: Reprinted in and adapted from King 2005 (in Clemetsen, 2016)

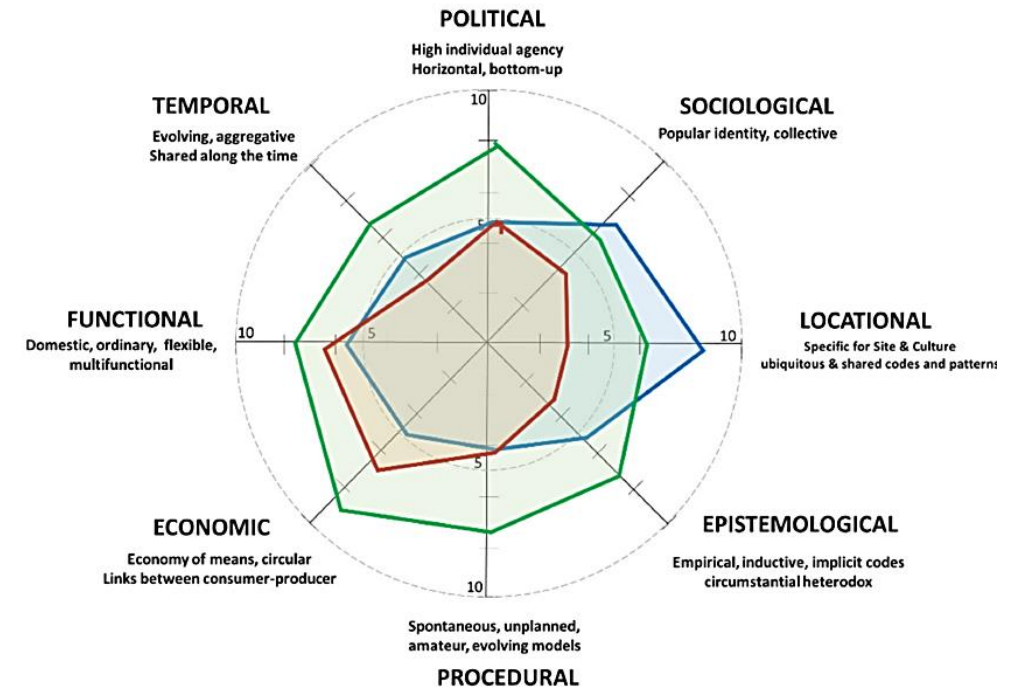
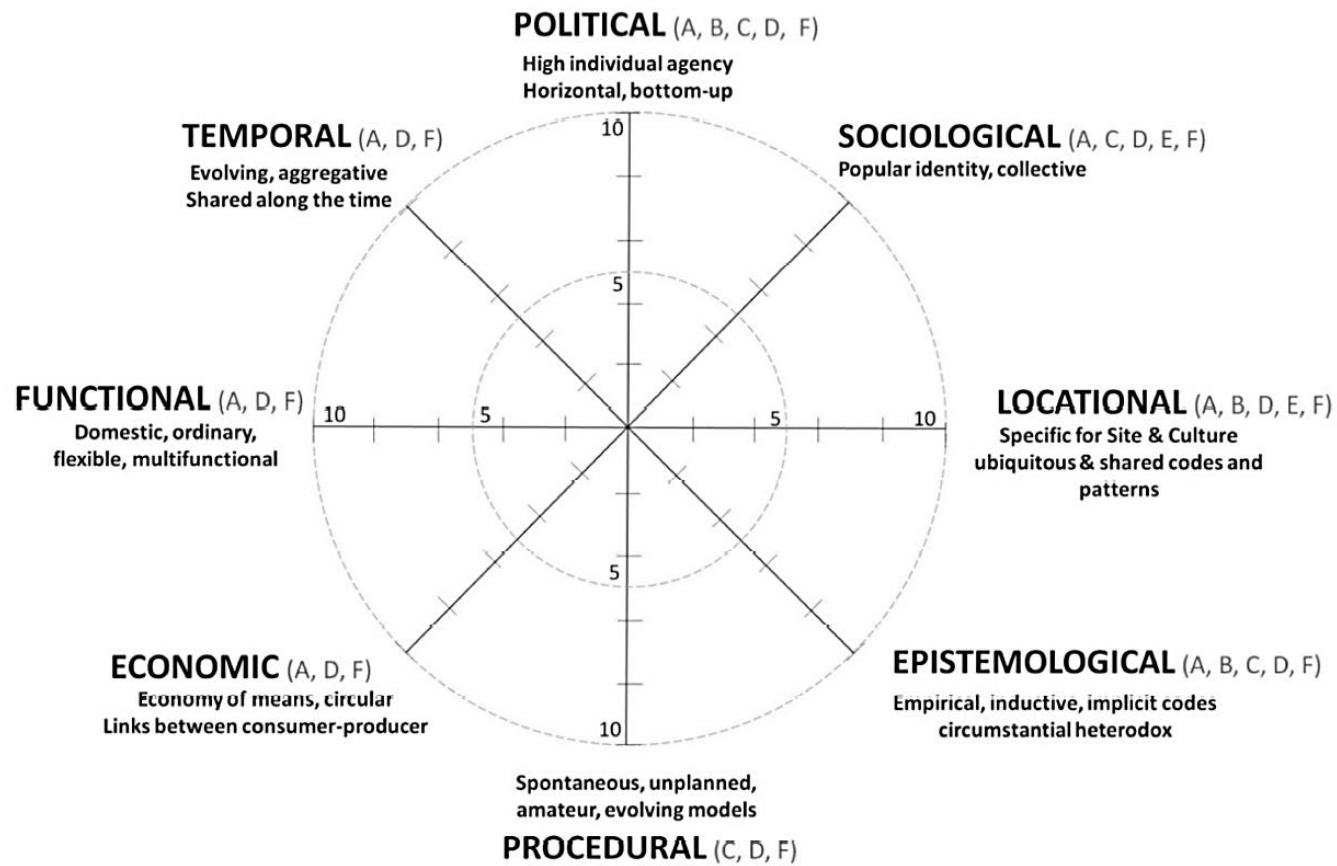


Landscape as an integrated concept; Swanwick and Land Use Consultants, 2002 (in Kidd, 2013)

Representing spatial systems: simplification and abstraction of a complex reality



VERNACULAR LANDSCAPES: A multifactorial phenomenon



House1: Designed by a professional architect using local materials and techniques and reinterpreting in a contemporary language some basic compositional factors (volume, shape, distribution and shape of openings, connection to the landform, etc.).

House2: Designed by a professional architect using a formal and material language disconnected from the site and traditions.

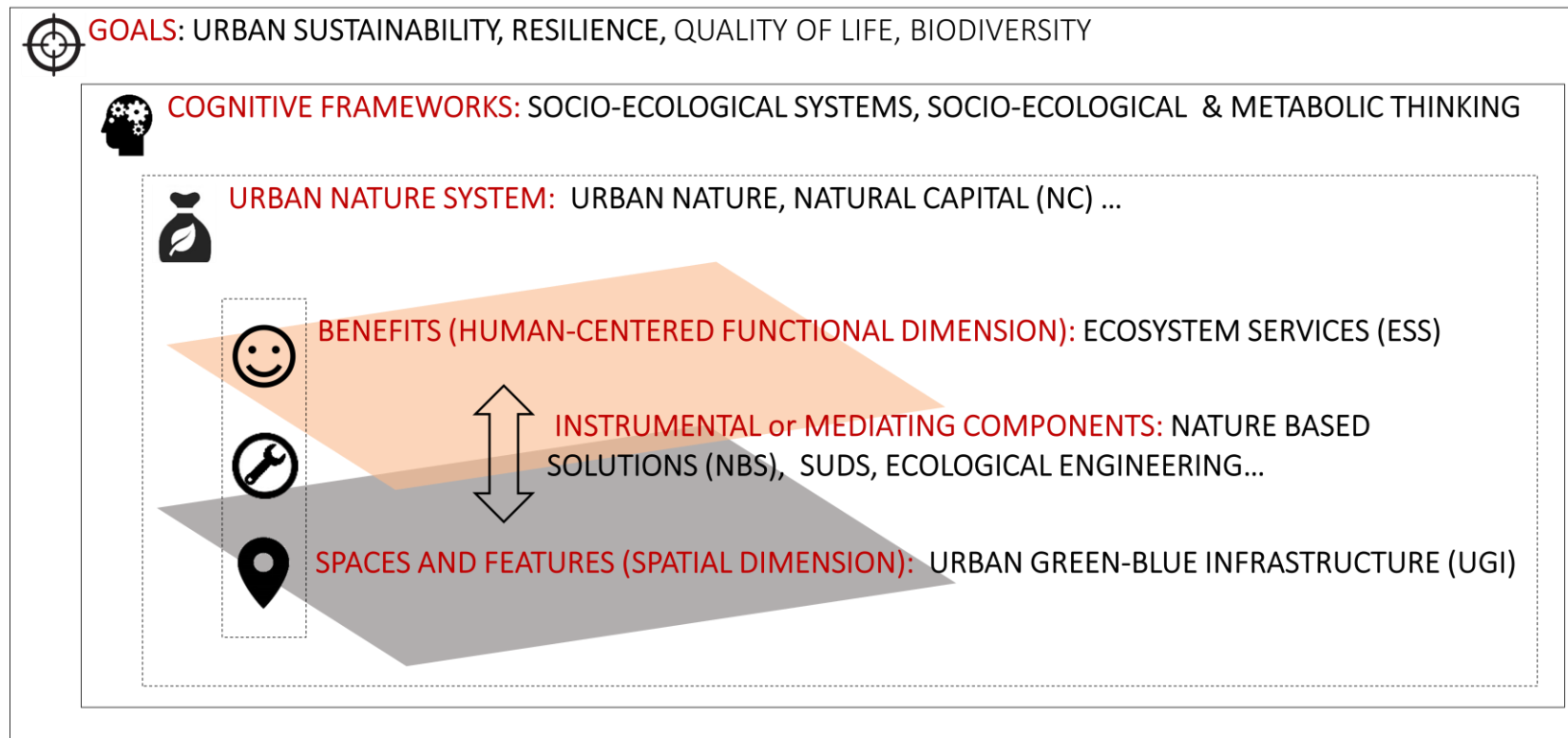
House3: Designed and constructed gradually by a local neighbor with his savings and with some leftovers from other constructions. For the design, he uses the experience accumulated in the house where he lived before and the advice provided by his family, friends and neighbors adding also some "nice" things that he saw on TV.

4. Some examples

4a. Some examples URBAN GREEN INFRASTRUCTURE (and DPSIR)

Studio Course on Green Area Planning (Aalto University)
Blue-Green Infrastructures for Finish/Baltic Cities

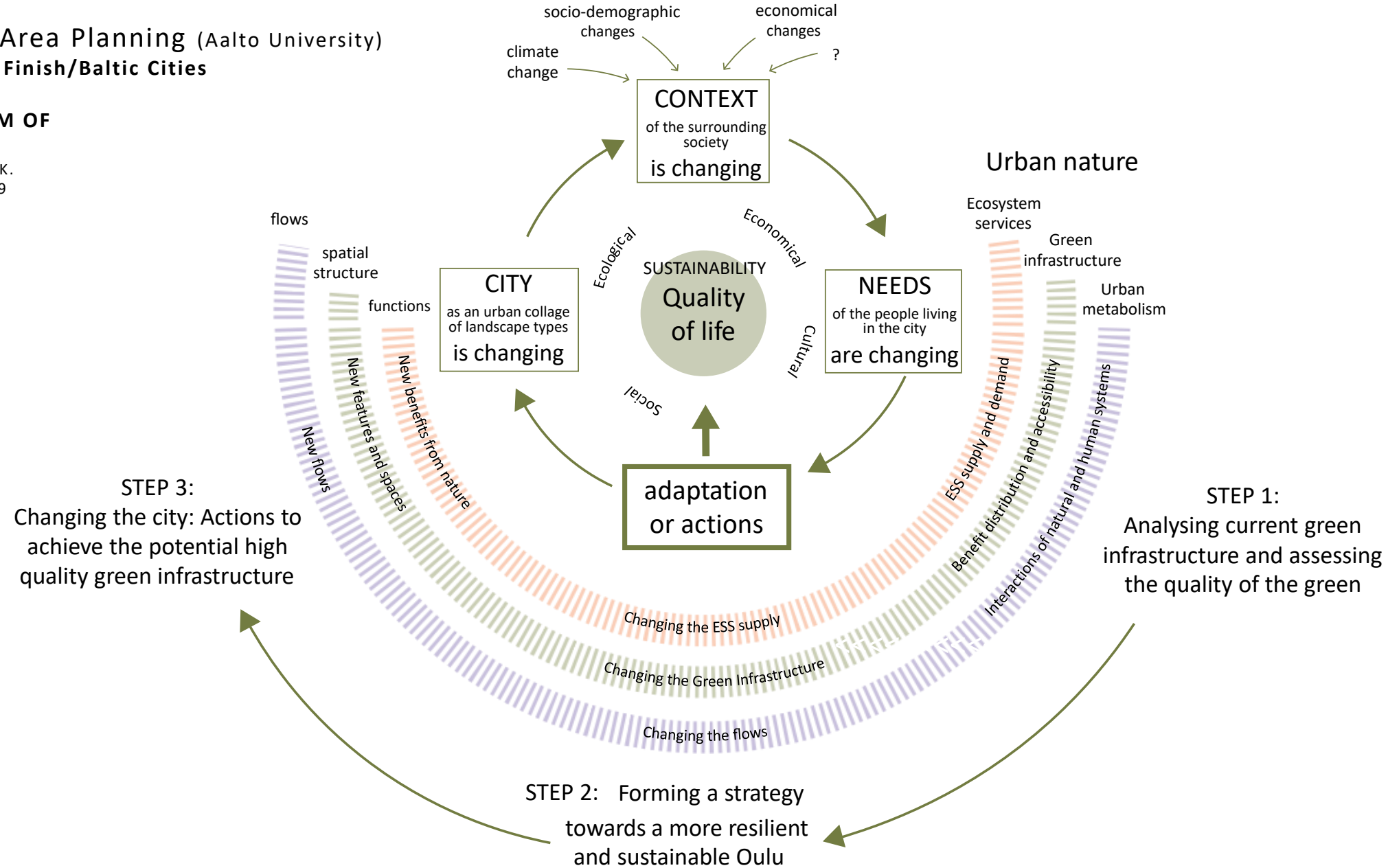
Activator: A RELATIONAL MODEL FOR URBAN-NATURE CONCEPTS (Galán, 2018)



Studio Course on Green Area Planning (Aalto University) Blue-Green Infrastructures for Finish/Baltic Cities

MODEL FOR THE GREEN SYSTEM OF THE CITY OF OULU

students: H.Y. Lai, Y. Liang, S. Kangas, K. Rahkola, C. Yao; teacher: J. Galan, 2019



Studio Course on Green Area Planning (Aalto University) Blue-Green Infrastructures for Finish/Baltic Cities

OULU "SMALL STREAMS MAKE A RIVER"

Oulu - a city by a river

The city of Oulu is located on the northwest coast of Finland. Founded in 1605, Oulu is the oldest and largest city in Northern Finland. The origin of the name Oulu is uncertain, but it might come from the Samish word oulu ("flooding water") or the Northern Savonian word uula ("channel").

Sources:
Climate strategy of the Oulu region, 2009
Sustainable Energy and Climate Action Plan (SECAP) of Oulu under the Covenant of Mayors (COM), 2018



In this study we have chosen to concentrate on approximately 15 km x 10 km area around the city centre, because it is a combination of different kinds of landscape: river, seashore, forests and urban city center as well as suburbs around it. The Oulujoki delta area is also the historical starting point of the city, so the study area also presents different time layers



Land use and urban structure

Oulu has traditionally been growing radially following the shoreline and Oulujoki river. Later, low-density housing and industrial areas have been developed also around the main roads leading to Helsinki, Rovaniemi, Pudasjärvi and Kattamäki. The dense, old grid structured city centre built after the fire in the beginning of the 19th century is located next to the Oulujoki delta area. The delta with its islands is an important recreational area. Other important green areas include the park zone of Kaupunginjoki and the Nallikari beach.

