**Rapid Deployment of an Energy-Producing and Sustainable Construction Material**

With massive energy demands on our cities and towns, existing surfaces of our built environment fail to meet and utilize potential energy-producing technologies. Existing solar arrays on roofs are rarely removed from the architecture of our daily lives, require clumsy equipment that is neither integrated nor aesthetically considered, and demand costly assembly processes which can only be installed by skilled experts.

There exists a need for smarter architecturally integrated materials that can provide affordable energy for our buildings, be easily assembled and displayed by anyone in the community, be modular and exist at multiple scales, and simplify and reduce the manufacturing process of photovoltaic systems.

This project investigates the design and development of a new, powered by their walls. A solar panel is applied on the tilted face. The aluminum case along with the attached solar panel is slid over a concrete block. The front of the aluminum case is tilted at a specific optimized angle depending on the geographic location. The perforations allow ventilation to cool the wall and reduce the heat build-up inside. PV performance decreases dramatically when the PV cells heat up. This perforated method effectively prevents this energy loss.

Utilizing software called DIVA, solar irradiation simulations tested configurations of the wall at specific times of the year in various geographical locations. Informed decisions as to how to optimally angle the wall unit during the manufacturing process were made from these tests.

**Manufacturing**

The wall is composed of a reinforced concrete block and a high-tensile perforated aluminum shell. The wall was fabricated from one flat panel then folded to create its form. The scalable manufacturing process reduces cost, labor, waste, and time by enabling each unit to be fabricated from one flat panel. The unit is recyclable, and its simplicity enables it to be manufactured by a wide variety of unskilled and skilled workers. The process also takes advantage of the material’s properties. The metal shell is durable, easily folded, perforated and serves as the finished exterior skin of a building or shelter. The perforations allow ventilation to cool the wall and reduce the heat build-up inside. PV performance decreases dramatically when the PV cells heat up. This perforated method effectively prevents this energy loss.

**Assembly**

This next generation building material comprises a battery, an inverter, an outlet, and wiring located within a folded aluminum case. The front of the aluminum case is tilted at a specific optimized angle depending on the geographic location. A solar panel is applied on the tilted face. The aluminum case along with the attached solar panel is slid over a traditional concrete block measuring 16" x 8" x 8" and together becomes an integrated PV unit.

**Application**

Unoccupied urban spaces can be reinvigorated by charging walls that allow individuals to stop for a quick power-up. Walls become the power plant. The PV units provide remote villages in developing countries with a quick deployment strategy for constructing and energizing communities. Essential appliances like lighting and ovens can easily be powered by the material that the village homes are made of. Additionally, large retail and industrial buildings are typically constructed with black masonry. These oversized buildings generate high energy demands and require significant operating costs. The PV units can easily be integrated with the construction of these large spaces and help offset the high operating costs.

Prototypes were manufactured and a wall was constructed. The PV units were placed over concrete blocks and the wall was quickly assembled like traditional masonry construction. The wall was monitored and data was collected to track and record its performance.