

英国と日本の省エネルギーに関する法制度と 政府政策の比較分析、および省エネ実践の統計分析

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A Comparative Analysis of Legislation and Government Policies Relating to Energy Conservation, and a Statistical Analysis of Energy Conservation Practices, in the UK and Japan.

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Abstract In this research, relationship between peoples' consciousness of environmental capabilities of energy-saving in the UK and in Japan is investigated by using same questionnaires. The statistical analysis of the comparison is derived by using a hybrid approach to neural network and linear regression. The results showed that the consciousness which are obtained from Law, Education and Information, forces the Energy-saving action.

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Introduction:

As law and policy in the world, the 3rd Framework Convention on Climate Change Conference of the Parties in 1997(COP3, Kyoto Conference) in accordance with the Kyoto Protocol to the United Nations Framework Convention on Climate Change, the trading system of emission right of reduced CO² was started. The UK opened a trading office in 2005 for the first time in the world and has established the world's first law for the Climate Change Act 2008. It has also published a numerical goal of reducing to 80% of 1990 level for its all the green house gas emissions by 2050.

In order to contribute to Japan's goals in the Kyoto Protocol in 1997 and to the emission reductions such as Certified Emission Reductions (CER), Japan has compelled to reduction obligations to 6% of 1995 level, to within the 1.6% of the amount(from more than 100 million ton) of CO² equivalent. In fact the New Energy and Industrial Technology Development Organization (NEDO) has reported that from 2006 fiscal year to the 2014 fiscal year, Japan had to get the credit of the total 97,493,021 tons(CO² equivalent).

Carrying out an energy saving program for residential properties in Japan and also in the UK, is an essential factor in achieving these goals of the entire country. In this paper, we focus on homeusage of energy, differences in laws, policies and institutions of each country that are related and also the energy saving behaviours and energy-saving consciousness, are analysed using questionnaires' analysis.

1-1: Comparison Analysis on the Energy Act 2011, and The Climate Act 2008, in the UK and the Energy Conservation Law, and Global warming Countermeasure Law.

The both country have a couple of important Laws for the Energy-saving. In these Laws, there are also the obligations for people and city governments, for the Energy-saving including the education for them.

1-2: Comparison Analysis on the Scheme of Energy, and Energy-saving between the UK and Japan.

A) United Kingdom

1-2-A1: The Energy Act 2011 and the Climate Act 2008.

In the UK, the Energy Conservation Law was revised in 2011 (The Energy Act 2011), by using the Pipe-lines Act 1962, the Consumer Credit Act 1974, the Rent Act 1977, the Gas Act 1986, the Housing Act 1988, the Electricity Act 1989, the Government of Wales Act 1998, the Utilities Act 2000, the Sustainable Energy Act 2003, the Housing Act 2004, the Climate Change and Sustainable Energy Act 2006, the Energy Performance of Buildings 2007, the Energy Act 2008 revision, etc. These acts have been revised in response to the Energy Act 2011, framework regulations (Framework Regulation), practice provisions (Code of Practice); energy conservation consultant (Assessor Specifications), Certification Scheme Specks, (PAS 2030 is the standard against which all Green Deal Installers must work.), and an overall framework is produced.

This framework allowed the rise of PAYS (Pay-As-You-Save) system. PAYS is repaid without difficulty, because there is a golden rule in the system, that even if the landlord has changed, the system takes over the next landlord.

Japanese version PAYS system mimics that of the United Kingdom as the reference and this suggested some Japanese to propose measures made by a Low Carbon Society Strategy Centre (LCS). International Research Workshop on Policy Design to Induce Energy Efficiency Improvements within the Household Sector - Learning from the Green Deal Policy in the UK - , the Low Carbon Society Strategy Centre (LCS) Abstract. [7]

“Quote”

In the UK, there are about 26 million houses; several million houses have been rented out as Apartments. It's only really in the last maybe 15 – 20 years that the standard of new homes has been uplifted to a level that would be considered to be satisfactory in terms of energy performance. The

home heating is mostly natural gas but there is also oil, coal and for about 3.1 million homes, electricity is used.

Previously about 8 million homes were built in the period 1940-45 which were either solid walls construction, and renovation costs for these were estimated between 4000 to 14000 pounds. After the war the homes were built with what can be termed as 'cavity wall' - which is a double skin with an air gap between them. These can be renovated at about 500 pounds. Other measures for the heating hot water supply efficiency, there is such as Micro generation. In addition, Park Homes that have been built in for a short period of time (250,000 such houses), for which are no adequate building standards.

