

Product Fact Sheet – Space and water heating: Central heating boiler

Table 22. Overview of Central heating boiler

Country	MEPS	High Label	S&L metric	Test procedure	Reference test procedure & metric	Test Procedure (*)	Energy Performance Metric (*)	Notes
China	84%	92%-96%	Heat efficiency	GB 20665-2006; GB 6932; GB/T 13611 CJ/T 228	unknown	N/A	N/A	Gas boilers (incl. combi boilers)
EU	75%	$\eta_s \geq 150$	Seasonal efficiency (%)	As per Ecodesign regulation (see sources below)	FprEN 15502 is set to replace EN 297, EN 483, EN 677, EN 656, EN 13868, EN 15420	N/A	N/A	Gaseous fuel boilers (incl. combi boilers)
EU	42% (open) - 72% (closed)	EEI ≥ 104	Seasonal efficiency (%)	As per Ecodesign regulation (see sources below)	Modifies EN 15034:2008 (condensing boilers) and EN 304:1992; A1:1998; A2:2003 (atomizing boilers) ¹	N/A	N/A	Oil/liquid fuel boilers (incl. combi boilers)
EU	100%-115% (low temp)	$\eta_s \geq 175$	Seasonal efficiency (%)	As per Ecodesign regulation (see sources below)	Modifies FprEN 14825: October 2011	N/A	N/A	Electric heat pumps
EU	86%	$\eta_s \geq 175$	Seasonal efficiency (%)	As per Ecodesign regulation (see sources below)	prEN 50465: 2010 Draft ed;	N/A	N/A	Cogeneration boilers

US	78%- 84%	85%		10 CFR 430.23(g), 10 CFR 430.23(o), and 10 CFR Part 430 Appendix G to Subpart B		N/A	N/A	
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(*) Conversion factors

Notes:

1. For boilers with forced draught burner similar sections apply in EN 303-1, EN 303-2 and EN 303-4. For atmospheric, not fan-assisted burners EN 1:1998 applies. Ref:

http://www.eceee.org/ecodesign/products/boilers/testing_calculation_6April2011 ; p2

Products

1. Central heating boilers fall within the broader category of space heating. In this context, space heaters are devices which provide heat (in the case of boilers) to a water-based central heating system in order to reach and maintain at a desired level the indoor temperature of an enclosed space such as a building, a dwelling or a room. They are equipped with one or more heat generators. Boilers are space heaters which generate heat using the combustion of fossil fuels and/or biomass fuels, and/or using the Joule effect in electric resistance heating elements. Boilers heat water, providing either hot water or steam for heating. Steam is distributed via pipes to steam radiators, and hot water can either be distributed via baseboard radiators, radiant floor systems, or can heat air via a coil. Central heating boilers include boiler combination heaters which are boiler space heater also designed to provide hot drinking or sanitary water at given temperature levels, quantities and flow rates during given intervals, and are connected to an external supply of drinking or sanitary water.

Overview of international situation with regards to S&L for this product category

1. Due to total energy use and scope for efficiency gains in these products, boiler standards and labels are relatively numerous, internationally. However, standards are in a state of flux, and are not easily comparable. There is a general shift away from steady state to seasonal efficiency metrics, as a result of which standards are gradually being changed.

2. The standard in India appears to be based on steady-state operation whereas the EU and the US use seasonal efficiency metrics, although they differ. China's standard is not available. Test standards for boilers in other economies have not been identified.

3. China: Article 14 of the 1997 National Energy Conservation Law of China (revised 2008) provides the regulatory basis for mandatory energy efficiency standards for energy-consuming products and equipment. China National Institute of Standardization (CNIS) has been revising single-period mandatory energy efficiency standards and developing new standards to follow international best practice while the China Standards Certification Center has launched a new voluntary energy efficiency endorsement labeling program targeting the top 25% most efficient products. The mandatory categorical energy information label known as the China Energy Label was established in 2005. The MEPS program aims to remove the 20% least-efficient products from the markets targeted.

