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GREEN CITIES AND SETTLEMENTS

UNIVERSITY of OULU
OULUN YLIOPISTO

Greensettle research:
Defining the framework of Eco-municipalities

Ioannis Chamilos & Eva Pongrácz

University of Oulu, Thule Institute, NorTech Oulu

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Objectives of work

- Promote the use of environmental technologies to achieve resource efficiency in an urban context

- A key role is to tackle environmental challenges and address the environmental and economic impacts of cities

- In this study, the general framework and a sustainable planning method for municipality development is described through the concept of eco-municipalities

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Urbanization and resource efficiency

- Urbanization, inefficiency in resource use and climate change have created environmental stress

- Societies need to adapt cross-cutting sustainable solutions to overcome limitation provided by the scarcity of resources and the challenges of climate changes impacts

- Since resources are the main drivers of economic activities, a resource efficient built environment will positively contribute

  - to energy security,

  - to the reduction of greenhouse gas emissions and

  - to pollution of soil and water bodies, as well as

  - to the conservation of non-renewable resources

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The concept of eco-cities

- Eco-cities date back to 1975
- A group of visionary architects and activists created the non-profit organization called Urban Ecology
- The mission of Urban Ecology was urban planning, ecology and public participation in order to rebuild the cities in balance with nature
- In 1985, the Urban Ecology team collaborated with citizens of Berkeley California, to redesign a street for bicyclists, safe to walk and slow down the speed of cars.
- The name of this effort was "slow street" and the mission was to raise awareness on our dependence on fossil fuels
- Urban Ecology studies ecosystems, alternative transportation, environmental justice and urban design in modern cities
- Further on, eco-city initiatives have defined a common framework of ecological cities

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10 principles of eco-cities

1. *"Revise **land-use** priorities to create compact, diverse, green, safe, pleasant and vital mixed-use of communities near transit nodes and other transportation facilities"*

2. *"Revise **transportation** priorities to favour foot, bicycle, pubic transport over autos, and to emphasize access by proximity"*

3. *"Restore damaged **urban environments**, especially creeks, shore lines, ridgelines and wetlands;"*

4. *"Create decent, affordable, safe, convenient, racially and economically mixed **housing**;"*

5. *"Nurture **social justice** and create improved opportunities for women, people of minorities and the disabled;"*

Ref.: Urban Ecology

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10 principles of eco-cities

6. *"Support local **agriculture**, urban greening projects and community gardening;"*

7. *"Promote recycling, innovative **appropriate technology**, and resource conservation while reducing pollution and hazardous wastes;"*

8. *"Work with businesses to support **ecologically sound economic activity** while discouraging pollution, waste, and the use and production of hazardous materials;"*

9. *"Promote **voluntary simplicity** and discourage excessive consumption of material goods;"*

10. *"Increase **awareness** of the local environment and bioregion through activist and educational projects that increase public awareness of ecological sustainability issues"*