The top level of the goals of the UK is the following our;

1. Numerical goal of reducing at least 80% in emissions of all green house gases by 2050 from 1990 levels
2. Saving electricity bill
3. Enhance the safety of the supply of electricity
4. Employment growth and economic growth 60,000 employment forecast

Energy efficiency that is able to resolve the four issues, furthermore, also added that they also can contribute to health of the nation.

2014 achieve real in January point, 457,000 home energy conservation measures 540,000 felt they were conducted in (properties). Of these only 5%, was one-wall insulation. In addition, "Green Deal energy saving diagnosis" of 5 stars based on 145,110 have been made, of 1,721 Green Deal plan (mechanism for repayment in the electricity bill), has been performed. In addition, 1,711,044 Cash-back Vouchers have been performed.

Smart meters needs to be installed in 53 million households and small and medium-sized enterprises until 2020".

1-2-A2: Schemes for homes/properties' energy reducing repairs, and home micro generations on Energy, and Energy-saving.

Micro-generation Certification Scheme (MCS) - is owned by the Department for Energy and Climate Change (DECC) and Building Research Establishment (BRE) certify globally products and installers against robust criteria for micro-generation technologies under this scheme.

And for energy-saving renovation of the houses, micro generation (solar and geo thermal heat pumps, small wind power generation such as small hydroelectric power) there is also a subsidy system. Of these, energy-saving renovation of the house is built to Green Deal policy. Table 1 shows Micro-generation Statistics.

1-2-A3: Statistics on the home/property, car and micro generations.

There is a similar subsidy system in Japan. Table 2 (a) shows Itabashi City in 2014 fiscal year's new

Table1. Micro-generation Statistics

Technology	2009	2010	2011	2012	2013
Air source Heat Pump	103	1,342	3,684	7,515	9,705
Biomass	34	158	659	1,278	1,892
Exhaust air source pumps	-	28	163	127	14
Grund aie source pumps	466	943	1,467	20,88	1,324
Micro CHP(Micro combined heat and power)	-	124	330	112	31
Micro Hydro	-	18	37	12	1
Small wind	89	586	969	2,178	409
Solar PV	1,181	24,352	205,488	167,776	103,185
Solar Keymark	219	1,874	3,476	4,621	30,27
Solar Thermal	172	468	1,646	1,591	1,610
Ground Total	2,264	29,893	217,919	187,298	121,198

Source: International Research Workshop on Policy Design to Induce Energy Efficiency Improvements within the Household Sector - Learning from the Green Deal Policy in the UK - Low Carbon society Sorategy Cautre (LCS) Abstrcut Septonber, 2014.

Table 2. (a) Micro-generation Statistics in Itabashi City.

Technology	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
1 Solar(PV)	9	6	8	10	10	24	35	30	31	25	85	127	232	274	176	111
2 Solar water heating	3	1	6	2	4	1	0	0	0	3	4	2	4	2	1	1
3 Residential fuel cell systems (Enefarm)											5	21	31	73	118	143
4 Storage battery system for housing																15
5 HEMS																77
6 Secondary glazing																0
Gas power generation water heater								0	10	4	8	4	0			
CO2 refrigerant heat pump								43	40	39	118	85	101			
Latent heat recovery type water heater								86	70	107	126	86	227			
Ground Total	12	7	14	12	14	25	35	159	151	178	346	325	595	349	295	347

Source: Itabashi City Grant list for Eney saving 2014.

Table 2. (b) Micro-generations and Cars Statistics in Japan

Technology	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
1 Solar(PV)	15,879	20,877	25,151	38,262	46,760	54,475	72,825			1,531	101,013	187,664	235,817	276,051	288,117	131,182
2 Solar water heating						41,718	37,016	36,951	31,414	37,644	31,457	26,894	31,121	29,665	28,666	24,504
3 Residential fuel cell systems (Enefarm)											5,030	4,985	17,243	13,086	36,234	
5 Residential gas engine cogeneration system (Ecowill)					5,400	9,500	13,400	18,400	30,000							
High-efficiency water heaters (Eco-Jozu)				7,000	17,000	59,000	149,000	241,000	350,000							
Electric Car	1,690(1998-2003)					292	1,352	504	219	89	1,604	6,544	9,283	27,804	29,132	
Hybrid Car	8,137	6,864	11,537	7,706	16,024	39,530	35,605	33,276	299	470	32					
Storage batteries equipment											141	724	1,846	2,363		
Ground Total						204,515	309,198	330,131	411,932	39,734	139,277	226,811	295,310	348,969	382,149	155,686

Sources: Japan Photovoltaic Energy Association (JPEA), Fuel Cell Association (FCA), Next Generation Vehicle Promotion Center(NeV),ENERGY CORPORATION Web-site.

