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Local Government Response to Climate Change in the United Kingdom, Germany and Sweden

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EXECUTIVE SUMMARY

Global climate change will affect all aspects of society. Governments and businesses will face both short term and long term challenges. As the earth's climate warms and the dangers increase, it is evident that immediate action is required. Strategies and actions today and in the coming decades to mitigate climate change are needed. It is also clear that adaptation methods are necessary to prepare for the inevitable impacts that cannot be avoided as a result of a warming climate.

Many countries continue to work on mitigation strategies to address climate change. However, adaptation is now widely recognized as being fundamentally important due to the threat of future extreme weather events. The management of water and other natural resources will need to be addressed. Attention will also need to pay a particular focus on agricultural activities and the sources and generation of energy.

In the United Kingdom, Germany and Sweden a number of policy mechanisms have been implemented in local areas with respect to climate change. Flooding remains a major concern in the UK, Germany and Sweden and current adaptation strategies include the building of reservoirs and dykes in both the low and highland areas. Flood warning systems are also in place and require further development, specifically in Germany.

Increasing temperatures in the regions have prompted new spatial planning techniques, transportation strategies, the proactive management of housing quality and the promotion of energy efficiency. Escalating heat waves have signaled the need to improve early health warning systems across Europe and develop preventive emergency plans. Water conservation methods are progressively more supported in the household, industrial and agricultural sectors due to increasing temperatures in a number of areas.

Regulations regarding climate change in the three countries revolve in large part around the continued development and use of renewable resources, monitoring energy usage, and the promotion of energy efficiency measures in municipal buildings, households and new business development. Renewable resources include wind and solar power, geothermal energy, and the use of biofuels. Renewable resources are a significant part of Germany's climate change strategy and in 2003, 26 percent of Sweden's energy consumed came from renewable sources.

Funding for climate change strategies and environmental initiatives are provided by a number of organizations, governments, the private sector and Non-Governmental Organizations. Financial assistance and renovation grants are potentially provided to private households for reducing energy use and through building renovation.

In all three countries, there is a lack of information provided to the public in order to make society aware of both climate change impacts and ways in which to reduce personal contributions to the problem. While some areas of the UK are using information programs to

change travel and transportation patterns of employees, it is evident through research that both information and incentive programs are not being sufficiently utilized.

There are a number of institutional arrangements and partnerships in place in the UK, Germany and Sweden. The Cities for Climate Protection is an international campaign that currently has 118 local authorities from across Europe participating in the program (LGA, 2005b). Public, private and voluntary sectors in the UK often work together to address the impacts of climate change. In Sweden there are two major networks that focus on climate change mitigation, they are the Climate Change Municipalities and the Eco Municipalities.

In the UK, local governments have implemented a number of initiatives that include a Code for Sustainable Homes, climate change strategies and energy reduction campaigns, as well as intelligent metering that monitors energy used in cities. In one local area a solar village is being developed which, once completed, will provide 20 percent of electricity needs and 50 percent of hot water needs through the use of solar installations.

In Germany, renewable resources are the most significant tools in place to reduce climate change impacts. Wind power now provides more electricity in the country than hydropower. Subsidies are provided to those who want to install solar power to their homes and all types of solar applications are in use. Geothermal power is a renewable resource that is also being developed and used in a number of communities. It is not affected by seasonality, weather effects or temperature and is a clean source of energy.

Sweden wants to become the world's first oil free economy and has been pursuing clean and renewable energy sources in order to achieve this aim. Currently nuclear and hydroelectric power is in use to produce energy but increasingly Sweden is also turning to geothermal heat and solar power. A number of districts are being created that are sustainable and considered ecological cities through the environmental approach taken in the construction and sustainability of the areas. Public and private transportation is being changed to clean vehicles through the promotion of biofuel use and clean transportation such as electric and hybrid vehicles.

It is evident that there are environmental sustainability measures, climate change strategies and initiatives which have been met with a measure of success. What has been revealed is that there are very few performance measures and information programs in place to reveal the success of climate change strategies. Adaptation measures are discussed at length and the importance of these measures is understood, yet implementation remains a future priority.

Climate change will affect many local authority's services, assets and infrastructure. Water, waste management, and energy provision will all be affected. Extreme weather events[1] have shown that climate change will impact society and that infrastructure and services need to be designed to meet the risk (ICLEI, 2007a).

The challenge for the managers and political leaders of local government is to recognize the urgency of climate change and the opportunity to be pro-active and to take the lead in the

[1] Such as the flooding that occurred in the European summer of 2002 and 2005, and the extremely hot summer of 2003 and 2006.

interests of their community, without waiting for circumstances to force their hand (LGA, 2005: p. 14).

INTRODUCTION

This paper will discuss initiatives that local governments in Europe have implemented in order to address climate change. The specific focus of the research will be in the countries of the United Kingdom, Germany and Sweden. The effect of climate change in Europe has prompted a number of local governments to act. Impacts have already been witnessed with intense rains and severe flooding, heat waves, drought, and rising sea levels. Climate change may also have serious negative effects for agriculture, community planning, economies and ecosystems (GOS, 2007a).

Local governments in these three countries are working towards managing the new conditions and reducing emission contributions in local areas. Sustainable solutions are being implemented in order to reduce climate change impacts as a result of human influence. In Europe, municipal leaders and representatives of local governments are committed to improving and implementing climate change mitigation and adaptation strategies (Amir and Peshawar, 2005).

The paper begins with a discussion of the current and future impacts of weather variability on a number of areas. These include the economy; the environment; public health; culture and recreation; and local government asset and disaster management in Europe. Following is a section which presents local government policies that have been put in place to address climate change. The discussion then identifies case study initiatives that have been implemented by local governments in each of the three countries to address the problem. The approach taken in order to discuss local government initiatives and responses to climate change include a literature review, data analysis, internet research, and a review of government documentation and climate policy research.

