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Connecting urban and regional socio-ecological transitions: Paths to a non fossil society in the  
Swedish Stockholm-Malar area

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**Abstract**

**Introduction:** The embedding of cities in a wider regional frame is central for long term planning regarding the transformation of such parts of society. This holds especially true for urban centers of national or sub national status. In this presentation we are drawing on 4 years of research work and stakeholder consultations in the Swedish part of the EU COMPLEX project dealing with the transition to non fossil societies. In our presentation the regional multi layered governance which encompasses both a large (the Swedish capital) city and its surrounding region with an archipelago of larger and smaller towns is at the heart of the presentation. Our core interest is in the transition to sustainable and resilient urban futures. Especially we are drawing on the experiences from the Swedish case in the EU project COMPLEX.

**Method:** We are relying both on stakeholder consultations with regard to long term planning as well as on specific regional modelling efforts covering specific features as municipality planning, economic regional analysis, land use studies and cognitive analysis regarding decision making by individuals,

**Results:** We have focused on the systemic interactions of many different kinds covering long term developments (up to 2050). Our focus is to analyze features of the transition process of our urban-region at large and the connected decision making features e.g. in terms of scenario elaborations.

**Discussion:** We highlight the differences of opinions among a wide range of stakeholders with regard to their understanding of the issues, their ideological positioning about core matters of concerns and the various positions about appropriate paths for reaching the goals of the transition to a non-fossil urban-

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super region situation in our chosen case area.

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## 1. Introduction

The interest for urbanization processes has further increased the last decade. One important reason is that already half of world population already now live in urbanized areas and a reasonable prognosis in the UN system indicates a raise to 70 percent within the next few decades.

However, the focus of the interest has been varying. Of course the role of megacities and connected structural issues are high on the list of interest - both scientifically and policy wise. This concerns especially how the challenges with regard to these structures should be sustainably planned, managed and being made livable. Also the tele connections between these megacities is of increasing interest [1].

But in parallel to these concerns also the development of urbanized regions - including a pattern of a multitude of larger and smaller cities and urbanized areas - in an interplay with what since long and in a different context has been called their "hinterlands" is of rising concern. This zooms in on the relationship between the core urban areas and the areas of non urban character that do feed the more intensely urbanized "hot spots" also in a globalized world. [2, 3, 4]. Referring to the German language origin of the word "hinter" (meaning roughly "beyond") it refers to a structural situation in which a strong distinction can be made of urban "city" centers positioned spatially in a broader surrounding area of more or less non – urbanized character.

However, especially in an European context, the urban cores and the "hinterlands" are closely blended in a broader spatial pattern. This development is in itself of great importance. It holds true for traditional concerns related to the feeding of the urban spaces with needed raw material and energy. It also deals with handling of the reverse streams i.e. of getting rid of the waste from the urban cores. In some scientific and planning traditions this has been referred to as the issue of "metabolism".

But these concerns have gradually expanded to other considerations as well e.g. with regard to climate change issues. Here both the adaptation issues related to urban space - i.e. to be better prepared to handle changed heightened intensified temperature and shock weather conditions - as well as the mitigation concerns, i.e. the urban contributions to the global climate change conditions through emissions to the atmosphere from these urban "hot spots".

Not least the urban contributions to the carbon dioxide component of such outlets is here of great concern, especially as the urban part of this contribution globally is becoming increasingly more dominant e.g. through the coupling to the energy systems serving the urban configurations. Thus the interest in urban structures in their relation to the more or less non- urban structures – often in a regional context – is quickly growing.

During 2015 the world community - in the form of the member countries of the UN - have both agreed to adopt and carry through the 17 Sustainable Development Goals (SDG) as well as agreeing on an ambitious program to combat the current direction of global climate change (as was done through the Paris December 2015 Agreement of COP21). The goal is to keep global warming to stabilize below 2 degrees centigrade (and as close to 1.5 degrees as possible). In both these two UN agreements the role of sustainability for the urban parts of the world has been noted as strategically very important. These urban related issues will not least be discussed at the next UN meeting in Habitat III in Ecuador in the Autumn 2016. In this context the special SDG for sustainable development in urban areas ("cities") (i.e. SDG11) will be of central interest. The background to these concerns is that soon - in a few decades - 70 % of global energy use and 70 % of GDP are according to reasonable prognosis to be generated in the constantly larger conglomerates of cities. And over 70 % of the global population will live in these areas.