Report of the 1st High-efficiency gas water heater Defact Study Group, Tokyo Gas 8/11/2007, JAPAN GAS

energy and energy-saving equipment subsidy program performance. And Table 2 (b) shows Car and the new energy and energy-saving equipment subsidy program performance in Japan. The year where there is no subsidy system, is kept as blank. Itabashi City has a population of about 0.54 million people and for the whole in Japan, it is about 120 million - whereas the United Kingdom's population is 64 million as estimated at 2013.

1-2-A4: Incentives of the taxation, tax relief for house and Cash back vouchers.

UK's budget provision for 2014 is 200m pounds. This includes 125m pounds for the Cash back schemes, Green Deal Scheme. The indicative budget in 2015 is projected to be 19.2m pounds.

1-2-A5: Summary

In Japan, there is a different mechanism of repayment that comes with a system to houses. There as in the UK, because the interest rate is high, family structure is able to deal with the changes, and also it can be expected for future use.

B) Japan

There is no scheme as PAYS in Japan, now. However, they had the domestic credit systems and J-VER - "Offset Credit (J-VER) Scheme" system. In 2013, all of these credit systems migrated as "J-credit" system. Also it stated a system, such as a point awarded by the energy-saving cooperation by the same company.

There were subsidies of energy-saving equipment of eco-car, and the energy-saving labeling system. There had been eco-point system at the time of buying the energy-saving electronics. Also there are systems of the preferential tax, housing eco-point. In addition, home eco diagnosis systems have also been carried out every year.

All local government should perform the energy-saving to understand, and they are also doing energy conservation education for residents, and analyze of the energy-saving actions by questionnaire.

It also carries out every year "Household Energy Assessment project," done by the Ministry of the Environment. It started 3 years ago with 8,000 households per year, and in 2013 we have an assessment for 15,000 households.

In addition, it has been carried out same mechanism, such as point awarded when someone cooperates with electricity during peak time use by the same company. The economic analysis of the energy-saving policy will be given in Chapter 1-3.

Next section will deal with the following topics, i.e., The Energy Conservation Law and Global warming Countermeasure Law and their Government Ordinance, Schema/Polices on Energy and Energy-saving and on J-Credit system, Statistics on the home/property, car and micro generations, Incentives of the taxation, tax relief for house and cash back vouchers (Eco-Point vouchers).

1-2-B1: The Energy Conservation Law and Global warming Countermeasure Law and its Government Ordinance.

The law governing energy conservation that rationalizes of the use of energy (Energy Conservation Law) was enforced in 1978, and then revised as carried out today. The purpose of the Act is to secure the effective and rational use of the energy resources to advance the development of the Japanese economy. We quote the Article 1 for this purpose.

“Article 1 The purpose of this Act is - to contribute securing the effective utilization of fuel resources according to the economic and social environment concerning energy in and outside Japan, to take the measures required for the rational use of energy with regard to factories, transportation, buildings, and machinery and equipment as well as other necessary measures, to promote comprehensively the rational use of energy and thereby contributing to the sound development of the national economy.”

Japan is committed to make every effort in addressing the climate change towards the realization of the 6% reduction target (mean value between 2008 and 2012) over its 1990 Green House Gas (GHG) emissions under the Kyoto Protocol.

In response to this, the “Guideline for Measures to Prevent Global Warming” is approved by the Cabinet. The Promotion of Global Warming Countermeasures (Global Warming Law) on 9th October, 1998 - it's the one hundred and seventeenth issue). Japan is not joining the scheme of Kyoto Protocol from the second commitment period, but Japan is basing its activities on the Cancun Agreement.

The Convention on Climate Change 1998 was enacted. The act seeks to promote measures aimed at reducing global warming in line with the Kyoto Protocol, and to tighten controls on greenhouse gas emissions. It quotes the Article 1 and the Article 6.

