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Participatory Impetus for and Forms of Citizens' Co-Owned Power Plants: Cases from Higashi-Ohmi, Japan

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Abstract: Citizen-led local participation is considered the key to a successful energy transition, and citizens' co-owned power plants are an alternative and representative form of local participation. The extent to which citizens' co-owned power plants can embody "locality, democracy, participation, energy autonomy, poverty reduction, and energy justice" has led to many controversial discussions. In response to these meaningful questions, this study argues for the focus to return to the impetus and driving forces of local participation in energy. This study proposes six possibilities for the impetus of local energy participation and the types of participation they may create. In the case analysis of the Higashi-Ohmi Model, in addition to the compound disaster of the 11 March 2011 earthquake and the transformation of the Japanese power grid, the driving factors depend on the self-consciousness of local promoters who insist on independence from policy influence. By linking local networks to discuss "local needs," the residents form an integrated plan of "agricultural self-sufficiency, care system, and energy autonomy." They promote the overall economic cycle of the region with energy regional energy currency, which inspired other rural forms of citizen energy participation. In addition, the simultaneous development of small-scale local enterprises and the ability of the local government to adjust policies centered on the needs of residents are important conditions for implementing the Higashi-Ohmi model.

Keywords: co-owned power plant; participation; energy transition; regional currency

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1. Introduction

A decentralized energy system is the most common type of energy transition, representing a more resilient and sustainable energy system. Citizens' participation is seen as the core and the key to shifting from a centralized energy system to a decentralized energy system. The so-called "citizens' co-owned power plant" is diverse in terms of concept and practice, and it has many terms. Different organizations, both official and private, sometimes use various terms interchangeably when discussing the concept of a citizens' power plant. Examples of such terms include community energy, people's power plants, democratic transformation of energy, energy democracy mechanisms, local green power, energy autonomy, and participatory green energy [1–3].

Although "local, democratic, participatory, and energy-autonomous" are the principles on which citizens' co-owned power plants are based, the diversity of the operation of citizens' co-owned power plants in different parts of the world has led to many controversies and discussions, such as: what type of citizens' co-owned power plants can achieve citizen participation or energy autonomy? To what extent does citizen participation in energy help solve energy poverty? How can new forms of energy production achieve energy justice? [4] The answers to these questions require another look at the causes and drivers of local participation in energy, as the reasons for their initiation determine the formation of different types of citizens' co-owned power plants.

This study attempts to summarize the impetus leading to the emergence of the global citizens' co-owned power plants, all of which show that such a system is no longer driven by top-down policies but by both local and policy dynamics. The Higashi-Ohmi model of citizens' co-owned power plants in Japan is an inspiring example of the transformation and movement of residents to address local requirements.

The 2011 earthquake, tsunami, and nuclear disaster in northeastern Japan have pushed the world's anti-nuclear wave and energy reform one step further. In the aftermath of the 11 March disaster, Japan is facing tremendous demands for a greater electricity supply and calls for an energy transition. The trend of Japanese citizens' co-owned power plants symbolizes an important historical change in the development of the power system. In the past, power transmission and distribution were controlled by ten power plants until the rise of citizen co-owned power plants, which represent a new model of energy participation that challenges the previous monopolistic energy system.

What are the reasons and motives for the rise of citizens' co-owned power plants? In addition to tracing the causes based on the general context of the 11 March disaster and the application of the feed-in tariff system, this paper explores factors of grassroots at the local level. Among them, Higashi-Ohmi on the east side of Lake Biwa in Japan is representative and indicative. In Higashi-Ohmi, the history of citizen-led local environmental movements began in the 1970s with protests against red tide pollution. Subsequently, the people of Higashi-Ohmi began working on resource recycling, such as recycling bottle caps, recycling used oil into clean powder, and producing biomass energy. This became known as the "Yellow Revolution," and although it was started by the people of Higashi-Ohmi, it has since become popular throughout Japan.

In 2013, the "Welfare Mall," which combines friendly agriculture, a welfare system, and a citizens' co-owned power plant, was established. This is an example of radical bottom-up reform, and the residents are conscious of the fact that the area is separated from the previous policy-driven development model. This case study showed how the involvement of residents in energy production was closely related to the problems that residents are trying to solve: a large rural elderly population, lack of employment, and declining economic power. The extension of the "local needs" approach to citizen participation in energy will inspire other rural areas to develop autonomous energy.

This study is based on the author's attempt to understand the spirit and source of vitality of the local environmental movement by staying in a farmhouse and participating in local activities for one month each in 2014 and 2016. Additionally, a video interview was conducted in 2021 as a basis for long-term tracking and long-term observation. Interviews with key people and organizations in the local environmental movement in Shiga Prefecture during the fieldwork were used as a reference for analyzing the citizens' co-owned power plants, and different forms of participated citizens' co-owned power plants were analyzed according to the different motivations, stakeholder's benefit distribution, and networks.

The analysis of these forms of participation reveals how local businesses and residents, civic organizations, and regulatory adjustments with the government play an important role together, resulting in the formation of a particular citizen-co-built power plant in the region. The invention and application of a regional currency to return profits from citizens' co-owned power plants to the local economy are the most characteristic and inspiring. The successful use of the concept of 'solar money' links the practice of decentralized energy systems and decentralized currencies.

The framework of this study starts with a theoretical literature analysis, which consists of two parts: one is to compare the conditions and characteristics of centralized and decentralized energy systems, and the other is to analyze the motivation for decentralized energy systems and participatory forms of citizens' co-owned power plants. The case study of the Higashi-Ohmi model in Japan consisted of the following three levels: first, the methodology, including the method of fieldwork, scope, and research perspectives; second, the four cases of citizens' co-owned power plants in Shiga Prefecture, Japan, were used to understand the reasons for their generation, the different needs they respond to,

and the different forms of organization and operation. Furthermore, we analyzed the implications of the Higashi-Ohmi model for rural areas based on the characteristics of the cases. Finally, conclusions are drawn, and the limitations of this study are discussed.

2. Theoretical Literature Review

2.1. The Transition of Energy Systems

2.1.1. Basic Concepts of the Transition of Energy Systems

Distributed energy generation represents a new trend, meaning that energy conversion systems are located closer to consumers and that large energy conversion systems will be replaced by smaller ones [5]. According to Ackermann and Andersson [6], the definition of distributed energy generation should be based on criteria such as the purpose of use, location of the system, power scale, power transmission, technology, environmental impact, mode of operation, and ownership.

The term "decentralized energy system" is more frequently used in European countries, while "distributed energy system" is more widely used in Asia. In comparison, decentralized energy systems are slightly different from distributed energy systems in that they are autonomous and independent of other energy production systems. Distributed energy systems are broader in scope, with links between generation systems. In contrast, distributed energy systems are not necessarily decentralized energy systems, but decentralized energy systems are necessarily a type of distributed system [5]. In terms of the autonomy of an energy system, decentralized energy systems are the most autonomous, followed by distributed energy systems, and centralized energy systems are the least autonomous.

In terms of a system's operation, decentralized energy systems and distributed energy systems are both concepts relative to traditional centralized energy systems. A centralized energy system operates with a centralized energy delivery system to link the generation, transmission, and distribution system; the transmission system converts high voltage to low voltage and then transmits it to the end-users, such as houses, factories, or commercial buildings [7]. Centralized energy systems, such as nuclear or thermal power generation, rely on large scale storage of raw materials and waste, high temperature and pressure, and economies of scale to distribute electricity to a large number of users over a large geographic area through large scale electricity production, thus having a wider impact [8].

The decentralized energy system can be considered as the complete opposite system. First of all, "multiplicity" is the typical feature of this system, which includes a multiplicity of renewable energy production methods, energy storage systems, energy detections, and control systems [9]. The decentralized energy system utilizes different renewable energy sources, such as wind, solar, geothermal, etc., in different locations through multiple small to medium scale generation methods so that each location has the ability to produce its own electricity.

Furthermore, since energy production needs to be close to energy users, the impact of providing energy to a relatively small number of users within a limited geographic area is mostly local, and the number of users is relatively small [8]. Typical decentralized energy systems (or extreme cases of distributed energy systems) are, for example, small-scale electricity production systems in rural communities that provide a community-wide energy supply or single buildings where the electricity, heat, and cooling systems are self-supporting [5]. Figure 1 illustrates the transition of energy systems, including centralized energy systems, distributed energy systems, and decentralized energy systems.

