

Systems thinking and sustainability in urban development

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Goal for today

The goal for today addresses **cities** as sustainable living environments. We open various perspectives to sustainable urban strategies and discuss their connection to systems thinking.

Why are the cities in the core of sustainable development?

”IN TODAY’S WORLD THE ECOLOGICAL SIGNIFICANCE OF CITIES IS LARGER THAN EVER”

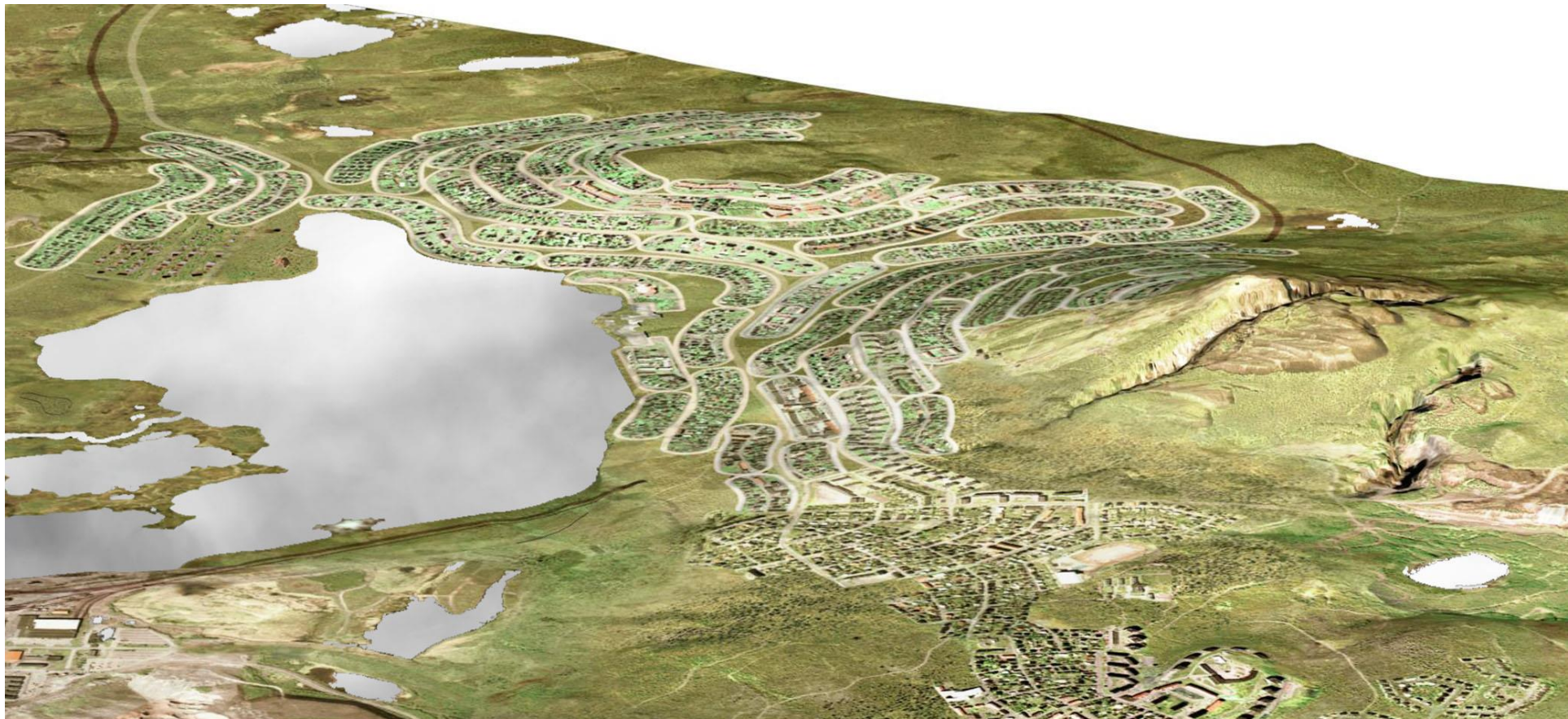
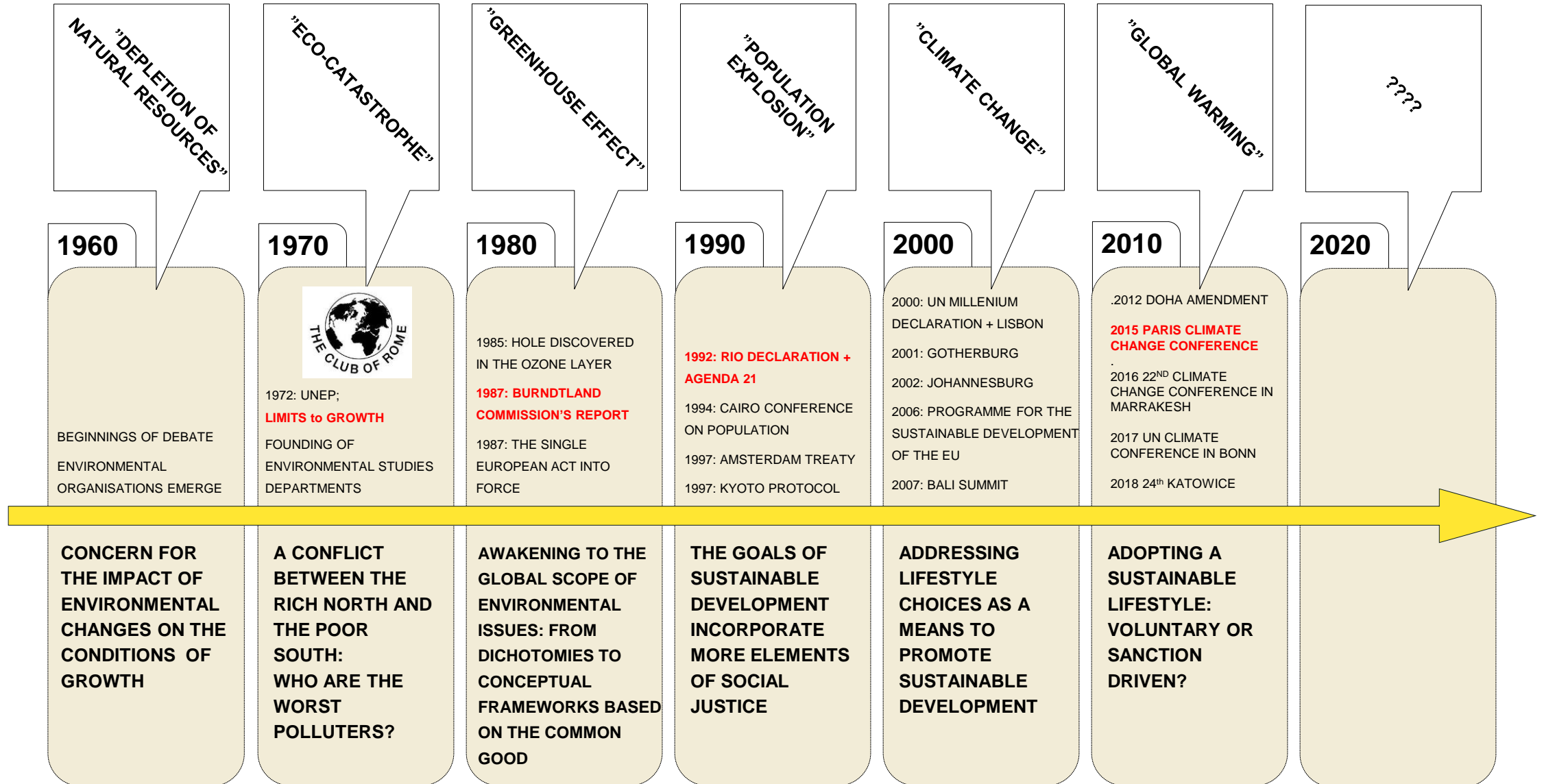


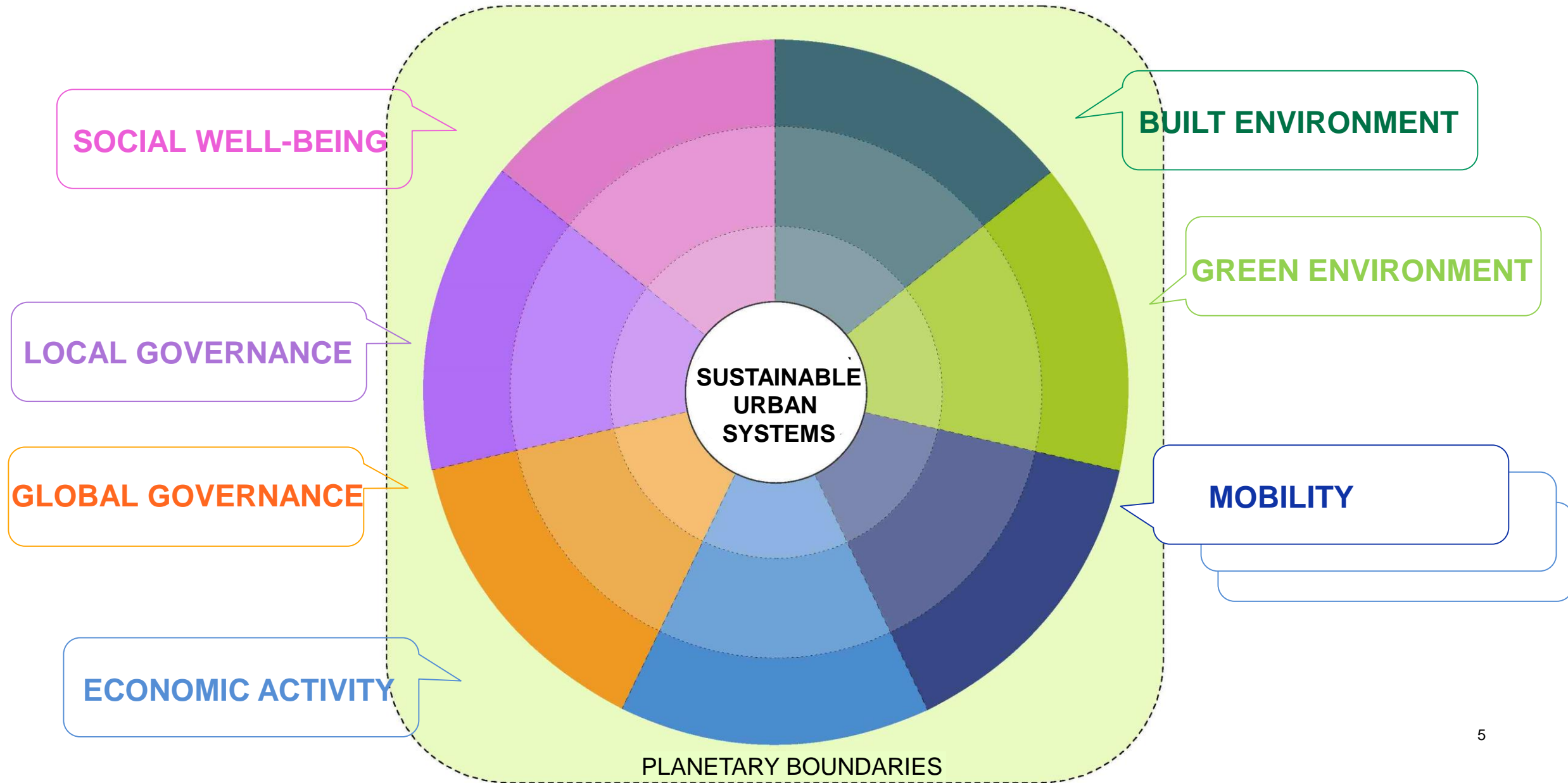
Image: Wilhelmson Arkitekter – New Kiruna / Peter Thuvander, Björn Andersson
Quote: Yrjö Haila, 2008

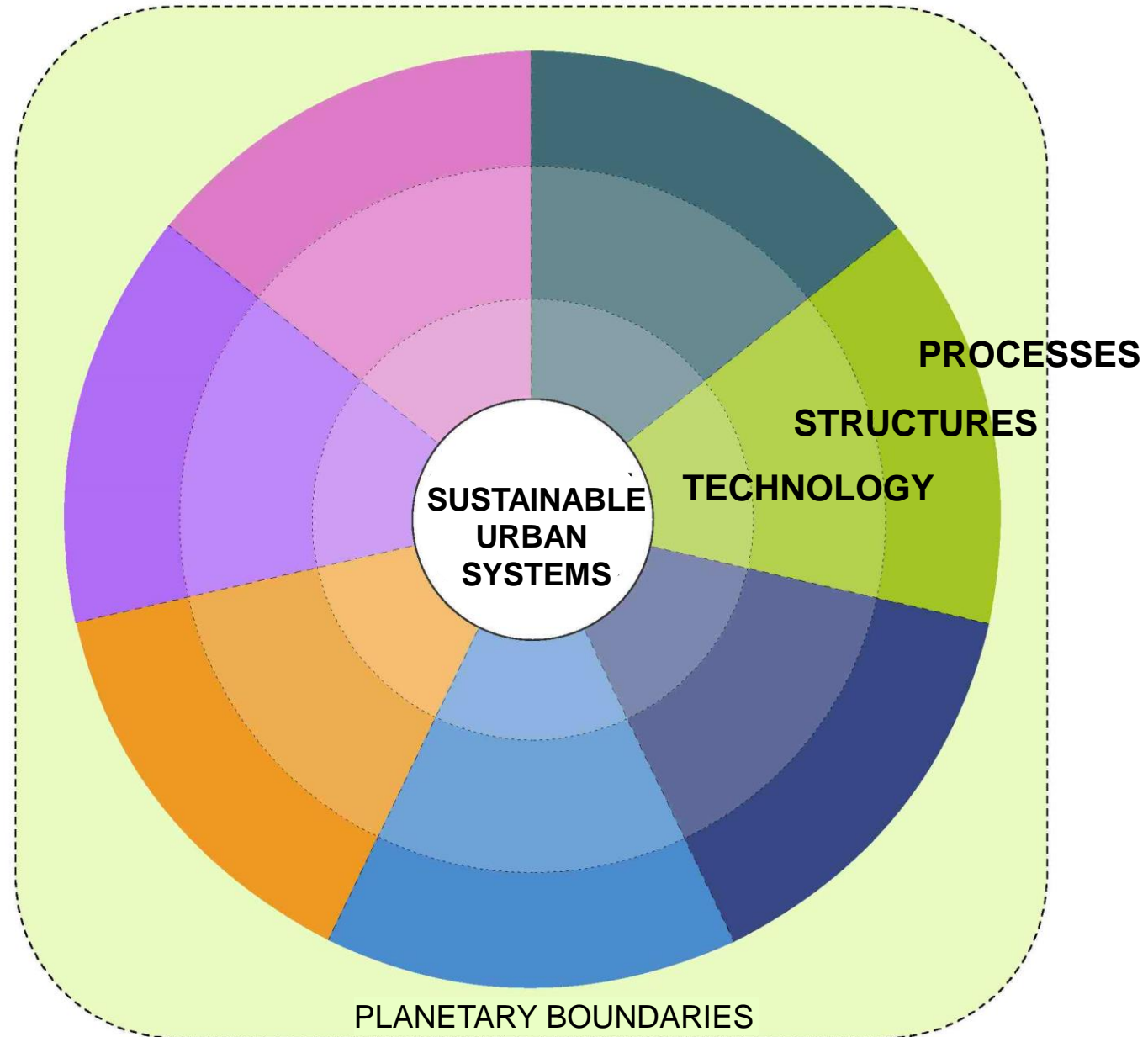
SUSTAINABLE DEVELOPMENT "POLITICAL" TIMELINE



SUSTAINABLE URBAN SYSTEMS

Staffans, Kyttä & Merikoski (eds.) 2008 <http://lib.tkk.fi/Reports/2008/isbn9789512299966.pdf>