“Article 1 In recognition of the serious impact of global warming on the environment of the entire planet, and the importance of efforts on the part of all humankind to actively and voluntarily address the universal issue of stabilizing greenhouse gas concentrations in the atmosphere at levels where human interference does not pose a danger to climate systems, the purpose of this Law is to promote global warming countermeasures by formulating a plan for attaining targets under the Kyoto Protocol and taking measures to promote the control of greenhouse gas emissions due to social, economic, and other activities, thereby contributing to the health and cultural life of the Japanese people, both now and in the future, as well as contributing to the wellbeing of all humankind.

As (Responsibilities of the general public)

Article 6 Members of the general public shall strive to develop measures for the control of greenhouse gases with regard to activities of their daily lives, and shall cooperate with programs of the national government and local governments for the control of greenhouse gases.”

The Energy Conservation Law, (Measures to Increase Public Understanding, etc.) Article 84, and

Table3. Summary of the Offset Credit J-Ver(December, 2013)
J-VER system which was renewed into the J-Credit Scheme.

Project type	Registration number	Verification(CO ² 10,000t)
Emission reduction	137	52.5
Forest Sink	113	10.6
Total	1250	63.1

Source; http://www.j-ver.go.jp/document/j-ver_generalization_jpn.

Article 85 (Consideration of Local Public Entities in Educational Activities, etc.) quote:

“(Measures to Increase Public Understanding, etc.)

Article 84 The State shall, through educational and publicity activities, endeavour to increase the public understanding of the rational use of energy, etc. And to ask for public cooperation for the implementation there of.

(Consideration of Local Public Entities in Educational Activities, etc.)

Article 85 Local public entities shall, when carrying out educational and publicity activities, give as much consideration as possible to contributing to increasing local residents' understanding of the rational use of energy, etc.”

1-2-B2: Schema/Polices on Energy and Energy-saving and J-Credit system.

The previous section, we have an overview of Laws and government ordinance related to the Energy Conservation. In this section we consider the measurement for energy saving.

1. Notification system: all of the new constructions and a part of the re-constructions are required mortification. In fact, almost of all of them builders are make it.
2. Appliances labelling system: the consumers can know the performance of the electric power.
3. Top Runner Program: For car and consumer electronics, etc., it was introduced the 26 equipment, as the Top Runner Program. And the 2 equipments were added, the currently the 28 instruments in 2013.

The offset credit (J-VER schema; Japan – Verified emission reduction); established by Environment Ministry in November 2008, is a verification scheme for credit generated through the reduction/removal by sinks of greenhouse gases carried out by domestic projects.

By utilizing the J-VER schema, funds for carbon offsetting by individuals, business, local governments and other can be directed to support domestic project proponents in forest management and vitalize local industries.

J-Credit system in 2013, domestic credit, and Kyoto credit were initiated to integrate J-VER Scheme. Kyoto credits are the reductions of greenhouse gas of each country have been established in the Kyoto Protocol.

All these means is that if the goal is not reached, there is a mechanism to compensate by performing the emissions trading from un used country. From 2006 until 2014, it was to get the credit of the total

Table 4. Statistics of the Domestic Credit. (Sumarized Until 2013)
Domestic Credit System which was renewed into the J-Credit Scheme.

1. Registration number		2. Verified for the Co ² Emission Project		3. Verified for the Domestic Credit Project Table	
Number	1,638	Number	1,466	Number	1,319
CO ² Emission in 2013 (CO ² 10,000t)	81	CO ² Emission in 2013 (CO ² 10,000t)	72	Verified the Domestic poroject	150
Sumarized CO ² Emission until 2013 (CO ² 10,000t)	196	average of one program	500	Rasio for all of the CO ² emission	86%
		Sumarized CO ² Emission until 2013 (CO ² 10,000t)	175		

Source: http://www.mizuho-ir.co.jp/publication/contribution/2013/san_kan1302.html

ProjectTable 5. Statistics in the J-Credit 2014.