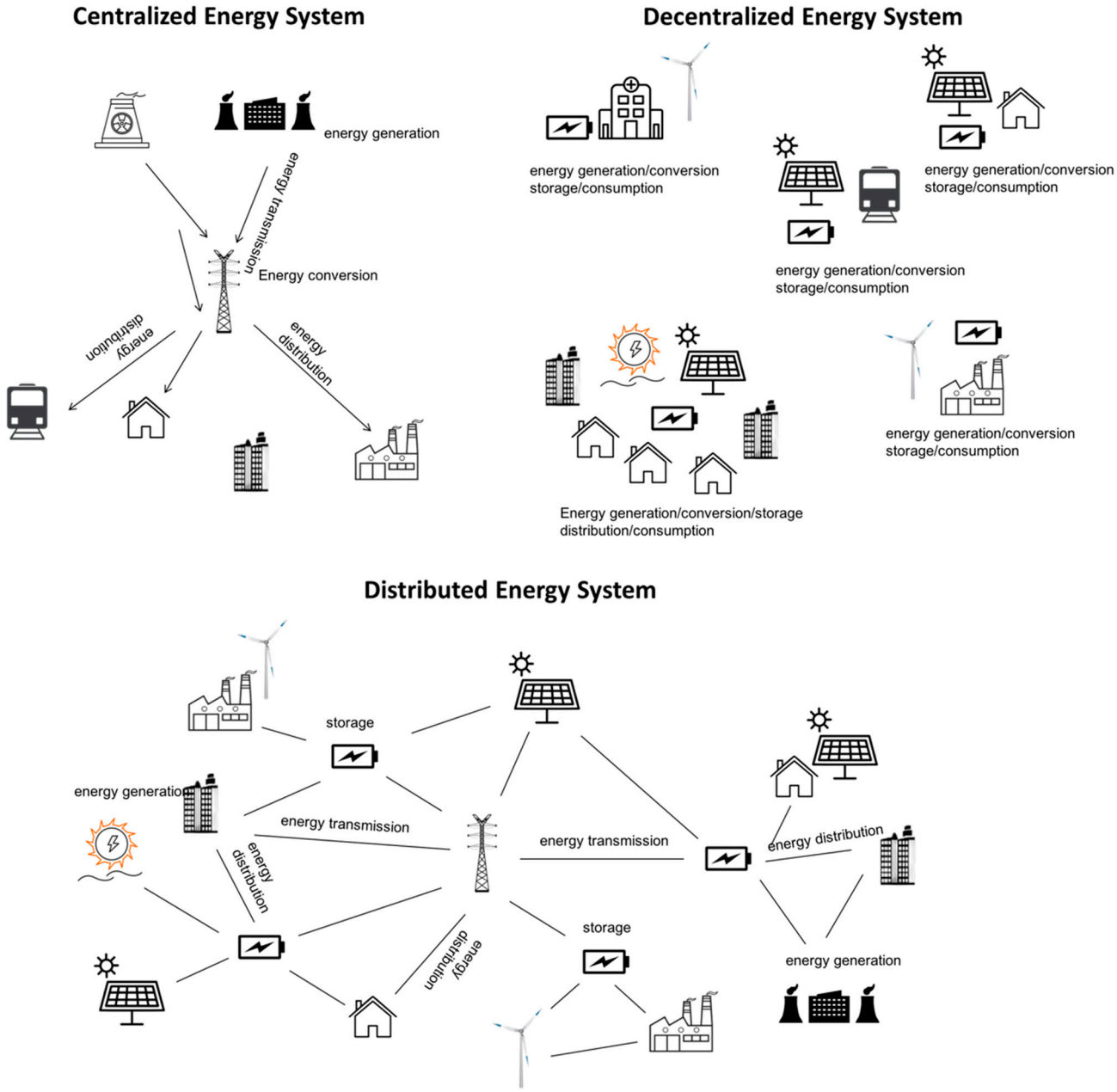

Figure 1. The Transition of Energy Systems. Modified from Alanne and Saari (2006).

The implementation of smart grids, smart meters, and energy storage systems have a very critical role in the transition of an energy system. The knowledge development of smart grids starts with the integration of large-scale renewable energy sources and distributed energy systems [10]. Smart grid combines advanced power network solutions with information and telecommunication technologies, and smart meters provide precise information about the network status and consumption data [11]. The challenges of smart grids and meters deployment are numerous, such as encompassing the complexity of data exchange between smart meters and relevant actors in liberalized markets, including data collection, data access, and privacy issues, as well as the costs and benefits involved for end-users, distribution system operators (DSOs) and retailers [12].

According to the Dynamic Modeling Approach of Dehdarian [12], the costs and benefits to DSOs, retailers, and consumers are interdependent. In a smart meter system, the electricity-saving effect reduces the consumer's expenditure on electricity, which in turn provides a positive externality for the retailer, who acts as an intermediary role between

the consumer and the DSO. In a dynamic, interdependent relationship, efficient electricity use and monitoring system lead to a reduction in variable costs that are deducted from the DSO's costs; however, the DSO, as the owner or renter of the smart meter technology, incurs higher initial investment and operating costs, so that the benefits of the overall system still do not allow for full recovery of the high investment costs. Since DSOs receive a negative return, they are not willing to initiate changes to technology. To make the system more balanced, policies could use intervention mechanisms that allow actors to share the investment costs proportionally, promote new market mechanisms for retailers to reduce the risk of demand fluctuations, or develop home energy management systems that address consumer needs.

2.1.2. Centralized vs. Distributed (Decentralized) Energy Systems

Comparison of Security, Energy Efficiency, Cost, and Power Quality of Energy Systems

The centralized energy system is a baseload power plant, and when it provides continuous power, the transmission system will cause high power loss, so the centralized energy system has low power efficiency, no guarantee of power quality, and high emission characteristics. Once a power outage occurs, it may cause widespread power outages, thus creating energy security problems. In terms of cost, in order to maintain a continuous energy supply and large-scale transmission equipment, capital concentration, control of electricity production and grids, etc., are required, and this highly variable and maintenance cost characteristic can only be afforded by governments or large corporations [7,13,14].

The main advantages of a distributed energy system are reduced transmission losses (high power efficiency), low emissions, and increased energy security as energy users no longer need to use power from more distant sources. Momoh and Meliopoulos [14] suggest that for sustainable electricity production, distributed energy systems should be infiltrated in the centralized energy system to reduce emissions and increase efficiency. In addition, although distributed energy systems have a higher level of reliability and quality of electricity services than centralized energy systems, the combination of distributed energy systems and centralized energy systems can provide better reliability and reduce losses if they are penetrated in the energy system network.

Ability to Respond to Local Needs

The distributed energy system is closely related to local needs. Comparing the two types of energy systems in responding to local needs, the centralized energy system is implemented at the centralized level with computer-based models and is generally considered to ignore the energy needs of rural areas and the poor. In addition, the consumption of fossil fuels causes environmental damage and deforestation and does not respond to the socio-economic and ecological factors of a region. In contrast, distributed energy systems are developed to meet local energy needs, are locally based, and emphasize incorporating local energy participation, increasing the efficient use of locally available resources, and keeping economic and social benefits local [15].

Vulnerability and Resilience

Distributed energy systems are less vulnerable to losses from a single source because they rely on multiple sources of energy. In addition, power generation is less likely to be cut off or destroyed than from one source alone, and distributed energy systems are more resilient because they continuously provide consumers with low electricity demand. However, renewable energy technologies are vulnerable to natural disasters, such as wind turbines shutting down during hurricanes and solar panels failing to produce enough power during hurricanes and periods of heavy rain [8,14].

In contrast, the low diversity of sources used in centralized energy systems makes them more vulnerable to specific source losses and less advantageous to rebuild due to the use of large-scale equipment. Centralized energy systems, on the other hand, have the advantage of being supported by governments and large corporations and involve a wider

range of users, making them easy to prioritize for reconstruction, which can help reduce losses for a large number of consumers. In contrast, small-scale electricity production has lower government and corporate rebuilding priority, takes more time to repair, and may cause longer-term health and environmental hazards [8,14]. Table 1 shows the features, advantages, and disadvantages of centralized energy systems compared to distributed energy systems.

Table 1. Comparison of Centralized and Distributed Energy Systems.

Centralized Energy System	Distributed Energy System
Features	
Conventional energy, high-voltage cables, control grid, large number of users, large-scale storage of raw materials and waste, and high temperature and high pressure operating conditions.	Renewable energy, smart grid, local impact, and the number of users (within a geographic area) is relatively small.
Advantages	
Base-load power plant and the priority of "reconstruction".	Less loss of transmission system, increased security of energy supply, smaller capital investment, less vulnerability to loss of a single raw material, sustainability of power sources, effective use of local resources, response to local needs, and higher power quality.
Disadvantages	
Large-scale equipment causes delays in reconstruction time, vulnerability to loss of specific materials, less sustainable power sources, security issues, high capital concentration, high cost of government and corporate financing, and ignores the energy needs of rural areas and the poor.	Energy storage systems are expensive and less of a priority for reconstruction.

2.2. Literature Reviews on Impetus for and Forms of Citizens' Participation in Co-Owned Power Plants

Why has local participation in renewable energy emerged? Why is local participation important in the energy transition? Furthermore, how is the emergence of citizens' co-owned power plants "embedded" in other areas, such as economic, political, and social dimensions, in addition to environmental and energy-related factors? In recent years, renewable energy development in the international community has increasingly emphasized the importance of the concepts of place or locality, such as theories of "place-based" [16] or "community-based" [17]. The bottom-up force represented by the micro-level in the Multi-Level-Perspective (MLP) is also a considerable illustration of the niche as an incubation space for novelties, which will be the seed of transition and change [18–20].

The following is an analysis of the motivations for local participation in energy and the corresponding organizational patterns of participation.

2.2.1. Decentralized Energy System as a Continuation of Traditional Way of Accessing Energy

From this perspective, decentralized energy systems have existed for centuries. In Scandinavia, for example, due to the lack of good transportation facilities and traffic conditions, wood was collected from the vicinity of homes, and each household had a wood-burning stove. Thus, society as a whole functioned decentrally until the era of

technological progress and mass production began, where the "first era of decentralization" came to a halt [5]. Asian communities were in the same situation [21]. In this regard, decentralized energy systems are a return to and continuation of traditional ways of energy production.

2.2.2. Local Acceptance of Large-Scale Renewable Energy Construction

In recent years, there has been a growing body of research on the local response to large-scale renewable energy construction. The local reactions to the local construction of large-scale renewable energy facilities, especially in rural areas, may lead to a slowdown or even stagnation of renewable energy development, while on the other hand, it may also lead to the development of new local patterns of renewable energy participation.

