

4E

Mapping Document

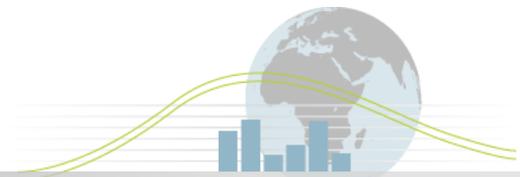


Country:	Korea
Technology:	Water Heaters
Sub Category:	Gas and Electric, Storage, Instantaneous and heat pump.

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 “*Water Heaters - Overall Approach to the Analysis - IEA 4E*” 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 regulations

See notes section 1.

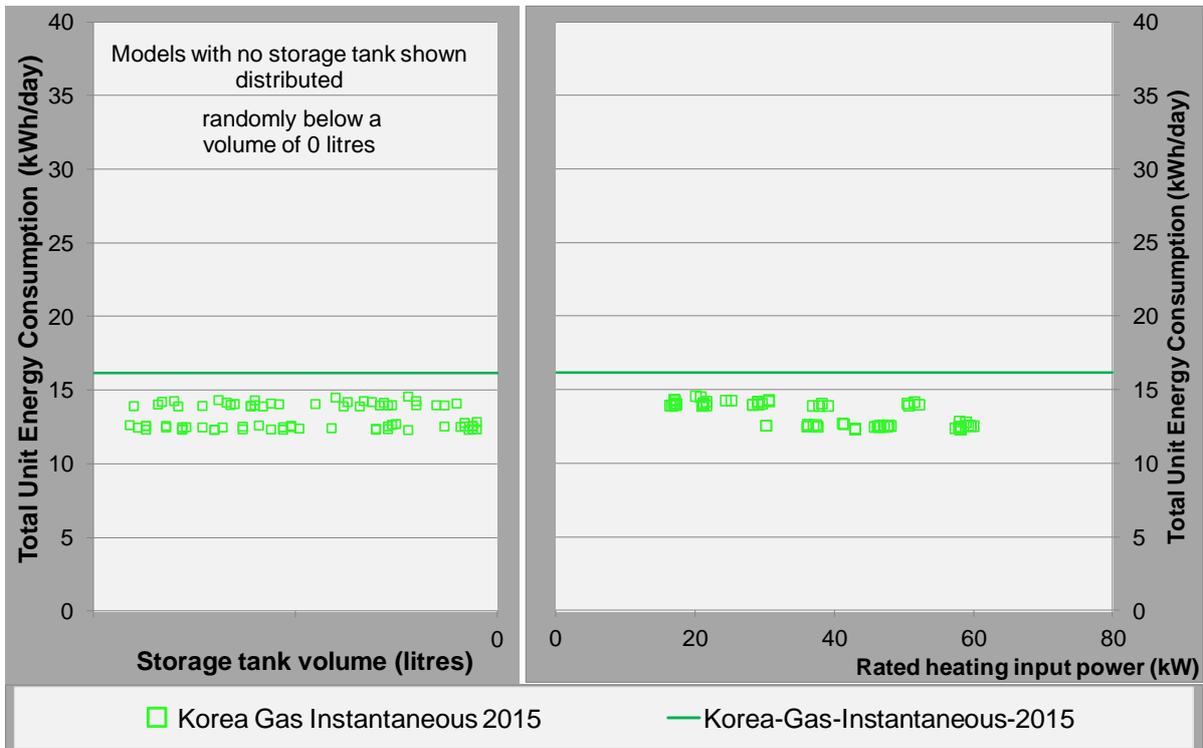
Korean water heating regulation is limited to instantaneous gas water heaters and requires a minimum thermal efficiency of 75% (73% prior to 1 October 2015). This will equate to a maximum threshold for daily energy consumption that will vary depending on the draw-off profile of the user.



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.)