There are many more aspects to these increasing roles of cities/urban conglomerations worldwide [5] both in a historical as well in a forward looking perspective. Just concentrating here on the urban

contribution to climate impacting emissions to the atmosphere it is very obvious that the pressure to find paths very soon to change current tendencies and work towards a less – or even zero - fossil world is very crucial. Also the timing aspect is here of great concern. The change cannot wait for too long.

The urban contribution to the global climate change conditions is thus rising and will have a strong influence in totality upon the global livable conditions [, 6, 7, 8, 9)]. In the very few next decades very large new – or old expanding – cities will have to be constructed. Then it is of central importance that this is done with strict recognition of sustainability principles – including those strongly pointing at ways to move towards a non fossil world. The experiences of urban development in Northern European countries – and not least in the Nordic countries – points at the importance of these policy, planning and performing activities, also in a broader international context. It is in this perspective our investigations of the prospects for relevant paths to non fossil conditions in our project case area “The Stockholm- Mälars region” should be seen,

## 2. The EU project COMPLEX and its Swedish case study

Within the broader COMPLEX project (2012-2016) dealing with support to decision making around transformation of society to non fossil conditions the Swedish regional case has a special interest. Here the combination of an important regional part of Sweden, which includes both the highly urbanized capital of the country i.e. Stockholm and the broader geographical space of the lake Mälars region provides a very illustrative case around these more general considerations. The region is situated in the Eastern part of Sweden docking to the broader Baltic Sea Region (see Fig. 1a, b, and c providing maps of the position corresponding roughly to the European regions SE 11 and 12.

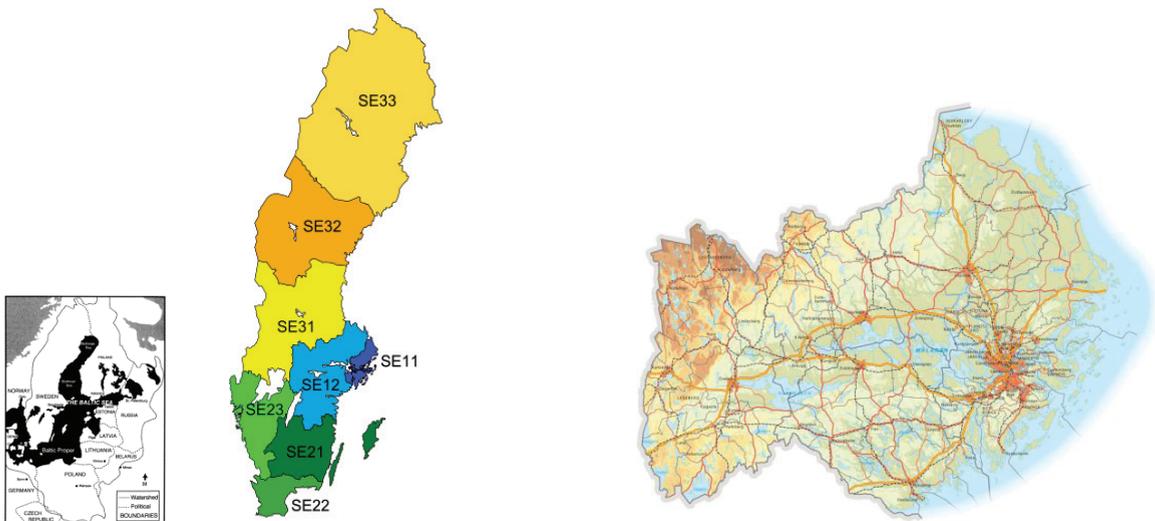


Fig 1a (left) Map over northern Europe. Black part in the center is the Baltic Sea.

Fig 1b (middle) Map over Sweden with numbers of European regions inserted.

Fig 1c (right) Map over the case Stockholm-Mälars region. (Stockholm city is the center in the east where all the communication lines – here the rail lines – converge. The connections over the region outlined in map 1c correspond to railway links between different medium sized cities in the region)

The Mälars region studies - within the COMPLEX project – has provided a “process understanding” and some instruments for support to the efforts to create the transition to a low carbon society by 2050. As roughly comprised by the two NUTS regions SE 11 and SE 12 (see Fig 1b) this area is one of the most

highly dynamic regions in northern Europe.