The NIMBY (not in my backyard) theory is often used extensively when exploring social acceptability. According to NIMBY theory, community resistance to the siting of risky renewable energy facilities can be seen as a malignant social symptom, which implies "frustrated states of anger and fear that result from perceptions of victimhood and threats to quality of life" [22]. The NIMBY theory argues that the technological dangers involved are exaggerated, advocating the use of technical data to convince people of their irrational fears. However, the NIMBY theory has been subject to much rethinking and challenges in the last two decades, demanding that the relationship between renewable energy technology and society should not be reduced to a NIMBY symptom and questioning the top-down decision-making attitude that the NIMBY theory presupposes [22–25].

The concept of "social acceptance" (public acceptance) focuses on local controversies or local responses to large-scale renewable energy, and critically reflects on the meaning of the term "acceptance". "In contrast to "acceptance," which may imply a passive, uninvolved decision-making process, support is action-oriented, suggesting agency and involvement. Thus, acceptance of renewable energy technologies may imply acceptance by those in power or by companies, requiring individuals and communities to accept and tend to reject opposing views. This top-down view is widely used in the decision-making process of energy construction and assumes that if people do not actively oppose energy facilities, they "accept" them. By taking this approach, coupled with "legitimate" energy policies and goals, policymakers can achieve a faster expansion of low-carbon energy facilities. However, literature focusing on the social aspects of renewable energy technologies has strongly criticized this view, as it may undermine the sustainability of these technologies [23]. Overall, the rethinking of large-scale renewable energy facilities or top-down decision-making mechanisms has led to a more participatory, bottom-up, and prudently evaluated form of energy engagement with universal participation.

2.2.3. Resistance to Corporate Hegemonies

Although social and ecological movements have drawn public attention to the demand for renewable energy in the late 1970s, renewable energy in most countries was dominated by large corporations. In order to oppose the corporate hegemonies and to protect available land, different types of citizen movements have emerged, such as community energy groups or renewable energy cooperatives, for example, Elektrizitätswerke Schönau (EWS) in Germany, Energy4All in the UK, Ecopower in Belgium, and Enercoop in France [26]. However, Huybrechts and Mertens [26] also highlight that "confronting unbalanced markets (e.g., monopolistic buyers, sellers)" does not naturally lead to small local energy organizations. In fact, many cases show that exclusive firms are too strong and prevent the emergence of other competitive rivals, not to mention smaller organizations such as cooperatives.

2.2.4. Renewable Energy Policy Transformation and Empowerment

In the process of the energy transition, "empowerment" has been regarded as the process of decentralizing the government from the original state-driven centralized energy system to include enterprises and the public in the roles of energy production, energy

supply, and energy services. Full empowerment will lead to the establishment of a new multi-stakeholder energy system and local energy policies that are responsive to local practices. Reform of electricity liberalization is also seen as a key element of empowerment. Although electricity market liberalization does not necessarily lead to lower electricity prices, which are still influenced by global and local energy prices and taxation, it is still seen as a prerequisite for citizens' participation in electricity generation, and theoretically, the greater the degree of electricity market liberalization, the greater the scope for citizen participation [27,28].

Regarding the motivations for empowerment, in many countries, the regime is considered to be the main obstacle to the development process of Just Transition, energy decentralization, and energy democracy. Heldeweg and Séverine [4] point out that in the EU member states, national policies still mainly implement centralized energy systems. They illustrate the necessity for a new institutional environment and regulatory coherence with examples of new energy communities in the Netherlands and the UK.

Although the current system of the state is seen as a barrier to energy decentralization, the methodological dichotomy of 'top-down/bottom-up' or 'state/local' as a theoretical default for analyzing local responses to large-scale energy construction is gradually breaking down, with Batel and Devine-Wright [16] arguing that this dichotomy presumes a discrepancy between the two and is likely to be neglected for further investigation. They test this critique with a survey study of electricity transmission in the United Kingdom, which does not support a discrepancy between the national and local levels. On the contrary, there are both differences and similarities between the two.

Thus, the process of empowerment is a two-way process involving the state and the public. What needs to be further investigated is whether the state is passively driven by the public, such as energy transformation trends from the locals shaking the state's political and economic interests and forcing it to transform [29] or whether the state is transforming due to interest considerations? For example, from the perspective of states' budgetary inputs, as the traditional centralized energy system requires high capital investment from the state, and a decentralized energy system can be a better solution to the state's financial burden in the long run. Overall, research on the interplay between energy initiatives from the local and policy levels is still very inadequate and needs more attention.

2.2.5. In Response to Local Needs

Decentralized energy reflects local needs and the optimal use of local resources. The use of local resources encompasses more than just energy resources; if we delve into the question of why local residents begin to think about what and how to use energy, we find that the energy issues they think about are related to many other aspects of local life, including diet, physical health, consumption habits, local economic development, and human resources and so on [30]. In this regard, the emergence of local energy requires consideration of structural factors, and conversely, the development of local energy causes structural changes throughout the local area.

2.2.6. For Investment Purpose

An online fundraising type of citizens' co-owned power plants is also shaping based on the concept of the public's investment in "renewable energy commodities". The initiating platform takes responsibility for the operation of the power plant, and the fundraisers from different places and backgrounds are not directly involved in the operation [31]. Holstenkamp [32] argues that in countries with market-based financial systems, such as the UK, fundraising plays a more important role in their renewable energy financial markets. In contrast, where local banking structures are more robust, such as in Germany, renewable energy fundraising is likely to be less prevalent.

Over the past decade, online fundraising has been defined as a broader 'alternative' financial market in Europe, and with the rapid development of renewable energy fundraising types since 2017, it is predicted that renewable energy fundraising should have the

potential to develop even faster in the next five years compared to general fundraising projects [33]. On the other hand, however, critical perspectives not only point out the ethical controversies of online fundraising but also question the lower degree of energy autonomy and energy security of crowdfunded citizen power plants, as well as their less localized nature [34]. In addition, it is worth further examining whether the larger capitalization and scale of operation of online fundraising citizens' power plants may be crowding out other small-scale, local forms of energy participation (e.g., cooperative or community types).

3. Methodology

The methodology of this study was based on fieldwork and in-depth interviews and data collected during in-depth interviews, which were conducted for one month in November 2014, as well as a three-week on-site interview in March 2016, and a video interview with the welfare mall operator in January 2021. The scope of the interviews was not limited to citizens' co-owned power plants but also delved into the history of the environmental movement in Shiga Prefecture and local activities related to the overall natural and human resource cycle.

The execution of the research is based on the following three principles:

(1) Snowball sampling:

The way the interviewees were chosen or could be chosen followed the tracing route of accumulation, where the later interviewees could be an acquaintance introduced to me by the former interviewees. The contents of each interview provided the content of the next interviews, such as when the interviewees referred to particular agents or persons [35].

(2) Hypothesis-breaking:

Both theoretical perspectives and research methods aim to refine and reflect certain hypotheses that have been frequently used for the analysis of energy transition. For example, studies of the local environmental movement tend to homogenize "locality" and "local people," ignoring the scope and definition of "local" itself, as well as the complexity of "intra-local." Therefore, this study needs to make gradual conceptual adjustments between the two field trips. Another example is that the "stakeholder" perspective is often used as the basis of analysis in the social sciences; however, this concept does not necessarily reflect the interactions between people in the local area or their perceptions of each other. As an outside researcher, one needs to pay particular attention to one's own preconceptions in this area.

(3) Mapping key persons:

The key players themselves are worth analyzing because they play an important role in every decentralized energy community or group initiative. It also helps to answer the possibility of decentralized energy expansion or cross-regionalization. However, in defining key persons, it is not advisable to define them subjectively by the researcher, although the researcher should be 'alert' to the commonly recognized key persons in the field and use long-term tracing and empirical experience as the basis of judgment. Although the interviewees in the first two trips to the field in this study were highly repetitive, the second one expanded the interviewees to include local residents in addition to the key persons.

4. Impetus for the Build-Up of Citizens' Co-Owned Power Plants in Higashi-Ohmi, Japan

4.1. The 311 Disaster

Strong impetus for the build-up of Citizens' Co-Owned Power Plants in Japan must be traced back to the nuclear accident of the 11 March 2011 disaster at Fukushima, although the first Citizens' Co-Owned Power Plants of the whole Shiga Prefecture had already been built in 1997, and the first one in Higashi-Ohmi was built in 2003. Compared to the 13 Citizens' Co-Owned Power Plants built during the 12 years before the 11 March 2011 earthquake, the number of newly built power plants has increased to 28 built after the 11 March 2011 earthquake during 2011–2017 in the Shiga Prefecture [36]. In terms of

nationwide Citizens' Co-Owned Power Plants, after the first Co-Owned Power Plants built in Miyazaki in 1993 and the next two built-in Shiga, Citizens' Co-Owned Power Plants have been built gradually in Japan until 2012, and the number has increased rapidly from 400 to about 800 in three years [37].

Due to the large-scale blackout and atomic disaster after the 11 March 2011 earthquake, small-scale and distributed renewable energy have been seen as the best alternatives [38]. Especially academic literature and official reports used to combine the concepts of disaster reduction and mitigation with Citizens' Co-Owned Power Plants [39,40]; the former has long been adopted as a major policy while the latter served as a new strategy to drive it forward.