Mobility

The topography of the city is very flat, which makes it suitable for cycling. The city has a cycleway network that covers the entire city and also neighbouring municipalities, and cycling is popular in Oulu even despite the climate conditions. Oulu has also been an important and international port since the 14th century.

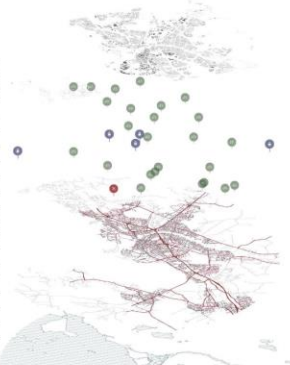
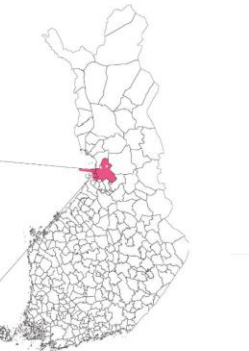
Nature and landscape

The landscape in the Oulu region has a great deal of variety: sea, archipelago, low-lying coastal land, river valleys, agricultural land, and extensive marshes. Special value is attached to marsh ecosystems and to the land-spill coast with its bird waters and seashore meadows. The flora and fauna are equally varied. Unfortunately, many of the species featured in the region have also become endangered.

Winters are colder, darker and longer than in southern Finland, but milder than in Lapland. Nordic climate and nature is more vulnerable to environmental changes, like climate change.

Population

With a population of slightly over 200,000, Oulu is the 5th largest city in Finland. The population of the city has been growing during the last decades, not only because of the municipal merger, but also because of people moving to the city, and natural population growth, which is currently stronger than in any other Finnish city. The city is known as a university city with highly educated people, innovations and technology.



Urban context

Point of infrastructure

Transport system

Hydrology

Topography

Population density

Landuse

Soil type

Conceptual framework

Definitions

Sustainability means ensuring a substantial level of environmental, social and economic quality in the future, while avoiding the negative consequences of current choices related to production and consumption.

Ecosystem services are benefits people can obtain from nature. They can be divided in three groups: supporting and regulating, provisioning and cultural services.

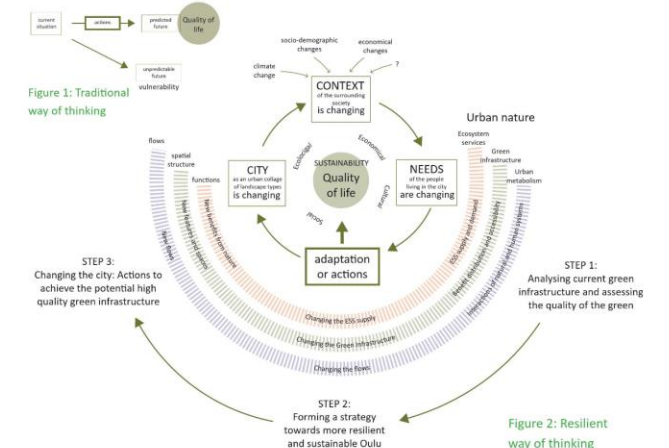
Biodiversity refers to the variety of life on Earth, in all its forms and interactions, from genes to species and ecosystems.

Urban metabolism is a conceptual framework for analysing, modeling and planning complex urban system material and flows. It describes technical and socio-economical processes that occur in cities, for example energy, waste and water.

Green Infrastructure is the spatial structure and network of natural and semi-natural areas and other environmental features designed and managed to deliver multiple ecosystem services.

Landscape type refers to a group of areas characterized by similar combination of natural and social factors, like urban typology and typical green types. Areas with same landscape type share some kind of problems and solutions.

With green infrastructure we refer to green-blue-infrastructure of the city, so the concept also includes different blue types, like lakes and the river. The smallest water systems, like ponds and rain gardens are included in green types.



What is going to happen in the future? Why Oulu should be more resilient and adaptive?

Oulu is facing new challenges. As in many other Finnish cities, the ageing and well being of the population are important issues in the near future. The population of Oulu is exceptionally young, but at the same time the amount of people over 75 years is going to increase 60% in the next decade. The city is also struggling with higher unemployment rate and more health problems compared to Finnish average.

The city is still growing fast, and as in the past, it is expanding radially - new residential areas are being built for example in Hukkaasaari, mainly on former forest areas. However, in the future, growth will take place as densification. This implies even more pressure on existing green areas.

According to the climate strategy of the Oulu region (2009) and Sustainable Energy and Climate Action Plan of Oulu (2018), the most important consequences of climate change include flooding, the rise of water level and also changes in wind, freezing and snowing conditions. Increasing and extreme rainfall will have its impacts for example on erosion, ground water level and rising of pollutants.

In traditional city development (Figure 1) actions take place to achieve the same or even higher quality of life in the future. But what if the future is something we don't expect? Then the actions might not be helpful, which makes the city vulnerable.

Resilient city development (Figure 2) accepts change as normal state of future: changing context means that the need of the people living in the city change, which means that the city has to be changed. Important difference between these two graphs is also the word adaptation - if the city is adaptive enough, there is no need to always use new resources for new actions, when new needs occur.

In order to answer to the complexity of the future needs, Oulu needs to be more sustainable and resilient. In this work, we are exploring the possibilities in improving the city's urban green structure to make the city more sustainable. We want to increase the quality of the green to increase the quality of life.

BUE-GREEN INFRASTRUCTURE FOR THE CITY OF OULU

students: H.Y. Lai, Y. Liang, S. Kangas, K. Rahkola, C. Yao; teacher: J. Galan, 2019

Studio Course on Green Area Planning (Aalto University)
Blue-Green Infrastructures for Finish/Baltic Cities

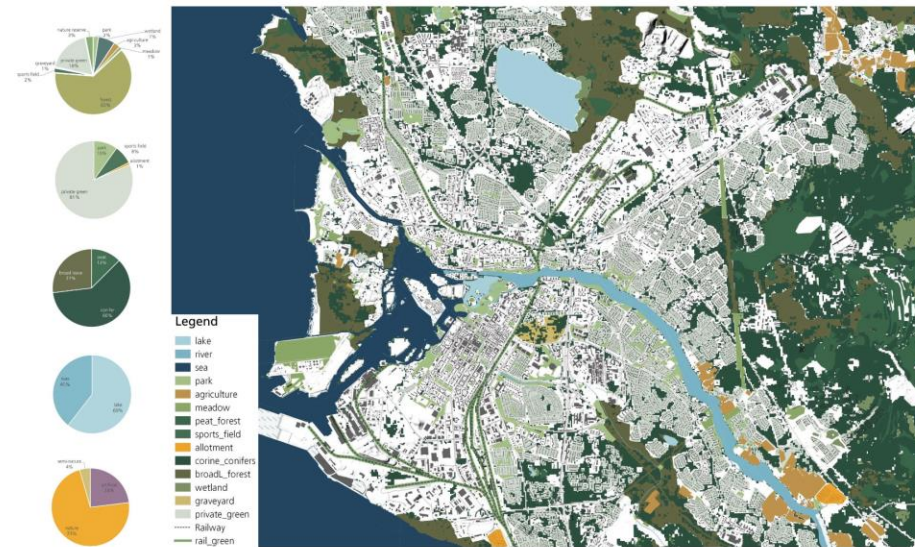
OULU "SMALL STREAMS MAKE A RIVER"



Step 1

The existing green infrastructure & urban fabrics

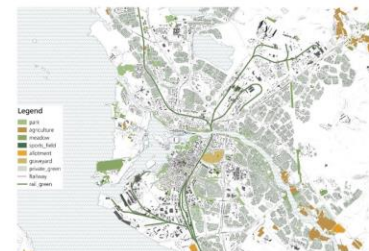
Green infrastructure - locations, spaces and features



Natural and rural green types



Semi-natural and artificial green types



Landscape types

Based on our analysis and the observations of the field trip we divided the city in four different landscape types: City center, Housing, Industrial sites and traffic green, and Nature and rural green. The areas are divided by their urban typology and typical green types, and each of them has typical problems and solutions. The radial urban structure of Oulu can be identified in landscape types map. The percentage of suburban housing areas is relatively high. Large part of the water edge is not connected to public areas. Apart from the grave yard, larger natural areas are located far from the city center, or inaccessible, like small islands.



City centre

Urban typology
city center and other dense apartment housing and commercial areas

Typical green areas
parks
private green
traffic green

Main problem
Lack of green and blue infrastructure in the urban areas

Industrial sites and traffic green

Urban typology
Areas with restricted use and access: industrial areas, surroundings of railways and highway

Typical green areas
brownfield
traffic green
forest

Main problem
Lack of biodiversity

Water's edge

Urban typology
variable - areas next to river or seashore

Typical green areas
parks, private gardens

Main problem
Inaccessibility of water

Housing

Urban typology
forest suburbs, low density apartment house area, detached housing

Typical green areas
private gardens
forests

Main problem
low diversity of green infrastructure

Natural and rural green

Urban typology
cottages, farms or other low-density housing areas

Typical green areas
forests
agricultural land
private green, (meadows, wetland, traffic green)

Main problem
lack of biodiversity

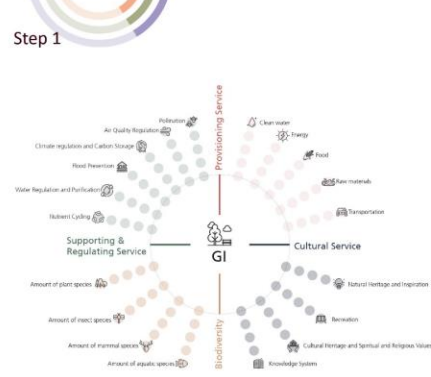
BUE-GREEN INFRASTRUCTURE FOR THE CITY OF OULU

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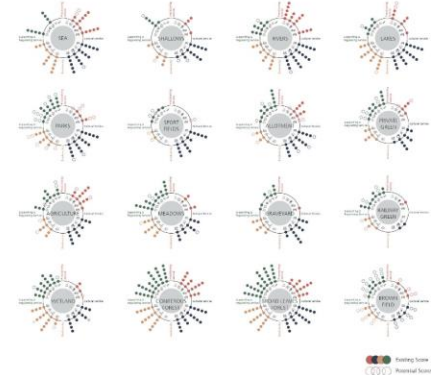
Studio Course on Green Area Planning (Aalto University)
Blue-Green Infrastructures for Finish/Baltic Cities

OULU "SMALL STREAMS MAKE A RIVER"

Assessing the current quality of the green through ecosystem services



We used the concept of ecosystem services to assess the current and potential quality of the performance of the green areas.
 In order to better understand the connection between different green types and their importance for ecosystem production and biodiversity, we gave each of the green types points according to their performance. Each of the fields were given points from 0 to 5 according to our group members expert analysis, field trip observations and scientific papers (e.g. Burkhard et al. 2012). Higher points means higher production and importance.



Sources
 Sustainable Energy and Climate Action Plan (SECAP) of Oulu under the Covenant of Mayors (CoM), 2018
 Burkhard, B., Kroll, F., Nedkov, S. & Müller, F. 2012: Mapping Ecosystem service supply, demand and budgets. Ecological Indicators 12 (2012) 17-29
 VILMO - Oulun viheralueverkosto ja luonnon monimuotoisuus 2014 ("The green infrastructure and biodiversity of Oulu")

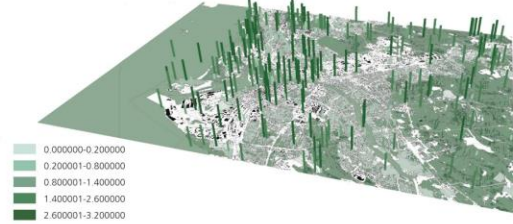
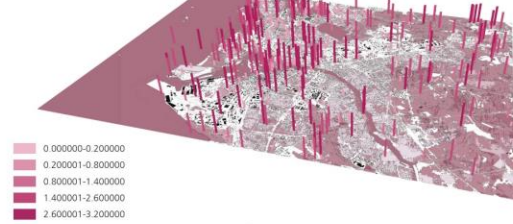
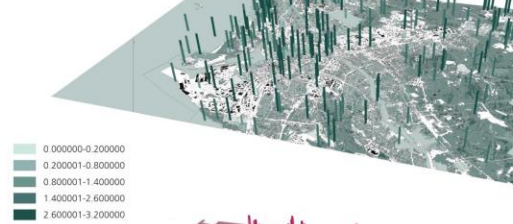
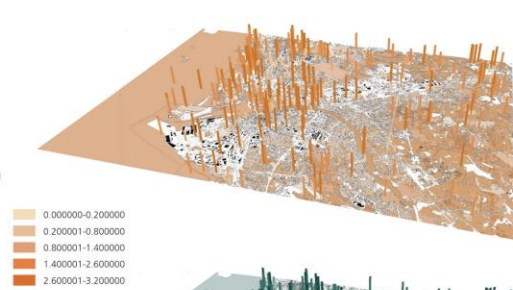
Ecosystem services
 The same land area can offer multiple benefits if its ecosystems are in healthy state. Ecosystem services approach enables us to assess not only the functions but also the multifunctionality of the green spaces.

Supporting and Provisioning services include products obtained from ecosystems, like food, water and wood.

regulating services include benefits obtained from the regulation of ecosystem processes as well as services necessary for the production of all other ecosystem services. The sea and forests are especially important areas for city scale water and climate regulation, and coastal areas with natural vegetation provide for example flood prevention. Agricultural land and meadows are beneficial for pollination and nutrient cycling. Especially parks and traffic green areas can have a local importance in for example air quality regulation.

Cultural services are non-material benefits obtained from ecosystems, like health, recreation and spiritual values. In Oulu they are mainly connected to the city center and the river.

Biodiversity
 In Oulujoki delta and other coastal areas with land uplift, succession and flooding offer multiple valuable coastal habitats, which are, however, also vulnerable because these areas are appealing for recreation, housing, harbours and industrial areas. Other important biodiversity hotspots include large continuous forest areas outside the city center. They offer large diversity of habitats, also for endangered species, as well as connections to untouched areas. These areas are threatened by the construction of new residential areas and the growing recreational pressure.



Green quality index map

After giving values to each of the ecosystem services per green types, we calculated averages for each of the four categories, and the overall average of these four numbers to get a final value for one green type.

After giving values to each of the green types, we were able to compare the quality of the different green types and produce a green quality index map for Oulu city districts. The index is a sum of green types surface areas weighted with green type specific scores. The darker the green, the higher the quality of the green.

It is important to notice, that the division was made by city districts. The map is not perfect tool to compare the accessibility of the ecosystem services supply, as some areas might get relatively low points even if there are high quality natural areas right next to them, only because they are located in different city districts. However, the green quality map can be used to quickly assess the distribution of ecosystem services and the changes between current and future green quality and where the biggest changes are going to happen. For example most of the natural areas already score so high in ecosystem service comparison, that the change will not be as significant as in the city center.

CALCULATION:
 A = area of green type (square kilometers)
 Q = green type quality score (weighting)
 Score of a district = A1*Q1 + A2*Q2 + ... + An*Qn

Urban metabolism

Like ecosystem services, urban metabolism approach can be used to assess the performative character of nature and the interactions between natural and human systems.

Urban metabolism is an analytical tool to understand the city through the flows of resources, such as water, nutrients and waste. Most of the flows are closely linked to the supporting and regulating ecosystem services like clean water and climate regulation.

In Oulu the supporting green and blue system is providing the city with among others, energy sources, drinking water and climate regulation. The City itself creates waste, waste water, nutrients and carbon dioxide which are flows that affect the city's green infrastructure and the surrounding system.