Europe has the highest population density (60 persons/km^2) of any continent; of the total European population, 73 percent live in urban areas (UN, 2004), with 67 percent in southern Europe and 83 percent in northern Europe (Alcamo, 2007). With more than 50 percent of the world's population living in cities, municipalities have a greater role to play to address climate change through the decisions they make (Amir and Peshawar, 2005). Local governments have the ability to change the amount of energy their communities use and consume. By making proactive and responsible decisions on areas such as land use, zoning, traffic management, building codes and any number of other activities, the effects of climate change can be significantly reduced.

FINDINGS

Section One: Climate Change Impacts on Local Government Activities in Europe

1.1 Asset Management

The effects of climate change and increased atmospheric CO_2 will have a number of consequences for European crop productivity, although Ewert *et al*. (2005) believe that technological developments[2] may help to mitigate the effects that climate change will have on the output of crops in Europe. However, this will mean greater strain on agricultural land as crop yields increase, and further stress on many water systems as availability decreases in the south and southeast as a result of higher temperatures (ibid).

Higher temperatures in Europe have the possibility of damaging rail and road surfaces. This in turn may reduce the comfort of passengers and threaten the stability of the transportation network (AEAT, 2003). With temperatures increasing, the use of air conditioning in private vehicles will rise significantly. There is a further possibility that there will be a reduction in the use of public transportation (Wooller, 2003). This may occur as a result of passengers not wanting to travel in conditions that are perceived to be uncomfortable due to increasing temperatures (LCCP, 2002a; LCCP 2002b).

An increase in extreme weather events may cause severe flooding, such as what has been seen recently in 2007. Underground rail systems and roads with inadequate drainage are at high risk of flooding and this will impact the transportation network of millions of commuters due to infrastructure damage (DEFRA, 2004). It is also believed that high winds may affect the safety of air, sea and land transport (Alcamo, 2007).

1.2 Economic Growth Management

A number of economic effects have been identified as a result of climate change impacts on Europe's economy in the future. Industries located on or near the coastline will be affected by sea level rise. Recreational activities and preferences may change as a result of weather effects (outdoor/indoor). As witnessed in a number of countries in recent years, damage to homes and to personal assets due to extreme weather events will increase the number of insurance claims and will stress the viability of the insurance industry.[3]

Climate change may have significant impacts on a number of marine fish and shellfish in the north-east Atlantic (Clark *et al*., 2003). Climate change also threatens to disrupt the spawning habits of marine life and increase the levels of pollution found due to weather effects and sea level rise (Alcamo, 2007) putting stress on the fishing industry.[4] This will have significant adverse economic effects for those communities that are dependent on the industry (Gitay, 2002).

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[2] Such as the introduction of new crop varieties and implementing improved cropping practices.
[3] The Association of British Insurers estimate that losses from natural disasters cost $60bn in 2003 and could be as much as $150bn by 2010 (LGA, 2005: p.9).
[4] Researchers emphasize that the ability to assess a number of impacts such as biodiversity, effects on ecosystems, and even the socioeconomic costs of climate change in coastal and marine areas is limited.

In Germany, a number of different sectors (navigation, energy, agriculture or water supply and sanitation) may be affected by low water conditions (EEA, 2007). Low water and dryness will require sustainable land-use management and infrastructural precautions will need to be taken.[5] Agriculture and forestry may also face water shortages and should use adaptation measures which include using crops adapted to drought stress and modern water saving irrigation systems (ibid).

1.3 Environmental and Public Health Management

Hurricane force winds, debris such as fallen trees, and intense flooding that has destroyed homes and businesses are just a few of the climate change impacts being felt in the UK in recent years. Warmer temperatures may also increase the risk of forest fires in southern Europe due to extremely arid conditions.

In Germany, it has been recorded that the last decade has been the warmest of the century and that the warming climate has had implications for plant activity and growing season length (Hulme and Sheard, 1999). With the location of Germany on both the North Sea and Baltic Sea, there is a high risk for devastating consequences from sea-level rise. This will also have significant impacts on biodiversity.

Countries in Europe will face increasing heat-related deaths as a result of rising temperatures and heat waves becoming more common, severe and widespread, as was seen in 2003. With more intense weather effects such as wind storms and flooding, climate change will significantly increase the risk of mortality and injury. There are also concerns that with the milder temperatures and the changes in variation of weather patterns, a number of insect-related illnesses and the risks of infection to communities may become more frequent (Lindgren and Naucke, 2006; Lindgren and Gustafson, 2001).

Water quality and quantity may be affected by climate change impacts. This will increase the risk to communities of water-borne disease and illness (Hunter, 2003; Kovats and Tirado, 2006). Just as water quality and safety is a concern, so too is the preservation of food in these areas where temperatures are increasing (Kovats *et al.*, 2004; van Pelt *et al.*, 2004).

In parts of Sweden where water flow is expected to rise, there is an increased risk of contaminants and toxins being dispersed as floods upstream of aquifers carry pollutants into lakes and watercourses (EEA, 2007). In the summer, there is an expected decrease of the inflow of water in southern and south-eastern Sweden. This combined with the temperature increase of Swedish lakes may have negative consequences for both the supply and quality of drinking water (ibid).

1.4 Disaster Management

With the increasing weather-related crises as a result of climate change in the UK, Germany and Sweden, local government authorities have had to reevaluate how disasters are currently being

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[5] Such as adequate water stocks in reservoirs or facilities for making sufficient water available in the areas affected by means of long-distance water pipelines.

handled and how to handle them in the future as the effects of climate change become more widespread and catastrophic. Schipper and Pelling (2006) note that there are considerable challenges to effectively manage disaster management and local actors need to institute coordinated planning and cooperative frameworks in order to be successful.

In the UK in 2005, local government leaders, chief fire and police officers, and representatives from a wide range of voluntary organizations, committed to working together when planning for and dealing with emergencies (LGA, 2005).

1.5 Culture and Recreation

It is evident that weather is a key factor when determining vacation destinations. Tourism is very closely linked to climate and a number of travelers venture to Europe each year for vacations. While increasing temperatures may benefit Europe as it becomes a larger tourist destination, the other health-related effects, as mentioned above, will eventually reduce Europe's appeal as they become more widespread as a result of climate change and temperature variations.

