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London'sHydrogen Economy:Negotiating the 'Global',the 'Regional' andthe 'Local'

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1. Introduction

The material presented here is a draft work in progress for internal UKSHEC

contexts to compare and contrast issues arising from specific hydrogen economy developments.

2. Preparation and Dropping-In: The 'Local', the 'Regional' and the 'Global' in London's Hydrogen Economy

The focus here is on two particular representations of the hydrogen economy in London: (1) the re-emergence of London-level government and the development of, and 'preparation' for a hydrogen economy and (2) London as a site, a 'test-bed', for 'global' capita

In *economic regeneration* issues London would take the lead in the application of renewable energy technologies. This relates to a facet of shaping London's role as a 'leader', whereas 'in the past the UK has lost opportunities to lead in a number of clean technology industries, for example wind turbines and PVs [photo voltaics], to countries such as Denmark, Germany, Japan and the United States', in 'an effort to make sure that fuel cells and hydrogen do not become another lost opportunity, a pro-active approach is being taken in London to support the hydrogen and fuel cell industries' (Mayor of London, 2004b, p.86). Whilst *social equity* issues, for example fuel poverty, would be addressed through tackling energy efficiency, particularly, through planning processes.

Through the setting and achievement of a range of targets against this agenda the aim is to make 'London a leading city for sustainable energy' (Mayor of London, 2004a, p.8). An important point of this wider agenda is that: 'As Europe's largest city, London is potentially both a major consumer and also a provider of hydrogen technology' (Gavron, 2002, p.4). A key pronouncement is that London can take the 'lead' in fuel cells and hydrogen technologies. A policy analyst with a close understanding of the Mayor's thinking suggested to us:

> He [the Mayor] wanted to be at the forefront of the world. He wanted to be seen as *the* city in the world that's leading on the hydrogen economy. Whether that's remotely feasible, you know, we'll see. But that's where he wants to be[1].

In being an 'early mover', however, a substantial amount of work is required to realise this objective (Mayor of London, 2004b). In particular the suggestion is that transport, which accounts for around 20 per cent of energy consumption in London, and given the large number of taxis, buses and delivery vans 'offers a massive opportunity for developing the use of hydrogen' (Mayor of London, 2004b, p.86; 87-8). This could exploit the 'large potential market for hydrogen' (Mayor of London, 2004b, p.86) and also the development of refuelling infrastructure that 'could "fan out" to the rest of the country' (Mayor of London, 2004b, p.86). Having said this:

[1] All quotations have been anonymised as agreed in the negotiations to conduct the interviews.

> We have to be honest. London – and the UK more generally – has made a slow start. Other world cities are well ahead in developing hydrogen economies (Gavron, 2002, p.2).

The acknowledgement is that there are different scales of activity for London to operate at in terms of the hydrogen economy. These include the unproblematically specified 'race' to be first mover in relation to other 'world cities', to 'fan out' refuelling infrastructure across the UK from London, but also to be able to deal with local level air quality and fuel poverty.

This relates to the view that London offers a specific and unique context for developing a hydrogen economy: 'And I think the thing about London is basically anything you do in London is going to be…a bigger scale'. The point about this according to one key political stakeholder was that: 'Everything in London must be the leader of anything [and be] perceived by the rest of the world as being so'. This is achieved through a constant process whereby: 'You tell everyone you are [the leader] and…people stop disputing it then'. The notion of a leader implicitly suggests a 'race' and 'competition' where 'there's a sense of a league table of who's making most

2.2 Dropping-In the Hydrogen Economy to the 'Test-Bed'

A key mechanism for the Mayor for encouraging the development of a hydrogen economy for London is the use of public transport with a lead role for Transport for London (TfL). This leads on to a second key representation of attempts to develop a London hydrogen economy through the CUTE (Clean Urban Transport for Europe) bus project. Although TfL are managing the London buses, as part of this project, they are also part of a much larger European-wide effort.

