



Creating homes and neighbourhoods  
that work well into the future  
and don't cost the Earth

# Technology Research Stream: Learnings and Opportunities

Beacon Stakeholder Symposium

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# Technology Summary Outline



- Early Beacon research – Project Confirmation Phase
- Recent research
  - learnings and opportunities
- Future direction

# Early Beacon Research

- Many technologies available, but not all technologies required exist
- More challenge with retrofit technologies
- Knowledge lacking on performance of existing technologies - need good reliable information
- Need to understand how technologies can impact on Beacon's goal
- Lack of information on materials and principles for selecting
- Waste minimisation and recovery important



# Recent Research Findings

- Energy – Renewable energy, PCMs, Windows
  - Insulation in progress  
(BRANZ, Scion)
- Materials – LCA, Waste  
(Scion, BRANZ, URS)
- Structures – New systems and factory built  
(elad enterprises)
- IEQ – what is IEQ and Beacon's role?  
(Massey University)
- Water – covered separately

# Renewable Energy Opportunities

- Five energy generation methods were reviewed
  - Solid fuel burners
  - Solar water heater
  - Wind generation
  - Heat pumps
  - Photovoltaic arrays
- Difference between low grade and high grade energy identified
- Base load electricity use high
- More house with large north facing windows
  - overheating issues
- Advantages of distributed energy



# Renewable Energy Opportunities

## - Solid fuel burners

- Importance of solid fuel burners (=530MW station)
  - used in 50% of New Zealand homes
  - cheap, available, carbon neutral fuel
- Emissions can be very low
  - Opportunity for development
- Ducting beneficial
- Large international growth in pellet burners
  - Good performance, easy to use
  - Infrastructure issues in New Zealand



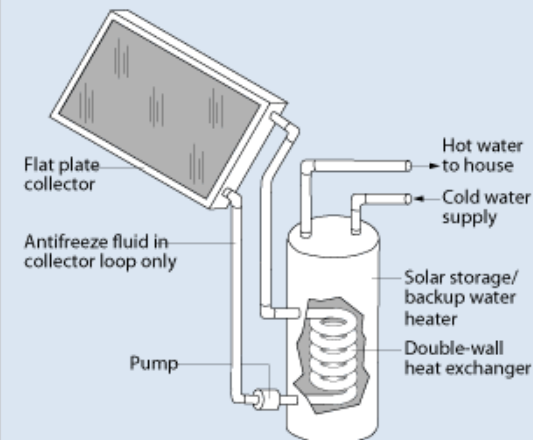
# Renewable Energy Opportunities

## - Solar water heaters

- 2500 units/year (Aus 20,000/year)
  - Many incentives in Australia
- If installed when water cylinders fail
  - 80,000 units/year (50% upgrade)
  - = extra 80GWh/year capacity
- Solar water heaters have much potential but:
  - Little reliable performance data
  - Seem overpriced in New Zealand (equipment and installation)
  - Limited incentives, cf Australia

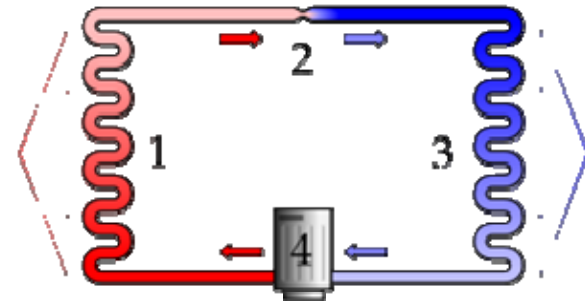


Active, Closed Loop Solar Water Heater



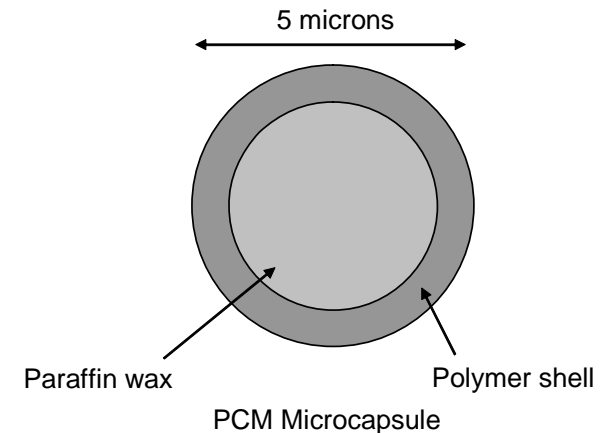
# Renewable Energy Opportunities

- Heat pumps seen large growth but not all good
  - summer cooling demand
  - poor efficiency when very cold
  - basic systems in New Zealand (air source)
- PVs and wind turbines have issues, but potential
  - cost, extra equipment, social (turbines)
  - PV technology advancing
- Options for further work highlighted, particularly:  
solid fuel burners, heat pumps, solar water heaters



