Drain Water Heat Recovery

What about the potential ?

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ACEEE 2010 Hot Water Forum
May 13th, 2010

Today's Presentation

> **Electric water heating in Quebec**

> **Heat recovery technologies**

> **Some lab results**

- Instantaneous performance
- Annual savings projection

> **Some statistics**

- Number of showers
- Length of showers
- Hot water Energy Consumption

Electric Water heating in Quebec

> **90 % of residential customers use electricity for Water heating**
  - Mainly 40 or 60 Imp. Gallons

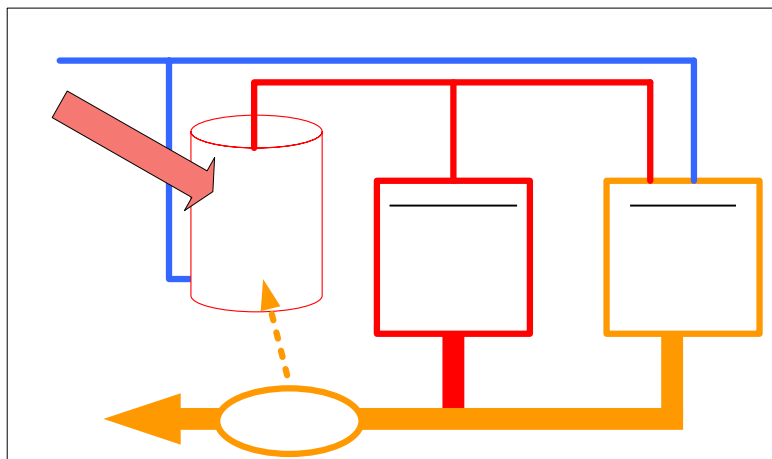> **Typically 20-25 % of home energy used**

> **Roughly 12 TWh of electricity**

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Heat recovery opportunity
-High Specific heat of water

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Heat recovery technologies

> **Many concepts, many patents, not so much products**
  - Grease, soap and everything else…
  - Avoid clogging, maintenance
  - Water use and drain
    – Batch process (Bath, dishwasher, etc)
    – Simultaneous (Shower, Hand wash, etc)
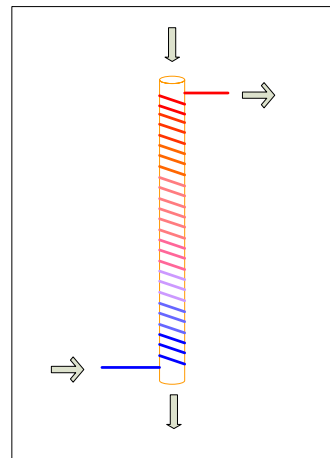
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Heat recovery technologies

> **Working Principles**
  - Transfer heat from waste to incoming water
  - Preheated water can supply
    – Water heater and/or
    – Cold tap shower
  - Works only for simultaneous draw and sink usages (showers…)

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Lab testing (2007)

> **Tested 40 & 60 inches units**
> **Protocol included**
> - Showers (2)
> - Bath
> - Dishwasher & clothe washer cycle
> - Toilette flushes
> - Hand washes, etc
>
> **220 liters (58 US gal) @ 60°C (140 °F)**

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Lab testing (2007)

> **45 to 53 % instantaneous performance**
> - For equal flow configuration
>
> **869 to 1021 kWh/yr of saving**
> - 700 to 900 $ investment
> - More than 10 years payback @ 0.07 $/kWh
> - Net Present Value positive
>   - No maintenance
>   - Long life expectancy

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Lab testing (2007)

> **Cross-effects** (heat coming from ambient air)
- Not important

> **Annual savings sensible to assumptions**
- Number of showers

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Lab testing (2010)

> **Impact of some installation variations**
- Insulation
  - No significant impact
- Drop height (Shower often on 2nd floor and DWHR in basement)

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Some statistics (from EWHD)

> **Energy Wise Home Diagnostic**

- Web tool helping customer to better understand their electric consumption and to promote energy saving

- Based on customer Inputs, Electric bills & Weather data

- More than a million customer since 2003

Some statistics (from EWHD)

> **Number of showers/week**

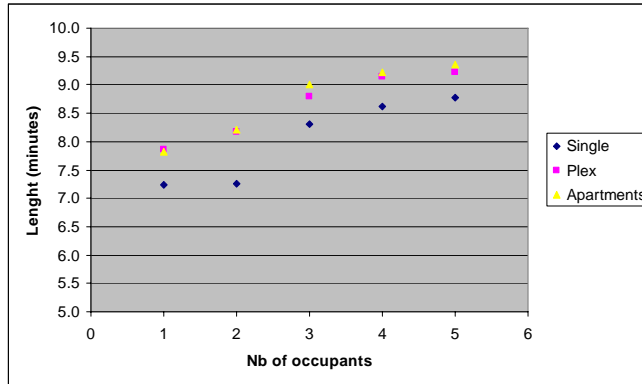| Nb Occupants	Single family	Duplex & triplex	Apartments
1	5.36	5.42	5.56
2	8.96	9.19	9.48
3	13.49	13.21	13.00
4	16.64	15.88	14.06
5	19.14	17.69	15.89

