

EDMC Energy Trend Topic – Data of concern

Demographic changes and residential sector energy consumption

YANAGISAWA Akira

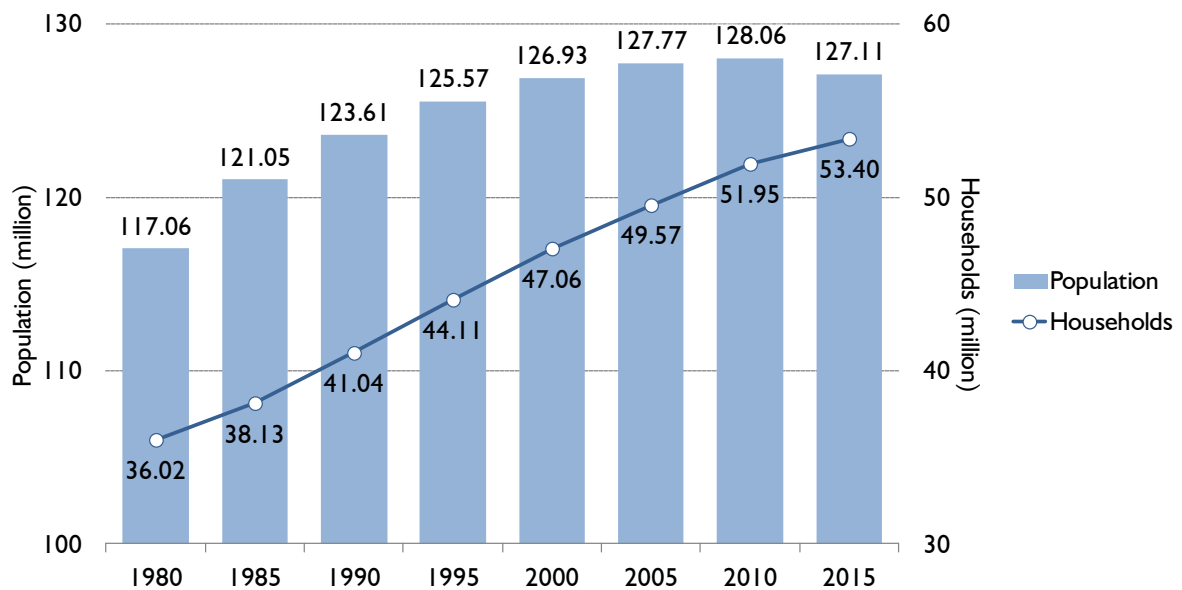
Senior Economist

Energy Demand, Supply and Forecast Analysis Group, The Energy Data and Modelling Center

Population declined by 950,000 in five years, but the decline made no contribution to reducing residential sector energy consumption

Japan’s population in the year stood at 127.11 million according to a preliminary report on the Population Census in 2015 (Figure 1). This represents a decline of 950,000 from 128.06 million in 2010, the first ever fall since the Population Census started in 1920. Meanwhile, the number of households continued growing, though with growth decelerating. The number in 2015 increased by 1.45 million from 2010 to a record 53.40 million.

Figure 1 | Population and households



Source: Ministry of Internal Affairs and Communications, “Population Census”

Population changes have influences on a wide range of areas including energy consumption. However, the population decline close to 1 million between 2010 and 2015 might have made no contribution¹ to reducing energy consumption in the residential sector² for the following reasons³:

¹ This means not any actual change in energy consumption between 2010 and 2015 but the impact of the population decline on energy consumption with no change assumed in other factors related to energy consumption.

