The Performance of Integrated Hydronic Heating Systems

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Aachener Ölwärme Kolloquium

14. September 2006

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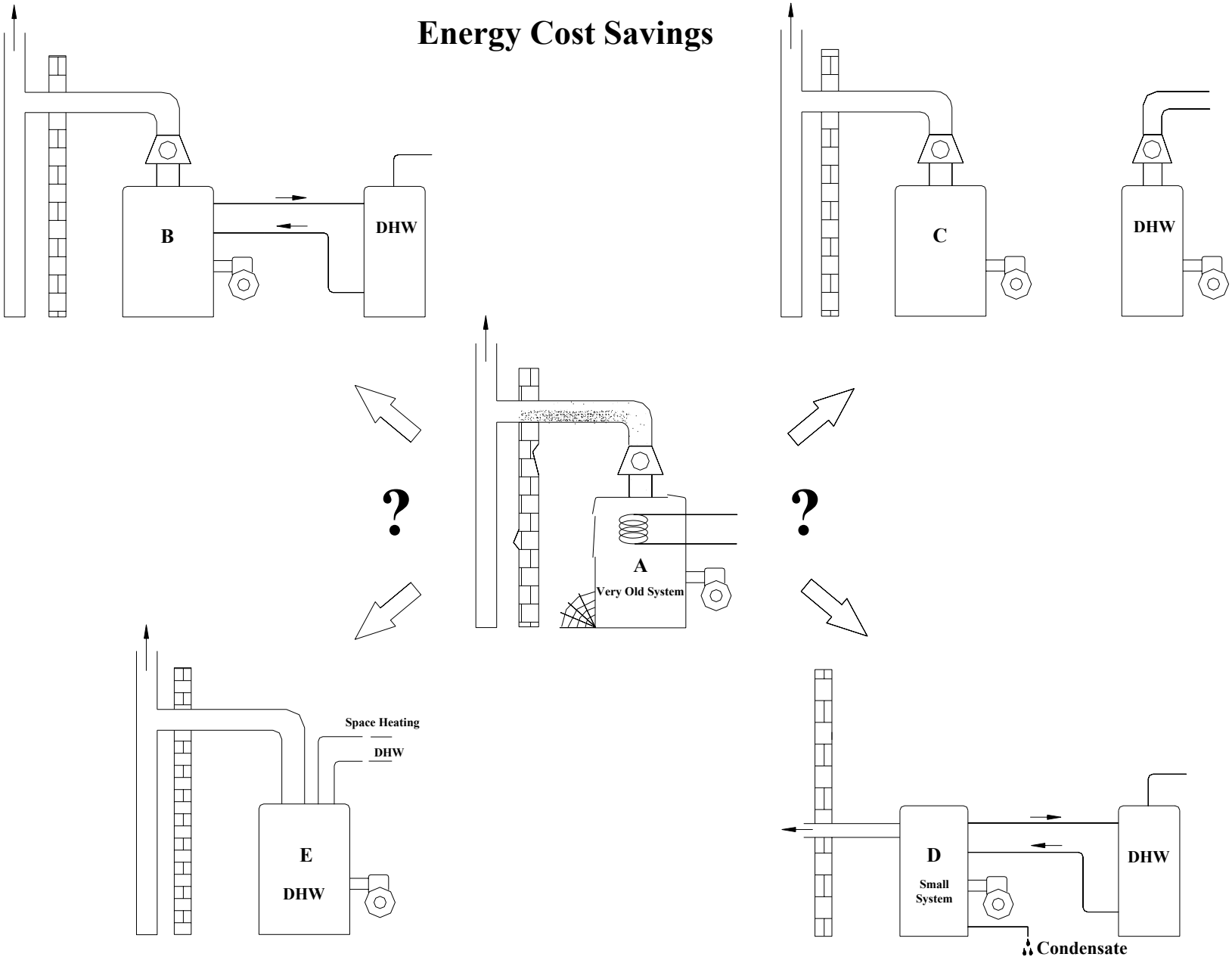
Energy Cost Savings



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Objectives

- Compare annual fuel use of different combination systems
- Systems to include boilers, water heaters, storage tanks and control concepts. Oil and gas –fired.
- Impact of oversize decisions
- Consideration of jacket and near-boiler piping losses, location dependent
- Consideration of electric power
- Understanding sources of losses

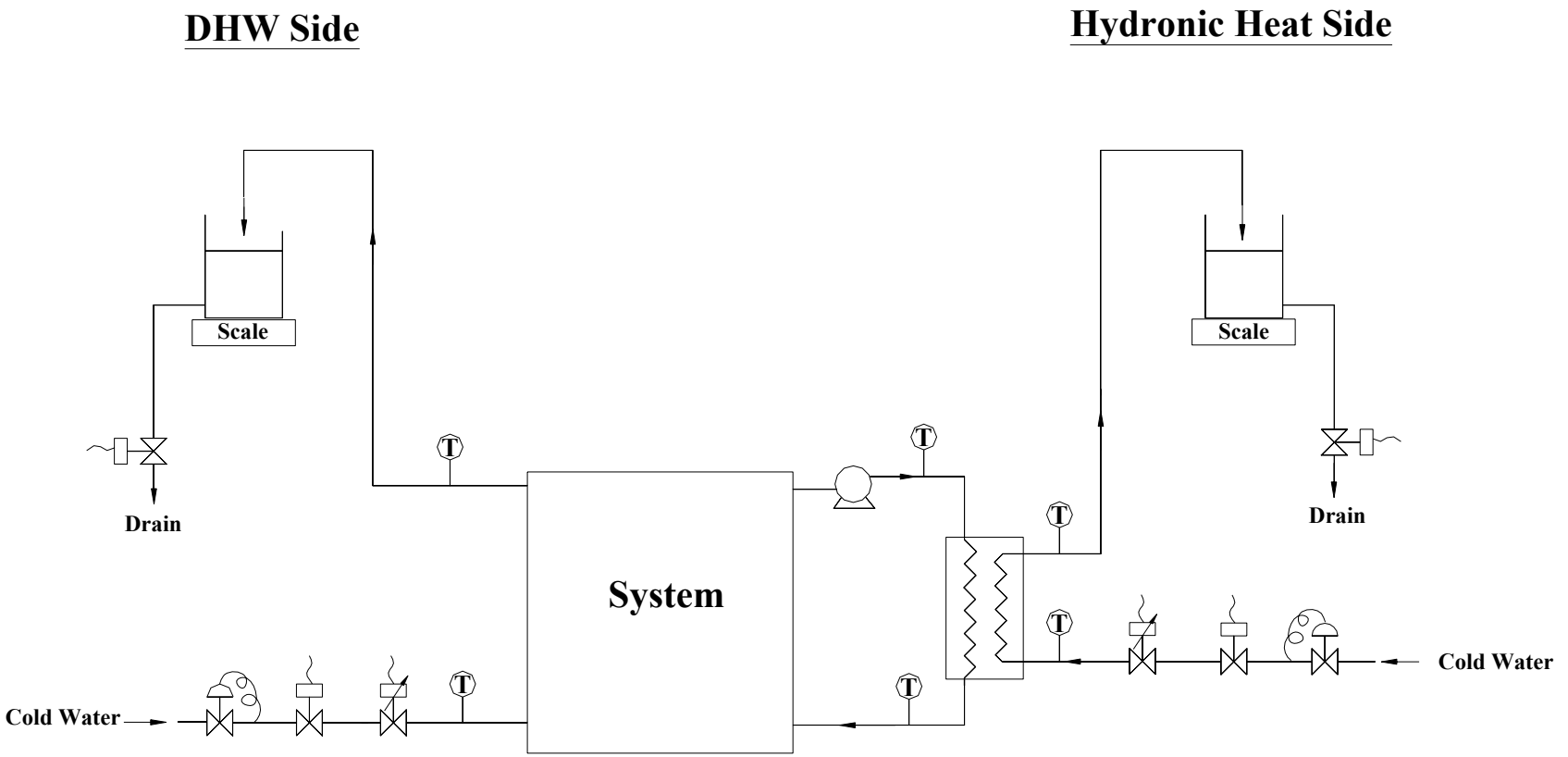
Units planned for tests

1. Cast iron, oil-fired boiler, severely oversized, fixed temperature, tankless coil
2. Cast iron, oil-fired boiler, slightly oversized, with indirect tank
3. Cast iron, oil-fired boiler, slightly oversized, with indirect tank, with outdoor reset control
4. Cast iron, oil-fired, well-insulated boiler with indirect tank
5. Steel, oil-fired, thermally purgable control with indirect tank
6. Water heater - dual use, oil-fired
7. Combi-system, oil-fired
8. Condensing oil boiler
9. Condensing, gas-fired with indirect tank
10. Cast iron, gas-fired with atmospheric burner, heat only, with outdoor reset
11. Cast iron, gas-fired with atmospheric burner, boiler and separate water heater

End Products

- Basic performance curves for each unit
- Input / Output curves and idle loss
- Analysis of fuel use and electric power consumption when used in different applications
- Summary tables – stand alone communication tool
- Follow-on project planned for technology transfer

