The New Energy Commons; Exploring the Role of Property Regimes in the Development of Renewable Energy Systems

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Abstract

The classical debate about the commons is of direct relevance for pre-industrial practices of energy provision, such as the collection of firewood or peat harvesting for heat, the grazing of draught animals on common land and the hunting of whales for blubber which was used for lighting. As a contrast, the industrial revolution was fuelled by fossil carbon and gave rise to modern corporate capitalism. None were richer or more powerful than the private enterprises which sought to monopolise the production and distribution of oil, like Rockefeller's Standard Oil. Threats of security of supply and climate change have recently led to the re-emergence of renewable energy as a politically and environmentally desired source of energy supply in (post)industrial societies. However in the light of strong public support and government subsidies and targets, the development of renewable energy has been remarkably slow. Our paper explores the desired development of distributed and renewable energy systems through the lens of property regimes. A closer look at ownership issues around access, exploitation and commodification of a range of different renewable energy systems reveals that a lot of the observed barriers to the growth of this sector can be explained in terms of enclosure of the energy commons. Powerful vested interests are in part to blame but some renewable energy systems are new commons and it could be argued that their enclosure is largely accidental, i.e. the result of old and redundant regulations. We argue that the development and adoption of appropriate (common) property regimes will have to lie at the heart of any serious effort to enable individuals and communities to contribute actively to a more sustainable and low carbon energy future.

Key words: *energy commons; anti-commons, renewable energy*

1 Introduction

The struggle for existence is the struggle for available energy

The above statement, attributed to Ludwig Bolzmann, is applicable to all life forms and to evolution in general (Lotka, 1922). Whether it is food, heat, light or motion/transportation, access to and control over energy is a fundamental factor in the survival of individuals and societies. The technological and social evolution of human society can be traced as a series of energy revolutions which have enabled us to utilise biomass energy, wind energy, hydro power, solar energy, fossil fuels and nuclear energy. The status of a country with regards to these energy transitions, is a blunt but useful indicator for socio-economic development; the richest and most powerful countries have been building nuclear power plants whilst the poorest countries are still largely dependent on renewable energy. Wasteful large scale use of finite energy resources has resulted in a global crisis of climate change and rising fuel costs. Both the unfettered extraction of fossil fuels and the equally unfettered release of CO2 in the atmosphere can be seen as examples of tragedy of the commons. The atmosphere is, as Hardin recognised, a classical example of a global common. But also fields of oil and gas can be seen in this light. The property rights allocated to countries on the basis of the spatial delineation of national boundaries, have limited meaning when fields straddle boundaries and oil and gas can migrate towards those who build more oil rigs or use the strongest pumps. The tragedy of the commons can also have a temporal dimension when current generation is, in the words of George Bush, addicted to oil, and is extracting this black gold at maximum speed to the likely detriment of future generations.

In recent years however there has been a potential sea change in energy development. One of the responses to this global crisis has been the increased interest in renewable energy in developed countries. All EU countries and many of the other (post) industrial countries have set targets for renewable energy. They are providing subsidies, tax breaks and other forms of support to achieve these targets, but many are struggling to achieve the required level of growth[1]. There is a growing body of literature regarding the barriers encountered, including financial, technical, institutional and societal[2]. However the role of property regimes in the emergence and persistence of these barriers, is yet to be explored.

Different types of renewable energy have fared differently in the history of human-nature relationship. The exhaustion of fuel wood (biomass energy) might be a classical example of the tragedy of the commons, but other resources such as wind and hydropower have very different characteristics. In the past they have been used extensively by man without any threat of over-exploitation. Some types of renewable energy, such as wave and tidal, have

[1] for example the UK has set a target of achieving 10% of the electricity from renewables by 2010. In 2003, elecricity from renewables stood at 3.1%, rising to 4.6% in 2006 (latest figure available).
[2] see for example van der Horst, 2005; Mitchell, 2007.

not been utilised much in the past. New technologies and demand for 'green' energy has turned these resources into truly 'new' commons.

