Standards and Labels for Water Heaters in Pakistan, ***A Recap***

clasp

Efficient Appliances for People & the Planet

A brief intro to benefits of having Standards and Labels

“Definition” of MEPS and Labelling

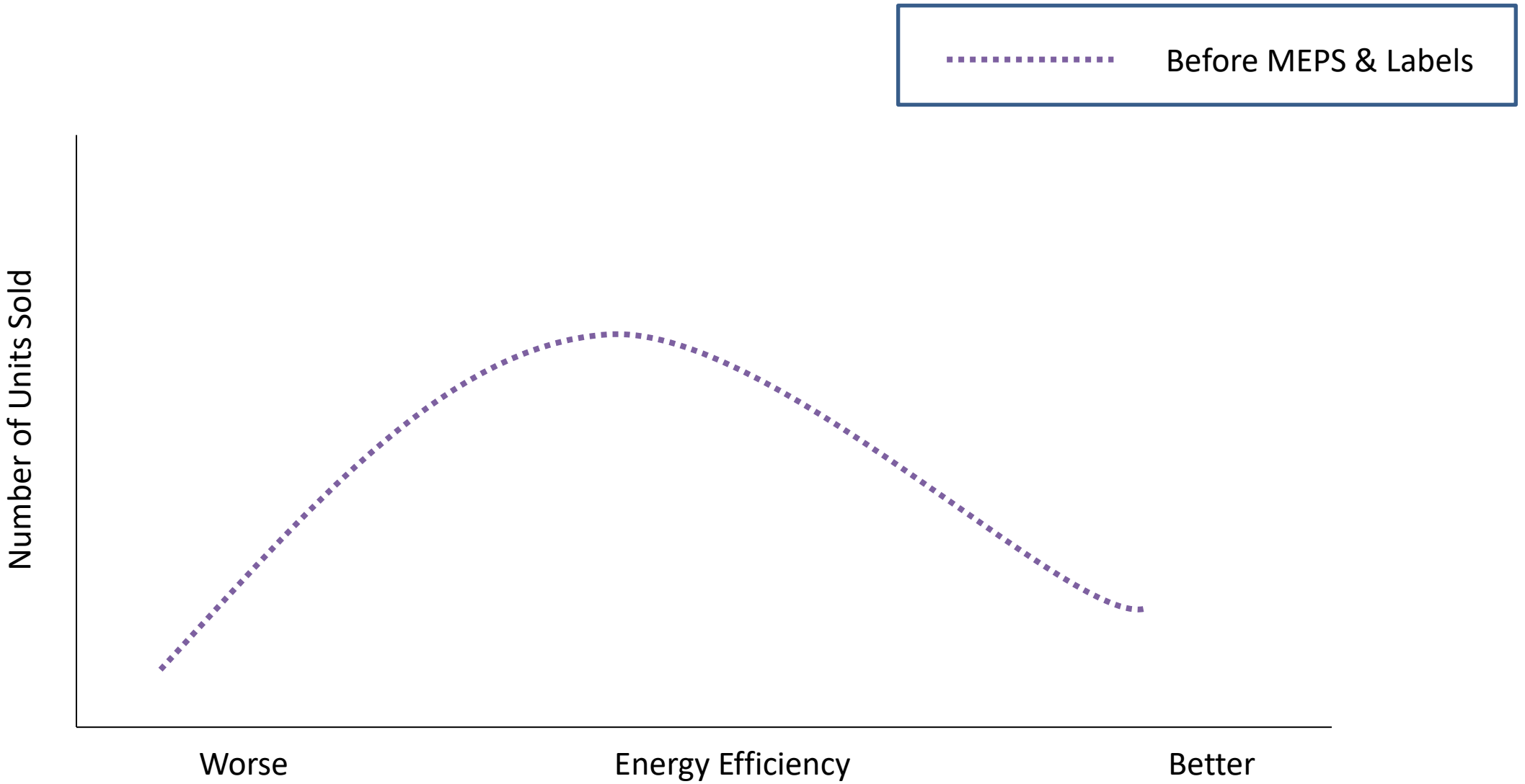
Minimum Energy Performance Standards (MEPS)

- Removal from the market of products that are deemed to have unacceptably low energy performance.