# Phase Change Materials

- Moderate temperature by storing energy in a materials phase change (melting or solidifying)
- Modelled thermal performance of the PCM
- PCMs better for keeping building cool, rather than keeping warm (if used passively)
  - better for commercial building
- Issues with encapsulating and temperature operating ranges suggest low potential for New Zealand



# Multi-paned Windows

- Many technologies available - 20 reported (glass, frames, coatings, gas fill)
- Thermal improvements:
  - Double glazing 70 to 100%
  - Thermal break (Al) 20 to 40%
  - PVC or wood frame 30 to 50%
  - Triple glazing 90 to 220%
  - Superwindow 500%



# Multi-paned Windows

- New Zealand situation – market size, custom made, AI
- Technologies to keep cool - tinting
- Not so clear on window impact in house system – thermal performance and LCA impact
- New product development potential in framing materials/systems



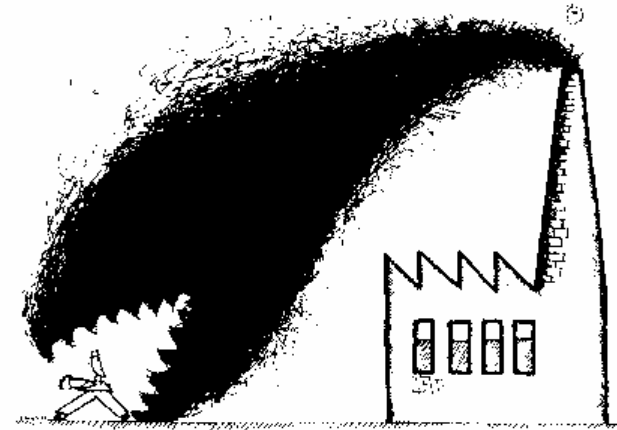


COLDER AT THE WEEKEND...

Shall we ask some friends round to keep the room temperature up?

# Materials - Life Cycle Analysis (LCA)

- Introduces concepts and protocols to evaluate environmental impact of materials, products and systems
- Energy & CO<sub>2</sub> embodied in materials introduced
- Need to consider linkage between effect of material on embodied energy and energy consumption in life and end of life.
- More sustainable buildings generally have lower 'in use impact' but higher embodied material impact
- Range of criteria to assess in LCA – Abiotic resources; Land use; Climate change; Ozone depletion; Ecotoxicity; Human toxicity; Photo-oxidant formation; Acidification; Eutrophication



# Materials - Scoping Waste

- Large proportion of landfill from residential construction and demolition (C & D)
- largest material waste streams from C & D:
  - Wood: 40%
  - Concrete/clean fill: 13 – 25%
  - Drywall/plasterboard: 18 – 26% (all by weight)
- Packaging large volume, low mass
- Introduces ‘Waste Hierarchy Model’

Avoid > Reduce > Reuse > Recycle > Recover > residue landfill
- Introduces ‘Cradle to Cradle’ thinking
- REBRI guidelines recommended



# Indoor Environment Quality (IEQ) -Draft report only

- A growing area of interest and international concern
- Strong link to health eg asthma issues in New Zealand
- Most vulnerable spend more time indoors (young and old)
  - Approx 75% of time indoors, aged over 65 – 90% indoors
- Areas considered:
  - VOCs (chemicals)
  - Biological
  - Humidity
  - Particles
  - Temperature
  - Noise
- Recommendations on how to make a healthy home given – house features
- To define Beacon's role - likely to focus on temperature, humidity and air-changes



# Sustainable Residential Structures



- A range of building systems reviewed
  - Limited information on performance
- Waste reduction and quality improvements claimed for factory built systems
- Opportunity to understand benefits of different systems – including environmental impact (LCA)
- Potential to develop new system based on understanding
  - Stand alone
  - Multi-residential



# Future Direction

- Need to understand opportunities and risks
- To be pursued within Beacon's Targets:
  - Energy
    - eg local generation (E2) - low grade and high grade energy
  - Materials
    - eg window frames
  - Homes
    - eg new (adapted) building structures
  - Water and Neighbourhoods
- Address current technology performance, value proposition & new opportunities