² Excluding vehicle energy consumption

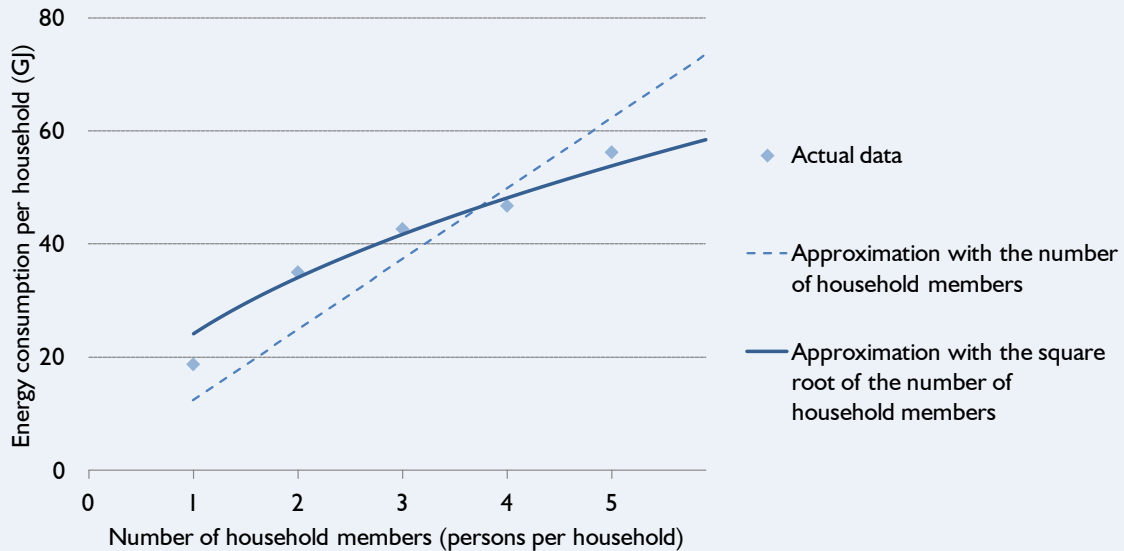
³ Strictly, the number of households and energy consumption by household size are required for an analysis on total energy consumption. However, such data are difficult to acquire. Therefore, this paper uses the average for assessment.

- (1) Energy consumption in the residential sector is susceptible more to a change in the number of households than to a population change.
- (2) The number of households increased due to a decline in household sizes as noted above.
- (3) Energy consumption per household does not decline in proportion to a fall in the household size (Box 1).

Box 1 | Household size and energy consumption per household

It is natural to deem energy consumption per household as proportionate to the square root or log of the household size rather than the size itself. Even if the number of household members declines from four to two, for example, energy consumption does not halve (Figure 2). This means that a decline in the household size leads to an increase in energy consumption per capita.

Figure 2 | Household size and energy consumption per household



Note: FY2012. Vehicle energy consumption is not covered.

Source: Agency for Natural Resources and Energy, "FY2012 Energy Consumption Survey (a fact-finding survey on buildings sector energy consumption)"

