The Solution that Might Have Been: Resolving Social Conflict in Deliberations about Future Electricity Grid Development

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Abstract

Increasingly, local opposition to new electricity grid developments cause lengthy delays and places financial and practical strain on the projects. The structure of the electricity industry is in transition due to the emergence of smaller but more numerous generation facilities. Also, the wider society and local communities increasingly engage with energy and environmental issues. At the same time, the traditional decision making frameworks and processes are proving less effective in solving the present time conflicts between local communities and other stakeholders. This paper proposes an economic approach to resolve such conflicts. We discuss how compensation, benefit sharing, and property rights can have a role in reducing community opposition to grid developments. However, we argue that these methods need to be part of an overarching policy towards conflict resolution in grid development. We then propose that such impacts can be addressed within the framework of 'weak' versus 'strong' sustainability. Finally, we suggest that the concepts of 'collective negotiation' and 'menu of options' in regulatory economics can be adapted to operationalise the suggested sustainability-based approach to arrive at more efficient and socially desirable outcomes. The proposed framework can lead to the identification of socially acceptable outcomes that could otherwise have gone undetected.

Key words: Electricity transmission; Social sustainability; public and local opposition; compensation and benefit sharing.

JEL classifications: L43, L94, D23, D70.

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1. Introduction

A timely development of national infrastructures is a prerequisite for economic growth and is generally associated with significant economic and social returns (Easterly and Servén, 2003). Such undertakings include electricity transmission networks[1], which following ambitious environmental targets need to connect a growing number of renewable energy facilities. While grid development projects normally have economic benefits, they often also involve adverse environmental impacts and give rise to community opposition.[2, 3] Failing to reach agreement on deployment and siting of projects causes lengthy and costly delays to the planning process and even jeopardise the project altogether (Kunreuther *et al.,* 1996; RGI, 2012).

Although community opposition to major national infrastructure projects is not new, the implications of local resistance for the future development of the sector are on the rise. The context of decision-making in the electricity sector has gradually shifted from one of being a primarily technical matter to an increasingly social, environmental, and thus political one. The current process, which can be described as a Decide-Announce-Defend (DAD) approach, is perceived to be unfair and to lack transparency (Tobiasson *et al.,* 2014). It is also unclear in terms of the roles of different stakeholders and how decisions are made, therefore eradicating potential local and public participation due to a lack of knowledge and information (Cotton and Devine-Wright, 2013). Consequently, the established decision making framework and processes seem increasingly ineffectively engage with more active local communities.

[1] Grid developments can also include the lower voltage network, distribution. This paper focuses on transmission developments only.

[2] Apart from transmission grid development, other developments that cause local opposition include airports, prisons, power plants and linear structures such as pipelines, and railways.

[3] Distributed generation resources and storage facilities can sometimes presents themselves as alternatives or complementary to grid expansion. Therefore, adopting a wider perspective and early stage discussions of these with the public will facilitate the resolution of potential conflicts. At present, the alternatives presented by developers are in the form of under-grounding or re-routing the proposed new lines.

There are three main reasons behind the increased involvement of the public and local communities in grid developments. First, the nature of the energy industry has been changing due to the emergence of smaller but more numerous generation facilities, thus increasing their visibility and potential local impact. Second, the public and community awareness and engagement in relation to the energy sector and environmental issues has increased. Third, whilst the nature of the sector and public engagement with the grid has changed, the institutional arrangements within which policy decisions are made have not changed.

Traditionally, the grid company is responsible for balancing the generation of and demand for electricity and long-term planning for the future development needs of the grid. The grid owners produce technical development plans and presents these to the sector regulator and the policy makers. The affected communities are also informed and their views are also heard and noted. However, the communities are increasingly left with the impression that their views and interests are overlooked for national and system interests. Within this context, traditional solutions such as financial compensations and final stage minor concessions are insufficient. Thus, innovative approaches are required to adapt the decision-making framework to better suit the evolving and future needs and features of the sector.

From an economic point of view, local opposition can be considered as the result of externalities caused by grid developments and imposed on neighbouring communities. Given the standard assumptions of economic rationality, perfect information and zero transaction costs, a solution that internalises the local externalities can, in theory, be derived. With regards to single location facilities, the potential for providing financial compensation to affected communities is explored in an extensive body of literature, initiated first by O'Hare (1977).

However, the practical applications of a financial compensation are not trivial, including the difficulty in estimating the exact costs and benefits of projects and the public perception of compensation as a bribe (Frey *et al.*, 1996). Other measures to foster acceptance and to increase the local retention of profits include the provision of community benefit schemes. These measures are particularly common in wind power developments and have been successfully implemented in countries such as the UK, Denmark and Germany (CSE, 2009; Cass *et al.,* 2010).

