GEOSPATIAL WORLD FORUM

Land Information Systems for Smart Cities
8 and 9 May 2014
Centre International de Conférences Genève

R34

Nikolai Bobylev, PhD

Addressing urban disaster risks via a combination of responsible land use and critical infrastructure management

Towards sustainable, liveable, smart, climate- neutral, resilient……cities

E-mail: *nikolaibobylev@gmail.com*

United Nations Economic Commission for Europe

COMMITTEE ON HOUSING AND LAND MANAGEMENT

UNIVERSITY OF BIRMINGHAM

MARIE CURIE ACTIONS

PEOPLE

Overview

- MDGs and cities‘,
- Urbanisation, land use and land cover change,
- Cities' dynamics in the UNECE region,
- Urban disaster risks,
- Critical Infrastructure state-of-the-art and global trends,
- Examples of managing/mitigating urban disaster risks: land use and critical infrastructure,

-Solutions & policy: smart, density, planning, infrastructure, lifestyles, futures?

MDGs and Post-2015 Development Agenda

UN Millennium Development Goals

Goal 7: Ensure environmental sustainability

Target 9: Integrate the principles of sustainable development into country policies and programs and reverse the loss of environmental resources

Post-2015 Development Agenda

New Goal: Address Global Environmental Change

New Goal: Ensure sustainable Urbanization

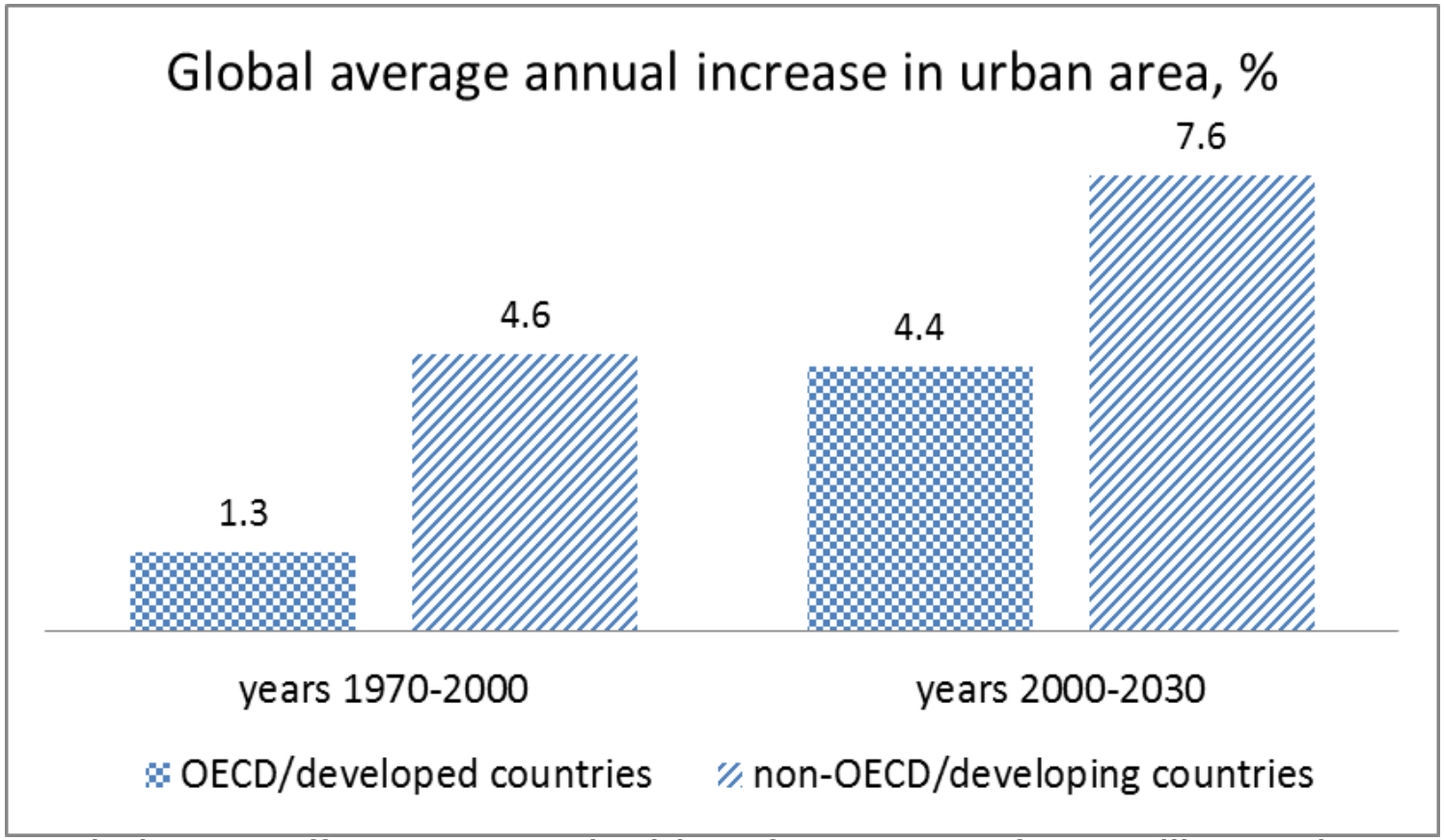
A Target : Create liveable human settlements

A Target : Preserve natural landscapes and ecosystems (as much as possible)

Global Environmental Change: land use

Climate + urbanization+ biodiversity…..

