

BARRIERS TO INNOVATION AND COMPETITIVENESS IN 11 GREEN ENERGY CLUSTERS: IMPLICATIONS FOR POLICY

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1 WHAT IS MISSING FROM CLUSTER POLICY?

Industry clusters have long been assumed to benefit from the knowledge, skills and resources of co-located actors to achieve innovation and competitiveness in regional clusters. National policies have drawn for many years on Michael Porter's ground-breaking analysis of the economic factors and conditions that need to be in place for this to happen. But are we missing something else that can help policymakers anticipate risk and improve the competitiveness of clusters?

This article reports on an in-depth study of green energy clusters worldwide - in Canada, Germany, California, Uruguay, Brazil, Chile, Spain, Italy, Scotland and South Africa. It shows a core set of barriers on the ground that are not being addressed. These barriers are surprisingly consistent across different country clusters, with clear practical implications for policy, if clusters are to provide a return on regional investment in the form of innovation and employment.

The study is unique in scale, scope and methodology, involving case studies over a period of ten years, on the perceptions, experiences and recommendations of managers in SMEs and large companies, staff in universities and policy makers in clusters around the world.

Qualitative interviews were used to identify the issues in the first phase, and quantitative measures were used to validate these at scale. Hundreds of interviews and thousands of validating surveys over the last ten years have given insights into both the genesis and the strategic management of practical barriers on the ground. These case studies have clear practical implications for policy and practice as a means of mitigating unnecessary risk and optimising opportunities for value creation.

BARRIERS TO CLUSTER DEVELOPMENT AND COMPETITIVENESS ON THE GROUND

What are the barriers which routinely hamper the expectation of competitiveness – creating cost and risk rather than value?

Across clusters in 11 very different countries, we have been able to produce robust qualitative and quantitative evidence of barriers which are not adequately addressed in policy, practice or professional development. Could they have been anticipated? How can they be addressed? What are the implications for cluster policy, and for the roles of stakeholders in the cluster?

We argue that this research fills a gap in theory, and most importantly in practice, where policymakers and cluster managers increasingly need to recognise and respond to barriers on the ground.

Many of the most recurrent barriers we identified are at precisely those interfaces between actors, where clusters are assumed to create value - through the co-location of knowledge, skills, and resources, and the potential for strategic collaboration (the so-called Triple Helix concept outlined by Etzkovitz et al in 1995).

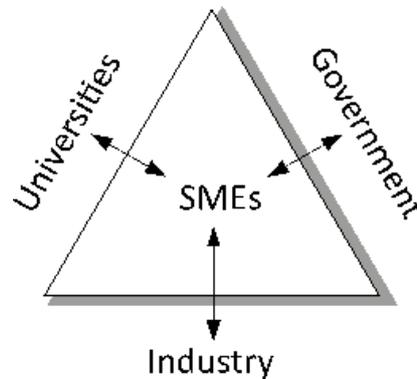


Fig.1 The triple helix concept assumes that value can accrue through co-location and collaboration

The paper outlines the principal barriers we identified at the interface with key actors in the helix.

- Universities (primarily in relation to research, innovation and training)
- Government (primarily in relation to policy, strategy and administrative process)
- Industry (primarily in relation to communication/collaboration with other organisations)

Does this co-located infrastructure support companies researching, developing and commercialising innovative concepts? Does it provide training and professional development in those areas required in this emerging market? Business managers across different clusters highlight surprisingly consistent evidence to the contrary, with clear implications for policy and practice.

For example, did companies find it easy to access support from universities to test, develop and market innovations? Were they able to access skills and training to meet the needs of this emerging market?

2 THE BUSINESS: UNIVERSITY INTERFACE

RESEARCH, TRAINING & INNOVATION BARRIERS

The experience of managers of companies developing projects on the ground was very different – particularly in the case of SMEs. The interface between Universities and SMEs was very widely perceived as creating barriers rather than creating value - precisely in those areas such as innovation, where clusters are expected to generate shared value. At the interface with universities, the principal barriers to productive collaboration can be subsumed under three headings.

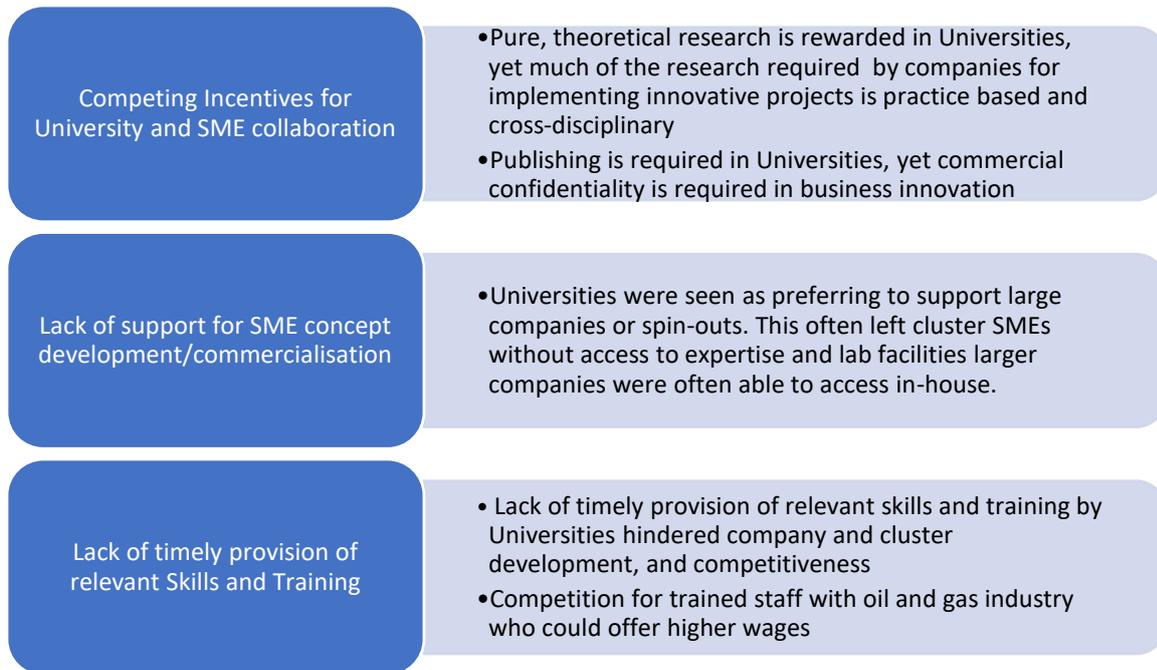


Fig. 2 Research, training and innovation-related barriers

COMPETING INCENTIVES FOR COMPANIES AND UNIVERSITIES

The interface between universities, and SMEs was one where competing incentives hampered knowledge transfer and innovation in precisely the areas where the collocation of Universities and businesses in clusters is assumed to support innovation. The barriers perceived by company managers were consistent across clusters, to a greater or lesser degree, even in regions with world class research Universities.

It seems evident that there were strong financial incentives for universities to focus on particular types of research and provision often at odds with the complex, commercial and practice-based needs of businesses on the ground.

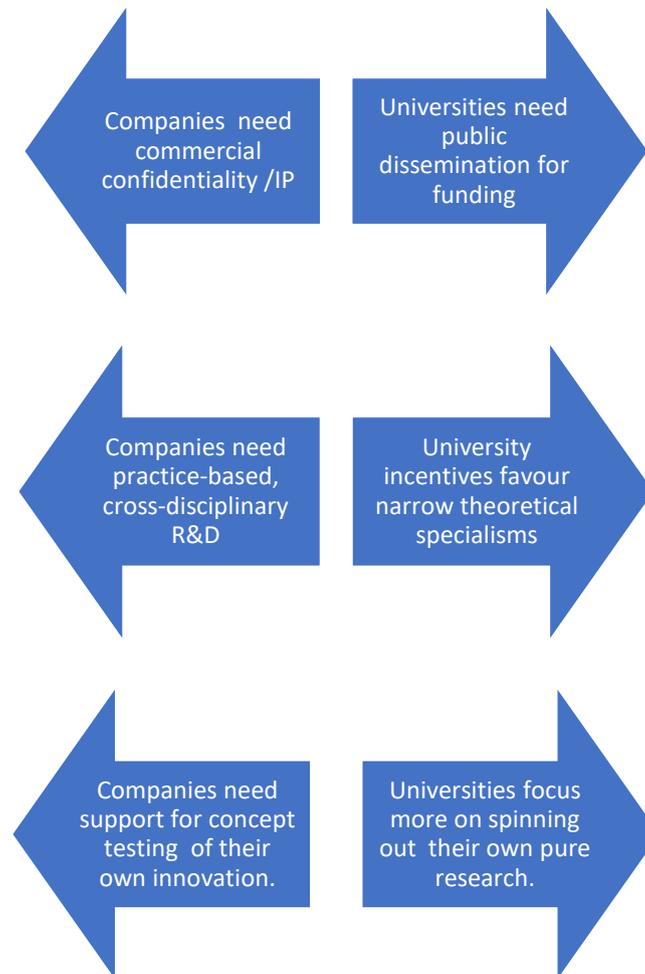


Fig.3 Force-field diagram showing competing incentives and working practices.

