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Canadian Passive House Institute

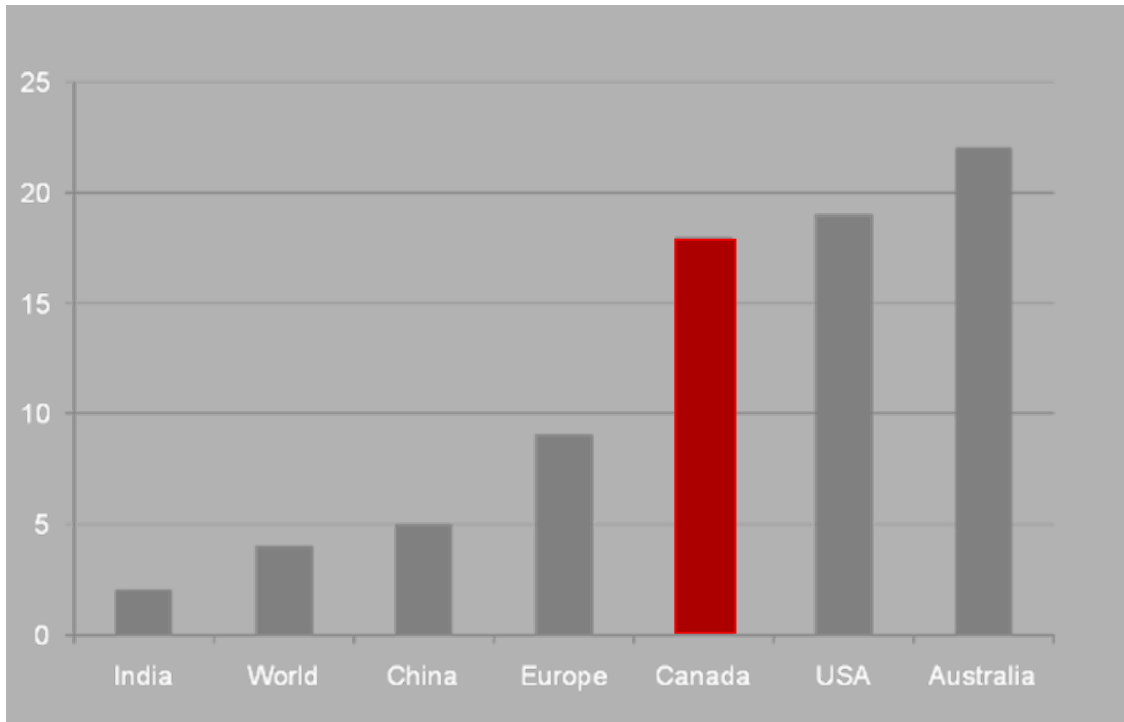
## **“Passive House in cold climates”**

Dr. Guido Wimmers



# emissions

- Kyoto protocol: Canadian target was to reduce emissions (based on 1990) by 2007 by - **6%**  
In fact emissions increased by **+ 27%**

