CLIMATE INNOVATION INSIGHTS | Series 1.6
Accelerating the Evolution of Climate Innovation Clusters

Climate Innovation Insights offers a platform for reflections and lessons from renowned climate innovation experts to spark discussion about the process of tackling climate change through innovation. The independent opinion pieces discuss best practices, different methodological approaches towards climate innovation and implications for business, society and politics. The series is supported by Climate-KIC, Europe's largest public–private climate innovation partnership.

Tackling Market and System Failures through Climate Innovation Clusters

Henrik Larsen and Gijs Diercks, Centre for Environmental Policy, Imperial College London

Key messages

- Climate change demands fundamental changes in the way societal functions, such as energy, housing, mobility and food, are fulfilled.
- Climate innovation clusters should not only focus on developing climate technologies, but also on successfully diffusing and using them.
- Innovation should go beyond a singular focus on technological solutions to include changes in business models, regulations, user practices and cultural meanings.
- For many regions, a strategy that emphasises the widespread use of an innovation is more realistic than aspiring to become the new Silicon Valley for cleantech.

Introduction

In 2006, the influential Stern Review declared that "climate change is a result of the greatest market failure the world has seen".[1] This compelling report concluded that the negative effects of greenhouse gas emissions are not adequately reflected in market prices, which makes it difficult for climate technologies to compete for market share. This market failure justifies policy intervention and the need for public subsidies to actively support the development and diffusion of climate technologies.

Innovation holds great promise for making climate technologies more competitive in terms of cost and performance. In this regard, climate innovation clusters (see Box 1) have attracted considerable attention from policymakers seeking to address climate change and regional economic development. Stimulating climate innovation clusters around particular technological domains is widely recognised as an effective method of support.

This *Insight* draws on research conducted by the Climate-KIC PhD programme at Imperial College London, UK. Using mobility as an example, it suggests that in addition to market failures, the nature and complexity of climate change presents a range of persistent system failures which policymakers need to address. This understanding is grounded in system innovation (see Box 2).

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Box 1. What are clusters?

Clusters are geographically concentrated networks of interrelated businesses, higher education and research institutions, and other public and private entities that develop, diffuse and use innovation.[2] Silicon Valley in San Francisco is often seen as an example of a successful cluster.

Box 2. What is system innovation?

System innovation means large-scale transformations or transitions in the way that societal functions – housing, mobility and food, for example – are fulfilled. A historical example is the transition from horse-drawn carriages to automobiles.[3]

The concept has developed over recent decades[4] and is receiving increasing attention from policymakers, as reflected in recent publications from the Organisation for Economic Co-operation and Development[5] and the European Environmental Agency.[6]

System innovation represents a broad view of innovation, covering not only technological change but also changes in markets, regulations and user practices across a wide range of sectors. System innovation helps to shape our thinking and understanding of sustainability transitions. Applying the concept to climate innovation clusters exposes important challenges.

Mobility as a socio-technical system

A system innovation perspective looks at systems as being socio-technical. This implies a dynamic relationship between technology and its social environment.[7] Technological change needs to work hand in hand with broader societal changes: in business models, user practices, cultural meanings, regulations and infrastructures.

In the case of low-carbon mobility, this implies that successful innovation goes beyond developing, say, a new electric car; innovators and policymakers must also consider how the introduction of this new technology will interact with other socio-technical elements, ranging from fuel infrastructure to regulation, as well as the symbolic meaning of car ownership. Figure 1 illustrates the different socio-technical elements that need to be taken into account, using mobility as an example.

The constant interaction of interrelated elements goes a long way towards explaining why socio-technical systems are inherently difficult to transform. In the mobility sector, climate technologies (such as electric vehicles) are competing with existing technologies that are supported by the powerful commercial interests of the automotive and petroleum industries. These strong vested interests, as well as sunk costs – in mobility, these include existing fuel infrastructures and established maintenance and distribution networks – work against the introduction of new technologies.[8]

The introduction of electric vehicles is also impeded by deeply embedded user practices and the cultural significance of cars, such as the expected range of a car and perceptions of status, individuality and freedom.

Climate technologies are therefore not just competing against market failures and incumbent technologies, but also against a wide range of system failures. This explains why innovation typically progresses incrementally, following particular pathways that are shaped by past decisions and historical context.[9]

Informing climate innovation clusters

A system innovation perspective has great potential to inform policies to support innovation clusters. In essence, it challenges policymakers to think about clusters around entire functional domains (e.g. mobility, housing and food) rather than focusing purely on singular technological solutions.

