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INNOVATION AND SUSTAINABILITY TRANSITION IN BECOMING AN ENERGY SMART CITY

РОЛЯТА НА ИНОВАЦИИТЕ В УСТОЙЧИВИЯ ПРЕХОД КЪМ ЕНЕРГИЙНО ЕФЕКТИВНИ ИНТЕЛИГЕНТНИ ГРАДОВЕ

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***Abstract**: The work towards becoming a leading energy smart city requires significant change and innovation, including both continuous incremental work and more radical, discontinuous innovation in the transition to a sustainable energy system. It requires creative destruction in replacing unsustainable with sustainable technologies, practices and infrastructures. City action planning needs to enable this work and secure innovation and transition capacity for this long term innovation and transitional work. In the paper guidelines are developed as an aid in this work and an input.*

***Key words:** energy smart city, innovation, planning, sustainability transition.*

***JEL Codes:** O31; O44; Q55; Q58*

INTRODUCTION

First, we must recognize that the outcome of transition and transition's target must be a sustainable biosphere capable of indefinitely supporting human and other species' life and welfare. All other intermediate aims and targets must refer to and be tested against this one. Energy efficiency is therefore not simply a target in its own right. The target is the reduction of effects of energy production and consumption harmful to the environment and to our future on this planet. While energy efficiency can contribute to this aim, in order to do so it must result in real lower gross energy demand and/or substitutions of renewable and carbon neutral sources for fossil fuel energy sources leading to substantial gross reductions in (towards the elimation of) carbon emissions.

We need to remain aware that the commodification of energy as well as the continuing invention of new uses for energy are factors that threaten to undo the good work of increasing energy efficiency (Read, Lindhult & Mashayekhi, 2015; Read & Lindhult, 2015).

The point, as far as energy efficiency is concerned, is we should be doing better. Energy efficiency and substitution of fossil fuels by renewable and carbon neutral sources should be causing steep decreases in energy demand and fossil fuel consumption and this is not at present happening (Read, Lindhult & Mashayekhi, 2015).

We need to not only demonstrate that we can reduce demand substantially and radically reduce fossil fuel budgets but also that we understand what alternative sustainable forms of development are and develop these and promote them to central governments and others.

1. THE AIMS OF TRANSITION

The primary aims of transition must always be kept in mind. The exact course of transition is always uncertain but we can know what we want to achieve as a result of transition. In order to achieve these primary aims we need to look beyond energy efficiency as an end in itself to factors like climate change and monitor our progress in relation to these. The main 'integrated' aim of energy efficiency is the radical reduction of carbon emissions and there are only two ways that carbon emissions can be radically reduced. One is by a substantial and continuing reduction of energy demand and the second is by a radical substitution of fossil fuels by renewable and carbon neutral energy sources.

We also have to keep an eye on the global picture. To put it in simple terms, globally the greatest energy consumption demand (and therefore the greatest pressure for continued fossil fuel use) is caused by development. Europe is doing reasonably well in holding demand stable to the

extent it is not developing. To the extent that Europe is developing in a conventional manner it is undoing the gains being made by energy efficiency. The global demand for development is at present unstoppable and the main reason, in simple terms, is global inequality. Greater global equality will mean not just a better standard of living for poorer nations but also a more secure world and less migration pressure for the richer.

In a fair world we would be substantially reducing energy demand and eliminating fossil fuel use and taking the lead in developing green and other 'postdevelopment' alternatives to the 'development' mindset that undermines global sustainability today.

There are today positive signs in the redirection of development towards sustainability in all sectors of society, although emerging and empowered to very different extent in different areas of the world. The window of opportunity for preventing huge climate deterioration is quite limited according to expert assessment, but city planning in medium sized cities has the opportunity to build on these positive forces and be a significant force and a leadership role for sustainability transition. City planning needs to mobilize and integrate innovation drivers in different sectors – business, public, civic, academic, natural – in the city, and channel them towards long-term sustainability transition aims and to develop a quintuple helix approach to innovation.

