



Natural Resources  
Canada

Ressources naturelles  
Canada

C E T C

CANMET ENERGY TECHNOLOGY CENTRE

# Energy Technology Development for Sustainable Housing

CLEAN ENERGY TECHNOLOGIES

**David Landsberg, P.Eng.**

Housing, Buildings and Simulation

Sustainable Buildings and Communities

CANMET Energy Technology Centre

# Sustainable Buildings & Communities

Experts in energy innovation for the built environment

Our research, development and deployment activities fall within the following areas:

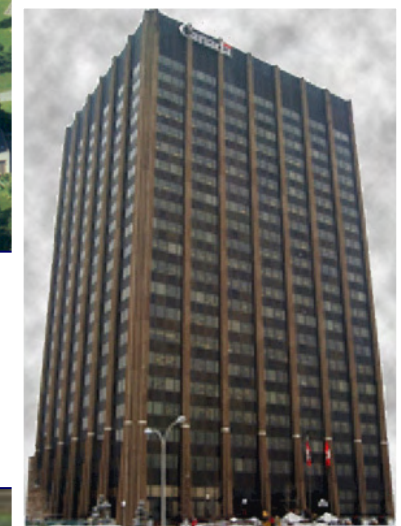
- Housing
- Buildings
- Communities
- District Heating & Cooling
- Distributed Energy
- HVAC & Energy Systems
- International Projects
- Renewable Energy
- Building Simulation R&D
- Simulation Tools Dev. & Support



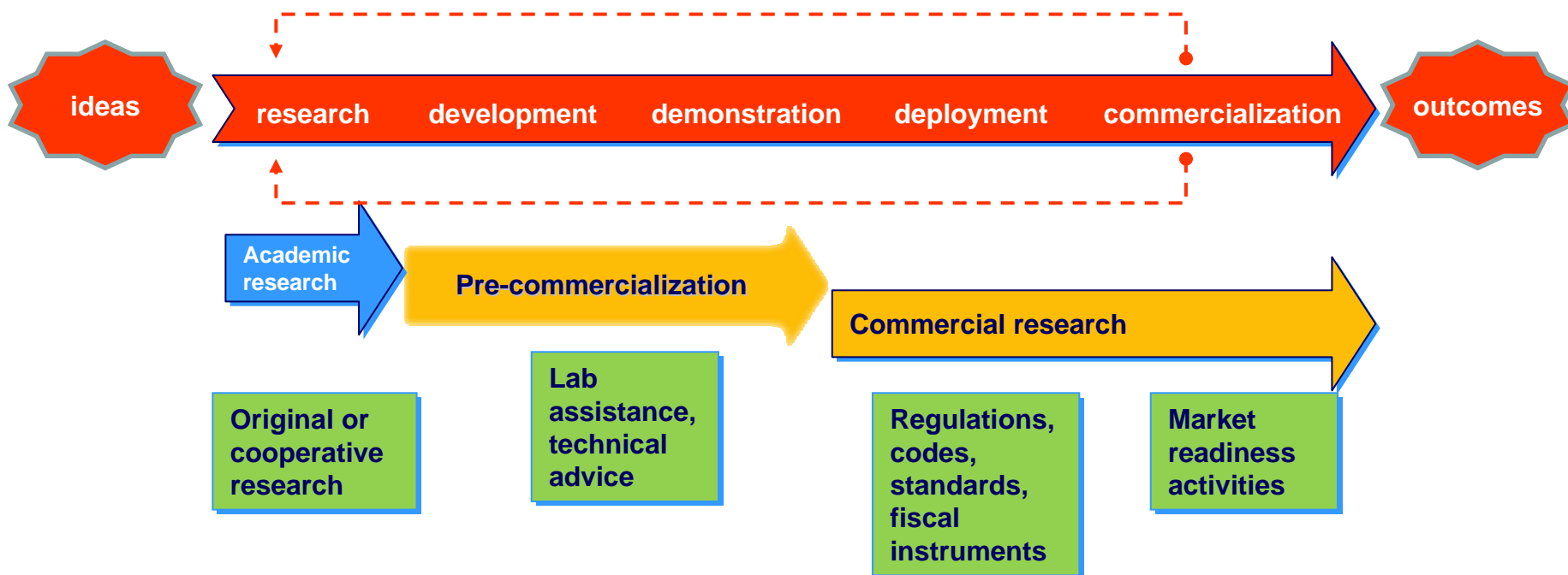
# Sustainable Buildings & Communities

Our main offices are in Ottawa, Ontario with lab facilities located in Ontario, Quebec, and PEI

- Staff of 75+ include skilled building scientists, engineers, architects, simulation specialists and software tool developers
- SBC accelerates the introduction of innovative energy technologies into the marketplace
- SBC experts facilitate the advancement of energy technologies from fundamental research to market deployment...

