Energy is essential for economic development and growth. With the rapid growth of development and the drive to expand the economy, society demands more electricity. Coupled with the realization that unsustainable energy production can have a detrimental effect on our environment. Solar energy is the most prolific method of energy capture in nature.

In recent years, the floodgates of research focusing on clean renewable energy have been opened by scientists who consider solar energy to be the most abundant source of energy that can satisfy society's demands, which stem from continual economic development [1–4]. Solar energy is at least utilized in 4 different ways in our daily lives, and this ranges from heating water to producing electricity. Photovoltaic (PV) technologies are at the top of the list of applications that use solar power, and forecast reports for the world's solar photovoltaic electricity supplies state that in the next 12 years, PV technologies will deliver approximately 345 GW and 1081 GW by 2020 and 2030, respectively [5].

Sun light is available for free everywhere, but the guarantee of using this light for solar power is restricted to solar farms and rooftop panels. Recently, transparent solar cells caught the attention of scientists due to their variety of possible applications in our daily lives. Transparent solar cells are already in use for these applications in some countries, while others are for the far future, once their efficiency is improved. Transparent solar cells can transform crowded cities from exclusively power consumers into power plants. Building integrated photovoltaics, also known as BIPV, is the nearest application for transparent solar cells. If all the buildings with 90% glass on their surface used transparent solar cells printed on the surface of the glass, the solar cells have the potential to power more than 40% of that building's energy consumption.

There are approximately nine technologies that apply to the fabrication of transparent solar cells, and they are a focal point of current research due to market demand and the potential applications of transparent solar cells (TSC). The centers of research that report some success with TSC are in Japan, Germany, the USA, and India. It should be noted that 90% of these technologies use an FTO or ITO conductor on glass, which has a layer with almost 10 Ω/sq resistance, using a thin film with a thickness of less than 20 nm [58,59]. Combined with intrinsic optical losses of the glass itself, these layers reduce the transparency by approximately 15–20% before the deposition of any other materials. Thus, the best transparency achieved currently is less than 80% [60,61], The technologies that achieved more than 20%. Schematic overview of a dye-sensitized solar cell operational principle. [31]. A.A.F. Husain et al. Renewable and Sustainable Energy Reviews 94 (2018) 779–791 781 transmittance with at least 1% efficiency are elaborated in chronological order below.

[1] Da Y, Xuan Y, Li Q. From light trapping to solar energy utilization: a novel photovoltaic-thermoelectric hybrid system to fully utilize solar spectrum. Energy 2016;95:200–10.

 [2] Tiwari Atul, Sharon Maheshwar, RB. Solar cell nanotechnology. New Jersey: Wiley; 2013.

[3] Hosenuzzaman M, Rahim NA, Selvaraj J, Hasanuzzaman M, ABMA Malek, Nahar A. Global prospects, progress, policies, and environmental impact of solar photovoltaic power generation. Renew Sustain Energy Rev 2015;41:284–97. http://dx. doi.org/10.1016/j.rser.2014.08.046.

[4] Fahrenbruch, Alan, RB. photovoltaic solar energy conversion. California: Elsevier; 2012.

[5] Tyagi VV, Rahim NAA, Rahim NA, Selvaraj JAL. Progress in solar PV technology: research and achievement. Renew Sustain Energy Rev 2013;20:443–61. http://dx. doi.org/10.1016/j.rser.2012.09.028.

[6] Kawashima T, Ezure T, Okada K, Matsui H, Goto K, Tanabe N. FTO/ITO doublelayered transparent conductive oxide for dye-sensitized solar cells. J Photochem Photobiol A Chem 2004;164:199–202. [http://dx.doi.org/10.1016/j.jphotochem. 2003.12.028](http://dx.doi.org/10.1016/j.jphotochem.%202003.12.028).

[7] Zeng K, Zhu F, Hu J, Shen L, Zhang K, Gong H. Investigation of mechanical properties of transparent conducting oxide thin films. Thin Solid Films 2003;443:60–5. [http://dx.doi.org/10.1016/S0040-6090(03)00915-5](http://dx.doi.org/10.1016/S0040-6090%2803%2900915-5).

[8] Goebbert C, Nonninger R, Aegerter M, Schmidt H. Wet chemical deposition of ATO and ITO coatings using crystalline nanoparticles redispersable in solutions. Thin Solid Films 1999;351:79–84. [http://dx.doi.org/10.1016/S0040-6090(99)00209-6](http://dx.doi.org/10.1016/S0040-6090%2899%2900209-6).

[9] Baek WH, Choi M, Yoon TS, Lee HH, Kim YS. Use of fluorine-doped tin oxide instead of indium tin oxide in highly efficient air-fabricated inverted polymer solar cells. Appl Phys Lett 2010;96:2010–2. <http://dx.doi.org/10.1063/1.3374406>.

 [10] Mack J, Kobayashi N. Low symmetry phthalocyanines and their analogues. Chem Rev 2011;111:281–321. <http://dx.doi.org/10.1021/cr9003049>.

