The Local Dimension of Energy

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The Local Dimension of Energy

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Abstract In this paper, we postulate that some of the best opportunities for reducing energy demand and carbon emissions are through stronger involvement and leadership from local government. We show that local government can and do have a significant impact on both energy production and energy consumption and are important participants for the implementation of distributed generation (DG). the progress being made by successful local governments can be narrowed to three key factors. First, they have all recognised the co-benefits of a local energy strategy: a reduction in fuel poverty, increased employment, improved quality of life and mitigation of uncertain fuel supplies and prices. Secondly, successful councils have strong political leadership and employee support to implement the structural change to bring about change. Thirdly, leading councils have gained momentum by working in partnership with utilities, private companies, NGO's, DNO's and government departments to raise finance and garner support. While climate change remains a global issue, some of the best strategies for mitigation are implemented at the local level.

Keywords Local Energy, Decentralised Energy, Energy Service Company (ESCo), CHP, District Heating

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1.0 Introduction

Over one-half of the world's population now live in urban centres and this number swells globally by 75 million inhabitants per year. Cities alone consume more than three-quarters of the worlds energy production through heating, transport and electricity use. In response to this challenge, many urban centres are now making strides to mitigate greenhouse gas emissions (GHGs) and take control over energy consumption and generation. In this chapter, we postulate that some of the best opportunities for reducing energy demand and carbon emissions are through stronger involvement and leadership from local government. We show that local government can and do have a significant impact on both energy production and energy consumption and are important participants for the implementation of distributed energy.

While the theory of free-riding goes some way to explain the difficulties in getting local governments to unilaterally cut carbon emissions, we show that many are starting to make progress and deriving direct benefit from self-imposed and targeted local energy strategies. In addition, we show there are clear benefits for local government who work

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with local business and residents to cut carbon emissions. Not only are synergies created and direct benefits derived for the climate but these partnerships are often financially rewarding to local government, business and the residents who participate.

In many parts of Europe, local government involvement in energy generation is well developed (e.g. Denmark, Sweden, and Finland) and already accounts for a significant proportion of energy supply. In contrast, there are only a few leading examples of local authority led energy schemes in the UK (e.g. Kirklees, Peterborough, Woking, Leicester and Aberdeen). Interestingly however, the localisation of energy services in the UK is evolving more systematically than in many other parts of Europe. For example, in addition to the development of more local and distributed energy, local governments in the UK are also considering demand reduction as a key component of their long-term energy strategies.

We show local government take responsibility for local energy matters for a number of reasons. Firstly, local government have a genuine and direct concern for residents exposed to fuel poverty; secondly, they have an increasing awareness about the affects of pollution and GHG emissions both locally and globally, and finally, they recognise that ambitious early action pre-empts future central government regulation. Equally important are the many ancillary benefits created when local sustainable energy strategies are adopted. These include regional economic regeneration, increased employment, improved energy security, lower energy costs, improved local environments and stronger connections between people and energy thereby encouraging further energy-demand reduction. However, such strategies only manifest when there is clear political leadership from within an elected council and a genuine willingness from employees within government departments

In this chapter, we will first discuss the development of local energy governance in a global political context and importantly, how locally driven energy solutions are making an important contribution to meeting energy and emissions targets. We follow this with a discussion on how to reconcile the conflicting benefits of an asymmetric centralised energy system with a more balanced and distributed energy system within the UK. We then look at the implementation of distributed energy solutions in Europe and discuss how localised energy systems have evolved in several European states. Learning from both local and international experience, several bespoke energy strategies are identified that have significant potential to contribute to local energy demand reduction and lower CO_2 emissions in the UK. The strategies identified include, Combined Heat and Power with District Heating (CHP-DH), Energy from Waste Facilities (EfW), demand side solutions using targeted financial mechanisms and finally, how ESCOs can be employed as an appropriate vehicle for delivering each of these strategies. Finally, the opportunities and barriers for wider adoption of such energy solutions are explored more fully with a UK-centric perspective.

2.0 Defining Local Energy

Climate change is widely regarded as a global problem requiring a global solution (Bulkeley & Kern 2006; DEFRA 2007; EU Insight 2009; HM Government 2006). It is on these foundations that multilateral agreements such as Agenda 21 and the Kyoto Protocol have been ratified. It is also the reason that such emphasis and political attention was directed at reaching an agreement during the Copenhagen Climate Change negotiations. With such immense political, economical and environmental inertia behind the present carbon intensive socio-economic system, concerted action at every level of society is necessary – and this is particularly true for the local level. For it is at the local level where policies are ultimately implemented, unique local solutions are found, the benefits of distributed generation are realised and the associated gains from social cohesion and co-operation manifest in both society and the economy.

Given the significant discrepancies in both scale and function of centralised versus distributed power system infrastructure, it is necessary to define the differences between these very distinct systems (Bouffard and Kirschen 2008). Distributed Generation (DG) is already well defined (See Bouffard and Kirschen 2008; Woodman and Baker 2008; Mitchell et al. 2009; Pollitt 2009; BERR 2008) and typically refers to energy that is generated close to the point where it is used. DG generation systems typically have capacities under 50MW and connect directly to a distribution network which generally refers to the part of the network with an operating voltage of 240/400V (sometimes up to 110kV). Distributed generation can be further categorised into three distinct groups (Figure 1.1):

1. Micro-generation is generation that occurs at the household level and includes technologies such as solar photovoltaic's, micro-chp and micro-wind.
2. Community energy initiatives usually evolve through grass-roots community led organisations and typically build power facilities under 200kW (see Hoffman & High-Pippert 2005; Walker 2008a; Walker 2008b).
3. Local energy systems tend to be led by local or regional government, district network operators or ESCOs operating at the miso-scale. Because of this Local energy systems tend to be much larger in capacity than both micro-generation and community energy, usually with sufficient capacity to supply a town, city or region. Because locally led solutions are often created with support from local government, they usually have strong organisational structures and develop strong networks with other locally based organisations and businesses and due to their size; they are able to leverage economies of scale usually only afforded to large centralised power plant.