Dr. Allen Perry in his position paper (2003) discusses the sustainability of the tourist industry. He believes there will be increased "destination-swapping" taking place in the future as a result of climate change impacts (p. 2).[6] Tourist destinations that are located on the coastal areas of Europe will require infrastructural upgrading to protect them from sea level rise.[7]

Perry (2003) discusses further that the skiing industry will continue to experience less snowfall and feel the financial impacts as a result of declining tourism. Schröter *et al*. (2006) believe that due to decreasing snowfall the tourism sector in Germany will increasingly feel the effects of changing weather patterns and note that there are "no adequate long-term adaptation measures available" (p. 53). Winter tourism will need to compensate for reduced snowfall by using artificial snow, which is already in use to cope with snow pack variability; though there are ecological concerns in the long term (Fukushima *et al*., 2002).

Transport issues arise for visitors to vacation destinations as the need for alternatives other than the use of a car or plane becomes a key factor when determining location. Destinations whose appeal is solely based on the natural environment may find tourism decreasing significantly as a result of climate change impacts on these areas. Ecosystems are the first to be affected by a changing climate. Therefore, any wildlife that tourists want to see may be affected by changes in timing due to variations in temperature. In addition, extreme weather events are having major infrastructural impacts and loss of land is becoming more frequent. It is in culture and recreation that mitigation to climate change is fundamental to help reduce the changes to nature and surrounding landscapes. A crucial interdependence exists between the climate, the environment, tourism and communities (Simpson and Ladle, 2007).

New forms of tourism may be promoted that are not sensitive to weather conditions. Eco-tourism and cultural tourism are two possibilities which move away from nature-based tourism

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[6] Such as coastal erosion, extreme heat waves, or lack of snow cover.
[7] These include tourist destinations such as beaches, wetlands, estuaries and even coastal golf resorts.

(Hanson, 2006). It is believed that people will change their activities and travel destinations in response to different weather patterns (Sievanen *et al*., 2005).

Section Two: Local Government Policies to Address Climate Change in the United Kingdom, Germany and Sweden

2.1 Water Supply and Wastewater

In Europe, there are currently reservoirs and dykes in both the highland and lowland areas to protect against floods. These are likely to remain as a means of protection against flooding. There are other adaptation measures currently under review that have received popular support. These include measures such as expanding floodplain areas, implementing emergency flood reservoirs, preserving areas for flood water, and flood warning systems, especially for flash floods (Alcamo, 2007). Europe will continue to feel water stress and the most common strategy remains trying to retain supply by creating new reservoirs.

Wastewater reuse is being considered, but due to concerns over health and disease has not grown significantly in popularity. There is significant interest in implementing greater conservation methods in the household, industrial, and agricultural sectors. Two ways in which this can be achieved is by 1) reducing the number of municipal and irrigation water systems that leak or are in poor condition and 2) through information programs.

Vulnerability is high in the water sector in all parts of Germany. Schröter *et al*. (2006) note that there are "few adequate adaptation measures" available locally which results in high vulnerability (p. 52). Sweden has "three major climate change monitoring institutions and the impact of climate change on hydrological cycles is closely watched" (Thampapillai, 2007: p. 9).[8] Thampapillai (2007) feels that the development of policy mechanisms on climate change with respect to water is taken very seriously in Sweden. Municipal governments are responsible for water supply and wastewater services. In 2002, there were an estimated 1550 hydropower stations located in Sweden and since 1997, hydropower development has been subsidized as part of a renewable energy initiative (ibid).

2.2 Increasing Temperatures

In the dense big cities of the UK climate change is being significantly addressed. Due to the size of the populations and the sheer number of businesses in these areas a greater impact can be made. Researchers (Alcamo, 2007; CLG, 2007b) believe that aligning spatial planning and transport strategies with strategic co-ordination of economic development activities, proactive management of housing quality and demand, and promoting energy saving initiatives[9] will help to reduce climate change effects. By developing urban planning initiatives that locate new building developments closer to business centres, the hope is that transportation demand can be reduced as more people choose other methods of climate conscious transport, such as walking or

[8] The Swedish Climate Modelling Programme, the Swedish Meteorological and Hydrological Institute, and the Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning.
[9] Energy initiatives include higher rates for higher consumption and incentives for reducing energy use.

cycling. Through environmental urban planning, heat islands[10] can be avoided in the larger cities.

Cities such as Malmö, Sweden have implemented very clear objectives in their environmental programs and action plans. In the long term the city is looking specifically at becoming a sustainable environmental municipality. One of the initiatives of the program is to cut CO_2 emissions by 60 to 75 percent by 2050.

In Europe, a number of adaptation measures are available in the energy sector. The top priority remains trying to change human behavior and includes the redesign of the energy supply system (Alcamo, 2007).[11] Reducing greenhouse gas emissions to mitigate increasing temperatures is a common mitigation technique. Energy conservation through building codes, low electricity standards, increasing energy prices, and public education remain to be used as adaptation techniques (Hanson *et al*., 2006). The use of renewable energy[12] is seen as an effective adaptive measure by moving away from using fossil fuels, which are non-renewable. Renewable energy use is increasing in Germany today and further research is ongoing.

To adapt to heat waves occurring in Europe, it has been noted that there is a need to continue developing early health warning systems and preventive emergency plans, particularly after the heat wave in the summer of 2003 (Garssen *et al*., 2005).

2.3 Flooding and Sea Level Rise

There are a number of strategies that are likely to lessen the risks of flooding. These include public flood warning systems and forecasts, and evacuation from low lying areas (EEA, 2007; Hajat *et al*., 2003; Ohl and Tapsell, 2000). In order to protect resorts and homes on the coastal areas from sea-level rise, it is possible that barriers may be constructed. It is also feasible that infrastructure will be moved away from the coastline.

