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Pakistan Railways: A Track Towards Modernization Amidst Enduring Challenges

In a significant push to revitalize its aging infrastructure, Pakistan Railways (PR) has embarked on a transformative journey, channeling over Rs31 billion into six major development projects under the Public Sector Development Program (PSDP).

This ambitious initiative targets the critical rehabilitation and upgradation of the country's extensive railway network, promising to usher in a new era of safety, efficiency, and reliability for both passengers and freight operators nationwide.

The cornerstone of this investment is a series of essential track safety projects spanning key corridors. With an allocation of Rs4.87 billion, the Rohri to Khanpur section in Sukkur Division is set for renewal.

Similarly, the Tando Adam to Rohri stretch will see Rs4.83 billion in upgrades. The vital artery connecting Keamari to Hyderabad in Karachi Division is allocated Rs5.4 billion, while the extensive Khanewal to Shahdara route via Shorkot, Faisalabad, and Qila Sheikhupura commands a Rs6.3 billion investment. Furthermore, the Sher Shah to Kundian section in Multan and the Rohri to Sibi section in Sukkur are earmarked for Rs4.9 billion and Rs5.49 billion, respectively.

The anticipated benefits are substantial. Upon completion, these projects are projected to significantly slash travel times, saving commuters from 25 minutes on the Keamari-Hyderabad line to a remarkable 106 minutes on the Sher Shah-Kundian route. This enhancement is expected to make rail travel a more competitive and appealing option, fostering greater connectivity and economic activity.

Beyond these critical track rehabilitation efforts, Pakistan Railways is simultaneously forging ahead with other strategic initiatives. The introduction of modern, air-conditioned trains like the Green Line Express and the Jinnah Express aims to elevate passenger comfort.

PR is also venturing into public-private partnerships

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Supplement On
31st PAKISTAN HVACR INTERNATIONAL EXPO & CONFERENCE 2026
FEB 12, 13, 14 | KARACHI EXPO CENTRE
Please See Pages 9-28

Government's Pro-Export Measures Hailed by Textile Council as Crucial Economic Signal

The Pakistan Textile Council (PTC), representing the nation's premier textile exporters, has extended formal gratitude to Prime Minister Shehbaz Sharif, Deputy Prime Minister Ishaq Dar, and Commerce Minister Jam Kamal Khan for their recent recognition of top exporters. The Council termed the acknowledgment a vital "vote of confidence" in the export sector and a clear reaffirmation of the government's commitment to fostering performance and global competitiveness.

In a detailed statement, PTC Chairman Mr. Fawad Anwar emphasized that this encouragement arrives at a critical economic juncture. "At a time when Pakistan has limited fiscal space due to the IMF program, the government's decision to support exports through smart, market-based measures is both courageous and economically sound," he stated.

The Council specifically applauded recent monetary interventions, including the reduction in the Export Refinance Facility (ERF) rate.

Mr. Anwar highlighted the pivotal role of State Bank Governor Jameel Ahmad in designing a framework that achieved this reduction without imposing a fiscal burden. He explained that a complementary 1% cut in the Cash Reserve Requirement (CRR) released over Rs. 300 billion in liquidity, allowing banks to absorb the ERF rate cut while maintaining stability. "This approach strengthens market liquidity, lowers exporters' financing costs, and preserves banking sector confidence—a testament to close fiscal-monetary coordination," Anwar added.

Further, the PTC welcomed the Prime Minister's announcement to remove cross-subsidies from industrial power tariffs, calling it a "long-overdue correction" of structural distortions that have penalized export-oriented industries. According to Anwar, these cumulative steps signal a decisive policy shift toward targeted, export-led growth as the economy enters a post-stabilization phase.

Addressing external trade challenges, the Chairman downplayed alarm over the recently concluded India-EU Free Trade Agreement. "There is no case for panic. Competitiveness—not fear—should guide policy," he asserted, arguing that the threat to Pakistan's EU exports is overstated. He expressed confidence that Pakistan's value-added textile exporters, with their strengths in quality, sustainability, and buyer relationships, are well-positioned to compete when the pact takes effect next year.

