

# Smart Home Technology in Milton, Ontario

Ian Rowlands, University of Waterloo

Presented at the Smart Metering & Advanced  
Metering Infrastructure Conference,  
Burlington, ON, 30 November 2009

Session 1B: Delivering End-User & Societal Benefits

# Purpose and outline

- Purpose
  - To report upon the analysis associated with a ‘smart homes’ project undertaken in Milton, ON, 2007 and 2008.
- Outline
  - Context
  - Methods
  - Results
  - Lessons
  - Future opportunities
  - Summary and acknowledgements

# Context: UW

- Research group in the Faculty of Environment, University of Waterloo (UW)
  - active in investigating the ‘technological-social’ interface **Sustainable Energy Research**
    - in other words, the ways in which new devices are deployed in communities (at various scales)
  - work across the University of Waterloo
    - active with colleagues in ‘WISE’ (the Waterloo Institute for Sustainable Energy)



# Context: Broader project

- Multiple partners



- Recruitment of household pilot participants in Milton, ON (July 2007 to November 2008)



# Methods – 1/4

- Goal:
  - To determine the impact of the installation of a home energy management system upon residential electricity consumption
- Challenge:
  - Outside of ‘the laboratory’, it is difficult to isolate a particular intervention and to determine its influence
- Strategy:
  - Attempt to identify appropriate ‘coupled pairs’

# Methods – 2/4

- Ideally, we ‘control’ for all factors that could affect electricity consumption patterns and potential

Characteristics of the external environment:

- weather
- prices
- media coverage



Characteristics of the inhabitants:

- number, ages and genders
- income
- education
- values, norms, attitudes

Characteristics of the house:

- size
- age
- envelope
- heating/cooling system

# Methods – 3/4

- Analyses of samples ranging in size from 19 to 123 households
  - characteristics of Milton, ON broadly
    - younger and wealthier inhabitants living in newer homes, ...
  - characteristics of those attracted to a ‘conservation study’
    - potential for improvement may be modest (and experience with time-of-use pricing may further heighten this)

# Methods – 4/4

- A ‘pilot project’: still learning
  - technological improvements during the course of the study
  - when/how were different systems operating?
  - selected customers’ perspectives as revealed by web activity
- Our ‘controls’: limited knowledge and modest matches
  - not know as much about both the participants and the control as we would have liked
  - and even with that which we knew, we did not secure not full ‘matches’ across all key characteristics

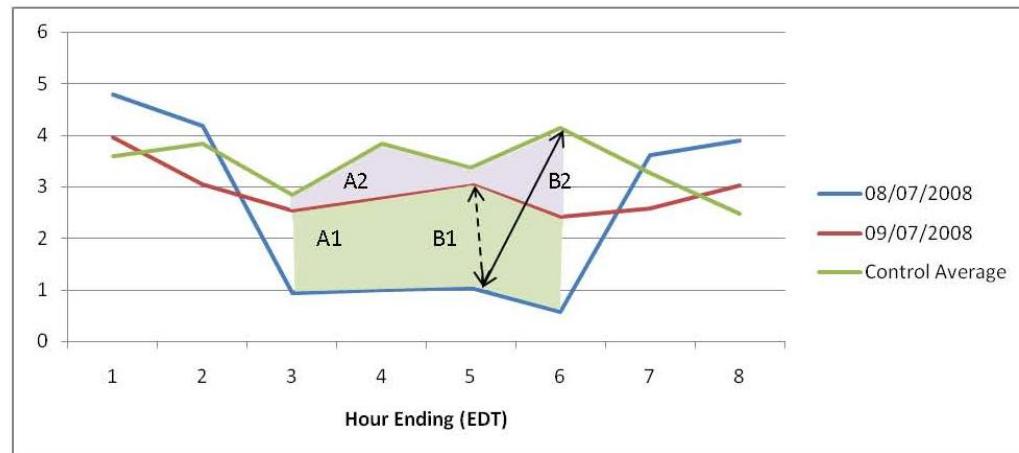
# Results – 1/3

- From the group as a whole
  - **larger homes** (at least those that consume more electricity) appeared to have greater potential for reductions than smaller (lower consuming) homes
  - those who went on to **time-of-use pricing more recently** (2007) appeared to have greater potential for reductions than those more experienced with time-of-use pricing (on it since 2005)