CUTE is underpinned by a public-private partnership established at the end of 2001 and involves the demonstration, over two years, of 27 fuel cell powered buses in nine European cities (Amsterdam, Barcelona, Hamburg, London, Luxembourg, Madrid, Porto, Stockholm and Stuttgart). The initiative is part-funded by the European Commission, through its DG TREN, to the tune of around 21 million Euro of a total of 60 million Euro. The remainder of the funding comes from a variety of interests in this public-private partnership. The network built around the initiative was brought together by Daimler-Chrysler, includes a central role for the energy provider BP and also to varying degrees 'more than 40 organisations throughout Europe and the rest of the world are now involved in the project' (European Commission, undated, p.4) - although local networks of transport providers, energy suppliers, political support and so-on may vary.

In undertaking these demonstrations within a number of urban centres objectives included: 'to illustrate the large spectrum of different operating conditions [for fuel cell buses] to be found in Europe'; but also to assess the 'design, construction and operation of the necessary infrastructure for hydrogen production and refuelling stations'. In addition there was a focus on the: 'Collection of findings concerning safety, standardisation and operating behaviour of production for mobile and stationary use, and exchange of experiences including bus operation under differing conditions among the numerous participating companies for replication'. Further objectives included an: 'Ecological, technical and economical analysis of the entire life cycle and comparison with conventional alternatives' and the 'quantification of

The London demonstration commenced in 2003 and involved a network including Daimler-Chrysler, BP, Transport for London, First London and the Energy Savings Trust. A key issue in the CUTE project has been the relationship between the functioning of the fuel cell buses and associated infrastructure development. Central in addressing fuel station development in London has been BP. BP draws on its own array of expertise in hydrogen production, distribution and retailing in 'identifying the most efficient and effective pathways to the Hydrogen Economy. At this stage we don't believe there is one clear winner, so the best way forward is to work a number of these paths by testing various technologies and the customer acceptance of them in detailed ground-level demonstration projects' (BP H2 Promotional Document). This is part of BP's 'evolving strategy' of identifying pathways and then modifying these pathways through feedback from local demonstration projects.

An interesting issue here is in looking at the two representations as negotiating the hydrogen economy between the 'global', 'regional' and the 'local'. Although this distinction is often crude it offers a useful way of thinking about the different representations. In thinking, for example, about the development of an agenda of a newly devolved London Mayor and the ways in which structures were built from the context of the GLA as 'preparation' for the hydrogen economy – within the constraints of a series of relationships at the national level and above - but also for understanding the attempts of 'global' capital, in a public-private partnership with the European Commission to demonstrate the 'transferability' of the hydrogen economy through 'showcase' cities, of which London was one. It is to the production and negotiation of these representations to which we now look.

3. Negotiating the 'Global', the 'Regional' and the 'Local' in Producing London's Hydrogen Economy

The negotiation of the 'global', 'regional' and the 'local' can be captured in terms of two processes: 'preparation' and 'dropping-in'. The process of preparation needs to be understood in terms of a new set of political arrangements in London, from 2000, and in particular the creation of the post of Mayor for London. Of particular significance were a series of eight statutory strategies:

> Energy wasn't one of them. It was not on that list and is not in the GLA Act, but the GLA Act had a section in it which allows the Mayor to do whatever else he wants as long [as it meets the] purposes of the Act. And he has made a decision to produce an energy strategy because it was seen a missing one. It was felt that on reflection the other strategies weren't going to be successfully implemented without [an] energy [strategy].

An interesting feature of the development of an Energy Strategy and its s relationships to a range of other strategies (e.g. Air Quality and Transport) related to the changing political arrangements in London and in particular the possibilities for the Mayor to develop strategic agendas of personal interest:

> One of the benefits of the Mayoral system, could be a disbenefit as well, is that all the power is invested in one individual who is both the chief executive and the chief political figure, who doesn't have to rely on decisions taken by Assembly members who only scrutinise. Which means in a positive instance like this it may be if the Mayor is particularly concerned about an issue he can decide as he has done in this case in energy and [propose] change. Ken is personally very concerned about climate change which is why he's gone to all the effort of having photovoltaic [technology] put on his own council buildings at great expense and stuff….And therefore under the Mayoral system one individual can decide that they want to do it and therefore put a load of resources into it. Perhaps it wouldn't get in the normal sort of great bureaucracy…and would no doubt would be very difficult in the normal council structure but would be relatively straightforward in our system.

