

Role of Researcher/Academia in making low carbon policy: UK

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Summary

Fukushima accident in Japan triggered the discussion worldwide on the role of science and its relation with policy. Based on their experience of BSE, UK has developed the institutional mechanism to solve this problem for the past couple of decades. This study focuses on the role of Researcher/Academia in making low carbon policy in the UK. UK researchers and universities can enjoy high a relatively high degree of independence of their research from the government due to its stature that guarantees its independence. One of the reasons is that "the Halden Principle" requires higher research education to be independent from the government in the UK. In addition to this robust institutional support, there was a recent movement for evidence-based policy in the UK, which requires more economic and scientific robustness, therefore role of engineers and social scientists are increasingly important. Social science has not been focused that much, but it will have a greater role in changing people's behavior with high level of uncertainty. UK businesses have played a leading role to move forward the climate policy such as UKETS as well as low carbon policy. The regular communication and consultation is a crucial basis for making integrated policy, which involves wide range of stakeholders. Involvement of citizens, on the other hand, is rather limited and their role should be considered further as the focus of low carbon policy moves to change of behavior. Climate Change Act 2008 sets out a framework that will put UK on the path to become a low-carbon economy, with clear, legally binding targets to reduce CO₂ emissions by at least 60% (later increased to 80%) by 2050, and 26% (later increased to 34%) by 2020 below 1990. These legally binding targets required structural change of the government to implement the necessary policies and measures especially by the integrating climate and energy policy.

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1. Current status of UK low carbon policy

1.1 Basic philosophy of UK climate policy

UK has been playing the leading role in making environmental policy since 1990s. UK was expected to play a leading role in shaping European Environmental policy from its inception when it entered into the EC in 1973 coincided with the Community's First Environmental Action Programme with its considerable domestic legislation and institutions which was already in place¹. However, having mature domestic structures can be seen to have created difficulties in changing their organizations, procedures and culture to adapt to the requirements of European integration (Lowe and Ward 1998). During 1970s-1980s, UK was described as an environmental laggard, or even the Dirty Man of Europe (Rose 1990), while Germany was considered as an environmental leader state. However, post-unification Germany has lost some of its environmental leader status and has found under pressure to reform its traditional approach to pollution control (Andersen and Liefferink ed. 1997). One of the reasons behind is described that, there was a shift in DG Environment's preference from regulatory approach to procedural measures and framework directives based on cost effective consideration. The German commissioner of the DG Environment took a tough stance toward all member governments in breach of EU laws, however, UK commissioner has been reluctant to pressure members states, putting greater focus on "subsidiarity principle"² in the EU environmental policy. UK, on the contrary, began to play a leading role with its practical and pragmatic approach to environmental policy (Wurzel 2006). This traditional policy making style is described by Erik Ashby and Mary Andersen as follows:

"British legislation must appear to our fellow European to be pragmatic, piecemeal, ad hoc, the product of experience, not principle: a policy to be described as a non-policy. Yet British policy has deep roots in history. It is the product of nearly two centuries of evolution in which impractical ideas have been eliminated, Utopian aspirations have been discarded, and the policies which have survived have been proved to work (Ashby and Anderson 1981)."

2.2 Revolution of UK climate policy

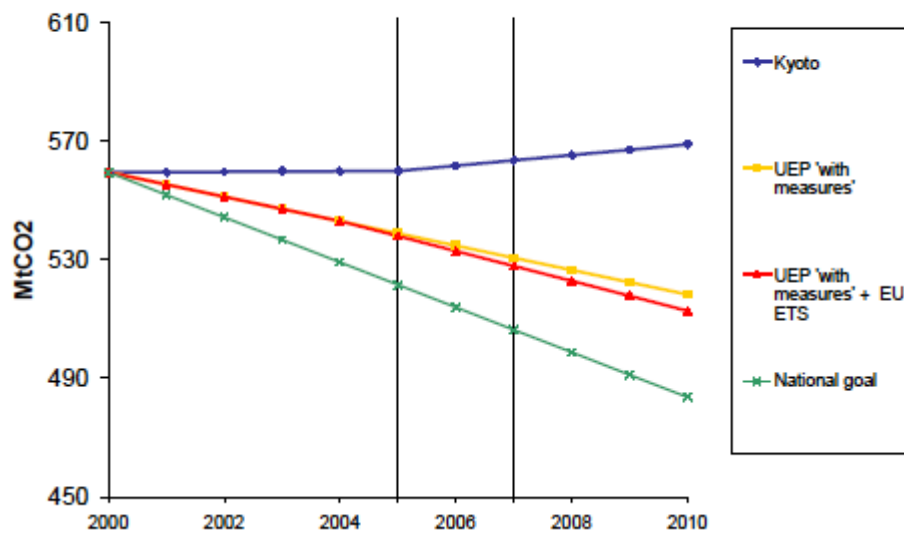
Based on this traditional philosophy behind, UK climate policy evolved in the early 1990s. In accordance with the adoption of the UNFCCC in Rio Earth Summit in 1992, UK decided to limit its emissions in 2000 to 1990 level. In the same year, the Commission proposed a Directive for a tax on fossil fuels, based on the Treaty which requires the unanimity of the Council, however this was

¹ Regarding UK environmental policy before 1990, see John, 2002.

