WORKING PAPER 7
June 2005

EmergingUK Hydrogen Economies:Policy/Urban andRegional Infrastructure‘Drivers’

Mike Hodson and Simon Marvin,
Centre for Sustainable Urban and Regional Futures (SURF),
University of Salford,
Cube Building,
113-115 Portland Street, Manchester M1 6DW.
Tel: +44 (0)161 295 4018.
Fax: +44 (0)161 295 5880.
E-mail: M.Hodson@salford.ac.uk
www.surf.salford.ac.uk

This working paper is one of a series of seven – detailed below - emerging from SURF's role as part of the UK Sustainable Hydrogen Energy Consortium. We welcome critically constructive feedback on these working papers.

Hodson, M., Marvin, S., Eames, M., (2004), *Technology Characterisation of the Hydrogen Economy*, Working Paper 1, SURF Centre, University of Salford, May.

Hodson, M., and Marvin, S., (2004), *Opening the 'Black Box' of the Hydrogen Economy*, Working Paper 2, SURF Centre, University of Salford, May.

Hodson, M., and Marvin, S., (2004), *Understanding Transitions to a Hydrogen Economy(-ies) with and through 'Regions'*, Working Paper 3, SURF Centre, University of Salford, October.

Hodson, M., and Marvin, S., (2005), *Re-Imagining Tees Valley in the Post-Industrial*, Working Paper 4, SURF Centre, University of Salford, May.

Hodson, M., and Marvin, S., (2005), *The 'Journey' to Wales' Hydrogen Economy*, Working Paper 5, SURF Centre, University of Salford, May.

Hodson, M., and Marvin, S., (2005), *London's Hydrogen Economy: Negotiating the 'Global', the 'Regional' and the 'Local',*, Working Paper 6, SURF Centre, University of Salford, May.

Hodson, M., and Marvin, S., (2005), *Emerging UK Hydrogen Economies: Policy/Urban and Regional Infrastructure 'Drivers'*, Working Paper 7, SURF Centre, University of Salford, June.

1. Introduction

understanding the different ways in which regions develop hydrogen economies, taking account of different scales of activity, both in terms of scales of policy and 'formal' politics and also a variety of other actors and institutions. From this we offer a discussion of a series of 'drivers' for informing understanding of urban and regional hydrogen economy developments. Finally, we conclude through exploring and evaluating the 'syntheses' and 'gaps' between different policy and strategy proclamations political of urban and regional hydrogen economy developments and these urban and regional 'drivers'.

2. Policy and 'Drivers'

This section outlines the 'drivers', interrelationships and pressures for a hydrogen economy in terms of 'relevant' policy contexts, here the EU in 'global' context, the UK Energy White Paper and subsequent attempts to develop a strategic framework for hydrogen energy in the UK. An important emphasis is on the relationship between national and supranational policies and strategies and developments and regions.

This is important as there have been numerous attempts to define the hydrogen economy, and infuse the concept with meaning (Dutton, 2002, Rifkin, 2002, POST, 2002). With this in mind, a broad definition of a hydrogen economy may be seen as concerned with a 'widespread and diverse production and use of hydrogen' (POST, 2002, p.1). The development of future hydrogen economies is generally seen to be underpinned by a number of 'drivers' with varying emphases in different international, national and local and regional contexts. These 'drivers' often concentrate on concerns related to widespread reliance on fossil fuels, including: reducing carbon dioxide emissions; confronting air pollution; increasing security of energy supply; and addressing industrial competitiveness. In terms of thinking about UK regions it is useful to understand and 'unpick' these 'drivers' in terms of the European Union (in a 'global' context), the UK policy context and the ways in which UK energy policy relates to regional developments.

2.2.1 Europe in a 'Global' Context

In terms of the European Union and policy there is particular emphasis on four issues; carbon dioxide emissions reduction and meeting obligations under the Kyoto agreement; addressing issues of energy security of supply; air quality and health

through a structure including an Advisory Committee (of a large industry presence, research, the European Commission, NGOs and representatives of national and regional government from numerous Member States), steering panels (with a strategic focus) and initiative groups (developed around specific initiatives and topics).

