



## Wind Energy Policy, Planning and Management Practice in the UK: Hot Air or a Gathering Storm?

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# Wind Energy Policy, Planning and Management Practice in the UK: Hot Air or a Gathering Storm?

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STRACHAN P. A. and LAL D. (2004) Wind energy policy, planning and management practice in the UK: hot air or a gathering storm?, *Reg. Studies* **38**, 551–571. This paper is set within the context of the growing international wind energy industrial sector. The central focus is concerned with evaluating the UK Government and Scottish Executive's renewable energy strategies, which to date have culminated in a distinct lean towards onshore wind energy expansion. Our interest in this area stems from the international debate on wind power which is now gaining momentum as a result of global and European climate management initiatives, and in particular from the fact that there has been much public opposition to new wind farm developments in the UK. The British experience differs to that in Denmark, and appears more akin to that of the Swedish experience, with the UK presenting an interesting case of the difficulties associated with implementing a 'renewables' strategy based on wind energy. The research focus in this paper is different to that mostly favoured in the international wind energy literature which typical focuses on the science and technology of wind farms or on providing an evaluation of technology-push and demand-pull public policies. Drawing on a thorough review of EU and UK governmental documents, the international wind energy literature, press reports, and recent empirical research undertaken in Scotland, our research considers the social impacts, including the public and perceived environmental impacts, of wind farm developments. Our principal research findings indicate that the UK Government and Scottish Executive are now facing a storm of protest from anti wind farm campaigners, and the extent of this opposition is now damaging the efficacy of the UK's national renewables wind energy strategy. Clearly, this should be of concern to both the UK Government and Scottish Executive and, drawing on international experience from other countries, we conclude with strong policy recommendations towards the enhancement, the exploitation and the acceptance of wind energy in the UK. Areas for future research are also outlined.

Renewable energy    Wind farms    UK environmental policy

STRACHAN P. A. et LAL D. (2004) La politique, le planning et le management de l'énergie éolienne au Royaume-Uni: du vent ou des nuages orangeux?, *Reg. Studies* **38**, 551–571. Cet article a pour toile de fond le secteur industriel international de l'énergie éolienne qui est en pleine croissance. Le point de mire c'est l'évaluation des stratégies du gouvernement britannique et de l'administration écossaise quant à l'énergie renouvelable qui, jusqu'à présent, ont abouti à favoriser le développement de l'énergie éolienne à terre. Dans ce domaine, l'intérêt remonte au débat international à propos de l'énergie éolienne et qui prend de l'allure à la suite des initiatives mondiales et européennes quant au management du climat, notamment à cause du fait que le développement des champs d'éoliennes a suscité beaucoup d'opposition de la part du grand public. Le cas britannique se distingue de celui du Danemark et semble se rapporter plus à celui de la Suède, le cas britannique représentant ainsi les barrières à la mise en oeuvre d'une stratégie en faveur de l'énergie 'renouvelable' fondée sur l'énergie éolienne. Dans cet article, le point de mire de la recherche se distingue de celui présenté dans la plupart de la documentation internationale sur l'énergie éolienne qui porte sur la science et la technologie de l'énergie éolienne ou sur l'évaluation des politiques publiques par la technologie ou par la demande. Puisant dans une critique détaillée des Journaux officiels de l'Ue et du gouvernement britannique, de la

documentation internationale sur l'énergie éolienne, des reportages, et des récentes recherches empiriques conduites en Ecosse, cette recherche-ci considère les conséquences sociales, y compris les impacts publiques et environnementaux, du développement des champs d'éoliennes. Les principaux résultats laissent voir que le gouvernement britannique et l'administration écossaise affrontent une tempête de protestations des militants contre le développement des champs d'éoliennes, et que l'importance de cette opposition au Royaume-Uni porte préjudice à l'efficacité de la stratégie nationale en faveur de l'énergie éolienne renouvelable. Evidemment, cette situation devrait laisser à s'inquiéter et le gouvernement britannique, et l'administration écossaise. Puisant dans l'expérience internationale des autres pays, l'article se termine sur de fortes recommandations de politique quant à l'augmentation, à l'exploitation et à l'acceptation de l'énergie éolienne au Royaume-Uni. On esquisse des sujets à rechercher.

Energie renouvelable    Développement des champs d'éoliennes    Politique de l'environnement au Royaume-Uni

STRACHAN P. A. und LAL D. (2004) Windenergie, Planung und Durchführungsverfahren im UK: leeres Geschwätz oder drohendes Ungewitter?, *Reg. Studies* 38, 551–571. Dieser Aufsatz will im Zusammenhang mit dem sich ausweitenden internationalen Industriesektor der Windindustrie verstanden werden. Sein Hauptaugenmerk ist auf die Bewertung der Strategien der Regierung des UK und der schottischen Exekutive zur Gewinnung nachhaltiger Energie gerichtet, die bisher auf eine deutliche Neigung zu Erweiterung der Seewindenergienutzung hinausgelaufen sind. Das Interesse der Autoren an diesem Gebiet wird durch die internationale Debatte über Windenergie hervorgerufen, die jetzt im Gefolge globaler und empirischer Klimaregelungsinitiative, und besonders durch die z.Zt. beträchtliche Opposition gegen die neuen Windfarmen im UK in Gang gekommen ist. Die in Großbritannien gemachten Erfahrungen unterscheiden sich von denen in Dänemark, scheinen jedoch der schwedischen näher zu stehen, wobei das UK einen interessanten Fall der Schwierigkeiten darstellt, die mit der Durchführung einer 'nachhaltigen' Strategie auf der Grundlage der Windenergie in Verbindung gebracht werden. Der Forschungsschwerpunkt dieses Aufsatzes weicht von dem in der internationalen Literatur über Windenergie am häufigsten vertretenen ab, die sich typisch auf die Wissenschaft und Technologie von Windfarmen oder auf die Erstellung einer Bewertung im Gegenteil auftretender politischer Bestrebungen der Technologie und der öffentlichen Nachfrage konzentrieren. Auf der Grundlage gründlicher Besprechung von Dokumenten der EU und der Regierung des UK, der internationalen Literatur über Windfarmen, von Presseberichten und in Schottland kürzlich durchgeführten empirischen Forschungen zieht diese Arbeit soziale Auswirkungen, einschließlich öffentlicher und als von Windfarmeinrichtungen verursachte, derart empfundene Umweltauswirkungen in Betracht. Die Hauptbefunde der Untersuchung besagen, daß die Regierung des UK und die schottische Exekutive sich nun einem Proteststurm der Windfarmgegner gegenübersehen, und daß der Umfang dieser Opposition nun der Wirksamkeit der britischen Strategie für landesweit nachhaltige Windenergie schadet. Bei der britischen Regierung wie auch bei der schottischen Exekutive sollte dies selbstverständlich Besorgnis auslösen, und, gestützt auf internationale Erfahrungen in anderen Ländern, kommen die Autoren zu dem Schluß, Stärkung, Ausnutzung und Annahme der Windenergie im UK nachdrücklich zu empfehlen. Gebiete für weitere Forschung werden umrissen.

Nachhaltige Energie    Windfarmen    Umweltpolitik des UK

STRACHAN P. A. y LAL D. (2004) Política de energía eólica, planificación y prácticas de gestión en el Reino Unido: aire caliente o tormenta que se avecina?, *Reg. Studies* 38, 551–571. Este artículo se enmarca dentro del contexto del creciente sector industrial de energía eólica internacional. El enfoque principal es evaluar las estrategias del Gobierno Británico y del Ejecutivo Escocés en torno a las energías renovables, que hasta el momento han culminado en una clara inclinación hacia la expansión tierra adentro de la energía eólica. Nuestro interés en este área se origina en el debate internacional sobre la energía eólica, el cual está ganando importancia debido a iniciativas de gestión climática tanto globales como europeas, y en particular debido al hecho de que ha habido una gran oposición pública a nuevos desarrollos de granjas eólicas en el Reino Unido. La experiencia británica difiere de la de Dinamarca, y parece ser más semejante a la experiencia sueca, con el Reino Unido ofreciendo un ejemplo interesante de las dificultades asociadas con la implementación de una estrategia de energías renovables basada en la energía eólica. El foco de investigación de este artículo es diferente de aquel que es aceptado mayormente en la literatura internacional sobre la energía eólica, el cual se centra o bien en la tecnología y la ciencia de las granjas eólicas o en proveer una evaluación de políticas públicas de promoción tecnológica y de incentivo a la demanda. Haciendo uso de una revisión exhaustiva de documentos de la Unión Europea y del Gobierno Británico, de la literatura internacional sobre la energía eólica, informes de prensa, y de estudios empíricos recientes llevados a cabo en Escocia, nuestro estudio tiene en cuenta los impactos sociales, incluyendo los impactos ambientales públicos y percibidos, del desarrollo de granjas eólicas. Los principales resultados de nuestra investigación indican que el Gobierno Británico y el Ejecutivo Escocés se están enfrentando a una avalancha de protestas por parte de activistas que están en contra de las granjas eólicas, y tal grado de oposición está dañando la eficacia de la estrategia nacional de Gran Bretaña de energía eólica como recursos renovables. Claramente, esto debería ser objeto de preocupación tanto del Gobierno Británico como del Ejecutivo Escocés, y haciendo uso de la experiencia internacional de otros países concluimos con fuertes recomendaciones de política hacia el aumento, explotación y aceptación de la energía eólica en el Reino Unido. También se señalan áreas para futura investigación.

Energía renovable    Granjas eólicas    Política ambiental del Reino Unido

JEL classifications: Q42, Q48, Q56

## INTRODUCTION

The recent UK Government Energy White Paper, *Our Energy Future: Creating a Low Carbon Economy* (DEPARTMENT OF TRADE AND INDUSTRY (DTI), 2003), pledges to reduce carbon dioxide emissions – the chief cause of global warming – by 60% in the next 50 years. To help deliver this ambitious goal, the UK Government aims to have 20% of the UK's energy needs supplied by renewable energy sources, e.g. wind, wave and solar power, by 2020. Consequently, it has put in place a 'technology-push' renewables energy support programme for businesses, a package costing some £250 million for the period between 2002 and 2006 (*ibid.*). The primary intention of the UK Government appears to be based around the notion of creating an opportunity for British businesses to become world-leaders in the international renewables sector just as the US (RUSSO, 2003), Denmark and Germany (KAMP *et al.*, 2003; MEYER and KOEFOLD, 2003) and Spain (ALVAREZ-FARIZO and HANLEY, 2002) have done during the last 25 years.

