

# A FRAMEWORK TO ANALYSE COMMUNITY ENERGY IN TOWNS AND VILLAGES

Conrad Kunze

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# A Framework to Analyse Community Energy in Towns and Villages

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## **Abstract**

The article develops an analytical framework to explain the successes and failures of local community energy projects in the countryside. Theoretical elements based on ownership, technology acceptance, value chains and public opinions are developed and synthesised in two concepts: 'technical complexity' and its antagonist 'social complexity'. The achievement of a mature community energy regime is explained as a continuous process of consecutive single steps in both social and technical arenas.

**Keywords:** *Renewable Energy, Rural Development, Community Energy, Germany*

# Introduction

Many community energy projects have been completed and even more are in the process of development. Since the political decision in Germany to phase out nuclear energy in the summer of 2011, the number of regions with such ambitions has greatly increased. In 2013, administrative districts representing a population of 22 million had a renewable-energy development plan with the ambition of a 100% supply in heating and electricity (congress erneuerbare energie regionen, 2013).

Empirical social research on this topic has been conducted earlier on, especially in the UK (Devine-Wright, 2006) which produced quantitative (Maille 2012; Seyfang et al., 2013) as well as plenty of qualitative findings (Raven et al. 2007; Walker 2008). Though, there are well developed macro theories on the global or national dynamics of the transition to renewables, a comprehensive theory to explain the transition in particular cases at the micro level is still missing (also, the transition or niche theory is not useful to explain particular cases but the general transition). Such a theory was useful, to better understand local differences and predict future developments and regional disparities.

This article introduces some elements for an analytical framework of community energy regions. It broadens the term community energy by emphasising the concept of social complexity. It shows how the mode of ownership is tightly connected to the acceptance of a technology in the public opinion of a region. The starting point of this is not a certain technology but a certain region with its characteristics. The framework shall contribute to the explanation of regional differences in the success or failure to achieve its renewable energy scheme. It concludes with a synthesis of social and technological complexity that can be read as a suggestion for a desirable community-energy policy in the countryside.

The findings draw on empirical research of the author in the German land Brandenburg in 2009 and 2010 (Kunze 2012). Despite some distinctive features of post-socialist Germany (Laschewski 2014), the framework should be applicable to community energy in Europe in general.

## What does Community Energy mean?

Regions in Germany do not refer to it as “community energy” but there are several other linguistic constructs. The most casual ones are energy autonomous region, 100% region, CO<sup>2</sup> free region or simply energy region. In science, the picture is not

less diverse with many concepts competing: energy-commons regime (Byrne, 2009), energy commons (Lambing, 2012), renewable energy system communities (res-network, 2013) and community energy (Walker and Devine-Wright, 2008). For this study a minimal definition is suitable and further limited to communities of place:

"Community energy can be defined as projects where communities (of place or interest) exhibit a high degree of ownership and control, [and are] benefiting collectively from the outcomes" (Walker and Devine-Wright, 2008 In: Seyfang et al., 2013, 978).

## **The concept of complexity**

Interactions between natural and human systems are often described in terms of complexity (Liu et al. 2007) or social learning (Berkes 2009). This article uses the concept of social complexity for the particular case of rural community energy to summarise all necessary efforts, organisers and investors of a community energy scheme have to accomplish. That typically involves the task to convince the population of the desirability of a certain technology (in as far as it is not already involved), to propagate financial and organisational involvement to stake holders and the public and to realise fundraising and legal permissions.