IT'S TIME TO CHANGE THE WORLD



<https://www.hrc.co.nz/your-rights/human-rights/our-work/global-goals/>

The global goals for sustainable development by 2030

SUSTAINABLE CITIES AND COMMUNITIES

	GOAL
ADEQUATE, SAFE AND AFFORDABLE HOUSING AND BASIC SERVICES	By 2030, ensure access for all to adequate, safe and affordable housing and basic services and <u>upgrade slums</u>
SAFE, AFFORDABLE, ACCESSIBLE AND SUSTAINABLE TRANSPORT SYSTEMS	By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, <u>women, children, persons with disabilities and older persons</u>
PARTICIPATORY, INTEGRATED AND SUSTAINABLE HUMAN SETTLEMENT PLANNING	By 2030, enhance <u>inclusive</u> and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries
CULTURAL AND NATURAL HERITAGE	Strengthen efforts to <u>protect</u> and safeguard the world's cultural and natural heritage
REDUCE THE NUMBER OF DEATHS CAUSED BY DISASTERS	By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, <u>with a focus on protecting the poor and people in vulnerable situations</u>

The global goals for sustainable development by 2030

SUSTAINABLE CITIES AND COMMUNITIES

	GOALS
PER CAPITA ENVIRONMENTAL IMPACT AIR QUALITY, WASTE MANAGEMENT	By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to <u>air quality</u> and municipal and other <u>waste management</u>
SAFE, INCLUSIVE AND ACCESSIBLE, GREEN AND PUBLIC SPACES	By 2030, provide universal access to safe, inclusive and accessible, green and public spaces, <u>in particular for women and children, older persons and persons with disabilities</u>
STRENGTHENING NATIONAL AND REGIONAL DEVELOPMENT PLANNING	Support positive economic, social and environmental links between <u>urban, peri-urban and rural areas</u> by strengthening national and regional development planning
HOLISTIC DISASTER RISK MANAGEMENT AT ALL LEVELS	By 2020, substantially increase the number of cities and human settlements adopting and implementing <u>integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change, resilience to disasters</u> , and develop and implement, in line with the Sendai Framework for Disaster Risk Reduction 2015-2030, holistic disaster risk management <u>at all levels</u>
SUSTAINABLE AND RESILIENT BUILDINGS UTILIZING LOCAL MATERIALS	Support <u>least developed countries</u> , including through financial and technical assistance, in building sustainable and resilient buildings utilizing local materials

IT'S TIME TO CHANGE THE WORLD

ENERGY

FOOD

WATER



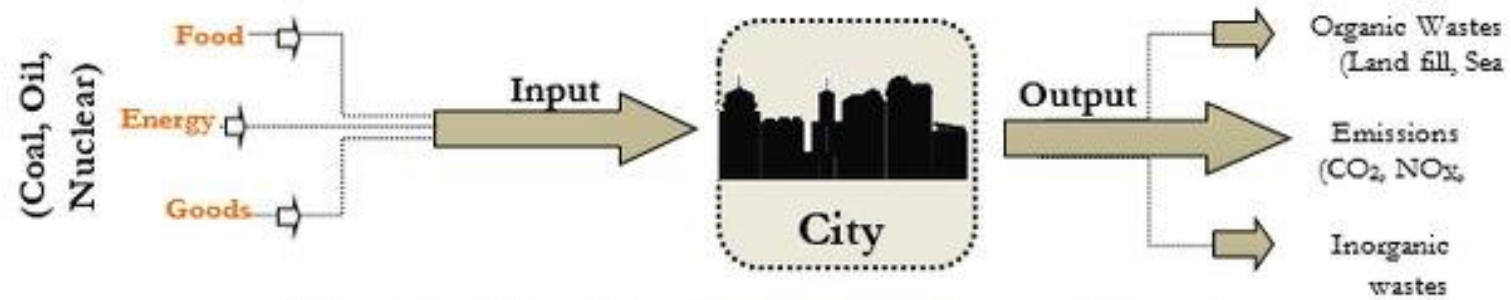
<https://www.hrc.co.nz/your-rights/human-rights/our-work/global-goals/>



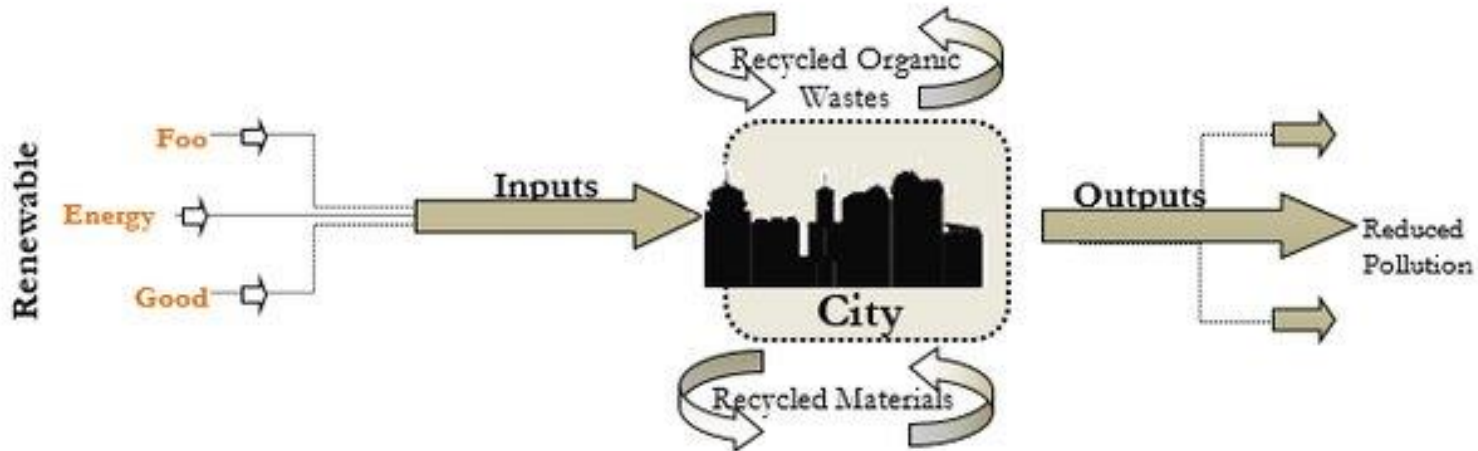
HOW TO GET MORE OUT OF LESS?

Urban metabolism

Adel & Magdy (2016): Ecological Threshold As An Approach for Balancing Carbon Metabolism in Cities

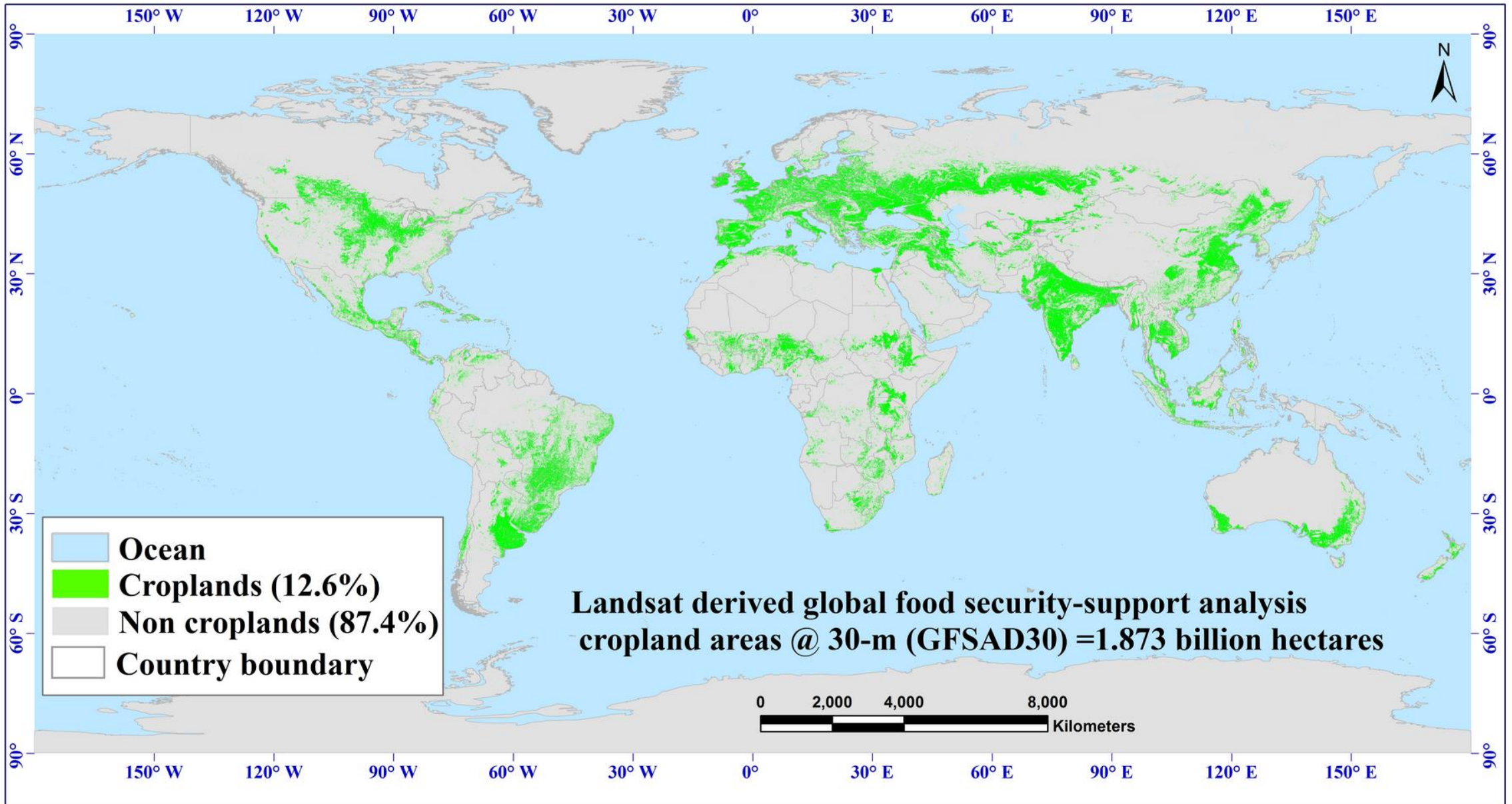


a- Linear Metabolism Cities (Consume and pollute at a high rate)

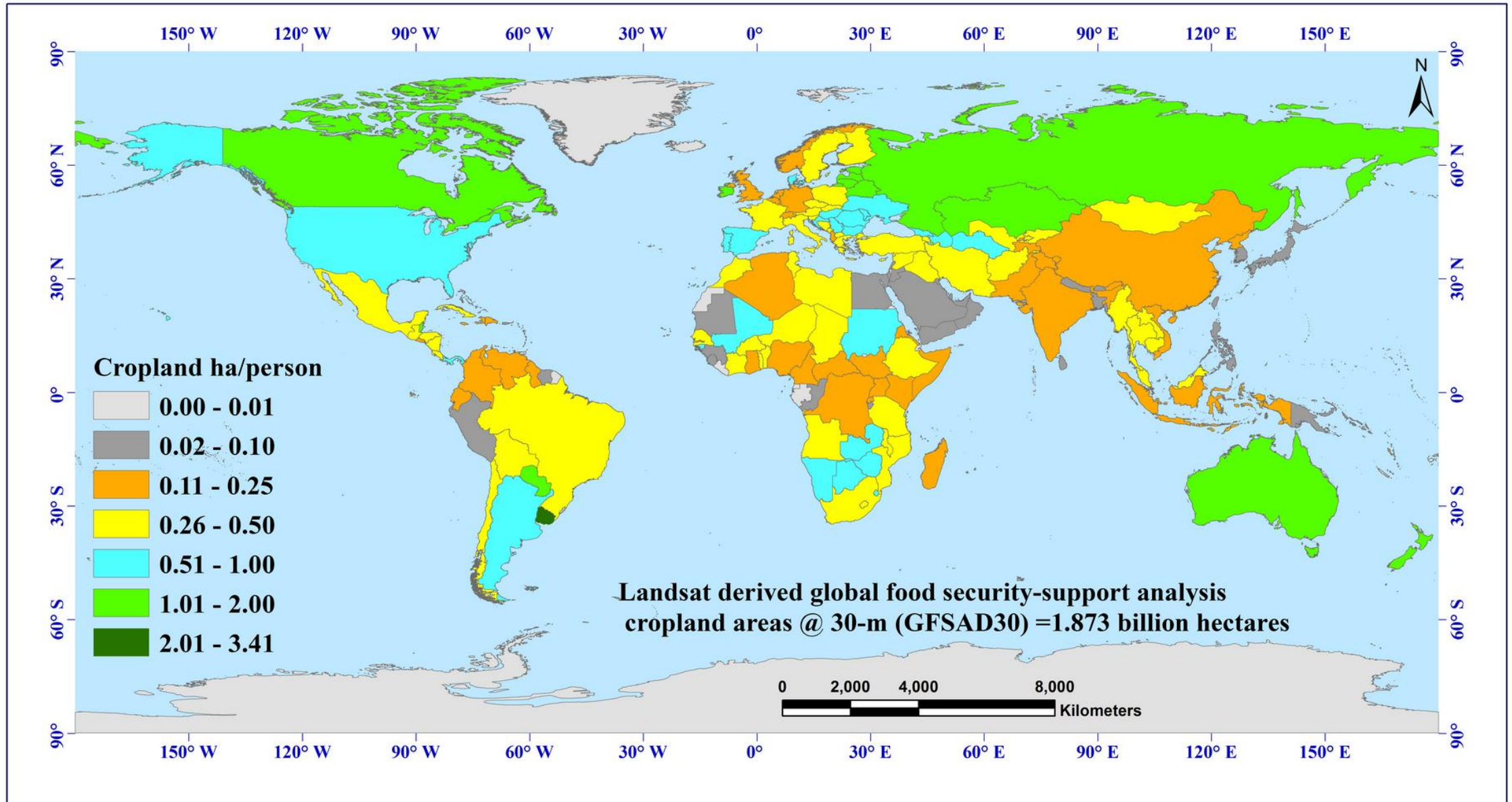


b- Circulative Metabolism Cities (Reduce consumption and maximize renewable)

