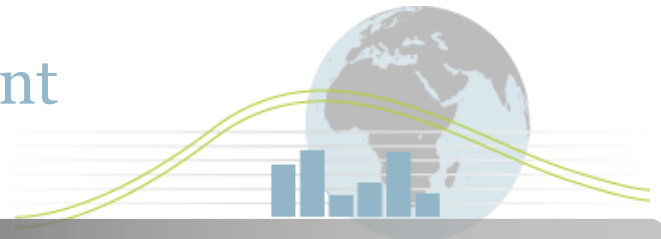


4E

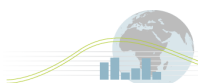
Mapping Document



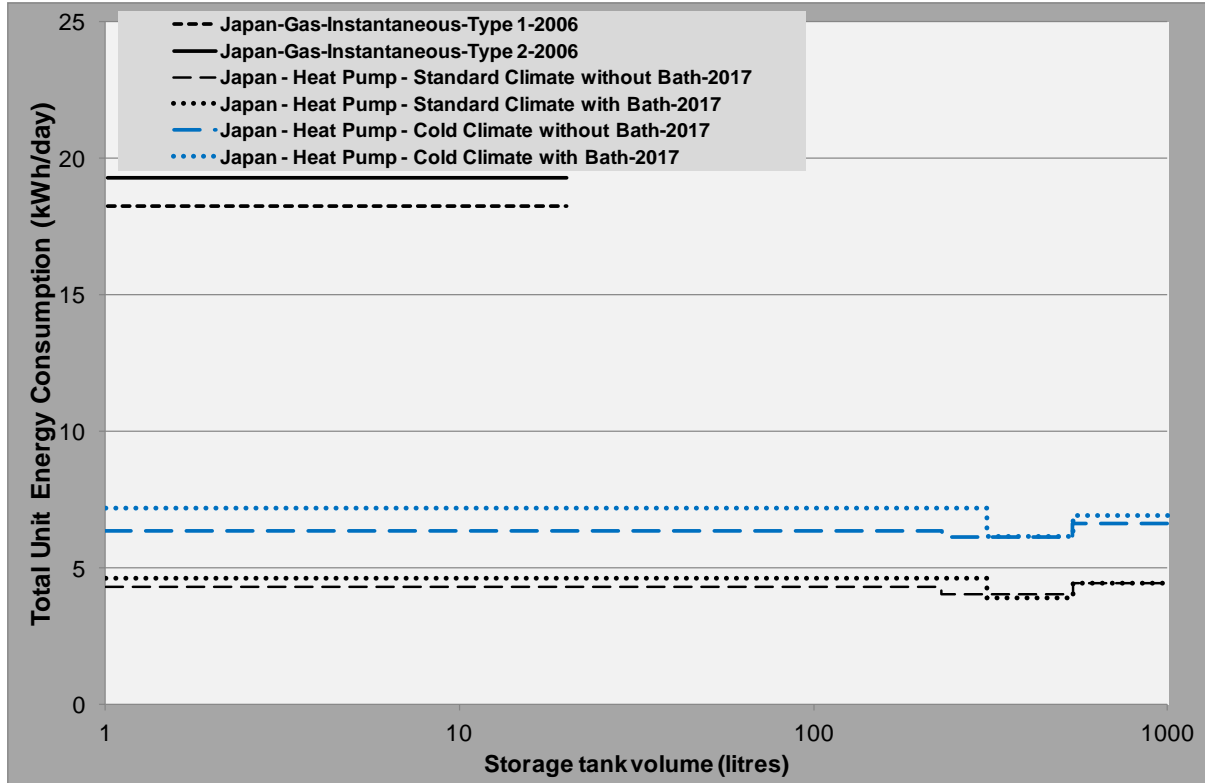
Country:	Japan
Technology:	Water Heaters
Sub Category:	Gas and Electric, Storage, Instantaneous and heat pump.

This Mapping Document is one of a number which present the recent and historical energy performance of gas and electric storage, instantaneous and heat pump water heaters for a number of individual countries. The performance of products at the national level will subsequently be compared against products from other countries in a Benchmarking Document.

These comparisons of product performance made in this Mapping Document are based on both a delivered energy and on primary energy basis. The generic methodology used for product comparisons is detailed in “*IEA 4E - Domestic Water Heaters – Mapping and Benchmarking Descriptive Methodology_6.0*” and the methodology used for delivered to primary energy conversions is detailed in “*Water Heater Energy and Fuel Conversion Factors*”. All documents related to water heaters developed under the 4E Mapping and Benchmarking activities can be found at <http://mappingandbenchmarking.iea-4e.org/matrix?type=product&id=18>.

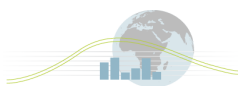


Water Heater Targets and Regulations



Key notes on Graph (see notes section 1 and 3)