Test Arrangement



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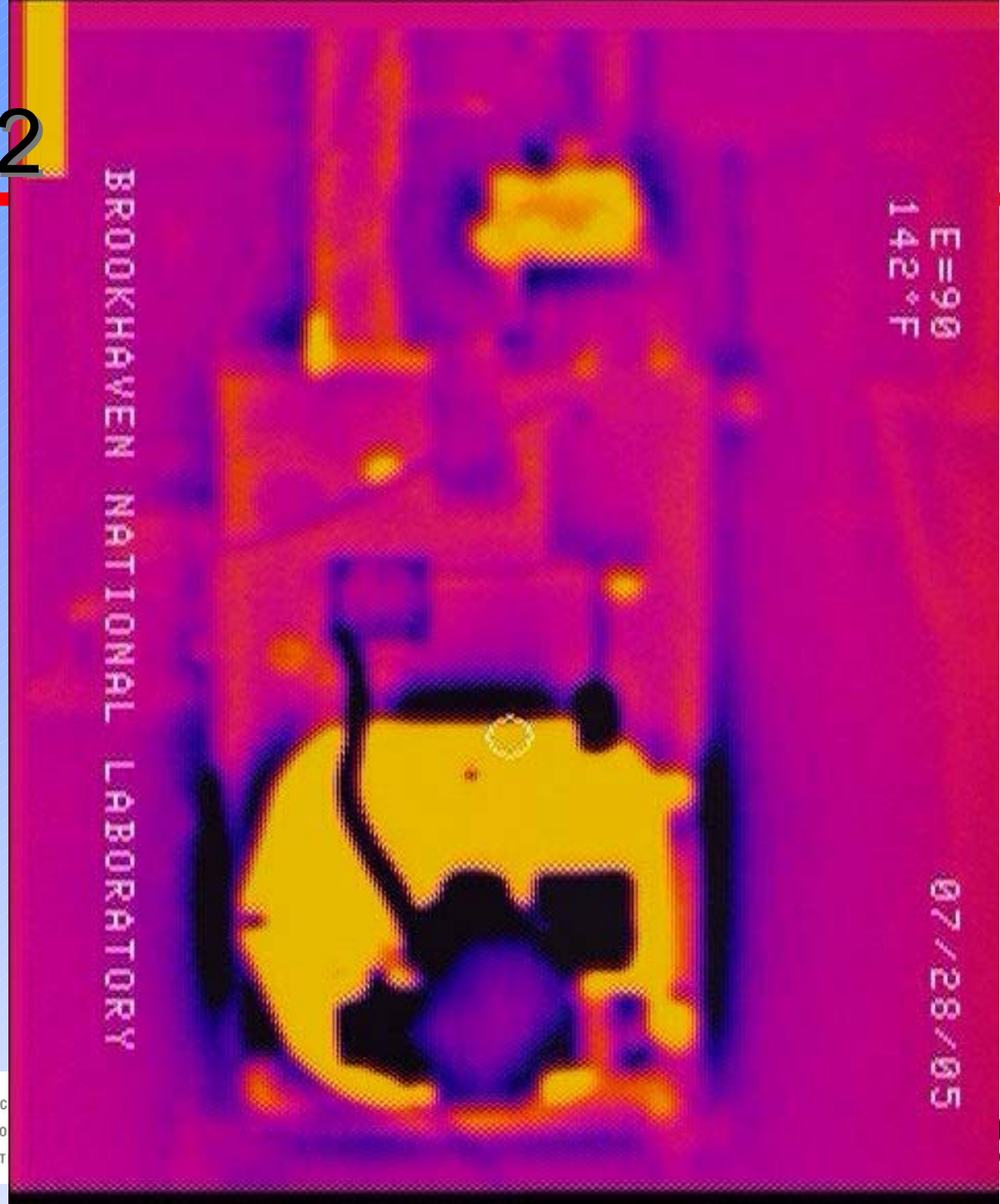

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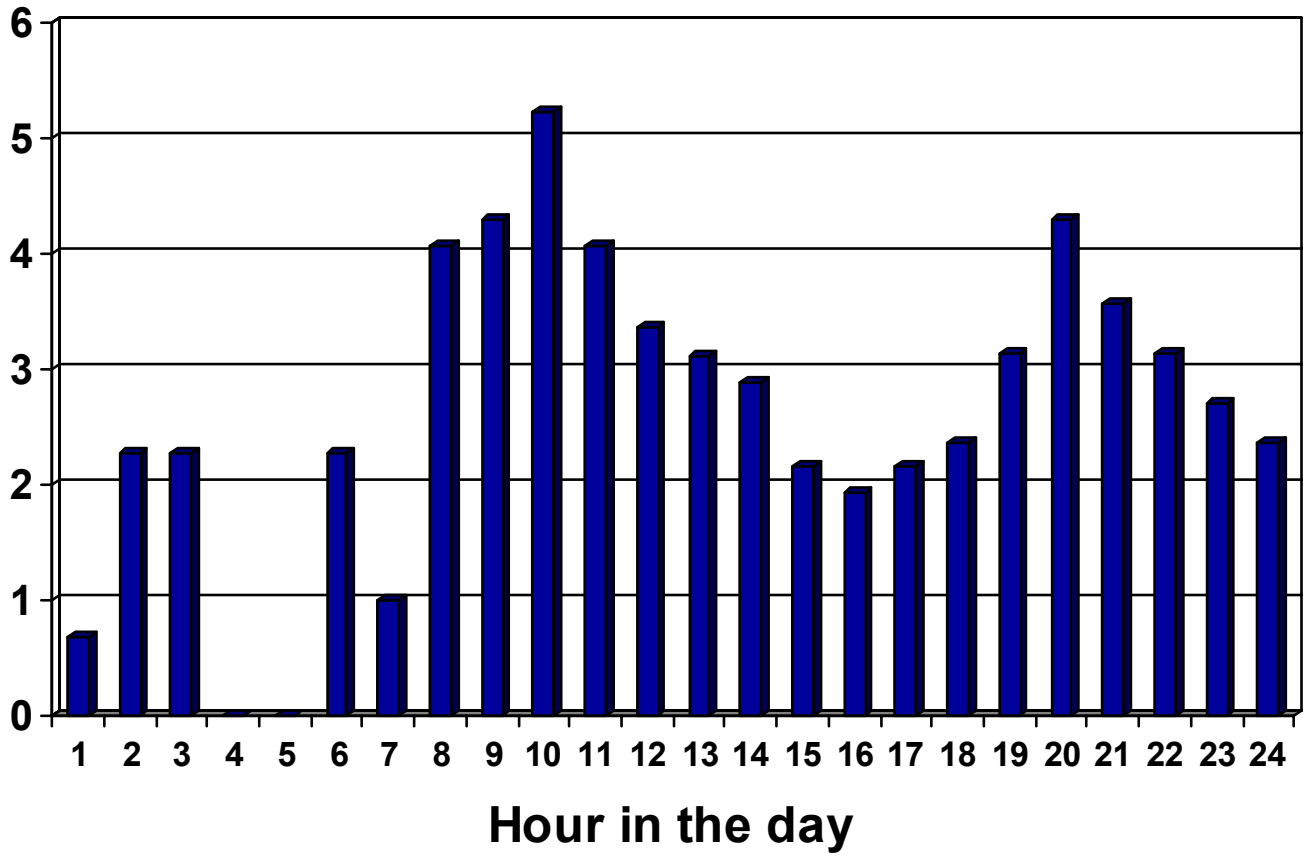
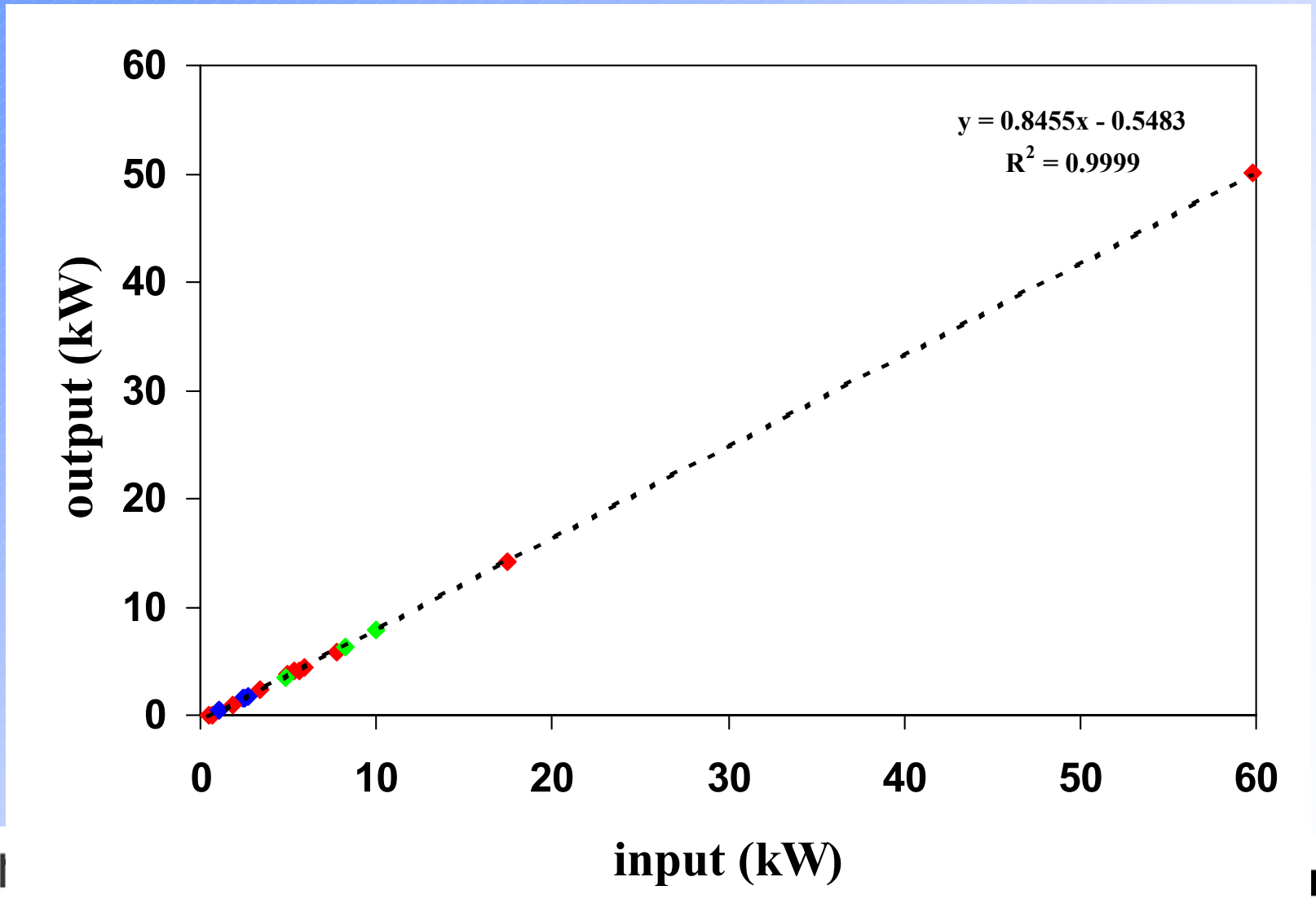
Daily distribution of hot water use (Gallons/hour)