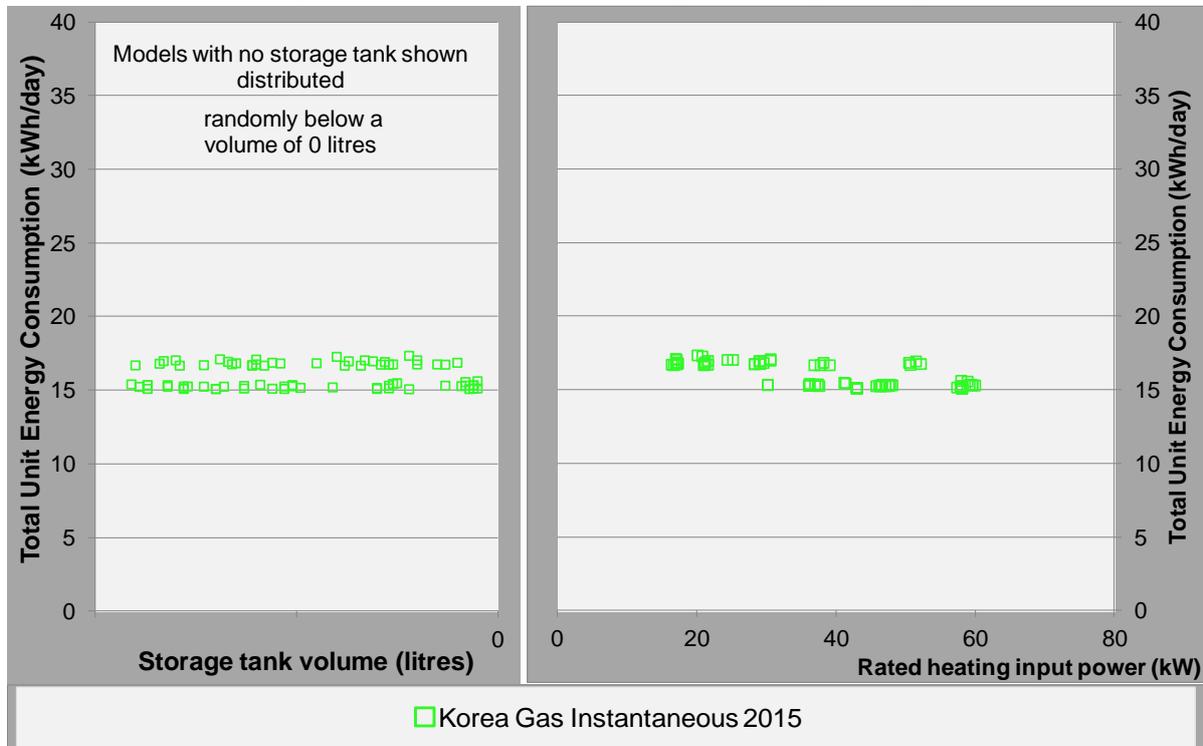
Key notes on Graph (see notes sections 1 & 2)

- The same models are shown on the two sides of the graph:
 - the first shows models randomly distributed below a storage tank volume of zero (as is consistent with mapping reports from other countries in which storage tank water heaters are also shown),
 - the second shows models consumption against rated heating input power.
- Korean regulations are based on minimum thermal efficiency threshold. Both the MEPS and product consumptions shown here are converted to a daily energy consumption value by assuming a draw off 302 litres of water per day at a temperature of 45°C with ambient conditions at 15°C.

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.)



