In light of low carbon futures – thoughts from a recovering engineer

Near zero emissions by 2050 in industrialised countries, required for staying below the two-degree target, is a challenging but also liberating thought. It may first seem like an impossible task. But a growing number of studies show that such a transition is possible from a resource and technology point of view, as well as affordable. It requires investments but these are largely recouped through lower expenditures on fossil fuels. The thought is liberating because it makes us shift our focus away from thinking about mitigation measures with the lowest marginal costs for reaching Kyoto- or 2020-type reduction targets. Instead, or in addition, it forces us to think about major technology shifts, as well as energy and transport system changes, that are likely to be required in the long term.

Various low carbon transition pathways have been explored and presented in several studies. These are typically based on engineering-economic knowledge and modelling approaches with a focus on quantifiable technical, economic and environmental implications. The deeper political and institutional implications, beyond the obvious observation that better policies are needed, have been left largely unattended. For example, institutionalized norms and cognitions both shape policy formation and tie into the larger framings of the field, and shifts in dominant or influential coalitions may lead to shifts in dominant framings and what types of policy instruments are appropriate. Realising the transitions require greater attention to governance issues. What is the role of government in making the transition? What organisational and institutional changes, e.g., in regulations and social norms, may be important? What will be key goal conflicts, or conflicts of interest, and how can they be dealt with?

A transition to a low carbon society in 2050 requires a vision and long term direction that goes beyond normal time perspectives in society and politics. It likely requires some sort of ‘social contract’ that can lay steadfast the direction of development. To maintain this over time requires a coherent vision, a positive narrative, for the low carbon society. A transition can probably not be motivated by climate change mitigation alone. The vision must encompass a broader idea about the development of society, including a better life, good health, work, justice, equity and other aspects that most people associate with a desirable society. A transition must also interplay with recurring structural crises and growth cycles in the economy, and lead to new businesses, sectors, markets and jobs.

1 The part about ‘liberating’ is actually something that my colleague Johannes Stripple said a couple of years ago. The memo relies strongly on work and discussions in the LETS2050 programme (Governing transitions to low carbon energy and transport systems, 2009-2013) which is now drawing to an end. I am indebted to Jamil Khan, Annica Kronsell, Fredrik NG Andersson, Mikael Klintman, Roger Hildingsson and many others for much of the thoughts in this memo.

A transition to low carbon energy and transport systems in the next 40-50 years may seem dramatic, revolutionary and transformative. But such a transition may also be considered as a relatively un-dramatic and evolutionary process where technology and behaviour co-evolve with changes in norms. It probably means that new consumption and travel patterns become the norm, partly due to changes in relative prices. The norms and expectations of future generations are formed in the society in which they grow up, and there is nothing to say that zero emissions is fundamentally incompatible with a good life. The past 50 years have been transformative in many ways but we, and younger generations in particular, seldom think about the past in that way.

There is always some sort of social contract between the state and its citizens, dividing responsibilities and with mutual demands and expectations on each part. The contract is changing over time and is subject to continuous renegotiation. For a large part of the 20th century in Sweden and many other countries it was about building the welfare state, with access to decent housing, health care and schools for all citizens. The basic ideas were embraced by most political parties although ambition levels and ways of getting there varied. Sustainability and zero emissions are presumably important parts of the future social contract if climate policy goals are to be achieved.

Climate change is often presented as the greatest threat of our time to society and the ecosystem services that human society depends on. Threats and crises generally lead to mobilisation and that action is taken. But crisis awareness also tends to fade fairly quickly. Therefore, a transition is probably difficult to make if it is motivated only by climate change and associated mainly with sacrifice. A low carbon transition must build on a positive future vision of a better society. Perhaps such a vision is already forming through low carbon scenarios and roadmaps, as well as ideas about sustainable cities and a green economy. The idea that it is possible to continue a positive development of society within the ‘planetary boundaries’ seems to be growing stronger.

What do we need?

Emission reductions of 20% to 40% by 2020 to 2030 seem viable without requiring fundamental or major technology, system or infrastructure changes. At least this seems to be the case in a Swedish or European context. Such targets can probably be reached by tweaking the existing energy and transport systems with improved efficiency and some fuel shifts.