# Results – 2/3

- From particular sub-groups
  - demand response potential
    - 19 homes, 5 episodes (4 hours each)
    - on average, a 44% energy decrease
    - on average, a 26% peak demand decrease

Figure 1 - Investigating the impact of the Home Energy Management Technology on one home on 8 July 2008 (kW consumption)



# Results – 3/3

- From particular sub-groups
  - top performers ... the ‘top 10%’

Table 3 – Electricity consumption reductions for ‘top’ sample households, with some ‘control’

	Total consumption 90 <sup>th</sup> percentile	Peak consumption 90 <sup>th</sup> percentile
October	-40.76%	-51.19%
November	-32.50%	-31.37%
December	-29.83%	-29.23%
January	-23.34%	-23.96%
February	-22.93%	-22.62%
March	-25.59%	-26.12%
April	-24.50%	-38.94%
May	-23.72%	-22.92%
June	-23.53%	-21.98%
July	-27.69%	-35.29%
August	-25.60%	-25.21%
September	-18.36%	-30.63%

*taking a ‘month-by-month’ view*

*looking across 12 months (with the same household)*

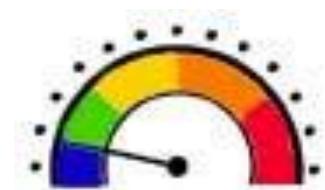
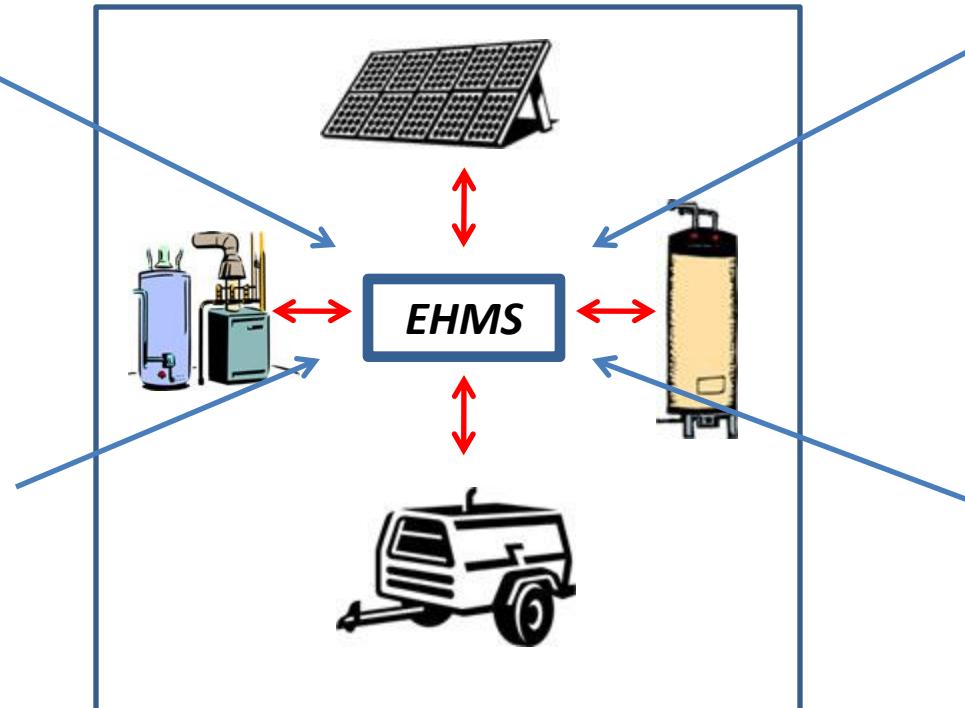
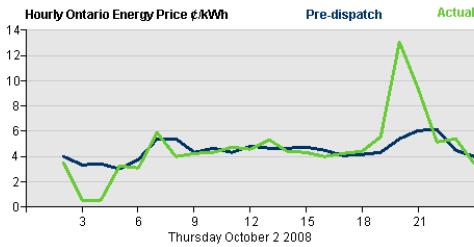
***The 90<sup>th</sup> percentile home had a 16% reduction in total consumption and a 18% reduction in peak consumption.***

