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Government of India

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MILLENNIUM ALLIANCE
Inspiring Innovation. Sharing Solutions.

cygni

CYGNI is attempting to solve one of the world's largest infrastructural challenges today by providing households with reliable, affordable, and cost-efficient power. One of their innovations is an Inverter-less solution, developed in collaboration with IIT Madras, which could be a game-changer and has the potential to light up homes with no access to electricity or limited access. This particular innovation was awarded by Millennium Alliance in Round 5 for further development. Peri-urban, rural, and other areas with no or near-off-grid conditions are their target markets. Power for all, 24 hours a day, 7 days a week, is a joint project of the Government of India (GoI) and state governments with the intention of providing power to all households, factories, commercial enterprises, and public needs at all times. Through their Innovative Solar-DC micro grid solution, CYGNI is attempting to contribute to the program's progress. CYGNI is on a quest to “Power a Billion Dreams” by developing new solar technologies focused on innovation and technology.

In India, of the 60 million homes (about 30 percent households) are off-grid. Another 30-40 million homes are near off-grid, where the power availability is intermittent. India's total domestic consumption is 200 TWh (terra-watt hours) per year for 1.25 billion people (an average of ~500 Wh/day per person). Average power consumption for grid-connected homes is 4 kWh per day as 33 percent homes do not have power. Lower-income homes consume less than 1000 Wh per day. CYGNI has been working on developing devices that enable the implementation of the Solar-DC Technology as well as on certain devices that work on 48V DC

CYGNI has developed several products to combat the mentioned issues in the following 3 technological areas:.

“Sustainable energy is the golden thread that connects economic growth, increased social equity and an environment that allows the world to thrive.”

- Inverter-less Solar-DC 48V Solution for off-grid and near off-grid homes.
- Inverter-less Solar-DC solution for Offices and Commercial complexes.
- Uninterrupted DC (UDC) solution.

Millennium Alliance Grant

Millennium Alliance grant (Round 5) was awarded to CYGNI Energy for its development of reliable, affordable and cost-efficient inverter-less Solar-DC solution for off-grid and near off-grid homes. The funding was categorized as Stage 1 funding, which implies that CYGNI's innovation was going through trials in order to finalize concept. With MA support, CYGNI launched a pilot in one district in Bihar which they later expanded to other geographies. The total amount given to CYGNI is Rs. 30,00,000.Millennium Alliance grant (Round 5) was awarded to CYGNI Energy for its development of reliable, affordable and cost-efficient inverter-less Solar-DC solution for off-grid and near off-grid homes. The funding was categorized as Stage 1 funding, which implies that CYGNI's innovation was going through trials in order to finalize concept. With MA support, CYGNI launched a pilot in one district in Bihar which they later expanded to other geographies. The total amount given to CYGNI is Rs. 30,00,000.

The Innovation

A microgrid is a power cluster composed of distributed generation, load, and energy storage devices that are clustered together in close proximity to one another. It allows for the use of renewable energy sources to create a green and clean environment. Power transmission losses are reduced since the Distributed Energy Resources (DERs) are located close to the load. DC is the production of DERs including solar panels and fuel cells. DC power can be generated using power electronics equipment in the case of wind power. A Direct Current Microgrid is created by connecting the DC terminals to electronic loads, electric vehicles, and batteries.

The grid is a system that links households, businesses, and other structures to centralized power sources, allowing us to use appliances, heating/cooling systems, and electronics. However, because of this interconnectedness, when a section of the grid has to be fixed, it affects everybody. A microgrid can aid in this situation. A microgrid normally works when connected to the grid, but it can also detach and function independently using local energy generation in times of crisis, such as storms or power outages. Distributed generators, batteries, and/or renewable resources such as solar panels may all be used to power a microgrid. A microgrid could run indefinitely depending on how it is fueled and how its requirements are managed.

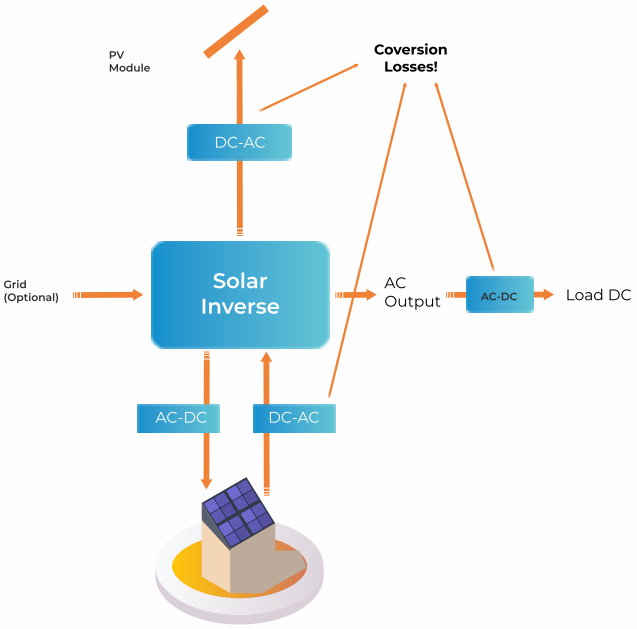
Initially, the energy was absorbed by a solar panel, which was connected to a solar invertor, which converted direct current to alternating current. Solar energy can only be directly harnessed for 8 hours a day, so if you need power during the non-solar hours, you'll need a battery. To charge the phone, any battery-based backup, also known as a backup charger, converts AC to DC. Similarly, an inverter converts DC energy stored to AC and supplies electricity to the appliances.

