Chapter 3

Climate Policy in Household Sector

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Abstract Compared to the industry sector, the progress of energy conservation of the household sector is very slow. It is because the household sector is more diverse than the industrial sector, and regulatory enforcement is much more difficult. The government can stop firms' operation if their environmental burden is too heavy but cannot stop household's activities. Therefore, the government needs to find energy conservation policies that are supported by the public. Like other countries, the Japanese government has introduced various energy conservation measures to reduce the energy usage from households for the past several decades. It has introduced energy efficiency standards for energy-consuming durables and provided subsidies to promote energy-efficient products in recent years. At the same time, it has raised the price of energy in order to provide households with an appropriate incentive to conserve. In addition, it has promoted renewable energy usage in the household sector. Facing climate change, the Japanese government has not introduced energy conservation measures systematically but rather on an ad hoc basis. In this chapter, we review energy conservation measures implemented in the household sector in Japan. We then make policy recommendations to enhance the effectiveness of energy conservation measures in the household sector.

Keywords Cost effectiveness · Energy conservation measures · Household sector

This work was supported by JSPS KAKENHI Grant Numbers 18H00837 and Institute of Economic Research of Aoyama Gakuin University.

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T. H. Arimura and S. Matsumoto (eds.), *Carbon Pricing in Japan*, Economics, Law, and Institutions in Asia Pacific, https://doi.org/10.1007/978-981-15-6964-7_3

1 Introduction

Households use energy for transport and housing. Excluding fuel consumption for passenger vehicles, household energy consumption accounts for about one-fifth of global energy consumption. However, the share exceeds one-third if the fuel consumption is included (International Energy Agency (IEA) 2016). For the past several decades, countries have implemented various energy saving measures to reduce household energy consumption. However, energy saving in the household sector has not been so successful, vis-à-vis other sectors. For example, in EU countries, while industry energy consumption decreased by 16.4% from 2005 to 2016, household energy consumption decreased only by 8.0% (European Environment Agency 2019). This trend is also visible in Japan: industrial energy consumption decreased by 17.9% from 1990 to 2017, while household energy consumption increased by 42.0% (National Institute for Environmental Studies 2019).

The Japanese government's mid-term target is a 26.0% reduction in greenhouse gas (GHG) emissions from their 2013 level by the year 2030¹ and to reduce household GHG emissions by 39.3% during this period (Ministry of the Environment 2020). Although household energy consumption began decreasing in 2012, the reduction over the past five years is only 12.3%, which is obviously too slow to achieve mid-term target.

Japan has had another difficult energy policy problem since 2011: The Fukushima accident increased awareness of the risks of nuclear power, while decreasing its public support. The share of nuclear power in the Japan's electricity supply before the accident was about 30%, and decreased to 1% in 2017 (Agency for Natural Resources and Energy 2017). Although the government states that the desirable share of nuclear power in 2030 is approximately 20–22%, there is strong objection to this plan (nippon.com 2015). On the other hand, Japan lags other developed nations in introducing renewable energy (see Chap. 4).

Slow progress in energy conservation measures and the difficulty in shifting toward alternative energy highlight the importance of household energy conservation measures. The objectives of this chapter are to investigate Japanese household energy conservation measures, and to propose policies to achieve the 2030 target.

This chapter is structured as follows. In the next section, we examine energy usage among Japanese households.² We review major energy conservation measures implemented in Japan and summarize their distinguishable features in Sect. 3. We conclude with policy recommendations to enhance the effectiveness of household energy conservation measures.

¹The long-term target is an 80.0% reduction by the year 2050. Chapter 1 discusses the long-term target in detail with its context.

²We exclude the energy consumption for vehicle usage from the analysis and focus on the energy consumption inside the household.

2 Energy Consumption Among Japanese Households

2.1 Characteristics of Japanese Households: International Comparison

Japan's energy consumption is characterized by a high share in the industrial sector and a low share in the household sector. Although its market share has declined in recent year, the industrial sector still has the greatest share of 46% in 2016. In contrast, the Japanese share of household to total energy consumption was 14% (Agency Natural Resources for Energy 2017). This share is much lower than that of the EU, 26%, (Euro Stat 2016), or the US, 21% (US Energy Information Administration (EIA) 2018).

