Social acceptance of wind turbines:

An empirical study using choice experiments

2022.0802

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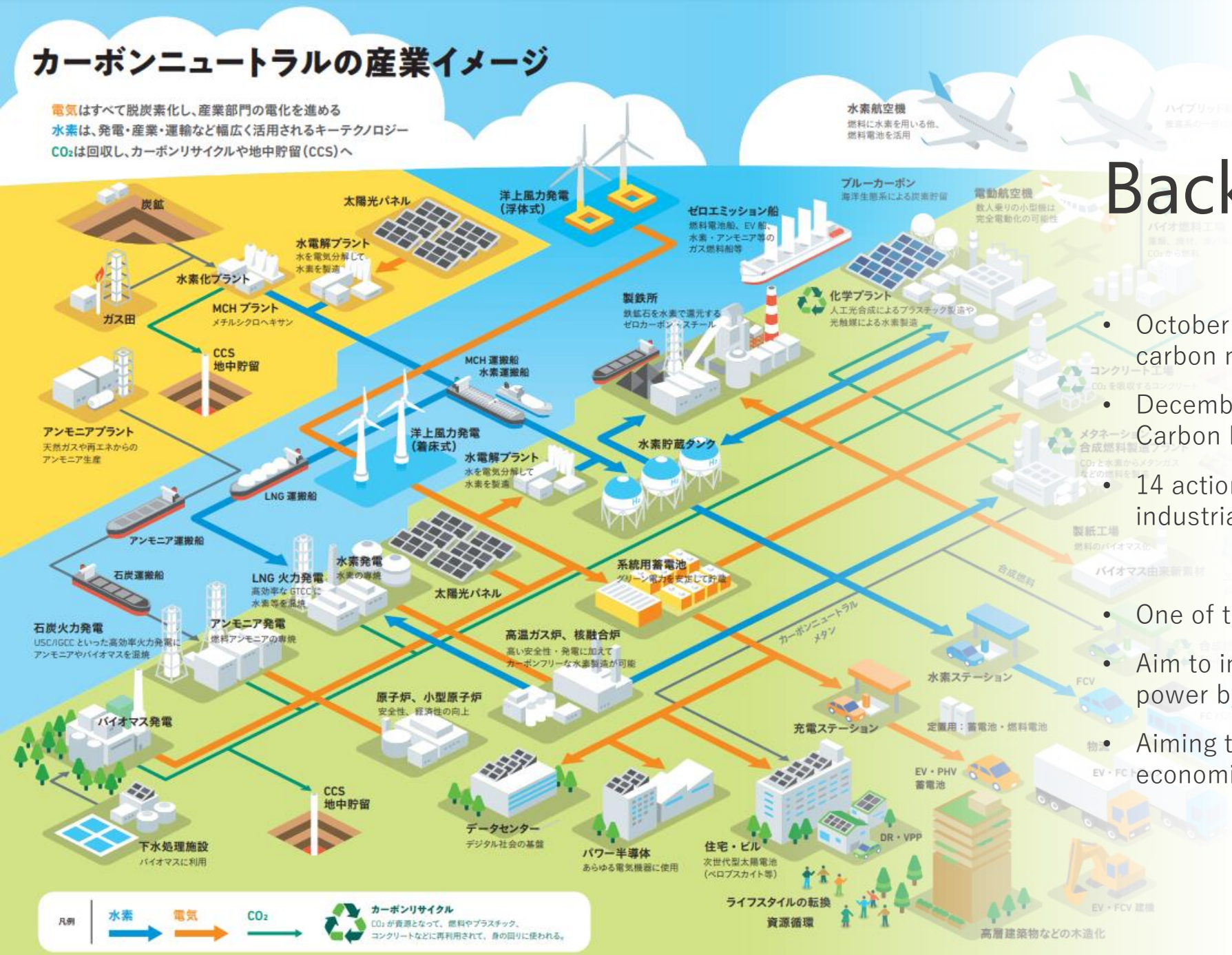
Introduction



出典：経済産業省　資源エネルギー庁

Background

- October 2020: Prime Minister Kan announces carbon neutrality by 2050.
- December 2020: "Green Growth Strategy with Carbon Neutrality by 2050"
- 14 action plans were formulated from both industrial and energy policy perspectives

