

GREEN PHILOSOPHY FOR SUSTAINABLE INFRASTRUCTURE: *Concept & Implementation*

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Our Green Campus

UCI has a long history of environmental and sustainability leadership dating back to the *Nobel prize-winning research of F. Sherwood Rowland* into the depletion of the ozone layer almost five decades ago.



The Big Issue: Climate Change





Potential Results

No Action

Action

Climate Change

We have roughly 3,650 days To do something very drastic about this climate change problem or else hundreds of thousands, millions of people, our children, our grand children will be displaced by catastrophes that will occur.

Ira Magaziner
Director,
Clinton Climate Initiative



**A continuing
Crime Against
our Children**

- **The world faces a challenging situation in the development of housing, agricultural, food security, educational and infrastructure systems**



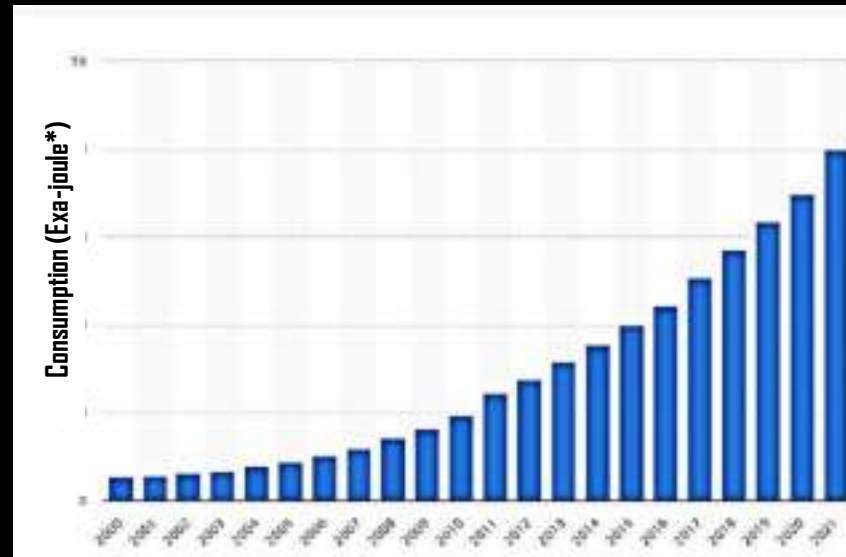
Facts

IMPACT OF BUILDINGS ON ECONOMY, ENVIRONMENT & COMMUNITY

- **40%** *of the world's energy and materials*
- **25%** *of the wood harvested*
- **17%** *of the water*

Facts

- The *primary energy consumption (PEC)* has grown during the 2021 (*≈40 exajoules**.)
- Between 2020 and 2021, PEC grew by a record high of 5.6% with a total of 1,306Mtoe (*Million Tones of Oil Equivalent.*)



* 1 Exa-joule = 10^{18} joules.