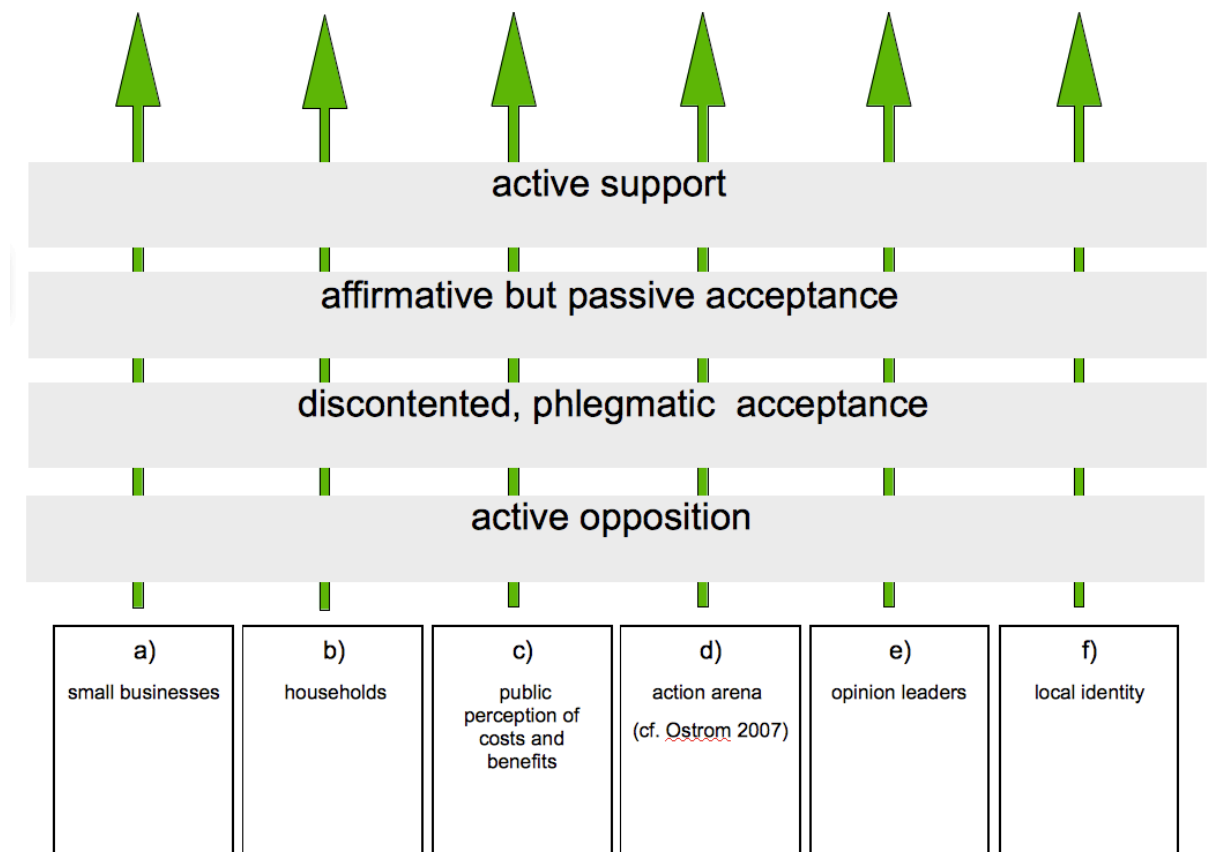
This concept implies that any endeavour in community energy is necessarily a public and political task, not a purely private or economic enterprise (cf. Bomberg, McEwen 2012). Analysing them as political processes does not neglect their obviously dependency on economic constraints and motivations of profit generation. However a political analysis has the advantage to be more open and less excluding to non-economic factors. (ibd.) Economic and non economic factors are here synthesised under the umbrella term social complexity. It is comprised of three elements, public opinion, technology acceptance and ownership.

## **Public Opinion**

The public opinion on renewables in a region depends strongly on the observable economic contributions for the region. These differ strongly, depending on the choice of technology, model of financing and ownership. Technologies will generate some tax income for a municipality in nearly every scenario. An energy technology is obviously much more beneficial, if it is financed by a local consortium of households and small enterprises instead of a non local single institutional investor. Local

ownership has a strong influence for the acceptance of a technology, even for the often conflictive wind turbines (Walker, 2008, 4402). This article argues, that not only the fact of local ownership but the structure of that ownership matters. The wider the shares of e.g. a wind turbine are distributed, the more people and households are involved, the greater the number of people that enjoy an economic benefit and in consequence the more friendly the public opinion.