Facts = Land cover change!



source: Bobylev & Jefferson, Sustainable Infrastructure for Resilient Urban Environments (SIRUE) 2012 – 2015

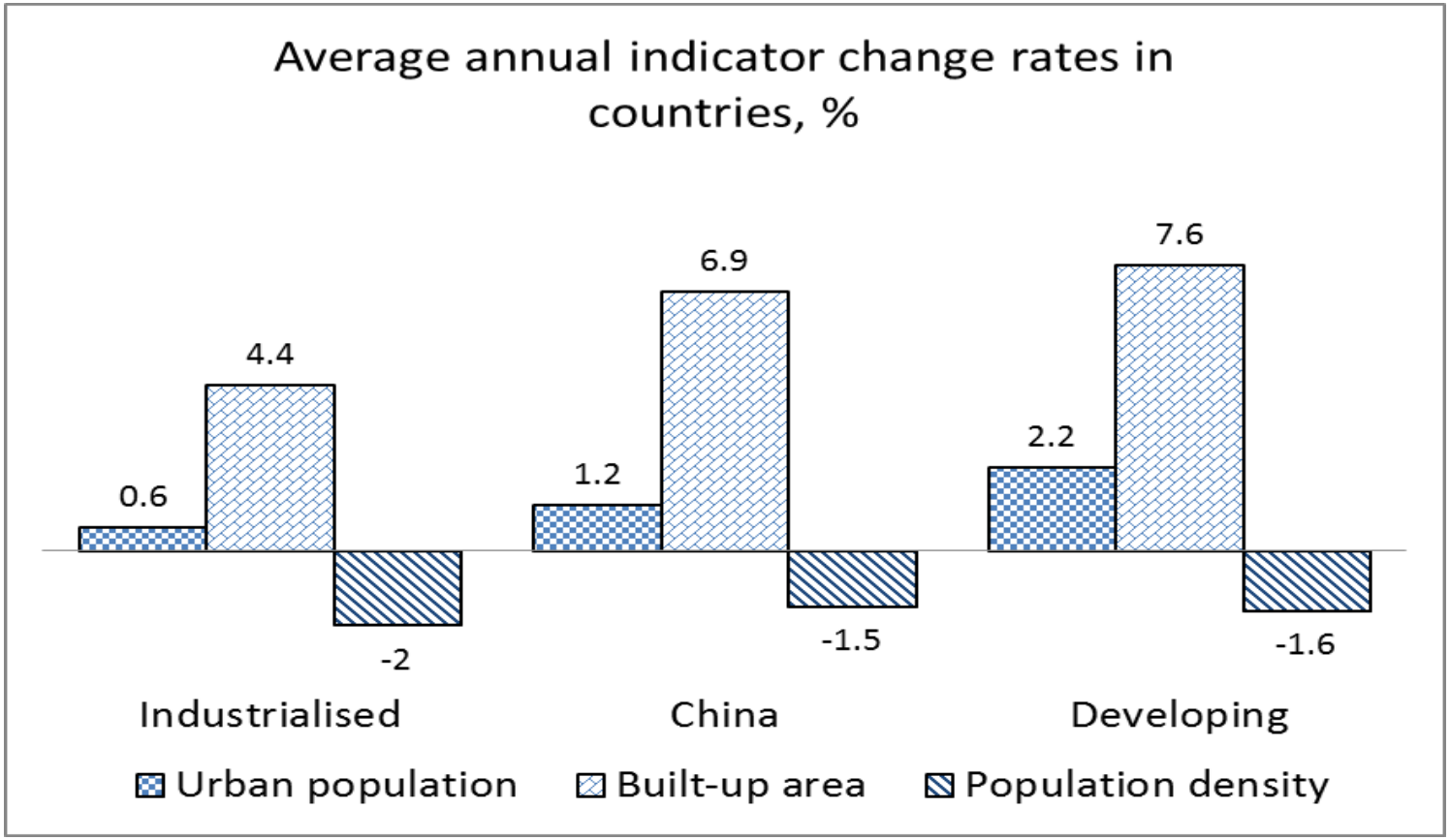
Data: Goldewijk K. and Van Drecht G., 2006; OECD 2008, Angel et al, 2005

*tolerances: built-up area equals urban area; OECD countries equals developed equals industrialised countries.

Global Environmental Change: land use

Climate + urbanization+ biodiversity…..

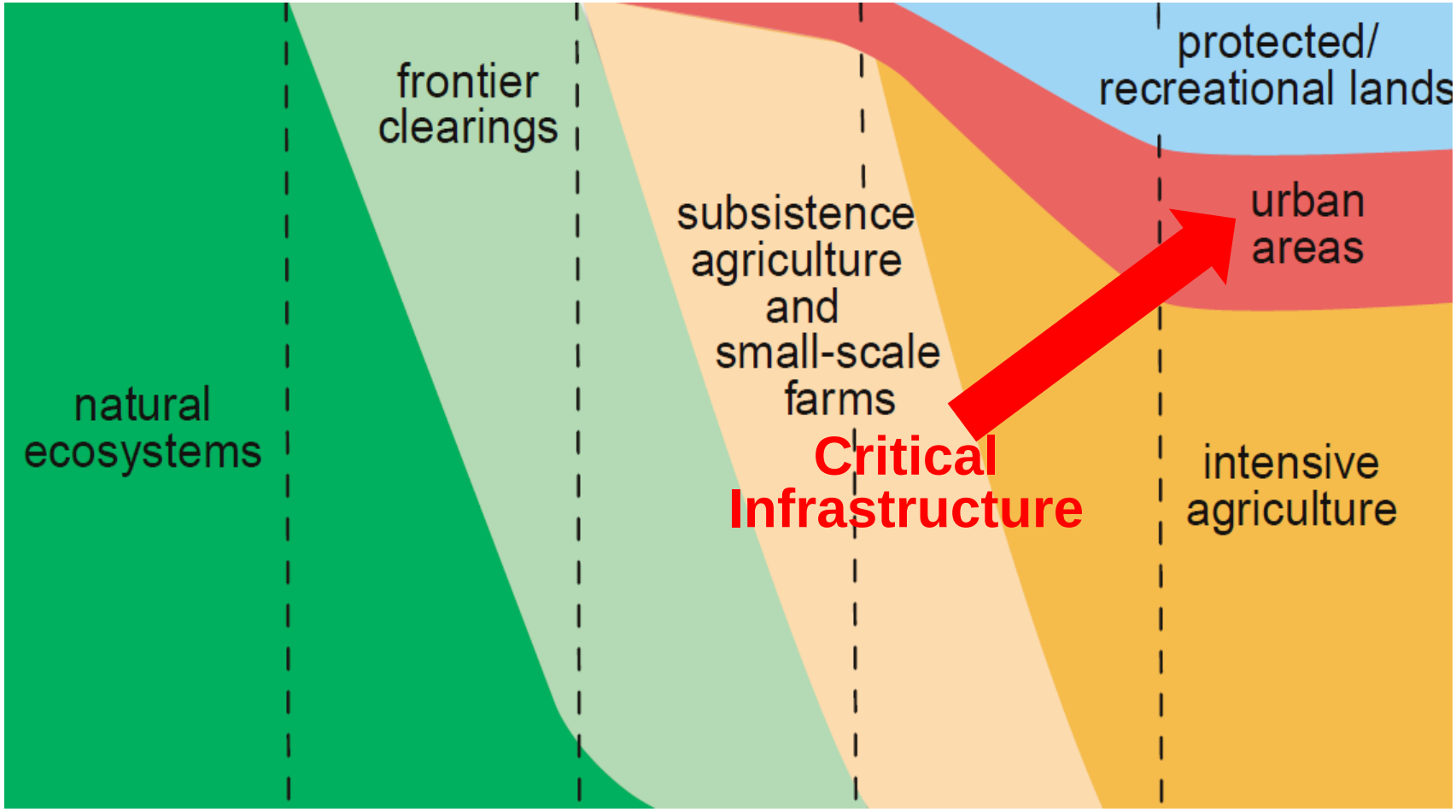
Policy = Urban sprawl? A Compact city?