This structure is important in a number of ways in relation to the development of a 'European' hydrogen and fuel cells agenda, but in particular in terms of the ways in which it informs streams of funding from the Framework Programme. The key point of this is that: 'The Framework Programme and national programmes will remain the main public-funding instruments for research, development and demonstration, while regional aid projects could provide opportunities for larger deployment initiatives' (European Commission, 2003, p.21). This is an acknowledgment that:

> Significant public sector involvement is critical to progress. Public sector funding is required to stimulate activity and share risks in research, development, and initial deployment (European Commission, 2003, p.16).

In many ways this agenda offers an implicit view of the urban and regional with an emphasis on 'markets', 'public', 'private', 'niches', 'demonstrations' the 'deployment' of technology and so on. With this in mind there was an important emphasis in Framework Six (FP6) on 'research' and 'deployment'. The total level of funding is difficult to calculate but, according to one key source[2], it included around 100 million Euro in the first call of FP6 and about 150 million Euro in the second call, with the potential for more to follow. The point being that 'it's grown…nearly exponentially over the last three Framework Programmes'. In terms of deployment a particular emphasis has been put on the development of 'hydrogen communities' (HyCom) and also a 'demonstration and pilot programme to extend the technology validation exercises into the market development arena, through a number of "lighthouse" demonstration projects' (European Commission, 2003, p.24). The idea behind HyCom was outlined by one key source, who told us that:

> We've got larger demonstration activities that may combine transport and non-transport applications that may really lead us to a new type of project that would not be a market project or a commercial project but still a

[2] All quotes and citations are anonymised as agreed with interviewees in the negotiations to undertake the interviews.

demonstration project. But in size and scale…one could invent, kind of, hydrogen communities that, of course, they are not going to be 100 per cent hydrogen powered, but in which hydrogen…will play a very important role and then, to establish such a hydrogen community as a demonstration project

> priority given to environmental aspects, but it's not sufficient on its own in terms of hydrogen.

The Energy White Paper did, however, emphasise local and regional scales, suggesting that local authorities and bodies and also Regional Development Agencies (RDAs) 'make decisions that are vital for energy policy - for example on planning, regeneration and development, procurement, housing, transport and sustainable development' (DTI, 2003, p.116). The White Paper highlighted building on these relationships to 'develop a new package of measures to promote national objectives through local and regional decision-making'. In many senses this view suggests that the local and regional levels are sites for the implementation of nation policy measures.

This said, a further point raised in the White Paper was that: 'This will enable local and regional priorities to be better reflected in national policy. Over time a more proactive role will be developed for local and regional bodies in energy policy', for example through the development of regional energy or regional renewable energy strategies and targets and involving 'a partnership of regional chambers, RDAs, Government Offices in the Regions (GOs), local authorities and other stakeholders, such as businesses, unions and voluntary groups' (DTI, 2003, p.116). In particular, 'RDAs' role as the drivers of regional economic development means that they can make a significant contribution to meeting the energy policy objectives set out in this white paper' (DTI, 2003, p.116). The interesting issue this raises is that 'meeting energy policy objectives' in the regions becomes entwined with regional *economic* development and raises issues about the possible tension between economic development and a variety of environmental goals outlined in the White Paper.

The interface of the relationship between the centre and the regions was tasked to The Sustainable Energy Policy Network (SEPN). Understandings of the relationship between the centre and the regions in terms of energy policy, and hydrogen in particular, from the centre were numerous. For example, one commentator with a keen appreciation of the DTI suggested:

> The question…as to whether or not the centre will co-ordinate the actions of different regions is a difficult one. And my own view would be that co-

> ordination in the sense of information exchange yes, co-ordination in the sense of saying, well that must happen there and that must happen there sort of thing, is actually not the way things are currently going. There's more emphasis in DTI terms of devolving money and decisions to the regional bodies than taking decisions at the centre.