In examining the detail of the UK renewables support programme, the new funding represents a three-fold increase in previous figures, reflecting a much stronger commitment by the British Government to tackling global climate change through harnessing renewable energy. In addition to the national policy goals for climate change and renewable energy, the Scottish Executive's<sup>1</sup> goals are interestingly much more ambitious. Here, the Scottish Executive suggests a commitment towards increasing the amount of electricity generated through renewable sources, along with promoting energy efficiency more widely in business and domestic housing (SCOTTISH EXECUTIVE, 2003, p. 2). The Scottish Executive Report *Building a Sustainable Scotland: Sustainable Development and the Spending Review 2002* summarizes the Executive's ambitions: 'We firmly believe that our policies and commitment, coupled with Scotland's natural resource and expertise, mean that producing as much as 40% of Scotland's electricity from renewable sources by 2020 is a realistic aim'.

With this in mind, there are a number of strands to the UK Government's and the Scottish Executive's renewable energy strategies and at the forefront of these is the desire to expand the number of wind farms. Indeed, wind power is recommended by a growing body of international literature supporting its benefits over other renewable sources and is seen to be the most likely renewable energy source to deliver the rather ambitious aforementioned targets (BLAIR, 2001; GARRARD HASSAN & PARTNERS, 2001; DTI, 2002, 2003; and MEYER, 2003). In terms of wind power potential, HANLEY and NEVIN, 1999, and IBENHOLT, 2002, suggest that Scotland as a location possesses a large part of the UK's potential for producing renewable wind, and this would appear to be an

important factor in explaining the UK Government's interest in wind power (see also SCOTTISH EXECUTIVE, 2000a, 2000b, 2000c, 2002b; and SCOTTISH EXECUTIVE DEVELOPMENT DEPARTMENT, 2002).

On reviewing the international wind energy literature, there appear to be two main strands of thought (which often overlap), but given the emerging UK experience of wind power implementation discussed in this paper, we recommend that more focus be given to a third strand, which is also supported by the works of ALVAREZ-FARIZO and HANLEY, 2002, and KAHN, 2003. In summary, the first strand tends to focus on the science and technological aspect of wind energy (RIGHTER, 1996; GRUBB, 1997; and LOITER and NORBERG-BOHM, 1999), and the second strand focuses on evaluating the national 'technology-push' and 'demand-pull' policies put in place to support sustainable energy production (MEYER and KOEFOLD, 2003). The technology-push policies refer to initiatives such as research and development programmes, while demand-pull policies are associated with a variety of market and regulatory mechanisms established by government (MEYER, 2003; MEYER and KOEFOLD, 2003). As discussed, we recommend that more attention be given to a third strand – that of the social impacts (including public opposition and the perceived environmental impacts) associated with wind farm developments. It is the intention of this paper to consider these issues more fully in evaluating the UK Government's wind energy strategy since 2000.

Our interest in renewable energy stems from the recent growth in international climate change initiatives arising from the EU ratification of the Kyoto Protocol in 2002; the difficulties in implementing such initiatives; and in particular, from the fact that, in the UK, battle lines are now being drawn between a pro and anti wind lobby. The UK public debate on wind power expansion has gained momentum during the last two years, to the extent that it is now beginning to challenge the efficacy of the UK Government and Scottish Executive's renewable strategies, with the limitations of wind energy being glossed-over by a pro-wind lobby. Drawing on evidence from organizations such as the American Wind Energy Association, and the European and British Wind Energy Associations, the UK pro-lobby fundamentally argues that wind power is the 'saviour' of the environment (SCOTTISH EXECUTIVE, 2000a, 2000b, 2000c; BLAIR, 2001; SCOTTISH EXECUTIVE, 2002a; SCOTTISH EXECUTIVE DEVELOPMENT DEPARTMENT, 2002; and DTI, 2002, 2003). In Britain, critics of this view insinuate that the pro-lobby primarily consists of the national Government and the Scottish Executive, along with a range of commercial organizations intending to build and manage wind farms (KNOTT, 1999; SCOTTISH EXECUTIVE, 2000a, 2000b, 2000c; PRATT, 2002; WILKS, 2002; SCOTTISH EXECUTIVE 2002a; DTI, 2002, 2003; and PELTIER, 2003). The principal wind farm

developers currently operating in the UK are Scottish Power, Powergen, Scottish and Southern Electricity, AMEC Wind, Renewable Energy Systems and National Power. It is interesting to note, at this point, that one of the principal reasons for the small public opposition to wind farm developments in Denmark during the 1980s and 1990s is that most Danish wind turbines are owned by local people in cooperative organizations, rather than being owned and managed by large utility companies such as those dominating the UK wind energy market (KAMP *et al.*, 2003). We discuss the importance of this later in the paper.

The UK pro-lobby has outlined a number of arguments for exploiting wind power, to the extent that they conclude that wind farms offer, amongst other benefits, an inexhaustible supply of clean energy, and in addition can have valuable economic spin-off benefits, such as providing new employment opportunities (SCOTTISH EXECUTIVE, 2000a, 2000b, 2000c, 2002; BROWN, 2002b; DTI, 2002, 2003; and KAHN, 2003). Furthermore, on this pro-lobby note, headlines drawn from various sources of the national and regional press in Scotland illustrate some of the anticipated benefits of wind farm developments as:

- ‘Locals Should Get Cheaper Electricity, Says Expert’ (*The Herald*, 2002b)
- ‘Abbot Group Nets £46 million Profit From Sale of Wind Farm Stake’ (*The Herald*, 2002c)
- ‘Tourists Bear No Ill Wind To (Wind) Farms’ (*The Scotsman*, 2002c)
- ‘New £21 million Wind Farm Generates Enough Power To Run 250,000 Homes’ (*The Scotsman*, 2002a)
- ‘Farmers May Reap A Harvest From The Wind’ (*The Herald*, 2001a)
- ‘Wind Farm Plans Could Generate 50 Jobs’ (*The Scotsman*, 2001b)
- ‘Reaping the Whirlwind of Alternative Energy’ (*The Scotsman*, 2001a).

In examining these headlines, at first sight it is very difficult to disagree with the arguments outlined by the pro-lobby. Indeed, it would appear rather precipitous to take issue with these, particularly since it becomes visible that the rush for wind power is a win-win-win situation for the Government, business, the general public and the environment. Voices of discontent are however growing, with approximately 40 community protest groups having sprung up in Scotland to fight wind developments in their respective local areas (*The Aberdeen Press and Journal*, 2001, 2003d, 2003e; *The Herald*, 2002a, 2003a). This trend is similar to the Swedish experience of wind power which has developed in parallel to the UK, where wind power has been growing at a very rapid pace during the last few years (KAHN, 2003). The Scottish anti-campaigners have set up an umbrella group called ‘Views of Scotland’, to provide support to new protestors,

who argue, amongst other things, that wind farms are scarring Scotland’s unique natural environment. Some of the other arguments presented by this group relate to planning consents, land use, noise pollution and dangers to wildlife (*The Herald*, 2001b, 2002a, 2002b; *The Scotsman*, 2002b, 2002d; ROYAL ACADEMY OF ENGINEERING, 2002; *The Aberdeen Press and Journal*, *March Energy Supplement*, 2003; *The Aberdeen Press and Journal*, 2003a, 2003b, 2003c, 2003d, 2003e). Consequently, headlines again drawn from Scottish national and regional newspapers illustrate the extent of the concerns that typify this anti-lobby movement:

- ‘Wind Farm Protestors To Stand At Election’ (*The Herald*, 2003a)
- ‘Wind Farms To Hit Scottish Tourism, Protestors Claim’ (*The Scotsman*, 2003)
- ‘New £30 million Wind Farm Proposal Faces Storm Of Protest’ (*The Aberdeen Press and Journal*, 2003a)
- ‘Wind Farm Danger Highlighted’ (*The Scotsman*, 2002d)
- ‘Skye Wind Farm Protest Lobbies Parliament’ (*The Scotsman*, 2002b)
- ‘Wind Farm Protestors Unite To Organise Opposition To Further Developments’ (*The Herald*, 2002a)
- ‘Why The Fashion For Wind Farms Is Wrong’ (*The Herald*, 28 November 2001).

Contextually, therefore, research conducted by this group (Views of Scotland) reveal that within Scotland there are now more than 120 wind farm sites either working, under construction or proposed. They outline that plans for further wind farm developments are coming in at the rate of one per week, with four applications being submitted on Christmas Eve of 2002 alone. Only two years ago, there were but four small working wind-powered sites and a few isolated turbines in Scotland. To further illustrate this rapid penetration of wind power in the UK, and in particular Scotland, recent research by the AMERICAN WIND ENERGY ASSOCIATION, 2003a, 2003c) indicates that the UK now features as eighth in the world, in terms of installed wind energy megawatt (MW) capacity, with 552 MW of installed capacity to date (with more than 87 MW of new capacity being installed during 2002 alone). This expansion in wind power, however, has not been supported by any sort of governmental awareness raising campaign to educate the Scottish populace to the benefits of a sustainable energy system based on wind power. Thus, the Government’s strategy to date is seen as being top-down, rather than, both top-down and bottom-up, as has been the case in Denmark (CHRISTENSEN and LUND, 1998). It is against the rapid penetration of wind power outlined and the UK Government’s general non-participatory approach to wind power expansion, that this paper critically examines the complex arguments for and against wind farm developments in the UK. In doing so, this paper attempts to examine the arguments for both the ‘pros’

and 'cons' drawing on published academic research and recent empirical research undertaken in Scotland, with the intention being to contribute to the emerging international debate on the expansion of renewable energy sources such as wind.

Against this backdrop, KAHN, 2003, reports that, as increased public opposition to such developments comes to the fore of the political and social agendas in, for example, the UK, Sweden and other countries, the debate in Britain will continue to gain in momentum. Hence, it is perhaps important to note that the UK implementation experience has been different to that in Denmark, and more akin to the Swedish experience, where there has also been much public opposition to new wind farm developments and a significant debate on the emerging social impacts of wind energy. We do recognize however, that although the UK experience is different to that of countries such as Denmark, much can still be learned from the experiences of the US, Germany, the Netherlands and Spain. For this reason we consider important issues in the development of their renewables programmes and, in particular, their respective renewables approaches, which the UK Government will find of considerable interest. Additionally, although the focus of this paper is principally on developing the third strand of the international wind energy literature, the challenges facing the UK case are significant to warrant increasing researcher attention. We should also point out that it was following the completion of our research project in late 2002 that the UK Government announced its intention to expand its interest in wind power to offshore wind farm developments. As such, we concentrate on onshore wind farm developments in this paper. Finally, prior to presenting a review of the international wind energy market, thus setting the UK renewable debate fully into context, we present the research framework used to support our empirical research.

