WORKING PAPER 4

May 2005

Re-ImaginingTees Valleyin thePost -Industrial

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

Introduction 2
A Historical Legacy: Opening up Possibilities through Adaptability 2
Historical Legacy and Locale 3
'De-industrialisation' and Job Losses 5
Creating New Synergies as a Response to De-Industrialisation 6
Making the Hydrogen Economy Visible for Tees Valley and Beyond 7
Making the Historical Legacy Visible 7
Communicating with 'Others' to Re-Imagine Tees Valley 8
'Stitching Together' the Tees Valley Hydrogen Economy 9
Creating a Shared Agenda 9
The Hydrogen Economy in the Tees Valley: Creating Jobs and Aspirations 10
'Global' Competitiveness and the 'Evolution' of Existing Industry 12
Interpenetration and Negotiation: 'Stitching Together' Scales of Governance 13
CPI and Renew Tees Valley as Strategic Interventions 15
Performing the Tees Valley Hydrogen Economy: Re-embedding Technologies in Unfamiliar Contexts 16
The Claim to Importance of the Historical Legacy 17
Lessons from Demonstration Projects 17
Engagement through Education 18
Design and Safety 19
Chasing Distinction through Demonstration Projects 19
'Transferability', Training and the Creation of Markets 21
Conclusion 23
References 24

Introduction

The material presented here is a draft work in progress for internal UKSHEC members only, building on a number of other working papers and complimenting two further case studies. On this basis we would welcome feedback and discussion from colleagues as part of a process of ongoing analysis.

This paper analyses attempts to develop a hydrogen economy in the Tees Valley in the North-east of England. In doing this we broaden out understandings of the development of a hydrogen economy from a dominant way of addressing such processes in terms of economic cost and technical capability issues related to hydrogen economy developments (see Hodson and Marvin, 2004a). Instead we conceptualise the production of a hydrogen economy in terms of the mutually shaping relationships of hydrogen and fuel cell technologies to the 'contexts' of their development – here the Tees Valley. In particular, through an earlier process of conceptualisation (Hodson and Marvin, 2004b) we highlight a series of three key issues to be addressed in understanding these mutual relationships: (1) the importance of the 're-emergence' of regions and the relationship to issues of technology and governance; (2) regional representations and issues of context; (3) and the performance of regional hydrogen economies, through infrastructure development.

In addressing these themes – and drawing on issues raised in this previous paper – we ask: (1) How is the development of a hydrogen economy in the Tees Valley represented in terms of a 'vision'? (2) How and why is this vision produced and what interests are included and excluded? (3) How does the vision relate to attempts to develop a hydrogen economy on the ground and what key issues are raised? We address these questions through drawing on a series of interviews with and observations of key stakeholders in this development and also utilising documentary evidence. In doing this we outline the processes through which a re-imagining of the Tees Valley via hydrogen economy development is produced, how and why and highlight a series of issues which arise from the re-embedding of hydrogen and fuel cell technologies in particular contexts. From this we make tentative suggestions around questions of what is 'transferable' from the Tees Valley context but suggest and encourage that more work is undertaken in different contexts to compare and contrast issues arising from specific hydrogen economy developments.

A Historical Legacy: Opening up Possibilities through Adaptability

Aspirations to develop a hydrogen economy in the Tees Valley can be understood in relation to finding a new rationale which aligns and adapts an existing industrial infrastructure (in the widest sense of the term) to a series of new and emerging agendas related to job creation and economic

competitiveness through 'new' energy technologies. The creation of a Tees Valley hydrogen economy rests on the historical legacy of 20th Century industrial Teesside, where proximity to the North-east coalfield and local salt mines and the development of the deep water Teesport related to the historical development of the Tees Valley chemicals and steel industries.

In particular, post-Second World War, the chemicals and steel industry on Teesside were dominated by ICI and British Steel respectively. In terms of the chemicals industry this resulted in the build up of a large asset base of existing infrastructure. The existing physical infrastructure is flagged-up in the Tees Valley Hydrogen Partnership's (TVHP) representation of a Tees Valley hydrogen economy as providing a production, distribution and storage infrastructure where hydrogen can be safely stored in 40 large salt caverns with an overall capacity of 600 tonnes, and distributed around 30km of pipeline between three large hydrogen generation plants straddling the River Tees. The salt caverns are a by-product of chlorine manufacturing in Teesside where the excavation of salt left large cavities which can be used to store hydrogen, LPG, petrol, crude oil, nitrogen and so on.

In terms of the relationship between those who consume and produce hydrogen in the Tees Valley there is an attempt to keep a broad equilibrium with the salt caverns offering the possibility, through storage, of flexibility in this arrangement. Uses of hydrogen on Teesside, that is to say consumption, are many and include using hydrogen to make nylon and to produce ammonia, which also goes into making artificial fertiliser. The manufacture of, for example, chlorine and methanol relies on the production of hydrogen. In addition some of the oil refinery plants on Teesside are consumers of hydrogen whilst others are producers. In total about 75,000 tonnes of hydrogen is produced a year on Teesside largely by steam reforming of natural gas. The arrangement of equilibrium between producers and consumers is largely to keep the 'system' in balance with very little export via the merchant hydrogen market. The system was historically controlled by ICI. In the wake of the sell-off of ICI assets in recent decades there is now no single controlling influence over the system although Huntsman act as an operator.

Historical Legacy and Locale

Beyond the physical infrastructure of the network, as an industrial centre built on coal, metals and chemicals, Tees Valley has considerable experience, the claim is made, in embedded processes in handling chemicals and fuels generally in a safe manner stretching over many decades. The dominance of ICI and British Steel as employers in Teesside for a large part of the 20th Century suggests that: 'you'll find…that in an area which has grown up with steel manufacture, steel processing, petro-chemical manufacturing and then in later years, an off-shore industry, you also

build up a certain people skills base, which is all well suited to hydrogen application as well'[1]. The historical development of a variety of skills and competences associated with these industries, within the tight geographical proximity of Tees Valley and surrounding areas led one key player in the sub-region to liken the availability of chemicals industry and hydrogen 'experts' and 'expertise' as metaphorically akin to a 'village fete' where goods and services are available to a community within one place.