Numbers Registration /verification Project	2014						Accumulated until 2014					
	Registration			Verification			Registration			Verification		
	Normal Type	Program type	Total	Normal Type	Program type	Total	Normal Type	Program type	Total	Normal Type	Program type	Total
J-Credit	41	11	52	5	11	16	67	35	102	5	14	19
J-VER			0			6			0			7
Domestic Credit	0	0	0	16	5	21	0	0	0	19	6	25
Total	41	11	52	21	16	43	67	35	102	24	20	51

CO ² 10,000t Registration /verification Project	2014						Accumulated until 2014					
	Registration			Verification			Registration			Verification		
	Normal Type	Program type	Total	Normal Type	Program type	Total	Normal Type	Program type	Total	Normal Type	Program type	Total
J-Credit	11,095	3.2	14.3	0.1	21.8	21.9	19.3	168,495	187.8	0.1	23.7	23.8
J-VER			0.0			0.3			0			0.3
Domestic Credit	0.0	0.0	0.0	1.9	35.8	37.7	0	0	0	2.4	36.0	38.4
Total	11.1	3.2	14.3	2.0	57.6	59.9	19.3	168.5	187.8	2.5	59.6	62.4

Source: 2015/3/31 J-Credit system management business Report; http://www.meti.go.jp/meti_lib/report/2015fy/000029.pdf

9,749 ton thousand 3,021 tons (CO² equivalent). The performance table it is shown in Table 3.

Domestic credit, quit in 2013 in what to target CO² reductions, it has been integrated into the J-credit system. The experence amount from 2008, it was shown in Table 4 and Table 5.

Transition to the J-Credit, from the J-VER, and Domestic Credit, which have been made in 2013, is shown in Table 5.

The J-Credit system, there are two committees, one is Steering Committee, another one with deliberation actually a separate project, the Authentication Committee to continue to approval and certification, and there are "the normal type" and "the program type".

By utilizing the J-Credit scheme, funds for carbon offsetting by individuals, businesses, local governments and others can be directed to support domestic project proponents in forest and the management vitalize for the local industries.

1-2-B3: Statistics on the home/property, car and micro generations.

To proceed with energy saving at home, it will require the introduction of energy-saving renovation or energy-saving equipment. But that are very expensive, it cannot be determined easily even if there is hope. So, there are subsidy programs.

The total of the funds in Itabashi city is shown in Table 2. In then energy-saving equipment and home repairers have been made also grant in the form of Eco point, a kind of the Cash back vouchers.

1-2-B4: Incentives of the taxation, tax relief for house and cash back vouchers (Eco-Point vouchers).

To proceed with energy saving at home, reducing them or tagged, it has been carried out, such as the reduction of income tax and gift tax to their children.

1-2-B5: Management of Average Usage of Electricity for Peak Demand period.

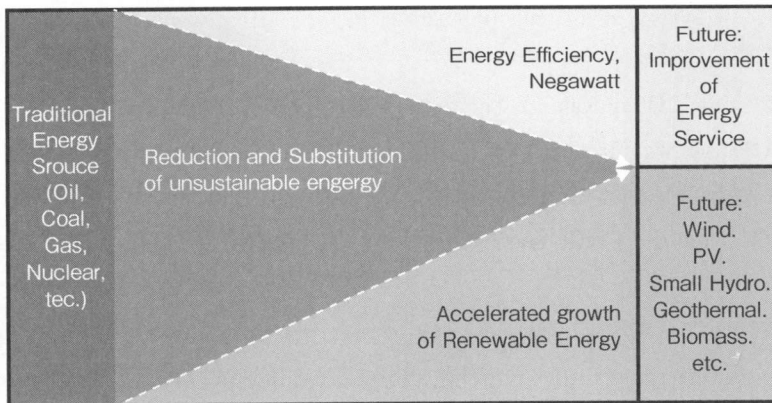
For the levelling of electricity use, the use of night time power and storage batteries can be considered. Also some companies are doing the point distribution system in then energy-saving behaviour.

The J-credit system of the “the Program Type” is not the only one household application in solar power in a plurality of homes that have been made. Visualization of power use can receive is to achieve information by HEMS.

1-2-B6: The Energy-consumption of the UK or Japan

The Energy-consumption of the UK or Japan will not reduce in general. But if the generation of sustainable energy has been promoted, then the target of the value of reduction can be increased.

Figure1: Energy Profile



Source: Fig. 2 Image of Energy Shift to Sustainable Energy (ISEP) of the RENEWABLES JAPAN STATUS REPORT 2014, EXECUTIVE SUMMARY, Institute for Sustainable Energy Policies (ISEP).

[8]

The Green House gas (GHG) emission will be reduced to the zero level by promoting the sustainable energy generation.