LAND USE AND FOOD PRODUCTION



LAND USE AND FOOD PRODUCTION



LAND USE AND FOOD PRODUCTION

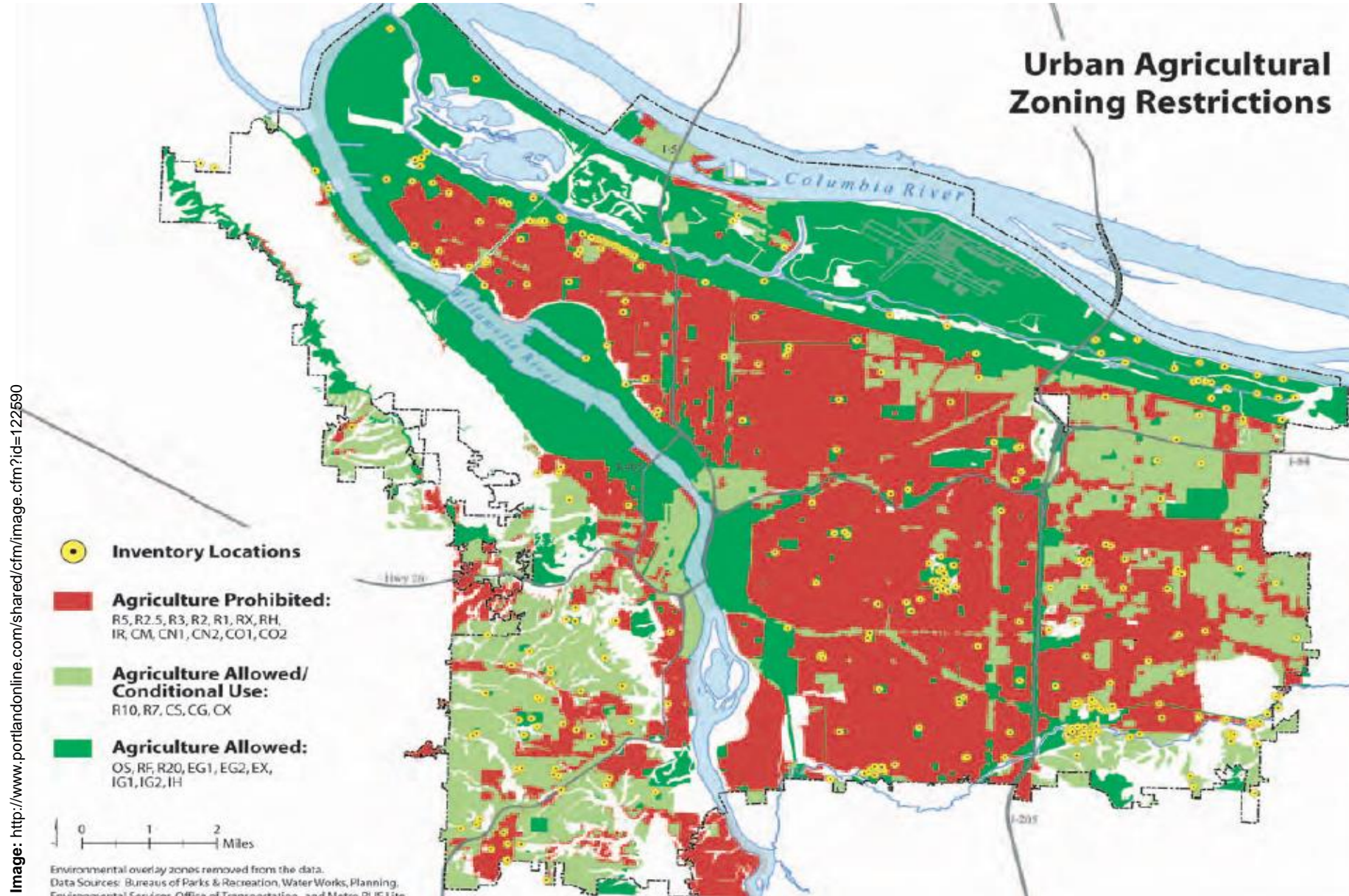


Image: <http://www.portlandonline.com/shared/cfm/image.cfm?id=122590>

SHELBY FARMS PARK

SUSTAINABILITY + RECREATION + AGRICULTURE



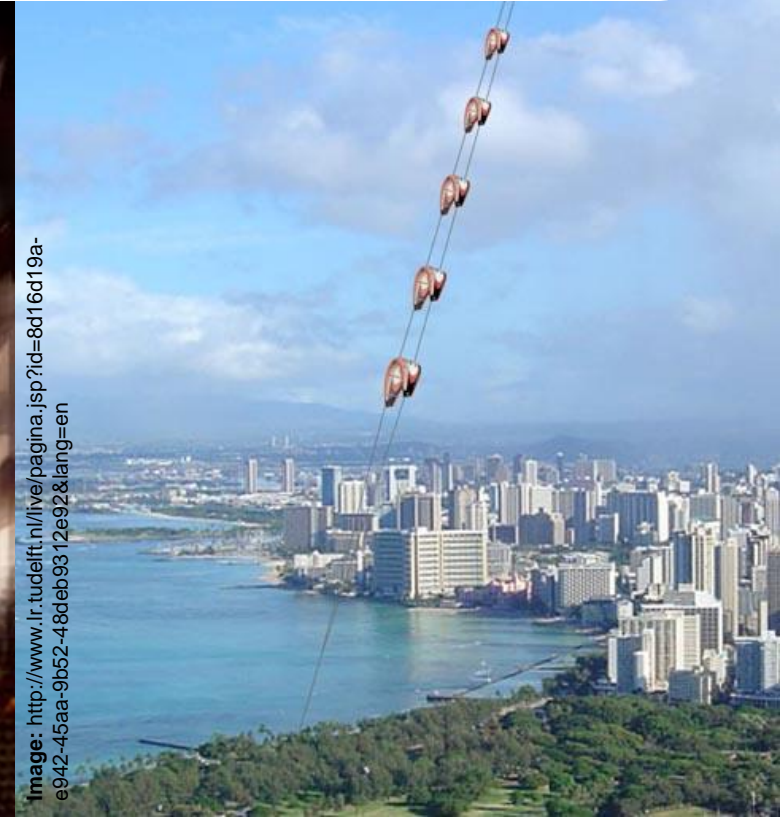
ENERGY-EFFICIENT COMMUNITIES

”WE MUST NOT BE SATISFIED WITH JUST SCRAPING THROUGH.
WE MUST GET READY FOR AN **ENERGY REVOLUTION**
THAT WILL CREATE AT LEAST AS MUCH GLOBAL TURMOIL
AS THE INDUSTRIAL AND INFORMATION REVOLUTIONS.”

Image: Masdar Development / Foster and Partners
Quoted from: Kaarin Taipale / HS 21.7.2008 (translation: xx)



Image: <http://www.lr.tudeift.nl/live/pagina.jsp?id=8d16d19a-e942-45aa-9b52-48deb9312e92&lang=en>



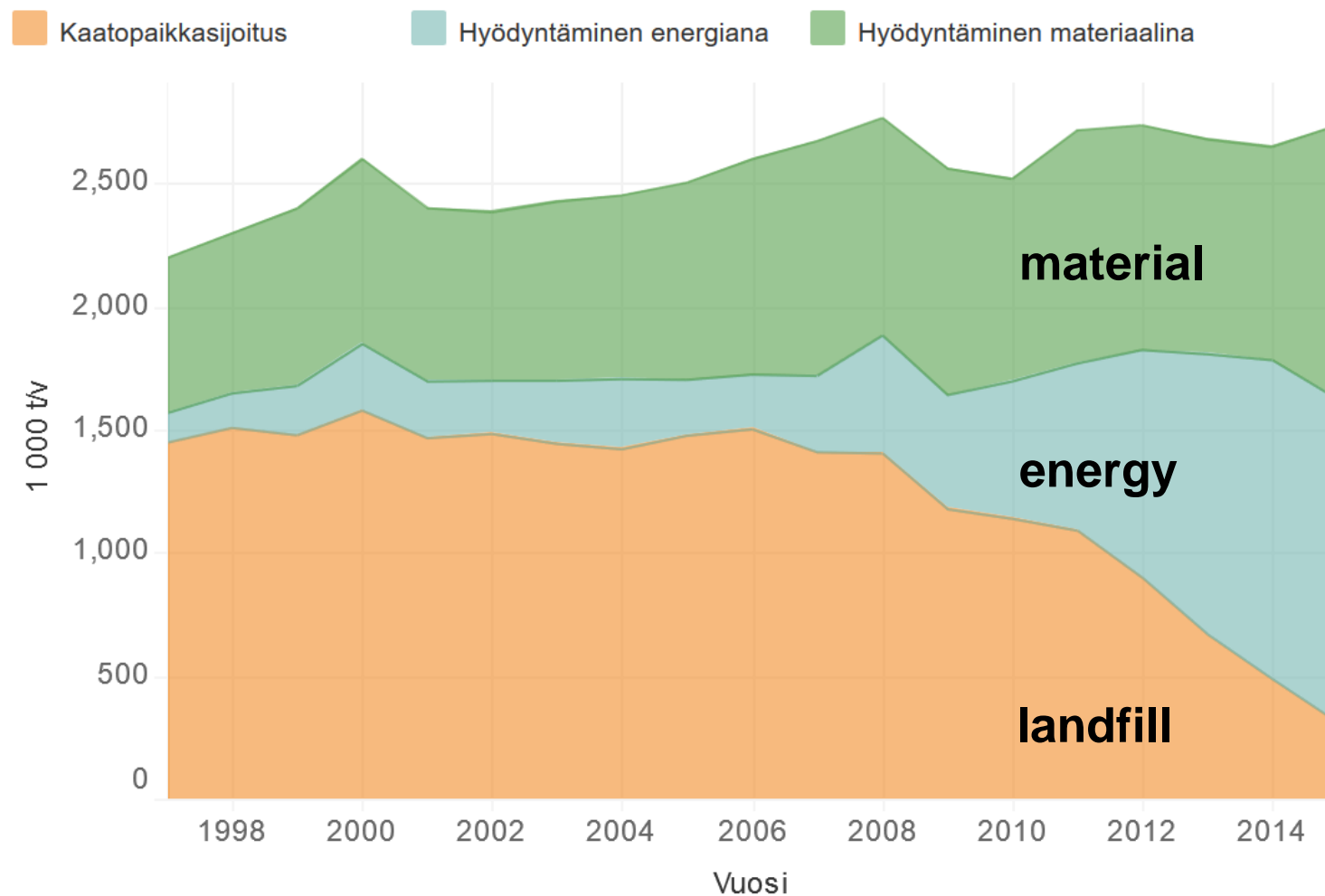
TARGETS IN RENEWABLE ENERGY CONSUMPTION



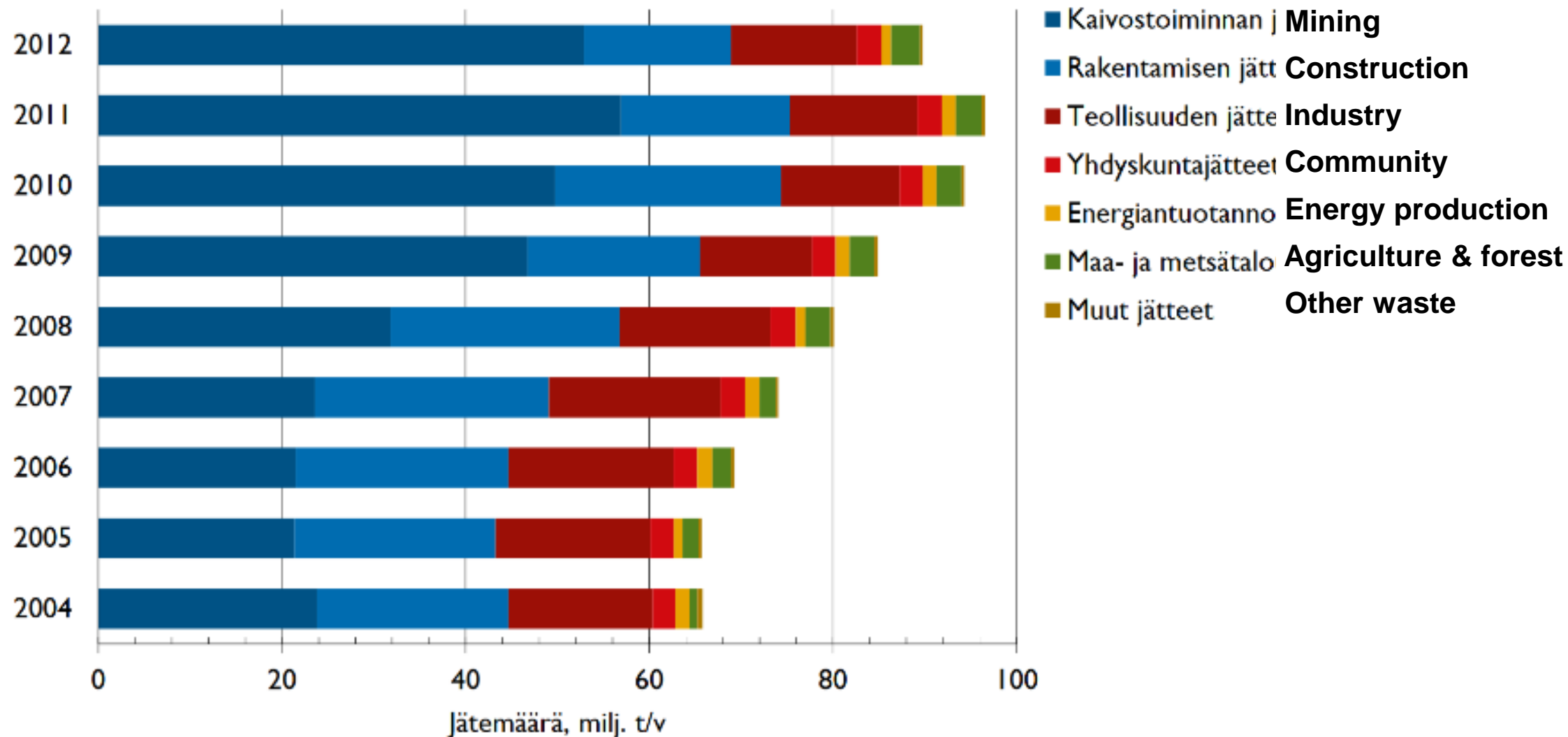
2016:
123 MILLION TONNES
OF WASTE IN FINLAND
2,27 million tonnes community waste

89%
OF COMMUNITY WASTE RECLAIMED
AS MATERIAL (41%) OR ENERGY (47%)
IN 2016

Yhdyskuntajätteen käsittely Suomessa 1997-2015



Vuonna 2015 yhdyskuntajätteestä kierrätettiin materiaalina hyötykäyttöön noin 40 %. Kaatopaikalle sijoitetun sekajätteen määrä on vähentynyt tavoitellun mukaisesti, se on enää noin 10 %. Lähde: Jätetilasto. Tilastokeskus. 2017.

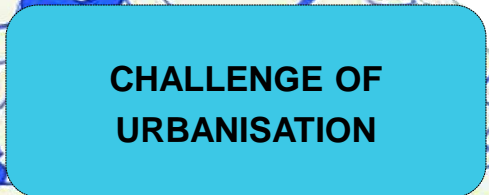
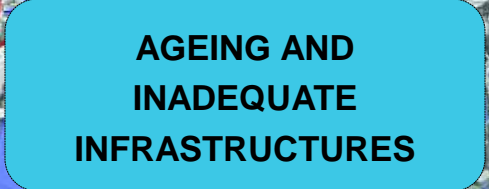
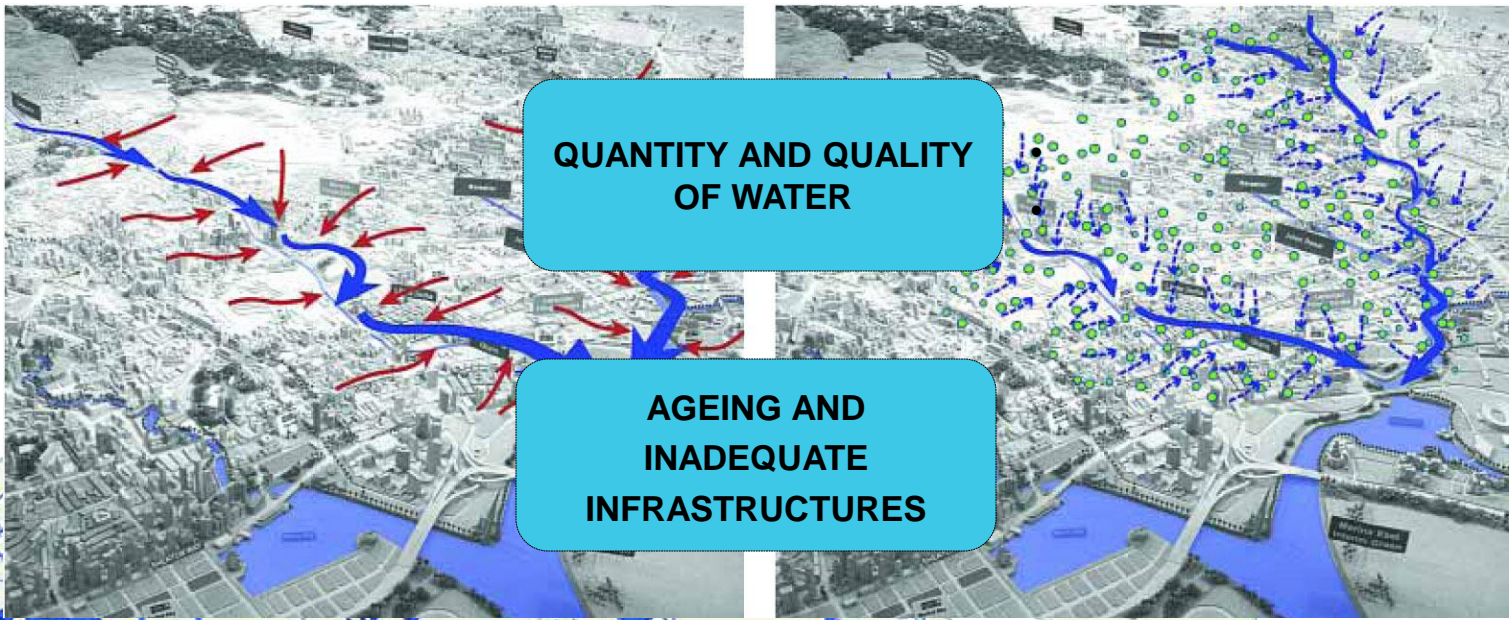


Total waste, million tonnes /year

Kuva 1. Suomen kokonaisjättemäärien kertymät sektoreittain vuosina 2004–2012.
Lähde: Tilastokeskus.