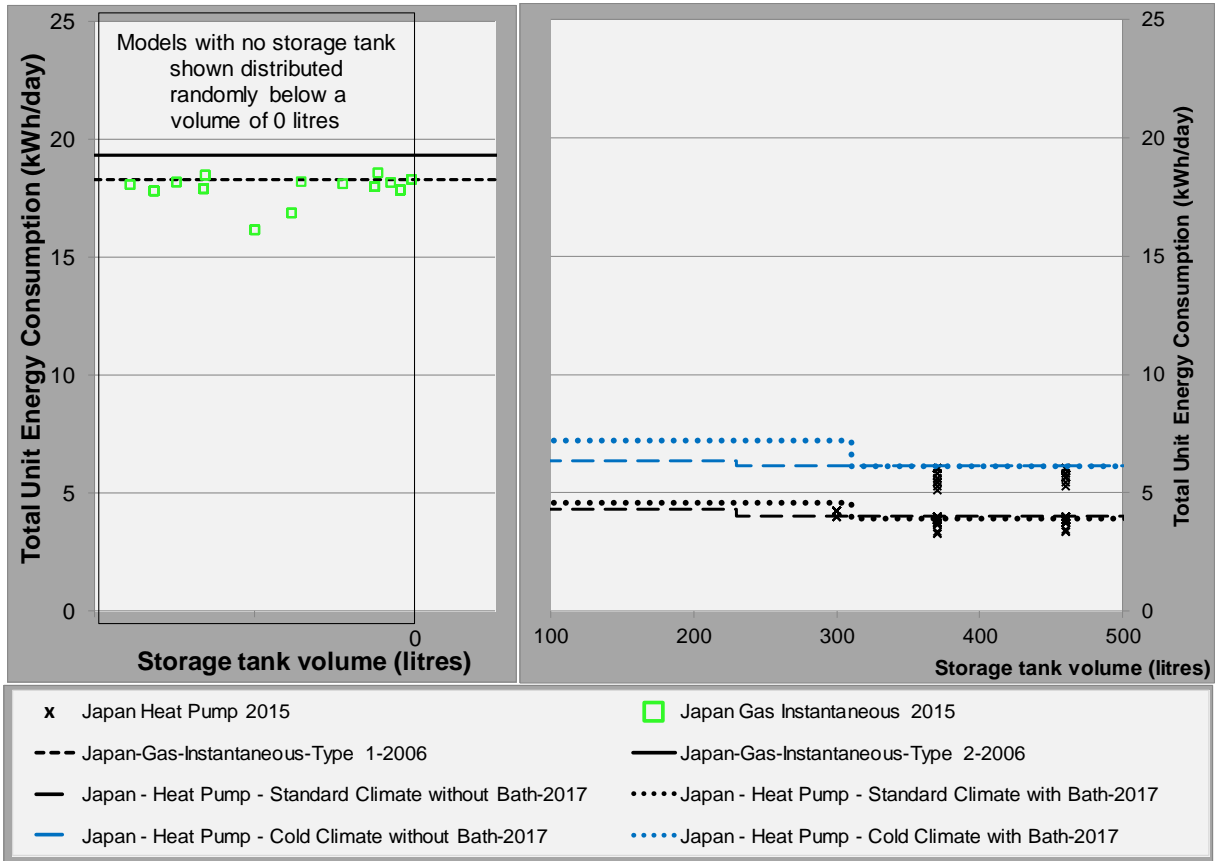
- Top Runner Targets for instantaneous water heaters are based on a thermal efficiency only. However, to present a Total Daily Energy Consumption to align with the mapping documents of other countries, a daily hot water demand of 12.251 kWh/day consisting of 51 draws of equal size is assumed.
- Individual draw off demands and targets for heat pump water heaters depend on a large number of factors. Therefore significant assumptions are made to present the performance requirements in a simplified daily consumption format. Details of the more complex performance requirements, and the necessary assumptions made are included in Notes Sections 1 and 3.



Water Heater Daily Energy Consumption (as declared)

Comparison of the energy performance of all types of water heaters in 2015 against national regulatory and voluntary performance requirements.

(Basis: delivered energy as declared under local test conditions.)



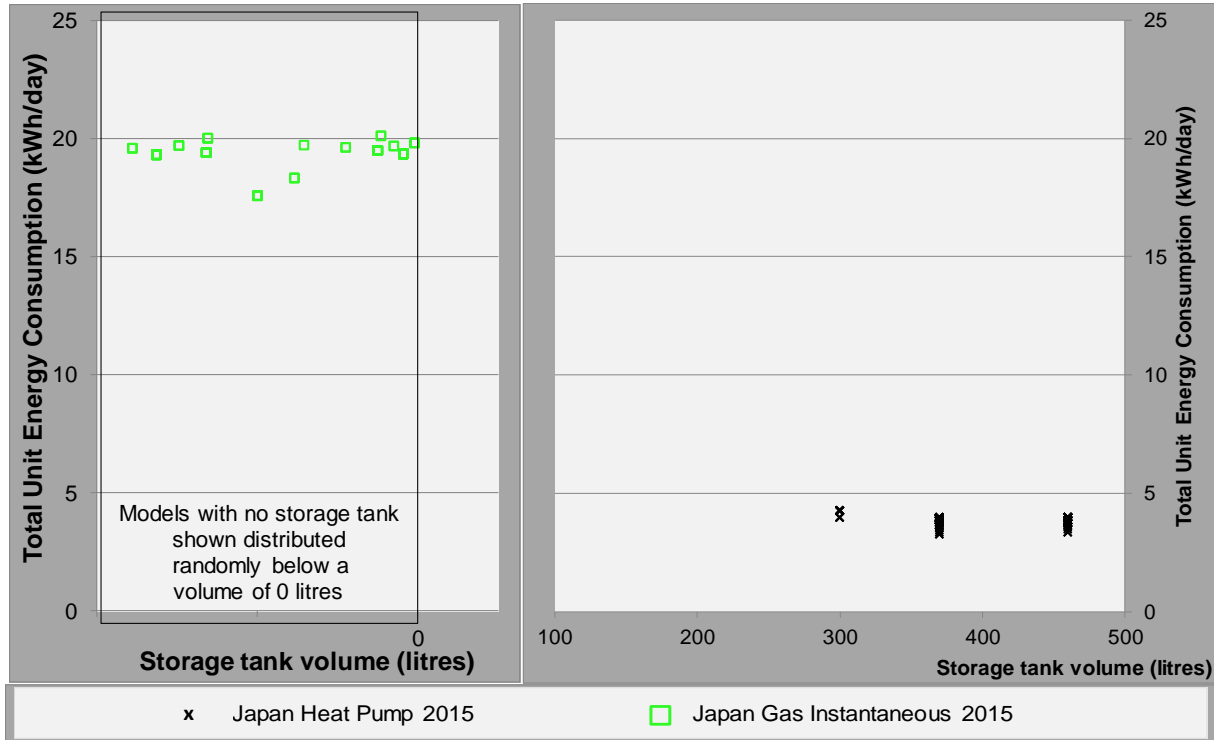
Key notes on Graph (see notes sections 1 & 2)

- The Top Runner Target for gas instantaneous water heaters is based on thermal efficiency. Similarly, the only performance data available in the gas instantaneous water heater data relates to the thermal efficiency of the units. However, to present a Total Daily Energy Consumption to align with the mapping documents of other countries, a daily hot water demand of 12.251 kWh/day consisting of 51 draws of equal size is assumed.
- Similarly, for heat pumps, a daily hot water demand of 12.251 kWh/day consisting of 51 draws of equal size is assumed. Further significant assumptions are made to present the performance requirements in a simplified daily consumption format, details of which are included in Notes Sections 1 and 3.
- Note some models *appear* not to comply with the lowest performance requirement. However, requirements are complicated and based on a range of functionality/temperature variations for which assumptions have been made in this analysis. Original data indicates that all models comply with specific requirements.
- The scales of the x-axes (volume) are different on the two sides of the graph.