The base of real consumption of energy will be variable depending on the sustainable energy generation. It is not necessary that the reduction of total energy consumption must be 80% of 1990 level. This logic has not been discussed with the population of either the UK or Japan. However, the reduction of the energy consumption is important to reach the target level of the stated national policy.

1-2-B7: Summary

CO² in the residential sector has increased rather than reduced. It is necessary to wait how much of the reduction is possible of the analysis by the energy conservation education by Reduction and tax, subsidy systems and Eco-Point system. Because of the fact that the increase in the number of households, and the increase of electrical products are estimated so, in the future, a fundamental policy is needed. J credit institutions, because it is already well-equipped system, is a system that is expected.

In contrast to this, the PAYS system of the United Kingdom is a system that can be without the initial investment cost, but in fact that is to fold the long-term loan at 7% interest rate.

The UK has a system that can contribute to the transition determination of energy-saving renovation. Already in Japan, there is also the electricity bill 0-yen house in the installation of energy-saving equipment, the period to exchange. They built these houses not as long as the United Kingdom. Further to remain in the house or even move seems to be difficult.

In levelling the use of power, the support of the region is very effective. Japan has already enough IT technology. It is believed that it must take advantage of this peak usage.

Chapter 2 Analysis of the questionnaires

In order to investigate the Statistical Analysis of Energy Conservation Practices, in the UK and Japan. I created the same questionnaire, and analysed the both countries' data, using the Hybrid Approach to Neural Network and Linear Regression.

2-1 Overview (where and when we did, what is the questionnaire, input data's number, etc.)

I investigated how energy saving questionnaire in Japan in the past did. As a result, each city and some universities were performed at a research institute. The city is as the work to global warming prevention should do their questionnaire for their habitants. At the same time, I had visited to hear about the questionnaires at Itabashi City. I could get the information of the energy conservation education as well as the questionnaires that they are doing every year. I'd got three kinds of the

questionnaires from the Itabashi City. I investigated the former questionnaires and I created the new one. My questionnaire was made by making reference to these questionnaires (see Appended reference). The former questionnaire was all about the Energy-saving Actions but not the Energy-saving Consciousness. Here I make an analysis about energy-saving actions and energy conservation awareness of personal behaviours at the same time in Japan, and the UK. And we analyze whether that the law, policies and ministerial ordinances improve the Energy-saving Consciousness or not. It might be based on the relation with the international movement, and they should keep the carbon dioxide emission limits while dealing with international regulations (like Kyoto Protocol) & countries.

My Questionnaire consists of four parts: Personal data, Residence data, The Energy-saving and Actions, and Open/Free questionnaire. It has the 79 ticks Yes/No of 22 questionnaires. I have got the UK's 72 answers, and Japan's 134 answers. These were from staffs of three schools in the UK, and the 75 students of Shinshu University in Japan. And 59 answers in Japan. Total of the answers is 206.

2-2 Statistical Analysis

2-2-1 For answers in sections I, II & III (using histograms, scatter graphs, multivariate analysis.)

In order to investigate the energy-saving consciousness, it is necessary to fix the model using 'A Hybrid Approach to Neural Network and Linear Regression' at first. I select the input variables and objective variable. A Hybrid Approach to Neural Network and Linear Regression was proposed by M. Asano, Tsubaki, and Yoshizawa in 2002. [1]

(1) Input variables.

The input variables should be selected explain the energy consciousness. This means it is select from the Personal data: five variables, Residence data: four variables, and the Energy-saving questions: five variables. The total is 14 variables. Before select the variables, I checked the histogram and 2 way tables. From 14 variables, I selected 8 variables;

1. You're Country? (UK, Japan)
2. Status in your residence (Child, Parent, Grandparent, Independent person, other),
3. Income (Less than £10000, £10000-£20000, £20000-£30000, More than £30000)
4. Have you heard of 'Green Deal'?
5. Q1_Do you know how to Energy-saving?
6. Q2_Have you heard of 'Pay-As-You-Save'?
7. Q3_Have you heard of the 'Energy-Saving Label'?
8. Q4_Do you know the worldwide mark for energy saving?

(2) Objective variable.

The objective variable is the weighted mean of the answers of the Energy-saving Actions. Because we have 70 ticks, so first it is necessary to select the variables about which actions are important for

Table 6. Result of the Hybrid Approach to Neural network and Linear Regression.