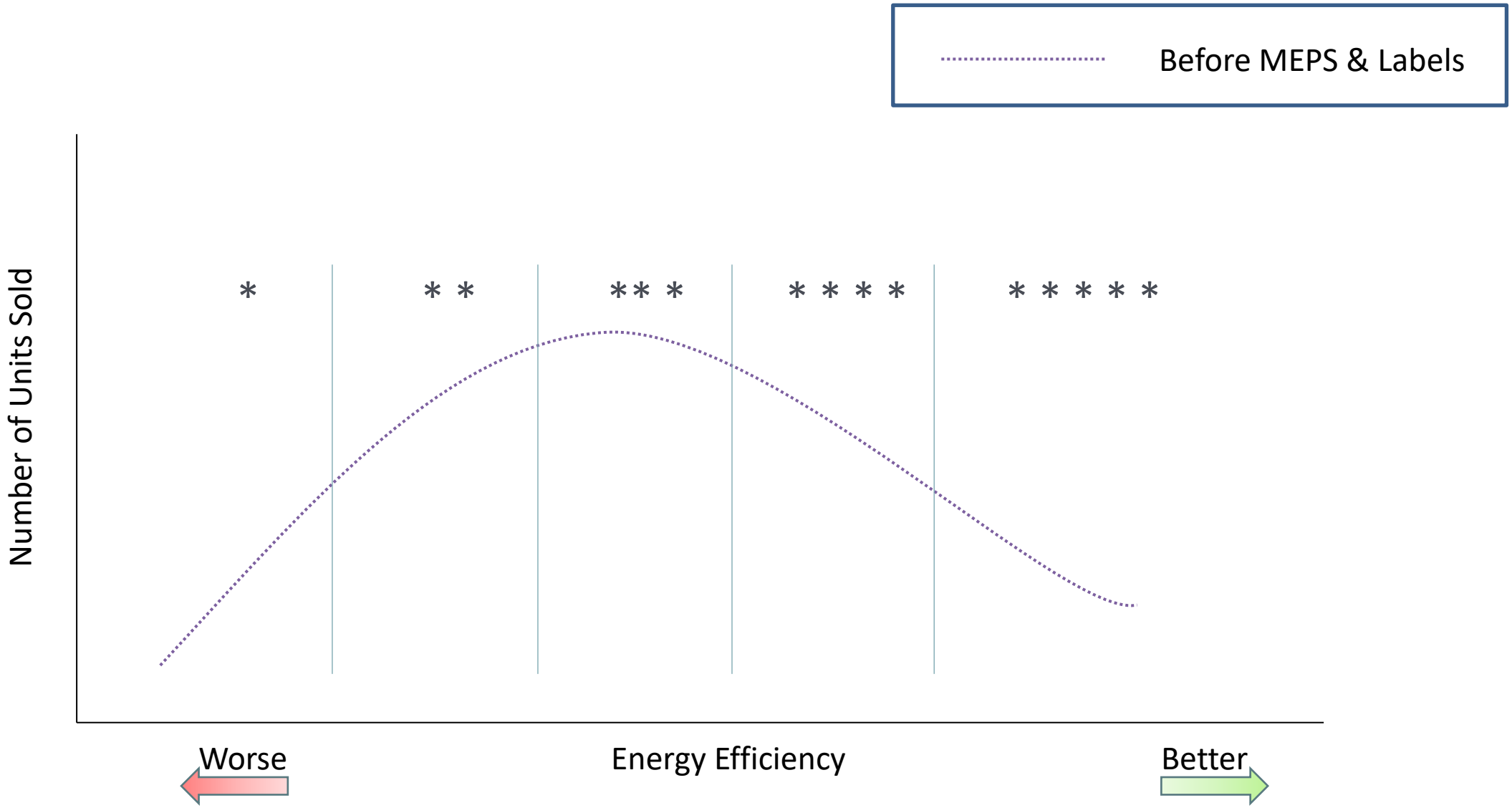
Labelling

- To categorise the energy performance of products to enable differentiation of the “better” products from the “less good” products.
  - *Consumers get more transparency for decision making*
  - *Allows effective implementation of other policy (eg procurement)*

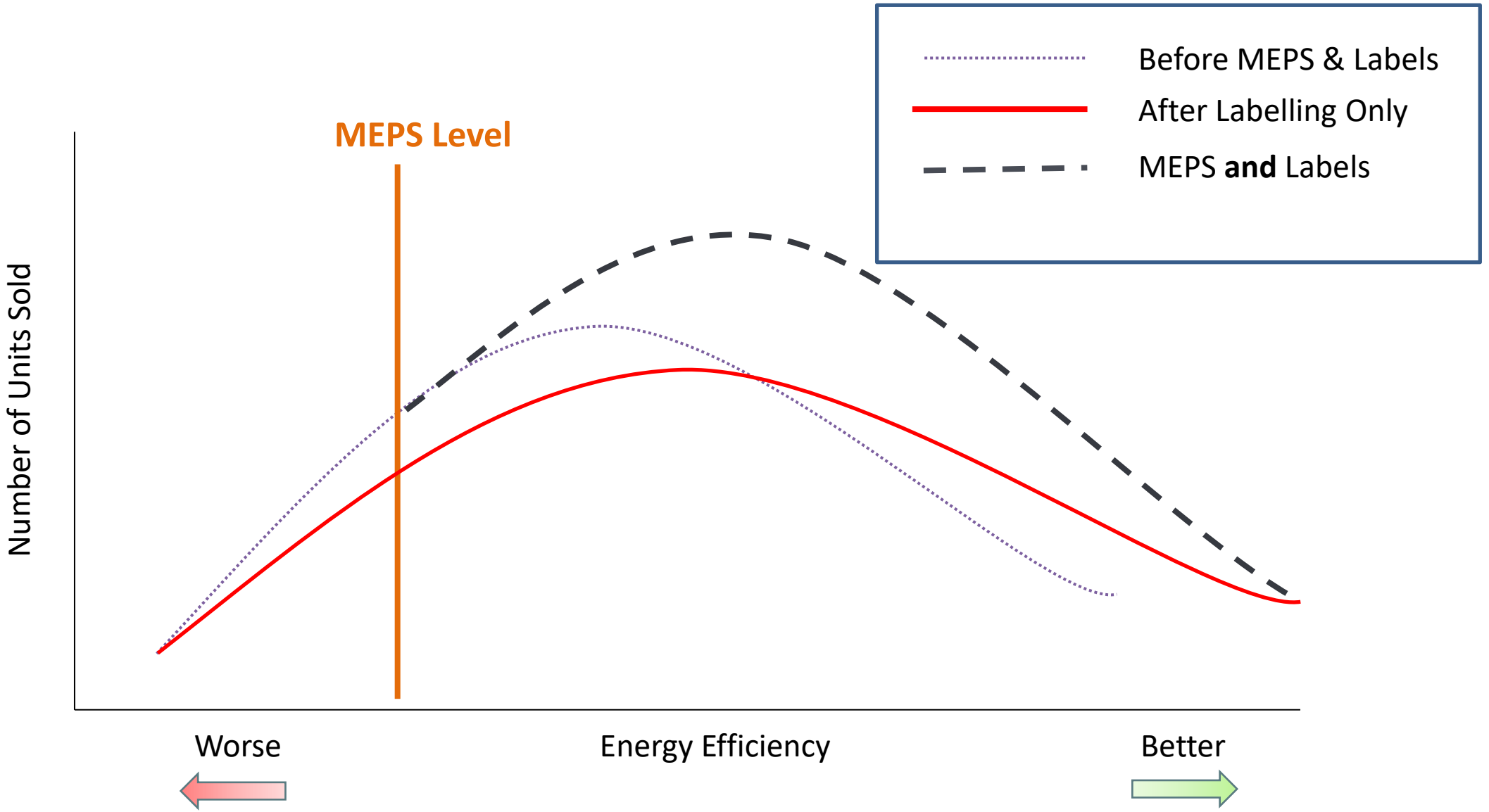
Distribution of Performance of Products in Market