4.2. Feed-in Tariff (FIT) Scheme

The other impetus was the implementation of a Feed-in Tariff (FIT) Scheme (fixed price purchase system) for Renewable Energy in 2012. According to Yosuke Toyota's questionnaire survey on the Citizens' Co-Owned Power Plants in Japan, the biggest challenges that occurred after building up the power plant were fund procurement and fund management. Related staff also believed that support for fund formation and fund procurement would be necessary for the prevalence of Citizens' Co-Owned Power Plants [37]. Under this condition, the Feed-in Tariff scheme plays a role as an economic guarantee of investment. Nevertheless, if FIT payments are set to a lower level, impetus or practical projects concerning Citizens' Co-Owned Power Plants will be delayed [41].

4.3. The Gradual Steps of Electricity Liberalization

From 1 April 2016, 'Liberalization of Retail Electricity Sales' went into effect, which has been called the beginning of the 'Epoch for choosing electricity'. Under this framework of comprehensive electricity liberalization, retail electric companies, including citizens' co-owned power plants, can sell surplus electricity to households, companies, or factories, instead of the only receiver being the ten general (monopoly) power plants in Japan, as was the case in former times. The registered number of retail electricity companies in Japan has reached over 414 by August 2017 [42].

From the consumers' side, shops and households were the most limited before the entry of 'Liberalization of Retail Electricity Sales', in which they had no choice but to accept the electricity transmission from 'general' electricity power companies such as Tokyo or Kansai Electric Power Companies. Only after 'Liberalization of Retail Electricity Sales' went into effect could they freely choose their electricity provider from various companies according to their lifestyle, values, and economic considerations. Under this framework, consumers can also choose electricity providers from other areas. For example, residents living in cities can buy electricity from nearby rural areas or purchase electricity from a nearby citizens' co-owned power plant to support the idea of 'locally produce and locally consume' [43].

From the electricity producers' side, the delivery objection of retail electricity companies changed due to past legal restrictions and the gradual liberalization of the electricity market. The first retail electricity liberalization started in March 2000, when factories, department stores, and office buildings in the category of 'super high voltage (2000 kW)' could start to choose electric power companies freely, including new entrants [42,44]. In 2004–2005, the targets expanded gradually to include medium- and small-scale factories and companies which belong to the 'high voltage (50–2000 kW)' category. From 1 April 2016, retailing electric companies can also be selected for households and shops in the 'low voltage (<50 kW)' category [44] (see Figure 2).

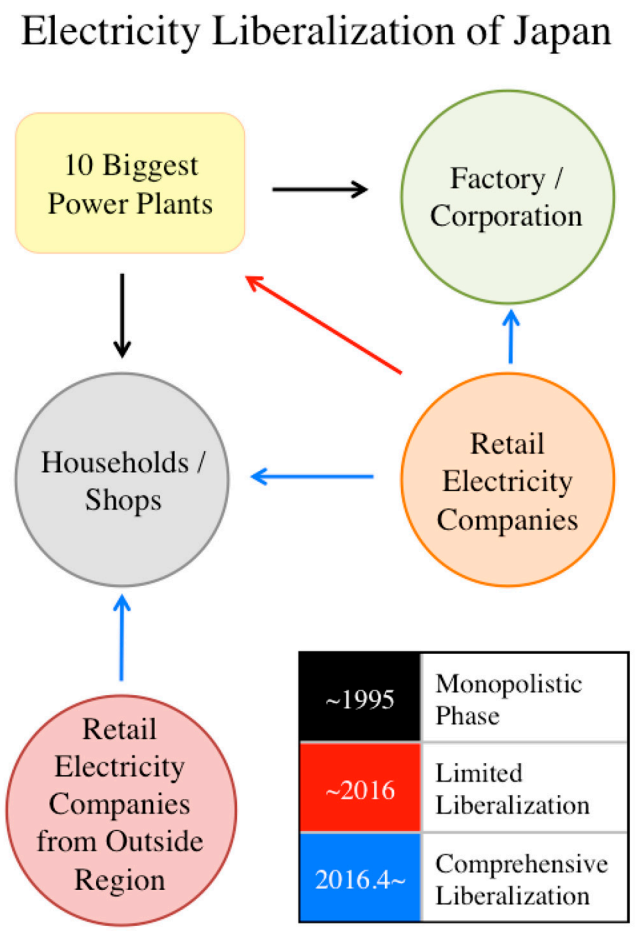

Figure 2. The gradual steps of electricity liberalization in Japan.

Retail electricity companies also serve as electricity service contractors who should communicate directly with consumers, including each household, and provide 'fee menus' and services in order to satisfy the needs of their consumers.

In summation, the policy of 'Liberalization of Retail Electricity Sales' aims to boom up various companies in the electric retail market and also revitalize competition among the electricity providers in Japan. Under this new policy, several related services are expected to increase, such as set discounts by a combination of electricity and gas, electricity and mobile phones, point service, and household energy-saving diagnosis services [45].

4.4. Grassroots Power of Rural Area

Citizens' or regional Co-Owned Renewable Power Plants have been tackled as a grassroots power while economic efficiency was not secured until the FIT Scheme was implemented [46]. As Nakajima E. said, grassroots activities that emerged from citizens' movements have a long history in Japan. Instead of losing their regional peculiarity under large-scale agriculture, Japanese rural areas preserve their uniqueness and vitality when dealing with the diversity of natural resources. This grassroots power could be regarded as a kind of social business of Japanese style that has also been embodied in citizens' power plants. For example, Citizens' Wind Power Plant in Aomori injected a part of its revenues into an environmental fund that helped the selling of local agricultural products such as apples. This idea was developed out of the expressed interests of investors of the power plant [47].

Interviews suggested that compared to other types of renewable energy resources, solar power has been found to be less approachable as a method of environmental protection than other activities such as used oil recycling, wood reuse, or farmland revitalization [48].

The reasons why local people invested in the Citizens' Co-Owned Power Plants were mainly related to trust in the initiators and also a belief in creating something good for the region together. Therefore, compared to other activities in which they could spend time together or share experiences and values, Citizens' Co-Owned Power Plants were not a prior activity that particularly caught people's attention and passion. In the following cases, the pattern of Welfare Mall Citizens' Co-Owned Power Plants especially demonstrated this intention.

Despite the common features among regional- and economic- orientations, following patterns of Citizens' Co-Owned Power Plants still showed their differences with regard to both purpose and design.

4.5. Role of Municipalities and Local Renewable Energy Enterprises

Since decentralized energy is an emerging concept in the region of Higashi-Ohmi, related public sectors also present their abilities to adjust and keep pace with this new demand of local people. Some regulations were amended to resemble plans. For instance, after the Citizens' Co-Owned Power Plants No.1 and No.2 were raised by residents from Higashi-Ohmi in 2003 and in 2010, respectively, part of the regulation on the "Usage Fee of the Administrative Assets in Higashi-Ohmi" was turned into "Guidelines of Facilities of Renewable Energy as Public Domain of Higashi-Ohmi", in which regional groups, NPOs (non-profit organizations)and specifically authorized corporations were targeted as the subjects of the regulation. The aims of these guidelines are to combine the facility of electricity in the city, the regional and non-profit activities, and regional coupons released by economic organizations in the city [49].

The projects of Citizens' Co-Owned Power Plants in Higashi-Ohmi were initiated by the implementers of the projects themselves and proposed to the municipality. In an interview with the section chief Yamaguchi, she emphasized that these cooperative relations were realized by the initiators themselves and had little to do with the central or prefectural government. "This was because of their (local initiators') common hope" [50], and local municipality plays a supportive role. Before 2015, Kyocera was the only Solar PV company in Higashi-Ohmi; therefore, the municipality in Higashi-Ohmi also supported it by providing funds. Kyocera won the bids in the public procurement with the lowest prices and cooperated with different Citizens' Co-Owned Power Plants in Higashi-Ohmi.

The municipality of Higashi-Ohmi also supported the local initiation through amending and regulating rules. For instance, the renewable energy lease agreement of public facilities was regulated in June 2012 due to the increasing participation in renewable energy facilitation from the regional groups and NPO. Following the needs of these local groups, the 'Guideline for Renewable Energy Facilities of Public Property in Higashi-Ohmi' was drawn up by the municipality and applied to regional groups and NPOs which satisfied the following conditions: (1) their main purpose is to lease rooftops of public property for the purpose of facilitating renewable energy, (2) constitute regional activities and non-profit activities inside Higashi-Ohmi and (3) issue regional coupons managed by economic groups of Higashi-Ohmi. In summary, the basic requirements are that these projects should be set up for the purpose of the common wealth of this region, such as co-owned PVs.

5. Patterns of Citizens' Co-Owned Power Plants in Higashi-Ohmi

The Citizens' Co-Owned Power Plants of Higashi-Ohmi was designed to be a part of the regional business cycle, which makes it significantly different from other Citizens' Co-Owned Power Plants [51]. Generally speaking, the first step for citizens in setting up a Citizens' Co-Owned Power Plants in a region is to raise funds and then to install solar panels. Contributors then share the profits. A possible weakness of this system is that contributors can use the profits freely, and consequently, the earnings might flow outside the given region. Another weakness is that investments might become a financial burden on the contributors (see Figure 3).

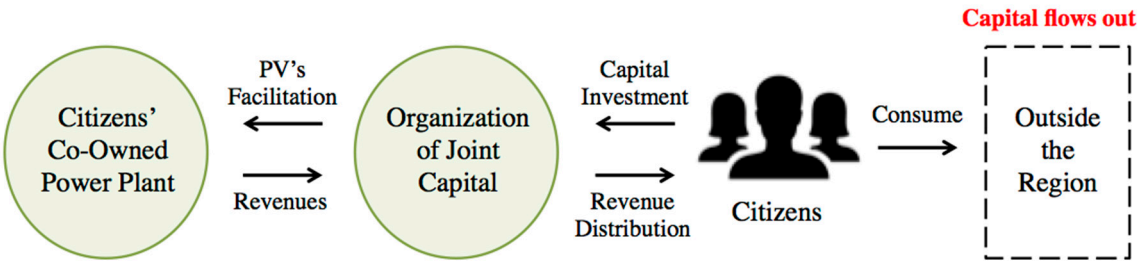

Figure 3. One possible weakness of the general Citizens' Co-Owned Power Plants: "capital flows out of the region". Source: modified from Hashimoto and Nakagawa [51].