² Article 4 of EU Treaty provides that "competences not conferred upon the Union remain with the Member States. Where an EU environmental legal rule conflicts with a national legal rule, EU law prevails according to the case *Costa v ENEL* (6/64)[1964]E.C.R.1265 (Krämer 2011).

amended due to strong opposition by the UK and finally could not find the approval in the Council. When the Kyoto Protocol was adopted in 1997, Burden Sharing Agreement required UK to reduce its GHG by 12.5% between 1990-2012 to achieve EU's 8% target of the Kyoto Protocol, but in the same year, UK set its domestic target to reduce CO2 emissions by 20% by 2010 below 1990 level. Chart 1 shows the relationship between UK target, updated energy projections (UEP) and EUETS (Chart 1).

Chart 1 – Relationship between UK targets, Energy Projections and EU ETS

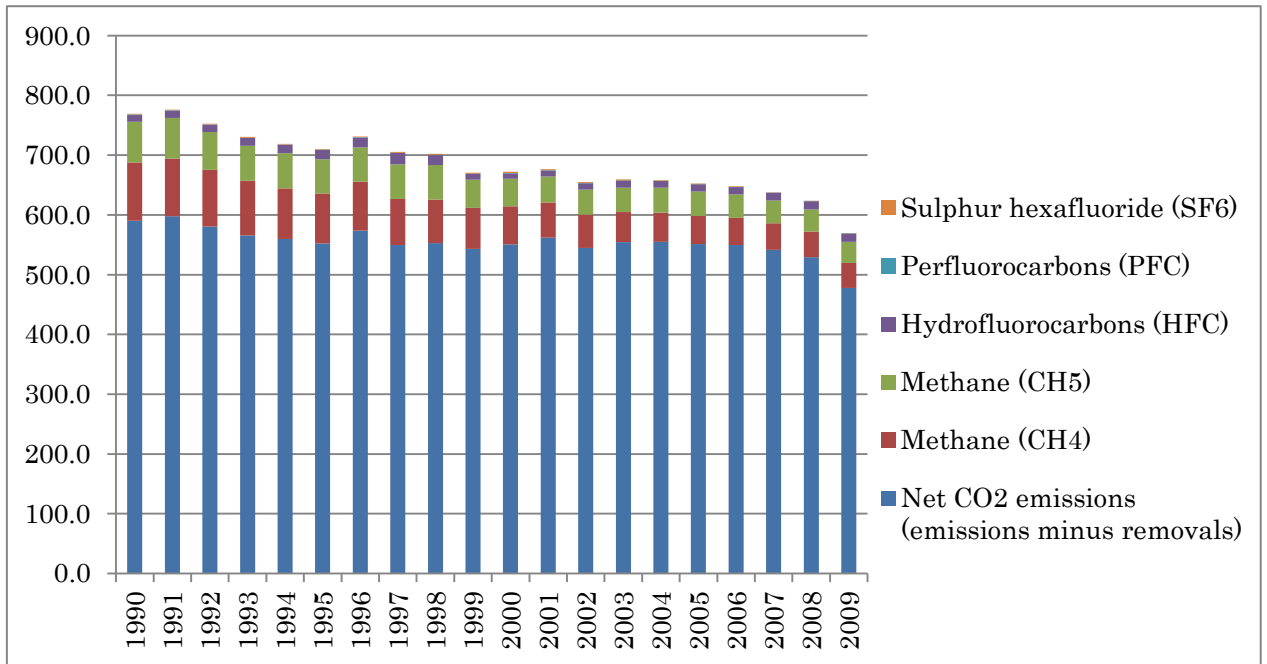


(Source) DEFRA 2004

UK introduced the Climate Change Levy in 2001, and as a policy mix, UK Emission Trading Scheme (UKETS) was introduced by allowing participants to the UKETS to reduce this Levy by 80%. UKETS is evaluated to provide the basis for the establishment of EUETS in 2005, but UK tried to coordinate with the EUETS after its introduction through the preparation of National Allocation Plans (NAPs). In 2005, UK took up climate change as one of the central issues to be discussed at the G8 Summit for the first time in 2005 in Gleneagles. 2006 Stern Review of the economics of climate change, which was initiated by the UK economist in the World Bank, insisted that without efforts to tackle climate change, it would cost the global economy between 5% to 20% of GDP, compared to much lower cost of global action around 1% of GDP by 2050. At the same time, economic opportunities are also pointed out arising from the transition to a low carbon economy (DEFRA 2007a). This UK report also influenced UN work on financing and investment flows. With its rigid domestic background, UK contributed to the development of climate policy at EU and international level.

Chart 1: Greenhouse gas emissions: weighted by global warming potential

(Unit: million tonnes carbon dioxide equivalent)