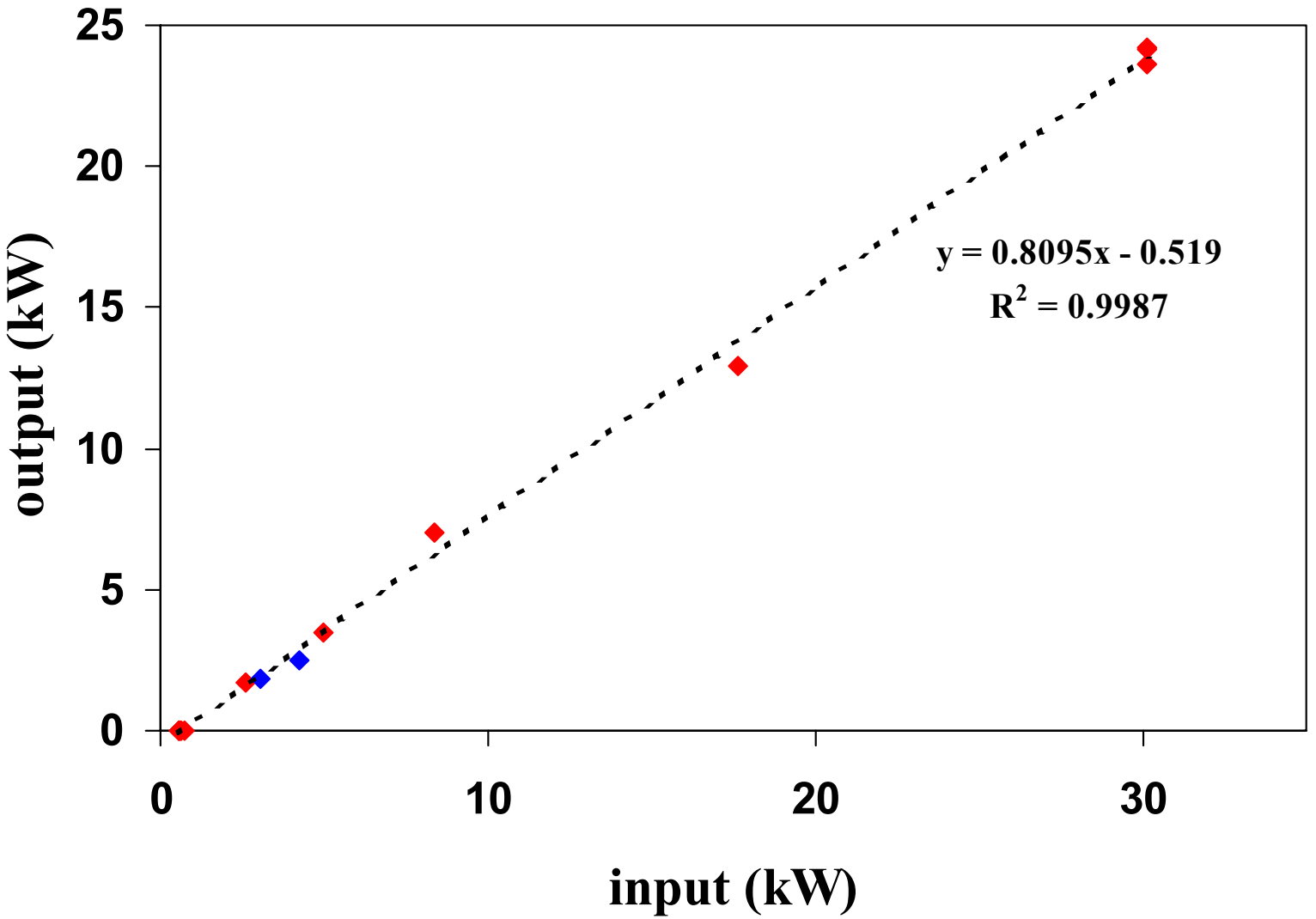
Units Tested to date

- Cast iron boiler with tankless coil
- Cast iron boiler with indirect DHW tank
- Steel boiler with indirect tank and purge control
- Condensing oil boiler
- Well insulated imported boiler with indirect

