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सत्यमेव जयते

Ministry of New and Renewable Energy
Government of India

Renewable Energy Akshay Urja

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The National Solar Mission

India Marching Ahead in Solar Energy

JUNE 2016

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Renewable Energy
Akshay Urja

COVER PHOTOGRAPH

The first Solar Park of India at Charanka, district Patan, Gujarat of 590 MW designed capacity. At present, 350 MW has already been commissioned. The solar electricity is being purchased at ₹4.50 per kWh. Another 240 MW is under installation by the Solar Energy Corporation of India.

Courtesy: GPCL, Charanka Solar Park

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Energy is the most important of infrastructural requirements and uninterrupted supply of energy is essential for development. In this article, **Onkar Nath** talks about how electricity supply from micro-hydro power projects has shaped economic development in remote regions of Uttarakhand.

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In this case study, **Dr Ashok Das** discusses the innovative Smart Village Nanogrid™ solution and their pilot village in Chhotkei, Odisha. He highlights that SunMoksha has invested years of effort to closely understand the challenges of energy access and has developed a holistic solution with a 'systems' approach to address these challenges.

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This success story article discusses about the implementation of solar thermal systems in Kargil under the 'Ladakh Renewable Energy Initiative' scheme of the MNRE. It also highlights the Ladakh Renewable Energy Initiative by the LREDA in Leh, Ladakh.

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सत्यमेव जयते
उपेन्द्र त्रिपाठी
Upendra Tripathy

सचिव
भारत सरकार
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SECRETARY
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MINISTRY OF NEW AND RENEWABLE ENERGY

MESSAGE

Starting with the 'Charanka Solar Park' in Gujarat, and closely followed by the 'Bhadla Solar Park–Phase I' in Rajasthan, solar parks have gradually emerged as a powerful instrument for the rapid development of solar power projects in the country. Charanka Solar Park in Gujarat is the first-of-its-kind large scale solar park in India with contiguous developed land, transmission connectivity, and provision of other amenities and infrastructure. The MNRE has rolled out scheme plans to set up solar parks in the country, each with a capacity of 500 MW and above; thereby targeting around 20,000 MW of solar power installed capacity. Smaller solar parks are also considered in Himalayan and other hilly States where contiguous land may be difficult to acquire and States where there is acute shortage of non-agricultural land. Under the scheme, 33 solar parks with a total aggregate capacity of 20,000 MW capacity have been sanctioned in 21 States so far. The solar parks in the country enable the States to meet their solar targets and renewable purchase obligations. In addition, the clean power generated by these solar projects play a vital role in reducing India's carbon footprint, promoting high-end technical investments and empowering local communities. Solar parks have also attracted many foreign investors.

The renewable energy sector has gained tremendous momentum over the last two years due to the announcement of conducive policies, national tariff policy with provision of 8 per cent for renewable purchase obligations (RPOs) to come from solar by 2022, boost to solar rooftops with a provision of ₹5,000 crore, and enhancement in the overall target to about five folds. Various States in India are playing a vital role to promote renewable energy in their respective areas and today 17 States have exclusive policy for solar energy and 26 States/ Union Territories (UTs) have announced net metering policies for solar rooftops.

I am very glad to interact with you all through *Akshay Urja* magazine and I seek your valuable suggestions for promoting renewable energy in the country. I am very sure and optimistic that *Akshay Urja* is fulfilling its role by creating awareness and motivation amongst all our fellow countrymen to support the use of renewable energy as much as possible, even in their daily lives. I would urge upon our readers to adopt at least one device/system that utilizes renewable energy in their daily life and, therefore, contribute towards mitigation of greenhouse gas (GHG) emissions.

With best wishes!