These attempts to build relationships and information exchange led one national level policymaker to tell us that:

> [On] energy policy generally, we're trying to work much more closely with the regions… [we're] trying to develop a partnership framework with the RDAs on a number of fronts, energy is one of those…It's trying to find ways of working with the RDAs and the regions and indeed the devolved administrations…So, what they're trying to do is to find areas…we give them £100,000 a year each as a, sort of, energy promotion amount of money and what we're looking for…in my area we're trying to find regions that are interested in co-operating with us on [various] projects. We haven't got very far…we haven't had that discussion yet.

Yet at the same time another closely linked policymaker when asked as to their understanding of energy developments in the regions suggested that 'the information we have is pretty much based on those individuals who bother to come and see us'.

At the heart of these attempts to begin a process of working more closely with regions

2.2.3 A Strategic Framework for Hydrogen

had no clear means to engage in international activities' (E4Tech et al, 2004, p.8). The latter of these was important as the report claimed that from 33 separate measures it proposed only three would 'offer opportunities for the UK to gain by leading international development efforts' whilst '13 would be best achieved by co-operating in international activities led by others' (E4Tech et al, 2004, p.6).

In many ways the approach undertaken, although involving some interviews with policymakers and energy 'experts', showed many similarities with a technology characterisation approach (see Hodson and Marvin, 2004a), particularly in using an 'energy chain modelling approach'. In doing this: 'Six hydrogen chains for transport were identified that could meet the UK's objectives to varying extents' (E4Tech et al, 2004, p.36).

This technical and economic focus resonated with the views of policymakers and experts, where in a 'summary of views' from the interviews that there was a: 'Strong consensus that the UK needs to develop as many technical options as possible to tackle climate change because the political challenges of changing lifestyles to use less energy are more difficult' (E4Tech et al, 2004, p.23).

The interesting issue of the six hydrogen chains is that: 'This is not intended to be a forecast of how hydrogen will be used, nor a design for the UK energy system. It identifies where hydrogen could deliver against the main priorities for the UK' (E4Tech et al, 2004, p.39). The acknowledgement being that: 'The transition to hydrogen for each application will happen at different times and rates, and to different extents, in different places' (E4Tech et al, 2004, p.16). To take examples: 'Remote

knowledge and revenue to support the development of the wider vehicle market – e.g. buses, forklifts'. The point being made that: 'Without these nearer term approaches, there is a risk that the hydrogen energy sector will stagnate, limiting the development

available' (E4Tech et al, 2004, p.103, emphasis added). In undertaking demonstrations:

> EU funding is critical for the initial demonstrations and this opportunity will expire soon. The use of hydrogen in transport beyond the demonstration stage must be encouraged by financial incentives (E4Tech et al, 2004, p.103).

In many ways the strategic view takes a technology characterisation view of the UK hydrogen economy emphasising key hydrogen transport 'chains' calculated and modelled in terms of technical capabilities and economic costs. The key issue is that whilst appropriation of the hydrogen economy zooms in and out of focus in the framework, through notions of 'deployment', 'applications', 'demonstrations', 'potential', 'niches' and so on, this says little directly about connecting this view of the production of the hydrogen economy with urban and regional contexts of appropriation.

Our aim here is to address this issue through outlining key underpinnings of UK urban and regional hydrogen economies and the extent to which they inform or are informed by national and EU level policy and strategies and the 'syntheses' or 'gaps' between the possibilities and manifestations of hydrogen economies.

The interesting issue here is that national energy policy provides a context through which regions may appropriate national and supranational policies in a variety of different ways depending on how regional partnerships are constituted in particular regions, how they understand the possibilities of the hydrogen economy, what their agendas in developing partnerships and so on. From these policy pressures, how do we think about the development of a hydrogen economy which links the production of the hydrogen economy (and its technical possibilities and economic costs) to regional contexts? And subsequently how do we understand the 'drivers' of hydrogen economies within these urban and regional contexts?