Although US household energy consumption differs widely among the states, the annual energy consumption of the average American household was 81.3 GJ (EIA 2015). Similarly, although there is a wide variation in energy consumption between countries, that of the average EU household was 54.0 GJ, according to the Eurostat (2016). In contrast, the average Japanese household consumed only 33.5 GJ (Ministry of the Environment of Japan 2016). The energy consumption per household in Japan is about the level of Spain and Bulgaria.

Japanese shares of electricity, natural gas, propane gas, and kerosene of total energy sources were 52%, 19%, 11%, and 18%, respectively (Survey on Carbon Dioxide Emission from Households (SCDEH) by Ministry of the Environment (2016)). In contrast, those in the US were 47%, 44%, 4%, and 5%, respectively (Residential Energy Consumption Survey (RECS) by US Energy Information Administration (2015)). In the EU, natural gas accounted for 36% of household energy consumption, electricity 24%, renewables 18%, and petroleum products for 11%, according to Eurostat (2016). Pertaining to CO₂ emissions, the shares of electricity, natural gas, propane gas, and kerosene, are 70%, 13%, 5%, and 12%, respectively in Japan. These statistics indicate that Japanese households heavily rely on electricity.

Table 1 compares energy use purpose across several countries, and indicates that Japanese households use less energy for space heating, but more for lighting and appliances. It is interesting to know that Japanese households use more energy also

Table 1 Final energy consumption by purpose (%)

	Japan	US	EU
Space heating	22.4	44.1	64.1
Space cooling	2.6	8.9	0.3
Water heating	23.8	18.5	14.8
Cooking, Lighting, Appliances etc.	51.0	28.6	21.0

Source Japan (SCDEH 2016) , US (RECS 2015), EU (Eurostat 2016)

for water heating. Perhaps, this result reflects Japanese habit having a bath instead of taking a shower.³

2.2 *Historical Change in Household Energy Consumption*

The National Survey of Family Income and Expenditure by Statistical Bureau of Japan (1980–2014) (NSFE) is a nationwide cross-sectional survey initiated in year 1959, and conducted every five years. It collects data on households' socioeconomic characteristics, such as income/expenditure, savings/liabilities, and ownership of durables, as well as housing information such as dwelling characteristics and site area. Using household micro data from NSFE, we report the change in household energy consumption from 1989 to 2014 below.

The NSFE data pose two major drawbacks. First, the data do not report the actual energy consumption; rather, only the average monthly expenditure. We calculated the average monthly energy consumption from the monthly electricity energy expenditure, which contains measurement errors, since the price of energy varies across regions and depends on the type of contract held by the household. Second the NSFE's sampling period is limited to between September and November, that corresponds to the fall season and require less energy for room temperature control. Therefore, the estimation based on the NSFE data may underestimate household energy consumption.

Although it is preferable to analyze the annual data to take account of the seasonal variation in energy consumption, we focus on energy usage in autumn due to the above-mentioned data limitation. Figure 1 shows the change in monthly energy consumption of Japanese households from 1989 to 2014. Electricity consumption increased until 2004 while natural gas and kerosene consumption decreased steadily; consequently, the overall energy consumption decreased from 4.70 to 3.61 GJ.

The share of energy sources varies between regions. Warmer urban regions use electricity mainly, while cold suburban regions use kerosene more intensively. More specifically, the share of kerosene in Hokkaido, the coldest prefecture in Japan, was 60.4% in 2014, while in Tokyo it was 19.6%; and the share of electricity in Hokkaido was 24.7% while in Tokyo it was 40.6% (NSFE 2014).

2.3 *Electric Appliance Ownership*

As explained so far, Japanese households depend on electricity for much of their energy consumption. Households use home electric appliances. Here, we report how the ownership of home electric appliances has changed among Japanese households since 1980s. Given that approximately 60% of the electricity is consumed for

³More than 50% of Japanese household take bath every day during the winter (SCDEH 2016).

Fig. 1 Change in household energy consumption. *Source* NSFE (1989–2014)

air-conditioning (AC), television (TV), refrigerators (REF) and lighting (Bureau of Environment Tokyo Metropolitan Government (BETMG) 2018), we focus on the ownership of these four electric appliances in this sub-section.