**Figure 1: Public Opinion and its causes in a certain local context towards a certain community energy project**



Source: Own graphic.

Community energy projects with a broad popular participation are – compared to the single institutional investor model – a challenge to organise. To convincing a large proportion of residents is often a difficult task for political entrepreneurs, even if the proposed model is beneficial for the community as a whole and for the single investors as individuals (Walker 2007 and Kunze 2012). The positive economic effects are usually not yet there, so the project depends on the good will of public opinion and the trust in the words of those that promise future benefits (Maille, 2012).

Public opinion is here operationalised with four possible states. The overt state of active opposition is well known from the anti wind turbine initiatives across Europe. Another state was often found in field research and is described as discontented,



phlegmatic acceptance. A passive disavowal that does not express itself in any hostile and observable action like law suits or grass roots initiatives. Its antagonist is a state called affirmative, but passive acceptance, which means, there is also little overt signs of activity but public opinion is favourable.

Active support is the state of a positive perception that manifests itself in broad participation in the financing of community energy or at least in visiting the evening gatherings to discuss and plan a project. Graph one displays a local public opinion dependent on causes that are summarised in the six boxes a) to f). The following paragraph explains each of them briefly. Box a refers to small businesses which are in the countryside usually an important part of public life. They contribute a tax income and offer employment, so their voice is heard in politics and the general public. Obviously their expectations of becoming a contractor to set up a biomass plant, install solar panels or construct a central heating network will shape their opinion on a community energy project.

Another possible motive is the prospect of reduced energy costs for heating and electricity of commercial buildings due to a local energy production that sometimes reduces consumer prices (Walker, 2008, 4401). Companies from the agriculture or forestry sector may be interested in long term contracting as deliverers of biomass.

Box b refers to private households who of course also consider the chances of financial gains, e.g. by leasing away or selling land for wind turbines or solar panels. In Germany the sums paid for the small plot of land a turbine requires can range from 10.000 (Kunze 2012) up to 90.000 (Handelsblatt 2013) Euro per annum.

A certain fear is sometimes arisen for wind turbines that might lower the market value of houses while a supply with cheaper local renewable energy would be a positive consequence. A very direct consequence to households comes with a central heating system. Households that want to be connected, have to make a long term decision, to change their usually oil or liquid gas powered heating to a central heating. This requires trust in the organisation of the new system, and the decision is made lightly if the private heating is already old and worn out. If many houses have just invested in a new private heating, they will hardly support plans for a central heating.

Box c refers not to a particular group but to the general perception of costs and benefits of a community energy project. There can be very different things on the cost side. In the case of wind turbines, there can be the low humming sound in events of very strong wind and the nightly blinking of the red position lights. Biogas facilities usually require lorries that bring the biomass and possibly cross a village and produce some noise and extra traffic. The facilities themselves may emit unpleasant odour, depending very much on whether they are running on e.g. corn or wood, or

manure. It is important to emphasise the subjective character of these cost-side factors. The sight of a turning wind turbine might be a pleasure for someone who owns a share of it, and welcomes every rotation as a small income contribution. (Warren/McFadyen 2010)

Successful community energy projects compensate shared costs with investment in collective goods. Those are typically a refurbished city road, street lamps, improvements of the football ground, investments in public transport, schools, kindergartens et cetera. Also prospective future jobs, though more often promised than realised, are often considered a common weal. Nevertheless, even one or two prospect jobs may be strong reasons in a village suffering from high unemployment.

As the cost side, so depends the perceived value of public goods on their appreciation by the public.

A free Kindergarten does not necessarily have to be appreciated by everyone, however in most cases it will positively influence the image of the wind park that finances it (Kunze 2012, 85-88). Many similar examples demonstrate how easily the perception can change from a “destruction” of the landscape by wind turbines to a “change” of a culturally shaped landscape (ibd.).