- One of the 14 areas [**offshore wind power**]
- Aim to introduce 10 million kW of offshore wind power by 2030 and 30 to 45 million kW by 2040.
- Aiming to achieve decarbonization and economic growth →Decoupling

Background

- If a large number of offshore wind turbines are introduced into Japanese waters in the future, the landscape and marine ecosystem may be affected
- Concerns of local residents about offshore wind power, and the possibility of an increase in opposition movements
  - Bell et al. (2005): 75% of all wind power generation projects planned were cancelled, despite the fact that 80% of the U.K. public is in favor of wind power generation.
  - The Case of Japan: Opposition by Fishermen and Local Residents in Shimonoseki
    - Don't make Shimonoseki full of wind power!
    - German company plans to build 40 units of 10,000kw offshore wind turbines off the coast of Toyoura.

出典：長周新聞，2020年8月22日　https://www.chosyu-journal.jp/yamaguchi/18327

Objectives

- It is an urgent issue to analyze social acceptance in detail and promote consensus building in Japan.

1. to assess the Japanese public's preference for offshore wind in Japan;
2. to investigate the conflict between decarbonization and local environmental protection through renewable energy use, also known as the "green vs. green debate";
3. to propose policy implications for the introduction of offshore wind farms.

- Conduct an Internet survey and a choice experiment with the general public (citizens) in Japan
  - Use a mixed logit model to include the heterogeneity of people's preferences in the model

literature review

International trends

- Quantitative evaluation of social acceptance and preference for offshore wind power is often based on surveys of local residents and tourists.

- Literature have clarified the characteristics of local residents and tourists who are receptive to offshore wind power generation facilities

International trends

- **Haggett (2011):**
- Discusses the adaptability of offshore wind based on a detailed review of onshore wind

- **Klain et al. (2020):**
- Conducted a choice experiment with residents of a New England coastal community in the U.S.
  - Finds that local residents strongly prefer offshore wind farms with reef effects (=external value)

- **Kim et al. (2019):**
- The impact of offshore wind power development projects on Korean citizens
  - Results of the experiment were added to CBA, suggesting that the benefits of the project were unlikely to exceed its costs.

- **Westerberg et al. (2013):**
- Study of the impact of offshore wind farms on coastal tourism in southern France

Japanese Trends

- **Maruyama et al. (2007):**
- Analyzes the socioeconomic dynamics of renewable energy technologies
- Examined the impact of citizens' initiatives on the social acceptance of renewable energy by focusing on community wind power generation.

- **Motosu and Maruyama (2016):**
- Focused on the acceptance of people who do not oppose wind farms, and clarified the implications of the silence situation
- Finds that most respondents are receptive to existing community wind farms, but have negative attitudes toward new wind farms

Japanese Trends

- **Nakano et al. (2018):**
- Focus on understanding differences between eastern and western Japan in citizens' preferences for renewable energy
  - East Japan: social acceptability of renewable energy and WTP influence citizens' strong interest in the global environment and willingness to participate in policy making
  - West Japan: Liberalization of electricity retail market and support for distributed generation system development found to be related

- **keeley et al. (2021):**
  - Identifying key factors influencing social acceptance of renewable energy in Japan as measured through WTP
  - Employs spatial data on renewable and non-renewable generation, natural and productive capital, and renewable energy potential

➢ Suggests the importance of factors specific to each region that influence public acceptance of offshore wind

➢ Specific conditions of each region, such as social networks and spatial factors, have a strong influence on the social acceptance of the population.

Methodology

Methods

- An online questionnaire survey was conducted to examine the social acceptance of offshore wind power.

- **Stated preference method:**
- Analysis using an analytical method called choice experiment (conjoint analysis)

Methods: what is choice experiment

- Conjoint analysis: A method in which the goods to be evaluated are understood as consisting of multiple attributes, and many kinds of goods are represented by different attribute levels, and then the evaluation of the marginal changes in each attribute is clarified.
- For example, forests provide multifaceted benefits such as water source recharge, carbon fixation, and timber supply, and conjoint analysis can be used to determine the marginal willingness to pay (MWTP) for each of these functions.
- Various question formats have been proposed for conjoint analysis, but in the field of environmental economics, “**choice experiments**" are generally used.