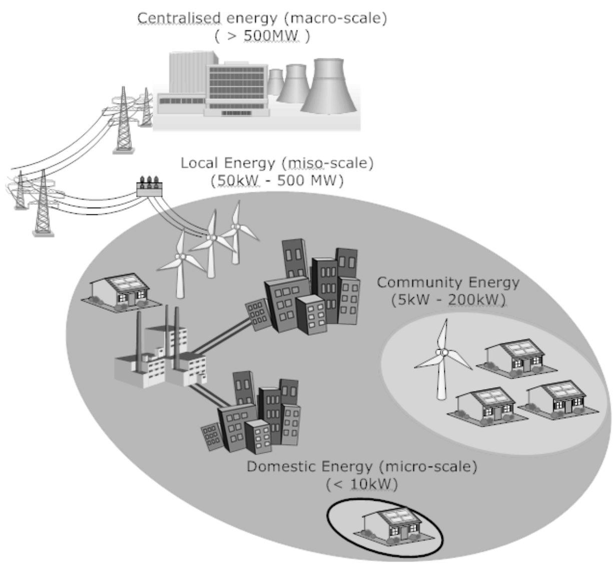

Figure 1.1: Graphical representation between centralised energy, local energy, community energy and micro-energy.

Local energy solutions are typically guided by local government but can also be established by co-operative organisations, non-profit organisations or an ESCO (Energy Service Company) where the ESCO represents the interests of multiple parties, either via a profit or non-profit motive. A further distinction of local energy from other forms of energy generation is that local energy generation typically first meets local demand. Depending on the system charges imposed on an embedded generator - which may be significant – it may even be competitive to sell excess electricity production in the open market. A further distinction and advantage of local energy solutions over community energy solutions is that local energy incorporates both demand side and supply side technologies to maximise energy service delivery and therefore local benefit (Torriti et al. 2010). For example, Aberdeen County Council implemented home energy efficiency upgrades to their social housing stock before connecting these same homes to a DH scheme. The key element of any local energy project is that it provides a bespoke solution for the locality, and reflects the specific needs and characteristics where it is deployed.

Electricity generation and distribution in Great Britain, similar to other industrialised countries, relies on a centralised energy system to meet the nations growing demand for electrical power. Even today, the UK relies largely on power produced by an aging centralised power infrastructure. However, analysis of data from recent history reveals things may be starting to change. It appears the trend for installing large, centralised power infrastructure has been diminishing since 1975, at which point the annual mean installed power station capacity in Great Britain reached its all-time peak (Figure 1.2). In addition, the number of new power stations commissioned each year, albeit at much smaller per-unit capacities, has been steadily increasing since the nineties. Such trends can be explained by the increasing attractiveness of smaller and more localised power systems such as combined cycle gas turbines (CCGT), wind, biomass and CHP installations.

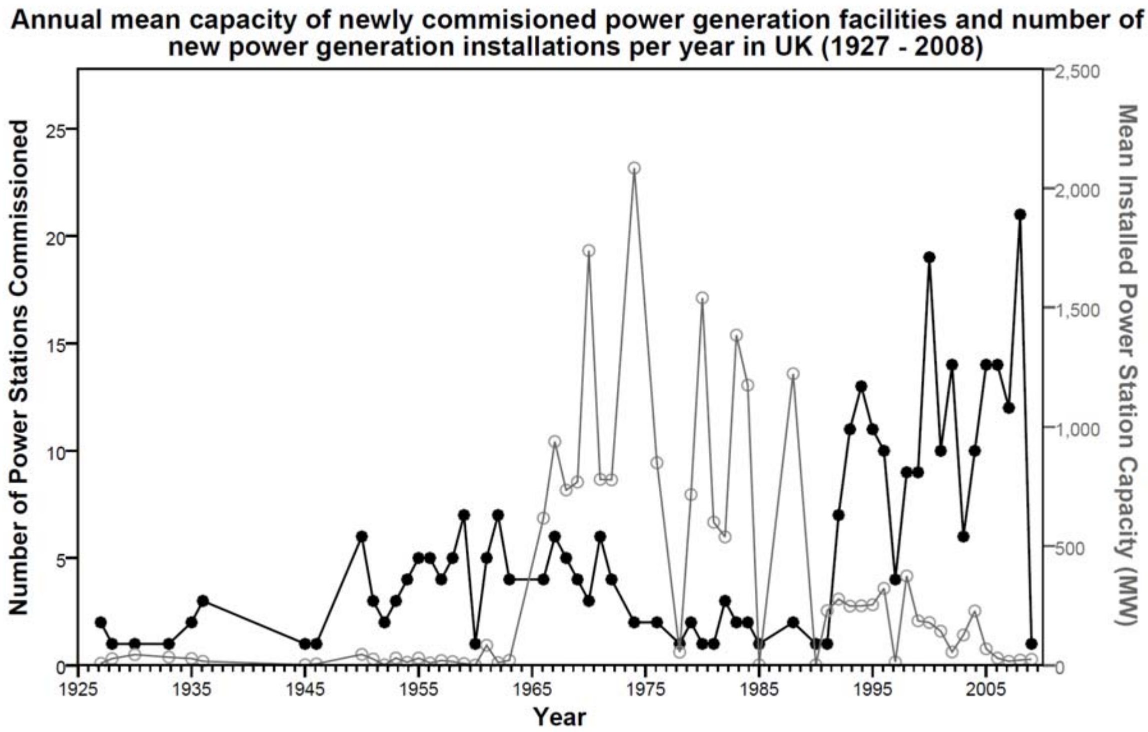

Figure 1.2: Trends in the annual mean installed power generation capacity of new power generation facilities compared to the annual total number of new installations. Source: DUKES Table 5.7

3.0 Putting energy services in context

It is a well-established notion that global problems require global solutions. In general, this has been the mantra adopted by the EU and other international conventions on climate change (Collier and Löfstedt 1997). However, an opposing view that has been advocated for some time by several leading authors (Schumacher 1973; Lovins 1979) is only now beginning to gain support. Global problems, such as climate change, not only require global agreement and leadership but also rely heavily on local action. This intuitively simple idea was notably recognised by the Brundtland Commission and later ratified by the United Nations in 1987 with the publication of "Our common future" (Brundtland and WCED 1987). This recognition of the importance of localisation and participatory processes for improving the world's environmental problems received renewed recognition when the majority of countries at the Rio Earth Summit signed Agenda 21 where it was recognised that effective participation of local government are a determining factor in fulfilling the objectives of Agenda 21 (United Nations 1992).

Recognising that local government represent the closest form of governance to people, they therefore play a vital role in educating, mobilizing and responding to the challenges of sustainable development. A key component to fulfilling this objective was "Local Agenda 21" (LA21) where local governments in each country were asked to undertake a consultative process with their respective communities. The initiative was designed, not only to create stronger rapport and participation in communities but also to promote cooperation and coordination between local governments, both locally and internationally. The UK is one of a handful of countries with a co-ordinated national LA21 strategy with more than 93% of municipalities having developed LA21 strategies this is encouraging when compared with France where there is less than 1% (ICLEI 2002). Despite the widespread acceptance of Agenda 21 in the UK, as a process, it remains under-resourced and at the margin of many local government structures; it receives little support amongst senior officers and is frequently undermined by the top-level strategic plans of councils (Chatterton 2001).