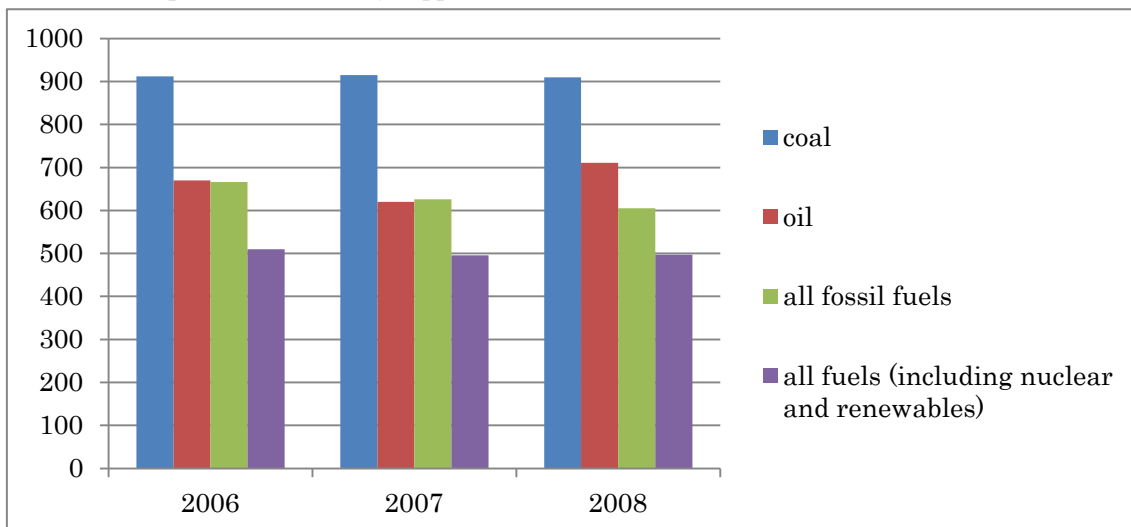


(Source :Created by the author based on DECC 2012)

It is estimated that CO2 emissions from power stations accounted of 32% of the UK total CO2 emissions in 2007. Emissions vary by type of fuel used to generate the electricity in 2007 (DECC 2009) (Chart 2).

Chart 2: UK estimated CO2 emissions from electricity generation 2006-2008

(tones of CO2 per GWh electricity supplied)



(Source) Created by the author based on DECC 2009

1.3 Current status of UK low carbon policy based on 2008 UK Climate Change Act

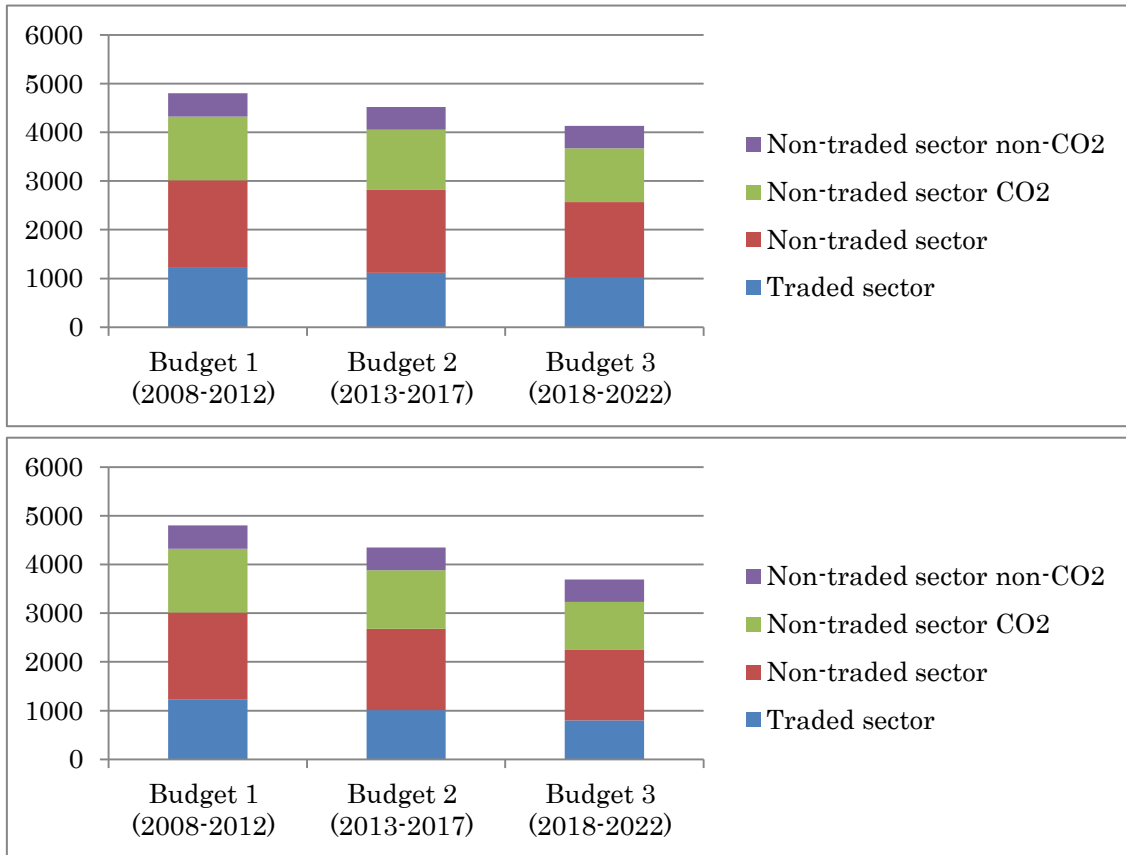
Long-term emission reduction target to achieve low carbon economy was revealed for the first time in the Energy White Paper 2003 (HM Government. 2007), setting out its 60% emission reduction by 2050. To avoid 2°C global warming above pre-industrial levels, this target was upgraded to 80% by the UK Climate Change Bill 2008, which also sets out the mid-term target of at least 26% to 32% by 2020 against 1990 levels. After the adoption of 2008 UK Climate Change Act in 2008, the mid-term target of 26% was also upgrade to 34% based on the advice of Committee on Climate Change (CCC). In 2009, “The UK Low Carbon Transition Plan” was published to achieve the Carbon Budget based on the Climate Change Act 2008. This illustrates how UK achieves the target of reducing 34% by 2020 below 1990 level (Table 1). In April 2009, the Chancellor announced the UK’s first three carbon budgets alongside his fiscal Budget, and also set out new measures such as legally binding carbon budgets for the first three five-year periods 2008-2012, 2013-2017 and 2018-2022, revised target of at least 34% reduction by 2018-2022, and commitment to tighten the budget after COP15 in Copenhagen(DECC 2009). This carbon budgets were broken down by the CCC (Chart 3).

