

Second Workshop on Potential Standards and Labelling for Water Heaters in Pakistan

Welcome



Efficient Appliances for People & the Planet

WORKSHOP PROGRAMME

11.00 – 11.10 am

Round of Introductions

11.10 – 11.30 am

Welcome Note – Background on national demand/supply of natural gas and briefing on planned actions by NEECA
Dr. Sardar Mohazzam – Managing Director, NEECA

11.30 – 11.40 am

Feedback from previous workshop
Amna Shahab - Consultant, CLASP

11.40 – 12.00 pm

Household and national level modelling of energy consumption of water heaters.
Muhammad Salman Zaffar – Technical Lead, CLASP

12.00 – 12.30 pm

Regulatory options and proposed performance levels.
Stuart Jeffcott – Team Leader, CLASP

12.30 – 12.45 pm

Question and Answer session

12.45 – 1.15 pm

Lunch and informal chat

Recap from the first workshop

(which was held at AVARI Lahore – 23rd September)

Ali Habib



Efficient Appliances for People & the Planet

WORKSHOP PROGRAMME

11.00 - 11.10 am

Round of Introductions

11.10 – 11.30 am

Welcome note (Background, & briefing on planned actions by NEECA on efficiency of Water Heating Appliances)

Manager Technical – Unit II, NEECA, Mr. Muhammad Umar

11.30 – 11.50 am

Current Market Dynamics of Water Heaters in Pakistan

Muhammad Salman Zaffar, Technical Lead, CLASP

11.50 – 12.15 pm

Introduction to CLASP - Benefits of MEPS, using 'Labelling'

Stuart Jeffcott – Team Leader, CLASP

12.15 – 12.30 pm

Briefing about workshop planned for 4th October in Islamabad

Ali Hassan Habib, National Team Leader, CLASP

Asad Mehmood, Manager Technical, NEECA

12.30 – 12.45 pm

Q and A session

12.45 – 1.15 pm

LUNCH and informal chat

To engage and establish a relationship between the manufacturers of water heaters and CLASP / NEECA to:

- Provide a background of current work on water heaters and why the need has arisen (mainly gas shortage)
- Introduce the audience to the concept of MEPS and Labelling and share some international examples, emphasising the importance for Pakistan.
- Introduce water heater suppliers to the government's desire to establish MEPS and labelling for Water Heaters.
- Establish if there were any key barriers to such regulation prior to publicising to a wider stakeholder group.

Broad agreement was reached on the following:

- Existing PSQCA standards (for gas storage and instants) are weak by modern standards *and* are not effectively enforced.
- There is significant space to improve the efficiency of all types of water heaters in Pakistan. Some areas for improvement are:
 - Need to improve burner efficiency
 - Tank's efficiency/ gauge

- Manufacturers were generally supportive of the idea of NEECA mandatory standards and labelling as a route to drive improvements in product efficiency, although the following caveats were raised:
 - Any regulatory requirements should not impact current year sales as the majority of products for the 2021/2 water heating season have already been produced
 - Required product performance improvements should be phased in over time to allow manufacturers to develop the appropriate skills

CLASP responded to both of the above points that all regulation takes a period to develop and implement. While it is clearly NEECA's decision on such matters, it is unlikely regulations will be finalised before the end of December and will hence miss this water heating season.

Further, if deemed appropriate, such regulations can include incremental steps to improved efficiency over time (eg efficiency improvements through simple actions on burner efficiency and insulation immediately, with broader basic design revisions in the future). Such a phased introduction is used in the new NEECA regulations for motors.

- Careful consideration should be given to how to ensure the smaller (artisan) suppliers are included in any proposed compliance regime to ensure price differentials are not increased and unintended migration to less efficient products occurs.

CLASP noted the introduction of mandatory labelling will help identify non-compliant products, and differentiate the better performing units hence justifying potential price differentials.

- Additional Government policy is likely to assist in any transition, for example:
 - Reduced duty on high efficiency component parts/products.
 - Development of labs and test methodology to verify the efficiency of water heaters.
- Consideration should be given to the wider policy issues related to efficient gas use. For example, encouraging a shift in space heating to reverse cycle AC units. However, such promotion should be accompanied by actions to improve the efficiency of those products

- Since Covid-19 it was difficult to conduct physical meetings with the manufactures. This consultative meeting was successful in establishing a relationship between the CLASP team and manufacturers / large traders of Water Heaters.
- The manufactures were given a detailed account of the background of work on water heater including what we know about the market so far. The workshop was able to generate enough interest for key stakeholders to show keenness to stay part of the process and attend future meetings on the subject like today where we will present some scenarios.
- The manufacturers overall showed their support and interest to develop the efficiency standards and their labelling regime.



Thank You

Water Heaters in Pakistan

The Current Situation

Muhammad Salman Zaffar



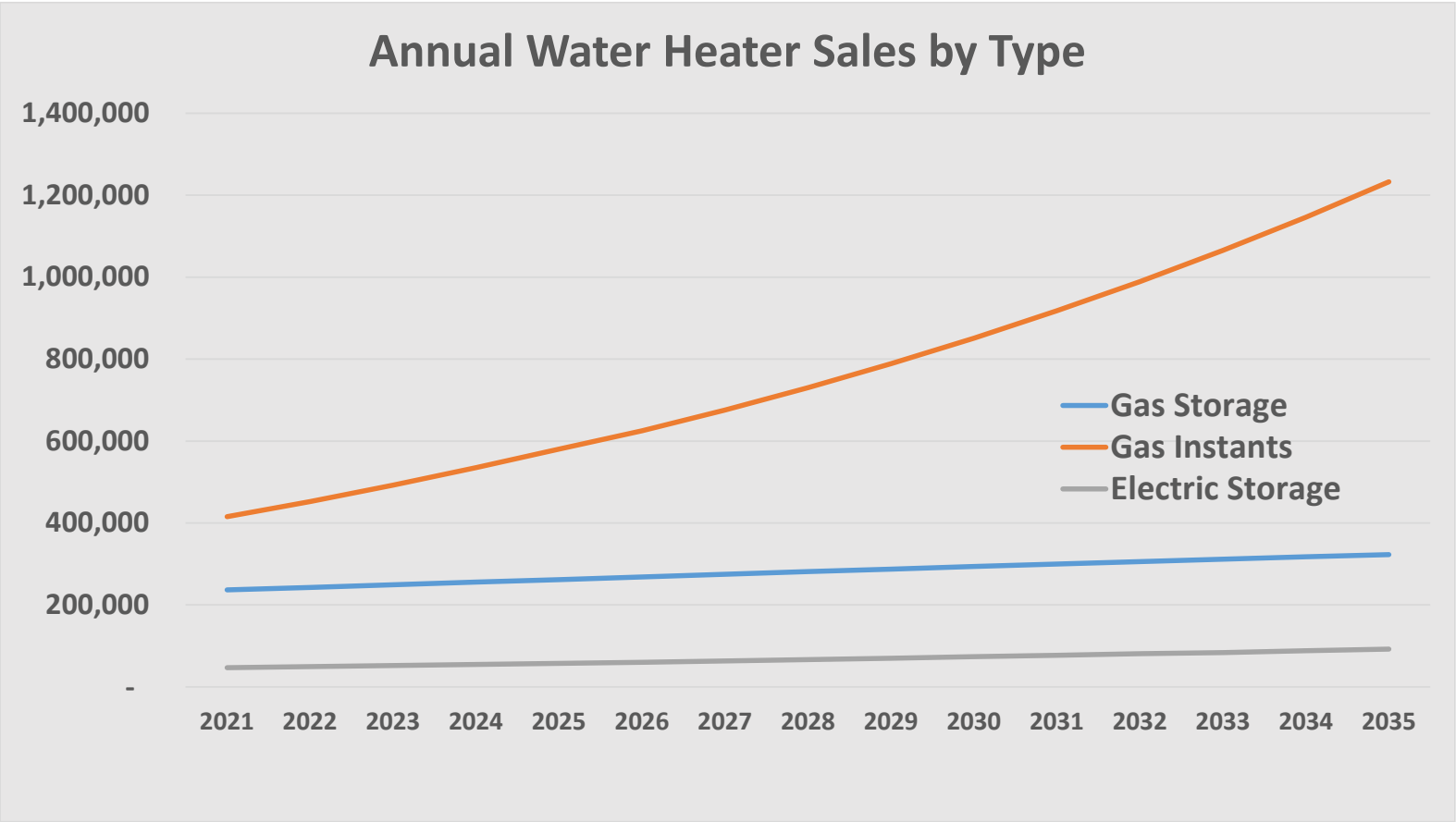
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- Current and projected water heater **stock** and **sales**.
- Current water heater performance in Pakistan for one household:
 - **Conceptual** water heater energy consumption.
 - **Assumptions** used in modelling water heaters in Pakistan.
 - Estimated **current** energy consumption of water heaters in Pakistani homes by type.
- Total (for all households) current **and projected** “Business as Usual” national energy (and gas) consumption of water heaters.

Current and Projected Water Heater Sales and Stock

- An assumed market growth of **4-5%**
- From 2015, significant migration towards instantaneous
- Average household installations:
 - 1.5 Gas Storage, *or*
 - 2.25 Gas Instantaneous , *or*
 - 1.5 Electric Storage , *or*
- Product lifetime of products
 - Gas storage – 20 years
 - Gas Instant – 5 years
 - Electric – 12 years

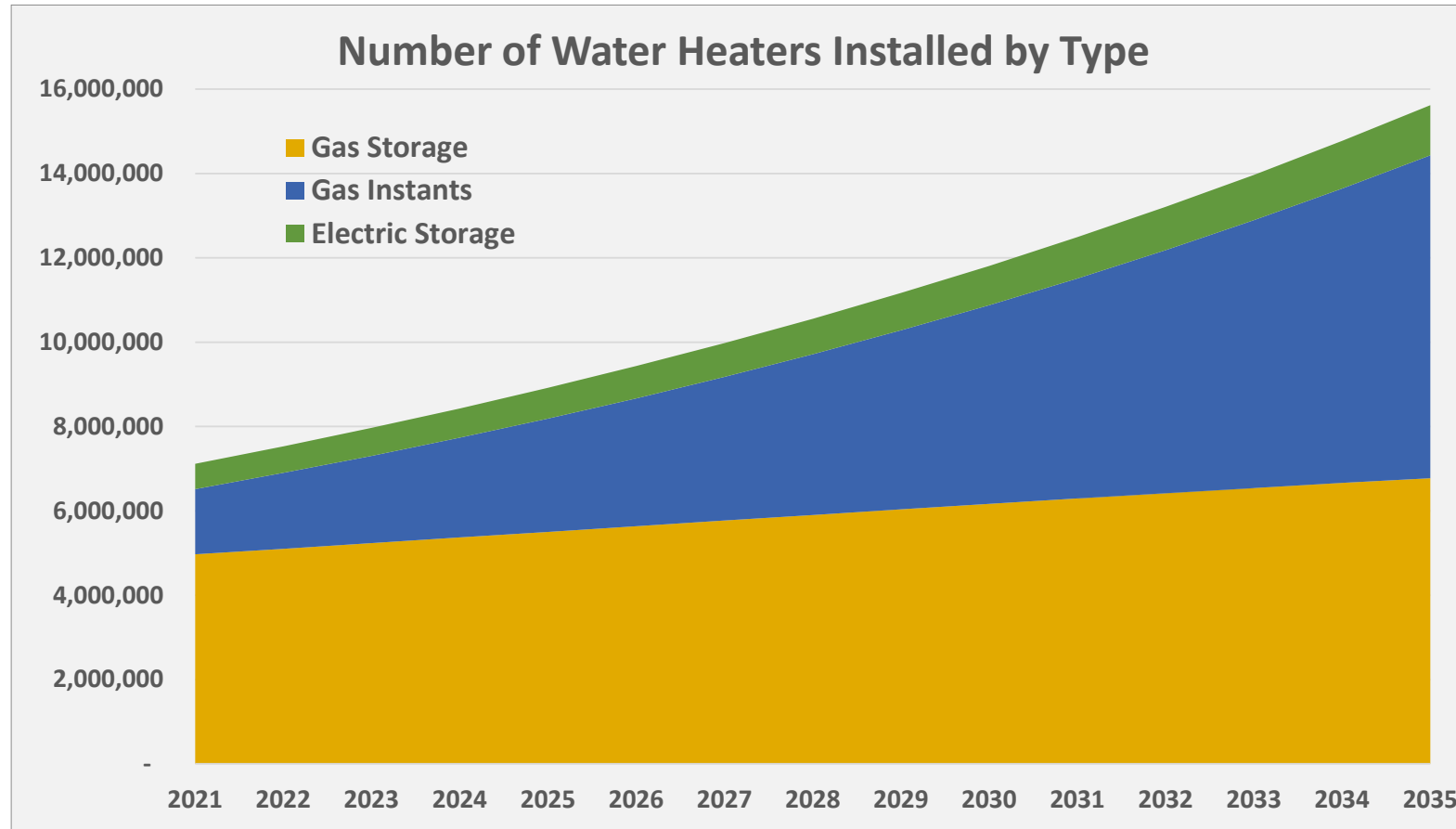
Unit Water Heater Sales Projections



If current trends continue, unit *sales* increase:

- 2015: 375,000
- 2020: 550,000
- 2025: 900,000
- 2030: 1.2m

Unit Water Heaters Installed (Stock)



Despite shorter lifetime of instantaneous units, overall installations still rise rapidly:

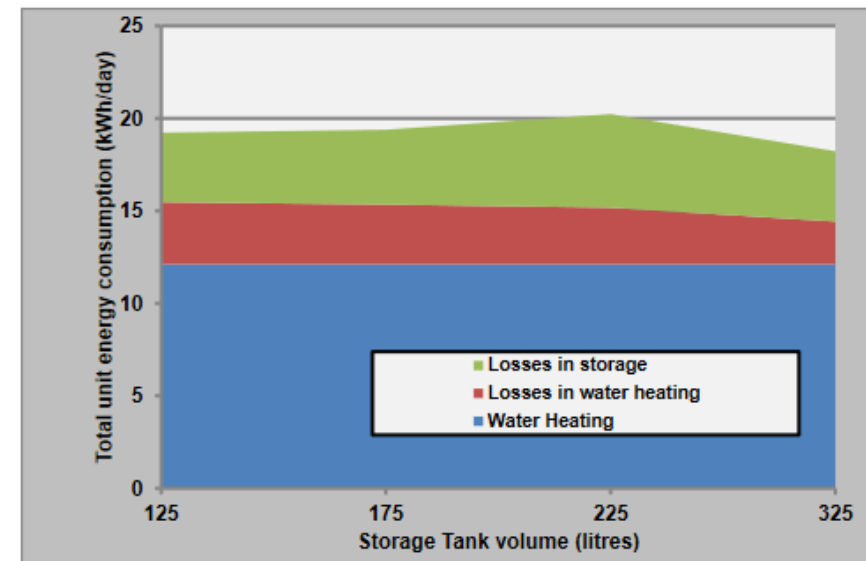
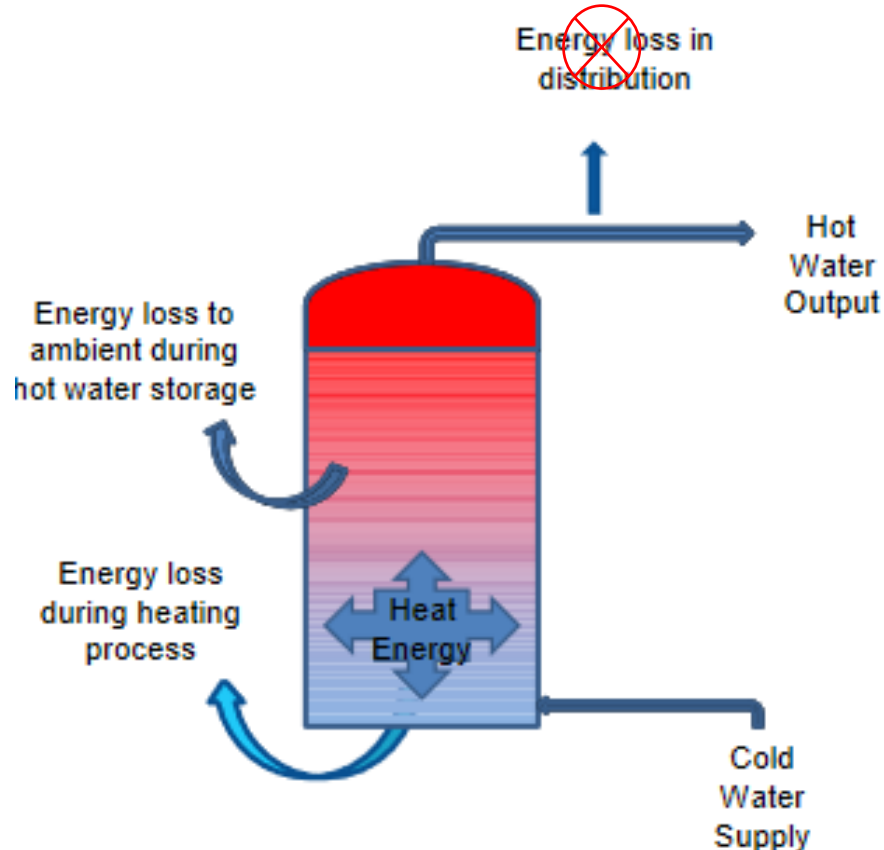
- 2015: 5.0m
- 2020: 6.7m
- 2025: 8.9m
- 2030: 11.8m

Current Water Heater Performance

Current Consumption of ALL types of water heater

Individual Water Heater Consumption =

- Energy embodied in the heated water
 - $\text{Mass of water} \times \text{SPC water} \times \Delta T$
- Energy lost in heating
 - Inefficiency of the heating process
 - “Start-up”/Warm-up energy
 - Pilot light
- Energy lost in Storage



Assumptions for Business as Usual (BAU) Estimates

Typical Products



Type	"Capacity"
Gas Storage Capacity	40 gallons
Gas Instantaneous Capacity	10 L/min
Electric Storage	40 gallons

Assumptions for Business as Usual (BAU) Estimates

Operating Conditions, Use and Costs

Parameter	Assumption
Household Daily Hot Water Usage (Gallons)	80 Gallon
Number of draws per day	10 draws (10 x 8 Gallon)
Operational days per year	180 days (6 month)
Operational hours per day	24 hr
Energy Costs	Electricity: 22.35 PKR/kWh Gas: 4.98 PKR/kWh (1460 PKR/MMBTU)
Number of units per household	1.5 Gas or Electric Storage Units per household <i>OR</i> 2.25 Instantaneous Units per household
Hot Water Temperature (°C)	Storage: 45C Use: 45C
Cold Water Temperature (°C)	21C
External (Ambient) Temperature (°C)	15C

Assumptions for Business as Usual (BAU) Energy Estimates

Performance Parameters



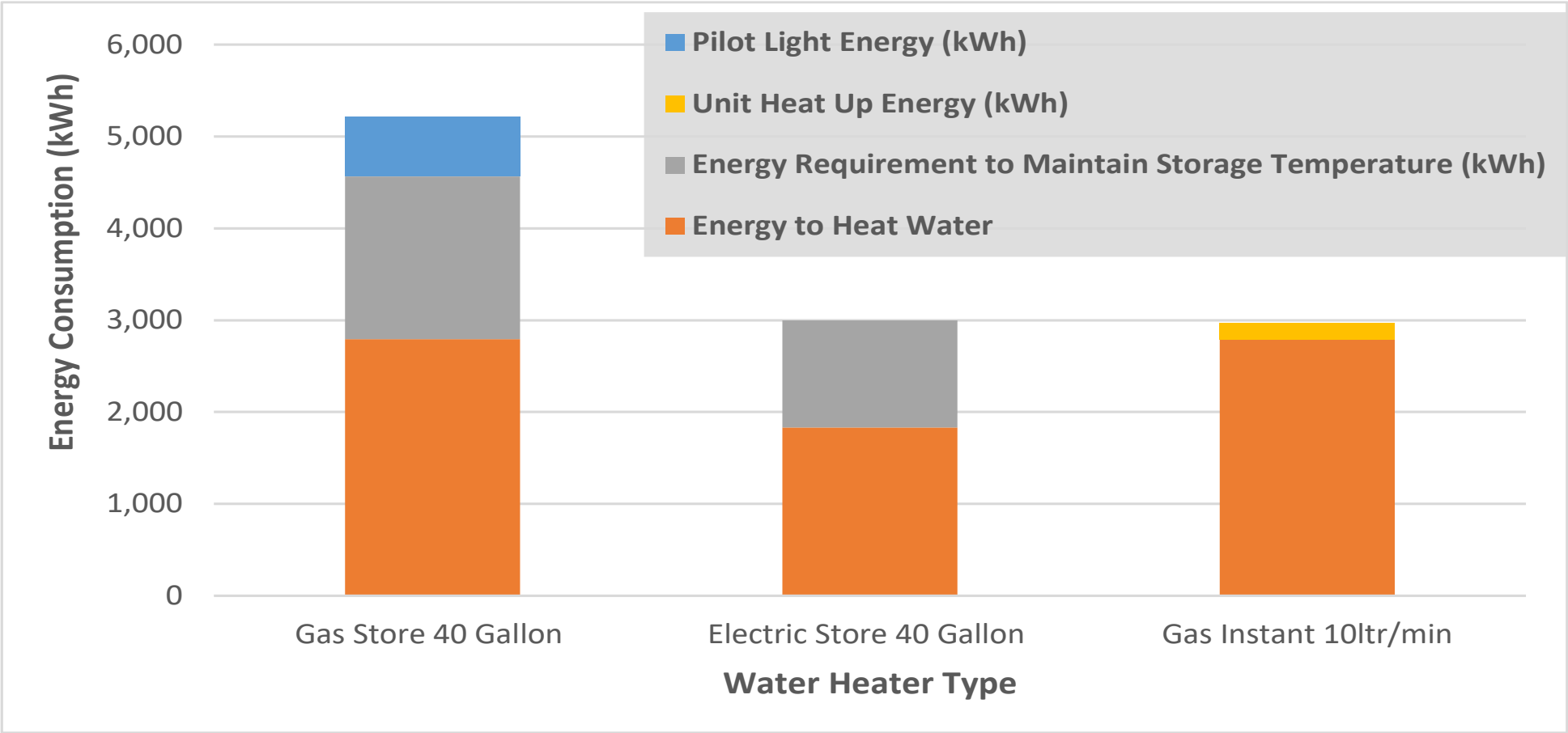
Parameter	Business as Usual (BAU)
Average Storage Heat Loss Rate (per hour)	Gas Store: 4.41% Elect Store: 4.41%
Adjustment to heat loss rate	80%
Heating (thermal) efficiency	Gas Store: 65% Gas Instant: 65% Electric Store: 99%
Heat-up energy (kWh)	Instants: 0.1kWh/draw
Pilot light consumption per hour (kWh/hour)	Gas Store: 0.1 kWh/hr <i>(assumes no electric ignition)</i> Gas instant: 0 kWh/hr <i>(assumes all electric ignition)</i> Electric: 0 kWh/hr