The majority of household appliances are now wired to energy-efficient DC appliances. Since the world runs on grid power, AC, and all distributed generation happens on DC, most appliances convert AC to DC or vice versa. DC is used for both storage and use.

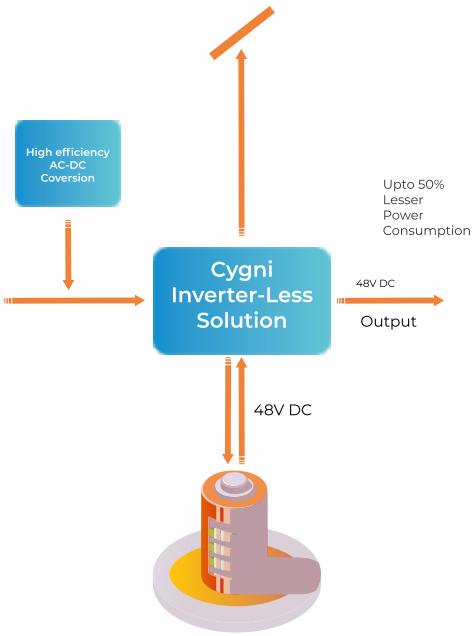
Due to this, CYGNI aimed to avoid all the unnecessary conversions and bring up a high efficiency solution i.e., inverter-less technology which connects directly to the solar panel, connected to battery which is an efficient lithium-ion battery and powers directly to DC. With this innovation they were able to save around 40-50 percent of energy which was earlier lost due to conversion

1- CYGNI Inverter-less system with Integrated Lithium-Ion battery, an intelligent solar charge controller, Communication via Bluetooth and GPRS, and optional AC input and output. Highly configurable system which can be customized based on the requirement

INVERTERLESS TECHNOLOGY



Solar Inverters



Cygni Inverterless

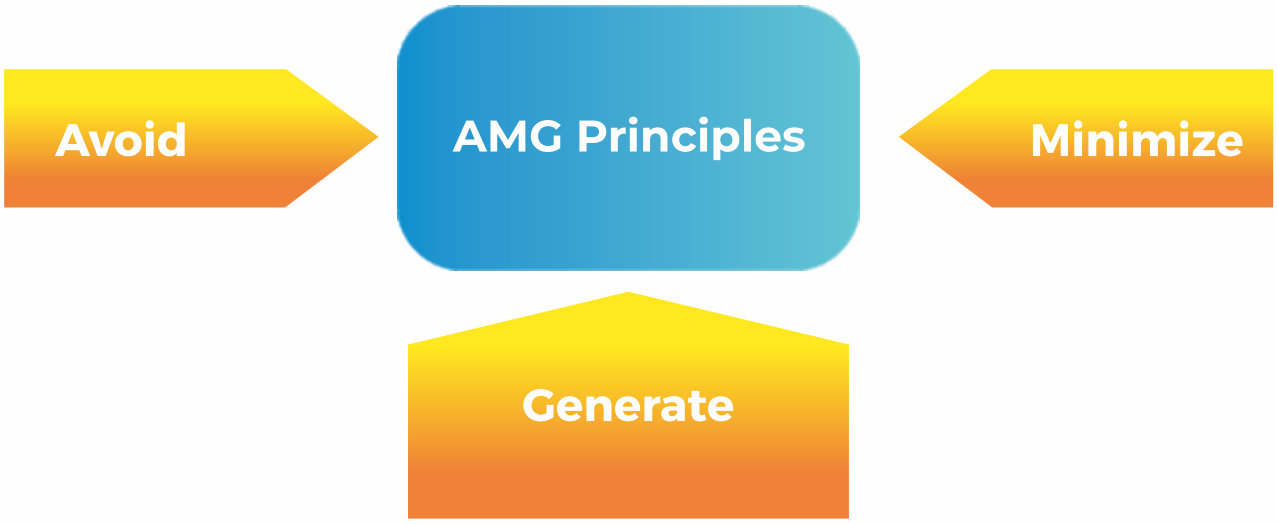
Impact
Environment

The system sequesters around 1 kg carbon equivalent per day. With all the installations done till day, they have sequestered around 17,500 tonnes of carbon equivalent per year. If a solar plant has a life of 20 years, then it sequesters around 3,50,000 tonnes of carbon dioxide equivalent which the company believes is one of their biggest contributions for the environment and climate change.