source: Bobylev & Jefferson, Sustainable Infrastructure for Resilient Urban Environments (SIRUE) 2012 – 2015

Calculated using data from: China Urban Development Report, 2010; He et al, 2012; UN-Habitat, 2011; Angel et al, 2005; UN-Habitat, 2013. *tolerances: built-up area equals urban area, excluding major green areas and water bodies; OECD countries equals to (1) developed (2) industrialised countries; data for China is for the years 2000 - 2009, data for the urban population is for the years 2010 - 2020, data for urban population density is for the years 1990 – 2000, the rest data is for 2000-2030.

Land-use transitions

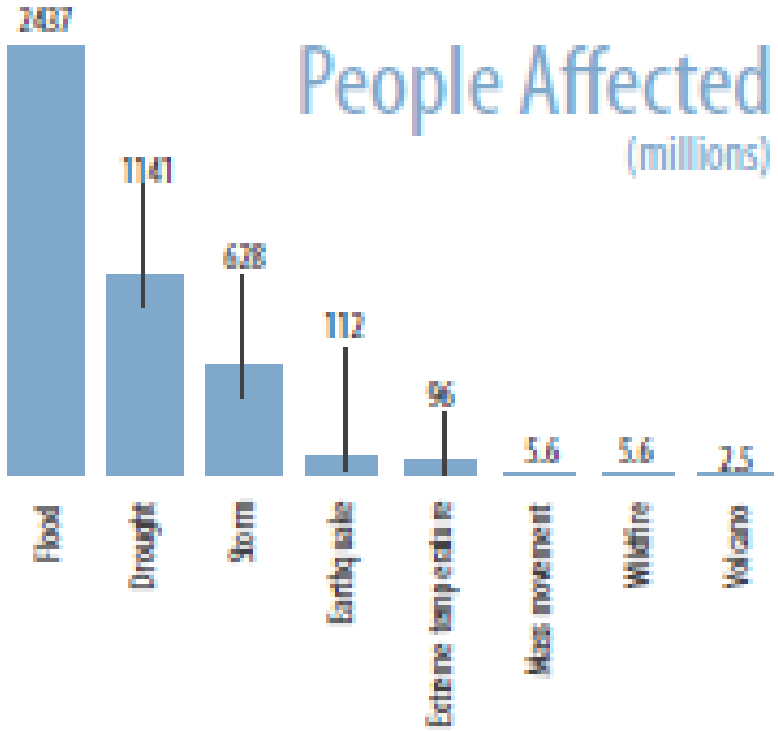


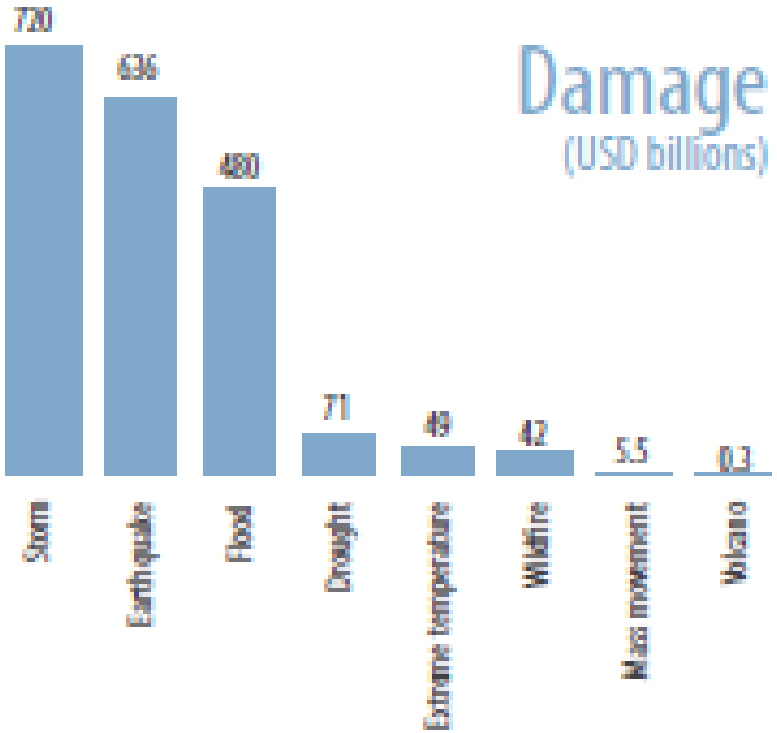
source: DeFries et al 2004

A sequence of different land-use regimes that may be experienced within a given region over time: from presettlement natural vegetation to frontier clearing, then to subsistence agriculture and small-scale farms, and finally to intensive agriculture, urban areas, and protected recreational lands.