General description of conversion for test procedures and metrics/ efficiency metrics and standards

1. EU: The EU central heating boiler MEPS and labeling regulations use test standards and procedures which enable fair comparisons between the reported seasonal efficiencies of conventional and combination² gaseous and liquid fuel boilers, electric resistance boilers, low and (separately) high temperature electric heat pumps (air and water source), and cogeneration (or micro/mini CHP) - for products with rated (maximum) heat output not exceeding 400kW³. Efficiencies are based on two test points (full and 30% load), determined according to established test procedures, and manipulated to consider further variables such as type/level of control, auxiliary power consumption, and potential solar energy input, and then reported in primary energy terms.
2. US: Elements of the US boilers testing procedures were unavailable⁴ for this analysis, however the calculation method includes fuel and power consumption during standby and active modes (including that related to electrical auxiliaries such as fans/blowers and/or pumps). ANSI/ASHRAE Standard 103-1993 is used to measure active mode efficiency. This document has been updated by ANSI/ASHRAE Standard 103-2007; IEC 62301 relates to the measurement of standby power.

Notes and assumptions

No new assumptions. Test procedures differ so substantially that no meaningful assumptions regarding the comparability of these could be made within the scope of this study. Significantly more research would be needed to understand test procedure differences and whether conversion factors could be developed.

List of sources

EU: Boilers Ecodesign regulation: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:239:0136:0161:EN:PDF>;

Working Document, testing and calculations - boilers:
http://www.eceee.org/ecodesign/products/boilers/testing_calculation_6April2011

India: standard:
http://www.beeindia.in/energy_managers_auditors/documents/guide_books/2Ch2.pdf

US: Regulation <http://www.law.cornell.edu/cfr/text/10/430/subpart-B/appendix-N>

China: Testing procedures - introduction:
<http://www.energylabel.gov.cn/en/images/upFile/634707765374757285.pdf>;

MEPS/labeling:
<http://www.energylabel.gov.cn/en/EnergyEfficiencyStandards/FormulationandRevisionofStandards/detail/731.html>

² Or 'combi' boiler - which, in addition to providing space heating, has instantaneous domestic hot water functionality

³ Labeling requirements are for products with rated output ≤ 70 kW only

⁴ I.e. those related to ANSI/ASHRAE Standard 103-1993 and IEC 62301

Product Fact Sheet – Space and water heating: Central heating furnaces

Table 23. Overview of Central heating furnaces

Country	MEPS	High Label	S&L metric	Test procedure	Reference test procedure & metric	Test Procedure (*)	Energy Performance Metric (*)	Notes
US	80%	95% (90%)	Annual Fuel Utilization Efficiency	10 CFR Part 430 Appendix N to Subpart B	ANSI/ASHRAE Standard 103-1993; IEC 62301	N/A	N/A	Residential gas furnace
US	80% gas ; 81% oil		Thermal efficiency (full load)	10 CFR 431.77	ANSI Z21.47-2006 and ANSI Z21.10.3-2011	N/A	N/A	Commercial gas and oil furnace
EU	72%		Seasonal space heating efficiency	EC Working Document ⁵	prEn1020:2007, EN1319:2009 EN 1196:2011, EN621:2009 EN 778:2009	N/A	N/A	Liquid or gaseous fuel residential furnace
Australia	70%		Thermal efficiency	AS4556	N/A	N/A	N/A	Indirect gas-fired ducted air heater

(*) Conversion factors

Product

1. Central heating furnaces fall within the broader category of space heating. In this context, space heaters are devices which provide heat to reach and maintain at a desired level the indoor temperature of an enclosed space such as a building, a dwelling or a room. Residential furnaces include gas, electric, and oil-fired furnaces. Furnaces heat air and distribute the heated air through the house using ducts.

Overview of international situation with regards to S&L for this product category

1. Minimum energy performance standards are in place in the US and under development in the EU. No standards were found in other economies. The EU and the US both use seasonal efficiency metrics, albeit different ones.

⁵ European Commission Working document on possible requirements for air heating products, cooling products and high temperature process chillers

General description of conversion for test procedures and metrics/ efficiency metrics and standards

1. Test procedures for these products are complex and could not be assessed in detail within the scope of this study. There are no available sources describing a comparison of these test procedures and a newly developed comparison would require an in-depth assessment of test protocols and results which is beyond the scope of this study.

Notes and assumptions

EU: test standards relate to draft Ecodesign requirements/MEPS, but are not available.

US: residential furnaces: elements of the US furnaces testing procedures are not publicly available, however the calculation method includes fuel and power consumption during standby and active modes (including that related to electrical auxiliaries such as fans/blowers and/or pumps).

ANSI/ASHRAE Standard 103-1993 is used to measure active mode efficiency. This document has been updated by ANSI/ASHRAE Standard 103-2007 - neither are available; IEC 62301 relates to the measurement of standby power and is not available.

