Integrated spatial and energy planning as a means to reach Sustainable Development Goals

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In order to reach climate protection targets, multiple measures are requested for the transition towards energy saving, a higher degree of energy efficiency and sustainable energy systems. The possibilities to design energy strategies is highly dependent on the local and regional spatial context, e.g. the spatial archetypes like urban, suburban, rural areas or small towns in suburban or rural surroundings or the regionally or locally available renewable resource base. Furthermore, including the spatial dimension in strategic energy planning leads to more realistic planning objectives and action plans with a higher probability of implementation (Stoeglehner et al. 2016). As a consequence, in Austria integrated spatial and energy planning gains higher importance as a field within spatial planning, that deals with the spatial dimensions of energy demand and energy supply in a holistic way (Stoeglehner et al. 2014).

In this presentation, the concept of integrated spatial and energy planning is introduced, new developments concerning methodology are presented, and it is discussed how this concept is linked to the sustainable development goals. In principle, strong links can be identified to sustainable development goals 7 (affordable and clean energy), 9 (industry, innovation and infrastructure), 11 (sustainable cities and communities) as well as 13 (climate action) – the latter SDG being the main motivation for the whole policy.

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RENEWABLE ENERGY AND ENDOGENOUS DEVELOPMENT FOR SDGs -
- CASE OF AWAJI GREEN FUTURE PROJECT-

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SUMMARY: This study is a local government's renewable energy policy based on endogenous development theory. In particular, it is a case study on Awaji Green Future Project in the Awaji Island. The goal of the Awaji Green Future Project has to implement a sustainable development on Awaji Island by exploiting its precious local resources. Various initiatives are being promoted in three categories: "sustainable living," "sustainable food and agriculture," and "sustainable energy." And these three projects aim to build a sustainable society and endogenous development while interrelating. As a result of the economic effect analysis of renewable energy in the Awaji Island, it is economically efficient to make full use of biomass power generation. It also suggests that consuming RE surplus electricity within the Awaji Island has a higher economic efficiency.

INTRODUCTION

Local government in Japan has been considering renewable energy policies that take into account the endogenous development model. Endogenous development is an economic theory construct a sustainable regional economic cyclical model by utilizing local resources such as natural capitals and traditional culture in the region.Since the 1970s, the endogenous development theory has been accepted by policymakers, NGOs, researchers working on sustainable development. As a result, Local governments in Japan have established comprehensive environment policies that solve public pollution problems, precious natural resources, and secure amenities, preserve cultural resources, communities of well-being.

For this reason, application of endogenous development theory is also tried in the renewable energy policy of local governments.

We have been considering local government's renewable energy policy based on endogenous development theory. This presentation will explain the case study in the Awaji Green Future Project. We will focus on the introduction of renewable energy and regional economic effects in the Awaji Green Future Project.

AWAJI GREEN FUTURE PROJECT AND RENEWABLE ENERGY

In Awaji Island, socio-economic problems occur in all areas, such as slowing economic growth, declining unemployment rate, incomplete employment, lack of successors to take over family management, just as in another rural area in Japan.

The Awaji Green Future Project was aimed at developing measures that address these problems within a limited region that takes advantage of the island's Unique geographical characteristics (Fig. 1).

The goal of the Awaji Green Future Project has to implement a sustainable development on Awaji Island by exploiting its precious local resources. Various initiatives are being promoted in three categories: "sustainable living," "sustainable food and agriculture," and "sustainable energy." And these three projects aim to build a sustainable society and endogenous development while interrelating (Fig. 2). The Awaji Green Future Project was designated as the Regional Revitalization Comprehensive Special Zone of the Cabinet Office (Japan) in 2011. The Special Zone has policy packages such as deregulation, financial support from the Central Government. The Awaji Green Future Project was able to accelerate various programs on sustainable development by being certified in this scheme.

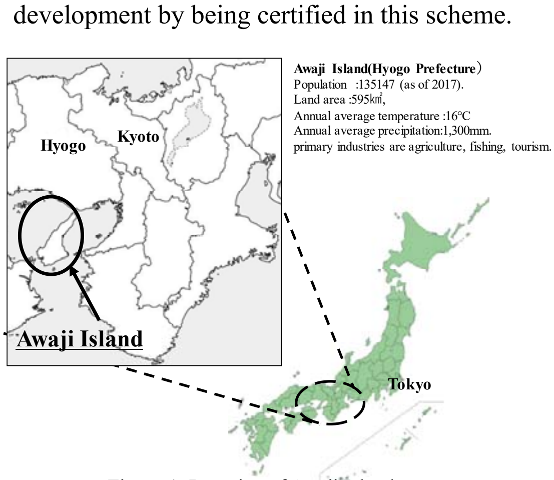

Figure 1. Location of Awaji Island.