Reduction	Co2 sequestered
GHG reduction per day	1kg
GHG reduction per year	350 kg
GHG reduction for 50,000 homes per year	17500 Tonnes
GHG reduction for 20 years	3,50,000 Tonnes

CYGNI's use of energy further contributes positively to the environment. The benefits come in two folds; one being use of renewable energy which is avoiding the use of fossil fuels. The second benefit is through energy efficiency where they follow the AMG principle i.e:-

- A – Avoid wherever possible.
- M - Minimize the generation. For example- using LEDs
- G - Generate i.e., wherever one cannot avoid and minimize, then the energy generated should be based on renewable energy. Thus, using renewable energy and focusing on energy efficiency is beneficial to the environment

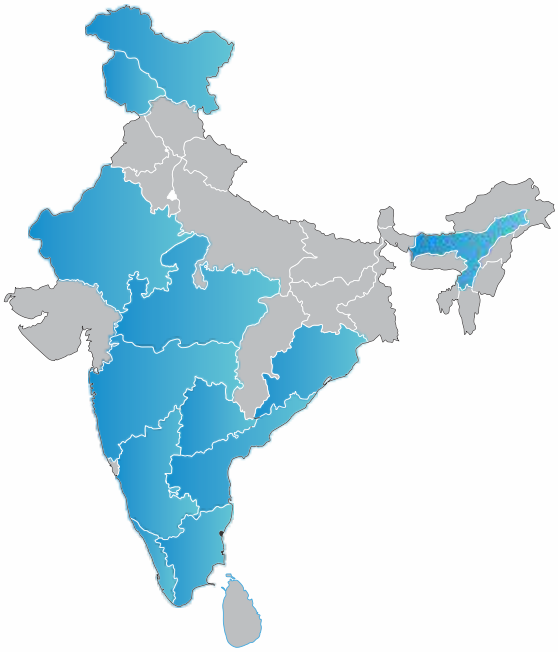


Employment

There are two types of employment generated by CYGNI- direct and indirect employment. There are more than 100 employees benefitting from direct employment, who are working on the design, development, technology management, manufacturing and installation of the innovation. Indirect employment is generated through the 75-80 channel partners who are placed all over India, from North-East to Rajasthan, Delhi-NCR to Southern states as well. They are ones who take Cygni's products and install them in project areas, and maintain them in those regions. This activity generates employment for about 400-500 people (direct and indirect employment). The duration of the indirect employment depends upon the length of the project itself. The organization sources local manpower to install and maintain their innovation in households.

Reach

CYGNI is currently present in eleven states in India, to work in areas where there was no supply or limited supply of grid power. Thus, the regions they chose include J&K, desert regions of Jaisalmer, and Phalodi in Rajasthan- among others.



States Covered	11
Villages Electrified	846
Home Powered	>40,000
Beneficiarires	>2,00,000
DC Capacity Installed	>11,000

States	Benegiciaries Covered
Assam	1,00,000
Rajasthan	20,000
Manipur	24,000
Jammu and Kashmir	28,000
Karnataka	7,000
Telangana	12,000

They wish to cover households in villages, and semi-urban settings, which currently lack energy. As per the SDG 7 (Affordable and Clean Energy), there are five tiers of measuring energy access. Tier 0 implies no energy in the house at all, whereas tier 5 implies that there is enough energy generated for the household to run a few appliances, in a few rooms for 23 hours.

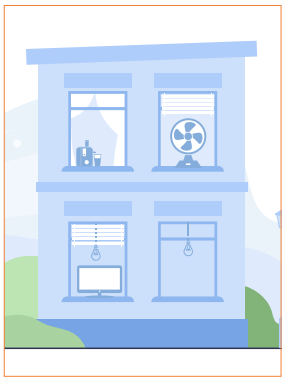
Multi-Tier Framework (MTF) redefines energy access as "the right to avail energy that is sufficient, available when needed, reliable, of good quality, convenient, affordable, legal, healthy, and safe for all essential energy services" rather than a binary count. That is, under the current definition, having an electricity link does not inherently imply having access to electricity, which often recognizes other factors such as efficiency and affordability. Energy access is rated on a five-tiered scale, with Tier 0 (no access) being the lowest and Tier 5 being the highest (the highest level of access) CYGNI believes that the households they have provided energy to now fall between tier 3 and tier 4, and some have even achieved tier 5