Universities are rated and funded, to a great extent, on their ability to publish research in high impact journals with specific requirements. Companies on the other hand, benefit from retaining the IP on innovations, and patenting rather than publishing to retain commercial confidentiality, given the reliance of many research-active SMEs on commercial innovation as a source of income.

"The current funding structure for Universities does not allow them to really help SMEs. They are more focused on their own funding and survival. SMEs are a necessary evil to them. Universities are creating unfair advantage over some SMEs. They have access to funding, spend it poorly and do not help SMEs on their journey. Universities wish to share knowledge with all. SMEs need some competitive advantage. ...What is the incentive for them to train their competitors? Some projects that are undertaken may have academic value but do not meet commercial value-adding requirements. For SMEs it's a waste of time."
(SME manager, California)

Universities tend to be rewarded, in terms of funding, for theoretical research, often in a single area of a single discipline, where they have advantages in attracting grant funding and publishing in high impact journals specialising in a particular area. Clearly the incentives in place militate against collaboration.

Mapping and managing the incentives in place for different players at such interfaces can be a useful tool in understanding and enhancing the outcomes of collaborative enterprises such as clusters.

The feedback from interviewees on the ground made this less tangible landscape more visible, showing how it shaped outcomes. While the flow of physical traffic and resources through the cluster is an integral part of the planning of physical infrastructure, the infrastructure for communication and collaboration between players is not, despite the role it has been shown to play in clusters.

LACK OF R&D SUPPORT FOR REGIONAL SMES

Practice-based research and cross-disciplinary research of the kind most useful for renewables at this point, is less likely to attract funding. Most high impact journals prefer theoretically rooted work. Practice-based, cross-disciplinary journals tend to be low impact.

In terms of the concept of/approach to innovation, there is also a mismatch. Universities focus more on the spin-out of in-house research – innovative materials for example, through university-based SMEs, while regional SMEs are seeking R&D support for concept testing and commercialisation of their own innovations, to meet more complex and practice-based research needs associated with new product development - of the kind described by von Hippel in 2004.

While larger companies often had access to in-house testing, SMEs were more dependent on the offer from regional Universities. This was widely perceived as difficult to access, and often not well suited to their needs for the reasons mentioned

Around a third of the companies responding to the surveys in most clusters had already developed or patented an innovation, and most were quite critical of the barriers they faced in finding support for concept development, laboratory testing and marketing specifically, and collaboration on practice-based research requirements more generally.

In addition to the funding issue, the lack of appropriate mechanisms, and the mismatch of aims and incentives was consistently evident as a barrier for companies. This was true of both new clusters, and established ones. In South Africa for example, one SME manager put his experience this way.

Knowledge transfer from universities and research institutions is relatively painstaking. If the players or network clusters doesn't really function well. The different stakeholders are active in their own area of interest and the character of joint projects where collaboration is promoted are of lesser importance. The University will then research a bit in their focus area but integrate the industrial application or commercialization less. However, this is needed immediately to transform the knowledge gained into new products. There certainly things can improve.

(S. African SME Manager)

Sometimes it was all simply too complex and bureaucratic.

Research and development are difficult to do in Italy – even if it is important. Have you ever seen a contract of R&D collaboration with a university? It would be less complicated with NASA.

(SME Manager, Italy)

This was also the case in established and well-resources clusters, such as California, highlighting the same mismatch of aims and incentives.

The University of XX has recently become the host for the XX Collaborative. The idea is that it'll act as a sort of bridge between academic researchers, the public, and industry, and policymakers....and then we are supposed to also be looking in terms of the economics of commercialization and other things like this. And what really jumped out is – there is a really big gap between what research is, and what companies are thinking, and policymakers are funding. And the coordination is very poor.

(Univ. Energy Professor, California.)

Funding for key elements such as concept development and commercialisation were a particular stumbling block raised by both companies and Universities, although some arrangements such as Knowledge Transfer Partnerships were seen as helpful.

Funding for smaller companies was seen as a critical barrier to both innovation and project development. As one Portuguese manager put it :-

The banks leave SMEs completely out in the rain, without loans, without financing...It cannot be that the European Union, the Central European Bank, lends a lot of money to Portuguese banks (and very cheaply), and afterwards nothing gets to SMEs.

(SME manager, Portugal)

In many ways this replicates the problems in North Sea oil and gas clusters identified in an earlier study (Ure et al 2007). Here the failure to recognize the financial vulnerability of SMEs in early phases of cost-cutting led to the loss of many research-active companies with specialist knowledge. This subsequently undermined the ability of the cluster to compete on the basis of innovation, and then required new measures to better support the survival and integration of such SMEs.

The renewable sector might benefit from taking account of the strategies developed by oil and gas cluster to address some of these very recurrent barriers.

LACK OF RELEVANT SKILLS AND TRAINING

Companies decried the lack of relevant skills and training in this rapidly emerging industry, and where this was seen as actively holding back development at every level. While this might have been expected in new clusters in rural areas, it was also evident in mature industrial clusters with world-class Universities.

This was clearly a new discipline, with increasing demand for both basic technical skills for installation and at a more strategic level. Even where there were people with scientific expertise, this was not translated into the kind of courses urgently needed for companies installing new products to take advantage of the market demand.

What training did exist was perceived by managers as superficial in many cases, and not geared to the real needs of an emerging market. Research, development and training needs on the ground were slow to be identified or responded to by universities, and the cost of course development often required the assurance of

uptake to cover development costs. In practice, this resulted in a lack of relevant training courses, except where a large company was able to pay for a significant number of places for employees.

For smaller companies with limited resources, and limited influence on policy, the competition for skilled workers at a professional and a practical level also put them at a significant disadvantage. As a result, this was widely seen as holding back the speed of company and cluster development in an expanding market.

There was little evidence of pro-active alignment of interests or incentives between the main actors in the helix to support outcomes for the cluster as a whole. This laissez-faire approach came at considerable cost.

LOOKING ACROSS CLUSTERS

It is generally assumed, and often proclaimed by universities, that Universities contribute significantly to the economy through research, innovation and professional development.

University collaboration with businesses and the wider community (activity known as 'knowledge exchange') plays an important part in improving the UK's economic growth and productivity, and in the success of our public services, Universities also help to ensure that the UK remains competitive in the global market by supporting greater business innovation and export-led, knowledge-intensive growth

(The Economic Role of Universities, Universities UK, 2015)

Yet the narrative presented by companies painted a very different picture.