Box d is called symbolic spaces. This refers to conventions where a village or a regional community gathers, typically annual festivities, sometimes still the Sunday service or Sunday’s football game. When a first community energy project or something similar has been successfully established, the young tradition to meet in a public building to discuss a proposal is a valuable precondition for any follow up project.

Besides the fact of assembling, the value of symbolic spaces depends on the rules in place. Elinor Ostrom has offered a long list with rules in place and rules in use that can establish an arena to set up and sustain common goods (Ostrom, 2007).

Box e is reserved for the small but influential group of opinion leaders. Usually, there are a few persons who’s voice carries authority. In the countryside that are sometimes the priest and the major, but often it is a certain family or persons without an official position (ibd.). Obviously, their opinions greatly matter and the fact that a community energy project has started means that they are part of the organising board or at least support it. If one of the opinion leaders of a village is hostile towards the idea of local renewable energy, then chances are bleak.

Box f refers to the local identity of a village or region. This is closely connected to box c, but deserves some extra attention. Especially regions that have lost an industry often face an identity crisis. After being a mining region or a heavy industry region for

a century, they carry on a certain self perception even when the whole industry has gone, like a phantom pain (Sperber 2012). If so, that will hinder new initiatives. If there is a tradition from coal or nuclear industry, that is typically hostile to renewables and will likely prevent initiatives before they even become visible. On the other hand, many ex-mining regions changed their identity, in the case of the French Ungersheim even towards an eco-city. (Vermeulen, 2010; Wolsink, 2012)

## **Technology Acceptance**

Different technologies face different problems of acceptability of the public. As deduced from an empirical field research in Germany between 2009 and 2011 (Kunze, 2012) typical applications of renewable energy in the countryside are ordered according to their demand for popular support. The list starts with non-conflictive technologies for which to rally is rather easy and ends with those that are complex and potentially conflictive.

1. Combined Heat and Power Units installed in basements
2. Photovoltaic and Photo Thermal plants on roofs
3. Small-Wind-Turbines installed on or behind houses
4. Larger Photovoltaic and Photo Thermal plants on the ground
5. Biomass/Biogas Plants
6. Large Wind Turbines
7. Central Heating System for a whole village

Combined heat and power units hardly ever raise any concern. They are installed in a basement, and are not seen, heard or smelled. They neither cost much nor need any visible construction works. The same holds for photovoltaic and photo thermal cells on roofs except that they are visible.

Small wind turbines have diameters between 2 and 8 meters. They do not require much construction works and usually produce no noise. However, depending on where they are installed, they might be in the view of some houses or streets.

Larger Photovoltaic or photo thermal plants are often installed on the ground. Their size makes them sometimes an object of discussion as they do change the impression of a landscape.

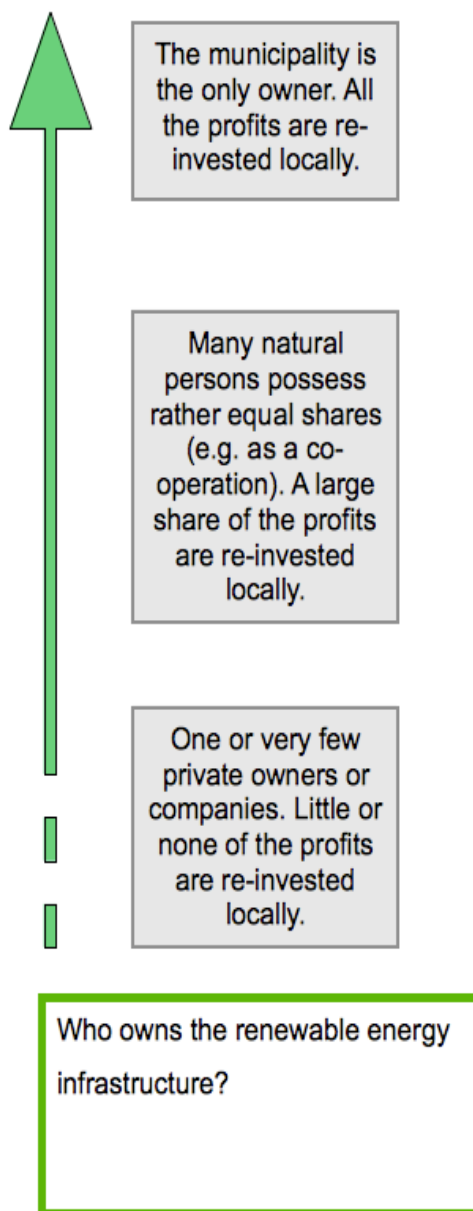
Biomass and biogas plants can emit an odour and lorries have to bring the biomass. Biogas plants run on manure and are more odour intensive and thus more