Although transition is characterized by uncertainty, we can be sure that that change must translate into either radically less energy demand or into radically different energy sources (Read, Lindhult & Mashayekhi 2015). We can also be sure that resources in general must be either used much less or that the processing and lifecycles of resources will be handled very differently. How can we characterize change at this level of process? In general modern humans have used resources in a linear way, securing resources as raw materials, processing them for use, using them and leaving processing byproducts (including energy and emissions) and obsolete material as waste behind. Most natural processes on the other hand as well as many in traditional societies are circular. 'Waste' is recycled as raw material for further use.

City planning efforts should in future therefore be guided by the values of an integrated ecology and the principles of a circular economy, see figure 1, to reduce the footprint of energy production and consumption to what the local environment and the planet at large can handle to reproduce the ecosystem.

2. CIRCULAR ECONOMY

While modern humans have used resources in a linear way, securing resources as raw materials, processing them for use, using them and leaving processing byproducts (including energy and emissions) and obsolete material as waste behind, most natural processes and many in traditional societies are circular.

It should be clear that recycling loops will never return things to their original state – within each cycle energy is used which cannot all be recovered and, more significantly perhaps, there will be irreversible entropy gains. It should be clear as well that the capacity of local areas to deal with resource cycles in more complete ways may be rather low – sometimes much lower than present-day local area capacities which are achieved by importing materials, energy and energy sources and exporting waste and entropy, often to far-off lands (Hornborg 2001). This is one of the 'achievements' of contemporary globalization.

Core feedback loops need to be in place and work efficiently and leakages minimized. In working with innovation in energy efficiency towards a sustainable future it is important to recognize that efficiency is the relation between valued outcomes and performance targets, and resources to produce them, e.g. a system with coal based power plants for heating and electricity production can be very efficient if just heating and electrical power services as considered, but is quite inefficient if the performance target include environmental effects, like non-renewability of resources and leakage of greenhouse gases. In spite of the obstacles, including an inevitable drop in a different 'efficiency' ('economic efficiencies' that discount costs to the environment) and the economic productivity of linear processing, there is much more to be gained through closing lifecycle loops and treating material processes in more 'ecological' ways.