Effect of Labelling: Transparently "Grading" Product Performance



Effect of MEPS and Labelling



MEPS and Labelling around the world (2014)

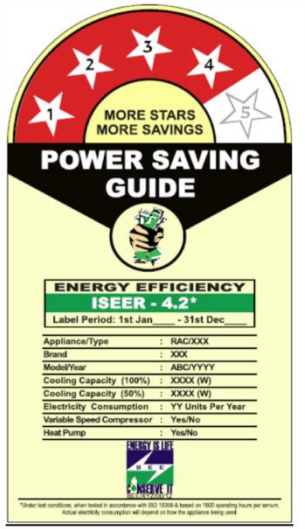
	Minimum Standards	Comparative Labels
Europe	939	652
Asia Pacific	243	228
North America	92	44
Central America	43	88
Middle East	79	78
Africa	57	59
Total	**1453**	**1149**

1,900+

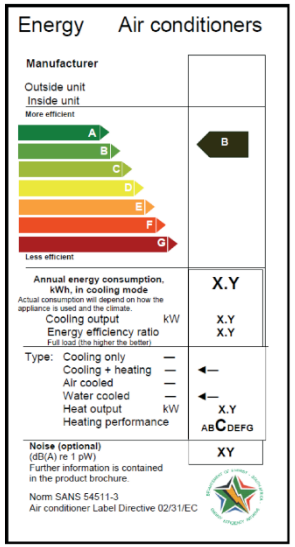
Source: Energy Standards and Labelling Programmes Around the World: in 2013, Department of Industry, Australia (2014)

Label Examples

Australia



Europe



China

USA

Korea

Standards and Labelling in Pakistan

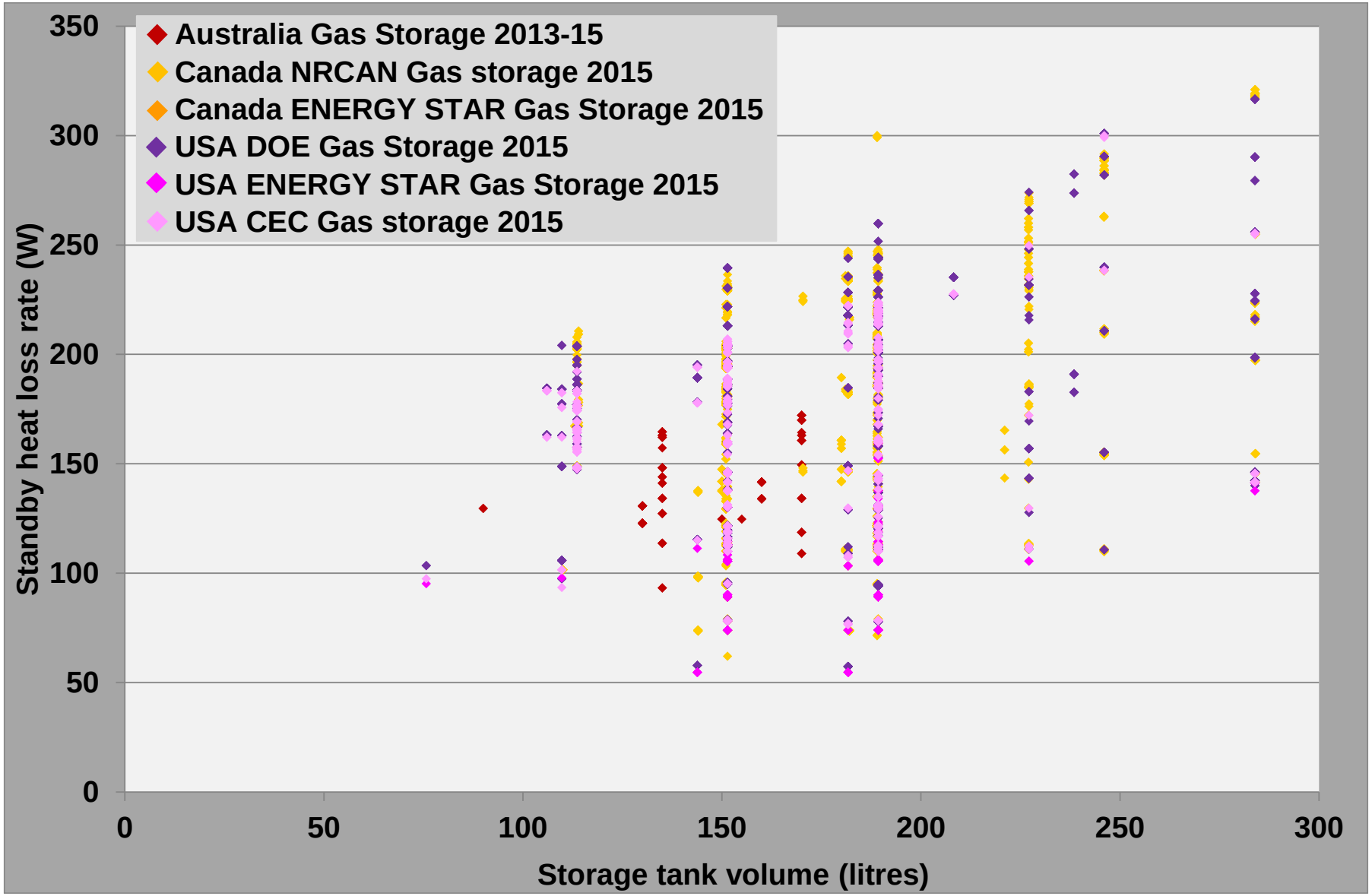
Currently Voluntary for Fans

Soon to be Mandatory

- **Fans**
- Air Conditioners
- Refrigerators
- LED lights
- **Electric Motors**
- **Water Heaters**
- ***Commercial Refrigeration***