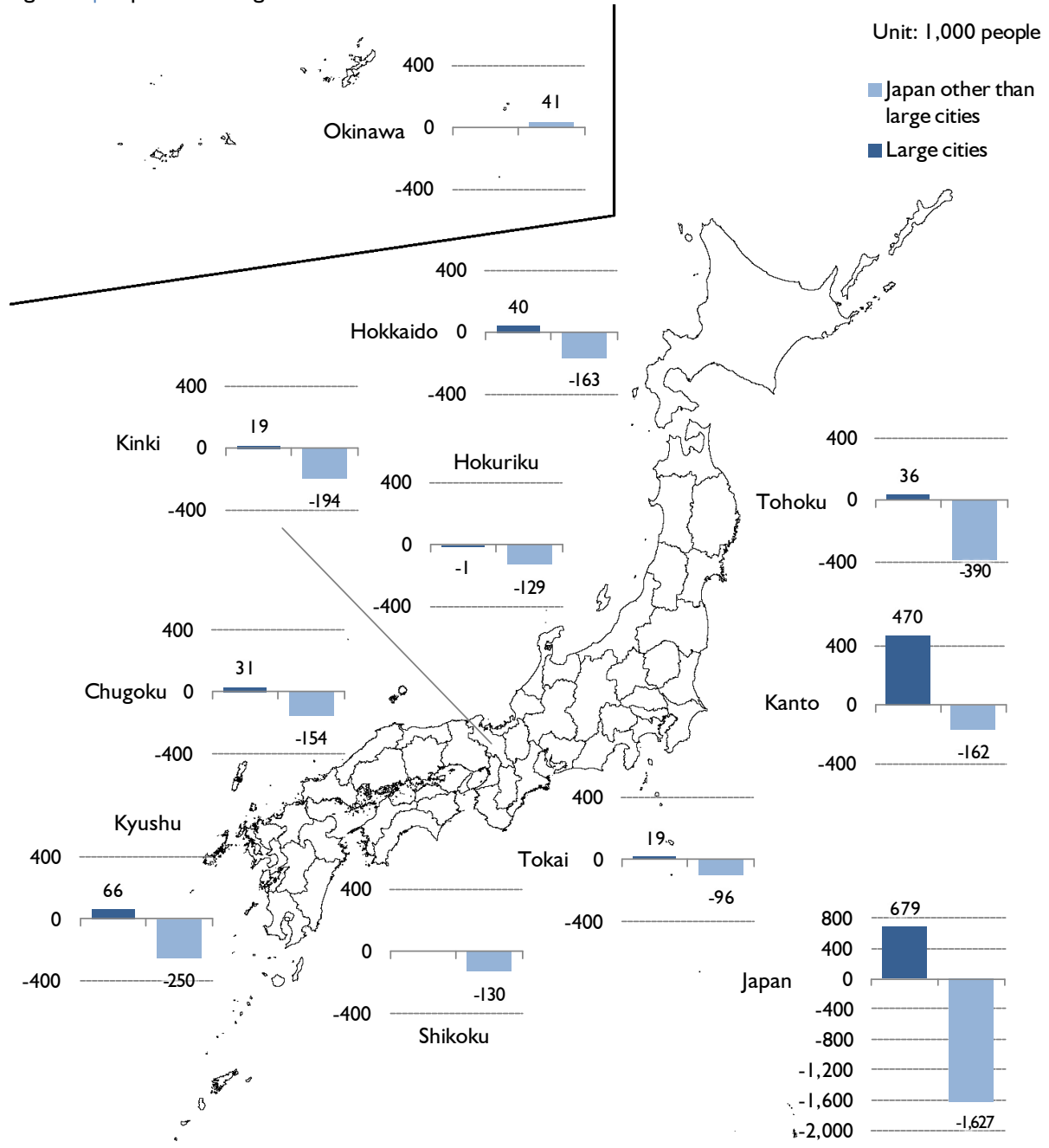
People moving to Kanto and large cities

While population in the whole of Japan declined, demographic changes differed from region to region. Of the 10 regions⁴ in Japan, eight regions, including Kinki and Tokai that had been posting population growth in the past, recorded population drops in the latest census. In contrast, population increased by 310,000 in the five years in Kanto and by 40,000 in Okinawa. While population increased by 680,000 in the large cities⁵ combined, that in the rest of Japan declined by 1.63 million. Population in the large cities expanded not only on a national basis but also for all regions where large cities exist, excluding Hokuriku (Figure 3).

⁴ The 10 regions are Hokkaido, Tohoku, Kanto, Hokuriku, Tokai, Kinki, Chugoku, Shikoku, Kyushu and Okinawa. Kanto covers Ibaraki, Tochigi, Gunma, Saitama, Chiba, Tokyo, Kanagawa, Yamanashi and Nagano. Hokuriku covers Niigata, Toyama, Ishikawa and Fukui. Tokai covers Gifu, Shizuoka, Aichi and Mie. Kinki covers Shiga, Kyoto, Osaka, Hyogo, Nara and Wakayama. The classification is based on the definition for the Family Income and Expenditure Survey by the Ministry of Internal Affairs and Communications.

⁵ The large cities are the 20 government-designated cities and the special wards of Tokyo, based on the definition for the Family Income and Expenditure Survey by the Ministry of Internal Affairs and Communications.

Figure 3 | Population changes between 2010 and 2015



Note: Shikoku and Okinawa have no large cities.

Source: Ministry of Internal Affairs and Communications, "2015 Population Census (preliminary population data)"