US: commercial furnaces: 10 CFR 431.77 is based on ANSI Z21.47-2006 and ANSI Z21.10.3-2011 which are not available.

Australia: AS 4556-2011 is not freely available, however AS 4556-2000 is available: see sources below.

List of sources

EU:

http://www.eceee.org/ecodesign/products/Lot21_Central_Heating_Products/resolveuid/de7c01a9779244bb81b82a3ddd68a9be

US: http://www.energystar.gov/index.cfm?c=furnaces.pr_crit_furnaces ;
<http://www.law.cornell.edu/cfr/text/10/part-430/subpart-B/appendix-N>

US DOE test procedures and regulations, Residential Furnaces.

http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/72

US DOE test procedures and regulations, Commercial Furnaces.

http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/71

Australia: <http://www.paltech.com.au/standards/AS4556-2000.pdf>

Product Fact Sheet – Space and water heating: Other space heaters

Table 24. Overview of Other space heaters

Country	MEPS	High Label	S&L metric	Test procedure	Reference test procedure & metric	Test Procedure (*)	Energy Performance Metric (*)	Notes
EU	38% to 79% dep. On types		Seasonal efficiency	Annex III 'EU134_EN_1_1 Lot 20 Ecodesign WTO (Jul2013)'	Useful efficiency: for all other open/closed fronted appliances and cookers: EN 16510-1:2013 §7.3, A.6.2 for pellet fired appliances: EN 14785:2006 §6.4.2 , A.4.7 & A.4.8 for slow heat release appliances: EN 15250:2007-06 §6.3, A.4.6 & A.5 & A.6.2.2	N/A	1	Solid fuel local space heater
EU	42% (open fronted); 72% (closed fronted)		Seasonal efficiency	Annex III 'EU134_EN_1_1 Lot 20 Ecodesign WTO (Jul2013)'	useful efficiency - prEN 613:2000 §7.11.2 EN 1266:2002 §6.12 & §7.12	N/A	1	Gaseous or liquid fuel local space heater
EU	36%-38.5%		Seasonal efficiency	Annex III 'EU134_EN_1_1 Lot 20 Ecodesign WTO (Jul2013)'	IEC/EN 60335	N/A	1	Electric local space heater
EU	80%-88%		Seasonal efficiency	Annex III 'EU134_EN_1_1 Lot 20 Ecodesign WTO (Jul2013)'	Luminous: EN 419-1; EN 419-1: Tube: EN 416-1; EN 416-2; EN 777	N/A	1	Commercial local space heater (luminous or tube)
US	N/A		Annual Fuel Utilization Efficiency	10 CFR Part 431	unknown	N/A	N/A	Unit heater

(*) Conversion factors

Product

1. Space heaters are devices which provide heat to reach and maintain at a desired level the indoor temperature of an enclosed space such as a building, a dwelling or a room. The products falling under “Other Space Heaters” include space heaters not covered under Central Heating Boilers and Central Heating Furnaces, as described above.

Overview of international situation with regards to S&L for this product category

1. Currently, there are few standards and labels present in this product category, and few existing test standards. Notwithstanding possible regional variations in product design, this may render potential for future harmonization of test standards high, as in general these heating products make strong candidates for future minimum standards and labels.

General description of conversion for test procedures and metrics/ efficiency metrics and standards

1. Conversions of test procedures are not possible because test procedures are sometimes unknown, largely not aligned with international procedures and there is no comparative information available on which to base a comparison. Conversions for efficiency metrics are indicated for various products all within the EU, which uses different test procedures but ranks heating products with the same functionality on the same efficiency scale.

Notes and assumptions

EU: Local space heaters (LSHs) are due to be covered by a single Ecodesign (MEPS) and a single labeling regulation which enables fair comparison between the efficiencies of the following products: open and (separately) closed-fronted LSH using solid (fossil or biomass) fuels; solid fuel cookers; open and (separately) closed fronted LSH using gaseous or liquid fuels; electric fixed, electric portable and electric storage LSHs (all $\leq 50\text{kW}$) and; (for Ecodesign/MEPS only) commercial luminous and commercial tube LSHs ($\leq 120\text{kW}$). The labeling regulation excludes commercial LSHs. Efficiencies are based on established test procedures, and then manipulated to consider further variables such as type/level of control, auxiliary power consumption, and then reported in primary energy terms. The test standards mentioned above refer to useful efficiency tests only; tests related to power consumption, pilot flame energy consumption, etc., can be found in the 'transitional methods' WD listed in the sources section of this document (below).