Ref.: Urban Ecology

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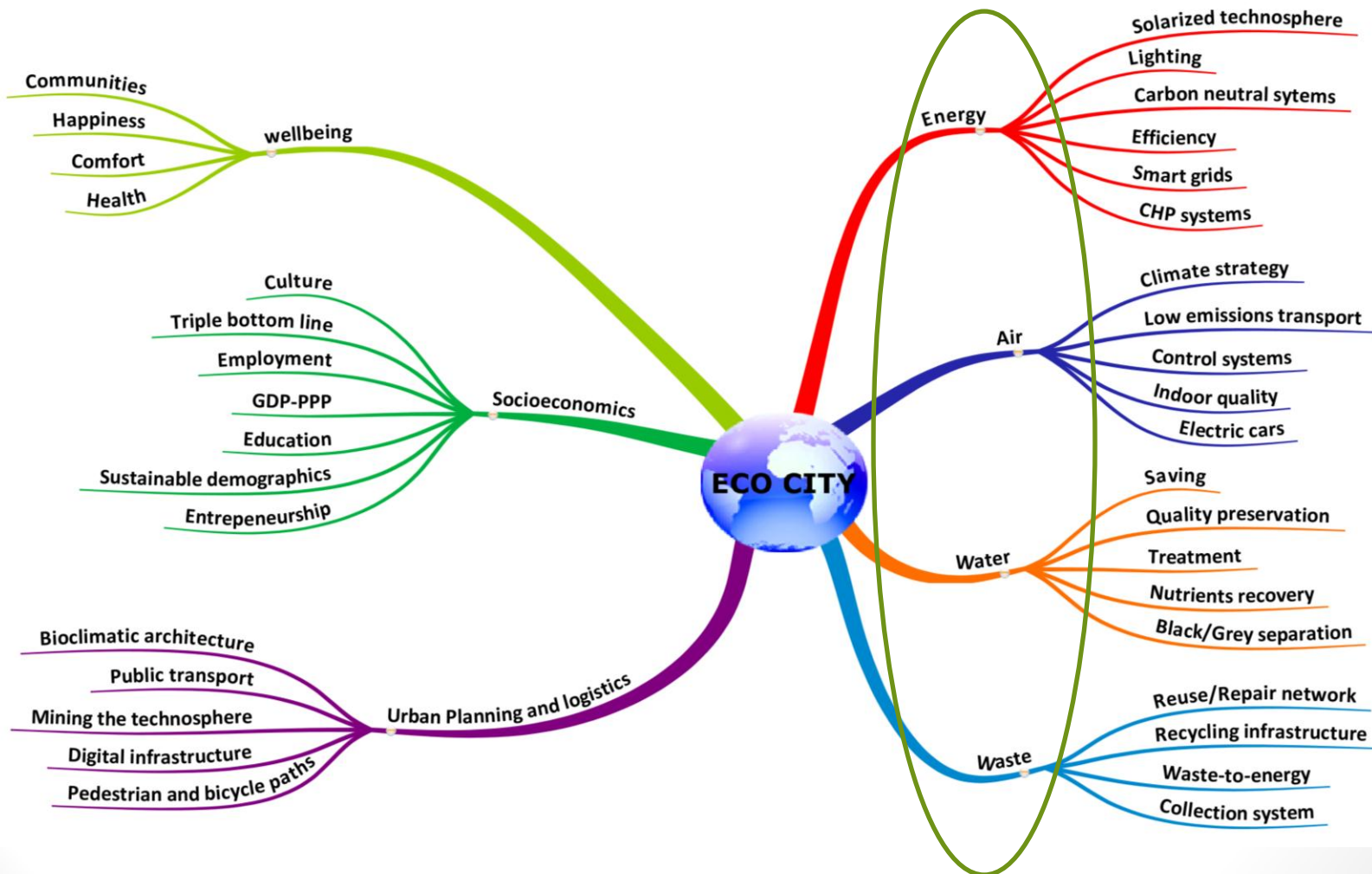# What are "appropriate technologies"?