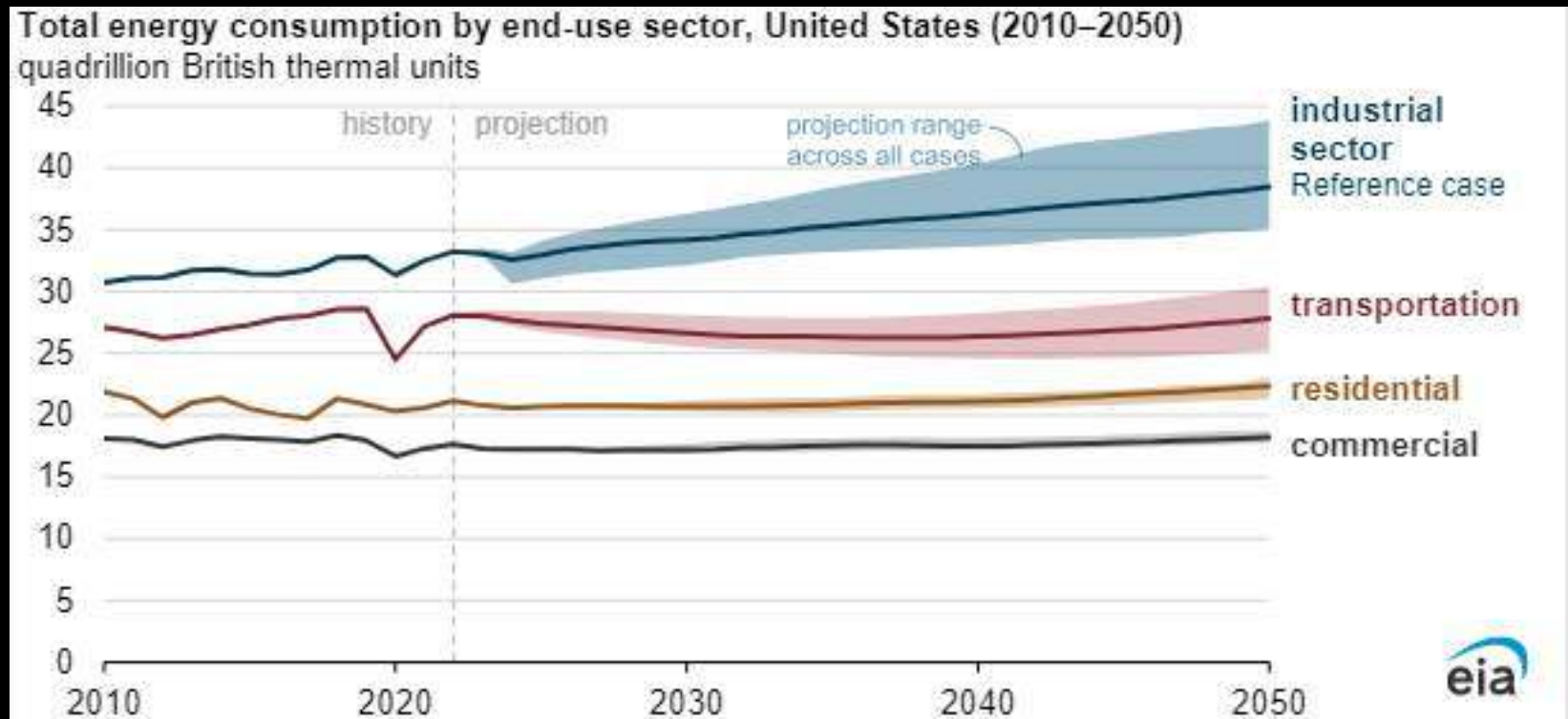
ENERGY DEMAND IN BUILDINGS

The United Nations Environment Program (UNEP)* reported that:

- *CO2 emissions from buildings and construction hit new high, leaving sector off track to decarbonize by 205*
- *In 2021, investments in building energy efficiency increased by 16% to USD 237 billion, but growth in floor space outpaced efficiency effort, and*
- *The sector's 2021 operational energy-related CO2 emissions were up 5 per cent over 2020 and 2 per cent over the pre-pandemic peak in 2019.*

US Energy Information Administration (*eia*) Report

According to the US Energy Information Administration (*eia*), the expected increase in US energy consumption is between 0% and 15% from 2022 to 2050 *due to economic & population growth, and increased travel* offsetting continued energy efficiency improvements.



Data source: U.S. Energy Information Administration, [Annual Energy Outlook 2023](https://www.eia.gov/) (AEO2023)
<https://www.eia.gov/>

Green Building Basics



What is a Green Building?

*Feel pleased when enter, enjoy every minute inside (serenity and health), and regret leaving!"**



**Articulated in the book 'Natural Capitalism' by Hawken et al. (2000)*



What is **Green** Design?