Water Heater Daily Energy Consumption (equivalent service)

Comparison of energy performance of all types of water heaters in 2015.

(Basis: Delivered energy use with identical local daily draw-off profiles.)

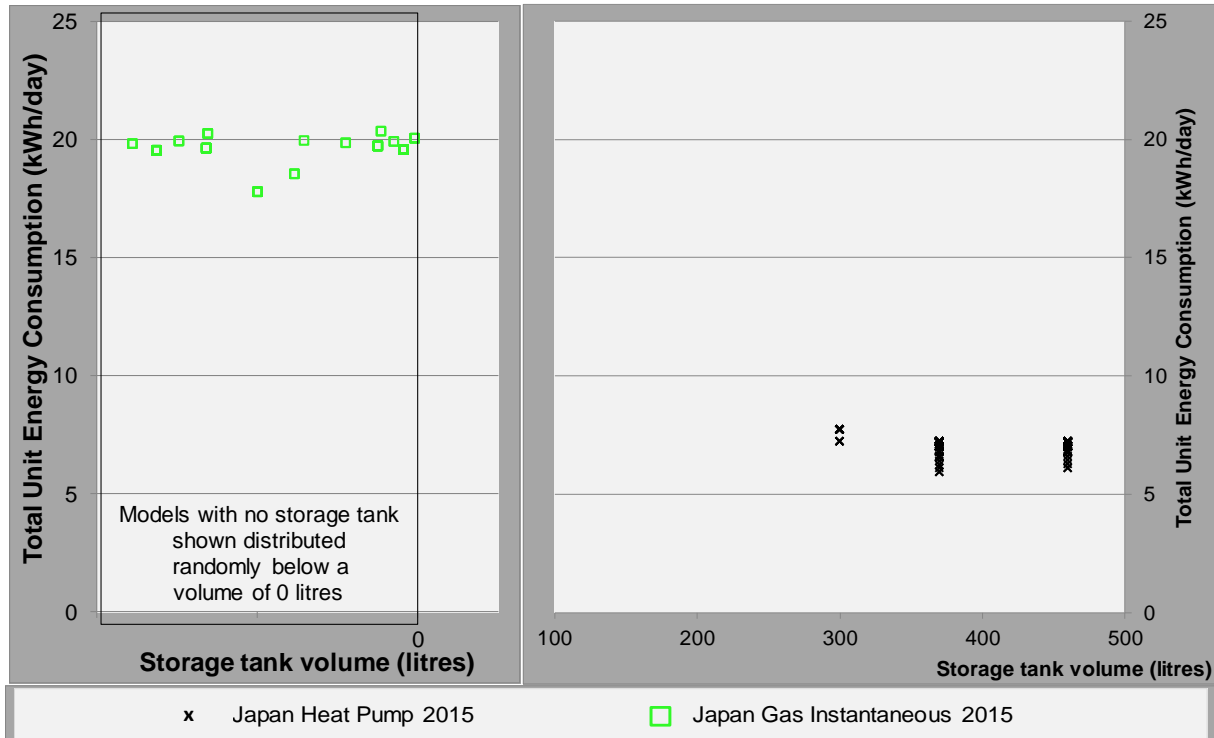


Key notes on Graph (see notes sections 1 & 2)

- The Top Runner Target for gas instantaneous water heaters is based on thermal efficiency. Similarly, the only performance data available in the gas instantaneous water heater data relates to the thermal efficiency of the units. However, to present a Total Daily Energy Consumption to align with the mapping documents of other countries, a daily hot water demand of 12.251 kWh/day consisting of 51 draws of equal size is assumed.
- Similarly, for heat pumps, a daily hot water demand of 12.251 kWh/day consisting of 51 draws of equal size is assumed. Further significant assumptions are made to present the performance requirements in a simplified daily consumption format, details of which are included in Notes Sections 1 and 3.
- Heat Pumps registered as “cold climate” units have had performance adjusted to “standard” climate conditions.
- The scales of the x-axes (volume) are different on the two sides of the graph.

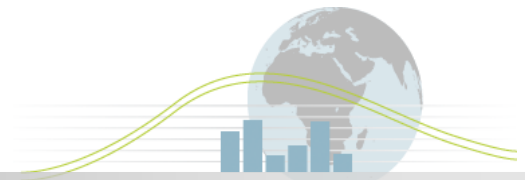
Water Heater Daily Consumption (equivalent service – primary energy)

Comparison of energy performance of all types of water heaters in 2015.
(Basis: Primary energy use with identical local daily draw-off profiles.)



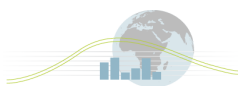
Key notes on Graph (see notes sections 1 & 2)

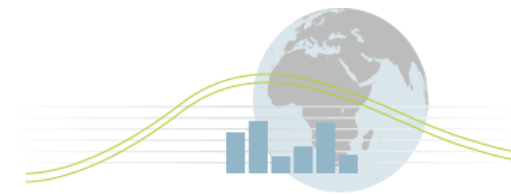
- The Top Runner Target for gas instantaneous water heaters is based on thermal efficiency. Similarly, the only performance data available in the gas instantaneous water heater data relates to the thermal efficiency of the units. However, to present a Total Daily Energy Consumption to align with the mapping documents of other countries, a daily hot water demand of 12.251 kWh/day consisting of 51 draws of equal size is assumed.
- Similarly, for heat pumps, a daily hot water demand of 12.251 kWh/day consisting of 51 draws of equal size is assumed. Further significant assumptions are made to present the performance requirements in a simplified daily consumption format, details of which are included in Notes Sections 1 and 3.
- Heat Pumps registered as “cold climate” units have had performance adjusted to “standard” climate conditions.
- The energy consumption of models shown are converted to equivalent primary energy values using estimated total losses (as listed in the 2012 IEA World Energy Balance data) of: gas: 1.2%, electricity: 44.9%.
- The scales of the x-axes (volume) are different on the two sides of the graph.