Relative to renewable energy and other single location infrastructure facilities, grid developments have received comparatively limited attention from academic researchers (notable exceptions include Ciupuliga and Cuppen, 2013; Cotton and Devine-Wright, 2013; Soini *et al.,* 2011). This is particularly the case with regards to compensation or community benefit schemes. Arguably, there are some shared characteristics between single location facilities and grid developments, such as large sunk costs, negative externalities, public goods, information asymmetries and similarities in resistance from local communities. However, the technical characteristics and economic regulation of transmission grids necessitate design of innovative approaches to organise local community impact and involvement in grid development. Therefore, there is a need for alternative modes of conceptualising community opposition and engagement with grid development projects (Batel *et al*., 2013).

Drawing from established economic theories and concepts, this paper suggests a new approach based on the environmental sustainability perspective to facilitate a more efficient and socially acceptable planning and implementation of gird projects. The conceptual framework looks beyond the use of financial compensation to resolve grid and infrastructure development projects. Instead, we propose a sustainability-oriented framework that is strongly informed by economic theory but it also recognises the multidisciplinary of the issue. The proposed framework can also lead to the identification of socially acceptable outcomes that could remain undetected.

The paper is structured as follows: Section 2 outlines the economic properties of electricity networks and developments. Section 3 discusses the economics characteristics of community engagement in developments and reviews relevant literature. Section 4 outlines and applies an analytical framework to develop a conceptual model. Section 5 concludes.

2. Economics of Electricity Networks and Grid Development

2.1 Economic characteristics of electricity transmission networks

Electricity networks are regarded as being natural monopolies. This implies that they are highly capital intensive and their cost structure is such that their fixed costs are very large in relation to the total costs. This feature results in declining average costs as their scale increases. As a result, the provision of a given quantity of output by a single network is more cost efficient than by several competing networks. Consequently, such networks are subject to public ownership or some form of economic regulation. This is true for both high voltage networks (transmission) and lower voltage networks (distribution). Although this paper considerers transmission developments only it is worth noting that the distribution networks across Europe are undergoing a considerable change.

The introduction of smart technology, electric vehicles, and distributed generation are exerting pressure on the distribution grid to become more active in terms of managing and matching the supply and demand. The transmission grid is less affected by new technologies and is, compared to the distribution grid, already actively managing supply and demand since large generators are connected to the transmission grid. Moreover, transmission networks are considered as transportation networks – transmitting large volumes of high voltage electricity over long distances with no or few outlets along the way. This gives rise to particular issues as many communities do not benefit from the developments despite living next to it.

Network utilities generally operate under licence agreements that oblige them to connect the generators and end-users in a timely and effective manner. The utilities are also expected to operate the network in a cost efficient manner. In return, the utility can charge the users for the use of network services and earn a regulated return or revenue (Joskow, 2007). The network charges are, in the first instance, accrued to generators and retail suppliers but are ultimately passed to end users through their bills. Many networks in Europe operate under incentive regulation models that reward firms for cost efficiency and penalises high costs (Joskow, 2013).

The costs incurred by network utilities can be classified into allowable controllable and non-controllable costs. Non-controllable costs are regarded as being beyond the control of the management and are generally treated as pass-through and thus do not affect the profits of the utility. On the other hand, controllable costs are subject to reward and penalty incentives. A cost type or item that is disallowed by the regulator will directly and negatively affect the revenue and profit of the utility. Allowed operating costs can be recovered and allowed investments will earn a specified return (Jamasb and Pollitt, 2001).

A key objective of the sector regulator is to maximise the socio-economic welfare of the consumers. The regulator in effect acts as the guardian of public interest who cannot individually protect their interest. Costs that are over and above the efficient level will reduce the net system benefits. Although major grid projects may have net system benefits, uneven distribution of the costs and benefits as well as a disparity between private (developer) and social (local) costs, can cause distributional implications between local and national interests. It appears that while regulators are tasked with protecting public interest they are less able to balance the distributional inequity that arise between the local public and wider public. Compensations to local communities are also a financial transfer to ease the distributional implications between the communities and the consumers of the grid services as a whole. Prior to addressing the specific methods and mechanisms for compensation or community benefits, it is important to conceptualise the nature of community level environmental impact and entitlement to compensation in economic terms.

2.2 Economic characteristics of transmission projects

Transmission lines cross long stretches of land and each new project has a number of stakeholders, including the government, local authority, local businesses, landowners, local communities, and interest organisations. Each stakeholder perceives the grid projects differently and has their own view and experience of the decision process. These heterogeneous views and objectives of stakeholders often cause conflict of interest and opposition. Moreover, information asymmetries among the actors can intensify the frictions between stakeholders further as it can induce rent-seeking behaviour and reduce trust between them. Consequently, the economics of grid development can be characterised as having high transaction costs. Achieving agreements that internalise the externalities caused by transmission projects can be costly to negotiate, especially when the number of stakeholders and the range of interests involved are large (Tobiasson *et al*., 2014).