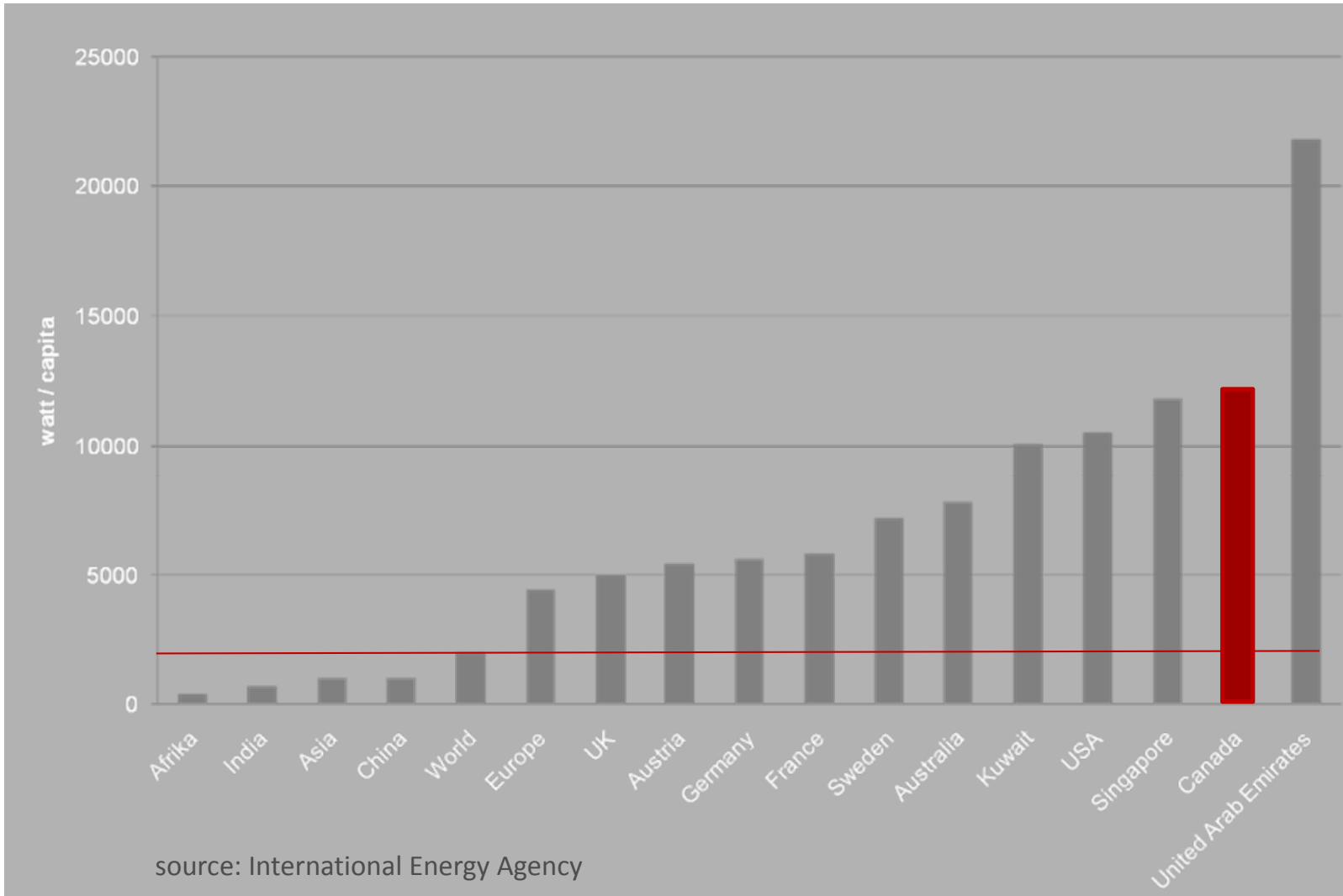


CO2 emissions per capita  
in tons per year

source: International Energy Agency



# primary energy consumption per capita



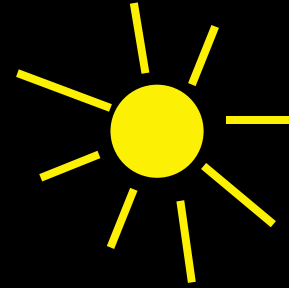
# future



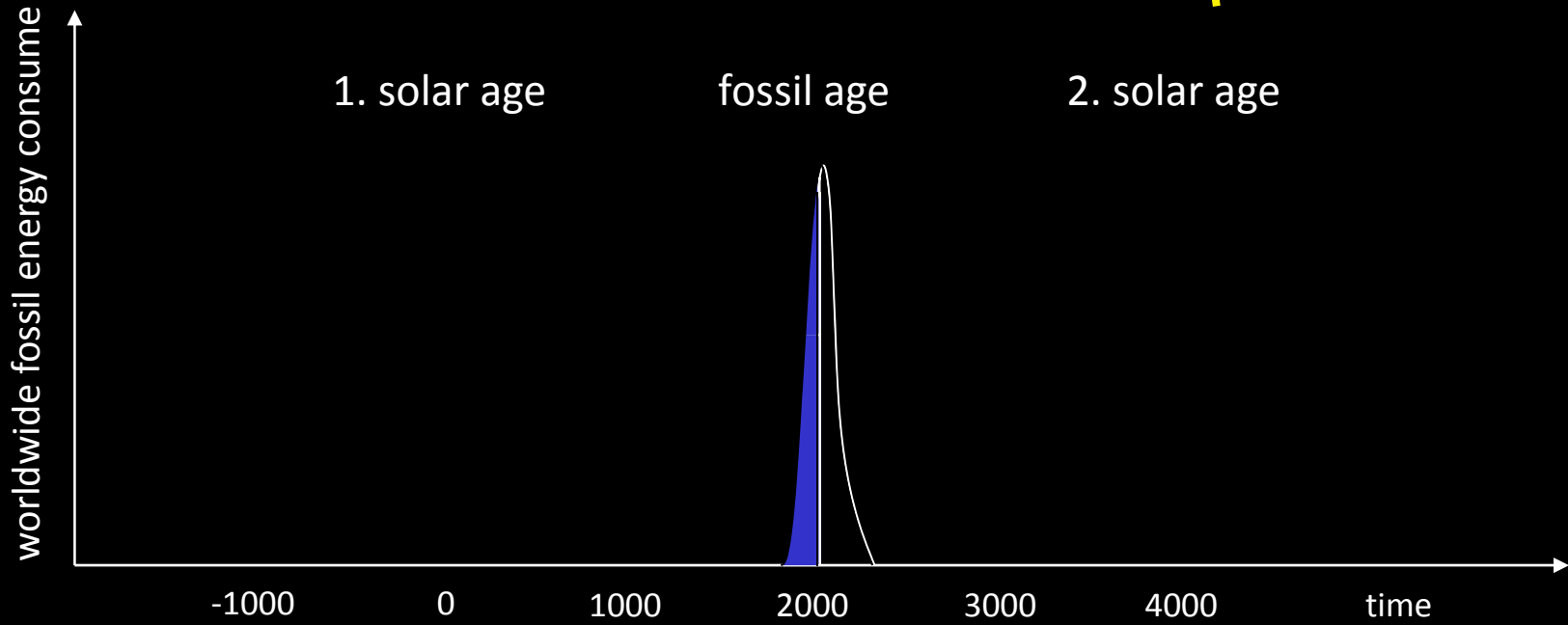
1. solar age



fossil age



2. solar age





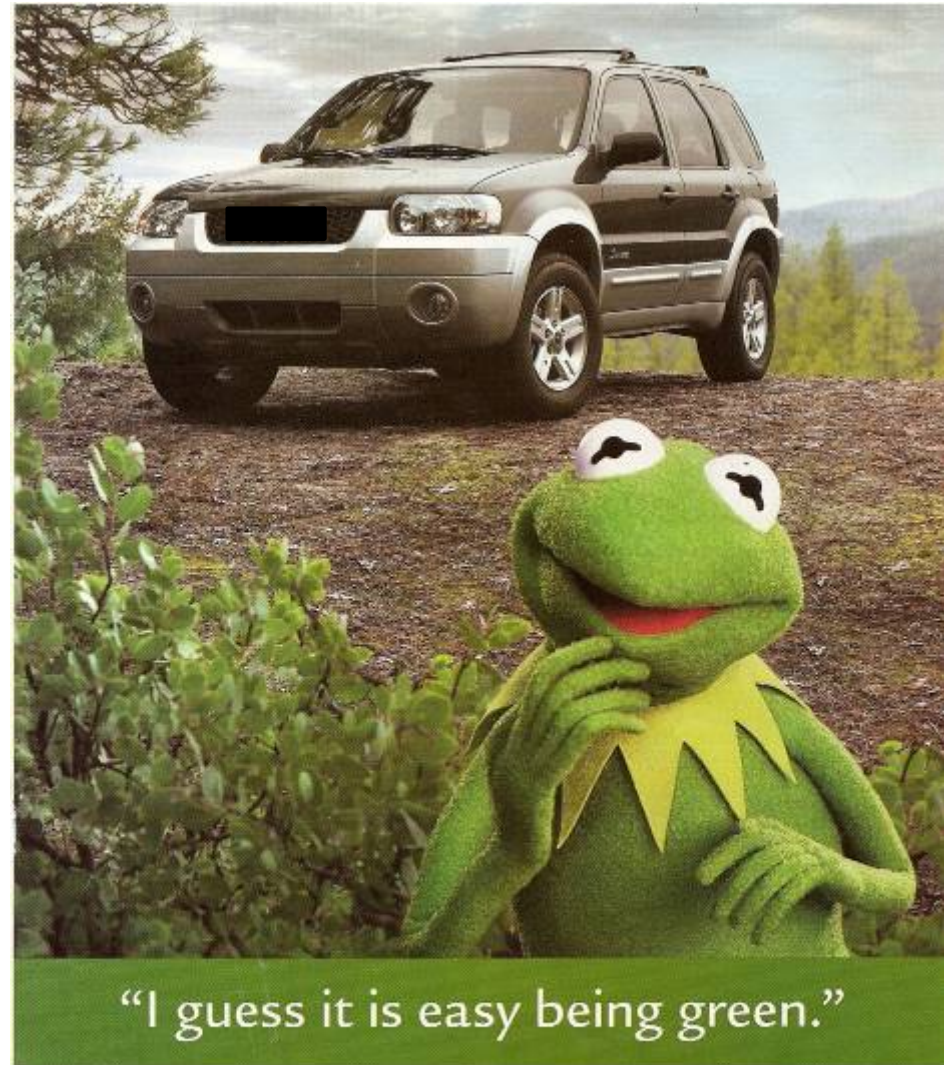
# evolution

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# examples of self-delusion

“Gasoline is a powerful hallucinatory drug. It’s habitual users will believe anything to avoid facing reality. Since when is a paltry 36 mpg ‘green’ or remotely sustainable? And the delusions only get worse....”

by William E. Rees



Presenting the 36 mpg Ford Escape Hybrid, the most fuel-efficient SUV on Earth.\* How green is that?  
[www.fordvehicles.com](http://www.fordvehicles.com)

ESCAPE HYBRID



\*Based on Automobile News, Transport Canada and US EPA. EPA estimated 36 city/31 hwy mpg, FWD. Actual mileage will vary. ©The Muppets Holding Company, LLC. All Rights Reserved.