Disaster magnitude in the international context

Displaced and evacuated in the world in 2008 – 53’000





DATA SOURCES: http://www.unisdr.org December 2012; EM-DAT - http://www.emdat.be/: The OFDA/CRED International Disaster Database; UN Stats http://unstats.un.org; OECD - http://stats.oecd.org

Urban Critical Infrastructure

Definitions:

Urban Physical Infrastructure (UPI)

- a set of artificial structures interconnected physically or functionally (Bobylev, 2007).

UPI includes physical objects like roads, bridges, sewerage, flood protection schemes, energy networks;

UPI is one of the major assets of a city in terms of **capital investment** and **critical services** provisioning.

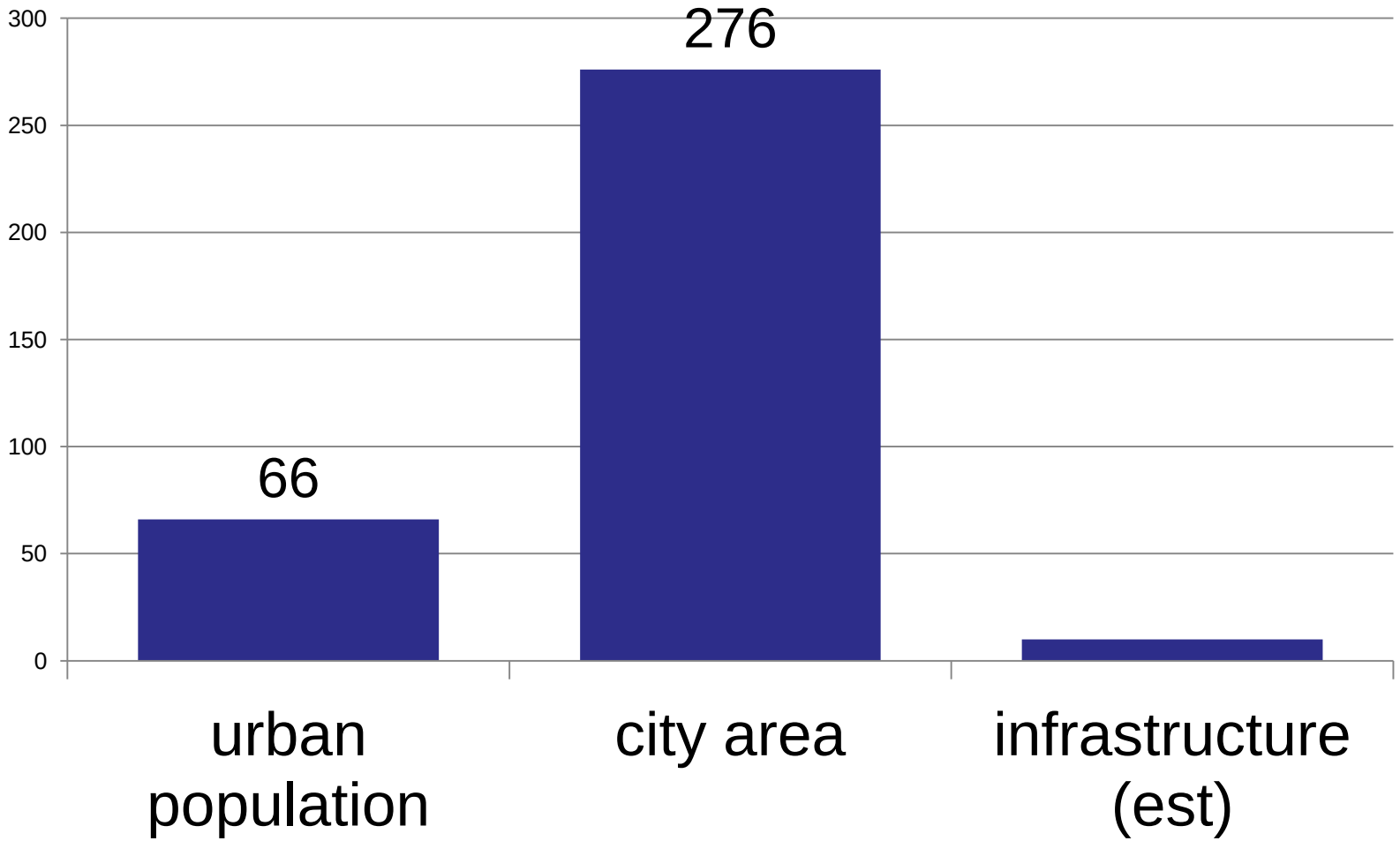
Critical Infrastructure (CI)

- the Infrastructure, upon which city functionality, as a system, depends on uninterrupted provision of its services (or UPI elements) (Bobylev, 2013).

Global [Urban Physical] Infrastructure Challenges – not enough, not catching up with development

Global growth by 2030, %

data sources: population (UN, 2007); area (Angel et al, 2005); infrastructure (OECD, 2006)



Urban Physical Infrastructure & global change

Outlook: UPI characteristics and factors of global change

UPI characteristic	*Evolution associated with* ***urbanization***	*Evolution a w* ***adaptation to climate change***	*Opportunities for* ***climate change mitigation***
Interdependence	↑	↓	-
Convergence	⇧	⇧	Can save resources such as energy
Critical facilities	-	⇧	None
Vulnerability	↑	↑	-
Sustainability	↑	↓	Sustainable, well planned infrastructure can help to mitigate climate change