The Mayor was, thus, able to define his role particularly through strategies that addressed themes of environmental concern, economic regeneration, social equity and a 'world' leadership role for London. In highlighting these aspirations the suggestion, implicitly, was that London's identity be shaped in terms of a more socially equitable and environmentally-friendly relationship between producer and consumer but also around being a 'leader' and a showcase in respect of the hydrogen economy. It is interesting in view of the Mayor's ambitions to examine the exrentalln

understood by 'others' but also how this manifested itself in attempts

hydrogen economy for London.

that these relationships mean that: 'we would look to DTI generally but not necessarily' as the resources available through programmes, for example, around fuel cell technology open up possibilities for demonstrations.

Indeed the rekindled relationship between the Mayor and the Labour government opened up the possibility for another conduit of ministerial contact for London:

> When Ken's manifesto was being put together these were the things that were being discussed with No. 10. You know, the first time we were talking about…the proposals for the Climate Change Agency…That's the mechanism really, through the Mayor's contact with ministers.

This level of influence with government and its departments also meshed with the perceptions of the view of London's scale and 'importance' as a 'world city' in that: 'The thing about London is basically anything you do in London is going to be a sort of national news of the world'. The perception, from a player close to London was that many of the demonstrations and attempts to develop hydrogen economies across UK regions were on a small scale:

> They do the same sort of thing in London and it's a much bigger deal. And, therefore, for the DTI getting London to do these things is a big step forward.

3.2 London and Whitehall

The issues of relationships between the centre and London relate to both the construction of policy and strategy and also issues of trying to 'implement' policies and strategies. So there was a degree of interrelationship in the processes of producing both the national UK Energy White Paper and the Mayor's Energy Strategy, according to one key stakeholder who suggested that the Mayor's Energy Strategy:

> Certainly began about four years ago and it began before the white paper started to be drafted. So I think that it would be fair to say that the London Energy Strategy had a major influence on the purpose of the national white paper. There was in general a lack of regional energy initiatives which tackled a whole range of energy issues…And I think they looked to us for quite a lot of guidance.

There was also the sense, according to somebody with a close understanding of various aspects of DTI thinking that the role of the centre in its relationships with the

regions generally is to ‘support and encourage’ through such things as ‘establishing some sort of guiding framework within which they can then see that their activities can play a part’ but also that the centre should in many ways ‘go with the flow’:

> I think it’s quite hard to get the regions to do something that the centre wants

and tackle environmental problems because they're the ones that are suffering most. And they're the one's sort of [concerned about the] long term future, about the welfare of the city. But it's also important…if you were a politician you'd want to be seen to be remembered as somebody who really changed things. Then one of the real things if you're the Mayor of London is to start to really change environmental policy…That's a real step forward and other people will follow.

drafting and redrafting of the Action Plan was in the process of shaping different aspects of 'stakeholder' thinking and trying to achieve 'consensus':

> So we used sort of a long term visioning document, strategic vision document to try to shape everybody's thinking and bring everybody along…The idea for what the hydrogen economy could look like and what the steps are to get there. So that we [achieved] consensus.

The key point of this is that 'the overarching vision is final production delivery of the hydrogen action plan which contains a set of objectives which we need to fulfil in order to meet the hydrogen economy'. There was acknowledgement that this needs 'considerable review and updating but that's been the overarching driver'. There are various constituent groups of the LHP which includes the London Hydrogen Forum, 'a stakeholder body which has a role in providing some consultation on key developments with core working groups, working as a discussion forum, some networking and so on'. There is also the Steering Group:

> Who basically meet as a body which is broken down into a numbers of key sectors which are needed to engage with, to deliver, the hydrogen economy. And we have representatives from most sectors.

The link from there is that the Steering Group manages a series of task groups which 'were selected quite carefully on the basis of how the objectives of the hydrogen Action Plan were falling out and what the actions were…as well'. These include 'the project-focused task groups which are aimed to set up the best project consortium to actually take all of the work on the ground'. There are, however, 'a series of other task groups which [are] called advisory and skills training communications, safety and regulation'.