Looking forward, the PTC outlined an urgent reform agenda for sustainable export growth, advocating for:

- The secure continuation of the GSP Plus status through robust compliance.
- Regionally competitive taxation with a reduced burden on documented businesses.
- Investment-linked tax incentives to spur private sector expansion.
- A stable, market-aligned exchange rate.
- Duty-free access to export inputs.
- The decisive removal of bureaucratic hurdles.

Reaffirming its partnership with the government, the PTC pledged to collaborate in translating macroeconomic stability into sustained export growth, job creation, and increased foreign exchange earnings for Pakistan.■

Pakistan Railways: A Track Towards Modernization Amidst Enduring Challenges

Contd from page R-1

(PPPs) to revitalize station development and onboard services, including the outsourcing of catering. A major focus is on boosting freight revenue, with plans to upgrade goods terminals and offer competitive tariffs to recapture market share from road transport. Notably, the strategic ML-1 project under the China-Pakistan Economic Corridor (CPEC) remains the long-term linchpin for a complete, high-capacity mainline overhaul.

However, the path to a full resurgence is fraught with persistent bottlenecks. Chronic financial constraints and circular debt severely limit PR's ability to fund even routine maintenance, leading to a reactive rather than proactive approach. Bureaucratic inertia and political interference often delay project approval and implementation, while outdated operational practices and an aging rolling stock fleet hamper efficiency. Furthermore, encroachments on railway land and vandalism of assets pose significant security and logistical challenges, diverting valuable resources.

The Rs31 billion investment marks a crucial, positive stride for Pakistan Railways, directly addressing decades of infrastructural decay. The concurrent new initiatives demonstrate a broader vision for modernization. Yet, the organization's journey remains a race against time. Overcoming deep-seated financial, administrative, and operational bottlenecks is imperative to ensure these substantial investments yield their full, sustainable potential, ultimately transforming Pakistan Railways back into the robust economic artery the country desperately needs. ER Report

Assay Laboratory in Pakistan

Mari Energies' Subsidiary Enters JV with Canada's MSALABS

Mari Energies Limited has announced that its wholly owned subsidiary, Mari Minerals (Private) Limited, has entered into a Joint Venture Agreement with MSALABS Limited, a Canada-based company, for the establishment and operation of a full-service assay laboratory in Pakistan.

According to the company, the proposed joint venture is subject to obtaining the required corporate, regulatory, and governmental approvals. Under the agreement, a dedicated project company will be incorporated with equal shareholding between Mari Minerals and MSALABS.

The planned facility will offer comprehensive, ISO-certified mineral testing services, covering the entire value chain from sample preparation to assaying. The laboratory is expected to play a key role in supporting Pakistan's mining and mineral exploration sector by providing internationally accredited testing services locally.

The company stated that the initiative aligns with its strategy to strengthen technical infrastructure for the country's mining industry and enhance the availability of globally recognized laboratory services within Pakistan.

Announces Gas Discovery at Tibri-1 Well in Balochistan

Mari Energies Limited has announced a gas discovery at the Tibri-1 exploratory well, drilled in the Kalchas South Block located in Dera Bugti District, Balochistan.

The Kalchas South Block is operated by United Energy Pakistan Limited (UEPL), which holds a 46 percent working interest. Mari Energies Limited owns a 44 percent working interest, while Dewan Petroleum (Pvt.) Limited (DPL) holds the remaining 10 percent stake.

According to the information shared by the company with the Pakistan Stock Exchange, Tibri-1 is the first exploratory well drilled in the Kalchas South Block. The well was spudded on November 11, 2025, and drilled to a total depth of 7,170 feet. Initial testing of the Dunghan/Sui Main Limestone (SML) formation has yielded encouraging results. The well flowed gas at a rate of 11 million standard cubic feet per day (MMSCFD) at a 64/64-inch choke with a wellhead flowing pressure of 561 psig. At a 32/64-inch choke, the well produced 6.5 MMSCFD of gas with a wellhead flowing pressure of 1,161 psig.