HYDROLOGY, WATER MANAGEMENT AND URBAN STRUCTURE

Images: Herbert Dreiseitl: <http://www.dreiseitl.de/> (Topos: Water: Design and Management 59/2007)

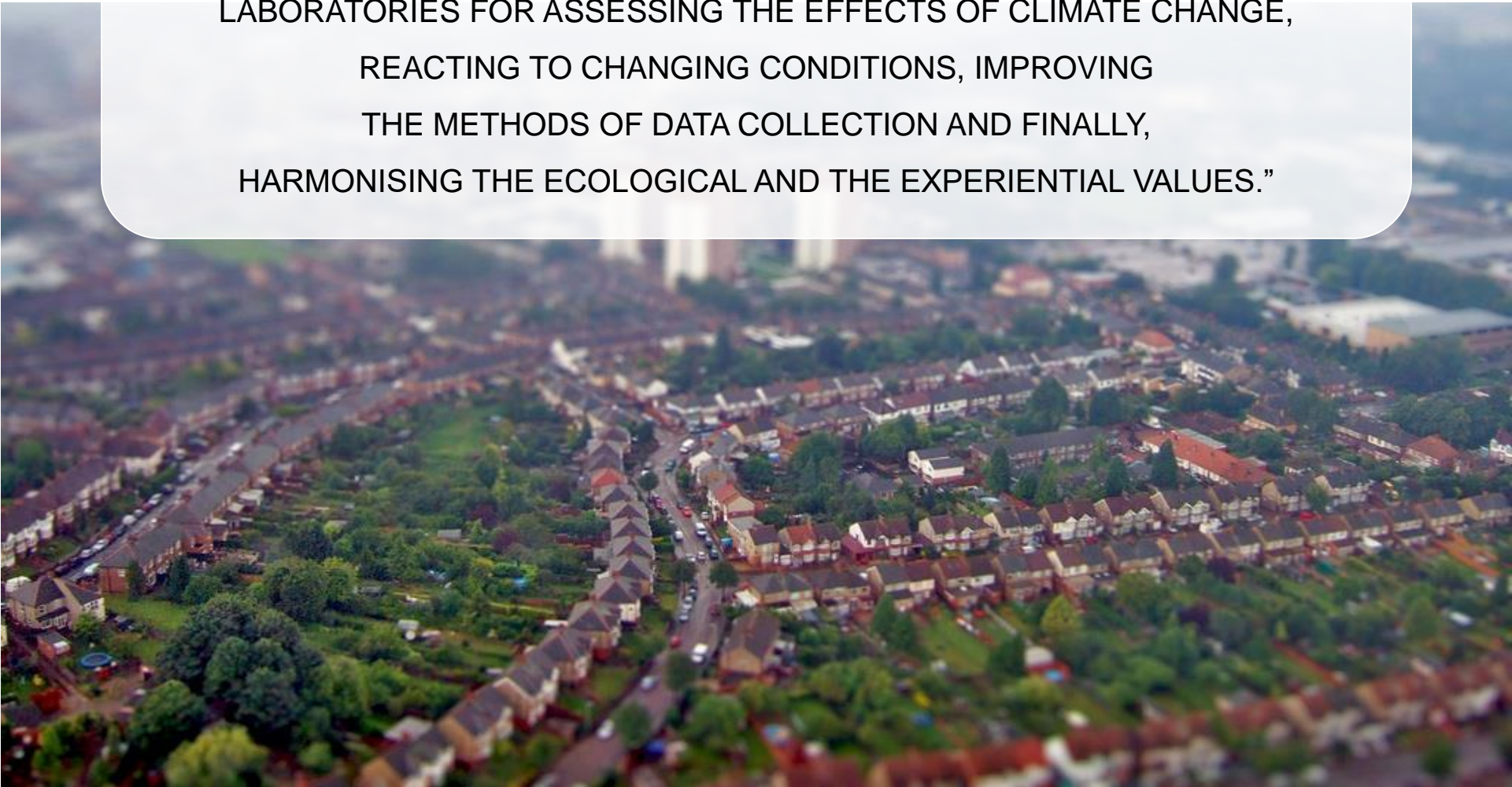




WHAT IS OUR VISION FOR FUTURE COMMUNITIES?

THE CITY AS A LIVING LABORATORY

"CITIES AND URBAN NATURE CAN BE SEEN AS LABORATORIES FOR ASSESSING THE EFFECTS OF CLIMATE CHANGE, REACTING TO CHANGING CONDITIONS, IMPROVING THE METHODS OF DATA COLLECTION AND FINALLY, HARMONISING THE ECOLOGICAL AND THE EXPERIENTIAL VALUES."



CITY STRATEGIES FOR THE FUTURE

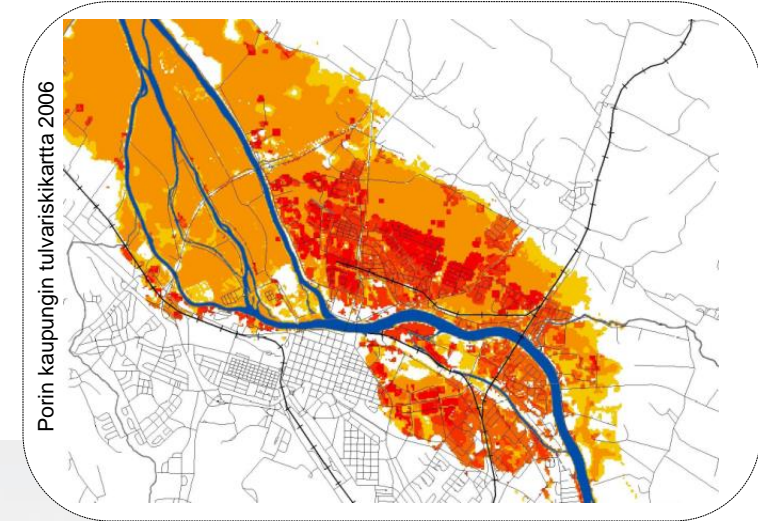
- ★ ADAPTING CITY
- ★ DENSELY BUILT CITY
- ★ GREEN CITY
- ★ SERVICE CITY
- ★ CRADLE-TO-CRADLE COMMUNITY



Image: Masdar Development / Foster + Partners



Image: <http://www.worldchanging.com/archives/008347.html>



ADAPTING CITY

Blue-green infrastructure (BGI)



DENSIFYING THE CITY

Voortrekker Road Corridor, Cape Town



GREEN CITY

New Jersey, USA



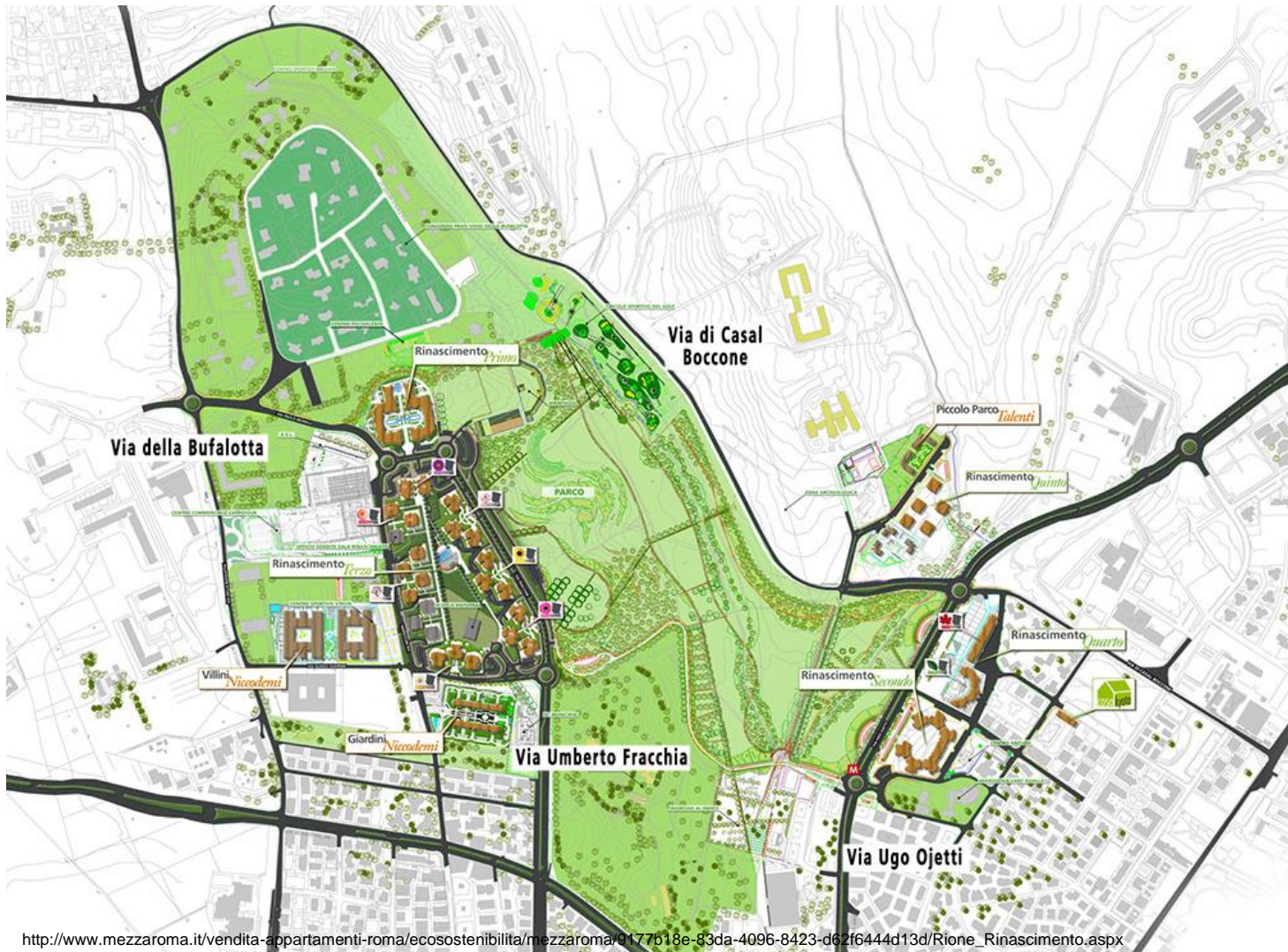
GREEN CITY

Bac Ninh City, Vietnam



RIONE RINASCIMENTO, ROME

GEOHERMAL ENERGY + MICROCLIMATE + LOCAL COMMUNITY + BIODIVERSITY



SMART & SUSTAINABLE CITY

Tour & Taxis, Brussels, Belgium



<https://www.archdaily.com/803549/vincent-callobaut-architectures-plans-for-eco-neighbourhood-in-brussels/587e1913e58ece6094000080-vincent-callobaut-architectures-plans-for-eco-neighbourhood-in-brussels-image/>

SMART & SUSTAINABLE CITY

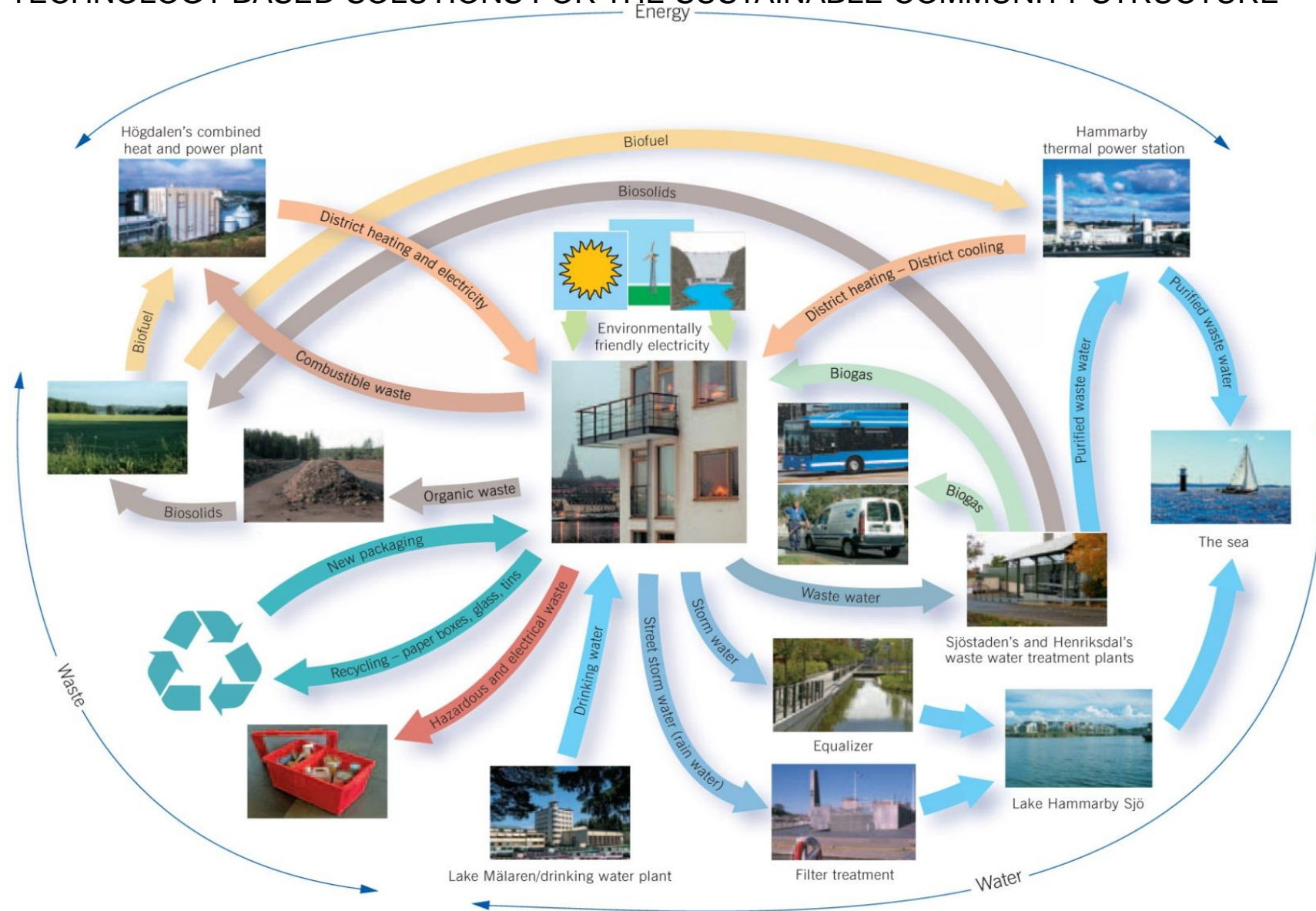
Tour & Taxis, Brussels, Belgium



<https://www.archdaily.com/803549/vincent-callebaut-architectures-plans-for-eco-neighbourhood-in-brussels/587e1913e58ece6094000080-vincent-callebaut-architectures-plans-for-eco-neighbourhood-in-brussels-image/>