Structure of the London Hydrogen Partnership

Source: London Hydrogen Partnership

Emanating from these structures, in particular from the Forum in 2002, was ‘a long wish list if you like of actions that we could take to meet objectives’. This wish list was ‘refined by the task groups…into a meaningful smart list and also as a way of building partnerships’. A key issue here was ‘that took a long time but it was very robust and defensible’. The appointment of development managers allowed them ‘some serious time to whittle that down further to a realistic short list of subjects which we now have’. The outcomes of these negotiations ‘form part of the Partnership’s business plan and advise what business model is necessary to take those forward’.

In addressing this a number of projects have been highlighted as planned or as possible – in addition to which a limited number of small scale projects have already happened. These demonstrations include not only a series of stationary demonstrations, such as a fuel cell powered Christmas tree in Trafalgar Square and fuel cell CHP projects, but also proposed transport demonstrations such as the introduction of 20 Ford Focus cars into London with associated fuelling infrastructure and water transport projects utilising hydrogen. The visibility of the LHP’s activities

can be seen through its 'education/awareness' raising activities such as the development of its website but also through public events including the delivery of a lecture by hydrogen economy 'guru' Jeremy Rifkin in London in October 2004 and a follow-up workshop in partnership with the London International Festival of Theatre (LIFT) exploring the relationship between culture and future fuels.

This leads to the issue of resource. There are two aspects prominent in thinking about this in relation to the LHP. The first is in identifying 'quick win' projects that will take some core resource from the Partnership to actually co-ordinate and get going. The second relates to anticipating the ways in which the LHP may function and setting this up 'in such a way that it can facilitate further projects that come through from anyone, no matter who they are, whatever time'

This facilitation aspect and priming with public money was important, according to one stakeholder in that: 'basically the industrial partners aren't willing to put money into projects unless the public sector's putting money, in many cases'. The issue being that 'they see the public sector putting the majority of the funding in and they know when to come into make things happen. And in a sense the wrong people have been in the room for that'.

In building up partnerships the 'obvious partners in the public sector in London would be the Boroughs'. The issue here is that the GLA, other than in the transport sector is not a service provider and therefore doesn't have services like that. There are possibilities in transport where a budget is allocated. The issue of resources is fundamental as:

> We haven't been sort of ready with huge amounts of cash other than to sort of just basically to set a Partnership up and fund the staff that are needed to keep it going. So I think there's been a little bit of attention there which I think now is 0 0 1 9080(of)-27mohave up cauense ave

stakeholder that 'we are able to offer advice about what is doable'. Whilst the flipside of this engagement was that another stakeholder claimed that the LHP was a 'talking shop'. This stakeholder blamed the 'inclusivity' and 'lack of financial resources' of the initiative and suggested that the hydrogen economy was a 'big boys' game. A big boys' game'.

3.5 Playing the Big Boys' Game: Dropping-In to the Test-Bed

The key issue of the CUTE demonstration is that rather than offer the 'bottom-up' political pressures for developing a London hydrogen economy it can be understood as a public-private partnership of European-wide fuel cell bus demonstration projects. Important here was the funding role of the European Commission's DG TREN, the role of networks of multinational capital in shaping more local concerns and the implicit assumptions that hydrogen and fuel cell technologies could be 'dropped-in' to particular 'experimental', 'test-bed' contexts and lessons be learned from these contexts.

The underpinnings of this are with the 'big boys' of multinational capital in that: 'in the early 2000, the late 90s, [Daimler Chrysler] had a very clear commitment on hydrogen and fuel cells and they thought that it would be a good idea to set up such a project to learn from real life experimentation'. The rationale underpinning this 'real life experimentation', according to a keen observer of the development of this initiative, was radical social and technical change:

> When we talk about replacing the heaviest infrastructure that moves our world, which is the energy infrastructure, and one of the most important industries, which is the automobile industry, from one way of doing things to something radically different it is unthinkable that one would move from one thing to the other. We have the car industry which is not only one century old but in permanent progress. So it's a mature technology that keeps evolving very fast and you try to catch up from one to another then you need to start use these kind of big projects to understand better how can we shift from one model to something that is dramatically different.