### THE RESEARCH FRAMEWORK

The research framework adopted in this paper consists of a number of stages and approaches. In the initial stage, an examination was conducted of the various academic materials that addressed the topic of the internationalization of the firm, which was followed by an assessment of general and governmental studies on renewable energy. This review highlighted a distinct lack of objectivity in the debate on key issues surrounding the area of renewable energy. In the main, these literatures took a very pro-wind power stance, with the limitations of wind power often being glossed-over in the international literature. In addition to identifying the principal strands of the international wind energy literature introduced earlier in this paper, this review also enabled us to identify the principal developments and drivers in the international wind

energy industry from the late 1970s to 2003, with a summary presented in the next section.

During the second stage of this study, the research focused at the European, UK national, and Scottish local level and we reviewed recent governmental policy documents on renewable energy and in particular wind power, whilst also undertaking a review of Scotland's national and regional press articles. Our comprehensive review of the European and in particular UK government literature on renewables is presented later in the paper. In reviewing the European and UK governmental literature, and the national and regional press, where articles were written from 1992 to March 2003, we aimed to glean an insight into the EU's, in particular the UK Government's (and latterly, the Scottish Executive's) energy policies as they related to renewables, and understand further the views and the status of various interest groups and the general public's perspectives on past, current and proposed wind farm developments.

The third stage of this study focused on the research methodology adopted in terms of the gathering of empirical data from participants at a series of meetings which were held and attended by members of the general public campaigning against the proposed siting of a wind farm near the coastal town of Peterhead (North East Scotland). These meetings produced considerable debate and, at times, were confrontational events, with battle-lines being drawn by polarized groups and the arguments for wind farms being constantly dismissed. Participation at these meetings provided an insight into numerous emotional aspects on the topic of wind farms, with unsubstantiated and under-researched claims often being made by the anti-wind farm movement. Following these public meetings a series of interviews were conducted using semi-structured questionnaire checklists on a sample frame consisting of anti-wind campaigners *and* those keen to exploit wind power, i.e. business executives from firms currently operating in the energy sector. The interviews were approximately of three hours duration, with the sample frame being capped at 16 – eight anti wind campaigners and eight business executives – following saturation point being reached.

### INTERNATIONALIZATION AND THE WIND POWER INDUSTRY: 1975–2003

Within the plethora of literature discussing the meaning and interpretation of organizational internationalization, considerable evidence exists which leads towards both broadening and deepening our understanding of business activities which transcend national boundaries (e.g. VAHLNE and WIEDERSHEIM-PAUL, 1977; HOOD and YOUNG, 1979; CAVUSGIL and GODIWALLA, 1982; PORTER, 1986; PARKHE, 1991; YAN and ZENG, 1999; REUER and KOZA, 2000; and HANVANICH and CAVUSGIL, 2001). Indeed, in a similar vein, with the drive towards worldwide standardization of consumer

tastes, the evolving concept of 'the globalization of the firm' is now accepted as a reality (e.g. HYMER, 1979; KOGUT, 1985; BUCKLEY and CASSON, 1992; CLARK and MALLORY, 1997; RAO, 2001; and RICCIARDELLI *et al.*, 2003) and, consequently, the use of electrical energy has shown significant growth. Likewise, internationalization processes have led towards a vast array of models and approaches intimating that international activities tend to evolve in stages (e.g. JOHANSON and WIEDERSHEIM-PAUL, 1975; CZINKOTA and TESAR, 1982; WHITE and POYNTER, 1984; JOHANSON and MATTSON, 1987; HOOD *et al.*, 1994, and HOHEN-THAL *et al.*, 2003). Such observations have not gone unnoticed and have therefore led towards a greater concentration, of a theoretical nature, on a number of fundamental but important issues associated with organizations balancing risk, experience, commitment and control of foreign involvement, in terms of a variety of perceived benefits in both the establishment and expansion of foreign operations, e.g. Shell, Scottish Power, BP, the Total Group, Stat Oil, Esso, etc. Critically, therefore, as firms from the energy sector continue to position and reposition themselves for the environmental uncertainty and, indeed, the rapidly evolving global markets facing all firms, there is growing pressure on governments to strategically intervene and legislate on environmental pollution caused by the energy sector, and therefore this behaviour cannot be ignored. Consequently, in considering the evolving nature of the development of the modern renewables industry, we note that it began around the 1970s, following the international oil crisis and the publication of the Club of Rome report, which warned of the imminent shortages of traditional energy sources such as oil and gas (KAMP *et al.*, 2003). The renewable energy source identified as having the greatest potential for exploitation was wind energy, and since its 'shaky' beginnings during the 1970s, wind power is now the world's fastest growing energy source, which is characterized by global wind power generating capacity having quadrupled in the last five years (AMERICAN WIND ENERGY ASSOCIATION, 2003a). These figures suggest that the global wind energy generating capacity in 2002 was more than 31,000 MW, with wind plants now powering the equivalent of 7.5 million average US homes, or 16 million average European homes (*ibid.*). In the early 1980s, the US dominated the wind energy market but since the mid 1980s Europe and in particular Germany, Denmark and Spain have taken the lead (LOITER and NORBERG-BOHM, 1999; and IBENHOLT, 2002) and we consider some of these issues further below.

### The US

LOITER and NORBERG-BOHM, 1999, and RUSSO, 2003, provide a thorough review of the wind energy market in the US from 1979 to 2003. Both sets of authors note that, in the early 1980s, new legislation

such as the Public Utility Regulatory Policy (PURPA) of 1978, offered financial incentives which were underwritten by federal government and these included: (1) The Crude Oil Windfall Profits Act of 1980; and (2) The Economic Recovery Tax Act of 1981. Furthermore, these were further enhanced by state government initiatives such as the California State Tax Credits, which brought about a great surge in wind energy developments in the US, particularly in California (CALIFORNIA ENERGY COMMISSION, 1981; LOITER and NORBERG-BOHM, 1999; and RUSSO, 2003). In the early 1980s the Californian wind energy industry was also nurtured by the direct intervention by the then State Governor, Jerry Brown, who personally intervened in order to ensure that the state's governmental institutions held wind energy in high esteem, thereby providing the aforementioned California state tax credit and establishing a regulatory environment that protected the wind energy industry (CALIFORNIA ENERGY COMMISSION, 1981; and LOITER and NORBERG-BOHM, 1999). These initiatives are seen as the bedrock of today's US renewables energy policies.

In continuing, HORZBORG, 1999, p. 2, suggests that the 1990s were both 'the best of times and the worst of times' for the wind energy industry in California. To illustrate this, in 1993 the California Public Utilities Commission (CPUC) issued its Biennial Resource Plan Update (BRPU), which set aside 1,500 MW of new electrical generation capacity for renewable resources. This resulted in much stimulus for the Californian wind industry, directly prompting large utilities to pursue contracts with wind producers and the wind companies to acquire new sites. Unfortunately, for the wind industry a number of utility companies petitioned the Federal Energy Regulatory Commission (FERC) who in 1995 dismissed the BRPU and then rejected appeals to its decision. The effect on the industry's focus was 'quickly changed from expansion to survival' (HORZBORG, 1999, p. 2). One of the hardest hit companies was the large US wind energy company Kenetech, which declared bankruptcy following this decision. While Horzborg notes that Kenetech is of course an extreme example, the 1990s did see many layoffs and cost-cutting measures as being commonplace throughout the US wind energy industry.

More recently, the US West Coast energy shortages and other developments, have once again seen the US wind energy industry dramatically grow, with WOODWARD, 2001, noting, for example, the Bonneville Power Administration's decision to accept proposals for 1,000 MW from renewable energy sources, particularly from new renewable wind farms (located in the Pacific Northwest). He also notes that when the then Governor in Texas, the US President George W. Bush, recently signed electricity restructuring legislation that required 400 MW of new energy generation by 2003 and 2,000 MW by 2009 (which is equivalent of 3% of the state's electricity needs), other US states

had been adopting revised renewable energy targets, though to date, these have been less ambitious than those outlined. Unfortunately, the US wind energy industry is still subject to a great deal of uncertainty over an important federal incentive – the wind energy tax credit (PTC) which was renewed in March 2002 but only until 31 December 2003 – with the US wind energy currently seeking an extension to avoid possible decline in the industry such as that which occurred when the PTC expired in 1999 and 2001 respectively (AMERICAN WIND ENERGY ASSOCIATION 2003c).

### Europe

Based on recent statistics from the AMERICAN WIND ENERGY ASSOCIATION, 2003a, wind energy developments in the US since the early 1980s have meant that wind plants in 27 states total 4,685 MW, equivalent to 1.3 million US households. Commentators such as BODAMER, 1999; KAHN, 2003; and MEYER and KOEFOLD, 2003, however, suggest that the US has been surpassed as the leader in the wind energy industry by European nations such as Germany, Spain and Denmark. The AMERICAN WIND ENERGY ASSOCIATION, 2003a, describes Europe as now being the ‘driving engine of global wind power growth’ in terms of existing capacity, plans for new wind farm developments, the manufacturing of wind turbines, and in the innovation in wind power technology. According to the European Wind Energy Association (reported by the AMERICAN WIND ENERGY ASSOCIATION, 2003a) some 5,871 MW was installed in EU countries in 2002 alone – and this is estimated to be worth €5.8 billion or US\$6.3 billion. Most of this capacity is located in Germany, Spain and Denmark which, combined, accounted for 89% of the wind power capacity installed in Europe during 2002. To put these developments into context, we have for illustrative purpose included the American Wind Energy Association table of the five top wind energy markets in Table 1. This table summarizes new wind capacity additions in MW since 2001, along with the total installed capacity, in MW, in these markets to the end of 2002.