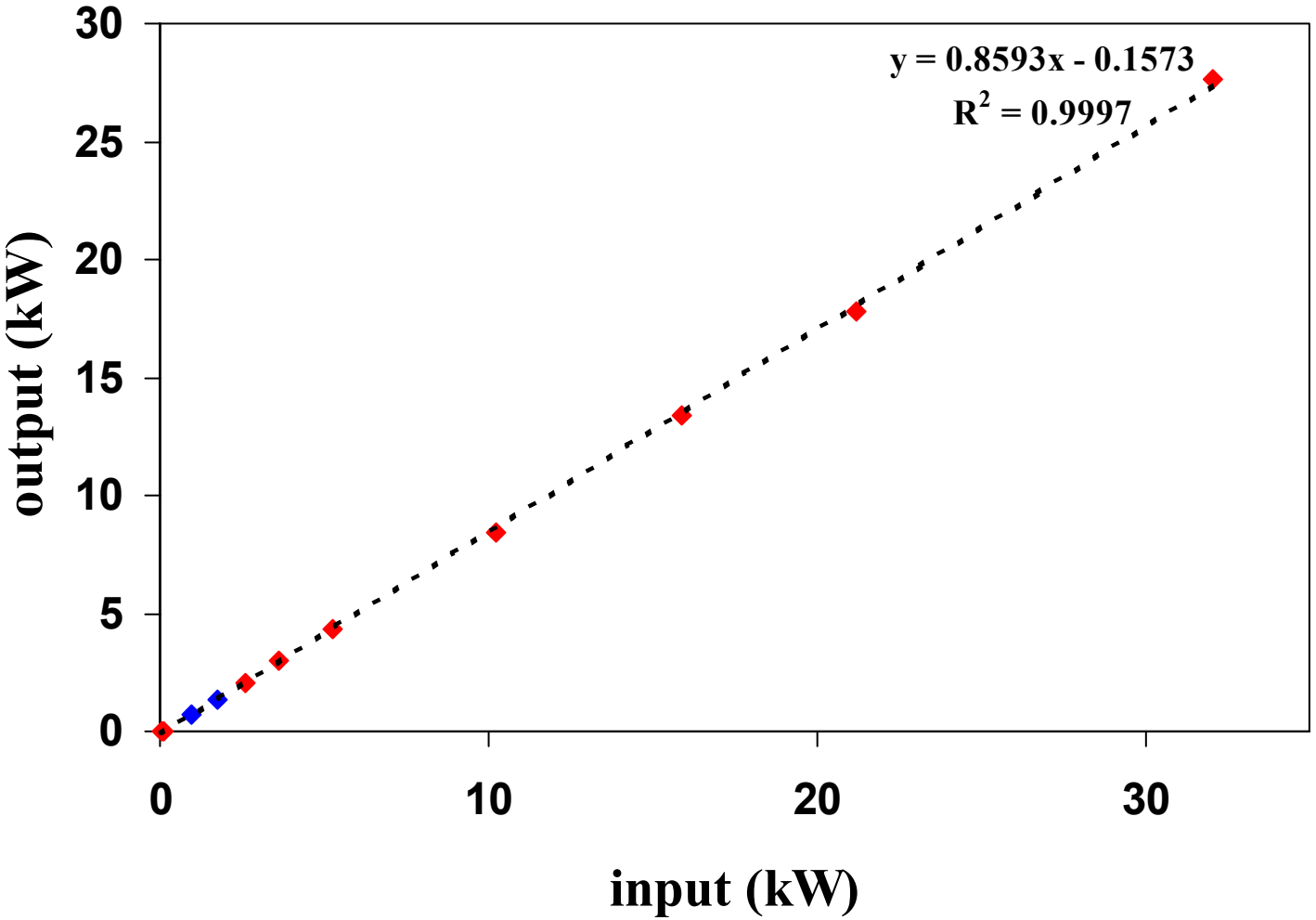
CI boiler with tankless coil



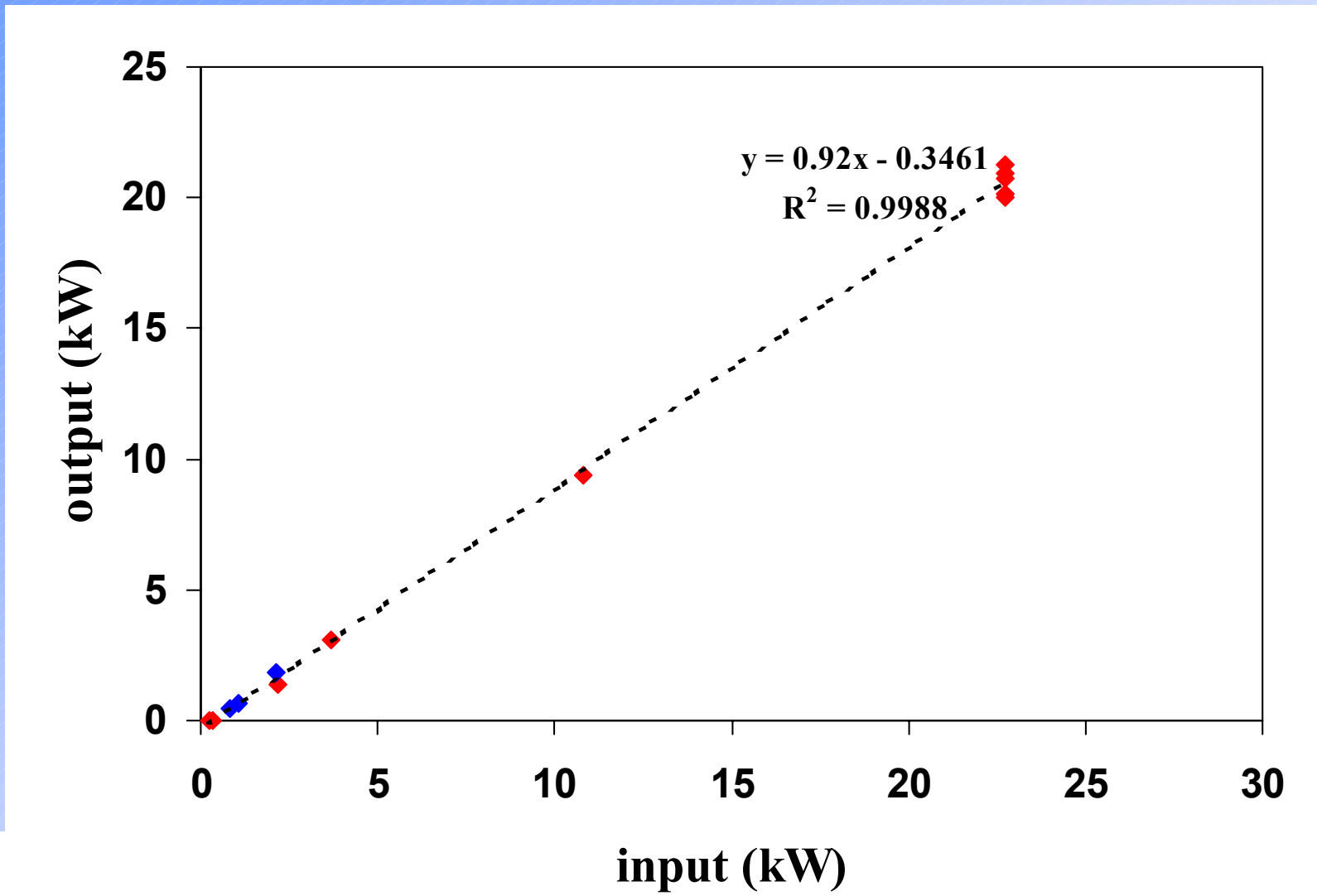
CI boiler with indirect



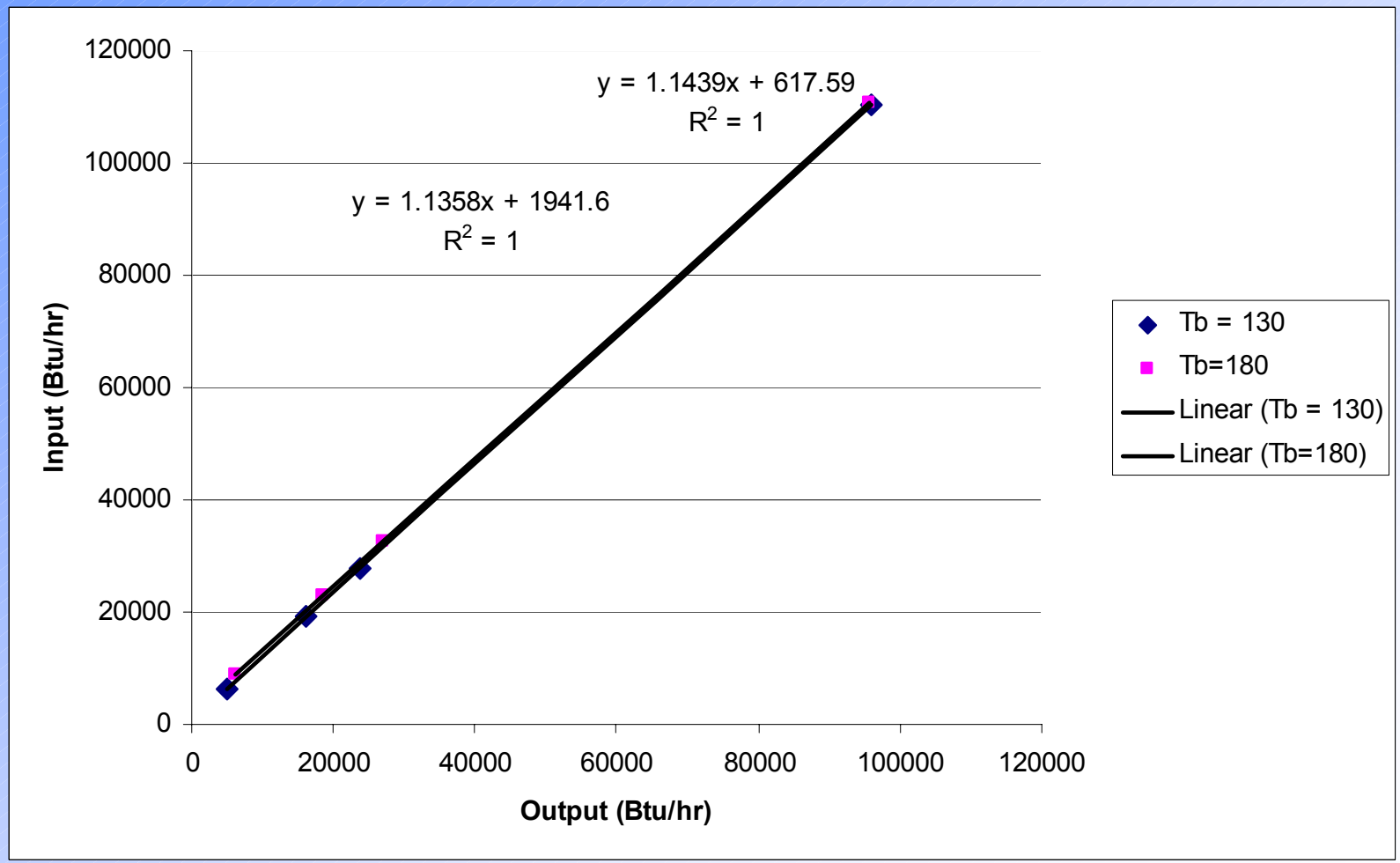
Steel boiler



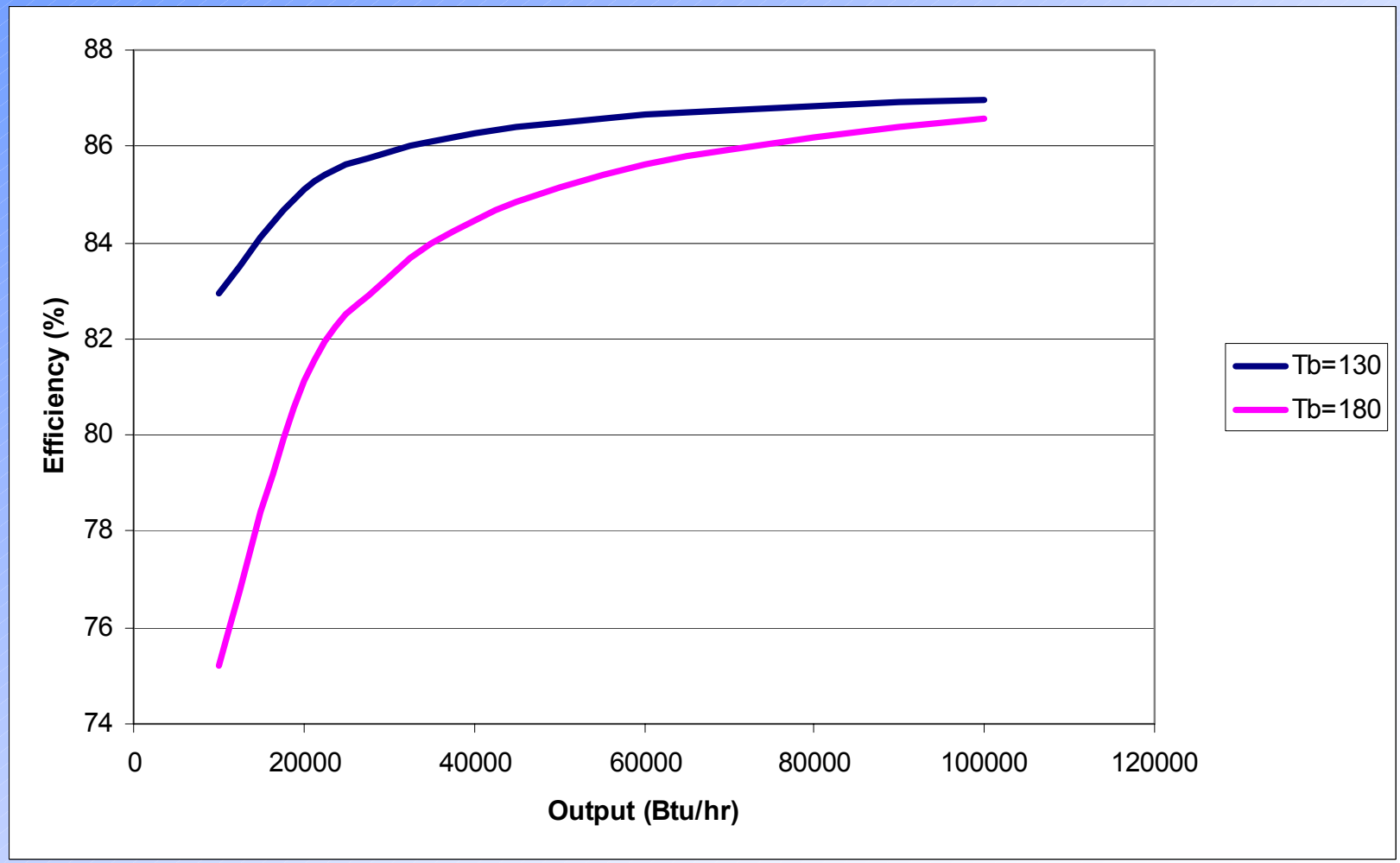
Condensing oil boiler



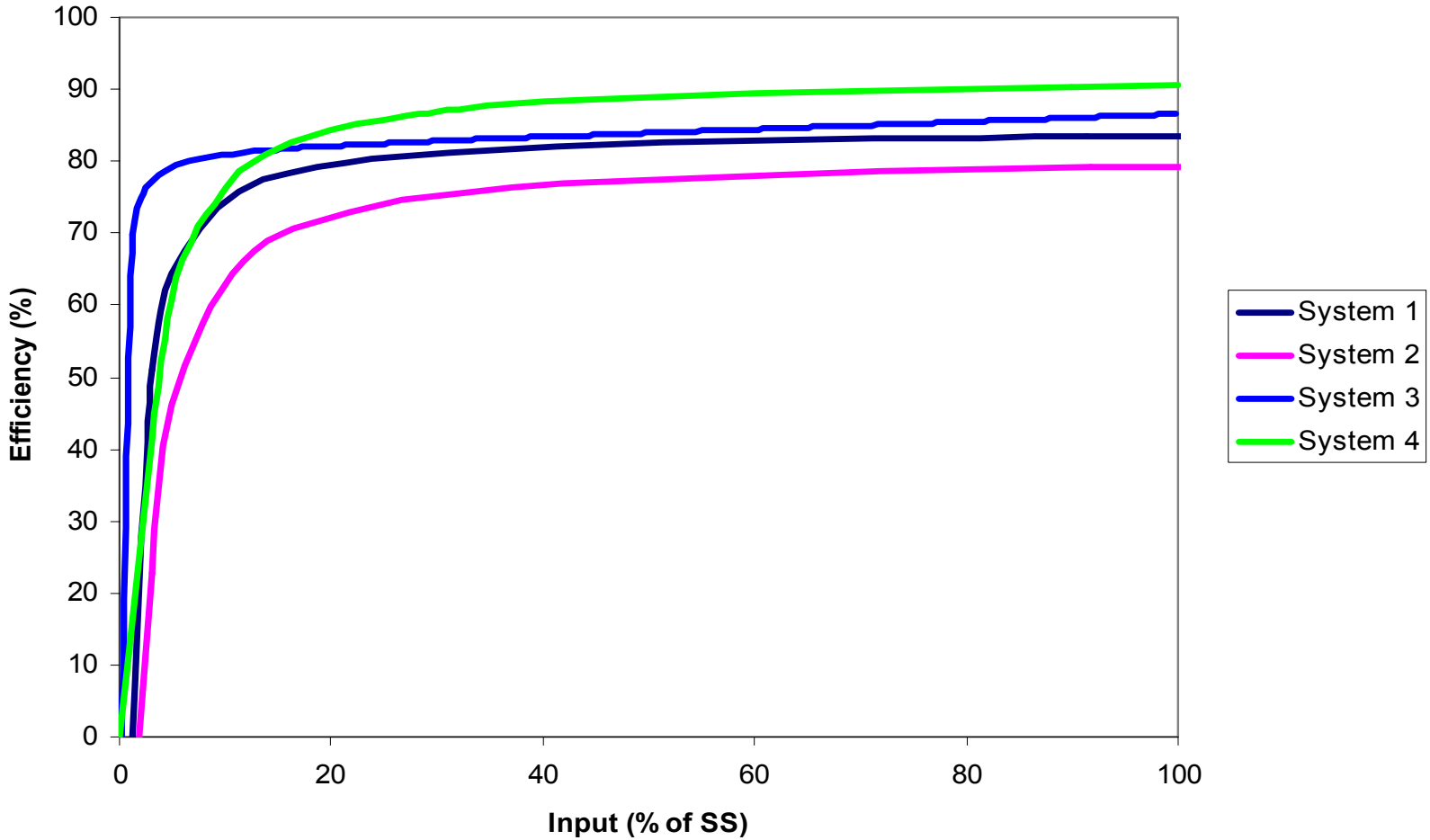