Estimated BAU Daily and Annual Household Energy Consumption by Type

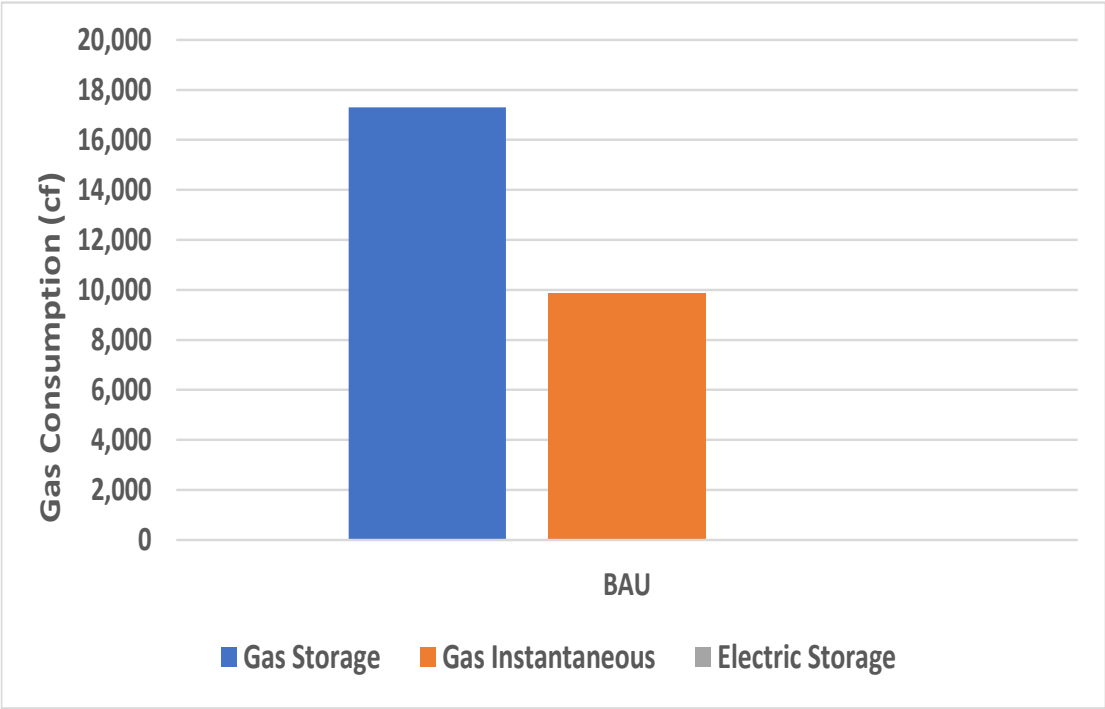
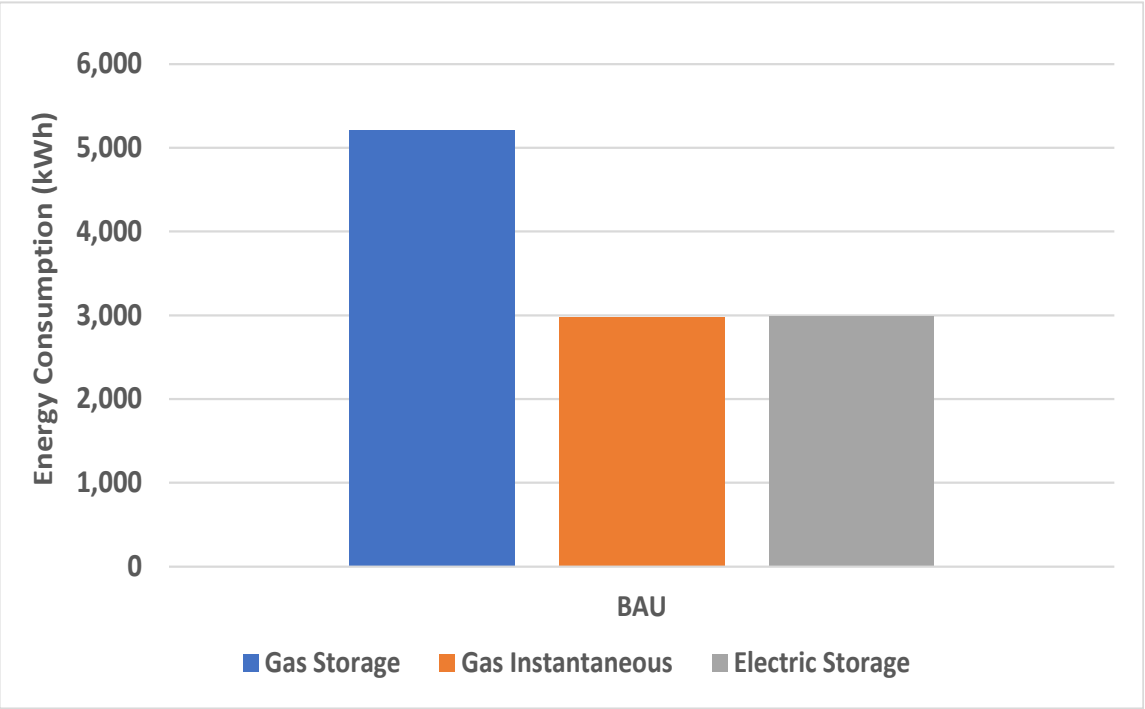


	Gas Storage (40 Gallons)	Gas Instant (10 L/min)	Electric Storage (40 gallons)
Hot water Demand (gallons)	80	80	80
Energy to Heat Water (kWh)	10.34	6.89	6.79
Energy Required to maintain storage temperature (kWh)	6.56	-	4.31
Unit Heat Up Energy (kWh)	-	0.44	
Pilot Light Energy (kWh)	2.4	-	-
Total Daily Unit Energy Consumption (kWh)	19.3	7.34	11.1
Daily Household Water Heater Energy Consumption (kWh)	28.95	16.51	16.65
Annual Household Water Heater Energy Consumption (kWh)	5,211.83	2,971.72	2,996.46

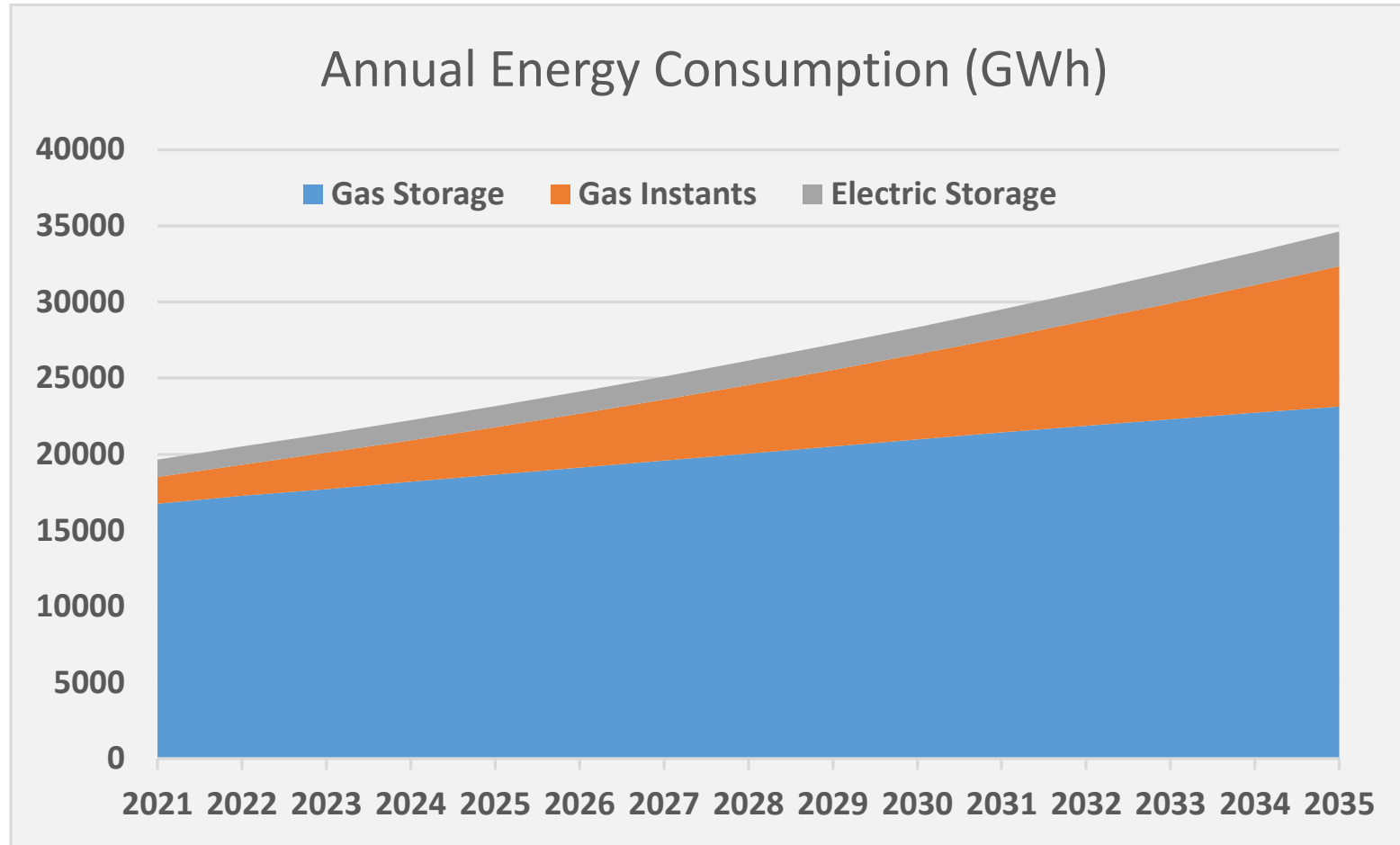
Estimated BAU Annual Household Energy Consumption by Type



Estimated BAU Annual Household Energy and Gas Consumption by Water Heater Type



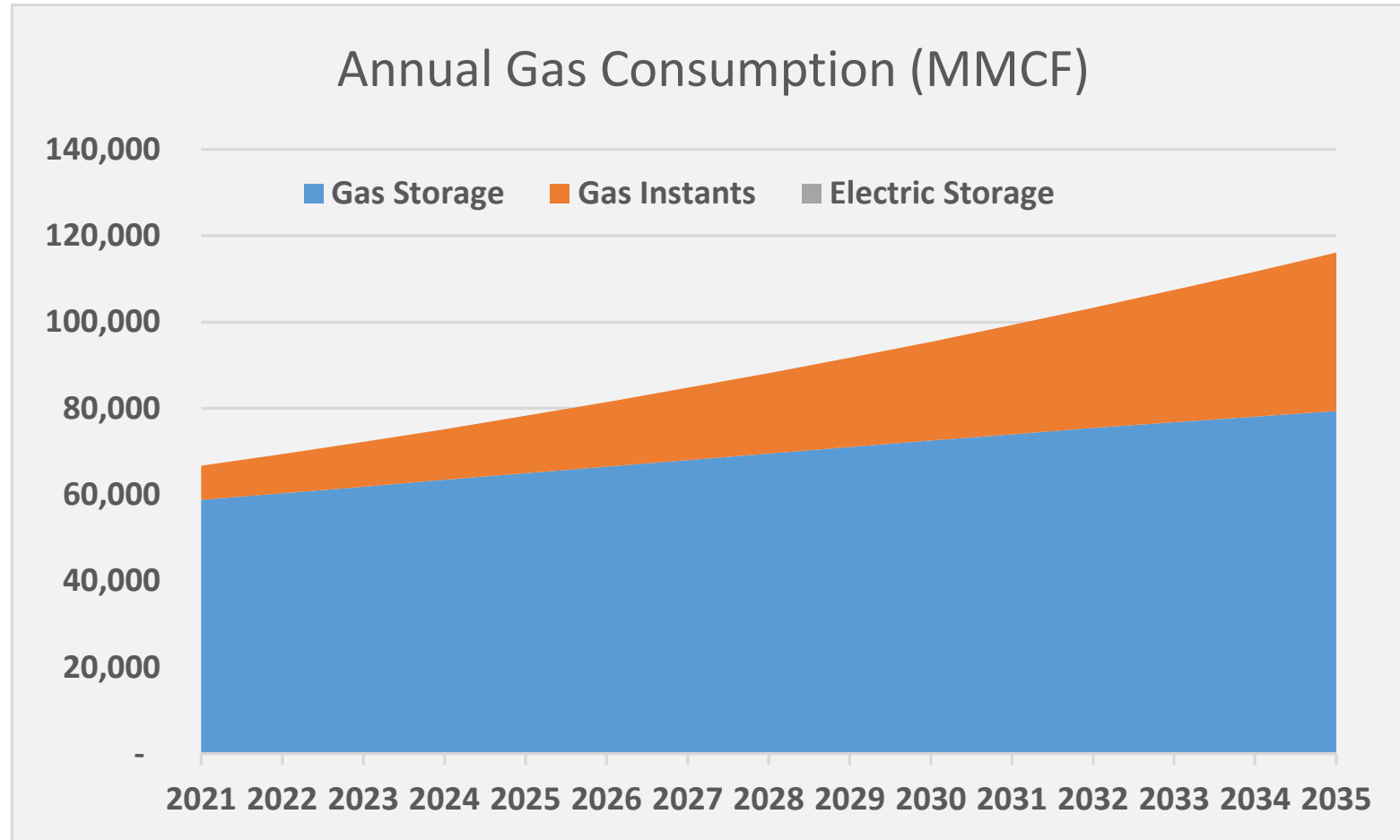
Total National current and projected BAU consumptions



Despite increasing penetration of instants, gas storage units continue to dominate energy consumption for the foreseeable future.