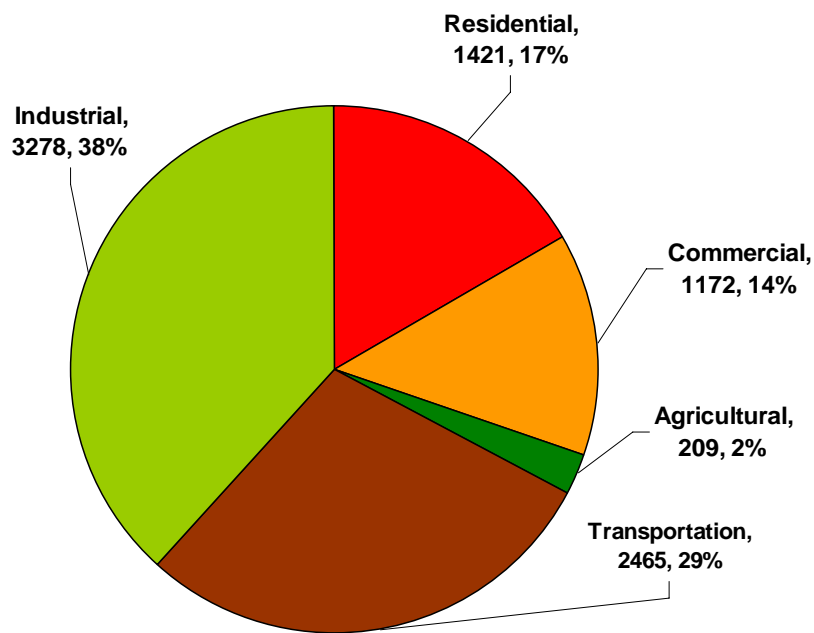


# NRCan Role in Energy and Housing



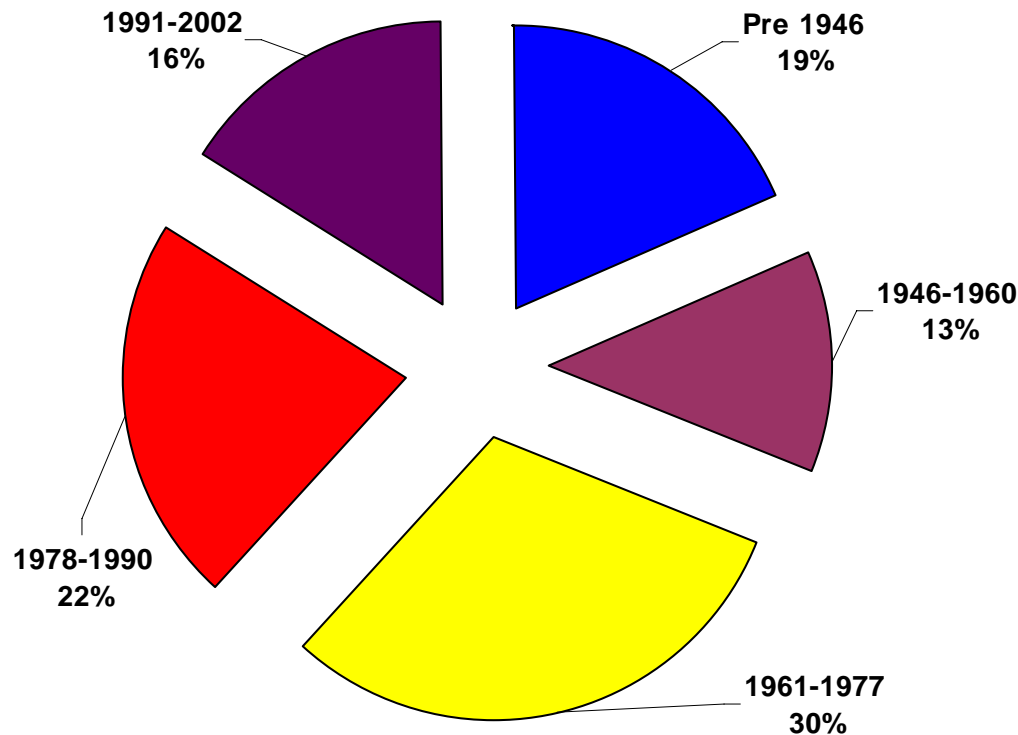
# Residential Sector Footprint

- Annual residential energy use is about 1,421PJ – about \$24 billion a year.
- Residential sector – average per household is about about 127 GJ - highest in the world (average \$2,400 per household).



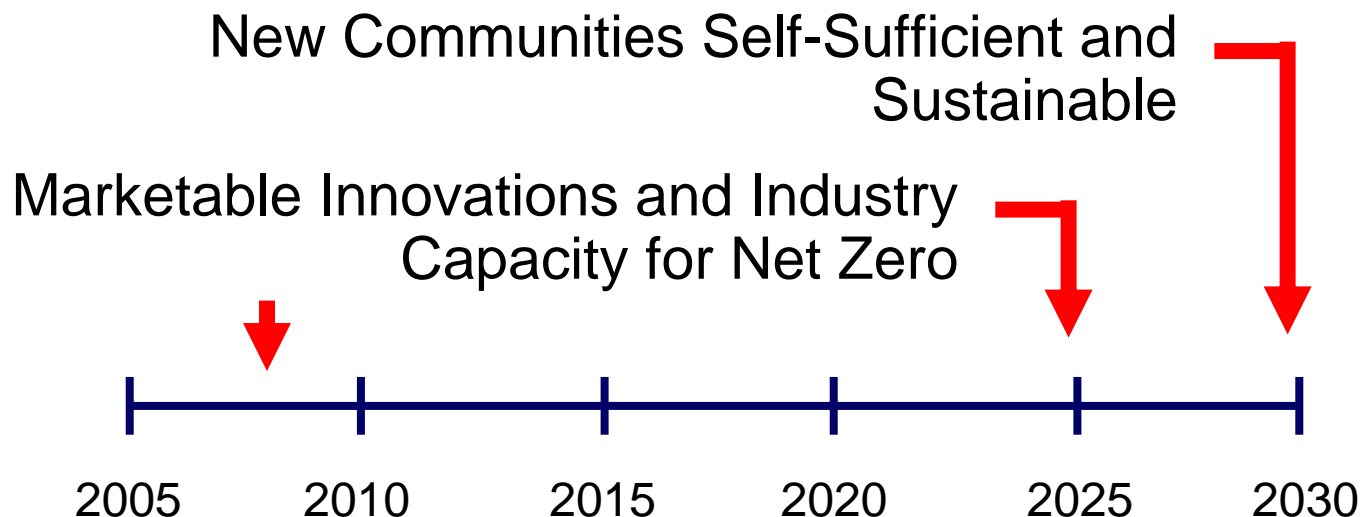
# Residential Sector Footprint

- In 2006, there were about 228,000 new houses. (About the same as 2005.)
- About 85% of housing stock is at least 15 years old.



# Our Goal is NetZero Energy

- A home that produces as much energy as it uses on an annual basis (***All energy used in a home***, including that for heating, hot water, ventilation, air conditioning and all miscellaneous electrical consumption)





# The Common Vision/Goal

Net Zero Energy Home Coalition Vision Statement:

- **...cleaner air, climate protection and, recognition for Canada as the world's first to adopt a national residential strategy for net-zero energy building design and construction**

Council of Energy Ministers, Energy Technology Working Group Vision:

- By 2030, all new homes will be built to net-zero energy standards and all communities built to be more livable for less cost, consuming less energy and resources.

NRCan Energy Technology & Programs Sector Vision:

- By 2030, new communities will be energy self-sufficient and sustainable, and today's existing buildings and houses will consume half of the energy that they consume now.