A greater use of renewable energy in (post) industrial societies would require a step-change from a centralised system of energy provision (electricity grid; gas grid; oil distribution networks and large power plants) towards 'distributed generation': Because the potential for utilising renewable energy is widely distributed in space[3], a renewable energy system requires many small-scale facilities to replace or supplement an existing energy system based on fossil fuels or nuclear. The spatial configurations of 'modern' renewable energy technologies often cut across the boundaries of existing property regimes. This throws up a number of challenges for the existing spatial planning and energy management systems in (post) industrial societies. The aim of this paper is to explore the role of private and common property relations in the development of modern renewable energy technologies.

The paper is structured as follows. First we provide a brief historical context for the exploitation of energy in human society. We then draw attention to the spatio- temporal configuration of renewable energy. Subsequently we analyse how this configuration may touch upon a range of existing property regimes and regulations. We then discuss how these property relations can influence the development of renewable energy systems, and how this influence can be interpreted in the light of existing literature about the commons.

2 Energy and history

Biomass energy was the first type of energy appropriated by humankind and the discovery of how to make fire is still considered as a milestone in the development of human society. It enabled us to keep warm, keep dangerous animals away and cook food to make it more bacteriologically safe and better digestable. Similarly, without the development of charcoal, effectively a (calorific) value added biofuel, we might have been stuck in the stone age, without a fuel that can melt metal[4]. The ability to create fire was the first technological innovation that enabled early humans to reshape their physical environment. For millennia, hunter-gatherers on all continents have used bush-fires to improve hunting, creating an altered and more open landscape in the process. Agriculturalists used slash-and-burn methods to prepare the land for cultivation and even these days fire is still widely (though often illegally) used as a tool to 'clear' land for grazing or farming, in some Mediterranean countries, the Amazon or Indonesia, where the massive scale of burning in recent years has resulted in smog across Southern Asia.

Biomass is often the only fuel available or affordable to the rural poor and in many developing countries it still constitutes the largest part of the primary

[3] With the exception of a limited number of locations with large-scale hydro-power or geo-thermal potential.

[4] For research on the relationship between the developmental phases of human society (incl. urbanisation) and energy consumption, see for example Odum and Odum, 1981; Martinez-Alier and Schlupmann, 1987; Huang, 1998.

energy consumption. Even where humans do not light bushfires or cut the forest to extract commercially valuable timber, the collection of firewood for domestic consumption can result in deforestation, which consequently leads to the degradation of soil and water resources, the loss of biodiversity and further threats to rural livelihoods. Firewood is a key resource in the classical debate about the commons, both in the history of western societies (e.g. Thompson, 1993), and in developing countries where the 'fuel wood crisis' has been widely debated (e.g. Hegan et al., 2003). By contrast, developed countries have had the luxury of experiencing a growing forest resource (the 'forest transition phase'; see Mather and Needle, 1999), whilst drawing increasing amounts of their (growing) energy needs from sources that are remote in both a geographical sense (imports) and a temporal sense (fossil fuels). Although there are geographically divergent trends towards 'post-productivist' rural landscapes (Phillips, 2005; Mather et al., 2006; Jack, in press), very few people in post-industrial societies are relying on biomass for their primary energy needs. Biomass energy is mostly used for amenity-dominated purposes such as log fires or barbeques.

A very similar trend can be recognised for many other renewable energy systems. Draught and riding animals, sailing ships, windmills and waterwheels have revolutionised our industry, commerce, culture, landscape and society and in the past. While still widely employed in developing countries, they have all but been abandoned in developed countries. With the exception of large-scale hydropower, the use of renewable energy in developed countries in the last 50 years has been limited to amenity, sport, historic or museum displays, hobbyist, university research and a small fringe of deep green environmentalists often deliberately living in remote locations where the mainstream energy alternatives are harder to come by.

The history of modern capitalism and especially corporate capitalism is intimately related to the practice of energy use in our society, i.e. to the package of energy/fuel type and its utilisation technologies. In his popular book 'the corporation', Bakan (2003) narrates how the corporation, declared illegal after the notorious South Sea Bubble of 1720, finally developed as a form of mainstream capitalism in response to the opportunities offered by the steam train; it was the only way to accumulate sufficiently large amounts of private capital to fund the long distance railway lines which opened up the US interior to large scale exploitation. The history of the oil companies, described in detail by Yergin (1990), shows how the oil majors, with Rockefeller's Standard Oil in the lead, encouraged the industrialised world to become (in the words of president G.W. Bush) addicted to oil and jostled for monopoly power over a source of wealth so vast that it has no comparison in history.