Measuring energy access: the multi-tiers

Tier 0

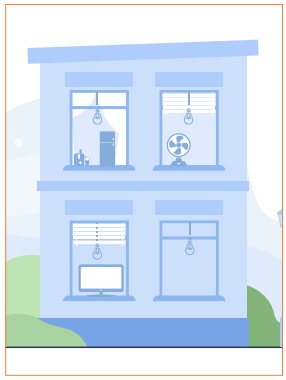
Tier 1
4 Hrs

Tier 2
4 Hrs



Tier 3
8 Hrs

Tier 4
16 Hrs



Tier 5
23 Hrs

Improving attributes of energy supply leads to higher toers of access.

They have directly benefitted about 2.5 lakh individuals, and have indirectly benefitted countless more individuals through providing energy to schools, primary health care centers, agricultural pumps etc. The beneficiaries do not pay any upfront capital cost, but only pay for the installation and upkeep of the innovation. Every year, a small amount of money is collected from the beneficiaries, which is used for the maintenance of the devices.

Indirect Impact

CYGNI's innovation has also had indirect impacts around the country. Women in rural villages are able to cook without chullas and other smoke-emitting devices which are usually detrimental for their health. Children are able to concentrate and study better as there is proper ventilation inside classes through the use of fans, which leads to lower absenteeism, and an increased enthusiasm to learn. Local shops also have an extended productivity time as they don't rely on daylight, and thus leads to greater income generation for them.

An experience which touched the CYGNI team was when an elderly gentleman of 101 years requested the team to meet him in his village. The man was extremly grateful to CYGNI, as due to their intervention, he had seen power in homes for thr first time. He narrated how his daily life usually came to a stop when the sun would set, but with CYGNI`s innovation, he would not need to rely on the day light as much as he had his entire life.

Influencing Goverment Policy

CYGNI has also managed to influence policy at the government level as well. In 2017, the government came up with a policy, “Guidelines for solar DC System for off-grid connected applications”, which was brought up by the Ministry of New and Renewable Energy (MNRE). The ministry had constituted an expert committee, which concluded that for both grid and off-grid system, DC systems are far superior in terms of technology and efficiency. For the development of the AC and DC micro grids, it was stated that the Bureau of Indian Standards (BIS) standard that CYGNI had brought was going to be followed.

The government also formulated another policy on the isolated off-grid solar plants in July, 2020 under MNRE. Due to the CYGNI, the government incorporated the following aspects:

- DC Appliances are more efficient and therefore, wherever possible the plant should be designed for using DC appliances only and in such cases applicable Low Voltage Direct Current (LVDC) standards specified by BIS should be followed.
- The MNRE/BIS specifications to be used for all system components.
- Only indigenous components should be used in the solar power plant.

Partnerships and Funding

CYGNI has a strong set of partnerships. They have received international recognition through the 'Greater Good Award' for their microgrid in San Diego, 2019. They also got an IEEE 'Empower a Billion' program affiliation. They have worked closely with India's Smart Grid Forum and Green Energy Council. CYGNI is the first company to be recognized under the Prime Minister's 'Start-Up India Program' and all the products are under 'Make in India' and 'Aatma Nirbhar Bharat'. Millennium Alliance played a big role in developing and outreach of their innovations which has led them to get partnerships. The company was able to participate in the 'Indo-Swedish' program.

S. No.	Partner	Grant Received	Year	Remarks
1.	Infineon-IITMIC	18 Lakhs	2020	Power Backup for Ventilator & isolation homes in off-grid and weak-grid areas for COVID-I9 patients
2.	IEEE Empower a Billion Lives	US $2000	2019	IEEE Empower a Billion Lives Competition
3.	Microgrid knowledge	Trip to San Diego, USA	2019	Greater Good Award for Microgrid 2019
4.	Start-up India Award	Trip to San Diego, USA	2020	Finalist under the Energy Category
5.	TiE50 Award Winner at TiEcon	Award	2019	Winner in the "Growth" category.

Future Plans

After the onset of the pandemic, the ventilator was a critical requirement. The company realized that the ventilators used required backup for running of the devices, and thus they used their innovation to power the medical devices as well. It got recognition under the Government of India 'Agni Scheme'. They did this in the state of Jharkhand in Nav Jeevan hospital which was a COVID isolation center. The project is funded by Infineon and Incubation Cell of IIT Madras. Earlier with the inverterless innovation, one could only charge phones, power fans and lights but now it can power ventilators and other higher power devices.

CYGNI plans to expand to other areas in the future as well, including lithium-ion battery packs for electronic vehicles. The innovation that is funded by Millennium Alliance can help in powering two wheelers and three wheelers.