Five design and construction practices that significantly reduce or eliminate the negative impact of buildings on the environment and occupants:

- 1. Sustainable site planning,*
- 2. Safeguarding water and water efficiency,*
- 3. Energy efficiency and renewable energy,*
- 4. Conservation of materials & resources, and*
- 5. Indoor environmental quality.*






FEATURES OF GREEN BUILDINGS

- Efficient use of Land & Landscape,
- Efficient use of water,
- Energy efficient and Eco-friendly Equipment and fixtures,
- Efficient Control & Building Management System,





Features of Green Buildings *(cont.)*

-  **Use of Renewable Energy,**
 -  **Use of Recycled/Recyclable Bio & Synthetic Materials,**
 -  **Improvement of Air Quality for health and comfort, and**
 -  **Overall budget saving in both short- and long run**
- 

RELATIONSHIP BETWEEN CONSUMED ENERGY AND IMPACT ON ENVIRONMENT

- It is important to recognize the *direct relationship* between *consumed energy* and *impact on environment*. In the construction industry, for example, adopting *green building approach* will result in *efficient use of energy with less negative impact on our environment*.

Sustainable Energy Resources





■ Wind energy production already competes with fossil fuel energy production, its ecological and social advantages making it all the more attractive. Europe is a world leader in the use of wind energy.



Biomass Energy Sources

- **Biomass**, as a renewable energy source, refers to living and recently dead biological material that can be used as fuel or for industrial production.
- **Biomass** refers to plant matter grown to generate electricity or produce for example trash such as dead trees and branches, yard clippings and wood chips bio-fuel, and it also includes plant or animal matter used for production of fibers, chemicals or heat.
- **Biomass** may also include biodegradable wastes that can be burnt as fuel. It excludes organic material which has been transformed by geological processes into substances such as coal or petroleum.



TIDAL ENERGY

Tidal energy is produced by the surge of ocean waters during the rise and fall of tides.