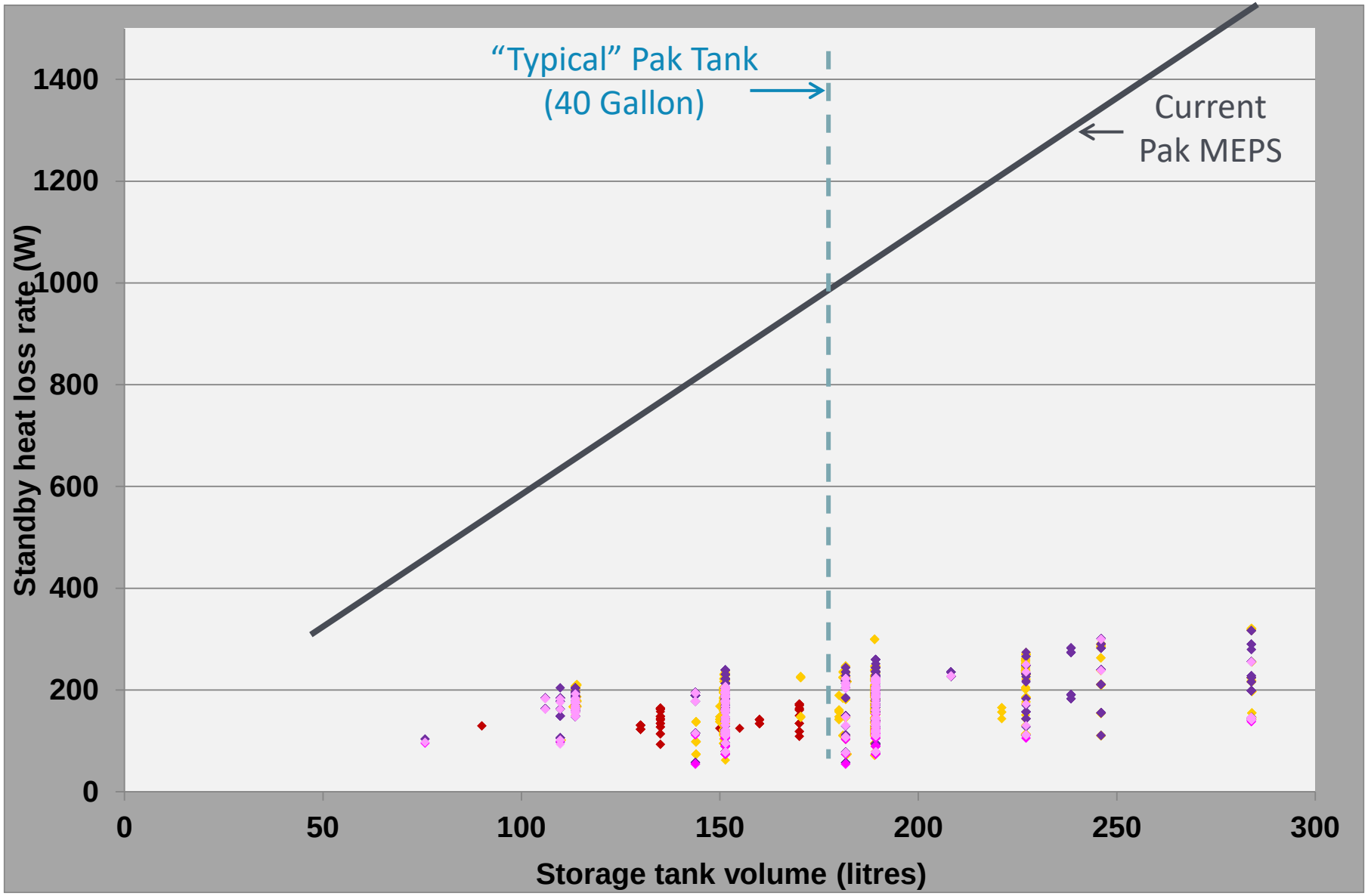
Work done to date

Comparison with International Water Heater



Rescaling the graphic to accommodate current Pakistani MEPS heat loss

Comparison with International Water Heater



Progress to date

NEECA/CLASP Workshops

First Workshop: 23 September – Lahore

- Background and need for revised regulation
- Introduction to concept of MEPS/Labelling of water heaters and international actions to date
- Establish if any key barriers to such regulation in Pakistan

Second Workshop: 13 October – Islamabad

- Estimate of current Pakistan water heater unit and household energy consumption
- Comparison of Pakistan Water Heater Performance to international benchmarks
- Initial estimates of *potential gas* savings from introduction of standards and labelling

Progress to date

Ministerial Meetings on Gas Conservation

- Three meetings took place in the month of October.
- PSQCA, PCSIR and NEECA were invited along with several other government entities like Gas Companies.
- Energy experts from various organisations also attended these meetings.
- Focus remained on gas conservation including gas appliances.
- Gave PSQCA the task to develop MEPS within 10 days of third meeting.
- NEECA to develop labels within 6 weeks of MEPS development.

Progress to date

- **5th November: At HIMA^Verte Office Present outline proposals for water heater regulation and test methods**
  - Present options for water heater improvements and estimate potential savings/benefits
  - Agree performance parameters and associated MEPS for “typical products”
  - Agree required revisions of water heater test method

- **15th November: Delivery of draft proposal to PSQCA for Circulation to Working Group/Stakeholders:**
  - Proposed MEPS for Water Heaters by major “capacity buckets”
  - Proposed revised testing methodology for gas storage water heaters

- **Mid December:**

Gas Storage Water Heaters: A test method was agreed by all stakeholders and published by PSQCA as PS 4858 (2021). This test method also includes a NEECA annexure on labels specifying Star levels. NEECA is yet to confirm if this has been ratified by competent authorities.