PERD/T&I (Federal Interdepartmental) R&D Goal:

- By 2025, achieve marketable innovations and the industry capacity for housing, buildings and entire communities
  - to be energy positive ← i.e. net zero energy or better)
  - to have zero "net" GHG emissions and
  - to achieve a Factor 5 (80% improvement) in their life-cycle (cradle to cradle) resource efficiency

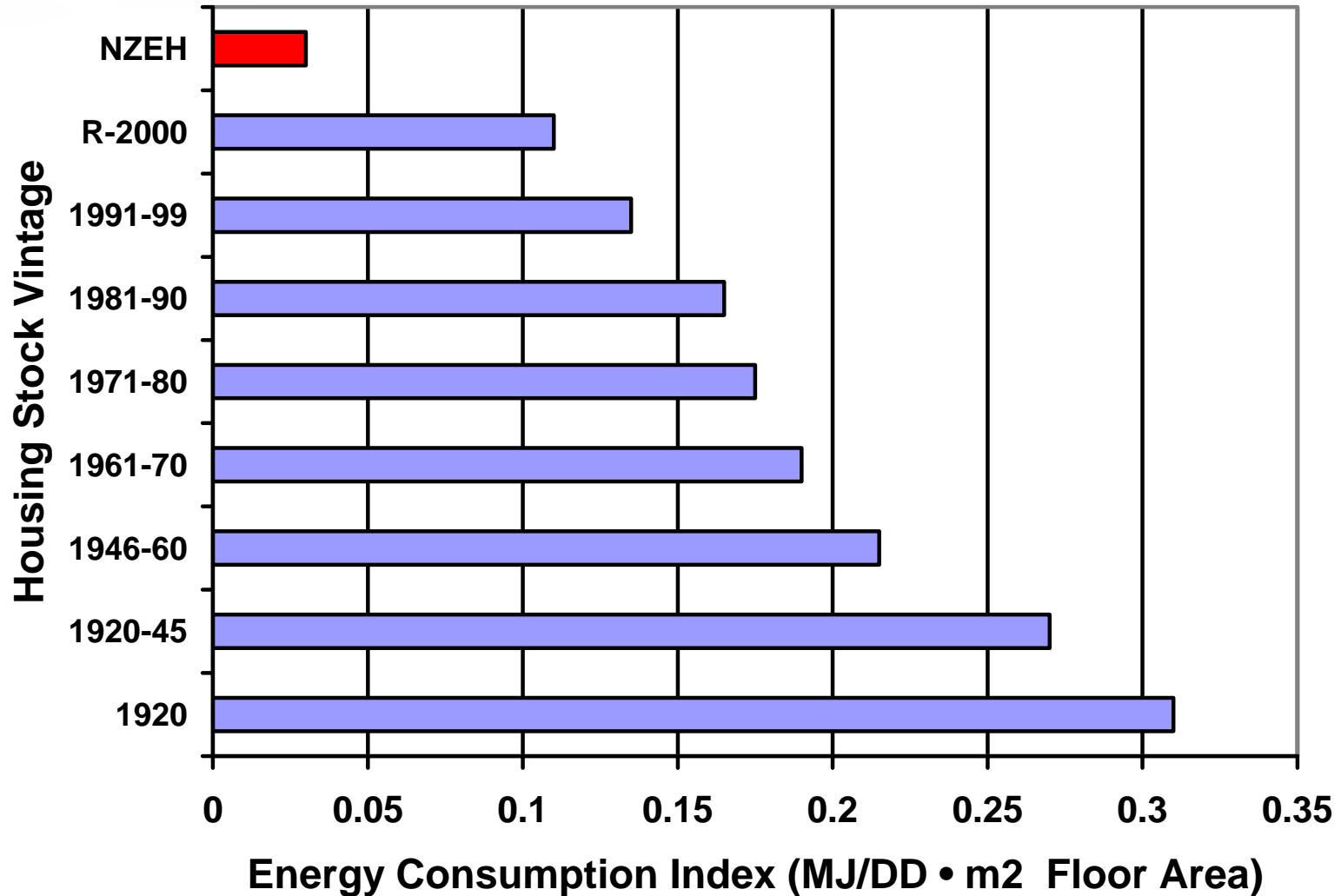
International: U.S. Net Zero Energy Program Goal

- By 2025, develop cost-effective, production-ready houses that use 70% less energy and generate the remaining 30%



