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DANIELE VETTORATO

Sustainable Energy Planning in Cities

Rotterdam, IHS, 22 June 2018

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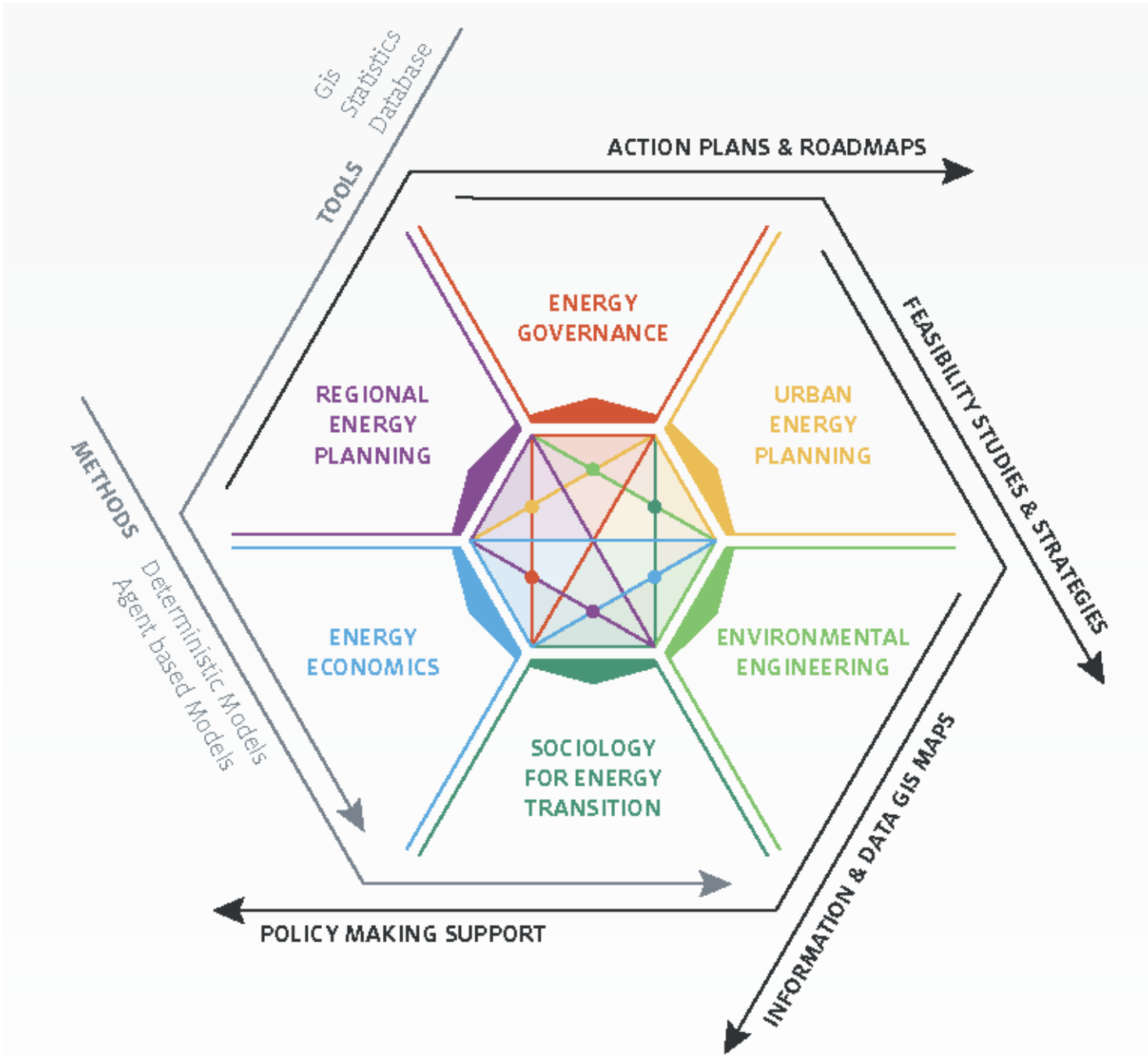
Renewable Energies

eurac research



eurac research

- Member of the board of Directors
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UN HABITAT
FOR A BETTER URBAN FUTURE

UN environment

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CTCN
CLIMATE TECHNOLOGY CENTRE & NETWORK

CONNECTING COUNTRIES TO CLIMATE TECHNOLOGY SOLUTIONS

UN environment UNIDO

TECHNICAL ASSISTANCE NETWORK CAPACITY BUILDING COUNTRIES TECHNOLOGY SECTORS NEWS & MULTIMEDIA CALENDAR SEARCH

Technical Assistance requests
Request visualizations
Submit a request

Technical Assistance

The CTCN provides technical assistance in response to requests submitted by developing countries via their nationally-selected focal points, or National Designated Entities (NDEs). Upon receipt of such requests, the Centre quickly mobilizes its global Network of climate technology experts to design and deliver a customized solution tailored to local needs. The CTCN does not provide funding directly to countries, but instead supports the provision of technical assistance provided by experts on specific climate technology sectors.

The CTCN delivers five main types of technical support on climate technologies:

- Technical assessments, including technical expertise and recommendations related to specific technology needs, identification of technologies, technology barriers, technology efficiency, as well as piloting and deployment of technologies.
- Technical support for policy and planning documents, include strategies and policies, roadmaps and action plans, regulations and legal measures
- Trainings
- Tools and methodologies
- Implementation plans

Technical assistance on climate technologies is provided

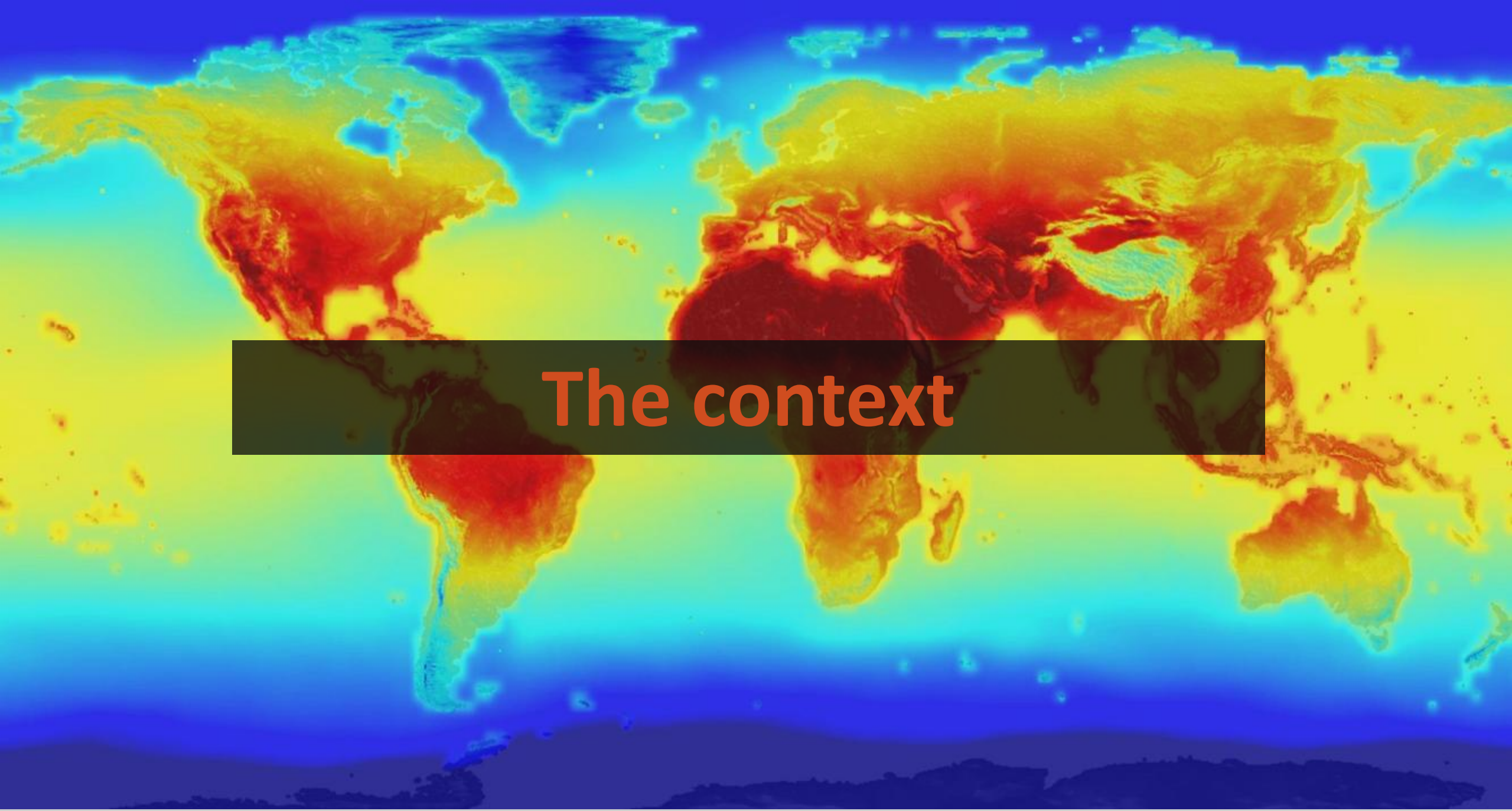
- To developing countries at the request of their NDEs
- Free of charge (with a value up to 250,000 USD)
- At local, national or regional levels
- To academic, public, NGO, or private sector entities
- For a broad range of adaptation and mitigation technologies
- At all stages of the technology cycle: from identification of climate technology needs; policy assessment; selection and piloting of technological solutions; to assistance that supports technology customization and widespread deployment

Fast Technical Assistance

In addition to the technical assistance request described above, the CTCN is providing Fast Technical Assistance (FTA) which consists of a short time response (up to 2 months) with a limited value of 15,000 USD, and referring to technology prioritisation, endogenous technologies assessment, policies and measures that are immediate priorities for the requesting country. For more information, please see the template here.

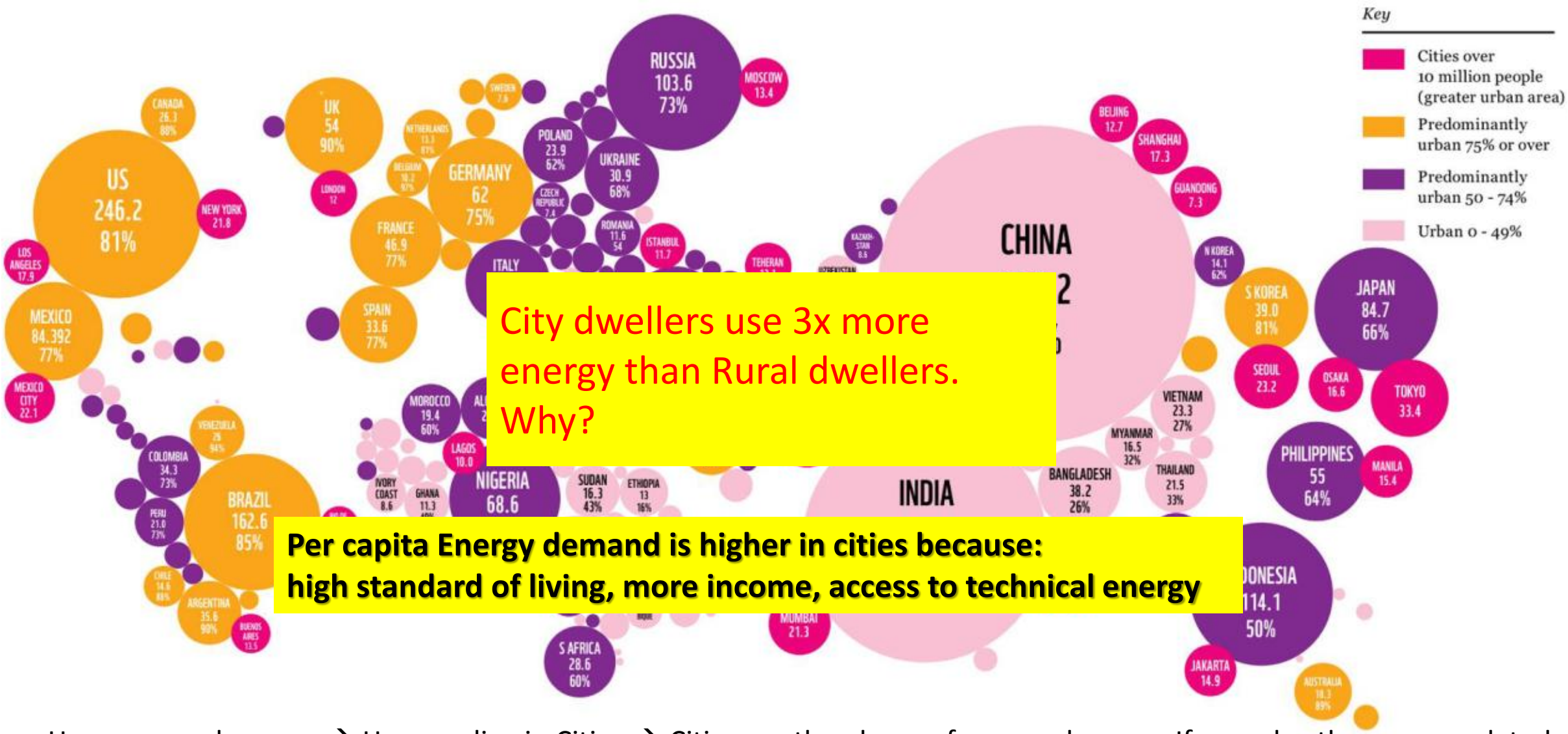
How it works

1. Academic, government, NGO and/or private sector representatives work with their National Designated Entity, the CTCN focal point selected by each country, to identify the type of technical assistance they need in order to implement their technology-related climate plans
2. The NDE conveys the request to CTCN
3. A team of climate technology experts from the CTCN, its Consortium, and Network work with the NDE to provide a solution that is tailored to the needs of the individual country

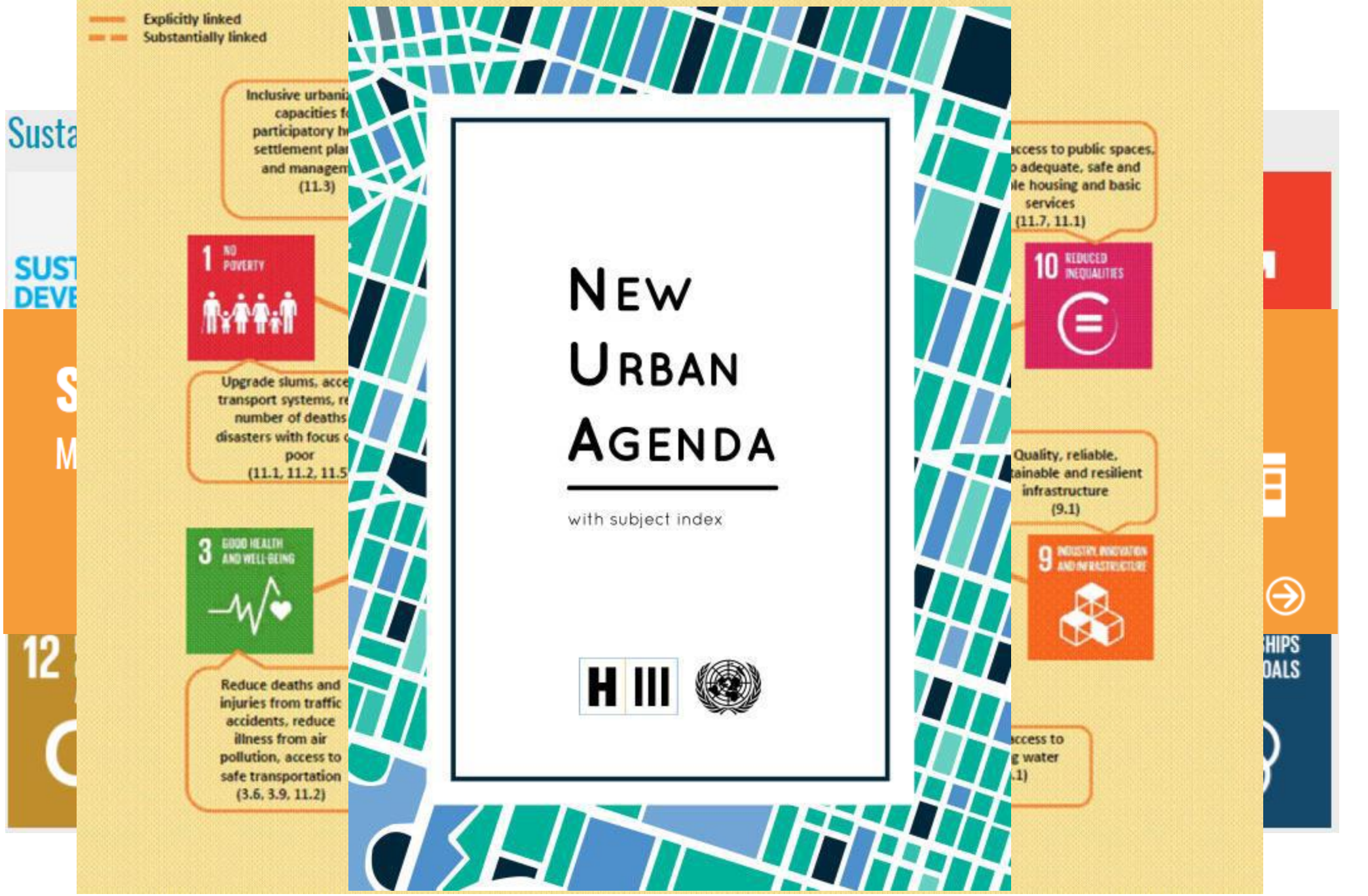


The context

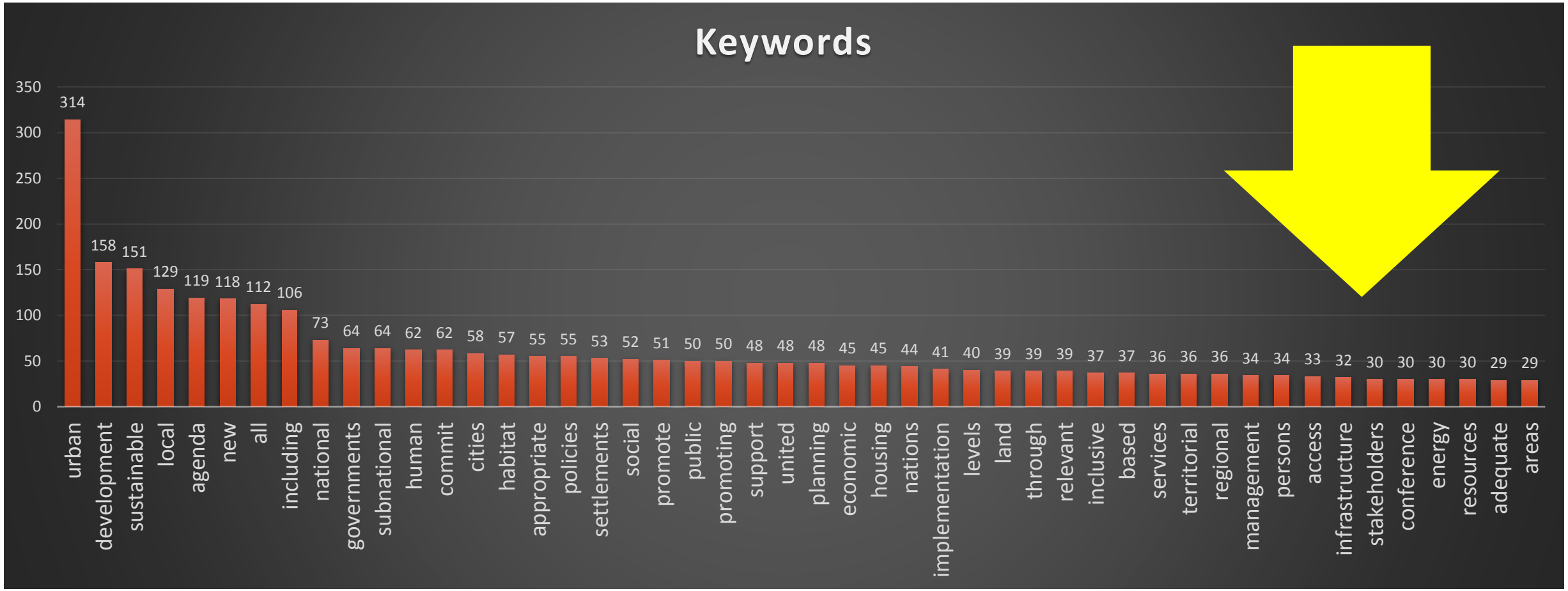
more than 50% of world population lives in cities



A. Humans need energy → Humans live in Cities → Cities are the places of energy deman = If we solve the energy related issuse in cities we solve at least half of the problem.