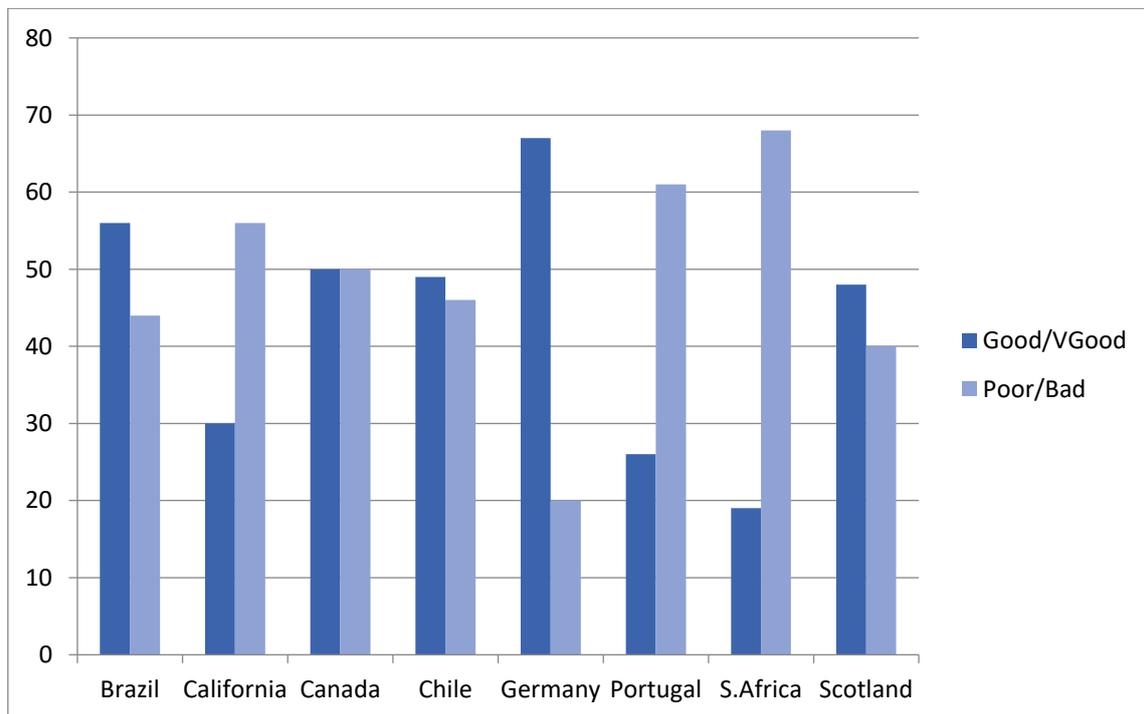


Fig. 4 Ratings of communication with universities by companies was often very poor.

The vision of collaboration and value creation commonly associated with clusters, and the role of universities in supporting them, has often been just that – a vision never translated into practice.

Changes in the incentives offered to universities could have made a very significant difference to the ability of regional companies to develop and market innovation, to roll out innovative projects, and to access training.

IMPLICATIONS FOR POLICY

To cut risk and add value in the cluster, University actors need incentives to better match the requirements of other actors in terms of research, training and support for innovation. Policy makers are in a position to shape outcomes by incentivizing Universities in the following areas in particular.

Research & Training

- To carry out more collaborative, practice based, cross disciplinary research with local companies to provide early foresight of problems and opportunities on the ground
- To disseminate this to policymakers and managers with greater speed
- To use this research to inform relevant training in time to meet the needs of the sector

Innovation

- To provide easier access and greater support for local SMEs seeking expertise, lab testing facilities and assistance to commercialise potential innovations.

Government should arguably take a more active role in creating the incentives for universities to align their offer with the needs of companies and of policymakers.

3 GOVERNMENT INTERFACE: POLICY BARRIERS

Companies across these very different regions highlighted a range of problems. Policy was consistently perceived as inconsistent, uncoordinated, poorly informed and poorly implemented.

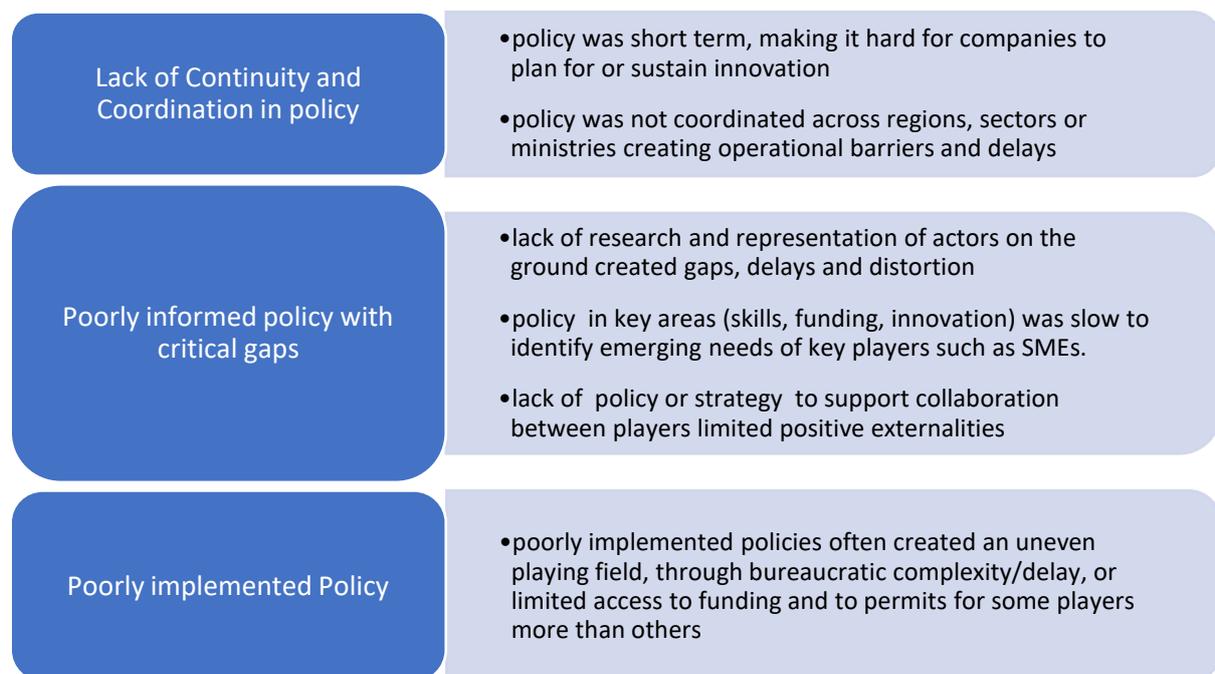


Fig. 5 Policy-related barriers

POLICY THAT IS INCONSISTENT AND UNCOORDINATED

INCONSISTENCY

When the government changes, the energy plan changes, which is an absurdity

(Italian SME manager)

Policy was typically seen as short term and unpredictable, with sudden political turnarounds that made it impossible for smaller players to plan or sustain either innovation, or long-term projects requiring investment. Given that most of the companies in green clusters are SMEs, and that many of these are research-active, this acts as a major barrier to Innovation, and to the generation of the benefits clusters are intended to bring to the region through employment and investment.

This was compounded by the lack of long-term stability in funding policy as governments changed. This naturally put smaller companies with limited research funding more at risk, as well as discouraging investment.

LACK OF COORDINATION

Obviously, you can't get to a position where you build a PV plant, and you are ready to go, and the grid connections are late or haven't been built!

(SME Manager, South Africa)

Policies

Policies in place were often not coordinated across regions, or across Ministries, making large-scale projects particularly prone to delay, and additional cost and risk. As one US manager put it "you have to deal with local authorities, with regional authorities, with the state, with the federal government, with the tax authorities...everybody is doing it differently".

While at the top level, policy statements lauded the need to support the development of renewable energy, poor coordination of renewable energy policies in practice often defeated that purpose. New renewable infrastructure, and administrative new processes were developed by national and regional governments with different priorities, and across Ministries with very different remits, policies and modus operandii.

Companies in some regions were unable to access the relevant document or permits without costly delays, and in many cases, projects were abandoned because the necessary administrative or infrastructure was not yet in place.

In countries such as South Africa, in the very early stages, this was a very real issue for managers. Some key policies were simply absent, or developed in the aftermath of major crises, as for example, in the lack of access to skills and professional development typically hindering company and cluster development.

Bureaucratic Processes

The same lack of coordination was evident in the processes companies were required to go through to obtain the requisite permits and certificates to install renewable products or take forward renewable projects. There was little or no coordination across Ministries and organisations in the administration of these requirements. The resulting bureaucratic complexity was one of the biggest obstacles companies reported— creating unnecessary delays and costs. Typically bureaucracy impacted SMEs in particular – not just in terms of delays and costs, but because they did not have the staff to devote to the administrative challenges required to apply

for funding for new projects, or to initiate projects requiring permits and agreements across different jurisdictions.

POLICY THAT IS POORLY INFORMED

Larger companies and established lobbies for oil and gas were perceived as having greater representation and greater influence on policy. SME managers felt they had no real voice in shaping policy – despite being the bedrock of the cluster, and the vehicle for regional benefits in terms of jobs, skills, innovation and niche knowledge. This led to critical gaps in policy, particularly since the needs of SMEs were very different from those of larger organisations.