- Long lifetimes
- Higher energy consumptions

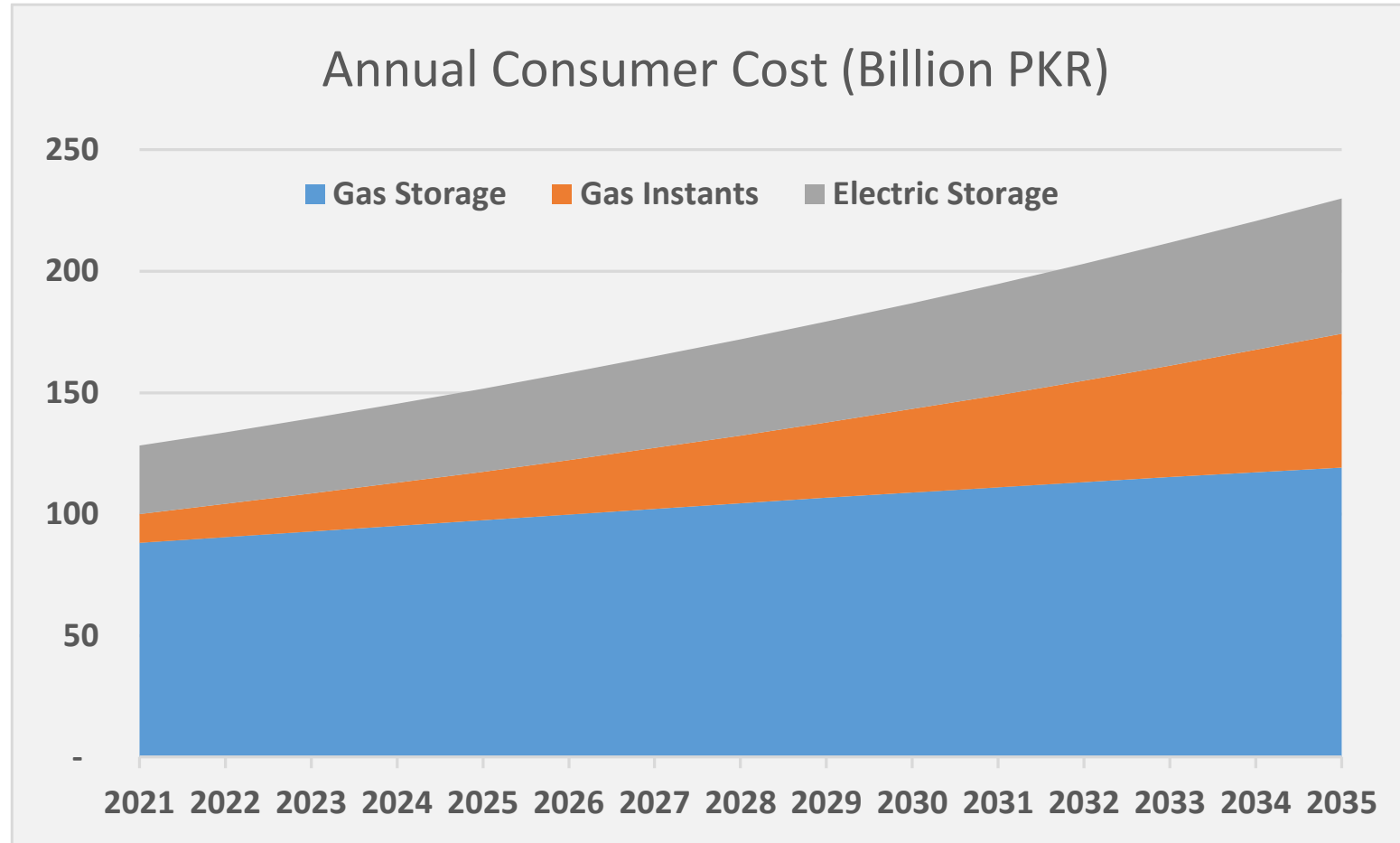
BAU GAS Consumption



Relative energy consumption directly reflected in annual gas consumption:

- 2020: 64,000 MMCF*
- 2025: 78,200 MMCF
- 2030: 95,600 MMCF
- 2035: 116,100 MMCF

- 2020 = 355 MMCF/Day
~ 6.9% PI national demand



Slight warning for policy makers who may wish to drive a switch to electric water heating

- 2020 energy consumed by electric storage units = 5.9% of total
- 2020 consumer costs of running electric storage units = 22% of total

i.e. halving electricity costs would not make electrical units cheaper to run



Thank You

International Comparison of Pakistan Water Heater Performance/Saving Potential

Stuart Jeffcott

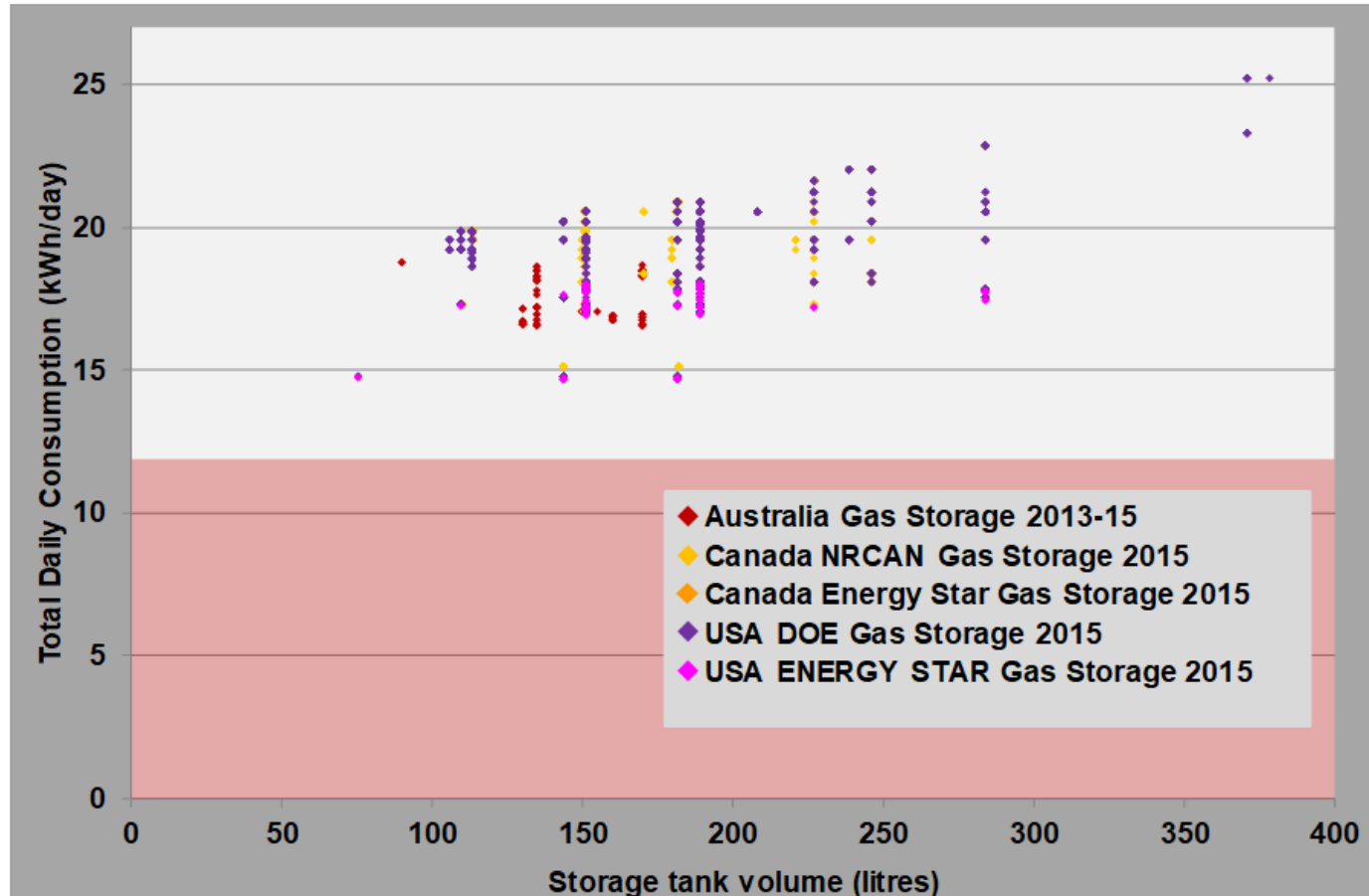


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- Comparison of Pakistani Water Heater Performance with International Equivalents
- *Potential* performance requirements for Pakistan – values to initiate discussion
- Options for regulatory approach

- International Energy Agency's 4E Benchmarking Report of 2017 compared the performance of water heating units in various countries against a defined a set of performance parameters
 - Hot and cold water temperatures
 - Number and size of hot water draws per day
 - ...
- The same parameters have been applied to the “typical” Pakistani water heaters defined earlier to give a comparison with international performance.

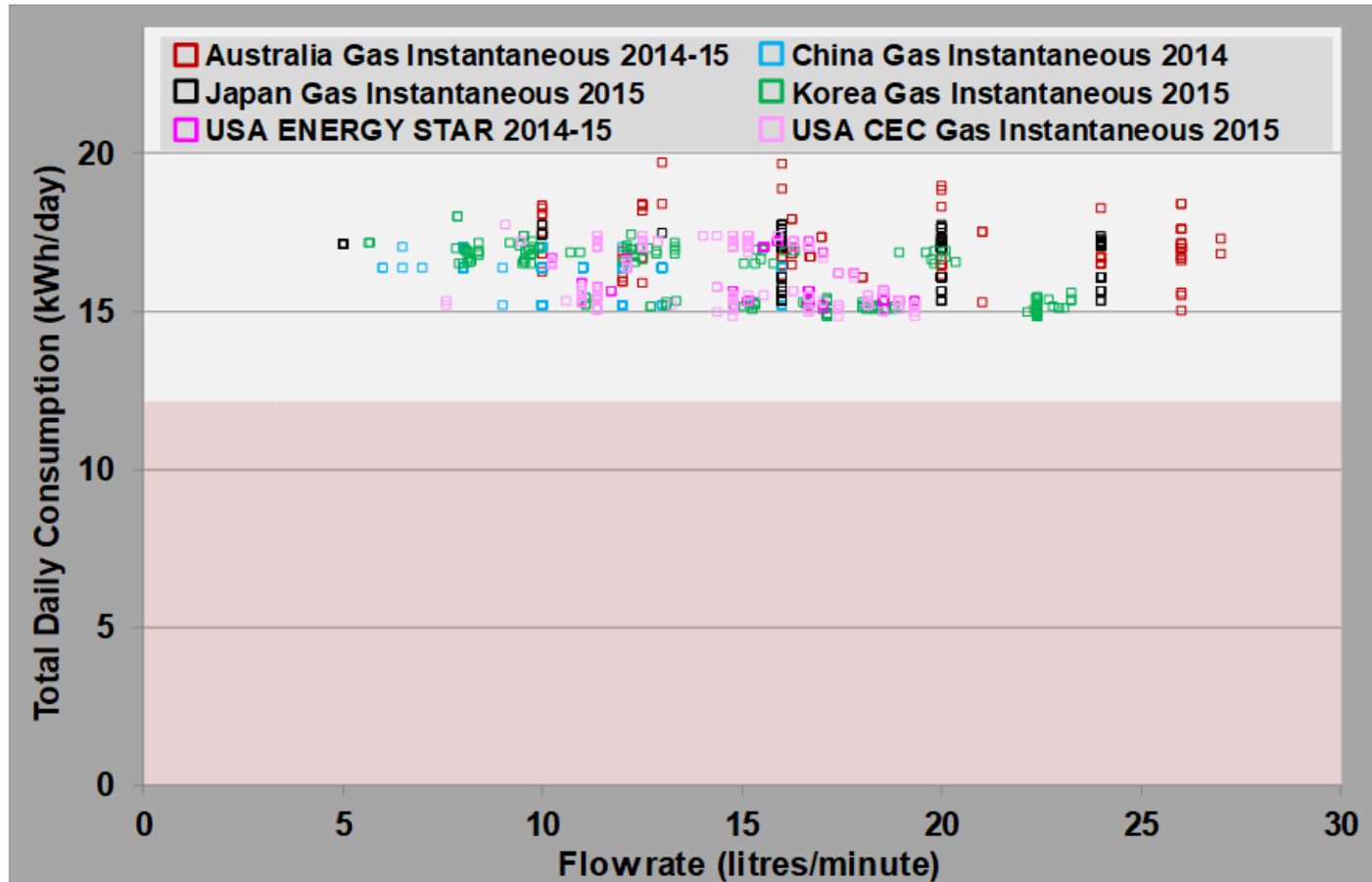
International Comparison: Gas Storage, IEA 4E Conditions



