Context and Items for Discussion

Benoit Cushman-Roisin
27 March 2018

We have come to realize that our ways of life are unsustainable.

Therefore,

"If we want things to stay as they are, things will have to change."

Jules B. LaPidis, President of the Council of Graduate Schools in 1998 (said in a different context)

In other words, we have no choice. Something’s got to change!
SUSTAINABILITY:
“The triple bottom line”
or “The three-legged stool”

It is essential not to endanger Planet Earth, but it would be pointless if this were achieved with no human population or with people living in unpleasant conditions. Furthermore, the quality of living standards is intimately tied to the economy. A good economy provides jobs to people who can in turn enjoy goods and services.

In the pursuit of sustainability, one ought therefore to consider three distinct elements: environmental quality, human welfare and economic vitality. This three-fold vision is commonly referred to as the “Triple Bottom Line”. I prefer the analogy with a three-legged stool because, if one leg is missing, the stool no longer holds up.

A catchy way of describing the Triple Bottom Line is to use the 3 P’s: or the 3 E’s:

\[ \text{Planet – People – Profit} \quad \text{or} \quad \text{Ecology – Economy - Equity} \]

Note that the three components are not equal. There is a hierarchy between them.

Humanity is part of Nature.

And the Economy is only one activity of Humanity.

There is a tendency, however, especially among economists, to consider people and the environment as parts of the economy. This should not be.
The built environment is a case in point:

Why do we build houses and other buildings?

To shelter **people** and their activities.

And, how can we afford to erect these buildings? Heat and cool them? Provide them with water? *etc.*

Because we have a working **economy**.

("When construction goes, the whole economy goes." – French saying)

Perhaps not traditionally but certainly in modern times, architects and builders have largely ignored the **environmental** impacts of their structures.

What are those impacts?

When we consider the service economy, we tend to think that, because it does not make products, it does not impact the environment in any appreciable way.

**WRONG !**

Think of the environmental impacts you create by having a house and living in it, or, say, by studying at a college.

1. These structures are made of materials, which had to be extracted from the ground and processed. *Think*: steel, wood, glass and plastics.

2. During occupancy these buildings need to be heated (or cooled) and lit. *Think*: Energy and the air pollution in generating it.

3. While you go about your activities in these buildings, you consume water, food, paper, *etc.* All these require processing, conveying and eventual waste.

4. And, when the building comes to the end of its life, it is demolished. How much of its materials is typically recycled? Next to nothing.
When U.S. commercial and residential buildings are combined, they represent 40% of the total energy use.

"It is clear that the building industry is part of the problem, not the solution"
– Michael Montoya, Green Building Fundamentals, 2009, page xi

What in particular can be done at the level of the built environment?

Well, we are not going to answer this one now. The entire course will be the answer to the question!

Just a couple of thoughts to get started:

"The right thing must be to make buildings and systems that pollute, contaminate, and deplete less than their predecessors do, right? But in doing that we simply become more efficient at doing the wrong thing."
William McDonough & Michael Braungart, Sustainable Architecture – White Papers, 2004

"Often, when sustainable strategies are embraced, there is a heavy emphasis on energy and resource conservation – factors easily quantifiable in terms of economic benefit. However, there is a growing consensus that the human-centered aspects of sustainable design – issues of health, well-being, comfort, and safety – offer even greater economic returns."
Kirsten Childs, Sustainable Architecture – White Papers, 2004

In other words, to think “green” we ought (1) to think in radically new ways and (2) to pay attention to the human factors.
For the moment, let us dwell into a few concepts.

→ in-class discussion

Question 1:

Mention of sustainability of human-made systems is often accompanied by energy considerations.

Why is energy so prominent?

Why we pay attention to energy use in buildings:

- We may be running out of oil. No sustainability here! And, increasing demand from China and India accelerates the problem.
- Combustion pollutes but the environment has a finite absorption capacity. (nitrogen oxides, sulfur dioxide, particulates, mercury, etc.).
- Combustion of coal, oil and gas – the carbon fuels – also generates carbon dioxide that affects our climate.
- Usually, the greatest costs of running a building are associated with energy, and this is what people measure and notice.
- Energy = hard data, but people = soft data → more attention paid to energy
- Building designers think of the structure and not so much about how people will later use the building and behave in it.
Question 2:

We as a society in an economic context cannot do without energy.

Why?
What are sustainable forms of energy?

Energy alternatives:

1. Use renewable sources of energy:
   ✓ sun – directly
   ✓ Sun – indirectly: wind, water (elevation or movement), biomass
   ✓ geothermal heat

2. Develop new technologies that extract energy from these primary sources and convert it efficiently and cleanly to more suitable forms of energy, such as electricity or a liquid fuel to facilitate transportation, storage and utilization.

→ Three parts to the energy component:

1. Sustainable sources of energy
2. Sustainable conversion, transport and storage technologies
3. Clean and efficient utilization.
Question 3:

Have you heard of “negawatts”?

What can we do to use less energy in the first place?

Energy conservation

1. Reduce need for heating and cooling:
   - wise siting of the structure
   - better thermal envelope
   - passive solar techniques
   - reflective (instead of absorbing) roofs
   - natural convection instead of forced ventilation
   - schedule activities so as to avoid peak consumption
     (on hourly or seasonal time scale)

2. Reduce need for electricity:
   - avoidance of some appliances (ex. cloth dryer, mini fridges)
   - energy-efficient appliances
   - daylighting to the extent possible
   - motion detectors to turn lights off
   - incentives for people to take stairs instead of the elevator
Question 4:

Having green technologies, green buildings, etc. is great … but

What about people’s behavior?
Shouldn’t we also have “green people”?
Sustainable Design Process applied to buildings

Building design and function set the load

- Building Shape
- Orientation
- Glass location
- Glass area & type
- Insulation values
- Thermal mass
- Building Volume
- Passive Solar

Minimize load as a first priority

Efficient building systems meet the load

- Daylighting
- Lighting
- HVAC
- Heat Recovery
- Optimized Ventilation
- Building Automation
- Domestic Hot Water

Use efficient, cost-effective systems

Primary energy systems supply the needed energy

- Electricity
- Steam
- Hot Water
- Chilled Water
- Cogeneration
- Solar Thermal
- Photovoltaics
- Biomass

Produce and distribute energy efficiently

People use the building and run the systems

- Schedules
- Controls
- Maintenance
- Setpoints
- Windows
- Equipment
- Education
- Commissioning
- Re-commissioning

Operate the building well

(adapted from David W. Madigan, Van Zelm Engineers, CT)