HYDRO ENERGY

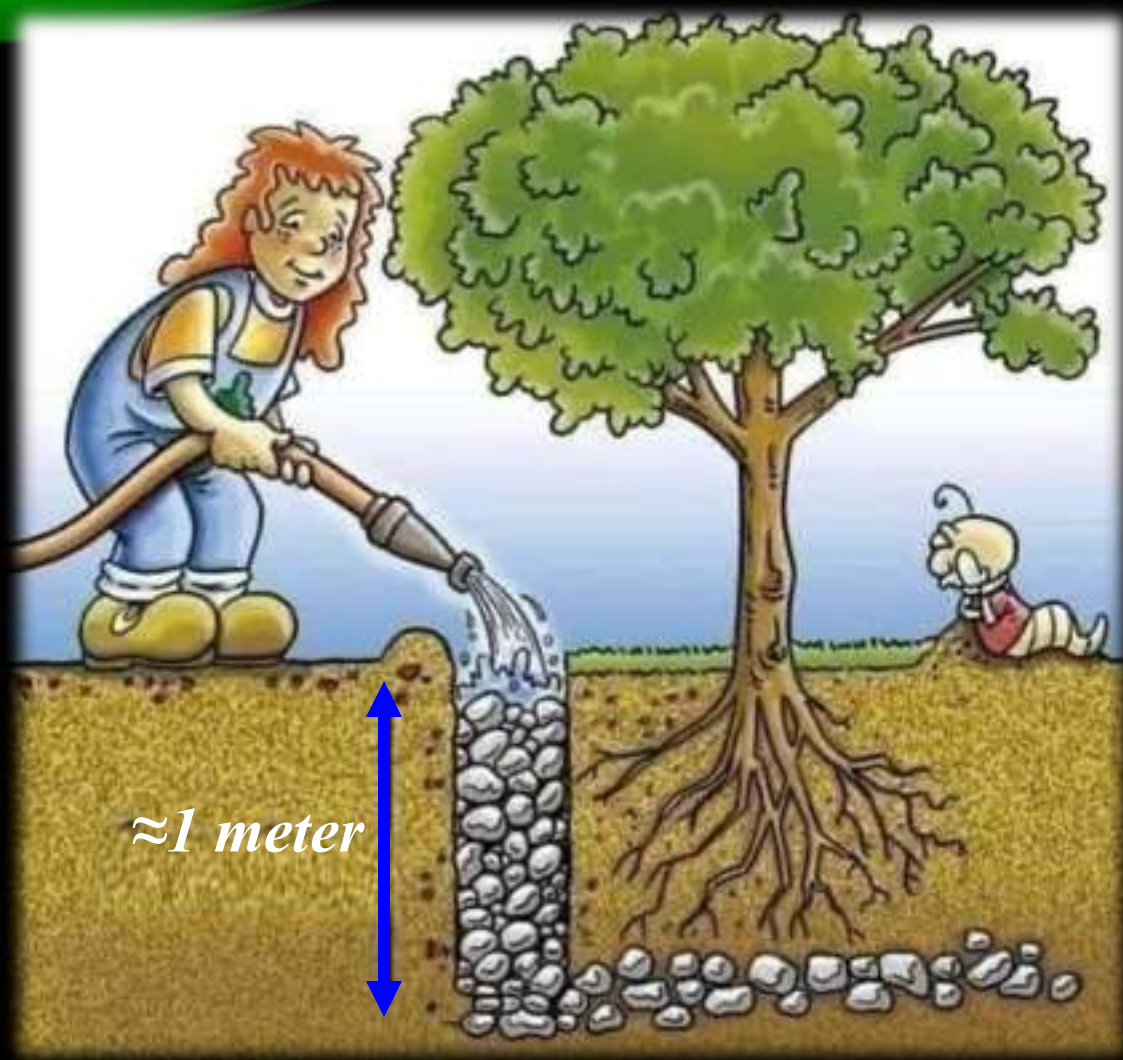


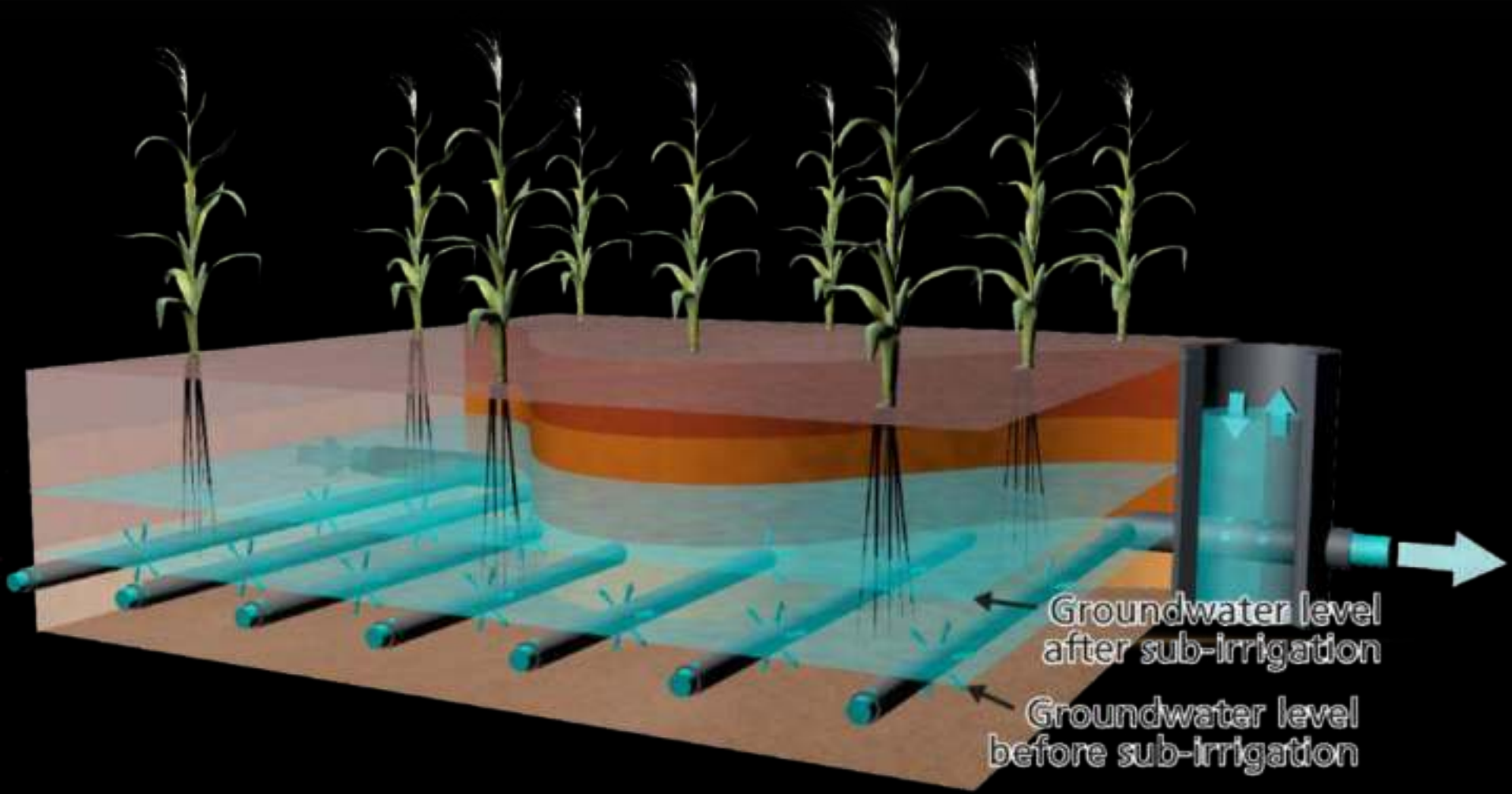
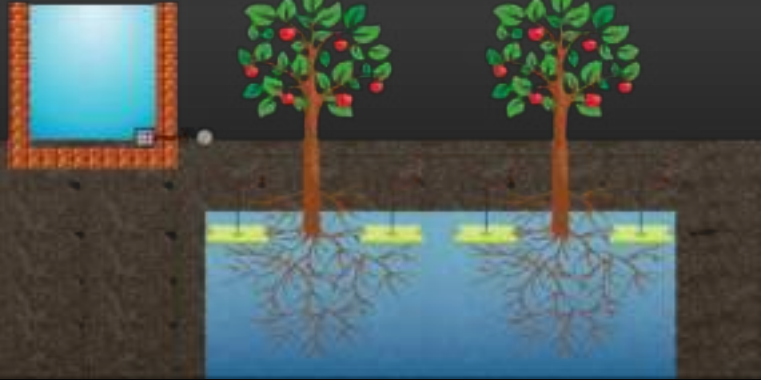
Water saving in agriculture















INTEGRATED RICE AND FISH FARMING



EVAPORATION CONTROL FLOATING COVER



THE 'FOG CATCHERS'

A local project in Morocco is using nets to capture moisture from the air

- *The system provides clean drinking water to 400 people in five villages,*
- *An upgrade in January will enable the 1,968 square feet (600 square meters) of netting to capture enough water for eight more villages*





GREEN BUILDINGS RATING SYSTEMS

GREEN BUILDINGS RATING SYSTEMS



EXAMPLES OF INTERNATIONAL GREEN BUILDING RATING SYSTEMS

- Leadership in Energy & Environmental Design (LEED-US) 
<http://www.usgbc.org>
- The Green Globe Rating System (United States) www.thegbi.org 
- Leadership in Energy & Environmental Design — (LEED-Canada) www.cagbc.ca 
- Green Star (Australia) www.gbcaus.org 
- Building Research Environment Assessment Method Consultancy (BREEAM) (UK) www.breeam.org 
- Building Environment Assessment Method- Hong Kong (HK-BEAM) www.hk-beam.org.hk 