- The ideological movement of Appropriate Technology (AT), founded by E.F. Schumacher in 1973
- AT methodologies, strategies and practices are related to economic development, environmental and social sustainability
- The goal is to utilize local resources for common benefits of the society and to introduce technologies compatible with local settings
- Some of these technologies are:
  - *Passive solar design*
  - *Solar collectors for heating and cooling*
  - *Roof-top gardens*
  - *Hydroponic greenhouses*
- The main goal of using AT is to promote self-reliance of people on a local level
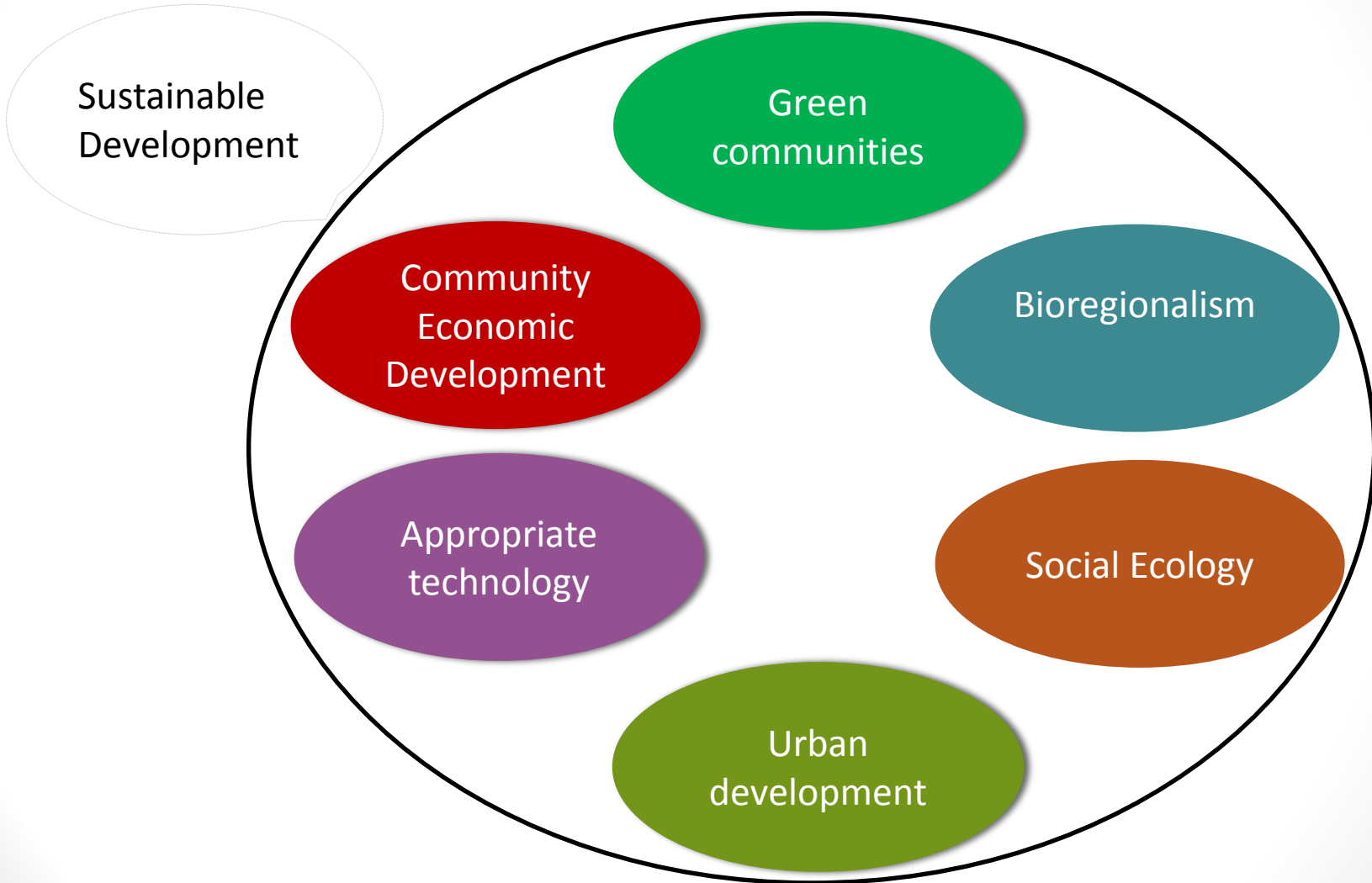
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Our additions…

- Smart houses (control system, energy balance, bioclimatic comfort)
- Solar, photovoltaic (PV) and solar thermal panels
- Windmills
- Heat pumps
- Waste & biomass-based energy
    - Pelletization
    - Gasification
    - Small scale CHP
- Solid state urban lighting
    - (e.g. led)

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The elements of an Eco-City

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Sustainable regional development

Sustainable Development

Green communities

Community Economic Development

Bioregionalism

Appropriate technology

Social Ecology

Urban development

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Energy-Water-Air-Waste boundary

- In nature, the biogeochemical cycles are closed
  - carbon cycle
  - water cycle
  - phosphorus cycle
- The interaction of the biogeochemical cycles, the energy and water cycles and that of human activity can be considered as the functioning of the global Earth System
- From a regional level to a city, town, village, neighbourhood level and, ultimately, to a building, the borders between these urban units create boundaries of interactions
- Within the concept of eco-city, a key activity is to control material, energy and waste flows across these boundaries
- In this research, the focus was on describing the Energy-Air-Water-Waste boundary and the selection of environmental sound technologies

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The Natural Step Framework

- The Natural Step (TNS) framework has been used as a participatory planning tool

- The method encourages authorities to generate targets for sustainability and apply integrated sustainability planning

- The method also fosters communication between public authorities and proponents to achieve resource efficiency

- The framework introduced a set of sustainability principles applying a certain methodology to look at the "big picture" of communities