List of sources

EU: Local space heaters Ecodesign Working Document (January 2014):
http://www.eceee.org/ecodesign/products/Lot_20_local_room_heating_products/ED_LocalSpaceHeatersFIN.pdf;

Labeling Working Document:
http://ec.europa.eu/enterprise/tbt/tbt_repository/EU135_EN_1_1.pdf;

Transitional methods (test standards):
http://www.eceee.org/ecodesign/products/Lot_20_local_room_heating_products/Transitional_method_local_space_heaters_postISC.pdf

US: <http://www.law.cornell.edu/cfr/text/10/part-431/subpart-N>

US DOE test procedures and regulations, residential direct heating equipment.
http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/68

Product Fact Sheet – Space and water heating: Industrial boilers

Table 25. Overview of Industrial boilers

Country	MEPS	High Label	S&L metric	Test procedure	Reference test procedure & metric	Test Procedure (*)	Energy Performance Metric (*)	Notes
India		N/A	unknown	IS: 13979 (packaged boilers), possibly IS 8753 (steam boilers/ generators)	BS 845 : 1972; BS 2885 : 1974; ANSI PTC 4.1	N/A	N/A	Industrial steam boiler

(*) Conversion factors

Products

1. Industrial boilers are used to generate steam and hot water for use in industrial processes.

Overview of international situation with regards to S&L for this product category

1. Minimum energy performance standards have been considered in Australia; however, they were not adopted. India has adopted some standards for industrial boilers; however, it is unclear what exactly is regulated. The actual requirements for India are unavailable.
2. **Australia:** MEPS have been considered for industrial boilers in a recent (2010) government study. In this study, test standards AS 2593: 2004 and AS 1228-2006 were considered as candidate standards, although at that time neither contain energy performance requirements nor test methods. See sources section below.
3. **India:** has in place the Indian Boiler Regulations of industrial boilers; however it is not clear whether these regulate for minimum energy performance standards *per se*.

General description of conversion for test procedures and metrics/ efficiency metrics and standards

1. Only India has implemented standards for industrial boilers. These standards seem to include various aspects of product performance, possibly including energy performance.

Notes and assumptions

No new assumptions. Given that there are standards only in India, a more detailed assessment of test procedures would not provide new information about comparability.

India: Indian standards IS: 13979 and IS 8753.1977 are publically available but have not been assessed (see sources, below) and international standards cited are not accessible: BS 845: 1972 is replaced by: BS 845-2:1987, BS 845-1987; BS EN 12952 1974 is replaced by: BS EN 12952-15:2003. Aspects of (or ASME) PTC 4.1 are available on line, but have not been assessed.

List of sources

Australia: <http://www.energyrating.gov.au/wp-content/uploads/2011/02/201009-indust-equip1.pdf> ; p46 & 47

India: <https://law.resource.org/pub/in/bis/S08/is.13979.1994.pdf> - contains full test standard.

Also see http://www.beeindia.in/energy_managers_auditors/documents/guide_books/2Ch2.pdf - contains calculations; http://dipp.nic.in/boiler_rules_updated/contentsregulation.htm ; IS: 13979: <https://law.resource.org/pub/in/bis/S08/is.13979.1994.pdf> ; IS 8753.1977: <https://law.resource.org/pub/in/bis/S08/is.8753.1977.pdf>