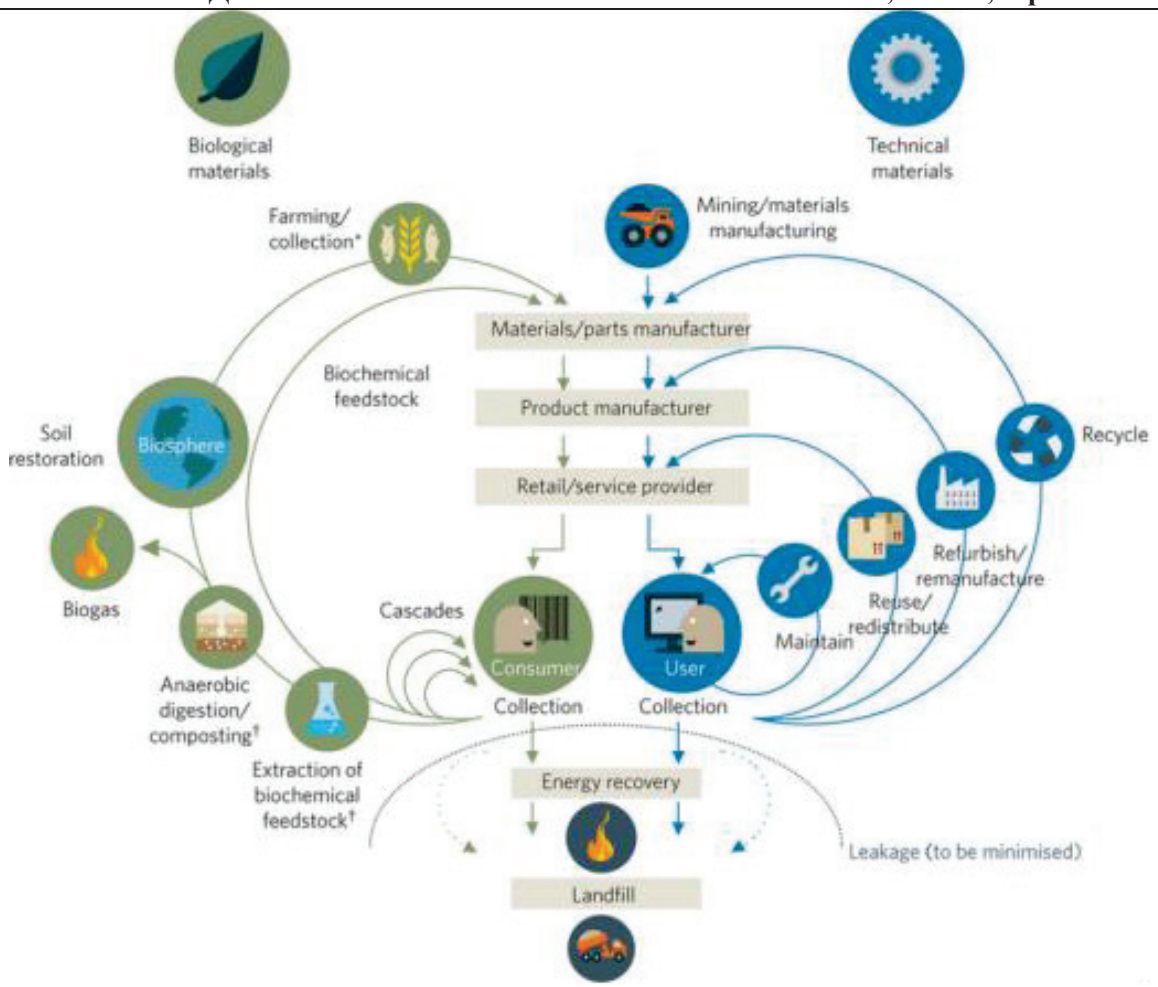

Fig. 1 Model of a circular economy (MacArthur Foundation, 2012)

One dimension in sustainability outcomes is resilience. The way to resilience – which is the task of the preparedness department in city planning – can come through a circular approach. However, one essence of resilience planning to have three alternatives available should one fail. Driving circularity to attempt to reach efficiency of resource use is fine only to a point, as it reduces resilience. For example: if people get unemployed there is a need to keep up their skills and competence and preparedness to join various activities should a disaster, like a climate event - flooding, hurricane, etc – occur. Efficiency might demand they seek work 24/7. The resilient city needs to have another approach to efficiency if it is to innovate itself into the sustainable future.

The circular economy as depicted here is not the whole solution. Alternative production models (prosumer, co-cooperatives etc.) to the materials-product manufacture-retail model shown here may be developed and important ecological and political detail needs to be added. From the ecological side the leakage of nutrients is a particular problem as are phosphate and nitrate cycles, while from the political side the roles of government and citizens need to be clarified.

With circularity as an overall aim in city planning, it is important to analyze where the city is situated, where it is moving as well as opportunities and requirements to innovate to achieve sustainability. It involves backcasting, scenario development, forecasting as well as simulating different developments, their effects and different ways to create a positive change. The concept of "backcasting" is central to a strategic approach to planning for sustainable development and innovation. A successful outcome is imagined in the future, then the question is asked: "what do we need to do today to reach that vision of success?" (The Natural Step).