**Introducing the Green Car of the Year.<sup>™</sup>**  
**The 2008 [REDACTED] Tahoe<sup>®</sup> Hybrid!**  
**America's first full-size hybrid SUV.**



That's right, *Green Car Journal's* Green Car of the Year<sup>™</sup> is the full-size Chevy Tahoe Hybrid. The announcement came at the Los Angeles Auto Show.

The award is given for new or significantly revamped alternative fuel-powered vehicles.

"This is a milestone in many respects," said *Green Car Journal* editor Ron Cogan. "People don't think 'green' when SUVs are concerned."

The 2008 Chevy Tahoe already has the best fuel economy in its class.<sup>\*</sup> And now, with its new two-mode hybrid technology, the Tahoe Hybrid is competitive with much smaller vehicles. While driving in the city, Tahoe Hybrid 2WD achieves the same city fuel economy as a 4-cylinder Toyota Camry!<sup>\*\*</sup>



Visual readout on the navigation radio displays whatever power mode you are currently in: engine idle, engine power, hybrid power, regenerative braking, or battery power.

These impressive fuel economy numbers can be attributed to Tahoe's Hybrid Propulsion Electric System that operates in three ways: electric power, engine power, or any combination of electric and engine power. That's one smart hybrid. For more information go to [chevy.com/FuelSolutions](http://chevy.com/FuelSolutions).

**Gas-friendly to gas-free.**



FUEL EFFICIENCY



ECO-FRIENDLY



HYBRID



ELECTRIC



FUEL CELL

**AN AMERICAN REVOLUTION** 

<sup>\*</sup> EPA fuel city, go to [FuelEconomy.gov](http://FuelEconomy.gov).  
<sup>\*\*</sup> Based on 2007 GM Large 2007 segment and 2008 EPA website. (See EPA website for more details.)  
<sup>†</sup> EPA fuel city, go to [FuelEconomy.gov](http://FuelEconomy.gov).  
<sup>‡</sup> Based on 2008 EPA fuel economy information at 21 MPG city.  
 © 2008 GM Corp. Buckle up, America!