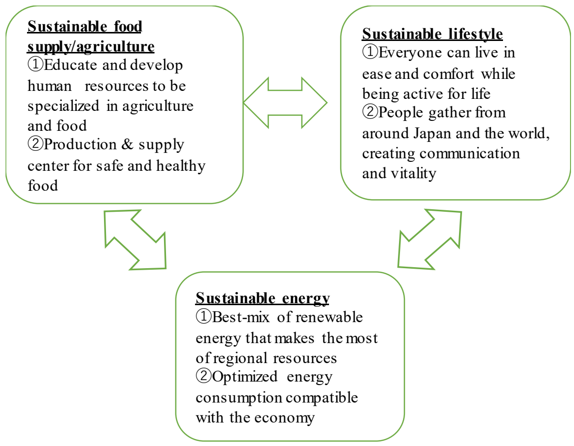

Figure 2.Three pillars of .Awaji Green Future Island Project

In these three main projects, outcome indicators up to the year 2050 are introduced(Table.1). And the Awaji Green Future Project aims at 100% energy self-sufficiency within the island. Also, since there is no fossil resource in the island, its energy self-sufficiency is based on RE such as solar, wind, biomass, tidal power and so on.

Currently, RE installed capacity is, in 189.5MW throughout the Awaji Island, is composed of solar power and wind power(Table.2). In solar power generation, two large solar power plants of 30 MW class operate, and one solar power plant of 10 MW class operates. All wind power generation is onshore wind power, and there are two wind farms of 37.5 MW (2.5 MW × 15 units) and 12 MW (2 MW × 6 units).

Table 1. Target of Awaji Green Future Island Project

		Current status Before 2010	2020	2030	2050
Sustainable energy	Energy self-sufficiency rate	22%	20%	35%	100%
	Carbon dioxide emission (Compared to 1990)	▲36%	▲39%	▲55%	▲88%
	Renewable energy(MWh) (*Expected power generation)	195,125	219,415	323,889	817,440
Sustainable food and agriculture	food self-sufficiency ratio	389%	300% or more	300% or more	300% or more
	food self-sufficiency ratio	110%	100% or more	100% or more	100% or more
Sustainable living	Life satisfaction	72%	60%	70%	90%
	population (resident population and nonresident population)	168700	175000	176000	168000

Table 2. RE installed capacity in the Awaji Island (as of 2017)

	Total capacity (MW)	Numer of Operators by power generation scale		
		1 MW≤1.9 MW	2MW≤9MW	10MW≤40MW
PV	134.433	28	6	3
Wind	55.1	3	1	2

Regional Economic Effect of RE

Regional economic effects by introducing renewable energy in Awaji Island were examined.The analysis method focused on the introduction of RE in and conducted an input-output analysis. We have created an input-output table of the Awaji Island added to the RE industry[1][2].Using the input-output table, we estimated the regional economic effect of the "sustainable energy" goals in the Awaji Green Future Island Project.

The point of analysis,①Estimated the regional economic effect at the time of achieving the 2050 power generation target (817.4 GWh). ②Clarified the regional economic effect and its influence on Awaji Island when 100% self-sufficiency of electric power is achieved.

Results summary

The regional economic effects of the 2050 RE generation target at the Awaji Island were the direct effect: 20.9 billion yen, the first indirect effect: 1.65 billion yen, the second indirect effect, 1.66 billion yen. Therefore, the total effect can be estimated at 24.29 billion yen.

However, the estimated is based on the direct selling revenue. Furthermore, it is an economic effect on the premise of continuation of the purchase price by FIT in 2017. For this reason, it is important to use electric power that does not depend on FIT or power sale for regional development.

Therefore, we assumed a scenario in which surplus electric power generated from RE is consumed in the area. In particular, in the scenario where the maximum use of renewable energy is made in the Awaji Island, 205.5 GWh of surplus power is generated. When this surplus electric power is used as an intermediate input, economic effects of about 600 billion yen can be assumed in the maximum case as a total effect.

The next point on the results summary, In the scenario where the composition ratio of biomass power generation is improved, the regional economic effect tends to be higher than PV and wind power. This is because resource procurement of biomass power generation is carried out within the Awaji Island area. Therefore, as a measure to raise the regional economic effect of the 2050 RE electricity generation target, it is necessary to pay attention to the regional economic effect that biomass power generation also possesses.

CONCLUSION

As a result of the economic effect analysis of renewable energy in the Awaji Island, it is economically efficient to make full use of biomass power generation. It also suggests that consuming RE surplus electricity within the Awaji Island has a higher economic efficiency.Therefore, it is important to build an energy system based on the biomass resources. Moreover, consuming surplus electricity within Awaji Island is also highly economical. For example, by conserving power as agriculture promotion and tourism promotion in Awaji Island, economic effects within Awaji Island can be maximized. It will lead to the development of Endogenous industries utilizing renewable energy.