The quality of drinking water is one of the most vulnerable features of Oulu. Drinking water comes from Oulu river, and the purification plants are already working on their highest capacity. There is not enough ground water to cover the needs of the people living in the city.

BUE-GREEN INFRASTRUCTURE FOR THE CITY OF OULU

students: H.Y. Lai, Y. Liang, S. Kangas, K. Rahkola, C. Yao; teacher: J. Galan, 2019

Studio Course on Green Area Planning (Aalto University) Blue-Green Infrastructures for Finish/Baltic Cities

OULU "SMALL STREAMS MAKE A RIVER"

Step 3 Pilot projects

Pilot projects are examples on how the strategies adapt to different landscape types and their typical green types. Each of the actions introduces new features or spaces (green infrastructure), new benefits (ecosystem services) and new flows (urban metabolism).

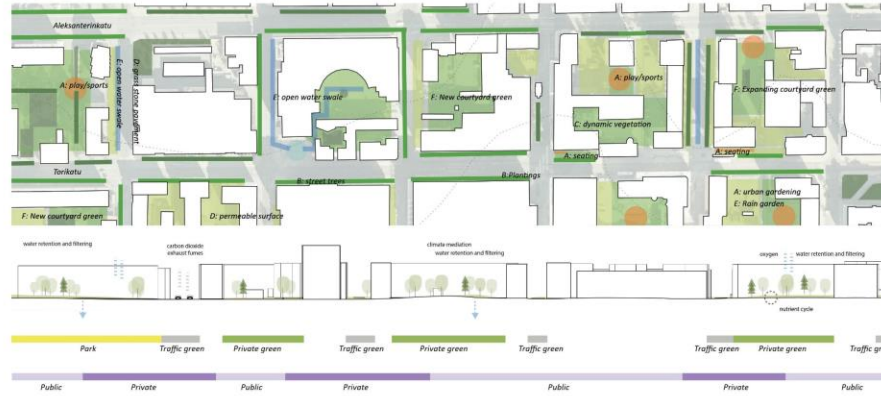
The locations of the pilot sites are selected to present the diversity of green types in Oulu, as well as connections between them.

Who is going to participate?

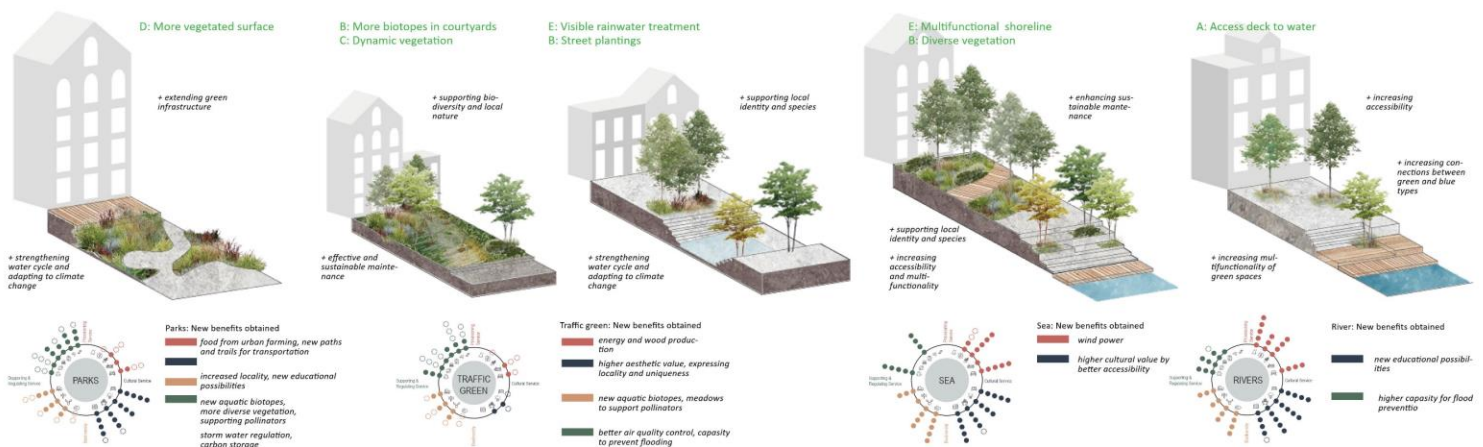
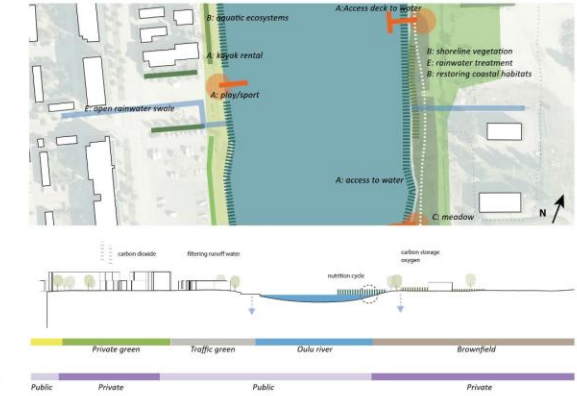
As seen in the graphs below the sections, green types include public and private areas. Public areas are usually owned by municipality (e.g. parks) or state (e.g. traffic green areas), private areas by city dwellers (eg. private gardens) or companies (e.g. brown fields around factories).

Most of our actions present bottom-up approach - they are relatively small actions that could take place in any of the backyards. At the same time, it's important that the municipality is also showing an example by introducing larger scale solutions on public areas as well as helping and supporting smaller scale actions made by private landowners. It's possible to control green areas by regulation, but voluntary actions should be preferred.

City centre



Water's edge

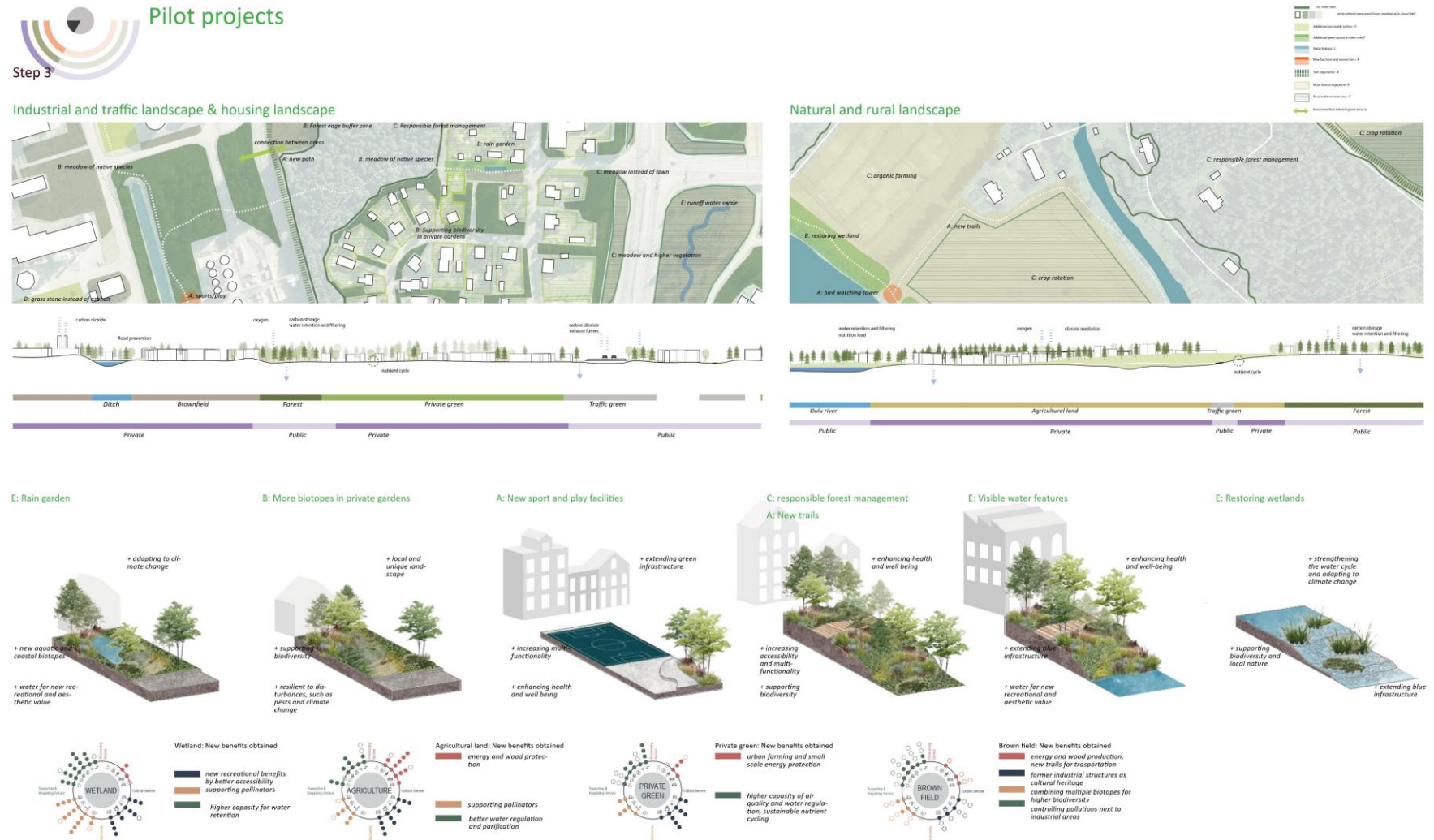


BUE-GREEN INFRASTRUCTURE FOR THE CITY OF OULU

students: H.Y. Lai, Y. Liang, S. Kangas, K. Rahkola, C. Yao; teacher: J. Galan, 2019

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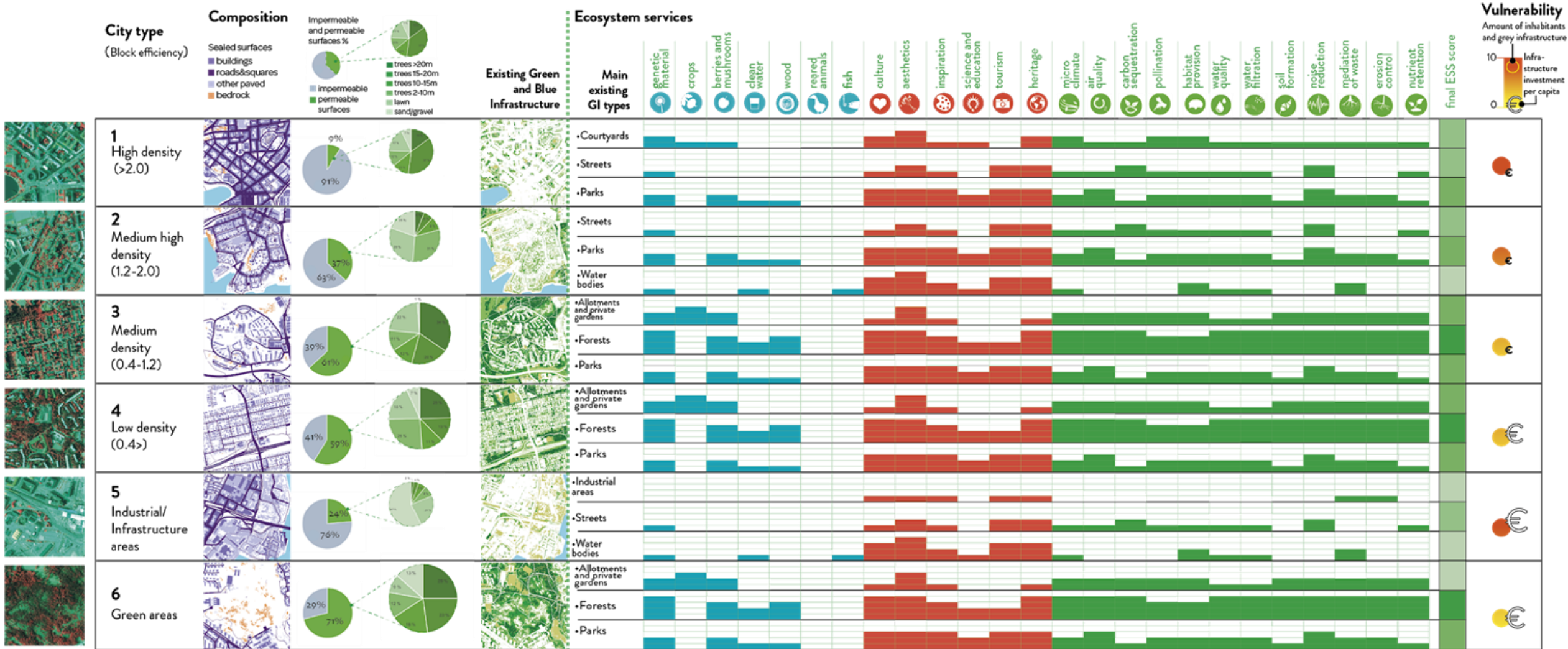


BUE-GREEN INFRASTRUCTURE FOR THE CITY OF OULU

students: H.Y. Lai, Y. Liang, S. Kangas, K. Rahkola, C. Yao; teacher: J. Galan, 2019

Studio Course on Green Area Planning (Aalto University). Blue-Green Infrastructures for Finish/Baltic Cities