3. Producing the Hydrogen Economy

developments through outlining technical 'possibilities' and 'options' in relation to 'costs' – through 'building blocks', 'options' and 'pathways'. Our analysis of emblematic TC documents (Hodson and Marvin, 2004a) claims that TC conceives of technological change through a process of narrowly framing understanding of what 'relevant' costs and technological possibilities are. We claim that this dominant way of narrowly characterising technological change in terms of the supply of technology would benefit from an appreciation of alternative 'ways of seeing' the development of hydrogen technologies, particularly in relation to 'contexts' of their appropriation, consumption and development. It also provides a basis for research which opens up the possibilities for sensitising policy interventions to contexts of appropriation and use in addition to technological characterisations of supply.

4. 'Connecting' the Production of the Hydrogen Economy to Regional Contexts

This raises the important issue of the hydrogen economy potentially developing differently in a variety of places. This was a common view amongst key 'stakeholders' with whom we talked, where for example a national level policymaker told us:

> I'm very struck by the fact that you're doing sort of a regional based thing because I think that's very much how the hydrogen economy is going to evolve. I don't think there'll be a sort of a one size fits all approach. Not in the early stages anyway.

This leads to how we think about 'regional contexts' in relation to the technical and economic possibilities of the hydrogen economy. The issue primarily is one of 'connecting' technologies with contexts of their appropriation. In particular we accept, but seek to stretch, an emphasis in some Technological Transitions (TT) approaches on the co-evolution of technology and society (Geels, 2002) by asking: where and when are 'society' in addressing technological transitions? More specifically, in view of the 're-emergence' of the region, in times of increased 'globalisation', but also the complex interpenetration of scales of governance manifest in 'regional' decision-making the issue becomes one of how and why particular representations - or attempts to re-imagine the region - through technological transitions are made visible? This links to a concern with the types of interests

involved in the production of these representations (‘partnerships’ in the language of the policy debate outlined previously), their expectations of technological transitions

Figure 1: Representation and Governance 'Drivers'

'Driver'	London	Wales	Teesside

as around a city-regional agenda of confronting issues of air quality, social equity, carbon emissions reduction and economic competitiveness. Through the CUTE project in London it was also viewed as related to the problems of managing uncertainty for multinational automobile and fuel corporations and on the focus of the European Commission's DGTREN for systemic transport change.

In Wales the problem was one of relatively poor economic performance both on an urban and rural Wales-wide basis. More specifically it was about the retention of jobs and economic activity related to the 'global' automobile industry and its supply chains in south Wales.

Whilst in the Tees Valley the dominant problem to be addressed was the decline of employment in its traditional industrial base, particularly chemicals and steel.

5.1.2 Perceived Possibilities and Expectations

This, then, related to a second 'driver' that being the **perceived possibilities and expectations** of the development of a hydrogen economy in addressing these issues and problems. In London this involved addressing the issues of air quality, social equity, carbon emissions reduction and economic competitiveness through the 'preparation' of a 'necessary' social context for the hydrogen economy – to the creation of social conditions favourable to a London hydrogen economy. Additionally, for the CUTE project the development of Europe-wide fuel cell bus demonstration projects in highly visible 'leading' cities, were seen as part of a 'test-cycle' informing MNC research and development and also understanding the 'transferability' of technologies across different European cities.

In Wales there was a move from the problem of relatively poor economic development to exploring, through a 'journey', the possibilities of a hydrogen economy through the construction of networks and visions in addressing this poor economic performance.

Whilst in Tees Valley addressing the decline of traditional sources of industrial employment was seen as requiring the adaptation of an existing physical and social

- This clarity (or lack of it) links to the possibilities for mobilising capacity and capability within local networks and as to whether such capacity and capability is made manifest or remains latent. That is to say the creation of a clear 'purpose' or basis for developing a hydrogen economy is underpinned by but also relates to the types and degree of local engagement.