Explaining the growth in the European wind energy

market in recent years is a complex and multi-faceted task but key factors introduced by IBENHOLT, 2002, and JUNGINGER *et al.*, 2004, include the success of the Danish and German Government’s in creating the political and institutional conditions for a thriving market in wind energy, along with Danish innovation in wind power technology. Denmark is reckoned to be the main pioneer in the development of commercial wind power technology and is currently the world’s largest manufacturer and exporter of wind turbines. These facts are supported by BTM CONSULT/DWTMA, 2000, which notes that half of the world market sales of wind turbines in 1999 were Danish. Furthermore, KAMP *et al.*, 2003, suggest that through a mixture of technology-push and demand-pull policies, the Danish Government has consistently (over the past three decades) supported wind energy. Technology-push policies have included research and development funding, establishing the Risoe National Laboratory along with other initiatives. Demand-pull policies have included providing support to private owners of single or clusters of turbines, with individuals, co-operatives or communities owning approximately 80% of installed wind energy capacity, and the other 20% owned by utility companies. It is widely known that such an approach has greatly reduced public opposition to wind farm developments. The UK Government and Scottish Executive can learn much from the Danish experience in this respect and, further, KAMP *et al.*, 2003, outline in the form of a policy learning and institutional support context, a number of other significant reasons for the wind energy successes in Denmark when compared to the relatively slow progress in The Netherlands.

Insofar as the growth in the European wind energy industry is concerned, this growth can be attributed to a variety of global environmental initiatives supported by the United Nations (UN) to reduce greenhouse gas emissions. These initiatives have prompted the European Commission to become an important driver in the European wind energy market, thereby promoting the development of a sustainable energy system, based more and more on renewable energy sources such as wind power, rather than on conventional fossil fuels which contribute significantly to climate change. The UN initiatives which have prompted the EU to act have been reviewed by MEYER, 2003, and these include the Framework Convention on Climate Change signed by 155 nations at the UN Conference in Rio de Janeiro in 1992, and a number of conferences of parties (COP) including COP 3 in Kyoto in 1997, at which agreements were reached on targets for greenhouse gas reductions. The reductions agreed are relative to emissions in 1990 and refer to a basket of six greenhouse gases dominated by CO<sub>2</sub>, with the targets being a reduction of 8% for the EU, 7% for the US, 6% for Japan and 5.2% on average for the industrial world. The collectively agreed timescale for reaching these targets is 2012.

Table 1. The top five wind energy markets, 2001–02

Top five wind energy markets (installed capacity, in MW)	2001 additions	2001 year end total	2002 additions	2002 year end total
Germany	2,659	8,754	3,247	12,001
Spain	835	3,337	1,493	4,830
US	1,695	4,275	410	4,685
Denmark	117	2,417	497	2,880
India	240	1,407	195	1,702

Source: AMERICAN WIND ENERGY ASSOCIATION, 2003a.



The Kyoto Protocol was ratified by the EU in 2002, with EU Member States having agreed to distribute the targets between them, and with the main solutions identified as energy conservation and the use of renewable sources; wind power was identified as the most important renewable source likely to deliver the 2012 targets. MEYERS, 2003, notes that there has been increased recognition during the last decade by the EU that the contribution of renewable energy sources should be increased from 6% to 12% by 2010. This has been spurred by many policy initiatives (see, for example, EUROPEAN COMMISSION (EC), 1997, 1998, 2000, 2001), which require EU Member States to commit and implement renewable strategies which have been most recently reinforced by the European Climate Change Programme (2000), the UN Summit on Sustainable Development (Rio + 10) (2002), and the EU Sixth Environmental Action Programme which guides the EU vision of sustainability from 2002–2010 (EC, 2002). It is against this backdrop that we now introduce the UK Government's and Scottish Executive's energy policies as they relate to renewable energy and, as such, provide a national case of the implementation process and the difficulties involved with implementing a renewables strategy based on wind power.

### UK ENERGY POLICY AND RENEWABLE TECHNOLOGY STRATEGIES

To help deliver their EU Kyoto obligations, the UK Government in 2000, as part of its Climate Change Programme, announced its policy goals for renewable energy (DEPARTMENT OF ENVIRONMENT, TRANSPORT AND THE REGIONS (DETR), 2000). The principal intention of this was to provide renewed impetus for the development of UK renewables energy, and to produce 10% of the UK's electricity requirements from such sources by the end of the first decade of this millennium. Ambitiously, therefore, in examining the UK Government's renewables policy, it is seen to have five prominent aims, and these have been reviewed in the SCOTTISH EXECUTIVE DEVELOPMENT DEPARTMENT'S, 2002, Planning Advice Note (p. 1).<sup>2</sup> According to this document these principal aims are centred on:

- assisting the UK to meet national and international targets for the reduction of emissions, including greenhouse gases
- helping to provide secure, diverse, sustainable and competitive energy supplies
- stimulating the development of new technologies necessary to provide the basis for continuing growth of the contribution from renewables into the longer term;
- assisting the UK renewables industry to become

competitive in home and export markets and in doing so to provide employment

- making a contribution towards the development of rural communities.

Although these targets appear substantive, more recently the Energy White Paper (DTI, February 2003) reaffirms the UK Government's desire to meet its Kyoto obligations and, in addition, commits to providing a framework towards strengthening the contribution of renewable energy sources. On this note, the Energy White Paper states: 'Renewable energy will play an important part in reducing carbon emissions, while also strengthening energy security and improving our industrial competitiveness as we develop cleaner technologies, products and processes' (p. 11).

Here, the UK Government indicates that renewable energy will play an important strand in its strategy towards tackling climate change and in making the transition towards a low carbon economy. The following presents an important section of the UK Government's vision for the energy system beyond 2020, as set-out in the Energy White Paper (p. 18):

The backbone of the electricity system will still be a market-based *grid*, balancing the supply of large power stations. But some of those large power stations will be *offshore marine* plants, including *wave*, *tidal* and *wind farms*. Generally smaller *onshore wind farms* will also be generating. . . . There will be much more *local* generation, in part from medium to small local/*community* power plant, fuelled by locally grown *biomass*, from locally generated *waste*, from local *wind* sources, or possibly from local *wave* and *tidal* generators.

In presenting this vision, the UK Government appears to fully recognize that much needs to be done in order to achieve some semblance of success in meeting primary targets. In examining where the UK sits – within an international context – it should be acknowledged that renewable energy sources have expanded far less in the UK than in some other European countries<sup>3</sup> (BROWN, J. A., 2002, BROWN, L., 2002). Indeed, this should now present the UK Government with a number of opportunities, as well as institutional, technical and other barriers (WILKS, 2002). To illustrate one of the technical challenges for policy makers, we note that to reach the renewables target outlined in the Energy White Paper, approximately 10,000 Mega Watts (10,000 MW) of renewable energy will have to be installed by 2010. This target will require an average annual build rate of 1,250 MW per annum. Unfortunately however, to date, approximately 552 MW of renewable energy has been installed, thereby highlighting a considerable shortfall. Notwithstanding this limited exploitation of technology, the UK Government recognize that there is huge potential for renewable energy sources. Indeed, with the Government's rationale for wind power being articulated in the Scottish Executive's Climate Change

Programme, the UK, and in particular Scotland, has a distinct advantage over other European nation states, as it harnesses over one-third of Europe's potential for natural wind power.

#### *The Scottish Executive's Climate Change Programme*

The Scottish Climate Change Programme (SCOTTISH EXECUTIVE, 2000b, 2000c) supplements the UK Climate Change Programme (DETR, 2000), which is designed to deliver the UK Government's Kyoto commitment. Implicitly therefore, the UK Climate Change Programme commits to reducing the 'six-gas basket of greenhouse gas emissions' by 12.5% below 1990 levels during the period 2008–12. Furthermore, there is a distinct move towards a domestic goal of a 20% reduction in carbon dioxide emissions by 2010, in addition to harnessing sources of renewable energy. The Scottish Executive states that it is committed to contributing to these goals, with the Scottish Climate Change Programme setting out the Scottish Executive's ambitions in these areas (SCOTTISH EXECUTIVE, 2000b, p. 7) thereby stating that: 'Climate Change is for real: it is happening . . . We in Scotland have to play our part in (the) global effort to reduce emissions'.

Here, the Scottish Climate Change Programme stresses the significance of Scotland's geography and climate towards providing an enormous potential for the development of renewable energy sources, with for example, the availability of wind as a resource being unparalleled anywhere in Europe (GARRARD HASSAN & PARTNERS, 2001). Consequently, renewable energy is seen to be executive devolved, thereby allowing Scottish ministers to set renewable energy targets for Scotland, with the Scottish Executive being clearly committed to increasing the amount of electricity generated by renewable sources. The Scottish Climate Change Programme (SCOTTISH EXECUTIVE, 2000b, p. 14) outlines this by stating: 'We have decided to aim for a further increase by 2010, similar to the planned increase for the UK as a whole, taking the Scottish total to around 17–18% by 2010'.

Contentiously, therefore, the Scottish Executive indicates that the additional renewables capacity required will probably come from wind power, while recognizing that a number of issues need to be addressed. Moreover, in adding to the complexity of this situation, inextricable links exist between how much additional power the Scottish electricity grid can carry, the cost to enable the additional generation capacity to be generated, planning consents, and the increasing number of local residents campaigning against new wind farm developments in their respective communities (*The Herald*, 2001b; 2002a, 2002b; ROYAL ACADEMY OF ENGINEERING, 2002; *The Scotsman*, 2002b, 2002d; *The Aberdeen Press and Journal, March Energy Supplement*, 2003; *The Aberdeen Press and Journal*, 2003a, 2003b, 2003c, 2003d, 2003e). These

issues are now the subject of much debate and controversy in Scotland, leading the Scottish Executive to recently revise their national planning guidelines (SCOTTISH EXECUTIVE, 2002a) and advice notes (SCOTTISH EXECUTIVE DEVELOPMENT DEPARTMENT, 2002) on renewable technology applications. Before reviewing these national planning guidelines and advice notes, it is perhaps appropriate to summarize the Government's reasons for focusing almost exclusively on wind power.

#### *Why wind power?*

IBENHOLT, 2002, indicates that wind power technology is now well established and widely accepted across Europe as a commercial source of electricity (see also the SCOTTISH EXECUTIVE, 2000a, 2000b, 2000c; WILKS, 2001; PRATT, 2002; DTI, 2002, 2003; PELTIER, 2003). Current wind power technology is based largely on Denmark's considerable experience with wind turbines between 500 kW and 1 MW. The technology has now advanced beyond the 1 MW to 1.5 MW size to more than 2 MW machines, which were initially intended for offshore, but are now featuring in proposals for onshore operations. Likewise, JUNGINGER *et al.*, 2004, note that recent advances in wind power technology now allow wind turbines to operate much more efficiently than was previously the case (BROWN, J. A., 2002; BROWN, L., 2002; PRATT, 2002).