Explicitly linked
Substantially linked
Inclusive urbani
capacities f
participatory h
settlement pla
and managem
(11.3)
1 NO POVERTY
Upgrade slums, acce
transport systems, re
number of deaths
disasters with focus
poor
(11.1, 11.2, 11.5
3 GOOD HEALTH AND WELL-BEING
Reduce deaths and
injuries from traffic
accidents, reduce
illness from air
pollution, access to
safe transportation
(3.6, 3.9, 11.2)
ccess to public spaces,
adequate, safe and
le housing and basic
services
(11.7, 11.1)
10 REDUCED INEQUALITIES
Quality, reliable,
ainable and resilient
infrastructure
(9.1)
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
ccess to
g water
.1)
NEW URBAN AGENDA
with subject index
H III

http://habitat3.org/the-new-urban-agenda/



RESOURCES EFFICIENCY

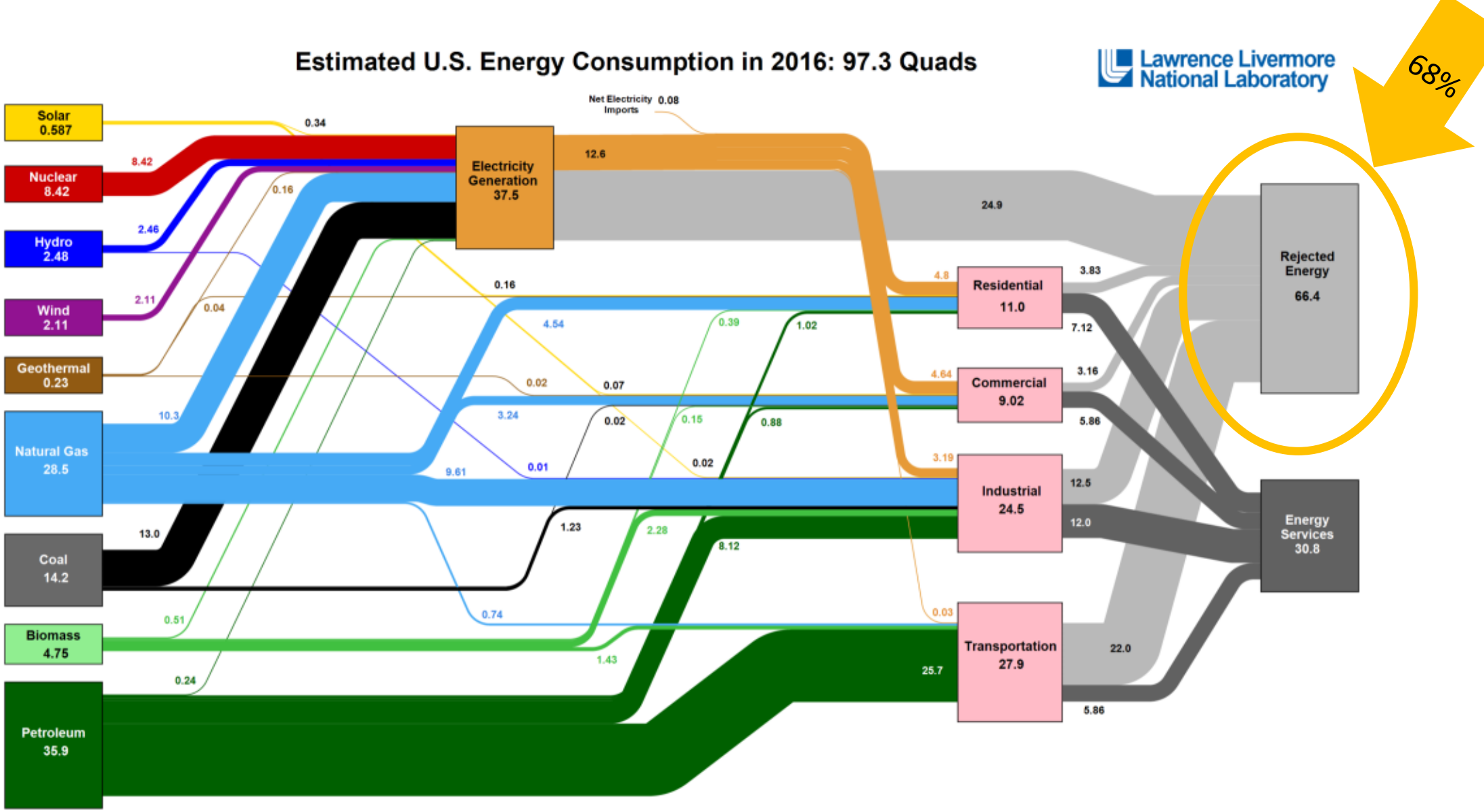
RESOURCE EFFICIENCY AS KEY ISSUE IN THE NEW URBAN AGENDA

Advancing sustainable consumption and production in cities

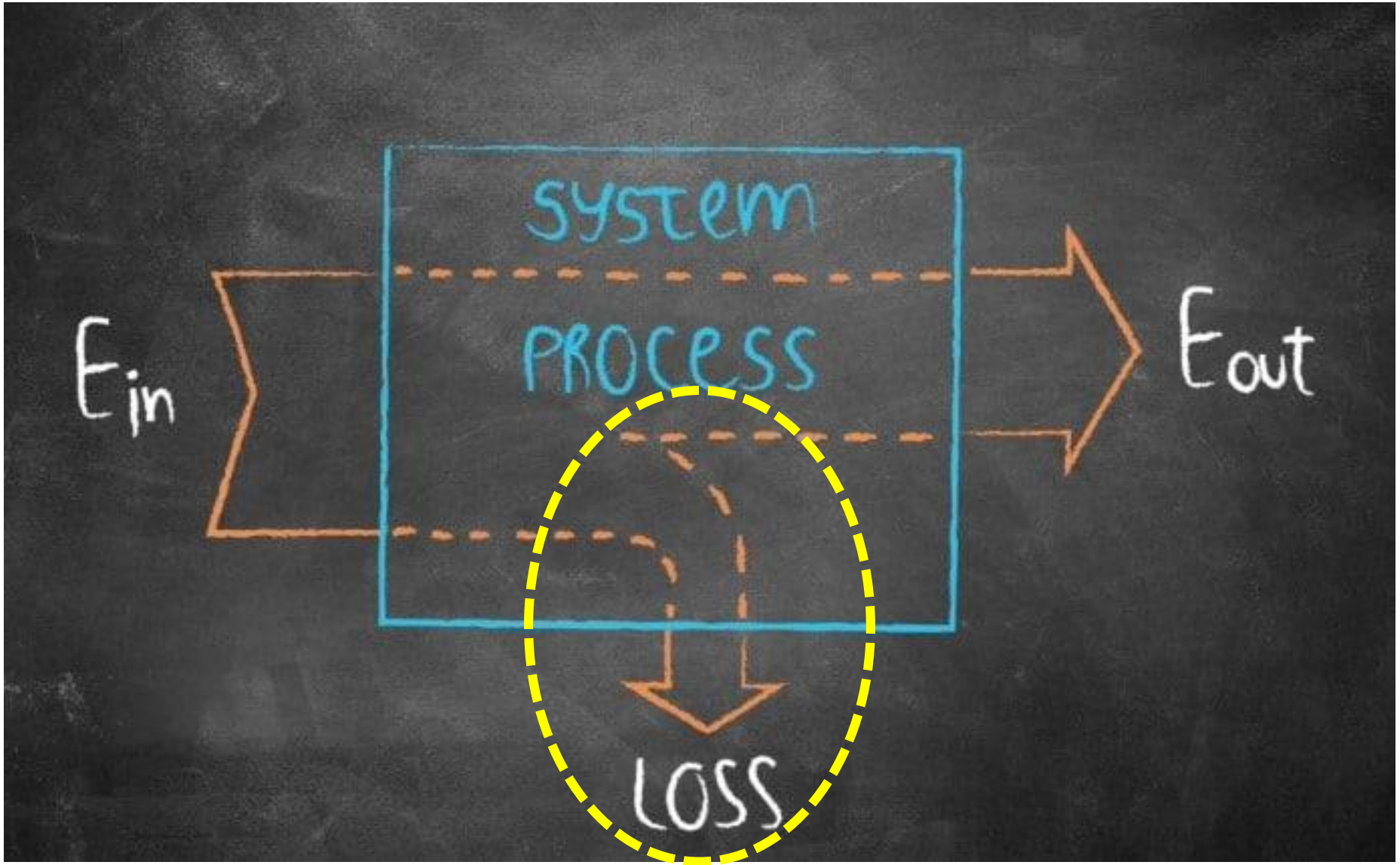
UNEP

Did you know?

- Global economic production and consumption is now concentrated in cities, where some **80% of global GDP** is produced.
- Cities occupy **2% of the world's land surface**. However, they consume **75% of natural resources**, produce **50% of global waste** and account for **60-80% of GHG emissions.** [2]
- Cities consume **15-20% of the world's food production.**[2]
- **780 million people** do not have access to drinking water.[2]
- By 2030, it is estimated that **energy and water global demand** of cities will increase **40 and 50%** respectively.[4]



B. Cities are inefficent in the use of energy. They can provide the same level of services with 50% of energy


system
PROCESS
E in
E out
LOSS

Urban planning can contribute to reduce energy demand/consumption by 50% in cities:

- what kind of economic activities take place; where and in what kind of buildings do people live; Climatic, geographic features...
- Which kind of infrastructure are in place and how they can be more efficient?
- How do people actually interact and behave? How does their behaviours result in energy consumption?
- How can we change the way resources flow, are converted and utilized in a city?

A.

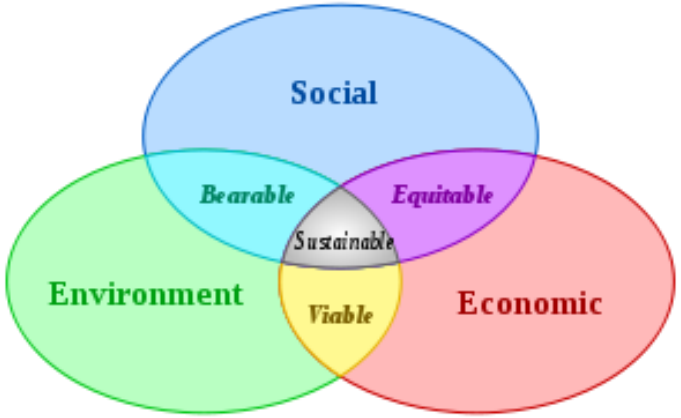
Definition of Sustainable Energy (Planning) in Cities

SUSTAINABLE ENERGY (PLANNING) IN CITIES

- **SUSTAINABLE DEVELOPMENT**
- SUSTAINABLE **CITIES**
- SUSTAINABLE **ENERGY**
- SUSTANABLE **ENERGY IN CITIES**
- SUSTAINABLE **ENERGY (PLANNING) IN CITIES**

Sustainable development definition

- The most widely known definition of sustainable development comes from the Brundtland Commission, which defined sustainable development as **"development that meets the needs of the present without compromising the ability of future generations to meet their own needs."**



Source: Rees, William E. and Roseland, Mark. 1991. Sustainable Communities: Planning for the 21st Century. Plan Canada. 31: 3. 15.

Is „Sustainable City“ an Oxymoron?

- Living in the city distances people both spatially and psychologically from the land that supports them
- Economic Production is Consumption
- Cities can maintain themselves and grow by importing high-grade energy and material from their host environments and by exporting entropy (degraded energy and material) back into those environments
- How much productive land/water (ecosystem) area is required for the corresponding production?

Source: Rees, William E.(1997)'Is 'sustainable city' an Oxymoron?',Local Environment,2:3,303 — 310