In order to solve these problems, the "Model of Higashi-Ohmi" attempted to place equal stress on ecology and economy with the idea of a regional currency and future fund [51]. Under this design, contributors receive the coupons of the earning distributions instead of cash. The Chamber of Commerce operates the coupons and cooperates with 400 shops in the region so that contributors can consume in these shops with limited time offers [30,39,51]. Through this mechanism, the Citizens' Co-Owned Power Plants will remain embedded in the regional economy and also, to some extent, promote the cycling of money into regional businesses. The idea behind the future fund was to raise 1% of power consumption fees of related companies and citizens and put it into the "Wind-Sun Future Fund" in order to support the overall renewable energy facilities in the city [51] (see Figure 4).

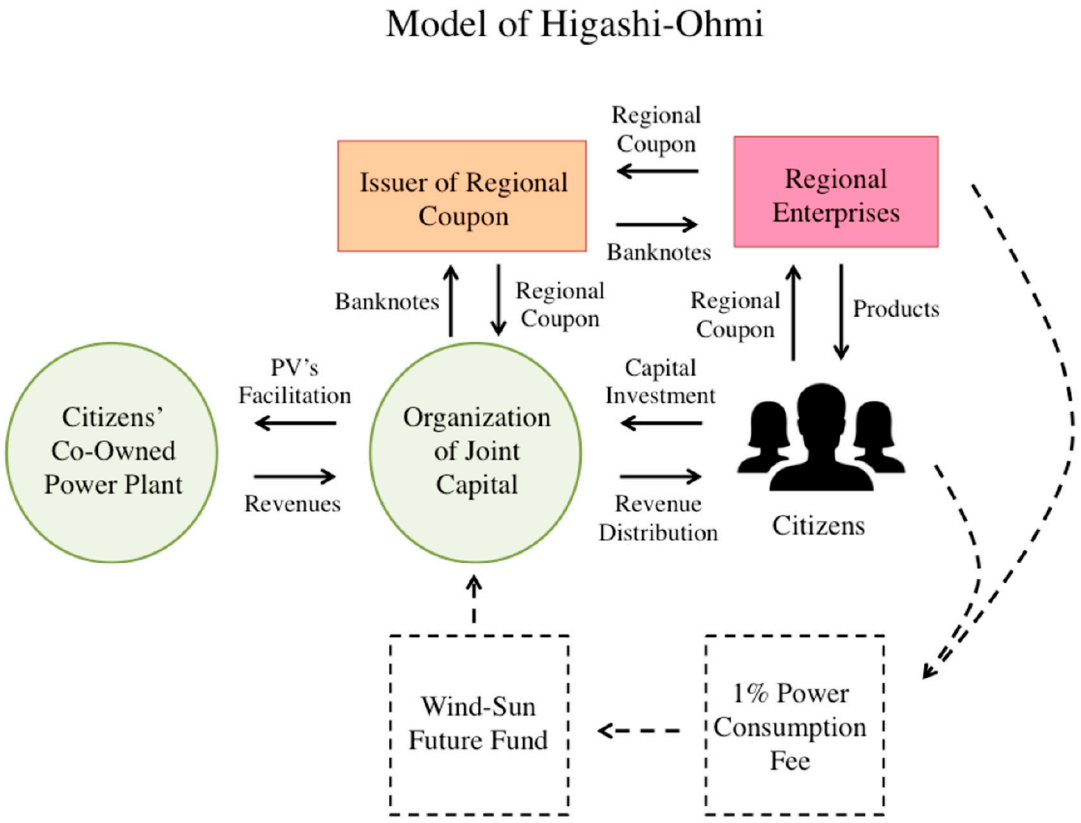

Figure 4. In the Model of Higashi-Ohmi, money circulates within the region through the combination of regional currency and Citizens' Co-Owned Power Plants. Source: modified from Hashimoto and Nakagawa [51].

5.1. Pattern 1: 'Sun Zan Project' (in Higashi-Ohmi)—Connecting Citizens' Co-Owned Power Plants and Regional Business

The investment capital of the Sun Zan Project was based on the joint investment. The Yokaichi Chamber of Commerce and Industry and the Higashi-Ohmi City Society of Commerce and Industry co-financed and established the Sun Zan PJ Co., Ltd., and obtained investment through private placements from citizens. This investment capital was used for the deployment of Solar PV, and the income of selling electricity returned to the investors with regional coupons. According to calculations by the end of 2013, the total construction cost was 16.2 million Japanese Yen, and private placements from citizens during the construction phase amounted to 150,000 Japanese Yen per citizen, with total numbers of 85 citizens/108 units (privately placed bond from March 2013 to March 2014) [39].

The administrative jurisdictional area of the 'Chamber of Commerce and Industry' is higher than that of the 'Society of Commerce and Industry', as the former extends to cities and the latter includes towns and villages. Both are forms of business networks, while the 'Chamber of Commerce and Industry' serves as a regional comprehensive economic organization and support not only for small and medium enterprises but also for international affairs such as international commerce arbitration, and the Society of Commerce and Industry puts more emphasis on small-scale businesses and their management and business progress. Both administrative organizations belong to the Ministry of Economy, Trade, and Industry (METI), and the Sun Zan PJ has been established with a new legal form as a company limited (Co., Ltd.). Sun Zan PJ was the first and only Citizens' Co-Owned Power Plant held by the Chamber/Society of Commerce and Industry and the eighteenth facility of Citizens' Co-Owned Power Plants in Higashi-Ohmi [52].

The specificities of Sun Zan PJ Co., Ltd. contain at least two parts. First, the bonus interest remains 2.0% regardless of changes in the revenues from selling electricity. Second, in terms of the business of Citizens' Co-Owned Power Plants, Yokaichi Chamber of Commerce and Industry is not only responsible for the Sun Zan PJ Co., Ltd. but also manages the bonus return project (Sanpo-Yoshi Coupon) for all Citizens' Co-Owned Power Plants in Higashi-Ohmi (see Figure 5).

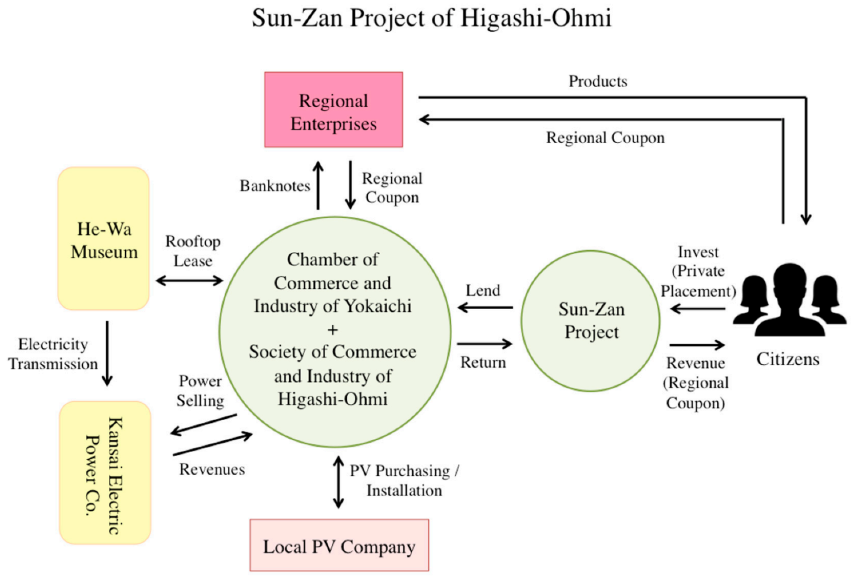

Figure 5. The Chamber of Commerce and Industry is the issuer of regional currency and the joint owner of the Citizens' Co-Owned Power Plant. Source modified from Prefecture-Shiga, 2016, 2017; Yokaichi Chamber of Commerce and Industry (2016).

According to the Guidelines for the Public Properties of Renewable Energy Facility of Higashi-Ohmi City, legislated in 2012 (Higashi-Ohmi City), the Chamber of Commerce and Industry contracted with Heiwa Museum of Shiga Prefecture with a 20-year roof

rental. The rental fee is 1.0% of the total annual revenue. The bonus returns to investors are calculated with the principle of 'equal monthly payments with interest over 20 years [39].

150,000 Japanese Yen/Unit, bonus 2%, duration of return 20 years

Total bonus interest:

30,000 Japanese Yen = (the principle 150,000 Japanese Yen/2) * bonus 2% * 20 years

Total proceeds:

180,000 Japanese Yen = amount of redemption 150,000 Japanese Yen + Total bonus interest 30,000 Japanese Yen

The annual amount of money received:

9000 Japanese Yen = 180,000 Japanese Yen/20 years

5.2. Pattern 2: Citizens' Co-Owned Power Plants of Welfare Mall (in Higashi-Ohmi)-Integration of 'Food, Energy and Care' (FEC)

The Welfare Mall established the following goal from the beginning: "In order to create a safe and comfortable living environment, we should be able to provide food and energy for ourselves, and adequate care is necessary" [53].