The UK Government and the Scottish Executive recognize that Scotland's geography and climate has the potential to harness wind power technology effectively and, in doing so, help to reduce the amount of electricity needed from conventional fossil fuel power stations (SCOTTISH EXECUTIVE, 2000a, 2000b, 2000c; GARRARD HASSAN & PARTNERS, 2001; and DTI, 2002, 2003). One of the main benefits of having electricity generated from wind power is that it produces zero carbon emissions (BLAIR, 2001; PRATT, 2002; and DTI, 2002, 2003). Thus, it helps to reduce harmful gases, e.g. carbon dioxide, sulphur dioxide and nitrogen oxides, produced by conventional power stations thus contributing to meeting its EU Kyoto obligations. The Planning Advice Note 45 (SCOTTISH EXECUTIVE DEVELOPMENT DEPARTMENT, 2002) provides the following statistic in illustrating how wind power technology can help to reduce harmful gas emissions: 'In 1999 UK wind farms produced over 0.5 billion units of clean electricity potentially offsetting more than 430,000 tonnes of carbon emissions'.

With this in mind, the global market for environmental goods and services is estimated to rise to US\$630 billion by 2010, with the international wind power industry estimated to be worth in the region of approximately US\$1.5 to US\$4 billion industry (BLAIR, 2001; WOODWARD, 2001) and employing

between 3,500 to 12,500 people worldwide (WOODWARD, 2001; DTI, 2002). Challengingly, therefore, the UK Government wants the country to become a leading player in these markets, with an anticipated creation of many new jobs, particularly in the manufacture of wind turbines<sup>4</sup> (BROWN, J. A., 2002; BROWN, L. 2002). Naturally therefore, it is expected that the UK's manufacturing industry will directly benefit from this, along with Scotland's oil and gas industry, where there is a highly trained workforce, and significant scientific and technological expertise. Some of the leading players in the UK oil and gas industry such as BP Amoco plc, Royal Dutch/Shell and AMEC Wind, are now well established in the renewables market (KNOTT, 1999).

While there appears to be a convincing rationale for the development of new wind power sites in Scotland, there are a number of potentially problematic issues associated with them. In order to address these concerns, the Scottish Executive has recently published revised planning guidelines and advice notes and these are now briefly reviewed.

#### *National Wind Farm Planning Guidelines and Advice*

The National Planning Guideline<sup>5</sup> (SCOTTISH EXECUTIVE, 2000a) provides a series of statements of Scottish Executive policy on renewable energy and it is the clearest summary of the Scottish Government's approach towards renewables. This document recognizes that, based on current technology, wind energy is one of the largest and most visible of the renewable technology sectors and acknowledges that the siting, layout and design of a wind farm is indeed a complex matter. This is conditioned by a number of technical, practical, economic and environmental considerations which seek to balance important factors such as wind capture, turbulence, access and power linkage, with the impact on heritage and local communities. The National Planning Guideline recognizes the attributes associated with wind farms and raises a number of issues that require to be considered and, where appropriate, addressed before a wind farm should proceed. These fall into four main categories and are outlined below.

1. *Visual impact.* The size and scale of the wind farm and its relationship to the characteristics of the locality and landform in which it is to be built is a relevant consideration noted by the National Planning Guideline, along with the visibility of the wind farm and the cumulative impact of neighbouring wind developments.
2. *Landscape.* The character of the landscape and associated infrastructure is a relevant consideration noted by the National Planning Guideline, and states that a cautious approach should be adopted in relation to particular landscapes that are valued such as National Scenic areas, National Parks or sites in the

inventory of designated landscapes. This should also be extended to regionally important landscapes such as regional parks, and parts of approved green belts, which may be valued due to their contribution to the landscape setting of nearby towns.

3. *Birds and habitats.* The National Planning Guideline states the importance of complying with international and national conservation obligations, recognizing that wind farm developments may impact on bird populations and habitats.
4. *Other considerations.* The National Planning Guideline also notes, because of the height of turbines and electro-magnetic fields generated, consideration needs to be given to airfield flight paths and military aircraft flying areas. Wind farms might also raise concerns about the likely impact on local amenities, with issues such as noise, construction traffic, interference with telecommunications and driver distractions.

This shaping of planning at both the national and local levels demonstrates some of the wide-ranging issues that have become increasingly important to the debate on renewables, which also include some of the difficulties at the operational level of policy implementation. Indeed, against this backdrop, the complexities of national planning cannot be underestimated or undervalued and we now consider the arguments for and against wind farm developments.

### **ISSUES FOR AND AGAINST NEW WIND FARM DEVELOPMENTS IN THE UK: EMPIRICAL EVIDENCE**

The National Planning Guideline would appear to be designed to encourage the planning system to play its full part in making positive provision for renewable energy developments. Indeed, based on current policy, this is reiterated in the Planning Advice Note 45 (SCOTTISH EXECUTIVE DEVELOPMENT DEPARTMENT, 2002, p. 25): 'Given the Scottish Ministers' commitment to addressing the important issue of climate change and the contribution expected from renewable energy developments, particularly wind farms, *it is important for society at large to accept them as a feature of many areas of Scotland for the foreseeable future*'.

Such is the strength of emotion on locational issues that the UK Government and the Scottish Executive are now facing a storm of protest, with an increasing number of communities entering the campaign against new wind farms. Notably, recent concerns regarding planning consents have become so topical that they are now receiving increasing levels of publicity in the Scottish national and regional media, which is resulting in substantial damage to the credibility of the Government's renewable strategies. Likewise, anti-lobby groups such as Views of Scotland, are also damaging the Government's credibility by arguing that new wind

farms are commercially motivated at the expense of local community interests and, moreover, that they are invasive, ugly and noisy. Additionally, some commentators are expressing doubts about the ability of wind farms to replace conventional power generation, with professional bodies such as the ROYAL ACADEMY OF ENGINEERING, 2002, in response to the Government's recent Energy White Paper (DTI, 2003), pointing out the dangers of over reliance on wind power. The UK Government and Scottish Executive are therefore facing a strong backlash of opposition to their policies. From this analysis, the following question arises:

*To what extent are wind farms ugly, invasive, noisy, detrimental to tourism, opportunistic and is there too great a reliance on them to deliver the ambitious goals of the UK Government and Scottish Executive's energy policy?*

Having brought a number of important issues associated with wind farms to the fore, the paper will now address this question and, in doing so, present the paper's principal research findings. Of course, in answering this question it should be recognized that any response will be dependent on the particular perspective that is taken, i.e. government, business, interest groups or the general public. Hence, with a number of arguments being presented, we attempt to navigate and present an unbiased assessment of these, with some of the more important issues being summarized in Table 2.

#### *Visual and aesthetic concerns*

Clearly, wind turbines are large, tall and highly visible structures with elements that can influence the visual or aesthetic impact of a wind project including:

- landform and landscape characteristics
- the spacing, design and uniformity of the turbines
- markings on the turbines and with how the turbines relate to the skyline
- supporting structures including service buildings and ancillary components like power lines
- access infrastructure such as roads.

The international wind energy literature (see, for example, ALVAREZ-FARIZO and HANLEY, 2002; and KAHN, 2003) does identify visual and aesthetic issues as being of concern, even in countries where wind turbines are commonplace, such as in Denmark, although this issue is often dealt with in a cursory manner. From the perspective of local residents, however, living in close proximity to a wind farm raises concerns on the visual impact of equipment and these are an important and common complaint. Consequently, wind farms are constantly being criticized as invasive and ugly, even in rural or remote areas where there are few residential developments. In the case of our own research of the proposed siting by Dudley Developments, of a £30 million wind farm consisting

of 42 wind turbines on 750 acres of farmland near Peterhead in Scotland, invasiveness and visual concerns were two of the principal objections to the proposed development. On this note, the Chairman of the Buchan Wind Farm Action Group (William Mitchell) who opposed the development stated that:

We're not against wind farms in principle, we simply believe that in this case the location is wrong ... The plans indicate some of the turbines will be within a few hundred yards of people's homes and that is not acceptable ... the visual impact of the structures will ruin (the residents) live. (*The Aberdeen Press and Journal*, 2001)

Those organizations supporting wind farm developments, such as the government, economists, and all of those business executives interviewed in our sample, indicate that they recognize public concerns over the invasiveness and the visual impact of past and current wind farm projects; however, with similar comments being a prominent and recurring feature in this debate, there are increasing claims that the fears of people such as William Mitchel are unfounded. Notably, therefore, business organizations such as Dudley Developments also cite a research report undertaken by the Scottish Executive (DUDLESTON, 2000), which examined the attitudes of local residents towards four operational wind farms in Scotland.<sup>6</sup> The primary aim of Dudleston's research was to investigate how residents felt about the existence and proximity of a local wind farm(s) and, in particular, to assess the extent to which residents' views are based on actual experience or, indeed, if perception was formed through the media, and other sources. Primary results revealed that:

- local residents were generally positive about their local wind farm
- those who live in close proximity to a wind farm were more likely to provide a positive response
- the proportion of respondents who had anticipated problems prior to the development of a wind farm was significantly higher than the proportion that actually experienced problems after the development
- the visual impact of the wind farm did not feature as an issue for the majority of local residents.

On providing an international perspective, the AMERICAN WIND ENERGY ASSOCIATION, 2003b, has recently reviewed more than 25 public opinion surveys from the US, Canada and the UK, which seem to support the results of DUDLESTON, 2000, although organizations such as Views of Scotland challenge Dudleston's findings.