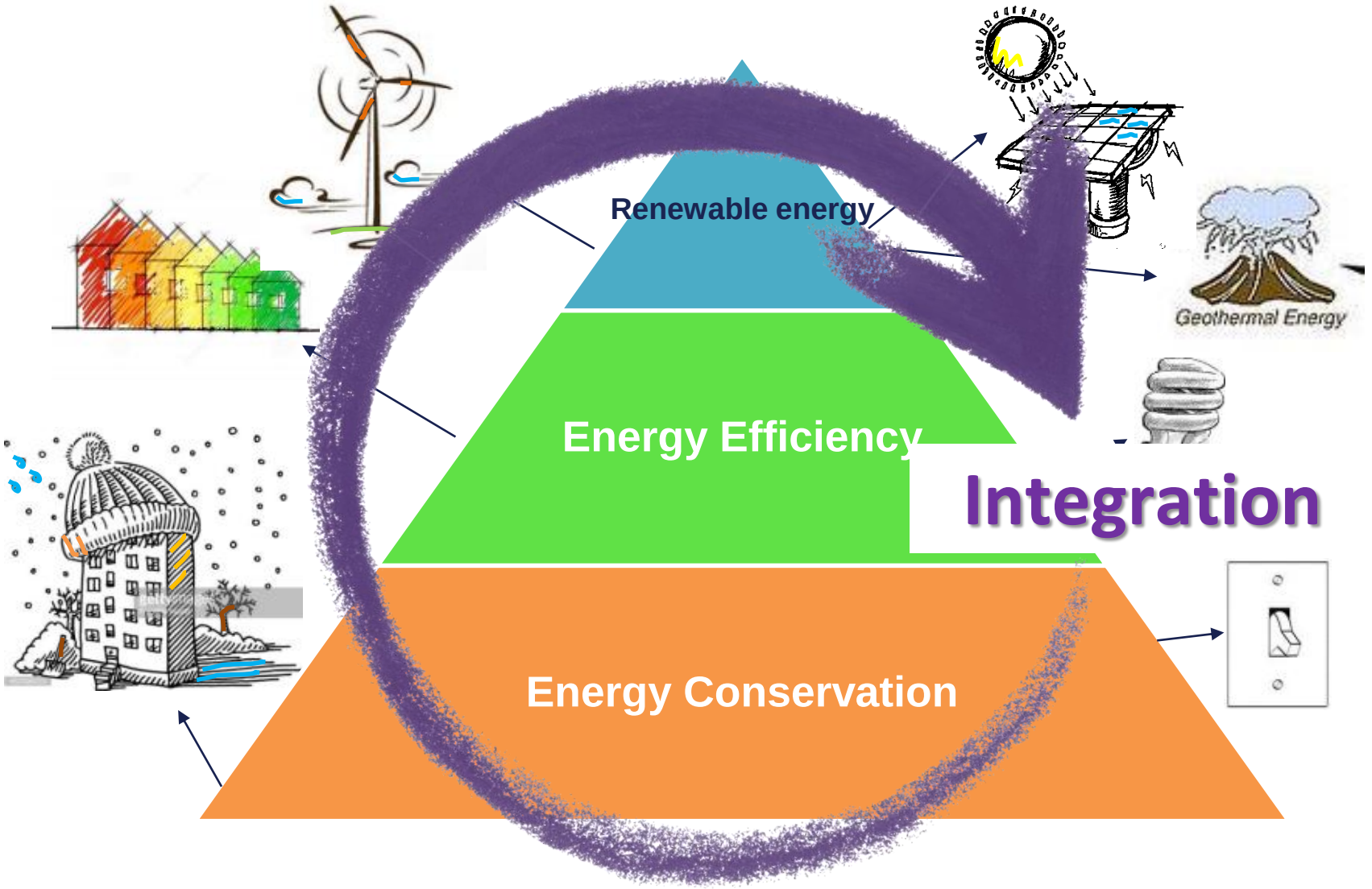
SUSTAINABLE **ENERGY**

Energy Saving / Conservation

Energy
Efficiency

Renewable
energy

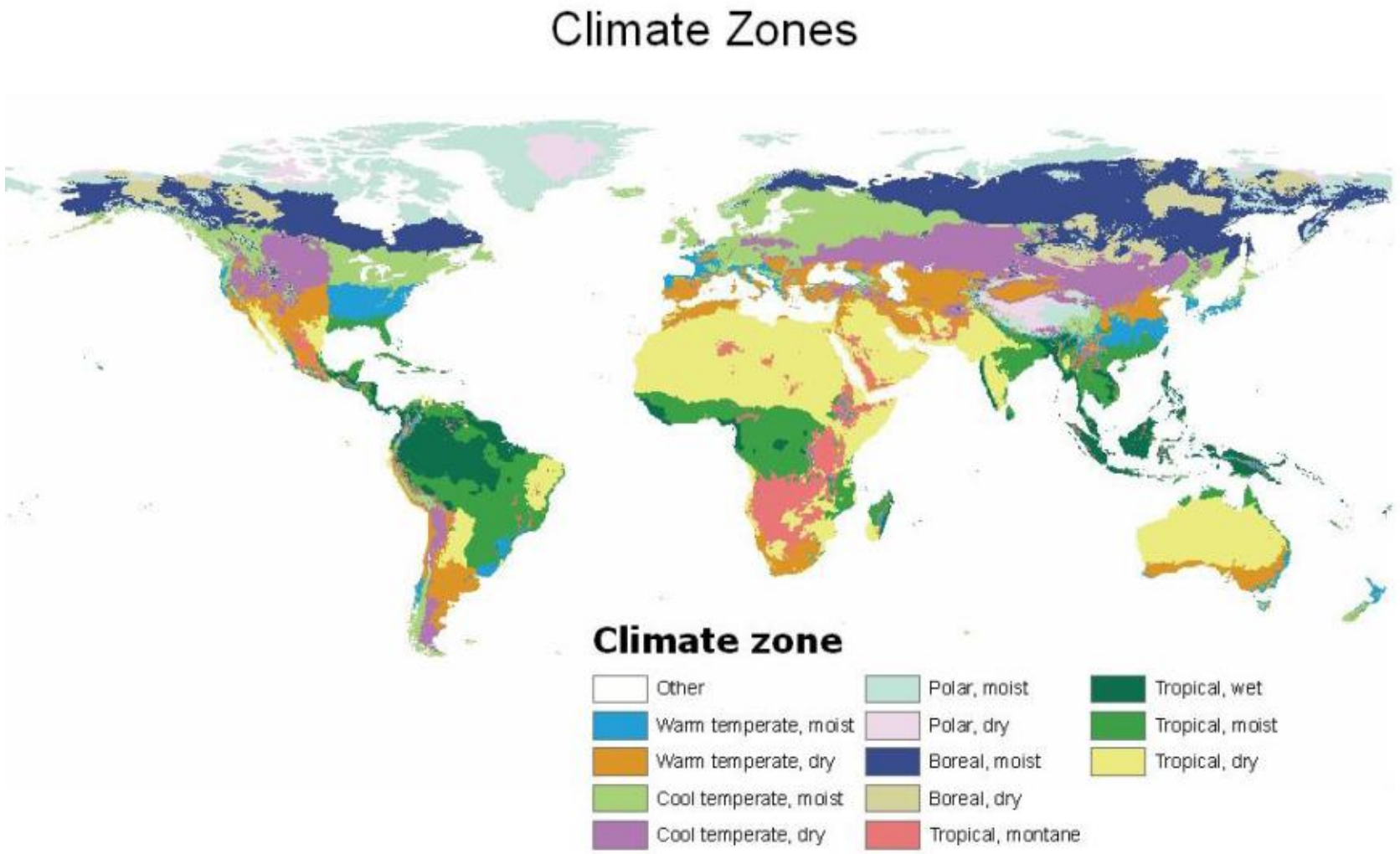
SUSTAINABLE **ENERGY in CITIES**



B.

Sustainable energy strategies applied to Cities

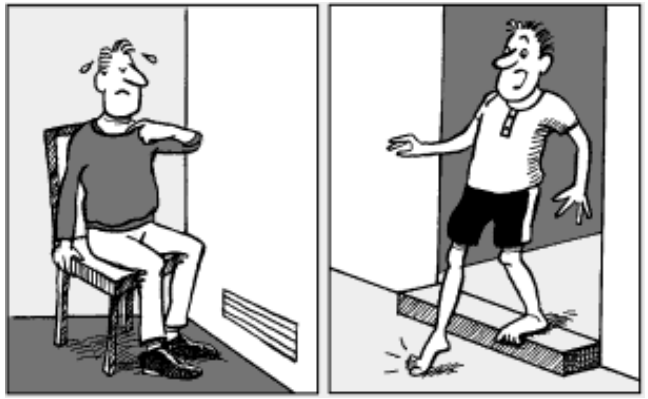
Climate Strategies

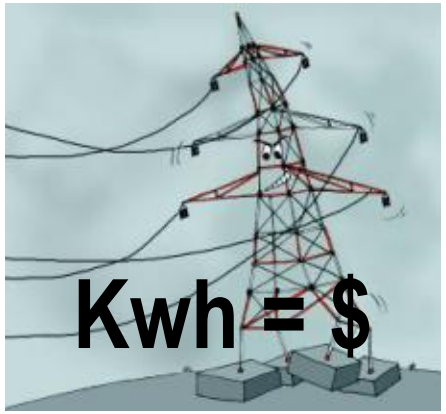


Climate Strategies

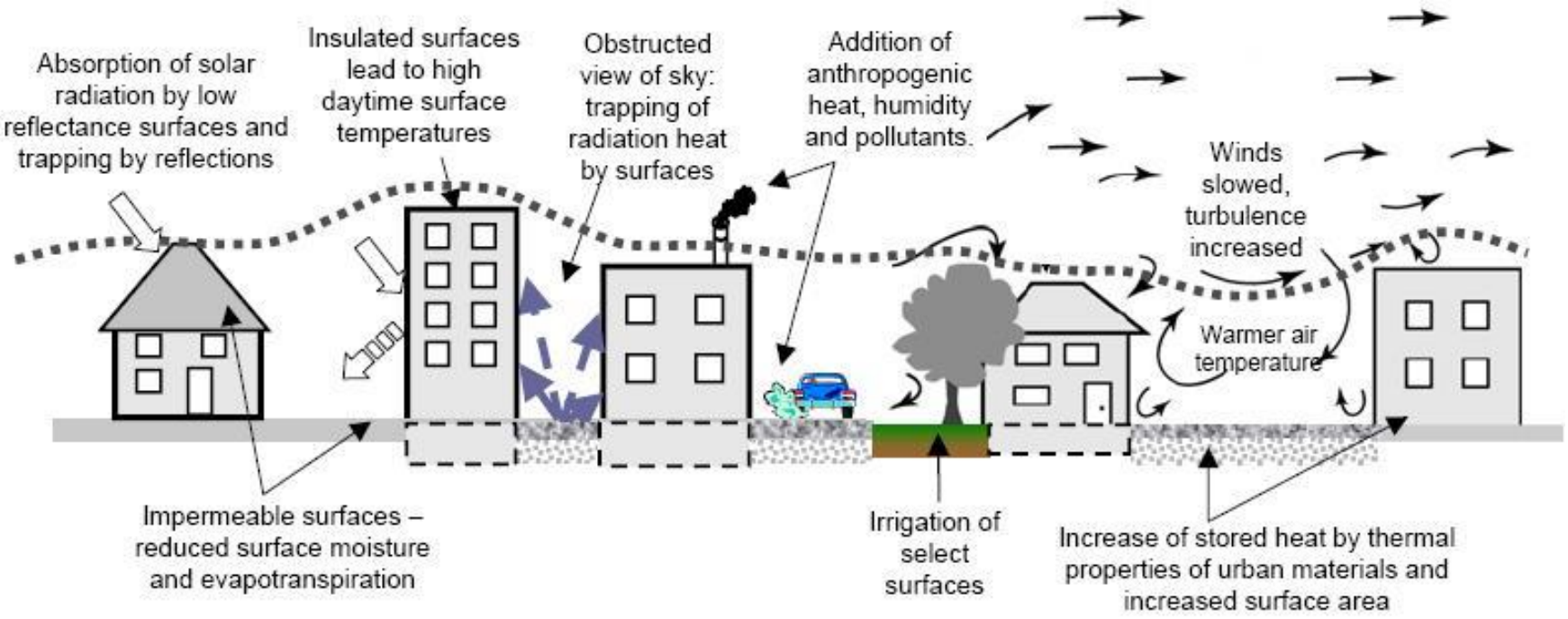
URBAN WARMING in tropical and medium latitude cities

- diminished thermal comfort;
- increased cooling demand;
- increased energy demand for cooling systems;



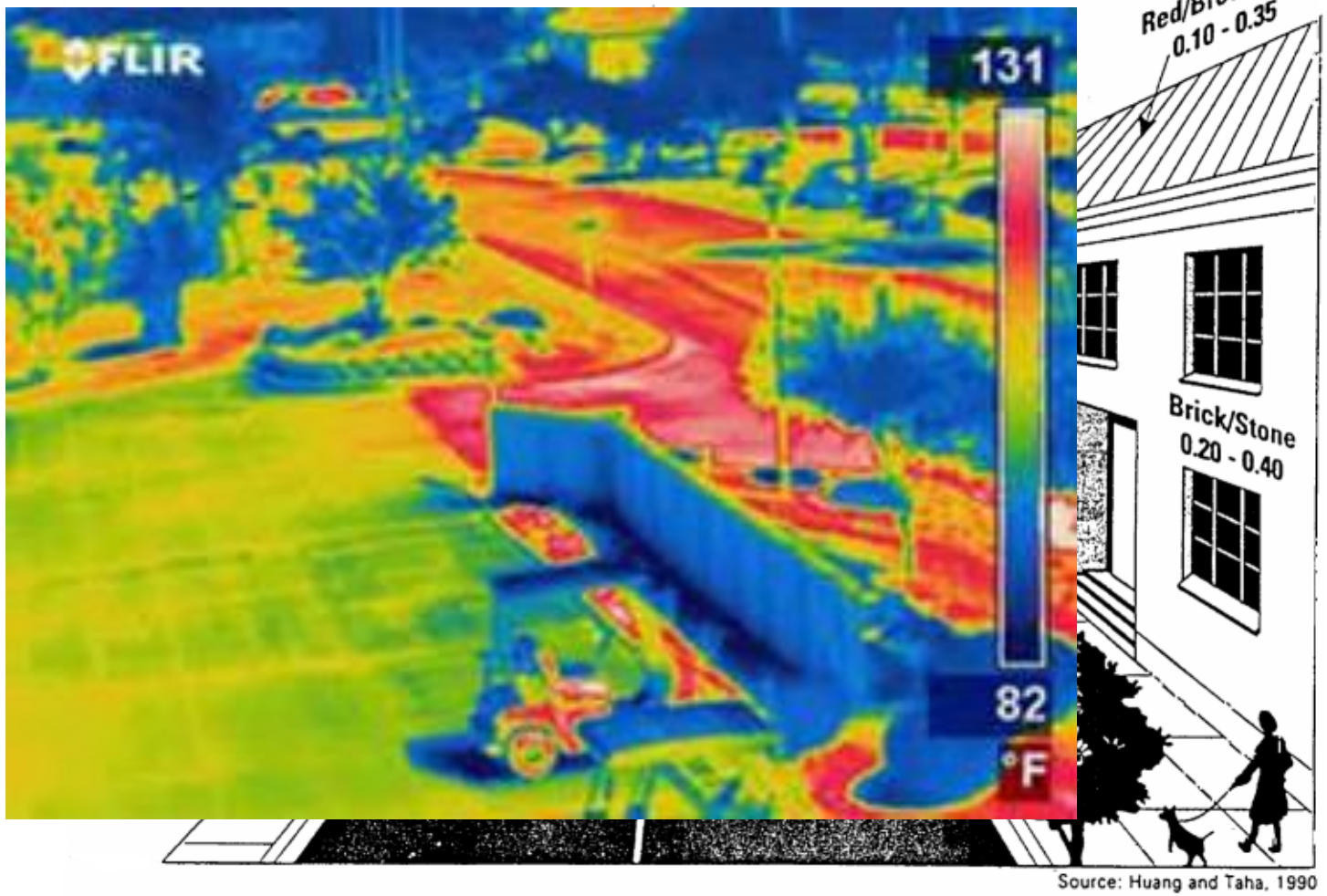


Climate Strategies



Modified from: Voogt J. 2006

Albedo

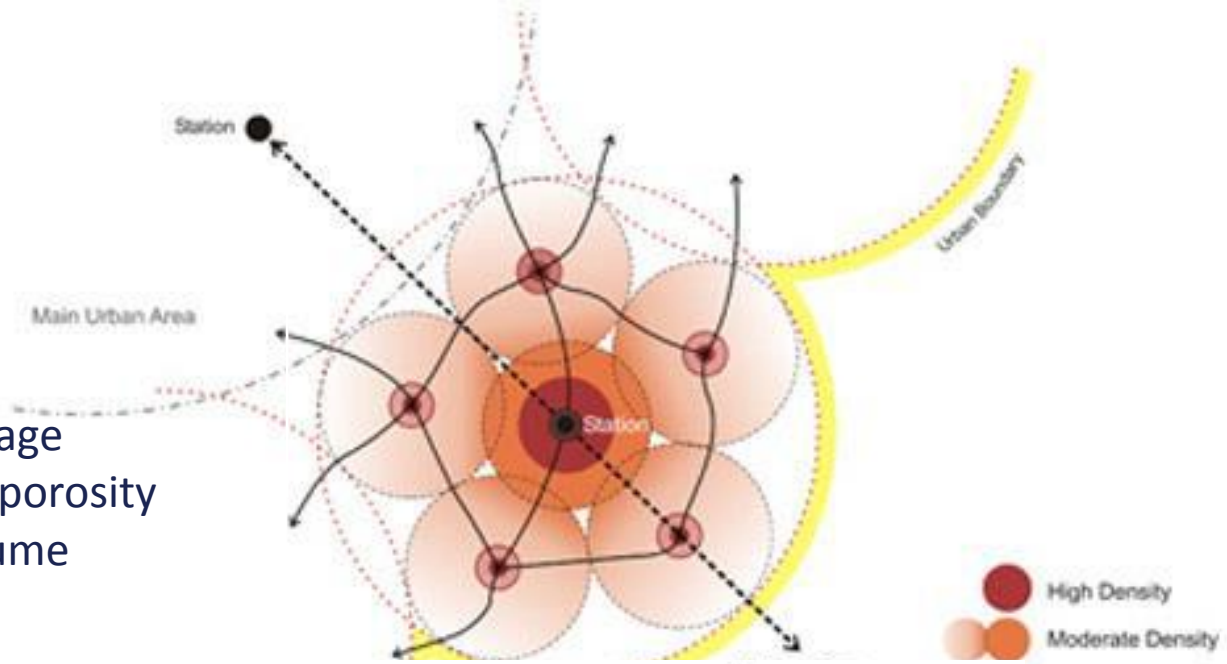


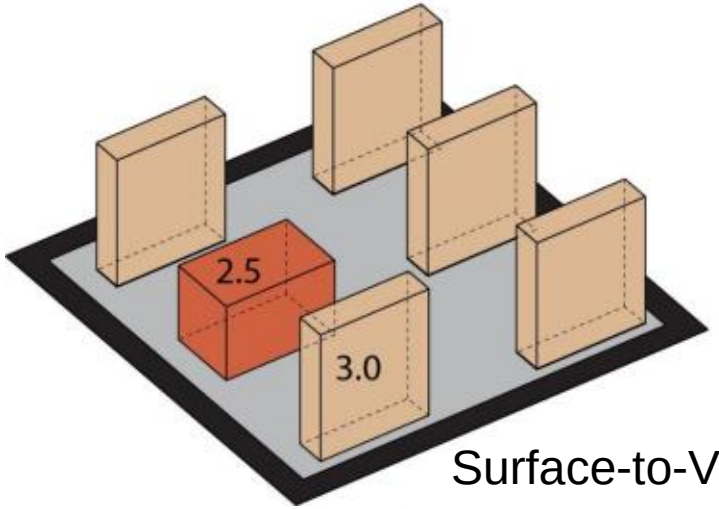
Source: Huang and Taha, 1990

Strategies in buildings and districts morphology

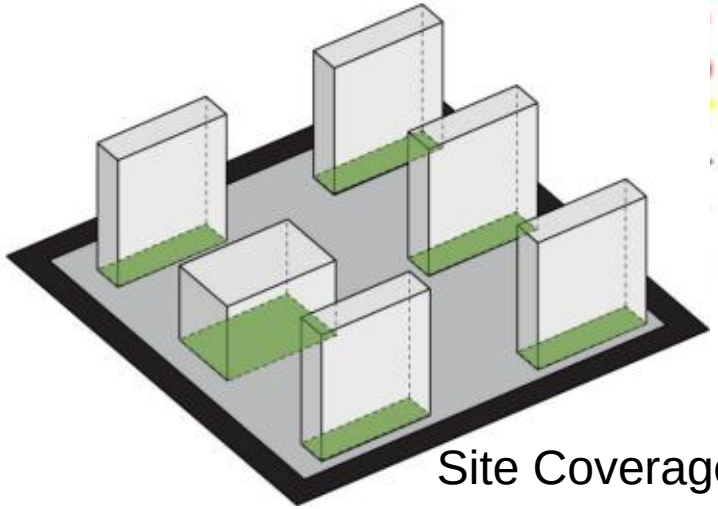
Density

- Increasing Density
- Appropriate building coverage
- Appropriate building mass porosity
- Appropriate surface to volume





Surface-to-Volume

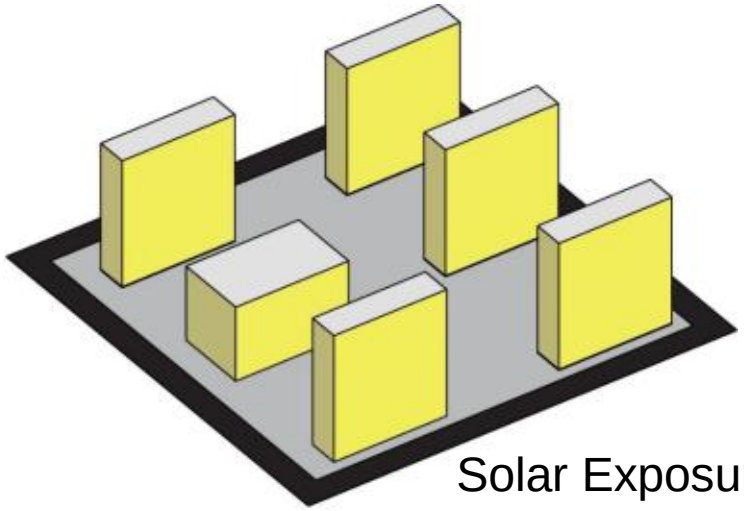


Site Coverage

Picture reference: http://www.plan4sustainabletravel.org

Strategies in buildings and districts morphology

- Neighborhood size
- Preserving green coverage, natural features and open spaces
- Site selection for renewable energy resources generation & storage
- Ample solar exposure / orientation