problematic. Large wind turbines are often a source of conflict as they change the landscape, blink at night and sometimes produce a humming sound.

A heating grid for a whole village can only operate if many or all houses are connected which gives heating grids a high potential for conflicts.

## Ownership and Local Value Creation

**Figure 2: Three main modes of financing and ownership**



Source: Own Graph

The contribution of renewables to local economies depends strongly on the model of ownership. Ownership is obviously determined by the chosen model of financing. The axis of Graph II depicts the three typical modes of financing.

The first possibility is a single or a few private investors. If we expect such big investors to follow a financial logic, they will re-invest the returns on investment where they can expect the highest profit. That is often not in the region but elsewhere so that the generated profits flow out of the region and do not add to its value chains.

The second possibility is displayed by the box in the middle of the same graph. Many people who live in the village or town buy shares of a project and thus enable its financing. The returns on investments are much more evenly distributed amongst many people. The likelihood of reinvestment in the region by daily consumption or investments in ones' house is high. Of course some people might spend it on a holiday or invest elsewhere, but the chance that the whole surplus is spent

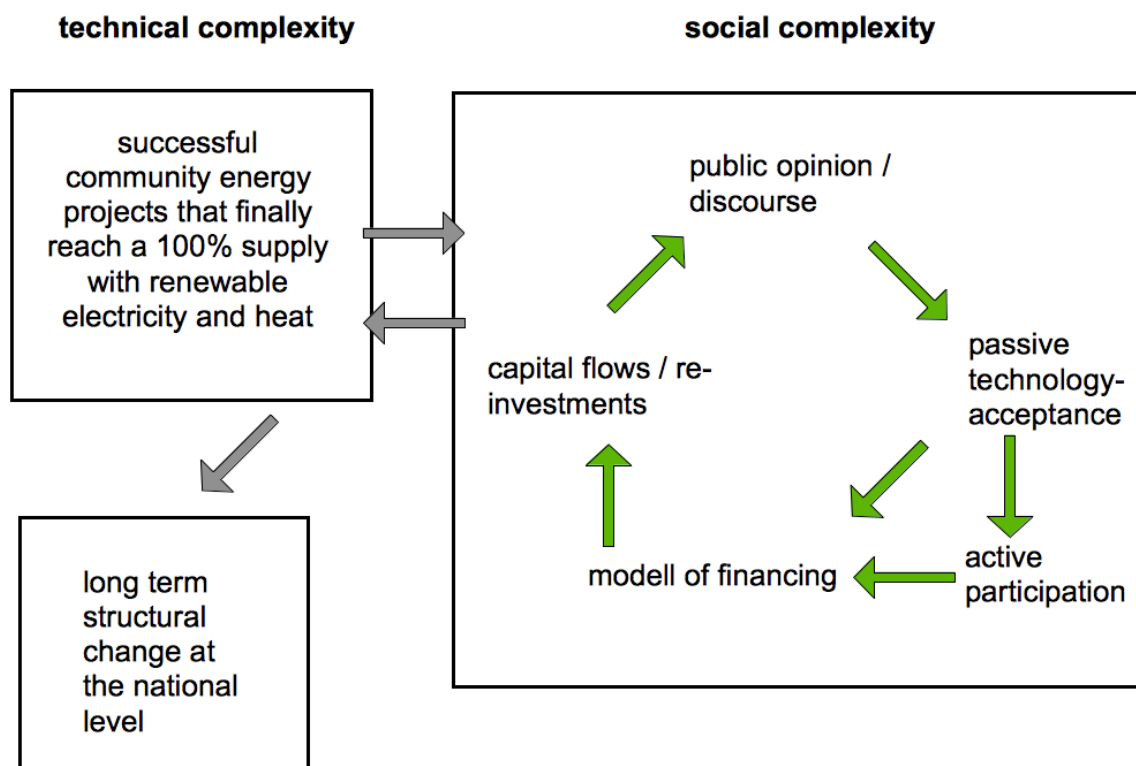
elsewhere, as it exists with a single private investor is ruled out.