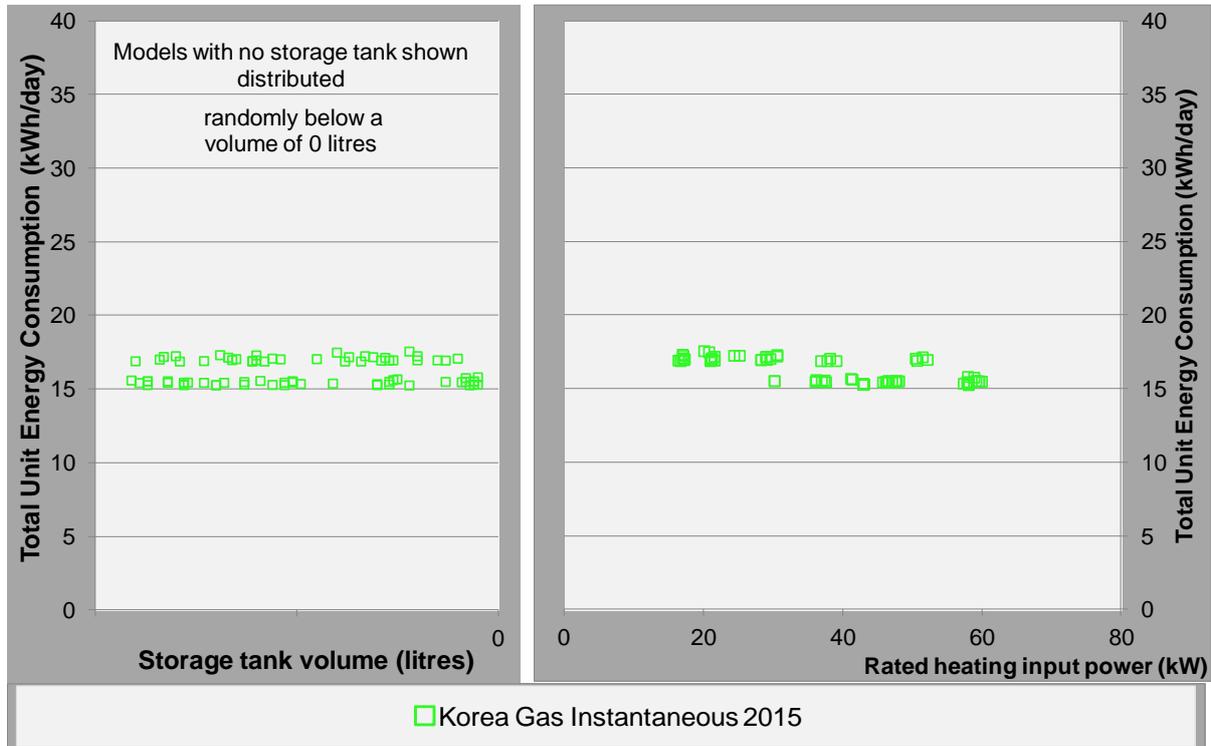
Key notes on Graph (see notes sections 1 & 2)

- The same models are shown on the two sides of the graph:
 - the first shows models randomly distributed below a storage tank volume of zero (as is consistent with mapping reports from other countries in which storage tank water heaters are also shown),
 - the second shows models consumption against rated heating input power.
- Korean regulations are based on minimum thermal efficiency threshold. The product consumptions shown here are converted to a daily energy consumption value by:
 - assuming a draw off 302 litres of water per day at a temperature of 45°C with ambient conditions at 15°C, and
 - estimating start up energy by assuming 3.2 starts per kWh of water drawn off.

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.)



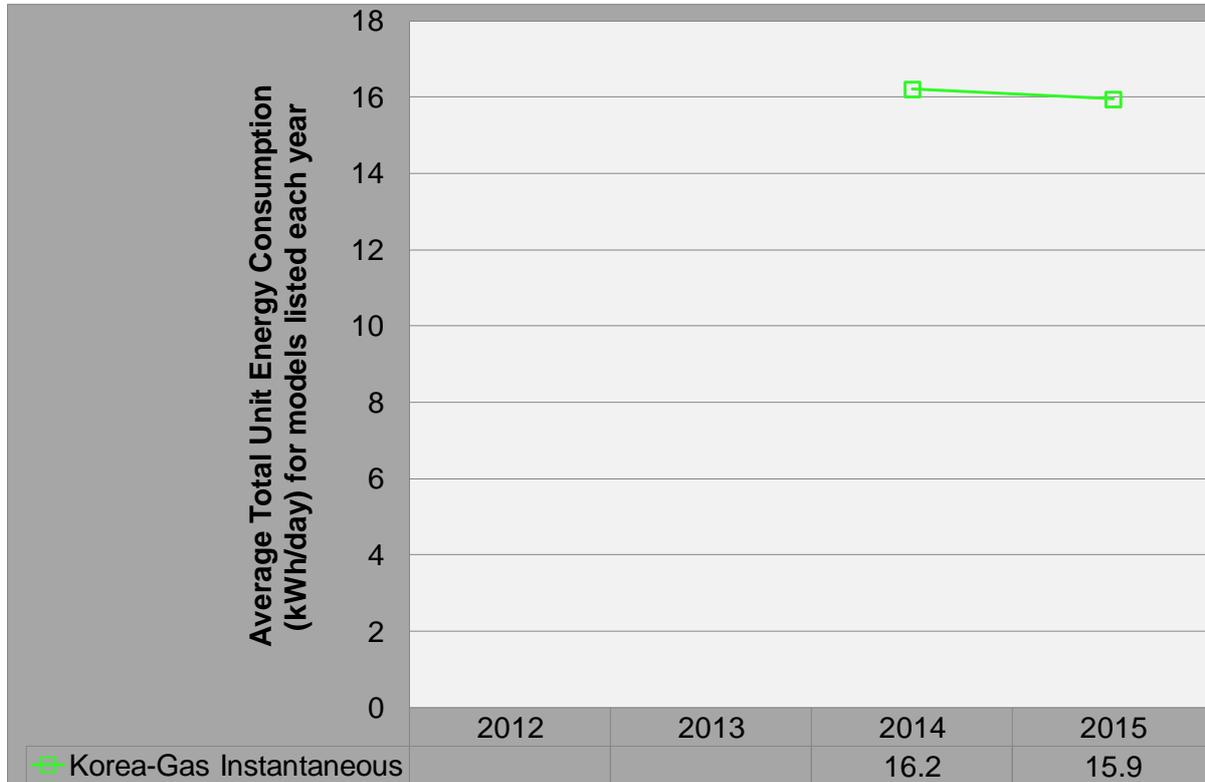
Key notes on Graph (see notes sections 1 & 2)