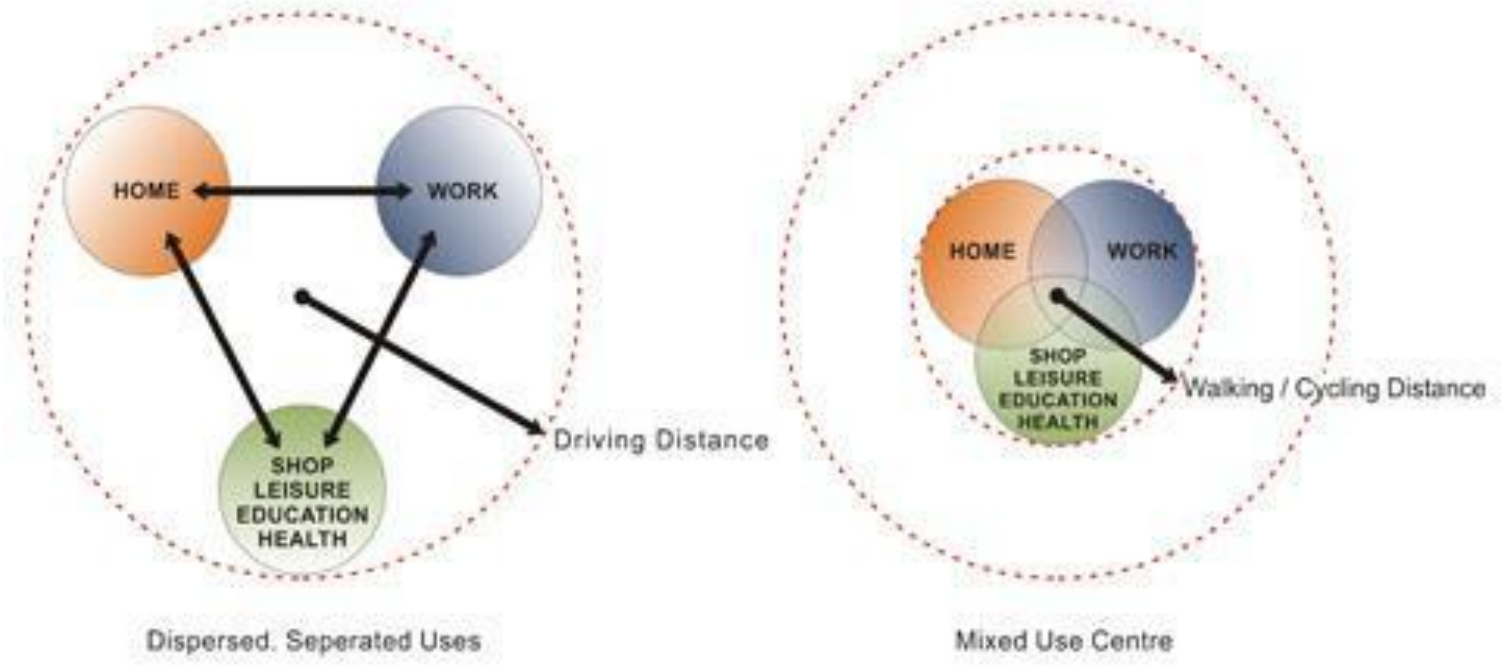
Solar Exposure

Picture reference: http://www.plan4sustainabletravel.org

Strategies in buildings and districts morphology

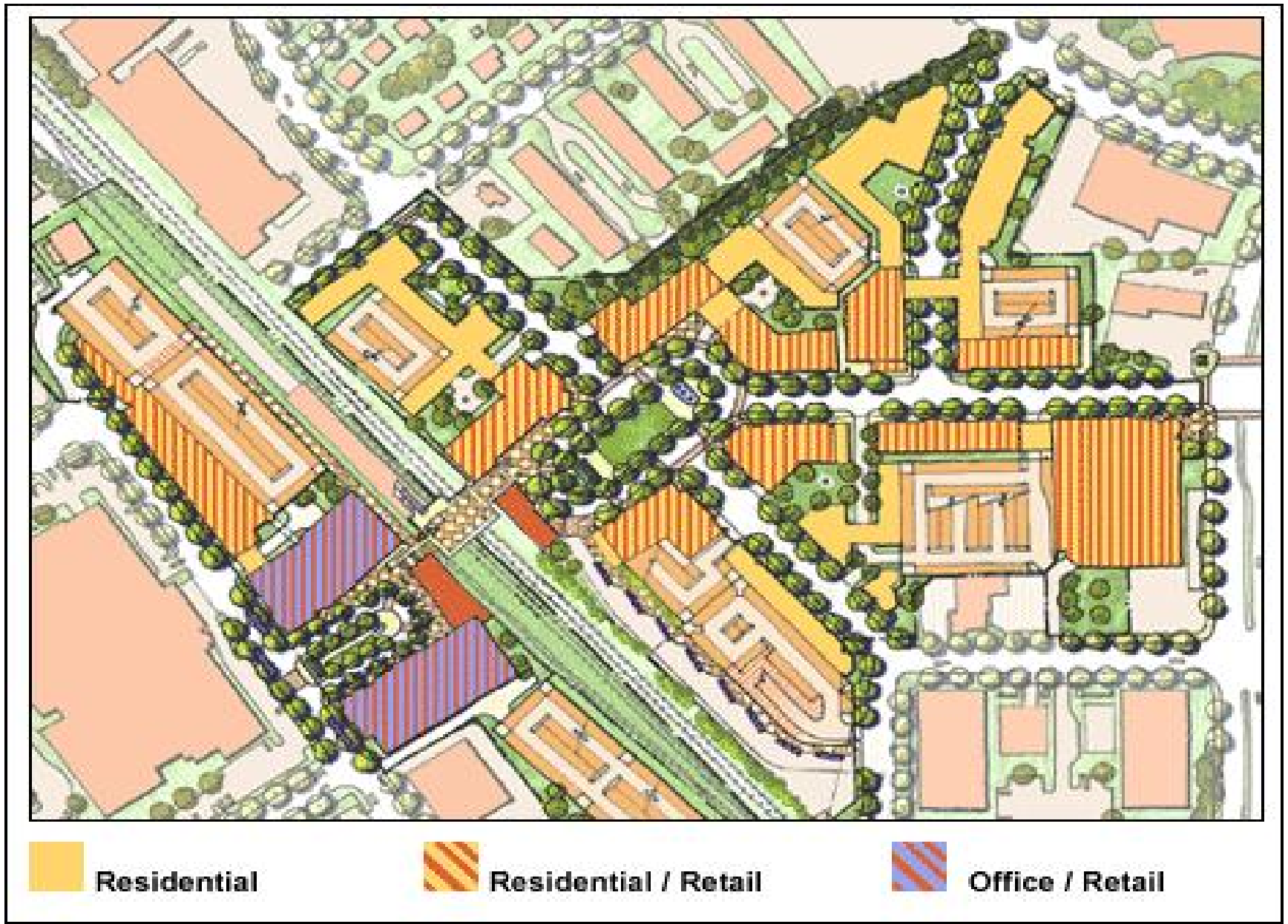
Diversity & Proximity

- Building function mix
- Land use mix
- Diversity of housing

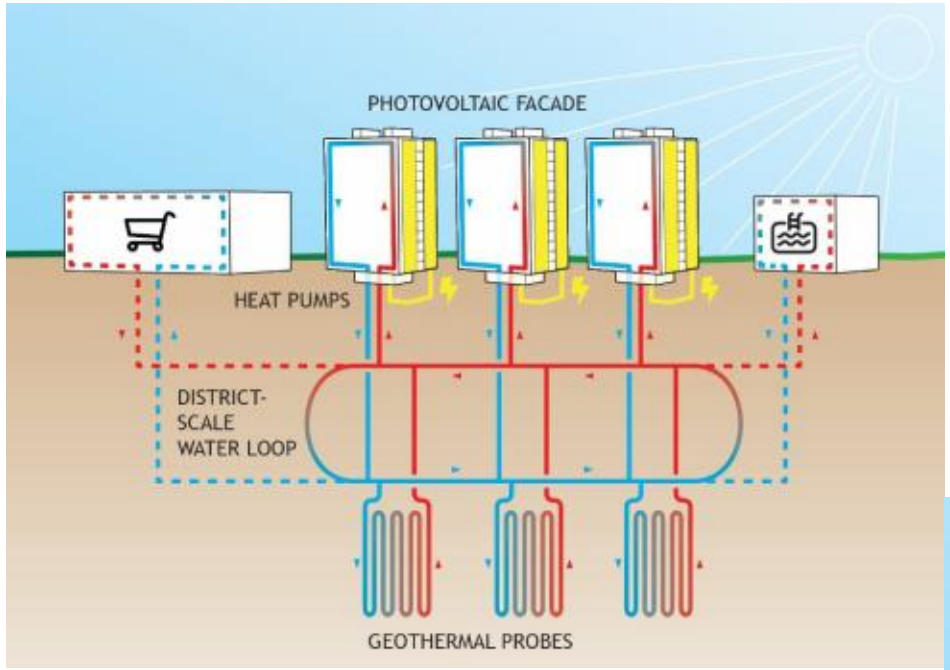


Picture reference: http://www.plan4sustainabletravel.org

Strategies in buildings and districts morphology

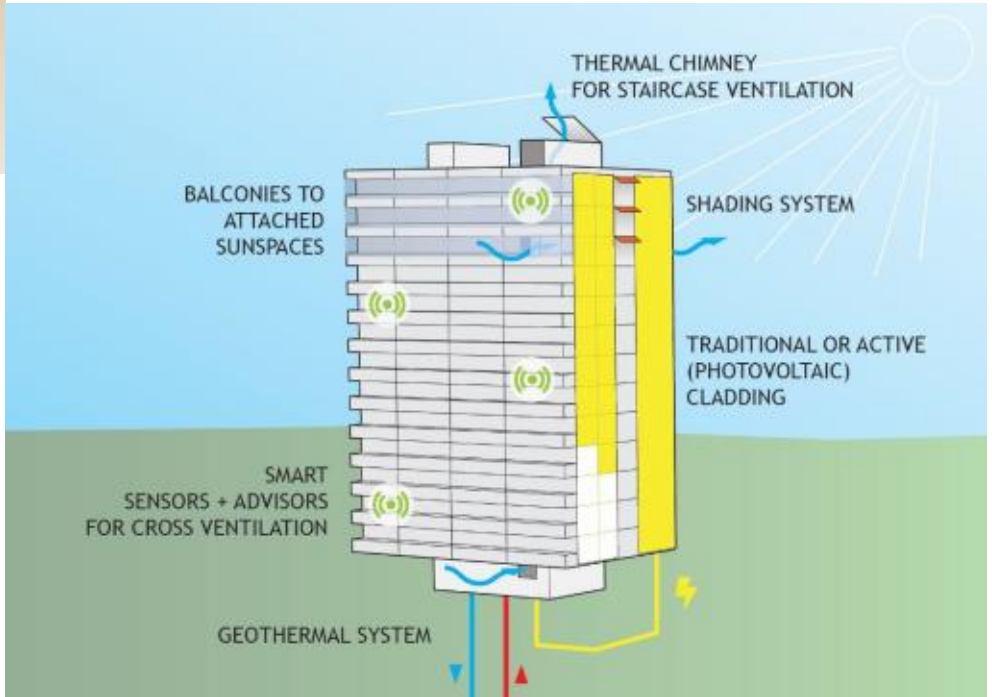


Strategies in buildings and districts



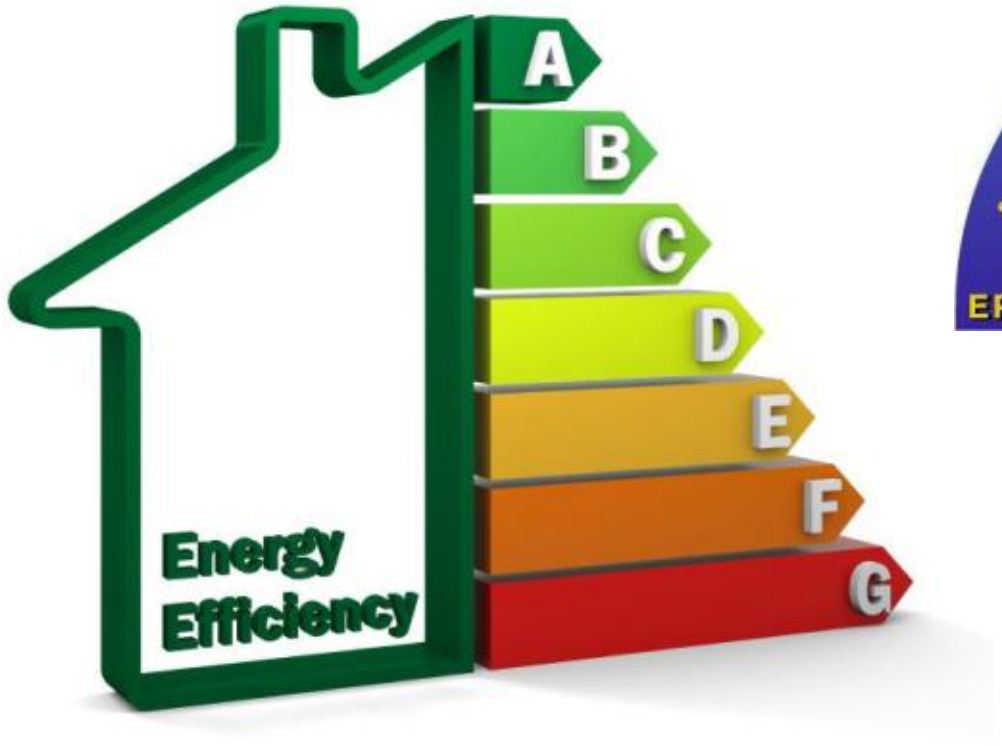
Source: EURAC

Integration of smart energy solutions at district and building scales

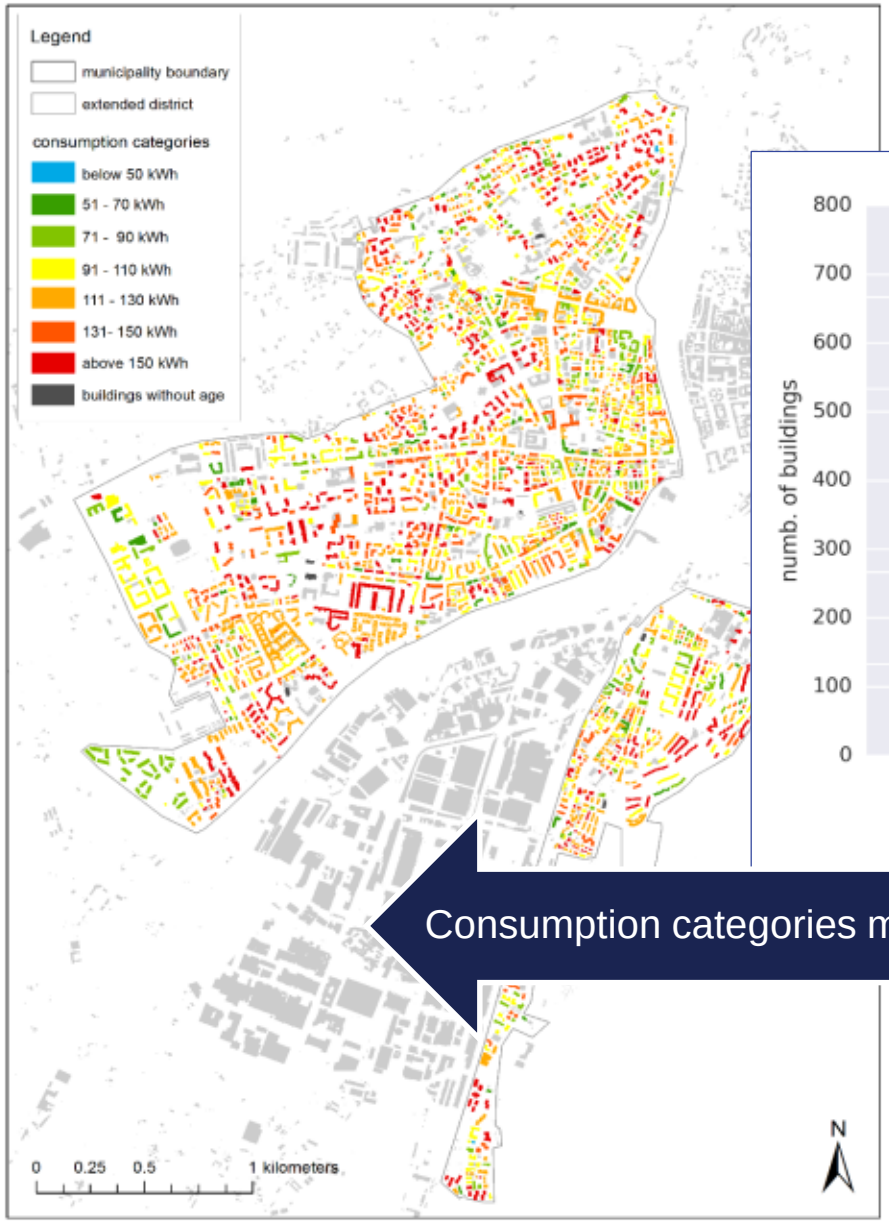


Strategies in buildings and districts

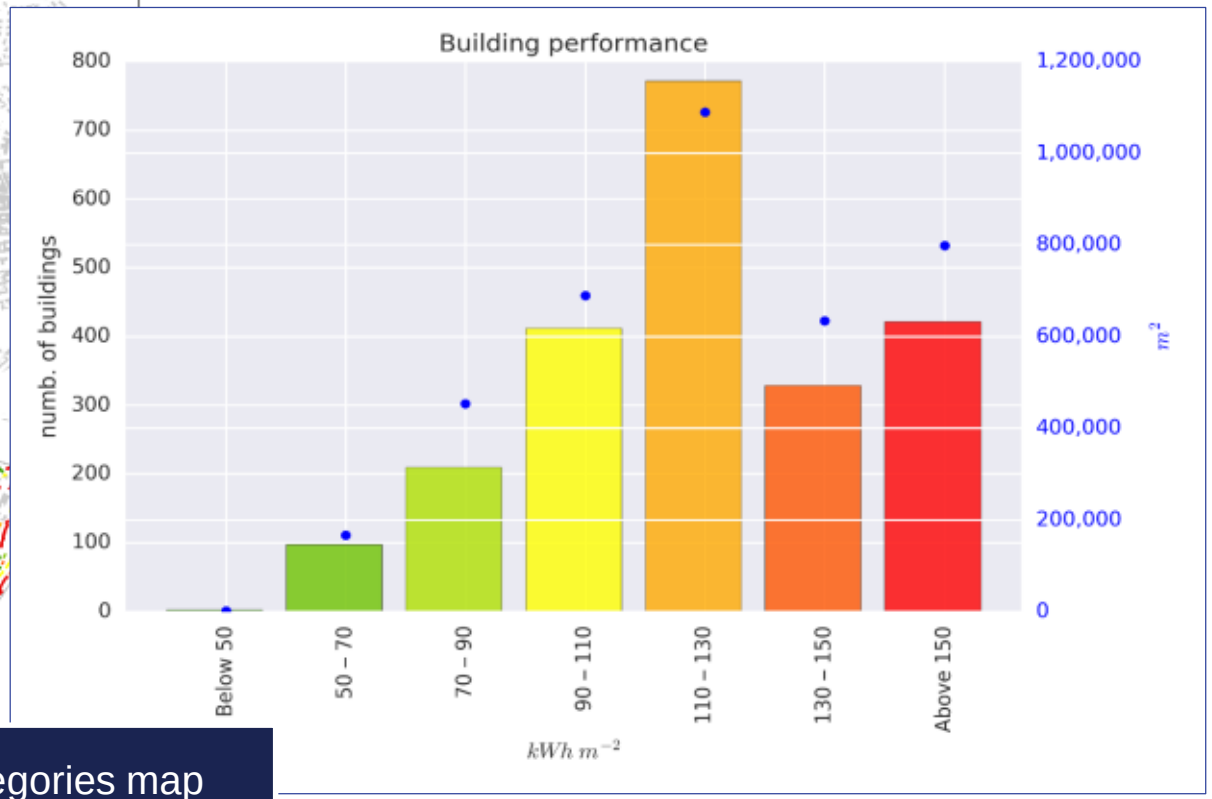
Energy certifications



Strategies in buildings and districts



Consumption categories map



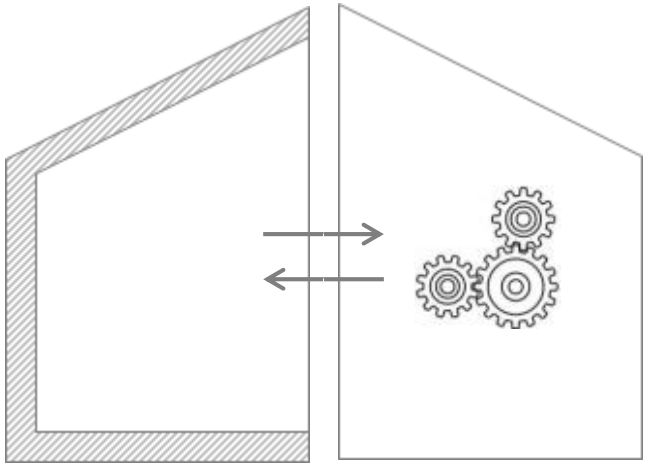
Sinfonia

Strategies in buildings and districts

Active and Passive solution packages for buildings

PASSIVE SOLUTIONS

1. Light weight ventilated facade
2. PCM insulation material
3. Aerating windows



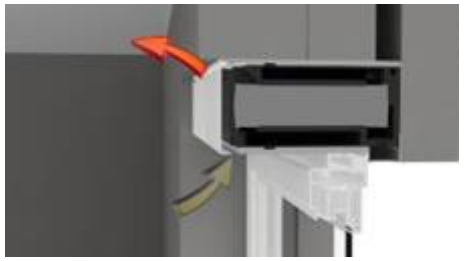
ACTIVE SOLUTIONS

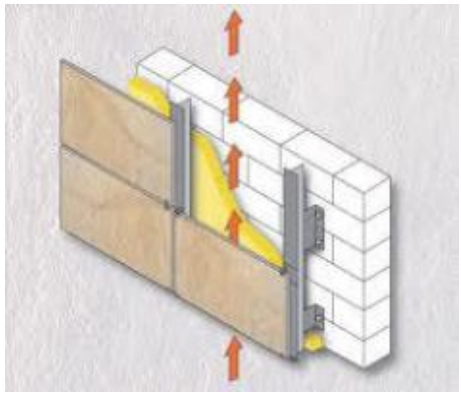
Biomass, Geothermal & Sun

1. ORC units
2. Ab/Adsorption chillers

