Electric and Natural gas Water Heating 4 Case Study Apartments

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We'll look at…

- Current commercial (general service) electricity and natural gas rates.
- Calculating the cost of demand rate electricity vs. natural gas for service water heating.
- Field energy monitoring results of 1 existing apartment buildings heating service water with Hi E gas and 3 with electricity.

Electricity Rates

Large Business Solutions Simple & Innovative Solutions through Partnership

Electricity Rate Schedule

Effective: May 1, 2014 / Replaces: May 1, 2013

	Basic Monthly Charge ($/month)		Monthly Energy Charge (¢/kWh)			Monthly Demand Charge ($/kVA)*	
			First 11 000 kWh	Next 8 500 kWh	Balance of kWh	First 50 kVA of Measured Monthly Demand	Balance Measured Monthly Demand
General Service Small	Single Phase	$19.73	7.752	5.381	3.552	No Charge	$9.09
	Three Phase	$27.82					
General Service Medium	$29.36		7.752	5.381	3.552	No Charge	$9.09
General Service Large < 30 kV	N/A		3.339			$7.72	
General Service Large 30–100 kV	N/A		3.105			$6.61	
General Service Large > 100 kV	N/A		3.009			$5.88	

*Monthly Billing Demand

The greatest of the following (expressed in kVA)

- measured demand; **OR**
- 25% of contract demand; **OR**
- 25% of the highest measured demand in the previous 12 months.

Notes

- Rates are as approved by the Public Utilities Board of Manitoba (PUB), effective May 1, 2014, and are subject to change.
- All Rates Schedules in the publication are applied on a MONTHLY basis except as noted.
- Accounts where the Monthly Billing Demand is 50 kVA or less within the past 12-month period, ALL energy in excess of 11,000 kWh will be charged at 5.381 cents/kWh.
- Primary metering of multiple Utility-Owned transformation services has an additional 2% added to the kVA for each transformer bank greater than one. There is also a one time 1% reduction on recorded demand and energy to account for transformer losses.
- Definitions of electricity terms can be found at www.hydro.mb.ca/regulatory_affairs/definitions.shtml.

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Electrical Billing Components

- Basic Charge
  - This includes the direct costs of metering, portions of the distribution system, as well as billing and customer service administration.
- Energy Charge
  - That portion of the charge for electric service based upon the electric energy (kWh) consumed.
- Demand Charge
  - That portion of the charge for electric service based upon the peak electric capacity (kVA) required each month.
- Taxes (GST, PST, City)

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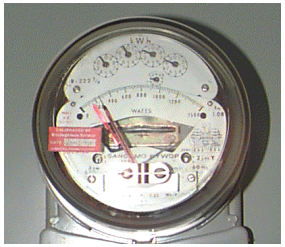
Demand & Energy Metering



kVA demand ~ km/h speed

kWh consumed ~ km’s travelled

Electrical Terminology

Power (Demand)	Energy (Consumption)
Horsepower (hp)	Kilowatt Hour (kWh)
Watt (W) = J/sec	Joule (J)
Kilowatt (kW) (1000 W)	Giga Joule (GJ)
Kilovolt Ampere (kVA)	Measure of how much
Measure of how fast	

Multiply POWER by TIME to get ENERGY

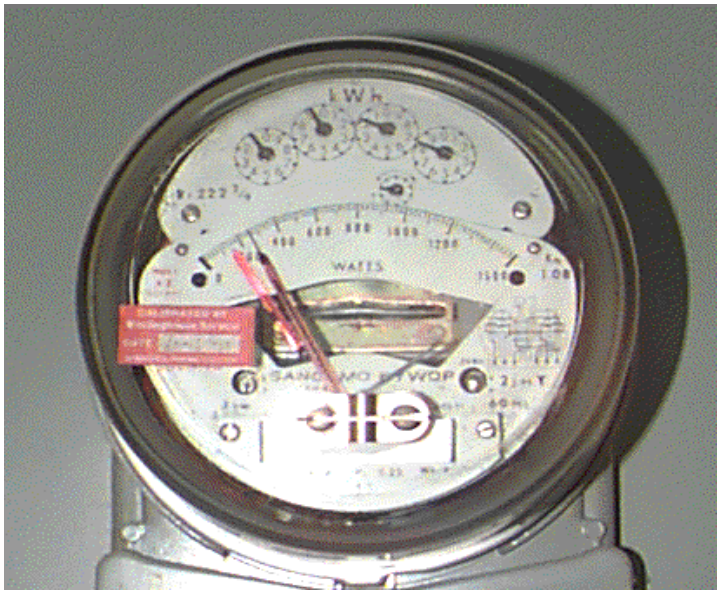
Demand Details

- Peak demand is the peak rate of demand for power in kilovolt-amps (kVA) recorded since the last meter reading.

- The billed demand is the highest actual demand recorded in a 15 minute floating time frame. Therefore, an electrical device has to operate for only 15 minutes to set the demand for the entire month.