Performance Levels for Gas Storage Water Heaters

Gas Storage: Proposed MEPS by CLASP/Himaverte

Heat Loss

Current MEPS	BAT	BAU	Proposed MEPS
10%/hour *4.4%/hour*	0.5%/hour *~0.3%*	7-10%/hour *3.5-4.4%/hour*	**2%/hour** **~0.8%/hour**

Pilot light

Current MEPS	BAT	BAU	Proposed MEPS
0.59kW/h	0 or 0.07kW/h	0.1-0.4kWh	**0.1kWh**

Thermal Efficiency

Current MEPS	BAT	BAU	Proposed MEPS
65%	74%	50-65%	**70%**

Gas Storage: PS 4858 Rev 2021

MEPS & NEECA Proposed Performance Levels

		1 Star	2 Star	3 Star	4 Star	5 Star
Thermal Efficiency	≤ 30 Gallons	>65%	>68%	>72%	>76%	81%
	30< Gallons ≤50					
	< 50 Gallons					
Standby Heat Loss		>10%/hour				
Pilot Light		1500 Btu/hr				

Our suggested performance levels

		1 Star	2 Star	3 Star	4 Star	5 Star
Thermal Efficiency	All Sizes	>65%	>70%	>75%		80%
Heat Loss/hour	≤ 30 Gallons	10%	3.6%		3.0%	2.4%
	30< Gallons ≤50		5.2%		4.4%	3.5%
	< 50 Gallons		5.9%		5%	4.0%
Pilot Light	All Sizes	1500 Btu/hr	340 btu/hr			Electric Only

Briefs on Gas and Electric Water Heaters

- Email to stakeholders dated 23rd December
- A brief each on Gas and Electric Storage Water Heaters was circulated
- These entail:
  - Technical Foundations
  - Improvement Measures
  - Some design options
  - Test procedures
  - Some examples of test procedures from other countries / EU

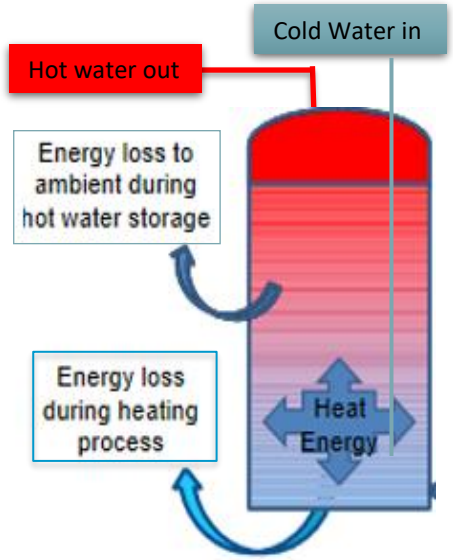
Suggestions to Improve Efficiency

Gas Storage: Suggestions to increase efficiency

Improvement options:

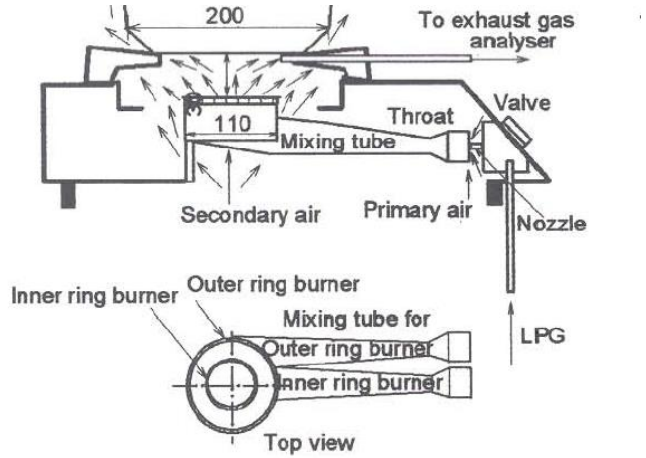
- Tank Insulation
  - Insulate tank top
  - Thicker insulation
  - “Foam/Polystyrene”

- Inlet Cold water pipe length



Gas Storage: Suggestions to increase efficiency

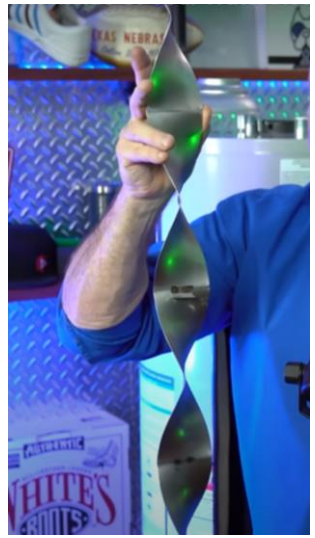
- Burner design
  - Optimisation of burner plate /tank base size / spacing
  - “Refined” burners
- Combustion chamber
  - Compact size
  - Airflow management



Gas Storage: Suggestions to increase efficiency

Flue:

- Baffle
  - Basic (zig-zag)
  - Conical baffle
  - Helix



Pilot Light

- Electric (auto) ignition
- Installation of max flow pressure valve

Presenting today

Meeting with Small group of Manufacturers'

Discussion was held with a small group of water heater manufactures on the current status of the Pakistan water heater test methods, MEPS and labelling.

- Agreed to present "finalised" test methods for gas instants and electric storage extracted from comprehensive Australian standards
- Proposals for MEPS and labelling thresholds for each
    - Both draft test method and proposed performance thresholds were circulated to all stakeholders on the 25th of February the manufacture before the workshop.
- Original plan to seek sign-off on electric storage today and give a week for comment on gas instants
- Now propose both to be tabled and discussed today, formally submitted next week if no objections/comments received.