The 2014 NSFE reports that 98.9% of households own REF, 98.3% own a TV, and 89.12% own an AC. The penetration of these electric appliances has completed and Japanese households have increased the number of TVs or ACs for the past 30 years. The 2014 NSFE reports that 79.87% of households own multiple TVs, and 79.87% own multiple ACs.

The 2014 NSFE asked respondents whether they were using light-emitting diode (LED), which is more energy efficient than conventional fluorescent lamps, and found that only 31.42% of households installed LEDs, suggesting a significant energy saving potential.

The ownership of home electric appliances is associated with households' characteristics. Table 2 shows the number of AC/LED/TV/REF used in the average Japanese

Table 2 AC/LED/TV/REF used in the average Japanese household

	Household size		Dwelling characteristics		Average
	Single-person households	Multi-person households	Detached house	The other types	
AC	1.83	2.74	2.96	1.57	2.66
LED	0.48	0.80	0.83	0.57	0.77
TV	1.50	2.21	2.33	1.47	2.15
REF	1.10	1.25	1.30	1.02	1.24

Source NSFE (2014)

household. The average household owns 2.66 ACs, 0.77 LEDs, 2.15 TVs, and 1.24 REF. Single-person households tend to own fewer appliances than multi-person households. For example, the average multi-person household owns 2.74 ACs while the average single-person household owns only 1.83 ACs. However, multi-person households more likely tend to install LEDs than single households, suggesting that multi-person households may be more energy saving.

Pertaining to the relationship between appliance ownership and housing characteristics, Table 2 indicates that households living in a detached house tend to own more appliances than those living in apartments; whereas the former uses LEDs more frequently than the latter.

In the Tokyo metropolitan area, the number of households increased from about 429 million to about 670 million from 1980 to 2015. However, the ownership of ACs per 100 households increased from 95 units to 301 units between 1982 and 2015 (BETMG 2018). Therefore, the growth rate of ACs is substantially higher than that of households. This is because Japanese households began purchasing additional air conditioners in order to make spending time at home more comfortable. This comparison growth rate suggests that the reduction of energy consumption is not an easy task even in a society with a declining population.

2.4 Electric Appliance Usage

Household appliance ownership is not directly associated with energy consumption and it is necessary to know how intensively households use appliances, in order to understand household energy consumption. Here, we report the intensity of appliance use from the SCEDH (2016).

Table 3 indicates a large variation in the time of TV and AC use across households. The median time of TV use is around 4–8 h. However, about 8% of households do not watch TVs on weekdays, and about 7.5% of households keep TVs on for more

Table 3 Intensity of appliance daily use

		Not use (%)	<2 h (%)	2–4 h (%)	4–8 h (%)	8–12 h (%)	12–16 h (%)	>16 h (%)
Time of TV watch on weekdays	Japan	4.5	8.0	27.0	38.8	14.3	5.4	2.1
	Tokyo	1.3	5.6	21.9	39.8	17.9	8.8	4.7
	Osaka	1.7	6.9	23.4	39.5	17.9	6.9	3.8
Time of the main AC use on summer weekdays	Japan	13.7	16.9	31.6	18.2	9.9	4.3	5.4
	Tokyo	4.9	9.2	28.3	20.0	15.1	9.8	12.6
	Osaka	4.5	15.7	31.0	22.3	14.6	6.6	5.2

Source SCDEH (2016)

than 12 h. Similarly, the median time of AC use on summer weekdays is around 4–8 h. However, about 13.7% of households do not use AC on weekdays, and about 9.7% of households keep AC on for more than 12 h.

Table 3 compares time of TV and AC use across regions. It shows that people living in Tokyo and Osaka (the second largest city) use both TVs and ACs more intensively than those in other regions. The average household in Japan owns 2.32 ACs. The average household in Tokyo owns 2.84 ACs while the average household in Osaka owns 2.91 ACs. This data suggests that households living in large cities own more ACs and use them more heavily.

3 Energy Conservation Measures

3.1 Energy Price and Carbon Pricing

Japan imports almost all energy from abroad and thus the energy prices have been set at a high level for both household and industrial uses. Considering that further energy price increases would lower the international competitiveness and impact economic growth negatively, introducing the carbon tax in Japan has been long debated; after two decades Japan finally introduced the carbon tax in October 2012 to mitigate warming mitigation.⁴

Carbon pricing is now considered as one of the most cost-effective measures to reduce CO₂ emissions, especially under the long-term target of de-carbonization. In this sub-section, we compare energy prices between Japan and other countries, especially the relative size of carbon taxes among the household sector. We focus on electricity, natural gas, and kerosene, which comprise almost 90% of Japanese energy usage (see Sect. 2.1).