HAMMARBY SJÖSTADT

TECHNOLOGY-BASED SOLUTIONS FOR THE SUSTAINABLE COMMUNITY STRUCTURE

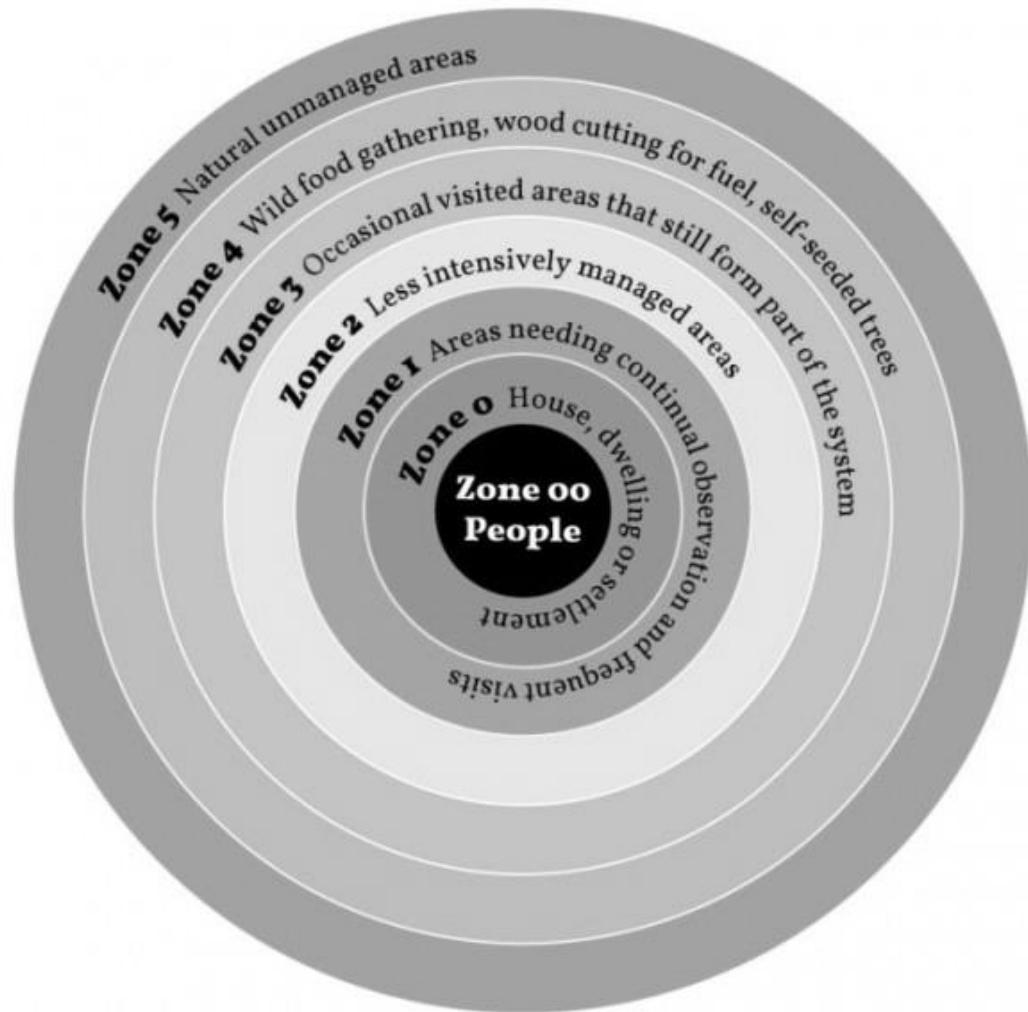


Source: The Hammarby model, <http://www.hammarbysjostad.se/>

HAMMARBY SJÖSTADT



PERMACULTURE CITY



ECO-CITIES, MEGA-CITIES?



Image: <https://www.theguardian.com/cities/2014/apr/14/china-tianjin-eco-city-empty-hospitals-people>

PLANYC 2030

EARTH + AIR + WATER + TRANSPORT + ENERGY + CLIMATE CHANGE



Image: Felix Molter

Cities and Systemic Change for Sustainability

Wolfram, M. & Frantzeskaki, N. 2016

Meta-analysis of research on *cities, systemic change and sustainability*, 115 references from three scientific data bases

Fields: key urban studies like governance, planning, geography, ecology, sociology

Two constitutive ontologies:

Socio-technical system (STS): societal change as conditioned by co-evolution between particular technologies, institutions (policy, regulation, markets) and practices (users, routines);

insights from historical STS transformations e.g., regarding energy or transportation, the interest has thus been in identifying options to overcome the path-dependency;

multilevel perspective, transition management, strategic niche management, technological innovation ecosystem

Socio-ecological system (SES): conceptualizing in particular the systemic property of resilience;

ecological functions and services such as the provision of fresh water, green space or biomass that are constitutive for the identification of the systemic relations studied, then considering the role of cultures, institutions, practices and technologies in forming and/or transforming the system;

stability, diversity & redundancy of components and feedbacks, capacity for learning, adaption, self-organisation

Cities and Systemic Change for Sustainability

Wolfram, M. & Frantzeskaki, N. 2016

Drivers of systemic change from different epistemological approaches:

> **Transforming urban metabolism and political ecologies**

motif: adjustment to global environmental change to stay competitive

focus: new technology and services, infrastructure

> **Configuring urban innovation systems for green economies**

motif: adjustment to global environmental change to stay competitive

focus: production and consumption patterns

> **Building adaptive communities and ecosystems**

motif: climate change, resource scarcity and biodiversity loss

focus: socio-ecological systems, ecosystem services

> **Empowering urban grassroots niches and social innovation**

motif: global environmental change + other individual and group-specific needs (employment, housing, mobility...)

focus: local communities, grassroots, justice, ethics

Cities and Systemic Change for Sustainability

Wolfram, M. & Frantzeskaki, N. 2016

Table 1. Prevailing epistemologies in research on cities and systemic change for sustainability—emphasis on drivers of change.

Epistemology/Drivers	Political	Economic	Ecological	Social	Cultural	Technological	Demographic
A: Transforming urban metabolisms and political ecologies (STS)	●●●	●●●	●●●			●●●	
B: Configuring urban innovation systems for green economies (STS)		●●●	●●●	●	●	●●●	
C: Building adaptive communities and ecosystems (SES)	●●		●●●	●●●	●		●
D: Empowering urban grassroots niches and social innovation (STS)			●●●	●●●	●●●	●	●

● = low, ●● = medium, ●●● = high.

Cities and Systemic Change for Sustainability

Wolfram, M. & Frantzeskaki, N. 2016

“There are a number of significant empirical gaps emerging.” - case studies with individual cities but hardly no comparative studies

“Despite all interdisciplinarity, there is still a lack of genuine contributions from key fields in urban studies such as planning, political science, engineering, economics or sociology.”

“Above all, the proportion of *transdisciplinary* research—*i.e.*, interdisciplinary studies defined and realized together by science *and* society stakeholders—is surprisingly low.”



WHAT IS SUSTAINABLE MOBILITY?

Smart **sustainable mobility**. A user-friendly transport system is a combination of intelligence, low carbon energy, and adaptable.

www.vtt.fi/inf/pdf/visions/2014/V5.pdf

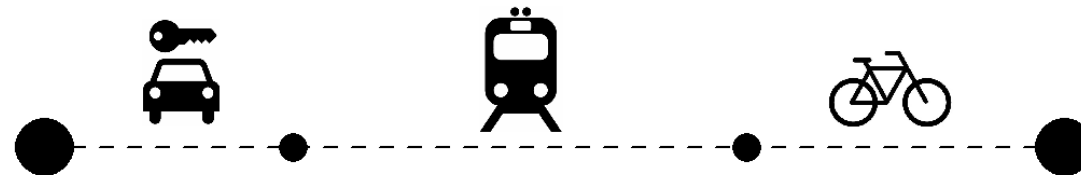
**USER FRIENDLY
INTELLIGENT
LOW-CARBON
ADAPTABLE**



<https://medium.com/transit-app/is-this-the-best-bus-in-america-b40b7bb4115d>

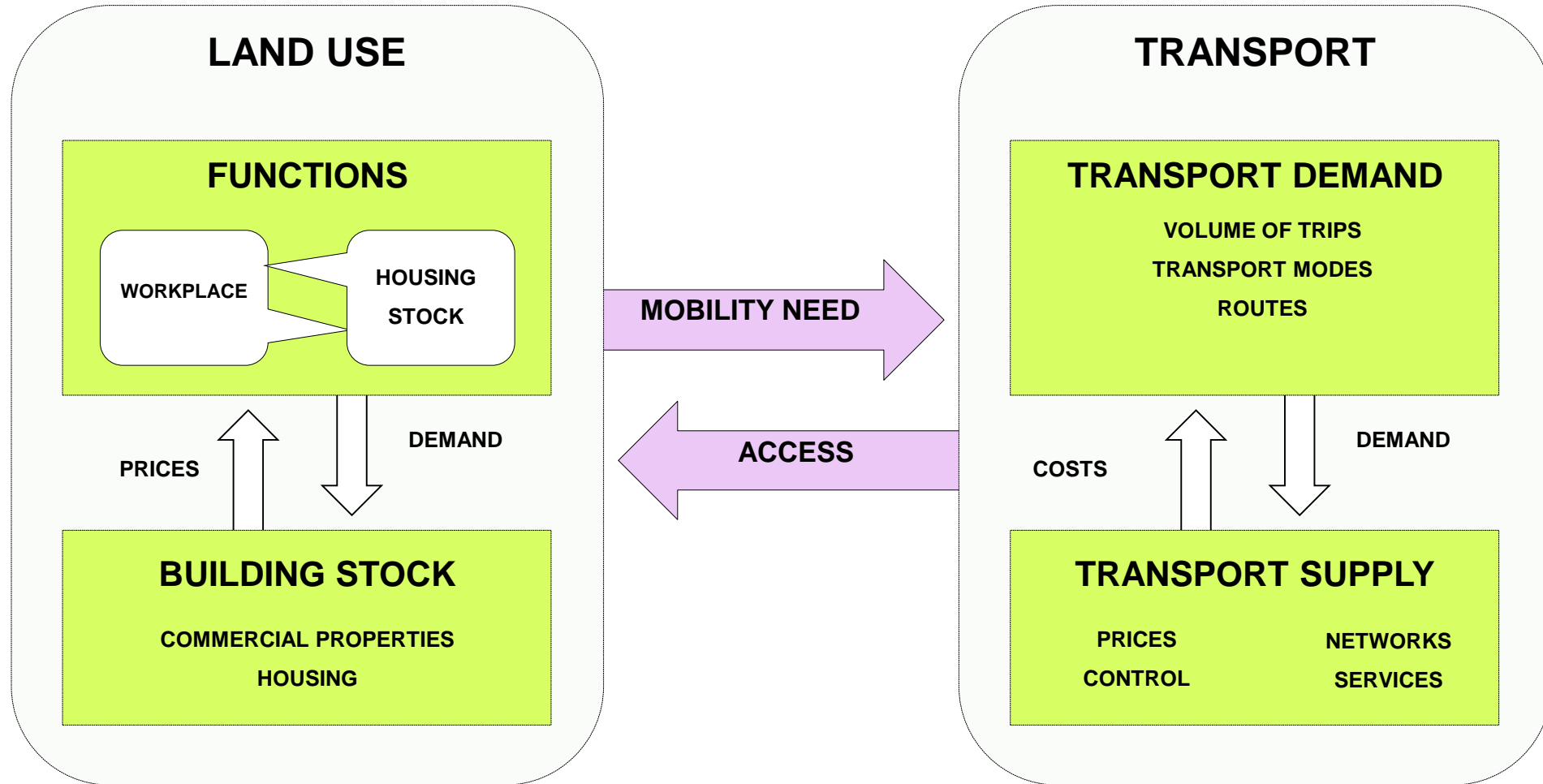
http://wwf.panda.org/what_we_do/footprint/one_planet_cities/sustainable_mobility/

A NETWORK OF DIFFERENT OPTIONS



RECIPROCAL INTERACTION

Source: Modified from Uudenmaanliitto 1997



RECIPROCAL INTERACTION

[Frontpage](#)[Construction](#)[Metro project](#)[Stations](#)[Publications and photos](#)[Feedback](#)[Contact information](#)[» Starting points](#)[» Objectives](#)[» Impact](#)[» Timetable](#)[» Costs](#)[» Safety](#)[» Station planning](#)[» Accessibility](#)[» Environment](#)[» Surveys and reports](#)[» Future](#)[» Automatic Metro](#)

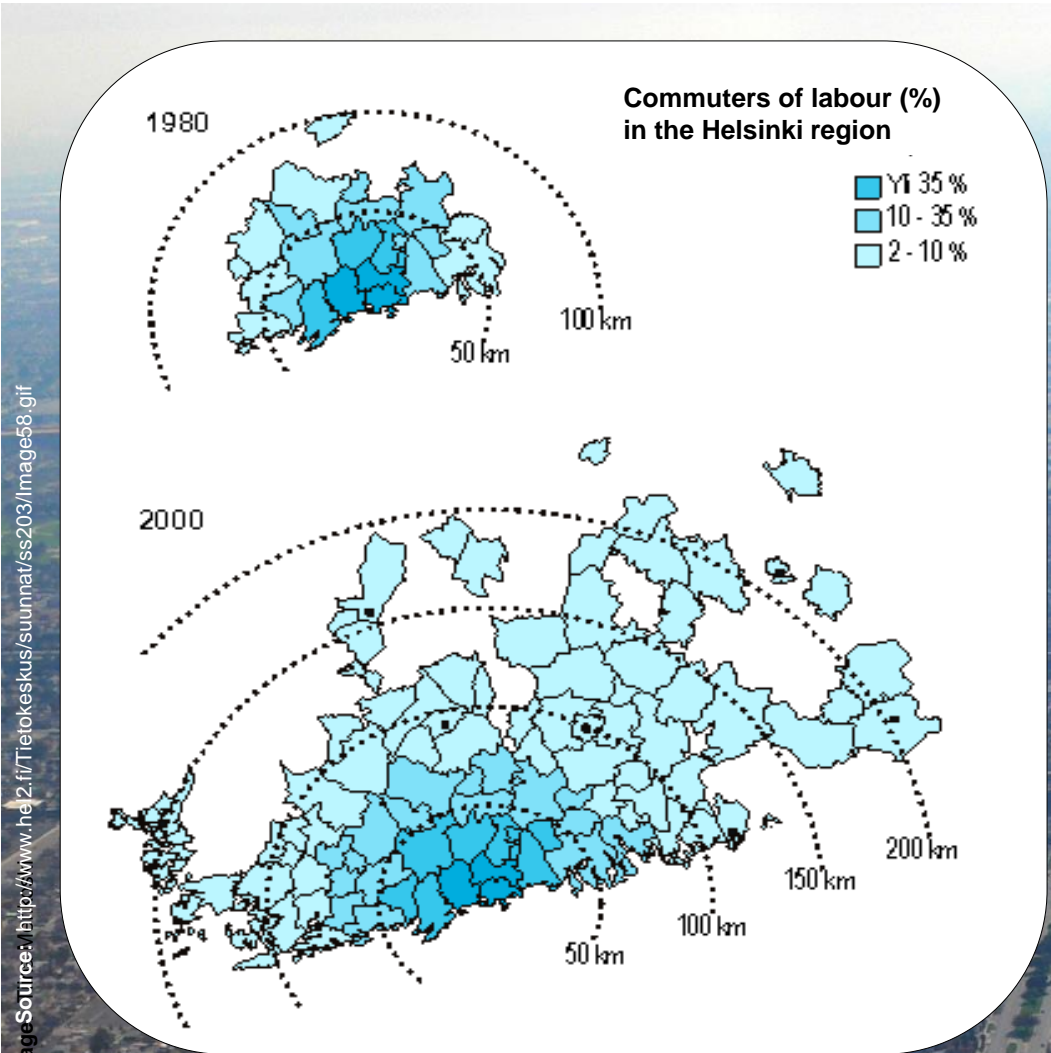
Metro shaping urban structure



http://www.lansimetro.fi/en/metro_project/impact

The metro will connect the southern parts of Espoo to the regional rail transport system. It is estimated that over 100,000 passengers will use the metro daily and that around 60,000 will cross the border between Helsinki and Espoo every day. The busiest stations are likely to be Tapiola, Matinkylä and Lauttasaari.