Feedback on ***NEECA-Clasp*** Workshop For Gas Water Heater Energy Efficiency Standards

PRESENTER:

TAJAMAL SHEHZAD

MANUFACTURERS REPRESENTATIVE

DATE: 02 MARCH, 2022

Contents.

Workshop outcomes.

Testing/performance method and labs.

MEPS.

Improvement and standard implementation.

Manufacturer requirements.

Workshop outcomes

Need of the workshop (gas consumption)

Efficiency of Gas Storage Geysers.

International standards for Gas Storage Geysers.

Importance of MEPS

How to improve energy efficiency through Baffle/Spiral strip/Pre-heat

Testing performance method and labs

Testing and performance workshop at PCSIR Lahore.

Labs requirements

1. In-house labs establishment approach
2. PSQCA lab and testing approach

MEPS

Proposed

Gas Instantaneous Water Heater	*Thermal Efficiency*
MEPS/1*	**70%**
2*	**75%**
3*	**80%**
4*	**85%**
5*	**90%**

Suggested

Gas Instantaneous Water Heater	*Thermal Efficiency*
MEPS/1*	**65%**
2*	**70%**
3*	**75%**
4*	**85%**
5*	**90%**

Improvements and Standards Implementation

1. Experimentation of three different models
2. Improvement of Burner Design
3. Auto Ignition
4. Improve insulation
5. Inside coating to avoid rust.

Manufacturer Requirements

1. Labs establishment
2. Enhance NEECA scop in terms of testing and validation product
3. Investment on technology
    1. Burner
    2. Heat exchanger
4. Reconsider import duties on specific parts/materials

Thank You.

Draft technical regulations for electric storage & instantaneous water heaters (Test Methods and Performance Requirements)

Stuart Jeffcott

HIMA^Verte

clasp
Efficient Appliances for People & the Planet

What performance parameters to regulate

- Electric Storage Water Heaters
  - Heating Efficiency
  - Heat loss (rate)

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- Gas Instantaneous Water Heaters
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  - Start-up Consumption
  - “Cool down” Waste
  - Pilot Light

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  - Start-up Consumption
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- Gas Instantaneous Water Heaters
  - Thermal Efficiency: Critical parameter for most energy use ✓
  - Start-up Consumption: Important parameter, but more complicated to measure ✗
  - “Cool down” Waste: Important parameter, but more complicated to measure ✗

Test Methods

- Many international test methods to choose from. However, choice limited by:
  - Those which test required parameters
    - For example, not based on tapping cycles with 24 hour consumption – complex tests (EU, US)
  - Those in English!

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  - AS/NZS 4692.1:2005 *Electric water heaters Part 1: Energy, consumption, performance and general requirements*.
  - AS 4552 - 2005 *Gas fired water heaters for hot water supply and/or central heating*

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  - AS 4552 - 2005 *Gas fired water heaters for hot water supply and/or central heating*

- *BUT* not do adopt full standards – both 100+ pages and too daunting
  - Proposed Standards contain all requirements for testing our desired parameters
  - Current copies maintain exact Australian number to allow cross-referencing

.

Don’t share widely

Text extracted directly from the Australian/New Zealand Standard

- Funded through purchases of standards (~$300 each)
- Approach being made to Standards Australia for approval for PSQCA to adopt
- Until approved and adopted, please do not share widely

Proposed Electric Storage Test Method – extracted from *AS/NZS 4692.1:2005 Electric water heaters Part 1: Energy, consumption, performance and general requirements*

1.1 Scope

- Storage water heaters of rated hot water delivery up to 630 L or nominal capacity up to 710 L.

- ~~Heat exchange water heaters with a heat storage volume up to 710 L.~~

- Water heaters that use electric resistive heating as the primary energy source.

[Not electric resistance "enhanced" heat pumps, solar units or direct/indirect gas]

1.4 Definitions

- **1.4.3 Casing**
- **1.4.4 Container**
- **1.4.12 Heating element**
- **1.4.13 Heating unit**
  - *Bobbin*
  - *Boosting*
  - *Main*
  - *Non-simultaneous boosting*
  - *Tubular-sheathed immersion*
- **1.4.20 Rated value**
- **1.4.24 Storage water heater**

APPENDIX B: STANDARDIZED TEST CONDITIONS
B2 TEST CONDITIONS

- **B2.1 Air temperature**
  - 20°C +/-3°C (max variation 3°C)
- **B2.2 Air movement for heat loss tests**
  - 0.25-0.5m/s (max variation 0.1m/s)
- **B2.3 Radiation**
  - Avoid it (Don't put it in the window in the sun, or next to the heater/halogen lamp….)
- **B2.6 Electricity supply**
  - Nominally 230V, +/-20% (but within the tolerance of the electrical measuring equipment)

- **B3.1 Container hot water measurement positions**
  - The magical 6 temperature measurement positions
    - *Fewer may be used if proven equivalent*
  - Measurement cable outlets
    - Anode opening/unused outlets/pressure relief openings/etc
    - *Used hot water outlet/used pressure relief value*
    - *Special hole*
- **B3.2 Container Temperature**
  - B3.2.1 Average temperature
  - B3.2.2 Temperature at cut-out
  - B3.2.3 Average core temperature
  - B3.2.1 Core temperature at cut-out

- **B3.4 Container set-up and installation**
  - Mount on platform 300-400m above ground
  - Input and output quick release fittings
  - Pressure relief value smallest possible (as close to bottom as fittings allow)
  - *Take everything else away and seal*
  - Insulate around all fitting and “holes” with 20mm of spray insulation
    - Except pressure relief value and specific fitting supplied with the container (eg alternative outlets)
- **B3.5 Electrical Connections**
  - Use only the bottom (main) heating element unless manufacturer specifies otherwise

APPENDIX B: STANDARDIZED TEST CONDITIONS
B4 Measurement accuracy and instrumentation