This asymmetry also meant policymakers missed early warning of problems, opportunities and implementation problems. (It is in this context that collaborative research with companies on the ground could have provided additional input).

INEQUITIES IN ACCESS TO /INFLUENCE ON POLICY MAKING

Many companies felt they lacked meaningful opportunities to (a) communicate concerns, and (b) have them taken account of in the decision-making process.

They (policymakers) are not very interested in our arguments. With government organisations the experience has been negative, in the sense of difficult, very difficult. There is a lack of dialogue in areas of mutual interest (between SMEs and policymakers) to speak about what people think.

(Interview A/6, SME, Portugal)

Large established players were seen as having overwhelming access and influence in shaping policy

The big electricity providers ... regard us as disrupting their business, and the nuclear energy lobby has been able to make their case and is doing that again. ... That's a well-rehearsed argument, and we've got to make our case against it ourselves.

Interview 8, Regional Collaborative, Canada

This perception of an uneven playing field, where some players shaped policy more than others, went beyond the cluster to the wider context of the energy industry. As one Canadian company manager put it “the biggest barrier in Alberta is the fact that the provincial government subsidizes the fossil fuels industry, but they don't do the same, or offer similar support for renewables.”

Stiglitz (2012) and Piketty (2013) point to the economic disadvantages of inequality, with the implication that there is a need for more government involvement to provide an even playing field for market forces to come into play. Economists such as Ketels (2012) and economic sociologists such as Scott (2011) flag the need for government to take a proactive role in ensuring this if the market is to operate fairly and efficiently.

The infrastructure in place (both real and digital) also presented individual actors with opportunities and incentives to create value for themselves at the expense of the cluster, as we saw in the Portuguese case, and others, such as this one in Spain.

The main problem is that the electric companies who authorize you to connect your installation to the national net are private companies. Company X, Company Y - all of them have their own engineering companies - who are focused – their main businesses are focused also on installation. ... So, they are our main competitors, and they are doing their own business. So, they keep the information of the net for themselves. ... So, I think it's not fair. The electric company must be a public company. And then in that way it was an equal opportunity for everyone. But this way they are private, and they are doing also this, not legal competence, I think, and you have to pass through their barrier to get your installation running.

(Large company, Spain)

For the market and the cluster to function as intended, respondents clearly felt government should be more pro-active in ensuring an even playing field in terms of representation and influence at the policy table. The evidence of other studies suggests that greater access to feedback from different actors allows policy to respond to changing realities on the ground.

POLICY THAT IS POORLY IMPLEMENTED

Even where policy was developed around the needs expressed the ground, it was often blunted or distorted by poor implementation. The bureaucracy associated with administration of permits was a case in point. Feedback on the implementation of policy on the ground is crucial if a cluster is to

- take advantage of market demand
- ensure implementation does not have undesirable consequences for some actors.
- remove unnecessary barriers to growth or competitiveness

LOOKING ACROSS CLUSTERS

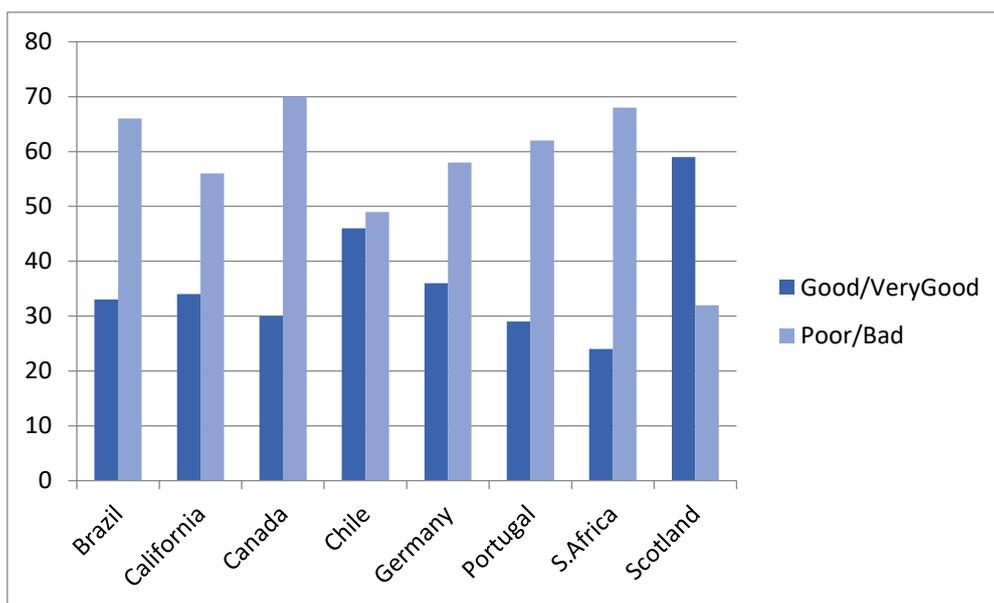


Fig. 6 Communication with policymakers was typically rated Poor or Bad, rather than Good/Very Good

The interview quotes (translated in some cases) provide a rich seam of evidence, validated at scale by surveys

CALIFORNIA	<p>Policy makers are not interested to talk to small companies. They just talk to companies which have deep pockets, and they want to have some donations before they do any decision. (SME)</p> <p>Policy makers seem to listen a little bit more to the big guys, and utilities of course. Some of the larger players in the solar industry resisted us and didn't want a German style FiT. The big players have rolled into the dominant position in the market, so they do not necessarily want to see all these new competitors coming into the market (SME)</p>
PORTUGAL	<p>Of course, we are disadvantaged... government always gives preference to the big companies. If someone here is running a small company with 10 or 20 people, the support is zero ... Everything that's big automatically receives support. Everything that's small automatically does not get support – this is the basic policy. (SME)</p>
	<p>The biggest companies have very strong links with government or certain parties. They are big families (Economic Dev. Assoc.)</p>
CHILE	<p>I don't think they do take them into account, because obviously there are no policies (to support SMEs) so there is little chance that they will meet the needs of my company. (SME)</p>
BRAZIL	<p>They need to establish mechanisms to facilitate and develop the life of small and medium enterprises, because people are facing many difficulties (SME)</p>
S. AFRICA	<p>The industries are not asked for their opinion, otherwise there would not be such objectives like the installation of 1 million units by 2013. Obviously, the industry could have told them earlier that is not realistic. (SME)</p>

Apart from failing to meet the needs of the SMEs that create value for the region, this gap in feedback also deprived policymakers of information about emerging threats and opportunities on the ground. It also meant the system was widely perceived as creating benefits for individual players at the expense of others. This was to the detriment of the cluster as a whole, and to the host region.

IMPLICATIONS FOR POLICY

The creation of an even playing field is arguably essential if the different actors are to benefit from co-location. The free-market approach espoused in some of the clusters does not mean that governments should take no role in ensuring communication and collaboration infrastructure is designed and managed - much as the physical infrastructure is.

Not only can these recurring barriers be mapped and managed, but it is important that they are, if clusters are to achieve their goals, and avoid unnecessary cost and risk.

REUSE RATHER THAN REINVENTION

Many of the strategies for achieving this have already evolved in other sectors/clusters and could be shared rather than reinvented. Oil and gas clusters have dealt with many of the same issues. One example is

embodied in the Pilot Supply Chain Project. This project in the North Sea Oil and Gas Cluster compensated for the loss of innovative SMEs by providing better representation and support, including Fair Payment Practices, Share Fairs. This turned the situation around and allowed the cluster to compete in terms of innovation as the sector transitioned from cost reduction strategies.