<i>Regression Statistics</i>					
Multiple R	0.6010				
R Square	0.3612				
Adjusted R Square	0.3319				
Standard Error	0.1690				
Observations	206				
				AIC	
				-617.69	

ANOVA					
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	9	3.16755	0.35195	12.31555	2.19555E-15
Residual	196	5.60123	0.02858		
Total	205	8.76878			

	<i>Coefficien</i>	<i>tstandard Erro</i>	<i>t Stat</i>
Intercept	0.2716	0.0335	8.1122
h2	0.4658	0.0827	5.6321
UK/Japan	-0.0186	0.0153	-1.2146
Status in your residence	-0.0154	0.0212	-0.7276
Income	0.0327	0.0106	3.0892
Green Deal	0.0892	0.0337	2.6446
Q1	0.0105	0.0302	0.3481
Q2	0.0738	0.0406	1.8175
Q3	0.0843	0.0346	2.4361
Q4	0.0184	0.0359	0.5119

objective variables the Energy-save Actions? Using some variables from 70, I created the Energy-save Action model. Next, I checked the histogram, Correlation matrix, the 2 way tables and regressions. Within the 70 variables, I selected the 8 variables;

1. Q11. Have you changed your bulbs to LED?
2. Q12. When you open the door of the refrigerator do you do so quickly to save energy?
3. Q15. Does more than one person use the same bath water in your residence?
4. Q5. Do you have an energy-saving car?
5. Q6. Has your family an energy-saving car?
6. Q20. Do you use an appliance or heating equipment to heat water in your house/flat?
7. Q21. Do you use an appliance or heating equipment to warm your house/flat?
8. Q22. Have you changed (or transformed or converted) your residence so as to include the following to heat your house/flat?

The component of the weights are the reciprocal of 'yes'; 127, 126, 141, 28, 24, 154, 180, and 32. The Neural network analysis was analyzed by the nnet function; Feed forward three layers neural network in R system [8]. The number of hidden layer is 2 units, so, 8-2-1 Feed Forward Three Layers Neural Network, as the linear output units. We select the first output vale of the hidden layer. I showed the result of the Hybrid Approach to Neural Network and Linear Regression in Table 9. And we showed the Asano- Bhattacharyya Graph in Figure 2[4], [5]. The input variable h2 is the output value of the

middle layer of the Neural Network.

The UK and Japan's questionnaire results showed that the energy-saving consciousness which are obtained from Law, Education and Information, forces the Energy-saving practices.

I compare the results of the three regressions: neural network's hidden layer's 2 input inputs linear regression, ordinary 8 input variables linear regression, and the Hybrid Approach to Neural Network and Linear Regression.

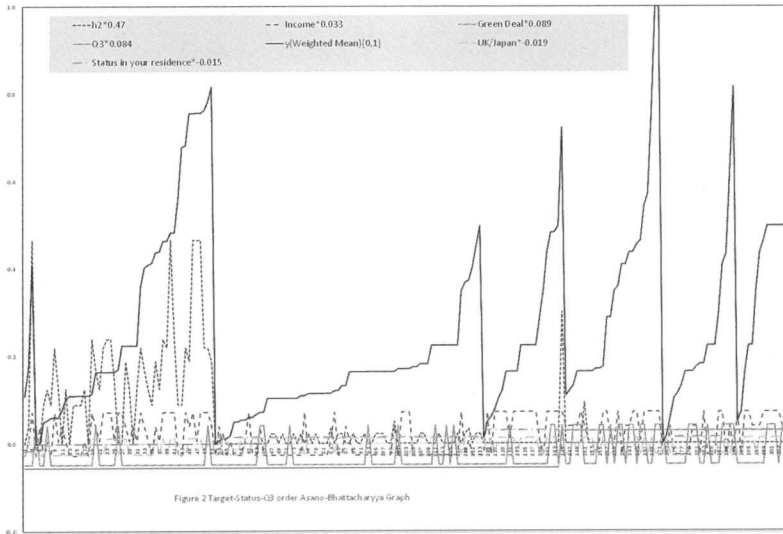


Figure 2. Target-Status-Q3 order Asano-Bhattacharyya Graph. This graph shows that the output value of the middle layer of the Neural Network (h2) is data edited for just two classes of the Status. If the data is time series data, this graph's x-axis should be Time. It is possible to find the change points [1], [2], [3], [4].