References

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Offshore Financial Centers in Global Ownership-Tax Rate Multilayer Network

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Poverty is one of global issues to address. More than 800 million people still lack access to adequate food, clean drinking water and sanitation. The United Nations set Sustainable Development Goals in 2015 where Goal 1 is “No poverty.” Not only international aids but also own financial resources are essential for reducing poverty, but many developing countries cannot raise enough tax revenues considering their tax rates which are similar with tax rates in developed countries. The tax-to-GDP ratios of developing countries are only 15 percent or lower, while those of developed countries are usually around 30 percent. One of the reasons is that their tax authorities of have less administrative capacities, compared to those of developed country. On the other hand, it is also pointed out as another reason that shifting profits from developing countries is easier than that from developed countries because most of developing countries do not have effective tax policies against international tax avoidance. The purpose of our study is to clarify what kind of industry firms located in offshore financial centers (OFCs) are used for tax reasons. To make policy response to profit shifting getting a better understanding of the roles of OFCs are important.

We categorize firms used for tax reasons into two groups which are sink-firm and conduit-firm. A sink-firm is to retain much foreign capital and a conduit-firm is to enable transfer of dividends without withholding tax. We tried to make clear what jurisdiction and industry sink-firms and conduit-firms concentrate by a calculation of sink, inward-conduit and outward-conduit centralities we proposed.

To identify affiliates used for tax reason, it is necessary to consider tax rates as well as ownership structures. In our study, a multilayer network analysis is conducted to reflect both of tax rates and ownership structures. The multilayer network consist of two layers. First layer represents ownership network. The vertices depict combinations of jurisdictions and industry classifications and the arks depict ownership relations and percentages of shareholder. The data comes from “Orbis 2015 database” produced by Bureau van Dijk and comprises ownership, industry and financial information about more than 30 million firms across more than 20 jurisdictions. Second layer represents withholding tax rate network. The network is complete graph, the vertices depict jurisdictions and the arcs depicts withholding tax rates imposed on dividends. The data is based on “Worldwide Corporate Tax Guide 2017” organized by Ernst & Young. These two layers are inter-connected at jurisdiction level.

For calculation of sink centrality, chains of length 2 are extracted from the first layer and a flow is given to each chain. The flow is obtained by multiplying firms operating incomes by percentage of shareholder firms. The sink centrality is calculated through subtracting flows leaving a combination from flows entering to a combination, dividing it by all flows and normalizing it by gross domestic production (GDP). Combinations whose sink centrality is larger than 10 are considered as "sink-jurisdiction-industry."

For calculation of conduit centrality, chains of length 3 starting from or ending on "sink-jurisdiction-industry" are extracted from the first layer and a flow is given to each chain. The flow is obtained by multiplying flows given to chains of length 2 by percentage of shareholder firm's shareholder firm. The inward-conduit (or outward-conduit) centrality is calculated through dividing flows from (or toward) "sink-jurisdiction-industries" by all flows, normalizing it by the GDP and multiplying it by lode centrality of second layer. Combinations whose both of inward and outward conduit centrality is higher than 0.001 are considered as "conduit-jurisdiction-industry."

25 "sink-jurisdiction-industries" and 37 "conduit-jurisdiction-industries" are identified. Table 1 shows top "sink-jurisdiction-industry whose sink centrality is higher than 30 and Table 2 shows top "conduit-jurisdiction-industry" whose both of inward and outward conduit centralities are higher than 0.005. As jurisdictions identified as "conduit-jurisdiction-industry" not small countries are remarkable while small islands which is usually thought as so called tax haven are remarkable as jurisdictions identified as "sink-jurisdiction-industry". From the point of view on industry, "Finance, Insurance" and "Wholesale and Retail trade" are remarkable.

As policy implications, it might be good for developing countries to make new tax policies focusing on the identified industries and pay more attention to counterparts when developing countries conclude tax treaties because developing countries might unexpectedly lose their tax revenue through some tax treaties they conclude.