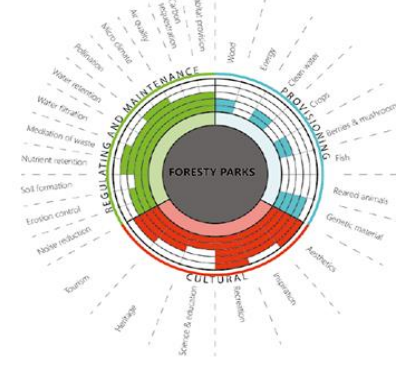
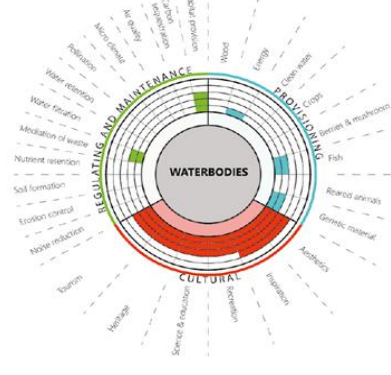
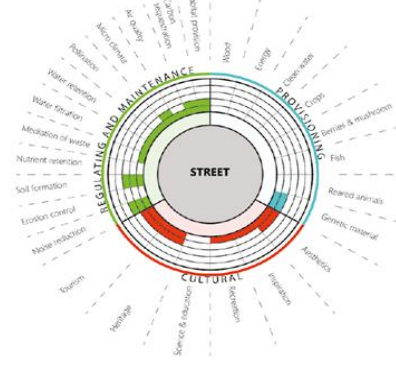
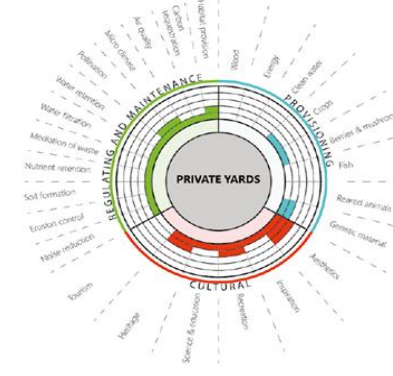
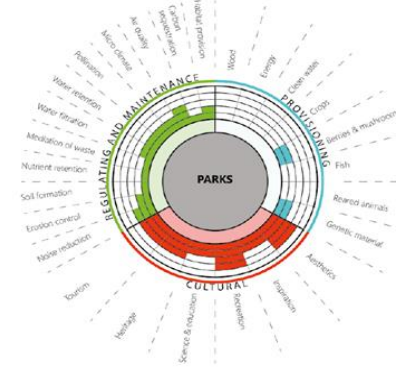
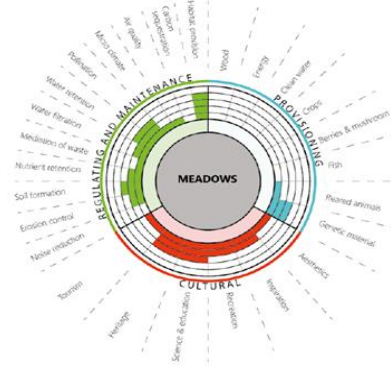
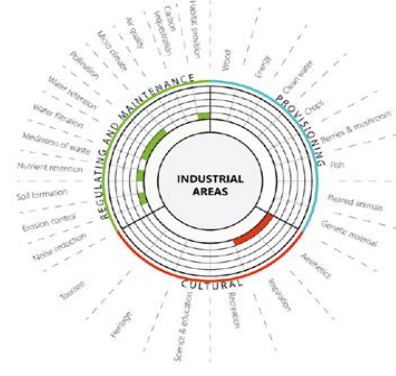
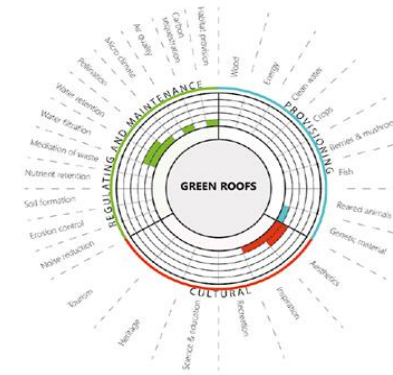
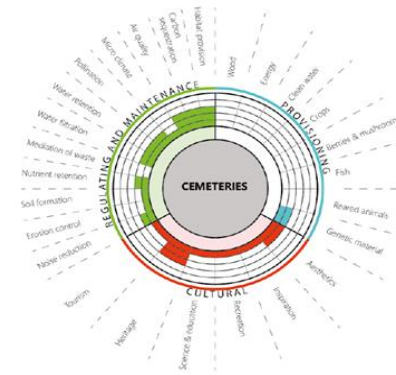
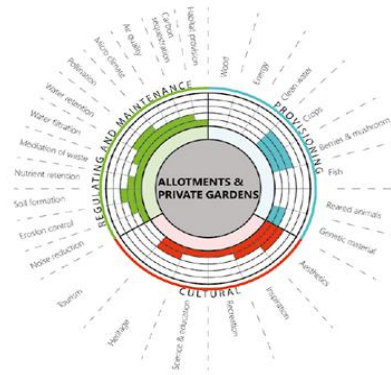
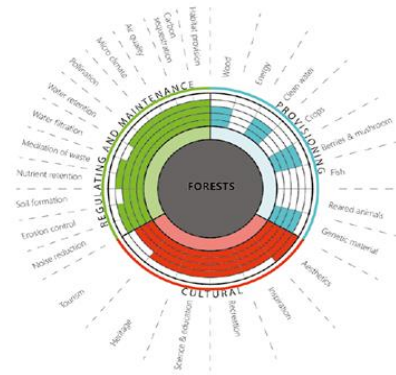
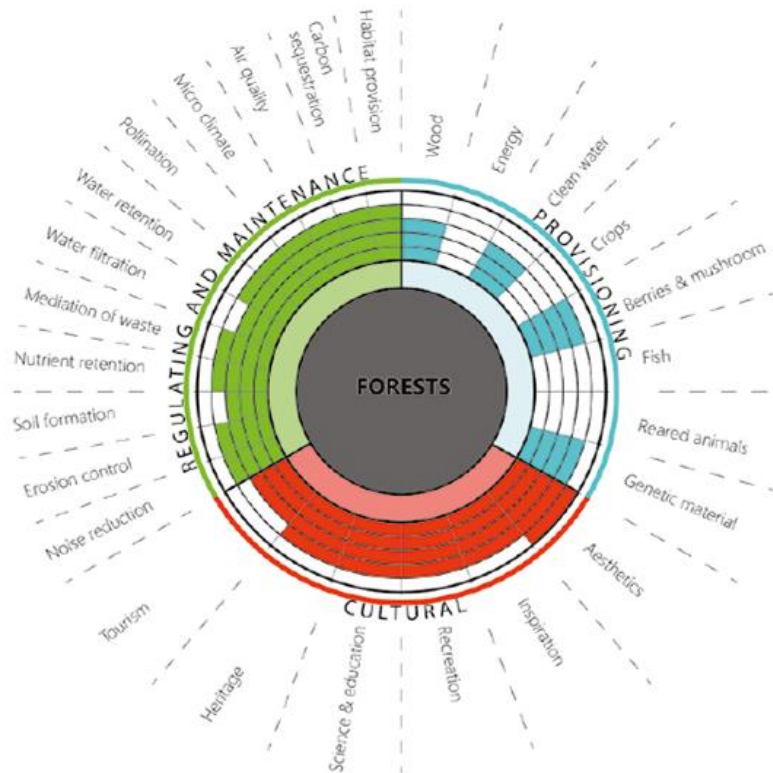
URBAN TYPOLOGIES, TYPES OF GREEN AREAS AND ECOSYSTEM SERVICES IN HELSINKI (Efraimsson, K.; Hakala, K.; Toivola, K. Green Area Planning, teacher: Juanjo Galan 2018)



Studio Course on Green Area Planning (Aalto University). Blue-Green Infrastructures for Finish/Baltic Cities

GREEN INFRASTRUCTURE, TYPES OF GREEN AREAS AND ECOSYSTEM SERVICES IN HELSINKI

(Efraimsson, K.; Hakala, K.; Toivola, K. Green Area Planning, teacher: Juanjo Galan 2018)



4b. Some examples URBAN AND REGIONAL METABOLISM

1 SUSTAINABILITY

Sustainable development is a moving target...

It often relies in the management of transitions and tends to be specific to each site ...

Urban sustainability can provide an integrated approach supporting urban plans and projects in a flexible and continuous process of change

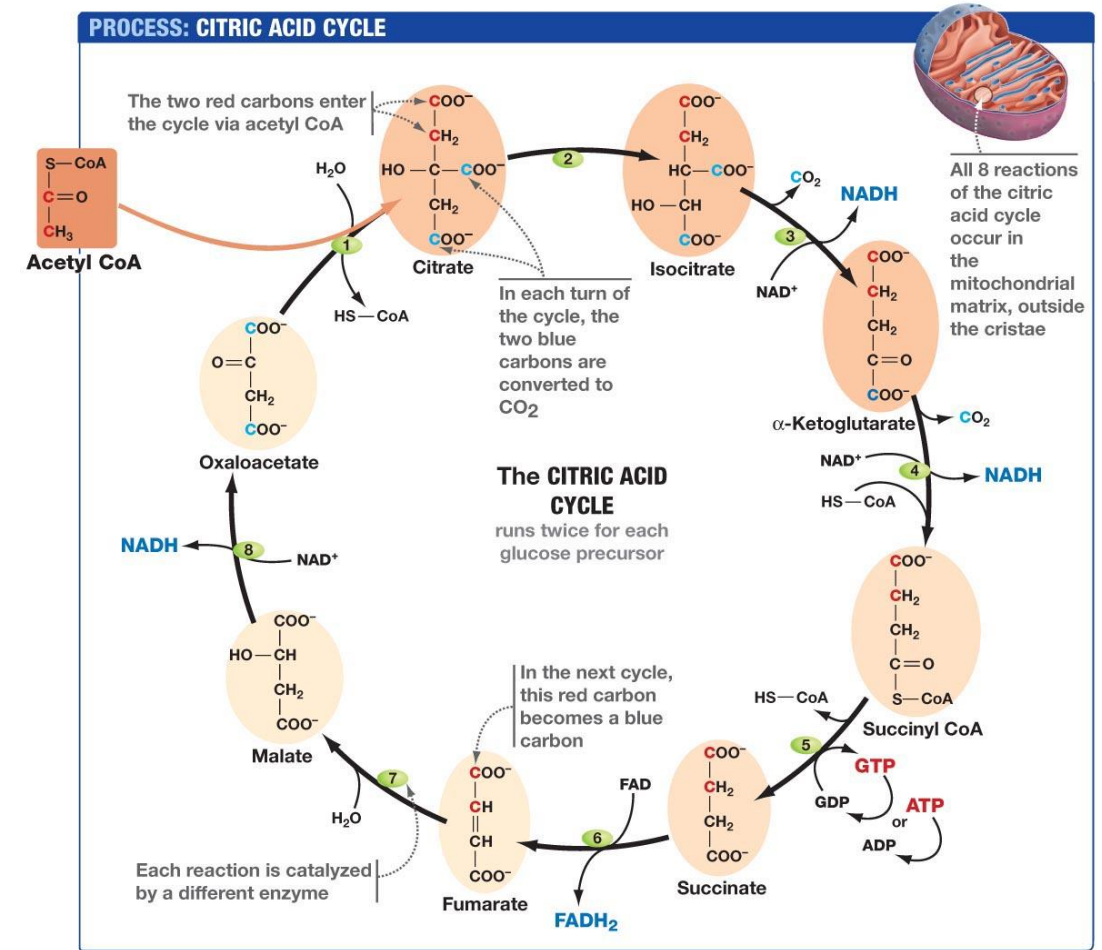
(Timmeren, 2014)



1 METABOLISM

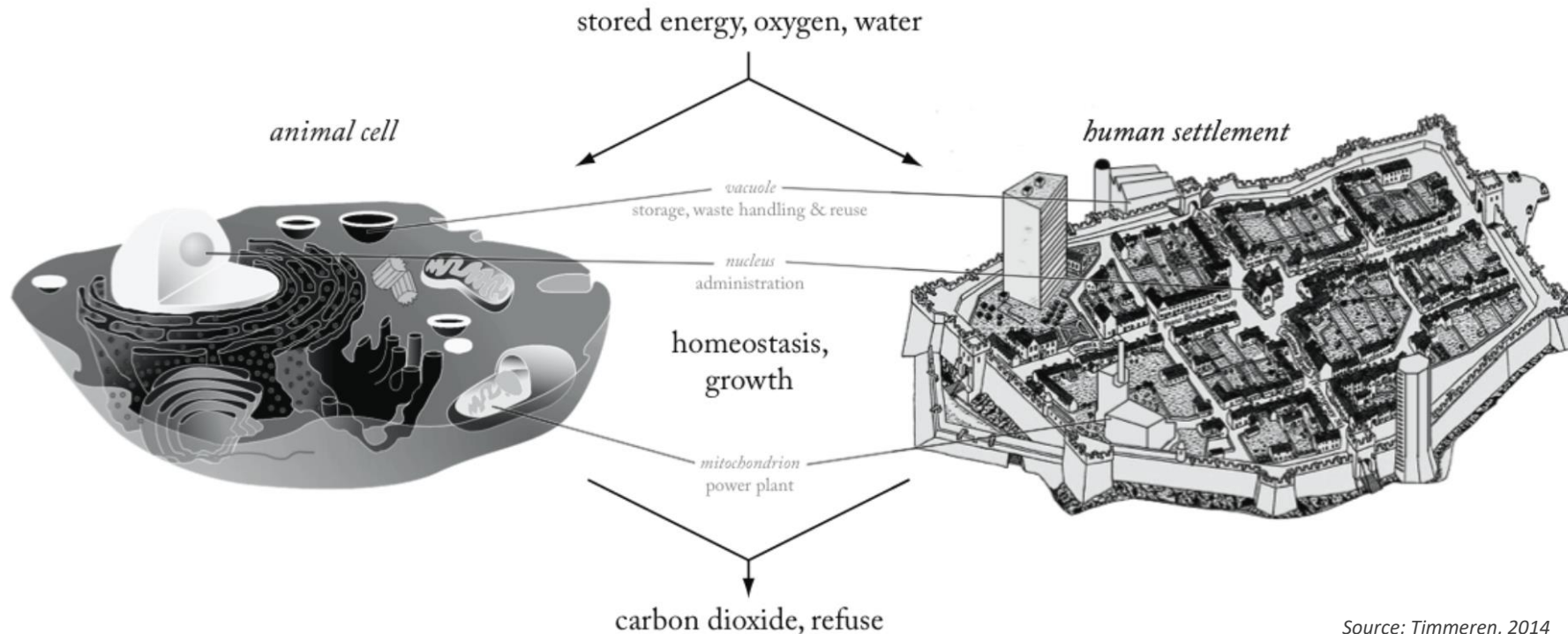
Metabolism: “The chemical processes that occur within a living organism in order to maintain life”

- **Catabolism:** The breakdown of complex molecules in living organisms to form simpler ones, together with the release of energy
- **Anabolism:** The synthesis of complex molecules in living organisms from simpler ones together with the storage of energy (Oxford Dictionary)



1 The Concept: URBAN METABOLISM

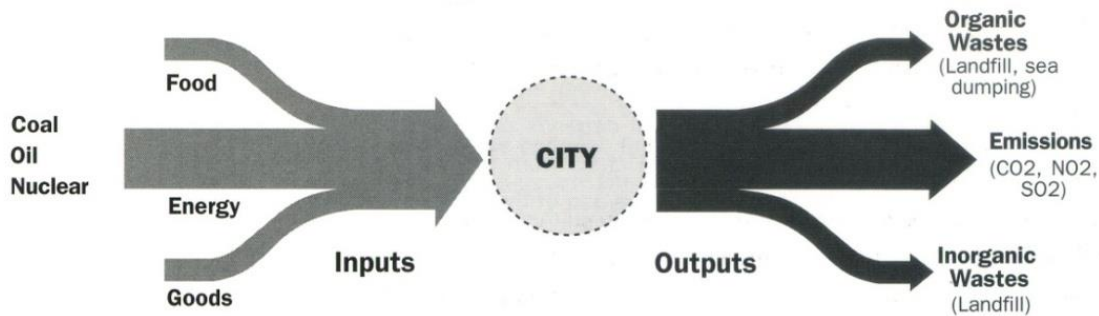
“The metaphor of a city, or living environment, as a living organism with a collective urban metabolism can be traced back for more than 150 years. More recently, the concept of urban metabolism has been used as an analytical tool to understand energetic and material exchanges ‘between cities and the rest of the world’” (Fischer-Kowalski, 2002 in Timmeren 2014).