Strategic societal choices and their consequences have been analyzed. This included stakeholder involvement through various workshops dealing with e.g. perceptions about the contemporary challenges and ideas about finding paths to a non fossil society - and how to address these issues for the future. (See figure 2 below providing a “methods map” of research activities performed). The work also included the design of a toolkit of models for analysis purposes including (with differentiated emphasis at different scalar levels) the following topics:

- A. (regional) Economic development and the impact of policy instruments
  - o A dynamic optimization model for cost effective low carbon paths
  - o This is done In relation to the regional land use
  - o Allocation of greenhouse gas emissions among sectors has been included
- B. (sub regional) Aspects of emerging land use patterns
  - o using locally produced willow to supply a biomass-fired CHP plant in considering climate impact in the surroundings of the city Uppsala
  - o Assess how variations within one landscape, in terms of soil quality and field location, influence the overall climate impact
- C. (municipality/local) Energy system changes in a municipality case
  - o The Municipality Case of Uppsala
  - o A roadmap scenario model
  - o Covering energy use and GHG emissions
  - o Including long-distance travel by some of the inhabitants
  - o 5 scenarios
  - o Large GHG-emission reductions can be achieved on a local basis
  - o Tool for making trade-offs and prioritize among possible alternatives
- D. (individual) Cognitive aspects of decision making at individual level
  - o Examples from transport and its impact on climate change.
  - o A neuro-computational model with focus on emotional and cognitive processes
  - o Three neural structures have been included: amygdala, orbitofrontal cortex (OFC) and lateral prefrontal cortex (LPFC)

These analytical approaches have had as their aim to connect the scientific support to the decision making functions at various levels, including policy processes at shorter and longer time scales. Also gaming sessions have been created together with decision makers in order to reflect on the interface between tools consisting of model software (illustrating complex societal decision making processes) and “decision making “reality” perceptions [10].

- o “Democracy3”, specifically adopted to the Swedish conditions and
- o The “low carbon pathway interests”
- o Workshop with policy makers. asked to reflect on the model and the gaming exercise
- o The model should simulate, i.e. provide structures to link parameters to governance.

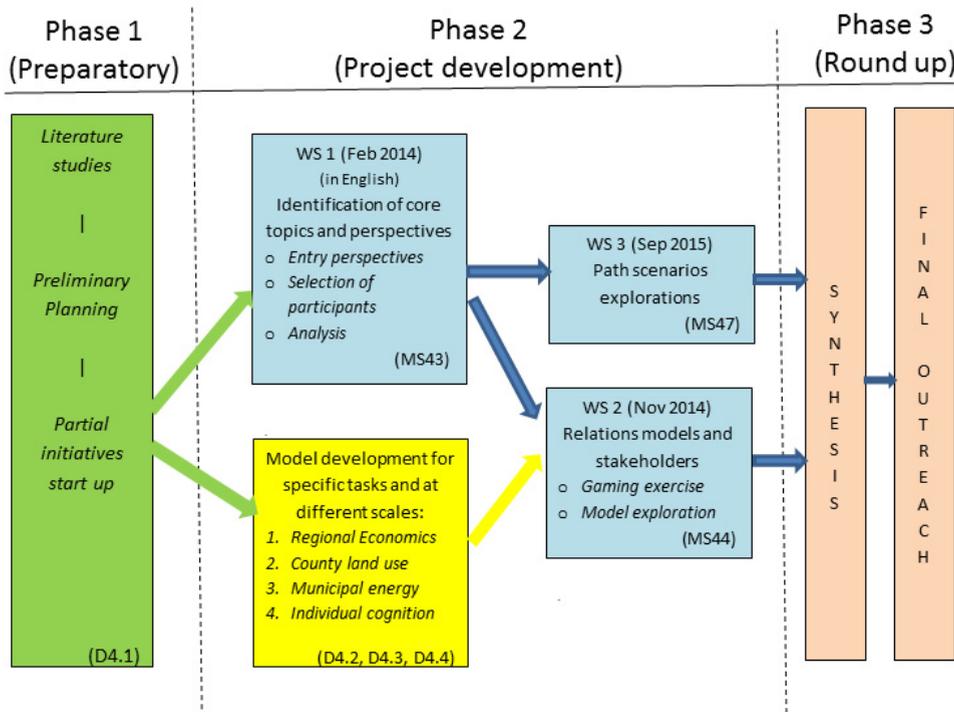
Overall the project focus was on finding integrative forms of support in order to guide the path to a low carbon society under varying climate scenarios, level and sector conditions and world situations. The integration of social science, natural science and technology has been an important theme.