In the UK, responsibility for managing storm water in urban areas is shared between local authorities, water companies, the Environment Agency, and Internal Drainage Boards (in drainage districts) (DEFRA, 2007b). There are a number of adaptation strategies currently being tested in the UK to lessen the effects of flooding and coastal erosion. These include strategic planning on the coastline based on local needs and circumstances, sustainable land use in floodplains and restoring floodplain woodland to alleviate flood risk (ENS, 2007).

To adapt to flooding in Germany, a Flood Early Warning System for the River Rhine has been developed by a Swiss-Dutch-German group in close coordination with Germany and the Netherlands (EEA, 2007). Flood control measures have only been partially introduced and it has been noted that more space is required for the expansion of rivers and for the designation of

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[10] A heat island is defined as an urban area having higher average temperature than its rural surroundings owing to the greater absorption, retention, and generation of heat by its buildings, pavements, and human activities.

[11] As Arnell in Alcamo (2007) notes, "the sensitivity of European energy systems to climate change could be reduced by enhancing the interconnection capacity of electricity grids and by using more decentralized electric generation systems and local micro grids" (p.560).

[12] Such as wind, solar and geothermal renewable energy sources.

flood areas. As stated in the European Environment Agency's Technical Report on Climate Change and Water Adaptation Issues (2007):

> *Dyke retrenchment measures, restoration of flood-plain forests and re-connection of old river arms are regarded by experts as effective flood control measures for rivers. These measures are regarded as partially implemented. Restrictions on use in flood areas, such as restrictions on new building are already regulated by law.*

Measures being implemented in Sweden include plans to expand provisions for the discharge of water from lakes to prevent flooding. The lowest point in Sweden is at Kristianstad, which is 2.4m below sea level. In order to eliminate the risk of the town being flooded, the local authority is working to analyze the threat and take action. Actions include expanding the enclosure within embankments and improving existing embankments around low lying areas (EEA, 2007). In Sweden, the importance of not relying solely on technical flood protection (e.g. raising dykes, enlarging reservoirs, upgrading drainage systems) is understood. Other measures being implemented to protect areas include the promotion of the natural retention of flood water (e.g. floodplain restoration, change of land use).

2.4 Regulation

Local government plays a major role in energy policy, both as a user and a provider of energy. Authorities have the potential to address climate change by implementing policy in important sectors such as energy, transport, urban planning and waste. Action in the energy sphere encompasses measures to improve energy efficiency in municipal buildings, housing and businesses. In addition, schemes to develop renewable energy have been tested through purchasing green power for the municipality, running demonstration projects, and facilitating the development of renewable energy in communities and businesses. Local authorities can generate energy locally through renewable methods such as harnessing tidal and solar power. Councils can also help to manage the level of energy consumption in their area through promoting energy efficiency measures in public transport (LGA, 2007).

One of the largest investments in Europe which aims to succeed in an ecological transformation is *Ekostaden Augustenborg* located in Sweden. This is the name for a number of projects that "together constitute one of the largest investments in Europe" (COM, 2007). In Sweden, renewable sources of energy such as solar heating and biogas are being developed and researched further. In 2003, 26 percent of all the energy consumed in Sweden came from renewable sources. Recently the Swedish energy agency said that it planned to get the public sector to move away from oil. Its health and library services are being given grants to convert from oil use and homeowners are being encouraged with green taxes.

In the UK, it is estimated that 30 to 40 percent of electricity demand could be met by installing microgeneration[13] equipment in all types of building by 2050 (CLG, 2007a). By using renewable technologies in buildings, carbon emissions can be significantly reduced. These can

[13] Microgeneration is the generation of zero or low-carbon heat and power by individuals, small businesses and communities to meet their own needs. Microgeneration technologies include small scale wind turbines, water turbines, ground source heat pumps, solar thermal collectors, solar electricity and MicroCHP installations.

range from wind and water generation to ground sources like heat pumps and biomass boilers (ibid). Buildings that use these technologies reduce emissions and also lower their fuel bills.

In Southampton, UK planning policy now includes climate protection concerns. The Local Plan for this area states that "applications for development will need to demonstrate that they have, where possible, incorporated passive solar design, potential for connection to combined heat and power implementation (CHP) or district heating schemes and the use of renewable energy technologies" (SCC, 2004). In the UK, local authorities have various duties which relate to climate protection, including the Home Energy Conservation Act and guidance on transport and land-use planning (Bulkeley and Kern, 2004). In London, congestion charging was introduced. A levy is placed on car drivers who use the central zone of the city during the day (TFL, 2007). Durham City Council has also introduced a road-user charge for a small part of the city (DCC, 2007).

Other mechanisms in the UK include local authorities being required to report on the levels of greenhouse gas emissions from the transport sector under the Road Traffic Reduction Act. Local Transport Plans (LTPs) must also take climate change into consideration when being prepared. With LTPs, local authorities can introduce demand management measures. These include "reducing the available road space for private vehicles, improving infrastructure provision for alternative transport, and through the use of workplace charging levies and road user charging" (Bulkeley and Kern, 2004: p. 21).

In the UK, a number of policies encompass adaptation. Other policies include mitigation measures, which involve taking action on energy supply, transport, and homes. There are a number of energy service companies which provide integrated energy services (e.g. heating, lighting) to customers rather than raw energy (e.g. gas, electricity). One example in the UK is Thameswey Energy Ltd., who enter into public/private joint ventures to deliver energy and environmental strategies and targets (primarily energy, tackling fuel poverty, water, and green transport) (TEL, 2007b).

In the UK, energy management of municipal buildings constitutes a large portion of the activities local authorities have undertaken in relation to climate protection. The development of the Councils for Climate Protection pilot and the introduction of Best Value Performance Indicators (BVPIs)[14] for energy use within council buildings have given energy management more weight (Bulkeley and Kern, 2004).

