POWER GRID

**Description**

POWER GRID hearkens back to the natural phenomena that kept our climate in harmony before human intervention, creating a simple yet profound refuge of trees amongst the high-tech buildings and infrastructure of Masdar City. 536 drought resistant Ghaf Trees, the national tree of the U.A.E., are planted in a simple hypostyle grid, inspired by traditional mosque architecture, and on axis with the nearby solar farm’s panels. Each tree passively sequesters carbon, attracts fauna, and contributes to a shady, cool, microclimate. The trees are inexpensive, and forgo the embodied energy of heavily processed, man-made materials.

POWER GRID contributes to the UAE’s extensive initiatives to replant native tree species, including the goal of planting one million trees in advance of hosting World Expo 2020. In addition, the Ghaf has been named the symbol of the 2019 “Year of Tolerance” in the UAE. The trees can thrive on little water, including the brackish groundwater in the area of Masdar City. Supplemental irrigation will be provided from greywater from the city, dispersed through plant cocoons placed at the base of the trees, slowly and efficiently releasing the water. Each tree will grow to approximately 4.5 to 6 meters in height, and the hypostyle grid places the trees at 6 meters on center in order to provide sufficient space for the mature trees’ canopies.

The proposal emphasizes the passive benefits of trees versus over-engineered and carbon intensive construction. An array of simple sensors, powered by low voltage derived from the trees themselves, tracks each tree’s growth and environmental contributions, including their growth rates, carbon sequestration, transpiration, attraction of native fauna, local cooling effects, and contribution to healthy soil chemistry. These data are displayed in real time on trees within the site itself, and at other key locations throughout the city, encouraging us to pause and reflect upon what we can learn from nature in our efforts to become more responsible inhabitants of the planet. As visitors explore the site, small displays strapped to the trees will show them how much carbon each tree has removed from the environment, as well as the collective effects of the entire array. Motion-activated cameras capture the activity of local fauna attracted to the trees as a living habitat and source of sustenance.

Photosynthesis is naturally a deeply efficient process, and research has found that the excess energy from photosynthesis goes into the soil around the roots of the plants in the form of sugars, which are then broken down by bacteria, releasing electrons in the process.  This process generates electricity both day and night, no matter the weather, as it is not directly dependent on the sun nor wind. Recent research has proven that these electrons can then be gathered by electrodes in the soil resulting in conservatively 0.1 watt per square meter of planting, yielding a 2 kW nameplate power capacity. Assuming approximately 50% efficiency, the trees would yield over 8,000 kWh of energy annually.

While this may not be enough to power significant parts of the city, it creates a sustainable, renewable source of electricity that would be more than sufficient to power the sensors monitoring the trees and the surrounding environment. Any additional power would be used for site lighting and the minimal irrigation system. In the spirit of experimentation and research at Masdar City, the site will also serve as a testing ground for other emerging methods to generate electricity from trees, including electromechanical generation through the trees’ movements, and nanotechnology to directly tie into photosynthesis at the trees’ leaves.

At approximately $10 USD per Ghaf tree planted, with $100 provided for the sensor infrastructure and irrigation device at each tree, the entire POWER GRID would require a budget of approximately $60,000, an extremely affordable cost given the benefits to the environment and the city.

POWER GRID envisions this key site in Masdar City not as a bombastic and grandiose entry into the city, but as a simple and contemplative natural refuge. The urban oasis reminds visitors that sometimes the best way to prevent harming our climate is to respect the beauty and wisdom of natural processes.

Environmental Impact

We expect the proposal to have little-to-no adverse effects on the local environment. In fact, the trees will provide habitat and food to native species, and improve the health and stability of the soil in the area. Ghaf trees are evergreens, and their leaves are a well known source of fodder for desert fauna. There is some risk that this density of trees would deplete groundwater reserves in the area, but supplemental irrigation would be provided so as to mitigate the issue. The deep root networks of the trees might interfere with nearby building foundations and underground infrastructure, so careful coordination would be required while designing the adjacent areas of Masdar City. Soil excavated during the planting of the trees could be reused for landscaping elsewhere in the city, reducing the environmental impacts of its transportation and disposal.