The third form of financing is not private but public. A major or city council can decide to invest tax money or money lend by a bank into an energy projects. Especially, when bank loans are used, even expensive technologies like wind turbines or big solar parks can be financed by a municipality (e.g. in the French village Ungersheim). This further diminishes the risk of a loss of profits as public administrators re-invest the profits on public project in the region, e.g. transport, schools, cultural events etc.

## Synthesis of models

In this section the forgoing models are synthesised in a framework to describe why some regions develop highly complex technical applications of renewable energy while others do not go beyond a few solar panels. Instead of limiting the explanans to technology, national politics, or macro-economy, this model takes the perspective of particular local setting and its social characteristics.

**Figure 3: Dynamic socio-technical model of an emerging local renewable energy structure and the effects on the supra-local national level**



Source: Own Graph.

The starting point of explanation is the public opinion of a locality (top right in figure 3). Passive technology acceptance means that only some technology application can be realised, precisely those which are less demanding like solar panels, combined

heat and power units or small wind turbines as described in section 5. Depending on the corresponding model of financing, local value chains can be strengthened and a part of the surplus could then be locally re-invested as private or administrative spending (see section on Ownership and Local values). Public and private revenues as well as positive effects of administrative spending (on kindergartens, street lights etc.) will obviously influence public opinion positively and allow to set up more new technologies that would not have been acceptable before (Berkes 2009; Kunze/ Busch, 2011).

As this cycle repeats a few times and one after another community energy project is realised, passive acceptance may become active participation as has been well observed in the field study (see figure 1). In this case, a higher number of residents accepts potentially conflictive technologies or even participates in their financing. First participative models in German villages are usually solar cells on schools or other public owned houses (Kunze 2012). Only later are citizen-wind-turbines financed and acceptable. A local energy system may thus evolve from very simple form to a highly complex one (see page 3f.).

The box on the left top refers to the technical complexity achieved at a local level. A 100% renewable energy system requires more than one type of production unit (wind, sun, water, biomass), storage and distribution capacity. In some cases, a smart meter system is introduced to run a virtual grid. The more of that is available, the higher the level of technical complexity. The first step, that is here referred to as low complexity can be e.g. a first solar panel.

If community energy projects further disseminate and increase in complexity, they can eventually form a de-central energy structure that is assembled by many small-scale and local producers (small box at the left bottom of figure 2). Community energy projects could establish connections to one another and substitute parts of the predominant structure of fossil, centralised and supra-regional energy networks. Thus a thorough change at the macro-level induced by a transformation from the micro-level is thinkable (Altvater, 2005 and Scheer, 1999).

## **Conclusion**

For villages and towns, Community Energy is a social and political chance as well as a challenge. If they benefit from the chances that open up with renewable energy depends on their ability to build a consensus and achieve a favourable public opinion regarding the first community energy project or projects. Participatory models increase the chances of local financing and acceptance even for conflict prone technologies like wind turbines. For acceptance and value creation, the question of ownership is crucial, both as a prerequisite and an outcome of political decisions.

A favourable social and technical development up to a point of a 100% renewable supply with strong local ownership and acceptance is more likely, if a project is rather implemented in several single consecutive steps than in a wholesale fashion. Those phases should leave enough time for the local community to re-bargain the conditions for the next investment, while assessing the consequences of such decisions already taken.

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