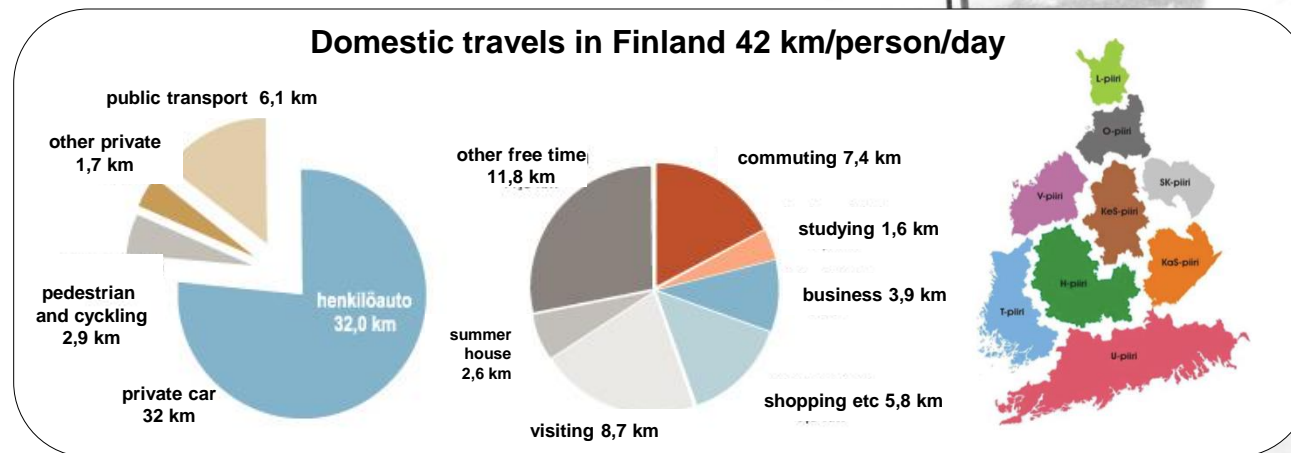
TRAVELLING – HOW, WHY AND WHERE?



ImageSource: <http://www.helsinki.fi/Tietokeskus/suunnat/ss203/images8.gif>

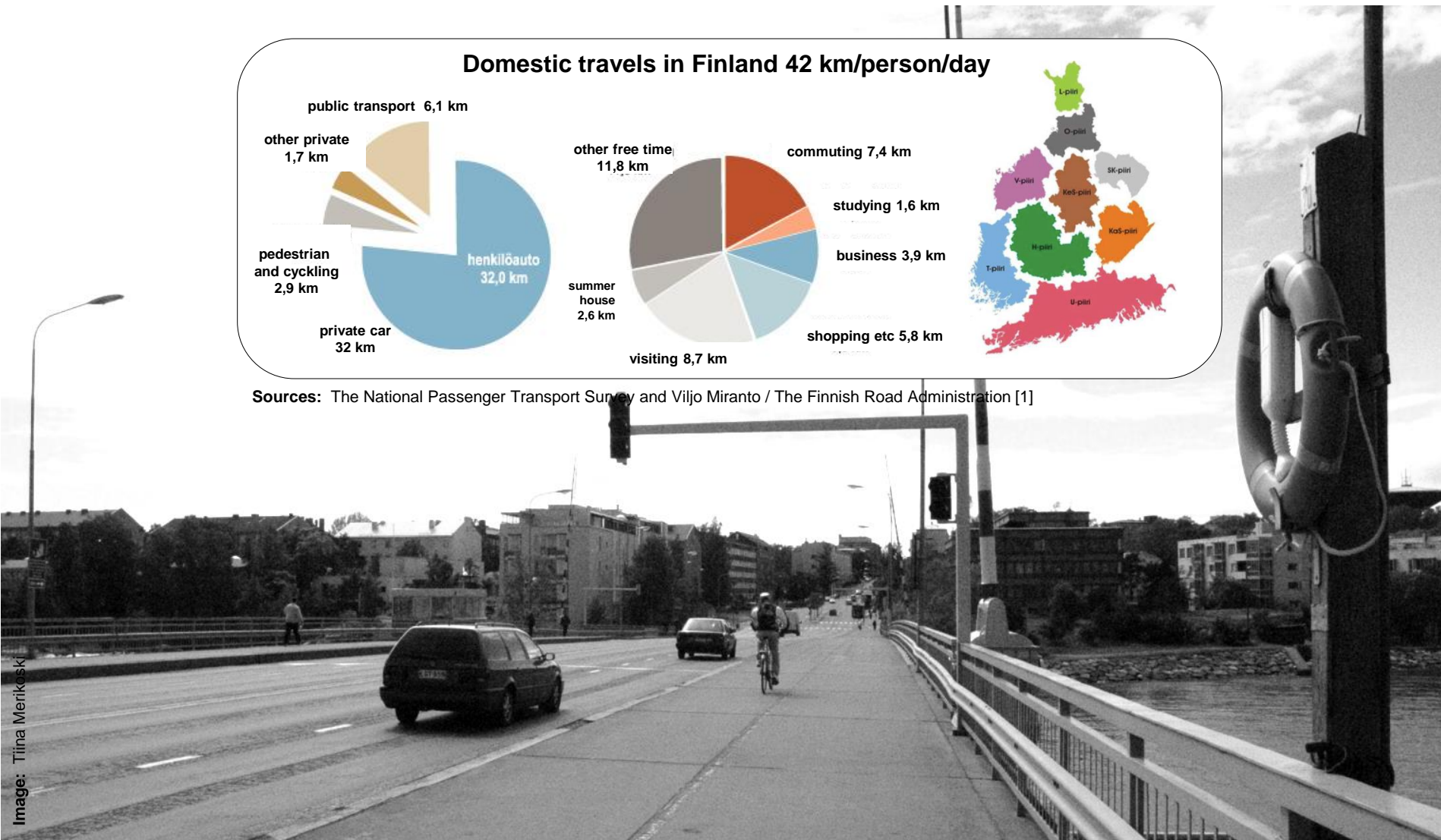


TRAVELLING – HOW, WHY AND WHERE?



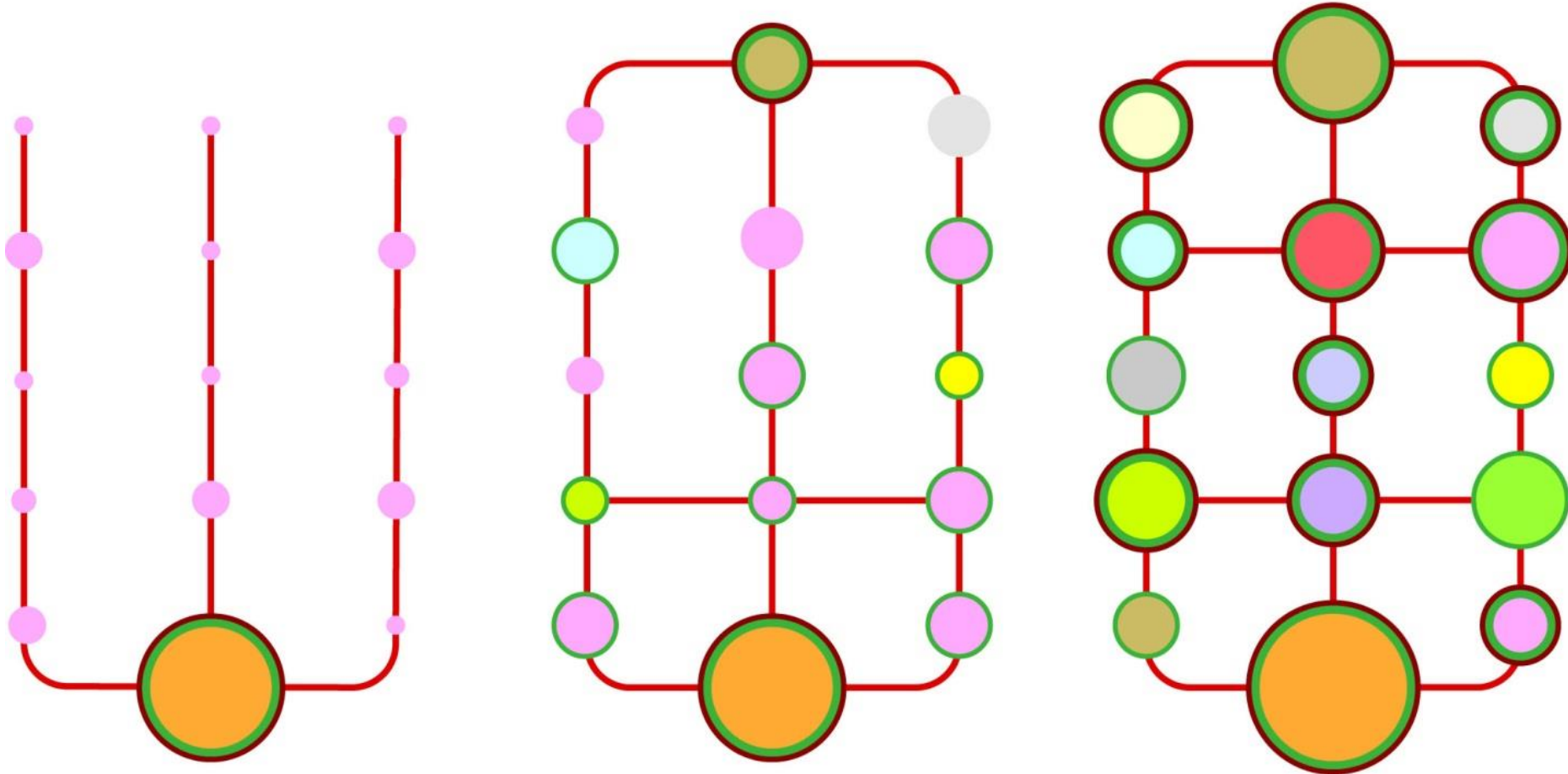
Sources: The National Passenger Transport Survey and Viljo Miranto / The Finnish Road Administration [1]