- Communities under this framework set common goals and create the assets for the future generation to inherit and continue to develop

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System conditions of TNS

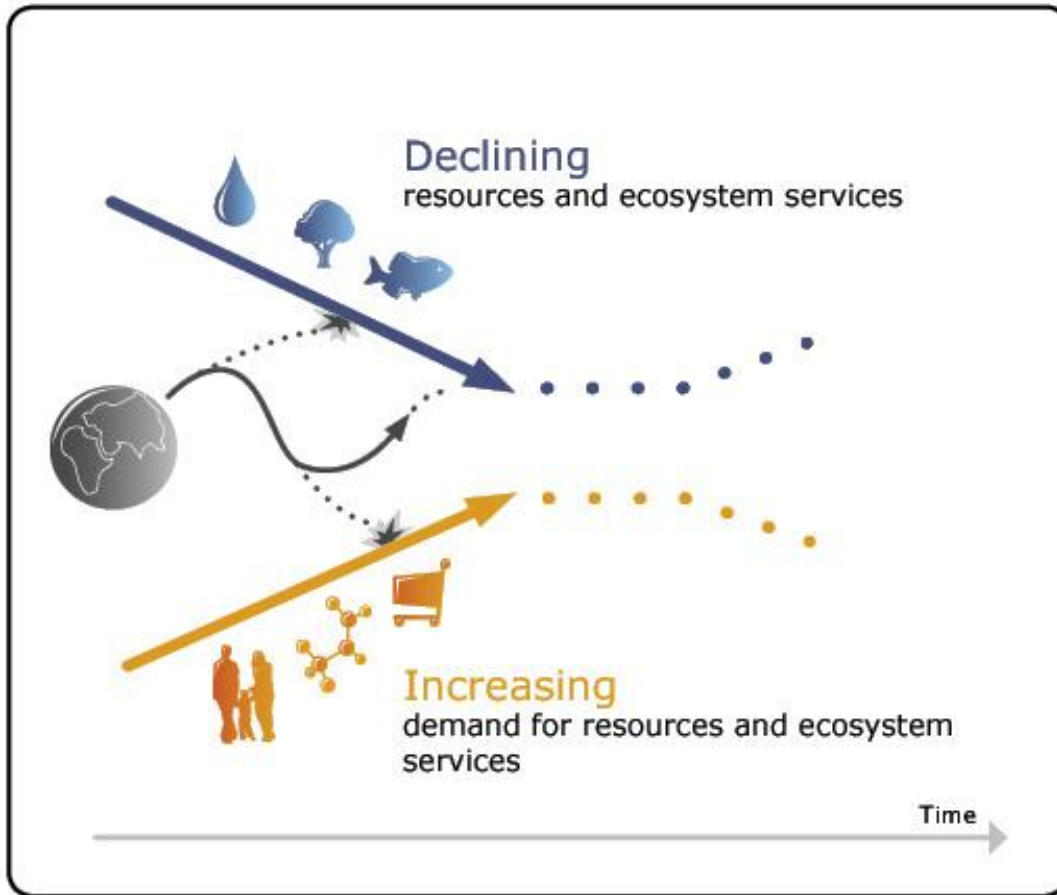1. Eliminate our contribution to systematic increases in concentrations of substances from the earth's crust