Evaluating Reset…



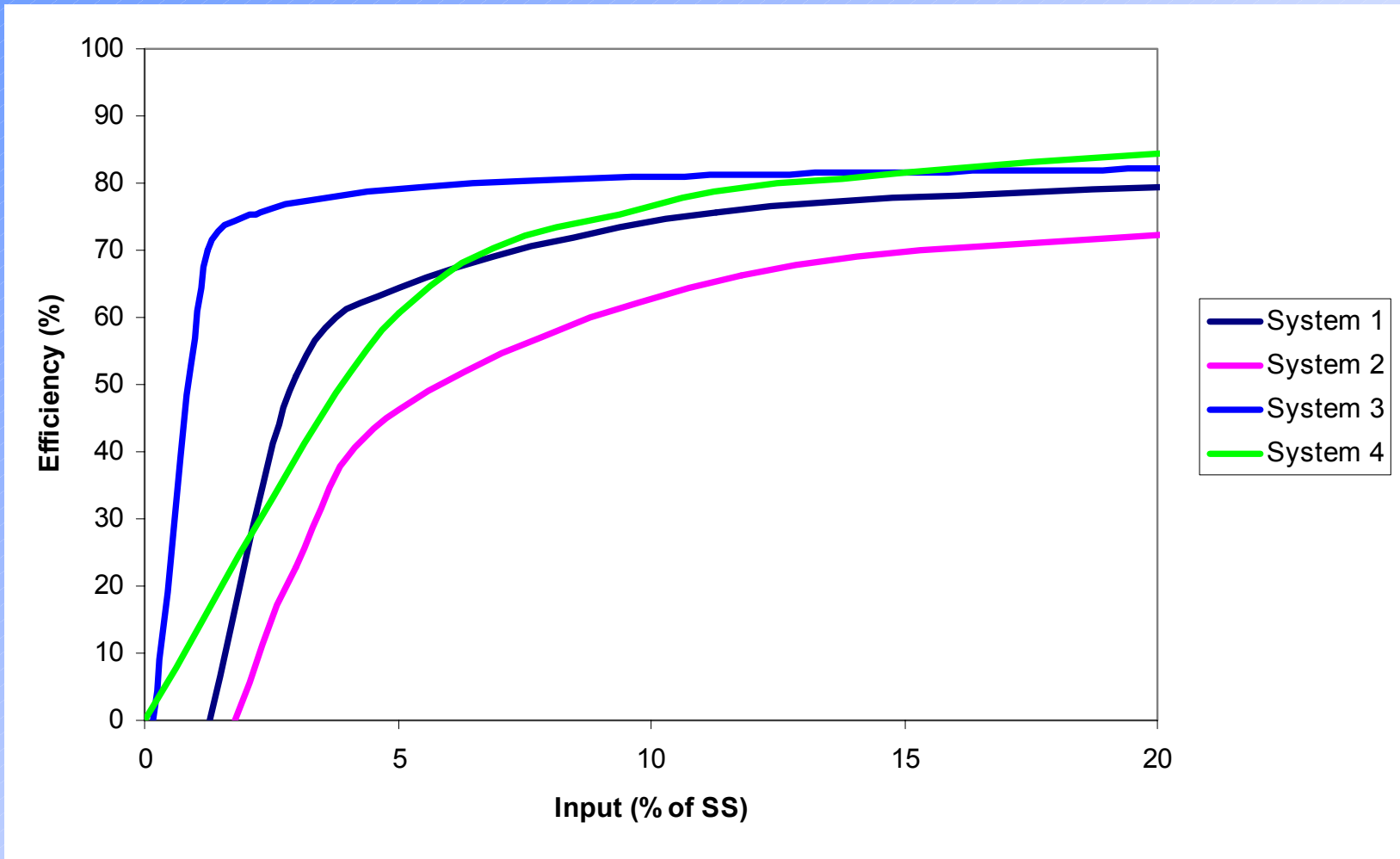
Evaluating Reset



Comparison of four systems



Comparison of four systems



Comparison of five systems

Unit	gph	Steady State Efficiency	Idle Loss (%)
1	1.46	83.7	1.2
2	.73	78.4	2.1
3	.78	86.5	.15
4	.55	92.0	1.5
5	.80	87.0	.6