Table 1: UK commitment of emission reduction

1992	Limit emissions in 2000 to 1990 level
1997	Emission reduction of 12.5% during 1990-2020 (based on Burden Sharing Agreement to achieve the Kyoto target) Set domestic target of reducing CO2 emissions by 20% below 1990
2003	Set 60% emission reduction by 2050 (Energy Whiter Paper)
2008	Setting emission reduction target of 26% by 2020 and 80% by 2050 below 1990 (2008 UK Climate Change Bill)
2010	26% target by 2020 upgraded to 34%

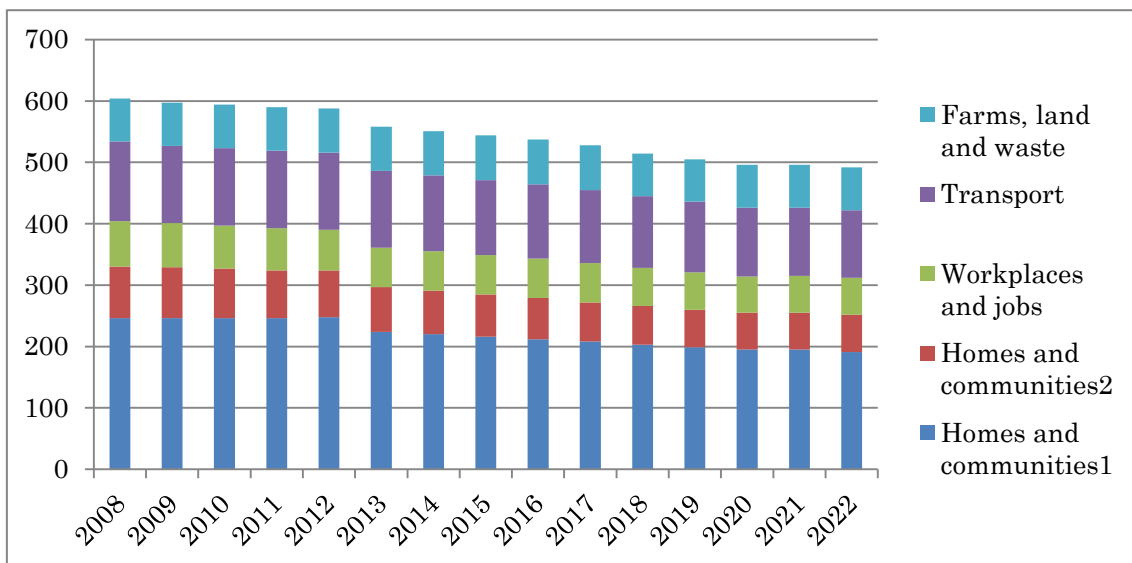
(Source) Kimura 2008

Chart 2: Interim (above) and intended below) budgets for the UK for 2008-2022 (MtCO₂e)



(Source: Created by the author based on CCC 2008)

Chart 3: Expected Contribution to the Net UK Carbon Account from Sectors as defined in this Transition Plan (Unit: MtCO₂e)



(Source) Created by the author based on HM Government 2009

Toward preparing the UK Climate Change Bill 2008, climate and energy have begun to be integrated. Both Energy White Paper 2007 and UK Climate Change Act 2008, in addition to Energy Act 2008 and Planning Act 2008, are part of the packages for the UK to transit to low carbon economy. Energy Bill 2008 published in tandem with the Nuclear Energy White Paper by the Secretary of State for Business, Enterprise and Regulatory Reform, was driven by the two long-term energy challenges; tackling climate change by reducing CO₂ emissions and ensuring energy. In 2007 along with the Energy White Paper, a consultation on the role of nuclear power in a low carbon economy was launched, but the High Court in a judicial review decided that this consultation process on building a new nuclear power had not been adequate, therefore the government decided the necessity of a new consultation process (DECC 2009). This shows the crucial role of the judicial system to take the necessary process in making low carbon policy, which has also fragility to be affected by the more stronger policies such as on energy and nuclear.

European Commission's proposals for tackling climate change and delivering a low carbon economy in Europe announced in January 2008 required UK the reduction of 16% GHG in sectors not covered by the EUETS by 2020 from 2005 levels, 15% of the energy consumed to come from, renewable sources by 2020, and 10% road transport fuels to come from renewable sources (DECC 2009).

Regarding "green economy", Green Economy Council was established representing wide range of sectors including SMEs, to talk about green growth with the government. In August 2011, a report "Enabling the Transition to a Green Economy: government and business working together" was released by the government in response to requests from the private sector for greater clarity on "green economy" and consequent series of dialogues between central governments, local governments and businesses. This report sets out government policies by 2020 such as climate change, resource efficiency, waste prevention, carbon capture and storage, offshore wind generation, and the Green Deal (DEFRA 2011a, DEFRA 2011b, DEFRA 2011c, Business link 2011).

In addition, to enhance the active involvement of UK private sector, UK government published "energy market plan" in July, 2011. UK will also establish public "Green Investment Bank" in April 2012.

Regarding long-term adaptation, UK published the Climate Change Risk Assessment (CCRA) in 2012 (DEFRA 2012).