2. Eliminate our contribution to systematic increases in substances produced by society

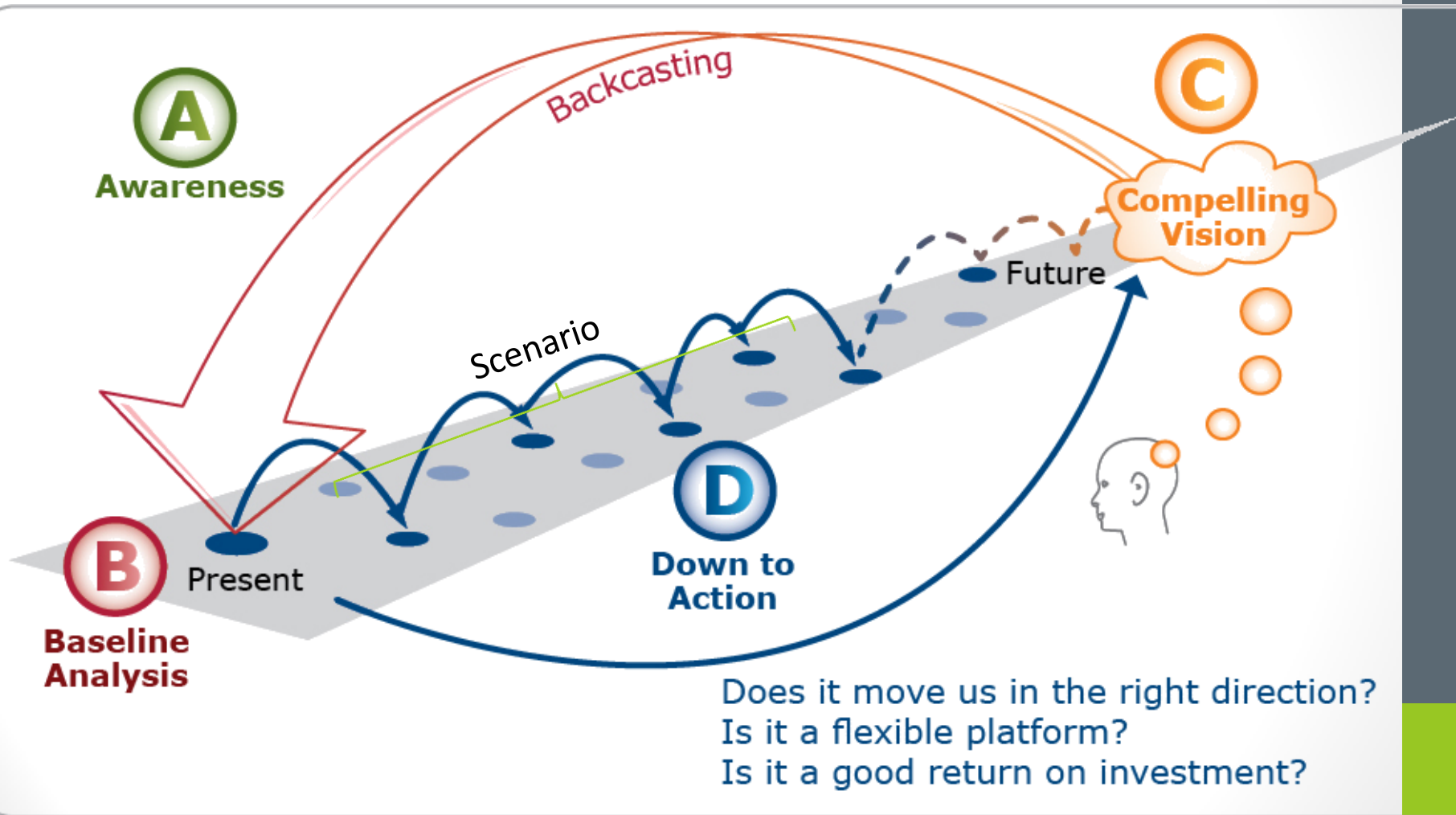3. Eliminate our contribution to systematic physical degradation of nature

4. Remove barriers that undermine human's ability to meet their needs worldwide

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The "funnel"

The ABCD method

Backcasting

A Awareness

C Compelling Vision

Scenario

Future

B Baseline Analysis

Present

D Down to Action

Does it move us in the right direction?
Is it a flexible platform?
Is it a good return on investment?

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Set of actions towards developing eco-cities

	A	B	C	D	E
	Urban Development	**Traffic & Transportation**	**Energy (Heat & electricity)**	**Municipal Waste Management**	**Water & Sanitation**
1	Prevent **urban sprawl**	Retrofitting city buses with catalytic converters	Energy saving plan for municipal buildings (using energy saving equipment and smart monitoring)	Improve present landfills and utilize landfill gas	Harvest rainwater for irrigation purposes
2	Densification of existing urban structure	Create dedicated bus lines	Energy and environmental inspection of public infrastructure to reduce energy losses and pollution	Identify priority waste streams to set up recycling systems	Subsidize water efficient taps and shower nozzles
3	Plan for mixed uses (better proximity to **urban functions**)	Extend roads to improve traffic flow	Pilot investment in small-scale decentralized system (e.g. waste-to-energy or bioenergy)	Set up recyclables collection points for citizens (such as **Ekopoints**)	Wastewater sludge utilization system (e.g. biogas production)