Energy price⁵ data in Table 4 were collected from Energy Prices and Taxes of IEA (2018). The table indicates that energy prices in Japan are higher than other countries: the prices of natural gas and electricity for Japan are 107.4 USD/MWh and 226.6 USD/MWh, respectively, the average prices in OECD countries are 53.9 USD/MWh for natural gas and 166 USD/MWh for electricity.

Table 4 indicates the size of energy taxes to energy prices; and that the sizes of taxes in Japan are lower than those in France or Germany. The tax size of natural gas for Japan, France, and Germany are 7.4%, 24.5%, and 24.3%, respectively, and electricity: 8.9%, 36.2%, and 54.5%, respectively. By removing tax payment, we can calculate each country's prior-tax base energy prices. The base price of natural gas for Japan is 99.5 USD/MWh, while for France and Germany, 59.3 USD/MWh and 56.6 USD/MWh. Similarly, the base price of electricity in Japan, France, and

⁴Presently, the tax rate is set at very low rate (0.76 yen/litter for Gasoline, 0.76 kWh yen/litter, 0.11 yen/kWh) (Ministry of Environment 2020).

⁵According to the IEA (2018), the energy price is defined as the ratio of the total amount of money spent on purchasing an energy and the total sales volume of the same energy over one year.

Table 4 Energy end-use prices in 2017 (converted using exchange rates)

	Kerosene (USD/1000 L)		Natural gas (USD/MWh)		Electricity (USD/MWh)	
	Total taxes (%)		Total taxes (%)		Total taxes (%)	
Japan	695.8	11	107.4	7.4	226.6	8.9
US	694.7	4.7	36.1	na	129	na
UK	649.8	26.8	55.3	4.8	205.7	4.8
France	832.6	32.7	78.5	24.5	187.3	36.2
Germany	642.8	26.7	74.8	24.3	343.6	54.5
OECD Europe	765.2		68.1		222.4	
OECD Total	738.5		53.9		166	

Notes na means data is not available
Total taxes mean the percentage of the energy end-use prices
Source Energy Prices and Taxes of IEA (2018)

Germany are 206.4 USD/MWh, 119.5 USD/MWh, and 156.3 USD/MWh, respectively. The price-differences between Japan and the other countries are substantial on the base price level.

Pertaining to kerosene, its price in Japan is lower than the average OECD countries. The prior-tax base price in Japan is about 619.3 USD/1000 L, which is the second highest price among the five countries listed in Table 3.

Thus, the base energy prices are relatively high in Japan but carbon taxes are relatively small. Indeed, the effective carbon price of residential and commercial use in Japan was 5 EUR/ton, while that of UK, Germany, and France was 23 EUR/ton, 26 EUR/ton, and 19 EUR/ton, respectively (Ministry of the Environment 2018).

3.2 Policy Measures to Improve Appliance Energy Efficiency

Energy consumption per service is reduced via energy efficiency improvement. Households might choose an energy-efficient product even without any policy intervention since they can save money. Manufacturers will develop an energy-efficient product to increase demand for their products. However, it is often difficult to achieve the sufficient energy efficient improvement necessary for the society when simply relying on household’s voluntary product selection and manufacturers’ voluntary investment,⁶ and thus the government has introduced policies to forcibly improve the energy efficiency of durable consumer goods. While policies for improving electricity

⁶Arimura et al. (2019) compared environmental policies between Japan and other developed countries and discussed the conditions for the voluntary approaches.

usage of home appliances have been widely implemented, the Japanese government has adopted similar strategies.