Bulkeley and Kern (2004) note that in Germany there have been "city council resolutions for the reduction of CO_2 emissions, the adoption of energy-saving models in schools, the provision of environmental advisory services for citizens and regulations for mandatory connection to and use of district heating systems" (p. 13). Many local governments in Germany implemented climate

[14] Best Value Performance Indicators (BVPIs) are a statutory set of 90 indicators developed by Government Departments to measure the performance of local authorities, that is, all local authorities must measure themselves against BVPIs. The data is collected and audited annually by the Audit Commission. They are called Best Value Performance Indicators or 'BVPI's' as they derive from the duty of Best Value on local authorities, which came into effect under the Local Government Act 1999. Prior to Best Value, the Audit Commission set similar measures of performance.

protection strategies and adopted action plans in the 1990s specifically related to the energy and transport sector. These strategies can still be found in all municipalities with over 400,000 inhabitants (Bulkeley and Kern, 2004).

In recent years many municipalities have further developed action plans, which now include completing detailed audits of energy use and CO_2 emissions (Bulkeley and Kern, 2004; Schrader, 2002). In Germany, efforts are being made to generate energy and district heating and energy is generated from biological waste (Bulkeley and Kern, 2004). Energy management of municipal buildings is implemented through energy saving projects and part of the amount saved is allocated to the Energy Commissioner or user of the building (e.g. 50/50 projects for schools). Energy contracting[15] with external operators is particularly popular and Hirschl (2000) notes that the demand for energy contracts mostly arise from the heating sector (over 90 percent).[16]

The UK, Germany and Sweden are also aiming to address climate change in the transportation sector by implementing a number of smaller measures and projects. There is an increase in construction of cycle paths, public transport development and zones with traffic calming.

2.5 Public Expenditure

Local and regional governments can receive national and regional funding. They can also apply for funding through other European funding schemes. These schemes usually require co-funding of 50 percent of the costs. The European Union cohesion fund supports large infrastructure projects in the field of environment and transport.[17] Recently the Commission "encouraged sustainable regional development projects that take into account energy efficiency and the creation of a diversified energy sector" (CEMR, 2006). There is an evident focus on measures that promote energy efficiency and renewable energy sources.[18]

Significant climate change funding opportunities are available in the UK to the public sector. Funding is provided by European organizations, the region, the UK government, the private sector (including the utilities and landfill operators), and the Non-Governmental Organization environmental sector (LGA, 2004).

In the UK, Leicester was awarded a £5.1 million grant to develop the first phases of an inner-city CHP and district heating scheme, fuelled by biomass, which will supply heat to four council housing estates, and to 16 council buildings (DEFRA, 2003). The Carbon Trust in the UK is

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[15] Contracting means that a contract with a private investor is placed. This private company invests in energy savings measures in the municipal buildings. The contractor gets all the benefits from the energy savings. After the end of the contract all installations become property of the local authority.

[16] The areas where contracting is used can be categorized into public buildings, private housing and industry. Some companies are specialized in particular sectors such as office and administration buildings, hospitals, educational and cultural institutions, sports and leisure facilities, gastronomy, shopping centres and different branches of industry (Hirschl, 2000: p.6).

[17] There are four structural funds: the European Regional Development Fund (ERDF), the European Social Fund (ESF), the Financial Instrument for Fisheries Guidance (FIFG) and the guidance section of the European Agricultural Guidance and Guarantee Fund (EAGGF) (CEMR, 2006: p.24).

[18] For further information on funds please see: EU Funding for the Environment: A handbook for the 2007-2013 programming period: http://assets.panda.org/downloads/eufundingforenvironmentweb.pdf and Sustainable energy and the structural funds - guidelines: http://www.bacchus.aeidl.be/guidelines.htm.

funded by the British Government. It is an independent company that is funded through the revenues from the Climate Change Levy. Its mission is to help business and the public sector to reduce carbon emissions and capture the commercial potential of low carbon technologies (Carbon Trust, 2007).

The *KfW-Programme* to produce solar power was introduced in Germany in 2005. It offers low-interest loans for small investments in solar PV generation. Private investors are the main beneficiary as only projects with an overall investment up to 50,000 are supported and 100 percent of the investment cost can be financed (CCD, 2007). As listed on the Climate Change Database:

> *The Reconstruction Loan Corporation (KfW) runs the programme. Credit terms can vary between ten and twenty years with a redemption-free initial phase of two to three years. As of July 2006, more than 25,000 loans had been provided, for a total amount of 784 million and a capacity of 199 MWp in photovoltaic (PV)[19] systems.*

If private households in Germany were to renovate and improve energy efficiency consumption, there would be the potential for a reduction of 60 percent energy use. With the building renovation program the German Development Bank is providing financial assistance for this process (Umweltdaten, 2007). In Heidelberg, more than 5 million euros were invested in the construction of cycle paths between 1991 and 2000 (Bulkeley and Kern, 2004) in order to promote reduction of private automobile use.

Private companies in Germany owned by the City of Munich, such as the *Stadtwerke*, charge 1.5 cent/kWh for electricity from renewable sources (Bulkeley and Kern, 2004: p. 31). These payments are then transferred to a special fund (ibid). Resources from here have been invested in innovative projects such as PV installations. In Heidelberg, a fund has also been created for investment in the expansion and distribution of renewable energy.

The local investment program in Sweden (1998-2001) provided a number of projects with funding for environmental initiatives and implementation. To offset additional costs associated with two environmental projects (Bo01 and Västra Hamnen) the Swedish Government allocated SEK 250 million in grants (COM, 2007a).[20] In the City of Malmö, seven different projects were allocated SEK 147 million in grants each. *Ekostaden Augustenborg* was the largest project in the local investment program. The Government allocated a total SEK 7.2 billion for the period 1998-2003 for grants to local investment programs (COM, 2007).

In Sweden, the government has set an environment policy objective that promotes passing to the next generation a society in which the major environmental problems have been resolved (COM,

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[19] Capable of producing a voltage, usually through photoemission, when exposed to radiant energy, especially light.

[20] The new city district will exclusively be supplied by renewable sources of energy. The energy used in the Western Harbour will be generated in or near the area. A large proportion of the heating needs will be extracted from sea water and groundwater and will be complimented with solar collectors. Electricity will be generated by wind power and photovoltaic cells. Bio gas will be produced from the area's waste and will be used to heat homes and power vehicles. An effective energy usage is essential in order to reach the target of entirely locally produced renewable energy. The buildings in the district are designed to minimize energy demands for heating and electrical equipment that is installed should be highly energy efficient.