Since the advent of oil and electricity, the grid has been a key characteristic of energy management in industrialised countries. Oil and gas are often transported through pipelines from producer to intermediates and/or from intermediates to consumer. Electricity is always transported by wire. The energy grid has become a natural monopoly, as did the transport grid (roads, railroads) and the drinking water distribution pipelines. Historically the grid developed organically as diverse local producers (individual entrepreneurs, cooperatives, local authorities) decided to do the logical thing: They collaborated and joined up their mini-grids so as to share infrastructural costs and reduce the risk of failure in supplying their customers, boosting consumer confidence in the process. In many countries the authorities eventually nationalised these separate natural monopoly networks and created a parastatal authority tasked with joining up all the local schemes, adjusting them to a single national standard, expanding their coverage across the country and managing this national distribution network for the benefit of society. These large state organisations often kept a long-term planning perspective, based on a ‘predict and provide’ model of public service delivery. For example in the UK this resulted in an electricity grid with 30% over-capacity; not cheap but very robust. The fashion of privatisation swept the utilities sector in the 1990s and a growing number of governments were keen to sell off government utilities, especially as this would save them the need to invest in old and decaying infrastructure which in many cases had been neglected since the oil crisis of 1973. Privatisation of the utilities sector has necessitated the development of a state-appointed energy regulator whose task it is to ensure that the companies owning a natural monopoly do not abuse it by providing poor services and over-charging for these.

Dependent on the developmental stage of the grid, producers seeking to join or to connect to an existing grid to transport water or energy to customers, have found it more or less difficult to succeed. Joining up was relatively easy in the early days of spontaneous collective action by producers. Under state control it was very difficult to join but where the state made a real effort to provide good services to communities, there would have been only a very limited demand for this form of entrepreneurialism. In the era of privatisation, the companies running the grid stand to gain very little from allowing small new producers (like those for renewable energy) to use their grid. It is therefore down to the regulator to encourage companies open up and allow third party access to their grid. The extent to which the regulator is indeed enforcing affordable access, will have a great influence on the size of the barriers experienced by new energy producers. In the past many green energy pioneers have complained about the institutional barriers for connecting to the grid, suggesting that appropriate enforcement by the regulator has often been insufficient.

3 The spatio-temporal configuration of renewable energy

Table 1 lists the different types of renewable energy and the key energy services these can provide. In addition to these basic energy services, renewable energy can provide a wide range of cultural, spiritual and amenity services.

Table 1: Types of renewable energy and the energy services they can provide. Specific conversion technologies are included in brackets.

	Electricity**	heating services (Space/water/food)	Lighting services	Transport services

Biomass energy*	X (steam or gas turbines)	X (stove, boiler, open fire etc)	X (open fire, lamp oil)	X (draught animals, piston engines, steam turbines)
Direct Solar energy	X (Photo voltaics)	X (passive solar; solar water heaters)	X	
Geothermal energy	X (steam turbine)	X		
Wind energy	X			
Hydro energy	X			
Wave & tidal	X			

* includes wood/straw, gas from anaerobic digestion, ethanol from starch or sugar, biodiesel from fat.
** can be used to provide heating, lighting and transportation and communication services.

The utilisation of most types of renewable energy is very low in comparison to the theoretical availability. For example it is often claimed that the UK has enough wind resource to cover all its energy needs, but currently wind farms only supply us with about 1% of our electricity needs (and electricity itself is only a minor part of the UK's total energy use). There are three fundamental geographical reasons why the use of renewable energy is always much smaller than its theoretical potential.

First of all, all types of renewable energy are unevenly distributed in space. For example most of the earth's surface receives solar radiation but the intensity depends on latitude, relief and cloud cover. Geothermal potential exists everywhere but the depth at which it is available depends on the geology. Hydropower exists everywhere where there is flowing water, etc.

Secondly, the technologies available for the utilisation of renewable energy are more place specific still. For example a river in a mountainous area can only be dammed in specific locations where the underlying rock is sufficiently stable and non-permeable and where a dam of limited size can create a large enough head. Similarly, the tidal regime does not change much along a 100 km coastline but the feasible opportunities to trap water at high tide, is strictly limited to those bays and estuaries which can be dammed.