The government introduced the Top Runner Program to improve the efficiency of energy-consuming durables in 1998. It set the energy efficiency of the products with the highest efficiency as the energy efficiency standard and requested manufacturers to achieve it before the specified target year. Although only 11 items were covered at the beginning of the program, seven items were added in 2002, two items were added in 2009, and five in 2013. Presently, a total of 31 items are subject to the Top Runner Program, resulting in significant improvement in the energy efficiency of energy-consuming durables. The energy saving of several electric appliances has improved twice or more than the target. For example, the energy efficiency of REFs has improved by 43% from 2005 to 2010, while its target was 21%. Similarly, the energy efficiency of TVs has improved by 73.6% from 2008 to 2012, while its target was 37%.

Households cannot examine the energy efficiency of products at the time of purchase. In 1995, to effectively inform consumers of product energy efficiency, the Japanese government introduced the Energy Star Program jointly with the US. In 2000, the Japanese government introduced the Energy Saving Labeling program based on the Japanese Industrial Standards. A green mark is placed if a product achieves the top runner standard, while the orange mark indicates that it did not. Manufacturers further provide consumers with detailed information including an energy-saving mark of the target year, an achievement rate of energy-saving standard, and an annual electricity consumption.

A strength of these programs is that they do not significant consumer effort. The Top Runner Program improves energy efficiency of the products sold, and the Energy Saving Labeling Program enables consumers to choose an energy-efficient product at the time of product replacement by reporting its energy saving benefit. To further promote the selection of energy-efficient products by consumers, the Japanese government started the Unified Energy Saving Labeling Program in 2006, in which the government requests retailers to indicate the energy efficiency of products with the number of stars, as well as the annual estimated electricity bills from using the products. Consumers require less cognitive skills to identify the energy efficiency of products since they can identify product energy efficiency by simply counting the number of the stars. Presently, six varieties of home electric appliances including AC, REF, and TV are covered under this program.

CO₂ emissions per household reached approximately 4520 kg CO₂ in 2016, about 50.9% was due to electricity. Pertaining to electricity usage, the shares of usage from REF, lighting, TV, AC were 14.2%, 13.4%, 8.9%, and 7.4%, respectively in 2009 (Ministry of the Environment 2019). This data suggests that improvements in energy efficiency of electric appliances are closely related to the reduction of the CO₂ emissions from households. However, households tend to not choose an energy-efficient durable even if they are informed of the detailed information about product energy efficiency (Allocott 2011; Jaffe and Stavins 1994). Moreover, not all households would equally react to such programs: for example, wealthy households with many family members are more likely to purchase an inefficient REF (Wang et al. 2019). Households living in rented houses are less likely to choose LED lamps

(Onuma and Matsumoto 2019). Since the energy-efficiency of appliances has been greatly improved through the implementation of the programs mentioned above, the next challenge is how to encourage households to purchase an energy-efficient appliance.

3.3 *Policy Measures to Improve Housing Energy Efficiency*

Households can reduce energy consumption by installing energy-efficient durables. Similarly, households can reduce energy consumption by improving the energy efficiency of their houses. Although both the purchase of energy-efficient durables and the renovation of old houses are energy-saving investments, previous studies have found that households respond differently to these two types of energy-saving investments. Ramos et al. (2016), and Trotta (2018) confirm that the environmental attitude can explain the purchase of energy-efficient appliances, but not for home renovation. This data suggests a different policy for improving the energy efficiency of houses vis-à-vis that of other energy-consuming durables.

In order to improve the energy-efficiency of houses, the Japanese government has introduced various measures including subsidies and a long-term tax reduction, and the most ambitious measure: the subsidy for net zero energy houses (ZEHs).⁷ These are houses whose annual primary net energy consumption is set at around zero (or less). Under the ZEH program, houses are constructed to save energy as much as possible, while maintaining a comfortable living environment. In the fourth Energy Basic Plan introduced in 2014, the Japanese government targeted make more than half of newly-constructed detached houses ZEHs by 2020, and the average newly-constructed house ZEH by 2030 (Agency for Natural Resources and Energy 2014).

In recent years, a series of subsidy programs have been introduced to promote ZEHs. The first, “ZEH support program”, started in 2015, which targets newly-constructed detached houses with more than 20% reduction rate of primary energy consumption as well as high thermal insulation performance. In the first program period, 1.3 million JPY would be provided for households constructing a ZEH, with 1.5 million JPY for households in cold regions. In 2016, 6146 subsidies were issued, the average reduction rate of the primary energy consumption including solar power among these houses reached to 120.7%, and with excluding solar power reached to 43.9%. With the success of the first ZEH program, the government continued it but reduced the amount of subsidies: 1.25 million JPY in 2016, 0.75 million JPY in 2017, and 0.7 million JPY in 2018 and 2019, although the number of issued subsidies has increased to 7100 in 2018 (Sustainable Open Innovation Initiative, SII 2019).