The growing emphasis of local decision-making is in direct conflict with the increasingly prominent role of supranational organisations, such as the European Union, and multi-national energy companies that are having increasingly prominent roles over national and international energy-policy (Burton and Hubacek 2007). In contrast, it remains the case that local government in the UK and elsewhere have limited influence over national and international energy policy (Collier 1996). Bulkeley and Betsil (2003) argue that in spite of this, global environmental governance is a multilevel process and sub-national governments play a crucial role, especially in the formation of transnational networks [see the Cities for Climate Protection (CCP) programme]. They claim that such transnational networks of sub-national governments represent a new form of environmental governance that simultaneously takes place at both global and local scales seeming to bypass the nation-state. Such processes are frequently over-looked when defining strategies for delivering environmental governance (Bulkeley and Betsill 2003). If programs like the CCP do indeed present a new form of environmental governance, do they then provide a means for overcoming the barriers for reducing local GHG emissions? If so, there will be an increasing role for local government leadership over the management and delivery of energy resources at the local level.

4.0 Reconciling local government strategies with local energy solutions

In both academic literature and public policy arenas, many well-supported arguments have been put forward that explain why local government are important for the supply, delivery and demand for energy services. Given that public administration accounts for approximately 5% of total energy demand in the UK[3] (DECC 2009a), significant savings can be made in the energy that is consumed in public buildings, hospitals, recreational facilities council offices, and other associated services. It is reckoned that Local Government consumes at least 26 TWh of energy per year resulting in more than 6.9 Mt of CO_2 emissions and subsequent energy expenditure in the order of £750 million[4]. Energy is one of the most controllable overheads in many local government buildings thus providing many opportunities for savings. Space heating, for example, is responsible for over two-thirds of local government energy consumption making it an ideal target for further reductions (Figure 3.1). Some facilities managers have even shaved up to one-third off their building energy costs through the implementation of energy saving measures. Street lighting is the next largest contributor of CO_2 emissions, responsible for approximately 41% of local government CO_2 emissions (Figure 3.2). Thus, simply replacing the street lighting can have a significant impact on CO_2 emissions.

[3] In 2008 total energy consumption in the UK totalled 225 Mtoe, public administration and services alone accounted for 11.5 Mtoe where 0.9 Mtoe came from electricity, 0.3 Mtoe came from renewables, 7.3 Mtoe came from gas, 0.7 Mtoe came from petroleum and 2.3 Mtoe came from other solid fuels.
[4] Office of commerce and government

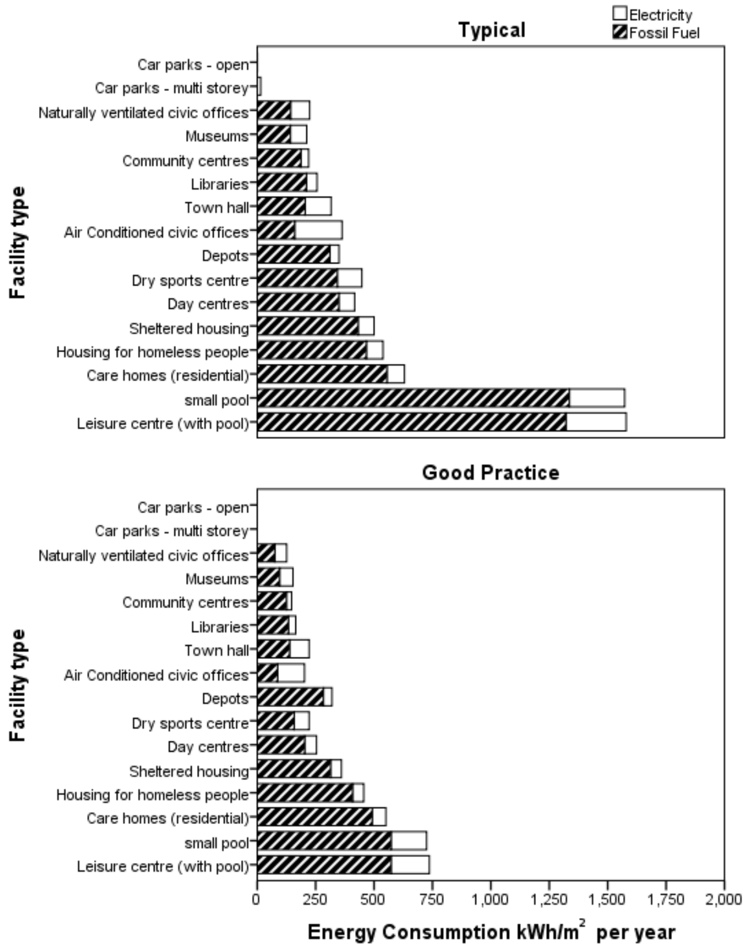

Figure 3.1: Energy consumption from local authority buildings and facilities.

Source: (Carbon Trust 2004, p.13)

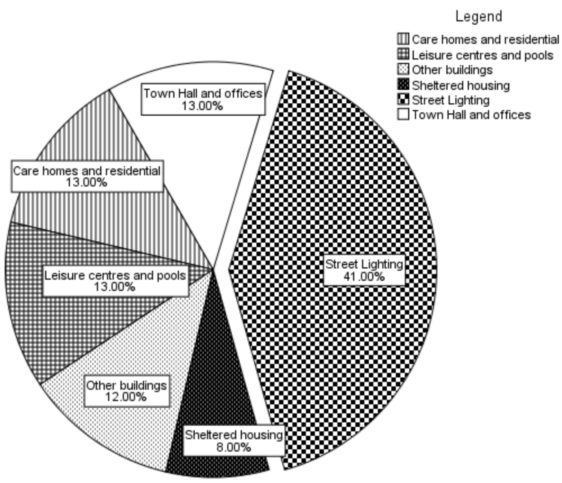

Figure 3.2: Breakdown of CO_2 emissions from local authority owned infrastructure (excluding social housing energy consumption).