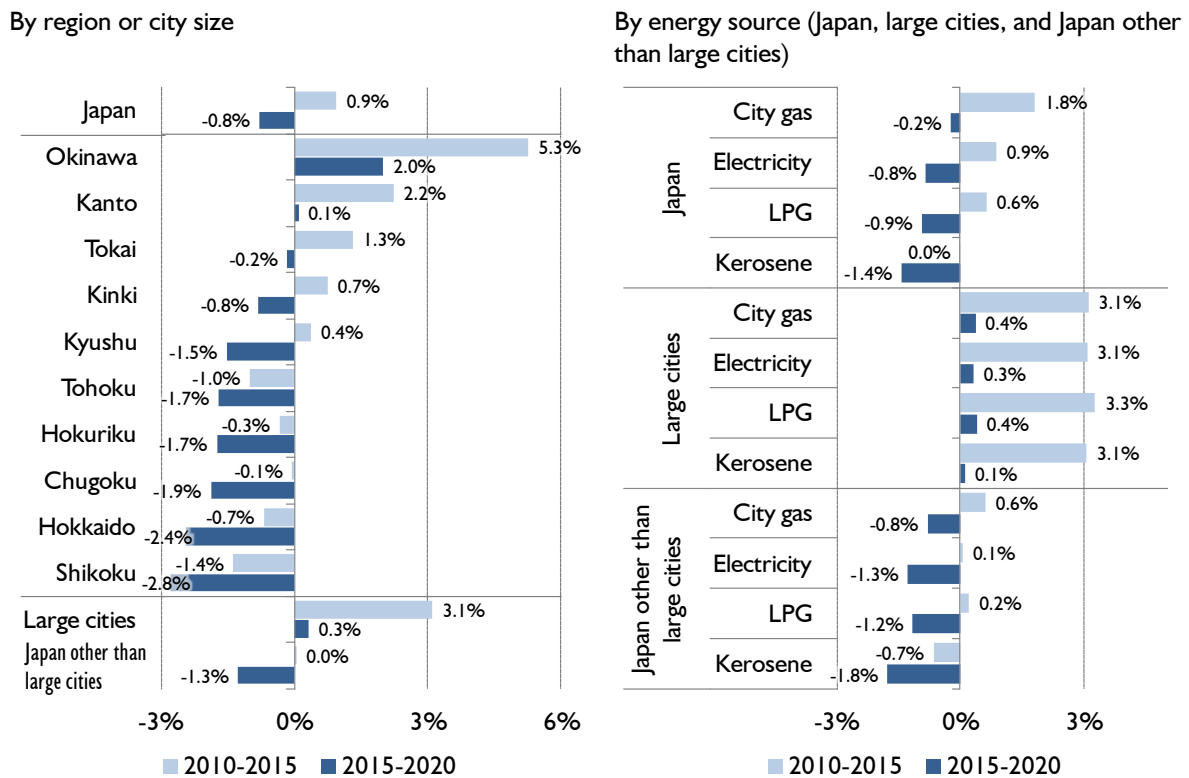
Demographic conditions that differ from region to region or depending on city size bring about influences that are different from those caused by the total population change. Demographic conditions that differ from region to region are behind rural economies that are less vigorous than the Tokyo metropolitan region, social infrastructure maintenance problems in rural regions and problems regarding the distribution of National Diet seats. Residential sector energy consumption is also susceptible to such demographic differences. For example, a population share decline in Hokkaido and Tohoku where heating demand is greater due to cold weather and a share increase in warmer Kanto can contribute to reducing residential sector energy consumption. A population share increase in the large cities where energy consumption per household is relatively less due to a larger number of multifamily dwellings can also contribute to reducing total energy consumption.

Demographic changes pushed residential energy consumption up by 0.9% in the past five years. How about the future?

What impacts have demographic changes including the total population fall, the reduced household size and the population shift to Kanto and the large cities from other regions exerted on consumption of various energy sources in the residential sector? This paper assessed⁶ the impacts using energy consumption per household (2015) broken down for 10 regions, two city sizes and four energy sources as estimated from the Family Income and Expenditure Survey⁷ by the Ministry of Internal Affairs and Communications, as well as demographic data in the Population Census.

Demographic changes between 2010 and 2015 pushed energy consumption in the residential sector up by 0.9% (Figure 4). This is due primarily to the increase in the number of households, as noted above. In Japan other than the large cities, however, demographic changes had little impact on residential sector energy consumption. An increase in non-large cities in some regions such as Kanto and Tokai offset a decrease in non-large cities in other regions such as Tohoku and Hokkaido. Among energy sources, city gas for which demand increases due to urban population growth posted the largest increase of 1.8%, followed by a 0.9% rise in electricity that differs from region to region or from city to city less than other energy. Kerosene (heating oil) changed little as a decrease in such regions as Hokkaido and Tohoku offset an increase resulting from the rise in the number of households.

Figure 4 | Demographic changes' impacts on residential sector energy consumption



In addition to the estimation for the past, we attempted to assess the projected impacts of demographic changes between 2015 and 2020. Japan's population will continue decreasing with the number of households increasing according to the National Institute of Population and Social Security Research (2013) "Population projection for Japan by region" and the NIPSSR (2014) "Household projection for Japan."⁸ However, the population decline will accelerate from 0.7% in the recent past to 2.0%, with the household growth decelerating from 2.8% to 0.5%. Even Kanto will see a population downturn of 1.0%. Among the 10 regions, only Okinawa will post a population increase. According

⁶ Energy consumption per household is assumed as proportionate to the square root of the number of household members.

⁷ As the Family Income and Expenditure Survey specifies city gas purchases in value alone, we used the Retail Price Survey by the Ministry of Internal Affairs and Communications to estimate city gas purchases in volume.

⁸ These projections are based on the 2010 Population Census.