In addition to the availability of skills and competence via the village fete, the local skills base was historically employed in large numbers in the chemicals industry and often lived in close proximity to huge chemicals complexes. This dependency through employment and also the constant visibility (and smell!) of the chemicals industry led one key player in the local chemicals industry to claim:

> That's another of the features of this area, compared with other places round the country, we will get off to a very easy start [in developing a hydrogen economy]. The people here have grown up with chemicals and petro-chemicals and what not. They're used to putting up with a lot in terms of general nuisance and noise and what not…You really have to avoid being a nuisance to people and as long as your plant doesn't actually make loud noises, suddenly catch fire, emit all sorts of toxic materials or smell awful…then people will accept that a huge chemical complex is a good neighbour. The day you release a cloud or something or other and it closes the road and disrupts lots of people then that takes you back, and all the big chemical producers are conscious of that…There'll be some people in some particular areas very close to these big sites who do have more than their fair share of unfortunate incidences, have got a somewhat cynical attitude to the big chemical players. There aren't too many of them…I think there are precious few people who actually genuinely think that the chemical installations that we've got are dangerous…So you've got basically an educated community here that has grown up with the chemical industry…They know that Teesside's full of people who know how to design and operate a chemical plant, hydrogen based and so on and so forth. They're used to planning processes, where people build yet another chemical plant and what not, they're used to seeing chemical tankers running through and around the streets. The concern people have is about heavy trucks going through the streets where children are walking to school. They're not saying "I don't like what's in these tankers" because they've got a good safety record.

The consequences of the historical legacy in terms of the local population is that there are well established processes, the claim is made, between local populations, representatives of the chemical complexes and local authorities with the outcome being that developing particular demonstration projects would often be easier in Tees Valley than in other areas of the UK. The issue being that other people undertaking demonstration projects have suggested that:

> They certainly believe that it [undertaking demonstrations] would be so much easier up here [in Tees Valley], partly because you've got local authorities who will look at all the

[1] All quotations are anonymised as was negotiated in the agreements for interviews.

> professionalism people have…[We have had] countless planning applications for huge chemical complexes in this area and compared with all of that *this really is a piece of cake*. You've got populations that are used to being involved in that kind of planning process. Because we've built some rather controversial things in the Tees Valley, then we've developed very slick processes for proper engagement with people in the consultation stage…So there are well rehearsed processes for bringing communities along with planning processes for things that are much more intrusive, than anything that's going to come out of this.

'De-industrialisation' and Job Losses

Processes of 'de-industrialisation' in the 1970s and 1980s had huge repercussions for Teesside's reliance on chemicals and steel as the basis for employment and local economic activity. According to one local authority on economic issues:

> I mean, it isn't that long ago the steel industry for example…I guess it would be the late '60's, for instance, would employ about 36,000 people. They now employ less than four [thousand]…and they produce more steel now than they did then.

British Steel's domination of steel employment in Tees Valley was mirrored by ICI's domination in chemicals. ICI, prior to processes of de-industrialisation, 'you find they owned most of the assets… most of the people worked for them and they built up the skills base'. ICI, over the last couple of decades sold off its heavy bulk commodity businesses 'to the point where they employ five or six hundred people there, in Teesside, rather than 35,000'. The consequence of this is that numerous multi-national concerns own individual plants in the Tees Valley. So that rather than 35,000 people all working for one employer there is now a situation of fragmentation where 'that employer employs five or six hundred people and then you have a few more thousand working for Huntsman and a few more thousand working for Shell etc'.

There is still a significant number of people employed in the chemicals and related industries in the Tees Valley:

> But there's fifty separate different companies which in the main are headquartered overseas and, again, that's the difference, because ICI was always officially headquartered in London but it felt like it was headquartered in Teesside. Huntsman are headquartered in Salt Lake City over in the United States…and so it goes on, as you go round the place. So we've moved from something which was a UK headquartered business, to something where it's a bit fragmented. The plants are still there, they're still employing significant numbers of people, but they're all to some extent satellites of overseas companies.

The key point is that a variety of wider 'global' and sectoral economic pressures, in addition to automation of various processes in the production of steel and chemicals provided a context which challenged the basis of local employment and economic activity. With this context in mind there

was a sense for one leading figure in the local chemical sector that historically Teesside had made a major contribution to UK economy but had little to show for it. Acknowledging this and broader processes of de-industrialisation affecting Teesside, there was a broad agreement amongst a small number of senior ex-ICI employees – or the 'ICI mafia' as one of its members called it – that a new rationale and desire was needed to help to find a replacement for the decline in traditional industries. There was some sympathy, according to one interviewee, for this nationally.

Creating New Synergies as a Response to De-Industrialisation

The historical legacy was based on sources of large-scale employment which were heading into decline. That is to say the available assets and skills base in the Tees Valley was in industries in decline rather than growth industries. The suggestion is that the development of a hydrogen economy on Teesside offered a basis for re-aligning these activities, skills and infrastructures with a number of currently perceived growth areas related to energy conservation, combined heat and power systems (CHP), CHP with fuel cells, hydrogen fuels and renewable hydrogen fuels. The development of a hydrogen economy in the Tees Valley was thus part of a wider strategy based on the perception that focusing on renewable energy and recycling, as high growth industries, offered a means, through adaptability of existing skills, assets and infrastructure in the creation of jobs and a competitive Tees Valley Economy:

> So a number of parts of the UK are trying to latch on to those as new sources of employment. The reason that that should work here is that if you look at the skills base that grew up naturally around the sources of employment [it] fits very, very well with an emerging renewable energy market…Building large offshore pipelines, when it comes to assembling fuel cells, things like that.

The strategy in Tees Valley worked at exploiting such 'synergies' which links the historical legacy to new sources of employment. So, for example: 'A lot of the plastic people are now trying to recycle were invented here'. Additionally this links together the historical legacy with the renewable and recycling agenda through suggesting that:

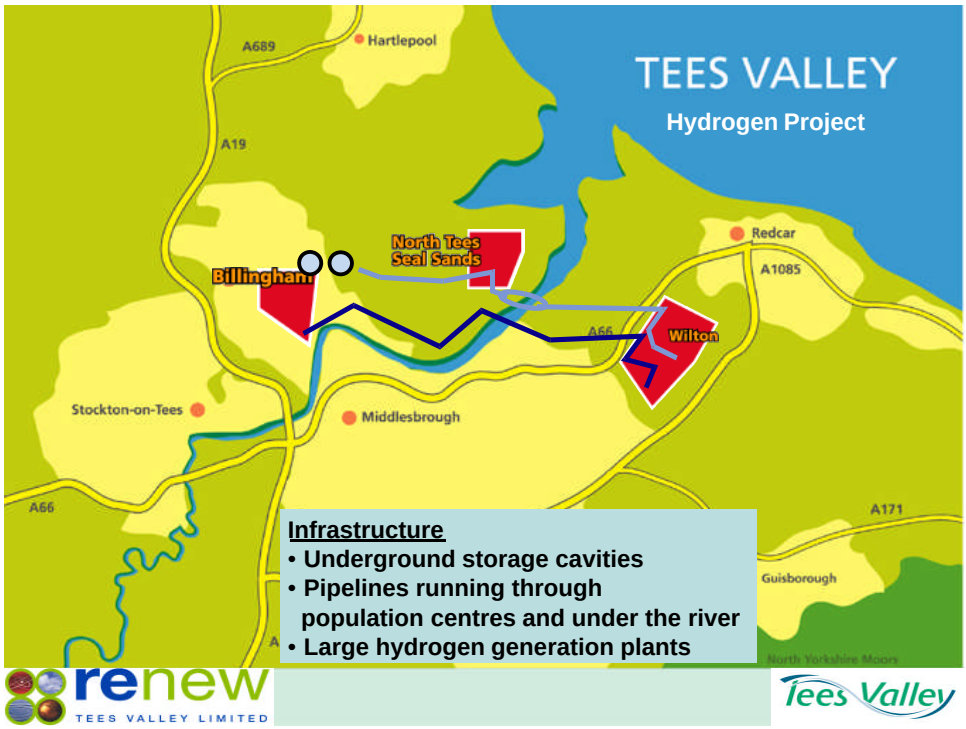
> We've got hydrogen here now and it's cheap, and it's available now for use. And we need to be developing vehicles that can use fuel cells. We need to be putting fuels cells into stationary applications. We can do that here and in parallel with all of this work on a larger project that would actually generate hydrogen without the release of CO_2, and at some stage those two come together.

As a basis for re-imagining the Tees Valley from its historical legacy to a hydrogen economy this representation is pushed further by the suggestion of a number of projects which would demonstrate the nascent hydrogen economy in action.

Making the Hydrogen Economy Visible for Tees Valley and Beyond

The suggestion was that there was an existing Tees Valley hydrogen 'system', physical in its nature but underpinned by associated skills, competences and public familiarity and 'acceptance' with hydrogen technologies. The notion of a Tees Valley hydrogen economy was 'made visible' through the simplified capturing of the possibilities of a hydrogen economy through the visually represented historically legacy.

Making the Historical Legacy Visible



The claim was that from the existing system, or physical infrastructure, a series of 'spurs' could be both added to the system or could be developed in a 'free-standing' way leaving open the possibility to 'connect' them to the system at a later date. The means through which the historical legacy would become linked to a future Tees Valley hydrogen economy was through a series of demonstration projects.

Representations of the hydrogen economy through proposed demonstration projects in the Tees Valley were integrated with symbolic buildings or monuments as a means of increasing visibility and awareness. This included, for example, a demonstration project involving the powering of a sign on the landmark Tees Transporter Bridge. In making fuel cells and the hydrogen economy

'visible' in Teesside there was the use not only of iconic and 'visible' buildings and landmarks but also an importance was attached to political symbolism.

Further projects included utilising fuel cells in a lighthouse, a school and a chapel. There was a five year project with 'physical work' which started in early 2004 at Middlehaven in Middlesbrough where there were plans to implement a CHP 'total energy' system to power a large urban redevelopment project in the Middlesbrough dockside area. The aim was that the power unit would incorporate 2Mwatts of advanced fuel cells, fed by existing hydrogen and fuel gas infrastructures, out of a total energy demand of 15MW[2]. Additionally a Fleet & Fuelling Project and a Green Hydrogen Project were planned. The first of these aimed to draw upon the existing 'system' installing a green fuel station to dispense compressed natural gas, hydrogen and combinations of both to fuel local fleets and contribute to a 'steady reduction in carbon content of fuels over a ten-year period'[3]. The Green Hydrogen Project sought to develop and incorporate green hydrogen into the existing hydrogen physical infrastructure. This included developing a major gasification plant producing hydrogen and electricity with the consequent CO2 being captured. This attempted to incorporate the geographical and geological position and advantage of Teesside in piping and capturing CO2 in North Sea aquifers and also in developing enhanced oil recovery[4]. There was also a facility, housed at the ex-ICI plant at Wilton, which addressed developments in fuel cell applications under the organisation of the Fuel Cells Application Facility (FCAF).

Communicating with 'Others' to Re-Imagine Tees Valley

The importance of the demonstration projects was not just in terms of developing a hydrogen economy 'within' Tees Valley but also, in addition to wider aspects of the historical legacy such as the local skills base and public acceptability, was about offering an example of the Tees Valley as a context within which demonstration projects and processes could ideally occur. This led one key player to suggest through his frequent contacts with the DTI that:

> We have been saying to DTI, if you are serious about developing a hydrogen economy but are not sure what it is going to be then we, on Teesside, can provide a national scale experimental platform. So come and play around and do it here until you know what you want it to be.

The capability to 'play around' was underpinned by the expertise and knowledge available through the village fete and allowed the key player to make the offer to the DTI that:

[2] http://www.epicc.com/Chem/middlehaven.htm [accessed 07/01/2004]
[3] http://www.epicc.com/Chem/fleeting.htm [accessed 07/01/2004]
[4] http://www.epicc.com/Chem/greenhydrogen.htm [accessed 07/01/2004]

> Given your [DTI's] interest in the development of renewables and carbon sequestration – even though you are not clear what it means – we have the perfect Chemistry and Meccanno set to play around with until we decide what we want.

[Commission]

This contemporary attempt to represent Teesside through developing a hydrogen economy had a coherent narrative which linked the sub-region's 20th Century history built on petrochemicals, steel and coal and the infrastructure, skills, knowledge and processes (the 'system') which was a legacy of this to widespread contemporary agendas of adapting these infrastructures, skills and processes to create new jobs and economic prosperity.

'Stitching Together' the Tees Valley Hydrogen Economy

This representation of the development of a Tees Valley hydrogen economy and the re-imagining of Tees Valley identity that this involved has largely been articulated here in an uncritical manner. The section of the paper examines the various interests, institutions and individuals that came together and attempts to align them, their agendas and resources in the production of a representation of the Tees Valley hydrogen economy. Subsequently the paper goes on to analyse attempts to 'make the hydrogen economy work' in the Tees Valley through an exploration of attempts to (re-)embed hydrogen and fuel cell technologies in 'unfamiliar' contexts.