More importantly, additional energy savings can be made from the more than 3.6 million homes in the UK classified as "social rented" where it is estimated a further 5% of total UK energy demand is consumed. It is not just through direct means that local governments have the power to reduce energy. As the layer of government closest to the citizen, local government have an important role in leading by example, communicating and creating opportunities for demand reduction and increased efficiency. Furthermore, local governments are responsible for large areas of policy that could be reformed to encourage significant behavioural change in business and residential sectors alike. They are also responsible for granting planning permission for local renewable energy sites as well as the renovation of old, and construction of new buildings. Consequently, local government can reduce energy consumption within their region by creating opportunities for, and influencing the behaviour of residents to change their energy consumption patterns (Coenen and Menkveld 2002).

Increasingly it is recognised that energy and climate policy go hand in hand. In the UK this is shown by the recent formation of the Department for Energy and Climate Change (DECC), formed to combine the policy objectives of both climate change and energy into a single government department. Such organisational changes do not need to stop there. Local governments are increasingly given responsibility for meeting CO_2 mitigation targets. Given the significant contribution of GHG's coming from energy production it makes sense local governments have influence over energy production and consumption within there localities. Commentators have also shown that climate change issues are best handled at the local level (Collier and Löfstedt 1997; Allman et al. 2004; Bulkeley and Kern 2006; Bulkeley and Betsill 2005; Burton and Hubacek 2007; Hopkins 2008). As energy use is an important contributor to climate change, it follows that local government's need greater jurisdiction over the supply, distribution and consumption of local energy. Indeed, it has been clearly identified by three consecutive government white papers on energy that a more devolved approach is required to meet future energy and climate change targets (DTI 2003;DTI 2007b; DECC 2009b).

The ability of local government to respond to energy objectives within their district depends on many factors. Elements such as the demography, geography, culture, urbanisation and economy are all important but perhaps the most critical factor is an authority's legal jurisdiction and political capacity to initiate change in their own locality. Coenen and Menkveld (2002) describe the framework in which a local government operates as their *playing field*. They identify two possible paths to enlarge the role of municipal involvement and therefore their capacity to initiate change for reducing emissions. The first is to increase the size of the *playing field* in which the local government operates and the second is to use the existing *playing field* as advantageously as possible. The former relies on a greater devolution of power and responsibility from central government or alternatively an increased willingness on the part of the local government to accept more responsibility in areas traditionally outside the councils remit - such as energy. The latter implies better management of existing governing responsibilities and processes. With this in mind, there is considerable scope to enhance the *playing field* of local government in the UK in both dimensions: local government can do what they are already doing better but they can also take control over new areas traditionally thought to be outside their remit. Energy is a particularly important example because historically this has been outside the remit of local government, thus leaving considerable scope and opportunity for local governments to start having a significant influence over energy consumption within their district.

Bulkeley and Kern (2006) contribute further to this discussion by identifying four modes of governance used by local government to implement change:

- ***self-governing -*** is the capacity of local government to govern themselves and is accomplished through better self management;
- ***governing by provision -*** is the shaping of local government practice through the delivery of particular forms of service or resources implemented by practical, material and infrastructural means;
- ***governing by authority -*** is the use of traditional forms of regulation and direction through sanction and law.
- ***governing through enabling -*** is when local government facilitate, co-ordinate and encourage action through partnerships, private voluntary-sector agencies and various forms of community engagement.

Using such a framework allows us to categorise local government influence over energy and emissions (Table 3.1).

Table 3.1: A framework to identify modes of governance for implementing local energy solutions

Self-governing	Self imposed carbon budgets. Monitoring and managing own energy and carbon emissions. Implementation of energy efficiency schemes within local government buildings such as schools, halls and sporting facilities etc. Using CHP (Combined Heat and Power) to supply heat and power to municipal buildings. Purchasing green energy from the market. Procurement of energy efficient appliances and technology. Installation of eco-house demonstration projects. Increasing the minimum efficiency standards for council owned social housing. Installation of renewable energy projects for meeting own energy demand.
Governing by provision	Energy efficiency measures in council owned housing. New organisational structures such as Energy Service Companies (ESCOs) that provide energy solutions to residents and businesses. Support for community level projects. Interest free loans for the installing energy efficiency measures.
Governing by authority	Minimum efficiency standards for new buildings. Minimum levels for energy conservation in the renovation of old buildings. Strategic planning to enhance energy conservation. Supplementary planning advice for energy efficient design. Supplementary planning and guidance for CHP and renewable installation. Contracts to guarantee the connection to CHP or renewable energy.
Governing through enabling	Campaigns for energy efficiency to the general public. Provision of advice on energy efficiency and demand reduction to business and citizens. Provision of grants or other financial incentives for energy efficiency projects. Promotion of renewable and decentralised projects.

Bulkeley and Kern (2006)

5.0 Lessons learned from the localisation of energy generation in Europe

Denmark, Finland, Sweden, Norway and the Netherlands were some of the first countries to take domestic action on greenhouse gas emissions agreeing to stabilise emissions at 1988 levels by the year 2000, two years before the Kyoto Protocol was conceived (Bergh 2002; Alfsen 2000). Today, Denmark is one of the most energy efficient countries in the world[5] and Sweden has one of the lowest CO_2 emissions per capita amongst all OECD countries. What made these countries unique and set them apart from other industrialised countries was their internal governance structure. For instance, the level of political jurisdiction of a local government can be placed on a spectrum ranging from those countries where local governments have considerable power to those where power is concentrated centrally. Sweden, Denmark, The Netherlands, Germany and Austria are countries with significantly devolved power and where local urban planning and municipal energy management policy is commonplace. In the United Kingdom, Ireland, France, Belgium, Spain, Portugal and Greece, local governments have much less influence over energy policy and a more centralised energy system dominates (Coenen and Menkveld 2002, p.110). Norway is one exception as traditionally they have a centralised system, but approximately fifty percent of energy capacity in Norway is owned by local government, a further 30% by the national government and the remainder by private enterprise. This is predominantly explained by the unusually high capacities of hydro-electricity generation and the trend for local management of this resource (Ministry of Petroleum and Energy 2007).

As clearly shown by Table 2, countries with more devolved political powers generally have much lower energy intensities or put another way, more efficient economic output per unit of energy consumed. Comparing two international examples – the USA and Japan - this distinction becomes even more prominent. Within literature, it is generally agreed that during the latter part of the 20th century Japan went through a process of democratisation and decentralisation, which led to local governments achieving a level of autonomy over policy and regional development agendas. In contrast, the USA has a somewhat centralised political administration where power for the most part of the 20th

[5] As measured by energy intensity in 2006 (gross inland consumption (GDP) / kg of oil equivalent) source: IEA Statistics http://esds80.mcc.ac.uk/wds_iea/TableViewer/tableView.aspx

century, has been directed towards central government. In federalism, Federal Government share power with semi-autonomous states and municipalities have no power except what is devolved through their mother State. A domino effect is thus created where Federal Government acquire increasing jurisdiction over individual States who in turn assume increasing power over municipalities. This is in stark contrast to Japan that has the lowest energy intensity in the world when compared to the USA, which has one of the highest; ultimately producing half as much economic output for each unit of energy input as Japan.