Storage and Heat-pump Water Heater Daily Energy Consumption over time

No time series data was available for heat pump water heaters.

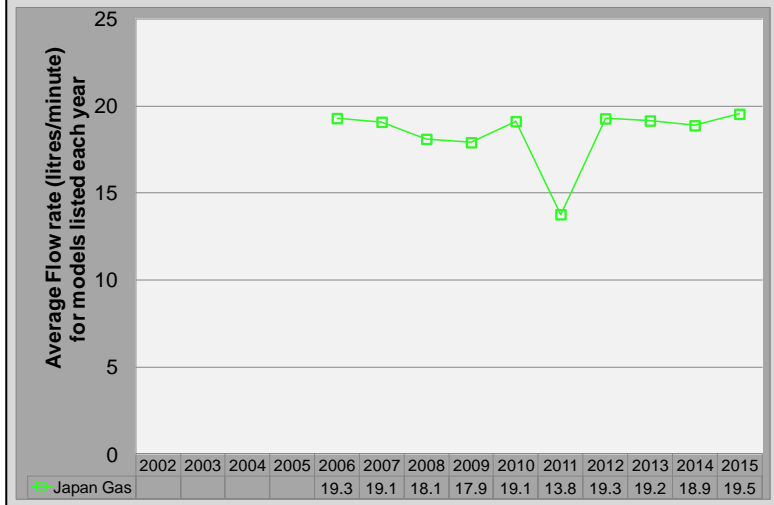
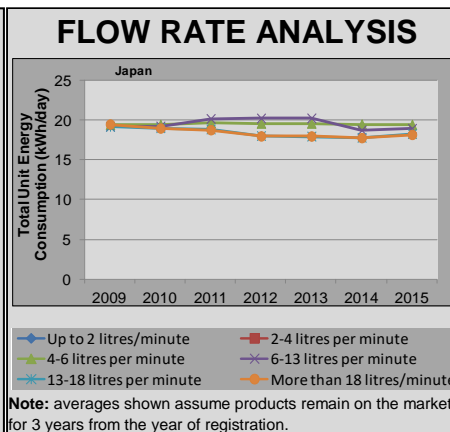
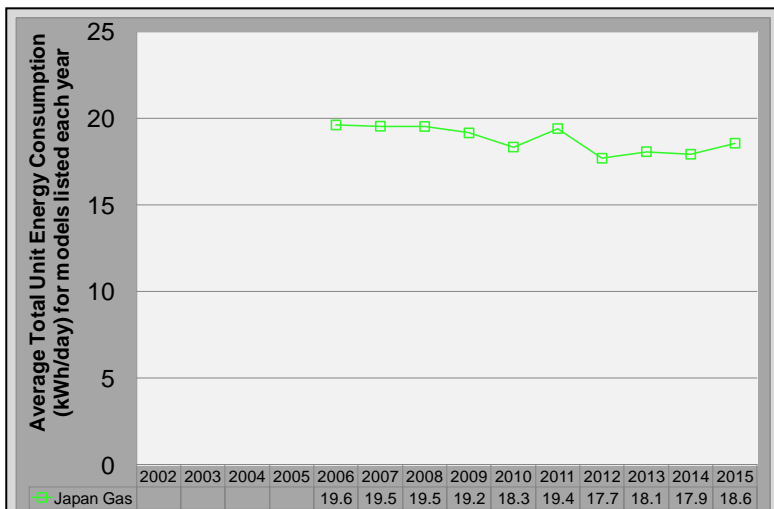




Instantaneous Water Heater Daily Energy Consumption over time

Comparison of energy performance of instantaneous water heaters over time.

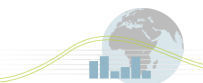
(Basis: Product weighted averages of values with identical local daily draw-off profiles.)

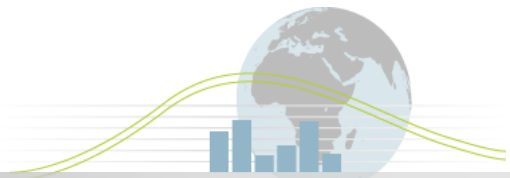


Key notes on Graph (see notes section 1 & 2)

- The only performance data available in the gas instantaneous water heater data relates to the thermal efficiency of the units. However, to present a Total Daily Energy Consumption to align with the mapping documents of other countries, a daily hot water demand of 12.251 kWh/day consisting of 51 draws of equal size is assumed.
- In the year 2011, the significant drop in average flow rate (and increase in average total energy consumption) is due to a large number of identical products with low flow rates being registered. This unusual pattern is not reproduced in any other year.
- For flow rate analysis, results show averages by flow rate ranges and assume products remain on the market for 3 years from the year of registration.

Issue date: 14 February 2017

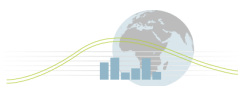




Major Policy Interventions (See notes Section 3)

The primary policy tool addressing product performance in Japan is the *Top Runner* programme. This programme sets future product performance targets based on a sales weighted, application specific basis. However, for water heaters, these targets are complex and are based on a variety of functional and application specific criteria which are summarised in Notes Sections 1 and 3. In 2002 specific targets were set for instantaneous water heaters to achieve by 2006 (no more recent targets set), with heat pump targets set in 2012 to be met by 2017.

In addition to the primary Top Runner policy intervention, Japan has supported the development and market take up of heat pump water heaters through Eco Cute, with subsidies introduced in 2002.



Cultural Issues (See Notes Section 4)

In a June 2014 presentation¹ BSRIA reported Japan as the fifth largest market for water heaters in 2013 (behind Brazil, China, Europe and North America) with gas instantaneous water heaters dominating the market with sales of approximately 3 million/year followed by heat pumps, at just over 400,000 and a small number from electric storage water heaters.

