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Energy: Local Resilience and Transition Process

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Introduction

Crises, most of which are difficult to predict, seem to be becoming a "new normal". What's more, different emergencies can occur simultaneously. Extreme weather events, threats to critical infrastructures, waves of migration, pandemics, blackouts due to power grid overload or the direct consequences of hybrid conflicts are now realistic crisis scenarios. It cannot be ruled out that dangers of a hitherto unknown nature will also emerge. The aim of this chapter is to provide some insights about how - from a theoretical perspective - local resilience can be strengthened through energy transition processes. Local level designs in a generic way here the lowest political and administrative decision-making level, typically and in most countries the level of municipalities.

The crucial importance of local resilience was highlighted by the COVID19 pandemic. The extent to which local institutions, and particularly local administrations and elected representatives, were unprepared for such an exceptional situation became apparent. However, the crisis also showed that there was considerable potential for creativity in the municipalities, and that this potential was put to good use.

Resilience

The term resilience is not used consistently in the literature and describes either a capability (Williams et al., 2017), a developmental process (Sutcliffe and Vogus, 2003), or a mix of different approaches (Hillmann and Guenther, 2021). Basically, resilience refers on the one hand to successful responses in crisis situations. On the other hand, the resilience-induced learning process also strengthens the ability to respond successfully to future crises (Vogus and Sutcliffe, 2007). Wenzel et al. (2020) argue that actors in such prolonged crises have only two relevant courses of action: "Exiting," and thus laying down the current activity, or "Innovating," which is linked to a strategic renewal of the previous pattern of functioning. "Exiting" is most often not an option at the level of municipalities.

Duchek's (2020) analyses emphasize the combinatorial nature of organizational resilience and consider it as a meta-capability: "(...) *we define organizational resilience as an organization's ability to anticipate potential threats, to cope effectively with adverse events, and to adapt to changing conditions*." (Duchek, 2020, p. 220).

This general theoretical framework can be transposed to the local scale in particular, three major axes of this meta-capacity of resilience emerge clearly:

1. Anticipatory capacity. It's not a question of "guessing" what will (or could) happen, but of preparing reaction schemes that increase the effectiveness of interrelations between different players, which could prove decisive in the event of a crisis.
2. Ability to withstand or absorb shock. This capacity is based first and foremost on the organizational ability to recognize the existence and seriousness of extreme events, without resorting to denial or a wait-and-see attitude. The speed of response can prove decisive in the event of a crisis. Secondly, the ability to develop solutions by creatively mobilizing and recombining resources.
3. Adaptability, which is based on the ability to manage the crisis over the long term, to facilitate the necessary adjustments, and even to integrate innovations developed out of necessity on a long-term basis.

Local energy transition

Leonhardt et al. (2022) define local energy transition (LET) as the transition from centralized fossil and nuclear energy generation to renewable energy generation and consumption at the local level. The local transition process is characterized by a high degree of private ownership and control, as well as collective benefits. It is driven by small-scale energy projects with local participation and local energy initiatives (Soares da Silva and Horlings 2020). The goal of the process can be to reduce greenhouse gas emissions due to energy generation and savings, to realize economic gains, to make locations less dependent from fluctuations on the energy market or to increase social resilience and economic resilience, i.e. independence from price fluctuations on energy markets (Drewello 2023).

The process of local energy transition is based on renewable energy and energy efficiency. Energy sobriety, which means reducing consumption by changing lifestyles, uses and behavior, may be part of a local strategy of local energy transition. Renewable energies are regarded as inexhaustible in terms of human time dimensions (Kaltschmitt, Streicher & Wiese 2007). These energies are solar, geothermal and tidal energy. Several other renewable energies are based on solar energy like wind and hydropower or renewable energy carriers like biofuels, biogas or green hydrogen.

Local self-sufficiency or local energy autarky, the target of this process, is conceptualized in literature as a situation in which the energy services used for sustaining local consumption, local production and transport are derived from locally renewable energy resources (Müller et al. 2011). Schmidt et al. distinguish between absolute and relative autarky (Schmidt et al. 2012). Absolute energy autarky does not allow any balancing, thus implying that energy resources are not imported at all. In this chapter, the concept of relative local energy autarky is applied. It describes a situation in which, on a renewable basis, in a location at least as much energy is produced as its inhabitants, businesses and buildings consume over the course of one year. This does not mean that a location is energy self-sufficient at any time during the year. Energy surpluses and deficits can occur at certain times of the year or on a particular day, e.g. due to intermittent renewable energy sources like wind and solar power.

Success factors of local energy transition

Local endowments determine the efficiency of investments in renewable energies. Local endowments are defined as all regional, location-specific factors that influence the process of LET (Drewello 2022).