Key implications from both this study and earlier work with oil and gas clusters include:

- more equitable and meaningful representation of SMEs at an executive level where and when regional and national policy is decided
- better access to funding for concept development, testing and commercialization for SME innovation
- mitigation of excessive cost and risk for SMEs in areas such as poor payment practices
- more streamlined and coordinated administrative processes to reduce bureaucratic delays/costs
- incentives for universities to carry out more practice-based research with companies in the field to identify and disseminate emerging risks, opportunities and requirements on the ground
- incentives for universities to respond more effectively and rapidly to emerging training needs

4 BUSINESS TO BUSINESS INTERFACE : CREATING SHARED VALUE

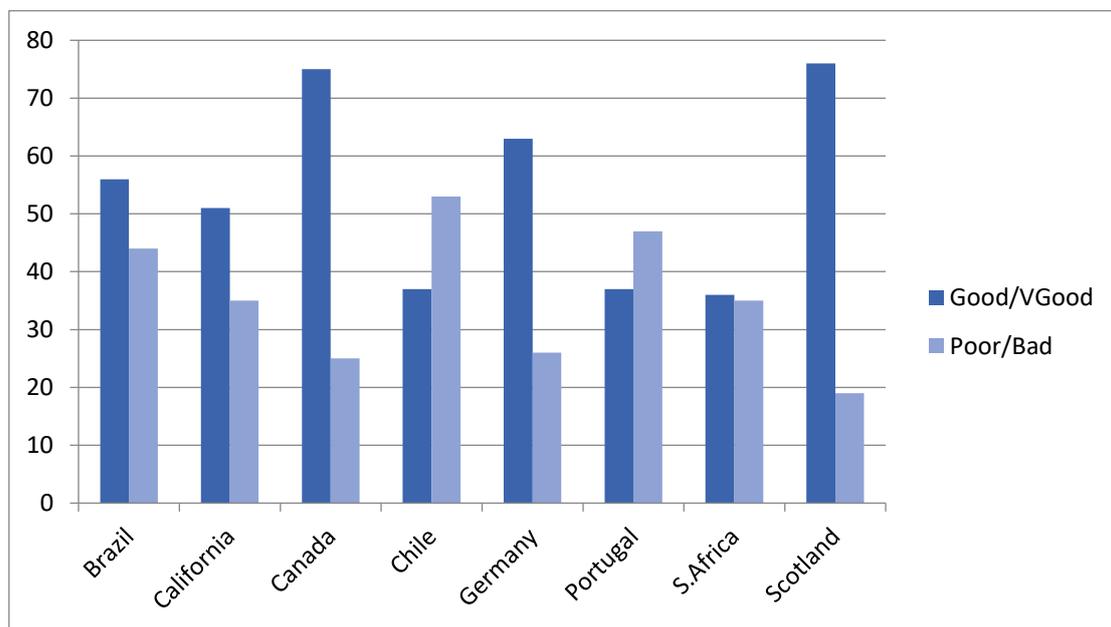


Fig. 7 Rating communication with other companies

Interaction with other business quite positively viewed across clusters (Fig. 7) however it should be acknowledged that most companies are referring to the many other companies already in their immediate supply chain, with whom they already have established working relationships.

CREATING LINKS AND STRATEGIC ALIGNMENTS

It is also clear from the interviews, and from the comments included in the surveys, that smaller companies often expressed an interest in more communication and more collaboration with larger companies, and in some cases, with companies in other clusters, for mutual benefit.

The Californian cluster was unusual in the extent to which they used Associations as a means of networking in this way.

The most successful strategy is partnering with [industry associations] and contributing as a part of [them]...SunPower, BP, First Solar and Sun Edison - established players in the US-you could work with them through these industry associations. (SME, California)

Companies in the nascent Chilean cluster were also seeking to use Associations and other business networks as a means of learning from other regions abroad

One of the objectives of the Centre for Renewable Energies is precisely to form all these international networks, with other centres like that. I mean, it is fundamental to maintain all these institutional relations to exchange experience. (SME, Chile)

They also pointed to this as a means of supporting technology transfer to enhance the sophistication of firms, and the competitiveness of products. They appeared to be drawing on the experiences of established companies from the mining, engineering and hydropower sectors which were well networked and internationally focused. The perceptions of business dynamics in Chile, in California and in Chile were qualitatively different from other clusters in a number of regards.

In California for example, Associations took a role in facilitating strategic alliancing across a wide range of stakeholders. This was perceived as contributing to the competitiveness of the regional market, and reflected a broader view of the dynamics in play than most other clusters..

I think the key here is to understand that companies are not competing among themselves, but rather, they are on the same side. And so the developers - all the engineering companies, all the generating companies – shouldn't be afraid of being united in an Association such as this, and to work with the government, work with the authorities, to achieve the big objectives which are the modification of the regulations.

(EconDev.Assoc/ ChCommerce, California)

This approach may stem from a different business culture. When asked about the factors that had supported the development of their respective clusters, the responses in California, and in Canada showed a quite distinct construction of the driving forces, with more emphasis on the unique business and entrepreneurial culture as a factor. It suggested a greater awareness of the potential of the value of facilitating strategic alliancing as a strategy for creating shared value.

IMPLICATIONS FOR POLICY

Although this strand of the wider research has focused on barriers, the interviews and the surveys showed that there were also opportunities to share a range of effective strategies from other clusters. Examples already mentioned include the provision of opportunities for companies to create alliances with other companies and organisations.

- In the home cluster e.g.
 - Share Fairs
 - Buddying renewable SMEs with larger energy companies
- In other clusters e.g.
 - using Associations as a means of making more international connections
 - using University-based research networks across clusters

RECURRING COMMUNICATION AND COLLABORATION BARRIERS

The cluster concept was originally based on the benefits evident from collaboration across a growing community of regional artisans in the Italian leather industry. Here companies shared long-standing channels of communication and collaboration and had incentives to share resources to advantage. These reciprocal ties are absent from many modern clusters, and the incentives in place often mitigated against this kind of collaboration.

The pattern of results in each cluster highlighted the interface between policymakers and businesses as particularly problematic, with university interactions with SMEs typically a close second, and the business-to-business interface much more positively rated.

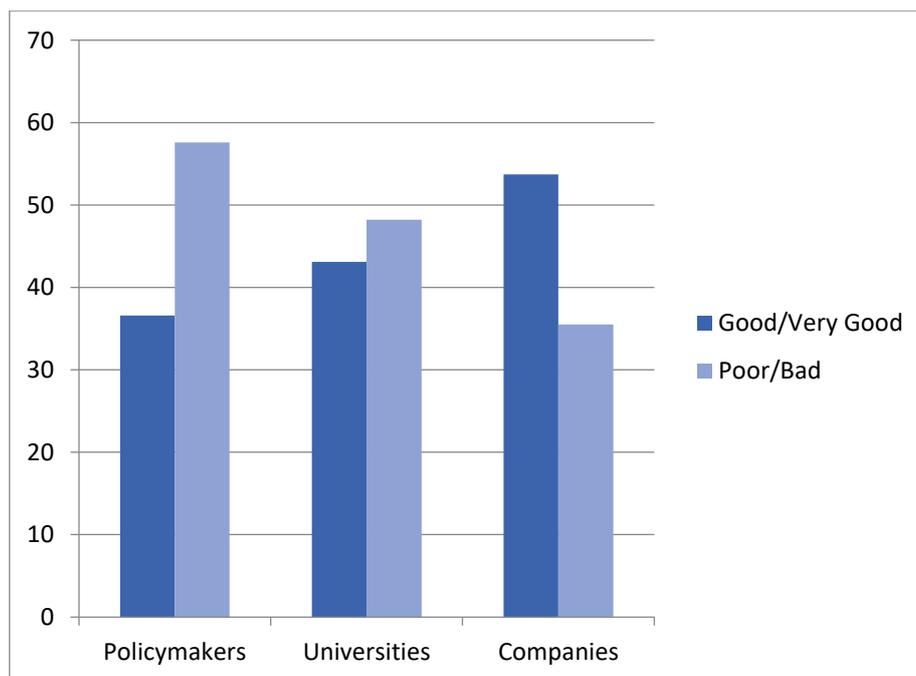


Fig. 8 Communication between companies and (i) government,(ii) Universities (iii) other companies.,

Asked in a separate question what changes would most improve the development of the cluster, the same pattern of issues was evident. If we zoom in further (Fig. 9), to look at perceptions within one of the individual clusters, in California, and ask managers what would most improve the situation in the cluster, the quotes are very revealing.