Upendra Tripathy
Secretary

अक्षय ऊर्जा से देश विकास
सूरज एक रूप अनेक

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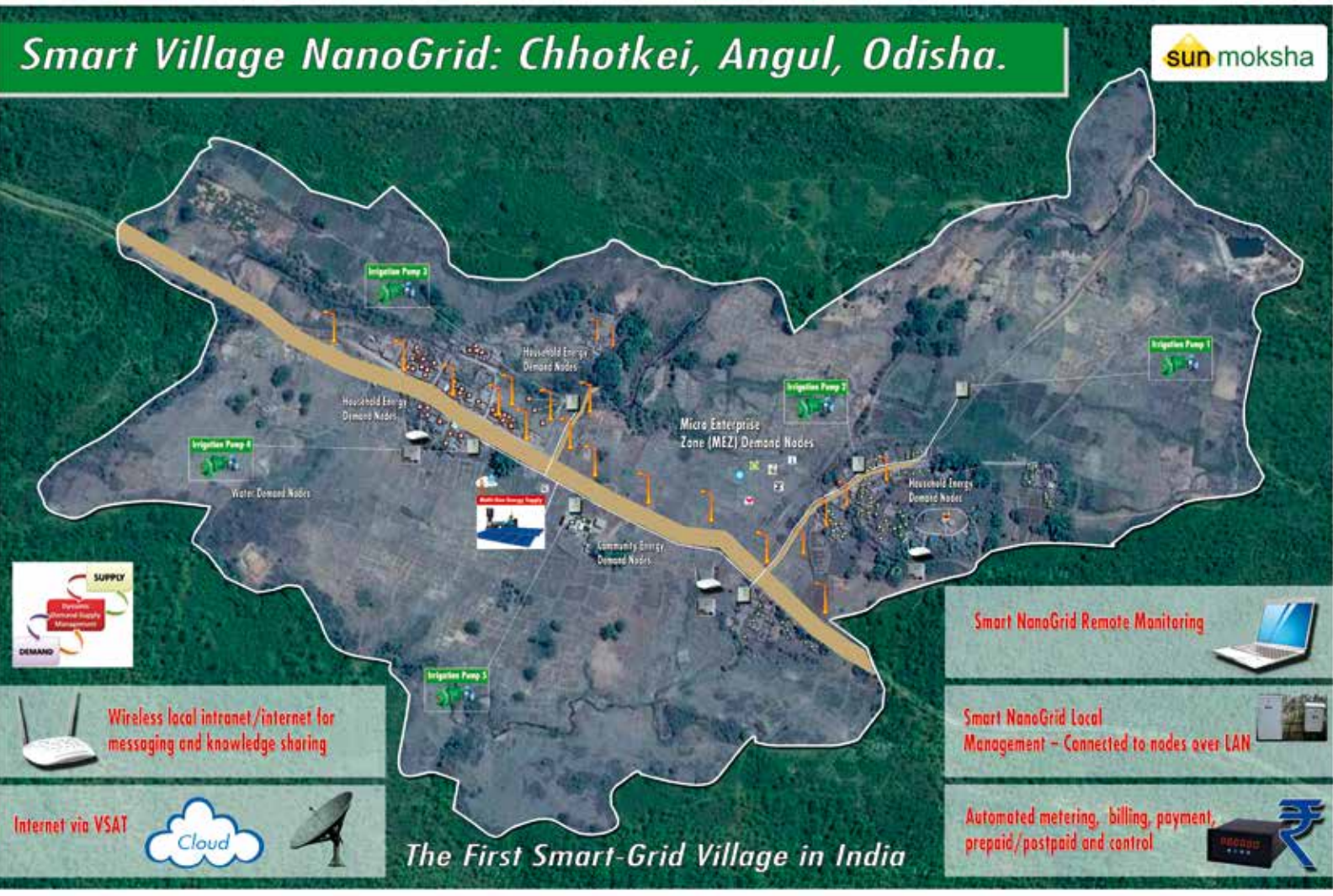
Smart Village Nanogrid

Energizing Rural Hinterland

In this case study, **Dr Ashok Das** discusses the innovative *Smart Village Nanogrid*™ solution and their pilot village in Chhotkei, Odisha. He highlights that SunMoksha has invested years of effort to closely understand the challenges of energy access and has developed a holistic solution with a 'systems' approach to address these challenges.



Challenges of Smart Village Energy Access

A comprehensive definition of an ideal village was proposed by Late Dr APJ Kalam as 'PURA' village for provisioning urban amenities for rural areas. A smart village builds around the vision of PURA. In our view, a smart village addresses the elements of PURA through both 'hard' interventions, such as agricultural improvement, energy sufficiency, rural industry and locally relevant livelihood, water and waste management, and improved digital connectivity, as well as 'soft' interventions, such as good governance, better public health services, sanitation, civic services, education and skill development, along with climate change adaptation. A smart village must also move the villagers up the value chain to improve socio-economic status of the citizens.

India's rural economy revolves around agriculture; however, it most often does not fetch them enough earnings. Serious efforts need to be made in moving the farmers up the value chain. We must establish local 'micro-enterprise zones (MEZs)' for agro and/or non-agro livelihood activities. It will improve the economic status of the rural populace, leading to 'Gram Swaraj'. Creation of livelihood and enterprise activities through sustainable resources will, in turn, reduce the pressure on agriculture and land, and lead to triple bottom-line impact.