A grid project can be thought of as having two types of costs – i.e. private costs in the form of construction and maintenance costs as well as external (social) costs accrued to third parties. The latter type of costs can include direct economic costs such as loss of revenue to owners of agricultural land and negative environmental externalities. The direct economic costs are observable and measurable through market prices or compensation methods. For instance, there are established norms and formulas for compensating owners of farmlands for loss of use value of land in terms of lost output and revenue.

The main difficulty arises, however, when taking the external costs in the form of intrinsic value of environmental amenities accrued to third parties, i.e. affected communities, into account. Grid development projects can be viewed as having an effect on public goods characterised by non-excludability and non-rivalry in consumption. The affected communities enjoy limited or no direct benefits from the project, similar to a railway passing the community without stopping at the local station. The effects of these externalities such as negative visual, health, and environmental effects as well as financial loss through reduced property values, translate into reduced utility and economic welfare (Cohen *et al*., 2014).[4]

[4] In the absence of explicit valuation, public goods can implicitly be assigned a monetary value of zero. Some scholars point to the ethical issues in placing monetary value on the environment (e.g., Sagoff, 2004). Others view monetisation as an option, while accepting that such valuation can be flawed, a value over zero is better than no value (see, e.g., Pearce 1994; Helm 2000). When the value of a resource is unknown or zero, it may be over-exploited. This often holds for resources that lack clearly defined property rights thus giving rise to conflicts of interest.

3. Community Engagement and Conflict in Grid Development

3.1 The causes of conflicts

A growing body of literature considers the motives behind and discusses possible measures to reduce community opposition to locally unwanted facilities. The pejorative label of NIMBY (not in my backyard) opposition is considered as outdated (Burningham *et al.,* 2006) and recent work has revealed a complex heterogeneous composition of opposition[5] (Batel and Devine-Wright, 2014; Cotton and Devine-Wright, 2013; Johnson and Scicchitano, 2012; Wolsink, 2000). Research to date is predominantly focused on single location facilities, such as renewable energy generation technologies (Jobert *et al.,* 2007; Wolsink, 2000; Devine-Wright, 2011), as well as waste and hazardous facilities (Johnson and Scicchitano, 2012; Kunreuther *et al.,* 1996).

Opposition to transmission projects, characterised as linear infrastructure, are similar to those of single location infrastructure. The main triggers of public resistance include strong place attachments to the local area; the type, level and quality of communication; lack of trust for the developer and governmental agencies; harmful effects on health and the environment; and unconvincing arguments for the need case of the new line and for any beneficial impacts arising from it [6] (Ciupuliga and Cuppen, 2013; Cotton and Devine-Wright, 2013; Devine-Wright, 2013).

Unlike local communities, landowners tend to be consulted at the initial stages of planning when the optimal route is being identified, mainly because they possess a legal right to their land and others cannot normally use the land without their consent. In theory, financial compensation offered at the market rate of the land should be accepted. However, in practice, this is not always the case, as seen in the development of a Irish gas pipeline where five landowners were imprisoned

[5] Rather than the homogeneous assumptions defining NIMBY opposition.

[6] Criticism of the need case often refer to alternative technological solutions, e.g. distributed generation and enforcing existing lines.

following their refusal to allow the developer access to their land (Gilmartin, 2009).[7]

Public and local opposition to new transmission lines is a common cause of costly delays and can emerge as a barrier to the realisation of future low-carbon systems. Recent cases of conflicts include the Scottish Beauly-Denny line, which was the subject of the longest ever public inquiry in Scotland (Tobiasson *et al.,* 2014); the France-Spain interconnection project, first proposed in 1980 and met by considerable opposition bringing round a second proposal in 2003 (Ciupuliga and Cuppen, 2013); and the Norwegian Hardanger transmission line, which was one of the 2010's most reported news stories in Norway (Ruud *et al*., 2011).

Devine-Wright *et al.* (2010) find that public beliefs of energy networks are rather detached from reality. Generally, electricity networks are seen to be represented by technological structures, such as cables and pylons, rather than organisations and systematic networks. Moreover, in the planning of new lines, the study found great disbelief in the process, especially regarding stakeholder engagement and who can actually influence project developments. The invisibility of network firms and disbelief in the planning process is thought to increase public opposition and delays to new infrastructure developments.

Public opposition is argued to have played a large role in the delayed France-Spain interconnection project (Ciupuliga and Cuppen, 2013). The project lacked transparency and the publics requests of undergrounding the line were ignored without explanation. As a result, citizens felt overlooked and cooperation between stakeholders ceased. Similarly, the Scottish Beauly-Denny project was criticised by local communities for disregarding their points of view and lack of communication. Trust and perceived procedural justice is arguably important for public acceptance (Bronfman *et al.,* 2012; Wüstenhagen *et al.,* 2007).