Product Fact Sheet – Space and water heating: Water heaters and storage tanks

Table 26. Overview of Water heaters and storage tanks

Country	MEPS	High Label	S&L metric	Test procedure	Reference test procedure & metric	Test Procedure (*)	Energy Performance Metric (*)	Notes
India		N/A	unknown	unknown	IS 2082:1993	N/A	N/A	Storage
China	3.7		COP calculated, no draw-off	GB/T213137-2008; GB/T 21362-2008	unknown	N/A	N/A	Heat pump water heater
China	N/A	N/A	unknown	CQC 2210-2009	unknown	N/A	N/A	Storage
China	≤1 (@≥50%)	≤ 0.6	Standing loss	GB/T 20289-2006 GB 21519-2008	IEC 60335-2-21: 1997	N/A	N/A	Electric storage water heaters
China	84%	86%	unknown	GB 6932 GB/T 13611 CJ/T 228	unknown	N/A	N/A	Gas instant.
China	N/A	N/A	unknown	GB 26969-2011, GB/T 12915-1991	unknown	N/A	N/A	Solar
EU	30% (27%)	$\eta_{wh} \geq 163$	Efficiency (%)	Regulation (EU) No 814/2013	EN 60379: 2004	N/A	1	Instantaneous or storage (multi-fuel incl. elec) : standards and labeling
EU	23% (20%)	$\eta_{wh} \geq 62$	Efficiency (%)	Regulation (EU) No 814/2013	EN 12897: 2006; EN 60379: 2004; EN 15332:2	N/A	1	Storage tank: standards and labeling

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EU	30% (27%)	$\eta_{wh} \geq 163$	Efficiency (%)	Regulation (EU) No 814/2013	EN 16147	N/A	1	Heat pump WH: standards and labeling
Mexico	84% (instant. Elec.)		Thermal efficiency	NOM-003-ENER-2011	ANSI-Z21.10.1/2009; ANSI-Z21.10.3/2004	N/A	N/A	Residential & commercial instant., quick recovery, and storage water heater
US	Gas: For products with a Rated Storage Volume (Vs) of less than 2 gallons: EF = $0.62 - (0.0019 \times Vs)$. Electric: For products with a Rated Storage Volume (Vs) of less than 2 gallons: EF = $0.93 - (0.00132 \times Vs)$.		Energy Factor	10 CFR Part 431.106	ANSI Z21.47-2006, UL 727-2006	N/A	N/A	Residential gas, electric instantaneous
US	Gas: For tanks with a Rated Storage Volume (Vs) of at least 20 and below 100 gallons: EF = $0.67 - (0.0019 \times Vs)$. Oil: For tanks with a Rated Storage Volume at or below 50 gallons: EF = $0.59 - (0.0019 \times Vs)$ Electric: For tanks with a Rated Storage Volume (Vs) of at least 20 and below 120 gallons: EF = $0.97 - (0.00132 \times Vs)$.		Energy Factor	10 CFR 430.23; 10 CFR Part 430 Appendix E to Subpart B	ASHRAE Standard 41.1-86 1986, ASTM-D-2156-80 1980	N/A	N/A	Residential gas, oil, electric storage
US	Gas: EF = $0.82 - (0.0019 \times \text{Rated Storage Volume in gallons})$ Elec: EF = $0.93 - (0.00132 \times \text{Rated Storage Volume in gallons})$		Energy Factor	10 CFR Part 430 Appendix E to Subpart B	unknown	N/A	N/A	Commercial gas, oil, electric instant.

	Volume in gallons)							
US	Gas: For tanks with a Rated Storage Volume at or below 55 gallons: $EF = 0.675 - (0.0015 \times \text{Rated Storage Volume in gallons})$. For tanks with a Rated Storage Volume above 55 gallons: $EF = 0.8012 - (0.00078 \times \text{Rated Storage Volume in gallons})$. Elect: For tanks with a Rated Storage Volume at or below 55 gallons: $EF = 0.960 - (0.0003 \times \text{Rated Storage Volume in gallons})$. For tanks with a Rated Storage Volume above 55 gallons: $EF = 2.057 - (0.00113 \times \text{Rated Storage Volume in gallons})$.		Energy Factor	10 CFR Part 431.106	ANSI Z21.47-2006, UL 727-2006	N/A	N/A	Commercial gas, oil, electric storage
Australia	N/A		Efficiency (%)	AS 4552:2005	unknown	N/A	N/A	Residential gas instantaneous
Australia	Max heat loss per day (kWh): 98%		Standing loss; kWh/day	AS/NZS 4692.1 and .2 :2005, AS 1056.1-1991/Amdt 5-2005	unknown	N/A	N/A	Residential unvented storage
Australia	N/A		Efficiency (%)	AS1056.1	unknown	N/A	N/A	Residential vented storage
Australia	N/A		Efficiency (%)	AS1361	unknown	N/A	N/A	Residential storage - 'heat exchange' type
Australia	N/A		Seasonal	AS/NZS	unknown	N/A	N/A	Residential

			Performance modelled (but not reported as SCOP), no draw-off	4234				heat pump water heater
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(*) Conversion factors

Products

1. Water heaters are products that utilize oil, gas, or electricity to heat potable water for use upon demand for activities such as washing dishes or clothes, or bathing. Water heaters include storage type units that store heated water in an insulated tank and instantaneous type units that heat water on demand.