Inputs

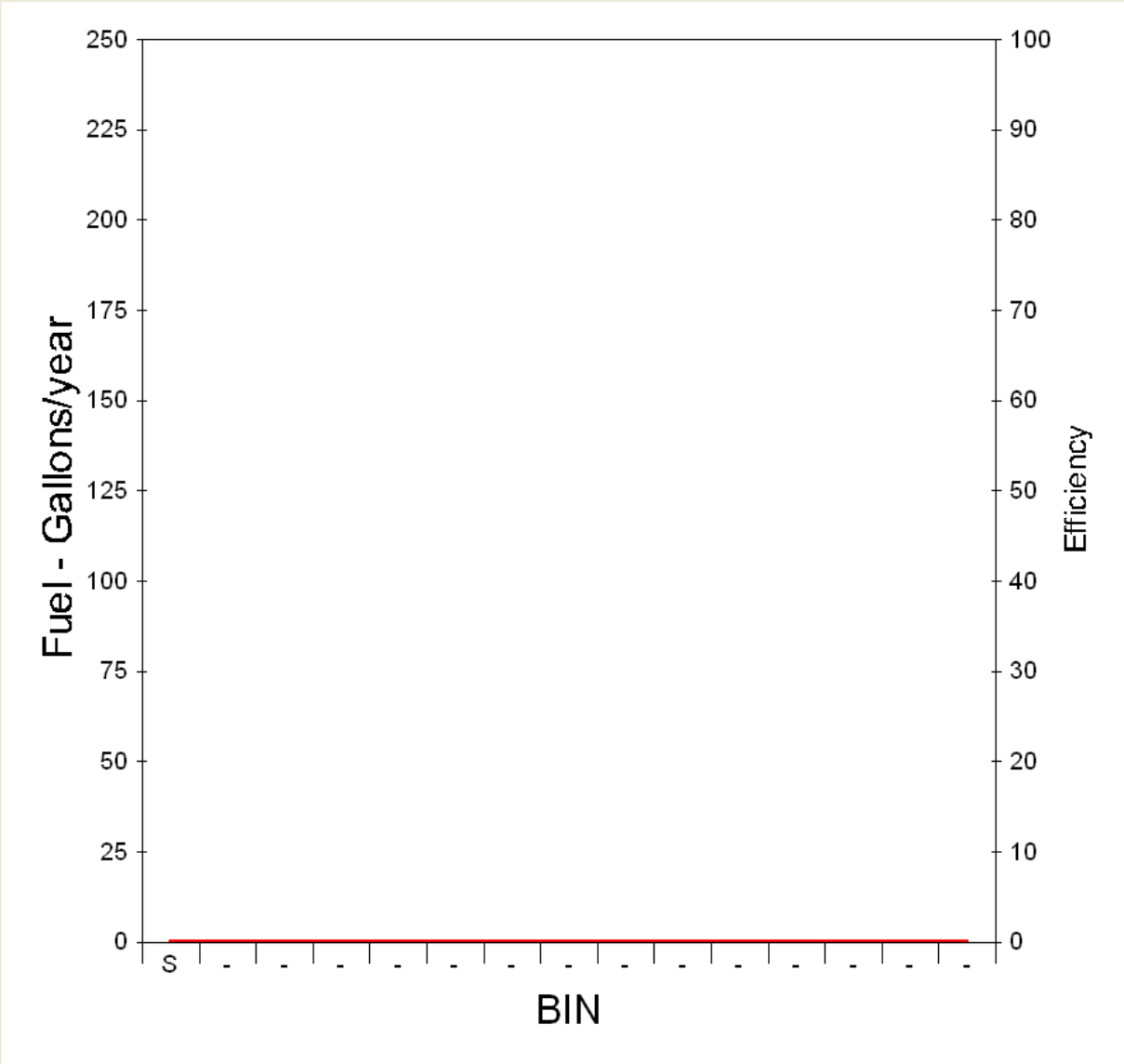
Steady State Eff.	80.0
Idle Loss	3.0
Oversize	3.0
Design Day Heat Load	40000
Domestic Hot Water (gal/day)	64.3
Oil Price ($/gal)	2.50
Inside / Isolated Location Factor	0

Calculate

Results

Seasonal Efficiency	
Annual Oil Used (gal)	
Annual Oil Cost ($)	
Amount of oil wasted (gal)	
Cost of oil wasted ($)	

End



Inputs

Steady State Eff.	80.0
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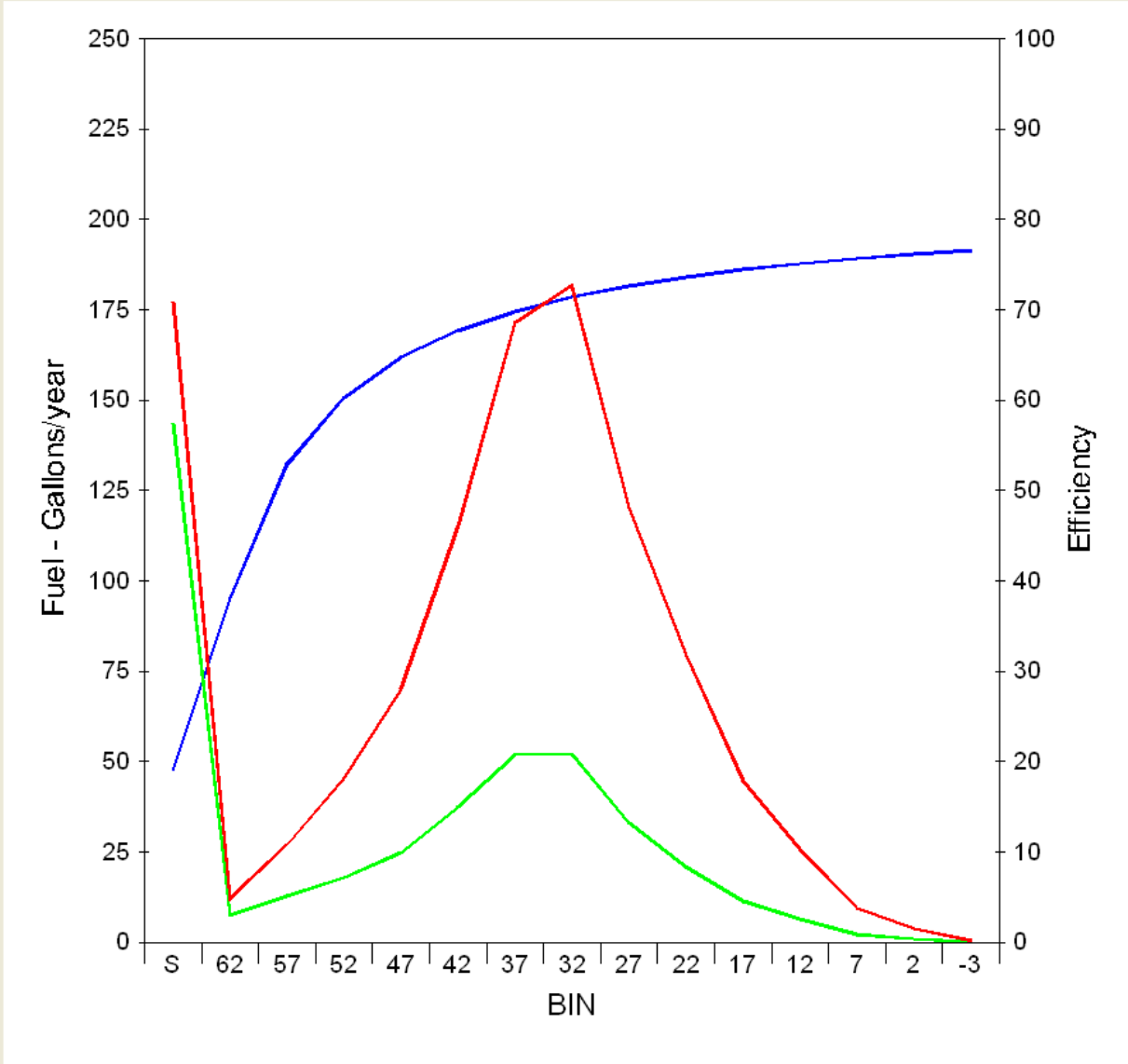
Design Day Heat Load	40000
Domestic Hot Water (gal/day)	64.3
Oil Price ($/gal)	2.50
Inside / Isolated Location Factor	0

Calculate

Results

Seasonal Efficiency	61
Annual Oil Used (gal)	1083
Annual Oil Cost ($)	2709
Amount of oil wasted (gal)	422
Cost of oil wasted ($)	1055