- This underpins, and is underpinned by, views of the relationships between hydrogen and fuel cell technology and regional contexts ranging from 'test-beds', to 'preparatory' to 'exploratory' and 'adaptable'. Or views of this relationship which largely underplays the active role local and regional contexts may play (e.g. 'test-beds'), or alternatively deals with building capacity and visions (e.g. in differing ways, the 'preparatory' and the 'exploratory'), or is underpinned by local and regional adaptability (e.g. the 'adaptable').

5.2 PRODUCING GOVERNANCE – Mediating Representation and Performance

An important issue is in focusing on how these views of the issues and problems facing a region and the responses to them through various representations were produced. A focus on **producing governance** is to emphasise the partial and negotiated way in which hydrogen economies are envisaged in particular regions. In particular the emphasis is on who has the ability to attribute these sorts of meaning to regional hydrogen economies – in particular which institutions are involved? What types of relationships do they engage in with 'others'

5.2.2 Types of Interrelationships Generated

Of considerable importance were the **types of interrelationships generated** by these institutional adaptations and underpinned by particular representations of the hydrogen economy, as outlined above. So, for example, there were a wide variety of interests involved in the 'inclusive' LHP, including public, private, national government, and so on. This underpinned a lengthy process through which different understandings of the hydrogen economy, drawing on varieties of technical, environmental, business, etc, forms of knowledge were negotiated in the production of the LHP's Action Plan.

The interrelationships underpinning the CUTE project were narrower than this and reflected the fact that this was addressing a specific transport demonstration. There was a core network of multinational interests (Daimler-Chrysler, BP) and the European Commission in a PPP added to by more local level interests in particular contexts, here London. The resources these actors were able to leverage (according to one source the costs of the initiative were split with DGTREN contributing around 21 million Euro of the 60 million Euro total) informed a particular test-bed view of the region, trumpeting a technology test-cycle and learning to inform future wide-scale systemic transport change.

In Wales the lack of clarity as to the specifics of how a hydrogen economy would address relatively poor economic performance, and the geographic scale of activities, led to a wide variety of interrelationships (for example encapsulated by the numbers and types of interests attending vision-building events such as that at Miskin Manor) and produced an ongoing negotiation of various forms of knowledge – a circulation and negotiation of ideas - drawing on a variety of relationships and 'stakeholders' on the 'journey' to Wales' hydrogen economy.

In Tees Valley, interrelationships were underpinned by movements from the local level up and the regional level down to 'stitch-up' regionally a 'common' understanding of the hydrogen economy starting from different perspectives. Such a process involved drawing on forms of knowledge of the possibilities of economic regeneration, knowledge of the technical and market possibilities of fuel cell and

hydrogen technologies, knowledge of regional economic strengths and attempts to strategically align these and so on.

5.2.3 Scales of Political Activity

A further important issue was the extent to which these interrelationships connected different **scales of political activity** or otherwise. In London, through the GLA and the LHP there was a focus on developing a coherent city-regional agenda but in doing so there was an acknowledged importance of geographical proximity to national level policymakers via the 'goldfish bowl'. In terms of the CUTE project there was an attempt to develop interrelationships which in many ways by-passed the national level to link the supranational and local and regional levels. There was also a focus on the comparative and competitive politics of 'world' and major cities both vying with one another and co-operating around common agendas.

In Wales the scales of political activity were both Wales-wide and south Wales specific in terms of the cultivation of networks but also with specific project group networks developed at the local level. These views sought to position Wales in terms of the confidence of a newly devolved Wales looking 'outwards' to Wales in Europe, through the development of networks and the bidding for Framework projects.