Creating a Shared Agenda

Bringing some strategic clarity to a disaggregated chemical sector in a deindustrialising sub-region was what brought a few ex-senior ICI employees - the 'ICI mafia' - to fill the gap left by ICI. In doing this in the 1996 EPICC (European Process Industries Competitiveness Centre) was set up, initially through a partnership including the University of Teesside, British Steel, ICI, Teesside TEC and local authorities as an acknowledgement of the strength of process engineering in the Tees Valley to act as a 'centre of excellence' in maintaining and enhancing this position. For one key player, however, in this process in the early days it was very difficult to create a shared agenda between these different interests. This was to the extent that he felt 'battle scarred' by the process.

Fast forward to early in the new millennium, where Forum for the Future, who had been undertaking various pieces of work for Middlesbrough Council, through discussions with neighbouring Redcar and Cleveland Borough Council suggested, according to one player close to discussions, that the idea of developing a hydrogen economy was increasingly being discussed amongst some of their associates. This led Forum for the Future to float this idea with local officials in the Tees Valley sub-region as, according to one of these officials, '*obviously* the best place to

look at this is Teesside'. Despite this 'obviousness' one key official when contacted by Forum for the Future suggested that: 'I hadn't thought about it [the hydrogen economy] at all'. The alliance between Forum for the Future and Tees Valley local authorities led to a seminar which brought together a series of key 'stakeholders'. The issue then was to move from an acknowledgement of the possibilities of the hydrogen economy in the Tees Valley to address achieving its potential. As one official involved in the process pointed out:

> So we then said, "well that was an interesting seminar, what do we do about this"? What we need is some assessment of the key areas in terms of promoting the hydrogen economy'.

The result was the commissioning of a study, funded by DEFRA and UK Steel Enterprise and undertaken by Forum for the Future.

From this report emerged a four-fold series of recommendations. The first of these sought to 'scope hydrogen-related technology potential in the area' through 'detailed economic, environmental and technical appraisals of specific fuel cell demonstration, infrastructure development and refuelling options'. The second recommendation focused on a comparison and contrasting of other UK hydrogen-related activities with the potential on Teesside and thus 'assess the merit of clustering hydrogen-related R&D in the Tees Valley' and subsequently establishing a UK centre of excellence 'built upon the area's specific advantages in terms of skills and knowledge resources'. A third point addressed the construction of a 'hydrogen forum' to bring a 'broad cross-section' of stakeholders from business, government and academia' to 'develop a strategy for furthering hydrogen-related options in the area'. The final recommendation sought to develop a hydrogen economy in the Tees Valley in a manner which strategically integrated this with wider developments in renewable energy (Forum for the Future, 2002, p.6).

The Hydrogen Economy in the Tees Valley: Creating Jobs and Aspirations

This report offered a framework through which the development of attempts to make the hydrogen economy 'work' on Teesside could begin. Although for some the development of a hydrogen economy was about developing a 'sustainability agenda'. The predominant motivation for local authority involvement, according to one person close to this process was in job creation and economic 'regeneration':

> It [developing a hydrogen economy] wasn't trying to improve the environment in particular. But if that's a benefit then great, we want that. But really what we are after is jobs and investment.

This required a focus on the strategic thinking outlined in the Forum for the Future report where 'now we have a strategy which is quite multi faceted in that sense is that hydrogen is an important part of it but only part of it'. In this sense the development of a hydrogen economy in Tees Valley needs to be seen as part of a 'sustainability' and job creation agenda which rests not just on hydrogen but also on wider processes of renewable energy technology innovation and application. The key point of this is that it allowed a number of local and regional stakeholders to see a variety of different possibilities which a renewable energy agenda might open up in relation to Tees Valley's existing skills and infrastructure base through potential processes of adaptability.

A common theme when talking to numerous stakeholders in the Tees Valley was a sense that Teesside had not received its 'due rewards' for its industrial outputs and that developing a hydrogen economy, as part of a strategy of economic regeneration, was also about 'trying to give people faith in the future of industry in this area'. Underpinning this was that 'so that people can see real benefit [of developing a hydrogen economy]. I've always been convinced that what we are talking about here is something to do with aspiration'. Fleshing this out, one stakeholder with a number of decades of experience of industry and regeneration claimed:

> But, you know, I'm absolutely convinced that part of the problem we have here is because there's a great sort of inferiority complex in a way which reverts itself into bravado…And that's the reputation here it's got. You ride around and you see chemical plants…And we need to counter all that. And you can counter that in all kinds of different ways but it's physically what the place looks like [which often is the focus]. And this is what I've been talking about isn't the strategy in total, there are lots of other aspects of the strategy which are all about physical regeneration and so on as well. But you know, I'm convinced that training, job opportunities, graduate retention, telling youngsters the future in this area is terribly important is important as anything else. But of course the jobs have got to be here and they've got to be real and it's got to happen. Because if everybody's got to be convinced…you just can't tell people, they've got to see it for themselves.

A material manifestation of the 'inferiority complex' was in 'poverty issues' with the idea that 'local ownership' of hydrogen economy development would be an important part of addressing this:

> There's poverty issues come into all that you know. So there's a whole deprivation agenda, a social agenda you can tie into this…to recycling schemes, etc…It touches on so much you know, civic pride…and sort of education and social aspects are at least as important.

There was an acknowledged tension between a 'sort of vision [which] is so inclusive' and being 'focused to deliver things'.

'Global' Competitiveness and the 'Evolution' of Existing Industry

The 'arrival' at this way of thinking had been gained through processes of learning through experience of inward investment in the sub-region in the 1990s and attempts to attract multinational enterprises which had little apparent resonance with the skills base and economy of the sub-region. The key point was that:

> I think what has become really apparent to us over the last ten years is that it's very difficult to introduce industries into an area which hadn't traditionally been here because no infrastructure [is in place]. The Samsung case has exemplified that really because there's no history of large scale electronics here…So consequently you bring someone like Samsung in and there's no local suppliers. They had to bring in, or encourage, other Korean companies to come in and then it was just simply a branch plant…[a] screwdriver operation, related to microwave ovens and those sort of things…And now, Samsung have pulled out and the place is up for sale, but it did have a major training centre attached to it, that's one thing we're trying to get…So, I mean, what the emphasis now is very much more looking at…what are the best opportunities to create jobs…it's undoubtedly an evolution from existing industries is our conclusion.