	Daily Consumption
IEA 4E Average	20 kWh
Typical Pakistani Product	41.24 kWh
Difference	+106%

**Red area actual embodied energy of hot water used*

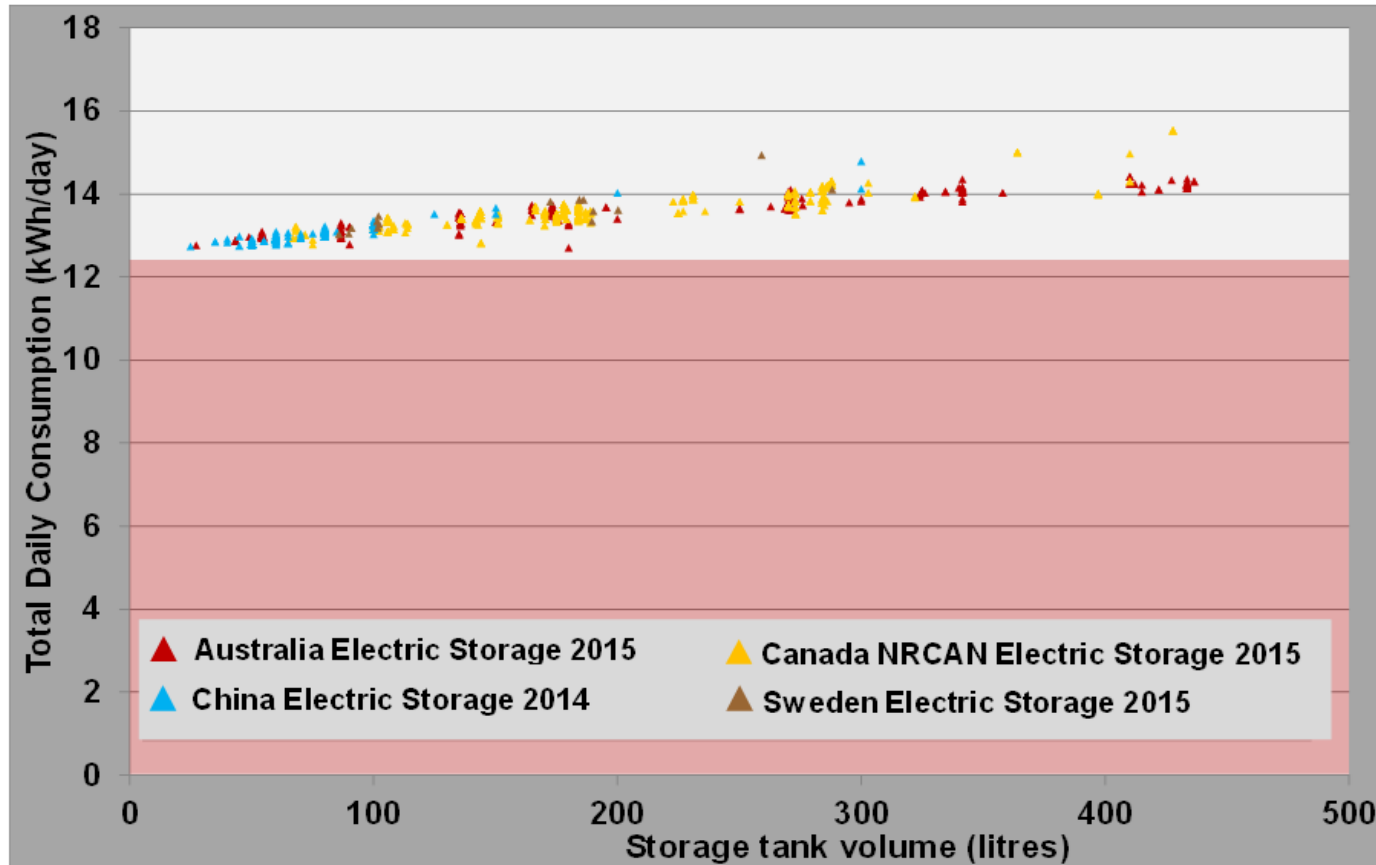
International Comparison: Gas Instantaneous, IEA 4E Conditions



	Daily Consumption
IEA 4E Average	17.5 kWh
Typical Pakistani Product	19.23 kWh
Difference	+10%

**Red area actual embodied energy of hot water used*

International Comparison: Electric Storage, IEA 4E Conditions

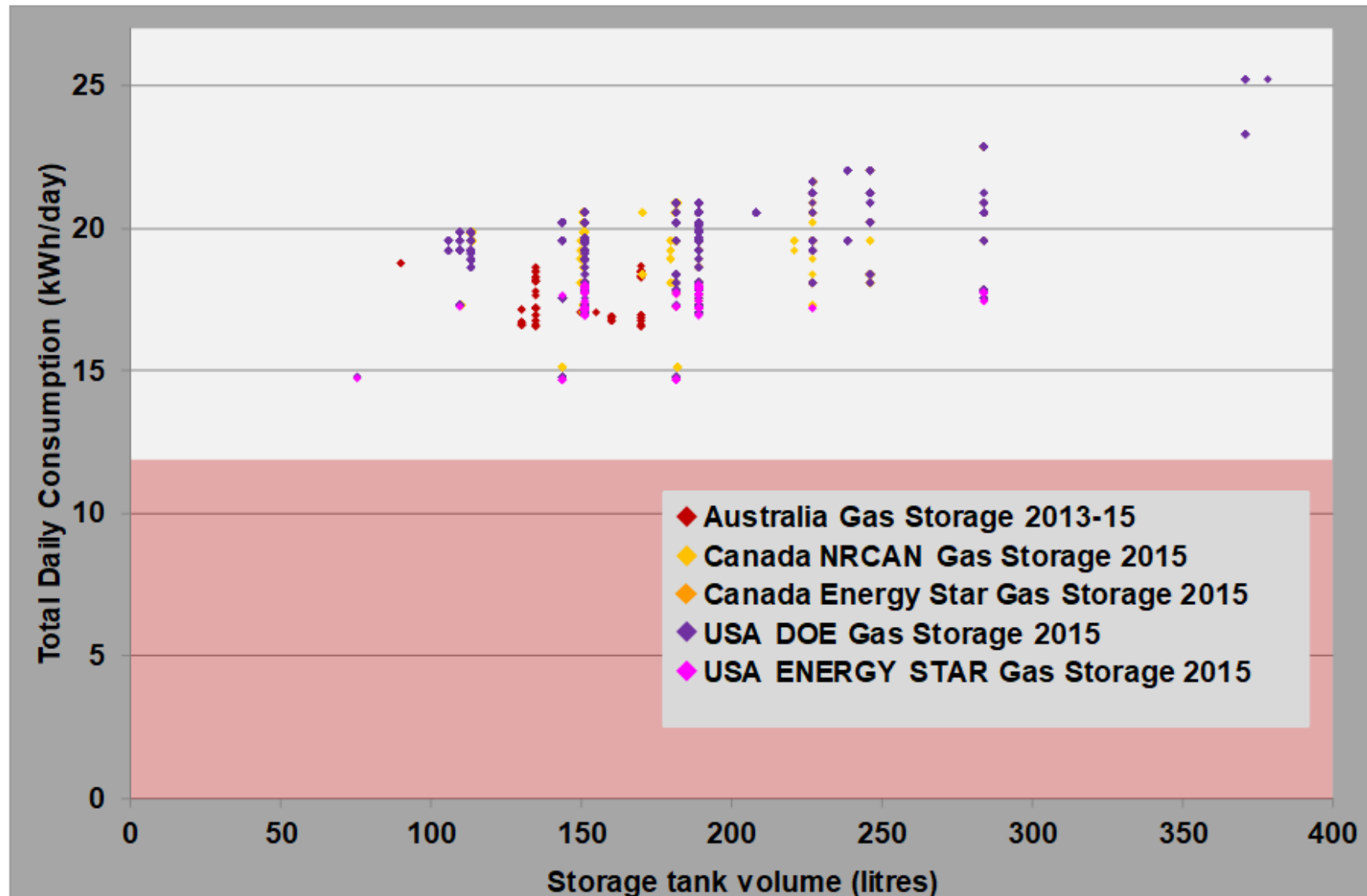


	Daily Consumption
IEA 4E Average	14 kWh
Typical Pakistani Product	25.5 kWh
Difference	+82%

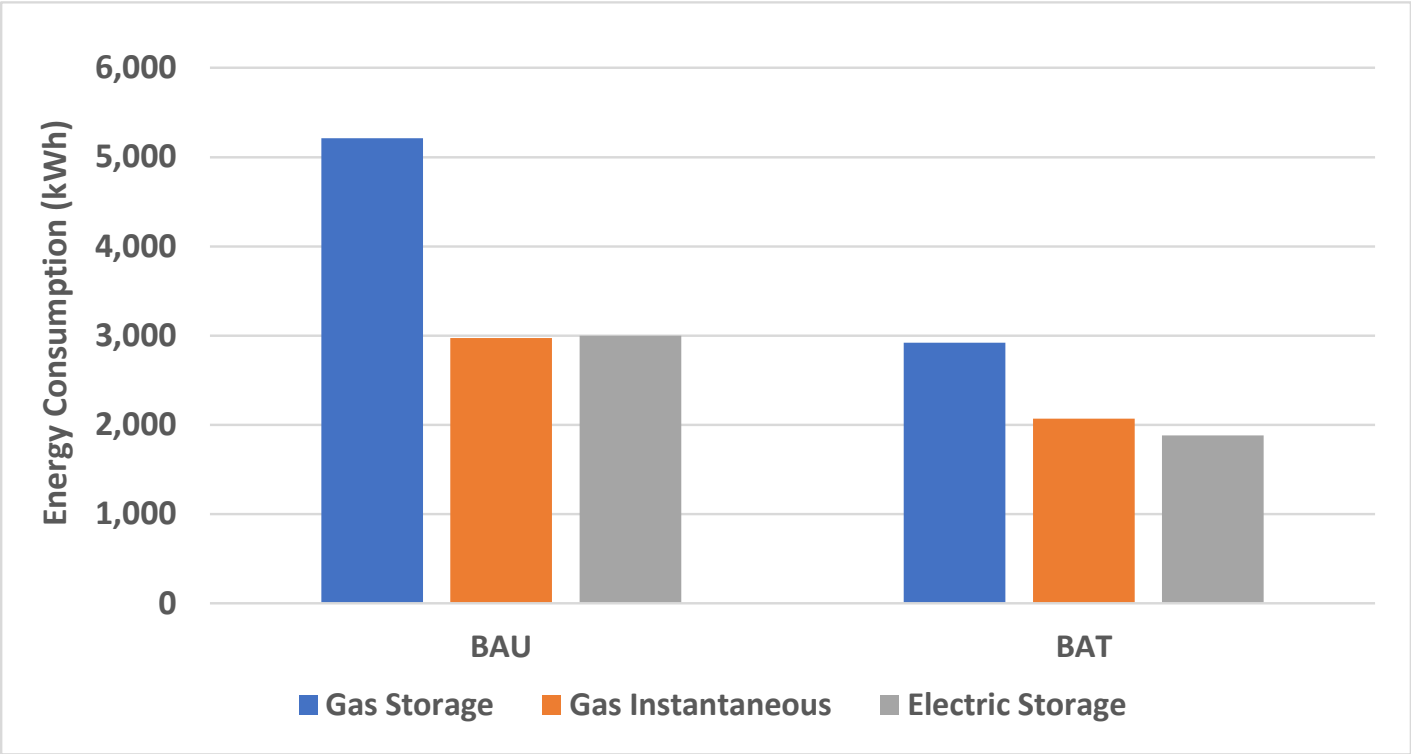
**Red area actual embodied energy of hot water used*