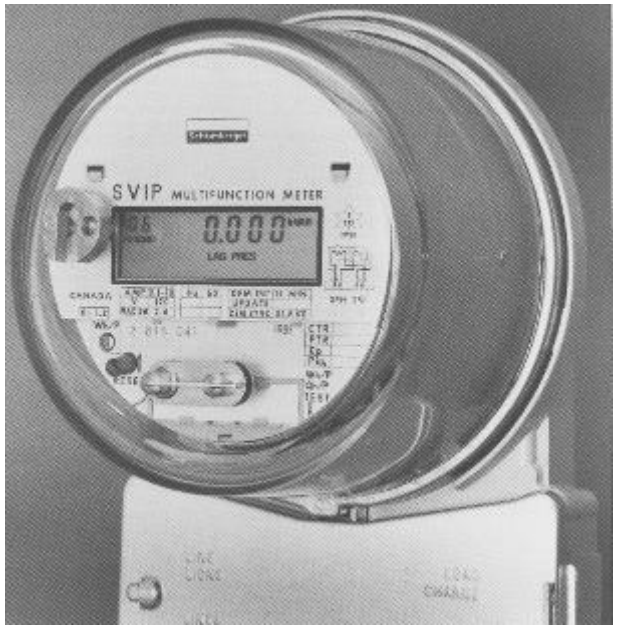
Mechanical Thermal Meter

- Thermal meter consists of a scale and 2 needles:
  - **Red** needle is active and moves as the rate of demand changes. Controlled thru a thermal coil (element) which acts as a damper (shock absorber) to slow down its reaction time.
  - **Black** needle is pushed up the scale by a tab on the red needle and is the one that is read monthly.



Pulse Meter

- Demand register of an Electronic Pulse meter measures:
  - the average kVA demand recorded over a 15 minute period.
  - the maximum 15 min. average kVA recorded since the last meter reading
  - kW & kVAR peaks
  - Power Factor at kVA peak, etc....



Natural Gas Rate Schedule

Effective: May 1, 2015 / Replaces: February 1, 2015

	Transportation & Delivery Related Charges						Gas Supply Related Charges	
	Basic Monthly Charge	Demand Transportation Charge	Demand Distribution Charge	Transportation to Centra	Distribution to Customer	Distribution to Customer Refund	Primary Gas*	Supplemental Gas
	($/month)	($/m³)	($/m³)	($/m³)	($/m³)	($/m³)	($/m³)	($/m³)
Small General Service (SGS)	$14.00	N/A	N/A	$0.0395	$0.1185	N/A	$0.1183	$0.1605
Large General Service (LGS)	$77.00	N/A	N/A	$0.0384	$0.0657	N/A	$0.1183	$0.1605
High Volume Firm Service (HVF)	$1,221.42	$0.4182	$0.1671	$0.0049	$0.0337	N/A	$0.1183	$0.1605
Mainline Firm Service (MLF)	$1,247.13	$0.4237	$0.1816	$0.0068	$0.0291	N/A	$0.1183	$0.1605
Interruptible Service	$1,254.45	$0.1232	$0.0855	$0.0037	$0.0145	N/A	$0.1183	$0.1710

*If you are a Western Transportation customer, contact your broker for the Primary Gas rate applicable to you.

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Rebundled Natural Gas Rates

Short Cut Method - Rebundled Sales Rates

Rate Class	Basic monthly charge	Re-bundled Demand charge ($/m3)	Re-bundled unit charge ($/m3)
Small General Service (SGS)	$14.00	N/A	$0.2843
Large General Service (LGS)	$77.00	N/A	$0.2304
High Volume Firm Service (HVF)	$1,221.42	$0.5853	$0.1649
Mainline Firm Service (MLF)	$1,247.13	$0.6053	$0.1622
Interruptible Service	$1,254.45	$0.2087	$0.1455

Unit Conversions

1 MCF = 28.32784 m^3
1 CCF = 100 cubic feet
1 MCF = 1 000 cubic feet

Billing Percentages

Service Type	Billing Percentages
Firm Service	81% Primary Gas; 19% Supplemental Gas
Interruptible Service	83% Primary Gas; 17% Supplemental Gas

Notes

- Rates are as approved by the Public Utilities Board of Manitoba (PUB), effective May 1, 2015, and are subject to change.
- Base Rates and T-Service Rates are available upon request.
- Minimum monthly bill is equal to the Basic Monthly Charge plus the Demand Charges as appropriate.
- Sales Service provided by Centra is subject to Centra's Schedule of Sales and Transportation Services and Rates as approved by the PUB. Copies of this document are available upon request.
- Definitions of natural gas terms can be found at www.hydro.mb.ca/regulatory_affairs/definitions.shtml.

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Large General Service Natural Gas Rate May 1/15

- **How to do a rate "re-bundling" calculation**:
  - Transportation Charge
    - $0.0384/cu.m. x 100% +
  - Distribution Charge
    - $0.0657/cu.m. x 100% +
  - Primary Gas
    - $0.1183/cu.m x 81% +
  - Supplemental Gas
    - $0.1605/cu.m. x 19% =
  - **Rebundled Effective Rate**
    - **$0.2304/cu.m**.

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Example Comparison

Natural Gas:

Operation = 8 hrs/day * 5 days/wk * 52 wks/year
= 2080 hrs/year

Use = (100000 Btu/hr / 35310 Btu/m3 / 80%) * 2080 hrs/year
= 7363 m3/year

Cost = 7363 m3/year * $0.2304/m3 = **$1,696/year**

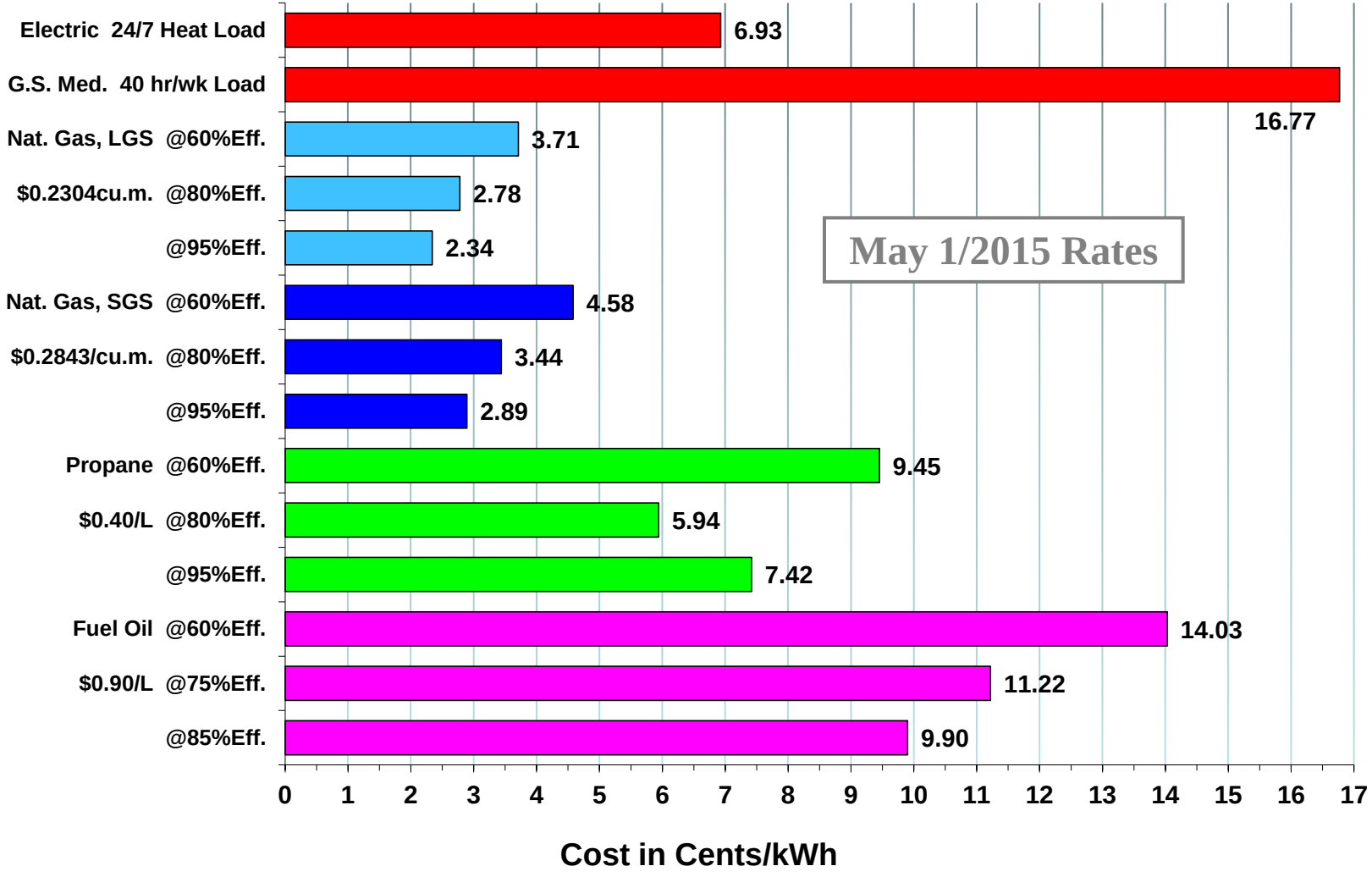
Electricity:

Demand = 100000 Btu/hr / 3413 Btu/kWh = 29.3 kW
= 29.3 kVA (using power factor = 1.0)

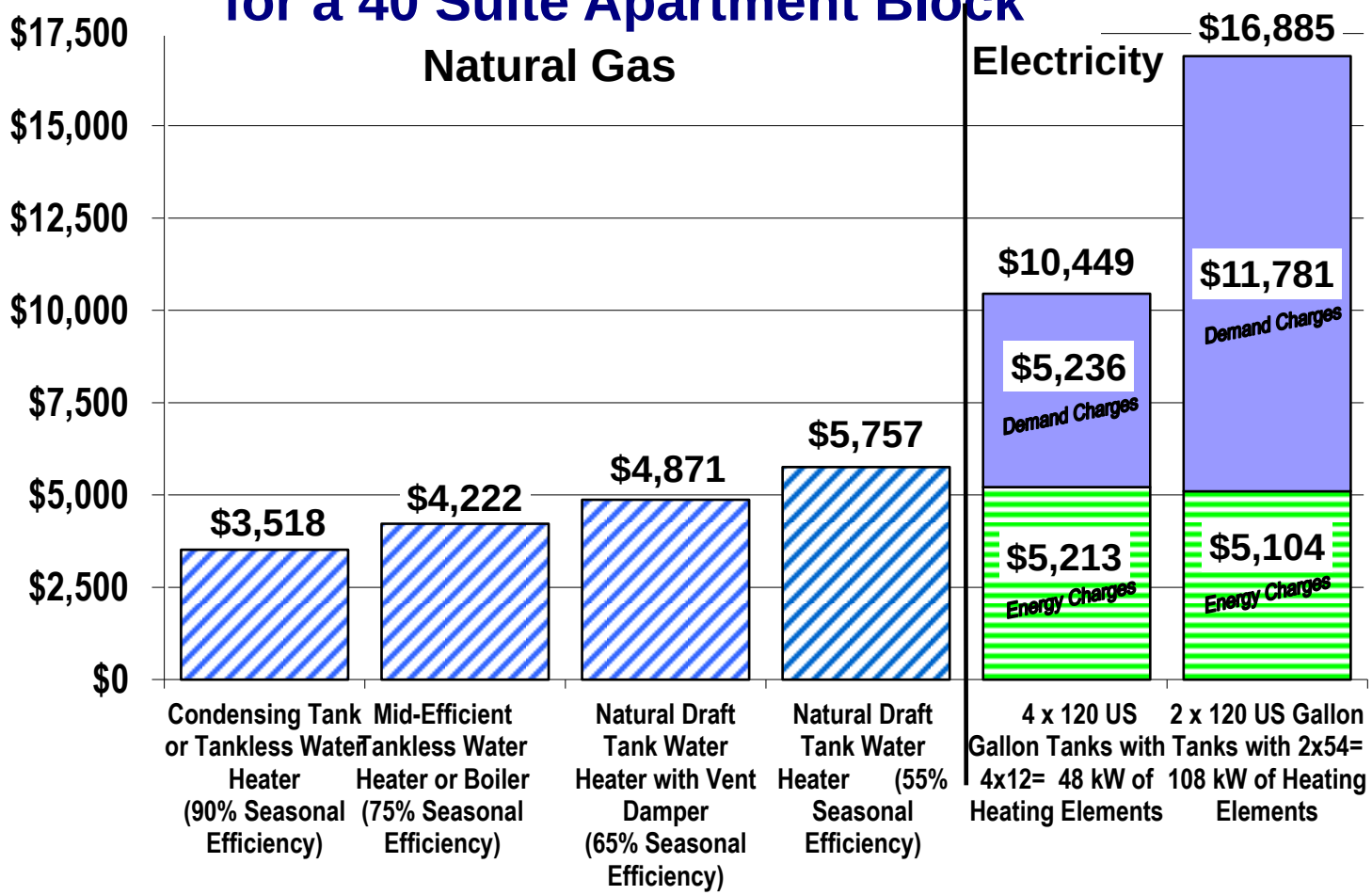
Energy = 29.3 kW * 2080 hrs/year = 60,943 kWh/yr

