Journal of Communications Finance
Volume II, Issue II, July-Dec 2025, pp. 38-42

3.3 *Surya* – The Jolt that Electrifies Bharat's *Atmanirbharta* and *Vikas*

Sh. Kanishak Aggarwal

Abstract

The role of the Sun in shaping India's civilizational, scientific, and technological progress has been profound. From ancient *Suryavanshi* dynasties such as the *Ikshvakus* and the *Cholas,* who drew strength and legitimacy from solar symbolism, to the astronomical text *Surya Siddhanta* authored by *Aryabhata,* the Sun guided India's early advancements in mathematics and physics. Today, this legacy inspires India's leadership in solar energy innovation as the nation seeks to become *Viksit* and *Atmanirbhar*. Solar power supports strategic autonomy by reducing dependence on fossil fuels and stimulates economic growth through expanding manufacturing capacity, especially in solar photovoltaics, semiconductors, and critical minerals processing. It also drives inclusive development through rural solarization, rooftop systems, agricultural solar pumps, and solar powered public infrastructure. Emerging technologies such as concentrated solar power strengthen reliability and efficiency, addressing energy storage and grid stability challenges. *Surya* therefore symbolizes a transformative pathway empowering India's rise as a global clean energy leader.

Keywords

Solar Energy Innovation, Surya Siddhanta, India's Clean Energy Transition, Suryavanshi Polity and Civilization, Solar Photovoltaics and Manufacturing Ecosystem

Introduction

History is replete with references to India's path to power, where the Sun served as the fuel for the ignition of Indian polity. Some of the well-known dynasties include the *Ikshvakus*, who claimed themselves to be descendants of the Sun God (Smith, 2008). This dynasty was adorned by kings like *Lord Rama,* whose reign was governed by the principles of *Dhamma*, which translated into *Ram Rajya*. The core of this polity was reflective of the Sun's unwavering luminescence. Another instance is the *Chola* dynasty, the *Suryavanshams,* who were able to establish India as a naval superpower (Subbarayalu, 2012).

Surya Siddhanta, authored by *Aryabhata,* is the epitome of the Sun's supremacy guiding India's path to scientific power (Pingree, 1970). In order to track the Sun's

position, the development of principles of trigonometry such as sine and cosine took place, a knowledge which later travelled to Europe and formed the foundation of modern-day physics and mathematics.

The calculation of the solar year as 365.258756 days is astonishingly close to real day calculations, an achievement possible because of India's scientific intelligentsia. Today, the same scientific ethos is steering India toward innovation in solar technology.

Solar power is not a novel idea when thought of from the lens of science, mathematics, and philosophy. The manufacture of the light bulb, a system that transforms electrical energy into light energy, serves as a model to build solar panels. Solar panels are the inverse of this technology, converting light energy into electrical energy.

Harnessing Surya's Power: Metamorphising Light to Energy

The Sun's energy can be harnessed in multidimensional ways not limited to electricity alone. It can be used in solar heating applications, solar disinfection, solar lights, solar furnaces, and solar pumps.

For the purpose of solar photovoltaics, if harnessed proportionally, it can activate the manufacturing cycle for the Indian economy. India's growing energy demands, as part of its path to becoming *Viksit*, require fuel, and this requirement can be fulfilled significantly by solar energy systems, for the Sun offers an infinite source of energy. In the paradigm of a clean energy world, where western notions dominate and industrial giants resist leap frogging, India can take the lead in solar Photo-Voltacs (PV) development. There is multiplier benefits associated with solar photovoltaic development.

Benefits of Surya's Halo

First and foremost is the reduction of dependence on fossil fuels, which has historically created *Nirbharta* on oil producing countries. This dependence is complicated by brewing geopolitical tensions, and solar energy helps in navigating them, helping India maintain strategic autonomy.

Second, is the development of industries that manufacture solar cells and modules, where India's manufacturing capacity stood at 7.6 GW as of June 2024, and the country's cumulative solar module manufacturing capacity reached 77.2 GW in the same period (Ministry of New and Renewable Energy [MNRE], 2024). Although the numbers are still modest, in comparison, in 2014 India had only 2 GW of solar module production capacity, highlighting India's decisiveness to become *Atmanirbhar*. This clearly highlights India's growing export demand to countries like the United States of America (USA), even when tariffs seem unfavourable.

This helps India capitalize on demand shifting away from China due to strained China-USA relations. These industries help absorb India's demographic dividend. The developments in the industry can be leveraged to develop semi-conductor fabs, the most sought after industry in the present technological paradigm, where the development of Graphics Processing Units (GPUs) is of central importance. These GPUs form the basis of high-performance computing and are crucial for running artificial intelligence (AI) systems, functioning as their central nervous system.

Third, is the development of critical-mineral refining industries required in the solar ecosystem. This involves the development of lithium battery packs, a prerequisite for energy storage in electric vehicles. Development of critical minerals refining is *sine qua non* for the modern electronics sector and will enhance India's stature as an export-oriented unit in the world's industrial landscape.

A case in point for solar power utilisation is the development of solar pumps used in agriculture. This development has inclusivised the growth. The *PM KUSUM* scheme is a revolutionary initiative transforming India's agricultural landscape, fulfilling irrigation needs and removing the negative externalities arising from electricity driven pumps (MNRE, 2020). Solarized pumps have helped farmers irrigate their fields, activating India's primary sector and energizing India's path to power.