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Set of actions towards developing eco-cities

	A	B	C	D	E
	Urban Development	**Traffic & Transportation**	**Energy (Heat & electricity)**	**Municipal Waste Management**	**Water & Sanitation**
4	Integrate infrastructure planning with service development	Incentives to reduce car use (walking & bicycle lanes)	Subsidize refurbishment of existing buildings for energy saving (energy saving equipment and monitoring)	Awareness raising campaign for waste prevention and minimization	Improve the efficiency of water purification plant
5	Plan for the *recreational aspects* of urban space	Biofuel –run vehicles for municipal fleet (buses, trucks…)	Energy saving street lighting system	*Wet/dry separation* of waste & organic waste collection	Improve the quality of water and sanitation infrastructure
6	*Participatory Planning*.	Plan for an infrastructure to support the use of electric cars	Promote use of renewable based electricity	Kerbside separate waste collection system	Awareness raising for water saving
7	Urban interaction (*UBI*) system	Transport *ICT* systems (logistics, timetables, etc.)	Development of *smart grids*	ICT system to optimize waste collection and transportation efficiency	Pilot areas/buildings with grey-water recycling system (*living machine*)

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Actions preferred by Kostomuksha municipality

|	A	B	C	D	E
	Urban Development	Traffic & Transportation	Energy (Heat & electricity)	Municipal Waste Management	Water & Sanitation
1	Prevent urban sprawl	Retrofitting city buses with catalytic converters	Energy saving plan for municipal buildings	Improve present landfills and utilize landfill gas	Harvest rainwater for irrigation purposes
2	Densification of existing urban structure	Create dedicated bus lines	Energy and environmental inspection to reduce energy losses and pollution	Identify priority waste streams to set up recycling systems	Subsidize water efficient taps and shower nozzles
3	Plan for mixed uses (better proximity to urban function)	Extend roads to improve traffic flow	Pilot investment in small-scale decentralized energy solutions	Set up recyclables collection points (*Ekopoints*[3])	Wastewater sludge utilization (biogas)
4	Integrate infrastructure planning with service development	Incentives to reduce car use (walking & bicycle lanes)	Subsidize refurbishment of existing buildings for energy saving	Awareness raising for waste prevention and minimization	Improve the efficiency of water purification plant
5	Plan for the recreational aspects of urban space	Biofuel –run municipal fleet	Energy saving street lighting system	Wet/dry separation of waste	Improve the quality of water and sanitation infrastructure
6	Participatory Planning	Infrastructure supporting the use of electric cars	Promote use of renewable based electricity	Kerbside separate waste collection system	Awareness raising for water saving
7	Urban interaction (UBI) system	Transport ICT systems	Development of smart grids	ICT system to optimize waste and management	Pilot areas with grey-water recycling (living machine)

Action priority matrix

	Low impact	High impact
Easy (short-term investment)	"Fill ins" Short-term investments, which come after the major projects and quick wins.	"Quick wins" Relatively cheap and easy initiatives or strategic decisions that can be quickly implemented
Difficult (long-term investment)	"Hard slogs" Actions which have low returns of investments and are time consuming; however, could be used at a different time and in different way to bring quick wins	"Major project" Long-term investments which, if broken down to smaller investments, could bring a sequence of quick wins

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Sorted actions from Kostomuksha municipality

	Environmental Economic and Social Impact	
	Low impact	**High Impact**
Easy (short-term investments)	*Fill-Ins*: **C.1:** Energy saving plan for municipal buildings **C.5:** Energy saving street lighting system	*Quick wins*: **A.7:** Urban interaction (UBI) system
Difficult (Long-term investments)	*Hard slogs*: **C.3:** Pilot investment in small-scale decentralized system **B.5:** Biofuel –run municipal fleet	*Major projects*: **A.1:** Prevent urban sprawl **A.3:** Plan for mixed uses **D.2:** Identify priority waste streams **E3:** Wastewater sludge utilization (biogas) **E.4:** Improve the efficiency of water purification plant **E.5:** Improve the quality of water and sanitation infrastructure

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Recommendation for the timeline