In Teesside the 'stitching-up' and aligning of agendas linked the local, sub-regional and regional scales together in informing a view of the adaptability of Teesside infrastructure in creating jobs, economic competitiveness and informing regional economic, science, technology and innovation strategies. There was also an emphasis on looking 'outwards' to DTI, in positioning the Tees Valley as a place where a government uncertain about the possibilities of the hydrogen economy could come and 'play about' in an area of existing and adapted expertise.

5.2.4 Key Issues

The above themes highlight a number of

level of resources (financial, forms of knowledge) that are available to key institutions, the types of resource available to them in terms of relationships (or 'social capital') and the ways in which institutional innovations are both informed by these resource issues and have consequences in terms of future resources which may be cultivated in terms of processes of learning through hydrogen economy developments.

- This, in turn, links to a variety of network forms of interrelationships underpinning regional hydrogen economy development. These differ in size, interests constituting them and degrees of alignment and it is the negotiations of such interrelationships, with their variety of aspirations, expectations and understandings of the possibilities of the hydrogen economy, which informs the production of regional representations.

- These interrelationships are not territorially bounded. Regional hydrogen economies are informed to different extents by a focus on different scales of political activity. Indeed the entry of 'external' viewpoints into the development of regional hydrogen economies was a significant 'driver' in all cases. The importance of this – if one refers back to the views of the regions made, often implicitly, in a number of national and supranational contexts – is that this informs an *ongoing negotiation* between the often different expectations of regional hydrogen economy development across different scales and contexts of political activities.

5.3 PERFORMING GOVERNANCE – Manifestations of Regional Hydrogen Economies

The last section outlined issues related to the production of governance, which followed on from representations of governance. That is to say, there was a concern with the types of interests and motivations for developing regional hydrogen economies and the capability of these different interests to inform the symbolic meaning of what a regional hydrogen might look like and why. The issue then relates to the role of those involved in the production of governance in moving the idea of regional hydrogen economies from representation and possibility to their

manifestations and what 'gaps' there are, if any, between the two. In this respect there is an important focus on three 'drivers': the **role of 'intermediary' organisations**, **consequences** and **transferability**.

Figure 3: Performing Governance 'Drivers'

'Driver'	London	Wales	Teesside
PERFORMING GOVERNANCE – Manifestations of Regional Hydrogen Economies			
Role of 'Intermediary' Organisations	LHP – Generation of wide-ranging network to create the 'route-map', know-how and know-who to support a London hydrogen economy PPP – Outside-driven network appropriated and embedded in particular place. Lack of intermediation initially between local people and MNC	H2 Wales – University led initiative seeking to produce networks from which sub-networks can negotiate the development and embedding of demonstration projects in a variety of local contexts HV Initiative – development of automobile industry supply chains with aim of retaining Wales' position in relation to the global automobile industry	Tees Valley Hydrogen Project – between technology providers and a series of demonstration projects in different contexts Fuel Cells Applications Facility – between fuel cell R&D and their application
	A few small scale demonstration projects and a range of cultural and educational events to inform publics		
Consequences	Relatively large-scale demonstration projects, driven through PPP, but		

Key Issues

Of importance the role of intermediary organisations between the production of hydrogen and fuel cell technologies and the various contexts of appropriation – what role might they and do they perform?

Various understanding of 'transferability' are highlighted: technological artefacts, know-how and processes, perceptions or images of regions.

Of importance is recognising the limited development of the hydrogen economy in relation to the above visions of re-imagination. But also that where development has taken place a number of issues are raised even in relation to small-scale demonstrations

5.3.1 Role of 'Intermediary' Organisations

Of interest in attempts to manifest the hydrogen economy in particular places was the **role of 'intermediary' organisations**. So, for example, the role of the LHP was in the generation of a wide-ranging network to produce a 'route-map', the know-how and know-who – the creation of a social context - to support a London hydrogen economy. In doing this the LHP positioned itself between the representation of the hydrogen economy in London and attempts to begin to create a social context for its 'realisation'.