The third reason is that the actual utilisation of renewable energy depends on demand. Population centres where these energy services can be consumed are unevenly distributed in space. Often this distribution is unrelated or even negatively correlated to the distribution of renewable energy. For example barren windy plateaus, volcanically active areas with good geothermal potential or mountainous areas with high hydro power potential often tend to be less densely populated than lowlands where these types of renewable energy are much scarcer. Areas with high and exploitable renewable energy potentials need to lie within feasible transport distance of population centres. The feasibility depends of course on the mode of energy transport, which may be up to 40 km for hot water pipes, perhaps a bit more for bulky biomass transported by tractor or lorry, hundreds of kilometres for electricity lines and thousands of kilometres for palm oil transported by ship (already an existing global commodity). Some renewable energy systems don't travel at all, but must be installed directly in the spaces where the end users can benefit. Examples of these include direct lighting services from the sun and lighting and heating services from the direct combustion of biomass. However even those types of renewable energy that do travel, depend on transportation facilities. For freely traded commodities such as biomass resources, road and harbour infrastructure is a limiting factor in terms of where it exist, but not in terms of access to existing infrastructure. For energy delivery which depends on the use of a centrally managed grid (e.g. electricity grid, gas grid, some oil pipelines), both existence and access can be highly problematic. For example wind-farms need to connect to substations on the national electricity grid and these are absent in the windiest places in the UK (off-shore and on the west-coast of Scotland). Where nearby grid connection is available, there have been many instances whereby the grid operator has thrown up barriers for entry.

In the case of hot water pipes, the network is often specially built to deliver heat from a new plant to new customers. From a free market perspective, this can represent a serious cost barrier as the investment has to be recouped whilst the other partner in the deal might switch. But then this perspective of freely traded market goods and services is obsolete when consumer and producer are tied together like this.
The pipes represent a property relationship between the producer and the end users which is characterised by interdependency and the expectation of continuity – in the light of which high connection costs are not much of a barrier. This expectation of continuity is either based on repressive regulation (where the consumer is left with no choice) or on models of ownership which extend beyond the private. In rented housing for example the consumer buys a service where heating options are more or less pre-packaged with the housing options (and in social housing this service is also subsidised). In private housing, consumers are only likely to sign up to district heating if they trust the supplier to provide them with a good quality service at an acceptable and stable price. Where public trust in private companies or public authorities is low (this tends to vary by country and by community), this can only be achieved through shared ownership models whereby the consumers have a direct say in the production of energy. Examples of such models exist in many rural areas in the US where many people are dependent on, and co-owners of, rural electricity cooperatives.

4 A typology of rights for the production of renewable energy

As discussed above, renewable energy systems can be rather diverse and there are many ways in which property relations can be relevant for the implementation of renewable energy systems. We have identified 10 different rights from an energy producer's perspective. In table 2, these rights have been listed in a logical order from energy generation to energy use. Below these rights are briefly discussed in four different thematic groupings; fundamental right, intellectual property rights, contractual producer-consumer rights/obligations and rights related to land.

Obviously the first right relates to the use of the resource in principle. This right may be limited by regulation. Window tax is a good example in UK history of a curtailment of this right. The moral outrage about this enclosure of the solar energy common gave us a word that is still in use today: 'daylight robbery'. As a modern example, our rights to lit a fire are often limited by health and safety regulations.

The right to use the technology relates to knowledge and especially to intellectual property rights (IPRs). A technology might be protected as a trade secret, by a trademark or as a patent. In some cases the owner of the IPRs may refuse to share this knowledge. In other cases the owner might charge a prohibitive sum for the use of the knowledge[5].

The rights relating to contractual agreement with the end user (the energy consumer), can be split up into two possible types of contracts (8 and 9); for the sale of energy (the simple case) or for the sale of energy services. In the case of the latter (known as an energy services company or ESCO), the producer may own and operate the energy utilising machinery installed at the premise of the end-user. This type of contractual arrangement includes duty of care and access for monitoring and maintenance.