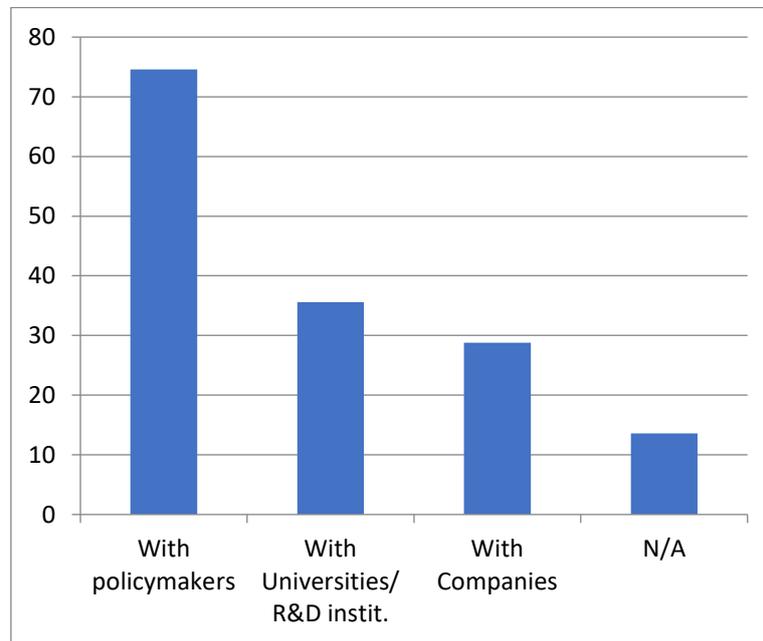


Fig.9 Views on improving collaboration among Californian SMEs. (Created by Rolletschke R. 2010)

The need for improved collaboration with policymakers was seen as crucial by 74.6 % of survey respondents, with collaboration with Universities and R&D institutes was rated as much less of an issue. There was also interesting variation in terms of distance from the centre, in that smaller clusters reported a greater sense of being side-lined. Those located further from the legislative centre felt less well represented – whether on the periphery of the main cluster in the Valley in California, in the regional sites in Canada far from national government, or in the emerging cluster in Chile far North of the seat of government in Chile.

Recent clusters are now often created in underdeveloped areas, as with the case of the Alentejo case in Portugal [Ure and Jaegersberg, 2015], where established channels of communication and collaboration had not yet evolved. While it would be unthinkable to develop a new cluster without giving some thought to the flow of people and materials to and from the area, the flow of knowledge and information between cluster actors is typically not planned, monitored or managed. The results underline the pressing need to map and manage this less tangible infrastructure to better leverage this.

MAPPING AND MANAGING THE FLOW OF KNOWLEDGE, INFLUENCE AND RESOURCES

The infrastructure shaping the ebb and flow of information and influence between connected players is both mappable and manageable, and could be harnessed to advantage, as social media platforms clearly do. Yet SMES overwhelmingly felt they were under-represented in these networks, except weakly, by Associations, and that their knowledge and requirements were therefore also largely ignored. This was a disadvantage for both companies and the cluster.

There was not only a failure to benefit from shared knowledge, skills and resources, but often extant historical or economic alliances between more powerful actors created a very uneven playing field for SMEs. This created value for individual organisations, rather than for the cluster or the host region.

Large players were seen as more likely to be shaping the policy agenda in early-stage clusters in rural regions, such as the Alentejo case we looked at in Portugal, and in the emerging hubs in South Africa. Yet it was also evident in mature clusters such as Germany.

The big electricity providers ... regard us as disrupting their business, and the nuclear energy lobby has been able to make their case and is doing that again. ... That's a well-rehearsed argument, and we've got to make our case against it ourselves.

(EconDev.Assoc. /Ch Commerce, Germany)

Another example from Brazil, where Petrobras controlled most of the oil and gas drilling and Eletrobras held most of the hydropower, nuclear and wind power companies, managers of smaller companies perceived this as a virtual monopoly that inevitably influenced the way renewables evolved as part of the matrix. Sometimes these asymmetries were embodied in digital networks also.

INEQUITIES EMBODIED IN DIGITAL INFRASTRUCTURE

The web-based portals which mediated the transaction of permits, registrations and accreditation in Portugal provided an example of how software can also embody or even extend the impact of those differences. The administrative portal used in the Portuguese case to manage registrations and other services was managed by one of the larger incumbents and was viewed by SMEs as unfairly limiting their access, and facilitating that of the incumbent. This was seen as distorting the free play of the market, as well as the ability of smaller players to compete in their offer to the pool of customers in the region.

If all companies had equal access there would be competition based on technologies and sales and not a question of who has the best access.

(SME, Portugal)

The risk that the increasingly digital channels of communication between players could benefit some actors at the expense of others is beginning to be recognized in a range of contexts.

CREATING VALUE FOR INDIVIDUALS AT THE EXPENSE OF THE CLUSTER

A recent call for research information to support the development of cluster policy in the US pointed out the need for a coordinated strategy to ensure this disbursement of public funds benefits the cluster, and the region, rather than individual constituents.

Cluster policy is NOT about interventions that enhance the private profitability of firms in a given location in ways that are not related to their level of productivity or innovation. For private profitability to align with the economic performance of a region, it needs to be based on strong productivity, rather than market restrictions or subsidies that achieve private profit by shifting value from the region's consumers and taxpayers to an individual firm.

(Harvard Business School Institute for Strategy and Competitiveness. (2010)

The design of communication and collaboration infrastructure is thus critical to the equitable sharing of dispersed knowledge, skills and resources within the cluster, and to the creation of value for the cluster as a whole.

A recent study by Edwards (2007) highlights the implications of different choices in the design of both physical and digital communication infrastructure.

Across virtually every type and class of emergent infrastructure we can identify provisional “winners” and “losers” — those whose positions, programs, work experiences, or general qualities of life are enhanced (or conversely, challenged and undermined) by the developing infrastructure. Clear examples can be found in the nineteenth-century towns through which rail lines did and didn’t pass, the former rising to prominence in the reorganized economic geography of the American West, the latter fading to shadowy reminders of past importance.

(Edwards et al 2007)

This is not a new problem, and arguably it is the problem of all large agglomerations of disparate entities. Democracy, after all, was one of the first mechanisms at scale to harness the power of disparate knowledge for collective benefit both politically and economically, and widely credited as the basis of security and economic benefits in the ancient Athenian city-state.

As Hayek put it, as far back as 1945 “The problem [of dispersed knowledge] which we meet here is by no means peculiar to economics but arises in connection with nearly all truly social phenomena ... and constitutes really the central theoretical problem of all social science where knowledge should be used that is dispersed among many people.”

The infrastructure for communication and collaboration in co-located clusters of different kinds need proactive design and management to create value for the cluster and the region. There should be clear mechanisms for knowledge on the ground to be harnessed as a resource in the creation of policy, and the incentives in play should encourage (rather than discourage) the strategic alignment of knowledge and resources.

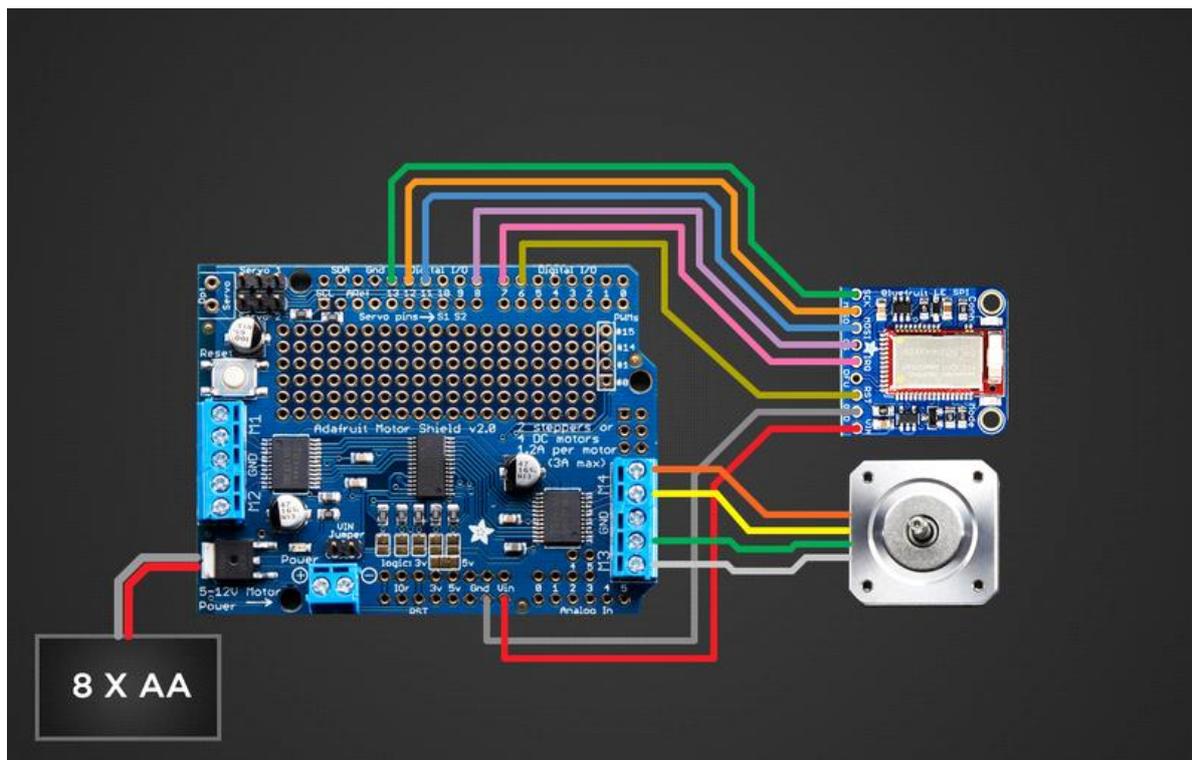


Fig. 10 Bridging the gaps and activating the circuits.

