# Research Topic: Energy and the Economy

## How demand for energy will affect future Building Systems

**(6.1) Problem Statement**

The PACE roundtable discussed the importance of energy and what impacts it has on the economy and construction industry. It is well known that the control of natural resources is the most powerful economic position that can be held. Without energy, the United States economy would falter. The continually growing need for energy in the United States is speeding up at a tremendous pace. Efficiency and innovation are the keys to solving the energy crisis that our country is experiencing. One specific way to reduce our consumption is the development of alternate energy sources such as wind and solar technologies. By integrating these types of systems into our infrastructure, energy consumption and carbon emissions can be lowered, which would result in a cleaner and more economically friendly country.

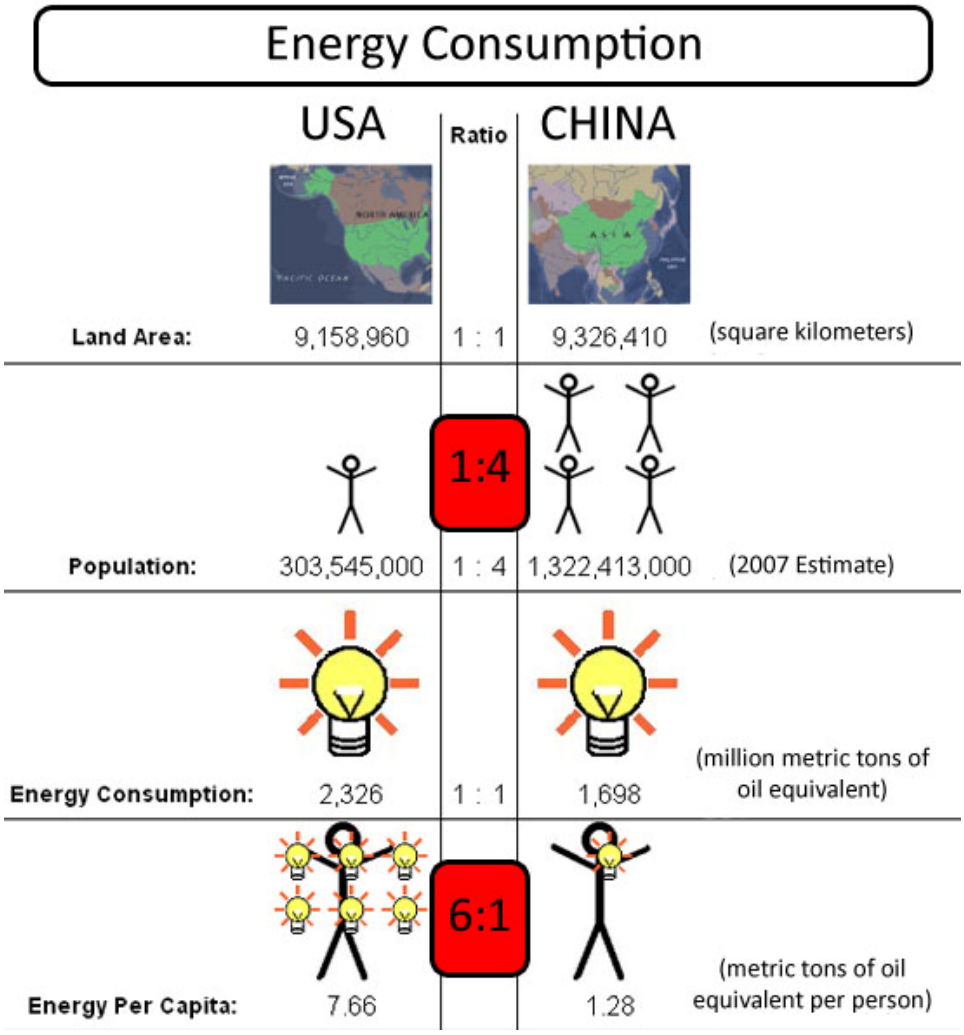
**(6.2) Research Goals**

The main goal of this analysis is to determine what the construction industry needs to do in order to integrate solar power into the design of a building through constructability aspects. Having the ability to run a building on its own self-generated power would have a great impact on both the economy and environment by reducing the dependency on foreign power sources and proving clean renewable energy that is integrated right into the building itself. The construction industry has taken small steps toward this goal in the last decade and plans to take even greater ones in the future. It is my goal to determine what alternative energy sources will be dominant in the future, and how they will affect the way that we design and integrate them into building systems. A more specific goal will be how they will be integrated into the United States' infrastructure through constructability; specifically focusing on solar power in the Mid-Atlantic region.