The majority of the rights listed in Table 2 relate to land in one way or another. The technology required to utilise the energy, needs to be installed somewhere. This right of installation (2) may be hindered in many ways. For domestic technologies, the ownership of the house is a key question, and then there may be additional regulations like planning permission and limitations like the conservation status of the house or the neighbourhood. Planning permission is a key barrier for many renewable energy facilities in developed countries. A more protective right (4) relates to the ability to prevent someone from erecting a structure in the vicinity of the facility, thus blocking the sun, wind, water or waves and reducing the energy yield of the facility. The right to the install connection cables from the facility to the grid (5), throws up questions about the different types of rights associated with a particular piece of land. This question is also relevant for access for installation and maintenance (6). In some cases this right can be just a one-off. Access to the grid (7) also relates to spatial infrastructure, but not necessarily to land directly. Disposal of wastes (10) may also relate to land, as in the case of the need to send ash from biomass energy plants to land-fill.

Table 2: Ten types of producer's rights which can be of key relevance for the operation of renewable energy systems (listed from production to consumption).

[5] For a recent debate about IPRs and renewables, see Barton (2007). For a more general debate about the development of technology and the role of IPRs, see Nelson (2003).

1	Right to use the resource (sun, wind, hydro, wood)
2	Right to use the land permanently to build & run the plant
3	Right to use the technology to capture the energy (possibly including the right to install, customise, maintain and/or update the technology)
4	Right to prevent activities on nearby sites which can limit existing access to wind/sun
5	Right of access to a (land) corridor to install connecting cables to grid,
6	Right of access to roads/corridors/space needed for building the plant (might require the building new roads, bringing in heavy machinery, removing physical barriers). This may be a one-off right during the construction phase, but it may be required repeatedly (but not permanently) e.g. for maintenance or upgrades
7	Right to deliver energy through the existing (e.g. electricity or gas) grid
8	Right to negotiate a contract with end users for the sale of energy)
9	Right to negotiate a contract with end users for the sale of energy *services*, whereby the end use machinery might be owned by the producer, or leased by/through the producer, - which would require the producer's right to use that technology)
10	Right to dispose of 'waste' materials (emissions to land, water, air)

Different renewable energy systems require access to different combinations of property rights. Figures 1-3 illustrate a number of (fairly standard) systems. Figure 1 represents three small scale domestic systems for direct consumption of energy services. These systems are limited in size and spatial configuration and they do not transport the energy over a long distance; in fact the producer and consumer is one and the same person or household. Consequently potential property rights issues relevant for these systems are relatively limited in number; involving the right to use this type of energy, the right to use the conversion technology, the right to install the facility on the house and the right to prevent a neighbouring land owner to erect a structure which will block the sun.

Figure 1: Rights associated with a domestic solar water heater (left), daylight (middle) and firewood harvested for personal consumption (right). The numbers correspond with property rights listed in table 2.

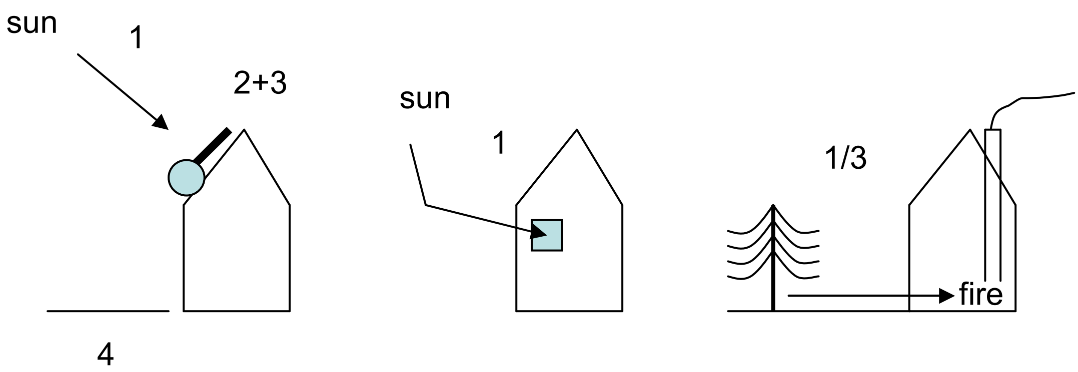


Figure 2: Rights associated with the different stages of the supply chain of electricity from wind, through an existing electricity grid to a domestic customer.