These water heaters with a very large diversity of functions. In particular, Within the datasets of 4860 instantaneous models presented for analysis, the breakdown is as follows:

- Water heaters that only supply hot water on demand (755 models)
- Water heaters with only a bath function (51 models)
- Water heaters that only circulate hot water for space heating (44 models)
- Water heaters that supply hot water and also have a bath heating function (2290 models)
- Water heaters that supply hot water on demand and circulate hot water for space heating (1678 models)
- Water heaters that supply hot water on demand, have a bath function and circulate hot water for space heating (42 models)

Water heaters that supply hot water on demand and/or space heating are similar to instantaneous models found elsewhere in the world (note products providing space heating functionality are beyond the scope of the current analysis). However, a bath function is a specific Japanese application where bath water can be drawn into the water heater to be reheated and then discharged again into the bath. This allows the bath temperature to be maintained for long periods. A similar bath reheat function is provided by a number of the heat pump water heaters.

Compared to the average Western European daily domestic hot water usage, the average Japanese usage is much higher. Japanese people's habit of taking hot baths (among others) brings the average consumption per dwelling per day up to around 420 litres at 85°C. It represented about 34% of the total domestic energy consumption in 1995² and 29% in 2009.

¹ Trends in the World Traditional & Renewable Heating Markets, Krystyna Dawson, BSRIA WMI

² REHVA Inside view into the Japanese heat pump market, Oct 2012

Key notes on data, analysis and additional information

1 Regulatory Framework

1.1 Instantaneous Gas Water Heaters

Top Runner

Top Runner is a Japanese regulatory programme that sets future product performance targets based on a sales weighted, application specific basis³.

Japanese gas instantaneous water heaters had Top Runner targets for 2006 set in 2002 and have not been revised since. These targets are based on the thermal efficiency of the gas combustion only and are detailed in Table 1⁴.

Table 1: Top Runner 2006 Targets for Instantaneous Water Heaters

Category	Product characteristic	Combustion system	Circulation system	Air supply and exhaust system	Target standard value (%)
1)	Instantaneous gas water heater	Spontaneous combustion	—	Open type	83.5
2)				Semi-enclosed type Enclosed type	78.0
3)		Power burner combustion	—	Semi-enclosed type Enclosed type	80.0
4)				Outdoor type	82.0

Test Method

The Japanese Standard test method for instantaneous water heaters is detailed in JIS 2109. Bourke et al provide a useful summary of the Japanese test method for instantaneous water heaters relative to similar test methods elsewhere in their paper "*Performance of gas [instantaneous] water heaters under various international test conditions*"⁵. An abstract from this paper is provided below:

[JIS 2109] is a combined product safety and energy efficiency standard. The thermal efficiency tests examine only the gas energy transfer to the water at maximum rate under thermal equilibrium conditions... No electrical energy use is included. Interestingly the base temperature specified by this standard for gas volume correction is 273 K (0°C) compared to the 288.15 K (15°C) used by the other standards. The absence of any start-up energy consumption, use of maximum gas rate at thermal equilibrium, and lack of electricity consumption means this standard should report significantly lower energy consumptions than the other standards considered.

The same paper also provides the summary of test conditions detailed in Table 2.

³ A useful summary of the Top Runner programme is provided at: www.climatepolicy.jp/thesis/pdf/09035dp.pdf

⁴ Judgement Criteria for Gas and Oil Appliances. Summary of Final Criteria. Available at: www.eccj.or.jp/top_runner/pdf/tr_gas_oil_appliances_summary.pdf

⁵ Performance of gas tankless (instantaneous) water heaters under various international test conditions" (Bourke, Bansal and Raine, Applied Energy, 2014)

Table 2: Summary Test Conditions for Instantaneous Water Heaters in Japan

Ambient temperature	°C	
Electrical supply	V	
Water pressure	bar	1.0
Incoming water temp	°C	15.0 ± 5.0
Temperature rise	°C	40
No. of start sequences		-
Water specific heat capacity		4190 J/kg K
Base gas pressure	kPa	101.3
Base gas temperature	K	277
Test room		
Test flow rates	l/ min	To achieve highest possible gas consumption
Test		
ΔT _{use}	°C	-
Daily water draw	litres	-
Energy consumption		-
Energy delivered	MJ/ day	
~ . . .		

1.2 Heat Pumps

Top Runner

Heat pump water heaters covered by Top Runner are all of the residential heat pump water heaters using CO₂ as refrigerants (such units represent 98% of the domestic heat pump water heater market in 2016⁶). However, products equipped with a functions to use heat generated for applications other than hot water supply or heat-retention of bath water (eg for space heating) are excluded from the scope.

Energy Consumption is measured based on JIS 9220 with the Top Runner targets for water heating only units are based on an Annual Water Heating Efficiency defined as:

$$\text{Annual water heating efficiency} = \frac{\text{Heat quantity acquired by hot water used in a year (MJ)}}{\text{Annual energy consumption (kWh)} \times 3.6}$$

The specific top runner targets for individual units are challenging to understand as the target is broken down by product categories which include variations for capacity, function

⁶ https://issuu.com/shecco/docs/guide_japan-2016/115

and geographical area of use (climate zones). However, the overall target set for heat pumps in the 2017 fiscal year is an Energy Consumption Ratio 3.16 which represents an expected overall improvement in average energy efficiency of 27% from reference year of 2009 (an increase in the Energy Consumption Ratio of 2.49 to 3.16) .

Readers seeking an in-depth understanding of the Top Runner targets and associated derivations are recommended to review the “2012 Final Report by Heat Pump Water Heater Evaluation Standards Subcommittee”. However, Table 3 gives an *indication* of the regulatory variation simply by describing the number of product categories, where:

- Hot water storage capacity is one of four groups: less than 240L, 240-320L, 320-550L and above 550L.
- Intended area refers to whether the unit is intended to be sited in a “normal” climate zone or a “cold” area.
- Heat retention function refers to the ability of a unit to not only heat hot water, but whether it is also able to maintain the temperature of a hot water bath.
- Number of hot water storage tanks is the number of storage vessels that can be supported by the heat pump unit.

Top Runner targets for each product group are also shown in Table 3. The target fiscal year for the heat pump water heaters is set as FY2017 with an expected overall improvement in average energy efficiency of 27% from reference year of 2009 (an increase in the Energy Consumption Ratio of 2.49 to 3.16). The product group representing 90% of the products shipped in Japan as shown in Table 4.