The PPP underpinning the CUTE project was an 'outside'-driven network appropriated and embedded in a particular place. There were interesting issues related to its role which relied on very little apparent intermediation initially between local people and its MNC/DGTREN agenda. In many senses the availability of relatively plentiful resources, underpinning the 'test-bed' view of technology, dominated to the detriment of local-level engagement.

The role of H2 Wales was as a UniversitytoUs5(a(9s Tm [(5r240(a)-256(Londonuo238(Tm [(

the development of automobile industry supply chains with aim of retaining Wales' position in relation to the global automobile industry.

On Teesside two different organisations were developed to inform the manifestation of a hydrogen economy. The first of these, the Tees Valley Hydrogen Project, sought to position itself between technology providers and a series of demonstration projects in different contexts. The second, the Fuel Cell Applications Facility, took a role 'connecting' fuel cell R&D to potential markets for 'application'.

5.3.2 Consequences

These organisations and the roles they undertook resulted in a number of **consequences**, the first of which was that, across the case studies, there were only a few small scale demonstration projects and a range of cultural and educational events to 'educate' and 'inform' publics. This said, many demonstration projects were in the planning stage and reflected that the securing of financial resources was of key importance but also that this needed some investment in terms of the development of a vision or representation and the cultivation of networks to underpin this. Of the few demonstration projects there was relatively high visibility in terms of the large-scale demonstration projects, driven through PPP, but which encountered local protests. It is interesting to note that the 'big boys' here suffered few of the financial resource issues of other initiatives and as such the perceived 'necessity' to 'prepare' and create a social context may not have figured as prominently, a consequence of which can be seen in terms of the bus refuelling station controversy related to the CUTE project.

Where there were attempts to engage in demonstration projects, for example on Teesside, the important issues raised included an awareness or an appreciation of 'selling' the hydrogen economy in terms of the advantages of regional context. There was also a recognition of the importance of engaging with publics through education. A series of design and safety issues were raised as was the importance of visibility and being distinctive through demonstration projects. In addition there was an emphasis on the importance of engaging local providers in training and also developing institutions to work between R&D and the market

5.3.3 Transferability

This leads to some suggestions as to what was considered **transferable** from regional hydrogen economies. In many ways the city-regional agenda of the GLA was London-specific and not transferable. There was, however, a sense that perceptions of London in terms of it being a 'world' city and at the forefront of hydrogen economy developments was transferable. The CUTE project view of hydrogen economy development in terms of the test-bed suggests in many ways that it is the technology that is transferable between contexts where lessons are learned

In the Welsh case there was an unclear sense that through 'rolling-out' the hydrogen economy across Wales that technology was transferable. Furthermore, the notion of Wales as a 'global showcase' suggests the transferability of a particular vision of 'new', confident Wales as well as attempting to position Wales as a technology exporter. This view of technology transfer also resonated with the HVI initiative relating Welsh technology and expertise to 'global' cars.

In Teesside transferability operated, through the notion of the 'experimental platform', in terms of the transferability of the message to DTI that Teesside is the place to prototype the hydrogen economy. If Teesside was then a 'first mover' the 'village fete' – the know-how and processes developed in Teesside – was seen as being transferable in being used to facilitate embedding the hydrogen economy in different regions.

5.3.4 Key Issues

What these themes highlight are a number of **key issues**, including:

- The importance of (understanding) the role of 'intermediary' organisations between the production of hydrogen and fuel cell technologies and the various contexts of appropriation, but also their role between the 'inside' and the 'outside' of the region. That is to say how do 'intermediary' organisations mediate between national, supranational and multinational corporation interests and the regional and local levels? A key question is: what role do 'intermediaries' form and might they perform?

- Of importance is recognising the limited development of the hydrogen economy in relation to the above visions of re-imagining regions. But also that where development has taken place a number of issues are raised even in relation to small-scale demonstrations. There is a large ‘gap’ between the possibilities and claims about regional hydrogen economies and events on the ground. That is to say that an understanding of attempts to develop regional hydrogen economies provides the possibilities to sensitise some of the more grandiose visions of regional hydrogen economies to the constraints and opportunities of particular regional context and the availability of ‘relevant’ relationships and resources.

