Building a Better Environment

The “built environment” can be defined as "the humanitarian-made space in which people live, work, and recreate on a day-to-day basis."[1] The built environment includes homes, streets, office buildings, and parks, as well as other man-made spaces.

The buildings and transportation systems that make up our built environment account for more than two-thirds of all greenhouse gas emissions. When designing the built environment, engineers focus on efficiency in order to decrease the energy required to produce the optimal outcome. Analyzing buildings for efficiency is the practice of dynamically balancing environmental, social, economic, and health benefits. These considerations can be applied to both residential and commercial buildings.

How can engineers help? As the population of the world increases, the number of residences required also increases. You and your team will consider the design of a residential home using green building practices, and compare this home with a conventional home, comparing the cost difference over the lifetime of the structure.

[1] Roof, K; Oleru N. (2008). "Public Health: Seattle and King County’s Push for the Built Environment.". *Journal of Environmental Health*. **75**: 24–27

Explore more:

The Seven Principles of Green Building
http://www.greendesignbuild.net/Pages/SevenPrinciplesofGreenDesign.aspx

Principles of Green Building Design from Monterey Peninsula College
http://www.ecologicdesignlab.com/files/MPC-pub090709.pdf

The EPA Guide to Green Building
https://archive.epa.gov/greenbuilding/web/html/

Federal Trade Commission: Energy Guide Labels
http://www.consumer.ftc.gov/articles/0072-shopping-home-appliances-use-energyguide-label

United States Office of Energy Efficiency and Renewable Energy
http://energy.gov/eere/office-energy-efficiency-renewable-energy

Energy Basics

Energy is used for transportation, manufacturing, and commercial uses that are essential to modern society. Humans cannot survive without the ability to capture, store, use, and transport energy. A civilization cannot advance without creating ways to translate energy to useful work.

Each year, the United States uses 28% of its total energy for transportation, moving people and goods from one place to another. Modes of transportation include cars, trucks, airplanes, boats, trains and buses. Reducing energy use through efficient practices and alternative fuels is a major initiative in planning for future transportation needs.

Energy allows manufacturers to transform raw materials into a final product for the consumer. The raw materials go through a number of stages during this transformation, which makes up a large percentage of industrial energy consumption. In an economic sense, energy performs work that adds value to the final consumer product. There are opportunities to improve energy efficiency at each step of the manufacturing process.

Historically engineering has driven advances in energy through its extraction, utilization, and transportation. This work had been largely with oil, coal, nuclear, and hydropower sources. Recently society has seen a need for the development and utilization of renewable energy sources, and engineers are at the forefront of that work.

How can engineers help?
Your team will explore calculations to increase the efficiency of energy use, find better ways to store electricity, and monitor and mitigate pollution.

Explore more:

U.S. Energy Information Administration: https://www.eia.gov/

National Renewable Energy Laboratory: http://www.nrel.gov/

National Academy of Engineering Solar Grand Challenge: http://www.engineeringchallenges.org/challenges/solar.aspx

Tesla Gigafactory: https://www.tesla.com/gigafactory

Foundation for Water and Energy Education: http://fwee.org/

U.S. Department of Energy, Office of Nuclear Energy: https://www.energy.gov/ne/office-nuclear-energy

Global Health and Engineering

Around the world, one of the most pressing global health challenges is neonatal (newborn infant) mortality. In Africa alone, over 1.16 million babies die before they are one month old. One of the greatest contributors to these alarmingly high mortality rates is neonatal hypothermia. These newborn babies often need to be transported from a rural location via ambulance to a hospital. In most cases, neither the ambulance nor the hospital has adequate access to electricity. As a result, many babies die of hypothermia during this process.

Though engineers have developed technologies to keep babies warm in high-resource settings, such as the United States, few solutions exist in low resource settings, such as sub-Saharan Africa. One of the biggest challenges for engineers in these settings is the lack of a stable electric grid. Many medical devices have high energy requirements, making sustainable use of these technologies difficult in hospitals without electricity. While engineers work on green energy alternatives for countries like the U.S., many of these solutions could be used to generate a stable and reliable source of power for countries without a stable grid.

Engineers play a crucial role in developing technologies that can keep infants warm during their first month of life. Limited access to an unreliable electric grid in low resource settings means engineers must develop technologies that effectively operate in available conditions.

How can engineers help? Your team will review available issues and options, considering energy requirements, efficiencies, and the sustainability of potential solutions in health care.

Explore more:

Access to modern energy services for health facilities in resource-constrained settings (World Health Organization)
http://apps.who.int/iris/bitstream/10665/156847/1/9789241507646_eng.pdf

Limited electricity access in health facilities of Sub-Saharan Africa (Adair-Rohani et. al)
https://www.ncbi.nlm.nih.gov/pubmed/25276537

Methods of Heat Transfer
http://www.physicsclassroom.com/class/thermalP/Lesson-1/Methods-of-Heat-Transfer

Thermal protection of the Newborn (World Health Organization)
http://apps.who.int/iris/bitstream/10665/63986/1/WHO_RHT_MSM_97.2.pdf

Neonatal hypothermia in low resource settings: a review (Kumar et. al)
https://www.ncbi.nlm.nih.gov/pubmed/19158799

Reducing Light Pollution

Light pollution occurs as the result of poorly designed artificial lighting that is used at night, causing one or more of the following effects:

1) *sky glow* - artificial reflected and ambient light which prevents the visibility of the natural night sky
2) *light trespass* - unwanted light that crosses property lines and degrades quality of life
3) *glare* - unshielded light which can produce a health and safety hazard

There is a perception of human safety when higher density artificial lighting is used at night. This is a primary reason light pollution exists everywhere in the world today. Existing research, however, does not support a link between artificial lighting and safety in most situations.

What has been established is that poorly designed artificial lighting produces negative impacts on humans and wildlife. Additionally, approximately 2.2 billion dollars in US energy consumption is wasted annually from inappropriately designed artificial lighting that shines directly into the sky. This inefficient and poor use of technology to light the night is a growing concern that contributes to our light pollution epidemic. Addressing light pollution is required if we want to engineer a greener world.

How can engineers help? Your team will be challenged to understand the factors influencing the design of artificial lighting and the impact of these factors on light pollution reduction. You will be asked to predict the likely outcomes of changes in lighting design as well as evaluate specific lighting applications for their ability to reduce light pollution.

Explore More:

http://www.darksky.org

http://www.darkskiesawareness.org/faq-what-is-lp.php

https://www.globeatnight.org/light-pollution.php

https://www.lightpollutionmap.info/ (check this site out to see light pollution in your area)

http://www.artificiallightatnight.org