# Lessons

- potential certainly exists
  - exciting results among selected sub-sets of the sample
- challenges associated with recruitment and engagement
  - this then leads to difficulties associated with controlling for other factors

# Future opportunities – 1/6

*'Vision' for the Energy Hub Management System project (partners on next page)*



# Future opportunities – 2/6

- University
  - University of Waterloo
- Utilities
  - Hydro One
  - Milton Hydro
- Private sector
  - Energent
- Government
  - Ontario Centre for Energy
  - Ontario Power Authority



# Future opportunities – 3/6

- Milton, Ontario pilots
  - ‘set and forget’?
  - what is discretionary?
  - what are the constraints?
  - ... on what do people optimize?
  - ... \$, kWh/MJ, CO<sub>2</sub>?
  - display metrics?

# Future opportunities – 4/6

- Social networking ? ... Twitter feeds ...

*'Even Buildings  
Have Twitter  
Accounts',*

27 August 2009

What are you doing? 140

Latest: Lyceum at University of Mississippi for 8/20/2009: (1588.02 kWh usage, 24.36 kWh peak) Yesterday I consumed -5.41% less energy and my pea... 35 minutes ago update

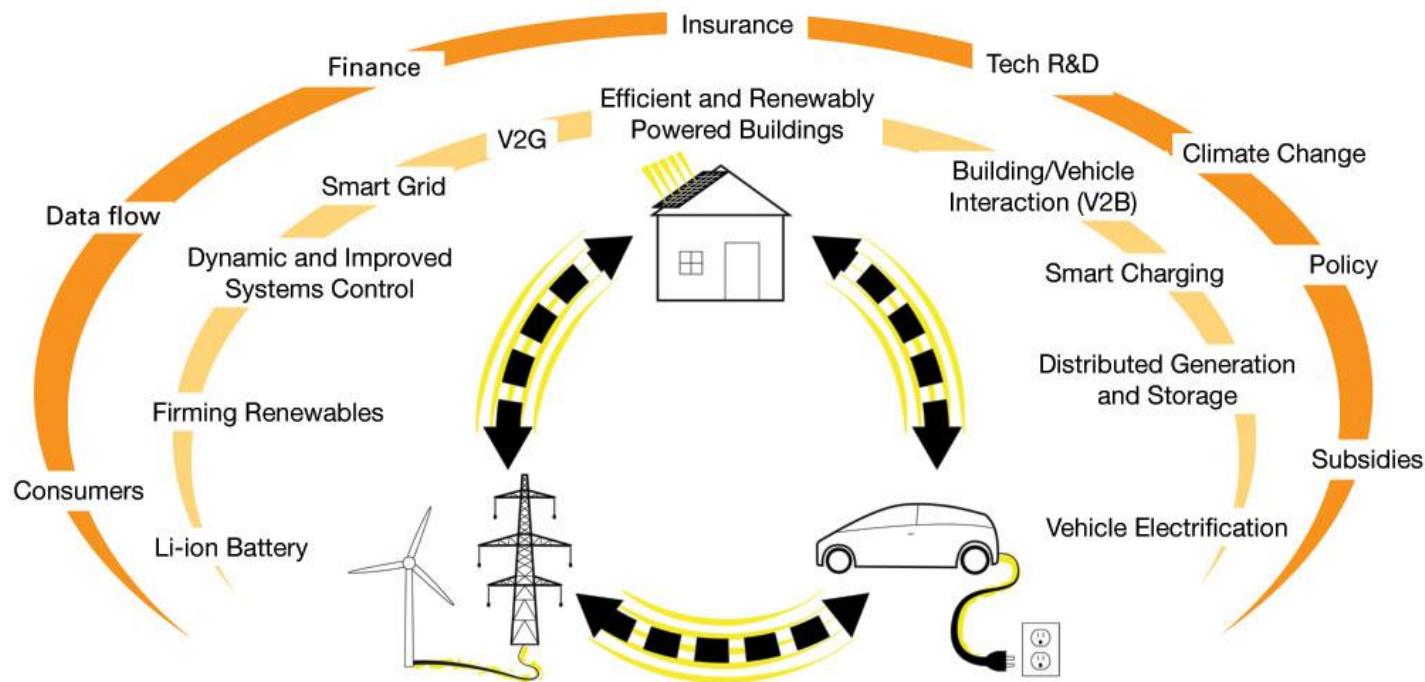
Home

**LyceumEnergy** Lyceum at University of Mississippi for 8/20/2009: (1588.02 kWh usage, 24.36 kWh peak) Yesterday I consumed -5.41% less energy and my pea... 35 minutes ago from twitterfeed.

**LyceumEnergy** Lyceum at University of Mississippi for 8/19/2009: (1618.92 kWh usage, 23.04 kWh peak) On the bright side, the peak was down -2.08%. But... 35 minutes ago from twitterfeed.

# Future opportunities – 5/6

- Link analyses with personal transport (the car in the garage)

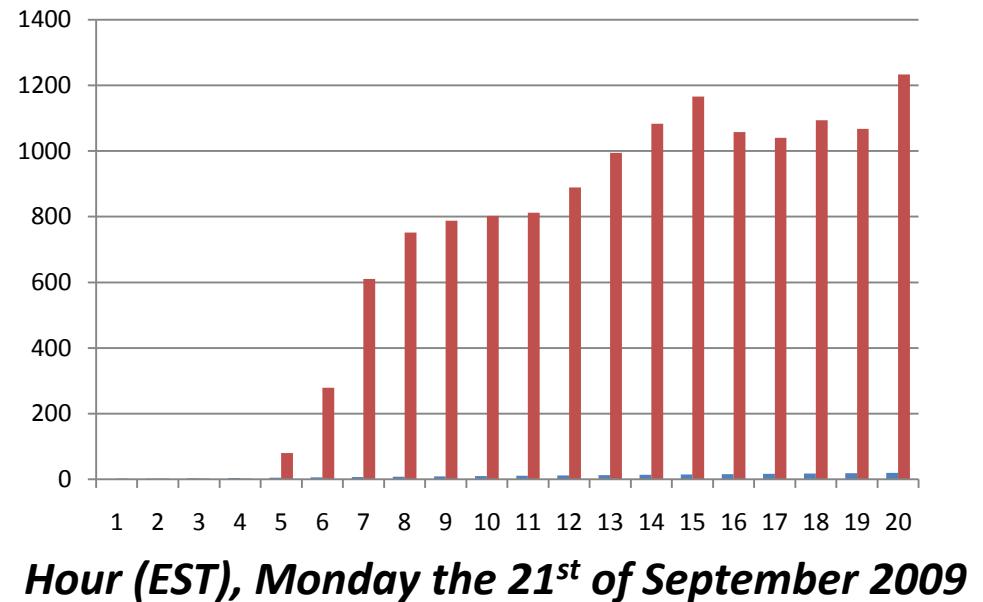


# Future opportunities – 6/6

- Personal carbon allowances



*Coal  
MW in  
Ontario  
system*



# Summary and acknowledgements

- Summary
- Acknowledgements



Bell University Laboratories

**Jeremy Schembri (MES, University of Waterloo)**

- Presenter's contact details:

Ian Rowlands

irowland@uwaterloo.ca, (519) 888-4567, ext. 32574