Walking In the Fields of Gold

**Project Description**

The concept capturing solar energy and photovoltaics has been around since the turn of the 17th century. Despite its increasing presence in the energy production competition, it has yet to be explored more aesthetically. Due to its rigid characteristics, physical appearance and high cost, it is mostly installed in large buildings and infrastructural projects and seldom celebrated as a design element.

*Walking in the Fields of Gold* is an art installation that integrates solar, wind, kinetic energy harvesting on the project site in Mannheim, Germany. The modules integrate canopies overhead that will utilize a Dye-Sensitized Solar Cell (DSSC) fabric. This allows the textiles to have energy harvesting capabilities. DSSCs are categorized as thin-film solar cells that are integrated into a textile structure. The Fabric will also utilize the motion captured by the wind in order to harvest secondary additional kinetic energy. On the ground level, piezo electric pavers will harvest kinetic energy from visitors’ footsteps proactively immersing pedestrians in the sustainable art installation. Lastly, the installation would include modules that collect rainwater that can be filtered and used for the agricultural program on site. The infrastructure not only provides power to the agricultural infrastructure on site, but also its adjacent community.

The relatively new scientific application of Dye-sensitized solar cells (DSSCs) could broaden the application of photovoltaics. Benefits include low production cost, scalability and simplified manufacturing. DSSCs have hurdles to overcome before reaching commercial production. However, once hurdles are successful navigated, applications for DSSCs can have implication across various fields including fashion, infrastructure, healthcare and emergency shelters.

The site will have features of a public park, but it will also be a platform for agricultural program and education. *Walking in the Fields of Gold* will be a series of modular follies that populate the site. The remaining area of any unused landscape will be used as agricultural grounds for harvesting food for migrant farmers.

**Mannheim Site**

*Walking in the Fields of Gold* will span over two lots on the Mannheim Site. The lots are sub-divided into smaller plots that would better curate a human scaled experience. The sub-divided plots are divided into 15 meter wide agricultural strips land will host different fresh food for the public. Finally, the 5 meter by 5 meter modular art installation will be integrated into the agricultural landscape.

**Modular Design**

The structural grid of each module is 5 meters wide, by 5 meter deep, by 5 meters tall. Each module consists of wooden structural members, DSSC fabric, piezo-electric pavers and/or water collection modules. The three-dimensional grid layout allows the system to be expanded horizontally and vertically in order to meet the power needs of its adjacent community, or to take advantage of its natural environment.

*Walking in the Fields of Gold* is comprised of various modular compositions that correlate to the universal battery sizes. “AAA” is the smallest composition and is comprised of four to six DSSC fabric modules and generates between 12.5 kWatt to 18.7 kWatt. The “AA” is comprised of 12 to 24 DSSC fabric modules and generates between 18.7 kWatt to 74.8 kWatt, it contains eight water modules. The “C” is comprised of about 30 DSSC fabric modules and generates roughly 93.5 kWatt, it also contains 16 water modules. The “D” is comprised of 52 DSSC fabric modules and generates 162.1 kWatt, It also contains 8 water modules.

**Technology**

The overhead canopies will be lightweight, flexible, and low-cost DSSC textile coated in polymethyl methacrylate (PMMA) for weather protection. The DSSC substrate will utilize a kinetic textile consisting of conductive multi-walled carbon nanotubes/polyethylene terephthalate (MWCNTs/PET) wires (7) allowing it to have weather protective, but structural resilience. The battery would also be integrated into the fabric so the need for a centralized battery location would be removed. The textile weaving process can be divided into three steps: battery textile weaving, photovoltaic textile weaving, and encapsulation-layer coating (PMMA).

On the ground floor paved walk ways are designed to capture kinetic motion use piezo electric panels that are commercially available.

Water collection modules would consist of a hydrophobic surface that would be piped to tanks that would use underground irrigation to provide water for the on-site agriculture.

**Efficiency and Energy Production**

*DSSC Fabric (Solar Energy)*

10% Efficiency of DSSC’s photovoltaic property (4)

1075 watt / square meter (2) (3)

1075 watt/ square meter \* 29 Square meter per unit = 29,000 watt per unit \*10%

=3117.5 watt per unit \* 404 units =1,259,470 watt or 1,259 kWatt

1259 kWatt \* 2000 hours of sun2=2,518,940 kilo watt per year or

2,519 Mega Watt per year

*Piezo Electric Pavers*

5 watts per step on a single paver \* 3,576 paver on site =17,880 watts (assuming all visitors are step experience the whole installation)

80% efficiency= 14,304 watts (1)

14,304\*(1/3600 hour) = 3.97 watt hour

1,000,000 visitors per year (5) (Based on visitors to Luisenpark Mannheim)

3.97 watt hour per step \*1,000,000 visitors = 3,973,333 watt hour or 3.97 Megawatt hour

*Total MWh provided annually*

**2250+3.97=2,523 Megawatt hour annually**

*Based on 2018 statistics 18,147 kilowatt hour were consumed per single family household in Germany, the power provided by this installation would provide power for roughly 140 homes.*

*Water Harvest*

2800 sq. meter of water modules

Average 725 liters per square meter per year (3)

=2800 sq. meter \* 725 sq meter per year = **2,030,000 liter per year**

**UN Initiative (6)**

*Affordable and Clean Energy*

The proposed project can provide affordable, sustainable and modern clean energy to its local community. Due to its relatively ease of construction it can also be installed in remote locations or places that need temporary shelter. The modular design also allows the infrastructure to be de-centralized and installed in private homes all the way to the infrastructural scale of the farm.

*Zero Hunger*

While the main crux of the project is to provide clean affordable energy. The site on Manheim can go beyond the program of a public park. It can be a platform for education and agriculture. It can also be a platform where affordable, sustainable food can be harvested. By revisiting how public parks can serve on the agricultural front, the world can make progress towards sustainable food security.

*Industry, Innovation and Infrastructure*

According to the UN reports, medium-high and high technology manufacturing productions were least impacted by the global crises, such as the pandemic. By building in such a way that would facilitate a demand for medium-high technology product, a resilient infrastructure can be built to promote inclusive and sustainable industrialization. This will foster innovation for higher efficiencies and product improvement.

*Sustainable Cities and Communities*

By integrating projects such as *Walking in the Fields of Gold*, it would not only democratize the public park experience, but access to food as well. Cities would be made to be more resilient, sustainable and inclusive.

*Climate Action*

Integrating energy producing technology will combat climate change in a bottom-up fashion from the local communities. With improvements to green energy technology, installations such as *Walking in the Fields of Gold* will increase the net energy surplus it provides to its community.

**Environmental Impact Summary**

*Walking in the Fields of Gold* utilizes technology that allows its textile to harvest energy from solar and wind energy in its canopy. The textile is created from DSSC technology which has relatively low financial cost compared to the silicon-based alternative. In addition to the financial cost difference, an argument can be made that silicon-based photovoltaics have a high sustainability ‘payback’ period. This is due to the environmental impact that is attributed to its manufacturing process.

Additionally, the piezo-electric panels and the ground floor will harvest kinetic energy from pedestrian footsteps. Finally, installation will feature an infrastructure that collects rainwater for agricultural irrigation.

The modular design allows off-site prefabrication and the system to be expanded in order to meet the power needs of its adjacent community, or to take advantage of its natural environment. Due to its relatively ease of construction it can also be installed in remote locations or places that need temporary shelter.

The proposed project can provide affordable, sustainable and modern clean energy to its local community.

**Work Cited**

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