The agricultural economy, in turn, revolves around the nexus of food, water, and energy. Access to energy plays a key role in socio-economic development of a nation. However, according to IEA's report on World Energy Outlook 2011, 1.4 billion people in the world do not have access to electricity, with 400 million residing in India. India's latest census data shows that 43 per cent of the rural population does not have access to grid electricity. For those who do have access, electricity is of very poor power quality and low reliability. The 2011 census data also shows that 40 per cent of the 'electrified' villages have less than 60 per cent availability of electricity. Energy deficit is the root cause of this gap.

Smart Village Nanogrid™—Addressing Challenges of Energy Access

SunMoksha has invested years of effort to closely understand the challenges of energy access and has developed a holistic solution with a 'systems' approach to address these challenges. While several solutions have been and are being implemented to make the microgrid model succeed in the rural hinterland, these solutions have been unable to achieve scale, due to several challenges. Our technical intervention, *Smart Nanogrid*™, addresses these gaps and requirements. The word 'Nano' signifies small, modular, and affordable for the masses. Uninterrupted access to energy and digital connectivity is paramount in our solution.

The *Smart Nanogrid*™ *Village* consists of a hybrid power generation unit from locally available renewable sources (solar, wind, biomass, biogas, pico-hydro, etc.) or grid power, a distribution grid to make power available to homes, streets, and most importantly, to farms and micro-enterprises, and a complete automation system for managing the microgrid operations. This brings energy-sufficiency to the village, and eliminates grid-dependency. The solutions offered are applicable in both electrified and un-electrified villages. The key technical intervention is the IoT/IT-enabled *Smart Nanogrid*™ which ensures reliable and predictable power supply through demand and supply management and citizen-centric power services. Citizens not only get quality, reliable power but can also schedule their power requirement accordingly to their convenience, view their electricity consumption and bill in real time, pay their bills and register their complaints through a Mobile App that is language-independent.
In addition to electricity, the system monitors and controls other resources, such as water, waste, agriculture, and environmental parameters. The system also manages consumer relation, technical support, training, local value-add services to consumers,

SunMoksha has invested years of effort to closely understand the challenges of energy access and has developed a holistic solution with a 'systems' approach to address the challenges of energy access. While several solutions have been and are being implemented to make the microgrid model succeed in the rural hinterland, these solutions have been unable to achieve scale, due to several challenges.

Picture 1: Chhotkei is a village in Angul,Odisha where grid electricity is yet to reach

Picture 2: The village has been supplied with a 30 kWp Solar-powered *Smart Nanogrid™* to meet the energy demands consuming about 20 kWp

and eGovernance. Reliable power and digital connectivity also enables tele-education, tele-medicine, and tele-panchayat facilities for the villagers, thereby, achieving the goals of digitally connected smart villages.

Smart Nanogrid™ not only ensures operational efficiency, but also the scalability, by remotely monitoring and technically supporting the village projects in a cost-efficient and timely manner. It makes data available to experts in real time for a timely intervention, in case of failures or malfunctions; thus bringing long-term sustainability and scalability. The cloud data is available to all remote stakeholders, such as sponsors, government agencies, implementers, O&M providers, and domain experts, to remotely monitor the performance of the project and intervene, if needed, bringing complete transparency. A special portal has been created at <www.smartnanogrid.net> to network all such Nanogrids for not only real time monitoring of the projects, but also for information exchange and cross-learning.

Social Interventions for Sustainability and Scalability

Innovative business models, access to finance, close partnerships with grassroots organizations and continuous skill development for scalable and sustainable operations and socio-economic development are key social interventions. The business model creates micro-enterprises in the villages in an MEZ (micro-enterprise zone) to not only make them self-sufficient, but also to create local economic growth and move the villagers up the economic value chain. The business model includes the *Smart Nanogrid™* operations, citizen services such as health, education, governance, and other viable microenterprises in the village. This aligns with our nation's vision of 'Start Up India, Stand Up India'.

Training and skill development to run the *Nanogrid™* and other microenterprises and livelihood activities, form the last important intervention. We have addressed this through integrated partnership with technical, vocational, and business institutions to develop skillset and entrepreneurial capacity. In a first-of-its-kind industry-academia partnership, R&D for *Smart Nanogrid™* has been conducted at the Living Laboratory at National Institute of Science & Technology, Berhampur, Odisha (NIST). Here faculty, student, and administration worked hand-in-hand with SunMoksha to develop, test and implement the solutions. The Living Laboratory also doubles up as hands-on skill training laboratory of the local operators, so that their skills are continuously upgraded with technology, as envisaged in the national skilling programme, 'Skill India'.