In terms of trying to address this way of understanding large-scale social and technical change the claim was made that multiple fuel cell buses and associated infrastructures needed, in a series of highly 'visible' cities, to be 'tested-out' under a 'variety of conditions'. There was some acknowledgement, in the context of the

European Commission, of the complexities of the interrelationships underpinning such 'experiments':

> The system in the broadest sense of the word is not that you have a technology that does something, it is that by introducing that technology you are changing the whole thing and to see how this change occurs you need to do it at sufficient scale…having tests in several cities in Europe…In addition to having to establish a supply chain for such a system - and I am talking about the industry and supply chain - not only supplying the hydrogen but supplying the spare parts, supplying knowledge, supplying maintenance. That can only be done if you have a sufficiently important system. If you are only testing one prototype what kind of information do you get that is actually telling you what is going to happen in a real market situation?

The notion of test-bed is interesting in that it also appeals to the competition amongst 'world' and 'European' cities in attracting such demonstrations. In this respect: '[Daimler Chrysler] invited all the cities to explain to them what they intended to do'. The cities presented themselves in terms of the agenda of real life experimentation where Daimler-Chrysler's role as one of the big boys was important in terms of their request for funding to the European Commission's DG TREN in that:

> [DGTREN] won't embark ourself if we don't see that everything is well organised and in place. So, once they have managed to find the consortium, they have managed to set clear objectives, they have somehow organised all the supply chain of the project. Once they have a clear work plan for what they are going to do and how they are going to learlogyt8learlwithe i

The claimed value for the cities, from a number of those involved in the project from the 'outside' was that 'these ten cities knew nothing about hydrogen and now they are probably *the* guys on hydrogen fuelled transport that one could find around the world and they have become world experts. They know more than anyone and they are invited to conferences all around the world to explain how it works because now hydrogen happens to be very popular in these circles'. At the level of one Commission perspective the claim is that there is the strategic issue and 'the discussion is what is next'? One view is '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 demonstration project. But in size and scale, in some precedent 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, as energy, will play a very important role'.

One key Commission position is, thus, that:

> I can tell you that one of the key things in which we will expand, a very important part of whatever project is eventually decided, would be the learning of the processes. Not that we are going to subsidise a lot of homes with fuel cells for generation or a fleet of vehicles or so on. We will probably subsidise some hardware but we will certainly invest on learning how the implementation of the deployment of all that hardware in this stage for CUTE and all the safety implications, all the market implications, all the competitiveness implications and all that we will want to learn if hydrogen, one day, proves to be a solution, such learnings would be more than necessary to move from where we are today to a different way of organising, I would say, the energy market. But maybe this may never happen.

3.6 The 'Big Boys'' Game and the London 'Test-Bed'

The case of London CUTE has seen a two-year trial of a partnership involving BP (providing the refuelling site and station), London Buses (as part of Transport for London) and more specifically First London as bus operator.

A key difference between this approach and the 'bottom-up' approach is the role of the 'big boys' in that:

This involved Daimler-Chrysler pulling together a series of networks in different cities where it was the type of interests involved and the scale of the demonstrations which was appealing to TfL/London Buses in that:

> We've always tried to shy away from some small technology companies who come to me and say "We can convert one of your existing buses to run like this or run like that", because we don't really believe it's…not sustainable. You need the major manufacturers involved to bring this new technology forward or to drive this technology forward.

There was some competition around the demonstrations, according to one stakeholder who suggested that nine cities were picked from around 30 who were interested. London being one of these for one stakeholder was 'inevitable' in that: 'I suppose given London had expressed they're interested, it's probably not surprising London

> that…one thing this project might bring once the buses stop running is a permanent piece of infrastructure in east London.