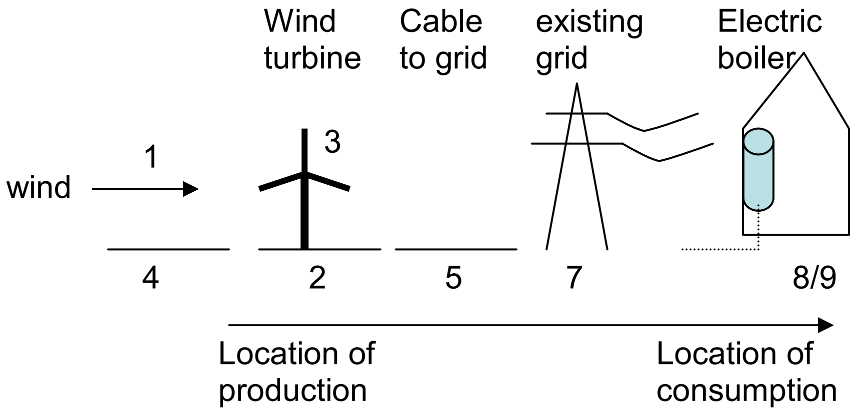
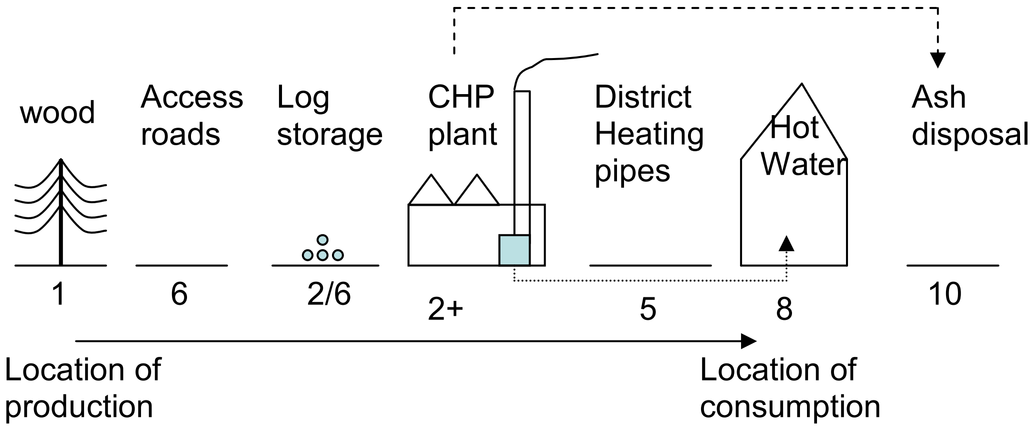


Figure 3: Rights associated with different stages in the supply chain of wood-fuelled district heating systems. The numbers correspond with rights listed in Table 2.


wood
Access roads
Log storage
CHP plant
District Heating pipes
Hot Water
Ash disposal
1
6
2/6
2+
5
8
10
Location of production
Location of consumption

In contrast, figure 2 and 3 represent larger renewable energy systems whereby the energy must be sourced in one location, transported over a longer distance and over existing infrastructure to the end user. As a consequence, the list of relevant rights is much longer here. In the case of biomass energy, storage and waste disposal are important additional aspects of property rights.

5 Discussion

Many of the above rights are curtailed or granted by the state. Regulation is seen by Hardin as one form of enclosing the commons, but obviously not all regulation results in a better protection and management of the commons. Old regulation which results in an underutilisation of new resources can be argued to be stifling and redundant. It might be 'daylight robbery' of an existing energy common or an accidental enclosure of a resource which could be a new common. Where an accidental enclosure is caused by regulations and property rights which involve many different stakeholders, it can be argued that Heller's tragedy of the anti-commons is in effect (Heller, 1998; Heller and Eisenberg, 1998). Heller illustrates this effect with the example of the management of shop space in Eastern Europe after the fall of communism. During this transitional period, he argues that too many stakeholders had exclusionary property rights over these buildings so that new entrepreneurs had to set up shop in temporary kiosks in the street. There are a number of parallels with renewable energy. First of all it is indeed hampered in its development by an old property regime which is in a state of transition (the government aims to have more renewable energy and is slowly removing the barriers, many of which stem from the old centralist predict-and-provide model of service delivery). Secondly we can see how entrepreneurs or pioneers who are striving to set up renewable energy facilities, are looking for loopholes and niches in these barriers. Whereas new traders in Eastern Europe set up kiosks in the street (where perhaps regulation was absent), renewable energy entrepreneurs have set up initiatives to utilise renewable energy in various creative ways that avoid these barriers. Some of these initiatives are distinctly located in the grey areas of existing legislation. For example one pioneer used a mobile wind turbine which was lowered at the end of the day, arguing that for temporary installations (he mentioned the example of flag poles) no planning permission was required. We also came across examples of people who burned diverse waste materials in their biomass boiler and who made and used biodiesel from waste oil without checking for or seeking formal government approval and one pioneer who contemplated the possibility to discretely install a micro-hydro turbine in a nearby stream without asking permission from the absentee land owner of that particular area.