Solar energy offers an independent and rural centric model for electricity supply, echoing Gandhian philosophy. This development has democratized the growth. Rooftop solar electricity generation is decentralized, making every individual the owner of their energy. This gives people liberty to utilize electricity even in previously untouched areas suffering from energy shortages.

Solar street lights have transformed the safety landscape for women, making public spaces more usable and productive. This has enabled the Indian economy to run on both wheels of the chariot, which earlier functioned on one.

The Solar Fresnel dish is a novel idea that can be used in schools to provide hot meals for students. The system continuously tracks the Sun to maximize radiation capture. The sunlight collected is redirected to a focal point to heat the substrate, enabling large scale cooking, especially beneficial in villages where the availability of Liquified Petroleum Gas (LPG) is limited or irregular.

Another promising domain for India is the development of Concentrated Solar Power (CSP). India should increase its focus on solar thermal energy systems. This is because the maximum efficiency for a single junction PV cell is nearly one-third, popularly known as the Shockley- Queisser limit (Shockley & Queisser, 1961), whereas solar thermal systems provide efficiency up to 45%. This significant

difference is reflected in land use requirements, crucial in a country where land burden is intense.

One of the advantages of solar thermal systems over photovoltaics is their prolonged energy generation capability. The molten salts used as a heating substrate remain hot for extended periods, similar to the principle used in solar ponds. This prolonged energy supply helps maintain the base load, which is essential for round the clock electricity and reduces the need for battery storage.

Challenges

There are challenges too while harnessing the solar energy; more procedural than technological. It is often seen that while new tenders are issued, a buzzword in the media, actual energy generation remains minimal due to multiple factors like lack of Power Purchase Agreements (PPAs) between the solar power generator (seller) and the distribution company or DISCOM (buyer). There is understandable hesitation on the part of DISCOMs due to fears that the price of solar energy may fall rapidly as technology advances. To overcome this, mandatory enforcement of strict regulatory timelines after bidding should be adopted.

Another hindrance is the evacuation of solar electricity from solar parks. Often, these parks are located in remote regions. Transmission infrastructure requires significantly more time to build than solar plants, thereby delaying energy evacuation. There may also be Right of Way issues. To overcome this, Green Energy Corridors need to be prioritized.

Policy unpredictability also creates uncertainty in investor sentiment. A unit standard deviation in policy may reduce investments by 11% (Singh, 2023). Changes in customs duty and the Approved List of Models and Manufacturers (ALMM) are such examples (MNRE, 2021).

A crucial problem is grid intermittency arising due to fluctuations in solar insolation throughout the day. This affects grid stability. Another challenge is that Direct Current (DC) power generated by solar panels which requires inverters to convert it to Alternating Current (AC) for transmission, increasing the losses. To address this, round the clock tenders must be prioritized and hybrid storage systems need to be developed.

Surya, thus, becomes more than a source of light; it becomes the electric field which powers the India's *sui generis* growth story.

References

i. Ministry of New and Renewable Energy. (2020). *Scheme for farmers for installation of solar pumps and grid connected solar power plants*. Government of India. https://mnre.gov.in/kusum

ii. Ministry of New and Renewable Energy. (2021). *Approved List of Models and Manufacturers (ALMM)*. https://mnre.gov.in/almm

iii. Ministry of New and Renewable Energy. (2024). *Year End Review 2023 – MNRE*. Government of India. https://pib.gov.in/PressReleasePage.aspx?PRID=1993743

iv. Pingree, D. (1970). The *Surya Siddhanta*: An ancient Indian astronomical text. *Journal of the American Oriental Society, 90*(1), 124-126.

v. Shockley, W., & Queisser, H. J. (1961). Detailed balance limit of efficiency of p-n junction solar cells. *Journal of Applied Physics, 32*(3), 510–519. https://doi.org/10.1063/1.1736034

vi. Singh, R. (2023). Policy uncertainty and renewable energy investment: Evidence from India. *Energy Policy, 172*, 113325. https://doi.org/10.1016/j.enpol.2022.113325

vii. Smith, R. M. (2008). *The origins of the Ikshvaku dynasty*. Oxford University Press.

viii. Subbarayalu, Y. (2012). Political geography of the Chola country. *Studies in History, 28*(2), 151–165. https://doi.org/10.1177/0257643013477220

*****

Author's Profile

Sh. Kanishak Aggarwal is an under-training civil servant of the Indian Revenue Service (Customs & Indirect Taxes). He is a graduate of IIT Delhi, holding a B.Tech degree in Mechanical Engineering with a distinguished CGPA of 9.33/10, for which he was awarded the prestigious Merit Prize. His academic excellence was evident early on, reflected in his JEE Rank of 614 and an International Rank of 597 in the NFO International Math Qualifier (2016).

He has a deep interest in research and innovation, with notable work in the development of Aluminium–Magnesium–Graphene Composite Coatings and theoretical contributions to the validation of the Minimization of Heat Dissipation hypothesis for solving the Navier–Stokes Equation. His inventive pursuits include creating a Thermal Reservoir for Siachen soldiers and designing an electricity-generating speed breaker. A dynamic and well-rounded individual, he has held leadership roles as Vice President of Sportech, IIT Delhi's annual sports festival, and Outreach Head of Tryst, the institute's technical festival. In his leisure time, he enjoys playing squash and chess, and pursues container gardening as a creative hobby.