

BSc/HND/HNC Built Enviroment Portfolio

Built Enviroment Services

M5X01836

Renewable Energy solutions for Building Services

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Introduction

For our second assignment in the Built Environment Services (M5X01836), we have been asked to choose and critically analyse a renewable energy source, that the University could incorporate into the next phase of development on the SA1 new campus site, a swimming pool and gymnasium complex in single storey, with a total floor area of 6,000 m². The complex will operate from 7am to 10pm, 6 days a week.

With consideration to the nature of the building and site, its geographical position and environmental conditions it is subjected to.

It is thought the Built Environment sector consumes up to 40% of the world's energy, and emits up to 30% of the global greenhouse emissions. The built environment sector's contribution to carbon emissions could double or even treble by 2050 if the construction does not act as a whole, because buildings have a long life-cycle that locks in energy use.

I hope to use case studies, online articles and other published information, along with some in-class notes, to gather the required information, to be able to present the case to the University for their consideration. I hope my solution should emphasise the system's positive aspects for energy generation, but also its limitations.

What is Renewable Energy?

Renewable energy is energy that is collected from renewable resources, which are naturally replenished on a human timescale, such as sunlight, wind, rain, tides, waves, and geothermal heat.[3] Renewable energy often provides energy in four important areas: electricity generation, air and water heating/cooling, transportation, and rural (off-grid) energy services.[4]

Based on REN21's 2017 report, renewables contributed 19.3% to humans' global energy consumption and 24.5% to their generation of electricity in 2015 and 2016, respectively. This energy consumption is divided as 8.9% coming from traditional biomass, 4.2% as heat energy (modern biomass, geothermal and solar heat), 3.9% hydro electricity and 2.2% is electricity from wind, solar, geothermal, and biomass. Worldwide investments in renewable technologies amounted to more than £216 billion in 2015, with countries such as China and the United States heavily investing in wind, hydro, solar and biofuels. Globally, there are an estimated 7.7 million jobs associated with the renewable energy industries, with solar photovoltaics being the largest renewable employer. As of 2015 worldwide, more than half of all new electricity capacity installed was renewable.

The main forms of renewable energy are:

- Wind Power
- Hydro Power
- Solar Energy
- Geothermal Energy
- Bio Energy

Wind Power

Wind power is the use of air flow through wind turbines to provide the mechanical power to turn electric generators. Wind power, as an alternative to burning fossil fuels, is plentiful, renewable, widely distributed, clean, produces no greenhouse gas emissions during operation, consumes no water, and uses little land.

Hydro Power

Hydro power or hydroelectricity refers to the conversion of energy from flowing water into electricity. It is considered a renewable energy source because the water cycle is constantly renewed by the sun. Historically, one of the first uses of hydro power was for mechanical milling, such as grinding grains.

Solar Energy

Solar energy is the technology used to harness the sun's energy and make it useable. As of 2011, the technology produced less than one tenth of one percent of global energy demand. Many are familiar with so-called photovoltaic cells, or solar panels, found on things like spacecraft, rooftops, and handheld calculators.

Geothermal Energy

Geothermal energy is the heat from the Earth. It's clean and sustainable. Resources of geothermal energy range from the shallow ground to hot water and hot rock found a few miles beneath the Earth's surface, and down even deeper to the extremely high temperatures of molten rock called magma.

Bio Energy

Bioenergy is one of many diverse resources available to help meet our demand for energy. It is a form of renewable energy that is derived from recently living organic materials known as biomass, which can be used to produce transportation fuels, heat, electricity, and products.

My recommendation

My recommendation for this project being undertaken by the university, would be to integrate solar energy into the construction of their new development.

Solar energy is radiant light and heat from the Sun that is harnessed using a range of ever-evolving technologies such as solar heating, photovoltaics, solar thermal energy, solar architecture, molten salt power plants and artificial photosynthesis.

It is an important source of renewable energy and its technologies are broadly characterized as either passive solar or active solar depending on how they capture and distribute solar energy or convert it into solar power. Active solar techniques include the use of photovoltaic systems, concentrated solar power and solar water heating to harness the energy. Passive solar techniques include orienting a building to the Sun, selecting materials with favorable thermal mass or light-dispersing properties, and designing spaces that naturally circulate air.

The large magnitude of solar energy available makes it a highly appealing source of electricity. The United Nations Development Programme in its 2000 World Energy Assessment found that the annual potential of solar energy was 1,575–49,837 exajoules (EJ). This is several times larger than the total world energy consumption, which was 559.8 EJ in 2012.

In 2011, the International Energy Agency said that "the development of affordable, inexhaustible and clean solar energy technologies will have huge longer-term benefits. It will increase countries' energy security through reliance on an indigenous, inexhaustible and mostly import-independent resource, enhance sustainability, reduce pollution, lower the costs of mitigating global warming, and keep fossil fuel prices lower than otherwise. These advantages are global. Hence the additional costs of the incentives for early deployment should be considered learning investments; they must be wisely spent and need to be widely shared.