[The renowned Centre Pompidou in Paris](https://www.archdaily.com/tag/centre-pompidou) is to open its doors to two living sculptures, embodying the future forms of spatial intelligence. The exhibition, titled “[La Fabrique du vivant](https://www.centrepompidou.fr/cpv/resource/c5nxa8r/rEgR5ye?utm_medium=website&utm_source=archdaily.com)” [The Fabric of the Living], will feature “H.O.R.T.U.S. XL Astaxanthin.g” by [ecoLogicStudio](https://www.archdaily.com/tag/ecologicstudio) in collaboration with Innsbruck University - Synthetic Landscape Lab, CREATE Group / WASP Hub Denmark - University of Southern Denmark, and "XenoDerma" by Urban Morphogenesis Lab directed by Claudia Pasquero at The Bartlett UCL.

Running from February 20th to April 15th, the exhibition will examine the notion of “living” in a digital era, where new interactions are emerging between the fields of life science, neuroscience, and synthetic biology. Permeating the entire urbanscape, this global, digital apparatus “encompasses miniaturization, distribution, and intelligence of manmade urban networks of in-human complexity, engendering evolving processes of synthetic life on Earth.”

For the exhibition, [ecoLogicStudio](https://www.archdaily.com/tag/ecologicstudio) founders Claudia Pasquero and Marco Poletto have created “in-human gardens”, two 3D printed living sculptures receptive to human and non-human life. With a design incorporating living organisms, both structures contain colonies of photosynthetic cyanobacteria. The structures themselves have been algorithmically designed and produced using large-scale, high-resolution 3D printing technology.

The H.O.R.T.U.S. XL Astaxanthin.g was designed by [ecoLogicStudio](https://www.archdaily.com/tag/ecologicstudio) in collaboration with Innsbruck University - Synthetic Landscape Lab, CREATE Group / WASP Hub Denmark - University of Southern Denmark. In the installation, a digital algorithm simulates the growth of substratum inspired by coral morphology, which is digitally deposited by 3D printing machines. The photosynthetic bacteria is inoculated on a bio gel medium in triangular units (or “bio-pixels”), arranged to form hexagonal blocks of 18.5cm.

The whole site benefiting from daylight is the main priority of the design, so that the concept of returning to the source of energy would become more tangible, with efficient benefiting from the solar energy. The utilization of direct insolation and solar chimney effect led to the creation of a transparent slope on the site that ends to an air ventilation tower on the north east of the site. The air under the transparent slope would be heated due to the greenhouse effect and would rise to higher levels that is the air ventilation tower and move the electricity producing wind turbine. The whole external surface is also made from transparent photovoltaic panels that produce a considerable amount of electrical power.

Being Iconic needs to be in touch with collective unconscious, also the significant coordination with the climatic and cultural characteristics of the context, and the symbolic aspect, the form of the design would make a close connection with the profound identity of each person. The form of the tent has been an inspiration for design specially the interior space. Project being expanded in the horizontal axis and the entrances being located in all directions have led to the close connection of the building with all the complexes around.

A green public space on the ground level is the best way to engage the people in the project, because of the semitransparent Bio Cells in structure of the roof this space would benefit from an ambient illumination of the sun with green shade of light.

At the ground level also we have a shallow pool on the south side that provides a reflection of the sunlight on the ceiling to maintain more light for the photosynthetic bacteria inside of Bio cells.

This design tries to replace the common image of an environment polluting factory with a nice image of a sustainable powerhouse, with utilizing a static method which is suitable for the climatic condition and has the least intervention in the environment. Plants and the greenery in the underneath layer, refer to the life power of the complex whose chimneys send out oxygen (O2) instead of carbon dioxide (CO2), in contrast with the other traditional powerhouses. The circular movement of the blades of the wind turbine would lead to creation of a mental image for people: the appropriate utilization of natural energies would lead to production of clean energy and the clean energy producing buildings can be designed as symbolic and beautiful ones.

As any building that has remained in the history of architecture is a representative for the ideas and building technologies of its own time, using 3d printing technology would make the construction of an optimized integrated porous spatial structure possible, that while transmitting the load only by 4 foundation points on the corners of the site, makes considering optimized bio cells for faster growth of the Cyanobacteria possible (based on the H.O.R.T.U.S.XL project), in addition to emphasizing on necessity of a change in the construction technology in the future. Also, in this way, storing water in the pipes right underneath the greenhouse layer has become possible, so that the building would be able to function during the night by using the heat stored throughout the day.

Constructing the spatial structure of the project with the 3d printing method would also let us eliminate the CO2 emission in the construction stage by choosing the special modern material options (which are ever-developing), and use florescent and phosphorescent materials in the body of the structure (the ceiling of the public space), so that the building would be lit during the night without consuming any electricity.

As the modern day construction technologies are ever-developing, the transparent layer on the exterior surface of the building could be chosen from the lightest polymeric materials, and with utilizing carbon fiber pipes as its structure, we can 3d print the lightest iconic building ever, in the future green energy capital of the world.