- **B4.1 Temperature**
  - 0.5ºK [IMPORTANT]
- **B4.2 Electrical Energy Consumption**
  - 1% at 10Wh
- **B4.3 Length**
  - 1mm
- **B4.4 Mass**
  - 1 second or better
- **B4.4 Time**
  - 1 second or better
- **B4.6 Water Volume**
  - 1% or better

- **C3.3 Heater Configuration**
  - Use element recommended by manufacturer, but not less that 1800W
- **C3.4 Temperature Requirement**
  - Run test with *core temperature* at 75°C, +/-2°C (ideally +/-1°C) – easiest with external control based on sensors

- **C3.4 The procedure!**
  - Fill the tank with cold water (and vent air) and disconnect feed pipe
  - Heat the hot water (using the bottom element) until it reaches the test temperature (75°C)
  - Allow to stabilise for 24 hours
  - Commence measurement (of power input) from a temperature control cut-out
  - Continue measure for at least 48 hours, or 4 temperature cut-out cycles (if longer).
    - Record water temperature, air temperature and energy consumption at 1m intervals for the duration of the test

APPENDIX C: DETERMINATION OF STANDING HEAT LOSS
C3 Calculations

- **Look at section, appears complicated calculation, but not…**

  Heat Loss = Energy input per period of time/Energy stored in the water (and tank construction)

  - corrected for differences in air and water temperature at start and end of test

- *Flaw No2 – value given by calculation is 24h standing heat loss in kWh – will correct to heat loss rate per hour and reissue!*

Proposed Electric Storage Performance Requirement

Proposed MEPS

Capacity	Heat Loss Per Hour at Test Temperature					
	Original MEPS					
<20	-					
20-30	-					
30-40	-					
>40	-					

Proposed MEPS

Capacity	Heat Loss Per Hour at Test Temperature					
	Original MEPS	*BAU*				
<20	-	*5.4%*				
20-30	-	*7.3%*				
30-40	-	*9.2%*				
>40	-	*11.0%*				

Proposed MEPS

Capacity	Heat Loss Per Hour at Test Temperature					
	Original MEPS	*BAU*	Typical International			
<20	-	*5.4%*	0.37%			
20-30	-	*7.3%*	0.50%			
30-40	-	*9.2%*	0.63%			
>40	-	*11.0%*	0.75%			

Proposed MEPS

Capacity	Heat Loss Per Hour at Test Temperature					
	Original MEPS	*BAU*	Typical International	Aus MEPS		
<20	-	*5.4%*	0.37%	0.55%		
20-30	-	*7.3%*	0.50%	0.79%		
30-40	-	*9.2%*	0.63%	0.81%		
>40	-	*11.0%*	0.75%	0.90%		

Proposed MEPS

Capacity	Heat Loss Per Hour at Test Temperature					
	Original MEPS	*BAU*	Typical International	Aus MEPS	BAT	
<20	-	*5.4%*	0.37%	0.55%	0.11%	
20-30	-	*7.3%*	0.50%	0.79%	0.15%	
30-40	-	*9.2%*	0.63%	0.81%	0.19%	
>40	-	*11.0%*	0.75%	0.90%	0.22%	

Proposed MEPS

Capacity	Heat Loss Per Hour at Test Temperature					
	Original MEPS	*BAU*	Typical International	Aus MEPS	BAT	Proposed MEPS
<20	-	*5.4%*	0.37%	0.55%	0.11%	1.5%
20-30	-	*7.3%*	0.50%	0.79%	0.15%	2.0%
30-40	-	*9.2%*	0.63%	0.81%	0.19%	2.5%
>40	-	*11.0%*	0.75%	0.90%	0.22%	3.0%

Proposed Labelling Tiers

Capacity (Gallons)	MEPS/1*				
<20	1.5%				
20-30	2.0%				
30-40	2.5%				
>40	3.0%				

Proposed Labelling Tiers

Capacity (Gallons)	MEPS/1*	2*	3*	4*	5*	
<20	1.5%	1.3%	1.1%	0.9%	0.7%	
20-30	2.0%	1.8%	1.5%	1.3%	1.0%	
30-40	2.5%	2.2%	1.9%	1.6%	1.3%	
>40	3.0%	2.6%	2.3%	1.9%	1.5%	

Proposed Labelling Tiers

Capacity (Gallons)	MEPS/1*	2*	3*	4*	5*	Typical International
<20	1.5%	1.3%	1.1%	0.9%	0.7%	**0.37%**
20-30	2.0%	1.8%	1.5%	1.3%	1.0%	**0.50%**
30-40	2.5%	2.2%	1.9%	1.6%	1.3%	**0.63%**
>40	3.0%	2.6%	2.3%	1.9%	1.5%	**0.75%**

Proposed Gas Instantaneouse Test Method – extracted from *AS 4552 - 2005 Gas fired water heaters for hot water supply and/or central heating*

Basic Concept

1.1 Scope

- … apply to gas water heaters with natural draught or fan assisted combustion systems, intended for use with natural gas, town gas, liquefied petroleum gas (LPG) and tempered liquefied petroleum gas (TLP) with gas consumptions not exceeding 500 MJ/h, and includes types intended for the supply of hot water at a maximum temperature of 99°C for

  (a) Sanitary, potable and drinking purposes;

So covers all types of instantaneous units within the potential domestic range, and pretty much all types of gas

1.2 Definitions

- **1.2.1 Adjustable control thermostat**
- **1.2.2 Ambient temperature**
- **1.2.4 Appliance regulator**
- **1.2.16 Capacity**
- **1.2.28 Control thermostat**
- **1.2.30 Determined gas consumption**
- **1.2.52 Gas**
  - *1.2.52.1 Natural gas (NG)*
  - *1.2.52.2 Simulated natural gas (SNG)*
  - *1.2.52.3 Town gas (TG)*
  - *1.2.52.4 Tempered liquefied petroleum gas (TLP)*
  - *1.2.52.5 Liquefied petroleum gas (LPG)*
- **….10 or so more**