CONNECTING THE CIRCUITS

The research indicates that without pro-active policy measures to create the right infrastructure for communication and collaboration, co-location will not foster innovation, competitiveness or employment in the host region. To use the analogy of the electric circuit – the energy can only flow if the pieces are correctly connected, without gaps or barriers.

The benefits of designing infrastructure that harnesses what system users now and can do is evident in social media (e.g. Amazon, Facebook). This has created value in ways that are applicable to a wide range of distributed communities online as well as in clusters.

If the intention of clustering is to leverage networked human and technological capital to regional advantage through knowledge externalities, then most of the renewable energy clusters we looked at do not provide the communication or collaboration infrastructure for this to happen. One might argue that in many ways it actually prevents it from happening. If co-location in clusters is intended to facilitate constructive exchange and interaction, the infrastructure in place requires urgent and pro-active redesign.

CREATING THE CONDITIONS FOR CO-LOCATION TO FACILITATE CO-PRODUCTION

Hundreds of interviewees and thousands of survey respondents were involved in identifying the barriers that recurred across country cluster and were also asked what would make a difference. One of the key elements was the need for more meaningful representation at the policy table.

EQUITABLE REPRESENTATION IN POLICY DEVELOPMENT

Assembling actors in a geographical cluster is not sufficient to leverage social, intellectual and organisational capital. The infrastructure must also be there for companies to come together regularly and effectively with policymakers to identify and respond to challenges and opportunities in a timely way.

SMEs were the most consistently under-represented in policy development, in meaningful terms, despite being the vehicles of over 90% of employment and much of the innovation in clusters. Given that clusters are intended to provide a return on investment for host regions, in terms of employment, innovation, infrastructure and investment, the extent to which their needs were poorly served is something of an own goal in policy terms.

This is not a new theme. In 1945, Hayek charged economists with over-emphasising the theoretical and the mathematical and ignoring other sources of knowledge which also impact significantly on economic outcomes – citing in particular the knowledge of those on the ground.

More recently Ober (2010) argues that the key to Athens's economic success lay in how the city-state managed and organized the aggregation and distribution of knowledge among its citizens. He explores the institutional contexts of democratic knowledge management, including the use of social networks for collecting information, publicity for building common knowledge, and open access for lowering transaction costs. He concludes that an ancient Athenian would be shocked at the extent to which modern economies ignore this resource. Sölvell (2015) also points to this issue specifically in relation to clusters, and it has also arisen in a host of other newly digital contexts such as eHealth. Providing better opportunities for actors on the ground to be listened to by policymakers and shapers was seen by companies as critical.

Sometimes lack of responsiveness to sources of feedback on the ground stems from over-reliance on an economic model as the primary source of policy. Schumpeter made this point as far back as 1942, and Mackenzie (2006) highlighted the extent to which this contributed to the Financial Crash. Both criticised economic models for a tendency to emphasise all but a few variables, ignoring a much more complex and dynamic reality.

Nee & Opper provide a fascinating look at the unusual case in China of policy moving away from a standard model to adopt a successful approach that developed on the ground. The paper looks at the emergence of a successful cluster in Shanghai through the collaboration of small entrepreneurial companies in the region, following a model that was very different to the model laid out by the central Chinese government at the time. The study is unusual in that it (a) looks at the emergence of this invisible architecture on the ground, and (b) the impact when central government decided to adopt this approach with remarkably successful consequences for the private sector in China.

The common thread in these studies is that although models are very effective 'black boxes' focusing on particular variables, the real world being modelled is constantly changing. In a fast-moving market, it is arguably more necessary than ever to monitor changes on the ground, complementing the broad brush of macroeconomic strategy with both feedback and research on the ground. This is a fascinating area

PRACTICE-BASED RESEARCH TO INFORM POLICY AND PRACTICE

Universities could also provide more effective research with users on the ground, as a complementary feedback loop for policy. While pure research (on innovative solar materials for example), clearly plays a critical role in innovation, there was a strongly voiced need for greater focus on practice-based research with

businesses on the ground – both to identify emerging issues, but also to provide the kind of research support companies needed – messy, multi-disciplinary and practice-based research that would support the installation of novel products in novel ways. Universities could be better incentivized to take more of a role in this. The current arrangements militate against this.

Many of the most recurring barriers across clusters were invisible to policymakers, and were often about practical interventions, (such as better coordination of regulations across regions and Ministries, or the streamlining of administrative and bureaucratic procedures for addressing permits). Early insight on these cuts cost and risk, as well as highlighting new opportunities for creating value.

POLICY TO INCENTIVISE COLLABORATION AT KEY INTERFACES

In the clusters we studied, the incentives at key interfaces were misaligned, and actively militated against the creation of shared value. This need not be the case.

In the context of eBusiness and eHealth, digital software can harness the knowledge and agency of distributed users in designing products or services to create shared value for both users and companies. Amazon, Facebook and many others are testament to this.

If the whole is to be more than the sum of the parts, as clusters promise, then the linkages and the incentives that mediate exchange between players also need to be taken account of in a more consistent way – and where they are absent or inequitable, intervention is required. Design by default appears to be an option that distorts market forces, and disproportionately undermines value creation for clusters.

WHAT HAS BEEN MISSING?

What has been missing in clusters is a more pragmatic understanding of the arrangements and scenarios on the ground, where needs, barriers and opportunities emerge. In dynamic and high-risk environments, the potential for early awareness of risks and opportunities is an asset, as is the ability to learn how other clusters have addressed comparable challenges.

The countries which create the conditions to leverage technical and human resources to advantage in this way will be able to identify potential problems early and benefit also from a portfolio of possible solutions from other more mature clusters or sectors where comparable problems have arisen.

The research suggests that although the pieces of the circuit are there, they still need to be correctly configured. Government has a role in creating an even playing field where market forces can operate more effectively, where policymakers are able to harness the knowledge and agency of actors on the ground and where the incentives in place support strategic alliances rather than militating against them Atkinson & Audretsch(2008).

IN CONCLUSION

SMEs are around 99% of all UK businesses and employ over 16 million people. They are one of the principal vehicles through which investment in regional clusters can be translated into employment, innovation and investment in those regional communities hosting them.

If this investment in renewables is to support levelling up, innovation, skills, employment or competitiveness in these regions then:-

- SMEs need to have a voice in shaping policy around their needs on the ground

- Universities need to be incentivised to do more practice -based research on the ground with SMEs to highlight barriers and opportunities at an earlier stage
- policymakers need to take a more pro- active role in ensuring that this inter-actor infrastructure is facilitating the intended benefits for the cluster and the region.

This was manifestly not the case in any of the regions we looked at. SMEs felt more powerful established stakeholders shaped the policies around their own needs. The barriers on the ground for SMEs were only addressed when significant problems became apparent. The evidence of these very predictable barriers and solutions in other clusters were ignored.

Will policymakers and cluster managers flag renewable clusters as an investment in regional jobs and innovation yet fail to provide the social and organisational infrastructure and incentives to make that possible?

Will they reinvent the wheel, with all the avoidable cost and risk?

Or will they do as the UK oil and gas cluster did with the PILOT initiative and pro-actively facilitate SME involvement in executive policy making - incentivising strategic collaboration towards common ends?