項目	整備案 1	整備案 2	整備案 3	
水源かん養機能	現状より 20%減少させる	現状を維持する	現状より 20%増加させる	
土砂災害防止機能	現状より 20%減少させる	現状より 20%増加させる	現状を維持する	
地球温暖化防止機能（吸収量）	16 万トン/年（現状より 20%減少）	24 万トン/年（現状より 20%増加）	16 万トン/年（現状より 20%減少）	この中からは選ばない
生態系保全機能	森林内の生物の種数は変わらない	森林内の生物の種数が 20%減少する	森林内の生物の種数が 20%増加する	
木材生産機能	67,200 ㎥（現状より 20%増加）	56,000 ㎥（現状と同じ）	44,800 ㎥（現状より 20%減少）	
1 年あたりの負担金（個人）	2,000 円	20,000 円	5,000 円	
	↓	↓	↓	↓
どれか 1 つを選択	□	□	□	□

選択型実験の設問例（岩田ら，2021）

Overview of the Survey

- Online survey: commissioned by Rakuten Insight
- Implementation period: December 22-23, 2020
- Number of responses: 900 samples
- Estimated by Stata16

Respondents' Attributes

Variable	Mean	Std. Dev.	Min	Max
sex 1: male 2: female	1.497	0.500	1	2
age Age (20-69)	45.817	13.481	20	69
nf Number of family members 1: 1 person, ..., 7: 7 or more	2.749	1.307	1	7
wj Offshore wind power in Japan (Pros or Cons) 1: Pro, ... 5: Con	2.419	0.875	1	5
hi Household income 1: less than 2 million yen, ..., 8: 20 million yen or more	3.468	1.614	1	8

Attributes and Levels

Attributes	Level 1	Level 2	Level 3
Distance from the shore (km)	10	15	30
Number of the turbines	20	30	40
Levy on renewable energy (yen/kWh)	1	3	5
Number of species that may be affected	30	60	90
CO_2 reduction (t/kW)	5	7	10
New job creation (worker/turbine)	20	30	50

Sample questions

Given the following offshore wind farm project plans, which plan do you think is preferable? Please choose one from plan numbers (1), (2), and (3).

Project Number	①	②	③
Distance from the shore	10km	10km	No windmills (Status quo)
Number of the turbines	40	30	
Levy on renewable energy	5yen/kWh	3yen/kWh	
Number of species that may be affected	30	60	
CO_2 reduction	7t/kw	10t/kw	
New job creation per turbine	30	20	

Results

Definition of Variables

Variable Name		Variable Definition
distance		Distance from the shore
nturbin		Number of offshore wind turbines
species		Number of species that might be affected
co2		Amount of CO_2 reduction
labor		Number of new jobs created
cost		Levy on renewable energy

Estimated results

	Coef: Mean	SD: Mean	MWTP (JPY)
distance	0.12	**0.22**	**98.20**
	(10.67)	(17.47)	[50.89 – 145.53]
nturbine	0.05	0.05	**36.63**
	(10.74)	(8.22)	[18.31 – 54.95]
species	-0.01	0.03	**-8.11**
	(-4.33)	(14.32)	[-14.92 – -1.39]
co2	0.09	**0.16**	**74.18**
	(5.78)	(7.95)	[17.56 – 130.81]
labor	-0.01	0.03	**-10.86**
	(-4.48)	(-5.21)	[-19.19 – -2.53]
cost	-0.12		
	(-3.66)		
Observations: 16,200; Log-likelihood: -4198.56			

Note: Z-values are in parentheses. 95% confidence intervals are in square brackets [min – max].

Discussion

MWTP

- The general public in Japan responds strongly to offshore wind power in terms of landscape-related distance and CO2 emission reductions that lead to climate change mitigation.
  - WTP of 98.2 yen for every kilometer that an offshore wind turbine is 1 km away from the coast
  - 74.2 WTP for every ton of CO2 saved by offshore wind turbines

Heterogeneity of preferences

- The general public has heterogeneity of preferences for all attributes
- “Distance” and “CO2 reduction” have a large variation in preferences and a high MWTP

➢ The results suggest that there are “green vs. green” debates among people:

- “Distance” and “CO2 reduction” suggest a conflict in people’s preferences

Implications

- **When planning and zoning** the construction of offshore wind projects in Japan,

I. Landscape (distance from shore) should be considered

II. Emphasis should be placed on the contribution to climate change mitigation

➢ Significant affect the social acceptance of offshore wind among the Japanese public

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