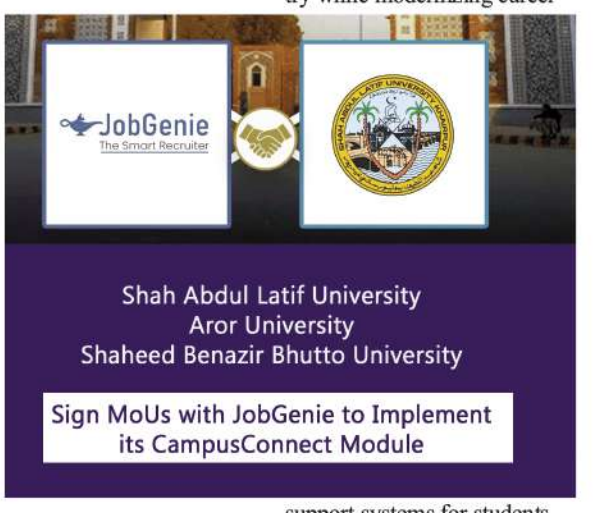
Further testing and evaluation are currently underway to assess the full production potential of the discovery.

The area had remained largely unexplored for an extended period due to security challenges. However, following the acquisition of additional working interest from DPL in July 2023, the joint venture resumed exploration activities in the block. The successful Tibri-1 discovery reflects the joint venture's renewed commitment to unlocking Pakistan's domestic hydrocarbon potential and contributing to the country's energy security.

The discovery is expected to support ongoing efforts to reduce reliance on imported energy and strengthen indigenous gas supplies. – ER News Desk

Three Universities Sign MoUs with JobGenie for AI-Based CampusConnect Career Platform

Shah Abdul Latif University (SALU), Aror University, and Shaheed Benazir Bhutto University have signed separate Memorandums of Understanding (MoUs) with JobGenie to implement its CampusConnect module, aimed at strengthening university career services through technology.



CampusConnect enables universities to efficiently manage student career services, maintain alumni records, and organize and host job fairs through a centralized digital platform. The system also allows institutions to onboard industry partners and facilitate AI-based engagement and placement opportunities for university alumni.

The initiative is expected to enhance collaboration between academia and industry while modernizing career support systems for students and graduates. University representatives termed the partnership a significant step toward improving employability and alumni connectivity through digital innovation. – ER Report

Agriculture Review

Food, Agriculture and Drug Testing

Punjab Inaugurates PAFDA, Described as South Asia's Most Advanced Science Enclave

Prime Minister Shehbaz Sharif and Punjab Chief Minister Maryam Nawaz formally inaugurated the Punjab Agriculture, Food and Drug Authority (PAFDA), described as South Asia's first and most advanced Punjab Science Enclave, bringing state-of-the-art agriculture, food, and drug-testing laboratories under one roof.

The inauguration marked the commencement of full laboratory operations at PAFDA. The prime minister and the chief minister also laid the foundation stone of a hostel for women scientists, underscoring the government's commitment to supporting scientific talent and gender inclusion in research.

The ceremony was attended by diplomats from 20 countries. The visiting dignitaries were briefed on the authority's capabilities, after which the premier and the CM toured multiple departments, observing laboratory procedures, sampling techniques, and testing protocols in agriculture, food safety, and pharmaceuticals.

PAFDA Director General Dr Talat Naseer Pasha informed the participants that the authority employs 232 scientists, the majority of whom are gold medalists, with women making up 70 percent of the workforce. He added that professionals from other provinces are also serving at the facility, making it a truly national scientific resource.

Dr Pasha explained that PAFDA is equipped to ensure stringent quality standards for food, agricultural produce, and pharmaceutical products. Its capabilities include nutrient profiling, microbiological safety testing, and ingredient verification, which are critical for consumer safety and export compliance.

He noted that the establishment of PAFDA would significantly reduce Pakistan's reliance on foreign laboratories for quality certification and help restore international confidence in Made in Pakistan products. A high-tech drug testing laboratory, developed with technical assistance from England and Türkiye, has already been made operational. So far, 42 advanced machines worth Rs 4.4 billion have been installed, while an additional 565 machines are planned to be added in the near future to further enhance testing capacity and precision.