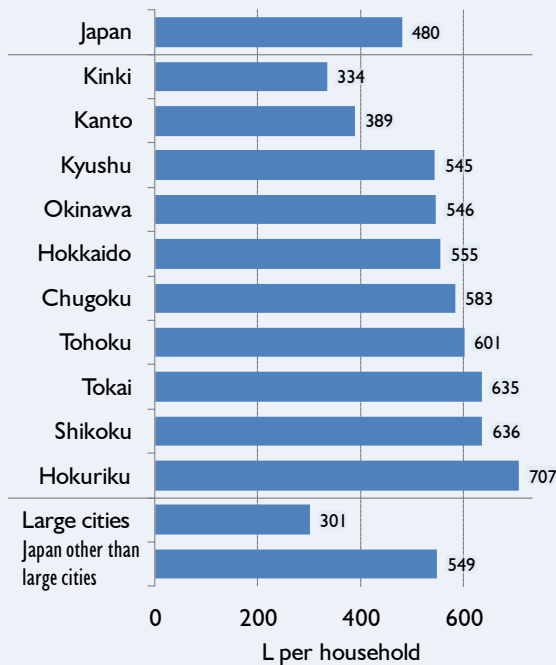
to our simple projection, even the large cities as a whole will record a 0.5% population drop despite an increase in Kanto (the special wards of Tokyo, Yokohama, Kawasaki, Sagami-hara, Chiba and Saitama) and Tohoku (Sendai).

As a result, demographic changes will reduce residential sector energy consumption by 0.8%. Many of the regions will see declines exceeding 1%. Even in the large cities, Kanto and Tokai where demographic changes boosted residential sector energy consumption by 1-3% in the past five years, consumption growth will decline close to zero or become negative. All four energy sources will be exposed to downward pressure. Among them, city gas will manage to post the smallest fall. However, city gas will record the largest decline from the past five years while city gas consumption rose by nearly 2%.

Box 2 | Demographic changes’ impacts on gasoline consumption

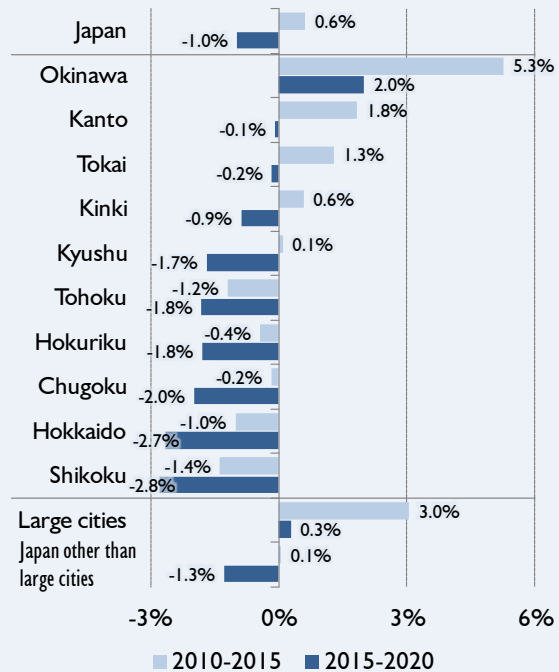
We also assessed demographic changes’ impacts on household gasoline consumption through private cars that is not covered by residential sector energy consumption. Gasoline consumption per household in Japan other than the large cities is about 1.8 times as much as in the large cities due to car ownership ratio and driving distance differences (Figure 5). In the future, therefore, gasoline consumption will post a 1.0% decline, the second largest fall after kerosene consumption that differs sharply from region to region (Figure 6).

Figure 5 | Gasoline consumption per household (2015)



Source: Ministry of Internal Affairs and Communications, “Family Income and Expenditure Survey”

Figure 6 | Demographic changes’ impacts on gasoline consumption



But don’t be fatalistic

In April, Japan fully deregulated electricity retail sales. So far, new participants in electricity retail sales and households switching from traditional suppliers to new ones have been seen mainly in the Tokyo metropolitan and Kansai regions where the population is larger than in the rest of Japan⁹. Even in these regions, however, demographic changes will gradually lose their electricity sales expansion effect.

However, we should not be bound by any fatalistic view that everything depends on population. Although some people place great expectations on the population decline in regard to climate change measures, residential sector

⁹ Another background factor is that electricity prices of general electric utilities in these regions have been relatively higher since the Great East Japan Earthquake.

energy consumption's fall through the population decline will be limited to only less than 1% in five years. Determinants of energy consumption are not limited to population and the number of households. Also affecting residential sector energy consumption are income, prices, temperatures, weather conditions, the efficiency of energy-using equipment, energy or electricity conservation behaviours, and the aging of population closely linked to demographic changes. Sales prices and costs as well influence earnings that are important for electricity business operators.

Electricity business operators are required to well grasp consumer needs in order to be selected in the market. Welfare for consumers is expected to increase through such adequate or appropriate competition.

Contact: report@tky.ieej.or.jp