Moreover, in a study on electricity generation sources Bronfman *et al.* (2012) find that perceived benefit of a new installation had the greatest effect on

[7] However, compensation to landowners are not considered here as each sector has established norms and methods of addressing direct losses. In this paper we focus on the environmental impacts of grid development projects on local communities, which are often ignored.

acceptability. This is one of the reasons to why opposition to transmission projects is particularly difficult to address and why the experience from single location facilities is of limited usefulness. Part of the difficulty in addressing the stakeholder conflicts in grid developments lie in the challenge to define, measure and compensate communities for their environmental impacts. The benefits of most infrastructure facilities are spread across the economy, whilst much of their adverse impacts tend to be local. This is also the case with energy generation plants.

However, for energy generation plants the capacities and outputs, and therefore the benefits, are more easily measureable in both physical and monetary terms. Meanwhile, the large geographic span of linear infrastructures often affects multiple communities rather than a single host community. Also, due to the complex design and technical nature of the grid, the system benefits associated with an incremental network expansion or enhancement project can be difficult to estimate. As such, local communities perceive the benefits of a transmission line as limited, thus intensifying conflicts.

3.2 The need for a new approach to grid conflicts

Although there are some shared characteristics with other energy facilities, the technical and economic features of transmission grid projects are different in several respects and thus require specific solutions. For instance, measuring the relevant output of an incremental new line for compensation and benefit sharing is considerably more complicated. Also, electricity transmission networks are natural monopolies and require economic regulation.

New grid projects are ultimately financed by electricity consumers through transmission fees collected on electricity bills. Thus increasing the project costs through either undergrounding lines or paying compensation is borne by all electricity users across the country. In terms of land-use, transmission lines are linear infrastructures, covering great stretches of land, thus affecting many stakeholders, types of land, land uses, and sensitive areas. Additionally, the physical features of networks complicate matters further as a change in one part of the network will also have an effect on the rest of the system. Consequently, specific benefits of grid upgrades are difficult to identify, quantify, and allocate. Rather than confined benefits of a single line, any upgrade benefits the reliability and security of the network as a whole.

Figure 1 illustrates the main insights from recent research and the economic characteristics of grid developments. The figure shows the key dimensions and features of community engagement when implementing a new grid project. On the one hand, issues related to private goods with few stakeholders are considered. Decisions are made based on individual preferences, choice and rationale. On the other hand, the issues related to public goods on a social level and rationale is represented.

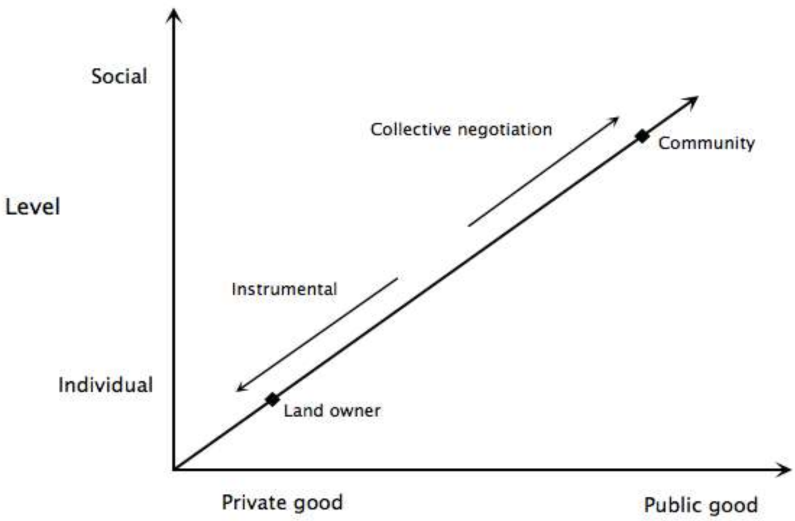

Figure 1. Dimensions of community engagement
Source: Adapted from Vatn (2005, 419)

The figure identifies two approaches to community engagement with grid projects. Goods, which have private ownership and entitlement, can be considered on an individual level as they involve few stakeholders. Issues on an individual level may therefore be managed through an instrumental approach. The term instrumental refers to a set framework that can be applied in a similar way in different situations without much modification. This is the current approach for compensation to landowners for structures placed on their land, for example, through offering a fixed amount per pylon or a wind turbine, dependent on its size or alternatively on its energy produced or transmitted.

Conversely, goods which are public in nature and entitlement, and thus must be considered on a social level, i.e. involve many stakeholders, require a collective negotiation approach. When the number of stakeholders is high, and a decision will affect large groups, the importance of communication increases, especially as two-way negotiations. As illustrated by the figure, communication on a collective level is the approach that could be adopted in engagement with communities. This is however seldom the case, giving rise to conflicts (RGI, 2012).

In order to increase public trust, reduce stakeholder conflicts, and encourage acceptance of new grid developments, recent research suggests better information provision and more emphasis on communication and community involvement at an earlier stage and in a more deliberative planning process (RGI, 2012; Newig and Kvarda, 2012; Cotton and Devine-Wright, 2012; CSE, 2009). Additionally, Ciupuliga and Cuppen (2013) highlight the role of dialogue in the planning process, which is argued to not only improve the potential to reach agreement but also benefit the project through the access to local knowledge and insights.