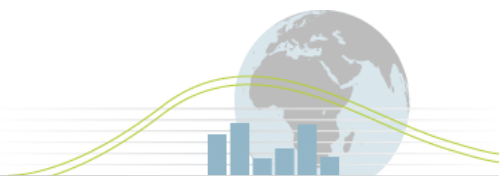
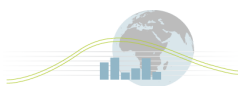


Table 3: Breakdown of Japanese Top Runner Heat Pump Categories and Target Energy Consumption in 2017

Category name	Designated household	Category				Standard energy consumption efficiency
		Storage capacity	Specifications	Reheating function	Number of storage tanks	
1	Standard	Less than 240 liters	Except cold district specifications	Y	One	2.8
2				Multiple	2.4	
3				N	One	3.0
4					Multiple	2.6
5			With cold district specifications	Y	One	2.3
6				Multiple	2.0	
7				N	One	2.6
8					Multiple	2.3
9		240 liters or more Less than 320 liters	Except cold district specifications	Y	One	2.8
10				Multiple	2.8	
11				N	One	3.2
12					Multiple	2.8
13			With cold district specifications	Y	One	2.3
14				Multiple	2.0	
15				N	One	2.7
16					Multiple	2.3
17		320 liters or more Less than 550 liters	Except cold district specifications	Y	One	3.3
18				Multiple	2.8	
19				N	One	3.2
20					Multiple	2.8
21			With cold district specifications	Y	One	2.7
22				Multiple	2.3	
23				N	One	2.7
24					Multiple	2.3
25		550 liters or more	Except cold district specifications	Y	One	2.9
26				Multiple	2.5	
27				N	One	2.9
28					Multiple	2.5
29			With cold district specifications	Y	One	2.4
30				Multiple	2.1	
31				N	One	2.5
32					Multiple	2.2
33	Small family	-	Except cold district specifications	Y	-	2.4
34			N	-	2.8	
35		With cold district specifications	Y	-	2.0	
36			N	-	2.4	

Table 4: Product Types Representing 90% of Heat Pump Water Heater Shipments in Japan

Category	Hot water storage capacity	Intended area	Heat-retention function	Number of hot water storage tanks	Shipment ratio
17	320 L or above, below 550 L	Normal area	With	Single	68.6%
18				Multiple	12.9%
19			Without	Single	8.7%



Test Method

The test method for Heat Pumps in Japan (JIS C 9220-2011) *Residential Heat Pump Water Heaters*⁷.

This standard is to be used in the design and manufacture of water heaters for hot water supply facilities primarily in the home (bathroom and kitchen). This standard covers electric vapour-compression type heat pumps that use as a refrigerant hydrofluorocarbons (HFC) or carbon dioxide (CO₂) (note that Top Runner and the data set provided only covers CO₂ refrigerant systems). The heat pump system consists of air heat exchangers, a hot water tank and hot water control devices such as those defined for use in the water heater.

However, this standard does apply to the following types:

- where the capacity of the refrigerant circulation system is greater than 11.58 kW
- that uses an HFC refrigerant that is either toxic or flammable combined with a temperature greater than 35°C, making the saturated vapour pressure exceed 3MPa, or alternatively if the refrigerant circulation system is equal to or greater than 19.3kW.
- the connection refrigerant pipe, hot water storage unit and pump unit are separable; there is no water storage on the premises; or heat source other than electricity is present.

Summary of Test Procedure

The water heater is filled with cold water and allowed to operate until thermostat cutout. Hot water is drawn off and the tank is allowed to recover. This is repeated until the recovery energy is within a specified repeatability. The test then proceeds into a series of 24 hour drawoffs. The drawoffs are specified for:

- Standard house (455.74 litres at 40°C) and small house (277.96 litres at 40°C)
- Summer, intermediate and winter drawoff profiles

The volume patterns are the same for each season – only the cold water supply temperature and the outdoor air temperature (for the evaporator and tank heat loss) varies by season.

Test Conditions and Procedures

Two main types of heat pump water heater are specified in the test:

- System with an intermediate holding tank
- System without an intermediate holding tank

The temperatures for the test are set out in the following table:

⁷ <http://www.webstore.jsa.or.jp/webstore/Com/FlowControl.jsp?lang=en&bunsyold=JIS+C+9220%3A2011&dantaiCd=JIS&status=1&pageNo=0>

Table 5: Ambient and water test conditions in JIS C 9220

Season	Ambient air °C ⁸	Cold water inlet °C
Intermediate (TC1)	DB 16°C, WB 12°C	17°C
Summer (TC2)	DB 25°C, WB 21°C	24°C
Winter (TC3)	DB 7°C, WB 6°C	9°C

Annex A specifies the setup for testing and Annex B sets out the measurements required to measure energy consumption.

Initially the tank is allowed to heat up and repeatability of recovery energy is established (stable operation).

Following this initial testing, there are a series of complex 24 hour drawoff patterns as follows:

- Hot water delivery temperatures are specified as 40°C -2K +0K (even though storage temperature is higher)
- There are 4 different drawoff types: wash basin, kitchen, bath, shower.
- Flow rates for wash basin and kitchen is 5L/min. Flow rates for bath are 10-15L/min and shower is 10L/min.
- Wash basin and kitchen events are generally less than 5L, a few to 25L, shower 20L or 50L, bath 180L
- Standard household and Small household profiles are specified by 3 seasons
- Standard winter - 51 events, 16.276 kWh (58.594 MJ), nominally 455.74 litres at 40°C equivalent (cold water 9°C)
- Standard intermediate - 51 events, 12.076 kWh (43.473 MJ), nominally 455.74 litres at 40°C equivalent (cold water 17°C)
- Standard summer - 51 events, 8.401 kWh (30.242 MJ), nominally 455.74 litres at 40°C equivalent (cold water 24°C)
- Small winter - 31 events, 9.927 kWh (35.737 MJ), nominally 277.96 litres at 40°C equivalent (cold water 9°C)
- Small intermediate - 31 events, 7.365 kWh (26.515 MJ), nominally 277.96 litres at 40°C equivalent (cold water 17°C)
- Small summer - 31 events, 5.124 kWh (18.445 MJ), nominally 277.96 litres at 40°C equivalent (cold water 24°C)

The volume and energy details of the 6 drawoff patterns are shown in the table below:

⁸ Note: All the analysis undertaken for this Mapping and the resultant benchmarking has used the dry bulb temperature as the basis. While technically this is incorrect and the wet bulb temperature should be used, the use of dry bulb is consistent with, and enables comparisons of, methodologies used in other countries analysed.