EXAMPLES OF INTERNATIONAL GREEN BUILDING RATING SYSTEMS

- Comprehensive Assessment System for Building Environment Efficiency (CASBEE) (Japan) www.ibec.or.jp 
- Green Pyramid Rating System (GPRS) www.egypt-gbc.org 
- LEED India www.igbc.in 
- Ecology, Energy Saving, Waste Reduction and Health (EEWH) (Taiwan) www.taiwangbc.org.tw 
- Green Zoom, Russia <https://greenzoom.ru/> 
- ESTIDAMA, United Arab Emirates - <https://www.upc.gov.ae/estidama> 

A scenic landscape featuring rolling green hills under a cloudy sky with a faint rainbow. In the foreground, a wooden fence runs across the frame. Several small, dark silhouettes of birds are scattered across the sky. The text "Examples of Green Buildings Technologies" is overlaid in the center in a bold, yellow font.

Examples of Green Buildings Technologies

UCI-CEE TEAM

Front-N-Center



OC Sustainability Decathlon 2023

P2S INC



ABREGO
Handmade in California



Irvine Ranch
WATER DISTRICT

LUTRON®

CNCA
CALIFORNIA
NEVADA
CEMENT
ASSOCIATION

ASCE
American Society of Civil Engineers



TranSystems
EXPERIENCE | Transportation



Low-carbon Ultimate Comfort Innovative Design

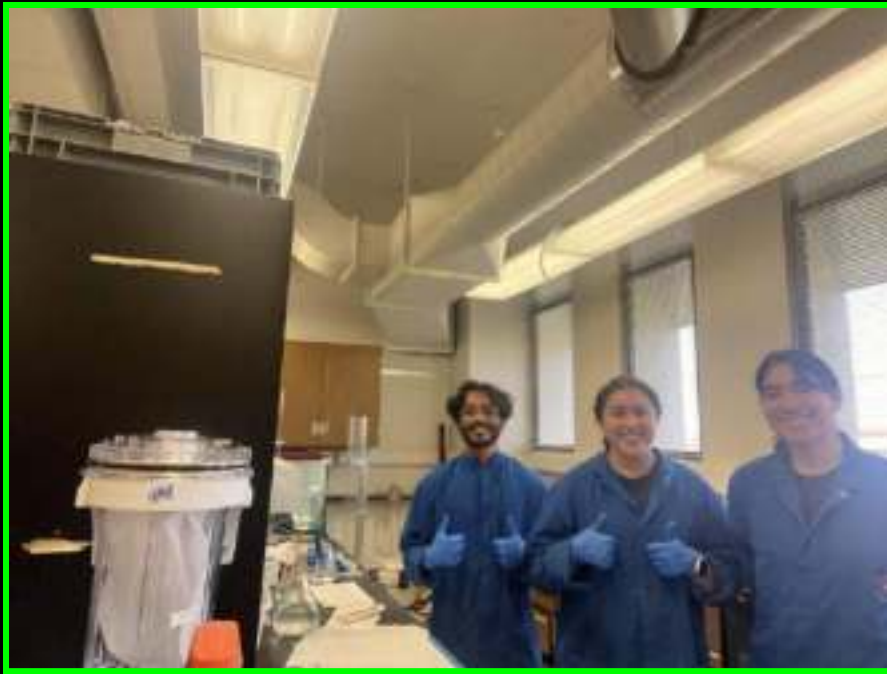
The OCSD Decathlon

Homes will be evaluated in 10 contests, each of which is worth 100 points. The team with the highest overall score wins the competition. The contests are:

1. Sustainability and Resilience
2. Architecture and Interior Design
3. Engineering and Construction
4. Communications and Marketing
5. Innovation
6. Energy Efficiency
7. Water Use and Conservation
8. Health and Comfort
9. Lighting and Appliances
10. Market Potential