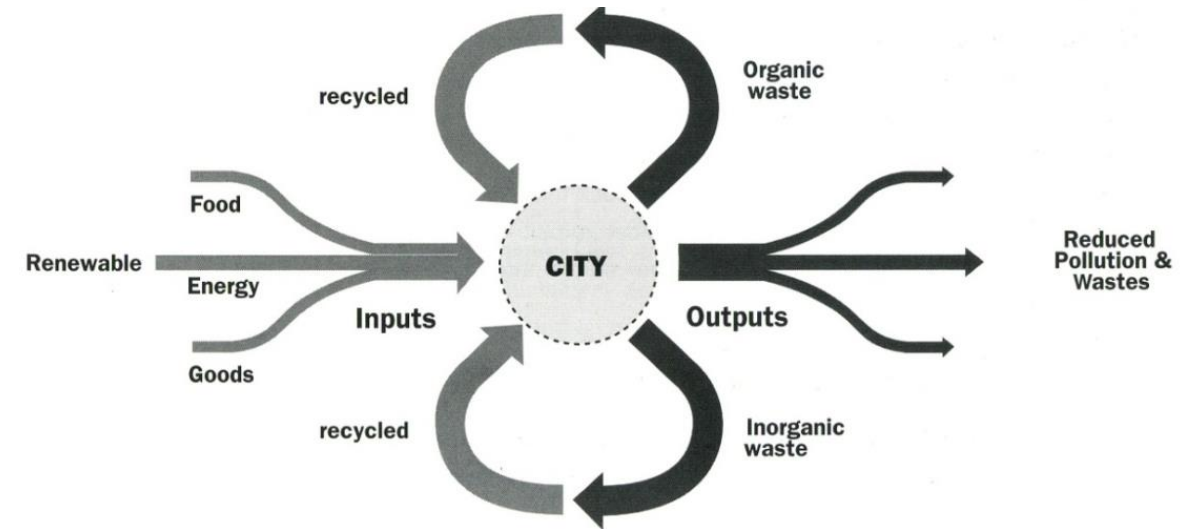
1 The Concept: URBAN METABOLISM

URBAN METABOLISM: ... A framework for MODELING complex urban systems' material and energy flows

Linear metabolism cities consume and pollute at a high rate



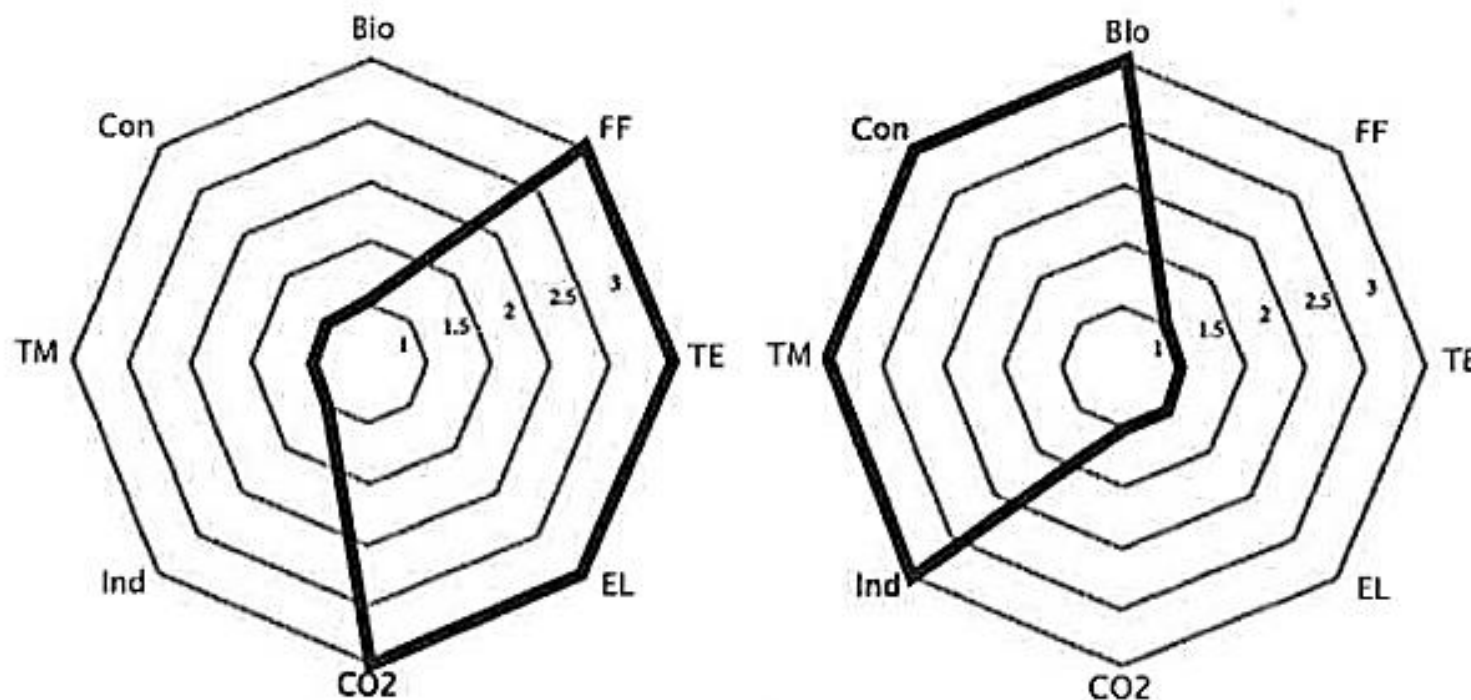
Circular metabolism cities minimise new inputs and maximise recycling



Source: *Cities for a small planet*, Richard Rogers, Faber & Faber, 1997

SUSTAINABLE TRANSITION FROM A METABOLIC PERSPECTIVE?...
How can planners, administrations and decision-makers use this approach?

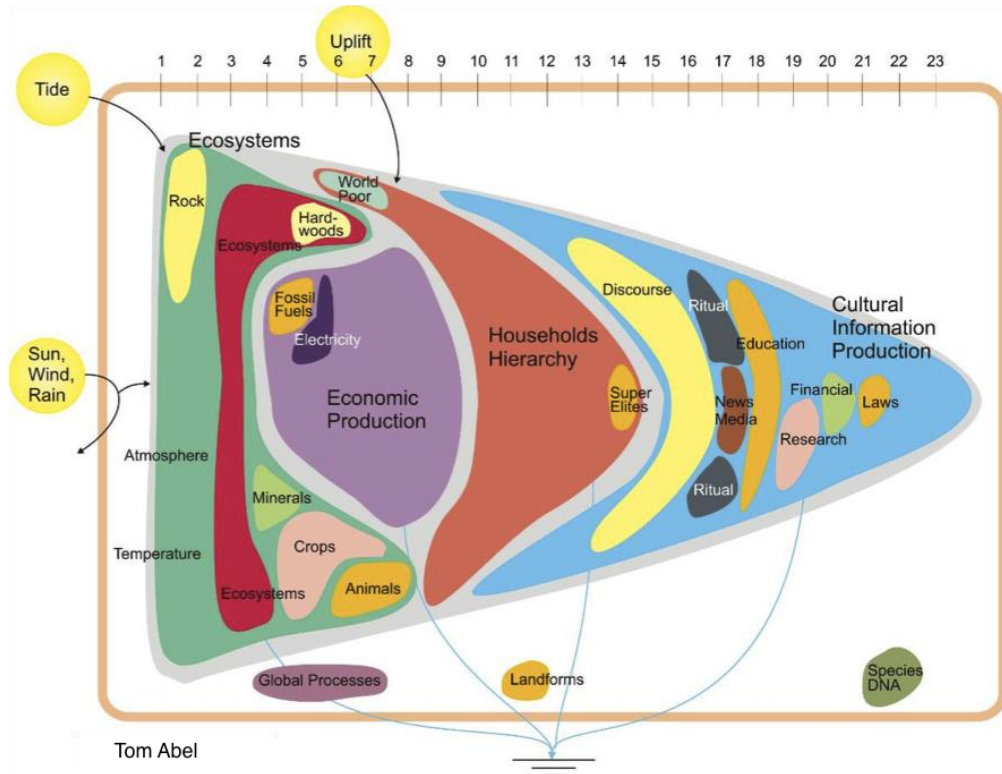
2 METHODS: MATERIAL (& ENERGY) FLOW ANALYSIS (MFA)



Two graphic representations of city resource-consumption types showing an energy-intensive city on the left and a material-intensive city on the right (Bio, biomass; FF, fossil fuels; TE, total energy; EL, electricity; CO₂, carbon dioxide emissions; Ind, industrial minerals; TM, total materials; Con, construction minerals).

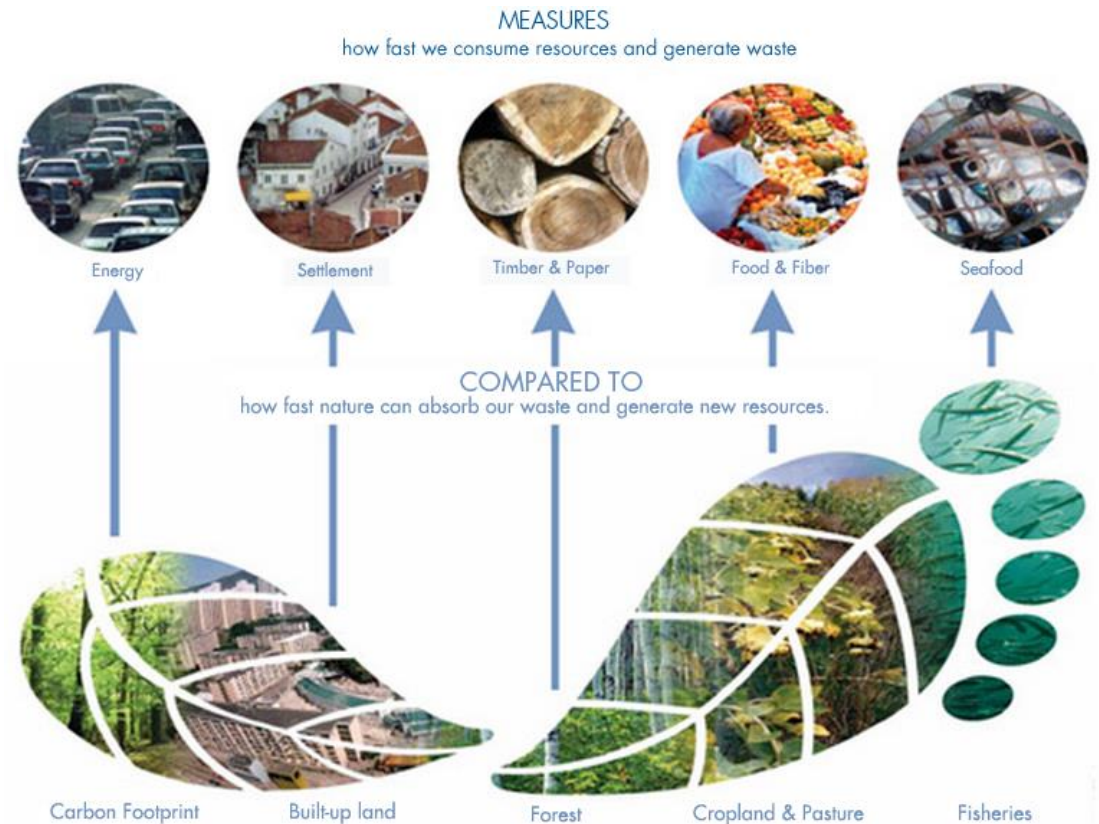
2 other METHODS:

EMERGY is defined as the total amount of solar energy that is used directly and indirectly to make a product or a service (Odum 1996).



Source: Transformity Depiction (Tom Abel)

ECOLOGICAL FOOTPRINT ANALYSIS: Ecological Footprint accounting measures the *demand* on and *supply* of nature (measured in global hectares)
 An intuitive tool for planning, decision-making processes and policy-making (Ferrão and Fernandez, 2013)



Source: Global Footprint Network

3 CHALLENGES

DATA a quantitative method

- **MEASURING WHAT?:** Water, Energy, Waste, Goods, Substances linked to key activities (Phosphorus, Nitrogen...?)
- **ACCURACY?:** Levels of extrapolation?, Account Balancing?
- **SOURCES?**

LIMITS System and Hinterland

- **DISTRICTS, CITIES, REGIONS?**

GOAL?

What for?

PLANNING?

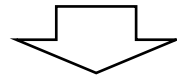
URBAN METABOLISM:

- A **framework** to study the functioning of cities in a transversal way...
- A **tool** to inform planning...

How can this connection between urban metabolic studies and planning take place?

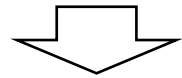
4 Example: SUSTAINABLE DEVELOPMENT of ROTTERDAM_2014

GOAL: To investigate “urban metabolism” can contribute to the city’s sustainable Development



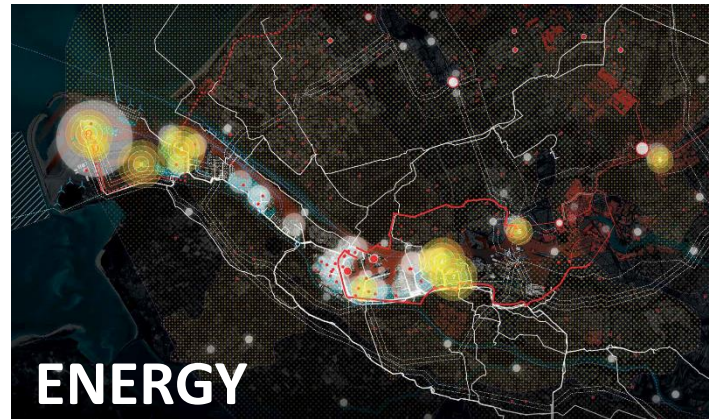
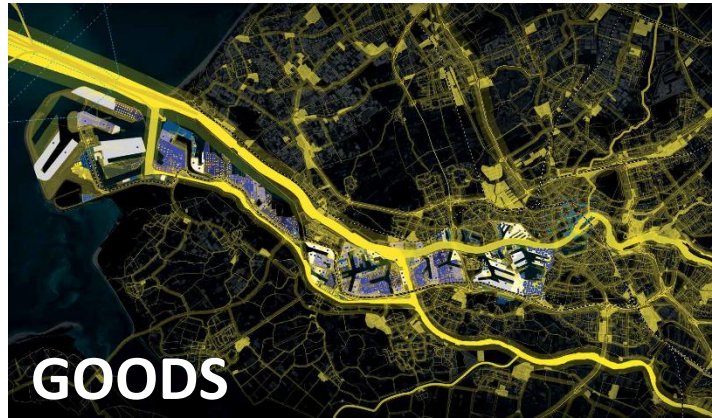
9 FLOWS:

- GOODS, PEOPLE, WASTE, BIOTA, ENERGY, FOOD, FRESH WATER, SAND & CLAY, AIR
- Quantification, Mapping



4 STRATEGIES to optimize flows in Rotterdam + **PILOT DESIGNS**

9 FLOWS: - GOODS, PEOPLE, WASTE, BIOTA, ENERGY, FOOD, FRESH WATER, SAND & CLAY, AIR



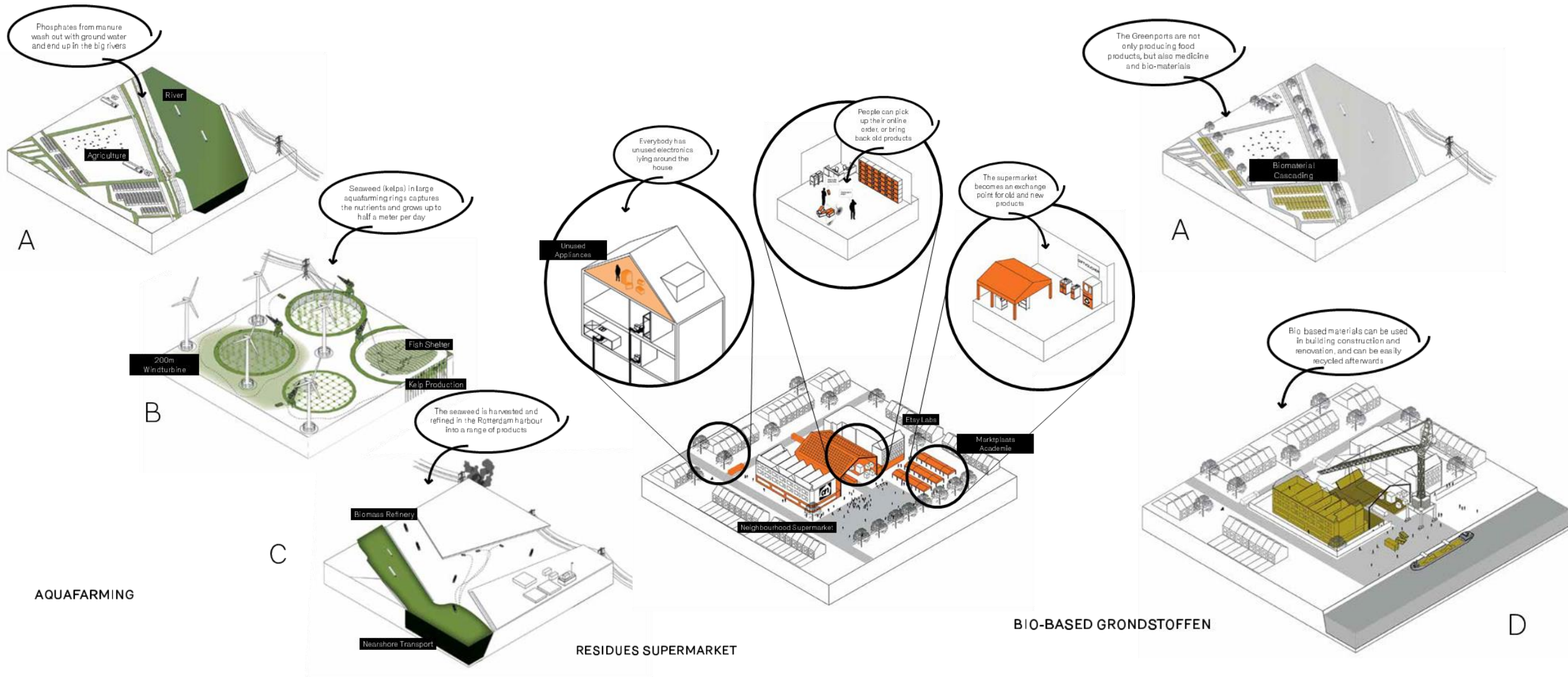
4 Example: SUSTAINABLE DEVELOPMENT of ROTTERDAM_2014