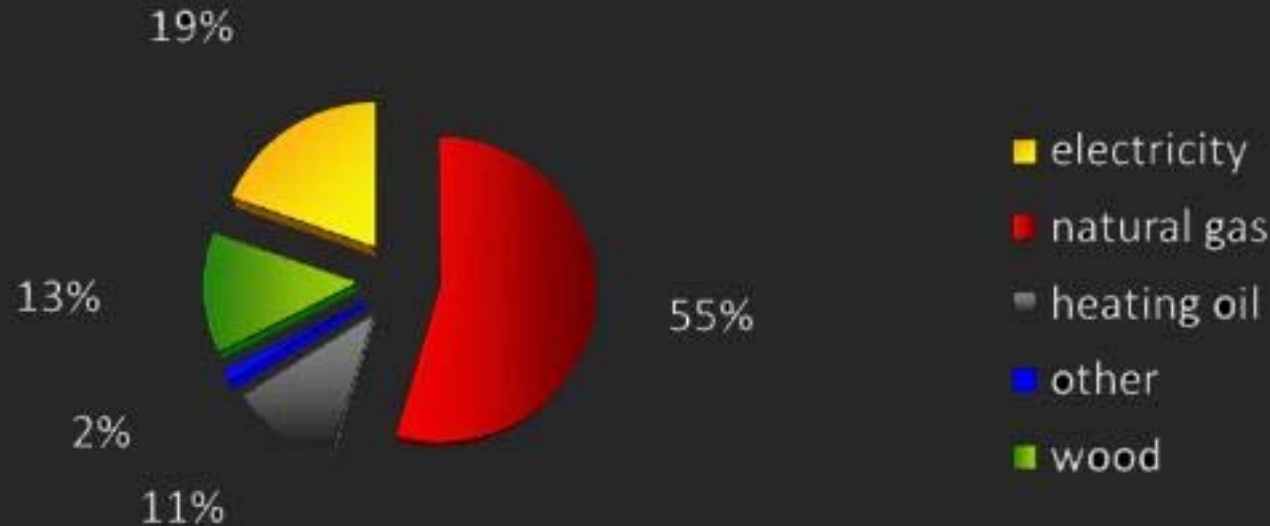
# priorities



“The energy that office buildings use for heating, lighting and cooling is the major component of their environmental impact – approximately 85% of the total life cycle impact for typical office buildings.”

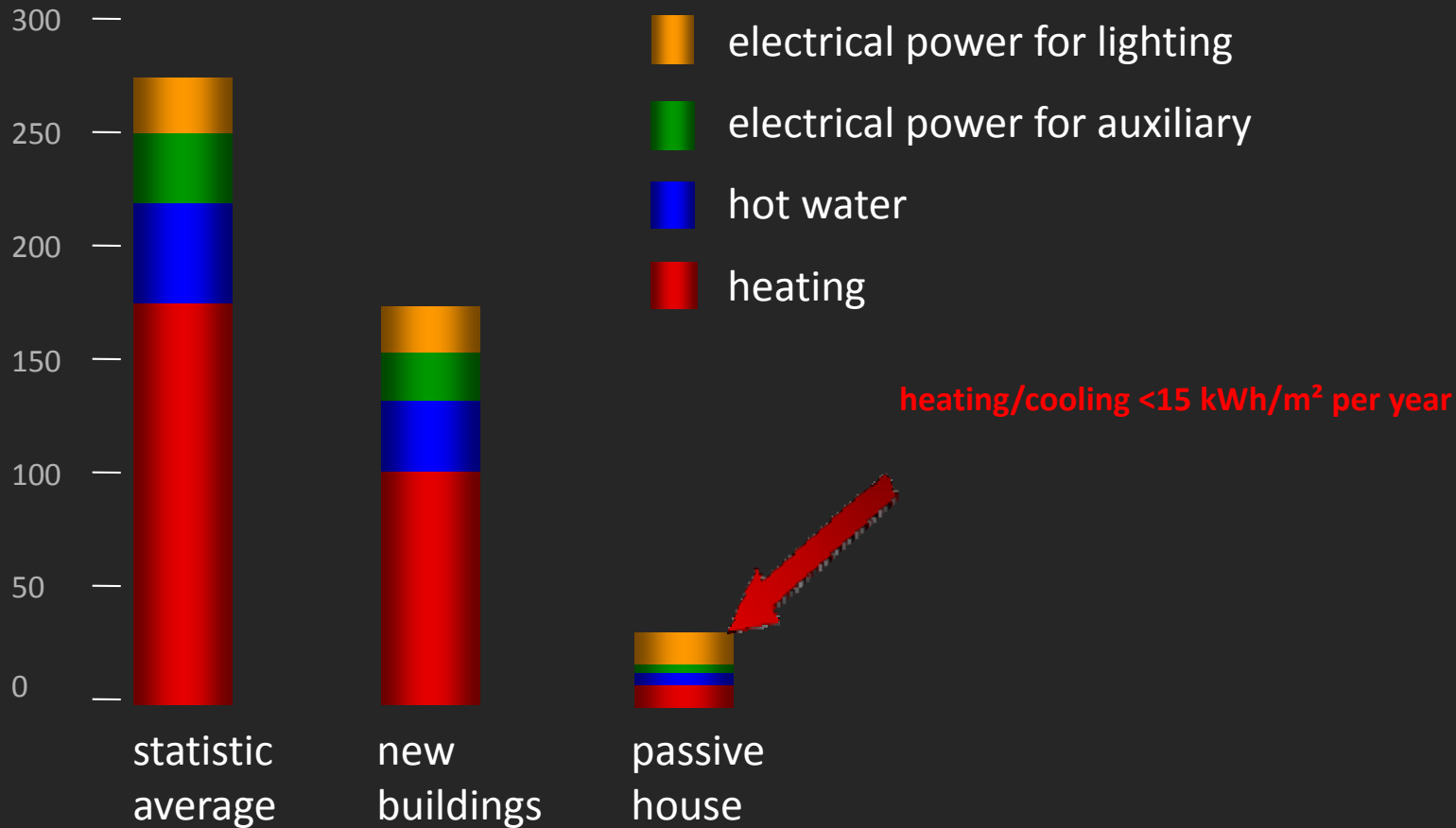
[LEED; Cole & Kernan, 1996; Winistorfer and Chen, 2004; Trusty & Meil, 2000; CORRIM, 2004]