Officials described PAFDA as a landmark step toward strengthening Pakistan's scientific infrastructure, ensuring food and drug safety, and improving the country's export competitiveness through internationally benchmarked testing and certification facilities. – ERMD

Surge in Counterfeit Pesticides:

CCP Warns of Threat to Farmers, Yields, and Environment

The Competition Commission of Pakistan (CCP) has raised serious concerns over the widespread presence of counterfeit and adulterated pesticides, terming it a major threat to Pakistan's agriculture sector, farmer incomes, environmental sustainability, and fair market competition.

In a recent report, the CCP noted that offenders involved in adulteration, counterfeiting, and misbranding often evade meaningful penalties, creating an uneven playing field for genuine manufacturers and dealers while exposing farmers to substandard and potentially harmful products.

The report highlighted that since pesticides are imported in bulk and repacked locally for sale, this stage of the supply chain is particularly vulnerable to tampering. During repackaging, products are frequently diluted with inferior materials or substituted with cheaper chemicals. These counterfeit pesticides are then packaged to closely resemble genuine brands, misleading farmers and distorting the market.

The issue is especially acute in cotton-growing

regions of Punjab and Sindh, where poor-quality pesticides have led to ineffective pest control, reduced crop yields, and increasing pest resistance. Farmers bear the financial losses, while legitimate companies suffer from unfair competition.

The CCP also warned that adulterated pesticides may contain hazardous substances that threaten human health and contribute to soil and water pollution. Several such instances have recently been reported.

A key challenge identified in the report is limited testing and quality assurance capacity. Although pesticide testing laboratories exist at federal and provincial levels, their number, equipment, and staffing are inadequate relative to the volume of imports and local formulations. Many labs lack modern equipment, standardised protocols, operational budgets, and qualified technical staff, resulting in insufficient pre-shipment inspections and weak post-market surveillance.

In 2024, the Sindh Agriculture Department launched crackdowns against counterfeit agricultural products. Department teams conducted raids in Shaheed Benazirabad, Sanghar, Golarchi, and Sajawal, seizing 5,318 bags of fake agricultural medicines and fertilizers.

In Sajawal, officials confiscated 400 bags of Hapo Granules and 68 bags of Vertaco products from an unregistered dealer. In Golarchi's Shaheed Fazil Rahu area, authorities seized thousands of suspicious bags, including 1,000 counterfeit Fertira Granules. Over 40 additional samples were collected from Sanghar and Shaheed Benazirabad for testing. — ERMD

The Reliability of Process Simulation Results in Chemical Engineering Industries: A Critical Assessment

Dr. Saad Nadeem

Process simulation has become the central nervous system of design, optimization, and troubleshooting in capital-intensive chemical process industries (CPIs) such as refineries, gas sweetening plants, and fertilizer complexes.

While these sophisticated software tools (Aspen HYSYS, Plus, ChemCAD, PRO/II, etc.) are indispensable, the blind trust in their outputs is a perilous mistake. Their reliability is not inherent but is earned through a rigorous understanding of their foundations, limitations, and the context of their application. This paper examines the factors governing the reliability of simulation results across these key sectors.

1. Foundations of Reliability: The Building Blocks

The reliability of any simulation hinges on the quality of its core components:

Thermodynamic Models: The single most critical choice. The model must accurately represent the phase behavior and properties of the specific chemical system.

Refineries: Complex hydrocarbon mixtures require sophisticated equations of state (EoS) like Peng-Robinson or SRK. Reliability for distillation columns depends on accurate prediction of vapor-liquid equilibrium (VLE), especially for non-ideal azeotropic systems.

Gas Sweetening: Simulating amine-based CO_2/H_2S removal involves highly non-aqueous electrolyte systems. Models must account for chemical reactions, ionic strength, and heat effects. Electrolyte NRTL or specific amine packages are essential.

Fertilizer (Ammonia/Urea): High-pressure synthesis loops (e.g., Haber process) demand accurate EoS for hydrogen, nitrogen, and ammonia mixtures. For urea plants, chemical equilibrium and simultaneous vapor-liquid-solid phases must be modeled.