Cost = 29.3 kVA/mth*12 mth/yr*$9.09/kVA + 60,943 kWh/yr*$0.03552/kWh
= **$5,543/year**

Alternative Heating Fuel Costs



Typical Annual Water Heating Costs for a 40 Suite Apartment Block



ENERGY RATES*

Natural Gas:
Large General Service
$0.2304/cubic metre

Electricity:
General Service Medium
Energy:
$0.03552/kWh
+
Demand: $9.09/kV.A

*Rates in effect on May 1, 2015

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Case Study #1 – 22 Suite Mixed Occupancy Apartment

- High efficiency gas tank type water heater
  - 100 USG, 199,900 Btu/h input, 95% thermal efficiency rating
- Tank fitted with monitoring equipment:
  - Water meter with pulse output on its cold water inlet pipe.
  - Gas meter with pulse output on gas supply pipe.
  - Energy meter on power venter fan motor.
  - RTD temperature sensors on water inlet and water outlet
  - Data logger collecting all temperature and pulse outputs at 5 minute intervals
- Monitored for 17 days

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Case Study #1 – 22 Suite Mixed Occupancy Apartment

- 30 people = 1.36 people per suite
- Metered gas consumption of 6776 cu.ft. over a period of 408 hours (17 days)
- Annual gas use estimate of 4,120 cu.m = 42,642 ekWh
  - 1421 ekWh/yr/person = $32/yr/person
  - 1938 ekWh/yr/suite = $44/yr/suite
- Metered DHW usage of 36,787 L / 17 days / 30 people
  - 72 L/day/person
- Average water T out = 118F (48C), T in = 42F (5.4C)
- Overall water heater efficiency of 90.1%
- Steady State efficiency of 94.5%

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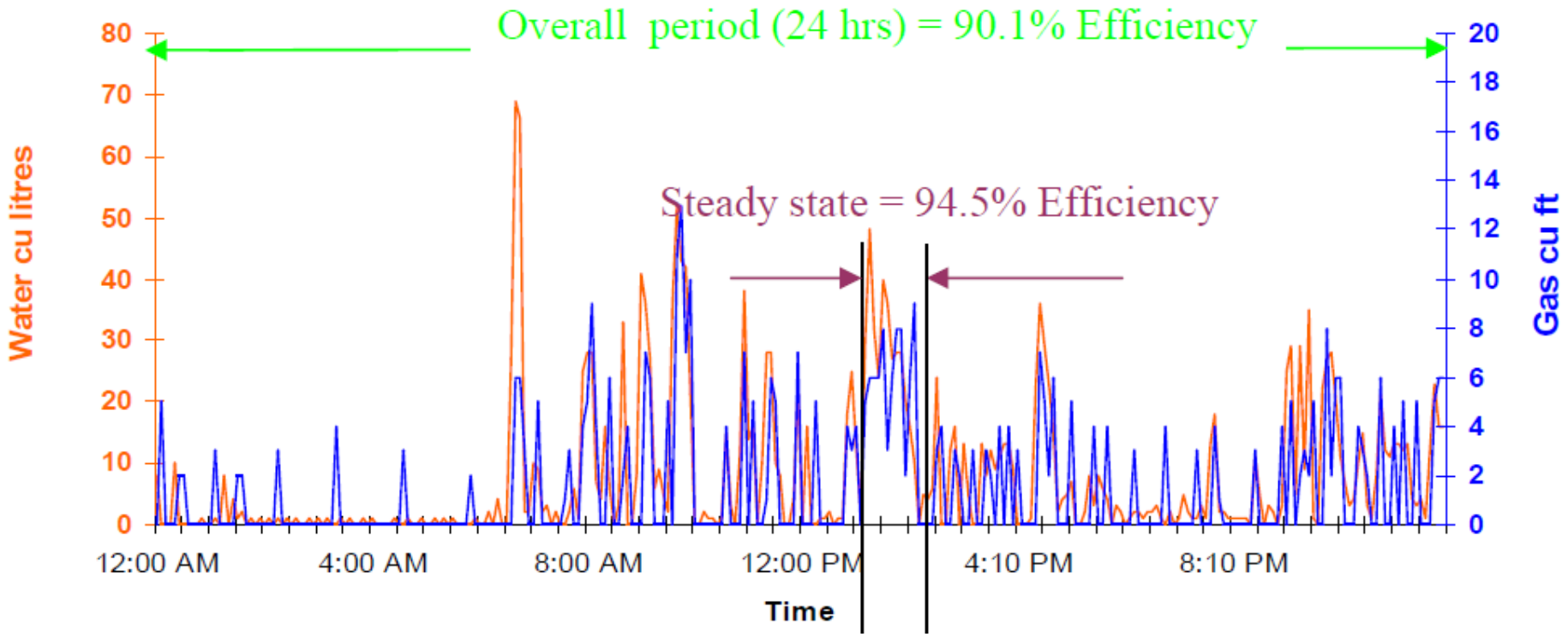
Typical Daily Usage: Water vs Gas Consumption *