Our study shows that several industries like "Finance, Insurance" are noticeable and need to be paid more attention because these industry might play important role from the point of view of profit shifting. Moreover, it is made clear that tax treaties are important for regulating conduit firms. These findings are useful for protecting developing countries' tax base. Developing countries can get adequate tax revenue by making tax policies reflecting our findings

Table 1. Top sink-jurisdiction-industry

Jurisdiction	Industry
Malta, Bermuda, Cayman Islands, Curacao, France	Finance, Insurance
Luxembourg	Professional, Scientific, Technical
Virgin Islands	Manufacturing
Luxembourg	Administrative
Bermuda	Construction
Marshall Islands	Transportation, Storage

Table 2. Top conduit-jurisdiction-industry

Jurisdiction	Industry
Netherlands, Luxembourg	Finance, Insurance
Luxembourg, Singapore	Wholesale and Retail trade
United Kingdom, Singapore	Manufacturing
Spain, Ireland	Professional, Scientific and Technical
United Kingdom	Administrative and Support service

An Assessment of Rural Electrification in Kenya

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According to the existing literature, including comprehensive sets of data provided by the World Bank and the IEA, challenges to the survivability of mankind, such as poverty, inequality and climate change, are most prominent in rural areas of Sub-Saharan Africa. There is a clear need for sustainable development in these areas, and providing modern energy access to people living in the rural areas could be one of the solutions for overcoming these challenges. In other words, rural electrification using renewable energy could promote the socio-economic development of rural communities and have beneficial effects on the natural environment. This research looks to assess the impact of rural electrification using solar PV in the case of Kenya. As an immediate result of undertaking this research, several of the sustainable development goals (SDGs) are addressed, namely SDG#1, SDG#7, SDG#10, and SDG#13. Modern energy access is known as being capable of improving human, economic, social and environmental conditions in developing countries, and therefore has the potential to play a significant role in achieving many of the SDGs.

National grid extension, mini-grids and solar home systems (SHS) are the three well-known methods of rural electrification. In our case study, we carry out an assessment of four electrification projects using a sustainability framework. The projects are national grid extension by the state-owned energy company (KLPC), a hybrid (solar-diesel) mini-grid developed by a donor organization (GIZ), a solar mini-grid and SHS installed by two private companies (Powerhive and Gennex). Rural electrification using solar PV refers to the last three projects.

Our sustainability framework consists of five dimensions, namely technical, social, economic, environmental and institutional. For each project, we assess the degree to which the project has contributed to solving the social (e.g. poverty and inequality) and environmental problems of the rural community. We used two kinds of questionnaires to collect quantitative and qualitative data during semi-structured in-depth interviews conducted with project managers and consumers. The collected data were then aggregated to display the performance of the four electrification projects in each of the five dimensions of the sustainability framework.

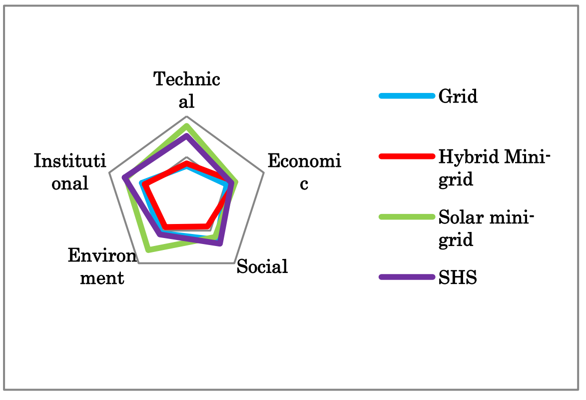
Over a two-week period in September-October 2017, the first author visited various rural locations in central and western Kenya where these electrification projects were implemented in order to carry out the interviews. In total, 71 households were interviewed. 17 of these households were connected to the national grid, 8 to the hybrid mini-grid (HMG), 33 to the solar mini-grid (SMG). The remaining 13 households owned solar home systems (SHS). The results of our assessment (illustrated in Table 1 and Figure 1) show that the solar mini-grid and the SHS are the best performing projects, having obtained the highest scores in several dimensions.

Table 1: Sustainability assessment scores for the four electrification projects according to five dimensions

** The highest scores are shown in **green**, and the lowest in **red***

	Grid	HMG	SMG	SHS
Technical	**0.39**	0.42	**0.88**	0.76
Economic	**0.52**	**0.63**	**0.63**	0.58
Social	0.64	**0.44**	0.60	**0.70**
Environment	0.54	**0.45**	**0.80**	0.56
Institutional	0.58	**0.54**	0.78	**0.80**

Figure 1: Sustainability assessment diagram



The results of our research have enabled us to develop two policy recommendations regarding the best way to achieve 100% modern energy access in rural Kenya. First, instead of extending the national grid, the government should rather promote the implementation of off-grid electrification projects using solar PV such as mini-grids and SHS (especially in the remote areas). Second, the private companies using solar PV for rural electrification have demonstrated their ability to not only more efficiently meet the demand for modern energy access, but also to ultimately promote social well-being. Therefore, the government should work together with those companies to achieve 100% electrification in Kenya. Instead of pursuing national grid extension, the government should facilitate the operation of those private companies, for example, by streamlining procedures and alleviating their regulatory burden.