However the potential new energy commons suffer not only from redundant enclosures but also from the 'comedy of enclosure' (Rose, 1987). This refers to situations whereby individual users receive increased benefits as the total number of users grow. This effect is widely recognised for communications technologies, but it clearly also occurs in the case of new renewable energy technologies. Increased number of users results in larger scale production of the technology, increasing competition and innovation and a reduction of unit price. Also the installation and maintenance is enhanced as installers develop their skills and experience, more installers are trained and quality standards are developed. In many cases also the social acceptance of new technologies grow as people become more familiar with (people who have) these technologies.

It can be no coincidence that the largest number of renewable energy systems are those that can be developed by the largest number of people with the smallest effort in terms renegotiating property rights (glass windows being the best example). The most widespread renewable energy systems are those that are cheap, applicable in many different settings, technologically simple and offer opportunity for self-sufficiency (i.e. the end user generates his/her own energy). It can be argued that the growing interest in micro-generation and living ‘off grid’ represents a new social movement of people who seek to regain control of their own energy future, utilise the new clean energy commons and take a greater responsibility in the protection of the global commons which have been so badly abused in the industrial era which saw the enclosure of fossil fuel resources to the benefit of the largest companies and some of the richest or most powerful countries in the world. Woods (2003) claims that public opposition to large scale wind farms (a major barrier to the deployment of wind energy in the UK) can be seen as a new social movement to protect the countryside against ‘industrialisation’ by large and powerful corporations. It is clear that these protesters are seeking to protect the ‘unspoiled’ views and ‘tranquillity’ of the post-productive countryside as a new common. The extent to which the off-grid movement and the countryside conservation movement overlap is an interesting question which we (unfortunately) cannot pursue in the space of this paper.

6 Conclusions

Humanity’s quest for access to and control over energy sources has transformed our physical and social environment. From the day our ancestors discovered the use of fire to keep warm and safe at night and to clear the land for short-term gain, to the socio-spatial structure of post industrial society based on cheap oil, globalisation and the big car economy, the evolution of our society has been mirrored by changes in property relations over the energy sources we depend on. The industrial revolution saw a dramatic change in these property relations as the large scale exploitation of fossil fuels required and gave opportunity to unprecedented levels of capital accumulation. The rise of environmentalism, our growing understanding of the threats of climate change, rising fuel prices and the expectation of peak oil have given impetus to a new energy transition, from large and centralised fossil fuel plants towards (more) small and decentralised renewable energy plants (distributed generation). This coveted transition is however hampered by the existing organisational structures which govern property rights that are of relevance to energy generation, transportation and consumption. The preliminary assessment presented here, has shown that some types of renewable energy systems, although desired from an environmental perspective and officially endorsed in government policies, are stifled by these existing property rights regimes. We have found many examples where existing property rights regimes act as barriers to the transition towards the full deployment of renewables and distributed generation. In some examples there are many different stakeholders who have rights of exclusion, so that the tragedy of the anti-commons appears to be applicable. Some types of renewables (notably biomass, potentially geothermal power) are not free from the risk of over-exploitation, thus bearing resemblance to Hardin's tragedy of the commons. However other renewables (e.g. wind or wave power) may be considered as potential new commons which are not at all under threat of over-exploitation (they are currently abundant and to some extent non-rival) but which are under-utilised because existing property relations hamper their exploitation. Removing these old enclosures will be required if these new commons are to be better utilised. However there is limited scope for what Chander and Sunder (2004) called the 'romance of the commons': new rules and regulations will also be required at some stage to manage these resources in the best interest of society and to mitigate (inevitable) conflicts in individual exploitation.

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