In order to install PV on the rooftop of the Welfare Mall, it raised funds from its staff members for two months in 2012 with three information sessions. Welfare Mall aimed to reach 100 units (100,000 Japanese Yen = 90–100 Euro/unit) when it launched the project, and it ended with 110 units (110,000 Japanese Yen), with a total of 63 investor members (each investor can invest one to ten units). In 2013, they started to install solar panels on the three buildings of the Welfare Mall, including the restaurant, the daycare center, and the café, with electricity generation of 23.2 kW, 5.8 kW, and 5.8 kW, respectively and the total electricity generation was 34.8 kW. In 2015, the annual total electricity generation reached 39.874 kW, accounting for 66.3% of the total use amount of the Welfare Mall [54].

The allocation of the profits from selling electricity was separated into three parts: about 10% remained as the repairing and management fees for the Welfare Mall Power Plant, such as the insurance against damage, hardware rehabilitation fees, or inspection fees. Another 20% was regulated to contribute to regional development or talent training, and the remaining roughly 70% flowed back to the investors [38]. The Regional Coupon was the only medium for bonus sharing. Investors received coupons as rewards for selling electricity and could use them in over 500 shops in the region of Higashi-Ohmi.

Welfare Mall collaborated with a local enterprise, 'Kyo Se Ra', for its PV installation, and the electricity generation would deliver back to the nearest power plant Kansai Electric Power, which provided electricity to the central and western parts of the main island of Japan (see Figure 6).

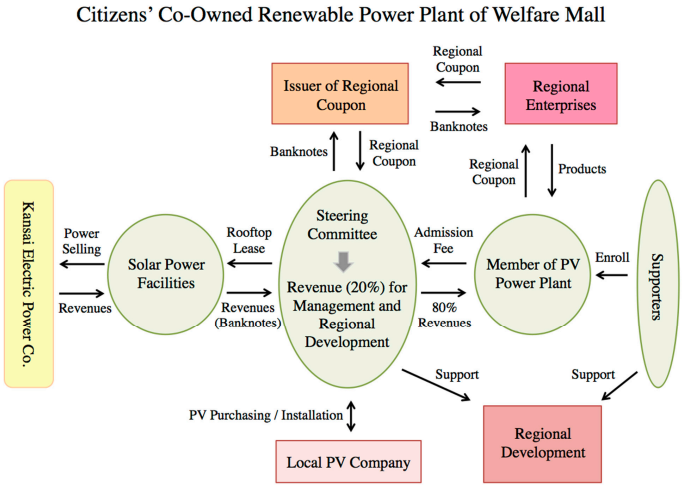

Figure 6. A model that uses regional currencies and allocates profits based on electricity generation. Source modified from Nomura (2013); Prefecture-Shiga (2017).

5.2.1. Comparison of Sun Zan Project and Welfare Mall

Investor Relations

The differences between Welfare Mall and 'Sun Zan Project' can be examined in at least three parts. Instead of obtaining investment through private placements from citizens, the Welfare Mall found investors from their staff members or acquaintances of members who also had confidence in the ideals of the Welfare Mall. Therefore, the term 'citizen' of the Citizens' Co-Owned Power Plants here for the Welfare Mall differ to some extent from that of the Sun Zan Project; the relationships between Welfare Mall and their investors or acquaintances were much closer than that of the Sun Zan Project, whereas Sun Zan Project's investors to their implementer were more distant and could be regarded in a real sense as 'citizens'.

Allocation of Bonus

The bonus for the investors of the Welfare Mall followed the real revenue of electricity selling, instead of the fixed interest rate based on the investment capital as the model from Sun Zan Project. Therefore, if the revenues of both power plants rose, only the investors of the Welfare Mall receive higher amounts of bonuses, whereas those from the Sun Zan Project would remain with the same amount of bonuses. However, investors of the Sun Zan Project would bear lower risks if electricity generation decreased sharply or management of the power plant failed. The other part of the specificity related to bonuses was that 10% of the total revenue had to flow back to the Welfare Mall as a management fee and 20% for regional development.

Meaning of 'Energy' in the Project

'Energy' was embedded differently into the principal business of the Sun Zan Project and the Welfare Mall. While the Yokaichi Chamber of Commerce and Industry and the Higashi-Ohmi City Society of Commerce and Industry has been established as business networks initially and contributed to the regional economic development and the Sun Zan Project was an additional project launched afterward, which served the same purpose as well as went with the flow of environmental development; 'energy' had been already integrated into the concept of 'FEC-Food, Energy and Care' when the Welfare Mall started its business with 'care for people' and 'healthy food made from local resources' as the driving concepts.

5.3. Pattern 3: Kawanami Town's Citizens' Co-Owned Power Plants (in Higashi-Ohmi) Cooperation of Neighborhood Association and Nursing Home

The cooperation between the Shimizuen Nursing Home and the Kawanami Neighbourhood Association started with the 'Agreement on Disaster Prevention', wherein both organizations at the Kawanami Town in Higashi-Ohmi were willing to promote renewable energy in their region and to ensure an emergency power supply in the event of a natural disaster. In 2012, the Kawanami Neighbourhood Association proposed a Citizens' Co-Owned Power Plant project, which went into effect the next year in December 2013 [55]. Since the power plant was co-built by both organizations, the lease on the rooftop of the Shimizuen Nursing Home building was cost-free.

Before the establishment of the power plant, 24 members of the Neighbourhood Association set up a 'voluntary group' first and then raised funds from October 2012 to November 2013. On the authority of Article 21 of the Constitution on the right of freedom of association in Japan, 'voluntary group' belongs to a 'non-corporate type NPO'. Compared to the 'corporate type NPO', a 'voluntary group' does not have to accept supervision from the government and can enjoy certain tax benefits [56]. However, it cannot open a bank account, rent an office, or buy a car. Therefore, a 'voluntary group' belongs to an 'incorporated association' in accordance with tax law. According to the rule of the voluntary group, every investor was limited to invest up to three 'unit' capital (every 'unit' equals 100,000 Japanese Yen). The establishment costs reached 4,432,000 Japanese Yen with a total

of 45 units (24 persons). The revenues of selling electricity will be charged as individuals' membership dues of the voluntary group [56].

5.4. Pattern 4: Moriyama Citizens' Solar (in Moriyama, Shiga prefecture) Donation Inter Vivos

Donation inter vivos refers to a lifetime gift consented mutually both by a giver who divests himself of the gift given in order to transmit the title of it to the donee, and the donee, who accepts it and acquires a legal title to it [57]. The 'Green Trust' of Moriyama Citizens' Solar has been designed as an over 18-year long-term contract trusted by the elders who hesitate to enroll in it. As Moriyama Citizens' Solar was raising funds, the trustors had to designate their descendants to accept the 'green gift' under the trust contract. The nontaxable limit amount of the lifetime gift will be transacted into the bank accounts of the appointed descendants according to the revenues generated from selling electricity (see Figure 7).

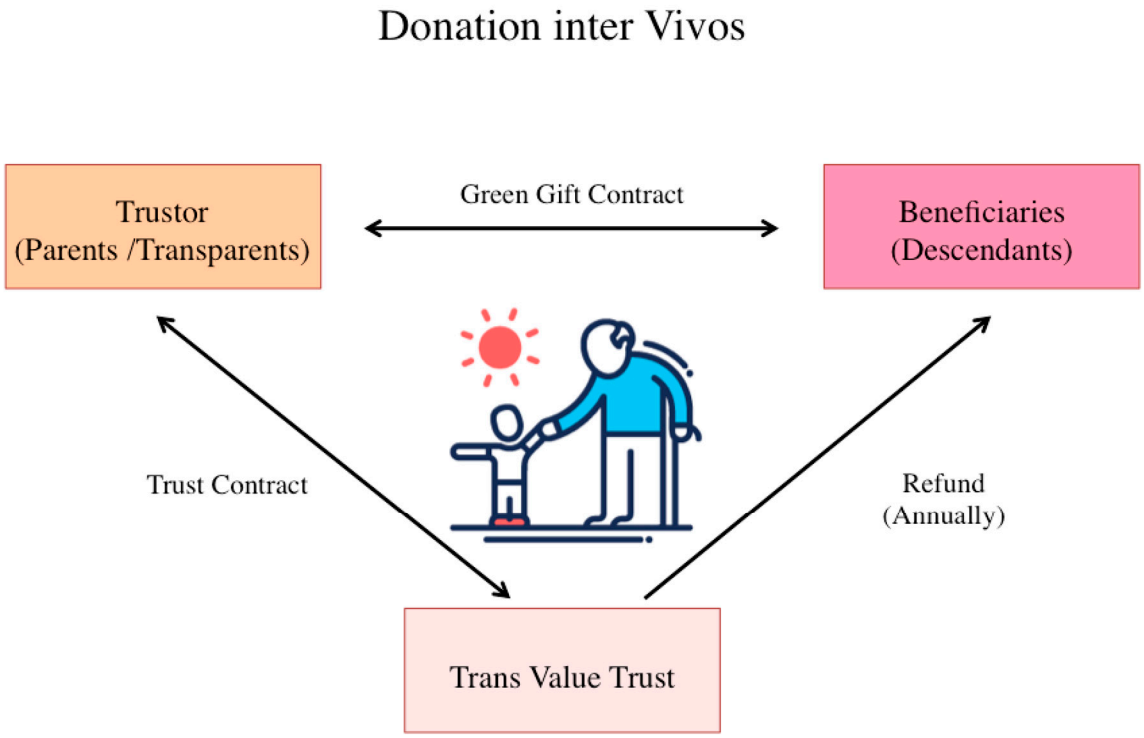

Figure 7. Under the Green Gift Contract, the trustors have to designate their descendants to accept the 'green gift'. Source: modified from Prefecture-Shiga (2017).