The lessons emerging from the above mentioned cases and similar projects suggest that they share some key features. Such conflicts are often treated on an ad hoc basis whilst trust and perceived procedural justice of the process is generally low. The conflicts are often treated as planning and financial compensation matters while sustainability and citizenship aspects are often the root cause of the conflicts. For example, financial arrangements such as compensations and benefit sharing schemes have been suggested as practical measures to redistribute the costs and benefits of large projects in order to make the outcome of decision-making more socially acceptable and economically efficient.

An important issue with a purely monetary approach is that it fails to take into account the broader range of reasons behind community opposition. Therefore, a broader theory-informed approach and conceptualisation of community engagement with grid projects is needed to devise structure and more effective solutions to resolve them (Been, 1993).

4. Towards a Sustainable Grid Development Approach

4.1 Financial compensation and benefit provision

A common measure to assist the siting of locally unwanted facilities, which has long been the focus of particularly economic researchers, is that of monetary compensation to prospective host communities. This notion was first introduced by O'Hare (1977), declaring it to be necessary for an efficient siting process. More recently, Lesbirel (1998) find compensation to positively facilitate the siting of energy plants in Japan while McAdam *et al.* (2010) argues that failing to compensate the host country of a pipeline is linked to mobilised opposition.

Community compensation through financial arrangements can in principal be in the form of (i) one-off lump sum payments, (ii) a stream of payments; or (iii) some form of part-ownership. Alternatively, the developers can offer direct investments in the community such as infrastructural upgrades (e.g. new and better roads, increased connectivity such as fibre optic broadband) or other benefits such as tax reductions or reduced energy prices.

Lump sum payments involve one-off payments to a community fund when the project starts operating. Assuming good management and careful investment the fund could generate continued income. Alternatively, a developer may offer annual payments. In wind power developments in the UK this is normally per megawatt (e.g., £5,000 per MW), linked to the generation capacity, energy output of the project, or a fraction of the revenues generated (CSE, 2009). As mentioned, given the nature of transmission development projects, the output and added benefits of a new line are difficult to determine rendering such measures difficult to implement. Instead a less direct option could be to link the size of compensation to total investments, number of pylons, or perhaps per km of grid length.

A share in the project can either be provided as a form of compensation from the developer or acquired as an investment (CSE, 2009). In a study conducted in Scotland, Warren and McFadyen (2010) find that local ownership may have a positive effect on public attitudes towards wind farms. Allan *et al.* (2011) suggests that local community ownership and thus local retention of profits increase the economic impact of wind farms. However, direct application of the instruments used in wind power developments for transmission lines is difficult. For a regulated industry, where profits are generally earned through return on assets rather than through market operation, the nature of the risks is different. Additionally, the deposition of the electricity grid and dependency with other parts of the network make it difficult to integrate community ownership of one or part of a transmission line.

However, offering financial compensation is not a one size fits all solution. Frey *et al.* (1996) argues that offering compensation to prospective host communities will have a negative effect on acceptance and Kunreuther and Easterling (1990) and Oberholzer-Gee *et al.* (1995), find no link between financial compensation and efficient siting and local approval of nuclear-waste repositories. Instead, the perception of compensation as a bribe and the crowding out of the feeling of civic duty can increase the opposition to the project. This was shown to be the case in a Swiss study where the rate of community acceptance of a nuclear-waste repository was found to decline, from 50.8 to 24.6 percent, when compensation was offered compared to when no compensation was offered (Frey and Oberholzer-Gee, 1997).

As a result, rather than using direct financial compensation, Frey *et al.* (1996) suggests that in-kind compensation, intended to benefit the community as a whole, weakens the bribe effect and thus supports the siting process of locally unwanted projects. An example of local benefit sharing is the provision of 'Community Benefit Schemes'. Such sharing schemes, which may contain "good-will" gestures, such as upgrading a road, a new playground, payments to a community fund or community ownership, have proven effective in increasing local support for wind power developments. This is particularly the case in countries such as Denmark and Spain, where local ownership, and thus greater local retention of profits, are more common (CSE, 2009; Warren and McFadyen, 2010; Allan *et al.,* 2011). However, UK communities remain unconvinced of the intentions behind the benefit provision with many still considering it as a method to silent opposition with bribes (Cass *et al.,* 2010). Even well intentioned developers seldom receive the trust of local communities, which may be partially due to the timing of the offered compensation (Aitken, 2010).

In the reminder of this section we discuss the building blocks of our proposed approach to compensation for environmental impact of grid development and contrast these with those of conventional measures to mitigate local opposition and conflict. These are outlined in Figure 2. Following from Figure 1, the suggested approach takes a public good view of environmental impact of sustainable grid development that can be subject to social and public policy decision making process. This places the proposed approach at the top right corner of Figure 1.