End



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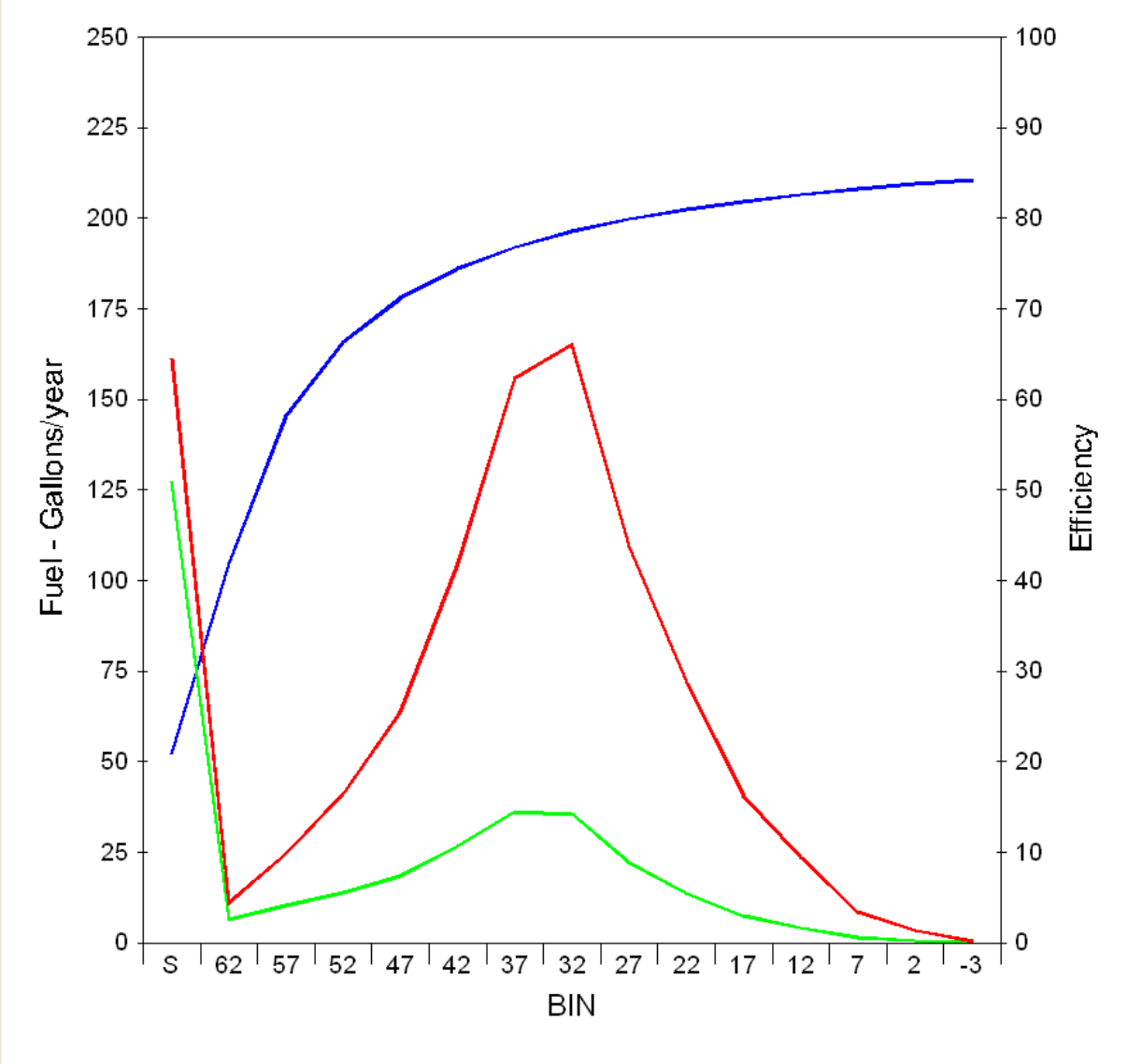
Calculate

Results

Seasonal Efficiency	67.1
Annual Oil Used (gal)	985
Annual Oil Cost ($)	2462
Amount of oil wasted (gal)	324
Cost of oil wasted ($)	809

End



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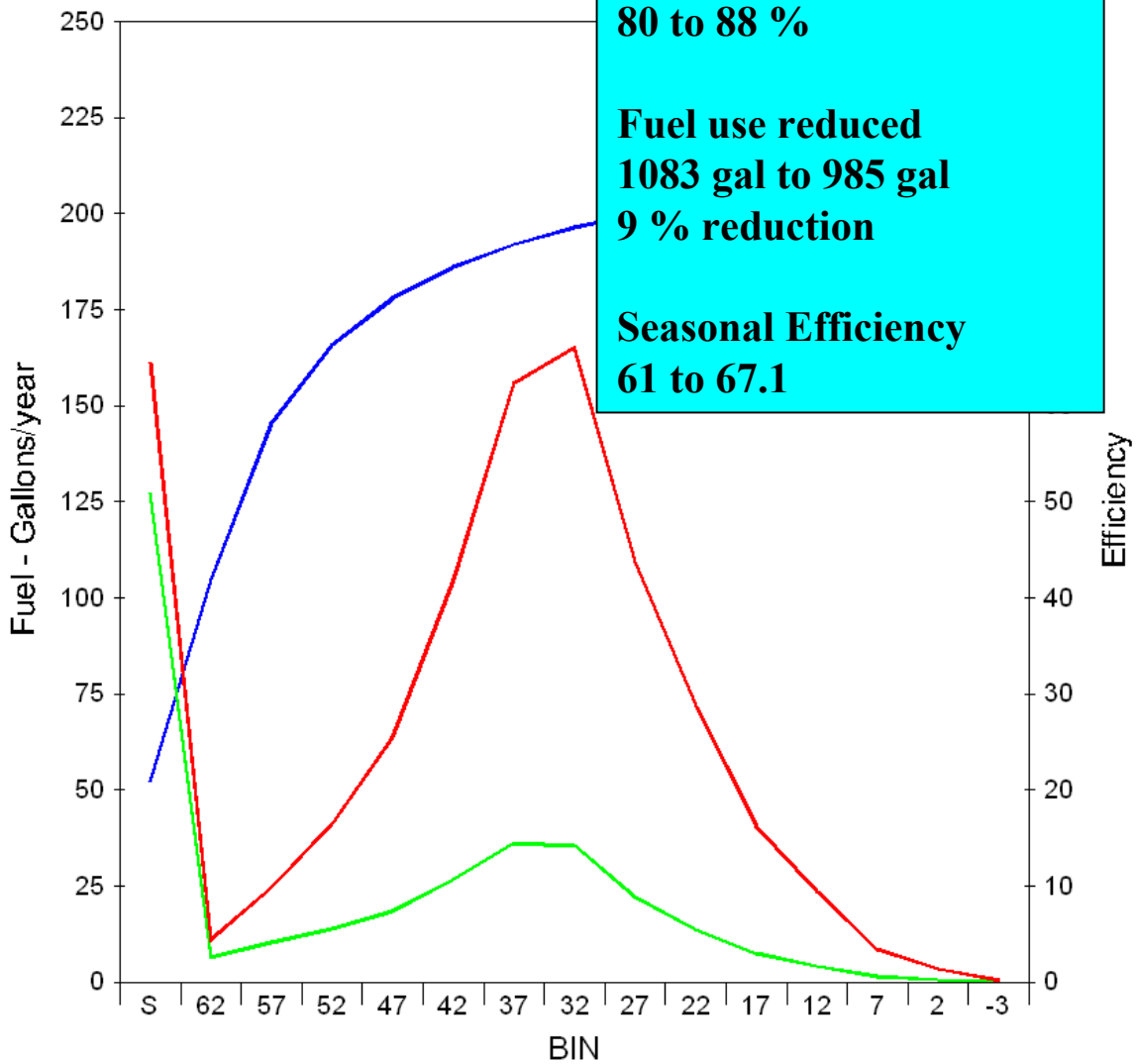
End

Steady State Efficiency
80 to 88 %

Fuel use reduced
1083 gal to 985 gal
9 % reduction

Seasonal Efficiency
61 to 67.1



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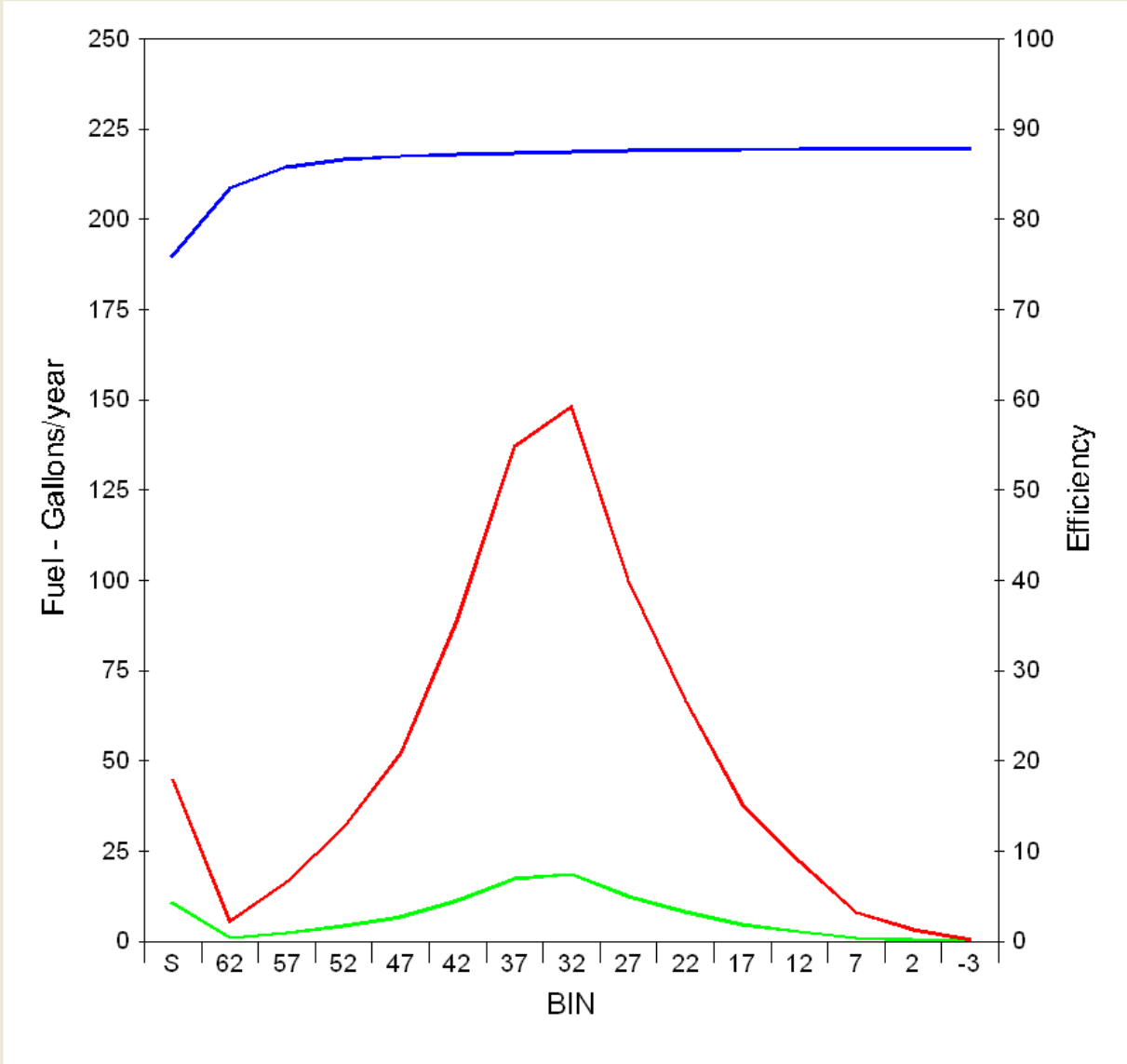
Calculate