Property Data: Simulation results are only as good as the underlying pure component and binary interaction parameter (BIP) data. Missing or inaccurate BIPs for key pairs are a common source of error, requiring regression from experimental data.

Unit Operation Models: The fidelity of reactor kinetics (for catalytic reforming, hydrocracking, ammonia synthesis), tray efficiency in columns, and heat exchanger fouling factors must be appropriately specified. Using idealized models instead of rigorous ones degrades reliability.

2. Industry-Specific Challenges & Reliability Considerations

A model uncorrelated to reality is unreliable by definition. Therefore, model calibration is the bridge between a theoretical simulation and a reliable plant tool.

Data Reconciliation & Parameter Estimation: Using plant operating data (temperatures, pressures, flows, compositions) to adjust uncertain parameters (e.g., heat transfer coefficients, reaction rate constants) within physically meaningful bounds ensures the model mirrors the real plant.

Scope Definition: Reliability is context-dependent. A model reliable for screening alternative solvents for gas sweetening may be wholly unreliable for detailed packed column design, which requires rigorous mass transfer models.

User Expertise: The greatest software cannot compensate for a lack of fundamental engineering knowledge. Understanding the physical phenomena, the software's algorithms, and the industry's operational quirks is paramount.

4. Limitations and the Role of Simulation

Even a well-calibrated model has inherent limitations that define the boundaries of its reliability:

Steady-State vs. Dynamic: Most models are steady-state. They cannot reliably predict transient behavior during startups, shutdowns, or upsets unless dynamic simulation is employed.

Equipment Reliability: Simulations predict process performance, not mechanical failure of pumps, compressors, or instruments.

"Unknown Unknowns": Simulations cannot predict unforeseen catalyst poisoning, unusual feed contaminants, or severe weather impacts unless explicitly modeled.

Thus, the role of simulation is not to provide a single "answer," but to:

1. Understand Trends: ("What happens if feed sour gas concentration increases by 10%?").
2. Optimize within Constraints: Find optimal setpoints for maximum yield or minimum energy.
3. Perform Risk-Free "What-If" Analysis: Test scenarios too risky or costly to trial in the plant.
4. Support Design & Debottlenecking: Size equipment and identify limiting process steps.

Table 1: **Industry-Specific Challenges & Reliability Considerations**

Industry	Key Processes	Reliability Pitfalls	Path to Higher Reliability
Refining	Crude Distillation, FCC, Reforming, Hydrotreating	Complex Feedstock: Real crude is thousands of components. Simulators use pseudo-components. Lumping/delumping schemes introduce error. Coking/Fouling: Steady-state models don't capture gradual performance decay. Catalyst Deactivation: Kinetic models often ignore time-dependent activity loss.	Use detailed hydrocarbon characterization (ASTM D86, TBP). Regularly update feed assays. Integrate reactor models with deactivation functions. Calibrate models frequently with plant data.
Gas Sweetening	Amine Treating, Sulfur Recovery (Claus)	Non-Ideality: Severe non-ideal behavior of amine-acid gas-water systems. Degradation & Heat Effects: Oxidative/thermal amine degradation changes solution properties, affecting capacity and corrosion. Equipment Hydraulics: Foaming, weeping, and flooding in columns are hard to model.	Use validated electrolyte thermodynamic packages. Incorporate plant data for amine degradation products and heat stable salts. Model absorber/regenerator with hydraulics (e.g., tray rating).
Fertilizer	Ammonia Synthesis, Nitric Acid, Urea Production	High-Pressure Equilibrium: Small errors in equilibrium constants at high pressure (150-300 bar) lead to large errors in conversion and recycle rates. Corrosion & By-products: In urea plants, carbamate formation and corrosion rates affect operational envelopes. Energy Integration: Highly heat-integrated; a reliability error cascades.	Use high-accuracy EoS—(e.g., Benedict-Webb-Rubin variants). Validate reactor models with pilot/operating data. Perform sensitivity analysis on heat exchanger network.