The Japanese government introduced “ZEH + program” in 2018 and “ZEH + R program” in 2019. The ZEH + program requires ZEHs’ average reduction rate of primary energy consumption to be 25%. The ZEH + R program asks sufficient energy

⁷Zero Energy Buildings (ZEBs) is discussed in Chap. 2.

provision during a power failure as well as the resilience strengthening option, in addition to the requirement of the ZEH+ program. The subsidy amount of the ZEH+ program is 1.15 million JPY/house, and that of ZEH + R program is 1.25 million JPY/house. The number of subsidies provided under three types of programs (ZEH, ZEH + , and ZEH + R) were 9172 in 2018 and 7345 in 2019.

Subsidies for companies began 2018 with “Detached-sale ZEH program. Aiming to support building companies to construct ZEHs, the program provides 0.7 million JPY (or 1.15 million JPY) per house to the building company (SII 2018). In 2018, the first subsidy program targeted at housing complexes (including apartments), “High building ZEH-M program” started, whereby projects with six floors or higher ZEH apartment can obtain a subsidy two-thirds of the total subsidized cost.

In addition, the ZEH builder mark and the ZEH planer mark have been implemented to increase the recognition of ZEHs among households as well as building companies. However, despite such efforts, only 15.3% of newly-constructed detached houses were ZEHs in 2017 (Agency for Natural Resources and Energy 2019), far below the 2020 target of 50%. Given the high housing construction, it seems difficult to achieve the target solely thorough the ZEH subsidy programs: with the average price of a new house in Japan of 34 million JPY (Japan Housing Finance Agency 2019), the subsidy amount to less than 4% of the construction cost.

3.4 Support for Solar Panel Installation

Solar panel, an important renewable energy, has been universally used in the household sector. In Japan, the first solar panel for residential use was installed in 1993. Given the expensive price of solar panels, the Japanese government introduced a subsidy program in 1994. The size amounted to 50% of the installation cost. Nevertheless, solar panels are unpopular, with only 3.14% of Japanese households installing them in 2005 (NSFE 2014).

The promotion of solar panels in the household sector was proposed again when formulating the Action Plan for Creating a Low-Carbon Society in 2008 (Ministry of the Environment 2008) and the revival of the subsidy program since 2009. Owing to this new program, the installation cost of the solar-panel system was lowered substantially. When introduced in 2009, households purchasing a solar-panel system with a unit price less than 700,000 JPY could receive a subsidy of 70,000 JPY/kW initially. However, the amount of subsidy kept decreasing continually to 15,000 JPY/kW when the program ended in 2013. This subsidy targeted households that purchased a relatively low-price solar-panel system. For example, in 2012, the subsidy for a system priced lower than 475,000 JPY was 35,000 JPY/kW, while that for a system priced lower than 550,000 JPY was only 30,000 JPY/kW (Eco life 2019).

In addition to the subsidy program, the government started a 10-year Feed-in Tariff (FIT)⁸ in 2009, promising that the surplus electricity produced by solar panels

⁸The detail of Feed-in Tariff is explained in Chap. 5.

Fig. 2 Households' annual energy consumptions on average. *Source* SCDEH (2016)

would be purchased by the power company in a fixed price in 10 years (Agency for Natural Resources and Energy 2009). The FIT made solar-panel investment more attractive, as households not only pay lower electricity bills but also make a profit by selling surplus electricity. The average solar-panel households earn approximately 153,755 JPY annually by selling surplus electricity (SCDEH 2016).

The new subsidy and the FIT positively affected the promotion of solar panel. According to the 2014 NSFE, approximately 60.12% of solar-panel households installed a solar panel system during the new subsidy program period, whereas only about 28.7% of the installed before 2009. Furthermore, the 2014 NSFE shows that solar panels have been promoted especially among multi-person households, as well as households living in detached houses. Among all solar-panel households, about 97.35% are multi-person households, while about 98.13% live in detached houses.