# Canada's total residential space heating energy use



source: Energy Use Data Handbook 2006

- 2/3 provided by fossil energy
- energy use for residential space heating 800 PJ = 222000 million kWh
- total floor space 1500 million m<sup>2</sup>
- if really every m<sup>2</sup> is heated 150 kWh/m<sup>2</sup>

for residential buildings in kWh/m<sup>2</sup> per year

Source: NRCan Dec.2005

for commercial buildings in kWh/m<sup>2</sup> per year



# forgotten pioneers of energy efficiency



Saskatchewan Conservation House, 1977

the “passive house” was borne in Canada!!!



# forgotten pioneers of energy efficiency



Photo by M. Isaacs March 2010

In 1977 a group of Canadian researchers built a demonstration house in Regina. The Saskatchewan Conservation House, the nearly airtight building had 2x double glazed windows, R-40 wall insulation, R-60 roof insulation, and one of the world's first heat-recovery ventilators.



# the first 'Passivhaus' in Darmstadt by Dr. Wolfgang Feist



11 years later, a German physicist, Dr. Wolfgang Feist, adopted this list, suggested a few further specifications, and coined a German word, Passivhaus, to describe the “modus operandi”.



# the Passive House Standard

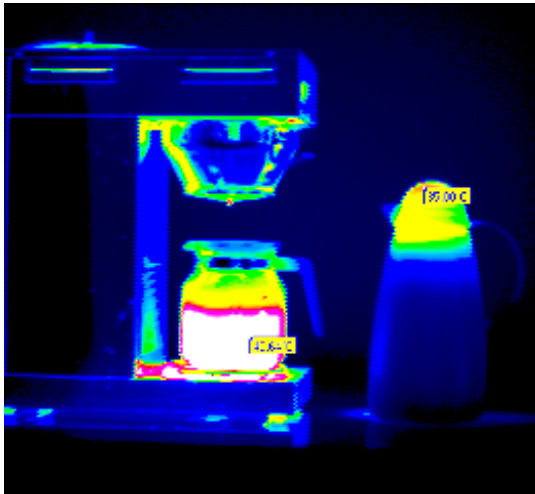
- **energy efficient**
- **comfortable**
- **economically** and
- **environmentally friendly** at the same time.
- Passive House is *not a brand, it is a building concept* which is open to all – and which has proved itself in practice.
- Passive House is the leading standard in energy saving in buildings worldwide: The energy saving for heating amounts to over 75 % in comparison with the legally prescribed building standards. The heating costs are very small – high energy prices make no difference to residents of Passive Houses.
- Passive Houses achieve this enormous energy conservation through the use of special energy efficient building elements and ventilation techniques.
- **Comfort is not impaired, in fact it's even perceptibly improved.**