4 STRATEGIES To optimize flows in Rotterdam + PILOT DESIGNS

1. **COLLECTING RESOURCES:** Obtaining raw materials from waste and food
2. **CREATING BIOTOPES:** Improving urban nature by local use of freshwater, sand and clay
3. **CHANNELING (ENERGY) WASTE:** The use of by-products of energy extraction
4. **CATALYZING RE-INDUSTRIALIZATION:** Boosting the quality of flows of goods, people and air

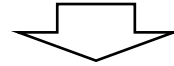
4 STRATEGIES To optimize flows in Rotterdam + PILOT DESIGNS

PILOTS Strategy 1. COLLECTING RESOURCES: obtaining raw materials from waste and food



4 Example: THE SIERRA CALDERONA STRATEGIC PLAN (Galan, 2013)

GOAL: Support Sustainable Regional Planning with metabolic inputs



4 FLOWS

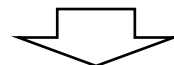
WATER, WASTE, ENERGY, PEOPLE

ECOLOGICAL FOOTPRINT ANALYSIS

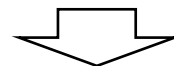
DIFFERENT USER PROFILES



REGIONAL STRATEGIES (5 SPECIFIC FOR METABOLISMS)



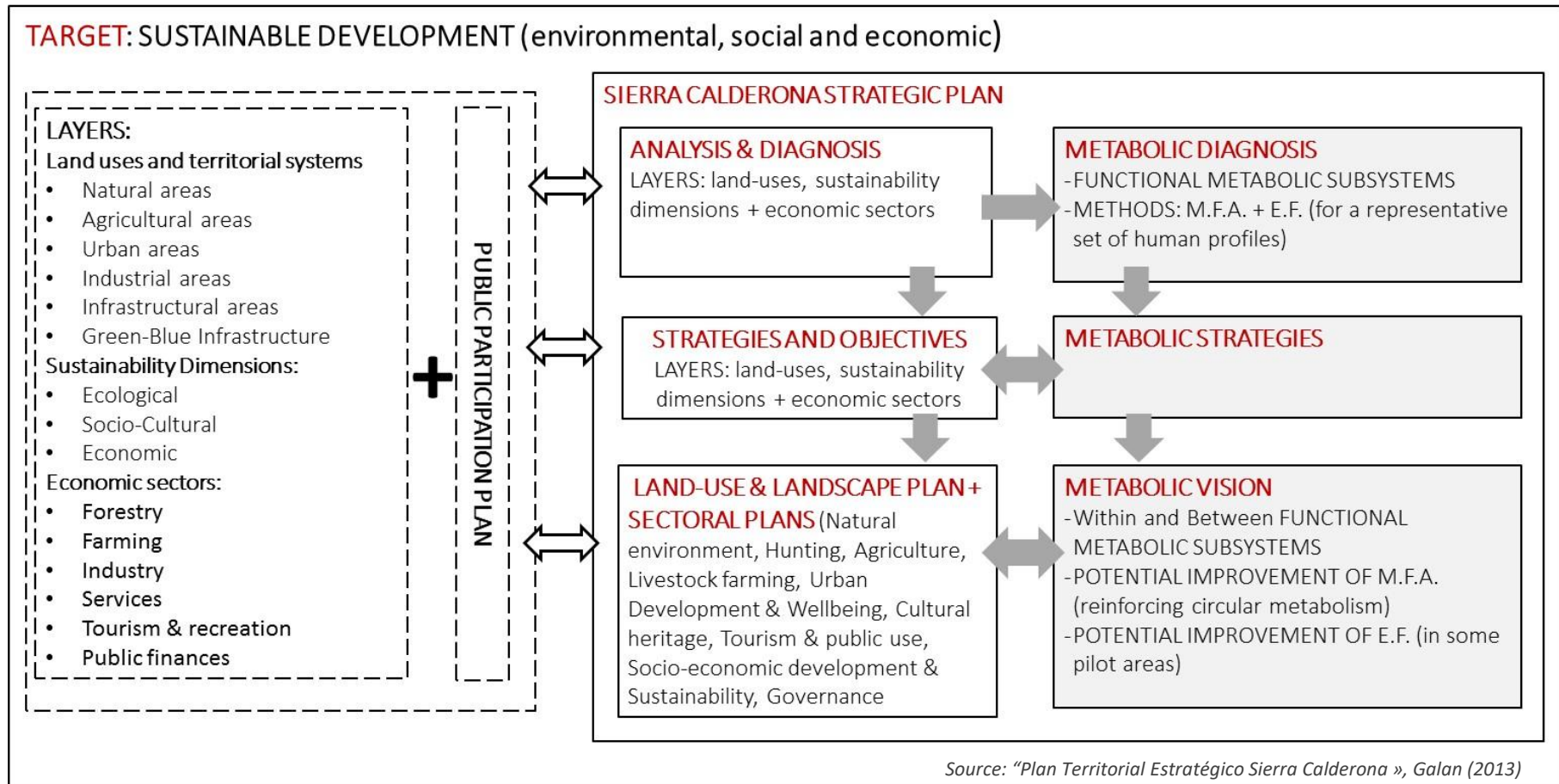
A VISION: A REGIONAL METABOLIC MODEL CURRENT & FUTURE



TOOLS: LAND-USE PLAN + SECTORAL PLANS + PILOT PROJECTS

4 Example: THE SIERRA CALDERONA STRATEGIC PLAN (Galan, 2013)

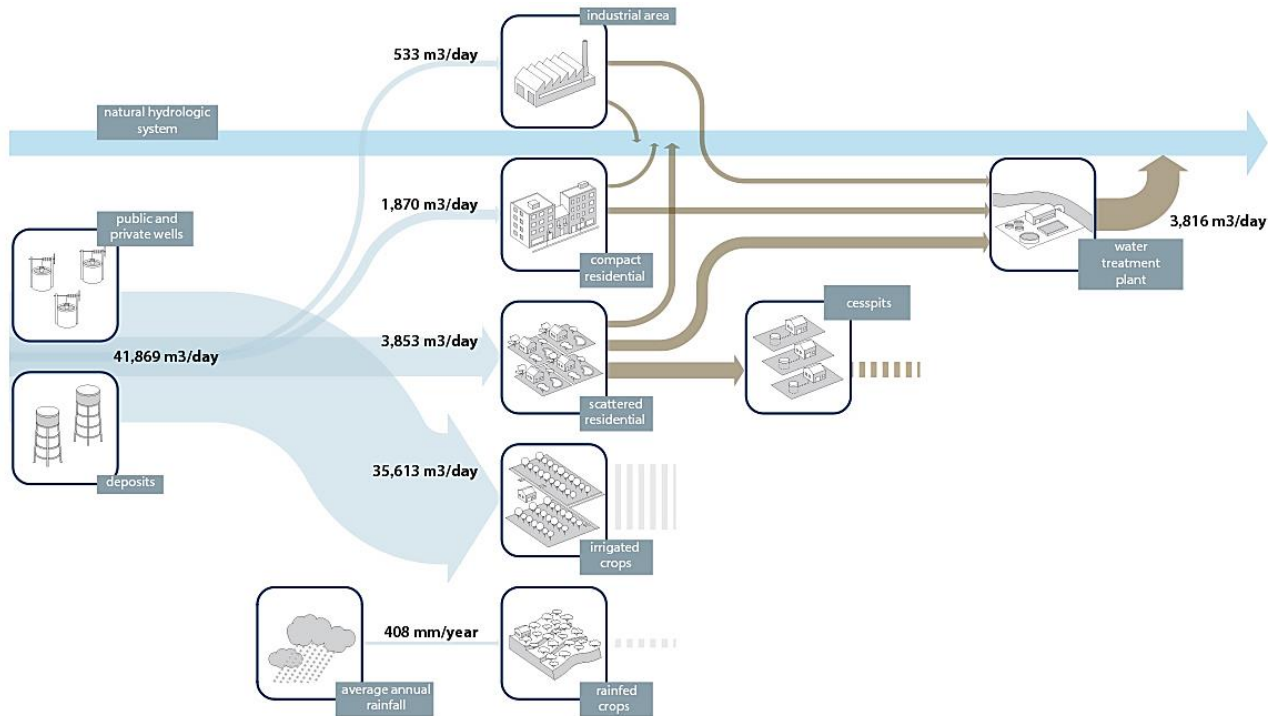
GOAL: Support and Inform Sustainable Regional Planning with metabolic inputs



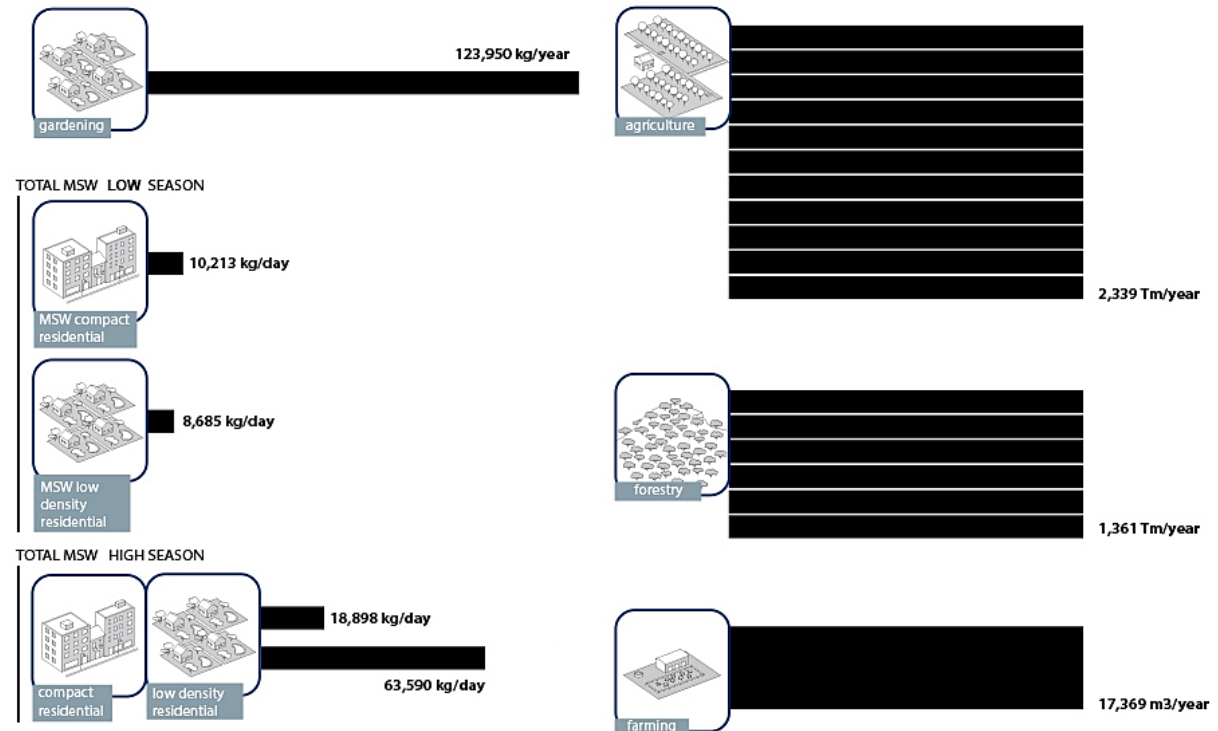
4 Example: THE SIERRA CALDERONA STRATEGIC PLAN (Galan, 2013)

CURRENT FLOWS: WATER, WASTE, ENERGY, PEOPLE

WATER



WASTE



4

Example: THE SIERRA CALDERONA STRATEGIC PLAN (Galan, 2013)

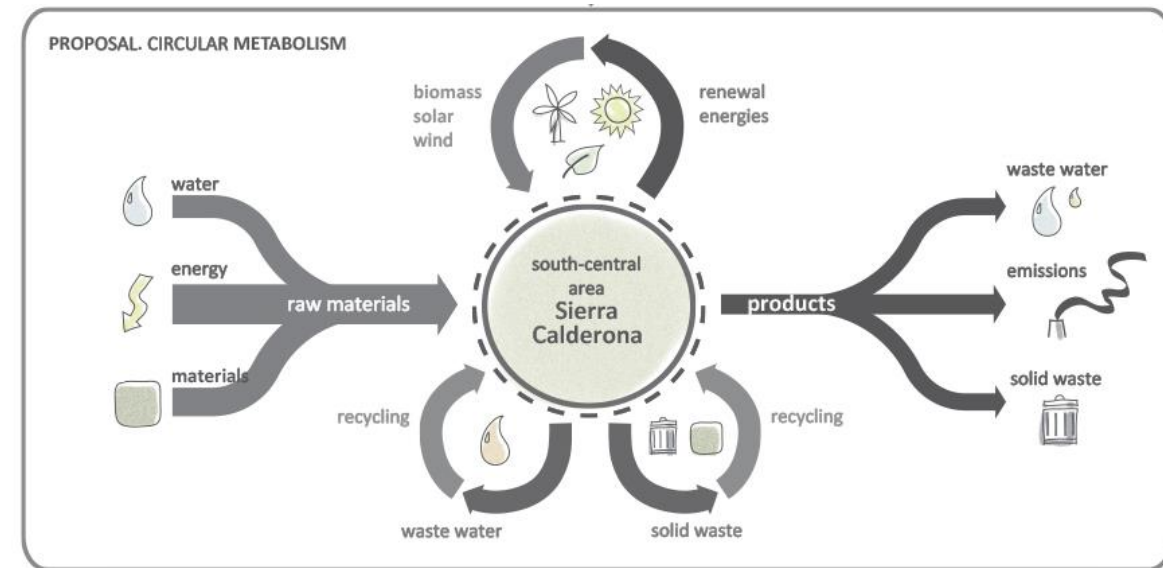
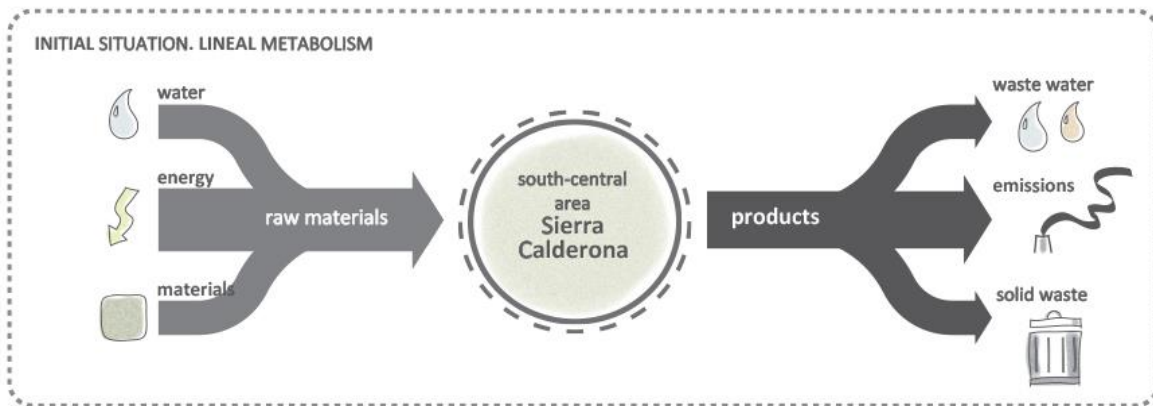
CURRENT ECOLOGICAL FOOTPRINTS