**Examples of CEE@UCI
OCSD Student Groups
Activities**



Water Recycling Group



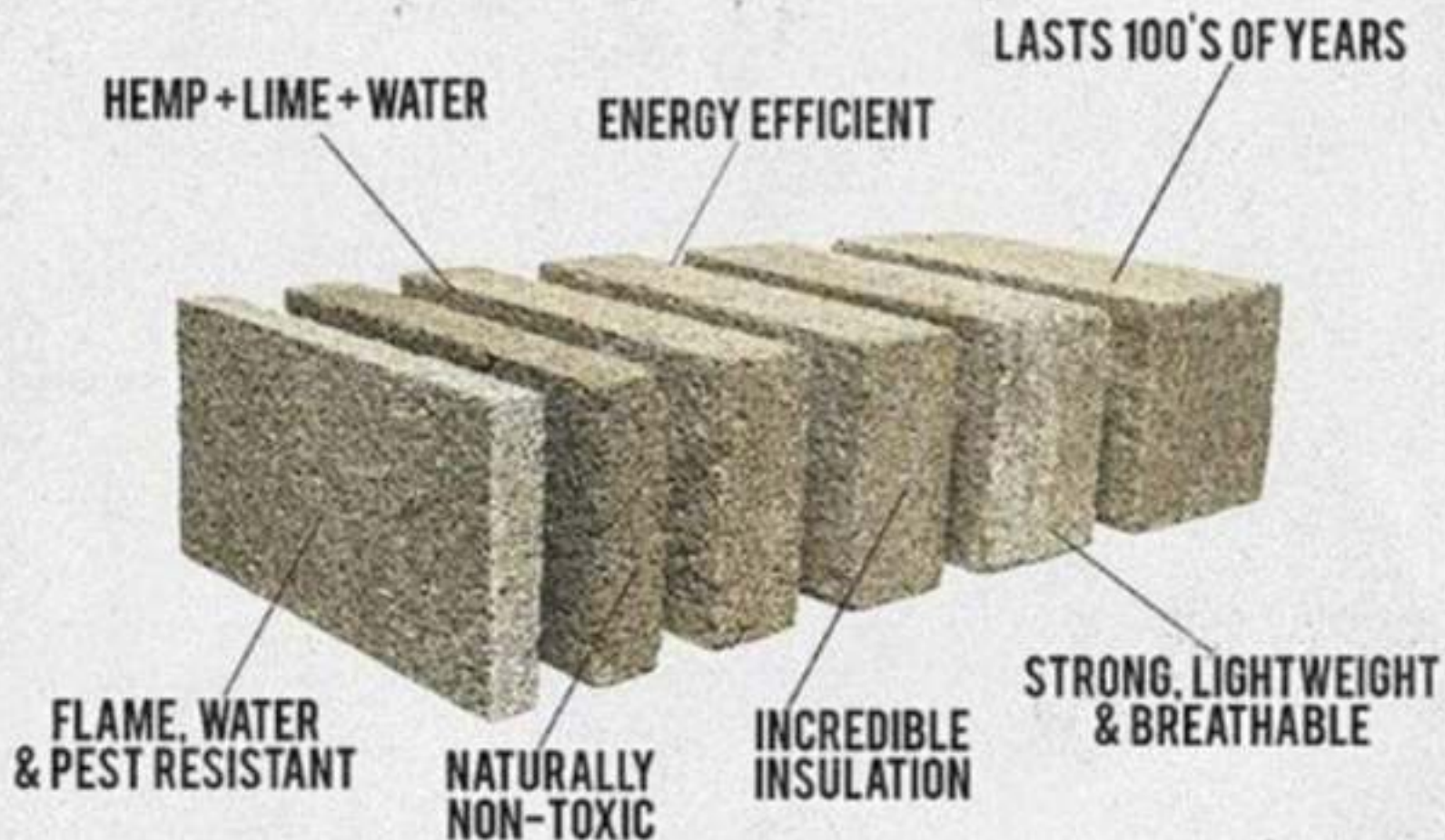
Materials & Thermal Insulation Group



HEMPCRETE

DESIGNED TO BUILD, NOT TO SMOKE.   