The idea of the 'Green Trust' was to pass on both assets and co-owned renewable energy to future generations (Table 2). After Moriyama Citizens' Solar was established by the 'Council for promoting Co-Owned Renewable Power Plants' in 2013, another citizens' solar facility with the same pattern was built up the following year [58]. This project had a rooftop lease agreement with Kawanishi kindergarten in Moriyama town. The investors included 36 individuals (10 people belonged to 'Green Trust') and two corporate bodies.

Table 2. Features and Operation: Four models of Citizens' Co-Owned Power plants in Shiga Prefecture.

Name	Legal Status	Investment Capital (Japanese Yen)	Profit Distribution	Main Features
Sun Zan Project	Co., Ltd. (stock company)	13,800,000	Interest rate 2.0% (based on investment capital).	1. Connecting Citizens' Power Plant and Regional Business by using regional currency. 2. Fixed profit distribution.
Welfare Mall	Co., Ltd. (stock company)	11,000,000	Seventy-percent of revenues of selling electricity goes back to members (investors).	1. Integration of 'Food, Energy and Care' (FEC). 2. Profit allocation based on a percentage of electricity generation. 3. Regional currency as feedback for electricity generation.
Kawanami	Voluntary group	4,432,000	Revenues served as individuals' membership fee.	1. NPO implementer. 2. Per investment capital limited to 300,000 Japanese Yen.
Moriyama Citizens' Solar	Council	8,800,000	The return goes to the bank accounts of descendants.	Lifetime gift.

5.5. Sanpo-Yoshi Coupon in Higashi-Ohmi: An 'Adhesive' to Connect Regional Economy and Renewable Energy

Coupon substitutes for money as a reward for the revenues of the Citizens' Co-Owned Renewable Power Plants. In fact, instead of only being an invention for the Co-Owned Renewable Power Plants, the coupon has been created and used mainly for the purpose of the economic boom in this region. Although the Chamber of Commerce and Industry of Yokaichi city developed the idea of coupon and started to issue it in the year 2010, they still hoped to extend the range and the rates of the usage by cooperating coupon with other fields or extending the usage of coupon to tourists [59].

The idea of coupon originally came from the Aomori city of northern Japan. While Higashi-Ohmi city has less than 120,000 people, less than half of the population of Aomori city, the Chamber of Commerce and Industry expected to reach half of the circulation (around 3–5 billion Japanese Yen annually) compared to that of Aomori city (around 6–10 Japanese Yen) [59]. However, the coupons are issued in different Cities of the Shiga-Prefecture, respectively, and they can only circulate within each city.

Coupon plays an adhesive role in creating reciprocal relationships between environment and economics. When we read any literature on the Co-Owned Renewable Power Plants of this region, they describe renewable energy as an additional value from the 'grace of the sun', whereby the coupon returns the grace back to circulate on the regional economy and the people of the region [55].

5.5.1. Reasons for Initiation: Regional Merchant Culture and the Global Financial Crisis

The regional merchant culture explains a part of why coupons replaced money as a reward for electricity production and sale. Regarding the coupon, the term 'Sanpo-Yoshi' (meaning 'benefits for all three sides') has always been added ahead of the coupon as the 'Sanpo-Yoshi Coupon', which refers to a business philosophy reminding local merchants ('Ohmi merchants') to not only keep their own benefits and that of their customers but also those of the whole society. From this logic, if the merchants do business well, then society will also benefit from it.

Historically, this term could be traced back to the Edo Period (1603–1867 A.D.), when the area of Ohmi was especially economically prosperous. Even in primary and secondary education, students learn the Sanpo-Yoshi principle as 'the benefits for self,

for the other side, for society as a whole', which has been regarded as a spirit or a starting point that should be passed on from generation to generation [55,59].

Under the concept of Sanpo-Yoshi, to keep richness circulating inside the region would be of utmost importance. Compared to money, coupon as a new currency has aimed to prevent the outflow of money to other regions and therefore will support local businesses. Through getting along with the local people during the authors' stay in Higashi-Ohmi, it was not hard to find that Sanpo-Yoshi was not only an official slogan but a prevalent belief rooted in this region, which also explained why local residents still support the coupon even if they faced difficulties in utilizing it.

The sudden occurrence of the global financial crisis stimulated the Chamber of Commerce and Industry of the Yokaichi city to adopt the idea of coupon. As the director of the Chamber of Commerce and Industry of Yokaichi explained, "Why should we turn our emphasis suddenly on the issue of the environment? Our duty is to ensure economic stability; however, when facing the Lehman Brothers collapse and the coming global financial crisis, we started to ponder an environmental plan in which residents will combine together to establish an ecological city where people produce for their own needs and sell through their own market channels, especially to make use of resources of this region, so that we can expect a long-term, prosperous regional economy and make sure this region will be in a stable status [59]".

5.5.2. Application and Performance of the Coupon

The shops inside Higashi-Ohmi city first have to register at the Chamber of Commerce and Industry so that they can become the shops at which customers can use coupons. The data in 2015 showed that in the year 2013, the utilization rate of the coupon was 29%, more than the 21% estimated based on consumption tendency by the Prefecture. By the end of 2014, the registered number of the shops reached 429 (537 shops as of March 2016), and the number of coupons that were issued annually amounted to 1398 (units: individual/household/enterprise) with the total amount of 17,825,000 Japanese Yen, from which the reward for facilitating solar panel constituted 115 units/5,381,000 Japanese Yen. The other two things for which the coupons have been issued include 'purchasing and utilization capital', referring to coupons bought by individuals, households, and enterprises to give as grants or favors, and for 'subsidy for private or social housing reform'. The former annual issue amount accounted for 1236 units/6,366,000 Japanese Yen, the latter 47 units/6,088,000 Japanese Yen (the Chamber of Commerce and Industry of the Yokaichi city, 2014).

The other way of application of the coupon was called 'Bonus for Facilitating Solar PV systems', referring to the bonus commission in which the households, shops, and offices that facilitate PV on the rooftops under 10 kW will receive the Sanpo-Yoshi Coupon as an extra bonus. 'Bonus for Facilitating Solar PV system' especially benefits those who use PV produced by the enterprises inside Higashi-Ohmi city: 1 kW for 15,000 Japanese Yen (upper limit 75,000 Japanese Yen); while those who sign a contract with the enterprises outside of Higashi-Ohmi city receive only 10,000 Japanese Yen for 1 kW (upper limit 50,000 Japanese Yen). This design apparently showed its preference for the local PV installers [55].

5.5.3. Bottlenecks in Promoting Coupons

Through the interviews with the members of the Co-Owned Renewable Power Plants, the usage of the coupon appeared to be, to some extent, inconvenient. When talking about the convenience of money and the coupon, a member of the Co-Owned Renewable Power Plant of Welfare Mall agreed that money is undoubtedly more convenient than a coupon, as "You can use money in other prefectures, such as the near Hikone Prefecture, while the coupon is only confined in Shiga Prefecture. As to the deadline of the coupon, it is also a pity that it cannot be extended, but sometimes you are not aware of the deadline" [60]. Nevertheless, she believed that for the purpose of regional development, the usage of

coupons still has its own good. Another member of the Co-Owned Renewable Power Plant of the Welfare Mall felt that the range of usages of the shops was limited. However, just like the member's belief, the core concept of the coupon was self-sufficiency and for the good of this region.

The Chamber of Commerce and Industry did not adopt the direct interviews or questionnaires with their users of the coupons; however, they could still hear some responses from their surroundings. "We heard from the citizens that the duration of a half year was too short; however, the duration was regulated by the law. The other response was that the denomination of the coupon was too small . . . This relates to the relationship of government, economics, and society, so in the following path, the feelings of the local people will be subtly affected" [61]. The inconvenience of the coupon could be apparently sensed during the interviews; however, it seemed not to be a big problem for the members of the Citizens' Co-Owned Renewable Power Plants. Neither the members nor the Chamber of Commerce and Industry ever planned to cancel the design of the coupon. On the contrary, the Chamber of Commerce and Industry still tried to find ways to expand the circulation of the coupon in this region.

5.5.4. Query on Sanpo-Yoshi Coupon's Effect on Regional Economics

Sanpo-Yoshi Coupon has been designed to boom up regional economic circulation; however, the effect of the coupon has not been very significant yet. The reason for this can be surmised by the discrepancy between residents' daily consuming habits and the limit of the coupons. First, it might create a feeling of inequality regarding the return on investment if a member invests in Citizens' Co-Owned Renewable Power Plants with money and receives their return with coupons. Although more than 400 shops in the local area cooperated with the usage of coupons, a part of the sellers' market was still outside of this circulation. As mentioned above, users could not consume freely due to the limit of the denomination of the coupon. Therefore, the degree of convenience between using money and coupon in consumption is very different. Second, how can one define the geographical range of a regional economy? Officially, it is necessary to delineate the geographical range based on the administrative border in order to issue the coupon; however, consumers' demand or residents' concepts of 'region' are not certainly determined by the administrative borders. Third, the coupon has never replaced money but was also not a part of the regional currency and accounted for a certain fraction of residents' currency usage for consumption. Therefore, more observation should be conducted on the actual effect of the Sanpo-Yoshi Coupon on the booming economy of Higashi-Ohmi.

6. Implications of the Higashi-Ohmi Model to Rural Areas

6.1. Difficulties in Promoting Citizens' Co-Owned Power Plants in Rural Areas

Rural areas generally have a high proportion of elderly people, insufficient manpower and employment opportunities, and fragile energy systems. In this context, the development of decentralized power systems in rural areas will face the following difficulties.