# what is a Passive House?



- a Passive House is a **very** energy-efficient building which requires such a small amount of heat that it can be heated mainly by “passive” sources such as incoming sunlight and existing appliances
- heat recovery via a mechanical ventilation system is necessary



# what is a Passive House?



- a Passive House still needs some energy, but the specific heat demand is minimal.  
15 kWh/m<sup>2</sup>year
- specific heat load shall not exceed 10 W/m<sup>2</sup>
- entire specific *primary* energy demand including domestic electricity must not exceed 120 kWh/m<sup>2</sup>year
- The PH Standard *should* become a precondition for the Living Building Challenge and for any Net Zero House initiative



# major criteria for Passive House

- specific space heating/cooling demand  $\leq 15 \text{ kWh}/(\text{m}^2\text{a})$
- envelope
  - minimize heat bridges  $\psi \leq 0$
  - U-values
    - window  $\leq 0.8 \text{ W}/(\text{m}^2\text{K})$
    - exterior building elements  $\leq 0.15 \text{ W}/(\text{m}^2\text{K})$
  - pressurization test result @ 50 Pa  $\leq 0.6/\text{h}$
- entire specific **primary** energy demand  $\leq 120 \text{ kWh}/(\text{m}^2\text{a})$



## Essential factors which influence thermal comfort

- Air temperature
- Surface temperatures
- Local temperature differences (vertical and horizontal)
- Draughts
- Relative air humidity



# residential





# office building, Innsbruck



- heating energy 8 kWh/m<sup>2</sup>
- blower – door test 0.23/@ 50Pa
- in slab radiant heating and cooling
- heat recovery ventilation
- heat pump





# elementary-school in Ainet (altitude 750m)



- reconstruction and extension 2006
- heating energy 14 kWh/m<sup>2</sup>
- solid wood construction
- heat recovery ventilation
- heat pump – geothermal power





# secondary school, Klaus







# production facility renovation, wolfurt





# residential passive house in Innsbruck, 26,000m<sup>2</sup>



## Project facts:

- Location: Innsbruck
- Number of rental dwellings: 354
- Basement parking lots: 405
- Dwelling area: 25,910 m<sup>2</sup>
- Gross floor-space: 35,000 m<sup>2</sup>
- Volume: 167,000 cubic meters
- Total building costs excl. VAT, incl. all crafts, development costs, financing costs: €uro 51,828,000.00
- Certification: passive-house certified by the Passivhausinstitut Darmstadt



# Schiestlhaus, 2154m





# Passive House in Montebello, QC







## the result

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- **energy efficient** (up to minus 90%)
- **comfortable** (all ASHRAE comfort criteria achieved)
- **economically** (reasonable additional cost, increased value, significantly lower operating costs)
- **environmentally friendly** (very low environmental longterm impact, energy plus easily possible)
- **healthy** (constant hygienic air quality)



# Where are we going?

- Up to today over 25000 Passive Houses were build in almost every climate zone in over 20 countries around the world
- In 2009 the EU passed a directive asking that all states legislate Passive House construction by 2016 for new construction and renovation
- Energy efficiency/renewables are now bigger employers in Germany than the entire auto industry (BMW, Audi, Mercedes, Porsche, VW etc)
- Unfortunately currently no Canadian window or HRV manufacturer comes anywhere near Passive House requirements. But what incentive do our manufacturers have to reach these high standards?
- CMHC, NRCan, CaGBC, BC and City of Vancouver are very much interested in Passive House
- CanPHI trained in 2010 almost 100 highly motivated professionals in Passive House design
- CanPHI is currently more than 30 Passive House Projects in Canada



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Canadian Passive House Institute

[www.passivehouse.ca](http://www.passivehouse.ca)