From a governmental policy perspective, the reasons for the UK Government's and the Scottish Executive's commitment to promoting wind power developments more widely has already been outlined, along with the importance of society to accept wind farms. Whether wind farms are ugly and invasive or not would appear to be of less importance to the UK Government and

Table 2. Synthesizing the key arguments of the pro and anti wind farm lobbies, along with other actors

The UK Government and Scottish Executive	The pro-wind industry lobby, e.g. individual companies and lead bodies	The anti-wind lobby, e.g. local activists and community interest groups	Other actors, e.g. independent professional bodies
<p><i>Political will:</i> articulated as a cleaner and less polluting source of energy</p> <p><i>Governmental goals:</i> makes a significant contribution towards meeting international obligations and national targets for the reduction of greenhouse gases</p> <p><i>Business leadership:</i> has the aspiration of British business becoming world leaders in the renewables market, with attached economic spin-off benefits and technological developments</p> <p><i>Locational advantages:</i> the UK's geography and in particular Scotland has the potential to harness wind power</p> <p><i>Broader aspirations:</i> having secure, diverse, sustainable and competitive energy alternatives</p>	<p><i>Assists government policy:</i> meeting national targets on greenhouse gas reductions through the development of an appropriate substitution strategy</p> <p><i>Significant financial benefits:</i> large profits for a developing technology within a mature energy industry with an emerging market segment</p> <p><i>Commercial and social acceptability:</i> the renewables energy market, and in particular onshore wind power, is now a well established and widely accepted source of electricity in Europe</p> <p><i>Economic development:</i> through inward investment and tourism in rural communities, the generation of new employment opportunities particularly in the design and manufacture of wind turbines</p> <p><i>Technological innovations:</i> stimulating the development of new and more reliable renewable technologies, with recent advances in wind power technology, now allowing wind turbines to operate much more quietly and efficiently than in the past</p>	<p><i>Planning process:</i> commercial exploitation focus over local community interests and concerns thereby engineering a socially unacceptable tolerance of wind farms</p> <p><i>Visual and aesthetic concerns:</i> Scotland's unique natural environment is being scarred</p> <p><i>Pollution:</i> noise generated by large wind turbines producing a spectrum of nuances</p> <p><i>Wildlife and habitats:</i> direct and indirect negative impacts</p> <p><i>Aviation and communications:</i> air safety, communication disruption and radar interference</p> <p><i>Tourism:</i> detrimental economic impacts in rural economies dependent on tourism revenues</p>	<p><i>Institutional and technical barriers:</i> impact on the national grid given the unreliable nature of wind power, the difficulties in storing large quantities of electricity, the build rate required to commission wind farms.</p> <p><i>Costs:</i> estimates indicate that maintaining conventional capacity to provide back-up power will be approximately £1 billion</p> <p><i>Investment:</i> other renewable technologies are being ignored in favour of wind power generation</p> <p><i>Competitive advantage:</i> British companies having difficulty in catching up on the experience and knowledge of their European counterparts</p>

the Scottish Executive than achieving governmental policy goals, which were outlined earlier. This is reiterated by comments by the Right Honorable Brian Wilson MP, the UK Energy Minister, who recently stated: 'If we are to meet our targets, we will require both large-scale wind farms and micro-farms . . . People will eventually get used to seeing turbines' (*The Herald*, 2001).

Such comments add fuel to this fiery debate, and interestingly, the UK Government and the Scottish Executive would appear to recognize that some regional and local landscapes will be more able to accommodate wind farm developments than others would without significant disruption to landscapes. Consequently, the UK Government and the Scottish Executive must recognize that in those particular areas of the country where the impact of wind farms may be significant on the environment, in terms of the capacity of the landscape to absorb such developments, it is extremely important to lessen these. This, of course, presents the Government with a challenge in that it must grapple with two apparently diametrically opposed stances, i.e.

'clean' electricity versus landscape and the protection of nature. In defence of the governmental desire to expand the number of wind farms, they do recommend that in a situation where a wind farm development may have a significant visual or other impact, then *a cautious approach be recommended*. It is debatable as to the exact interpretation of this statement and, indeed, does this 'recommendation' go far enough towards addressing protester concerns? However, there is a communication that strongly urges planners to consider the siting of wind turbines, along with the general design and layout of wind farms, to the extent that there should be widespread consideration towards any inherent characteristics of surrounding landscape such as landform, ridges, hills, valleys and vegetation in decision making (SCOTTISH EXECUTIVE DEVELOPMENT DEPARTMENT, 2002, pp. 25–28). This *should* enable the impacts of any proposed wind farm to be minimized, but interpretations on this document appear to be blurred.

Indeed, in spite of these recommendations, a very common complaint made by the anti wind farm lobby

in the UK has been that these and other considerations are being ignored by the local authority planning process, and that many proposed wind farms remain ugly and invasive. For example, one of the respondents from the interview survey conducted after a public meeting regarding the Dudley Developments wind farm project stated: 'Modern wind farms are a far cry from windmills of old. They are big and ugly' (interview with Peter Stevenson, anti-wind farm protestor).

Similar claims were also made indicating that:

- the planning process is unclear
- the views of local residents have consistently been ignored
- further guidance and advice is necessary by central government to allow local authority planners to make fair and consistent decisions regarding the siting and layout of proposed wind farm developments.

Against this backdrop, following a series of interviews conducted with the local protestors who opposed the siting of the Dudley Developments wind farm, content analysis of the dataset revealed a general consensus that there should be significant public involvement in order to allow the interests and views of residents to be factored into the development. In examining studies from both Denmark and Sweden, this form of inclusion was found to have been integrated into the approaches adopted by governments (KAHN, 2003). Furthermore, the finer analysis of the data alluded to a strong consensus for this process to include a series of fully transparent public residents' meetings, where it would be possible to discuss the visual and aesthetic impact of the proposed project, along with other important issues, e.g. anticipated noise levels. Interestingly, in the context of this study, many public meetings were held, independent of the planning process; however, this resulted in approximately 1,000 letters of protest being sent to the decision makers of the local council (Aberdeenshire Council). Perhaps the UK Government and the Scottish Executive could once again learn much from the participatory approach to new wind farm developments that is favoured in countries such as Denmark and Sweden (LOITER and NORBERG-BOHN, 1997, 1999; KAHN, 2003; and MEYER and KOEFOLD, 2003).

#### *Noise concerns*

There is a substantial literature on the history of the technology of wind turbines (RIGHTER, 1996; GRUBB, 1997; LOITER and NORBERG-BOHM, 1999; and KAMP *et al.*, 2003) with some of this literature (see, for example, the AMERICAN WIND ENERGY ASSOCIATION, 2003c) recognizing that there are two distinct types of noise associated with wind turbines. The first is a mechanical noise produced by the gearbox generator and other parts of the drive train, and the second being an aerodynamic noise produced by the passage of blades through the air. Furthermore, there

can also be wind-generated background noise, which has been noted to be significant in some instances (SCOTTISH EXECUTIVE DEVELOPMENT DEPARTMENT, 2002, pp. 21–22).

Thus, the potential for high noise levels has been highlighted by the UK anti-wind farm lobby as being a major concern in the proposed siting of wind farms. On this note, in the case of Renewable Energy Systems siting of a 12 turbine wind farm at Ark Hill, near Glamis in Scotland, farmer David Brown brought in a management consultant to investigate the potential noise from the proposed wind farm near his home. In outlining his concerns to his regional newspaper the *Dundee Courier* (24 MAY 2001), Mr Brown stated:

I am worried about the noise which would come from these machines . . . It is difficult to understand what it is like to live with a noise 24 hours a day . . . My house, and quite a few others, would be around 600 metres from several turbines. At one wind farm site in the North of England, the residents find the noise unbearable at that distance . . . The Company who supplied the turbines there, blame the site. If that is the case we could be in for trouble here because the Glamis site is similar . . . If this site is built and is as noisy as I am led to believe, then our lives could become unbearable'.

Further analysis of the collected interview data for this study, we found that noise concerns, in addition to the invasiveness and visual impact of the proposed development, were problematic and of significant importance to this group. Commenting in his regional newspaper, *The Aberdeen Press and Journal*, 2003c, Neil Alexander, whose home is close to the proposed wind farm stated: 'Living near these [wind turbines], the sound would be similar to having a six-lane motorway nearby'. Such views were consistent with the vast majority of this particular group and, in summary, the anti-wind lobby residents living near to the proposed wind farm developments are clearly and deeply concerned with issues surrounding the levels of potential noise generated by wind turbines.

In responding to these concerns, the pro-wind farm lobby suggests that well designed wind turbines are generally quiet. Indeed, this is further highlighted by recent studies into the design improvements to wind-turbines, which found that the noise generated by modern wind turbines has greatly been reduced (BLAIR, 2001; BROWN, 2002a; and PELTIER, 2003). Additionally, in this case example, Renewable Energy Systems (RME) claimed that the method used by Mr Brown's consultants to calculate noise levels was flawed. Furthermore, RME claimed that the consultants appeared to be unaware of the procedures and discussions drawn up by government departments to inform and calculate noise from wind turbines. Such discrepancies are unquestionably damaging to this debate, particularly when so much uncertainty exists over the actual pollution figures. Indeed, results showed a growing distrust by anti-wind farm groups in the claims

Table 3. Indicative noise levels

Source/activity	Indicative noise level dB(A)
Threshold of pain	140
Jet aircraft at 250 m	105
Pneumatic drill at 7 m	95
Truck at 30 mph at 100 m	65
Busy general office	60
Car at 40 mph at 100 m	55
Wind farm at 350 m	35–45
Quiet bedroom	35
Rural night-time background	20–40
Threshold of hearing	0

Source: SCOTTISH OFFICE EXECUTIVE DEVELOPMENT DEPARTMENT, 2002, p. 21.

made by business organizations on pollution figures, and this is in itself damaging to both government claims and government policy.

Notably, the Government Report, *The Assessment and Rating of Noise from Wind Farms*, reported in *Planning Advice Note 45* (SCOTTISH EXECUTIVE DEVELOPMENT DEPARTMENT, 2002) outlines a framework for the measurement of wind farm noise and gives indicative noise levels that should offer a reasonable degree of protection to wind farm neighbours, without placing unreasonable restrictions on proposed wind farm developments. Here, a series of recommendations are presented, which can be regarded as relevant guidance on good practice. Furthermore, the *Planning Advice Note 45* (SCOTTISH EXECUTIVE DEVELOPMENT DEPARTMENT, 2002) presents data which give an indication of the noise generated by wind turbines, and demonstrate comparative noise levels generated by wind turbines with other everyday activities (see Table 3).

Finer analysis of Table 3 reveals some interesting data and one question that must be asked is 'why have the promotion of these figures not been fully exploited by those in favour of wind farm developments?'. With this in mind, these informational figures do make interesting reading, and they tend to invalidate the claims made by the anti-wind lobby. Markedly, although in terms of our literature review, we could not find any data to confirm or reject the Scottish Office figures, this is an area that warrants further research.

#### *Commercial exploitation versus community interests and related concerns*

In examining the international wind energy literature and, in particular, the Danish experience there are claims that the rush for wind power is a win-win-win situation (KNOTT, 1999; BLAIR, 2001; WILKS, 2001; BROWN, 2002a, 2000b; and PRATT, 2002). Here, strong evidence suggests that new wind farm developments result in many opportunities being

created, with typical benefits being increasing business profits, employment and environmental enhancements. But not all actors are convinced. For example, an important and interesting article on this issue is expressed in the article entitled 'Wind Energy – Free as Air or All Puff and Bluff?' (*The Aberdeen Press and Journal, March Energy Supplement*, 2003, p. 4) thereby introducing a distinctly negative spin on recent wind power developments. Here, the anti wind farm lobby present the crux of one of the more important arguments by stating: 'There is something intuitively unhealthy about the "dash for wind" that makes one suspicious that getting as much generating capacity built as fast as possible is more to do with commercial gain and advantage, than creating solutions for future energy supply'.