Image: Tiina Merikoski

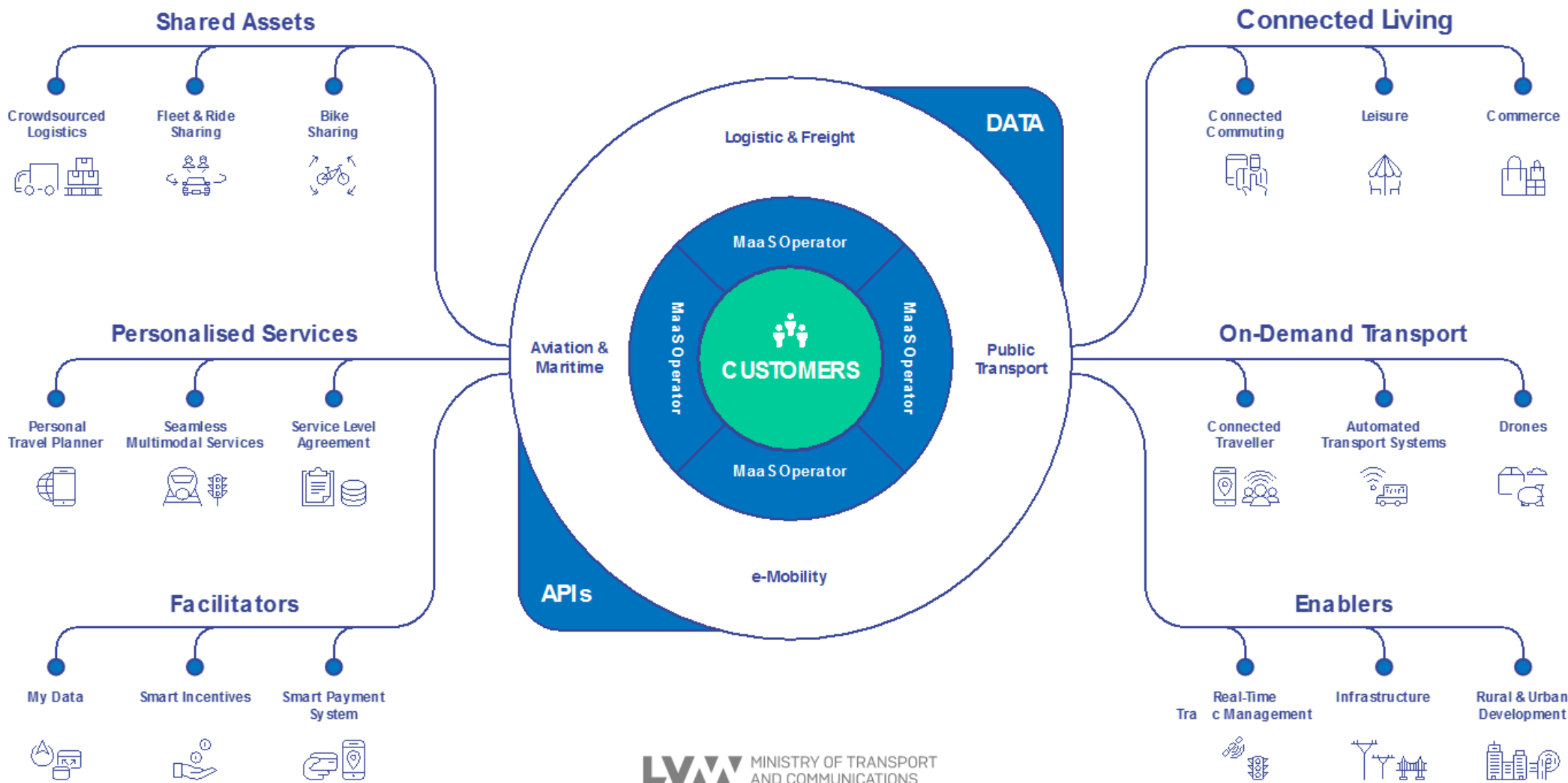


A MULTICENTRED AND NETWORK-BASED URBAN STRUCTURE

Images: Tina Merikoski



MOBILITY AS A SERVICE

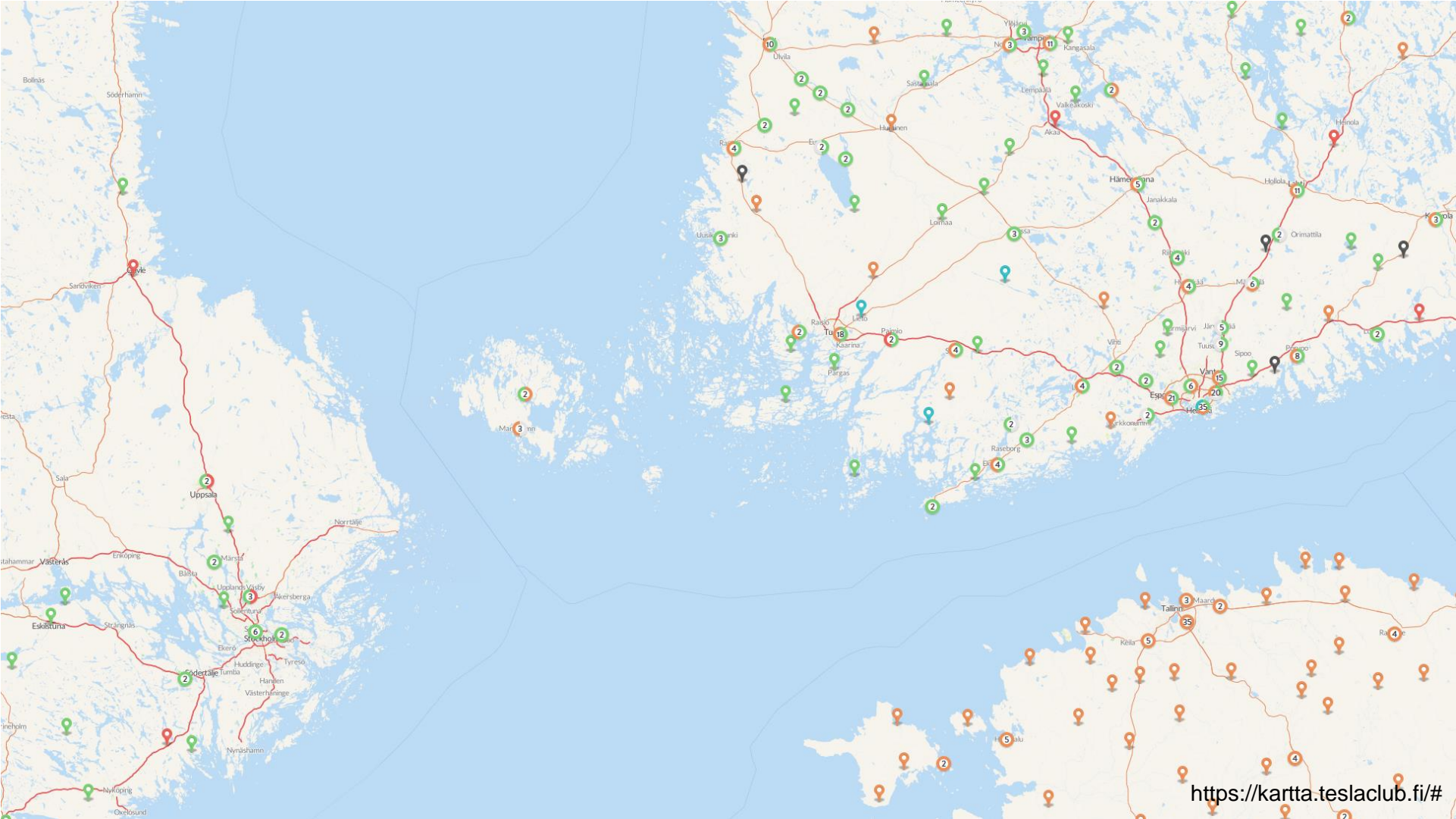


SERVICE INNOVATIONS SUPPORTING CYCLING



Image: BikePortland.org / Jonathan Maus

INFRASTRUCTURE FOR EV CHARGING STATIONS



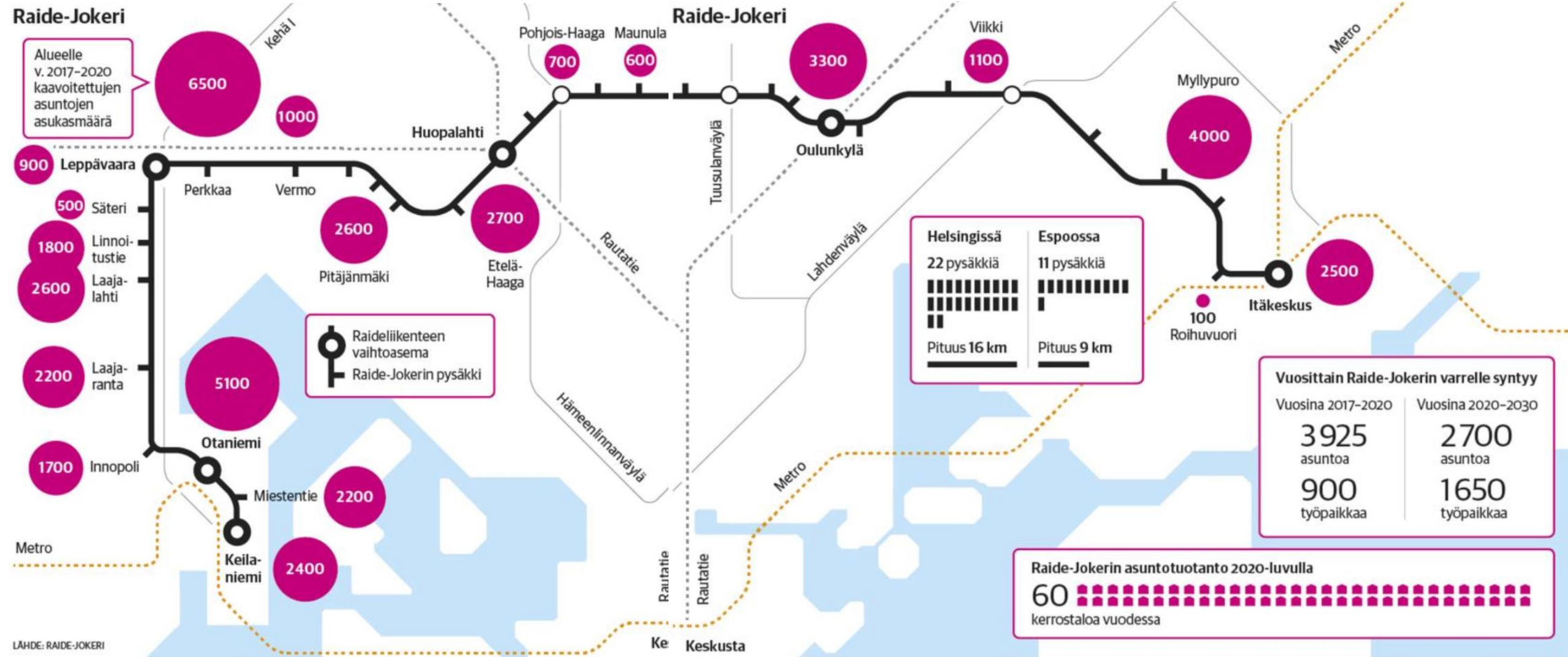
TECHNOLOGICAL INNOVATIONS



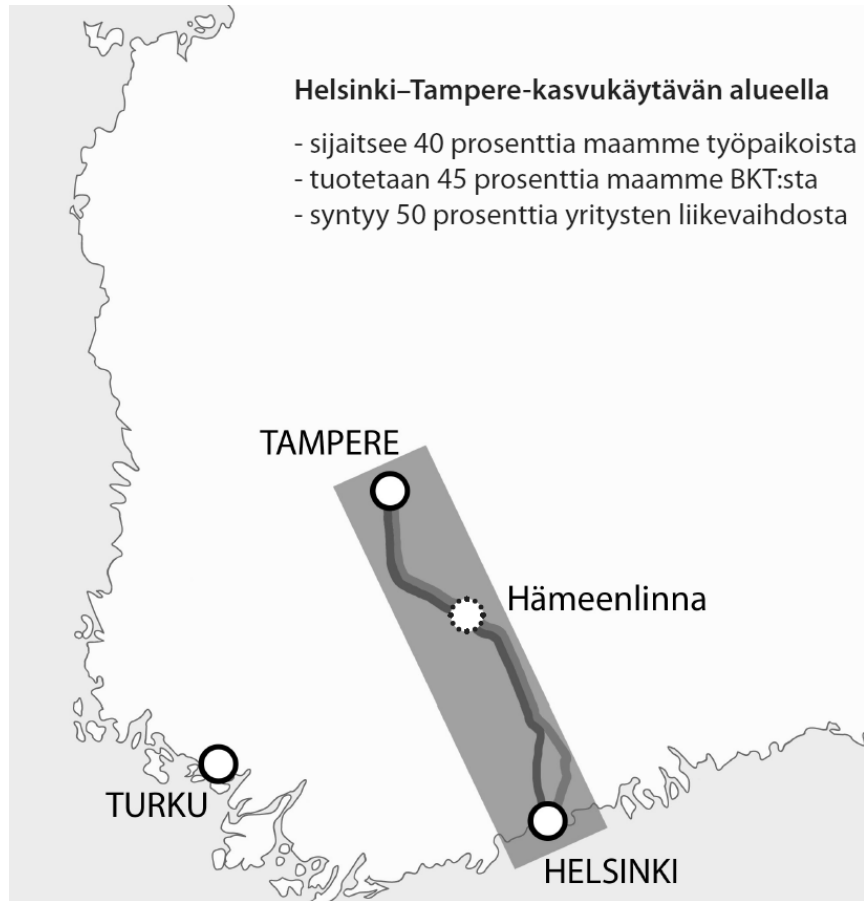
Image: Tiina Merikoski



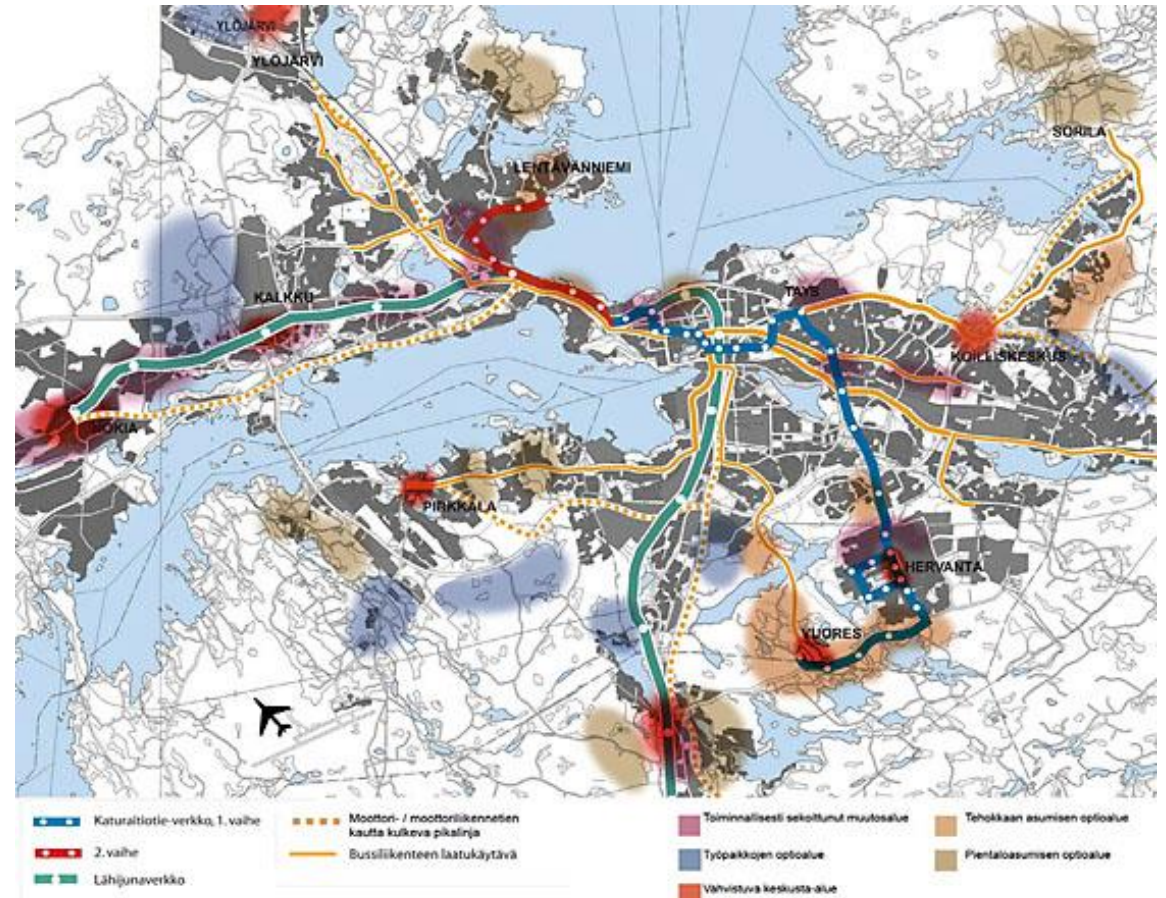
Transit Oriented Development TOD



Transportation and urban structure



<http://www.soininvaara.fi/2015/10/24/kaupunkien-voitto-6-montako-kaupunkia-suomeen-mahtuu/>



http://www.kaupunkiliikenne.net/Tampere/tpc_historia.html

Urban population in Finland

Population change in 10 biggest cities 2017-2040

Näin kaupunkien väestömäärät muuttuvat

Väestömuutos vuonna 2040 vuoteen 2017 verrattuna

MDI:n ennusteen mukaan

change %
muutos,
prosenttia

	population asukasluku		change % muutos, prosenttia	
Helsinki	783 637		21,8	
Tampere	260 633		12,4	
Oulu	217 904		8,0	
Turku	208 669		10,0	
Jyväskylä	149 981		7,0	
Kuopio	121 651		2,9	
Lahti	118 554		-0,9	
Joensuu	75 610		-0,6	
Seinäjoki	66 870		6,7	
Vaasa	67 122		-0,4	

Koonnut: JUHA-PEKKA RAESTE / HS, grafiikka: IINES VIKIÖ / HS, lähde: MDI

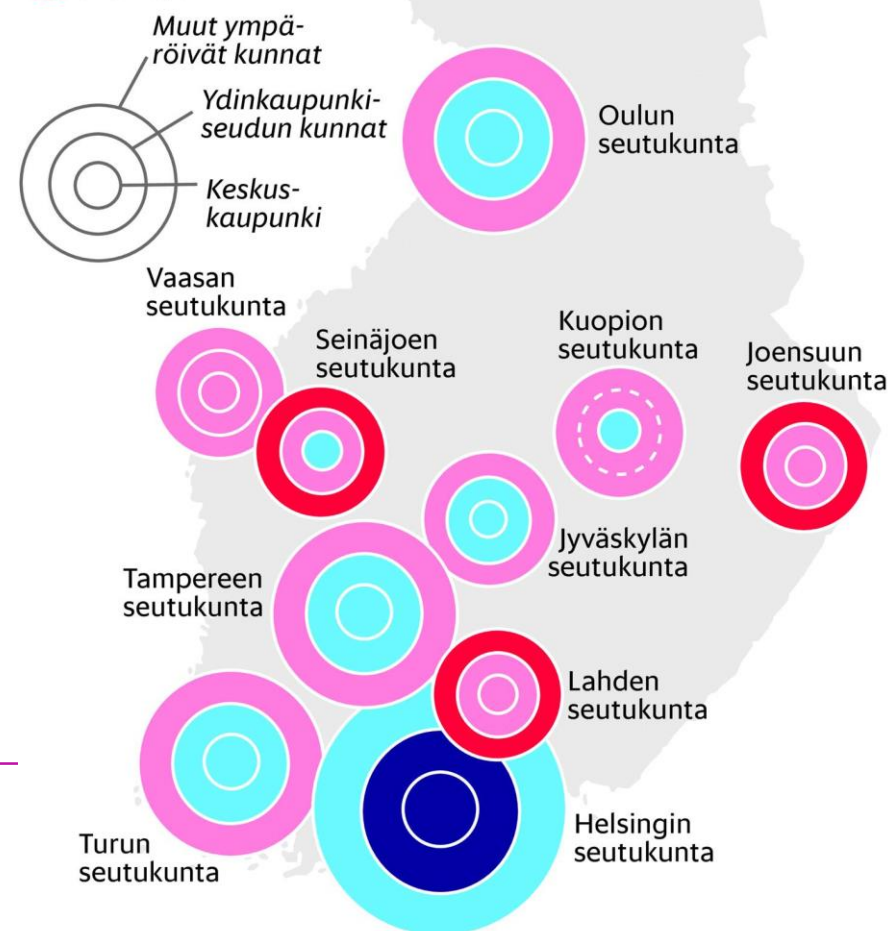
Vuonna 2040 Suomessa kasvavat lähinnä Helsingin, Tampereen ja Turun seudut

10 kaupunkiseudun väestömuutos 2040 MDI:n ennusteen mukaan

Relative
change in
population,
2017-2040,
%

Suhteellinen väestö-
muutos 2017-2040,
prosenttia

- yli 15,0
- 0,0-15,0
- -0,1...-15,0
- alle -15,0



Koonnut: JUHA-PEKKA RAESTE / HS, grafiikka: IINES VIKIÖ / HS, lähde: MDI

Säynäjoki, A., Heinonen, J. & Junnila, S. (2012). A scenario analysis of the life cycle greenhouse gas emissions of a new residential area. Environmental Research Letters.