2007). Climate investment programs in Sweden have been proposed to enable municipalities, companies and others to apply for grants to take measures to reduce greenhouse gas emissions. For 2006, the government proposed extended allocation for climate investments by SEK 200 million for 2006 and SEK 320 million for 2007 and 2008 (GOS, 2007b).

The Swedish government's Local Investment Program is an initiative that provides funding for local-level sustainable development projects. The program's objectives are to prioritize ecological sustainability at the local level, increase public awareness, support implementation of Agenda 21 plans, stimulate cooperation between participants, and generate employment (IISD, 2007a; IISD, 2007b).

2.6 Information and Incentives

To raise the consciousness and awareness of individuals, it is clear that community initiatives can play a significant role. These help an individual feel as though they are able to have influence over the conditions around them with respect to climate change and mitigating its impacts (DEFRA, 2007a).

The UK is using initiatives that focus on changing the behavior of employees. In Southampton, employees are being encouraged to travel to work in a sustainable way through the Green Transport Plan[21] and receive a newsletter about internal environmental initiatives that are taking place in the local authority. In Leicester, behavioral change is promoted through the use of the real-time monitoring system, as well as through the Green Travel Plan. In Kirklees, change is promoted through the Eco-Management and Audit Scheme (EMAS)[22] process which monitors business and other organizations' environmental performance.

In Germany, to improve awareness of climate change of private consumers and business owners, local authorities are active in disseminating information and relating the experiences that have been gained from municipal pilot projects. German municipalities are very active in the promotion of energy savings for private households as well as for stakeholders (trade, industry, building industry). In many German cities energy forums and energy committees have been established (Bulkeley and Kern, 2004).

2.7 Institutional Arrangements and Partnerships

The Cities for Climate Protection (CCP) is an international campaign run by the International Council for Local Environmental Initiatives (ICLEI). Local governments are provided with a

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[21] A Green Transport Plan is a way that organizations and businesses can manage the transport needs of their staff and visitors. The aim is to reduce the environmental impact of travel associated with work, whether by plane or car. A Green Transport Plan encourages employees to use cars and plane travel more wisely while providing employees with incentives to use alternative modes of transport and communication.

[22] The Eco-Management and Audit Scheme (EMAS) is a management tool for companies and other organizations to evaluate, report and improve their environmental performance. The scheme has been available for participation by companies since 1995 and was originally restricted to companies in industrial sectors. Since 2001 EMAS has been open to all economic sectors including public and private services. Participation is voluntary and extends to public or private organizations operating in the European Union and the European Economic Area (EEA) — Iceland, Liechtenstein, and Norway. An increasing number of candidate countries are also implementing the scheme in preparation for their accession to the EU (Bulkeley and Kern, 2004: p.29).

framework in order to be able to work on local issues such as air quality, energy costs, traffic congestion, waste management and quality of life. Currently there are five hundred local governments participating in the campaign from all over the world. In Europe, there are 118 local authorities participating in the program (LGA, 2007).

The South East Climate Change Partnership investigates, informs and advises on the impacts of climate change in South East England[23] and helps to promote adaptation measures. Public, private and voluntary sector organizations work together with a common vision to address the impacts of climate change. These organizations believe that there will be positive opportunities that will arise from climate change, as well as the opportunity to work together to reduce the threats (SECCP, 2007).

To promote awareness about the use of energy in Leicester, UK the Energy Management Group, the Energy Agency and the Energy Advice Centre together have been involved with various projects. Two examples of the initiatives being used include 1) the Energy Education project, which uses an Electric Energy Advice bus to tour local schools and 2) promoting the installations of energy efficient home improvements (Bulkeley and Kern, 2004).

A program has been implemented with an aim to improve Sweden's ability to adapt to the effects and impacts of climate change. The Stockholm Environment Institute (SEI) joined forces with the Swedish Meteorological and Hydrological Institute, Stockholm University and Lund University to work on the program, funded at SEK 40 million (SEI, 2007b). Two major networks in Sweden focus on climate change mitigation – the Climate Municipalities with 21 members, and the Eco Municipalities with 68 members (Elander and Gustavsson, 2007).

There are municipalities that have sought cooperation in international networks such as the Union of Baltic Cities, ICLEI and Cities for Climate Protection (ibid). Elander and Gustavsson (2007) note that local and regional level businesses, voluntary organizations and public authorities are involved in networks, especially with regard to biofuel production, which can bring economic advantages to many regions.

In Germany, the IFEU[24] promotes the active exchange between local governments in Germany, Japan, and the USA to develop climate protection partnerships. Local climate protection is the priority with a specific focus on evaluating the implementation of local climate protection measures and observing local CO_2 emissions (IFEU, 2007). Results are to be discussed with all participants and thus foster the cooperation to work together to achieve new initiatives for climate protection (ibid).

There are also a number of environmental non-governmental organizations (NGOs) in Europe that prefer an approach to greenhouse gas emission reductions. They favor a specific focus on renewable energy and demand reduction, using combinations of incentives for clean technology, legislative requirements and fiscal instruments (CAN, 2007).

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[23] The South East of England covers the geographical areas of Berkshire, Buckinghamshire, Hampshire, Isle of Wight, East Sussex, Kent, Oxfordshire, Surrey and West Sussex.
[24] *Institut für Energie- und Umweltforschung Heidelberg GmbH.*

Section Three: Local Government Climate Change Initiatives in the United Kingdom, Germany and Sweden

3.1 United Kingdom

On December 13, 2006, the Code for Sustainable Homes was launched, which is a standard for sustainable design and construction of new homes. This is an assessment tool that developers can implement in the building of new homes in order to achieve a high standard of environmental performance. The department of Communities and Local Government (CLG) is committed to protecting and enhancing the environment and to tackling climate change. CLG has published a consultation with proposals to make the Code mandatory. Other initiatives that CLG has implemented include Building a Greener Future (including energy and carbon standards into future building regulations), the 2016 Zero Carbon Homes Taskforce, and a number of housing and regeneration programs (building environmentally sustainable developments) (CLG, 2007a; CLG, 2007b).