We hope this study has highlighted the value of using students and interns in collaborative research of this type with players on the ground – both to provide policymakers with early insights into emerging barriers, and to support the training of the next generation of managers in the real-world issues impacting on clusters.

This study was set in motion by the comments of cluster managers in oil and gas companies who made it clear that they spent most of their time dealing with socio-technical and socio-political issues rather than technical ones and felt strongly that their training had not prepared them for this. By summarising the most recurrent issues we hope we have met these concerns at least to some extent and given back something in return for the generosity of those we spoke to.

REFERENCES AND SELECTED BACKGROUND READING

Atkinson R Audretsch D (2008) Economic Doctrines and Policy Differences: Has the Washington Policy Debate Been Asking the Wrong Questions? Information Technology and Innovation Foundation Washington

[EconomicDoctrine.pdf \(itif.org\)](#)

Becattini G (1979) Dal settore industriale al distretto industriale.

Becattini G, Pyke F and Sengenberger W (eds) 1990 Industrial Districts and Inter-firm cooperation in Italy. IILS, Geneva

Bourdieu P (2005) The Social Structures of the Economy Cambridge: Polity Press

British American Business Partnership with the Dept. for International Trade (2021) The ' Making a Difference' Report [Making-a-Difference.pdf \(babinc.org\)](#)

Burt R (1992) Structural holes: the social structure of competition

Caballero RJ (2010) Macroeconomics after the Crisis: Time to Deal wit the Pretense-of-Knowledge Syndrome. MIT Dept. of Economics Working Paper No.10-16

Callon M and Rabearisoa V (2003) The increasing involvement of concerned groups in R&D policies: what lessons for public powers? In Geuna A [Salter A J](#) and Steinmueller W E eds (2003) Science and Innovation: Rethinking the Rationales for Funding and Governance Edward Elgar pp30-68

Cluster2Cluster website www.cluster2cluster.org

Edwards PN, Jackson SJ, Bowker GC, Knobel C (2007) Understanding Infrastructure: Dynamics, Tensions and Design, National Science Foundation Workshop Report. Deep Blue.

EERE Commercialization RFI on effective cluster policy, published by the Department of Energy's Office of Energy Efficiency and Renewable Energy and available on http://clustermapping.us/sites/default/files/files/resource/DOE_RFI%20Cluster%20Development%2010-22-13.pdf Accessed 9th Jan. 2016

Etzkowitz, Henry; Leydesdorff, Loet (1995-01-01). "The Triple Helix -- University-Industry-Government Relations: A Laboratory for Knowledge Based Economic Development". Rochester, NY.

Golsorkhi D, Rouleau L, Seidl D and Vaara E (2015) Cambridge Handbook of Strategy as Practice, Cambridge Univ. Press

Granovetter M (2005) The Impact of Social Structure on Economic outcomes. *Journal of Economic perspectives* 19 (Winter): 33-50-

Hayek F (1945) The Use of Knowledge in Society. *American Economic Review* XXXV, No. 4 (September) pp 519-530

Jaegersberg G & Ure J (2005) Inter-Regional Cluster Strategies: Value-Adding Partnerships between Government Education and Industry in the Automotive Supply Chain *CE2005* July 2006 Dallas USA (Best Session Paper) In Sobolewski M and Ghodous P (eds) *Next Generation Concurrent Engineering: Smart and Concurrent Integration of Product Data Services and Control Strategies* Proceeding of the 12th International Conference on Concurrent Engineering: Research and Applications ISPE Inc ISBN 0-9768246-0-4

Jaegersberg G and Ure J (2008) Creating Value Within and Between European Regions in the Photovoltaic Sector. In Curran R, Chou S, Trappery A (eds). *Collaborative Product and Service Life Cycle Management for a Sustainable World*. Springer, London

Jaegersberg G and Ure J (2011) Barriers to Knowledge Sharing and Stakeholder Alignment in Solar Energy Clusters: Learning from Other Sectors and Regions in the Solar Energy Supply Chain: Learning form Clusters in other Regions *Journal of Strategic information Systems (JSIS)* Joint-authorship

Jaegersberg G and Ure J (2003) Inter-Regional Cluster Strategies: Enhancing the Competitiveness of the German Brazilian Automotive Supply Chain *Virtual SC Conference* 17-28 November Cranfield University UK

Jaegersberg J and Ure J (2008) Creating Value Within and Between European Regions in the Photovoltaic Sector *15th ISPE International Conference on Concurrent Engineering (CE2008)* 18-22 August Belfast Ireland Joint authorship.

Jaegersberg, G., Hatakeyama, K., Ure, J., Lloyd, A.D., 2002. Leveraging regional, organizational and human resources to create competitive advantage: a new framework for professional development. In: Jardim-Gonçalves, R., Steiger-Garção, A. (Eds.), *Advances in Concurrent Engineering*. Swets and Zeitlinger, Lisse, pp. 439–446-

Ketels C, Lindqvist G, Solvell O (2012) The role of cluster organisations. The EU Cluster Observatory

Mackenzie (2006) *An engine not a camera; how financial models make markets*. MIT Press, Cambridge

- Marshall A (1919). *Industry and Trade*, Macmillan: London, p. 287
- Morosini P. 2004. *Industrial Clusters, Knowledge Integration and Performance*. *World Development Journal* Vol. 32, No. 2, pp. 305–326 Elsevier UK-
- Nee V and Opper S (2012) *Capitalism from Below. Markets and Industrial Change in China*. Harvard University Press
- Ober J (2008) *Democracy and Knowledge: Innovation and Learning in Classical Athens*, Princeton University Press. Princeton and Oxford.
- Piketty T (2013) *Capital in the Twenty First Century*. Editions du Seuil, Belknap Press. (English version printed in 2014)
- PILOT Supply Chain Project on <http://oilandgasuk.co.uk/wp-content/uploads/2015/05/SC021.pdf>
- Porter M. (1998). *On Competition*. Boston: Harvard Business School Press, p.225
- Reason P. and Bradbury H. (2008) (eds) *The Sage Handbook of Action Research: Participative Inquiry and Practice*. Sage, CA
- Sawhney M & Parikh D (2001) *Where Value Lives in a Networked World*. *Harvard Business Review*. 79(1): 79-86
- Schumpeter (1942) *Capitalism, socialism and democracy*. Harper Brothers, London
- Scott BR (2011) *Capitalism: Its Origins and Evolution as a System of Governance*. Springer
- Stiglitz J (2012) *The Price of Inequality*. Allen Lane, London
- Suchman I (1995) *Making Work Visible*. *Commun ACM*. 38 (9): 56-64 (Sept. Issue)
- Tapscott T & Williams AD (2007) *Wikinomics: How Mass Collaboration Changes Everything*. Atlantic Books,
- Universities UK (2015) *The Economic Role of Universities*, Report Universities UK, 2015) Available on http://issuu.com/universitiesuk/docs/theeconomicroleofukuniversities_c8b621395591ab/46?e=15132110/13449524 Accessed 31/5/2016
- Ure J & Jaegersberg (2005) *Invisible Architecture: the benefits of aligning people processes and technology* British Computer Society
- Ure J (2000) *Constructing Competitive Advantage through Networked Communities of Practice*. ICEED/CIDEE International Conference for Education and Economic Development July 2000 Univ Tecnologico de Tabasco, Tabasco State. CIDEE.Memorias de la Sociedad.
- Ure J et al (2003) *Scaffolding Knowledge Sharing & Decision Support in Distributed Web-based Systems* Presented to the International Society for Production Enhancement (ISPE) Collaborative Engineering Conference CE2003 Madeira In Jardim-Goncalves R Cha J and Steiger-Garcao A (eds) *Enhanced Interoperable Systems* Swets and Zeitlinger Lisse
- Ure J, Jaegersberg G, Lloyd AD, Procter R (2007) *Integrating Innovation in the Regional and Inter-regional Oil and Gas Supply Chain: Case Studies From a Trans-regional Research Network*. European Symposium on Innovation Management Practice (ERIMA), 15–16th March 2007, Bidart (Biarritz), France

Ure J, Malins J, Murray P and Juwah C (2001) Beyond Constructivism: Generative Networked Environments, ALT-C Conference 'Changing learning Environments', September, Edinburgh

Von Hippel E (2004) Democratizing innovation Cambridge MA: MIT Press