**(6.3) Background**

There is no doubt that as Americans, we are afforded luxuries that the rest of the world does not have access to. Whether it is freedom, schooling, or abundance of resources, it is our duty as human beings to use these luxuries responsibly. It is a known fact that the average American consumes over 25 times more resources than the average person from a developing country. That means that a family in a developing country would have to have 75 children to have the same environmental impact as an American family with three children.

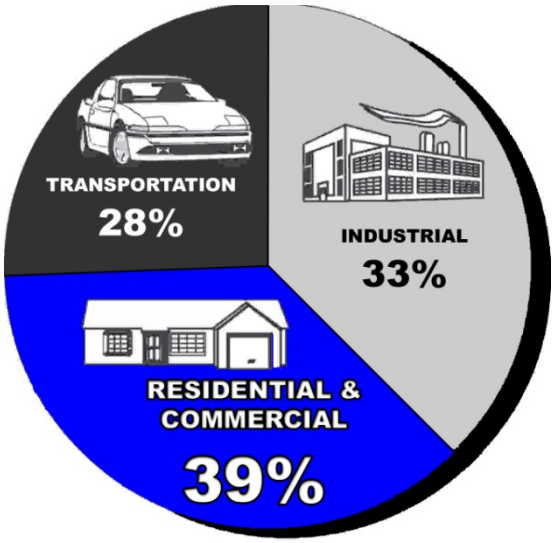
As a quick reference to exactly how much energy the United States uses than the rest of the world. Refer to the diagram on the next page. It compares the United States with China, who some say will overtake the US as the dominate world power in the next few years.




Taking into the account the information provided in the figure above, it can be seen that while the United States and China share an almost equal land area and a relatively close total energy consumption ( China still uses 27% less energy) it is striking how much energy the US uses compared to its population. Even though the US has about **one forth** the population of China, the average American uses more than six times the amount of energy than that of an average Chinese citizen. This makes one wonder, why do we need so much energy and what are we using it for?

Still even more staggering is the fact that while the US makes up for approximately 5% of the world population, it uses more than 24% of its resources. Again, the question is posed; why do we need so much and what are we using it for?

**(6.4) A Look at Energy Consumption per Sector**



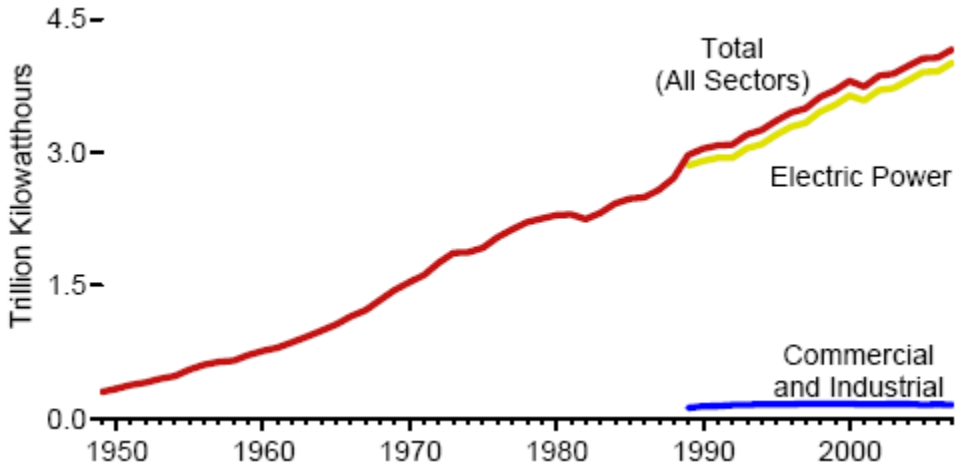

Energy consumption in the United States is broken down into three main sectors:

- Transportation
- Industry
- Residential and Commercial

Among these, residential and commercial account for the highest portion totaling 39%. Residential refers to any place where people live and commercial refers to a place that people work. These are grouped into the same category because the energy consumption is used in basically the same way.

When breaking down this category even further, we find that heating and cooling loads account for half of the total energy used. This is an important figure when talking about the construction industry because in order to save money, building must be constructed as efficiently as possible.

Advancements in technology have made it easier to save money on electric and gas bills, however, there is still room for improvement.



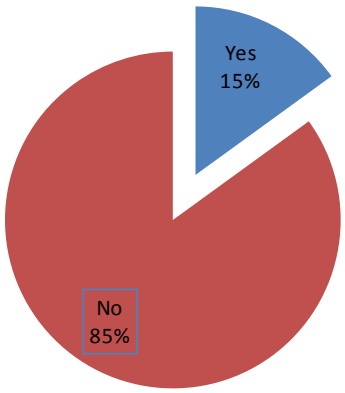

As you can see from the Figure __ above. The total US electricity net generation in all sectors grew from 0.3 trillion kilowatt hours in 1949 to 4.2 trillion kilowatt hours in 2007, failing to increase in only 2 years (1982 and 2001) over the entire span. Most generation was in the electric power sector, but some occurred directly in the commercial and industrial sectors.