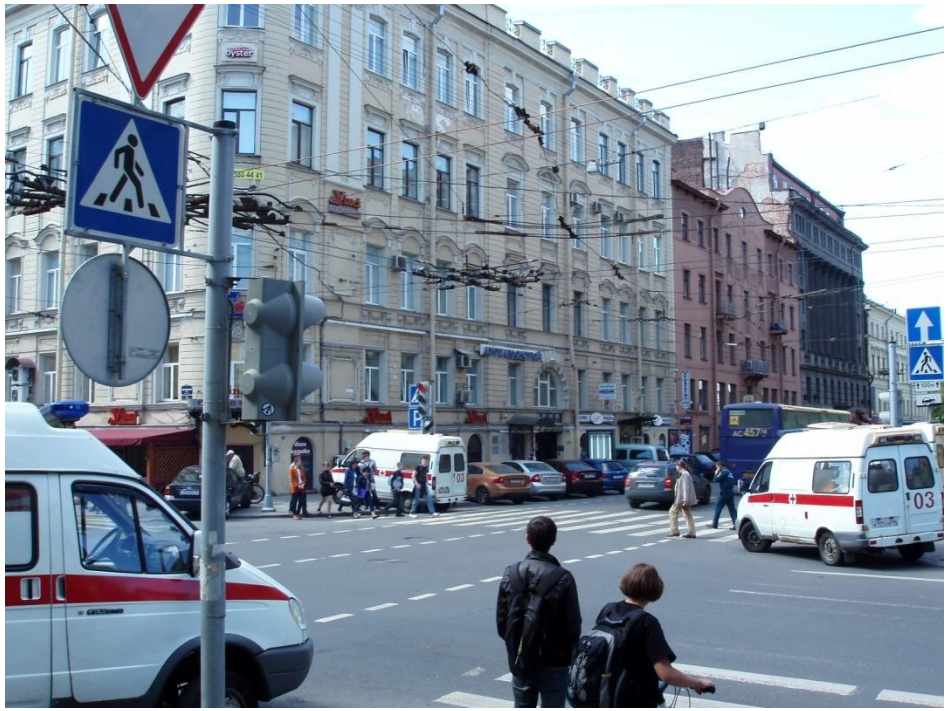
Example 2

- Emergency response Infrastructure planning

critical infrastructure

Lack of critical infrastructure – deficiencies in provisioning of urban services

Example: lack of emergency response infrastructure in London and Saint Petersburg



Example 3

- Irresponsible land management, no critical infrastructure

<u>Russia wildfire summer 2010 crisis:</u>

22 July – 30 August 2010

Total area burned 6 mil. ha (Belgium x2)

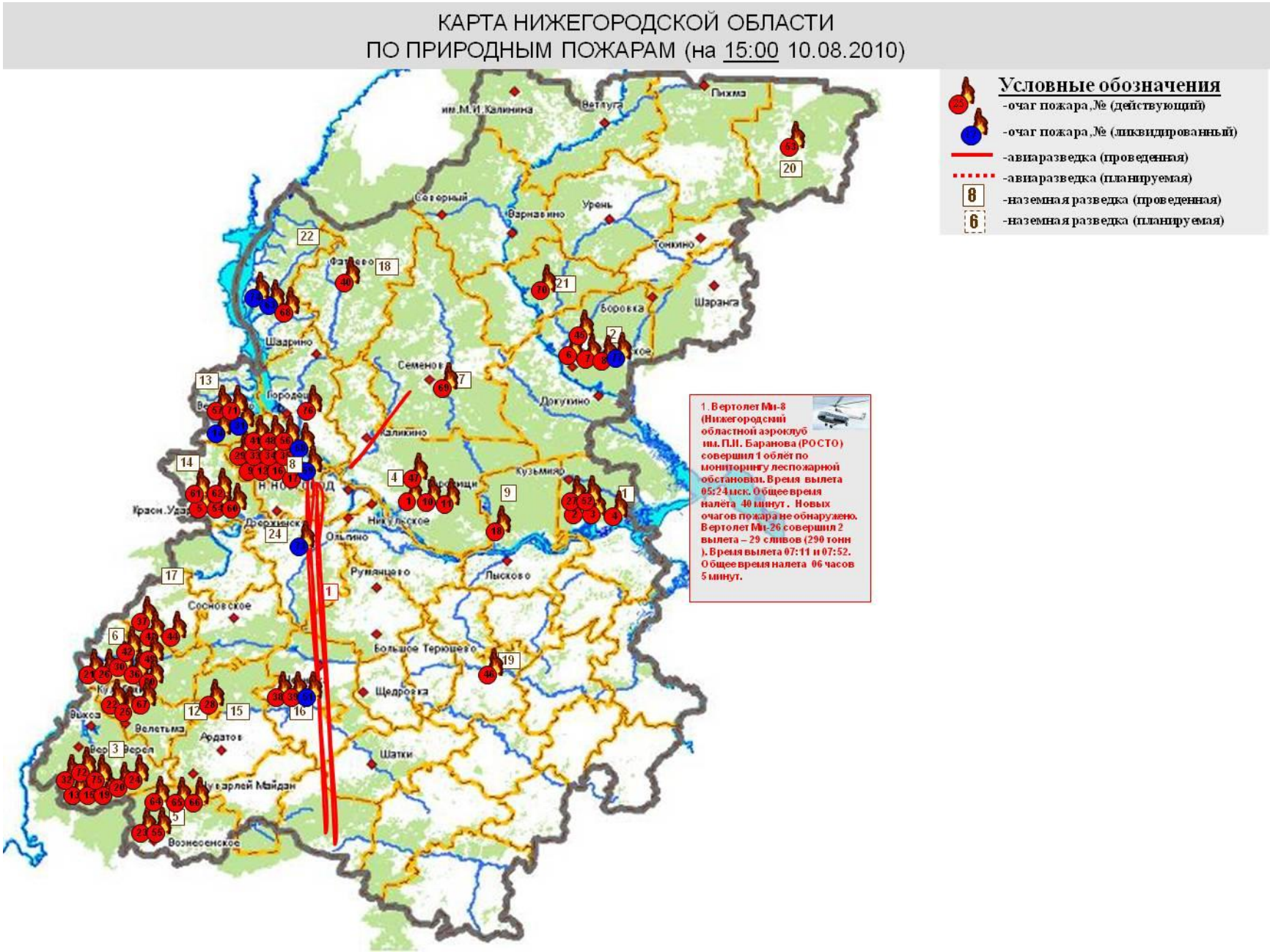
199 human settlements in 19 regions affected

3591 families homeless, or 7237 persons

1799 persons needed medical attention

62 persons died

A map of wildfires in Nizegorodsky region on August 10, 2010



Mitigating urban disaster risks: land use and critical infrastructure

Findings (Bobylev, 2010):

-Natural disasters advance urbanization. Yes.
-More disasters – more urban the world is going to be; even more rapid urbanization than estimations?
-Equity, fairness, human rights???