- The same models are shown on the two sides of the graph:
 - the first shows models randomly distributed below a storage tank volume of zero (as is consistent with mapping reports from other countries in which storage tank water heaters are also shown),
 - the second shows models consumption against rated heating input power.
- Korean regulations are based on minimum thermal efficiency threshold. The product consumptions shown here are converted to a daily energy consumption value by:
 - assuming a draw off 302 litres of water per day at a temperature of 45°C with ambient conditions at 15°C, and
 - estimating start up energy by assuming 3.2 starts per kWh of water drawn off.
- Primary energy is estimated using total losses (as listed in the 2012 IEA World Energy Balance data) of: gas: 1.2%.



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 sections 1 & 2)

- Korean regulations are based on minimum thermal efficiency threshold. The product consumptions shown here are converted to a daily energy consumption value by:
 - assuming a draw off 302 litres of water per day at a temperature of 45°C with ambient conditions at 15°C, and
 - estimating start up energy by assuming 3.2 starts per kWh of water drawn off.





Major Policy Interventions (See notes Section 3)

Korean water heating regulation is limited to instantaneous gas water heaters (the predominant product in the market). The regulation provides:

- A minimum performance standard set at 73% thermal efficiency
- A comparative labelling requirement

The minimum efficiency requirement was increased in 2015 to a thermal efficiency of 75% on 1 October 2015.





Cultural Issues (See Notes Section 4)

Korea has a unique culture such that almost 100% of households choose under floor heating systems that circulates hot water coming from gas or oil boilers through the floor. This system also provides hot water supply for sanitary use. Thus the vast majority of sanitary hot water is provided through gas- or oil-fired combi-boilers.

The South Korea heating system stock is dominated by gas and oil boilers, which account for 57% and 26% of the energy consumption in 2008¹. In recent years, condensing gas boilers have replaced oil boilers due to aggressive advertising and recognition of their greater energy efficiency.

Korea is the 2nd largest gas boiler production country after UK.

¹ IEA HPP Annex 42 Korea market overview April 2014, Korea Institute of Energy Research



Key notes on data, analysis and additional information

1 Gas instantaneous water heaters

Regulatory Requirement

Korean water heating regulation is limited to instantaneous gas water heaters (the predominant product in the market).

Regulation was originally under the Ministry of the Knowledge Economy Notification 2011-263: Regulation on Energy Efficiency Labelling and Standards². The scope includes water heaters with an input of less than or equal to 70.0 kW gas input (252 MJ/hour). The regulation provides:

- A minimum performance standard set at 73% thermal efficiency
- A comparative labelling requirement with threshold values shown in Table 1 and an example label shown in Figure 1.

Table 1: 2011 Labelling Performance Requirements for Instantaneous Water Heaters

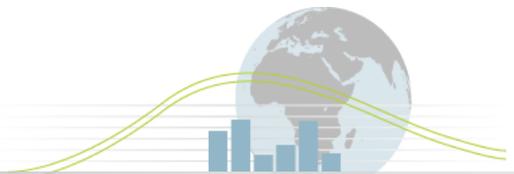
R (Thermal Efficiency)	Standby power (sleep mode)	Labelled Performance Level
93.0% ≤ R	≤ 3.0W	1
88.0% ≤ R	N/A	2
83.0% ≤ R < 88.0%	N/A	3
78.0% ≤ R < 83.0%	N/A	4
73.0% ≤ R < 78.0%	N/A	5

Figure 1: Example of 2011 Instantaneous Water Heater Label



The minimum efficiency requirement was increased in 2015 to a thermal efficiency of 75% on 1 October 2015.