2. Low Carbon Policy Making Process in the UK

2.1 Structure of decision making process in the UK low carbon policy before and after the Climate Change Act 2008

UK Climate Change Act 2008 is the central pillar to move UK toward low carbon economy and it is useful to look at how this Act was created. Since 2002, UK government had examined the proposal by the Royal Commission on Environmental Pollution to reduce CO₂ emissions by 60% by 2050 (Lockwood et al. 2007) and was mentioned in the Energy White Paper 2003. After the Queen's statement in 2006, Minister of DEFRA published the "Draft Climate Change Bill" (DEFRA 2007b) and related strategies. After public comment period (from March to June 2007), review before the legislation by three committees of the Parliament³, announcement by the Prime Minister Golden in September⁴, publication of the first amendment Bill of the in October (DEFRA 2007c) after the administrative policy speech, this Bill was submitted to the Diet in November (10 Downing Street 2008). After the publication of the second, third and fourth amendment⁵ (DEFRA 2008) based on the discussion in both Diets, publication of advice by the Committee on Climate Change (CCC), this Bill finally became law on November 2008 (Worrilow 2008).

The legislation process can be described as wide-open by involving as many stakeholders as possible. However, the traditional British legislation had been to leave considerable discretion to Minister and officials. This fostered a style of political management characterized by internal administrative arrangements within relatively closed communities (Lowe and Ward 1998).

UK Climate Change Act 2008, mandating also long-term emission reduction of 80% by 2050, is the

³ Ad hoc Joint Committee on MPs and Peers, Environment, Food and Rural Affairs Select Committee, and the Environmental Audit Committee have published the following reports. House of Lords Commons Joint Committee on the Draft Climate Change Bill. 2007. Draft Climate Change Bill. Volume 1 Report together with formal minutes.

<http://www.publications.parliament.uk/pa/jt200607/jtselect/jtclimate/170/170i.pdf> DEFRA. 2007.

House of Commons Department of Environment, Food and Rural Affairs Committee. Draft Climate Change Bill. Fifth Report of Session 2006-07. Volume 1.

<http://www.publications.parliament.uk/pa/cm200607/cmselect/cmenvfru/534/534i.pdf>

House of Commons Environmental Audit Committee. 2007. Beyond Stern: From the Climate Change Programme Review to the Draft Climate Change Bill. Seventh Report of Session 2006-07.

<http://www.publications.parliament.uk/pa/cm200607/cmselect/cmenvaud/460/460.pdf>

⁴ Golden Brown contributed to the introduction of carbon budget at the time of announcement of the Climate Change Bill in 2006.

⁵ Climate Change Bill (As amended on report). March 8, 2008. Available at

<http://www.publications.parliament.uk/pa/ld200708/ldbills/044/200708044.pdf>; Climate Change Bill (As amended in Public Bill Committee). July 2008. Available at

<http://www.publications.parliament.uk/pa/cm200708/cmbills/129/2008129.pdf>

world first law to promote the establishment of “low carbon economy⁶”. This enables government to have more power to implement policies and measures to move forward to low carbon economy and promotes investment by industry. Under this Act, Carbon Budget is allocated to each ministry and should be managed economy-wide in the long run.

2008 Climate Change Act formalized the climate policy making process by combining climate part of DEFRA and energy market part of BIS (Department for Business Innovation and Skills) to establish the new Department of Energy and Climate Change (DECC) in October 2008. This merger of department was easy due to political leadership to implement the this Act.

2.2 Role of Researcher/Academia in UK low carbon policy

2.2.1 Role of Researcher/Academia

Researchers in the research institutes or “Academia” in the universities have been playing a crucial role in policy making process including that of climate policy in the UK. However, it has not been assessed to what extent such researchers/academia are involved in forming climate policy in a comprehensive manner. This section reviews and analyzes the role of advisory body such as Committee on Climate Change (CCC) and Research Council, research institutes and universities based on the interview survey in the UK in October 2011, commissioned by the Institute for Global Environmental Strategies (IGES), Japan.

Committee on Climate Change (CCC)

The Committee on Climate Change (CCC) was appointed in “shadow” form in March 2008 and became a statutory committee on 1st December 2008 when the Climate Change Bill became law. Its principle function is to recommend the level of the UK “carbon budget”, defining the maximum level of CO₂ and of other GHGs which the UK will emit in each 5 year budget period, beginning with 2008-12 based on this Act. The essential role of CCC is to provide advice on how fast and how the UK can and should progress towards a low carbon economy and to identify whether that path is feasible at manageable economic cost by assessing the technologies that are or might be available to deliver low carbon energy and increased energy efficiency, the potential for consumer behavior changes that reduce energy consumption and carbon emissions, and likely effectiveness of the policies presently in place or potentially applicable in future with significant uncertainty. As of 2008, CCC consists of eight members; one with background of finance, three with economics, two with natural science, one with engineering and one with energy (CCC 2008).

⁶ In Japan, “low carbon society” is used as describing the wider change of the society. (Kimura 2008, Nishioka 2011)

Research Council

Research Council plays a crucial role in the UK by giving advice and deciding the allocation of research budget.

Research institutes

National research institutes established by the Research Council such as **Energy Research Center (ERC)** and **Tyndal Center** has more independence from the government than those established by the government such as Hadley Center. Carbon Trust was established by the government, but it was independently operated afterwards. Green Investment Bank, to be established in April 2012, will be established in the similar form of Carbon Trust.

There are also several influential research institutes in the UK. Some of the UK think-tanks such as **Institute for Public Policy Research (IPPR)** has political role to impact to some Party in the Parliament. **The Centre for Low Carbon Futures** is a research center, focusing on research, development and demonstration (RD&D) of low carbon innovations. This center was established by the Universities of Hull, Leeds, Sheffield and York and started its research activities in 2010 and its collaborative and multi disciplinary approach is their strength (The Centre for Low Carbon Futures 2011). There are some research institutes established and operated based on the strong individual researcher. **Climate Strategies** is the research institute established by one of the former Member of Committee on Climate Change, as well as professor at Imperial College and Cambridge University.