In the next 10 to 20 years, however, we need continued RD&D to develop the technologies, systems or infrastructure solutions required for deeper cuts post-2030. A limited set of primary energy sources and energy carriers means that we can be quite certain about what represents key low carbon technologies in this longer term. Energy efficiency and renewable energy technologies are well known examples. Other examples include electro-thermal processes and perhaps hydrogen in industry, electro-fuels (from electrolysis) for transport, alternative cements, and process technologies to produce bio-based chemicals. Some technologies are modular, e.g., for energy efficiency (e.g., lighting and appliances) or distributed generation (e.g., ground source heat pumps and PV systems). In other cases the transition involves major infrastructure investments in CCS, super-grids or hydrogen systems,

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as well as new transport infrastructure with rail or electrified roads. These are very different contexts from a governance and policy perspective.

The transport sector is a good illustration that the climate issue cannot be reduced to an isolated environmental problem that is solved by technology alone. First, some technical solutions, such as electric vehicles or public transport systems, are associated with changes in norms and behaviour. Second, climate change is only one of many problems associated with transport together with noise, physical barriers, other air pollution and accidents. In addition, environments where possibilities to walk or bicycle (i.e., daily physical activity) are limited lead to health problems. The complexity and multitude of challenges speak in favor of broad coherent strategies, which in the case of transport may include:

- New vehicles and fuels through a range of policies to develop, introduce, and deploy improved technologies.
- Changes in behaviour, travel patterns and demand, choice of travel modes and acceptance for new technical solutions through a range of measures at different levels and across sectors.
- Changes in planning processes, for example to better integrate planning of transport and buildings, to facilitate the above.
- New policy paradigms where improved accessibility rather than increased mobility becomes the guiding principle.
- Changes in goals and mission statements (e.g., the recent change in wording from being a ‘builder of roads’ to being a ‘builder or society’ by the Swedish Transport Administration)

The list is no recipe for a more sustainable transport policy. This must be shaped through broader political processes. The point is that climate policy must be deeply integrated with other policy domains, and that technical change co-evolves with changes in norms and behaviour.

**What do we have to work with?**

Carbon pricing, of some sort, is necessary but certainly not sufficient for governing a transition. Complementing and flanking policies, and changes in institutions (e.g., rules, norms and cognitions) related to the different mitigation options are needed to maintain speed in the transition, and to handle goal conflicts and conflicts of interests, as well as unintended side-effects. Planning and permit procedures, and combinations of regulation, economic incentives, information, and R&D efforts are important elements of coherent policy packages, in addition to carbon pricing. Voluntary (e.g., carbon offsets) and experimental (e.g., climate labelling) approaches can be a testing ground for policy learning and a mechanism for empowerment and increasing public awareness. Voluntary and ‘soft’ approaches can, in turn, increase acceptance for future more binding policy.

The appropriate design of policy packages will vary across geographical and sectoral boundaries, as well as technology areas and system solutions. To exemplify this: energy efficiency in buildings, wind power, and CCS are three low-carbon energy solutions with very different characteristics in terms of, technology, stakeholders, markets, and institutions. Experience shows that straightforward regulation can be justifiable and effective in some areas (e.g., building codes and appliance standards), benefit sharing schemes are often
important to ensure stakeholder buy-in (e.g., for local acceptance for wind power) and public-private partnerships can be important for risk sharing and to leverage funding and capacity (e.g., in the case of CCS and other major demonstration projects under the EU NER300 program).

Climate change economics has been dominated by two perspectives. From an engineering-economic perspective mitigation costs have been calculated bottom-up to construct mitigation cost curves (including negative cost or ‘no-regret’ options). Another perspective is macro-economic modelling that shows how mitigation (often through carbon pricing in the models) leads to a modest reduction in future GDP-growth. But due to the dynamic nature of economic development in the long term, with path-dependencies, growth cycles and recurring structural crises, these perspectives should be complemented with more evolutionary economic perspectives.

In economic history, the development is characterised by growth cycles associated with the advent of new ‘general purpose’ technology, e.g., the steam engine, electricity or information and communications technology. Climate change mitigation requires investments, money that could have been spent on something else and thus have an ‘alternative cost’, but these investments are likely to shape new development paths and growth cycles in the future. There are many signs that most industrialised countries are now, 2010 to 2020, in economic structural crisis. This creates opportunity to change the direction of economic development. In contrast, when the economy is in a growth phase with high returns on capital, it is much harder to change direction. It is not possible to know beforehand what will drive the next economic cycle but it would be prudent to try and make it green.