Table 4.1: Energy intensity of the economy: Gross inland consumption of energy divided by GDP at constant prices in 2006 (*Kilogram of oil equivalent per 1000 Euros)*

Countries in Europe with greater devolution of power to local government bodies	
Denmark	118
Austria	145
Germany	155
Sweden	188
Netherlands	188
Countries in Europe with greater central government control	
France	179
United Kingdom	193
Greece	205
Spain	211
Belgium	219
Portugal	225
Other international examples	
Japan	115
United States	291

During the 1970s, Denmark's energy system was highly centralised consisting of a small number of large plants. Today the country receives heat and power from 16 centralised and 415 decentralised CHP plant (Odgaard 2009). Such rapid deployment of CHP-DH during the 90s can largely be attributed to pro-active energy policy that targeted energy saving, technological development and the involvement of energy distribution companies (MURE Network 2002). The root of government policy to focus more on decentralisation and CHP-DH were triggered by the oil crisis in 1970s at which time over ninety percent of energy demand was met by oil imports. District heating now forms the backbone of the Danish energy system with almost all heating networks served by CHP plant and the vast majority of those owned by local government and co-operatives. With so many people reliant on the Danish heat networks, heat prices are heavily regulated to ensure consumer protection against natural monopolies. For example, the heat supply law stipulates that DH networks must operate on a non-profit basis and heat and electricity prices must be cost reflective (IEA 2009).

Unlike Denmark's heavily regulated approach, Sweden adopted a more market based and local government led approach not underpinned by a strong central government incentive regime. In Sweden for example, local government brought together the owners of high-energy consuming buildings such as apartment blocks and company owned office buildings so they could collaborate in the investment of DH where it may have been to expensive for one entity to consider it alone. In Sweden during the early 1970s, DH networks were heavily dependent on fossil fuels but now over seventy percent of fuel for DH comes from renewable feedstocks such as biomass and municipal waste. In Finland, aside from a small initial tax rebate to kick-start the sector, minimal regulation was required to support the introduction CHP-DH networks, nevertheless, more than 65% of Finland's thermal electricity production now comes from CHP plant (IEA 2008a). In addition, electricity taxation is focused on end use - not on production, therefore providing fair conditions for electricity production optimisation by the CHP owners. Fuels used for energy generation are however subject to excise taxes. The Finnish Government has also maintained low barriers to entry for producers wishing to enter the electricity market. Any competitor that conforms to the necessary safety legislation can connect to the grid, paving the way for large CHP schemes that under normal conditions would have taken years to receive planning approval. Figure 4.1 represents the proportion of CHP generation capacity throughout Europe averaged between 2001, 2005 and 2006.

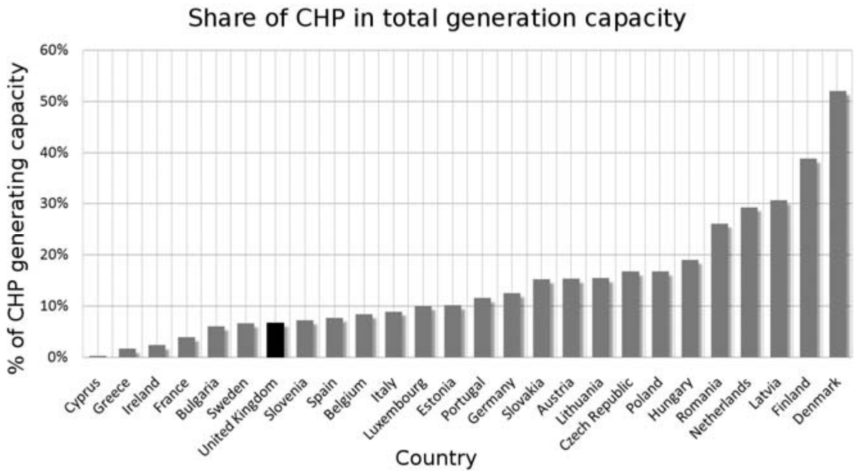

Figure 4.1: The EU share of generating capacity coming from CHP

Source: IEA data and analysis; data merged from years 2001, 2005, 2006.

6.0 Local dimensions of energy demand in the UK

6.1 Political realities

In the UK in contrast to many other parts of Europe, the relationship between central government and local government is governed by the principle of *Ultra Vires.* Accordingly, local government only have permission to do what they are statutorily permitted to do. This is in contrast to many parts of Europe where local government can undertake any activities that they consider in the interests of their communities, unless they are statutorily *not* permitted to do so. This has considerable implications for local energy projects in the UK. However, as will be shown this has recently started to change and the implications of this shift could lead to significant changes to the energy sector in the UK.

Local government in the UK are democratically constituted bodies that assume multifunctional roles covering such areas as education, health, social housing, planning, waste management, regeneration and in some limited cases the provision of energy. Prior to 1970, local government in the UK enjoyed a high degree of discretionary power with considerable say in the delivery of public services (Bulkeley and Betsill 2003). With the introduction of the Local Government Act (2000) and more recently the Sustainable Communities Act (2007) local governments have faced significant reform to their organisation, function and finance. With this new modernisation agenda municipalities have gained a new level of financial independence and responsibility, leading some commentators to suggest that local governments in the UK now have 'partial autonomy' (Bulkeley and Kern 2006). Worthy of particular mention is the conferment to local government of the *power of wellbeing* with the Local Government Act (2000). With this new devolved power local government have the powers to act on any area "likely to have a positive impact on the lived experience of the people in the area" (Communities and Local Government 2009, p.32). This relatively new piece of legislation gives local government wide-ranging powers in a number of new areas but unfortunately, anecdotal evidence suggests local governments are moving far too slowly to make any real or lasting impact. It is predicted the trend for increased devolution of power from central government to local government for the economic and social wellbeing of localities will continue and ultimately lead to increasing roles for local government in the management and governance of local energy resources.