Universities

Many of the influential universities have independent research body inside the university and operate their programs. For example, **University of Cambridge** holds several research groups such as Electricity Policy Research Group. **Oxford University** has Oxford Institute for Energy Studies. The Director of this institute is also the Managing Director of Oxford Climate Policy, a not-for-profit company aimed at capacity building for developing country climate change negotiators. Reflecting the importance of universities, some of the research institutes are located inside the universities so that many university professors could be involved easily both in academic as well as policy research activities such as UKERC and Imperial College. Geographical advantage of **Imperial College**, making use of geographical advantage in London, holds many professors and researchers to contribute to low carbon policy making process. Imperial College 2011). Some universities make coalition to move forward the low carbon policy such as “40% housing” project initiated by the coalition of UK universities. **University of Leeds**, in consortium with other south-west universities such as Manchester University, is leading the development of low carbon technologies such as energy efficiency, renewable energy and carbon capture and storage.

An interview survey shows that the role of universities expected by the government is to change the debate in a long-term through reports and discussions and to be involved in consortium with industries to develop low carbon technologies. Recently role of universities have changed Higher education institutions in the UK were not constitutionally part of the public sector and enjoy a relatively high degree of strategic and operational autonomy. However, developmental trajectories and organizational re-imagining and reshaping of UK universities over the last two decades or so have been fundamentally directed by the ideological context and organizational strategy set down by New Managerialism and New Public management (Deem et al. 2010). The findings base on the interview survey that evolution of energy research around 2002-2003 in the universities were driven by the policy needs rather than academic interests can be explained in this context.

2.2.2 Relation with other stakeholders

Government

UK government has played a leading role in formulating climate policy, especially by involving a limited number of key industries in this process. UK ETS was introduced with a strong initiative by Lord Marshall, a representative of industrial group at that time. Even carbon offset, where private sectors plays a main role, UK government play an active role such as establishing Carbon Trust and setting developing a Code of Best Practice for Carbon Offset Providers. Their approach to involve in the private sector activities is different from the Netherlands, for example, where government mostly relies on offset providers to take responsibility themselves (Peeters 2011). Regarding Green Investment Bank to be established in April 2012 by the government, public fund comes from the Treasury, but it has board independent form the government to leverage private fund and involve private sector in the future.

An interview survey shows that regular communication between the related ministries is the basis for making transition policy to low carbon economy. A roadmap on green growth “Enabling the Transition to a Green Economy: government and business working together” was originally developed by the Department for Business Innovation and Skills (BIS), but as a result of regular consultation, was released jointly by the Department for Environment, Food and Rural Affairs (DEFRA) and the Department of Energy and Climate Change (DECC).

In terms low carbon technologies, Environmental Products and Services Regulation Council (EPSRC) plays a role in early stage of technology research and Technology Strategy Board (TSB), the independent institution inside the BIS, decides which technology to invest for demonstration of low carbon technologies. Economists and science group also play an important role in BIS.

Reflecting this situation, there is increasing number of experts including those holding Ph.D. in the government.

Industry

Role of the Confederation of British Industry (CBI) is to communicate with the government representing industry. Due to its strong voice, its membership includes universities, in addition to industries. UK industries have played a key role in formulating climate and low carbon policy such as ETS. It was also the UK company, Future Forests, to initiate the first carbon offset as business in 1997.

Citizens

Despite the effort to promote communication with citizens by the government, it seems that the role of UK citizens has been relatively limited in low carbon policy, but it should be further assessed.

3. Issues for effective low carbon policy

Relation between science and policy: Independence and neutrality of scientists

For science-based policy making to be realized, the scientific community has responsibility to make knowledge more accessible and policy-relevant for decision-makers to affect societal change (LCS • RNet 2010). UK researchers and universities can enjoy a high degree of independence of their research from the government due to its stature that guarantees its independence. "Halden Principle" requires higher research education to be independent from the government in the UK. Government also respects the independence and neutrality of scientists and each ministry has a process to incorporate scientific knowledge and views into policy by holding scientific advisors. If the Prime Minister makes a different decision from the advice given by the Chief Scientific Advisor based on the discussion by the Scientific Advisory Group for Emergence (SAGE), he has to explain the reason to the public.

Since the Prime Minister Tony Blair from the Labor Union took his office in 1997, there was a new movement for evidence-based policy, which requires more economic and scientific robustness. One of the triggers for this is the BSE problem in 1996. UK has been one of the most developed countries of communication of science technology, but this event drastically forced UK to move from "Public Understanding of Science* PUS) to dialogue or public engagement, due to so-called "Threat of Trust" in the "Science and Society: The Third Report" by the Special Committee on Science and Technology of the Lower House. Recently government such as BIS, NGOs, academic societies started to support this public engagement. This science communication moved to "Trans-science communication", where science is necessary but science itself cannot solve the problem (Chilvers 2010, Kikuchi 2011). Research on climate change is one of those areas which requires this "Trans-science communication."