There are geographical, geological and meteorological conditions that influence the production of renewable energies. Even within individual countries, these natural conditions can differ considerably between regions. Proximity to coasts and locations within mountain ranges usually facilitates the use of wind as a source of renewable energy. The geographical proximity to rivers enables the installation of water turbines. In coastal regions tidal power plants may be installed. The use of solar energy is favored by a long average annual sunshine duration and by a low variation in the length of daylight over the year. Geologically stable areas may allow the use of geothermal energy. Sufficient land is also required for all these types of energy. Local demographics are another important influential factor. Big-city neighborhoods with their high population density require different, possibly more large-scale approaches to energy supply than rural areas. Energy saving may play a more important role in urban areas as there is less land available. Another category of endowments are economic structures of locations. In agricultural regions, there is usually potential for the use of biogas. In industrial regions, waste heat from industrial processes might be fed into a local heating network.

Understanding the networking mechanisms in communities is important for improving the management and success of the LET process. Research suggests that collaboration is critical for LET project implementation (Portney 2005; Brody 2003). Participatory models of governance have a particular stimulating effect in solving local challenges. They lead to greater acceptance and a stronger incentive for the commitment of the stakeholders (Hawkins & Wang 2012). This governance approach is also known as collaborative governance. It brings multiple stakeholders together in common forums with public agencies to engage in consensus-oriented decision making (Ansell & Gash 2007).

A supporting network of local stakeholders may improve the local capacity to develop, implement and manage the LET process with their specific knowledge and expertise (Sharp, Daley & Lynch 2011). This network has to be built in the location in order to foster the process of LET. There is a general belief in science and politics that the key for solving global and complex issues of sustainable development lies in the strength and innovativeness of local communities and initiatives, entrepreneurs, and their networks (Aranguren, Larrea & Wilson 2010). Local actors are seen as experts of their living environment. They are most qualified to find effective and creative solutions to specific local challenges of the LET. It has to be considered as well that a high level of innovation is not limited to agglomerations as the regional competitive approach might suggest. Shearmur (2015) and others point out evidence for innovation even in rural and peripheral locations triggered by social and network proximity, local knowledge that is difficult to communicate, or close connection of local actors with local resources (Cooke 2011; Petrov 2011).

Nevertheless, there is a risk of failure of local networking. Strong social networks as well as predefined and consistent institutions on the local level might lead to a separate and closed community. They might limit the ability to adapt and integrate new external information (Kokx & van Kempen 2010; Andersson & Ostrom 2008). Therefore, collective actions might become impossible. To avoid such difficulties in the networking process, a trained and well experienced network manager, who initiates, coordinates, manages, and monitors projects in the LET process, might be very helpful. The position will usually be located in the municipality or in a local public company but can also be filled in smaller communities by civic engagement or a civic enterprise.

Local Energy as a strategy for resilience

In conclusion, local energy transition can be part of “robust” strategies (in the sense given by Ansell et al., 2021) of local public authorities in the face of crises. Considering the theoretical framework developed by Duchek (2020) there are three main reasons for this.

1. Concerning the ability to anticipate:
   Local network providers are responsible for grid stability. Supply and demand in the electricity grid must always be balanced. In the case of an imbalance, a blackout threatens. With the increasing share of renewable energies, the management of the distribution grid faces new challenges. Strong fluctuations in energy production can occur, which might put the security of supply in question. Possible bottlenecks caused by too much simultaneous consumption or feed-in are a danger to the operation of distribution grids and must be prevented. An important goal is to enable the grid manager to recognize future grid utilization through accurate fore-casts and to signal this to the market participants. New forms of local energy markets are on the rise with the intention to integrate the price signal into the market and to consume locally produced energy, e.g, the peer-to-peer approach (Shipworth et al. 2019). The integration of digital technologies in grids, so-called “smart grids”, enables grid operators to better forecast imbalances. Storage facilities can compensate for imbalances between supply and demand. Producers or consumers can also be switched off if necessary.

2. Concerning the ability to withstand or absorb shock:
   LET can strengthen the ability to withstand on the local level, as an important success factor for the LET process is the formation of a local stakeholder network. A functioning network includes the municipality, citizens associations and cooperatives, private companies and farmers, grid operators, etc. These actors are the local experts who complement each other with their specific knowledge of strength and weakness of local energy markets, renewable energy potentials, and the distribution grid. They build trust through co-operation. Such a network is able to include the specific local context in the search for measures in a crisis. It is also suitable for developing preparatory measures in the event of a crisis and systematizing decision-making processes. Furthermore, the combination of local renewable energy production, smart distribution grid and energy storage adapted to requirements may create a local “energy island” that can be disconnected from the national grid in the event of a large-scale blackout. The local grid then may be capable of supplying at least the local critical infrastructure.

3. Concerning the ability to adapt and to evolve:
   The effects of a catastrophic, potentially novel, crisis event can never be fully anticipated. Rather, it is to be expected that the truly catastrophic effects of such an event are unforeseeable. Dealing with past crises and systematically analyzing the mistakes made, the necessary resources, responsibilities and decision-making processes leads to learning effects and possibly also to innovation. The LET stakeholder network should be involved in this process of reappraisal in the form of training and further education, workshops and disaster exercises, alongside emergency services such as the fire brigade, paramedics and local political decision-makers. By dealing with the unpredictable, mechanisms are created that enable a faster response and a more effective choice of resources to be used in an emergency.

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