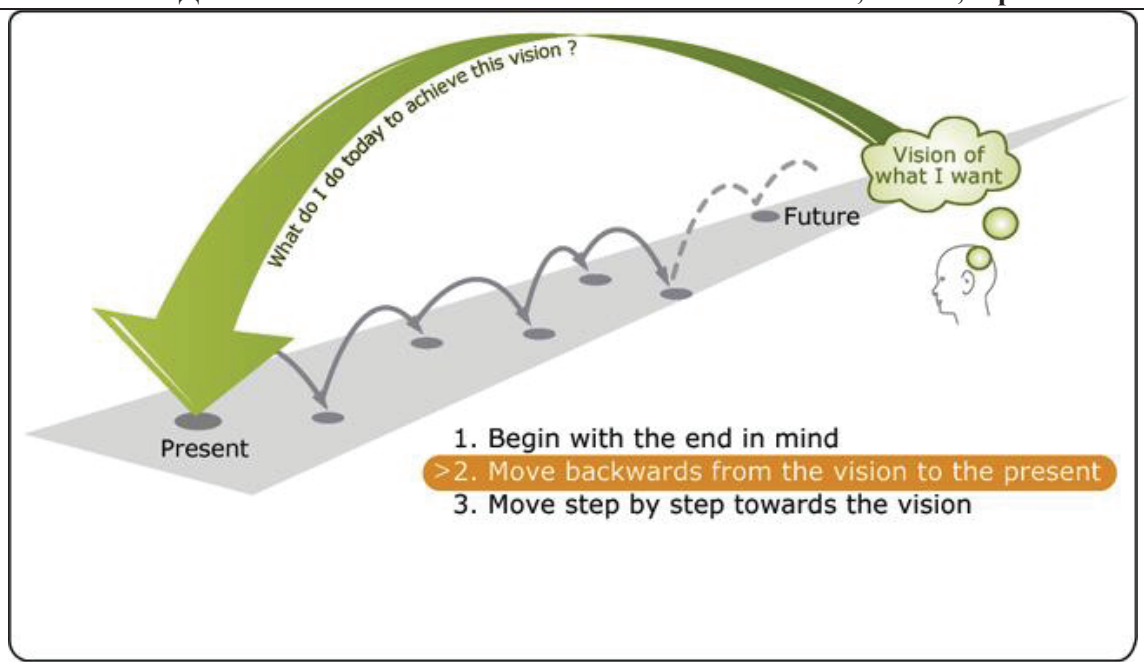

Fig. 2 Backcasting (The Natural Step)

3. WHAT SHOULD CITY PLANNING FOCUS ITS INNOVATION EFFORTS ON?

Innovation is 90% about framing the challenge. This is done first by mapping the system and looking for circularity potentials. Intervention points should be chosen at points that can create a change to circularity. Intervention should make use of local capital (human, social, resource, technology) and local incentives and disincentives (personal incentives, taxes and fees,

The planning process needs to spread the analysis as wide as possible to capture all non-circularity processes. The planning scope should be as wide as the planning authority reaches and beyond. If possible alliances should be made with other authorities to 'close loops' across political boundaries.

Mappings:

• Inputs and outputs of materials, components and commodities, fossil and other fuels, energy, losses and leakages (radiant heat, industrial heat, cooling, water, phosphates and nitrates, biological materials and nutrients).

• Behavior patterns.

• Infrastructures and the affordances and behaviors built into them

Analysis:

• Circular processes analyzed in steps, looking at actual behavior, identifying steps that break the cycle, 'backstepping' to identify the causes of cycle breaks.

• Maintenance processes. Assessing social and technical performance, building and maintaining human, social, resource and infrastructural capital.

Strategic factors:

• A capital approach. Create inventories of existing capital to support the circular economy: human (experts, practitioners, public), social (institutions, schools, universities, consulting firms), resource (local resources, socio-eco-system), infrastructural (built infra, public transport, energy, water, effluent etc.)

• Incentives and disincentives. Create inventories of fees and taxes levied (transport, land rent, water, sewage, parking, permits, etc.).

In working with innovation, many existing technologies and solutions need to be in different way modified and adjusted to fit the local environment technically and socially, as well to support its use. City action planning can enable these innovation processes. Inspiration and learning from others is essential, but imitation often do not work. Technologies used in the latter case need to be adapted but also integrated with existing solutions, as well as done in a culturally proper way in the context

of the very old Christian culture and what is permissible innovation in this context (systemic innovation).

Thus innovation, also focused on implementing already existing best available practice, often require significant investments. City planning can help to overcome barriers and investment requirements to reaching a more sustainable energy system for the city.