The focus on developing a hydrogen economy in Tees Valley was about learning the lessons of the appropriation of so-called footloose 'global' capitalism as being importantly tied-up with local embedded resources and processes. The latest phase of Tees Valley regeneration looked to the landscape pressures for renewable energy technologies and innovation. It sought to address this through a level of appreciation of the 'existing' context in Tees Valley which took account of but went beyond physical hydrogen infrastructure and skills. It was also about adapting the sub-region's skills base and infrastructure to a variety of recycling and renewable energy technologies and the possibilities for jobs and investment that this may open up.

It was, furthermore, about acknowledging a perception of 'global' competition in 'that whilst Teesside is a fairly good location related to other chemical industry [locations] there are other, better locations and so the competition's pretty tough'. In this respect the idea of developing a Tees Valley hydrogen economy was one of imagining a future Tees Valley set alongside various concepts for sub-regional economic regeneration, including, for example, a 'coastal arc' focusing on tourism down the Teesside part of the NE coast or a Tees Corridor environmental concept. This also related to the tension of competition and co-operation between local and sub-regional authorities where collaboration may be 'necessary' but where 'each authority is looking after itself'. This may manifest itself in the battle for funding where in trying to achieve 'strategic fit' alignment is sought between local economic priorities and those that are sub-regional and regional.

Interpenetration and Negotiation: 'Stitching Together' Scales of Governance

An important issue was then a series of relationships between the local, sub-regional, regional, national and international scales of activity. In terms of hydrogen economy development in the Tees Valley the issue became one of how the narratives and objectives outlined above could be aligned with a variety of other political and institutional agendas at different 'levels', particularly in terms of the resource implications of this. Important were developments in terms of the regional development agency, One North East's, regional economic strategy and also its *Strategy for Success,* the sub-region's *Tees Valley Action Plan* but also the influence of and attempts to influence central government and the European Commission. In the case of the regional and sub-regional complimentary developments 'came out in parallel, and then there was a lot of discussion about, "hang on a minute, how do these things interface at a regional local level"…my objective was to make sure that opportunities in the Tees Valley are realised'. In doing this it was fundamental that:

> Regionally and sub-regionally we are stitching these things [different agendas] together. So, although we came to the same conclusions [we did so] from different start points. If we don't, then we are not going to get the best out are we? So it's been a very deliberate and very conscious effort to stitch those [agendas] together.

This involved aligning these objectives with the regional development agency's emerging science and innovation programme, *Strategy for Success* (S4S). The development of S4S had been partially in acknowledgement that 'in effect seventy years of regional policy in the North-east haven't really given a step change in economic performance required' and that although 'there's been some major impacts with various programmes and policies over the years, nothing had really lifted the North-east from being bottom of the economic league table to mid-table or higher…The Strategy for Success is a bit based on the fact that traditional regional economic policy wasn't working particularly well in the region, although, obviously having some positive impact'.

The key points of the S4S, which have relevance for the development of a Tees Valley hydrogen economy are as follows: that (1) innovation in science and technology needed to build on existing regional strengths; (2) that an understanding of what regional strengths were including an appreciation of existing – often disconnected – activities was required; (3) the types of mechanisms and structures which may be used to plug any gaps; and (4) that strong links between the research base and business and industry were developed.

An appreciation of key regional strengths was premised on a key study, undertaken by Arthur D Little consultants. A key existing regional strength was seen as being the area of environmental

technology, including the process industries and new and renewable energy technologies. In particular respect of Tees Valley the research and development facilities at the Wilton plant accounted for:

> It was estimated 25 per cent of the commercial R&D in the North East…You know it had 600 graduates working in that place. I mean it's a powerhouse, all sorts of products, plastic products which are now common place, all started off and researched around here.

The strength of process industries in the Tees Valley and at Wilton in particular led to the setting up of one of the North East's five regional centres of excellence, the Centre for Process Innovation (CPI). The Centres of Excellence offered a means of bringing together both public and private facets of the regional research base to develop technologies to the extent that they 'can be utilised for commercial purposes'[5], 'so that the Centres' role really is, to a certain extent, networking…[but] it's a secondary role, it's really the commercialisation of R&D, in their particular technology'.

In doing this,

> Centres will seek to secure additional funding for research, transfer and business development activities, market the knowledge base and the Clusters, provide intelligence on Cluster needs, secure suitable equipment and related facilities and secure appropriate incubation facilities. A lean operating structure is proposed, whereby the Centres are virtual organisations with a core co-ordinating staff[6].

The aim was to achieve a degree of strategic interrelationship between Centres of Excellence, which was addressed in a number of ways, including:

> They all have regular meetings, the chairs of the boards all have a regular meeting as well. And even finance directors have regular meetings…So to a certain extent the Strategy for Success team, part of One North East still obviously, has some of that role of making sure that interaction happens but it also happens on a sort of a technology and commercialisation level as well. But a lot of the centres are working very closely together on particular issues. So for example, on hydrogen NAREC which is the energy centre of excellence and CPI, of course innovation, are working both very closely on the hydrogen and fuel cell type [initiatives].

Not only were there attempts at strategic alignment across the Centres of Excellence but also between the S4S initiative as a whole and a range of other regional programmes and strategies:

> So what we have to do really is influence the skills agenda and skills programmes, the property and infrastructure programmes - across the board really - the business support

[5] http://www.strategyforsuccess.info/html/cen_excel.html [accessed 13th January 2005]
[6] http://www.strategyforsuccess.info/html/cen_excel.html [accessed 13th January 2005]

> programmes. You know, we can't hope to deliver all those so what we have to do is basically say "here is the technology, or sort of business focus that will really help drive the region forward and if we can all work together"…really sort of get the momentum that we need behind it, and then obviously the idea is it's then fully delivered by private sector investment in sort of the medium and long term.

In addition the S4S raises a series of issues about the ways in which this regional initiative is both influencing of and influenced by central government. The development of clusters has been a central tenet of DTI. Attempts by the North-east to influence central government can be seen in a number of ways. These include the networking potential of key individuals, for example, the ex-Chairman of the Science and Industry Council (the 'Strategy for Success'), Sir Ian Gibson who was chief executive of Nissan Europe and on the Bank of England Committee and who is 'very well linked in with DTI and well linked into the European level in various institutions'. The S4S initiative itself has, according to a key regional player, 'clearly…fed into the Innovation Review and to a certain extent the Technology Strategy that the DTI have done or are doing'. Also the Science and Industry Council initiative developed in the North-east (and the North-west) 'has kind of been embedded in national policy'. Additionally, 'the movement that's starting to happen on the things like cluster policy, trying to make that work more effectively in the UK…there are some indications that national policy is to a certain extent feeding off regional policy from some of these areas'. There was, the claim was made, a 'recursive' element to this in that 'the Innovation Review, the recent comprehensive Spending Review and…the Lambert Review are starting to kind of direct regional policy to a certain extent. And to a certain extent that reinforces what we've been doing'.