Woking Borough Council provides energy to its local community using hydrogen fuel cell technology, and is the only local authority to win a Queen's Award for Enterprise (WBC, 2007). Woking is currently working towards implementing a climate change strategy for the whole of the Borough (LGA, 2005a). Woking Borough Council is one of the first boroughs in the country to sign up to complete a Climate Change Strategy. The strategy has a number of energy saving initiatives. These include the development of the UK's first sustainable energy fuel cell, the first private wire electricity, district heating and cooling sustainable energy station in the country, and the use of photovoltaic cells on a number of council owned properties to create sustainable electricity (TEL, 2007a; WBC, 2007).

In 1990, Leicester City Council (LCC) set an objective to reduce consumption of energy and CO_2 emissions by 50% by the year 2025. Monitoring the energy that is used in the city has been a central focus. This is done by using intelligent metering that feeds data back into the Council every 30 minutes from public buildings and also from some small and medium-sized companies within the City (LCC, 2007). Though the implementation costs are high[25] the LCC finds the system cost effective. The payback time is estimated to be around five years. The initial savings can be found from water and gas usage due to improved control and further monitoring helps to identify additional savings and improves energy awareness through increased training (CEMR, 2006).

Other areas in the UK are implementing laws in urban planning and development in order to ensure that energy efficient measures are taken when building new residential, industrial or business areas. In the London Borough of Merton, the planning law requires that all new industrial, warehousing, office and live/work units outside of conservation areas above a certain size must incorporate renewable energy production equipment to provide at least 10 percent of anticipated energy requirements (LBM, 2007).

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[25] Costs for implementing this system are an average of £3000 per building. In addition software costs and the staffing costs to monitor the buildings need to be incorporated. There is also an annual service charge to ensure that the meters are maintained and that the system is operating properly.

In Kirklees, a solar village is being developed. It is linked to a regeneration scheme and will include 121 solar powered homes. Once installed, 20 percent of the electricity needs and over 50 percent of the hot water needs will be provided by the solar installations (KMC, 2007; CEMR, 2006; EMBCC, 2007). The project will reduce both the tenants' fuel bills and carbon dioxide emissions (over 50 tonnes per year) (KMC, 2006). The project has already created social and economic benefits, enthusiasm among tenants, and new local jobs and skills in photovoltaic installation.

3.2 Germany

In Germany, municipalities are engaged in climate protection policy only on a voluntary basis (Bulkeley and Kern, 2004). The municipalities may choose to be active in climate policy or not. It is evident through research that German municipalities and local governments are dedicated to addressing the climate change problem. In order to address energy deficiencies and reduce greenhouse gas emissions there has been a large transition to the use of wind power. Germany now has the highest installed wind turbine capacity in the world, with 21 GW in 2006 (SEI, 2007a). Wind power now provides more electricity than hydropower.

Other sources of power include biomass and increasing analysis of energy storage options. Germany has become the world leader in the production and use of biodiesel, accounting for nearly half of the world total in 2005 and production increased more than five-fold during 2000-2005 both in Germany and several other EU countries (ibid).

The City of Stuttgart is using a revolving fund to invest in energy efficiency. The initial investment cost is paid by the city's energy department. Based on the yearly savings, other departments return the investment cost generated by the energy efficiency measures (CEMR, 2006). An example provided in the guide for local and regional governments published by the Council of European Municipalities and Regions (CEMR, 2006) describes the cost savings for the thermal insulation of a roof:

> *If the investment cost for thermal insulation for a school roof is 20,000 euros, the energy department pays the investment and the school pays back the amount of their energy savings to the energy department, in this case 4,000 euros per year. In five years the investment is paid back and new investments can be made (p. 8).*

In the City of Wuppertal, electricity is produced by the town's waterworks. In the future, hydro electric power will be provided from the two dams and the water pipes of the waterworks. Two nearby dams which are used for the city's water supply were found to be (in a 2003 feasibility study) worthwhile for also producing electricity in the city (CEMR, 2006). "The incline of the pipes as well as the volume of water is sufficient for three new hydroelectric power plants" (ibid: p. 22).

In Freiburg, energy policies revolve around energy conservation, the use of new technologies such as combined heat and power, and the use of renewable energy sources such as solar to meet new demand, instead of fossil fuels, with the goal of realizing an ecologically-oriented energy supply (Dauncey, 2003). In 1996, a city resolution called for the reduction of Freiburg's CO_2 emissions to 25 percent below the 1992 level by 2010 (ibid). In order to achieve the target,

initiatives in the areas of transport, waste and industrial production, as well as energy efficiency measures were required.

Freiburg also pursues a number of solar activities and their efforts to reduce energy consumption are considerable. All solar projects include the use every kind of solar application.[26] Freiburg averages 1800 hours of sunshine a year and all of the solar energy captured is fed into a grid instead of being used on the spot or stored in batteries (Dauncey, 2003; ESC, 2007). The solar module production plant (*Solar-Fabrik*) has zero emissions. The factory is powered by 570 square metres of PV, and a rape seed oil-fired combined heat and power plant (Dauncey, 2003).

Badenova is a regional power supply company in Freiburg which is jointly owned by a number of regional municipalities. The company offers a subsidy to customers who want to install photovoltaic panels. The electricity sold finances the program and is invested into further energy plants (photovoltaics, biomass and small hydropower) (ESC, 2007).[27]

There are a few regions in Germany that can harness geothermal power. In 2003, Germany's first geothermal power plant became operational in Neustadt-Glewe. The plant provides hot water and heating to private households. Geothermal sources can be used year round and are not affected by the weather or seasonality (GRE, 2007; Bußmann, 2007).[28] Energy can be created from local resources and are not dependent on international energy markets. It is a source of power generation, heat supply, cooling, energy storage, and the desalination of water (Bußmann, 2007). Geothermal energy has lower investment costs compared to other renewable sources of energy.