Different land use patterns will have different effects on the climate. Climate, in turn, will constrain the options for land use. Whether land is used for agriculture, forestry, housing, industry, energy production, or infrastructure will depend on regional, national and EU policies, but also on cultural values and (sometimes conflicting) interests between various stakeholders. As a general position the dynamics with regard to most of these features require analysis that can capture different aspects of complexity arising e.g. from non linearities, irreversibilities, and potential thresholds involved.

The studies explored existing models and developed new ones where needed, taking into account conditions of uncertainty and asymmetric information. The models were intended to aid stakeholders in their decision making, by linking policies at the (sub-national) regional level to those at the levels of households and municipalities, as well as at national and supra-national levels. Considerable attention has in the overall analysis been paid to decisions made under uncertainty, risk cognition factors and

risk-management approaches.

In Figure 2 (below) the methodological steps in the analysis are described. A time line is given from left to right. The two interplaying major methodological approaches are presented, i.e. on the one hand stakeholder workshops/ network build up and encounters (Phase 2 in the upper part), and on the other side a carefully selected set of models illuminating specific features (phase 2 – lower part). (Labels in the lower part of the blocks- e.g. MS43 - indicate special reports to the EU for that particular activity).



**FIG. 2. OUR WAY OF ADDRESSING THE ISSUE OF SOCIETAL TRANSFORMATIONS FACING CLIMATE CHANGE – TOWARDS A LOW CARBON MÄLAR REGION 2050**

Thus we have had the following methodological aims and characteristics of the investigation:

- Multiple stakeholder presence
- Multiple levels exposed (from the individual to the European level)[11]
- Interplay of methods
- Contributions both from disciplinary and interdisciplinary approaches
- Balancing qualitative and quantitative approaches

These aspects are then input elements to a Systems Analysis oriented "orchestration" integrative work (see the right part of Fig. 2) also using scenario investigations about paths.

### 3. Some analytical reflections on the outcome

The population of the Mälars Region amounts today to approximately 3.6 million, which constitutes about 1/3 of the total population in Sweden. One of the main characteristics of the region is the location of the

capital of Sweden, Stockholm, which has a population of approximately 1 million.

In terms of an urban oriented reflection over the region it is obvious that the historical position and strong role of Stockholm (also being the capital of Sweden) has created a very dominant function in the overall region. This may or may not be strengthened in the future with effects on how the non fossil scenario could be reached. The scenario standing against a continued increase in relative strength for Stockholm covers a more distributed regional approach in terms of a wider population spatial distribution, more spread work possibilities in the wider region, changed preferences to live life in somewhat smaller city centers (and even countryside areas). This is the opposite development track to further draw more people into the central Stockholm hub (including the suburbs in a quickly expanding sub center structure strongly linked to Stockholm central city mobility capacities).

A mixed scenario combining the two opposites does involve a broader spatial population distribution over the entire region – but with strong commuter links to Stockholm (supported by new infrastructure investment as speed rails and regional frequency trains). This is close to the current planning ethos, although still with a strong Stockholm core. However, the stronger spatial distribution option might both be supported by technological means (tele connection IT services), institutional changes in work life (more possibilities to perform high competence work also from distributed facilities). Also the cultural preference about how to live the “good life” may boost a more distributed alternative. However this is not totally clear so far.

Both of the two binary options (i.e. a strong Stockholm City focus or a very distributed living over the entire regional surface) have different consequences for paths towards non fossil societies. At the moment it is not clear which of the spatial solutions that may provide the strongest support for a non fossil condition. It depends on a broad range of technical issues (e.g. choices of energy technological solutions e.g. electrification of the transport system), of city planning tendencies (e.g. compactification of the use of large city geographical space), of consumer preferences (e.g. more or less use of cars, both with regard to private ownership or to more “pool” like use structures in a circular economy perspective) or institutional issues (e.g. deliberate and encouraged spatial distribution of central public service nodal points as state agency allocations. As an example currently the head office of the national Energy Agency has just a few years ago been moved from Stockholm to the small Mälars region town Eskilstuna). A current increased intensity in the debate about structuring of regions, including combining several of them at national level into larger units may also have spatially distributional effects.