Overview of international situation with regards to S&L for this product category

1. Despite the popularity of water heating standards and labels, few commonalities appear to exist as regards to their testing of efficiency. The possible exception relates to standing losses in storage water heaters/storage tanks. While the exact measurement methods for these standards have not been accessed, it is likely that they are broadly comparable. Other test methods are likely to vary widely; due to variations in draw-off regimes each economy tests its heaters to - which have a significant impact on performance.

2. **EU:** The EU standards-setting approach is broadly laid out in European Council (EC) Resolution of May 1985, which sets out the responsibilities between the EC legislator and the European standards bodies (CENELEC, CEN, ETSI), in a legal framework, allowing for the free movement of goods. The EC Directive (in this case, the Ecodesign of energy using products Directive 2009/125/EC, and Energy labeling Directive 2010/30/EU) define the essential requirements, while the European standards bodies draw up corresponding technical specifications which meet these essential requirements: thus compliance with the standards confers conformity with these requirements. Such specifications are referred to as 'harmonized standards'. A European standards adopted by CEN, CENELEC or ETSI implies an obligation to implement these standards nationally, and withdraw any conflicting standard (see sources section, below).

3. **Russia:** according to the Energy Charter Secretariat (2009; see sources below), Russia introduced a framework for energy efficiencies labeling in 1999 - standards have existed for a range of appliances for some time prior. However MEPS and labels have not been well implemented, if at all, are voluntary or lack a proper mandate, and are thought to have little impact: "GOST 51380 introduced the general requirements and the methods for the verification of energy efficiency indicators for energy consuming products listed in GOST 51388 - a manufacturer declaration, certification testing procedure and statistical data analysis."

4. **India:** India has identified water heaters as a priority for standards and labeling, however development has been stalled due to the absence of local testing facilities capable of testing to ISO standards (see sources below; India). India has a national standard body, BIS, responsible for formulating and implementing national standards, and production, quality and EMS certification.

The Bureau of Energy Efficiency is responsible (under the Energy Conservation Act, 2001) for the Standards and Labeling Program. Laboratories are accredited by the National Accreditation Board. Water Heaters ('Storage water geysers') fall under the current S&L Program. Solar water heaters are being considered for energy ('Star') labeling (See sources section, below)

5. **China:** Article 14 of the 1997 National Energy Conservation Law of China (revised 2008) provides the regulatory basis of mandatory energy efficiency standards for energy-consuming products and equipment. China National Institute of Standardization (CNIS) has been revising single-period mandatory energy efficiency standards and developing new standards to follow international best practice while the China Standards Certification Center has launched a new voluntary energy efficiency endorsement labeling program targeting the top 25% most efficient products. The mandatory categorical energy information label known as the China Energy Label was established in 2005. The MEPS program aims to remove the 20% least-efficient products from the markets targeted. See sources (esp. the LBL document) for further detail.

6. **Mexico:** NOM-003-ENER-2011 relates to hot water storage, quick recovery, and instantaneous water heaters of either residential or commercial sizes. Test methods include multiple draw offs, and are publically available (see sources, below). Referenced standards include ANSI-Z21.10.1/2009, "Waters Heaters Gas. Volume I, Storage Water Heaters with Input Ratings of 75,000 Btu per Hour or Less ", and ANSI-Z21.10.3/2004, "Waters Heaters Gas; Volume III; Circulating tank, instantaneous and large automatic Storage Water Heaters ".

7. **Storage tanks and storage water heaters:** according to Otago University (New Zealand, 2011) maximum standing loss limits (kWh/day) apply in the US, Canada, Australia, New Zealand and the EU - all of which are broadly comparable. However, test procedures used by each country have not been accessed and test procedure differences are known to significantly influence reported standing losses. Note however that China's standards are related to IEC 60335-2-21: 1997, which also measures standing losses of storage tanks or storage water heaters. India also has minimum standing loss requirements for water heaters, details of which are unknown.

General description of conversion for test procedures and metrics/ efficiency metrics and standards

1. **Heat Pump Water Heaters:** There is insufficient information to attempt developing conversion factors between standards. Key considerations include: whether and if so in what way draw-off/usage patterns are included in the test; heat-up period; consideration of standby operation; maximum single draw off (at given temperature); ambient temperatures & humidity for tests; evaporator defrost cycle; how controls and booster electric resistance heaters are treated (for more detail see SEAD report referenced below).