Initial Estimates of National Saving Potential from Water Heaters

The savings POTENTIAL: Gas Storage BAT

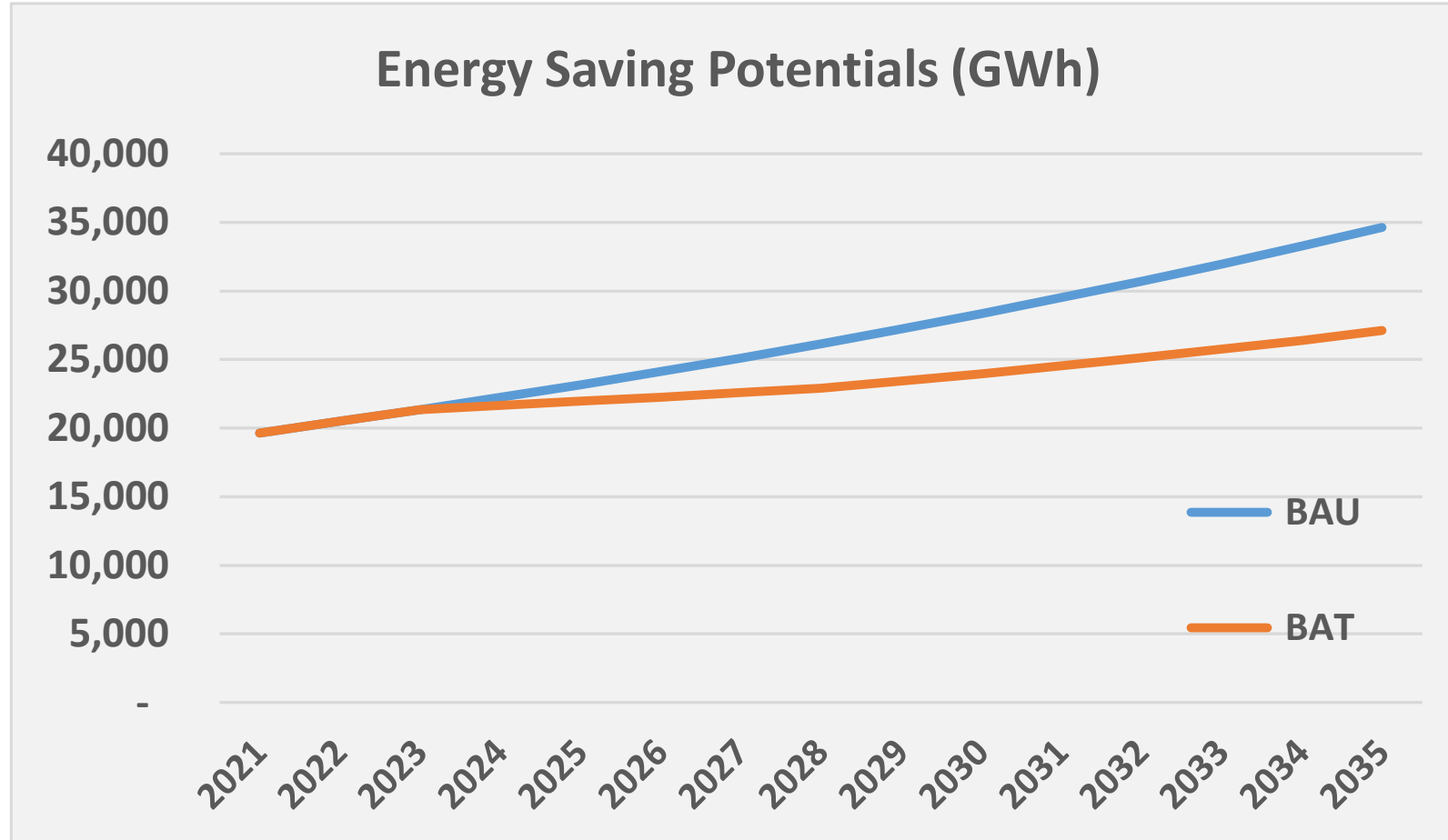


SCENARIO	Description
BAU (Business As Usual)	The performance of Pakistani water heater in the “in-use” conditions experienced in Pakistani households.
BAT (Best Available Technology)	The performance of the MOST efficient internationally available water heaters (of similar construction) in the “in-use” conditions experienced in Pakistani households. Most efficient water heaters based on most efficient products from IEA 4E Benchmarking Report for domestic gas and electric storage and gas instantaneous water heaters.



	BAU	BAT	Diff
Gas Storage	5,212	2,920	+79%
Gas Instantaneous	2,972	2,070	+44%
Electric Storage	2,996	1,882	+59%