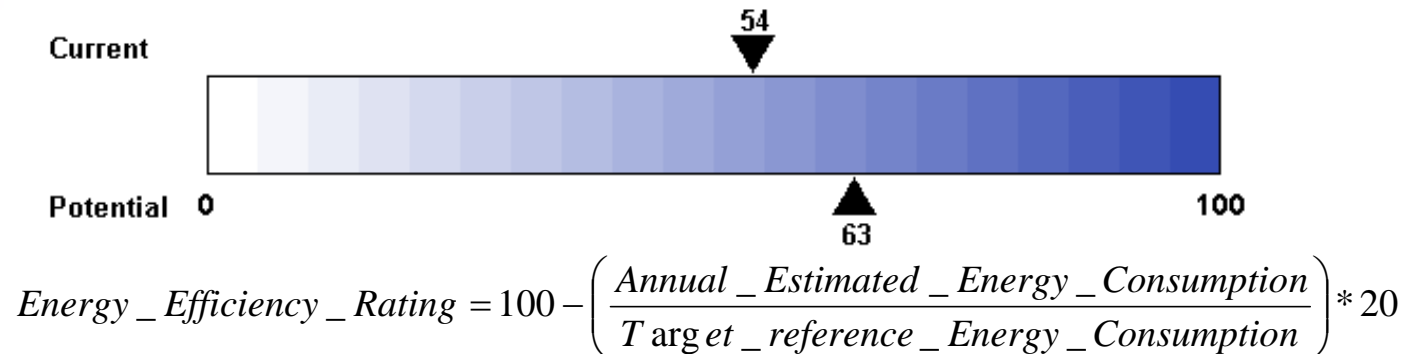


# Trends in Housing



# EGH Rating System

## Rating scale and definition



## Annual estimated energy consumption includes

- Space heating consumption
- Domestic hot water loads
- Base electric loads

## Target Reference Energy Consumption

- Space heating – based on DDs and house volume
- Hot water – 225 L/day at 55 C
- Base loads – 24 kWh/day

## Rating scheme ranges from zero (0) to 100

- Zero (0) indicate very inefficient home
- Rating of 100 indicates no 'purchased' energy

## **STANDARD RATING CONDITIONS**

- 4 occupants (2 adults, 2 children) present in the house 50% of the time
- 21 °C for main floors and 19 °C for basement and service rooms
- 225 liters/day of domestic hot water
- 24 kWh per day electricity consumption for lighting and appliances
- 0.30 ach minimum during the heating season
- 30-year averaged weather data used



# Calculating the Rating

Building simulation software tool design, development and support

- **Residential:** HOT2XP, HOT2000 & HOT3000(beta), HOT2EC,
- **Commercial:** EE4-CBIP, EE4-Code, EE web wizards
- Software available from [www.sbc.nrcan.gc.ca](http://www.sbc.nrcan.gc.ca)