Reduction of the energy demand (heating, cooling, electricity)

More efficient heating, cooling and electricity energy production



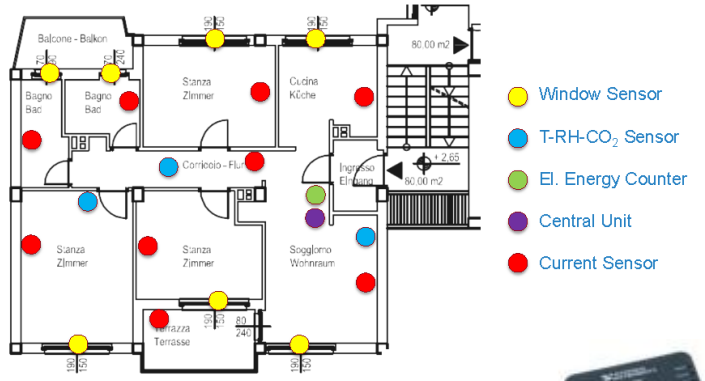


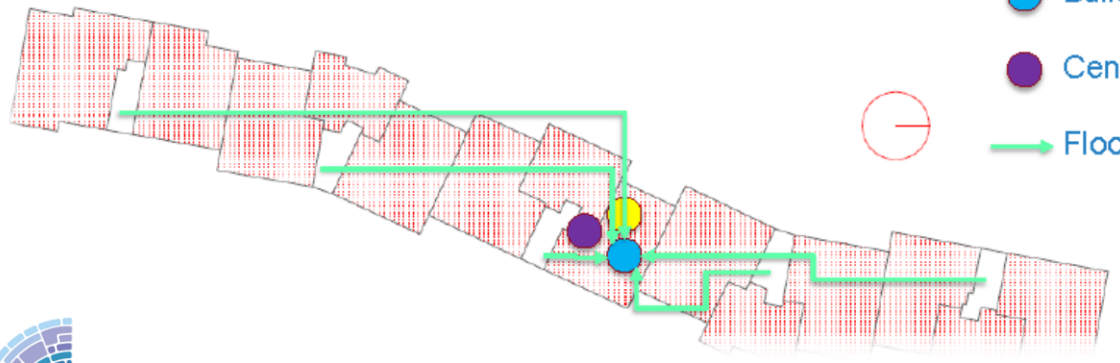
Strategies in buildings and districts

Large scale monitoring system and data aquisition

- ✓ Better building energy management
- ✓ Direct feedback to tenants
- ✓ Tenant awareness and participation

Flat System



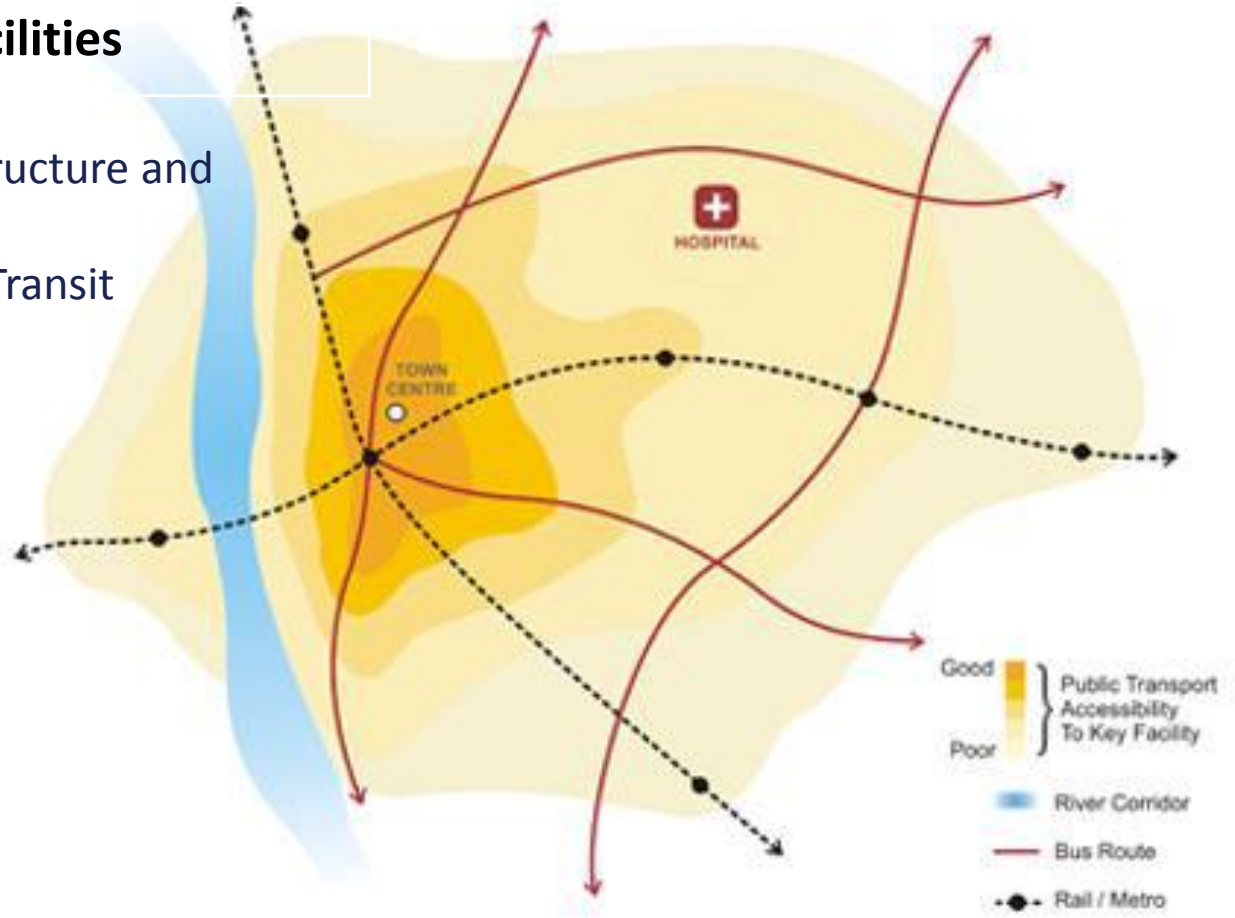


Sinfonia

Strategies in urban mobility / transportation

Accessibility Of Key Facilities

- Access to Existing Infrastructure and Services
- Access to Transport and Transit Systems

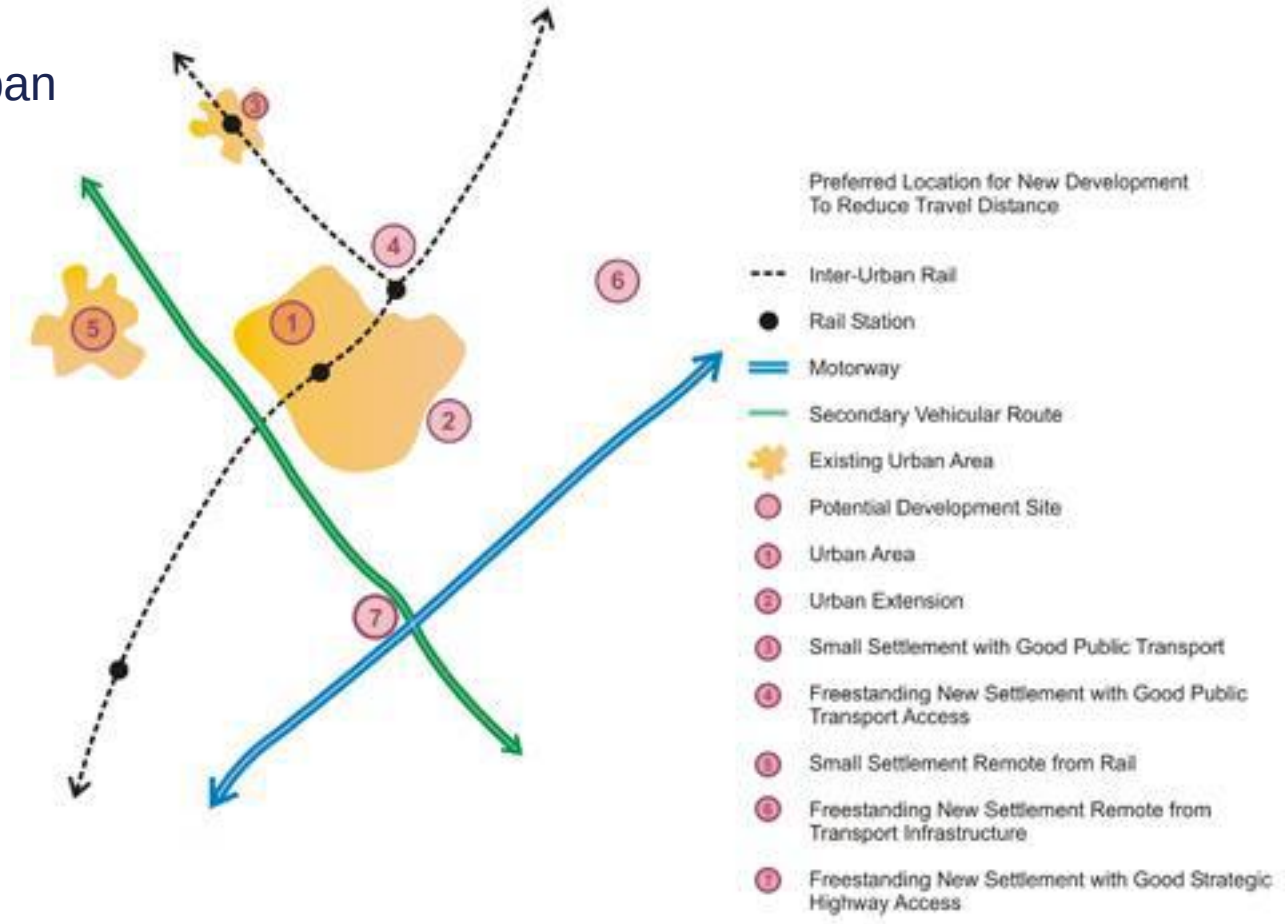


Picture reference: http://www.plan4sustainabletravel.org

Strategies in urban mobility / transportation

Development Site Location

- Strategic Development Location
- Development inside urban boundaries



Picture reference: http://www.plan4sustainabletravel.org

Strategies in urban mobility / transportation

Design

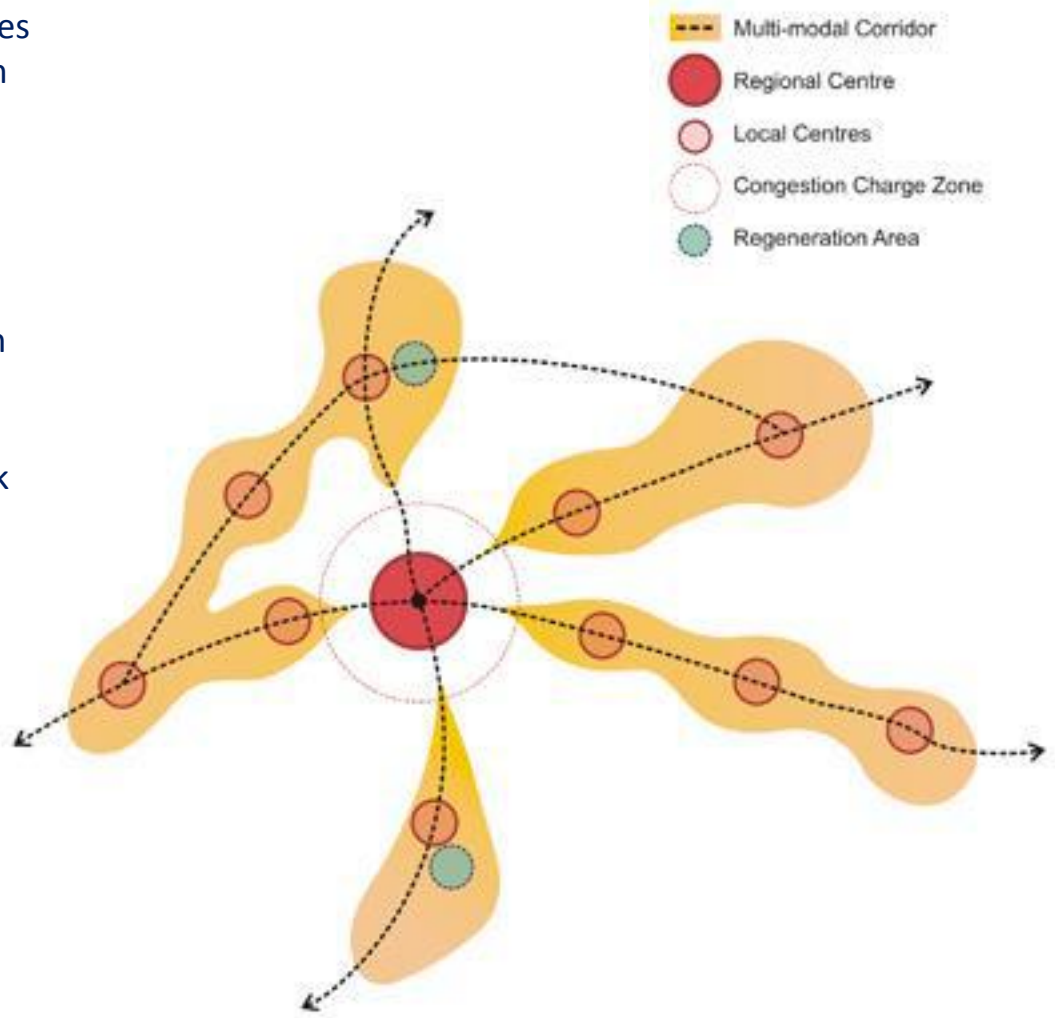
Motorway width
Pedestrian & cycling facilities
Pedestrian and bicycle path design

Accessibility

Parking plans and siting
Road density, Cul-de-sacs
Bus Rapid Transit routes
Pedestrian and cycling path