A particular challenge for the Stockholm-Mälars region is the heterogeneity among counties with respect to economic prosperity and environmental performance. This may – according to one thought line expressed in some of our strategy workshops - be perceived as an argument for delegation of decision rights on policy choice and implementation from central to local jurisdiction. One important justification - according to this thought line - is the gains obtained from local knowledge on economic and environmental performances and formation of local communities pursuing sustainable use of resources.

However, literature points at potential costs. The neglect of impacts on other jurisdictions is one problem. There might also arise an exhausting competition among jurisdictions about risk handling issues. The main task and challenge in reaching a carbon neutral Stockholm-Mälars region is then how to identify, quantify, and balance advantages and disadvantages of different policy instruments at jurisdictional delegation levels. (Ref. to the work within our project made by Ing-Marie Gren and collaborators. See above in the short presentation of the work at the “regional level” in terms of economic modelling) [12]. A specific consideration is then how the current jurisdiction “in between” the national state and local municipalities should be designed for the future.

There is a strong focus in the political and planning communities in the region (but also among industrial actors) on transport and physical mobility issues, also in combination with issues around workplaces and housing. One of the currently used indicator systems with high weight in regional policy is focused on commuting times to the Arlanda International Airport from different spots in the region. In the current discussions these considerations are now also gradually – but somewhat slowly - also being broadened to include the entire energy-climate-water-food nexus of issues. This nexus is closely connected to the

spatial bio-geographical concerns that relate to climate change impacts on the biomass production (i.e. the future of agriculture and forestry issue). It also relates to matters concerning carbon sinks and in general terms the competition of land uses. Here the concept of ecosystem services has been articulated as an important and emerging indicator to be included in transition models. This means that there is a new range of other types of indicators than the usual ones that currently are under development.

Culturally oriented drivers for change and the topic of what could in the future constitute “social status” is something that is under emerging concern. This connects e.g. to how the GDP measure is used as indicator of progress, and what it reflects (and not). Another concern for further elaboration is the need to create novel policies in ways that are informed by cultural perspectives. Given the cognitive landscape of expressed types of interests, a number of policy-oriented concerns are rising as well as the need for reformed indicators of change. The consumption issue is articulated as a very important topic related to this. This relates to a range of issues including ways of choosing personal spatial mobility (see studies in our project e.g. [13] ), but also about eating habits (e.g. the quickly changing meat eating preference, at the moment changing quickly to more vegetarian dishes, with meat still in a strong but changing situation). All these considerations have strong impacts on the alternative paths to non fossil society outcomes.

All these points given so far could only be seen as an exemplification of issues that have come up during our research on the case of paths to a non fossil society option within two to three decades. Also the assessment of how long it may take is an area of political debate. For a partial solution in the non fossil domain as the transformation to non fossil conditions the time for Sweden - and thus for our case area - has been indicated as 2030. A recent (2015-2016) Governmental panel on these matters with cross parliamentary party representation (i.e. the Miljömålsberedningen – dealing with the interplay of environmentally oriented goal structures - led as chair by Mr. Anders Wijkman, former Member of the Swedish Parliament and later member of the European Parliament) reflects about the total societal system to be changed by 2045. This could be seen as a prognosis, but also alternatively as a cross party political intention.

Thus the Swedish societal system at many levels and by many actor segments (including industry and the business community) and by organizations in civil society (e.g. NGOs in the environmental and consumer protection fields) and the media is strongly moving in the direction of actualizing the transformation towards a non fossil Swedish condition within a few decades. However the precision in the operative directions is still up for more analysis preparing for actions in terms of e.g. decisions on long term infrastructural investments (e.g. in the transport sector). In some sectors it is already voiced that the state of art is a non fossil condition. A recent overview on this matter by the Swedish Energy agency is quite optimistic in this direction. This is not to say that the more difficult parts of the transition (e.g. the transport sector) already have settled – even in principle. A special State investigation on the transport sector indicated that a non fossil future might be reachable by 2030, but this position is still under debate.