Photo credits: Alexey SAZONOV/AFP/Getty Images. Images taken near Voronezh on August 1, 2010.

Mitigating urban disaster risks: land use and critical infrastructure

A charred car sits near destroyed buildings in the village of Mokhovoe Russia on Friday, July 30, 2010. (AP Photo/Dmitry Chistoprudov)

Mitigating urban disaster risks: land use and critical infrastructure

Example 4

- Solutions:
- A - Strengthening resiliency of critical infrastructure (huge investments, is magnitude of a challenge compatible with resources?)
- B – Ecosystem services and infrastructure (combination of services delivery) [another dimension of “Smart”]

Ecosystem and Infrastructure services

- Ecosystems exclusively (in the past)
- Ecosystems and Infrastructure (at present)

In the Future:

- Infrastructure?
- Infrastructure and engineered ecosystems?

- Ecosystem- a set of interacting species and their local, non-biological environment functioning together to sustain life (Odum, 1971, Moll and Petit, 1994)
- Infrastructure - a set of artificial structures, interconnected physically or functionally

Ecosystem and infrastructure services consumption trends (major consumption)

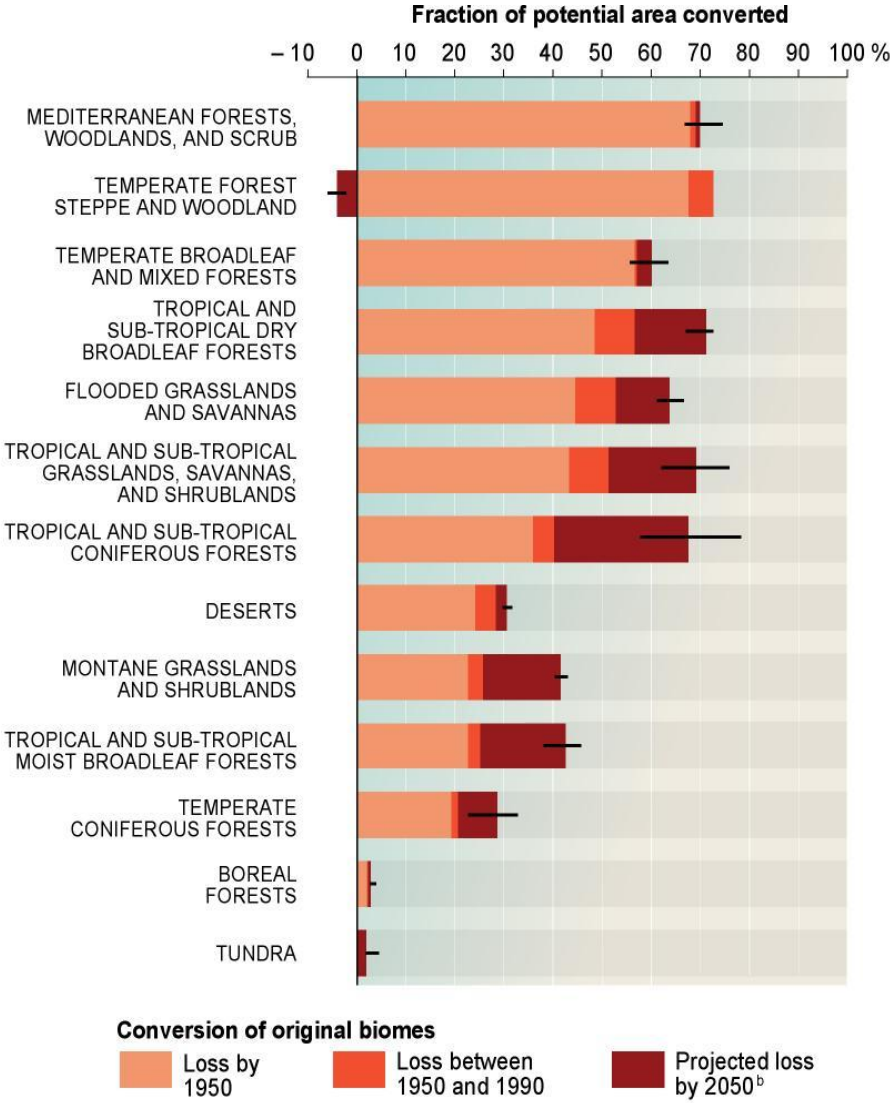
Service to human welfare	*Rural areas developed countries*	*Urban areas developing countries*	*Urban areas developed countries*
Clean air to breath	E	E	E
Comfortable climate conditions	E	E	E
Water level in water bodies (for shipping, amenity, biota)	E	E	E I
Groundwater level	E	E I	E I
Water quality to use as amenity and recreation	E	E	E
Drinking water provision	I	I	I
Soil formation	E I	E	I
Waste decomposition	E	E I	I
Biological populations control	E	E I	I
Habitat	E	E I	I
Food	I	I	I
Raw materials	E	I	I
Recreation and outdoor activities	E	E I	E I

Ecosystem and infrastructure services consumption trends (all consumption options)

Service to human welfare	*Rural areas developed countries*	*Urban areas developing countries*	*Urban areas developed countries*
Clean air to breath	E	E	E
Comfortable climate conditions	E	E	EI
Water level in water bodies (for shipping, amenity, biota)	E	EI	EI
Groundwater level	E	EI	EI
Water quality to use as amenity and recreation	E	E	EI
Drinking water provision	E I	E I	I
Soil formation	E I	E	I
Waste decomposition	E I	E I	I
Biological populations control	E	E I	E I
Habitat	E	E I	I
Food	E I	I	I
Raw materials	E	I	I
Recreation and outdoor activities	E	E I	E I

Unprecedented change: Ecosystems

- 5-10% of the area of five biomes was converted between 1950 and 1990
- More than two thirds of the area of two biomes and more than half of the area of four others had been converted by 1990



Milliennium Ecosystem Assessment
http://www.millenniumassessment.org

Ecosystem and Infrastructure services: 2 trends

- Main trend - substitution of ecosystem services by infrastructure services
- Minor reverse trend - infrastructure failings to provide services of a needed quality and quantity at a reasonable expense prompt going back and make ecosystems to provide these services
- Infrastructure-Ecosystems solutions: Compressed in space and **intensive delivery** – **requires rigorous data analysis, geospatial data, smart approaches**.