² MKE_Notice_2011-263 version part2.doc available from www.kemco.or.kr/nd_file/kemco_eng/MKE_Notice_2011-263.zip



Test Methodology

Until recently the test method under which products must be tested to assess compliance with efficiency regulations was KS B 8106 (2009)³ which specified that thermal efficiency is measured for a standard temperature rise of 40 K at the rated hot water flow. A range of other tests are also specified such as the temperature of the hot water, speed of heating from a cold start and temperature stability.

In 2015, the test methodology was replaced by KS B 8116 (2015). While there were a number of very minor amendments to the test methodology, overall the energy related tests are very similar. The only significant changes are the standard temperature rise has been reduced from 40 K to 30 K and Degree of Accuracy of Gas Consumption has been strengthened from $\pm 10\%$ to $\pm 5\%$.

³ Source KEMCO from http://www.kemco.or.kr/new_eng/pg02/pg02100200_2.asp . The same source also notes KS B 8116 defines the heating capacity of the unit [and includes a wide range of design, construction and performance requirements that are not related to energy and energy efficiency].

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 “*Water Heaters - Overall Approach to the Analysis - IEA 4E⁴*”. This report also describes in detail a number of general assumptions that were necessary for the dataset 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 Korean Energy Agency data

2.1.1 Source

Korean data was supplied by the Korean Energy Agency in March 2016 and contained the following data:

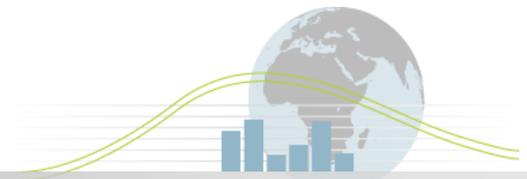
	2014	2015
Gas Instantaneous	90	77

2.1.2 Limitations and specific assumptions made for this dataset

Korean regulations are based on minimum thermal efficiency threshold 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 302 litres of water per day at a temperature of 45°C with ambient conditions at 15°C, giving a draw- energy demand of 12.113kWh/day.
- **Start up energy:** 3.2 starts per kWh of water drawn off and a energy consumption per start of 0.067 kWh per start (a reference value for instantaneous gas water heaters adjusted proportionately to take account of the different temperatures in the Korean test).

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



3 Notes on Policy

Regulatory (MEPS and Labelling) information is provided in Notes Section 1.



4 Notes on Cultural Issues

Korea has a unique “Ondol (Korean floor heating system, <http://en.wikipedia.org/wiki/Ondol>)” culture such that almost 100% of households choose under floor heating systems that circulates hot water coming from gas or oil boilers through the floor. This system also provides hot water supply for sanitary use. Thus the vast majority of sanitary hot water is provided through gas- or oil-fired combi-boilers. A room air conditioner for cooling and a gas boiler for heating is typical heating system in Korea households. Korea is the 2nd largest gas boiler production country after UK. The South Korea heating system stock is dominated by gas and oil boilers, which account for 57% and 26% of the energy consumption in 2008⁵. In recent years, condensing gas boilers have replaced oil boilers due to aggressive advertising and recognition of their greater energy efficiency.

Data has been taken from the report for CLASP “Scoping Study for Residential Water Heaters Mapping and Benchmarking Project”, June 2014, Waide Strategic Efficiency Ltd, ARMINES, LBNL and CEIS (hereafter referred to as the CLASP Scoping study). Sales data is show in Table 2.

Table 2 Water heater sales for Korea (CLASP)

	Volume (1000 units)	Percent Sales
Gas Instantaneous (combi)	1079	80% approx
Gas Storage	N/D	N/D
Electric Instantaneous	N/D	N/D
Electric Storage		3% approx.
Oil (combi)	200*	13% approx
Solar	N/D	N/D
Heat pump	N/D	N/D
Totals		100%**

* data for 2012

** note the percent sales values shown do not sum to 100% because the remaining sales are N/D (not disclosed).

Source: KEMCO personal communication.

⁵ IEA HPP Annex 42 Korea market overview April 2014, Korea Institute of Energy Research