Figure 2 indicates the differences in annual energy consumption (the sum of electricity, natural gas, propane gas, and kerosene consumption) between solar-panel households and non-solar-panel households (SCDEH 2016). (The energy produced by solar panel is not included.) Figure 2 shows that solar-panel households use less energy than households without solar panels, a propensity more palpable among multi-person households and households living in detached houses. The annual energy consumption of non-solar-panel households is 43.08 GJ while that of solar-panel households is only 30.8 GJ. As for households living in detached houses, the annual energy consumption of solar-panel households is 30.04 GJ, and that of non-solar-panel households is about 45.17 GJ.

4 Conclusion

In this chapter, we reported the characteristics of the energy consumption of Japanese households, and then reviewed the policy measures implemented in Japan for residential energy conservation. Like other developed countries, the Japanese government

has introduced various programs to improve energy efficiencies of energy-consuming durables. Among them, the most effective policy is probably the top runner program: the energy efficiency of appliances has greatly improved for the last several decades. According to a survey by Ministry of Economy, Trade and Industry (METI) (2007), during the period 1997–2004, the energy efficiencies of televisions (TVs), air conditioners (ACs), and refrigerators (REFs) improved by 25.7%, 67.8%, and 55.2%, respectively. Nevertheless, much of energy saving effects has been lost due to stock and size increase (Inoue and Matsumoto 2019). The fact tells that it is difficult to reduce residential electricity consumption merely through technological innovation.

Even if it reliably reported that energy investment is beneficial, many households will not invest in energy efficiency. In recent years, many studies have been conducted worldwide in order to find effective programs to induce households to choose energy-efficient durables. Although many interesting findings have been reported in recent studies, it is expected that the effectiveness of incentive programs would vary across countries. Thus, it is necessary to find effective programs for Japanese households. However, at present, it is not well-known what types of households do not invest in energy efficiency and what type of information households are likely to respond to. Further research is clearly needed.

Although various subsidy programs have been introduced for the last several decades, those programs primarily focus on the purchase of new products. Such subsidy programs would be effective for durables with a short replacement cycle, and less effective for the durables whose replacement cycle is slow. And given that the amount of subsidy is small compared to the purchase price, the subsidy program for energy-efficient houses seems less successful currently (Matsumoto 2016). Given that household energy efficiency improvement will substantially impact carbon mitigation, it is important to find more effective programs for penetrating energy-efficient houses. Although a system to display the total energy performance of houses has been introduced in Japan (Housing Performance Evaluation and Display Association 2019), its usage is low, and will (as in other developed nations) be necessary to popularize it in the future.

A palpable weakness of the subsidy programs is regressivity: Almost all subsidy programs, including for solar power and new appliances, support the purchase of durables, but households obviously must purchase them to receive subsidies. The households using such a subsidy program lived in detached houses where solar panels could be installed, or were those who had an additional deposit to replace electric appliances during the specified subsidy period. Therefore, in past subsidy programs the poor supported the rich to enable him or her to use energy services at low cost. Perhaps, such regressive policies will not be able to retain public support. A publicly acceptable policy, must not only account for energy consumption, but also energy consumption purposes.

Japan introduced the carbon tax in October 2012 to mitigate global warming, which was simply added to the old energy taxes (Chap. 1). As we mentioned before, the tax rate is low presently but is expected to increase in near future. The distinguishing feature of this new carbon tax is that it is uniformly applied on a CO₂ basis regardless of the purpose of energy use. In contrast, the conventional energy taxes

were adjusted by the energy use purpose. Although the new carbon tax effectively mitigates carbon, it is regressive. In particular, the new carbon tax is more stringent for low-income households living in cold regions. Thus, the government should introduce redistribution policies when it increases the carbon tax.

The rapid spread of renewable energies is essential for significant energy savings in the household sector. Households with a strong interest in environmental problems installed a renewable energy system initially, and subsequently households with sufficient financial asset installed it by using subsidies. However, the system penetration is still low, and more households will need to use renewable energy equipment in the future. Even if various policy options for renewable energies are introduced, it will be difficult to achieve the energy conservation target. It is, therefore, necessary to investigate energy use purpose in order to judge whether a household is using essential energy for life or is wasting energy. Without that knowledge, it is impossible to speculate how much energy can be reduced.

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