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Case Study #2 – 42 Suite Mixed Occupancy Apartment

- Tank 1 - 120 USG, 54 kW of elements
- Tank 2 - 120 USG, 40 kW of elements
- 74 people = 1.74 people per suite
- Metered water tank consumption of 17,027 kWh over a period of 852 hours (35.5 days)
- Annual consumption estimate of 175,000 kWh
  - 2365 kWh/yr/person =$222/yr/person
  - 4166 kWh/yr/suite = $392/yr/suite
- 94 kW of monthly peak demand contribution

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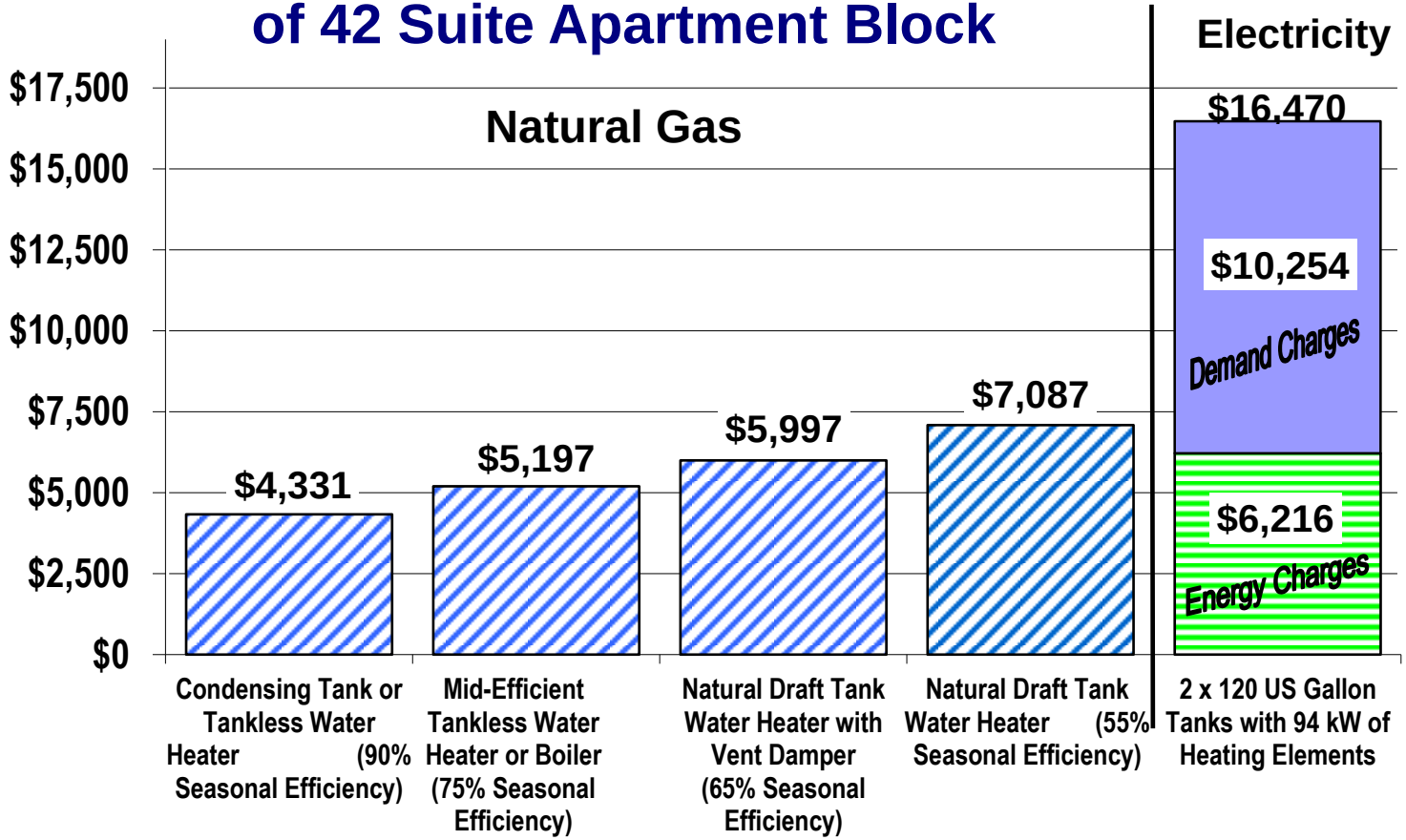
Annual Water Heating Costs of 42 Suite Apartment Block