Role of social science in low carbon policy

Despite its relatively short history of economics and social sciences (mode 2 based on solution) which contributed to climate change compared to natural science (mode 1 based on evidence), their use is essential in identifying a feasible transition to a low carbon society by analyzing human behavior with a higher degree of uncertainty (LCS • RNet 2010). At the initial stage, economists have played a crucial role such as UKETS, Stern Review and The UK Low Carbon Transition Plan in deciding the realistic and agreeable level of commitment to achieve the target. At the time of introducing renewable obligation targets in electricity supply, economists play an important role in providing cost and benefit analysis on subsidies given for technologies for energy-intensive sectors such as steel which requires special treatment. However, due to recent movement for evidence-based

policy in the UK, which requires more economic and scientific robustness, role of engineers and social scientists are increasingly important. Social science has not been focused that much, but it will have a greater role in changing people's behavior with high level of uncertainty.

Allocation principle of research budget

Budget allocation is crucial basis for the independence of researchers/academia. DECC spends 17 million pounds of public fund for climate change research a year through a knowledge exchange program. This budget is allocated by UK Research Council based on project/program-based, rather than institution-based. This enables possible to effectively and efficiently use the limited budget for necessary research for policies and measures. Recently, in addition to academic aspect, policy impact has been also focused on in terms of budget allocation on climate research.

Europeanization of low carbon policy

Europeanization of UK environmental policy has been much more deep seated and wide ranging than one would expect to find in a state with long history of environmental policy making which dates back over a century or more, and a distinctly reluctant attitude to European integration (Jordan 2004). UK initiatives to establish low carbon economy contributed a lot to the formulation of EU climate and low carbon policy, at the same time, UK was influenced by the EU policy. Whether large states such as UK are more successful in influencing European policies is subject of research on "Europeanization", which analyzes how the EU affects states (top-down Europeanization) and how states can influence the Union (bottom-up Europeanization), and its combination (Cini and Barragàn 2010). According to this concept, UK approach can be characterized as a combination of top-down and bottom-up Europeanization, but a bit more flavor for bottom-up Europeanization. Setting ambitious long-term targets was identified as an element of leadership, particularly within the EU, where the UK is already a key actor in shaping European policy (Lockwood and Bird 2007).

International contribution on low carbon policy

IPCC is rooted in the interface between climate science and climate policy and its assessment reports are not "policy prescriptive" (Mbengue 2011). The number of UK scientists who contribute to IPCC processes are more than any other countries reflecting the domestic atmosphere and respect to put importance to science and UN-based IPCC itself. Stern Review It was the UK economist in the World Bank who initiated the 2006 Stern Review of the economics of climate change, which also influenced UN work on financing and investment flows. It was also the UK which took up the issue of climate change as one of the crucial agendas of G8 Summit, in Gleneagles.

4. Way Forward

Fukushima accident in Japan triggered the discussion worldwide on the role of science and its relation with policy. UK, based on their severe history of BSE, has been developed the institutional mechanism to solve this problem for the past couple of decades. High independence of researcher/academia from the government through the statute and principle, evidence-based policy, the regular communication and consultation among the related stakeholders and more preference for policy impact are worth to be considered for other countries as well.

At the same time, there are still the remaining issues to be discussed and examined further. The importance of the role of scientists were beginning to be identified, but it is not yet clear how to cope with the high level of uncertainty in dealing with changing people's behavior. More solid methodology is expected to be developed. Although legally binding targets under Climate Change Act 2008 required structural change of the government especially by integrating climate and energy policy, it requires more time to assess and review the implementation of necessary polices and measures. Compared to industry and research/academia, involvement of citizens has been rather limited. The recent shift from dialogue to science communication is expected to promote the communication with and involvement of the citizens, which could provide solutions to the necessity of behavioral change, a bottle neck of recent low carbon policy.

References

- Andersen, Mikael Skou and Duncan Liefferink (ed.). 1997. European Environmental Policy: The Pioneers. Manchester: Manchester University Press.
- Ashby, E. and Anderson, M. 1981. The Politics of Clean Air. Oxford: Clarendon.
- Business link. 2011. Green economy for business. Available at <http://www.businesslink.gov.uk/bdotg/action/detail?itemId=1096705244&type=ONEOFFPAGE&furlname=greeneconomy&furlparam=greeneconomy&ref=http%3A//www.defra.gov.uk/news/2011/08/05/encouraging-green-growth/&domain=www.businesslink.gov.uk>
- Centre for Low Carbon Futures. 2011. <http://www.lowcarbonfutures.org/>
- Cini Michelle and Barragàn, Nieves Pérez-Salòrzano. 2010. European Union Politics: Third Edition. New York: Oxford University Press.
- CCC (Committee on Climate Change). 2008. Building a low-carbon economy-the UK's contribution to tackling climate change. London: TSO (The Stationary Office).
- Chilvers, Jason. 2010. Sustainable participation? : Mapping out and reflecting on the field of public dialogue science and technology . Harwell: Sciencewise Expert Resource Centre.
- Davies, Rod and Heaton, Chris. Energy System Modelling Environment (ESME)—A tool for national energy systems design. Energy Technologies Institute (ETI). Presentation at UK Embassy of Japan's seminar, Ministry of Economy, Trade and Industry. Tokyo. July 2011.
- DECC (Department of Energy and Climate Change). 2009. Digest of United Kingdom Energy Statistics 2009. London: TSO (The Stationary Office).
- DECC. 2012. 2010 final UK greenhouse gas emissions: data tables. Available at http://www.decc.gov.uk/en/content/cms/statistics/climate_stats/gg_emissions/uk_emissions/2010_final/2010_final.aspx
- Deem, R. Hillyard, S. and Reed, M. 2010. Knowledge, Higher Education, and the New Managerialism: The Changing Management of UK Universities. Oxford: Oxford University Press.
- DEFRA. 2000a. Draft Climate Change Bill published. New Release March 13, 2007. www.defra.gov.uk/news/latest/2007/climate-0313.htm
- DEFRA. 2004. EU Emissions Trading Scheme-UK National Allocation Plan 2005-2007.
- DEFRA. 2007a. Taking Forward the UL Climate Change Bill: The Government Response to Re-Legislative Scrutiny and Public Consultation. October 2007.
- DEFRA. 2007b. Draft Climate Change Bill.
- DEFRA. 2007c. Benn sets out Strengthened Climate Change Bill. New Release October 29, 2007. <http://www.defra.gov.uk/news/2007/071029a.htm>
- DEFRA. 2008. Benn announces statutory review of 2050 climate targets. New Release 18 February,