Example 5

- Floods (urban+) management

- Expensive solutions anyway,
- A challenge: can we optimize by using smart approaches?

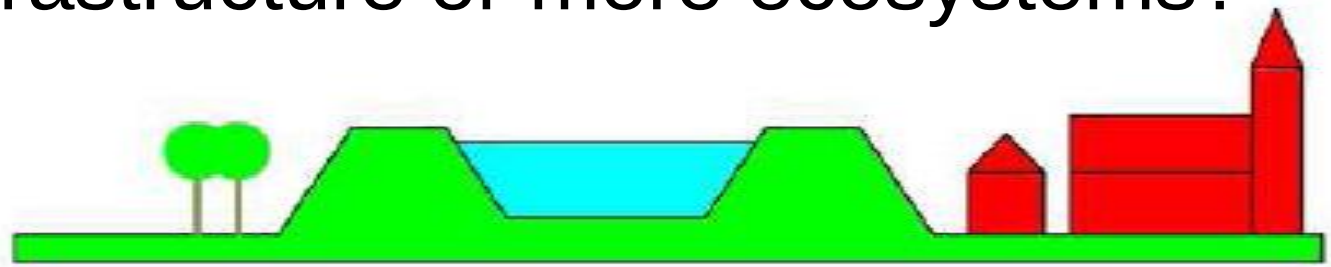
The Netherlands:
combating floods using retention areas

(after Ron Cörvers (Open University of the Netherlands / Maastricht University – ICIS) presentation, 2008)

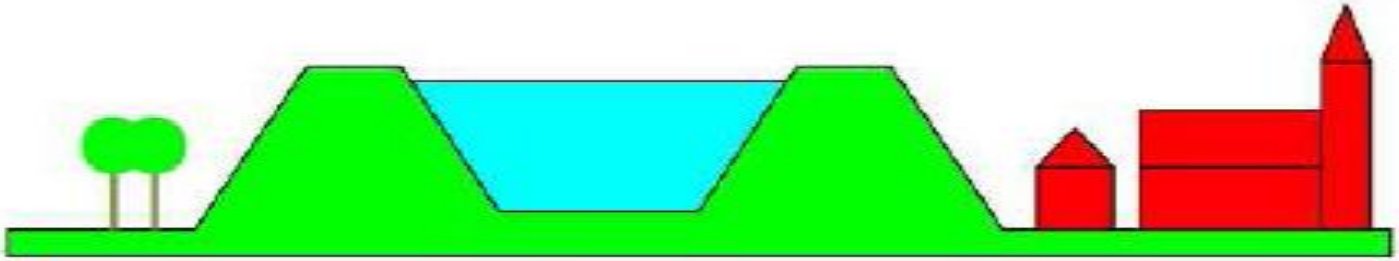
1993 & 1995 extremely high waters in river delta (flow rate >12,000 m3/s at Lobith on the Rhine).

More infrastructure or more ecosystems?

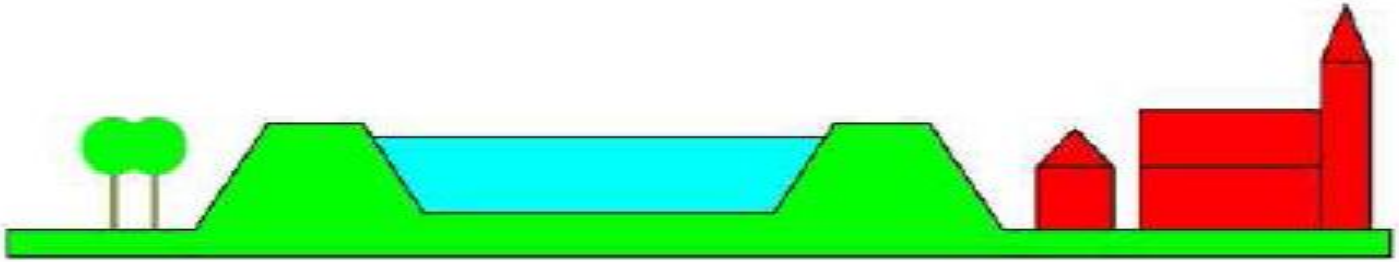
Current situation



Traditional solution



New approach



Spatial planning in the Netherlands: nature development

(after Ron Cörvers (Open University of the Netherlands / Maastricht University – ICIS) presentation, 2008)

Example 6

- Land use & Infrastructure risk mitigation response options: surface run off
- Expensive+smart? Can it make a difference?
- Opt for conventional sustainability approaches to land use?

Excessive surface run off management

Critical infrastructure: G-Cans, Tokyo is an underground infrastructure for prevention of flooding during rainy season
Source: G-Cans project, Tokyo (http://www.g-cans.jp/)

Example 7

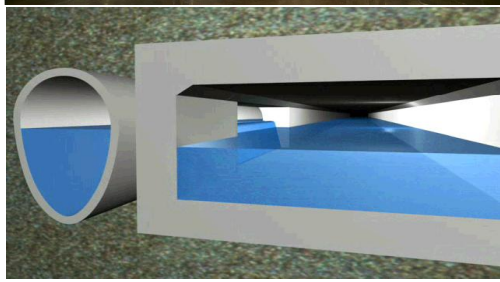
- Smart city solutions and integrated (physical and institutional infrastructure) management

Smart Cities:
A technology or policy led development?

An example: Addressing vulnerabilities to climate change

A problem of urban water runoff after heavy rain (incl. flash floods)

- Flooding and inundation
- Untreated water discharge into surface water bodies;
- Infrastructure damage;
- Disruption if critical (vital) urban services



Conventional solutions:

- Reduce runoff (trees, green zones);
- Increase capacity of drainage infrastructure.

Smart city solutions:

- Manage runoff between city areas (valves, barriers, automated water management (smart grids)).
- Inform citizens to temporary cut domestic water use (e.g. for one-two hours).