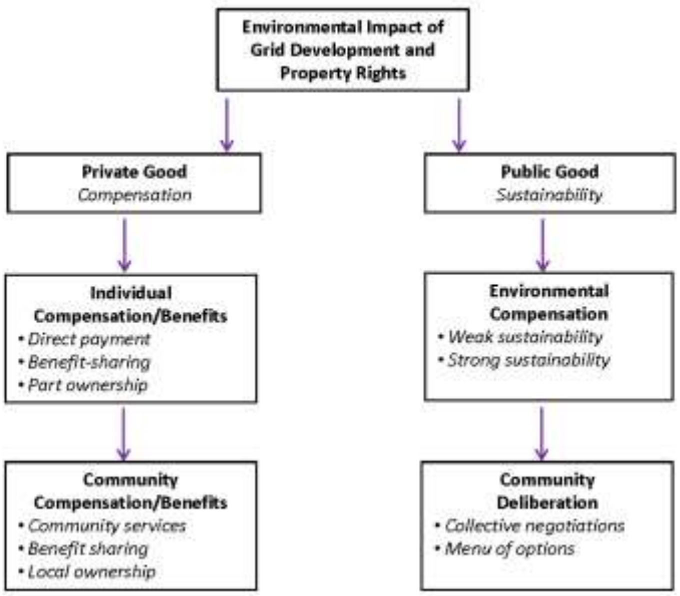

Figure 2: Environmental impact of grid development and compensation

4.2 A property rights view of grid development

While the communities affected by grid development may oppose the projects, the nature of the community claim on the local environment needs some consideration. The affected communities (apart from landowners) do not normally have a private ownership right to the landscape in question. Nevertheless, they have the right to the use of their immediate natural environment along with the general public.

However, if a community have enjoyed the benefits of a public good, such as a landscape or scenery, over time, a right to use may come to be perceived as actual ownership entitlement or right to these[8]. Such formation of entitlement or rights is common and also occurs in the case of subsidies, licences, or quotas that are awarded and renewed over long periods of time. A community can assume or behave as having a property right or private entitlement to local aspects of public goods adversely affected by grid projects. Thus the perception of entitlement to a quasi-private property or user rights becomes a central, though subtle, aspect of the opposition to the project.

Using a property rights view, we consider a simple case of community compensation or benefit receipt to reach a resolution. In order to construct a new transmission line, there are two technical options: An overhead line at cost (A) or, a more costly partially undergrounded cable at cost (B). The cost difference between the two options is thus (B-A) and undergrounding is assumed to achieve project acceptance.[9] If the general public holds the property rights to the affected landscape, the local communities can be thought as having a willingness to pay (WTP) to avoid the project. This WTP will be equal to (B-A) and to the willingness to accept (WTA) of the general public (or network utility) as they are indifferent between the two options given that the project costs to them remain the same.

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[8] Note that this view of entitlement and benefit is purely from an economic perspective, opinions of other fields of research, such as environmental phycology, would no doubt differ.

[9] Although this may not be a realistic assumption in real world situations we use this simplified view to illustrate our example.

Alternatively, the property rights to the landscape can be allocated to the affected local communities[10]. In this case, the community can accept the project through a WTA mechanism. In this case, the society or the developer will have a maximum WTP that is equal to the cost difference between the underground and overhead options (B-A), which is also equal to the maximum WTA the communities can achieve. If the communities demand more than (B-A) they will receive nothing as the developer will choose to underground the line.

Following Coase (1960), the outcomes of the above two cases are equal in terms of economic efficiency as the WTA and WTP will be equal to (B-A). However, depending on the initial allocation of property rights, the distributional effects and the actual or perceived equity implications are significant and crucial from a political economy point of view. For example, the former case may be perceived as being unfair that the communities should be expected to pay off the wider society in order to avoid the negative impact of the project or have the line placed underground.

Theoretically, WTA and WTP are assumed to be equal. However, experimental evidence suggests that WTA is usually greater than WTP. Following the example above, we have two potential outcomes. Independent of whether the property right lies with the community of the developer, if WTP is higher or equal to the cost of undergrounding, the project will go ahead and placed underground. If however, the cost of undergrounding the line is greater than the WTP, the project will not be realised. Again, the implications in terms of social and distributional point of view are significantly different and will affect the manner in which the project will be perceived.

4.3 A sustainability approach to grid development

The economic approaches to community engagement in grid development based on individual or collective compensation, benefit sharing, and property rights

[10] Note that transmission lines may affect other than local residents although not captured by this approach.

allocation can help reduce community opposition to grid development projects. However, these approaches have, on their own, methodological and practical shortcomings. The main limitation is related to that of identification as well as the lack of clear property rights and assignment of such rights in the absence of clear entitlement to these. In addition, although such approaches could help reduce the level of conflict, they may not necessarily be desirable from an environmental sustainability point of view as they are generally short-term approaches without a sustainability and intertemporal rationale. Therefore, the above economic instruments can be more effective when used within a high level environmental strategy that links the individual and community interests to an overarching social policy and public decision rule and process (see Cain and Nelson, 2013). Given the above reasoning, we propose an economics informed environmental sustainability approach as the basis for a coherent and comprehensive decision framework.