Test Gas Specification

TABLE 1.1

TEST GAS TABLE

Test gas	Application	Composition percent							*Characteristics		
		Hydrogen	Methane	Propane	Propylene	Butane	Nitrogen	Air	Heating value MJ/m³	Relative density	Wobbe index MJ/m³
N	NG	-	97.5	1	-	-	1.5	-	37.8	0.571	50.0
Na		-	86	14	-	-	-	-	45.7	0.692	55.0
Nb		13	87	-	-	-	-	-	34.4	0.492	49.1
Nc		-	90	-	-	-	10	-	34.0	0.596	44.0
S		-	-	55	-	-	-	45	52.1	1.296	45.7
X	LPG	-	-	100	-	-	-	-	95.8	1.553	76.9
Y		-	-	-	-	100	-	-	125.7	2.078	87.2
Z		-	-	-	100	-	-	-	88.5	1.476	72.9
T	TLP	-	-	27	-	-	-	73	25.4	1.142	23.8
Ta		-	-	29	-	-	-	71	27.3	1.153	25.5
Tb		-	-	25	-	-	-	75	23.6	1.131	22.1
A	TG	50	-	18	-	-	32	-	23.0	0.619	29.2
B		65	-	7	-	-	28	-	14.5	0.423	22.2
C		28	-	18	-	-	54	-	20.3	0.817	22.5
D		50	-	15	-	-	35	-	20.2	0.602	26.0

* The reference conditions for the characteristics are 15°C, 101.325 kPa, Dry. The test gases shall be of a composition and of combustion characteristics as shown in the table. Where base gases of the required combustion purity are not available suitably blended gases of the same Wobbe index and other combustion characteristics may be used. In case of dispute gases strictly shown in the table shall be used.

NOTE: The listed characteristics for test gas 'Y' are based on the properties of iso-butane.

- **3.1.1 Test Gases**

  (c) *[example]* Appliances intended for use with propane only shall be tested with test gas 'X'.

- **3.2.2 Setting up appliance for testing**
  - *3.2.2.1 General - set up as per manufacturers instructions*
  - *3.2.3 Appliance gas regulators not to be removed during testing*
  - *3.2.4 Protection from accidental draughts*
  - *3.2.5 Prevention of gas rate variation*
  - *3.2.6 Pressure and gas volume test equipment:*

    (a) A wet test gas meter, which shall be calibrated before use..

    (b) An adjustable regulator of adequate capacity fitted to the meter inlet.

    (c) Pressure gauges connected to meter inlet, appliance inlet and pressure test point, to read to the nearest 10 Pa.

    (d) A thermometer, graduated to at least 0.5°C installed to measure the gas temperature. The meter water temperature gives a sufficiently accurate figure.

    (e) A barometer, to measure atmospheric pressure in the laboratory correct to 30 Pa.

    (f) A means of determining within l% the heating value of the gas being used.

    (g) A means of determining within 2% the relative density of the gas being used.

- **B52.2 METHOD**
  - The efficiency is determined by measuring the heat supplied in the delivered water by measurement of temperature rise and flow rate, and comparing this with the metered heat input in the gas consumed.

- **B52.3 APPARATUS**
  - …
  - *4 Test room with ambient temperature controlled to 20°C ±1°C*
  - …

- **B52.4 MATERIALS**
  - …
  - *2 Water supply at 15°C ±1°C.*

- **B52.5 PREPARATION OF APPARATUS**
  - …
  - *2 Fit temperature sensors in the water connections as close as possible to the water inlet and outlet.*

- **B52.6 PROCEDURE**
  - *B52.6.1 Thermal efficiency*

1 Operate the appliance.

*2 Adjust the water flow rate through the appliance **[to achieve a 45°C output]** as follows:*

(i) Non thermostatic

(ii) Thermostatic/Temperature controlled

3 When conditions are steady, and not less than 10 minutes after lighting, start the test.

4 At the instant water is diverted to storage vessel, note gas meter reading and commence timing.

5 Pass a mass of water through the appliance of

(i) approximately 70 kg if nominal gas consumption is greater than 40MJ/h;

(ii) approximately 25 kg if nominal gas consumption is 40 MJ/h or less.

6 Record hot and cold water temperatures continuously during the test.

7 At the instant water is diverted to waste, note final gas meter reading and elapsed time.

8 Determine the volume of gas used.

9 Determine mass of water collected.

10 Determine average water temperature rise during the period of the test.

- **B52.7 CALCULATIONS**
  - *B52.7.1 Thermal efficiency*

    The thermal efficiency is given by the formula:

$$\text{thermal efficiency } (E)\% = \frac{W \times (T_2 - T_1) \times K \times 100}{C \times Q \times 1000}$$

    where

    W = mass of water in kg

    T1 = initial water temperature in °C

    T2 = mean outlet water temperature in °C

    K = specific heat of water (4.186 kJ/kg °C)

    C = heating value of gas in MJ/m³

    Q = corrected volume of gas used in m³ (see Appendix E)

Proposed Gas Instantaneous Performance Requirement

Proposed MEPS

Thermal Efficiency				
Original MEPS				
65%				

Proposed MEPS

Thermal Efficiency				
Original MEPS	BAU			
65%	65-72%			

Proposed MEPS

Thermal Efficiency				
Original MEPS	BAU	*BAT*		
65%	65-72%	*87.5%*		

Proposed MEPS

Thermal Efficiency				
Original MEPS	BAU	*BAT*	Korea	
65%	65-72%	*87.5%*	73%	

Proposed MEPS

Thermal Efficiency				
Original MEPS	BAU	*BAT*	Korea	Proposed MEPS
65%	65-72%	*87.5%*	73%	70%

Proposed Labelling Tiers

	Thermal Efficiency		
Label Threshold	Original	Korea	Proposed Thresholds
*MEPS/1**	-	73%	70%
*2**	-	78%	75%
*3**	-	83%	80%
*4**	-	88%	85%
*5**		93%	90%

Next Steps

Salman Zaffar