## Simulation Software



Version 9.11



Version 2.5

HOT2<sup>EC</sup>

Version 1.0



Version 1.0



Version 1.0

GS<sup>TM</sup>

Version 2.0



Version 1.0e



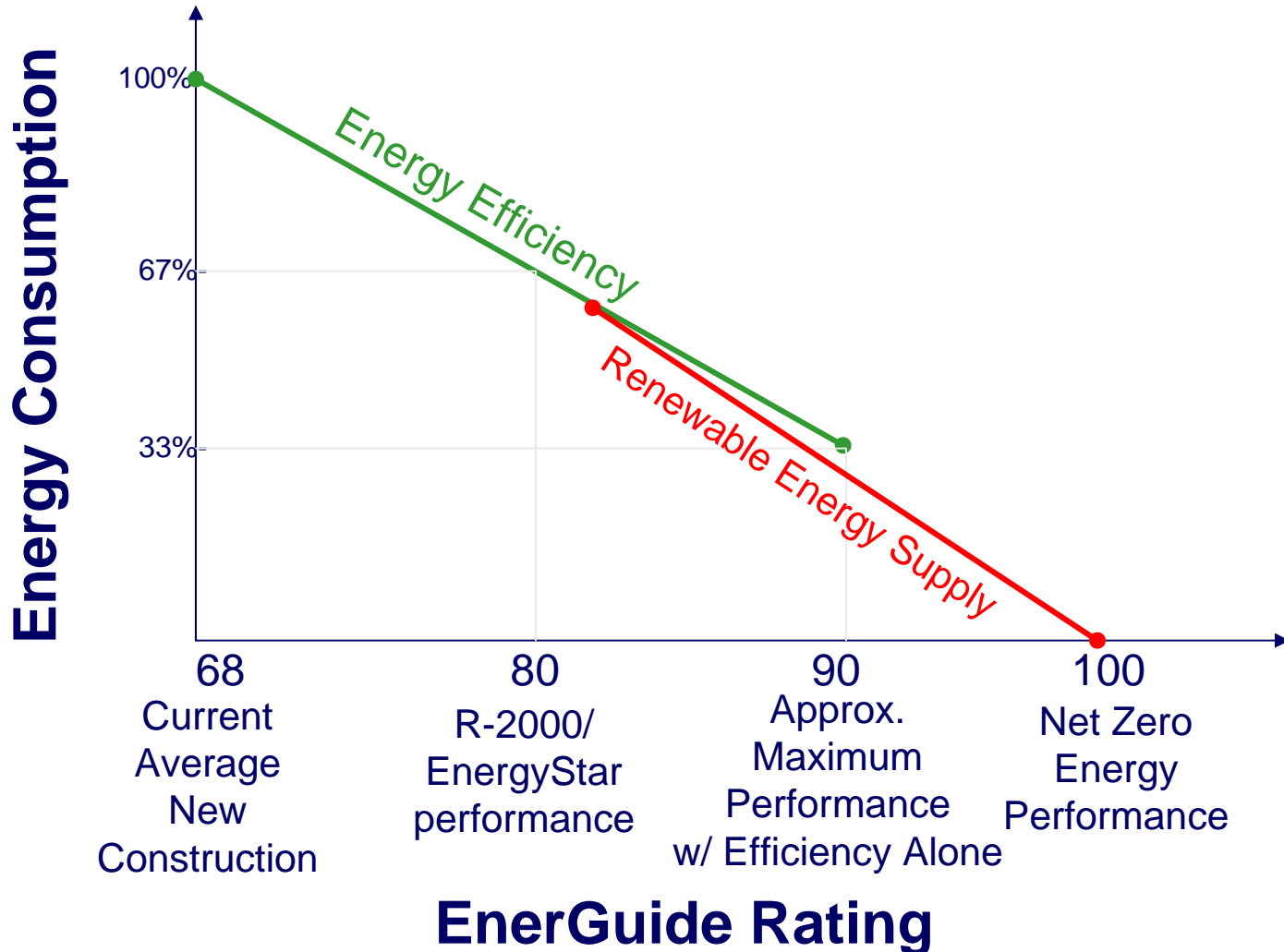
Version 1.40



Version 1.40



# Getting to Net Zero



# Getting to Net Zero through Codes

## British Columbia

- Target set for BC Building Code to require EGH 77 by 2011

## Nova Scotia

- Target set for NS Building Code to require EGH 80 by 2010

## Ontario

- Ontario Building Code 2007 requires either:
  - Demonstrated Design to EGH 80
  - or
  - Prescriptive Efficiency Measures
- After 2011: Demonstrated Design to EGH 80



# Getting to Net Zero through Technology

## Efficient Building Envelope

- R56 Walls (Double Stud)
- R56 Foundation Walls
- R100 Ceiling
- Triple Glazed Windows (W, S, E)
- Quad Glazed Windows (N)



## Result

- **EGH 86**





# Getting to Net Zero through Technology

## Passive Solar Design

16.9 m<sup>2</sup> of south glazing (10% of floor area)