What obstacles need to be removed?

Barriers or obstacles to the key technical mitigation options: energy efficiency, renewable energy, nuclear power and CCS have been described in the literature and are well known. For energy efficiency it is about the ‘pay-back gap’, misplaced incentives, transaction costs and the potential lack of rationality of end-users. For renewables it is about costs, transaction costs, siting conflicts, grid codes and regulation, environmental impacts, etc. For nuclear power it is about costs, insurance, waste handling, nuclear safety and weapons proliferation. For CCS it is mainly about public and political acceptance, in addition to costs. Various policy instruments can be, and have been, used to remove such obstacles. A standard taxonomy is regulation (e.g., building codes and efficiency standards), economic sticks and carrots (e.g., taxes, feed-in tariffs, and investment grants), and information or other instruments (e.g., labelling, R&D, and education).

On a more general level one of the greatest obstacles appear to be political-economic, and related to issues of distributional effects or ‘winners and losers.’ This is covered extensively in the memo by Douglas Macdonald. But adding to that is the observation that new economic interests will grow from the transition. In Europe, the renewables industry has grown into a relatively powerful lobby in the past 10 to 20 years. Incumbent actors (e.g., energy companies, technology companies, and the pulp and paper industry) are also changing their positions and revising their climate strategies in light of evidence, technical development and

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4 NER300 was originally conceived to raise funds through auctioning of emission permits under the ETS and give investment grants to major CCS demonstration projects. It was extended to include other major sustainable energy projects such as smart grids, wind parks and biorefineries.
experiences. For example, climate policy may increase costs but if these can be passed through to consumers it need not jeopardize profitability. Many of the European industry associations are in the process of developing low-carbon roadmaps for their respective sectors (CEPI, the Confederation of European Paper Industries, published theirs in November 2011).

The other main obstacle has been picked up by Michelle Betsill in her memo – that climate change cannot be dealt with as a discrete environmental policy problem but requires mainstreaming into all decision making. Another way of expressing this is to talk about the need for policy integration and coherence. For that we need mechanisms. A small but relevant example is that EU member states are (since 20xx?) required to report on climate policy together with other policies (e.g., economic, social, and labour policy) thus signalling the central and important character of the climate issue. But which mechanisms that work best is likely to be a very contextual issue – depending on tradition, culture, policy style, etc. Nevertheless, I would like to propose three important and interconnected recommendations for moving in the direction of a low-carbon transition (assuming we stand by the two-degree target and its implications):

- Develop mechanisms for greater transparency and monitoring of policy in a transition context.
- Reconsider whether administrative structures, organisation and jurisdictions in government are apt for the transition.
- Consider ways of creating new long term lock-in situations and pathways that are consistent with low carbon transitions

**Transparency and monitoring:** A transition requires long term direction and governance at all administrative levels. Do we have the appropriate instruments for monitoring, transparency and accountability in relation to climate policy targets? In other areas, there are control mechanisms and ‘watchdogs’ that monitor, check and report. One example concerns bodies that assess proposals for new legislation (e.g., asking if it is compatible with constitutional law?). Another example is national audit offices. Could low carbon transitions entail a new or expanded role for them or do we need new institutions (such as the UK climate change committee)?

**Administrative structures and mechanisms:** The need for mainstreaming, integration and coherence is well recognised. But it is debatable and probably highly contextual what are the best approaches for doing this. A specific issue I would like to raise is how roadmaps, scenarios and carbon budgets can be used as tools or mechanisms for governance, for learning and strategizing, as well as for policy integration and asking questions about governance and policy strategies. Should roadmaps be institutionalised as important tools for long term climate governance? If so, who should be responsible, who participates, and what should the process look like?

**Creating the low carbon lock-in:** The need for long term stability and direction raises the issue of whether there are mechanisms that can answer to this need? This could be mechanisms that put some aspects of climate policy at arms-length from short term political demands and temptations. The EU ETS, although presently weak, may qualify as an example. Some feed-in and quota-based systems for renewables support also provide long term stability to investors and once established may be difficult to change overnight. The UK Climate Change Act and associated Climate Change Committee is a case in point (but may not be suitable in other contexts).