BAU and BAT: The Potential Energy Saving Envelope



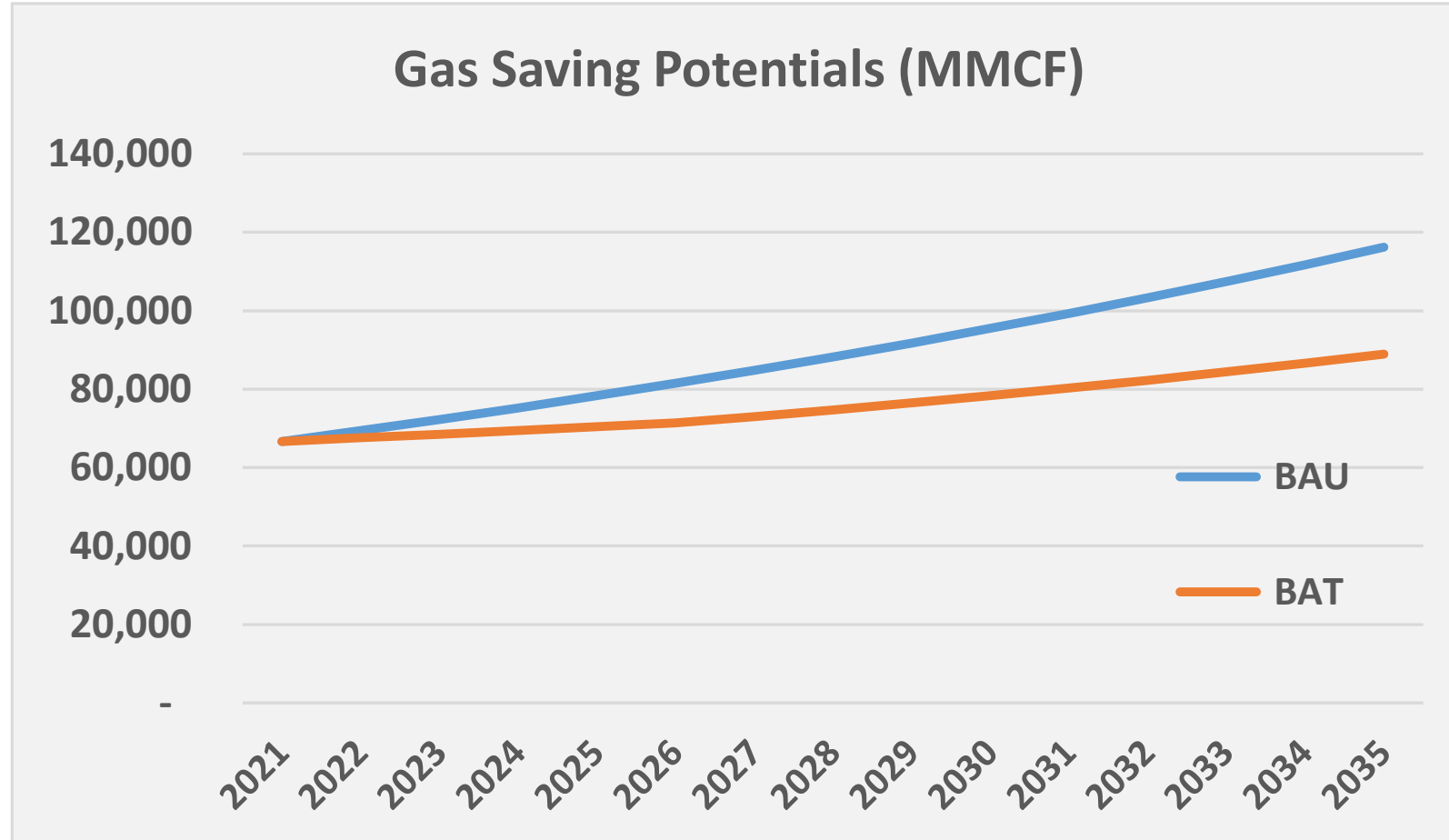
BAU vs BAT Annual Savings

- 2022: 591 GWh
- 2025: 2,534 GWh
- 2035: 8,841 GWh

BAU vs BAT Cumulative Savings

- 2025: 6,190 GWh
- 2035: 65,773 GWh

BAU and BAT: The Potential Gas Saving Envelope



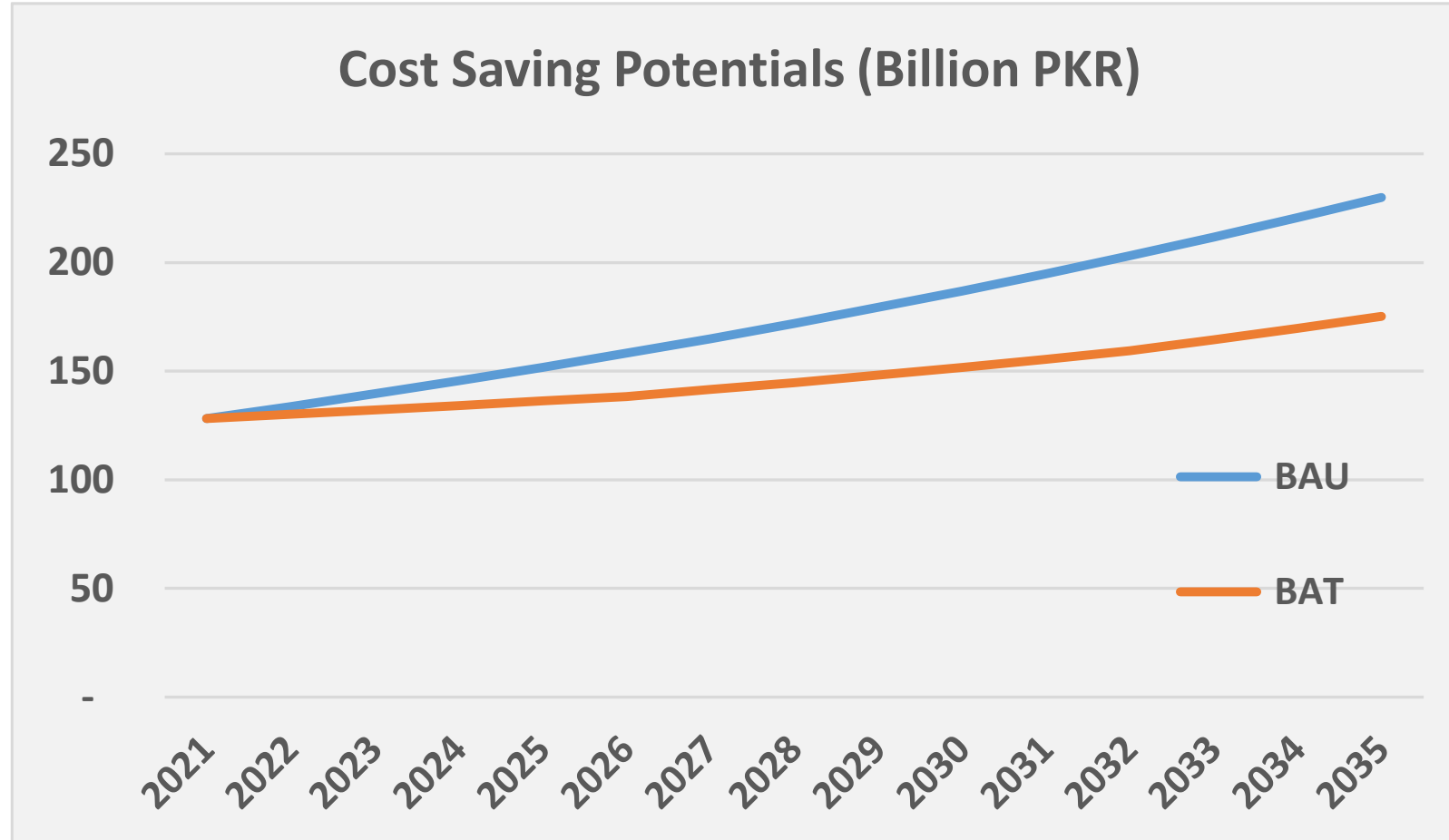
BAU vs BAT Annual Savings

- 2022: 1,834 MMCF
- 2025: 7,861 MMCF
- 2035: 27,266 MMCF

BAU vs BAT Cumulative Savings

- 2025: 19,209 MMCF
- 2035: 202,389 MMCF

BAU and BAT: The Potential Cost Saving Envelope



BAU vs BAT Annual Savings

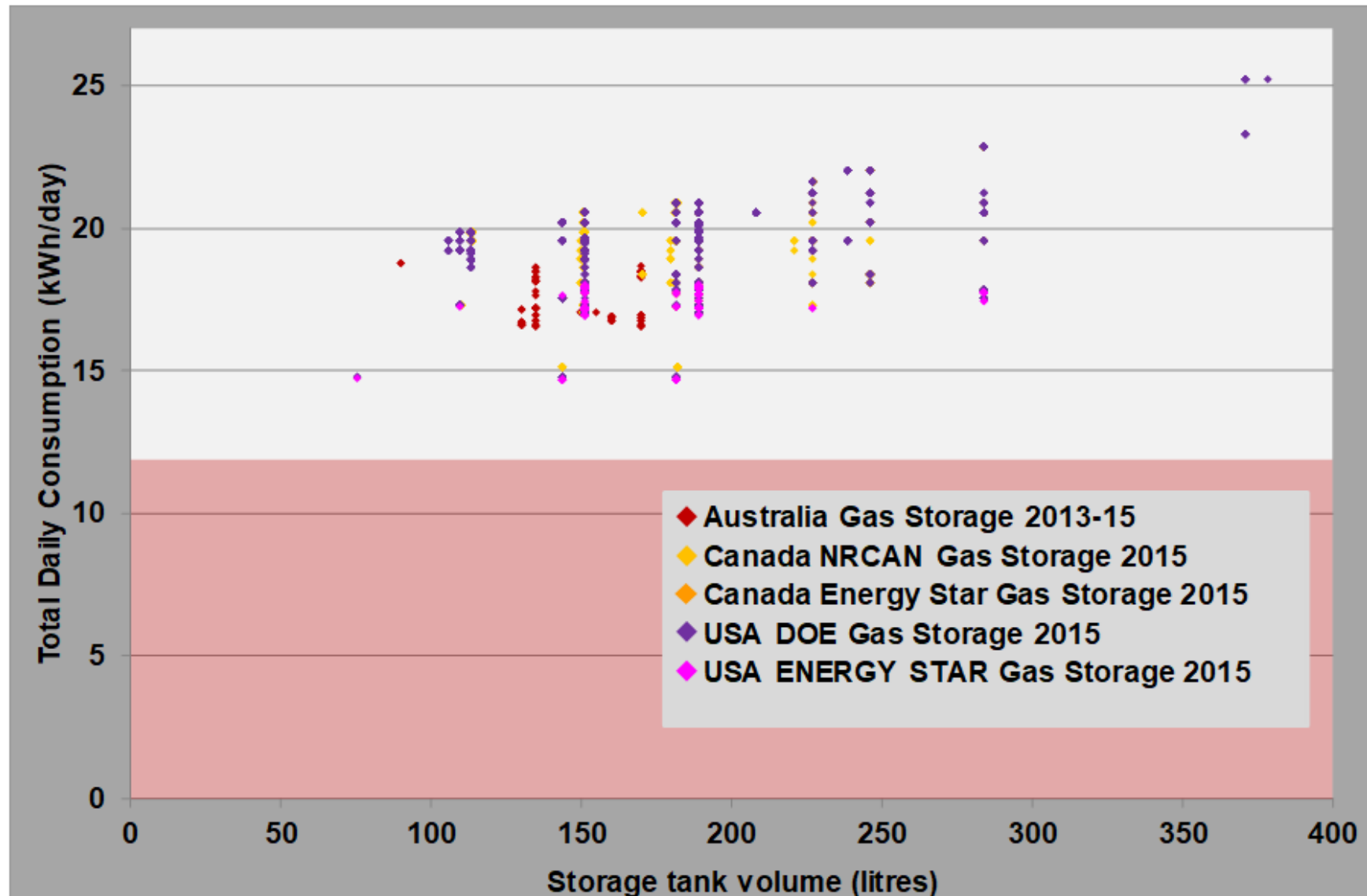
- 2022: 4 Billion PKR
- 2025: 15 Billion PKR
- 2035: 55 Billion PKR

BAU vs BAT Cumulative Savings

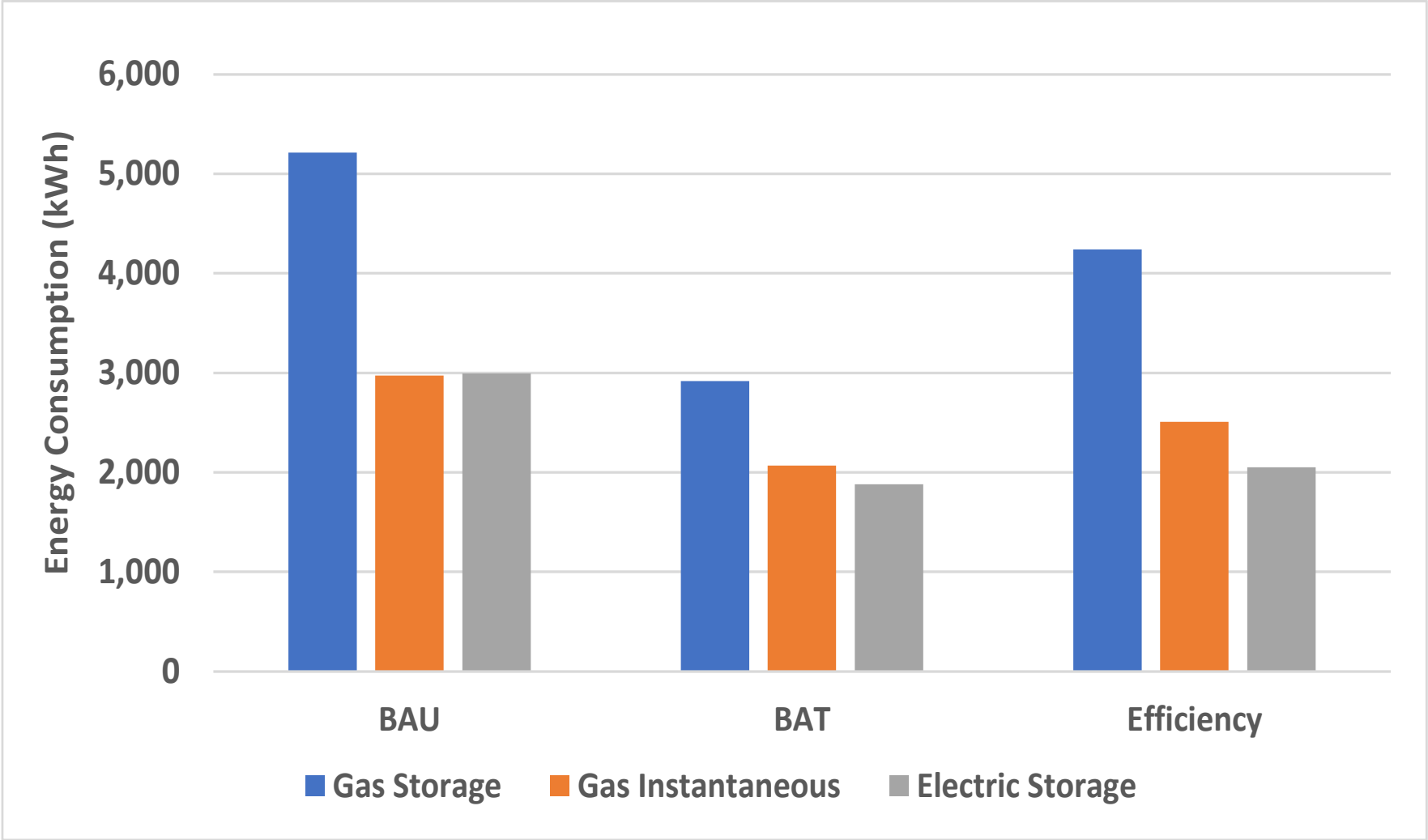
- 2025: 38 Billion PKR
- 2035: 411 Billion PKR

Possible \neq Practicable?

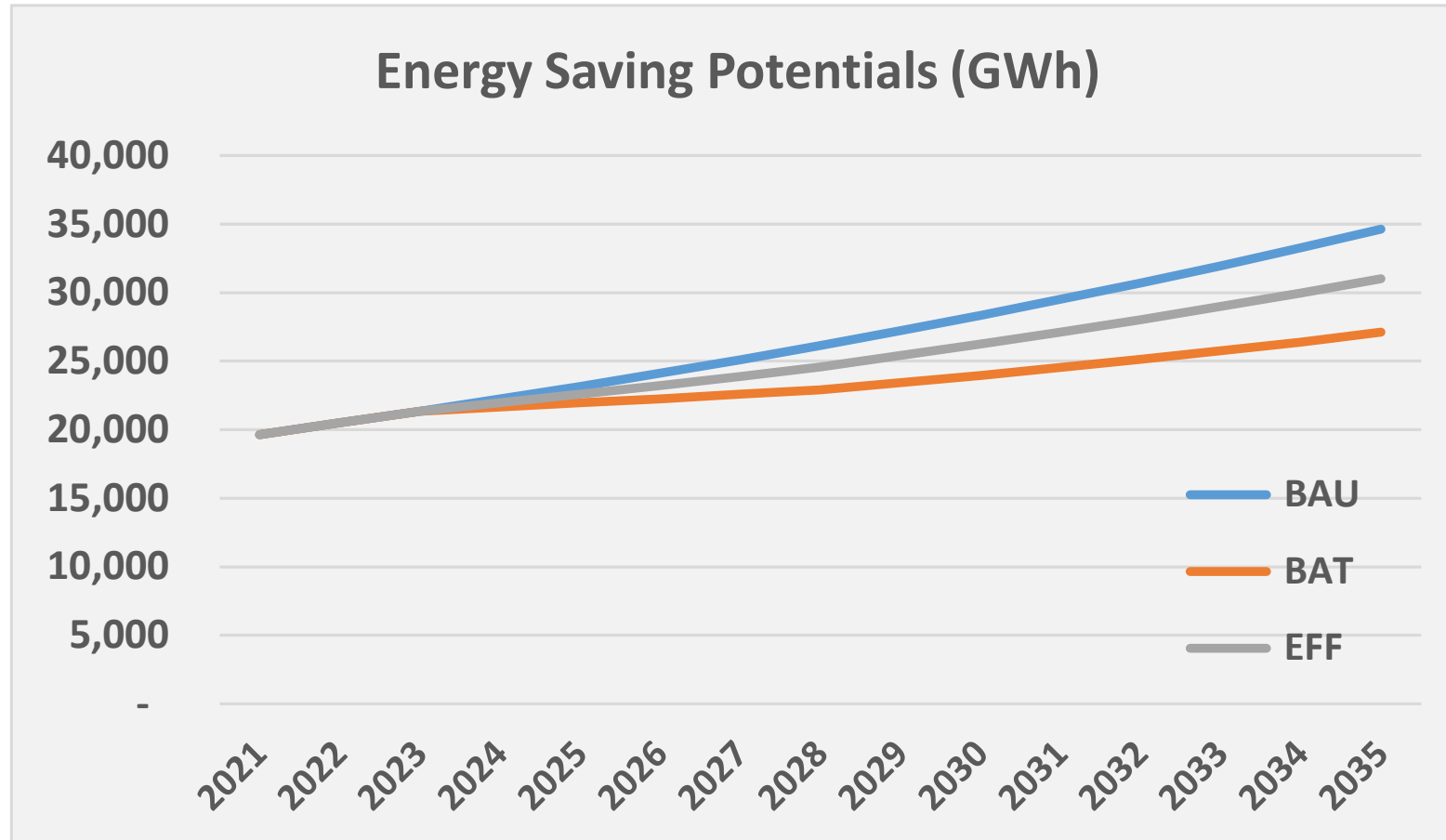
The savings POTENTIAL: Gas Storage BAT



SCENARIO	Description
BAU (Business As Usual)	The performance of Pakistani water heater in the “in-use” conditions experienced in Pakistani households.
BAT (Best Available Technology)	The performance of the MOST efficient internationally available water heaters (of similar construction) in the “in-use” conditions experienced in Pakistani households . Most efficient water heaters based on most efficient products from IEA 4E Benchmarking Report for domestic gas and electric storage and gas instantaneous water heaters.
EFF (Efficiency)	The performance of the LEAST efficient internationally available water heaters (of similar construction) in the “in-use” conditions experienced in Pakistani households . Least efficient water heaters based on least efficient products from IEA 4E Benchmarking Report for domestic gas and electric storage and gas instantaneous water heaters.