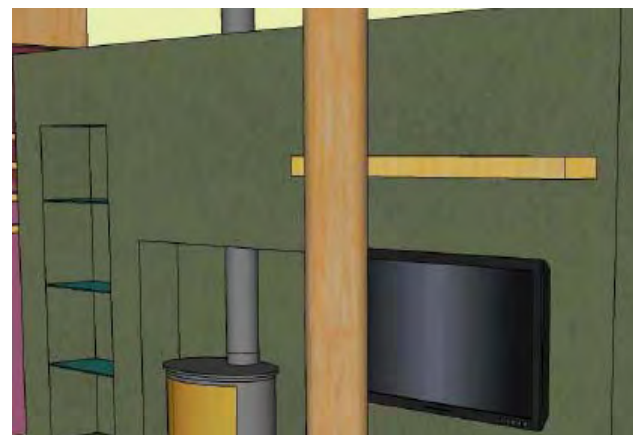
20,000 kg thermal mass

- Feature wall
- Concrete counter tops
- Extra drywall

Daylight further reduces electricity consumption

Result

- **EGH 93**

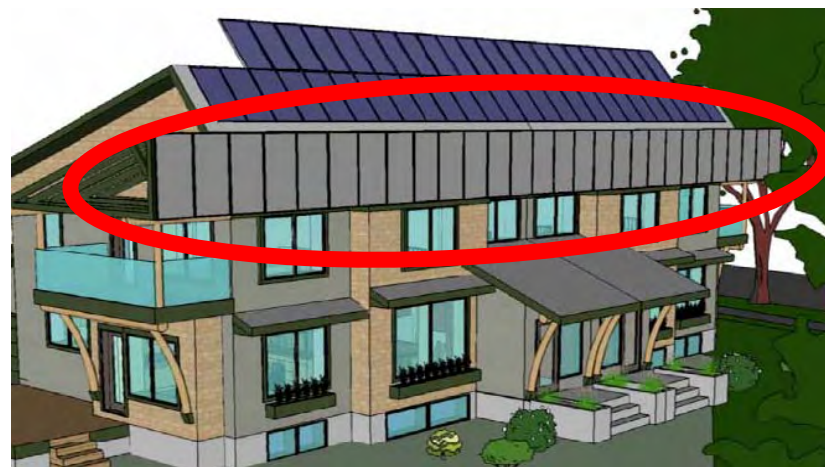




# Getting to Net Zero through Technology

## Solar Thermal System

- Combined home and water heating
- High-efficiency flat-plate collectors mounted on a vertical tilt
- 17 000 litres of water storage in basement for home heating
- 300 litres of hot water storage for water heating
- **Result EGH 96**



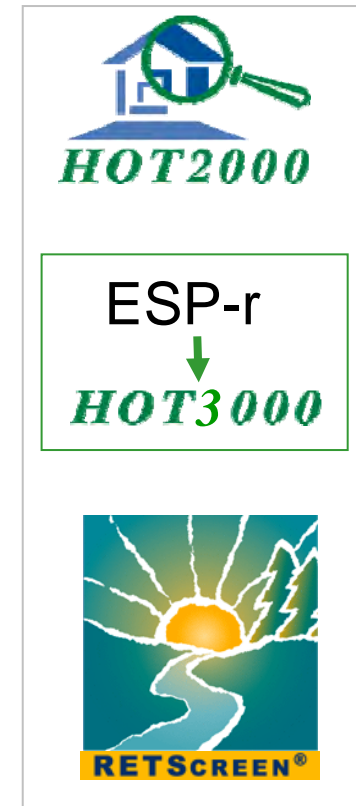
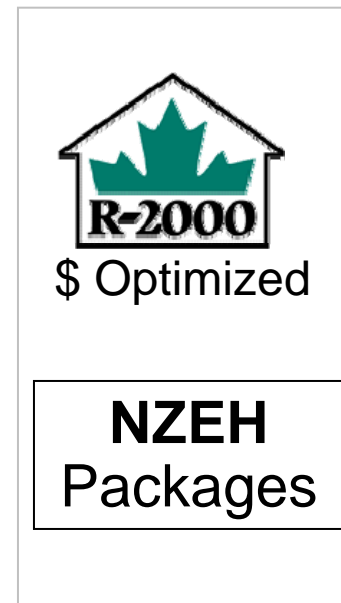
## PhotoVoltaic System

- 28 Sanyo 200 W PV modules  
5600 W in bright sunshine
- Grid-dependent, exports to grid every day of the year
- No battery bank
- **Result EGH 100.4**



# HBS Support of Net Zero Homes

- Technology Development & Refinement
- Systems Integration & Optimization
- Simulation Software Development
- Technology to Market Efforts (Removing Barriers)
- Partnering with Federal & Provincial Agencies, Universities, Manufacturers, Utilities



# Advancing Technology - Example

## Integrated Mechanical Systems

- Initial Concept
- Technology Development
- Lab Testing
- Field Trials
- Standards Development
- Simulation Tools
- Program Support (OEE, DSM)
- OTPF 0.92
- A Piece in the Net Zero Puzzle!



Thank You!