7.0 Opportunities for introducing local energy solutions for the UK

7.1 Local government experience

Local government have the potential to exploit many distributed generation and local energy solutions. The first step for an authority implementing energy strategies is to learn from the experience of other local governments (see Kelly and Pollitt 2009). For example, Kirklees council and Woking borough provide advice and consulting services to other local governments wishing to learn from their experience. The second step is then to gain a deeper understanding for the composition of energy demand within their locality. The following questions are generally answered during this stage:

- Where is the demand located – spatial?
- When is it required - temporal?
- How much is required – physical capacity?
- What type of energy is required – resource availability?

After this information has been collected, bespoke strategies for the locality can be planned. Several of the most common solutions implemented by local governments include CHP-DH, EfW (Energy from Waste), the establishment of ESCOs and the introduction of financial incentives for installing energy efficiency measures. The opportunities and potential barriers of each of these core strategies shall now be discussed.

The district of Kirklees has long been recognised as a pioneer for implementing sustainable development and has featured as a case study in several peer reviewed journal articles (Bulkeley & Kern 2006; Burton & Hubacek 2007). Located on the Western border of Yorkshire and Humberside, Kirklees was the only local government to enrol in the UK emissions trading scheme (UK ETS)(Kirklees Council 2010). This commitment required the council to reduce in-house emissions by some 12% between 2002 and 2006. During the first stages of implementation, the Council learned about the importance of accurate and frequent monitoring of fuel consumption across all of its sites. The Council achieved this by installing an Electronic Data Interchange (EDI) and billing system thus enabling the council to get monthly energy consumption statistics for all of its sites. By receiving this information electronically, the council was able to monitor energy consumption patterns and identify high consumption areas and peaks in demand. Properties that were identified as high-energy consumers were then targeted for energy efficiency technologies and upgrade.

Similarly, Peterborough Council located on the border of the East Midlands in 2009 identified the need to develop a county wide local energy strategy and set about collecting accurate data on energy consumption and emissions for Lower Super Output Areas (LSOA's) for the entire borough (Peterborough Council 2010). It is thought this data collection exercise is the first occasion an energy audit of this scale has been conducted by a local government (Harker and J. Chatterton 2009). Armed with new, highly disaggregated information about energy consumption the authority could develop baseline energy projections and construct future energy options for the borough. A main finding from this analysis was that a single countywide energy strategy would not work across all LSOA's within the city. Instead, more targeted energy strategies for each zone would produce optimal results.

Local governments who have made the decision to reduce emissions and take leadership over energy have also instigated targeted programs. For example, in Kirklees a new corporate change programme was established to meet the targets established in the Local Area Agreements (LAA). The programme aimed to raise local awareness, reduce green house gas emissions, improve energy management of buildings and support the business community to work together through a 'green network' (Kirklees Council 2007). Within the strategy both mitigation and adaptation issues were addressed in parallel and included long-term strategies like developing biomass wood-stocks for district heating and the completion of a climate impacts profile to quantify extreme weather events for climate change adaptation. In order to implement these targets a new reporting and organisational structure within the council was established incorporating a low carbon board of senior managers reporting directly to the executive management and the council cabinet. In this new reporting structure, six climate change sub-boards are responsible for meeting targets in key strategic areas.

The following sections will discuss key benefits and barriers to complimentary and competing strategies for implementing different local energy strategies.

7.2 Strategy: CHP with District Heating (CHP-DH)

Although CHP and DH networks do not necessarily go hand in hand, the majority of local governments who have pioneered DH systems have also installed CHP plant to meet local base-load heat demand (Aberdeen, Nottingham, Southampton, Leicester, Woking, Barkantine). The decision by a local government to install a CHP-DH network is made for several reasons. First, CHP-DH networks provide affordable and manageable onsite energy generation and distribution for council owned infrastructure such as halls, schools and swimming pools. They also provide affordable heating and electricity for council owned housing as a way to reduce energy costs and alleviate fuel poverty (BERR 2007). Finally, CHP-DH is a proven technology that has real potential to reduce CO_2 emissions both through energy efficiency gains and through the combustion of low carbon fuels such as biomass and waste (Torchio et al. 2007; DTI 2007b; IEA 2008b). In addition, CHP-DH provides increased energy security because it can be operated in island mode (independent from the grid) but also because when local low carbon fuels are used, susceptibility to the volatility of international energy markets is mitigated.

Ancillary benefits include a more robust and better-managed heat infrastructure; increased employment opportunities and therefore local economic regeneration and the building up of local capacity. Unfortunately, the number of CHP-DH networks in the UK has stagnated despite a significantly decreasing heat to power ratio and increased government intervention to encourage CHP development (Figure 6.1).

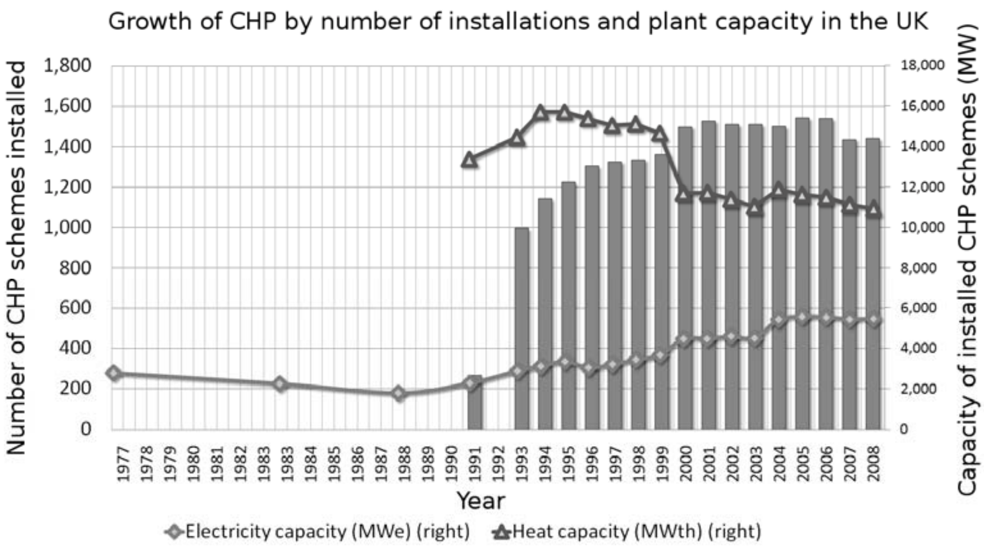

Figure 6.1 : Growth of CHP capacity in the UK (1977-2006)

Source: Graph created from data on the DUKES database (2008)

7.3 Strategy: Energy from waste (EfW)

Fuelling CHP-DH networks using municipal waste is increasingly becoming the method of choice for local governments. This is driven by (1) central government's ambitious target to reduce waste sent to landfill by some fifty percent by 2020 (2) an increasing landfill tax (3) environmental problems arising from poorly managed landfill sites and (4) a government target to have twelve percent of all heat coming from renewable resources by 2020 (HM Government 2009). Although the mix of waste disposal options is primarily driven by the Governments Waste Strategy (DEFRA 2008), local government have increasing responsibility for meeting targets through significant increases in both recycling and EfW facilities (Biffaward and C-Tech 2003). In 2006 waste processed in EfW accounted for eight percent of total waste or 2.8 Mt, sufficient to heat and power ¼ million homes; in 2020 EfW facilities are expected to process at least twenty-five percent of total waste generated providing heat and power for over one million homes. (Environmental Services Association 2009).