Yet this needs to be seen in the view that:

> I think in ten years time a high proportion of the new vehicles will be hybrid vehicles of some description, with batteries. What the power source is might still be conventional diesel, might be something else and I think the government have set that 20 per cent of new vehicles being low carbon by 2012. I think we're confident the industry will be comfortably achieving that by 2012 – 2014 or whatever, comfortably. And I think London will be comfortably leading the way on that. And I suspect…we'll be discussing with Mercedes or MAN or somebody about possibly taking fifty fuel cell buses in four or five years time.

3.7 The 'Test-Bed' as Managing Multinational Corporation Uncertainty

The key player in addressing fuel station development in London was BP as part of the CUTE bus project. BP started thinking about hydrogen relatively recently, 'probably about 5 or 6 years ago' and is based on 'managing uncertainty for BP as a company'. At this point two people were involved which grew to four in the UK and one other in Chicago. Hydrogen activities are part of BP's Gas Power Renewables business sitting alongside, for example, solar and wind.

BP draws on its own array of expertise in hydrogen production, distribution and retailing in 'identifying the most efficient and effective pathways to the Hydrogen

This involved ‘trying to learn through real world experience about this range of different pathways that we can use’. The pathways emanated from discussions within BP and initially ‘we came out with probably 20, 25 different so-called pathways that we thought were worth looking at in more detail’. The notion of pathways, in BP, drew on the metaphor of the ‘supply chain’ but is ‘not as linear as that’. Using an ‘egg diagram’ different ‘steps’ in pathways offer different pathway options.

BP’s ‘Pathways to the Hydrogen Economy

fairly sort of classic technology development cycle of sort of build and test

4. Performing the Hydrogen Economy in London

In this section we wish to focus on the CUTE demonstration project to highlight aspects related to the adaptability of technologies and design, the role of government in the project, how meaning was negotiated around the project and in particular in relation to the provision of a fuelling station, but also other infrastructure related issues, before finally examining some of the lessons which can be drawn from this. Key aspects of the demonstration were that BP made the decision that a publicly accessible hydrogen fuelling station forecourt, next to an existing fuel station at Hornchurch. This was one of five CUTE fuelling stations designed to test out different pathways. The fuelling station in London was the only one of the five which was publicly accessible.

4.1 Issues of Maintenance and Vehicle Range

The number of public buses in London totals nearly 8,000. This compares with three fuel cell demonstration buses running on the number 25 route. This may be seen in that the peak vehicle requirement on route 25 is something like 35 buses:

> I mean if you were a regular traveller on route 25 then I suspect over the

One of the aims of the project is to understand actually what the impact of various operating conditions is on range. But that's clearly an operational challenge because it doesn't make the vehicles that operationally practical.

The claim was, however, made by someone with an understanding of the Mayor's position that:

> The Mayor's energy strategy was quoted at length and the London Plan at the public inquiry and it made an enormous difference to the Secretary of State's

> much as is possible. It's partly about operating the bus in service to get experience but it's also trying to raise the profile of the technology. So…we've just had an approach from Blue Peter, because they want to… take it to the Television Centre and have it in the show…We [are] actively trying to use it for those sorts of purposes throughout the two years.

The planning application for the fuelling station was finally successful in 2004 with the station due to commence operation early in 2005.

4.3 The Importance of Visibility and Symbolism

The delays in the planning process meant that the hydrogen was provided by BOC who have a gas distribution centre in close proximity to the bus garage. In doing this they set up a temporary compressor and fuelling station 'where they just truck

the wider benefit of society…in the future there's got to be a different set of

Groups, resulted in a number of proposed and ‘implemented’ small-scale demonstration projects.

The second representation was one of seeing a London hydrogen economy as being ‘dropped-in’ to London as part of a process of the alignment of interests of a number of private, large corporations with the agenda of the European Commission’s DG TREN. The key issue here is that projects of technological development through the hydrogen economy were passed down for demonstration and testing in specific places, or ‘test-beds’. A key issue is an implicit understanding that technologies are transferable and that processes of testing in high-profile cities will not only outline what is to be learned but also create visibility through the proximity of politicians, the mass media and concentrations of local populations.

In the case of the CUTE demonstration project in London a series of issues were