Some statistics (from EWHD)

> ## Average length of showers

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Some statistics (from EWHD)

> ## Averages/week

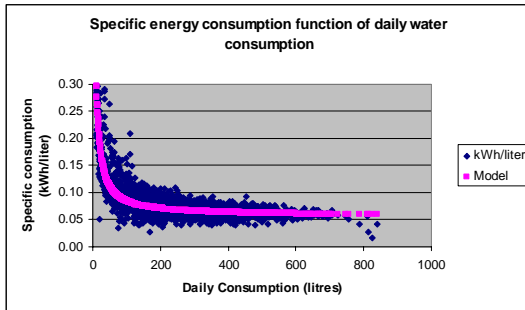|	Single	Plex	Apartments	Weighted Average
Number of showers	12.20	9.88	8.48	10.94
Total time	99.07	84.07	70.57	89.87
Average length	8.12	8.51	8.32	8.23

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Some statistics (from EWHD)

> **From hot water consumption to Energy consumption**

- 59 Customers
- January to April 2007

Specific energy consumption function of daily water consumption

$$\frac{Q_{Model}}{m} = C_p \Delta T + \frac{\beta}{m}$$

$\Delta T = 48.2\ °C\ (119\ °F)$

$\beta = 2.87\ kWh/jr\ (120\ W)$

Some statistics (from EWHD)

Energy consumption for Showers (kWh/yr)
9.5 l/min (2.5 USGPM)
Incoming water @ 12 °C (54 °F)
Shower @ 40 °C (104 °F)

	Single	Plex	Apartments
1	627	689	701
2	1 051	1 211	1 255
3	1 807	1 877	1 892
4	2 313	2 347	2 094
5	2 708	2 633	2 401

Some statistics (based on EWHD model)

Total hot water consumption (kWh)

Nb Occupants	Single	Plex	Apartments
1	2234	2050	2006
2	3154	3002	2935
3	4306	4050	3917
4	5237	4936	4508
5	5960	5567	5115
Weighted average	4 035	3 803	3 076

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Some statistics (From pilot project)

59 customers, January to April 2007

Hot water consumption (@ 60°C - 140 °F)

$y = 54.21x + 14.559$
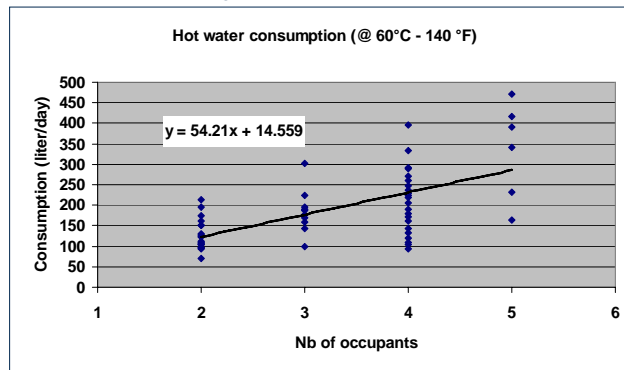
- Smaller than standard reference (ASHRAE)
  - 156 vs 236 liters for 2.6 occupants

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Some statistics (From pilot project)

59 customers, January to April 2007

Hot water Energy consumption (kWh)

$y = 3.1337x + 3.2839$

kWh/day vs Nb of occupants (scatter plot, y-axis 0 to 35, x-axis 1 to 6)
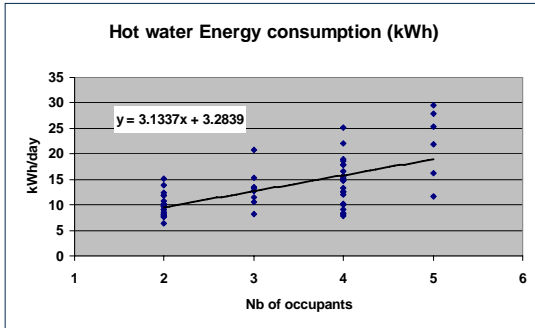
- Larger than EWHD
  - But worst part or the year (Jan to Apr)

Hot water Energy consumption (kWh/yr)

Nb Occupants	EWHD	Pilot
1	2234	2344
2	3154	3489
3	4306	4630
4	5237	5774
5	5960	6918

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