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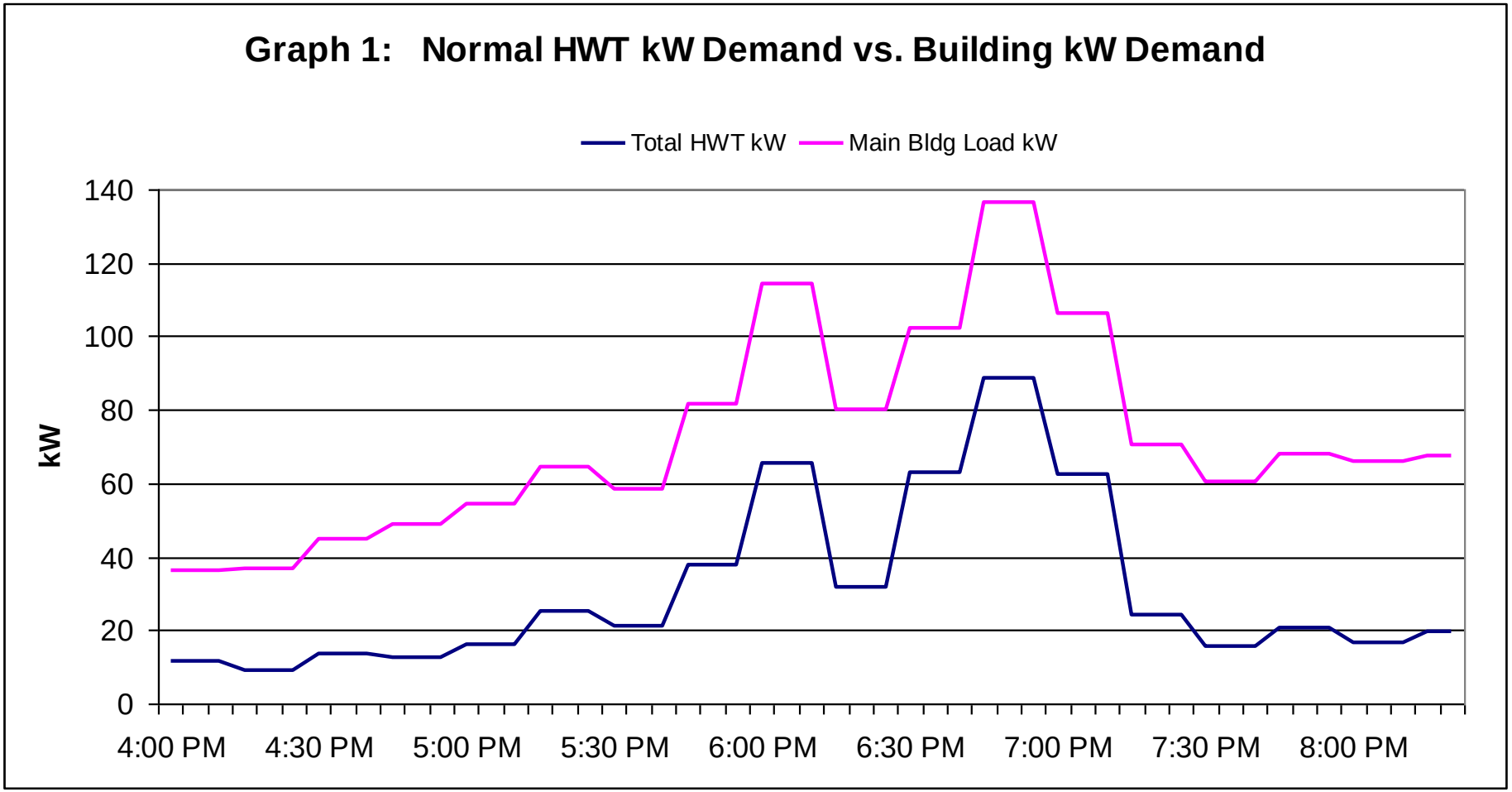
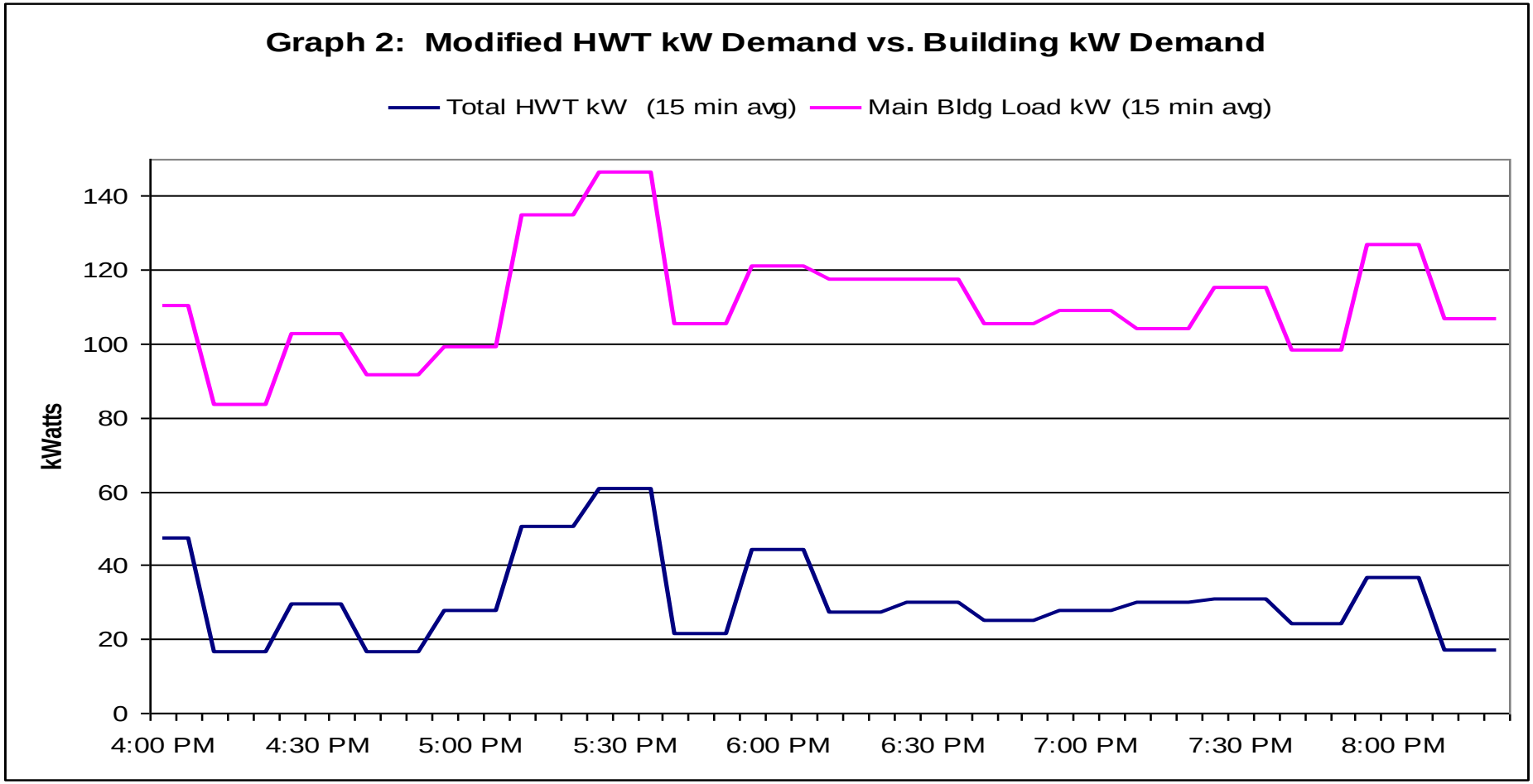