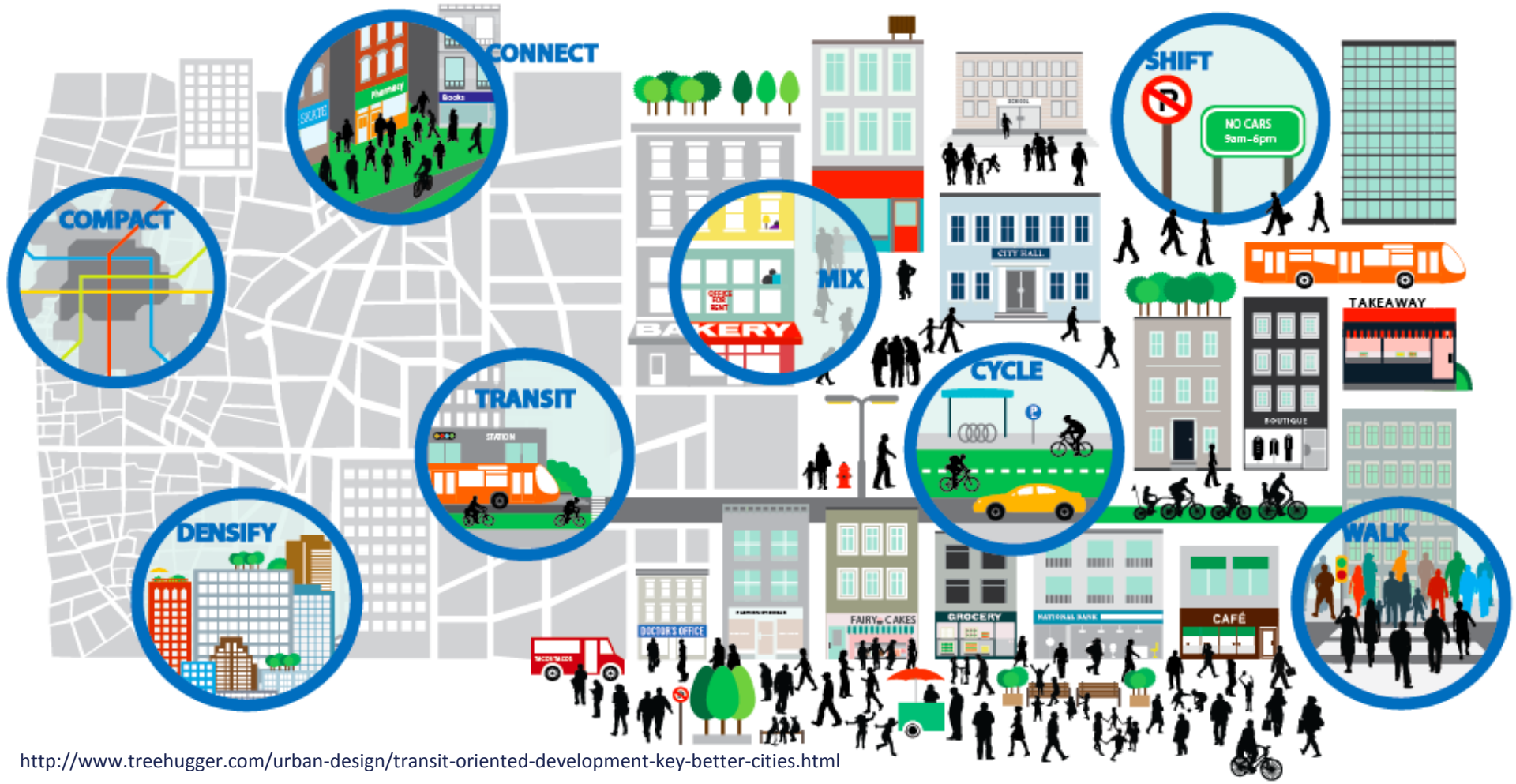
Development & Location

Strategic transport network
Transportation Oriented development



Strategies in urban mobility / transportation

Transport Oriented Development (TOD)



http://www.treehugger.com/urban-design/transit-oriented-development-key-better-cities.html

Strategies in urban mobility / transportation

Integration of EV and urban logistics

Strategies in energy supply infrastructure

Development

- Anticipating land for renewable energy generation, distribution, and storage e.g. solar PV farms, DHC etc.
- Green Construction
- Efficient supply of public and private space
- Efficient utilization of space

Energy Supply

- Joint infrastructure planning & delivery
- Electricity supply & distribution
- District heating & cooling
- Waste heat utilization
- Cogeneration systems
- Waste-to-energy systems
- Waste energy

Energy efficiency / waste incineration / gassification

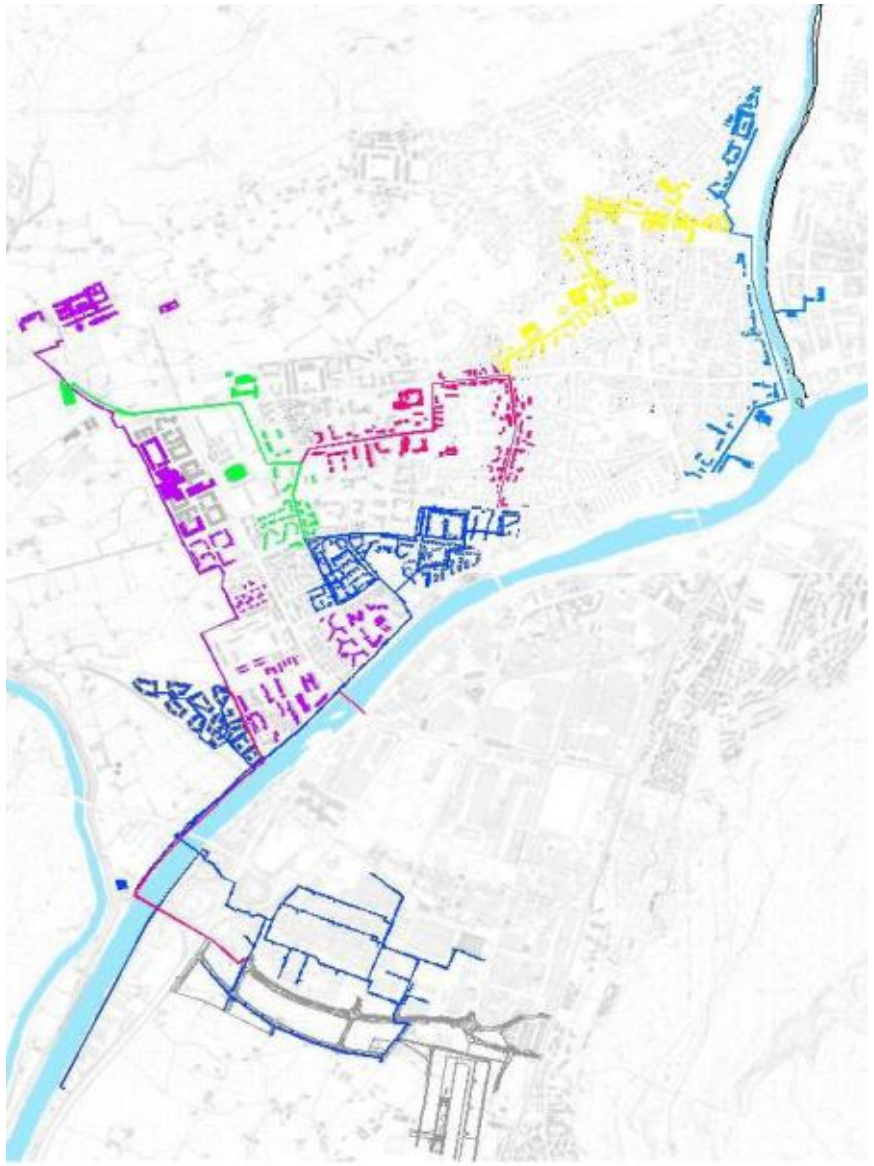
- Waste is for a large part not a renewable source
- But it is fuel which is already on sight and has to be disposed, therefore a thermal / electrical use in combination with a district heating and cooling or power production can be an efficient solution

Waste incineration plant in Bolzano Italy

Strategies in energy supply infrastructure

District heating (and cooling) systems

Allows to transport centralized produced heat by cogeneration, renewables and or waste heat into city centres with a high urban density



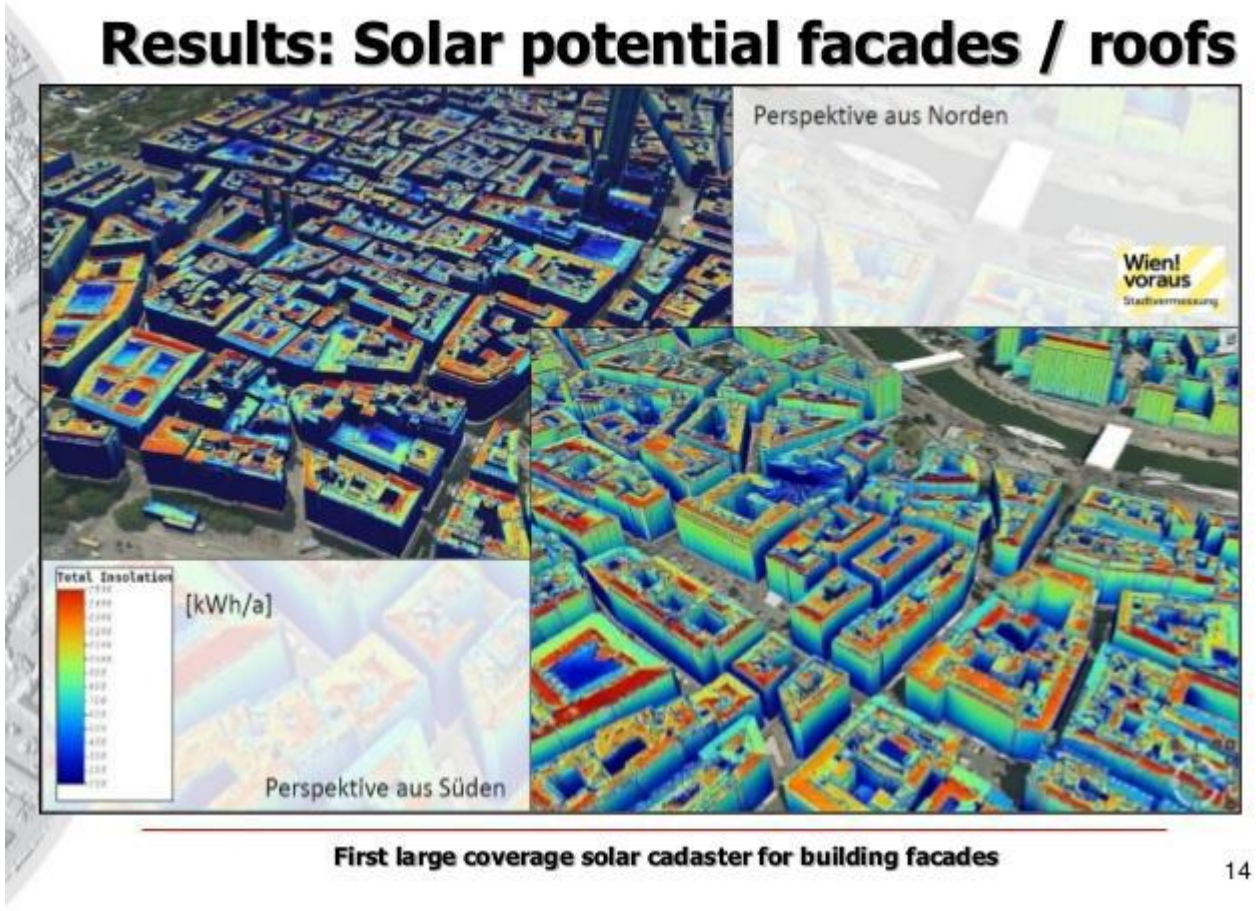
SEL – Ecotherm
Outlook on the district heating and cooling system under construction in Bolzano

Strategies in energy supply infrastructure

Photovoltaics integrated in buildings

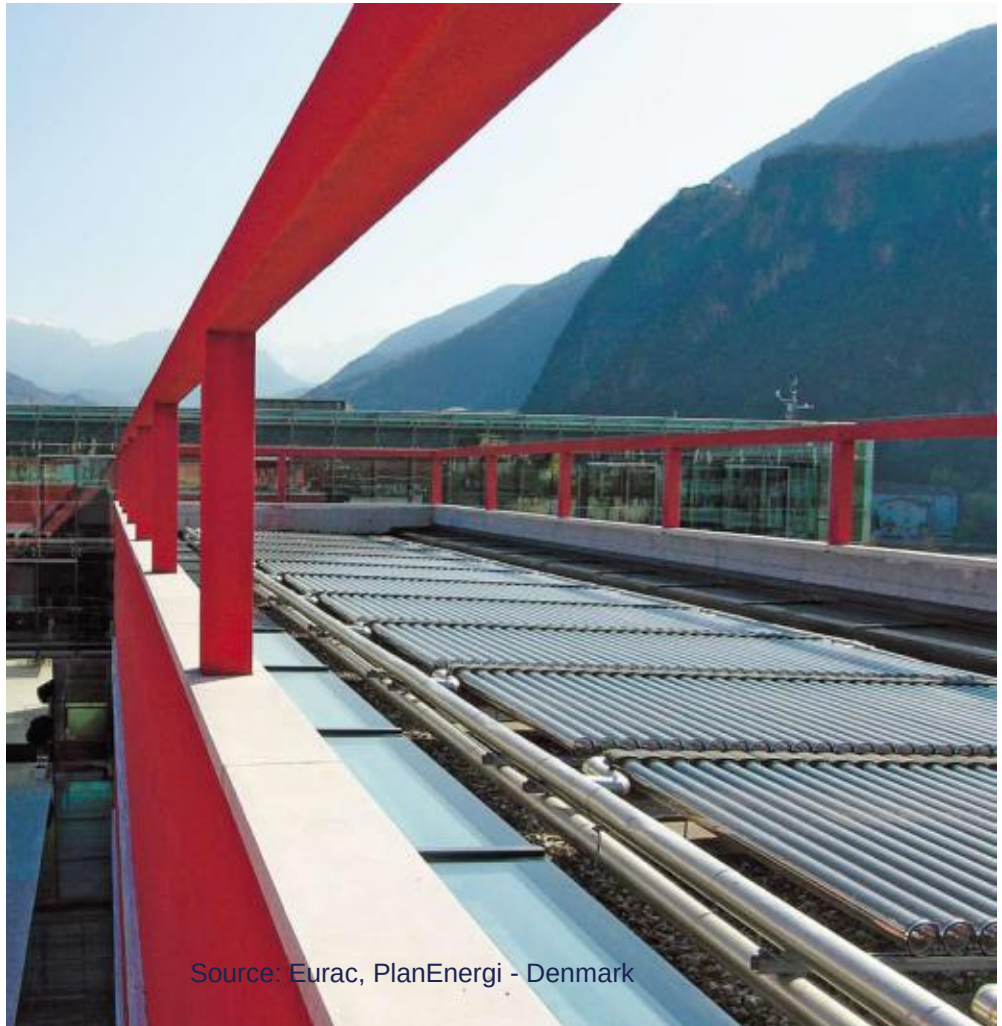
SEL Solar Rimini,
Rimini Fiera, 4,3 MWp

Solar Potential Calculation



Strategies in energy supply infrastructure

Solar thermal systems



Source: Eurac, PlanEnergi - Denmark

Strategies in energy supply infrastructure

Biomass

- Wooden biomass can be used in different stoves and kinds. In rural areas there is often a tradition to do so and store place is available

Strategies in energy supply infrastructure

Geothermal energy

Deep geothermal is usually used for power production ev. as well using the waste heat, shallow geothermal is used only for heating and cooling purposes

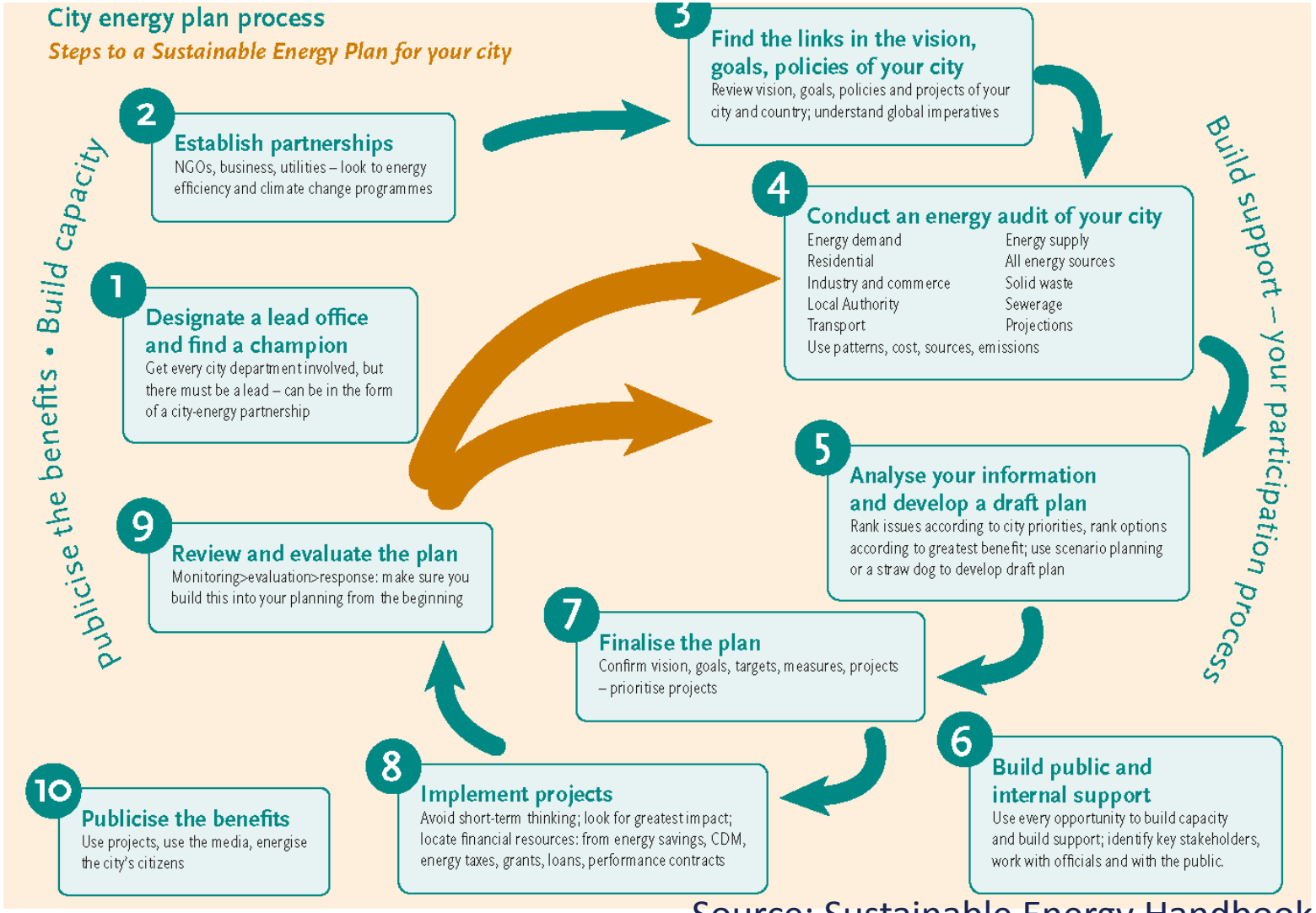
Bundesverband Geothermie, conserve energy future

D.