2008. Available at <http://www.defra.gov.uk/environment/climatechange/uk/legislation/pdf/govt-amendment-package.pdf>;
- DEFRA. 2011a. Encouraging green growth: Government and businesses working together. Available at <http://www.defra.gov.uk/news/2011/08/05/encouraging-green-growth/>
- DEFRA. 2011b. Enabling the Transition to a Green Economy: government and business working together.
- DEFRA. 2011c. <http://www.defra.gov.uk/news/2011/08/05/encouraging-green-growth/>
- DEFRA. 2012. The Climate Change Risk Assessment (CCRA). Available at <http://www.defra.gov.uk/environment/climate/government/risk-assessment/>
- Kimura, Hitomi. 2008. UK Climate Change Bill. Environmental Quarterly, No. 149. Tokyo: Hitachi-Kankyo-Zaidan. (In Japanese: Igrisu Kiou Hendou Houan)
- HM Government. 2007. Meeting the Energy Challenge. A White Paper on Energy. <http://www.berr.gov.uk/files/file39387.pdf>
- HM Government. 2009. The UK Low Carbon Transition Plan : National strategy for climate and energy. Presented to Parliament pursuant to Sections 12 and 14 of the Climate Change Act 2008. Available at http://www.decc.gov.uk/assets/decc/White%20Papers/UK%20Low%20Carbon%20Transition%20Plan%20WP09/1_20090724153238_e_@@_lowcarbontransitionplan.pdf
- Imperial College. 2011. <http://www3.imperial.ac.uk/people/robert.gross>
- Jordan, Andrew. 2004. The United Kingdom: from policy “taking” to policy “shaping”. In Jordan A. and Liefferink, D. (ed.) Environmental Policy in Europe: The Europeanization of national environmental policy. London: Routledge Taylor&Francis Group.
- Kikuchi, Mekoto et al. 2011. Science Lecture not be disguised any more. Tokyo: Koubunsha. (In Japanese: Mou Damasarenai-tameno Kagaku)
- Kimura, Hitomi. 2008. UK Climate Change Bill. Environmental Quarterly. No. 149.
- Krämer, Ludwig. 2011. EU Environmental Law: Seventh Edition. London: Steel&Maxwell.
- LCS-RNet. 2010. International Research Network for Low Carbon Societies: Synthesis Report of LCS-RNet Second Annual Meeting. 20-21 September 2010. Berlin, Germany.
- Lockwood, Matthew and Bird, Jenny with Alvarez, Raquel. 2007. 2050 Vision: How can the UK play its part in avoiding dangerous climate change? IPPR.
- Mbengue, Makane Mousie. 2011. The Intergovernmental Panel on Climate Change (IPCC): A Singular Model of Expertise at the International Level. In Kerbrat, Y. and Dubois, S. (ed.) The Transformation of International Environmental Law. Paris: Editions A. Pedone and Hart Publishing.
- Nishioka, Shuzo. Design for low carbon society: Is it possible to achieve zero emissions? 2011. Iwanami-Shinsho, No.1324. Tokyo: Iwanami-Shoten. (In Japanese: Teitanso-Shakai-no-Dezain: Zero-Haishutsu-ha Kanouk)

Peeters, Marjan. Improving citizen responsibility in the North and its consequences of for the South: voluntary carbon offsets and government involvement. In *Climate Law and Developing Countries: Legal and Policy Challenges for the World Economy*. Benjamin J. Richardson, Yves Le Bouthillier Heather McLeod-Kilmurray and Stepan Wood (ed.). New Edward Elgar Publishing Limited: UK.

Lockwood, Matthew and Bird, Jenny with Alvarez, Raquel. 2007. *2050 Vision: How can the UK play in avoiding dangerous climate change?* London: IPPR.

Lockwood, Matthew. 2007. *Behavior change and energy use*. Positive Energy. London: IPPR.

Oxford University. 2011. Oxford Institute for Energy Studies. <http://www.oxfordclimatepolicy.org/contacts.shtml>

Rose, Chris. 1990. *The Dirty Man of Europe. The Great Britain Pollution Scandal*. London. Simon and Shuster.

Sheail, John. 2002. *An Environmental History of Twentieth-Century Britain*. New York: Palgrave.

WorriLOW, David. 2008. *Towards a low carbon UK*. Presentation at 3rd Japan-UK Workshop on Low carbon Society. 15 February 2008. Available at http://2050.nies.go.jp/3rdLCSWS/presentation/Day3_Symposium_Highlevel_ppt_DavidWorriLOW.pdf

Wurzel, Rüdiger K.W. 2006. *Environmental policy-making in Britain, Germany and the European Union: The Europeanisation of air and water pollution control*. Manchester University Press. 10 Dawning Street. 2008. <http://www.number10.gov.uk/output/Page13708.asp>