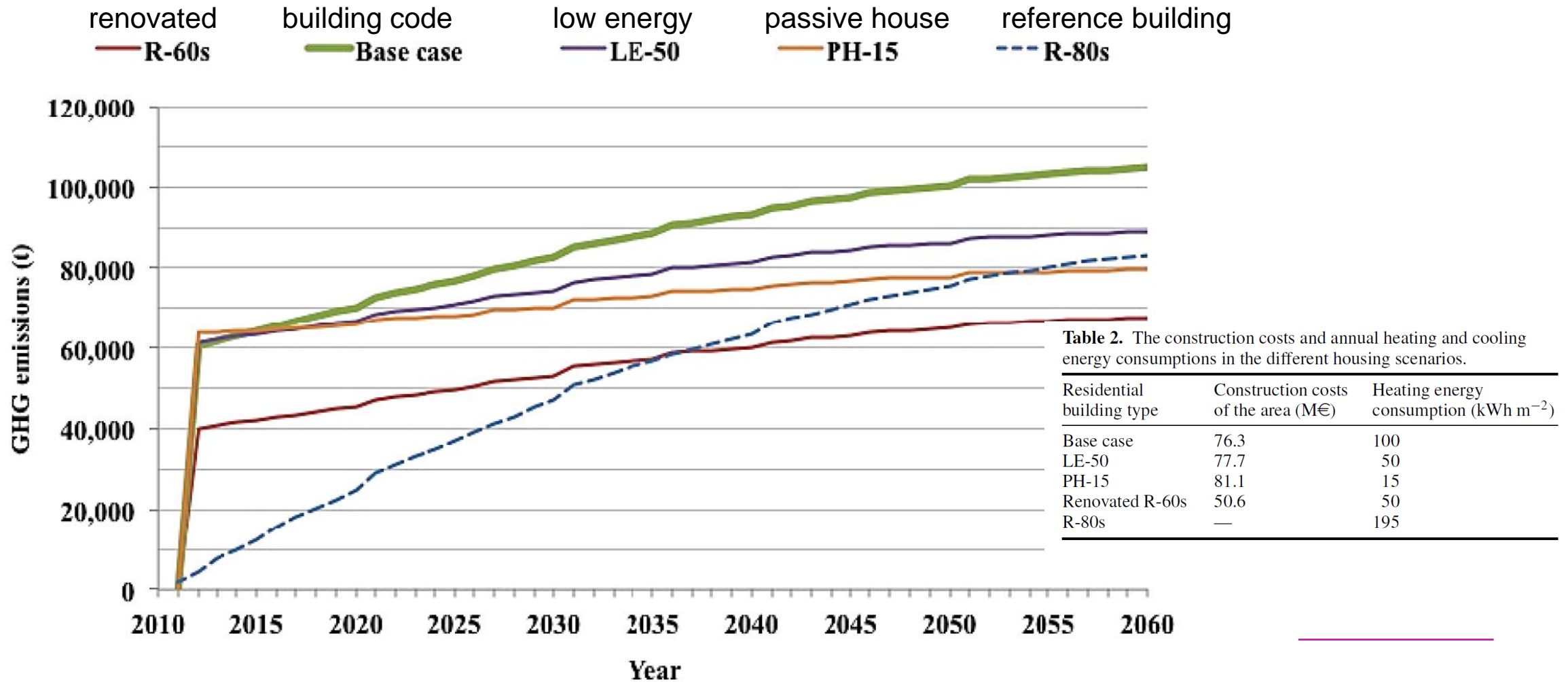


Figure 1. The cumulative GHG emissions over a 50 yr time horizon for the different housing scenarios.

Pasila

The Heart of New Helsinki





Central Pasila city model

System tray area showing system icons: a speaker icon, a network icon, a battery icon, and a clock displaying the time 14:17 and date 15.1.2018.

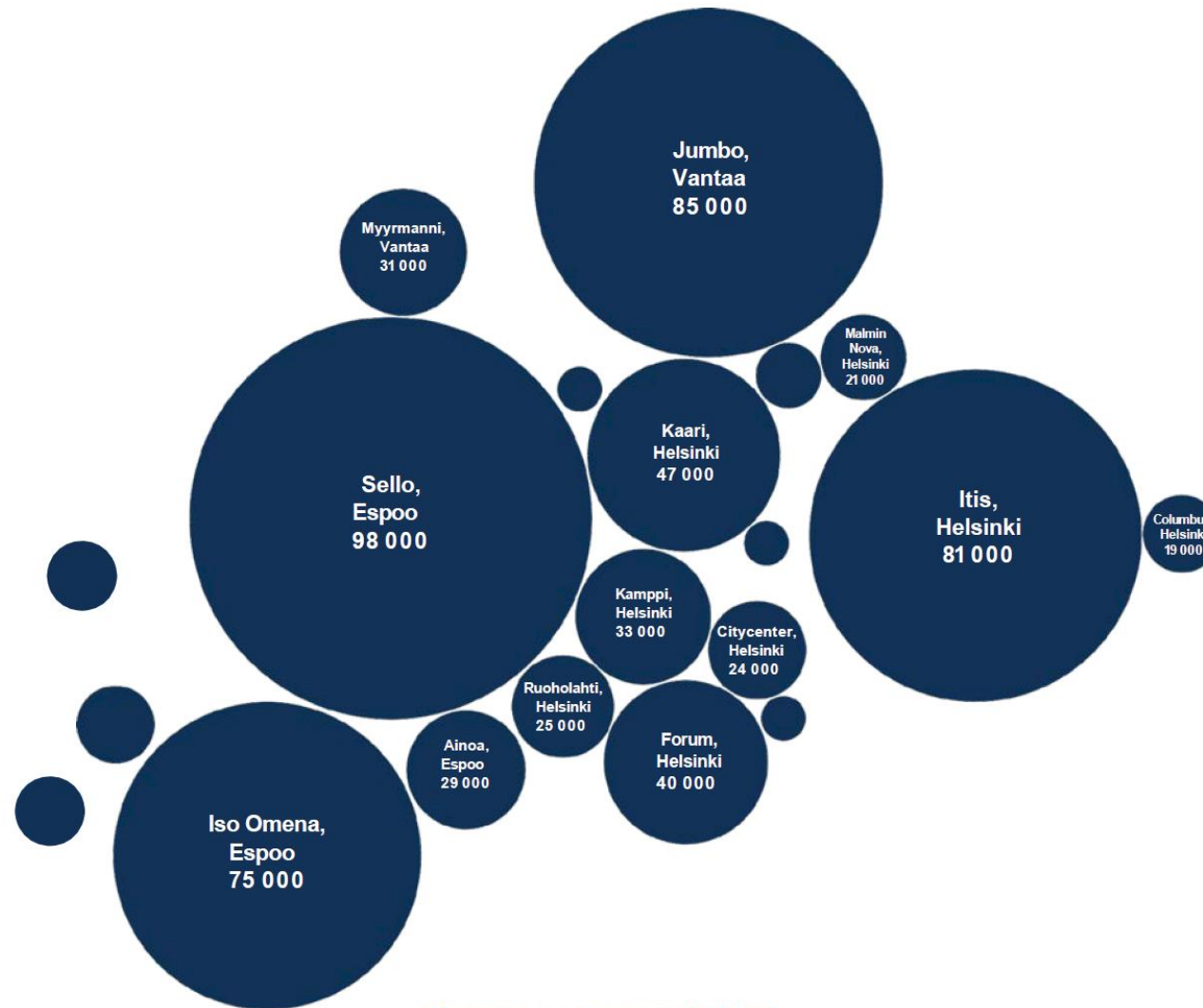
Windows taskbar showing several application icons: a globe icon, a blue square icon, a blue 'e' icon, a traffic cone icon, a green 'X' icon, and a red 'PDF' icon.

01:25



2017

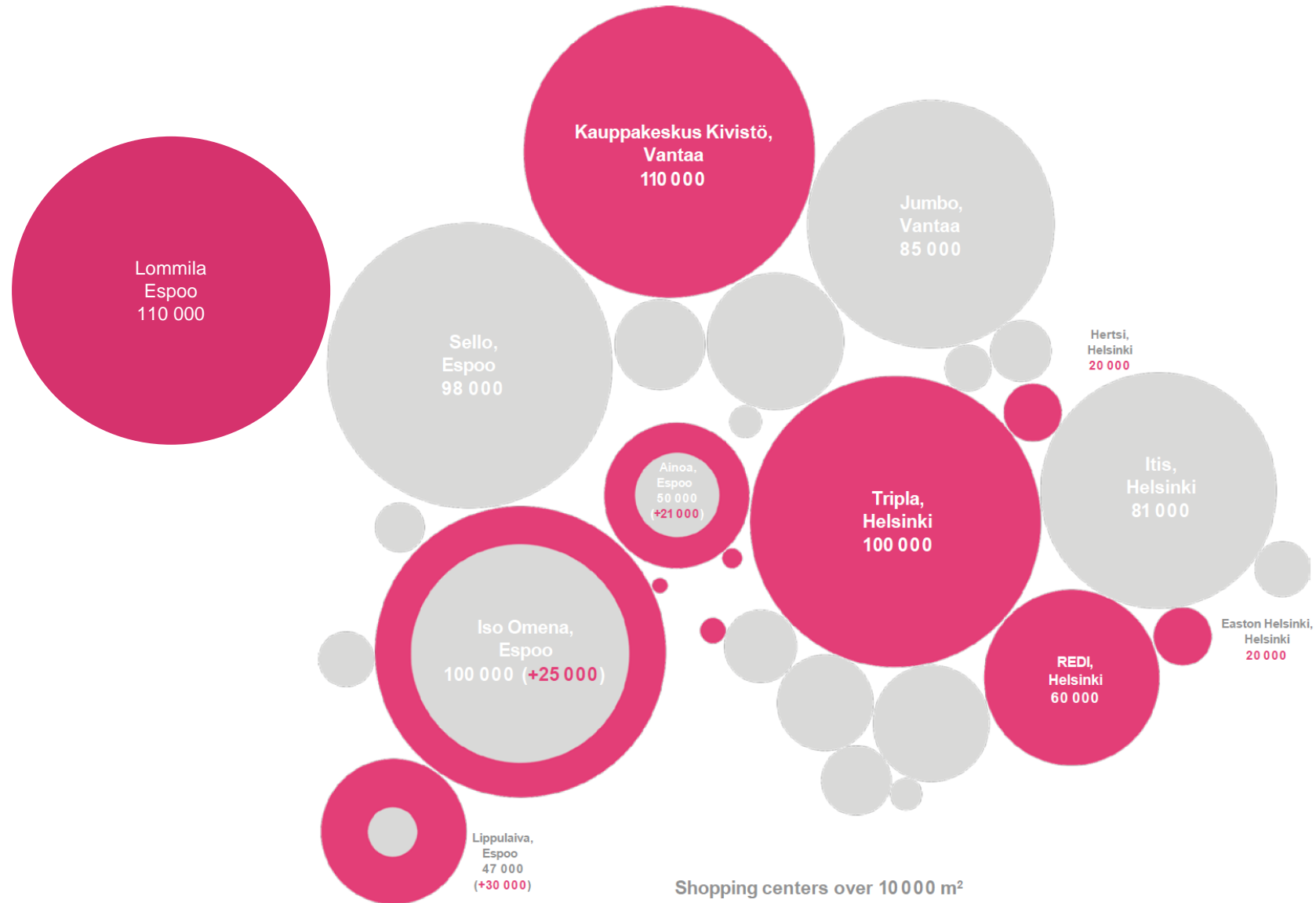
A total of 710 000 m² of retail area in malls



Shopping centers over 10 000 m²
in the Helsinki metropolitan area
(Leasable Retail Area, m²)

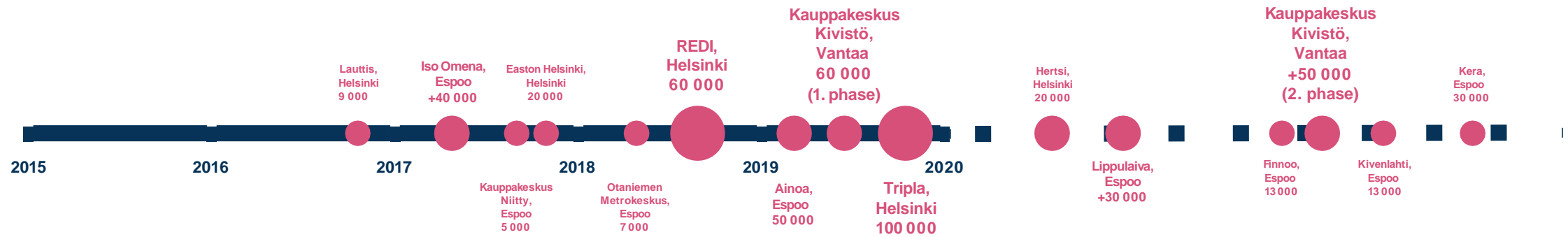
2030

Additional 445 000 m² of retail area in 13 years (+63%)



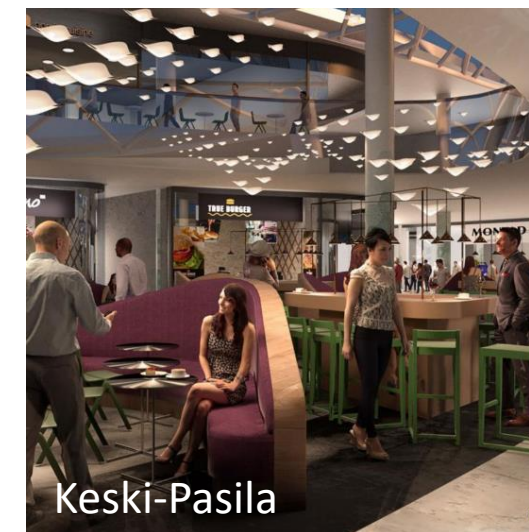
Shopping centers over 10 000 m²
in the Helsinki metropolitan area
(Leasable Retail Area, m²)

TIMELINE



Leasable Retail Area, m²

FUTURE LOCAL CENTERS





SO, WHAT IS YOUR VISION FOR FUTURE CITIES?