CPI and Renew Tees Valley as Strategic Interventions

The lineage of CPI can be traced back to EPPIC – the early difficulties of which were highlighted at the start of this section. Within CPI sits its Fuel Cells Application Facility (FCAF), the role of which is to offer 'a physical resource to identify, expedite and facilitate the development of applications for fuel cells'[7]. In particular the role of the FCAF is 'to support the development and deployment of fuel cells into real-life applications in both static and portable (but not automotive) opportunities'[8] and it is funded from the regional level.

Renew Tees Valley emerged at the interface of an alignment between Redcar and Cleveland Borough Council and the sub-regional Tees Valley Partnership. The Redcar and Cleveland Employment Action Plan identified six key areas and economic sectors as priorities for economic regeneration in the borough one of which was premised on opening up employment opportunities for the people of the borough in the face of – but adapting to the legacy of – the decline of

[7] http://www.epicc.com/Chem/fcaf.htm [accessed 07/01/2004]
[8] http://www.uk-cpi.com/main.asp?Section=4353&User=clylroxpasxayenuyzdhjfjhaid [accessed 14/01/2004]

traditional industries in the area. With a background of higher than the national average figures in unemployment, Redcar and Cleveland took a central role in setting up Renew Tees Valley through TVAP funding 'to address opportunities in renewable energy and recycling'. In doing this they sought to align local economic regeneration priorities with those of the sub-regional and regional as the TVAP represented the sub-region's proposed programme of activity over a three year period (2003-2006). The body charged with lobbying, monitoring and implementing the sub-regional action plan was the Tees Valley Partnership from where funding was gained for the Renew Tees Valley within which sits the Tees Valley Hydrogen Project.

The Tees Valley Hydrogen Project (TVHP) was set-up in 2001. The TVHP takes as an understanding that its role in the development of a hydrogen economy in the Tees Valley is in strategically intervening to encourage innovation and the adaptability of declining industries and an existing skills base to new economic concerns and sources of employment. Renew Tees Valley and the TVHP as such function as organisations designed to make a strategic intervention – as 'intermediaries' - in a process of adapting existing skills bases, public perceptions and infrastructures. On this basis, within a decade: 'Renew Tees Valley will have ceased to exist because the whole thinking is…set it up for the five or six years to make a strategic intervention'. This process was to be undertaken on the basis of the vision outlined previously, through the strategic intervention of the TVHP, initially through developing demonstration projects. It is to this process that we now turn.

Performing the Tees Valley Hydrogen Economy: Re-embedding Technologies in Unfamiliar Contexts

Much of the vision of early 'delivery' of a Tees Valley hydrogen economy was tied-up with the development of highly visible demonstration projects. These initiatives raise a series of issues in relation to attempts to re-embed in the context of a school, a crematorium, an urban development project and so on technologies which we're developed in the context of the chemicals industry and the 'laboratory'. These issues include asking why would key stakeholders wish to involve themselves in these demonstration projects? How was meaning around a hydrogen or fuel cell technology negotiated within, for example, the context of a school? What sort of design and technical adjustments were made to these technologies? What sorts of issues regarding the adaptability and development of infrastructures occurred? In what ways were environmental issues raised? To what extent were markets for these technologies shaped and what was it, if anything, that was 'transferable' from context to context?

The Claim to Importance of the Historical Legacy

The development of demonstration projects needs to be seen within the context of Tees Valley where a series of historically developed 'well rehearsed processes' included engaging consultancy companies to develop environmental impact statements, and also to organise various public consultation evenings. These processes were outlined by one key player in the sub-region, who said:

> There's something as well about signalling these things well in advance. So when you've done it many times before I can see the time line for the project and I need to have the PR time, like, for the project as well. So you say, "When do I start to put it into general editorial in the local press? When do I start to become more specific? When do I start to try to find people who might actually make supportive comments about these things? When do I start to get some brochures published and hand them out in local libraries? When do I want to get some models made of whatever this thing is that I want to build and give an interest for people to see them? When do I want to start convening public meetings and when do I want give more details of what this is, and how do I dovetail this with the official regulatory process? When am I formally planning to go to the planning commission, and when am I hoping that is all going to be closed up?" When you've done that many times before on similar projects across the Tees Valley, you become quite good at it. Now you'll never get something through that really you shouldn't be building.

This key stakeholder continued:

> So they would go along with lots of very well prepared stands and what not, lots of literature, to make sure that the opinion formers are invited as well as having an open invitation for the public. We'll have the right number of these, think them carefully through, what level of detail you want to expose at different stages of the development of the project and so on. And I've been impressed when I've gone along to these to see that they will actually muster the right panel of experts for these evenings so that nobody can throw in a genuine question and not get a pretty credible answer on the evening. And we'll have one or two experienced local authority people there who can spot those with just stupid ones and [that] are not genuine. I'm not expecting everything to be sweetness and light. If you're used to running this type of process you'll say [I'll see] this train up the hill, over the top and down the other side. You can see when it's hovering on the top and it was starting go back down the other side and who are the people who are still in the back carriage who right to the bitter end [are 'obstructive']. So I've seen these meetings being run where that judgement's being made and decided which of these questions are being asked are really worth following through, because that's a genuine attempt to establish some commonality, and which is just the last of some NIMBY who will stick with his particular hobby horse even after everybody else has moved on…What you can't do is take something that shouldn't be built and try and persuade people it should be. There is no process for something like that.

Lessons from Demonstration Projects

As part of a series of TVHP demonstration projects, a local school was to take part in the demonstration of a fuel cell domestic CHP. The school was selected with the help of the local authority. This raised a key question for one key figure in the Teesside hydrogen community:

> Let me take an example, like putting one [a fuel cell] into a school. You say well this is hydrogen, as a petro-chemical professional I know how to design safe hydrogen installations or chemical plants. How do you take something which is engineered to be safe in that environment and re-engineer it to be safe in a school?

There was an issue prior to this in that the rationale for developing demonstration projects, from a TVHP perspective, was captured in their vision of an emerging hydrogen economy in the Tees Valley. A key point here then is not only how the headteacher and governors are brought onside but also a whole range of stakeholders. What if they simply don't want to? Or don't perceive a need to? The issue was one of how to enrol the headteacher and governors into this project and in selling the benefits to them. Or to put it another way: why would the headteacher and governors see a need or a benefit from engaging with the project? Not only did those involved in developing the project see a need to involve the headteacher and the governors but also to engage a variety of stakeholders (technologists, local authority planners, etc) in a consultation process which had been adapted from a chemical industry risk assessment process called a Hazard and Operability Study.