Demonstration of Smart Village Nanogrid™ at Chhotkei, Angul, Odisha

The first *Smart Village Nanogrid™* has been implemented at Chhotkei village in Angul district in the state of Odisha—the first such smart microgrid implementation in India. Chhotkei is a small remote village inside the hilly and scenic terrain of Satkosia Tiger Reserve about 160 km from the state capital, Bhubaneswar. While Angul is one of the most developed districts of Odisha, and the powerhouse of the state lighting the country, it unfortunately fails to expel the darkness underneath. Chhotkei is one such village in Angul where grid electricity is yet to reach. Approximately 600 villagers, living in 140 households spread over 235 ha of land, continue to live in darkness (Picture 1).

The village has been supplied with a 30 kWp Solar-powered *Smart Nanogrid™* to meet the energy demands of 140 households, 20 streetlights, a temple, and three community centres consuming about 20 kWp. The rest 10 kWp has been set aside for day-time use by irrigation pumps and microenterprises, such as stitching, rice-puff machines, provision stores, poultry, refrigerators, oil mill, welding, cold-rooms, etc., to improve agricultural output, enable value-addition to agriculture, and generate employment (Picture 2).

Power is supplied to the distribution boxes, spread throughout the village, over underground electrical cables to minimize losses and set up long-lasting infrastructure. It is distributed to the consumers through metering & control system of the *Smart Nanogrid™*, managed by *NanoSoft Remote™*. Local underground optical fibre cables (OFC) and Wi-Fi hot spots for local area network and VSAT for Internet access to the cloud have been implemented for communication between the controllers and the server and for remote monitoring. *NanoSoft Remote™* manages metering, billing, payment, differential tariff, and alerts/cut-off, if unpaid. The system switches off power supply, if a consumer exceeds maximum energy or power allocated. It schedules demands of microenterprises, irrigation pumps, street lights, etc., to match the power generation constraints. The cloud data is available to all remote stakeholders, such as sponsors, government agencies, implementers, O&M providers, and remote experts for monitoring and timely interventions, if needed. In addition, a village MEZ has been created to develop micro-industries for livelihood. A community health and tele-medicine centre is being set up to provide basic health amenities. Similarly, tele-education and village-information-kiosk facilities are planned to be set up. Motivated local youth have been hired and trained for project implementation and O&M of the system post commissioning (Picture 3). This ensures sustainability of the project.

Picture 3: Motivated local youth have been hired and trained for project implementation and O&M of the system post commissioning

Impacts of Smart Village Nanogrid™

SunMoksha has addressed the challenges of smart socio-economic development by creating an ecosystem encompassing all key components of technology, business, skills, and social engineering. *Smart Nanogrid™* has a profound impact on the lives and livelihood of villagers. The solution works around the nexus of three E's – Energy, Education, and Employment for Empowerment. It establishes robust technical solutions and business models that can be rapidly deployed and scaled up in the villages, especially for the underserved and unserved communities.At the Chhotkei village, significant changes are creeping in, over the past few months since the project has been implemented. Children have started to study in the evening, women and adults have access to light and entertainment, and the youth have access to opportunities. A youth has returned from the nearby town to create own opportunity in the village. Another youth has started an electronic repair business. Street lights have enabled social interactions and fearless stroll through the village streets and pathways. The transformation is a journey and the long-term impact will be seen over the months and years to come (Picture 4).

Picture 4: Street lights have enabled social interactions and fearless stroll through the village streets and pathways. Youths have also started electronic repair business

Support, Recognition, Awards, and Accolades

The Smart Nanogrid™ at Chhotkei was financially supported by Wartsila India Pvt. Ltd, Navi Mumbai, a Finland-based MNC, under their CSR initiative. The Odisha Renewable Energy Development Agency played a significant role in this project. They facilitated the interaction and support of the villagers in implementing and running this project. They also interfaced with local authorities for necessary permissions and support. NIST Berhampur, provided support for R&D, testing and implementation of the project. Recently, the Ministry of New and Renewable Energy (MNRE), Government of India, along with The Department for International Development (UK-DfID), to showcase this first smart microgrid project to national and international stakeholders with interest in rural development. MNRE Secretary Shri Upendra Tripathy and Joint Secretary Shri Tarun Kapur (Picture 5) presided over the workshop and assured all support to adopt this model across states. The project also won Smart Village Award at the 2016 Smart Cities India Awards in Delhi. AU

Picture 5: Support to the project from the government

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