Results

Seasonal Efficiency	86.7
Annual Oil Used (gal)	763
Annual Oil Cost ($)	1908
Amount of oil wasted (gal)	102
Cost of oil wasted ($)	255

End



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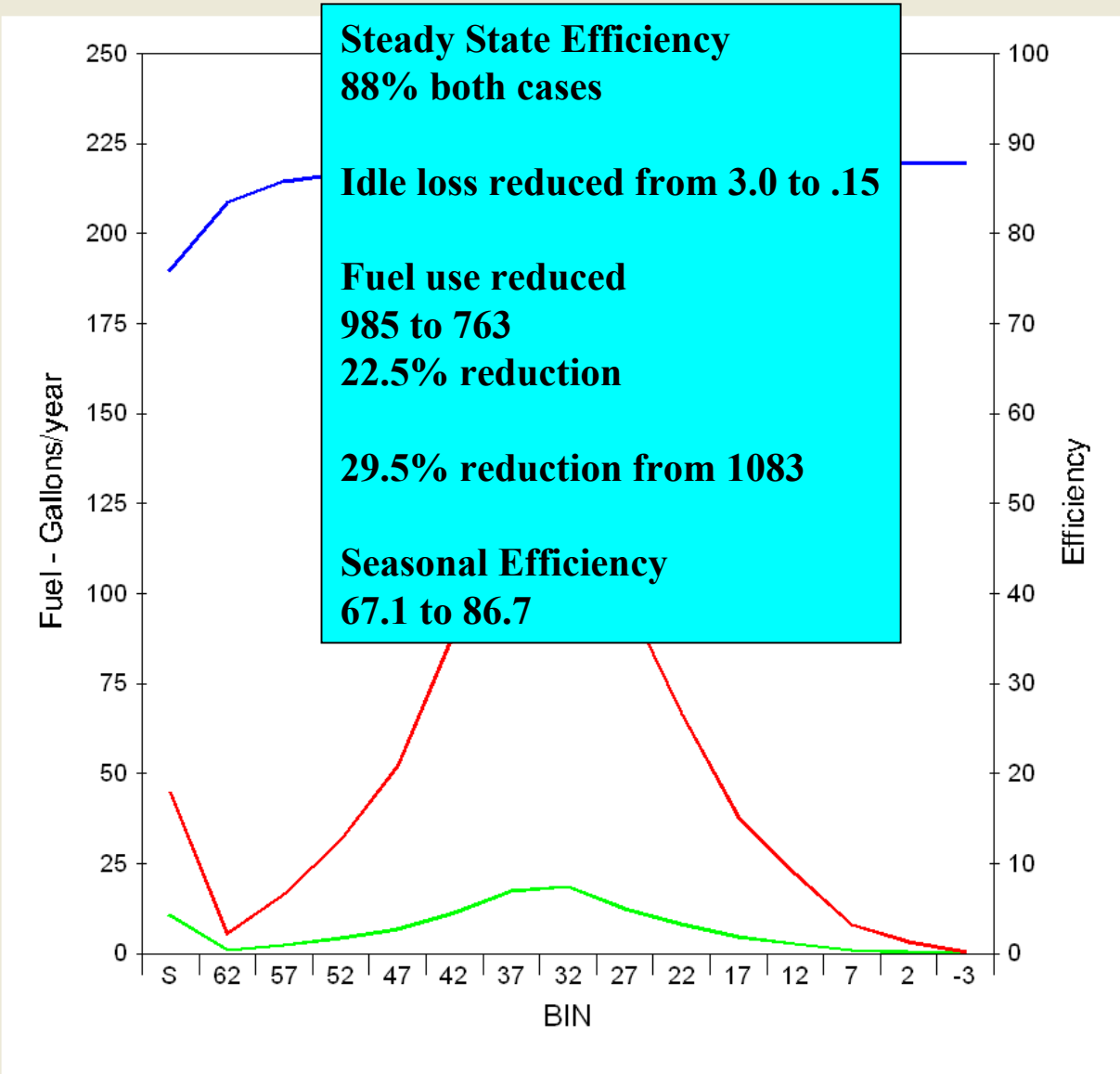
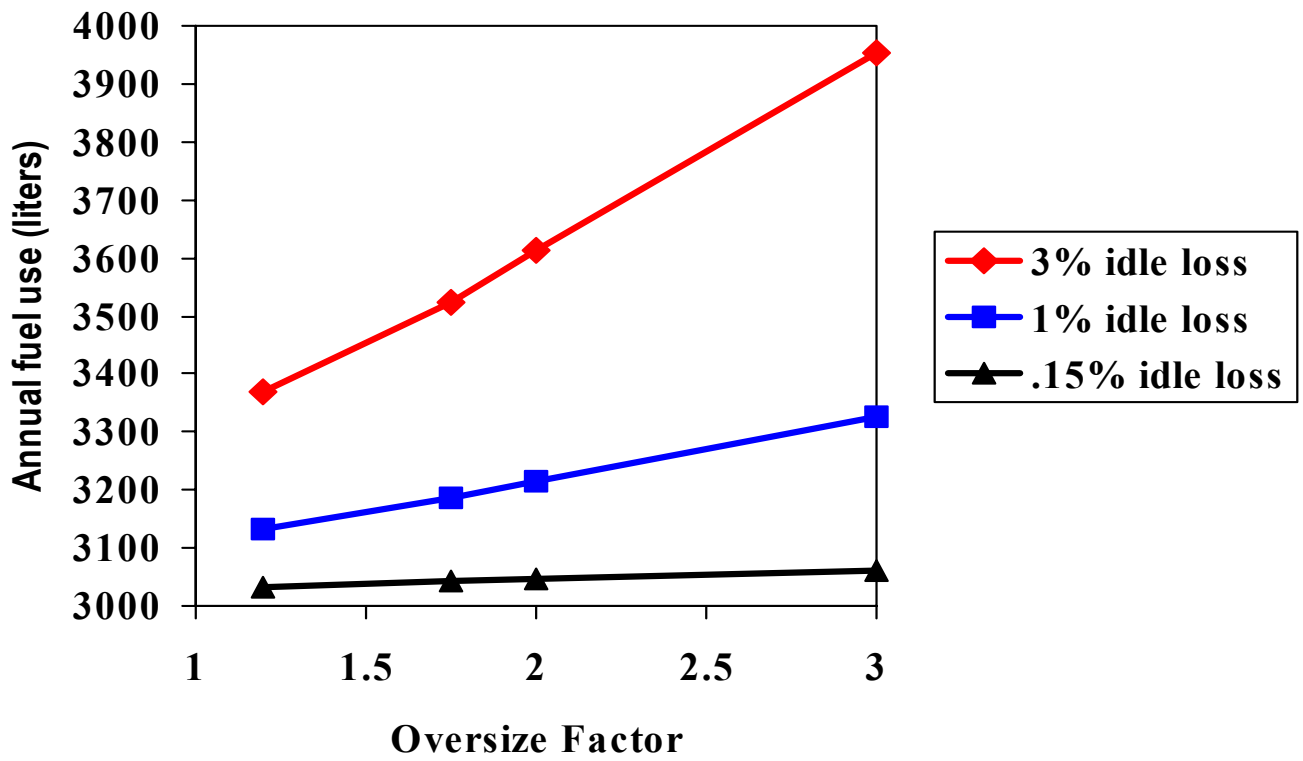


	Steady State Efficiency	Idle Loss	Oversize Factor	Annual Efficiency	Annual Fuel Use	Reduction from Baseline Case
	(%)	(%)	-	(%)	(gallons)	(%)
1- Baseline	82	3	2	68.7	855	0
2	88	3	2	73.7	797	6.8
3	92	1	2	86.4	680	20.5
4	88	.15	2	87.2	674	21.1
5	92	.15	2	91.1	645	24.6

Oversizing


4000
3900
3800
3700
3600
3500
3400
3300
3200
3100
3000
Annual fuel use (liters)
1
1.5
2
2.5
3
Oversize Factor
3% idle loss
1% idle loss
.15% idle loss

Conclusions

- Linear input / output approach good for integrated systems
- Low load losses very big impact on annual fuel use
- As idle losses are reduced, impact of oversizing is reduced
- Opportunities for energy saving larger than steady state efficiency suggests

Project Sponsors

- NORA
- New York State Energy Research and Development Authority