Graph 1: Normal HWT kW Demand vs. Building kW Demand
Total HWT kW
Main Bldg Load kW
kW
140
120
100
80
60
40
20
0
4:00 PM
4:30 PM
5:00 PM
5:30 PM
6:00 PM
6:30 PM
7:00 PM
7:30 PM
8:00 PM



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Case Study #3 – 52 Suite Mixed Occupancy Apartment

- Tank 1 - 120 USG, 27 kW of elements
- Tank 2 - 120 USG, 27 kW of elements
- 87 people = 1.67 people per suite
- Metered water tank energy consumption of 10,221 kWh over a period of 410 hours (17.1 days)
- Annual consumption estimate of 218,200 kWh
  - 2508 kWh/yr/person = $157/yr/person
  - 4196 kWh/yr/suite = $262/yr/suite
- 54 kW of monthly peak demand contribution

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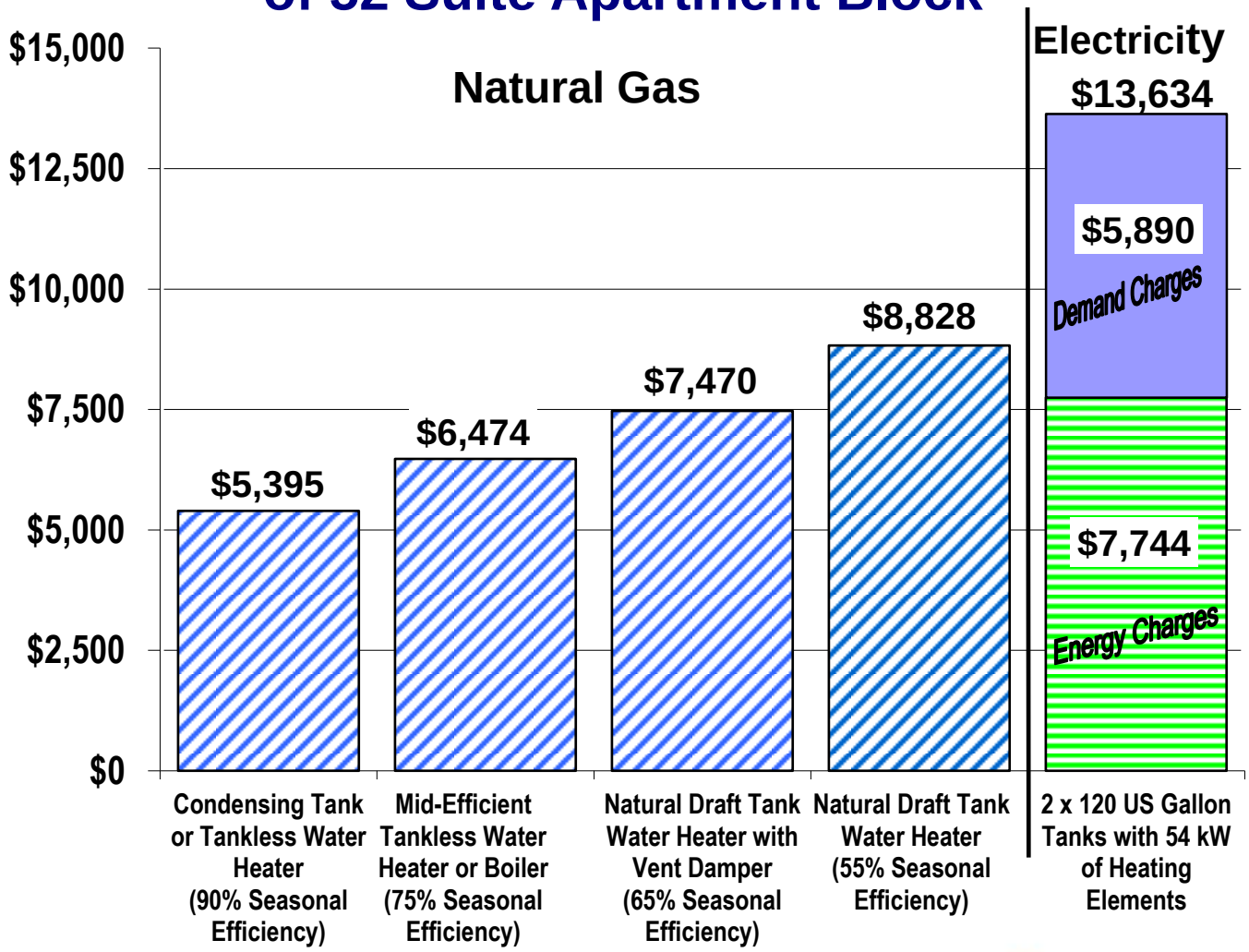
Annual Water Heating Costs of 52 Suite Apartment Block