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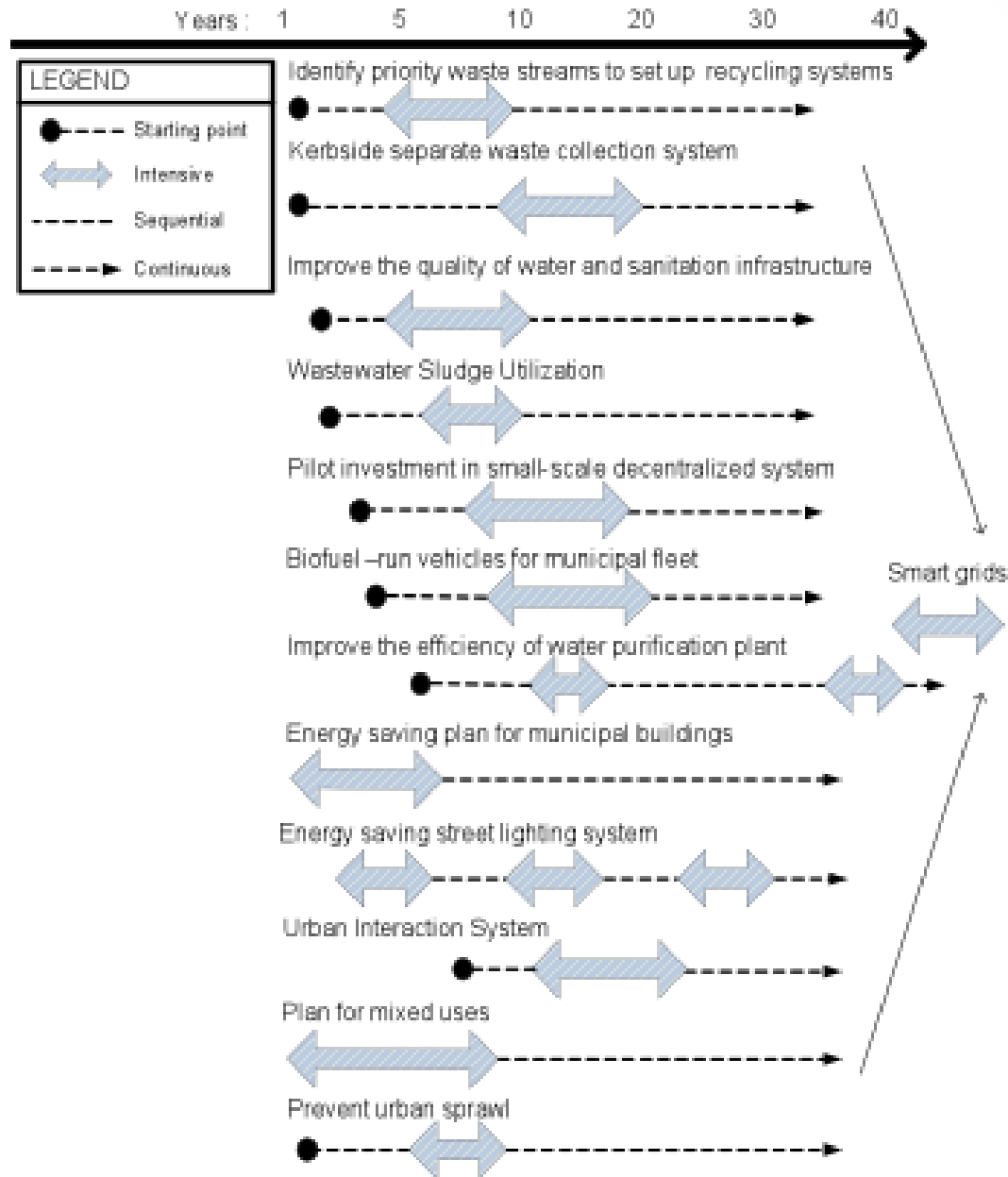
Summary

- Environmental technologies such as sustainable energy systems, water treatment technologies, air pollution control and waste management have a key role to achieve resource efficiency in cities

- Resource efficiency can be rephrased as minimization of negative environmental impacts, from using less energy-water-air-waste resources in order to improve economic activities and wellbeing

- In this respect, resource efficiency can be achieved by optimizing the energy-water-air-waste networks and realizing synergies between these networks

- There are still many open questions on how cities could be developed

- The main concern in this work is how to best apply environmental technologies under the process of sustainable development

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