How to implement?

IMPLEMENTATION PROCESS

City Energy Plan process



Source: Sustainable Energy Handbook – UNEP 2012

IMPLEMENTATION PROCESS

i. Key stakeholders

- Local Government Authorities and Staff (city development planning, public works and general services, city engineers office, etc.)
- National and Regional Development Agencies
- Utilities (Fuel, Electricity, Water & Sanitation, Telecommunications)
- Real Estate Developers
- Business Community (industry, trade and commerce, service)
- Public Transport Operators
- NGOs/CBOs and Citizens Groups
- Citizens

IMPLEMENTATION PROCESS

ii. Challenges

Administrative Challenges

- e.g., fragmented responsibilities; split incentives, and conflicting interests of stakeholders; lack of mainstreamed energy and climate change in urban planning processes

Legal Challenges

- e.g., lack of updated and supportive laws and regulations for EE and RE initiatives; restrictive regulations

Policy Challenges

- e.g., missing local authorities support; changes in administration often translates to change in policies; lack of information & awareness on actual costs & benefits of energy related interventions

Social/behavioral Challenges

- e.g., lack of awareness of local communities, resistance towards changes in lifestyles and attitudes (inertia)

Technical & Financial Challenges

- e.g., not skilled/knowledgeable city planners & engineers for sustainable energy development; lack of financing for energy related initiatives

Policy tools for energy efficiency

- Efficiency standards for products (national aspect)
- Energy certification for buildings (voluntary and / or obligatory)
- Tax reduction for energy efficiency investments (national aspect)
- Financial support for energy efficiency investments
- White certificate system (national aspect)
- Carbon tax
- Target setting / plan elaboration / monitoring

Policy tools for renewable heating and cooling

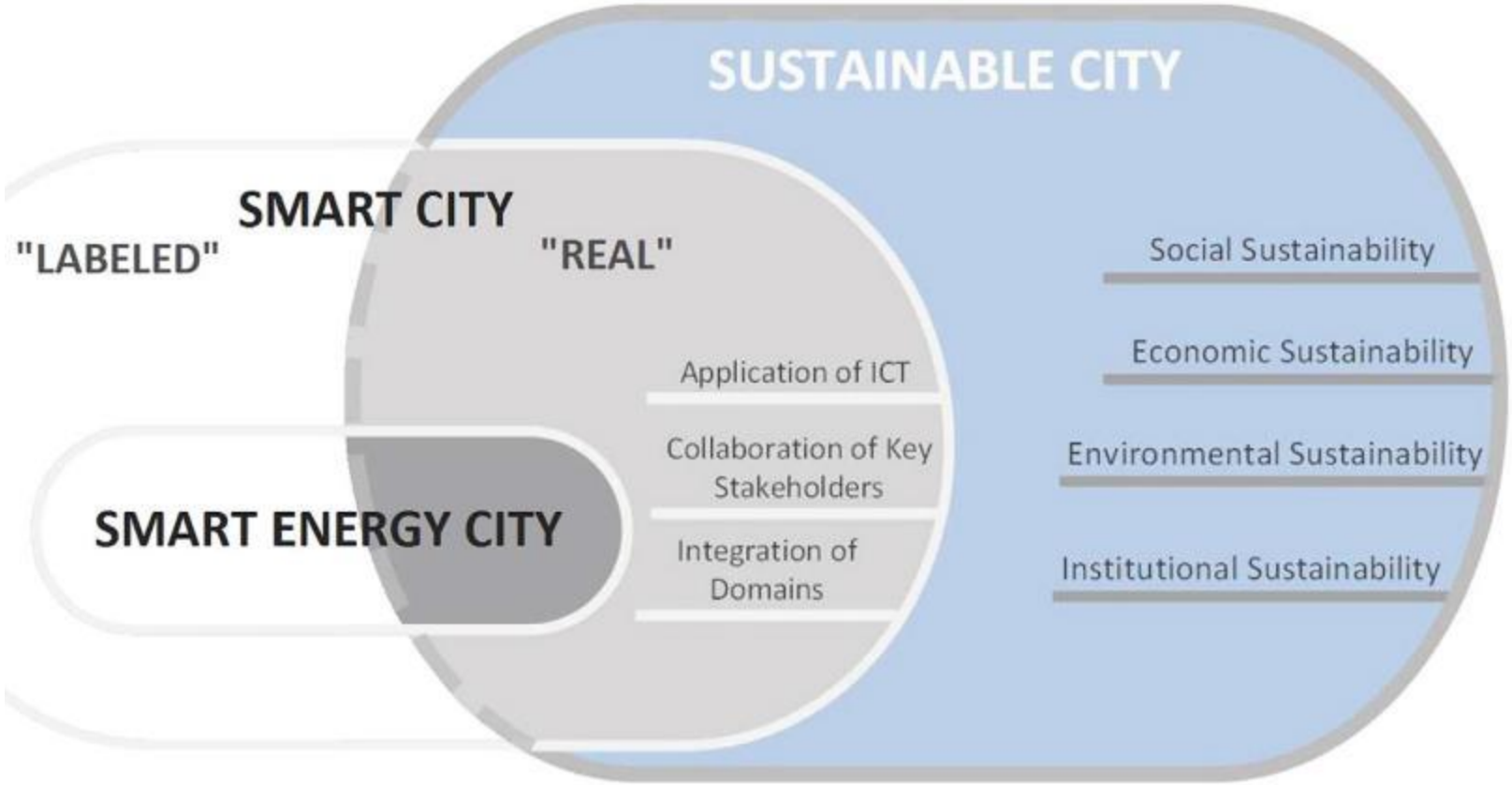
- Building standards / obligations (e.g. solar thermal obligation for all new residential buildings)
- Tax reduction for RES heating & cooling investments (national)
- Financial support for RES heating and cooling investments
- Carbon tax
- PPP's for the realization of infrastructures

Policy tools for renewable electricity

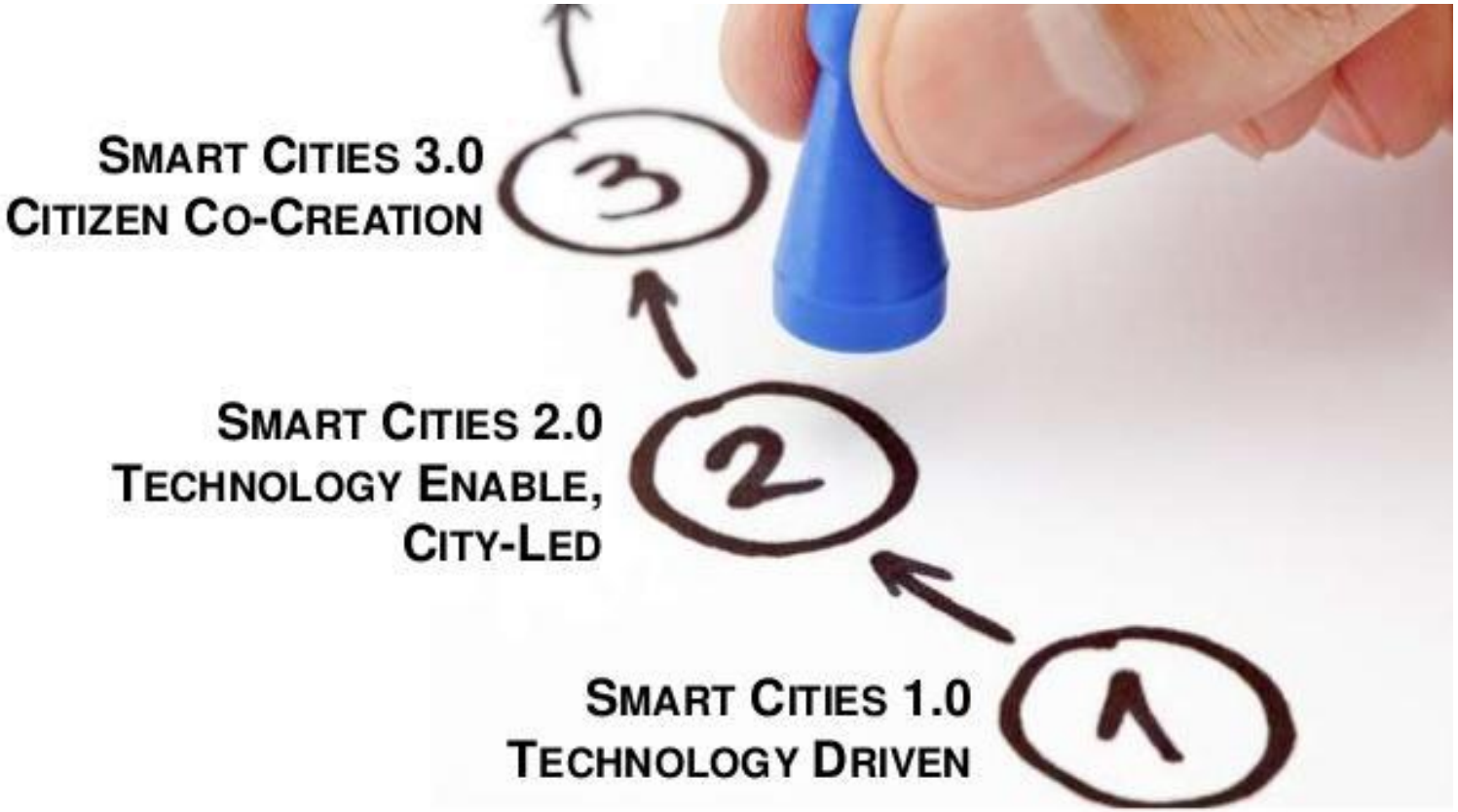
- Feed in tariffs (national aspect)
- Connection priority / obligation for the grid operator (national aspect)
- % target obligations for energy utilities (national aspect)
- Green certificate system (national aspect)
- Accelerated procedures regarding permits and clarity in the bureaucracy process (e.g. one stop shop concept)
- Building codes for allowance / obligations for PV

E.

New trends in implementation: the SMART CITY

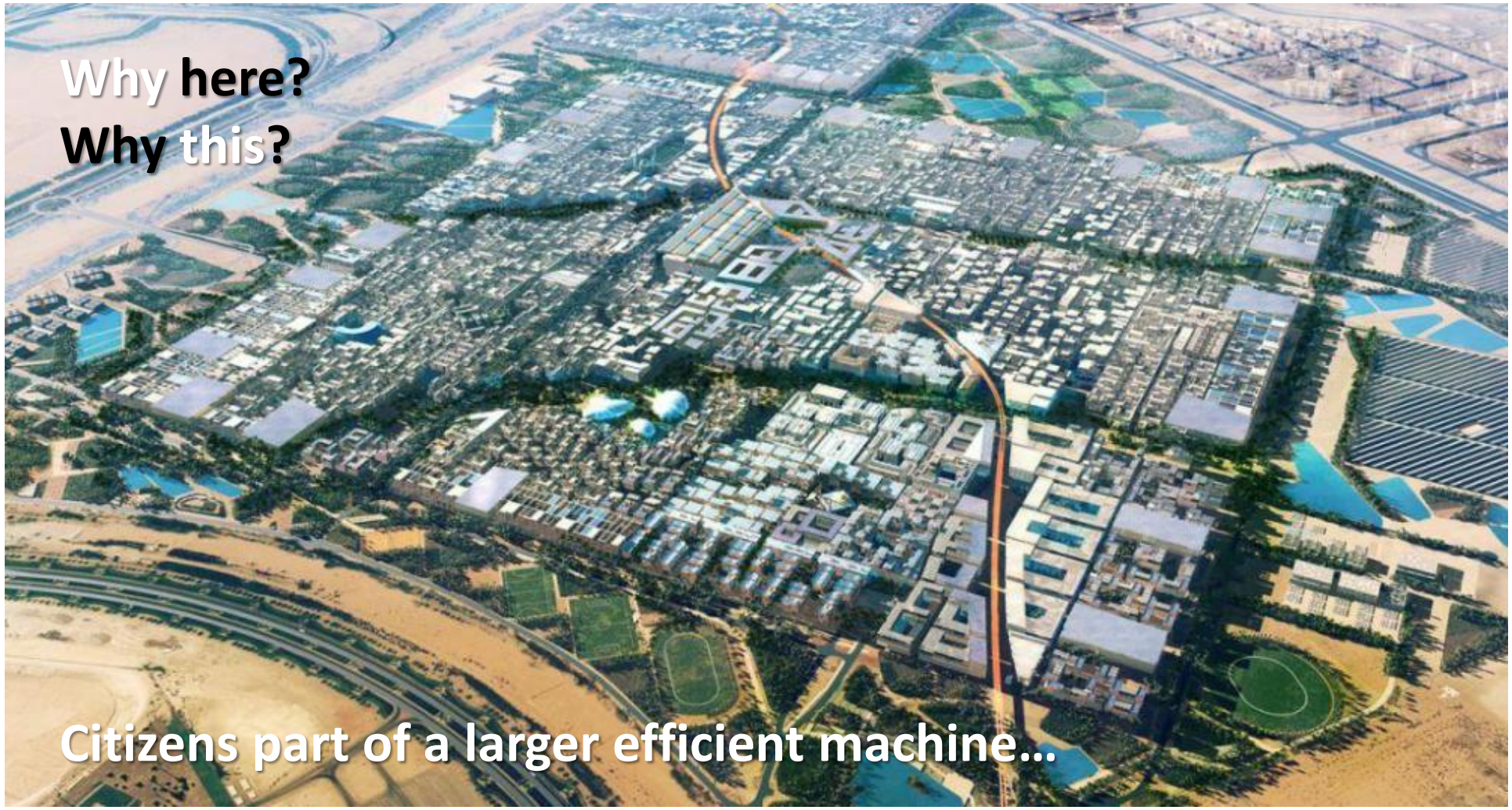

SUSTAINABLE CITY
SMART CITY
"LABELED"
"REAL"
SMART ENERGY CITY
Application of ICT
Collaboration of Key Stakeholders
Integration of Domains
Social Sustainability
Economic Sustainability
Environmental Sustainability
Institutional Sustainability

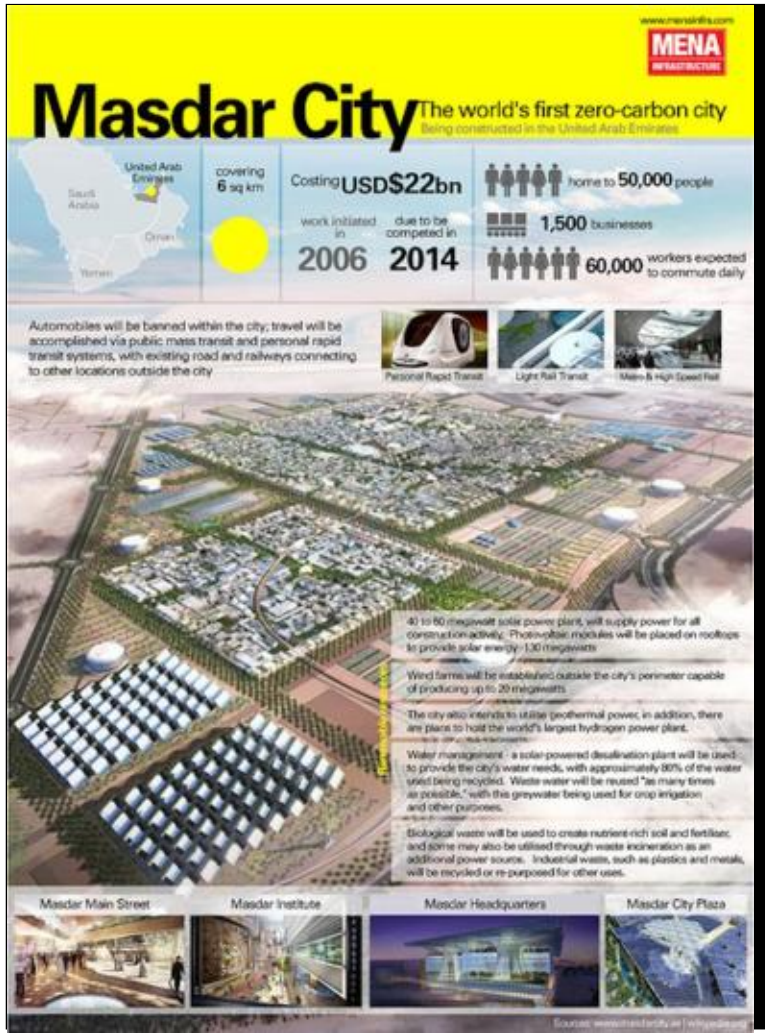
Eurac: 2016


SMART CITIES 3.0
CITIZEN CO-CREATION
3
SMART CITIES 2.0
TECHNOLOGY ENABLE,
CITY-LED
2
SMART CITIES 1.0
TECHNOLOGY DRIVEN
1

- SMART CITIES 1.0: TECHNOLOGY DRIVEN

  - Smart Cities 1.0 is characterized by technology providers encouraging the adoption of their solutions to cities that were really not equipped to properly understand the implications of the technology solutions or how they may impact citizen quality of life.


Why here?
Why this?
Citizens part of a larger efficient machine…



Masdar City to become the world's first green and net-zero energy in the world by 2016

Only about 5% of the original six square kilometer building area has been developed.

Developers expected 50,000 permanent residents and 40,000 commuters

In 2016, there are only 300 permanent residents of Masdar City and 1700 commuters

- SMART CITIES 2.0: TECHNOLOGY ENABLED, CITY-LED

  - This phase has been led by cities, as opposed to technology providers. In this generation, the municipality–led by forward-thinking mayors and city administrators–takes the lead in helping determine what the future of their city is and what the role is for the deployment of smart technologies and other innovations.