- There is a variability in understanding what may be ‘transferable’ from different regional and local contexts and to where. ‘Transferability’ was highlighted in terms of: technological artefacts, know-how and processes, perceptions or images of regions.

6. Conclusion

This paper has outlined the importance of thinking about regional hydrogen economies not only in terms of technical and economic possibilities but also in respect of appreciating the regional contexts within which such developments occur. It is important to acknowledge that such regional contexts are not bounded and fixed but are best understood as a ‘nested’, fluid and complex interpenetration of scales of activity –

The second issue refers to relationships, or **who** was involved in regional hydrogen economy developments, **how** they were involved and what their motivations were, or **why**? This also relates to capability, or the types of resources they brought along (**what**).

The third issue is informed by performance, or the production of knowledge, action and forms of learning and how this related to the development of resources (**what** and **how**) in pursuit of a particular view of regional 'purpose' in the manifestation of a hydrogen economy and its consequences.

The key point to note is that there is a chasm between the representations of the hydrogen economy outlined in the case studies and manifestations of the hydrogen economy. The reasons for this are many and complex and whilst a start has been made in outlining key 'drivers' in the narrative above a continued and focused attention on regional contexts and 'drivers' of hydrogen economies is required.

References

DTI, (2004), *Creating a Low Carbon Economy: Progress on Regional Implementation of the Energy White Paper*, DTI: London.

DTI, (2003), *Our Energy Future: Creating a Low Carbon Economy*, DTI: London.

Dutton, G., (2002), *Hydrogen Energy Technology*, Tyndall Centre Working Paper No. 17.

E4 Tech, ElementEnergy, Eoin Lees, (2005), 'A Strategic Framework for Hydrogen Energy in the UK', Presentation by Adam Chase to ESRC Seminar Series 'Analysing Social Dimensions of Emerging Hydrogen Economies', Manchester, 24th February.

E4 Tech, ElementEnergy, Eoin Lees, (2004), *A Strategic Framework for Hydrogen Energy in the UK*, available http://www.dti.gov.uk/energy/sepn/hydrogen_framework_full.pdf

European Commission, (2003), *Hydrogen Energy and Fuel Cells: A Vision of Our Future*, European Commission: Brussels.

Geels, F., (2002), 'Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and a case study', *Research Policy*, 31, pp.1257-74.

Hodson, M., and Marvin, S., (2005a), *Re-Imagining Tees Valley in the Post-Industrial*, Working Paper 4, SURF Centre, University of Salford, May.

Hodson, M., and Marvin, S., (2005b), *The 'Journey' to Wales' Hydrogen Economy*, Working Paper 5, SURF Centre, University of Salford, May.

Hodson, M., and Marvin, S., (2005c), *London's Hydrogen Economy: Negotiating the 'Global', the 'Regional' and the 'Local',*, Working Paper 6, SURF Centre, University of Salford, May.

Hodson, M., Marvin, S., Eames, M., (2004), *Technology Characterisation of the Hydrogen Economy*, Working Paper 1, SURF Centre, University of Salford, May.

Hodson, M., and Marvin, S., (2004a), *Opening the 'Black Box' of the Hydrogen Economy*, Working Paper 2, SURF Centre, University of Salford, May.

Hodson, M., and Marvin, S., (2004b), *Understanding Transitions to a Hydrogen Economy(-ies) with and through 'Regions'*, Working Paper 3, SURF Centre, University of Salford, October.

POST, (2002), *Prospects for a Hydrogen Economy*, Parliamentary Office of Science and Technology: London.

Rifkin, J., (2002), The Hydrogen Economy: The Creation of the World-Wide Energy Web and the Redistribution of Power on Earth, TarcherPutnam: New York.