These are questions which are difficult to address largely due to the process of 'implementation' being ongoing and the sensitivity involved. The gaining of agreement to develop and implement a fuel cell within the uncertain context of the school was a process of learning by trying. The perceived need for negotiation, through the Hazard and Operability Study, is an acknowledgment of the anticipations of key players in the demonstration projects that: 'It's not until you begin a project that you can confront the real and practical problems in real time'.

It is these anticipations of technological possibilities and the expertise and know-how available locally which are important. These are important in the sense that dealing with the uncertainties of how to go about embedding a fuel cell within a school relies on the availability of a vast array of different forms of local 'relevant' knowledge – a knowledge base which relates to the metaphor of the village fete.

Engagement through Education

The idea to situate a fuel cell in a school was undertaken not solely as part of attaining a wider public visibility for the development of a Tees Valley hydrogen economy at a basic level but also through seeking to link the demonstration project initiative to integrating aspects of hydrogen economy and technology development into school cirrcula. This was interesting not only in that it introduced the idea of a local hydrogen economy to children at an early age but also in that it offered a means of engaging parents and grandparents through such initiatives:

> We've also developed an educational package in particular in various schools. There was one big event when we had about a thousand schoolchildren attend…[exploring] the hydrogen economy, what it's about…And every child has two parents and four grandparents and eventually word begins to spread.

Processes of influencing understanding in producing meaning were seen as particularly important in relation to perceptions of safety around fuel cell technologies.

> So you're finding that your having to educate people. They have all the right motivation. They understand that some of their ideas are actually very dangerous. So you're effectively saying "no, what you want to have is hydrogen in a cage" and the cage needs to be big enough so you're saying that people will walk past with cigarettes in their hand, no matter what, even in a school where they're not allowed to smoke, you have to expect it to happen…What you will find as well is that there are perceptions, and so for example [we] had to go along and talk to the school governors about the process so that they could satisfy themselves that if there were ever…a minor problem how would they actually defend the fact that this was put in? What you will find, of course, is that their school children are going to have jobs in the hydrogen economy, fuel cells are on the curriculum, they can actually demonstrate because they've got the fuel cell so there's all sorts…of reasons for having it there. But they have to satisfy themselves that it's justifiable and you can just imagine someone whose child hasn't been allowed to go to this school or something decides I want to make some mischief so I'm going to scare or something, which could be used to create an interesting newspaper story…You have to go into that with your eyes open.

Design and Safety

The adjustments to technical and design aspects of fuel cells can be illustrated not only by through the example of the school but also through a visitors centre outside of a chapel which was a demonstration project using a fuel cell domestic CHP. The professional expertise, of those involved with the development, of dealing with hydrogen technologies within the chemical industry needed to take account of the context of development and in particular the first thing that distressed people often do on leaving the chapel is to light up a cigarette! The issue is:

> So you can't say it's a non-smoking area. Now the hydrogen economy can't come to your place where there are people until you find a way of engineering in safety. So you then say, we actually have to have these hydrogen storage cylinders and store it in the centre of a much larger compound than any other different chemical plants simply because the reason I can't guarantee that people wont be inside that compound. So you end up saying, where is the flammable zone and therefore where do I put the…safe fence and so on?

Chasing Distinction through Demonstration Projects

An interesting aspect of the Tees Valley hydrogen economy vision was in the ways it sought to adapt both the existing physical infrastructure and to link that up to new standalone demonstration projects. The example of the Middlehaven urban development project is interesting to look at in this respect. Middlehaven sits around six kilometres away from the existing physical infrastructure and

the aim and anticipation of being fed from the existing system would require not only linking up this demonstration project with existing hydrogen production and distribution infrastructure but also the active involvement of Huntsman who control the system, and at present – according to one view - show little apparent inclination to opening the system up as a utility. In this instance the representation of the Tees Valley hydrogen economy around adapting existing infrastructure, as yet, does not equate with the performance of the hydrogen economy where there are a number of demonstration projects which are standalone.

The rationale for the development of a CHP at Middlehaven was as part of a much larger economic regeneration project. In this respect the key priority of Middlehaven in terms of the hydrogen economy is: '[Economic] development and jobs and getting industry moved into the area' with environmental issues further down the agenda, 'low priority' and which 'could often drop off the agenda'. The Middlehaven development had previous planning incarnations as an attempt to regenerate and transform the Middlesbrough docks area. The current approach to development was to be more distinctive in construction taking account of environmental issues. As land prices were often relatively inexpensive the focus was on developing buildings to high environmental regulatory standards and drawing on innovative and decentralised forms of energy was one aspect of what made it distinctive. In this sense this is where the story of the hydrogen economy emerges in the demonstration project at Middlehaven. Although environmental standards and regulations were a highlight of the Middlehaven development these were still underlying issues in relation to attracting inward investment and jobs through 'environmental' distinction. The distinction may be that: 'Interest in that site [Middlehaven] hasn't been as great as others'. In this case one facet of the marketing of this site was through positive perceptions of its environmentalism, according to someone close to this process. Somebody else suggested, somewhat scathingly, that many of the waterside developments in the area were attempts to ape Salford Quays and he thought they would struggle to attract people – asking one of us, pejoratively, to 'smell the air'! Despite these negative perceptions there were many suggestions that the local authority took environmental protection more seriously than many councils.

When discussing the early stages of the most recent phase of development at Middlehaven someone close to the initiative highlighted the ways in which the processes of developing the Middlehaven CHP 'total energy' system was one of 'muddling through'. This led the same person to highlight the importance of the village fete. Drawing on the village fete was necessary as: 'There is a need to overcome a tremendous level of minutiae that gets in the way'.

‘Transferability’, Training and the Creation of Markets

Some, but by no means all, of this ‘minutiae’ related to dealing with bids for funding. This relates to an interesting recollection regarding the process of gaining funding for the Middlehaven development from the EU. Someone involved in this process suggested there was much agonising and difficulty in trying to fill out a section of the application for funding which related to ‘transferability’ or what was transferable. The initial feeling of this individual and his colleagues was that as the development was in a specific context they could not see what was transferable. Following this the issue was whether the technology was transferable and subsequently whether it was a process of bringing different interests together that was transferable. The suggestion was that it was only through learning by trying that the ‘issues’ and ‘barriers’ become apparent within specific contexts of projects and demonstrations. The context sensitivity and specificity in developing hydrogen technology projects within this particular historical legacy was influential in underpinning the notion that the village fete and processes, practices and mechanisms were what was considered transferable.