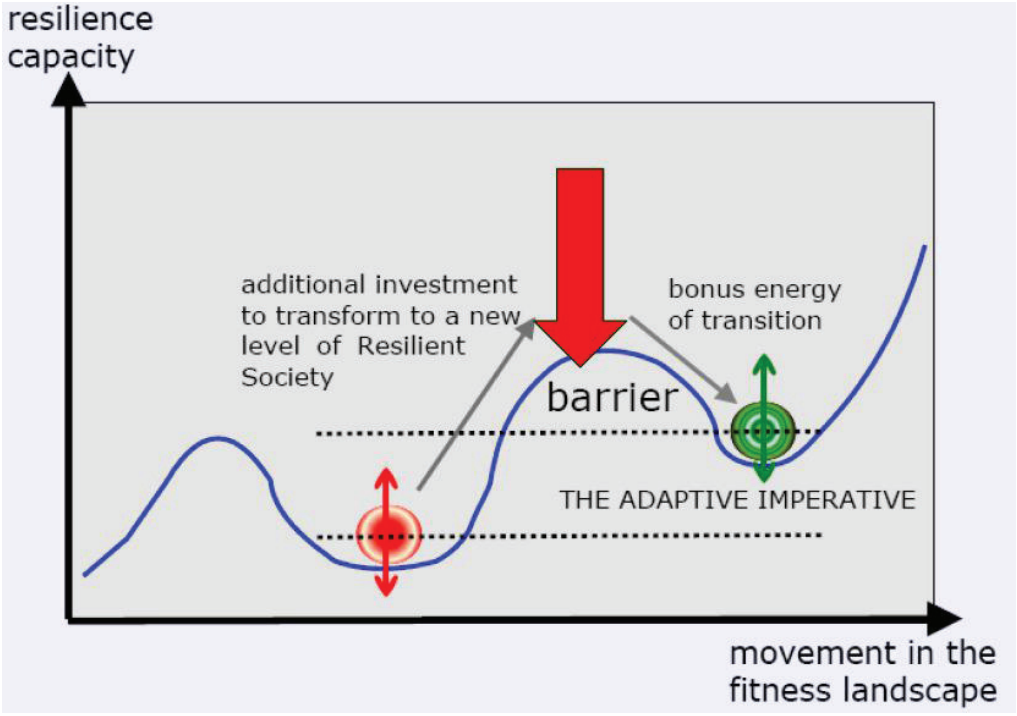

Fig. 3 The challenge of transition

How to work with and further innovation? Existing research on sustainability planning and transition (e.g. Smith, et.al., 2005) as well as experience from the cities indicate that a strategic orientation involving the following factors is important:

- Broad engagement of different stakeholders across sectors in working with sustainability innovation;
- Coordinated multi-level work among a network of community actors horizontally as well as vertically where top-down policies meet bottom-up initiatives;
- Looking ahead having a long term perspective on transition beyond short term goals;
- Shared visions which guide the work of community actors;
- Political commitment and support for sustainability innovation, implying that it is politically legitimized and embedded in existing policy-making frameworks;
- Resource availability and mobilization for investments and development work, such as finance and expertise;
- Nisches, spaces and sites for experimentation with new and alternative energy solutions. Experimentation can help explore a wide variety of options, both incremental and radical, which when proved their worth can accelerate the transition process;
- Ascertained dynamic mechanisms of change making sure that efforts persist even though immediate results are not materializing or setback occurs. This can be done by establishing innovation management capabilities in terms of good practices, competencies, relations and routines.

The planning ideal of coordinated empowerment where actors cross sectors are actively and collaborative is taking part in the work should not hide the fact that innovation for sustainability transition is a complex, systemic innovation journey involving tensions and conflicts between actors, different choices of technologies and worldviews. This is something which city planning need to adapt to and navigate. A proposal for city planning is consider the horizons in the figure below and analyze the situation and battleground of innovation involving city stakeholders.