This alternative economic approach can be explored based around the concept of environmental sustainability and the related notion of intergenerational equity. Within this perspective, the adverse environmental effects of grid projects can be viewed in terms of transformation of natural assets from one form to another. As first suggested by Hardwick (1977) and Solow (1986), the total value of a non-renewable environmental resource can be preserved over time by investing or transforming the benefits or rents from the use of a natural resource into other assets. This transformation can be in the form of strong or weak sustainability.

In a strong sustainability viewpoint, the total value of a resource or natural asset is to be maintained for current and future generations if an equivalent value of environmental asset can be created from the rents. This can, for example, be part of an ecological strategy which attempts to preserve ecosystem services. On the other hand, within a weak sustainability view, some form of financial or social capital (in this case perhaps community capital) of the same value can be created from the benefits of the project. Other possibilities such as transforming the natural asset into physical or human capital can also exist in the spectrum of sustainability options (Ayres *et al.,* 1998; Dietz and Neumayer, 2007). Weak sustainability draws on the notion that environmental problems are caused by inefficient use of natural resources. By monetising externalities (caused by inefficiencies) the costs can be internalised and a solution devised. The economic rent from a project would be redistributed and social costs would equal to private costs. Practical examples of weak sustainability policy in include the sovereign funds in resource rich countries, such as Norway who uses the Norwegian Petroleum Fund to invest part of their proceeds from oil extraction in the North Sea in financial assets.

The environmental impact of a grid development can be viewed in terms of weak and strong sustainability. If a grid development project is deemed to produce a net socio-economic surplus this implies the project can compensate for the environmental damage of the project. This compensation can be in the form of creating an equivalent benefit or value elsewhere. Within this framework, the wider society as a whole must decide on the acceptable form of the transformation and conversion of the value of the natural assets affected by grid development while preserving their total value – i.e. whether the natural asset affected should be transformed into another natural asset or into physical, financial, social, or human capital. This decision should be part of a high level and long-term sustainability strategy that informs the decision-making framework, rules, and processes.

4.3.1 From compensation and benefit sharing to community investment

Compensation of a public nature can be perceived to be fairer and more honest compared to individual monetary compensation and is thus more likely to be successful (Terwel *et al.,* 2014: Frey *et al.,* 1996). However, grid projects have lasting inter-temporal environmental impacts. A weakness of ad hoc and narrow approaches based on compensation and benefit sharing is that they may result in one-off short-term solutions and settlements that do not ensure dynamic and inter-generational equity. Therefore, preserving the value of an environmental asset will often require investment in other assets that produce sustainable long-term benefits.

It is, in principal, possible for the society to adhere to a strong or weak sustainability criterion and create 'community capital' through 'community investments' in another form of capital. For example, the Beauly-Denny transmission line project had an element of both strong and weak sustainability; the developers were required to improve the environment along certain sections beyond the effect of the new line and in two cases they were also required to provide financial compensation to affected communities[11].

Assigning compensation to individual members of a community is impractical as the transaction costs would increase significantly with allocating individual compensation rights. Also, the task of identifying *who* is entitled to compensation is difficult as there are often no defined criteria. Proximity to the new line may seem an obvious measure - for example, Sims and Dent (2005) find that proximity to a transmission line lowers property prices and Gibbons (2014) suggests similar results with regards to wind power developments. However, where the dividing lines for compensation should be drawn is difficult. A more suitable approach is therefore to aggregate compensations and the method agreed on through collective negotiations on a society-wide level.

4.3.2 Community investment through collective negotiation

As a complement to traditional regulatory approaches, some regulators in North America have adopted negotiated settlements between utilities and their costumers to determine cost, price and operating projections. Negotiated settlements have proved to limit the regulatory workload, decreasing delays and increase efficiency (Doucet and Littlechild, 2006). Similarly, community investments can benefit from applying the method of negotiated settlement, or here, collective negotiation.

Offering investments in community infrastructure or services is common in wind power developments, often labelled as 'community benefits'. Upgrading roads or recreational spaces gives a developer the opportunity to work directly with the community. Transmission developments involve several communities (rather than one host community as in the case of energy generation facilities) and each

[11] This additional cost was approved by Ofgem the energy regulator as it was a condition of the consent from the Scottish ministers.

community has specific needs that can be identified through participation in the planning process and addressed when developing the compensatory approach. Furthermore, by encouraging the stakeholders to reveal private information about their preferences, negotiations between the developer and the community about the level and type of compensation can increase social welfare. Here, the concepts of weak and strong sustainability can act as a starting point and guide the negotiations on how the environmental costs of a development are to be allocated and how the rents from it may be redistributed.