6.1.1. Difficulty in Raising Funds

Renewable energy technology has a high cost and investment threshold. In rural areas, it is more difficult to raise capital than in urban areas, regardless of the form of citizens' participation in power generation, such as community-based, cooperatives, or internet fundraising. If citizens' power plants require a one-way capital injection, it will be difficult to create incentives for rural residents to invest [62].

6.1.2. Reliance on Subsidies

Most rural areas do not have sufficient capital to cover the costs of solar panels. Although appropriate government subsidies for rural areas can stimulate citizen participation, if rural areas rely too much on government subsidies, people will not be willing

to invest once the government removes the subsidies [63]. This suggests that a subsidy-dependent region will not be sustainable or autonomous.

6.1.3. Profits from Citizens' Power Plants Are Not Equal to Local Economic Interests

Data from rural-type citizens' co-owned power plants suggest that if the solar panels of citizens' power plants are built by solar system providers and if local people possess no knowledge and technology, the plants may not accomplish local industrial development and community transformation [62].

6.2. Specificities of the Higashi-Ohmi Model and Its Implications to Rural Areas

The Higashi-Ohmi model of citizens' co-owned power plants can serve as inspiration for the development of decentralized energy systems in rural areas because, although local residents of Higashi-Ohmi promote citizens' co-owned power plants aiming local economic growth, the local economy is not only a concept of economic growth but also an integrated concept of the local economy to meet various needs of the local community. The Higashi-Ohmi model has the following specificity for reference.

6.2.1. Independence from Policy Decisions

In the case of the Welfare Mall, for example, during the years of preparation from 2009, when residents came together to discuss the project, until 2013, there was an unwritten consensus among the participants—"free from administrative and political influence" [64]. In many of these discussions, local people participated as individuals, not as representatives of their jobs. They recognized that many workplaces had been inefficient for a long time and thus wanted to bring in a more energetic element. This was performed not only for the sake of the "city" where they work but also for the sake of the "Aito", town to which they belong. As the manager, Nomura, says, "If it's about administration, it's a policy, but to change the status quo of the area, you have to think outside the box. If we want to change for the better, we have to change this old model". Such a mindset defines the Welfare Mall as highly autonomous and action-driven from the bottom up, as opposed to a top-down renewable energy policy [53].

6.2.2. Local Needs Are Determined by Local Residents

In rural areas, energy issues are closely related to elderly care. Three of the four citizens' co-owned power plants in the Higashi-Ohmi model are related to the elderly. The second model, the Welfare Mall, was developed with senior care as the starting point. The third model, the Kawanami Town's Citizens' Co-Owned Power Plant, is a nursing home where the roof of the building is the site of the citizens' co-owned power plant. The fourth model, the Moriyama Citizens' Solar, is designed to primarily serve the elderly, and the solar panels are a commodity for investors to invest in for their descendants.

The concept of the Welfare Mall was based on understanding and responding to local needs, and the entire model combined key local figures in the fields of welfare, healthcare, environment, agriculture, and urban planning [65].

After numerous meetings and discussions, the local issues became clear. For example, elderly people with mobility problems cannot remove the garbage or cook, while healthy elderly people can still help others but do not know the social channels and do not have many places to communicate with each other. Many of the young people who are unsuccessful in urban employment refuse to return to the workplace after returning to their hometown. There are also people with cognitive impairment who lack adequate welfare and care and have no access to work. There are still many residents who have no place to sell homegrown vegetables, homemade produce, or crafts. The local timber industry has also disappeared due to the decline in the Japanese logging industry, despite the abundance of timber resources in the area [64,66,67].

The motivation for the establishment of the citizens' co-owned power plants is not only to generate profits but also to solve the above-mentioned problems in order to create

a society where the elderly and the physically and mentally challenged are adequately cared for, where food is self-sufficient, where the natural environment of the region is revitalized, and where resources can be fully recycled. Residents' awareness of local issues has strengthened mutual trust and led to the establishment of citizens' co-owned power plants. This is also how the regional currency works: as a substitute for cash, the regional currency restricts local residents participating in the citizens' co-owned power plants to a limited number of local stores at a fixed time, but local residents voluntarily accept the restriction considering the overall local economic cycle.

6.2.3. Prioritize Local Enterprises in the Development of Energy Industry

The case of Shiga in this study shows that considerable importance is given to the development of local enterprises to promote energy autonomy. Locally produced technologies are more likely to be accepted by locals than imported foreign technologies. This may be related to the creation of local jobs or simply residents' favorability for the local enterprises, but it still requires further study, specifically regarding the relationship between residents and local enterprises.

In the case of Higashi-Ohmi in Japan, residents did not have a negative attitude toward the local solar power plant Kyo Se Ra, which is prioritized by the municipal service [50]. Another example of an energy-related enterprise is the timber company Kikito, which is based on the concept of wood recycling and reusing surplus wood for business cards. However, small-scale local enterprises generate a minimal percentage of overall economic profit, but local residents consider it beneficial energy autonomy. As the official from the City Hall, Yamaguchi, said, "what people are trying to do now is more ideological than economically beneficial" [68].

Another interesting example is the heater used in the interior of the Welfare Mall, which was made in cooperation with a local company. Currently, the logging business in Japan is gradually declining. Because wood is more expensive in Japan, it is primarily imported, and fewer people are working in the mountains. To revive mountain forest resources, the local government has resumed the cutting and cultivation of wood, and the cut wood will be disposed of by the welfare center for the handicapped as a source of income. Additionally, as imported wood stoves can only burn wood from broadleaf forests and cannot be used in Japan, locally developed stoves that can burn broadleaf and coniferous leaves have the advantage of being more easily heated than homemade stoves and can promote the revitalization of local businesses, as well as bring the local community closer to energy autonomy [53].

7. Conclusions and Limitations

7.1. Conclusions

In this study, the literature analysis of energy system transition illustrates that decentralized energy systems have the advantages of high electricity efficiency, high energy security, high-quality electricity, sustainability, and low vulnerability compared to centralized energy systems. In a decentralized energy system, the geographic distance between energy consumers and energy producers is reduced, and the role of local residents is no longer that of passive energy consumers in the old system but rather that of active energy producers and users ('energy prosumer') or even energy distributors. The energy transition process is not satisfied by "top-down" policy guidance. Instead, reflective grassroots power and local participation are key players in a resilient and sustainable energy system.

The driving forces for local energy participation are summarized as follows: (1) a return to pre-industrial decentralized energy thinking; (2) a rethinking of large-scale or top-down renewable energy policies; (3) resistance to corporate hegemonic monopoly; (4) empowerment from the government, which is a fundamental condition for local participation in the energy market; (5) desire to solve local problems or meet local needs; (6) the investment motives of residents dispersed across regions.

The Higashi-Ohmi model of citizens' co-owned power plants in Shiga Prefecture, Japan, has developed its unique and diverse forms against the backdrop of numerous problems, such as an aging rural population, the migration and unemployment of young people, and changes in agriculture and forestry. The Sun–Zan Project is a type of citizens' co-owned power plant that is open to the citizens of Higashi-Ohmi, with the aim of revitalizing the local economy through the use of fixed interest rates and rebates in the form of a regional coupon. The Welfare Mall is a typical rural community type, with a strong foundation of trust, and is a comprehensive business that is agriculturally self-sufficient, care-focused and provides energy autonomy.

Compared to the other three cases, Kawanami is the only citizens' co-owned power plant built for establishing a local emergency power supply system by a group of volunteers. The Moriyama citizens' co-owned power plant is a model for gifting solar energy investment from the elderly to the next generation. This model of increasing incentives for energy participation is highly inspired by the aging community and rural areas that lack the will to raise funds.

The final three characteristics of the Higashi-Ohmi model summarized in this study are intended to provide some insights for other rural areas that have difficulty raising funds and thus rely on subsidies: (1) a high degree of autonomy and all actions are based on the spirit of independence from policy decisions; (2) An understanding of local problems and addressing local needs; (3) small-scale local enterprises in local development.

More research should be devoted to the characteristics of local energy development in remote villages, particularly for the challenges encountered, so that the wrong viewpoint will not be applied to them once the specificity of the rural type is clarified. Additionally, Shiga Prefecture has an important history of bio-energy development, and future research could focus on the overall energy cycle, natural resource cycle, and human cycle related to bio, solar, and wood energy.

7.2. Limitations

The analysis of Japan's electricity law, including the FIT system and electricity liberalization, focuses primarily on the impact of the legal system on local participation. However, in reality, the electricity industry is related to the strong co-construction relationship between the energy industry and the government, which has a significant impact on the participation of local Japanese residents and plays a key role in Japan's overall energy transition. Over the past few years, the liberalization of Japan's power system has fluctuated. In particular, the restart of nuclear power plants shows that the court decision to shut down was invalid. Conversely, the dominant interests in Japan's central power plants are significant. The Kansai power plant, for example, influenced the liberalization of the business and thus the power system. Therefore, we will continue to analyze the impact of this political and economic structure on Japan's energy policy.

This study does not specifically consider the impact of the Higashi-Ohmi model on other regions in Japan. During the authors' fieldwork in 2014, they also contacted other cases in Japan, such as was the case in the Gamoh district in Shiga Prefecture. Due to the success of the Welfare Mall, the Gamoh district intended to develop an integrated system of food, care, and energy based on this model. However, this study was unable to cover the development of the district due to insufficient resources. If we can track its development, it will help us evaluate the applicability of the Higashi-Ohmi model in other areas of Japan.

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