Conclusions & Policy Summary

<u>Addressing urban disaster risks via a combination of responsible land use and critical infrastructure management</u>

The risks (natural (weather); manmade (complexity)) are increasing

Both are extremely important: land use (ecosystems) + infrastructure.

Key policies:

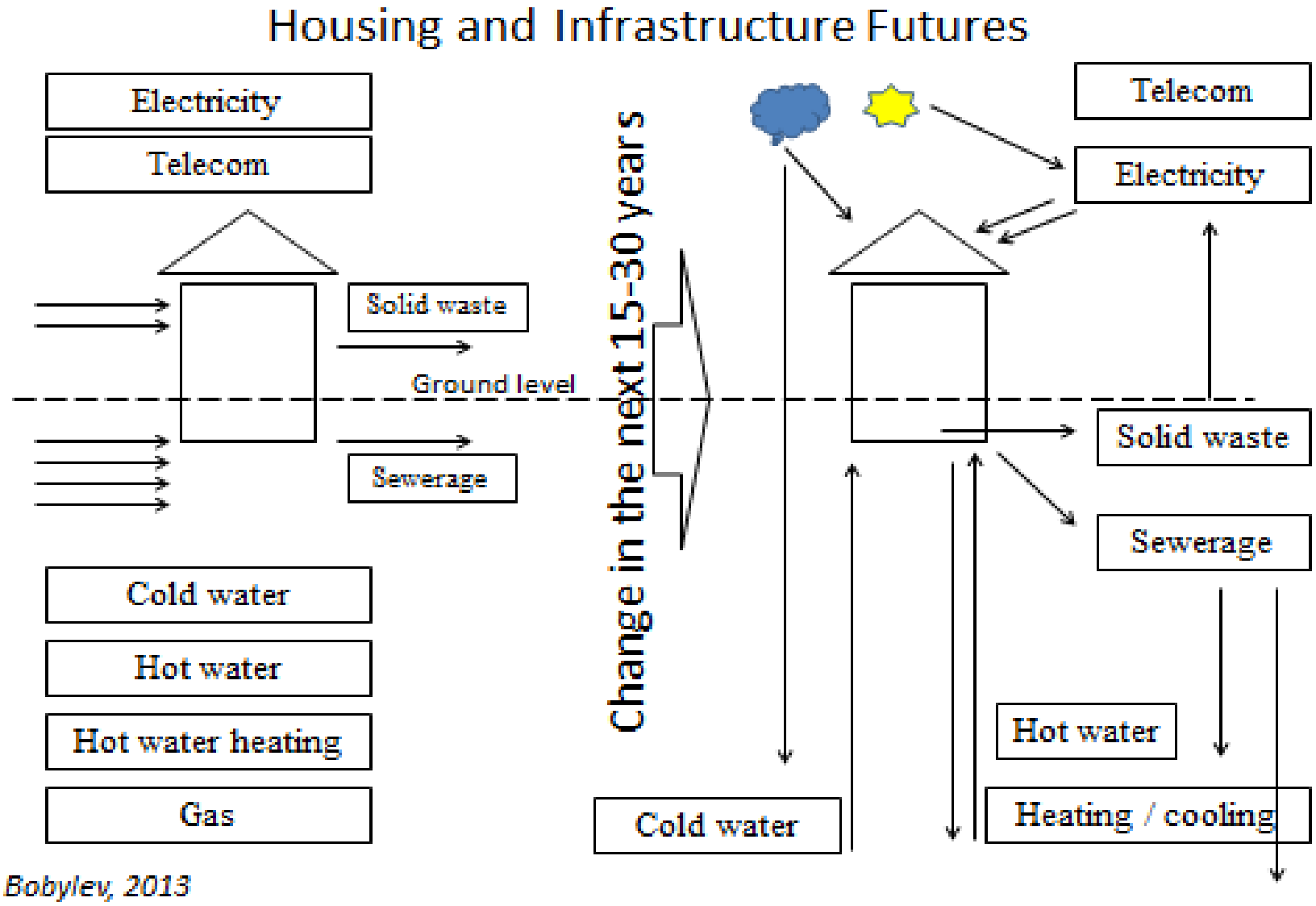
-Global Environmental Change & Quality of Life

-Urban density and efficiency

-Planning!!!, land use & infrastructure, 3D planning,

-Targets and indicators – urban data!!! (UN, WB)

Next: Urban Innovations:
land use and critical infrastructure management



Housing support infrastructure development trends (from Bobylev, upcoming)

references

Projects:

Bobylev & Jefferson: Sustainable Infrastructure for Resilient Urban Environments (SIRUE) 2012 – 2015. European Comission FP7 PIIF-GA-2010-273861 http://cordis.europa.eu/projects/rcn/100003_en.html

Bobylev & Parriaux: SNSF Scientific &Technological Cooperation Programme Switzerland-Russia, Ecole polytechnique fédérale de Lausanne, 2011.

Publications:

Bobylev N, Hunt DVL, Jefferson I, Rogers CDF, (2013) Sustainable Infrastructure for Resilient Urban Environments. Published by Research Publishing. pp. 906 – 917.

Bobylev, N (2013) Urban physical infrastructure adaptation to climate change. In: J.B. Saulnier and M.D. Varella (eds.), Global Change, Energy Issues and Regulation Policies, Springer.

Sterling, R., Admiraal, H., Bobylev, N., Parker, H., Godard, J.P., Vähäaho, I., Rogers, C.D.F., Shi, X., Hanamura T. (2012) Sustainability Issues for Underground Space in Urban Areas. *Proceedings of the ICE - Urban Design and Planning*, 32p. DOI: 10.1680/udap.10.00020

Bobylev, Nikolai (2009) Mainstreaming Sustainable Development into a City's Master Plan: a Case of Urban Underground Space Use. Land Use Policy, Elsevier.

Photo credits:

Nikolai Bobylev;

Berliner Wasserbetriebe and Berlin Institute of Technology;

G-Cans, Tokyo (http://www.g-cans.jp/).

Thank you for your attention!

E-mail: nikolaibobylev@gmail.com