CityBikes app, App&Town, SOS info built thanks to **Open Data** of the City
ioT trash cans report their real-time status
ApparkB and Bicing encourage **smart mobility**
Smart City Campus Innovation Area to promote synergies and **innovation in urban solutions**
SMARTCITY
EXPO WORLD CONGRESS


BARCELONA Virtual Situation Room powered by CITYZENITH 5D Smart City
25 JUL 2014
BUILDINGS
ENERGY
DAY LIGHT
CAMERAS
100-80%
80-40%
40-20%
all layers

- SMART CITIES 3.0: CITIZEN CO-CREATION (COMMUNITIES?)

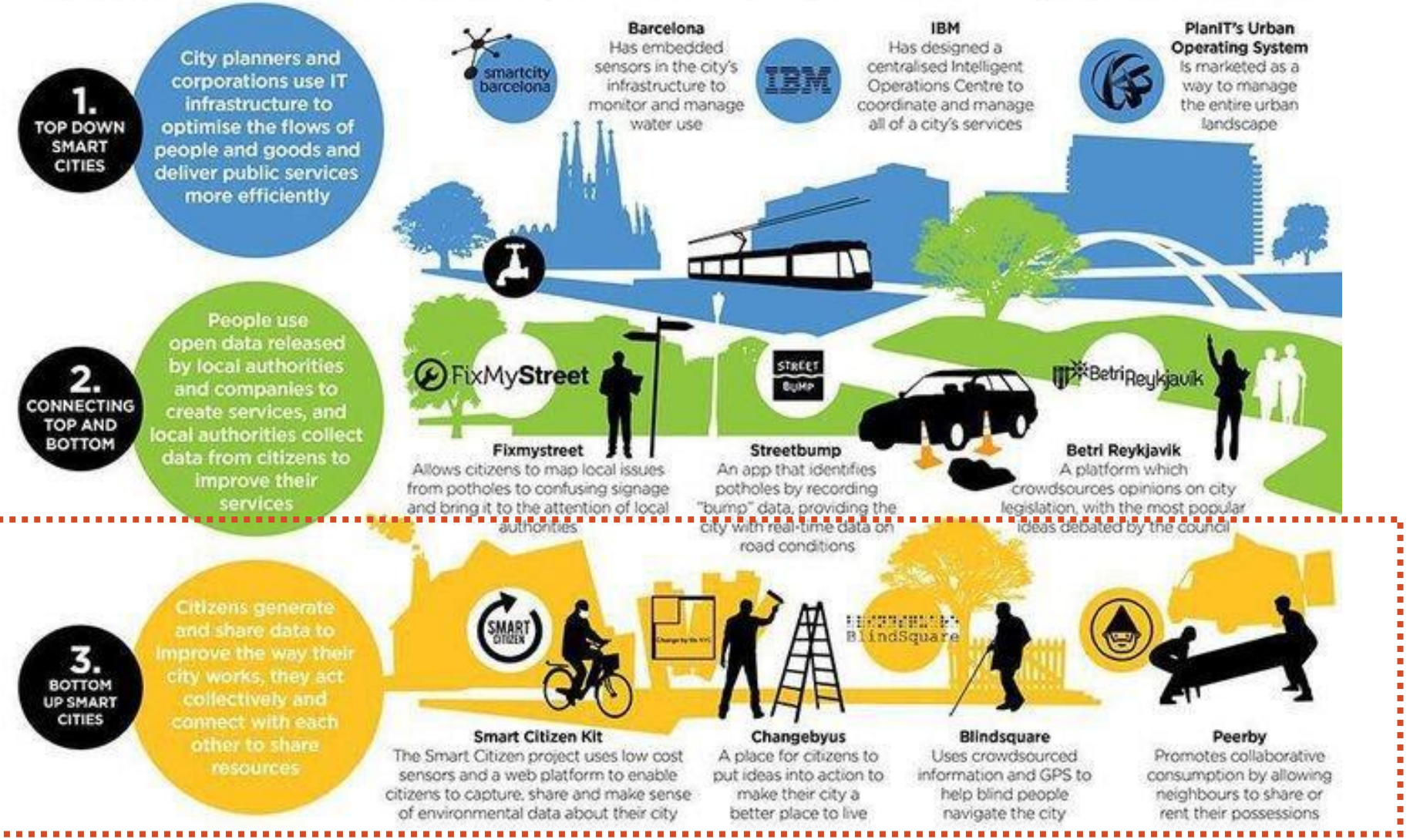
  - smart cities are beginning to embrace citizen co-creation models for helping to drive the next generation of smarter cities

  - A living lab is a research concept. A living lab is a user-centered, open-innovation ecosystem, often operating in a territorial context, integrating concurrent research and innovation processes within a public-private-people partnership.

  - The concept is based on a systematic user co-creation approach integrating research and innovation processes. These are integrated through the co-creation, exploration, experimentation and evaluation of innovative ideas, scenarios, concepts and related technological artefacts in real life use cases.

SMARTER SMART CITIES

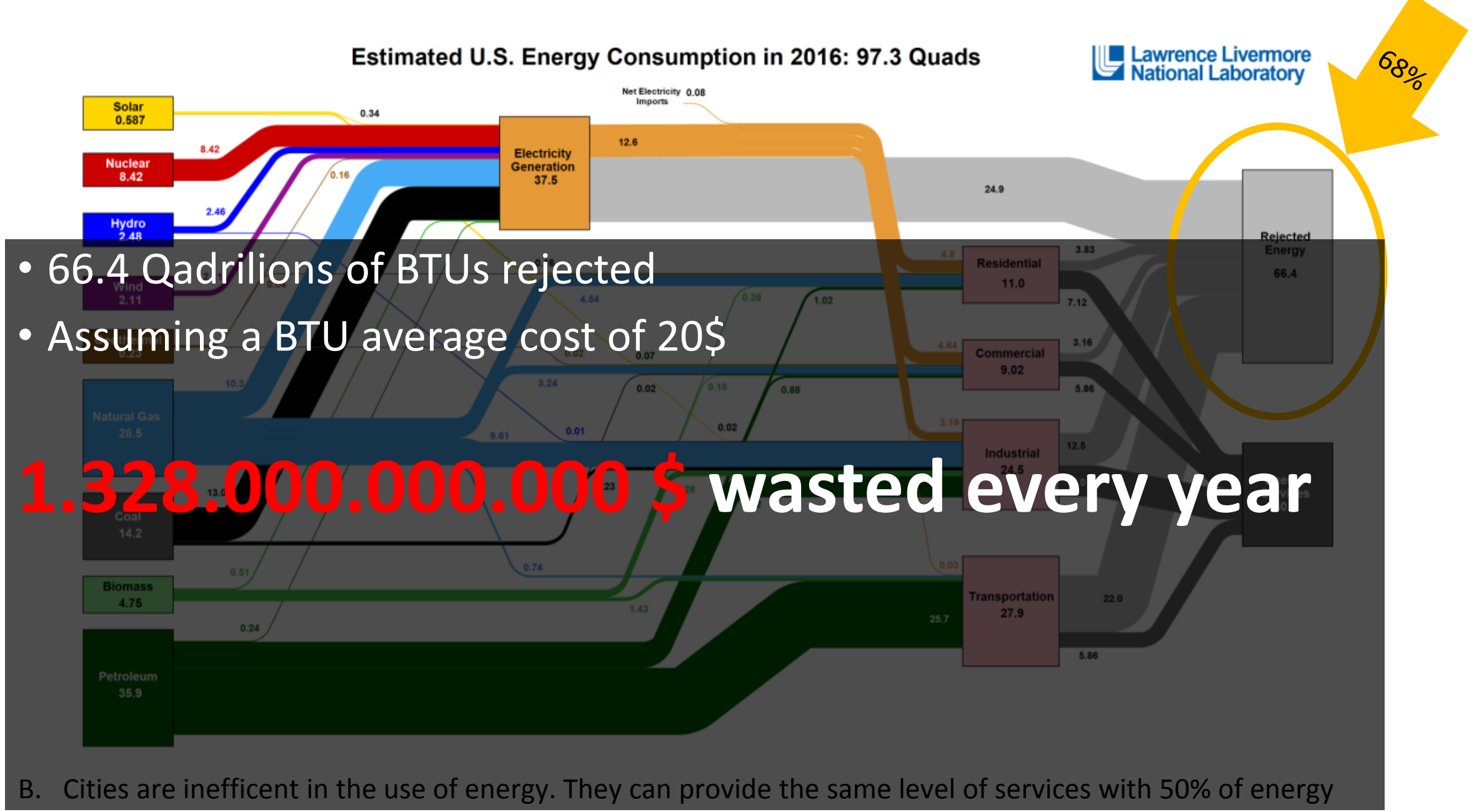
The "smart cities" agenda is mainly focused on top down technological initiatives (embedded sensors, data integration and analytics).
The real smart cities of the future will mobilise human intelligence as well as artificial intelligence, bottom up creativity as well as top down control.




QUADRUPLE HELIX MODEL
ACADEMIA
GOVERNMENT
INDUSTRY
USERS

E.

How to finance?



- 66.4 Qadrilions of BTUs rejected
- Assuming a BTU average cost of 20$

1.328.000.000.000 $ wasted every year

B. Cities are inefficent in the use of energy. They can provide the same level of services with 50% of energy

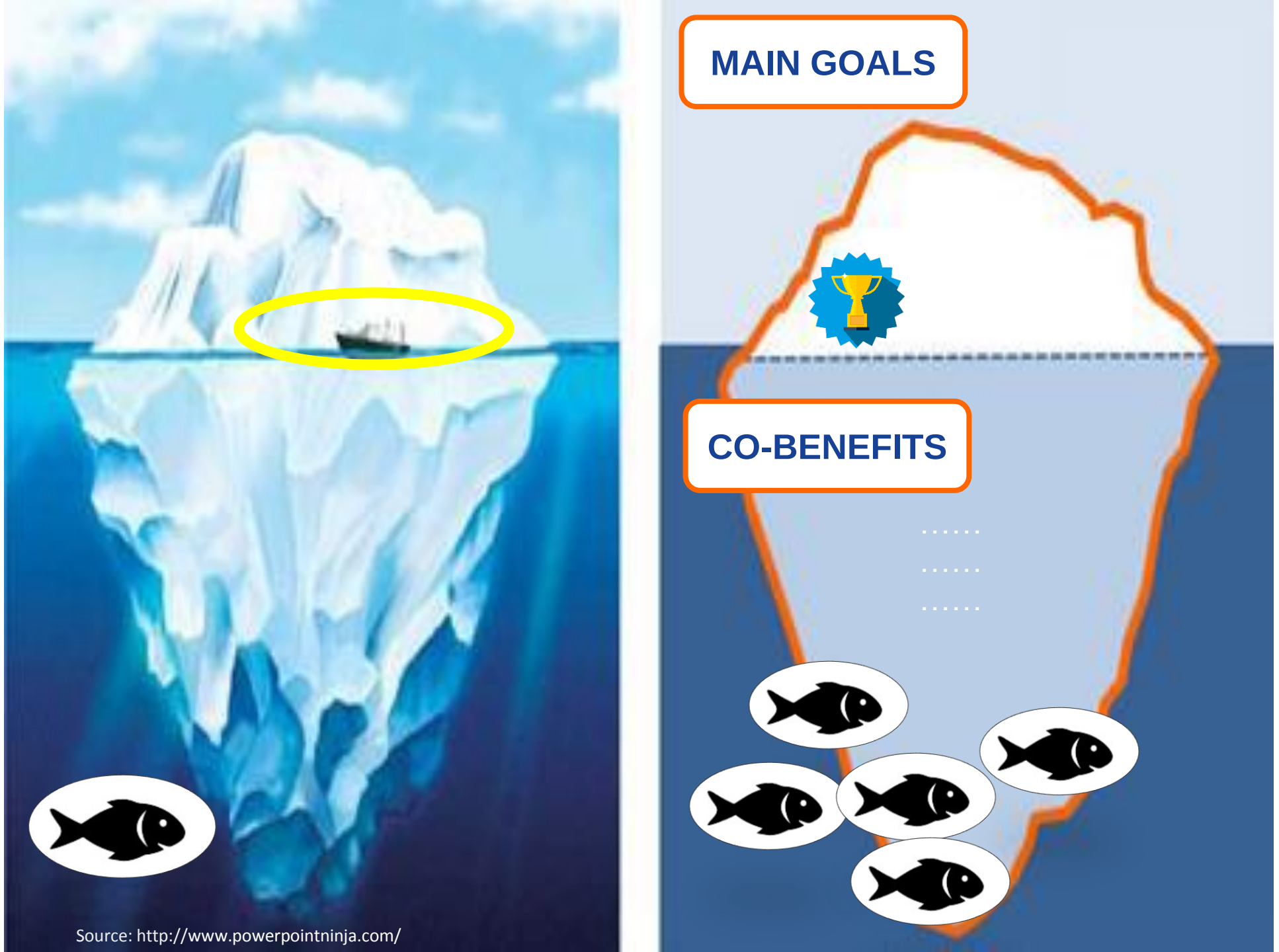
ONE PROJECT

ONE GOAL

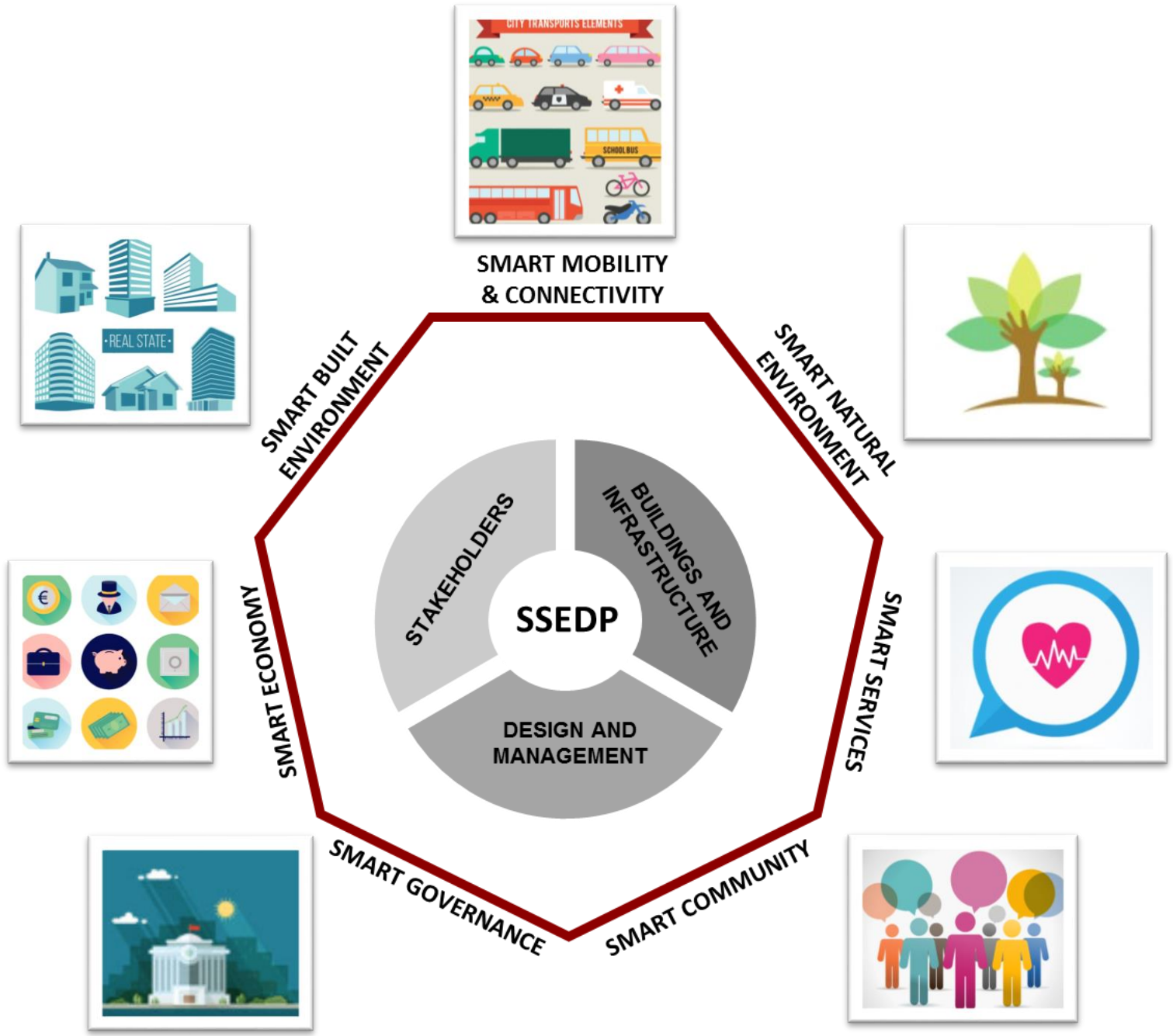
SEVERAL CO-BENEFITS

A co-benefit is any socio-economic and environmental positive effect related to the execution of a project, exceeding the primary goal, regardless if intentional or not.

Source: International Energy Agency (2014)

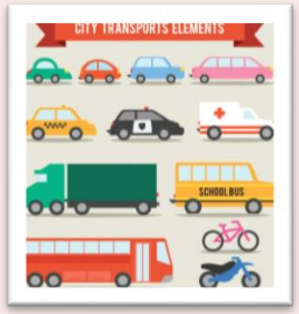

MAIN GOALS
CO-BENEFITS
Source: http://www.powerpointninja.com/

Smart and Sustainable Energy Development of Cities



	Smart natural environment	**Local air quality improved**
		Environmental resources management improved
	Smart services	**Health and well-being of residents increased**
	Smart community	**Fuel poverty tackled**
		Users awareness on energy-related issues increased
		Neighbourhood identity enhanced

	Smart governance	**Innovation in processes and decision-making**
		Territorial attractiveness increased
		Institutional relationship and networks created
	Smart economy	**Local labour market stimulated**
		Positive change in local tax revenue
		Softer loan conditions
		Local energy supply chain established
		Energy services developed
		Innovation in technology development and adoption
		Professional skills development

	Smart build environment	**Property value increased**
		Costs reduction of buildings life cycle
		Resilience of energy infrastructures increased
	Smart mobility & connectivity	**Reduced pollutant emissions** **Reduced numbers of veichels** **Optimized and integrated transport system**

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