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+
Demand:
$9.09/kV.A

*Rates in effect on May

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Case Study #4 – 31 Suite Seniors Apartment

- Tank 1 - 120 USG, 30 kW of elements
- Tank 2 - 120 USG, 27 kW of elements
- Tank 3 – 120 USG, 30 kW of elements
- 35 people = 1.12 people per suite
- Metered water tank consumption of 5,898 kWh over a period of one month (30 days)
- Annual consumption estimate of 71,759 kWh
  - 2050 kWh/yr/person = $156/yr/person
  - 2315 kWh/yr/suite = $176/yr/person
- 27 kW of monthly peak demand contribution because all flow short circuited thru the one middle tank. Two outer tanks never operated and contributed to peak.

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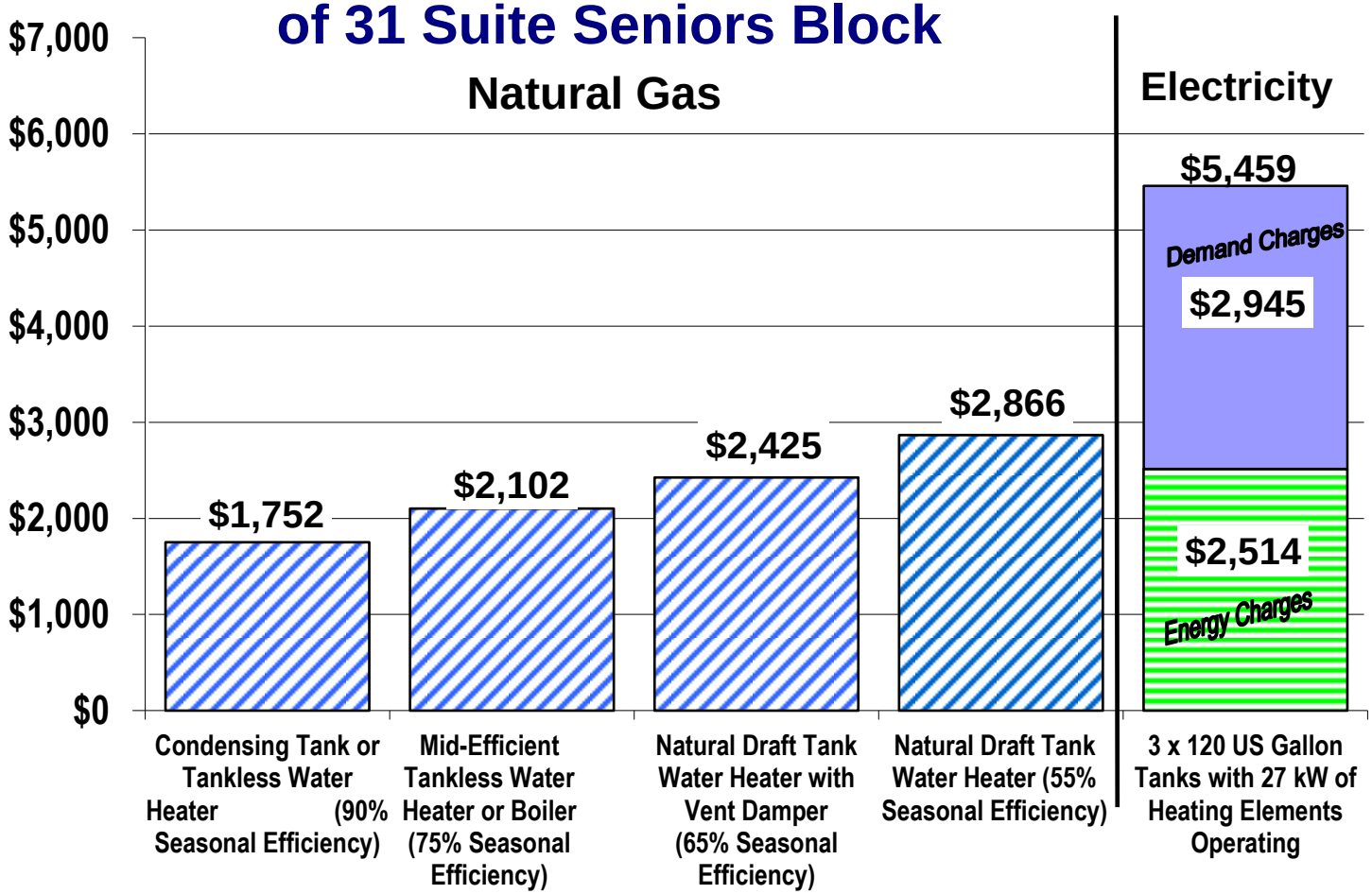
Annual Water Heating Costs of 31 Suite Seniors Block



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MORE INFO

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