	CARBON FOOTPRINT	FOOD FOOTPRINT	LODGING FOOTPRINT	SERVICES FOOTPRINT	TOTAL FOOTPRINT	NUMBER OF EARTHS
AVERAGE AREA STRATEGIC PLAN	11.68	17.19	4.79	9.75	43.4	2.76
Person living in a compact town and working in a nearby industrial estate	4.9	16.5	3.6	7.5	32.62	2.08
Housewife living in a compact town	5.7	14.9	3.6	7.5	31.75	2.02
Person living in housing estate working in the city of Valencia	17.1	19.5	4.5	10.6	51.73	3.29
Part-time farmer living in a compact town and working in the local service sector	5.7	16.5	6.1	12.7	40.92	2.6
Retired person living in a compact town	4.9	12.4	3.2	6.6	27.03	1.72
Retired person living in a low-density housing estate	15.2	17	6.5	9.1	47.73	3.04
Children living in a compact town	5.7	16.5	2.4	11.6	36.22	2.31
Children living in a low-density housing estate	17.4	19.5	7.4	12	56.24	3.58
Young person studying at a university in the city of Valencia and living in a compact town or low density housing estate	9	16.5	3.6	7.5	36.59	2.33
Seasonal resident (summer)	22.8	19.5	6.5	12	60.82	3.87
Person working in the military camp	20.1	20.3	5.3	10.1	55.78	3.55
NATIONAL AVERAGE	12.9	14.9	4.8	9.4	42	2.5

Source: "Plan Territorial Estratégico Sierra Calderona », Galan (2013)

4 Example: THE SIERRA CALDERONA STRATEGIC PLAN (Galan, 2013)

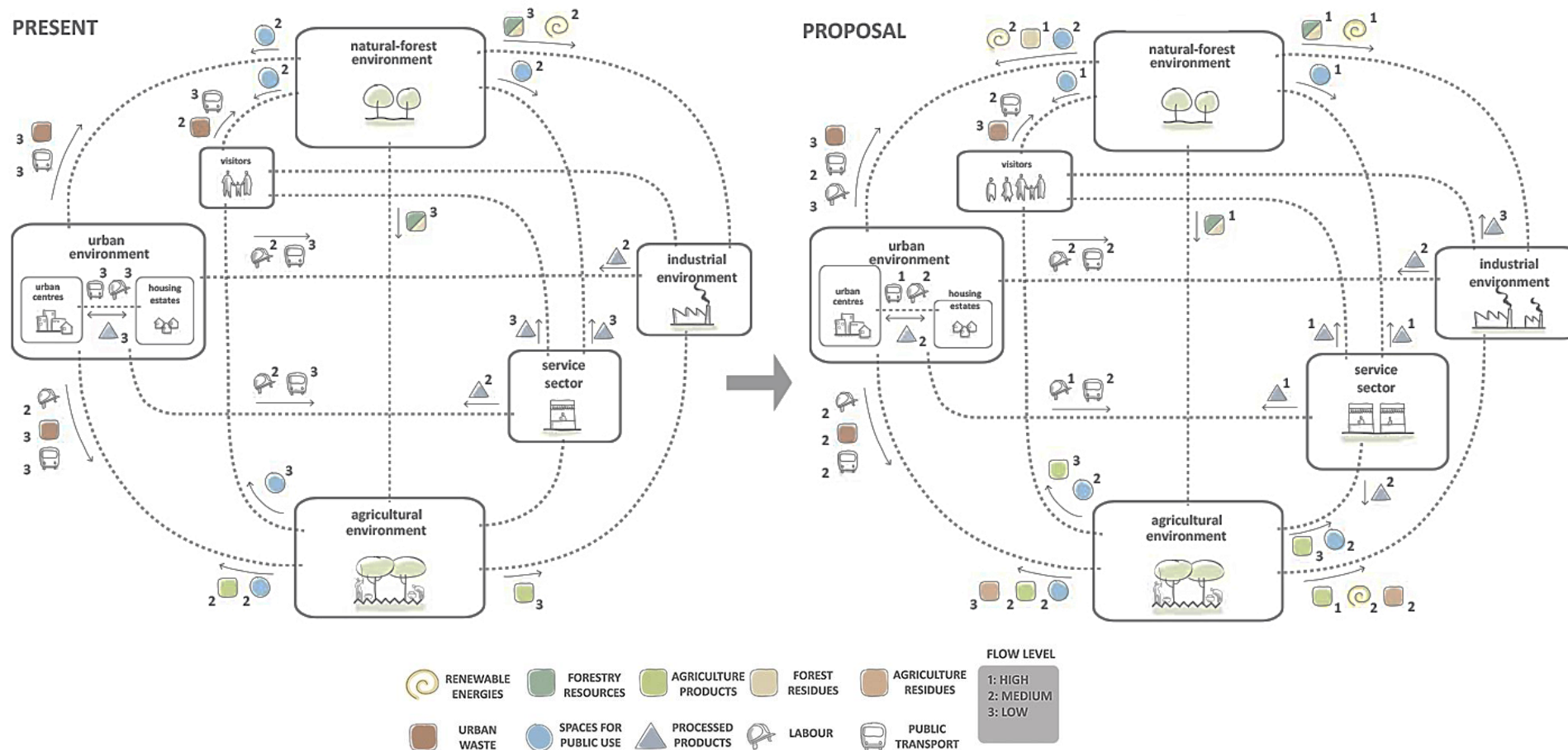
REGIONAL STRATEGIES (5 SPECIFIC FOR METABOLISMS)



**SUSTAINABLE TRANSITION
TOOLS FOR THAT?**

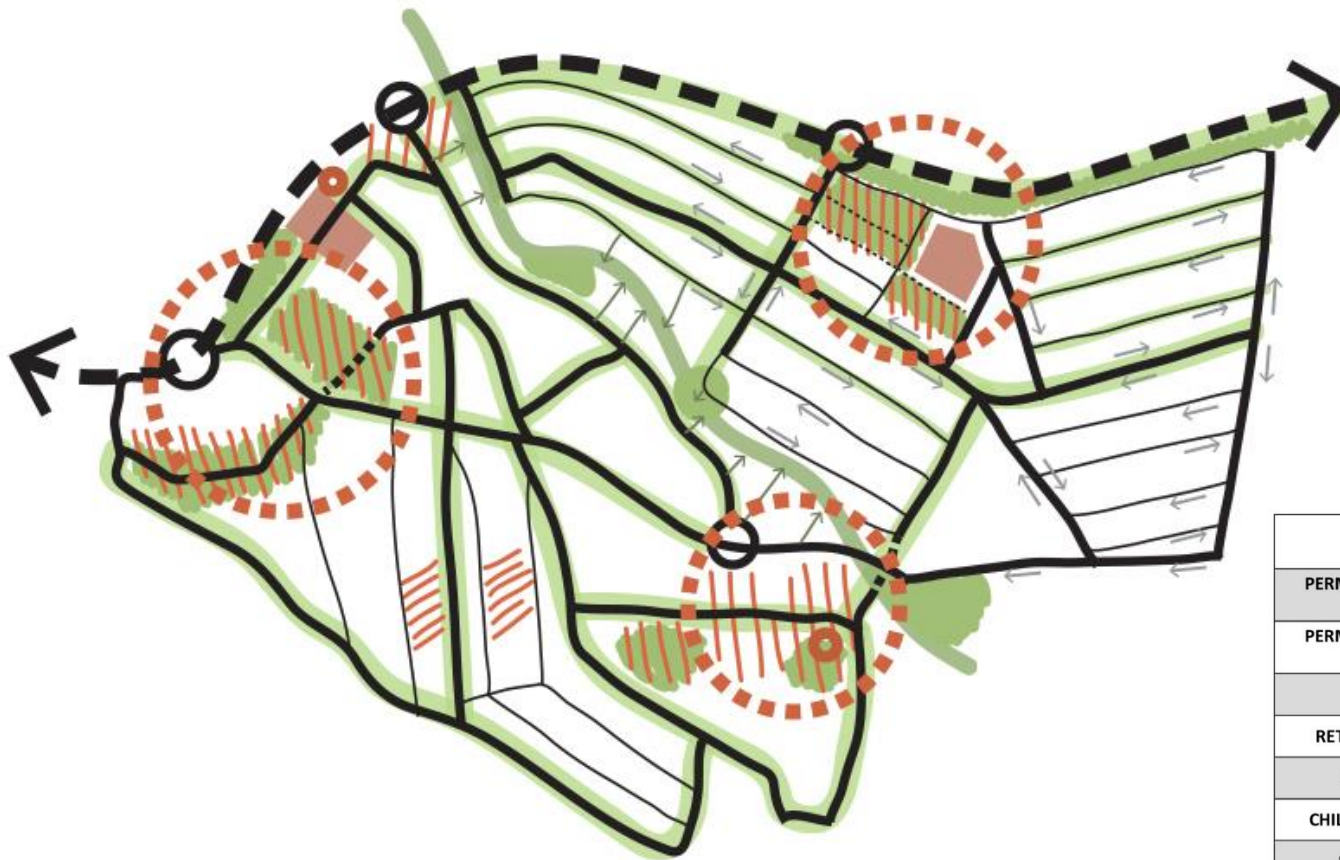
4 Example: THE SIERRA CALDERONA STRATEGIC PLAN (Galan, 2013)

A VISION: A REGIONAL METABOLIC MODEL: CURRENT & FUTURE



4 Example: THE SIERRA CALDERONA STRATEGIC PLAN (Galan, 2013)

TOOLS: LAND-USE PLAN + SECTORAL PLANS + PILOT PROJECTS



- Main internal road
- Secondary internal streets
- Green axes
- Green areas
- Densification
- Service hubs

	CARBON FOOTPRINT	FOOD FOOTPRINT	LODGING FOOTPRINT	SERVICES FOOTPRINT	TOTAL FOOTPRINT	Number of Earths
PERMANENT RESIDENT WORKING IN THE AREA (CURRENT)	17.1	19.5	4.5	10.6	51.7	3.29
PERMANENT RESIDENT WORKING IN THE AREA (AFTER PROPOSAL)	4.9	16.5	4	7.5	32.9	2.09
RETIRED RESIDENT (CURRENT)	15.2	17	3.2	6.6	42	2.67
RETIRED RESIDENT (AFTER PROPOSAL)	4.9	12.4	4.5	9.1	30.9	1.97
CHILDREN RESIDENT (CURRENT)	17.4	19.5	7.4	12	56.3	3.58
CHILDREN RESIDENT (AFTER PROPOSAL)	5.7	16.5	3.4	11.6	27.2	2.37
SEASONAL RESIDENT (CURRENT)	22.8	19.5	6.5	12	60.8	3.87
SEASONAL RESIDENT (AFTER PROPOSAL)	7.5	16.5	3.2	11.6	38.8	2.47

Source: "Plan Territorial Estratégico Sierra Calderona », Galan (2013)

4c. Some examples LANDSCAPES OF PRODUCTION

VISUALIZING LANDSCAPE SYSTEM RELATIONSHIPS
 (11.07.2022, Juanjo Galan Vivas, Polytechnic University of Valencia)

STUDIO COURSE: 'LANDSCAPES OF PRODUCTION'
Aalto University, 2019, Teacher: Juanjo Galán

FORESTRY 1/4
 DIFFERENT SCALES OF FORESTRY TODAY
 1 FINLAND 2 UUSIMAA 3 PERI-URBAN

AGRICULTURE 3/4
 SPECULATIONS OF FUTURE
 1 SPECULATION 2 CRITERIA 3 IMPLEMENTATION - FUTURE

Sustainable Hedonism in the peri-urban area of Helsinki 3/4
 ANALYSIS OF JUMBO
 CRITERIA FOR THE PROPOSAL
 1) Green infrastructure network
 2) Agriculture intensification
 3) New urban structure

INFRASTRUCTURE IN PERIURBAN 3/5
 WASTE MANAGEMENT
 LANDSCAPE

Towards diverse and sustainable outdoor recreation 3/5
 6 Case study - Gumböle area
 7 Applying planning strategies for Gumböle area



1 INITIAL MAP WITH GREEN FINGER CONCEPT

2 COLLABORATION WITH OTHER ACTORS IN THE AREA OF PERI-URBAN

KEY DRIVERS OF CHANGE
 1) URBANISATION
 2) TECHNOLOGY DEVELOPMENT
 3) CLIMATE CHANGE

CRITERIA FOR THE PROPOSAL
 1) Green infrastructure network
 2) Agriculture intensification
 3) New urban structure

CONCEPT 1 zero km products & healthy eating
CONCEPT 2 recreation heaven & tourist attraction
CONCEPT 3 circular economy
CONCEPT 4 climate rescue

FLOWS

CUSTOMERS
 HEDONISM AGRICULTURE FORESTRY

COMMERCE & SERVICES
 MATTER SERVICE

RECREATION
 SERVICE

WASTE, WATER & ENERGY
 SERVICE ENERGY

INFRASTRUCTURE & LOGISTICS
 IMPORT EXPORT

3 FINAL MAP IN COLLABORATION WITH THE OTHER ACTORS
 Ristos new role and his new friends
 + city / society development

legend
 hybrid waste treatment plant
 new, densified housing areas
 railway
 highway
 RING III
 important green gateway to natural areas
 important recreation area
 agriculture-oriented development + recreation

ECOSYSTEM SERVICES
 A - agriculture
 F - forestry
 C - commercial
 W - waste

Aalto University School of Arts, Design and Architecture MAR-E1034 LANDSCAPES OF PRODUCTION: THE PERIURBAN COLLAGE
 Roudina Lumintyy

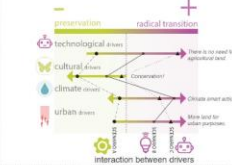
STAFF TRAINING SEMINAR
TELOS project
 (Rome, Italy, 11-13 July 2022)

AGRICULTURE

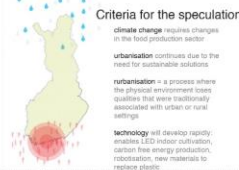
SPECULATIONS OF FUTURE

3/4

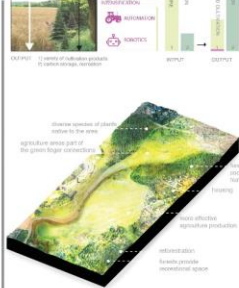
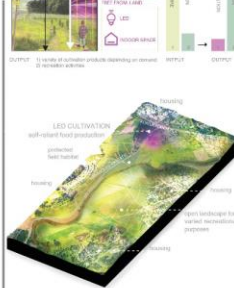
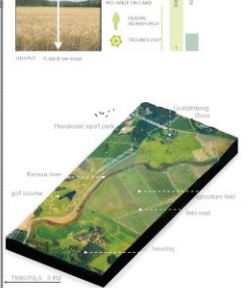
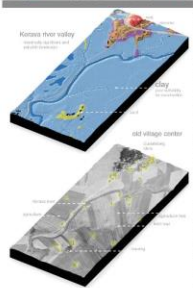
1 SPECULATION OF THE FUTURE, YEAR 2100