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Palm Leaf



Bamboo Structures



UCI SETH Lab





EXCESSIVE POLLUTION KILLS THOUSANDS OF FISH EGYPT



FEB 2020



NOV 2020



More than 1.5 billion masks believed to have entered oceans in 2020

UCI Research on Recycled Low-Density Polypropylene (LDPE) Hybrid Beams





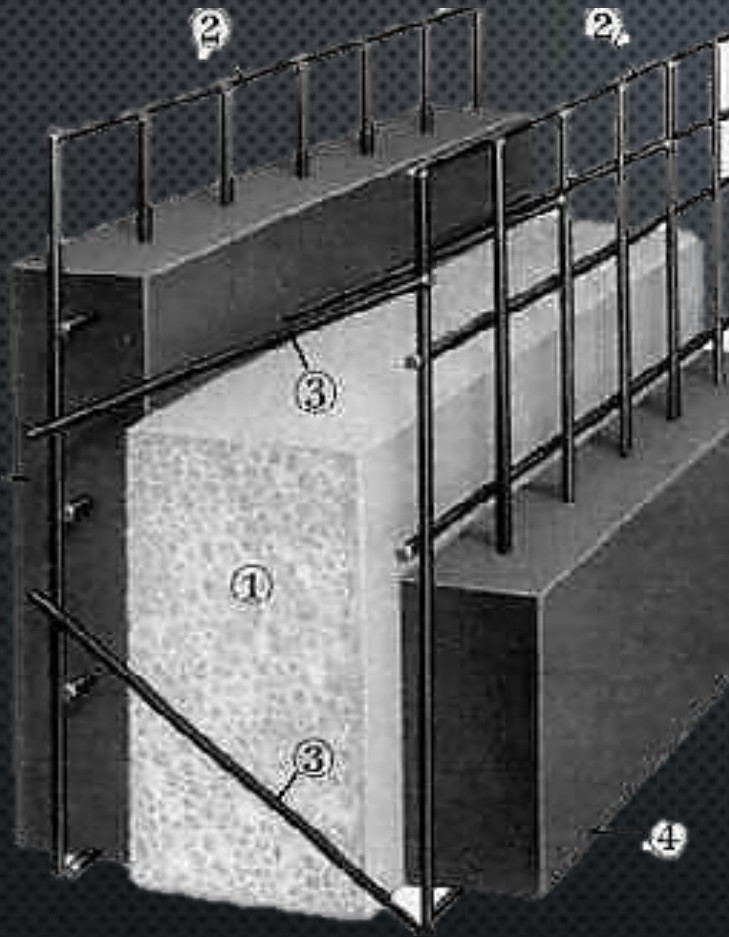
LDPE Hybrid Beams for Collision Protection of Bridge Piers & Columns (Oakland Bridge, San Diego Bridge, ..)



Recycled High-Density Polypropylene (HDPE) Building System



Basic Components of the Construction Tridipanel Sandwich System




1. Expanded Polystyrene (EPS) foam core for insulation.
2. Wire mesh on outer sides of the EPS
3. Welded wire truss diagonals
4. Mortar or Concrete Shell.



3D Enbuil Construction





1,200 square Feet **Net-Zero
House Built in 11 Days
(North Africa Desert) 2018
Designed by Prof. Mosallam**

3D Enbuil Construction





THE NET-ZERO HI`ILANI ECOHOUSE - BIG ISLAND OF HAWAII

Eco Villages and Eco Resorts

HUBBELL DOME HOME CALIFORNIA





BASEMENT WALLS



Sand Bags House



Rice Straws House





Rice Straws House

Rice Straws House



Rice Straws House



Tips for Getting Greener

- ❖ Expand the use of Solar Heaters,
- ❖ Expand the use of Solar Electricity,
- ❖ Expand the use of Water recycling,
- ❖ Make construction demolition recycling a mandatory,
- ❖ Provide incentives for following green
- ❖ Include the green concept in your school curriculum, and
- ❖ Educate public and officials.



Thank you...

Prof. Aymen Mosallam