SEAD and CLASP recently published a study into the potential for harmonization of international test standards for heat pump water heaters. This report describes test procedure differences in more detail and discussed the potential for harmonization of test procedures. The report describes some limited comparative testing which finds that different products give extremely different result when tested with different test procedures, confirming that it is currently impossible to derive conversion factors for heat pump water heater test procedures.

Notes and assumptions

China: for electric storage water heaters, reference standard IEC 60335-2-21: 1997 - which refers to standing losses and is not publicly available. China's standards are not available (in English, at least). GB/T 21362-2008 (heat pump water heaters) defines a 'Commercial & Industrial' HPWH as one with 'nominal heating capacity of 3000W and above', however residential applications may

have capacities well above 3kW. China's test standard (as with Korea's) requires no draw off test.

Australia/New Zealand: heat pump water heaters: AS/NZS 4234 and AS/NZS 5125 enable physical testing to determine key performance characteristics of a unit from which computer modeling is possible for a wide range of usage patterns and operating conditions. The modeled results are then used to determine efficiency/compliance with MEPS energy rating and to check whether it meets MEPS. MEPS and labeling standards are under development.

EU: all dedicated domestic water heaters (with a rated heat output \leq 400 kW, including those integrated in packages of water heater and solar device), whether powered by oil, gas, electric resistance or electric heat pumps, are subject to the same MEPS and labeling requirements (and are therefore suitable for residential or commercial application). These requirements are broken down into sizes determined by a product's ability to meet various minimum usage patterns/load profiles. The test procedures allow efficiency credits for 'smart control' which enables the heater to adapt to/predict future usage when in normal use. The EU Ecodesign and labeling regulations distinguish between water heaters and storage tanks - both of which are within scope. The former (which are directly heated) are subject to operating efficiency requirements, while the latter are subject to standing loss requirements only. There are separate, but directly comparable MEPS and labeling requirements for the water heating function of combination (or 'combi') boilers.

US: Heat pump WH: the US (and Canadian) test method includes a single draw-off (repeated 6 times), for use in a mandatory EnergyGuide label, and for the voluntary Energy Star label (from 2015). See sources below - Heat pump water heaters. General: US test procedures are publicly available, but have not been compared with others, which are either unavailable or (e.g. EU) partially available.

Russia: Both minimum standards and labels exist for electric water heaters, and a label only for gas water heaters.

List of sources

Russia: Energy Charter Secretariat: Policies that work; introducing energy efficiency standards and labels for appliances and equipment; p25:
http://www.encharter.org/fileadmin/user_upload/document/EE_Standards_and_Labels_2009_ENG.pdf

India: http://www.un.org/esa/sustdev/publications/energy_casestudies/section3.pdf; p36;
Institutional background: <http://eneken.iecee.or.jp/data/3694.pdf>

China:
<http://www.energylabel.gov.cn/en/EnergyEfficiencyStandards/FormulationandRevisionofStandards/detail/735.htm>; LBL: http://china.lbl.gov/sites/all/files/china_sl_info.pdf

India: http://www.beeindia.in/energy_managers_auditors/documents/guide_books/2Ch2.pdf

Mexico: http://www.dof.gob.mx/nota_detalle.php?codigo=5203930&fecha=09/08/2011

Australia: <http://www.energyrating.gov.au/products-themes/>

EU: Standards setting:
http://ec.europa.eu/comm/enterprise/newapproach/standardization/harmstds/index_en.html;
<http://www.cenorm.be/cenorm/index.htm>



Water heaters regulation (MEPS):

http://www.eceee.org/ecodesign/products/water_heaters/Water_heaters_Ecodesign_Reg_814_2013.pdf; esp. annex III;

Water heaters labeling regulation:

http://www.eceee.org/ecodesign/products/water_heaters/06_Energy%20Labelling%20Water%20Heater-C%202013%20818.pdf

US: test procedures:

US DOE test procedures and regulations for residential water heaters.

http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/27

US DOE test procedures and regulations for commercial water heating equipment.

http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/51

Storage tanks: <http://www.otago.ac.nz/csafere/research/otago055640.pdf>

Heat pump water heaters: SEAD (June 2013) Heat Pump Water Heater Standards Interim Report - Final