Although optimising the innovation 'ecosystem' between businesses and knowledge institutes remains at the core

Figure 1. A system for mobility with socio-technical elements

Source: Climate-KIC, adapted from: Schot, J. and Kanger, L. (2016) *Deep Transitions: Emergence, Acceleration, Stabilization and Directionality*. Science and Technology Policy Research Unit, University of Sussex: Brighton

of cluster dynamics, policies need to include a broader range of actors, including users, consumers and citizens. This implies that a variety of climate innovation clusters are conceivable, depending on the types of actors involved. Some may focus more on technological innovations, while others focus on social innovation for their diffusion and widespread use.

> *"No matter how technologically advanced and superior solutions are being developed, they are of little value if they are not successfully implemented, used and diffused."*[10]

For example, some climate innovation clusters are well positioned to develop climate technology solutions, such as electric vehicles, but these clusters are few. A system innovation perspective emphasises the importance of including other issues, such as rolling out essential infrastructure, adapting regulations, training maintenance workers and changing perceptions about car ownership or the necessary range for a car. For many regions, a strategy that emphasises the widespread use of innovations is more realistic than every region aspiring to become the new 'Silicon Valley for cleantech'.

Elements needed for climate innovation clusters

Table 1 lists examples of the different elements needed for a climate innovation cluster, informed by a system innovation perspective.[11] Together with Figure 1, it provides a checklist for policymakers who want to embrace a more holistic view of climate innovation clusters.

Case study: UK Autodrive

The example of UK Autodrive[12] illustrates the interactions among these different elements in a climate innovation cluster. UK Autodrive is the largest of three UK consortia launched to support the introduction of self-driving vehicles to the UK. It brings together leading technology and automotive businesses, forward-thinking local authorities and academic institutions to deliver a three-year trial of autonomous and connected vehicle technologies, which is taking place in Coventry and Milton Keynes.

UK Autodrive is a great example of how climate innovation clusters can go beyond a singular focus on technological solutions. As well as the technology aspect (i.e. the cars), the consortium is investigating important aspects of automated driving, including safety and security, legal and insurance issues, public acceptance of connected and autonomous vehicles, and the potential of business models to turn automated driving systems into reality.

Further, the consortium has emphasised the need for evaluating public awareness and acceptance, which is being done through public demonstrations of the interactions between conventional passenger vehicles and self-driving cars. The early results show that these local experiments do not lead to large technological breakthroughs; rather, experimentation deals with simple but vital infrastructural adaptations and technological specificities. The experiments also highlighted more complex issues around legislation, increasingly complex interactions with other road users, and the effects on local public acceptance of new technology.

The effect of such a local focus for a climate innovation cluster is also evident. A survey showed that 61 per cent of adults in Milton Keynes would be interested in using the driverless vehicles, compared with just 39 per cent nationally.[13] This demonstrates that the UK Autodrive project has had a real impact where it matters most: diffusing, implementing and using new technologies and practices.

Table 1. A framework for climate innovation clusters

Elements of innovation clusters	Sub-categories
Actors	• Companies: start-ups, small and medium-sized enterprises, large firms, multinational companies • Knowledge institutes: universities, research institutes, technical schools • Public and private entities: government, legal organisations, banks, consultancy firms • Civil society: users, consumers, citizens
Institutions	• Hard: rules, laws, regulations, instructions • Soft: customs, common habits, routines, established practices, traditions, norms, expectations
Interactions	• At the network level • At the level of individual actors
Infrastructure	• Physical: artefacts, instruments, machines, roads, buildings, networks, bridges, harbours • Knowledge: expertise, strategic information • Financial: subsidies, financial programmes, grants

Conclusions

- Conventional cluster policy typically has a narrow supply-side focus on innovation around single technological solutions. A system innovation perspective implies that climate innovation clusters should also focus on diffusion, implementation and the use of climate technologies.

- Climate innovation clusters should not necessarily be guided by supply-side actors like businesses, research institutes and universities. Other organisations that are centrally placed in socio-technical systems, such as local authorities, community groups, trade associations or public transport organisations, may be better able to mediate between the private sector, knowledge institutes and other public and private bodies.[14]

- A broad definition of innovation implies the active inclusion of networks comprised of a wider and more diverse set of actors, including users, consumers and citizens.

To summarise, this *Insight* is not a plea for clusters not to focus on the research and development of new climate technologies. There is a need for this and some places are particularly well positioned for such an approach, as shown in other briefings in this series. However, for many regions, choosing a broad strategy that emphasises diffusion and widespread use is just as valuable.

The diffusion of innovation must be in the fabric of city-regions.

Endnotes

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Our partnership consists of dynamic companies, the best academic institutions and public authorities. We drive innovation in tackling climate change through creative partnerships large and small, local and global, and between the private, public and academic sectors. The UK and Ireland is a core geographic region within Climate-KIC and is home to some of the most energetic climate innovation clusters and businesses in Europe.

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Contact details:

ukandireland@climate-kic.org

facebook.com/ClimateUKandIreland

@ClimateKIC_UKI

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