CRITERIA



IMPLEMENTATION - FUTURE



AGRICULTURE

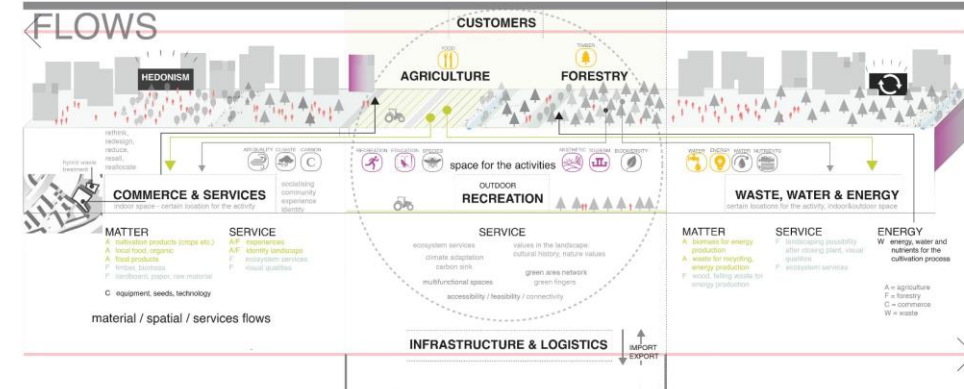
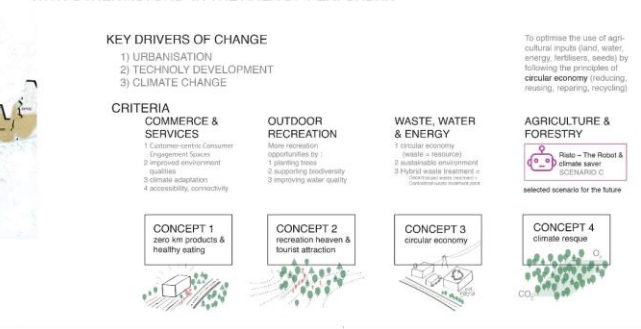
SPECULATIONS OF FUTURE

4/4

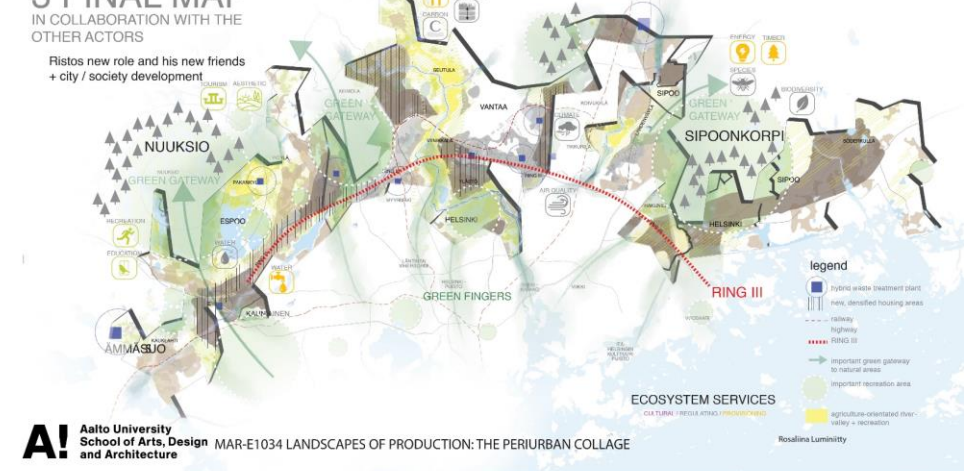
1 INITIAL MAP WITH GREEN FINGER CONCEPT



2 COLLABORATION WITH OTHER ACTORS IN THE AREA OF PERI-URBAN



3 FINAL MAP IN COLLABORATION WITH THE OTHER ACTORS



4d. Some examples

LANDSCAPE PLANNING AND ECOLOGY

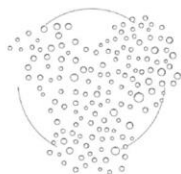
**STUDIO COURSE: 'LANDSCAPE
PLANNING AND ECOLOGY'
(Aalto University, 2019)**

**StudentS: Allan Delesantro, Elka
Lupunen and Kati Efraimsson**
Teacher: Juanjo Galán)

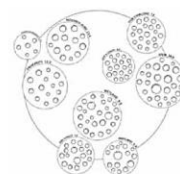
Otaniemi: Embracing Complexity



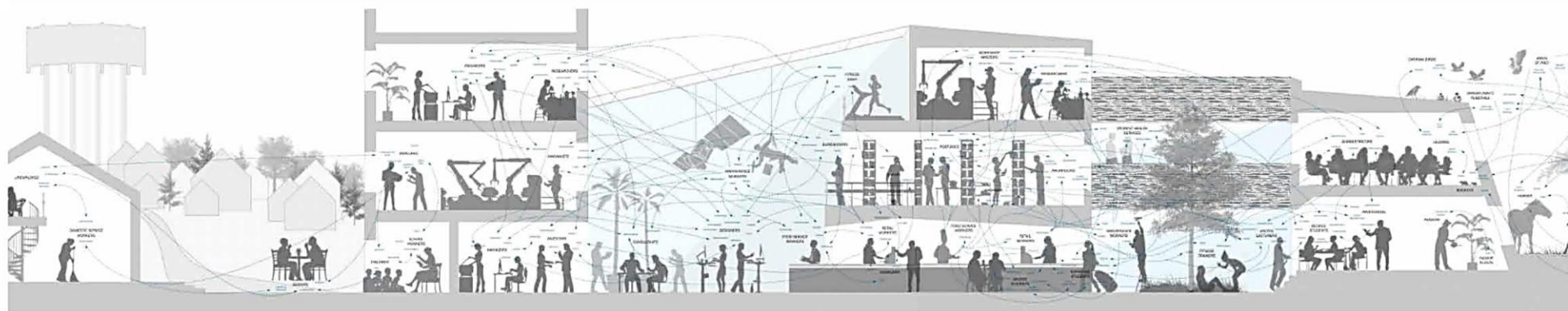
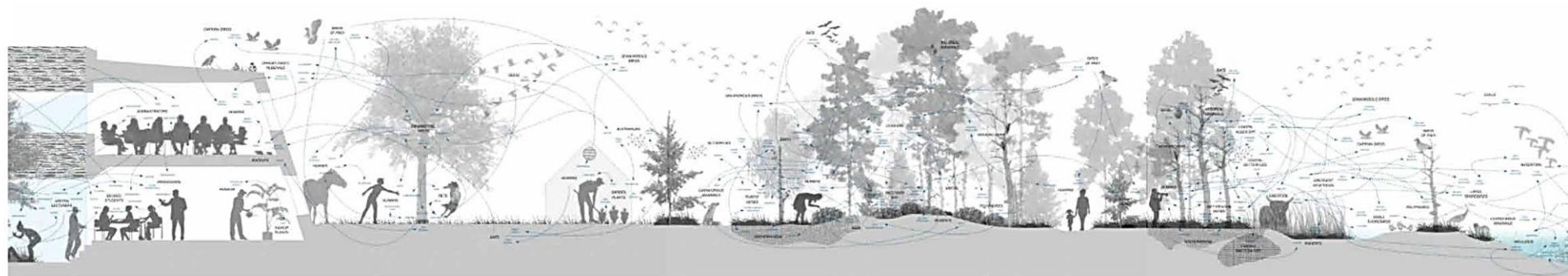
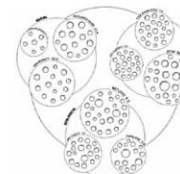
Actors



Typologies



Subsystems



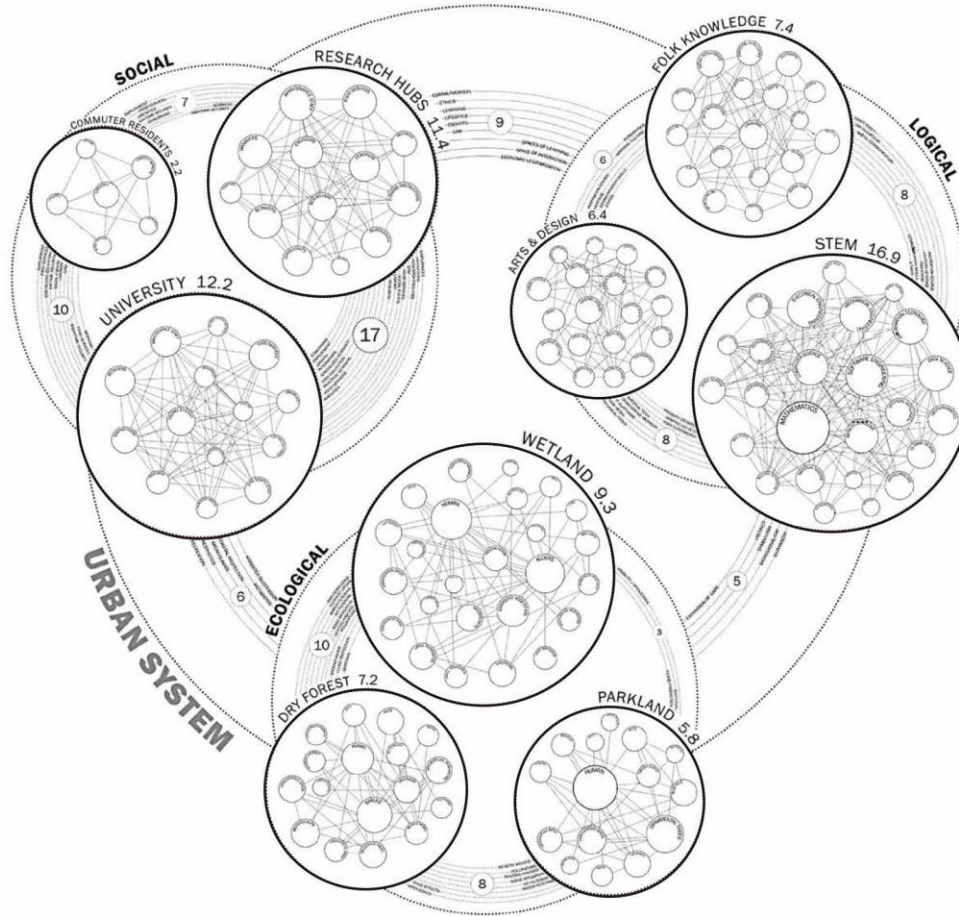
Country / City Finland, Helsinki
University / School Aalto University - School of Arts, Design and Architecture
Academic year 2019-2020
Title of the project Otaniemi: Embracing Complexity
Authors Allan Delesantro, Elka Lupunen, Kati Efraimsson

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Measuring & Mapping Complexity

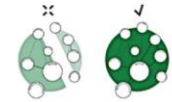


$$\text{Complexity value of a patch} = \begin{matrix} 1. (\text{actor connectivity score} \times \text{patch size}) \\ + \\ 2. (\text{typology connectivity score} \times \text{perimeter}) \\ + \\ 3. (\text{subsystem connectivity score} \times \text{adjacencies}) \end{matrix}$$

Connectivity Scores & Spatial Modifiers

Actor Connections

Actor connections occur internal to each typology. We have identified connections in which one or both actors have a benefit. For the purpose of our value system we ignore negative connections, like parasitism, predation or herbivory to focus on those connections which contribute the most to resilience.



Actor Connectivity Scores

Actor connectivity scores are the sum off all connections found within a typology. A one-way connection receives a score of 0.1 points. A mutual connections receives a score of 0.2 points.

→ Patch Size

In the mapping of complexity values, actor connectivity scores are weighed by the size of the patch in which they occur. This takes into account the importance of large and continuous patches that allow all these actors to come into contact and thus actualize these connections. While these connections are still possible between fragmented patches, they are made more difficult and fewer. Thus our scoring process generalizes that they are weaker because of this fragmentation.

Typology Connections

Typology connections occur when one typology within a subsystem offers or receives a benefit from another system. These are different than actor connections because they are created and transmitted not by individual actors, but by the functioning of assembly as a whole unit.

→ Edge Effects

In the mapping of complexity values, typology connectivity scores are weighed by the length of the perimeter where the two typologies are in contact. This takes into account that direct contact allows the two typologies to participate in their connections more readily and promotes successful interactions of actors internal to those typologies.

Typology Connectivity Scores

Each pair of typologies receives a connectivity score based on the number of connections between them. Each connection is worth 1 point.

Subsystem Connections

Subsystem connections occur when the functioning of an entire subsystem, consisting of all three typologies contributes a benefit it or service to another subsystem. These require translations between different realms of the material, social and cognitive and are thus often abstract.

→ Mosaics

In the mapping of complexity values, subsystem connectivity scores are weighed by the number of patches from other systems that the core patch comes in contact with. This takes into account the value of heterogeneous patterns of land-use allowing more complexity and exchange of connections across systems.

Subsystem Connectivity Scores

Each pair of subsystems receives a connectivity score based on the number of connections between them. Each connection is worth 1 point.

Hypotheses

Complexity

Connections are mutual interactions between actors.



Resilience

Complexity leads to resilience through redundant connections.



A problem of valuing

Capitalist valuing leads to reduced complexity.



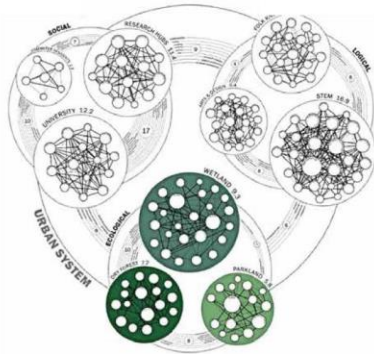
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Envisioning New Connections

Ecological Subsystem



1 (actor connectivity score x patch size)



1+ 2 (typology connectivity score x perimeter)



1 + 2+ 3 (subsystem connectivity score x adjacencies) (subsystem connectivity score x adjacencies)



Diagnosis

Complexity performance is weak throughout the campus areas. Parkland benefit from adjacency to large forests. Forest suffer greatly due to fragmentation. Wetlands and forest produce a strong combination.

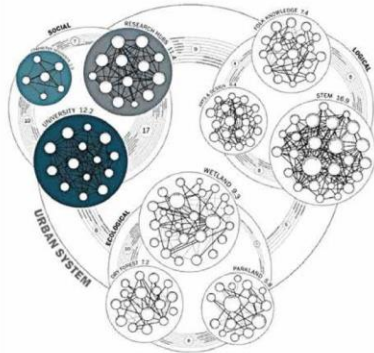
Spatial improvements

- Forest network
- Unified green campus
- Wetland restoration

Connectivity Score improvements

- Dry meadow herbs
- Pest management
- Stormwater management
- Cervids
- Garden plants
- Understorey management
- Spawning grounds
- Water filtering
- Bees
- Psammophytes
- Ecology as a study
- Livestock

Social Subsystem



Diagnosis

Complexity performance is strongest in the large campus core which combines university and research typologies and benefits from adjacency to forest ecotopes. Fragmentation and segregation of research and university patches on the edges of Otaniemi causes weak scores.

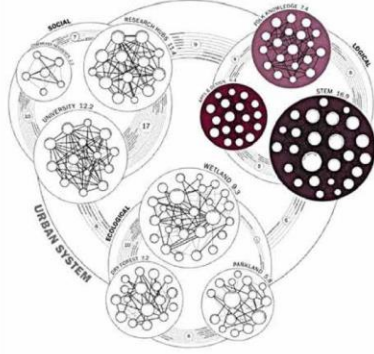
Spatial improvements

- Unified campus
- Mixed housing
- University expansion

Connectivity Score improvements

- Produce
- Food workers
- Prototyping
- In-situ manufacturers
- Resident scholars
- Informal transit
- Nature-based learning
- Participatory research
- Entertainers
- Nightlife
- Co-working
- Crafts people

Logical Subsystem



Diagnosis

Complexity performance is strongest where all three logotopes interact since they have relatively equal typology connectivity scores. The high strength of STEM activities is increased by their spatial concentrations.

Spatial improvements

- Expanded research
- Arts on Tech campus
- Residence hall workshops

Connectivity Score improvements

- Practice-based design methods
- Culinary Arts
- Designed experiments
- Oceanography
- Rune singing
- Storytelling
- Agricultural science
- Cultivation knowledge
- Living Arts
- Participatory-based design methods
- Diffuse production
- Food science



Thanks!

(Juanjo Galan Vivas, juagavi@urb.upv.es)