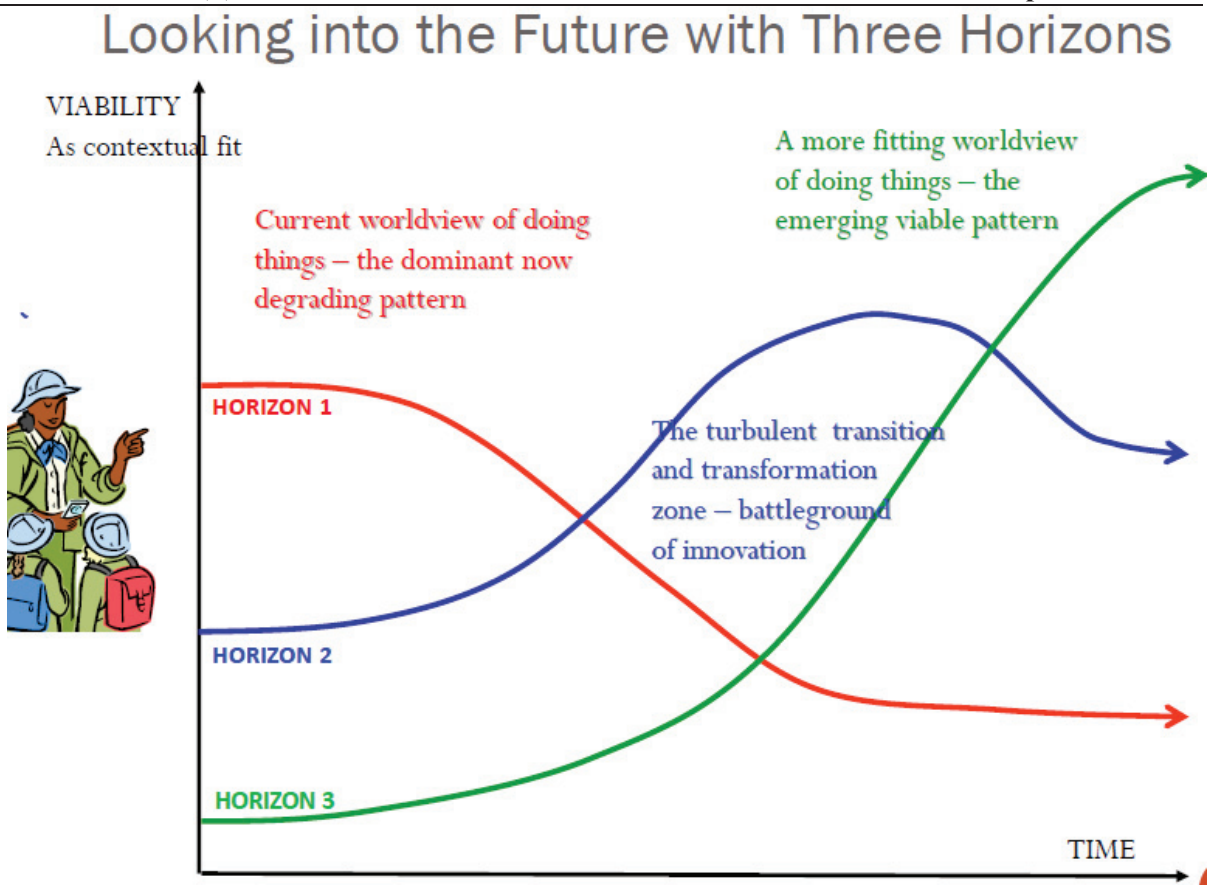

Fig. 4 Three horizon approach to scenario development of Sustainability paths (Sharpe, et.al., 2016)

Horizon 3 is gaining ground today, but still in a pace where the footprints of mankind is worsening. Considering the considerable population living in medium sized cities, there are considerable and urgent work which can be done in upgraded city planning, provided a shift to horizon 3 can be embedded in city action planning.

CONCLUSION

City planning need to deal with a number of concrete challenges experienced to consider in innovation and transition work. It shows that the transition to energy smart cities is a complex, systemic innovation journey where also seemingly simple technical solutions, are facing many-sided innovation challenges requiring a spectrum of city planning measures. To enable city innovation and transition processes the follow points is worthy of consideration;

– Broad based, interactive, participatory and situational approach is commendable;

– There is no one best way – processes elvolve through creative emergence and adaptation as much as elaborate planning;

– Cross-sectorial efforts is needed, e.g. Public-partner partnership, activism, ecoliving, ecopreneurship, circular business models, political struggle and agreements, etc.;

– Build momentum and activity – structure process through open, democratic dialogues, projectification and experimentation;

– Transversality (Cooke, 2012) is a core element for long run progress, build networks, alliances and broad influence.

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