Sustainable Village

Illinois Institute of Technology
IPRO 301 – Spring 2005
Why Sustainability?
Why Sustainability at IIT?
The campus uses 127 million gallons of water each year above and beyond the daily needs of the students, faculty and staff.
Why Sustainability at IIT?

To sequester the greenhouse gas emissions produced as a result of IIT’s main campus, 1.3 million trees would have to be planted each year.
Teams

○ IPRO 301:
  ● Sustainability Team:
    ○ Research in Sustainability
    ○ Roadmap for IIT
  ● House Team:
    ○ Design “House of the Future”

○ IPRO 304b:
  ● Renewable Hydrogen Fueling Station
What is Sustainability?

- Sustainable developments are those that “meet present needs without compromising the ability of future generations to meet their needs” (WECD, 1987)

- Focus on 3 Areas
  - Energy (Fuels / Electricity)
  - Environment (Air / Water)
  - Economy (Waste / People)
Sustainable Philosophies

- Consumers to Producers
- Waste Stream Utilization
- Conserve, Optimize, Maintain
- Eliminate burning of Fuels
- Public participation
- Treat Energy as Capital, not a Commodity
- Green Unit
Roadmap

- **2005**: Work with “Energy and Sustainability Institute” to begin developing “Sustainability Committee”
- **2006**: Invest in Green Energy
- **2007**: Begin campus building improvements
- **2008**: All campus vehicles hydrogen-based
- **2015**: Energy and Sustainability Institute eliminates burning of fuels in 100 companies
- **2020**: 100% Green Curriculum
- **2025**: Sprinkler system and dual distribution water system
- **2030**: Eliminate steam plant
- **2035**: Implementation of green technology
- **2040**: All buildings developed on campus will have an “energy payback cycle” of no more than 5 years
Roadmap

Work with “Energy and Sustainability Institute” to begin developing “Sustainability Committee”

Invest in Green Energy

2005  2006  2007

Recycling
Roadmap

- Begin campus building improvements
- Energy and Sustainability Institute eliminates burning of fuels in 100 companies
- All campus vehicles hydrogen-based
Roadmap

- Eliminate steam plant
- Sprinkler system and dual distribution water system
- Implementation of green technology

2025

100% Green Curriculum

2030

2035

2040

All buildings developed on campus will have an “energy payback cycle” of no more than 5 years
Green Unit

Ventilation

O₂

CO₂

Heat

Light

Potable water

Waste water
House Team
Objectives

- Case Study for Future Sustainable Efforts at IIT
- Vision of Sustainable Measures for Surrounding Community
- Application of Green Unit Concept
Solar Thermal Collectors
Solar Chimney
Double skin façade
Photovoltaic panels
Greenery
Test bed for green products
Energy efficient windows
Changeable exterior panels
Reclaimed wood from site
Interior Lab to test materials
Additional Systems

- Storm Water Collection & Treatment
- Geothermal Heat Pump for Heating/Cooling
- Rapidly Renewable Materials
- Recycled Polymers for Paints & Cabinets
Comparison to Typical House

○ Net **Water** Consumption:
  ● Traditional: 127,400 gallons/yr
  ● Our House: 5,100 gallons/yr

○ Net **Electricity** Consumption:
  ● Traditional: 10,656 kWh/yr
  ● Our House: -1,822 kWh/yr
Comparison to Typical House

- **Materials** Reusable?
  - Traditional: NO
  - Our House: YES

- Year-round **Ventilation**?
  - Traditional: NO
  - Our House: YES
Future Steps

- EnPRO
- Continue Dialog with Administration
- Publicity / Outreach
  - Website: www.iit.edu/~svillage
Conclusion of IPRO

- Advisors are crucial
- Communication of Ideas and Visions
- Team Management
- Project Scope
Thank you

- Tellabs Foundation
- Bill Abolt
- Nancy Hamill
- IIT Faculty and Staff Members
- Advisors
Team Members

- **Students:**
  - Andrew Higashi
  - Anna Ninoyu
  - Bez Robinson
  - Evans Ogbebor
  - Jef Larson
  - Mike Staats
  - Philip Golucki
  - Siddha Pimputkar
  - Tony Thomas

- **Instructor:**
  - Prof. Said Al-Hallaj

- **Advisors:**
  - Anand Sathyan
  - Darcy Evon
  - Elena Savona
  - Joseph Clair
  - Kris Kiszynski
Backup Slides
Budget

- Estimate: $300 / ft$^2$  
  (Average House: $100-150 / ft^2$)

- Total footage 4,200 ft$^2$ = $1.26$ million

- Estimated cost of special systems: $91,000
# Comparison - Energy

<table>
<thead>
<tr>
<th></th>
<th>House of the Future</th>
<th>Traditional Home</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tot. Energy consumption</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Electricity)</td>
<td>7,500 kWh/yr</td>
<td>10,656 kWh/yr</td>
</tr>
<tr>
<td>(Natural Gas)</td>
<td>0 MBTU/yr</td>
<td>72 MBTU/yr</td>
</tr>
<tr>
<td><strong>Electricity production</strong></td>
<td>9,322 kWh/yr</td>
<td>0 kWh/yr</td>
</tr>
<tr>
<td><strong>Net Electricity consumption</strong></td>
<td>-1,822 kWh/yr</td>
<td>10,656 kWh/yr</td>
</tr>
</tbody>
</table>
## Comparison - Water

<table>
<thead>
<tr>
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<th>House of the Future</th>
<th>Traditional Home</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Water used</strong></td>
<td>32,777 gallons/yr</td>
<td>127,400 gallons/yr</td>
</tr>
<tr>
<td><strong>Water collected</strong></td>
<td>27,677 gallons/yr</td>
<td>0 gallons/yr</td>
</tr>
<tr>
<td><strong>Net Water consumption</strong></td>
<td>5,100 gallons/yr</td>
<td>127,400 gallons/yr</td>
</tr>
</tbody>
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Natural Ventilation

Preheat of outside air

To the house

From the house

Exhaust air

ERV

Outside air

Winter

Summer

PV ventilation

Outside air

Winter: capture heat created in facade

Preheat of outside air

PV panels

Summer: circulate cooler air to remove hot air
Equaris Water System

- Decentralized look at the water problem
- More sustainable than our current centralized solution
- Eliminates need for large plants, sewer and septic tank infrastructure
- Reduces depletion of water reserves, because people are more aware of water consumption
Solargenix – CPC 2000

- Efficiency: 78%
  (System efficiency: 40%)
- Savings: 50-80%
- Temperature provided: 40°- 98°C
- Cost: ~$2,500/system
Geothermal Heat Pump

- Potential savings: 30%-70%
- Cost: ~$3,500/ton
  - Output t: 115°F in winter, 45°F in summer
  - To the radiant floor for heating
  - To fan coils for cooling
  - Backup for solar water heating with optional Desuperheater
Electricity

- Renewable Hydrogen Fueling station
- Additional building-integrated PV production = 3.6 MWh/year with 3.5 KW array in south façade
- Energy efficient appliances
Common / Laboratory Area
Bed Room / Bath
Roof / Test Site
Rooftop

3.5 - ROOF/GREEN/
SOLAR THERMAL