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India's energy transition is becoming increasingly technology-driven, requiring smarter grids, advanced computing, data-led decision-making and skilled professionals. As the country expands renewable energy, green hydrogen and grid automation, stronger links between technology, research and education will be essential.

In this conversation, **Prof. Sandeep Kumar Shukla**, Professor & Director, IIIT Hyderabad, speaks with Nandini Jha of **Elets News Network** about leveraging AI, computing and research to address India's energy challenges, from smarter grids and predictive maintenance to green hydrogen and digital SCADA. *Edited Excerpts:*

ENGINEERING THE ENERGY TRANSITION

IIIT Hyderabad's Roadmap for AI, Research and Innovation



India needs an estimated \$7 trillion in investment to reach net zero by 2070. Given this scale, how can IIIT Hyderabad's research in AI and computing be directed toward solving practical energy problems like grid optimisation and predictive maintenance, and how can these research areas be woven into undergraduate and graduate coursework?

The \$7 trillion figure is really a systems-efficiency problem before it is a capital problem — every percentage point saved

in transmission losses or asset downtime reduces what has to be built. IIIT Hyderabad's strengths in machine learning, time-series forecasting, signal processing and IoT map directly onto this: load and renewable-generation forecasting, state estimation, anomaly detection on transformer and feeder telemetry, and reinforcement learning for dispatch and demand-response scheduling. Our Smart City Living Lab already treats the campus as an instrumented testbed for energy, water and air-quality data, which gives students real sensor streams rather than synthetic datasets. Curricular

integration is the easier half. Rather than adding standalone electives, energy problems can become the running case studies inside existing ML, IoT, optimisation and data-systems courses, with our dual-degree and honours research tracks carrying interested students into full projects.

Telangana is targeting 554 KTPA of green hydrogen production by FY35, alongside pilot projects in geothermal energy. Does IIIT Hyderabad have plans to introduce specialised courses or research labs in these emerging areas, and how do you see academia-industry collaboration shaping the skill sets students need for such niche fields?

Telangana's 554 KTPA target and its geothermal pilots will need far more computational and control talent than the headline chemistry suggests, electrolyser efficiency modelling, materials discovery for catalysts, digital twins for hydrogen production and storage, reservoir characterisation for geothermal, and safety-critical monitoring systems. Those are areas where our computational natural sciences, spatial informatics and embedded systems groups can contribute meaningfully alongside domain partners. An institute like ours is unlikely to build a hydrogen plant; what we can build is the modelling, sensing and analytics layer around one. That argues for a joint-lab model rather than a purely internal one, where industry supplies the physical assets and process data and we supply the computational depth. For students, the skill set that matters is hybrid: strong fundamentals in ML and systems, plus enough thermodynamics and process engineering literacy to ask the right questions.

With India aiming for 500 GW of non-fossil fuel capacity by 2030 and over 50% of installed capacity already non-fossil, how is IIIT Hyderabad preparing its students, across computer science, electronics, and allied disciplines, to contribute to this scale of transition, whether through research, internships, or industry projects?

The transition to 500 GW is as much a digital problem as a generation problem, because variable renewables shift the difficulty onto forecasting, balancing, storage management and grid stability. Our students across computer science and electronics are already trained in the primitives this needs, control systems, embedded design, VLSI and power-aware computing, distributed data systems, and machine learning. What we are working to strengthen is the applied bridge: capstone and honours projects framed around real energy datasets, internships with utilities, renewable developers and energy-analytics firms, and research assistantships that let undergraduates join ongoing lab work early. Our dual-degree structure is well suited to this, since a student can spend two years on a single applied problem. The aim is graduates who understand both the algorithm and the physical asset it is controlling. Further,

industry sponsored PhD program where PhD students work specifically on problems formulated by the relevant industry players is another approach we would like to pursue.

The Summit's discussions include digital SCADA and grid automation as priority areas. How is IIIT Hyderabad's expertise in AI, IoT, and data systems being applied to real-world energy challenges, and are there plans for structured fellowships or joint projects with utilities like TGTRANSCO or TGNPDCL?

Modern SCADA and grid automation are, functionally, large-scale streaming data and control problems with hard reliability and cybersecurity constraints, squarely within our work on IoT platforms, edge computing, time-series analytics, and secure systems. Our Smart City Living Lab has built and operated end-to-end sensing-to-dashboard stacks with open data standards, which is directly transferable to feeder-level monitoring, outage prediction and automated fault localisation. Working with utilities such as TGTRANSCO and the discoms would be the natural next step, and the most productive structure is usually a joint project anchored on a specific operational pain point, feeder loss reduction or transformer failure prediction, say, rather than a broad MoU. Structured fellowships that place our postgraduate students inside utility control rooms for extended periods would also address the sector's own reported difficulty in hiring data-capable engineers.

India's Panchamrit commitments include cutting one billion tonnes of projected emissions by 2030. As a premier technology institute, what role do you see IIIT Hyderabad playing in building broader energy and climate literacy among students outside core engineering programs, so that graduates across disciplines carry this awareness into their careers?

Even at a technology institute, most graduates will not work directly on energy systems — they will work in product, finance, policy, design and research, where climate decisions still get made by default rather than by intention. That makes broad literacy worth building deliberately. Our human sciences and cognitive science programmes, along with the humanities components every student takes, give us a natural place to introduce energy systems, carbon accounting and climate policy as general-education content rather than as specialist electives. The campus itself is a teaching instrument: students who can query live consumption data from their own buildings develop an intuition that a lecture cannot supply. Our entrepreneurship centre adds a second channel, since climate-focused ventures pull students from every discipline. The goal is graduates who recognise an energy or emissions dimension in their work and know enough to act on it. Currently, our Computational Humanities Centre is actively planning for a degree program for technology policy making — a liberal arts program at the intersection of technology and society.