Solar Water Heating

Solar hot water systems use sunlight to heat water. In low geographical latitudes (below 40 degrees) from 60 to 70% of the domestic hot water use with temperatures up to 60 °C can be provided by solar heating systems.[23] The most common types of solar water heaters are evacuated tube collectors (44%) and glazed flat plate collectors (34%) generally used for domestic hot water; and unglazed plastic collectors (21%) used mainly to heat swimming pools.[24]

As of 2007, the total installed capacity of solar hot water systems was approximately 154 thermal gigawatt (GWth).[25] China is the world leader in their deployment with 70 GWth installed as of 2006 and a long-term goal of 210 GWth by 2020.[26] Israel and Cyprus are the per capita leaders in the use of solar hot water systems with over 90% of homes using them.

Photovoltaics PV

Photovoltaics (PV) is the conversion of light into electricity using semiconducting materials that exhibit the photovoltaic effect, a phenomenon studied in physics, photochemistry, and electrochemistry.

A photovoltaic system employs solar panels, each comprising a number of solar cells, which generate electrical power. PV installations may be ground-mounted, rooftop mounted or wall mounted. The mount may be fixed, or use a solar tracker to follow the sun across the sky.

Solar PV has specific advantages as an energy source: once installed, its operation generates no pollution and no greenhouse gas emissions, it shows simple scalability in respect of power needs and silicon has large availability in the Earth's crust.[1]

PV systems have the major disadvantage that the power output works best with direct sunlight, so about 10-25% is lost if a tracking system is not used.[2] Dust, clouds, and other obstructions in the atmosphere also diminish the power output.[3][4] Another important issue is the concentration of the production in the hours corresponding to main insolation, which do not usually match the peaks in demand in human activity cycles.[1] Unless current societal patterns of consumption and electrical networks adjust to this scenario, electricity still needs to be stored for later use or made up by other power sources, usually hydrocarbons.

Photovoltaic systems have long been used in specialized applications, and stand-alone and grid-connected PV systems have been in use since the 1990s.[5] They were first mass-produced in 2000, when German environmentalists and the Eurosolar organization got government funding for a ten thousand roof program.[6]

Advances in technology and increased manufacturing scale have in any case reduced the cost, increased the reliability, and increased the efficiency of photovoltaic installations.[5][7] Net metering and financial incentives, such as preferential feed-in tariffs for solar-generated electricity, have supported solar PV installations in many countries.[8] More than 100 countries now use solar PV.

After hydro and wind powers, PV is the third renewable energy source in terms of global capacity. At the end of 2016, worldwide installed PV capacity increased to more than 300 gigawatts (GW),[9] covering approximately two percent of global electricity demand.[10] China, followed by Japan and the United States, is the fastest growing market, while Germany remains the world's largest producer, with solar PV providing seven percent of annual domestic electricity consumption.[11] With current technology (as of 2013), photovoltaics recoups the energy needed to manufacture them in 1.5 years in Southern Europe and 2.5 years in Northern Europe.[12]

I have come to this decision following my research of case studies brought to our attention in an in-class lecture.

The first case study that I took into consideration, is the Restoration of the Clifton Lido, Bristol. This is an extremely good example of Solar Water Heating. The pool had fallen into significant disrepair by 1990 when it was closed to the public, and was considered for demolition. However, the Lido and accompanying public house were designated Grade II* listed building status on 12 June 1998 and is set in a Conservation Area.

In 2005 it was acquired by the Bristol Glass Boat Company, who restored the pool with the addition of substantial spa facilities with saunas and other treatment rooms and built a restaurant and café. It reopened in November 2008 as The Lido, Bristol. The pool is kept at

24 °C, and the building offers spa treatments and massages. Priority is given to members, meaning day visitors are turned away at busy times.

As part of the eco-friendly project, it fitted a £50,000 solar thermal heating system by Backwell-based solar energy specialists Solarsense which includes 80 sq m of solar thermal evacuated tubes on the roof that capture the sun's energy. This is then used to heat water for the 24m swimming pool, hot tub and showers, as well as heating the building itself.

It has been estimated that heating the building and facilities at the Lido, would be a massive £90,000 per year, but with the solar heating system, the cost has now come down to £60,000 per year, saving the Lido a cost of £30,000 per year. This meaning tht the installation costs would easily be out done in less that 2 years of running the building. The Lido solar project also won Best Renewable Energy Scheme at the 2009 Regen SW Green Energy Awards. he Lido is an almost perfect customer for a solar thermal system. The installation at Clifton, with 800 Thermomax vacuum tubes, is one of the largest in the UK.

Conclusion

In conclusion to my findings on the case study, I believe that solar heating would be the best option to integrate into the fabric of the building during its construction. I believe the university would benefit massively from the vast savings per year, against the relative small cost of the installation costs. Based on the Clifton Lido project, the savings could be up to £30,000 per annum, which could be re-invested into the university to better the facilities.