By contrast the ‘minutiae’ also led to anticipations of the future about where although a hydrogen pipeline may go into domestic housing alongside a gas pipeline:

> How you can train the hydrogen equivalent of a corgi fitter? You could let just anybody come into your house and maintain your central heating boiler but we need to have people that you can be confident in…When you’ve got those trained people and you’ve got piped hydrogen going into houses then it’s much easier from the safety point of view than trying to create a system around hydrogen cylinders and so on.

This, then, involves higher education providers in processes of adaptability of existing skills and in the provision of training:

> But what have we got here. We’ve got colleges and universities who are very much into apprenticeship training that sort of thing, [large] apprentice training centres such as [an] ex British Steel and ICI joint operation…And so there are a lot of people [in these institutions] sort of saying “[we’re] very interested in what comes out [of the hydrogen economy]”.

This related to a bigger issue – and in doing so the role of the FCAF – in creating markets. As part of the process of creating markets the FCAF was engaged not only to ‘train people who are engineers, scientists, technicians or what ever, in fuel cell technology’. That is to say that the *processes* through which lessons were learned from attempting to develop demonstration projects and create markets for fuel cell applications were perceived as being ‘transferable’ to the extent that to become first-movers in this respect was where competitive advantage lies. The rationale, for

example, being that ‘if you could do it [put a fuel cell] in a school with all the health and safety issues, you can do it anywhere’:

> You’ll find by doing the countries first few fuel cell installations you learn a lot how to manage that type of project. They will offer to manage projects all over country and then they will train other people to be able to manage project’s themselves.

Through the Centres of Excellence concept the suggestion is that there are attempts to create stronger links between public and private facets of the research basis in development of technologies and their application. Linking the research base strategically is one facet of the development of a Tees Valley hydrogen economy as is the development of supply chains for a future Tees Valley hydrogen economy which includes new SMEs and the adaptability of SMEs ‘whose future always seemed to be inextricably linked to ICI and Corus, and now they’re looking for work with employing those skills somewhere else’. The creation of jobs and investment through the Tees Valley hydrogen economy is thus an acknowledgment of the importance of attracting ‘appropriate’ inward investment and being able to draw on existing know-how, through the research base, as well as offering the skills, training and other forms of support necessary to encourage an adaptable and entrepreneurial local SME culture.

> When I see a big potential inward investment coming I can tip-off various SMEs in this area so they start gearing up for that. Or on the back of some of our bigger projects…some would be creating new business for local companies so they could expand.

The extent to which local SMEs were able to do this is uncertain in that ‘you will see contradictory messages about SMEs’ which is probably not surprising when one thinks that ‘there’s 19,000 SMEs in the Tees Valley’. There is a sense that:

> There are quite a few people who have managed to leave big companies like ICI on the right financial terms, and of course and when they’ve done it a lot have set up their own business. So I’m slightly ambiguous on this one, I really don’t know whether I think we’ve got that entrepreneurial spirit there or not. I can certainly point to specific examples of people, who are doing it.

This returns us to the notion that the Tees Valley hydrogen economy development was primarily about job creation and economic competitiveness, and the issues above point to the complex series of relationships, interests, institutions, aspirations and expectations which have become involved in the early stages of this development.

Conclusion

This paper has outlined a vision of the development of a Tees Valley hydrogen economy but has, also, through analysis of the production and performance of this vision drawn out a number of issues from this particular context. This includes the importance of re-imagining a particular (here) sub-regional context – of seeing a 'new beginning' for the Tees Valley. The importance of this vision was in its attempt to link the identity of the sub-region, as one of job creation, competitiveness, hope and pride in localities and the sub-region, to an adaptability of previously dominant but now declining large industrial skills and infrastructure.

That is to say that a historical legacy including a physical infrastructure – the Meccanno set – and also the village fete, and an ability to adapt this, was acknowledged as being important in contemporary urban and sub-regional regeneration attempts. This, in turn, was learned through the experience of previous rounds of 'unrelated' inward investment to the sub-region. As part of this process of adapting skills and infrastructure but also of commercialising locally developed R&D there was a key role on thinking strategically and 'stitching up' and aligning a series of agendas at different scales of activity (from the local, the sub-regional, regional and national) – some more successfully than others.

There were also roles for new 'intermediary' organisations to perform the stitching together of some aspects of this 'shared' agenda, including Renew Tees Valley and the TVHP and also the FCAF's role in bringing together aspects of the research base and commercialising of renewables, hydrogen and fuel cell technologies, also as a 'champion' for the Tees Valley in encouraging inward investment and the adaptability of the sub-regional skills and infrastructure base.

The importance of the historical legacy was seen in attempts to dis-embed hydrogen and fuel cell technologies from the context of the chemicals industry and the 'laboratory' and re-embed them in unfamiliar circumstances through a series of examples of learning by trying. The development of, for example, a stakeholder forum in a local school and what this can tell us about why key stakeholders would wish to involve themselves in these demonstration projects or how meaning was negotiated around a hydrogen or fuel cell technology and what sort of design and technical adjustments were made in this context are usefully addressed here. As are, through a number of demonstration projects, issues regarding how or whether the adaptability and development of

infrastructures occurred; to what extent environmental issues were raised; and the ways in which markets for these technologies were shaped.

What is not clear is what is 'transferable' from the Tees Valley context to other hydrogen economy developments elsewhere. We have some clues on this issue through the attempts at filling in the 'replicability' section in the funding bid highlighted above and also through attempts to set-up FCAFs elsewhere. What is it that is transferable? Is it the processes of stakeholder engagement outline above? Is it various other forms of know-how developed within the context of the Tees Valley? Does a process of 'reinventing the wheel' need to occur in every contextual development and demonstration of hydrogen and fuel cell technologies or can more 'generalisable' understanding and regulations be developed? This is a particularly difficult question if it is related to the varieties of ways in which humans act. We have some clues from this paper about the importance of processes of negotiating transformation but these have been developed within a specific set of circumstances. What we need to do now is to examine hydrogen economy developments elsewhere to discuss what is distinctive to particular contexts and what may be seen as more 'generic' in relation to this issues we have outlined here.

References

Forum for the Future

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.

Tees Valley Partnership (Undated), *Tees Valley Action Plan 2003-2006*.