This is what the debate on the time schedule all is about. But the Swedish government has recently (in 2015) made strong statements that Sweden have as its political goal to be a leading nation among industrialized welfare nations to reach a non fossil situation not too far into the future i.e. heading for finalizing this task in - what could be interpreted in the still not finally defined - time window around 2030-2050

#### **4. Policy considerations aiming at a path towards a fossil free society**

To round up this presentation the following aspects provide some of the insight that we consider we have absorbed during the project process of investigation based on analysis and presence in the Swedish system, with emphasis on our chosen case region. Thus leaning on a multitude of experiences from the Swedish case study in the COMPLEX project - as well as drawing on other reflection inputs from the current literature and international conferences inputs - the following main points could be seen as

suggestions to the top political structure in the region i.e. the Mälardalsrådet (roughly meaning “The Advisory council for regional issues in the Malardalen area, including the city of Stockholm”). (Our case study has since long followed the Council work, especially in its efforts to outline transformations of the region including the path to a non fossil society. And we have also contributed to the Council Annual meetings in 2015 and 2016 presenting some of our findings).

1. The transformation to a non fossil society includes all aspects of society. That relates to all different levels of society, to all sectors and forms of stakeholder types. It also involve civil society at large and relates to the living conditions to all of the citizens of the region. This means that it is not only an issue of a change of the technical aspects e.g. of the energy system and related infrastructural mechanisms, but the transformation also connects to consumer behavior, and in more general terms issues about where we want to live and work in the future and how the inhabitants of this region within a few decades would consider what a well functioning society might entail, especially caring for the particular needs of persons of all ages and gender.
2. The transformation will not only create challenges of change, but will also invite new possibilities. This means that although the change is necessary and deep going it may also provide new competitive means in an international context – given that a change trajectory is chosen that encourages such possibilities. Thus the region should use the transformation process to serve these purposes at national and European levels to demonstrate solutions developed in the technical and ecological domains to foster avant guard forms of societal competitive ways forward – also serving other countries with less initial advantages for such performances.
3. The transformation requires a mobilization of the entirety of our society. This means that our democratic processes are fully used to invent and implement changes using a deepened planning process with democratic consolidation. Innovations should be encouraged – not only with regard to technology but also with regard to how society could be changed e.g. through changes of laws, rules, administrative processes, stimulation to risk taking and renewal in all sectors and by all actors as well as through the creation of new patterns of collaboration. There will be a need to creatively scrutinize our current patterns of values facing the new challenges within all strata of society – public official structures, the business community and civil society alike. The further move towards a future oriented activity interest and openness towards change will be of strong importance. But this also put demand on the stronger segments of society to responsively caring for parts in society with more limited capacities.
4. The transformation is made within a very large complex system with many partial couplings. This means that the complexity will have to be orchestrated in partially new ways. This can be prepared through various ambitious experiments both at limited levels and actor spaces, but also in large constellations involving the needed investments for such actions. Such transformation experiments must be conducted in line with the goals of a fossil free society – and be done through strong encouragement, maybe deliberate relaxation of certain rules and with several diversified tests with varied starting points. However, the total overview of the process will never exist at any one time. Thus the constant upgrading of the vision in relation to path experiences has to develop in a dynamic interplay over the time.
5. The transformation is being performed in a societal context within which there are several interplaying levels (e.g. the level of the individual, of the local municipality, the county, the sub-regional, the region, the national and the EU-levels – also influenced by the constantly changing international conditions at large). This means that the interplay between levels has to be given considerable attention. What once was a reasonable distribution of labor and responsibility might not be the same in the future due

to changed conditions. The pressure to move quickly to a fossil free society also put stress on the governance architecture. Different versions of interplay between “bottom-up” and “top-down” solutions have to be conceived, developed and tested.

6. The change towards a non fossil society is necessary. However, it can also provide advantages for other aspects of change in society.  
This means that a diverse set of solutions developed for the purpose to bring us to a non fossil society might also be supportive of other changes that are needed. One already very well known example is that goals related to the handling of climate change may go very well hand in hand with efforts to reduce health effects from harmful components in the atmosphere – not least in heavily urbanized areas. Such synergies have to be better explored and mobilized – much better than what is the case today. This also calls for more cross sectorial connectivity innovations.
7. The transition is of course of a broad nature, but also have distinct regional dimensions.  
This means that the societal conditions that historically have been developed over long time in our specific case region also in the future must be guarded and cared for – but now in a directed non fossil context. The new possibilities that probably might be generated should be encouraged. An essential factor for success in this endeavor is a well spread sense of participation in the change process by large segments of the population in society. This means that all persons in society should be needed in one way or the other – and this should be conceived of in a multi generational perspective.

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