The central focus of this paper points toward the economic benefit that the Renewables Obligation Certificate Scheme provides 'wind farmers' with, in terms of a guaranteed market for those companies owning a 100 MW wind farm expecting to earn profits in the region of £270 million over a 20-year period (p. 4). Consequently, the potential to earn such high profits largely explains the increasing interest in wind power. Additionally, our results unanimously show that business executives view this as a very competitive but rapidly expanding market that cannot be ignored. While we take the view that there is little wrong with a company generating such large profits, the concern of some commentators is that wind farm technology is mature, with mainly Danish or German companies dominating the international market. In the UK domestic market there are some British companies in the wind power market segment; however, if they are to make a real impact in this market, then in the main they have perhaps 20 years of experience and knowledge to catch up on. We have already made the point that Denmark is the largest manufacturer and exporter of wind turbines with half of the world's sales in 1999 being made by Danish companies. Strategically, therefore, according to WILKS, 2001, the wind power market could be already out of the reach of many British companies. Nevertheless, when speaking at the 'All Energy Opportunities Conference' in May 2002, Ross Finnie (Scottish Minister for the Environment and Rural Development) highlighted the importance of the emerging renewables sector and the potential opportunity for establishing a new Scottish industry, by stating that:

With its history of working in difficult environments such as the North Sea in pursuit of oil and gas, Scotland is ideally placed to build its existing expertise and world-wide reputation for engineering excellence ... That means jobs to provide the infrastructure for Scotland, and the chance to compete for a slice of the rapidly growing international market, which could be as much as £10 billion per year by 2010. (SCOTTISH EXECUTIVE NEWS ONLINE, 29 May 2002)

Such statements do indeed articulate a number of economic benefits that underpin the strategic decision making of government. Consequently, with the increasing number of foreign companies setting up operations in Scotland's energy sector, indications are that new jobs will be created as a result of their investment. Unfortunately, extant research fails to estimate with any degree of accuracy the numbers, the types of jobs, or in what sectors these new employment opportunities will arise (WILKS, 2001). This is a significant weakness in the economic argument for such projects and one that must be addressed if the UK pro-lobby, government and UK business, is to convince the anti-lobby of the economic benefits of proposed wind farm developments.

Currently, the anti-lobby has countered the economic argument on job creation by citing evidence that the largest of European wind farms employ no more than a handful of full-time and part-time employees. However, there is a business argument suggesting that many new jobs could be created in the manufacture of wind turbines, with the manufacturing industry benefiting greatly. On this note, the oil and gas industry is poised to gain, particularly as there is a highly trained workforce and an abundance of scientific and technological expertise that can be capitalized upon. On opening a new Vestas<sup>7</sup> wind turbine factory on the Kintyre peninsula in Scotland, this particular project was seen to employ 108 people, which was subsequently commented on by the Scottish First Minister Mr Jack McConnell, who stated:

I want Scotland to be a world leader in renewable energy generation and use. But I also want Scotland to become a centre for excellence in advancing the renewable energy technologies and scientific development . . . In taking the Scottish economy forward, we are focusing hard on science and workforce skills. That is right for Scottish companies, but also for those companies who want to come here to do business. We know that inward investors, like Vestas, are attracted to Scotland's well-trained workforce. (SCOTTISH EXECUTIVE NEWS ONLINE, 6 May 2002)

Demonstrably therefore, the Scottish Executive can be seen to have won some of the argument on the jobs issue, but the victory is clearly marginal and, consequently, the issue on jobs creation necessitates further inquiry.

#### *Wind farms and tourism*

Drawing on the experience of Denmark, the UK Government and the wind power companies vehemently claim that wind farms have no negative effect on tourism and indeed that they have the potential to be significantly beneficial to Scotland's 'tourism' industry. Contrary to this view, the anti wind farm lobby dismiss these claims and argue that wind farms

will certainly deter many tourists from visiting Scotland in the future. Both camps cite evidence in favour of their arguments, although substantive empirical evidence is lacking here; however, the AMERICAN WIND ENERGY ASSOCIATION, 2003b, state that research commissioned by the Scottish Renewables Forum and the British Wind Energy Association, in the form of an opinion poll carried out by the respected market research organization MORI, found that there were more than 300 visitors to Argyll in Scotland, which appears to dispel the belief that wind farms deter tourists from visiting Scotland. This research was carried out over two September weekends during 2002 in the Scottish locations of Tarbet, Inveraray, Oban, Campbeltown and Lochgilphead. Finer analysis of the data suggested that, when asked about what effect wind farms, had on their impression of Argyll (if any) the following result were found:

- 55% of the sample stated that their impression was 'generally or completely positive'
- 32% of the sample stated that their impression was 'ambivalent'
- only 8% of the sample stated that their impression was 'negative'.

Moreover and interestingly, this research was seen to reveal that 80% of people surveyed indicated that they would be interested in visiting a wind farm visitor and information centre during their stay (*The Herald*, 2002d). In countering these findings, the anti-lobby group, Views of Scotland, dismissed the MORI research where they claimed that it was biased in favour of wind farm developers who, incidentally, had provided MORI with a brief and who had paid for the research to be undertaken. Furthermore, in responding to this MORI research, a spokesperson for Views of Scotland stated in a newspaper article in *The Scotsman*, 2002c:

The problem with many surveys, including some produced for the Scottish Executive, is that they do not properly measure the evidence in an unbiased way . . . We are confident that MORI did a competent job within the remit given to them, but we note that the sponsors of the research, who specify the remit, were the Scottish Renewables Forum and the British Wind Energy Association. Both have a vested interest in persuading people to accept wind power stations and yet it will be the ordinary people of Scotland who will be affected when tourism suffers . . . We have to question the soundness of the assumptions upon which this research was based when it conflicts with the real experiences of ordinary people.

Following on from these comments, the position of Views of Scotland was strongly expressed in a recent Report entitled 'Incremental Change or Wanton Destruction' (*The Aberdeen Press and Journal*, 6 March 2003) which made its stance on wind farm developments very clear. It should be noted however, that this particular report is based on anecdotal evidence.



Observably, therefore, the report stated: 'Delegated by Westminster with meeting the bulk of the UK targets for renewable energy, the Scottish Executive, supported by politicians from all parties, has handed the countryside over to wind-power developers with scant regard for the environment, its ecology or the tourism industry' (quote from the *Aberdeen Press and Journal*, 2003e).

In this vein, the sentiments of Views of Scotland are also shared by a number of unlikely sources including Sir Jeremy Isaacs, former Chief Executive of Channel 4 and Director General of the Royal Opera House, and the organization VisitScotland. Consequently, Sir Jeremy is campaigning against AMEC's proposals to erect a £30 million wind farm consisting of 28 wind turbines near Edinbain, Island of Skye (Scotland) where each turbine is expected to be approximately 330 ft high. Here, he advocates that the impact of this project should not be underestimated and that it is important for the local planning authority to strike the correct balance between pressures for renewable energy; the beauty of Scotland's natural environment; and the effects that wind farms will have on the tourist industry on which Skye is dependent. He cites a recent VisitScotland survey, which showed that some tourists are put off by wind farms when he states: 'That is bad news for the people who run the caravan park here, or the Bed and Breakfasts or hotel and bad for the economy as a whole' (*The Scotsman*, 2003)

Similarly, a report by NFO SYSTEM THREE, 2002, states that Scotland's tourism industry is very different in nature and scope to that found in Denmark. Many international visitors coming to Scotland, as they do in other northern European countries such as Sweden, visit these countries for their internationally acclaimed and unspoilt scenic environments, whereas Denmark has a flat landscape and is largely urbanized, with few areas that are underdeveloped. Organizations such as Views of Scotland have used this argument to support their cause and note the recent research undertaken by a family business in Argyll, which has produced a warning over the potential harm that wind farms could have on the Scottish tourism industry. Here, holiday cottage proprietors, Tony and Georgina Dalton, carried out a survey of 100 people renting their cottage in Lochavich (Scotland), near where Scottish Power is planning to erect a two-turbine wind farm. According to *The Aberdeen Press and Journal*, 2002, the research found that over 70% said they would not return to the area if the wind farm was built, and 68% said they would not visit Scotland if wind farms proliferated the landscape.

From the evidence presented here, it should now become apparent that the tourism benefits (or otherwise) of wind farms are still the subject of much debate and controversy, with more thorough research needing to be undertaken in order to assess the anticipated benefits and costs of this energy substitution strategy, particularly from within a tourism context. Our own

survey results of the anti-wind campaigners and pro-wind energy business executives did not provide a new insight into this on-going debate and this can be partly explained by the fact that the Dudley Developments proposed wind farm site near Peterhead is not a tourist area. It is rather a business and industrial centre, dominated in particular by the fishing, agricultural, oil and gas, and construction industries and, as such, our sample of activists and business executives would not have perhaps considered 'tourism' as being an important issue. The jury is therefore still out on the tourism issue.

#### *Is the UK government relying too heavily on wind farms?*

From our literature review there are a number of concerns expressed by prominent professional and other organizations such as the UK ROYAL ACADEMY OF ENGINEERING, 2002, that there has been too much reliance on wind power, and have pointed out a number of weaknesses in the Government's current renewables strategy. The primary concerns of the Royal Academy of Engineering, many of which were also identified by our own survey respondents and in particular the business executives, focus on the potential issue of instability that wind power can cause to the national electricity grid. This is particularly important, given the inherent unreliable nature of wind power. Piggy-backed on this problem is the long-standing technological issue outlining the complexities and difficulties associated with the storage of electricity in large quantities and therefore there is indeed a need to develop more advanced means towards improving storage capacity. We do recognize that the science and technology strand of the international wind energy literature has been debating this issue for some time, which has resulted in the emergence of some partial solutions.

Another important issue that has been discussed by the international wind energy literature, which is also of concern, is the associated costs of maintaining conventional plant capacity in order to provide back-up power when wind power is light or absent. It is very likely that new technological solutions will be developed to this address this problem, so in the longer term this might not be a significant barrier. In the meantime, however, reliable estimates by ROYAL ACADEMY OF ENGINEERING, 2002, p. 26, indicate that it might cost in the region of £1 billion per annum to maintain conventional back-up power in the UK, thereby destroying the cost advantage argument.