BAU, BAT and EFF ENERGY Consumption



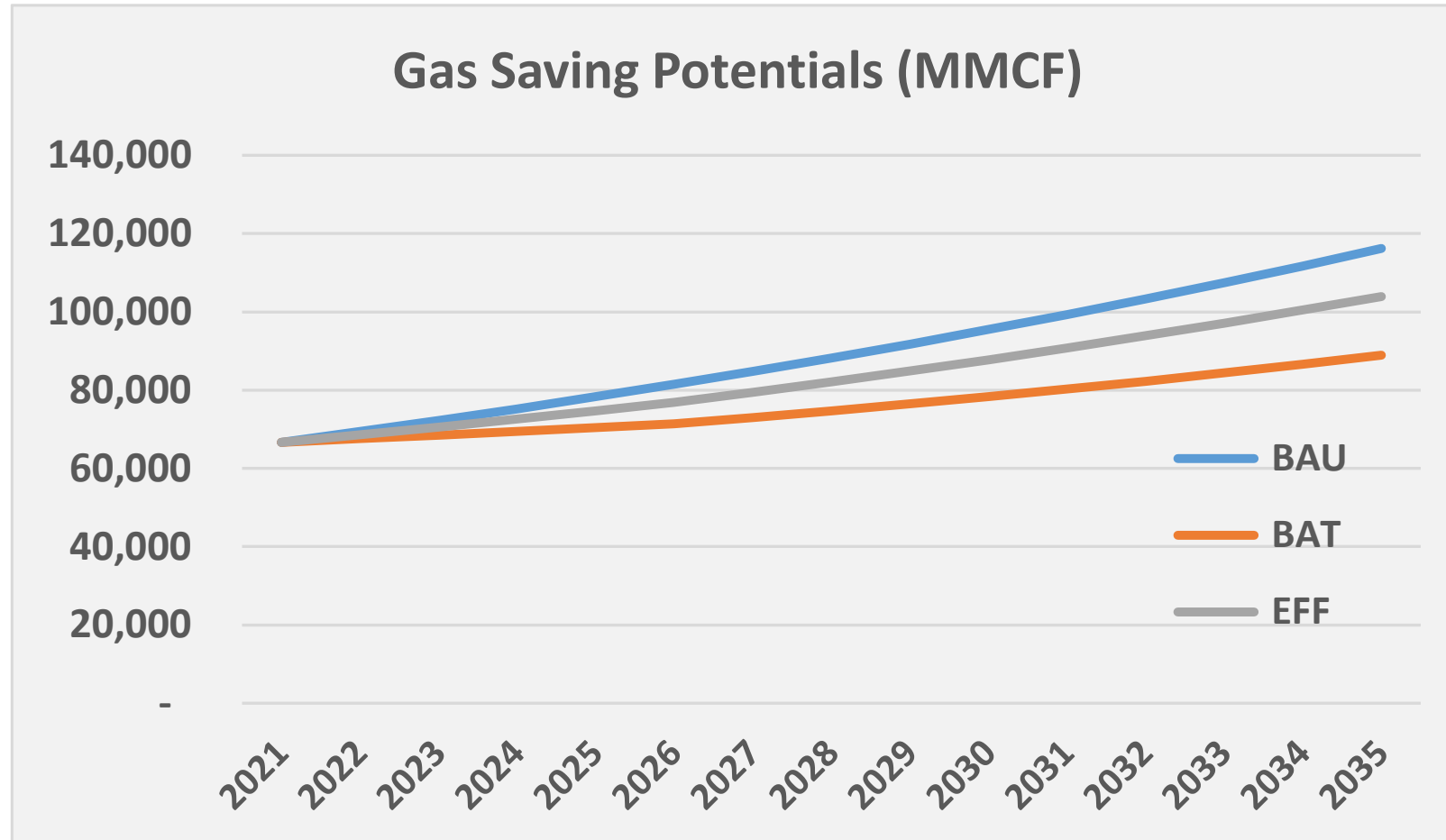
BAU vs EFF Annual Savings

- 2022: 283 GWh
- 2025: 1,219 GWh
- 2035: 4,206 GWh

BAU vs EFF Cumulative Savings

- 2025: 2,974 GWh
- 2035: 31,501 GWh

BAU, BAT and EFF GAS Consumption



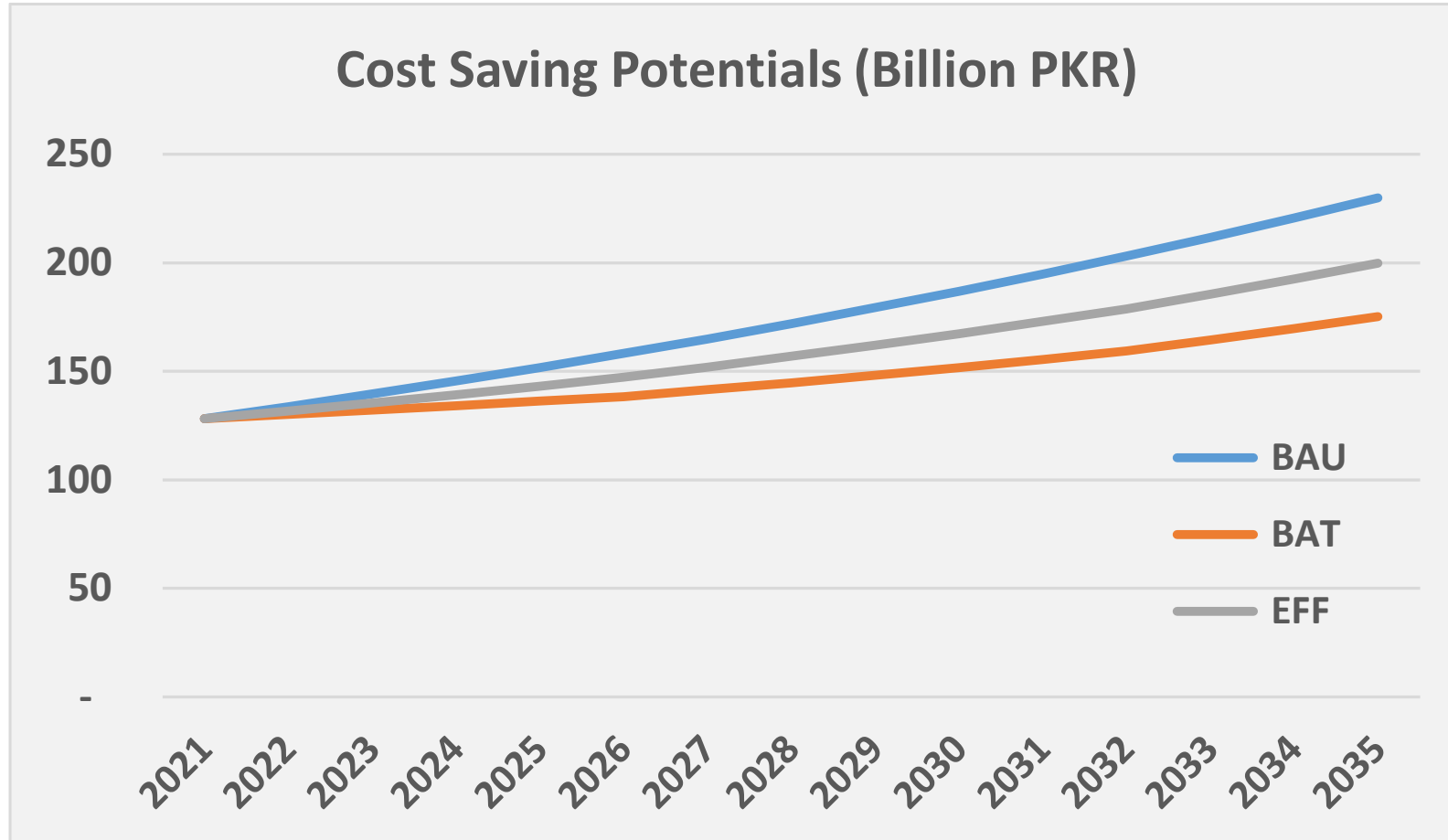
BAU vs EFF Annual Savings

- 2022: 832 MMCF
- 2025: 3,581 MMCF
- 2035: 12,197 MMCF

BAU vs EFF Cumulative Savings

- 2025: 8,737 MMCF
- 2035: 91,055 MMCF

BAU, BAT and EFF Consumer Costs



BAU vs EFF Annual Savings

- 2021: 2 Billion PKR
- 2025: 9 Billion PKR
- 2035: 30 Billion PKR

BAU vs EFF Cumulative Savings

- 2025: 21 Billion PKR
- 2035: 228 Billion PKR

Question 1

Do the EFF performance parameters represent a reasonable starting point for setting Standards and Labelling Values in Pakistan?

Parameter	BAU	BAT	EFF (Proposed)
Average Storage Heat Loss Rate (per hour)	<i>Gas Store: 4.41%</i> <i>Elect Store: 4.41%</i>	Gas Store: 0.49% Elect Store: 0.14%	Gas Store: 2.14% Elec Store: 0.66%
Heating (thermal) efficiency	<i>Gas Store: 65%</i> <i>Gas Instant: 65%</i> <i>Electric Store: 99%</i>	Gas Store: 87% Gas Instant: 96% Electric Store: 99%	Gas Store: 70% Gas Instant: 78% Electric Store: 99%
Pilot light consumption per hour (kWh/hour)	<i>Gas Store: 0.1 kWh/hr</i> <i>Gas instant: 0 kWh/hr</i> <i>Electric: 0 kWh/hr</i>	<i>Gas Store: 0.1 kWh/hr</i> <i>Gas instant: 0 kWh/hr</i> <i>Electric: 0 kWh/hr</i>	<i>Gas Store: 0.1 kWh/hr</i> <i>Gas instant: 0 kWh/hr</i> <i>Electric: 0 kWh/hr</i>

Options for regulatory approach

Regulatory Approach: Broadly 4 Options...

- Service Delivery - Technology Neutral
- Service Delivery - Best of Product Type
- Parameter Based
- Construction Based

Service Delivery - Technology Neutral

MEPS	LABELS	Hard to Develop?	Observations/Risks
Yes	Difficult to explain?	VERY Hard	<ul style="list-style-type: none">• Either drives market to electric storage or heat pumps or requirement very weak.• Life very difficult for gas storage to have any place in market• Developing “equivalent service” very difficult particularly with no market data• Testing relatively easy

Service Delivery - Best of Product Type

MEPS	LABELS	Hard to Develop?	Observations/Risks
Yes	Not comparable between type, potentially misleading	Hard	<ul style="list-style-type: none">• Leaves all products in the market therefore not maximising efficiency• Artificial construct to keep all in market.• Testing relatively easy

MEPS	LABELS	Hard to Develop?	Observations/Risks
Yes	Not comparable between types, potentially misleading	<i>Relatively easy</i>	<p>Based on what? Currently “worst” 4E – not really very robust:</p> <ul style="list-style-type: none"> • Int best practice – naive • Range in country – will not know until tested/registered • And what basis (as per above) <ul style="list-style-type: none"> ○ Other service parameters – reheat (recovery) time? • Testing (depends on variable selection)

MEPS	LABELS	Hard to Develop?	Observations/Risks
Sort of but to what end	No	Easy	<ul style="list-style-type: none">• What value in mandating construction, outcome is what is required.

On the working assumption regulation will be introduced, which approach is most suitable?

- Technology Neutral
- Best of Product Type
- *Parameter Based*
- Construction Based

Views?

Proposed Forward Plan

Stuart Jeffcott



4 October: *Proposals on mechanisms to regulate Water Heaters in Pakistan, and initial performance requirements.*

4 November: Proposals for test method(s) adjustments if required, with potential revisions to provisional proposed performance requirements

17 November: Proposals for compliance approach based on industry mapping and supply chains

15 December: Presentation of complete draft MEPS for three water heater types.



Thank You