I show in Table 7 Result of the Linear Regression; the 8 input variables. Table 8 shows the comparison of the models. The Hybrid Approach to Neural Network and Linear Regression has both the accuracy and interpretation.

About accuracy, the Neural Network model is best of three, but this is less interpretation than the Hybrid Approach to Neural Network and Linear Regression. We show the coefficient of the three Layard Feed Forward neural network model in Table 9. The coefficients of middle layer of the first variable of the middle layer 6.558, and the second is 0.468. This means the second variables is small role, but data editing just the classes. The second unit of hidden layer is selected by the AIC.

2-2-2: Open question's (IV) answer

The 29 persons within 206 answers write their opinions. All is about the importance of the energy-saving.

Table 7. Result of the Linear Regression; the 8 input variables

Regression Statistics					
Multiple R	0.5078				
R Square	0.2579				
Adjusted R Square	0.2277				
Standard Error	0.1818			AIC	
Observations	206			-613.203	

ANOVA					
	df	SS	MS	F	Significance F
Regression	8	2.261044	0.28263	8.56	5.54539E-10
Residual	197	6.507735	0.033034		
Total	205	8.768778			

	Coefficien	tstandard Erro	t Stat
Intercept	0.3385	0.0336	10.0622
UK/Japan	-0.0402	0.0159	-2.5287
Status in your residence	0.0575	0.0181	3.1764
Income	0.0595	0.0101	5.8669
Green Deal	0.0594	0.0358	1.6589
Q1	0.0367	0.0320	1.1447
Q2	0.0445	0.0433	1.0281
Q3	0.0498	0.0366	1.3588
Q4	-0.0196	0.0380	-0.5171

Table 8. The comparison of three linear regressions.

Model	Input variables	Multiple R	Standard Error	AIC	interpretation
The feed Forward Neural Network : Hidden layer - Output layer	2	0.6524	0.1575	-638.0	
The Linear Regression	8	0.5078	0.2579	-613.2	○
A Hybrid Approach to Neural Networks and Linear Regression Analysis	9	0.6010	0.1690	-617.7	○

Table 9. The coefficient of the three layered feed forward neural network.

Input variables of input layer	The First unit of the middle layer	The Second unit of the middle layer	The output value of middle layer	
Intercept	-5.075	-12.784	Intercept	0.135
Country(UK or Japan)	0.0001	-3.338	The output value of the first unit	6.558
Status in your residence	-0.278	8.217	The output value of the Second unit	0.468
Income	0.581	0.442		
Have you heard of 'Green Deal'?	1.147	-6.685		
Q1_Do you know how to Energy-saving?	-0.143	6.503		
Q2_Have you heard of 'Pay-As-You-Save'?	0.887	-7.286		
Q3_Have you heard of the 'Energy-Saving Label'?	0.866	-7.490		
Q4_Do you know the worldwide mark for enery saving?	-0.134	-16.297		

2-3: Summary of Chapter 2

Using the Hybrid Approach to Neural Networks and Linear Regression analysis, it is able to analyse that the Energy-Saving Consciousness which are obtained from Law, Education and Information, forces the Energy-saving action.

Asano- Bhattacharyya Graph shows a useful way for the interpretation of the model and the role of the each input variables.

Chapter 3: Conclusion and Proposal

The energy-saving consciousness which are obtained from Law, Education and Information, forces the Energy-saving action. It is necessary the education, information, scheme and Law.

The education for energy-saving should be more forced. The home energy saving system should be accepted for more houses.

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Questionnaire relating to energy and energy-saving consciousness in the UK and Japan (I. Personal Data, and II. Residence)

I. Personal Data:

Sex Male Female

Age group 10-19 20-29 30-39 40-49 50 or over

Occupation Student Self-employed employment Housewife Retiree Other

Status in your residence Child Parent Grandparent Independent person Other

Which country do you reside in? UK Japan If 'Other', Write country.

II. Residence:

Flat House College dormitory Shared house Other

How many people live with you? - 1 2 3 4 5 or more

Size of residence - 50m³ 50-300m³ 300m³ or over

Total gross yearly income of everyone living in your residence

Less than £10000 £10000-£20000 £20000-£30000 Over 30000£

III, IV, V continue

Privacy Policy:

The information provide in this questionnaire will be used solely for the purpose of data gathering and statistical analysis. The information provided will not be used for any other purpose.

If you have any questions regarding this questionnaire please contact; asano@ic.daito.ac.jp

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