In addition to these technical barriers and perhaps the most significant is the scope of the building programme required to commission wind farms at the required rate to meet the Government's policy ambitions in the field of renewable energy (*ibid.*, p. 27). This remains a significant problem, particularly in the light of the general publics of both the UK and Scotland who may not tolerate further onshore developments, although this could potentially be addressed

by the UK Government's recent decision to expand offshore wind farm developments. Even if the technical barriers are overcome through technological innovation, we still see the social unacceptability of wind farms in the UK as being the most significant threat to the Government's renewables strategy, and one which must be addressed without further delay. On this note, we outline a number of policy recommendations below.

### CONCLUSION AND POLICY RECOMMENDATIONS

This paper has been set in the context of the international wind energy industry, with important developments in North America and Europe having been outlined and considered. In establishing the international context for the research, we have been principally concerned with evaluating the UK Government and Scottish Executive's renewable energy strategies since 2000, which have arisen as a result of global environmental initiatives by the UN to reduce greenhouse gas emissions, and by the European Union to develop a more sustainable energy system based on renewable sources. The UK Government and Scottish Executive's renewable strategies have a number of different strands attached to them, and these culminate in a leaning towards wind power. This paper examined some of the difficulties involved with implementing a renewables policy based on wind power, and a number of prominent literary sources were used to underpin international experiential learning.

The UK experience of wind farm developments reveal that planning systems have had difficulties in handling wind power, which are not dissimilar experiences to those of countries such as Sweden and The Netherlands. In differentiating the UK from countries such as Denmark, however, we note that the rapid penetration of wind power in the UK, and in particular in Scotland, has resulted in much opposition from citizens and other interests groups, to the extent that wind power is now being presented as a controversial technology *per se*, while we do recognize that this is probably the only renewable technology that can currently compete on economic terms with traditional UK energy sources. To date, the UK Government and the Scottish Executive have not attempted to fully educate the general public and other interested parties to this fact, or indeed of the other merits of an energy system based on renewable energy sources, and this seems to have been a significant failing on the part of their implementation strategies. The UK Government and Scottish Executive now need to launch a comprehensive and integrated awareness campaign to convince the UK general public of the merits of a renewable energy system based on wind power.

In addition to general awareness raising, there is also a need for greater citizen participation in the planning process. It is clear that the general characteristics of

wind farm developments call for a well-structured planning system, from the national level down to the local authority level, and one which addresses the obvious dilemma between the promotion of wind power by the national governments, and the various political structures of the regional/local planning system that regulates the siting of turbines, and allows for citizen participation. Studies such as those conducted by KAHN, 2003, suggest that citizen participation in both the general planning system and in the assessment of particular projects can lead towards significant benefits in the reduction of public opposition. Such an approach demonstrates a greater clarity in understanding consumer behaviour and allows for both strategic and tactical approaches to be rapidly developed in order to handle conflicts as they arise. The current UK planning system should therefore be revised to incorporate appropriate regional and local plans for wind power developments, with these being coordinated at the national level to reflect the following five major objectives:-

1. National and governmental aspirations
2. Regional and local planning aspirations
3. Economic and technological exploitation
4. Address local consumer concerns
5. Address environmental impacts, including visual and aesthetic, noise and other concerns.

Implementing strategic initiatives to address the above issues would overcome many of the criticisms made by the various anti wind power organizations.

The evidence provided from studies conducted in the US and Denmark indicate that the UK Government and the Scottish Executive must make a long term commitment to wind power, and establish clear demand-pull public policies to provide a consistent and long-term market for wind energy. LOITER and NORBERG-BOHM, 1999, p. 95, state that 'the goal of technology policy should be not simply to create a market ... but also to encourage innovation ... and, to provide the strongest incentive for innovation, policies must provide a consistent and long-term market for wind energy'. Experience from Denmark also suggests that, in such markets, local involvement in the ownership of turbines can play an important role in reducing the sort of public opposition encountered to wind farm developments in the UK. CHRISTENSEN and LUND, 1998, indicate that the Danish Government has made local ownership an important dimension of its implementation strategy, with many wind turbines being owned by partnerships of between 20 and 50 families. On a similar note, TOKE and ELLIOT, 2000, found that, in Germany, a common form of economic involvement is wind farms jointly owned by local farmers and schemes organized by commercial wind farmers who sell shares to local people; this is supported by the national government and regional/local councils. This form of governmental strategic behaviour

differs to that of the UK where wind farm developers are large commercial organizations. Hence, in order to learn from the market leaders in wind farms, there is a distinct requirement for a greater degree of economic involvement of the local population, and furthermore, this needs to be encouraged and supported by national and regional government demand-pull public policies. Currently in the UK, the populace is unaware of any policy measures to promote local ownership, and again this seems to be a failing of the top-down approach currently favoured by the UK Government and Scottish Executive; this issue requires to be addressed – urgently.

In establishing technology-push public policies, the UK Government and Scottish Executive would be well advised to follow the advice of professional bodies such as the Royal Academy of Engineering, and furthermore, the authors of this study strongly recommend that the UK Government should invest more widely in the full gambit of renewable technologies currently available, including, for example, offshore wind, wave and tidal power, while recognizing that time horizons for the maturity of these technologies, particular the later two, are much longer term. In the context of offshore wind power generation, some of the larger commercial organizations are being encouraged to invest and develop offshore wind farm technology,<sup>8</sup> with some notable success to date. The business executives surveyed in this study felt that there were significant opportunities for offshore developments and that such developments might help to overcome current issues and problems associated with onshore wind developments, although there is a rapidly emerging debate on the marine impacts of such developments. The business executives surveyed also identified that photovoltaic's could – with the proper encouragement and funding – make a contribution to the UK's renewables targets, particularly since countries such as Germany have already rolled out photovoltaic with some considerable success (see also ROYAL ACADEMY OF ENGINEERING, 2002, p. 30). Wave and tidal power in the UK also requires much more research and development funding, particularly since these technologies have been used successfully in countries such as France for over 30 years. Clearly, there have been many mistakes made by successive UK governments throughout this 30-year period, which require both immediate attention and strategic action, in terms of significantly increasing current incentives for introducing renewable energy alternatives and indeed for developing renewable technologies.

Still linked to technology-push public policies, transport accounts for approximately 40% of all energy consumption and, consequently, it is important that the Government also addresses energy consumption that is currently demanded by transport, otherwise the Government's strategy would appear to lack dimension. A recent US State of the Nation address by President

George W. Bush in November 2003 announced plans to invest \$2.5 billion on researching hydrogen fuel systems for road vehicles. This initiative is seen by many as an important step towards changing US industry and consumer behaviours, in terms of 'greener thinking' and 'energy conservation', and redefines the agenda for many in both the developed and developing nations. The use of wind energy to electrolyse water to produce hydrogen for fuel could span a new industry in hydrogen-fuelled engines, fuel cell applications and the like (*The Aberdeen Press and Journal, March Energy Supplement*, 2003) and is a further example the UK should be considering to add further subsidies and stimulate investment. Hence, the UK Government and Scottish Executive, along with business, would be wise to invest in this developing technology, as there is currently a real opportunity to become global players. Finally, as outlined earlier, British firms have a significant number of years of experience and knowledge to catch up on, if they are to make any real impact in the international wind power market. The Government must consider these conclusions carefully and respond with vigour, otherwise the emotional rhetoric of 'creating world-class firms' constantly being articulated by politicians and government officials will remain as unobtainable and unrealistic visions.

## FUTURE RESEARCH

An important objective of this paper has been to develop a third strand to the international wind energy literature, which typically treats the social and environmental impacts associated with wind farms in a cursory manner, and therefore there is a mandatory requirement to stimulate future research in this area. We do hope that we have provided a sound rationale for our approach and conclude the paper by calling for significant future research in this area. Hence, as this rapidly evolving and politically sensitive area of electricity generation substitution strategies unfolds, it is clear that there are a number of important issues that require further research and some of these are outlined below.

Our paper indicated that there is a distinct need to measure more fully the perceived visual and aesthetic impacts of wind farms. While managing visual and aesthetic concerns is clearly an important issue in the planning process, KAHN, 2002, suggests that there are currently no reliable measurement tools available, with levels of impact being dependent on personal preferences. The effect of this makes decision making more complicated and further highlights the need for citizen participation to hear a full range of preferences. Additionally, this creates an opportunity for government to commission further research studies into identifying performance indicators for measuring impact levels. There is also the need for research into the different ways in which citizens can contribute to planning decision making in general, and the assessment of

particular projects, perhaps through citizen juries and citizen advice panels which are currently uncommon. BOVERKET, 2003, purports that there has been little research undertaken on how such techniques work in practice, even in countries such as Sweden where they are used, and there does seem to be a need for further research in this particular area. Furthermore, there is also a need for further research into the national and regional economic benefits attributed to wind power expansion with extant research, as we noted, failing to estimate the numbers, sorts of jobs and in what sectors new employment will arise. Linked to this, there is also a need for more research into the economic impact of wind farms on the UK tourism sector, with our own research indicating that this remains a controversial issue particularly in countries such as Sweden and the UK. Finally, LOITER and NORBERG-BOHM, 1999, indicate that there is an urgent need for research which should examine the sorts of technology-push and demand-pull policies that would create a long-term market in wind power. In the context of the UK, such research should consider, for example, the sort of local ownership and other schemes, which would help to overcome public opposition to wind farms. Any such schemes should fully reflect the national and regional cultures of the UK and warrant further enquiry.

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## NOTES

1. As a result of the devolution settlement, responsibility for environmental policy is devolved to the Scottish Executive. The UK Government does retain overall responsibility for energy policy and as such is a reserved issue. Renewable issues, however, are executively devolved allowing the Scottish Executive to set renewable energy targets for Scotland.
2. A Planning Advice Note is a government document which provides advice on good practice and other relevant information.
3. During 2000, for example, the UK produced 1.3% of their electricity from renewable sources, compared with 16.7% in Denmark, 4% in The Netherlands, 3.2% in Germany and 3.4% in Spain (DTI, 2003, p. 45).
4. Internationally, the companies that dominate the manufacturing of wind turbines are Vestas, NEG Micon, Enron, Enercon, Nordex, GE Wind Energy and Bonus.
5. A National Planning Guideline provides statements of Scottish Executive policy on nationally important land use and other planning matters, often supported where appropriate by a locational framework.
6. These wind farms are Hagshaw Hill, South Lanarkshire; Windy Standard, Dumfries and Galloway; Novar, Highlands; and Bein Glas, Argyll and Bute.
7. Vestas is the world's leading manufacturer of wind turbines.
8. Denmark is proposing to produce 50% of its electricity from offshore wind by 2030 (DTI, 2001)

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