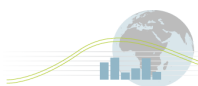


Table 6: Assumed hot water demand conditions for three seasons in JIS C 9220

Schedule name	Number of Draws	Daily load kWh/day in hot water	Daily load MJ/day in hot water	Average MJ/draw
Std Winter	51 (56) *	16.276	58.594 (62.714)	1.149
Std Intermediate	51 (56) *	12.076	43.473 (46.533)	0.852
Std Summer	51 (56) *	8.401	30.242 (32.103)	0.593
Small Winter	31 (34) *	9.927	35.737 (37.471)	1.153
Small Intermediate	31 (34) *	7.365	26.515 (27.799)	0.855
Small Summer	31 (34) *	5.124	18.445 (19.221)	0.595

The energy input, energy output and COP for each drawoff profile is then calculated.

Annex C then specifies how to calculate the seasonal annual energy consumption for the heat pump water heater. There are two climate profiles: a standard climate and a cold climate. The annual performance measure for each climate essentially specifies a number of days at each average daily ambient temperature. The standard climate specifies the number of days for each daily average temperature ranging from 0°C to 30°C in 1K increments. The cold climate specifies the number of days for each daily average temperatures ranging from -9°C to 26°C in 1K increments. The performance at each daily average temperature bin is determined by interpolation (or extrapolation) of the measured values for the three seasons tested.

The specified number of days at each temperature is set out in Table 7.

Table 7: Number of days at each temperature for standard and cold climates in JIS C9220

Item	Temperature °C	Standard climate (C1) days	Cold climate (C2) days
1	-10	0	0
2	-9	0	1
3	-8	0	2
4	-7	0	3
5	-6	0	5
6	-5	0	8
7	-4	0	11
8	-3	0	13
9	-2	0	15
10	-1	0	16
11	0	1	20
12	1	1	16
13	2	5	13
14	3	9	11
15	4	15	9
16	5	17	10
17	6	17	11
18	7	15	11
19	8	15	9
20	9	13	10
21	10	12	9
22	11	11	10
23	12	12	11
24	13	10	11
25	14	12	12
26	15	13	13
27	16	13	15
28	17	14	15
29	18	15	13
30	19	14	13
31	20	15	11
32	21	15	9
33	22	13	9
34	23	14	9
35	24	11	6
36	25	12	4
37	26	13	1
38	27	14	0
39	28	15	0
40	29	7	0
41	30	2	0
42	31	0	0
43	32	0	0
	Total days	365	365
	Average T	15.5°C	8.5°C

2 Data Analysed and Specific Assumptions Made

The overall approach to the analysis undertaken in order to present the results shown in this mapping report is described in “*IEA 4E - Domestic Water Heaters – Mapping and Benchmarking Descriptive Methodology_6.0*”⁹. This report also describes in detail a number of general assumptions that were necessary for all datasets analysed. Details of each of the datasets presented in this mapping report and the specific assumptions made in order to process the data are presented below.

2.1 Japan

2.1.1 Source

Japanese data was supplied by the Ministry of Economy, Trade and Industry (METI)¹⁰ in June 2016. However, some gas instantaneous units also provided functionality for central heating and some heat pump units had more than one storage tank. To maintain comparability with products from other countries, these units have been excluded from the analysis. Hence, the total data sets and number of products analysed were as follows:

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Gas Instantaneous	252	87	101	258	147	462	695	150	325	356
Heat pump	0	0	0	0	0	0	0	0	0	208

2.1.2 Limitations and specific assumptions made for this dataset

Japanese regulations for gas instantaneous water heaters are based on minimum thermal efficiency thresholds and consequently the data provided only listed results for thermal efficiency. In order to present daily unit energy consumptions for the models listed, the following assumptions are made:

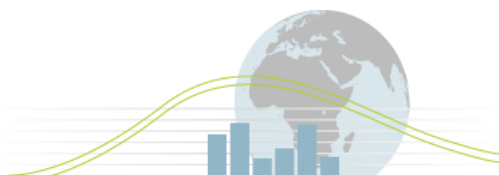
- **Energy to heat the water:** a draw off energy demand of 12.251kWh/day (applies to all graphs)¹¹.
- **Start up energy:** 51 starts per day and an energy consumption per start of 0. 0.0889 kWh per start (a reference value for instantaneous gas water heaters adjusted proportionately to take account of the different temperatures in the Japanese test).

As shown in Notes Section 1.2, the test method and regulatory framework governing heat pump units in Japan is complex and calculation of energy consumption relies on knowledge of a large range of product performance information at differing temperature ranges, the intended use of the product and its intended area of installation, etc. However, very limited product delineation data is available for analysis. The only product level data available is energy consumption efficiency, the number and capacity of storage tank(s), and the percentage of performance against the Top Runner target. Thus, based on this data it is not possible to accurately produce a true “average daily energy consumption” for all models. **Therefore, an approximation of energy consumption for each model has been made**

⁹ Both documents are available at <http://mappingandbenchmarking.iea-4e.org/matrix?type=product&id=18>.

¹⁰ "Ministry of Economy, Trade and Industry (METI)" <http://seihinjyoho.go.jp/>

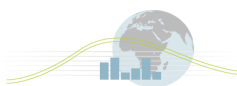
¹¹ This is an average of heat pump standard winter, intermediate and summer loads defined above.



based on the assumptions in Table 8, but these indicative values for daily energy consumption SHOULD NOT be quoted as actual performance values for the models.