It is clear why EfW facilities are increasingly chosen by municipalities. First, waste is regarded as a semi-renewable energy resource, since approximately 70% of municipal solid waste (MSW) is defined as being carbon neutral (Energy Future Solutions et al. 2005). Second, there is strong evidence from Europe that countries that rely heavily on EfW have high recycling rates (DEFRA 2008, p.78). Third, EfW is seen as a win-win solution where waste and energy problems are solved simultaneously. Finally, waste not being sent to landfill sites eliminates the creation of methane - a GHG twenty times more potent than CO_2. Evidence for the competitiveness of EfW is shown by the success of the existing twenty operational facilities in the UK and the growing number of predicted or planned new installations. In 2007, 29 Mt of MSW was produced, where thirty-one percent was recycled, eleven percent was used in EfW facilities and the remainder, fifty-eight percent, went to landfills (DEFRA 2009) . Using conservative estimates, we calculate that at least 25 TWh of heat and power[6] can be produced from MSW in the UK annually. This equates to about five percent of present UK domestic energy demand (heat and electricity) estimated at 500 TWh per year (DECC 2009a). Supplementing municipal waste with industrial and agricultural waste could significantly increase this unexploited energy resource considerably.

There are however many barriers for implementing EfW. For example, all EU states must meet stringent regulatory requirements concerning pollutant emissions to air, land and water (EU Directive 2000/7/76/EC). Such demands require costly abatement, monitoring and control equipment thus making large plants more cost effective through economies of scale. Despite strict anti-pollution regulations, NIMBYISM (not in my back yard) has hampered many EfW facilities and remains a significant hurdle for local governments to gain public acceptance (Franchini et al. 2004; GreenPeace 2004). There are also serious shortcomings in plant efficiencies with some EfW plant rated with efficiencies below twenty-five percent, however coupling EfW with CHP and district heating could help with this dramatically. Large plant size coupled with unpopular public opinion has driven EfW facilities outside population centres and away from heat

[6] This assumes that over a third of waste is recycled and 20 Mt/y of combustible waste is produced each year. The Net Calorific Value (NCV) for MSW of approximately 2.5 MWh/t (Energy Future Solutions et al. 2005) with a plant conversion efficiency of 50% approximately 25 TWh/y of heat and power could be produced.

consumers, making heat delivery through district heating not cost effective, or impossible. In order to combat this trend Scotland has now introduced minimum efficiency standards for all new EfW facilities (Scottish Environment Protection Agency 2009).

When the benefits of CHP and EfW are combined with DH, synergy in the delivery of more sustainable energy can be demonstrated. Local government are shown to assist these schemes first by connecting their own buildings to the scheme but also by acting as a financial guarantor for the scheme by offering long-term energy demand contracts for the supply of heat and power to council owned infrastructure. Local government can influence local planning laws to facilitate the installation of pipe-work and the connection of new buildings to the scheme. Furthermore, as a co-ordinator and representative, local government can offer encouragement and other incentives for residents and local business to connect to heating networks. Finally, local government have access to both national and international funds that can be used to offset some of the high upfront capital expenses required for installing CHP-DH networks.

7.4 Strategy: Establishing an Energy Service Company (ESCO)

Among local government in the UK, there is an increasing trend to use ESCOs for managing local energy services. This trend is also supported by the government with one of the major recommendations coming out of the government's heat and energy saving strategy for a new focus on delivering local low carbon heat and electricity. There is also growing acceptance among stakeholders that local authority ESCOs are a viable and appropriate special purpose vehicle (SPV) capable of delivering 'energy services' such as heat and light rather than merely units of gas and electricity. Usually ESCOs are collaborative ventures owned by both public and private organisations, and can be either profit or non-profit motivated. ESCOs provide many benefits but most importantly, they allow for the organisation and ownership of the supply, delivery and consumption of energy locally. The benefits of creating an ESCO include bulk purchases of energy efficiency measures, implementation of creative financial mechanisms, energy performance contracting and the direct specialist management of energy resources. Because an ESCO is an independent company at arms length from the owners, they lower risk on large projects and provide a legal mechanism for the apportionment of shares and profits. For example, in Peterborough an ESCO is proposed to bring together the interests of several parties including EDF, Peterborough City Council, British Gas and Opportunity Peterborough (Harker and J. Chatterton 2009). Indeed, in the Governments 'renewable heat and energy saving strategy' it is clear ESCOs will play an increasingly important role for delivering future energy services in Britain.

Two categories of legal contracts are used in the creation of ESCOS that represent the varied interests of parties involved. One of the most common contracts in the UK is 'energy supply contracting' (ESC) where consumers are sold energy at pre-agreed rates. The ESCO guarantees a level of energy service and is then free to act and make decisions for energy efficiency purposes to reduce their own costs. The ESCO or contractor is responsible for maintenance and offers support for the duration of the project. These schemes are frequently financed using the Build Own Operate Transfer (BOOT) financing model. The second category of contracts usually implemented by ESCOS is Energy Performance Contracting (EPC). Using EPC methods, it is possible to drawdown on future savings gained from installed energy efficiency measures in order to provide sufficient finances to invest in the energy efficiency measures in the first place. ESCOs are thus able to provide energy performance guarantees for the provision of energy, the cost of energy, and energy savings. The energy savings can then be distributed in a pre-arranged agreement between the ESCO and the client, where the client can choose to reinvest in more improvements if desired. This approach differs from pure ESC methods because savings in both energy production and delivery are targeted (Energy Saving Trust 2008; Smith 2007; TNEI 2008; Zeman & Werner 2008;).

