Architecture and Buildings in a Warming World

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Durango

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Cure the disease or just treat the symptoms?

Climate change is a symptom!

What is the disease?
I = P • A • T

I = Impact on the environment
   now mostly Climate Change (CC)

P = Population

A = Affluence (An insatiable appetite for material goods)

T = Technology

By:
Paul Ehrlich &
John Holdren
Presently world population is over 7.6 billion people and it is expected to peak at about 11 billion, which is a 45% increase!
What is the carrying capacity of planet earth?
Climate Change = \( P \cdot \text{Affluence} \cdot T \)

Antilia
- World’s largest private residence
- 27 floors
- 600 permanent staff
- 1 – 2 Billion dollars cost
- Mumbai

Countries with the most affluence: United States, Australia, and Kuwait
Climate change = P • A • Technology

Dirty energy

Efficiency

Clean renewable energy
Who is on more surefooted ground?

CC = P x A x T
Embodied & Operating Energy

U.S. ENERGY CONSUMPTION

BUILDINGS 48%

TRANSPORTATION 27%

INDUSTRIAL 25%
Zero Energy Buildings (i.e. Operating Energy)

1. **Efficiency** - insulation, solar responsive design, passive cooling, mechanical equipment, etc.

2. **Renewable energy** - photovoltaics, wind, biomass, etc.
Use Solar Responsive Design!
What is solar responsive design and how is it done?
PV (photovoltaics) (highest cost)
Active solar (expensive)
Ventilation preheating
Daylighting (moderate cost)
Shading (moderate cost)
Passive solar (low cost)
Window size (free)
Window placement (free)
Building color (free)
Building orientation (free)
Office Building
NREL Colorado, USA

Building Orientation

BedZED - Beddington Zero Energy Development
Building Color

A white roof has 50% less heat gain than a black roof.

White is the greenest color!

“Making roofs and pavements white or light colored will reduce global warming as much as taking all cars of the world off the road for 11 years.”

Steven Chu, former US Secretary of Energy and Nobel Laureate
Dark roofs are nice, but they sure are hot!
Volunteers working for New York City’s White Roof Project

Ahmedabad, India has a program to paint roofs of government, schools, and slum dwellings white

White is beautiful!
Green roofs or vegetated roofs?

Biophilia
Window Placement

Window Size

Las Vegas, USA
Shading

the most important solar strategy?
Passive Solar Heating

Trombe Wall  Clerestory
Daylighting

Light shelves

Heiffer International

Arkansas, USA
Ventilation Pre-heating

Transpired solar collectors

NREL Support Building
Active Solar Water Heating
Photovoltaics (PV)

First roofs then walls

- Active solar
- Ventilation preheating
- Daylighting
- Shading
- Passive solar
- Window size
- Window placement
- Building color
- Building orientation
Efficiency First

Conventional building

Solar cells (PV) required

Energy efficient building

Electrical Load
Thank you  lechnnm@auburn.edu