Table 8: Assumptions Made in Calculating Daily Energy Consumption of Japanese Heat Pumps

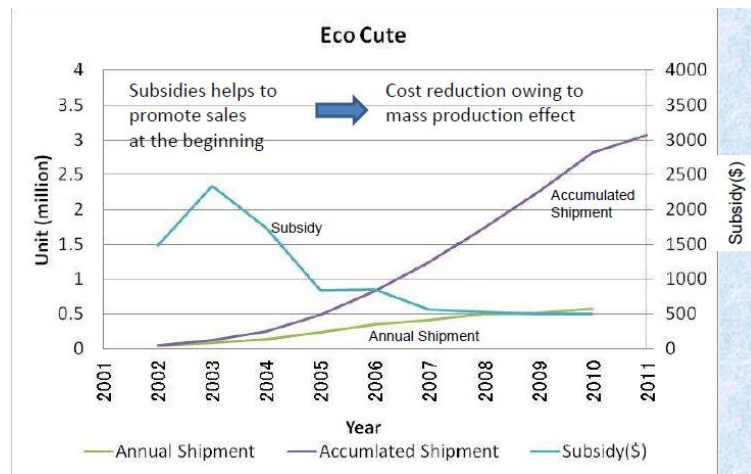
Variable	Assumption	Notes
Cold Water Inlet Temperature	15,5°C (Cold 8.5 °C)	Approximate average of three seasons
Hot Water Storage Temperature	65°C	Approximate average of three seasons
Ambient (External and Internal) Temperature	Standard 15.5°C (Cold 8.5 °C)	Approximate average of three seasons
Number of Draws per Day	51	Approximate average of three seasons
Hot Water Demand (at 40°C equivalent)	12.251 kWh/day 44.104 MJ/day 16097.81 MJ/year	Approximate average of three seasons
Compressor input power	1.6 kW	Typical Japanese value 1-2 kWh
Average Heating Capacity	5 kW	Typical Japanese value 4.5-6 kWh



3 Notes on Policy

In addition to primary Top Runner policy intervention (refer to Notes Section 1), Japan has supported the development and market take up of heat pump water heaters – called Eco Cute, with subsidies introduced in 2002. Sales and subsidy levels are shown in Figure 1¹².

Figure 1: Shipments and subsidies for heat pump water heaters (Eco Cute) in Japan (Hikawa May 2012)



¹² Energy efficiency supporting policy and heat pumping technology in Japan, IEA Heat Pump Programme Workshop, Takeshi Hikawa, May 2012

4 Notes on Cultural Issues

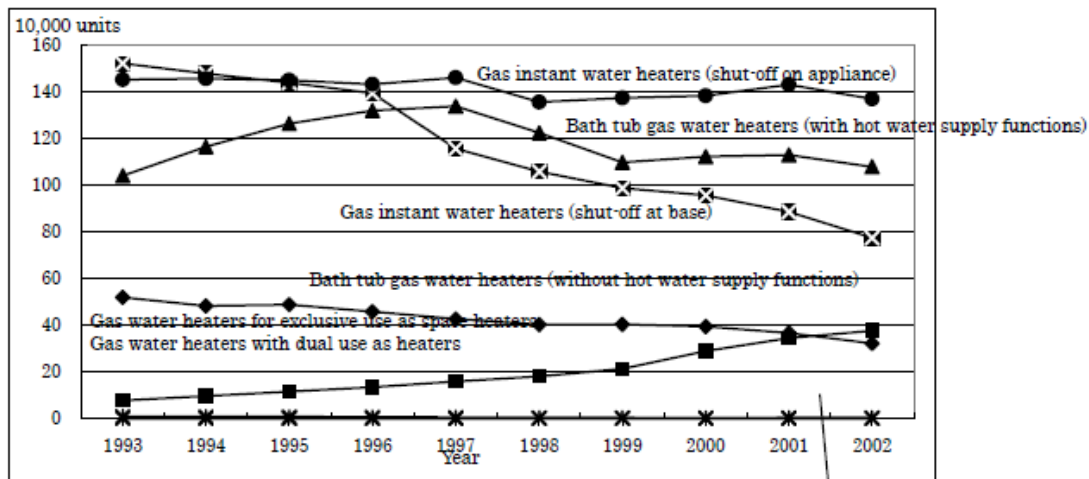
Compared to the average Western European domestic hot water (DHW) usage, the average Japanese DHW usage is much higher in daily consumption. Japanese people's habit of taking hot baths, among others, brings the average consumption per dwelling and per day up to around 420 litres of DHW at 85°C. It represented about 34% of the total domestic energy consumption in 1995¹³ and 29% in 2009.

In a June 2014 presentation¹⁴ BSRIA reported Japan as the fifth largest market for water heaters in 2013 (behind Brazil, China, Europe and North America) with gas instantaneous water heaters dominating the market with sales of approximately 3 million/year followed by heat pumps, at just over 400,000 and a small number from electric storage water heaters.

Data from the Top Runner review of gas water heaters in May 2004¹⁵ shows the trend in sales by type to 2002. This [illustrates] one particular aspect of the Japanese market – a substantial number of sales of water heaters dedicated for use to a single bath tub. This also [illustrates] that while most heaters are hot water about 10% of the market was for water and room heating. Gas water heater sales in 2002 totalled 3.9 million – suggesting a substantial fall in gas water heaters, which is likely due to the sales being displaced by heat pump water heaters.

Figure 2 shows Japan gas and oil water heater shipments by type to 2002 (Top Runner review May 2004).

Figure 2 Japan gas and oil water heater shipments by type to 2002 (Top Runner review May 2004)



(Source) Statistics compiled by the Japan Industrial Association of Gas and Kerosene

Bath tub gas water heaters (with heat exchangers installed inside bath tubs)
 Storage type closed vessel gas water heaters (quick heating type)
 Storage type closed vessel gas water heaters (slow heating type)
 Storage type closed vessel gas water heaters with normal pressure

¹³ REHVA Inside view into the Japanese heat pump market, Oct 2012

¹⁴ Trends in the World Traditional & Renewable Heating Markets, Krystyna Dawson, BSRIA WMI

¹⁵ (Top Runner) Final Report by the Subcommittee on Gas and Oil Powered Equipment Judgement Criteria Energy Efficiency Standards Subcommittee, The Advisory Committee for Natural Resources and Energy May 6, 2004