**PROJECT TITLE: Living Laboratory for Community Education of Solar Energy**

**I. PROJECT STATEMENT**

Climate change is the greatest threat facing humanity today. The rapid increase in atmospheric CO2 levels is a result of fossil fuel based energy sources. Energy consumption in homes is becoming a dominant component of our energy consumption. According to the Energy Information Agency of the DOE, American homes consumed 9,114 trillion Btu of energy in 2015. Reducing home energy consumption will be an important step towards meeting state and national limits on greenhouse gas emission reduction and moving towards clean energy.

This proposal is intended to create a showcase of solar power and battery technologies which will serve to educate students, homeowners and the general public about clean energy, home energy use, and energy efficiency. We plan to partner with a fraternity at the University of Minnesota Campus and to use their residence as the location for implementing all the technologies mentioned above.

The three-year project will begin with identifying the energy consumption patterns, conducting an energy audit, and deploying sensors to determine electrical power use of various appliances. Next, a rooftop solar photovoltaic system will be installed. Recognizing that the variable nature of renewables needs storage, a battery system will also be installed (Tesla Power-Wall or equivalent).

The entire process of implementing these changes will be documented in detail on a website, along with video clips, articles, photos, and raw data as well. A “before-and-after” comparison will also be made to show the effects of all these interventions. The fraternity will periodically invite school students to visit and experience all these technologies first hand. They will also hold periodic “open-house” sessions where members of the public can visit, and learn about rooftop solar power and batteries for its technical, economic and societal aspects. Also, there will be an indoor LED-powered setup to grow herbs and vegetables for the fraternity kitchen.

Finally, all of the material generated will be developed into modules with the help of the five high schools science teachers who have adopted our course (z.umn.edu/ee1701) for teaching in their schools under the College in the Schools program of the University of Minnesota. The material will be included in their own classroom curriculum and will also be available to anyone else, free of charge and free of copyright to be used in any educational program.

If approved, this project would be the first of its kind to create a “real,” living and live-in showcase of solar and battery powered residence that will encourage Minnesotans to make changes in their own homes to reduce their carbon footprint and improve their energy efficiency.

**II. PROJECT ACTIVITIES AND OUTCOMES**

|  |  |  |  |
| --- | --- | --- | --- |
| **Activity 1:** *Acquiring home, conducting energy use studies – “Before” phase*  **ENRTF BUDGET: $ 30,000** |  | | |
| **Outcome** | | **Completion Date** |
| *1. Liaison with fraternities and identify building to be used* | | *Sept 2020* |
| *2. Conduct Energy use audit, deploy sensors* | | *Dec 2020* |
| *3. Create a website and begin documentation* | | *Dec 2020* |
| **Activity 2:** *Install Rooftop PV and Battery Storage Systems*  **ENRTF BUDGET: $161,100** |  | | |
| **Outcome** | | **Completion Date** |
| *1. Design and install a rooftop PV system based on energy use data* | | *Sep 2021* |
| *2. LED setup for growing vegetables indoor* | | *Sep 2021* |
| *3. Install Batteries* | | *Sept 2022* |
| *4. Conduct “open-house” to disseminate the results and get feedback* | | *June 2023* |

**III. PROJECT PARTNERS:**

**A. Partners receiving ENRTF funding**

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Title** | **Affiliation** | **Role** |
| **Prof. Ned Mohan** | **Professor of ECE** | **University of Minnesota** | **Lead-PI** |
| **Prof. Paul Imbertson** | **Professor of ECE** | **University of Minnesota** | **Co-PI** |

**B. Partners NOT receiving ENRTF funding**

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Title** | **Affiliation** | **Role** |
| **N/A** | **-** | **-** | **-** |

**IV. LONG-TERM- IMPLEMENTATION AND FUNDING:**

**The Plan for this proposal implementation is as follows:**

**Year 1:**

1. Identify a fraternity house having a roof with southern unobstructed exposure for locating PV panels. This partner fraternity will agree to allow the energy efficiency improvements to be made and will make their premises open for open-house and informational sessions as described in the proposal.
2. Prior to any interventions, monitor all energy consumption including some summer and winter months.
3. Set up sensing, measurement and data logging equipment to record energy use, temperature, heating, cooling, etc.
4. Conduct energy audit with the help of the home energy squad and identify the need for improved insulation, etc
5. Create a data management plan and create a website and online repository to start collecting and curating all the collected data

**Year 2:**

1. Design rooftop PV system sizing based on energy use findings and install rooftop PV system.
2. Replace the existing incandescent and CFL lamps by energy-efficient dimmable LEDs.
3. Identify and install an in-home battery storage system
4. Install LEDs to grow vegetables and herbs indoors

**Year 3:**

1. Continue to monitor all energy usage and efficiency.
2. Document the changes in energy use as a result of each intervention and document the same on the website, along with the cost, and impact on the energy bill.
3. Conduct open-house and hold workshops to disseminate the results. Create modules for use in high school and university courses.

This project will continue beyond the three-year project funding as the living laboratory, for education in the University of Minnesota courses and courses at various high schools. The same will be true of the “open houses” for community education.

We are confident that one of the fraternities we contact will agree to participate because of their reduced electricity bill. In exchange, however, they have to agree to make their fraternity available to students and community visitors. Beyond the three-year funding of the project by LLCMR, the maintenance of the website will be performed by students in the EE1701/1703 course as their assigned tasks, in collaboration with the members of the chosen fraternity.