**(6.5) Solar Photovoltaic Panels and Construction**

Solar panels have been around for years. However, our current economic situation coupled with global warming and a fading ozone layer has brought this abundant natural resource we call the sun back into the limelight. Integrating solar panels into buildings has always been a topic of hot discussion for architects, contractors and owners. Architects often found them un-slightly. The design of a solar panel, since just recently, has resorted to a rectangular shape that was dark in color and provided no aesthetic purpose at all. The extremely high initial investment of a solar array is one of the main detracting features that owners are subjected to. Depending on the size and type of system, the payback period could be as large as 60 years. While integrating the solar system into a building has become easier in the past few years through advancements in inverters and the ability to tie-directly into the grid, contractors still face schedule impacts when installing an array.

A survey was sent out to contractors in the Mid- Atlantic region, which asked what the most common constructability concerns of a solar PV system were. 40 results came back, with the majority of them coming from the Greater Washington, DC area. The following section will show relevant results of the survey and attempt to explain the reasons behind the answers.

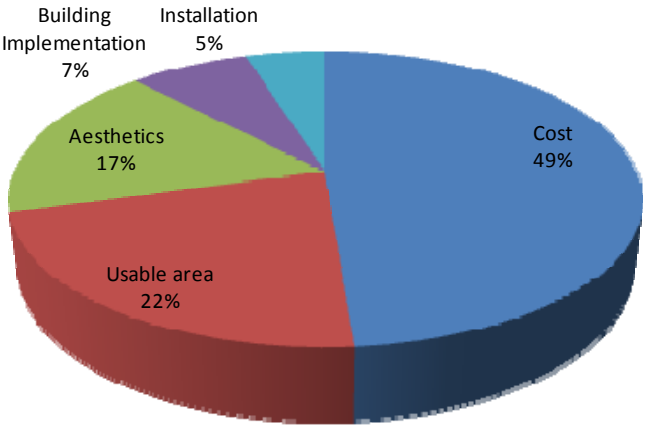
The first and most basic question that was posed was:



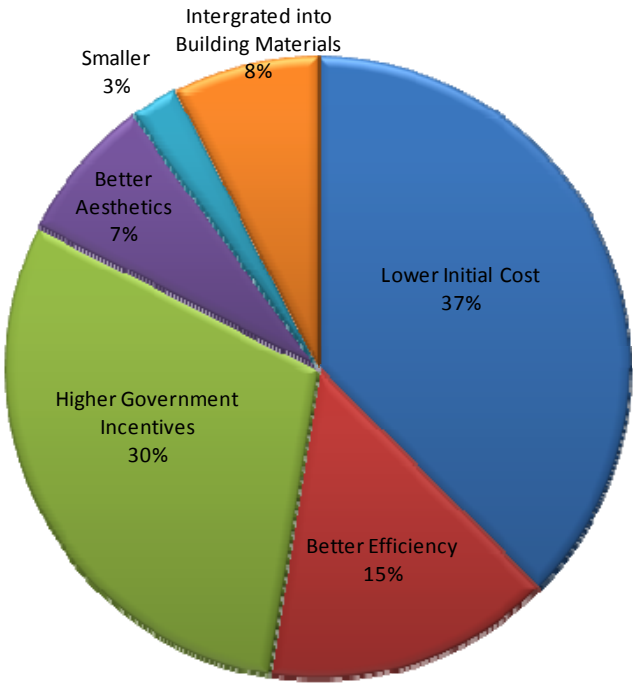

*Would you be inclined to install PV panels on the current project you are working on or your home?*

A staggering 85% of the 40 respondents polled said that they would not currently install a PV array on their current building or their home. The fact that such a high percentage declined installation alludes to the fact that something is still pushing consumers away from this energy saving technology.

What is the top constructability issue concerning the implementation of a solar array?