3.3 Sweden

By 2020 Sweden wants to become the world's first oil-free country. This is in response to climate change and the dangers of rising fuel prices (Vidal, 2006). Instead, Sweden will pursue clean and renewable energy (such as biomass and geothermal sources) (Nordic Culture, 2006). Currently Sweden uses nuclear and hydroelectric power to produce energy (Vidal, 2006). In the past decade, Vidal (2006) notes that heating has been converted to schemes which distribute steam or hot water generated by geothermal energy or waste heat.

The City of Stockholm has been promoting the use of clean vehicles for a number of years and almost half of the city's fleet now contains clean vehicles. Road traffic is one of the biggest polluters in Stockholm and promoting clean vehicles is one way the city works to reduce impacts. Investments in better logistics, traffic coordination, bike paths and reliable public

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[26] These include solar PV (photovoltaics - over 400 installations), solar thermal (for hot water), solar sunrooms or "wintergardens", passive solar design, solar cooling, and transparent solar insulation (which is able to convert the solar heat that hits a wall into useable thermal energy) (Dauncey, 2003).

[27] 10 percent of Badenova's customers have voluntarily opted for electricity from regional and renewable energy sources. By spending its energy dollars on solar and other renewable energy technologies, these dollars are also remaining within local circulation, instead of leaving the region to purchase gas, oil or uranium elsewhere. In addition to the economic and environmental benefits, Freiburg's citizens enjoy a pride in their city for showing this kind of leadership.

[28] Heat is tapped from natural hot water sources in watercourses under the earth know as aquifers. The thermal water is carried to the surface to feed the heat supply when it is then fed through heat exchangers to transfer the energy into the district heating system, and then pushed back into the earth.

transport, car pools, congestion charges, and emission restrictions on heavy vehicles are other ways the city addresses traffic and pollution problems (COS, 2007).

The Municipality of Växjö implemented a program to stop using fossil fuels. The municipal energy company increased the use of biomass in the district heating system (ICLEI, 2007b). As a result, by 2004 CO_2 emissions decreased by 25 percent per person compared to 1993 (CEMR, 2006). The Municipality of Kristianstad is also working on becoming fossil fuel free. This is being achieved with the use of biofuels, biomass (for heating and the production of energy), and biogas (fuel for buses and vehicles) (EU, 2007). Solar heating panels have been introduced in Kristianstad and home owners receive a grant for expenses related to investing in solar heating.

In Malmö, a new district in the Western Harbor, an "ecological city of tomorrow" (COM, 2007) has been created. The goal for the district is to become an international example of how environmental adaptation can be achieved in a densely built urban environment. The first development stage of the Western Harbor is referred to as "Bo01". The planning, building and construction has taken an environmental approach in the development of the area.

The district uses 100% renewable energy sources, such as sun, wind, and water. Energy is also drawn from refuse and sewage from the district. Organic waste from households is eventually transformed into biogas which can fuel cars and buses or produce heat and electricity (COM, 2007a; COM, 2007b). The district is provided exclusively with energy from renewable sources that is generated in or near the area. The new electricity grid and district heating network is linked to the existing systems of the city.[29] In this area, significant investments are being made in vehicles powered by environmentally sensitive fuels. Public transport vehicles run on environmentally friendly fuels, with the transport fleet made up of electric and gas-powered and hybrid vehicles.

The Municipality of Lund has two geothermal power plants and three wind turbines. The use of the geothermal plants has significantly reduced the use of fossil fuels and CO_2 emissions. In the first five years of use there was a reduction of 580,000 tonnes of CO_2 emissions and 200,000 m^3 of fossil fuel oil (Energie-Cités, 2002; Nilsson, 2007)). Carbon dioxide emissions have been reduced over 30 percent through reduced traffic and improved energy production. Lund has been successful in mitigating climate change effects by setting a number of key objectives in the local agenda. These include targets to reduce carbon dioxide emissions by 25 percent of 1995 levels by 2050, and reducing energy consumption for purposes other than transport by 25 percent by 2005 (ibid). By implementing such targets the local government authority in the Municipality of Lund proves that local action can achieve significant results.

[29] This bridges the time-lapse between the point of production and use of energy, without the need for specialized equipment for energy storage (COM, 2007a; COM, 2007b).

CONCLUSION

In the United Kingdom, Germany and Sweden local climate change policy has an important effect on the actions that local governments take to address climate change. There have been and will continue to be significant challenges in addressing greenhouse gas emissions from the transportation sector. As a result, energy policy plays an important role in creating and effectively implementing climate change policies and encouraging local action. The UK, Germany and Sweden have made tremendous efforts and continue to promote internationally and locally the importance of addressing climate change.

Due to past emissions it will be necessary for adaptation methods to be found and implemented to address the impacts that will result from the warming trends already present. There are a number of options available and it is clear that more far-reaching adaptation will be necessary in order to reduce vulnerability to future climate variability. It is evident that there will be a number of limitations and costs involved that require further understanding. Yet the number of adaptive responses available is very large. These can range from technological advances, changes in behaviour (citizens, businesses and government), management techniques and policy implementation.

When addressing climate change and implementing efforts to adapt and mitigate its effects, local governments must also be aware of timeframes. Clearly there needs to be both short term and long term planning and courses of action. In the short term, existing technology, resources, information and incentive programs aimed at individuals and businesses can be used to reduce emissions. In addition, further research and development in technology and implementing adaptation measures against climate impacts can have significant results in greenhouse gas emissions reduction.

In short term methods and planning there must also be a solid view of the long term objectives. Long term goals can serve to increase an interconnected view of the measures required to make a difference environmentally, socially, and economically. Society can be mobilized by continuing to raise the public's awareness of the current and future threats and risks associated with climate impacts from climate change. Society needs to be prepared for the risks associated with weather extremes and local government responses through policy and climate initiatives are fundamental to increasing public awareness. A global change is occurring and a society equipped with the incentive, knowledge, and direction to make a difference can help to address a worldwide concern.

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