Oberholzer-Gee *et al.* (1995) find that granting authority to affected communities and two-way negotiations, thus customer and public participation in the planning process, increases local approval of the facilities. Such negotiation will open for innovative solutions that would not have been envisaged by policy makers and developers as local knowledge and needs is utilised, thus increasing the efficiency and welfare effect of the outcome (Doucet and Littlechild, 2006; Ciupuliga and Cuppen, 2013). This is further emphasized by Kunreuther and Easterling (1996), arguing the case for a voluntary siting process and negotiated compensation, rather than using predetermined compensation measures without community influence.

Moreover, compensating the communities rather than the individual members reduces the transaction costs low as the number of participants in negotiations is lower. Nevertheless, even when the number of participants is low, negotiations risk the possibility of a breakdown if the parties fail to reach an agreement. In order to reduce the probability of unsuccessful negotiations, an independent authority such as the sector regulator could step in as mediator, which will intervene in case that no agreement is reached. It is, however, in the interest of both parties to reach an agreement as, in case of failure to agree, the regulator can impose a socio-economically less favourable outcome (Doucet and Littlechild, 2006). Appointing an ultimate decision maker and arbitrator also limits the appeal of hold up as it is less likely that one party to negotiations can delay the process through rent seeking behaviour.

4.3.3 Menu of options method for collective negotiations

At the presence of uncertainty and information asymmetry it is difficult to form and maintain robust principal-agent relationships. The transaction costs are higher in negotiations, leading to inefficient outcomes. In regulatory economics, the use of a menu of options or contracts is expected to reduce the effect of uncertainty and information asymmetry (Laffont and Tirole, 1986; Laffont, 1993). Keeping consumer welfare constant, the regulator can offer the firm a choice of different regulatory contracts, which essentially consist of different combinations of cost sharing provisions (a fixed component and a component dependent on the responsiveness of the firm's revenues to costs). The firm will choose the optimising contract depending on its cost opportunities (Joskow, 2007). Pareto improvements are possible since consumer welfare is kept constant and firms can increase their welfare due to the flexibility to choose an optimising contract based on private firm information which was previously unknown by the regulator (Crew and Kleindorfer, 1992).

A menu of contracts can thus be used in order to elicit information and increase efficiency. Drawing on the theory of economic regulation, a similar approach may be developed to optimize the provision of sustainability-based compensations for transmission grid projects. In this, the developer offers the affected community a set of compensatory measures. The cost of different alternatives can be held constant at a reference cost, for example in the above case at the difference between the cost of an overhead line and an underground cable. Given the knowledge in terms of different compensatory options, a menu of options may, for example, consist of choices between community fund payments, infrastructure developments, community ownership, and environmental investments.

By providing a menu of options, the communities can choose among a set of sustainable solutions that maximizes their welfare depending on their attributes and value to the community. This self-selecting process is preferable since choosing one contract or option is the equivalent of revealing internal information, which would otherwise remain unknown. Thus the process is more efficient than if the developer or the government were to design and implement a policy without consulting the community through collective negotiation within a sustainability framework.

5. Conclusions

The electricity networks need to upgrade and expand in order to meet the future demands of the sector, including connecting smaller yet numerous conventional and renewable generation facilities. However, many new transmission lines are facing opposition from the affected local communities on the grounds of their environmental impacts. The conflicts cause delays and prolong planning thus adding to the project costs and foregone system benefits. The conventional decision approaches seem unable to resolve many of the conflicts. There is therefore a need for a new approach to address the community opposition to grid development projects.

In this paper we discussed direct compensation and benefit sharing methods, as well as property rights approaches and how these measures can play a role in reducing community opposition to grid development. However, these methods currently lack an overarching theoretical and methodological framework to structure and guide the process, which is important for gaining the trust and acceptance of communities and society as a whole. Additionally, methods based on purely compensatory measures are not devised to allow for public and local participation in the planning process and therefore fail to address the underlying causes of opposition.

We suggest a socio-economic approach to grid development that is based on the concepts of weak and strong sustainability and that the environmental affected by grid developments, rather than the community per se, can be compensated within a sustainability approach. It is however ultimately for the larger society to decide, through public and social policy decision framework, on the nature of the compensation along the spectrum of weak to strong sustainability options - e.g. in the form of lasting investments in environmental, physical, financial, social, or human capital. This compensation can, to an agreed upon extent, accrue to the affected communities; although it is up to the society decide on how and on the level. While financial compensations appeal to the consumer dimension of communities and members as economic agents, compensation in the form of environmental assets appeals to the citizenship dimension of these.

The suggested mechanism can be in the form of collective negotiations between the communities and developer with the consent of the regulator and policy makers. Collective negotiations ensure that stakeholders are better able to participate in the decision-making framework. The efficiency and acceptance of the outcome of collective negotiations can then be further improved through the use of a menu of options; an established concept in regulatory economics. This paper provides a conceptual framework that unlocks an area of potential empirical research. Future studies should examine the practical application and the process of operationalizing the sustainability approach.

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