Increasingly, ESCOs also offer services to improve household efficiency or provide finance for the development of district heating networks. In sum, ESCOs are seen as an appropriate way to minimise risk; increase revenues; appropriately apportion ownership rights; and provide specialist energy services typically outside of public experience.

7.5 Strategy: Creative financial instruments

Local government also have significant potential to encourage and implement energy saving strategies in residential homes within their district. Usually schemes administered by central government are only available for the elderly or those people on qualifying benefits (e.g. Warm Front). In Kirklees however, Warm Zone Plus was established to provide free cavity wall insulation to all residents, not just those in fuel-poverty. In the first two years of Warm Zone Plus (until July 2009) over 143,000 homes engaged with the scheme and 43,000 homes received free insulation with the average householder saving £209 per year, equating to total savings in the order of £8.9 million per year (Kirklees Council 2009).

Similar schemes often provide the upfront capital, sometimes as a grant (Warm Zone Plus) but more commonly as a loan with little or no interest being demanded from the resident. Any balance remaining on the loan is then paid back when the property is sold – when there is sufficient funds to cover the expense. Examples of such schemes include the Kirklees Re-Charge scheme or Suncities project (Environment Unit and Browne 2008). Alternatively, the energy savings achieved during the life of the investment can be used to pay back the initial capital. There are however several barriers preventing these schemes from being more widely adopted. Large sums of up front capital are usually required to finance the scheme and although this sum is generally paid back over time, the interest is generally written off. Overcoming these barriers requires securing finances from multiple sources and innovative accounting methods. Kirklees Council managed to do this with grants from Scottish Power, the National Grid, the Regional Housing Board and the British Gas Energy Trust. Implementing and managing these financial arrangements can be complicated and administratively burdensome and generally leads to local government outsourcing the management of financial schemes to external management companies including ESCOs.

8.0 Discussion

The UK government has recognised that distributed generation can make a significant contribution to reducing the UK's carbon emissions (Woodman and Baker 2008). Moreover, when municipalities make the decision to implement energy strategies they have many tools and opportunities at their disposal such as planning and regulation, waste disposal systems, grants and subsidies, district wide energy strategies and energy consumption in council owned buildings. In addition, municipalities who have implemented energy strategies have seen cost savings, increased employment and improved quality of life for their citizens. For example, since 2001 the Cornwall Sustainable Energy Partnership – comprising local government, universities and private companies – has been working to reduce CO_2 emissions. In 2009, funding was agreed for a £42m wave energy facility. An economic impact assessment estimated that the project would create almost 1,000 jobs and boost the local economy by a further £332m over 25 years (and a further 800 jobs and £228 million elsewhere in the UK) (Audit Commission 2009).

There are also many co-benefits for local authorities adopting these types of solutions. For example local governments receive increased energy resilience through a more diverse energy supply; they mitigate uncertain and volatile international energy prices and they secure the regeneration of local economies through the sourcing of local energy supplies such as biomass and waste. When local governments have responsibility over local energy systems, they create economies of scale through supplying energy to their own infrastructure but also through economies of scope by providing demand side efficiency solutions and developing creative opportunities for reduced energy consumption.

Since 2008 two-thirds of all Local Area Agreements (LAA's) have specific targets for reducing CO_2 emissions from a 2005 baseline, however, only one in five have a stretching target and fifty have no target at all, including fifteen of the highest emitting localities. Targets range from 1% reduction in Bristol to 15% in Kirklees with the median reduction target being 10.6%. If all areas where targets are set achieve the anticipated level of reductions this will achieve just 6% of the CO_2 savings required to deliver the UK 2050 target. A small number of local governments have made GHG inventories, developed strategies and implemented energy solutions despite such measures are not a legal requirement (Audit Commission 2009, p.18).

The lack of ambition shown by local government may partly be explained by the significant barriers to overcome, several of these include:

- ***Significant upfront capital costs*** inhibit investment from public and private sectors in supply and distribution infrastructure such as district heating pipe work or high-volume efficiency programs.

- ***Long pay back periods*** are typical of high cost and large-scale renewable energy projects making investment in such projects unattractive when compared with other high return and low risk investments.

- ***Increased risk*** due to high upfront capital costs and long pay back periods of energy saving projects command higher financial returns for a project increasing the initial hurdles a project must reach before it is even deemed viable.

- ***Hidden costs and high transaction costs*** that are a result of brokering and maintaining public private partnerships or establishing organisations like ESCOs discourage investment.

- ***A convoluted and difficult national subsidy and rebate system*** acts as a deterrent for new entrant's thus preventing competition and lower energy prices.

- ***Political and economic 'lock-in'*** from existing centralised infrastructure disadvantages small, variable or unpredictable power.

- ***Insufficient information or 'know-how'*** amongst public bodies for creating and implementing local energy systems is low and requires national programs to build capacity.

- ***Policy restrictions*** on private wire networks (PWNs) and an insufficient market for heat provide little incentive for large industry to supply waste heat into DH networks.

- ***Principal-agent problems*** inhibit investment in energy efficiency because the owner of the home does not pay the energy bills and is therefore not interested in making the investments required.

- ***Consumer preference problems*** occur when a consumer resists change to a more efficient alternative such as energy saving light bulbs.

- ***Negative externalities*** such as locating renewable energy projects close to city centres may encourage local opposition and prevent projects moving forward.

- ***Many local governments lack good quality data*** about the housing stock in there region making it difficult to target effectively and assess opportunities to get the best value for money.

As shown, a number of barriers act to prevent local energy deployment (Kousky and Schneider 2003), but as presented by Allman and Fleming (2004) these barriers change depending on the stage or level of progress a local government has made towards implementing local energy strategies. Whilst local governments provide many of the answers for increasing the uptake of distributed generation, they are also sometimes become part of the problem. Planning rules and regulations need to appropriately reflect the benefit that distributed renewable energy provides to society. Without such support the rollout of distributed renewable energy infrastructure may not take hold.

9.0 Conclusion

The progress being made by successful local governments can be narrowed to three key factors. First, they have all recognised the co-benefits of a local energy strategy: a reduction in fuel poverty, increased employment, improved quality of life and mitigation of uncertain fuel supplies and prices. Secondly, successful councils have strong political leadership and employee support to implement the structural change to bring about change. Thirdly, leading councils have gained momentum by working in partnership with utilities, private companies, NGO's, DNO's and government departments to raise finance and garner support. With increasing uncertainty over international global climate change negotiations and similar challenges facing national energy targets, locally led solutions are set to be an increasingly important dimension for both the supply and demand for energy. It is therefore important that regulation reflect the benefits of the local dimension to energy.

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