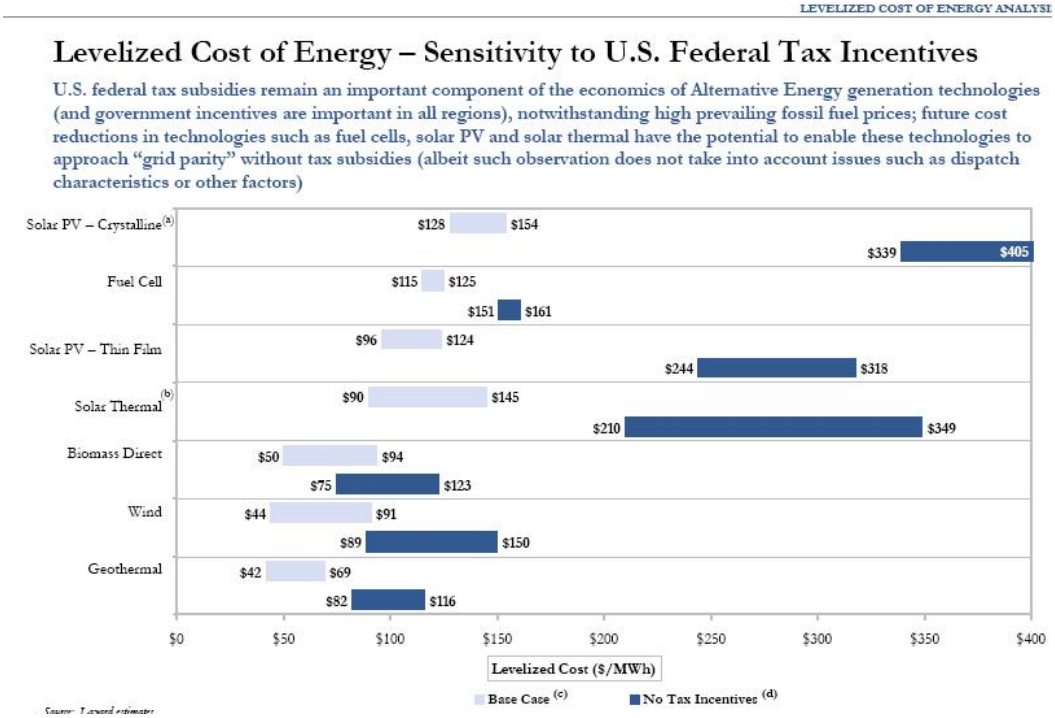

Cost was the number one answer that deterred people from installing a system. This is likely due to a low amount of government incentives available as well as the high cost of the panels and installation. Available area and correct orientation is also a major concern. If a building is not oriented South or if it has limited roof area, it makes solar arrays largely unappealing. The bottom three concerns were aesthetics , connecting the system to the building, and overall installation process.




What would make you more willing to install a system?

Initial cost is the main concern in this question. Lowering manufacturing costs would be one way to reduce the initial installation cost of the system. The government has taken small steps in trying to promote the use of clean renewable energy within the country. Providing more incentives seems to be the overall mood of the polled population. A new budget presented by the Obama administration should help future incentives for solar production and installation grow.

Below is a chart of levelized energy cost with tax incentives. It shows costs of PV as they currently stand without any government funding and what amount would need to be given in order for it to compare to other leading renewable sources.



**(6.6) Solar Growth**

Decreases in the cost of installation and favorable regulatory environment should protect the continued growth of solar energy production in the US from effects of the economic crisis. It is imperative that the government provide greater incentives to implement such energy technologies so that the US may once again rely on its own self for energy.

Photovoltaic production worldwide has been doubling every two years, increasing by an average of 48% each year since 2002, making it the world's fastest-growing energy technology. 90% of this generating capacity consists of grid-tied electrical systems, in which PV panels generate electricity and interconnect with a utility's power line.

According to a recent report by Global Data, a business information company providing global business information reports and services, the US is the fourth largest solar PV market in the world. The market has grown from 168 megawatts (MW) in 2001 to around 1,111 MW by the end of 2008. Grid-connected solar PV grew to 61% of all solar PV installations, accounting for 677 MW in 2008.

The solar industry is poised for a rapid decline in costs that will make it a mainstream power option in the next few years, according to a new assessment by the World Watch Institute in Washington, D.C., and the Prometheus Institute in Cambridge, Massachusetts. Global production of PV cells, has risen six fold since 2000 and grew 41 percent in 2006 alone. While this growth is significant, it is still restrained by a shortage of manufacturing capacity for purified polysilicon, the main component is solar cells.

There is great news for future production with the advancements in thin-cell technology and more efficient production of polysilicon. The current situation will be reversed in the next two years as more than a dozen companies in Europe, China, Japan, and the United States bring on unprecedented levels of production capacity. Combined with technological advances, the increase in polysilicon supply will bring costs down rapidly. According to Prometheus estimates, the price is expected to decrease 40% in the next three years. By roughly 2010, electrical utilities will be looking to manage the competitive threat posed to their markets by distributed solar generation.