Conclusion

The reliability of process simulation results in refineries, gas sweetening, and fertilizer industries is a multi-layered achievement, not a given. It is built upon the careful selection of thermodynamic models, accurate property data, and representative process models, all tailored to the specific chemistry and challenges of the industry. This technical foundation must then be cemented by continuous calibration with real plant data and guided by seasoned engineering judgment. Ultimately, a reliable simulation is a *living model*—continuously validated and updated. It serves as a powerful, but not infallible, digital twin that informs decision-making, drives efficiency, and enhances operational understanding, while always acknowledging the complex, sometimes unpredictable, reality of the physical plant. The most reliable outcome of any simulation is often not a number, but a deeper insight into the process itself.

Dr. Saad Nadee m is a highly accomplished academic and researcher in the field of Chemical Engineering, currently serving as an Assistant Professor at NED University of Engineering and Technology (NEDUET), Karachi.

Scaling Technology-Driven Enterprises

Engr. Dr. Muhammad Nawaz Iqbal

Scaling technology-driven businesses starts with a paradox: the innovation that initially drives success becomes the limit to further growth. Founders usually design systems that do not last but are creative and innovative.

The shift from invention to institution involves a metamorphosis of structure, where agility is maintained, and complexity increases. The actual scalability is not the simple duplication of output but the multiplication of value creation without proportional increases in friction, expense, and vulnerability. This requires a conscious move from heroic improvisation to contrived reliability.

A technology enterprise is not a set of products but a dynamic web of dependent processes—technical, organizational, informational, and economic. The stress of growth makes every node tense and all the weak links large. Scaling enterprises can view bottlenecks as indicators and not failures by drawing the architecture of constraint. By this, they start becoming adaptive systems, which can self-regulate and improve themselves, rather than being linear operations.

Elastic systems are dynamically distributed to such an extent that demand spikes are not existential threats. But architecture is not technical only. It represents an assumption that the future will be more complicated than the present and that resilience should be planned in advance, not handled in retrospect.

Information becomes the lifeblood of the scaling company. As organizations grow, the returns on intuition decrease, whereas the returns on evidence increase. As high-growth companies, they incorporate sensory capabilities in all operations, which transform user feedback, operational data, and environmental indicators into constant feedback loops. The business turns from a decision-making hierarchy into a learning organism. In these systems, there is a higher flow of knowledge than authority, and adaptation becomes an emergent feature as opposed to a managerial directive.

But excellence in technology does not necessarily create scale; cognition in the organization must grow similarly. Initial-stage teams live under the influence of tacit knowledge and mutual understanding, which are overcome by expansion. Knowledge in scalable business ventures is externalized in the form of documentation, codified procedures, and cultural heuristics. They make implicit norms explicit so that they can bring about coherence even in the absence of proximity. By so doing, culture is not just a social phenomenon but a technology.

In a scaling sense, leadership changes to orchestration as opposed to control. The role of the leader changes to that of problem-solver, environment designer, and the person who creates the conditions within which thousands of decentralized decisions become consistent with strategic purpose. This demands belief in shared intelligence and patience with discrepancies within limited intent. Power ceases to be about giving orders and becomes about creating an informational and ethical environment in which people make their own decisions.

There is the complexity of economic scalability. Technology-based firms are characterized by high fixed costs and near-zero marginal costs, which present the possibility of exponential returns. But such a structure also increases initial errors in judgment. Pricing models, customer acquisition strategies, and capital allocation mechanisms have to be designed with foresight. Sustainable scale arises when the growth of revenue is greater than the rate of growth of either operational costs or organizational entropy.

Network effects also complicate the scaling equation. The more participants in the platform, the greater the value for the rest of the participants, and self-growth dynamics are generated. However, networks are delicate systems; any disproportion among interested parties can lead to a quick crash. Scalable enterprises will thus not just invest in the growth of users, but in a balance of incentives between customers, partners, developers, and regulators. An unbalanced scale is prone to accelerated instability.

Even innovation itself has to be scaled. Creativity in small firms is informal and decentralized; in large ones, it has to be industrialized. Leading technology enterprises create innovation pipelines and research ecosystems, a mixture of exploratory experimentation and rigorous validation. Failure is an input and not an outcome, and discovery is controlled by portfolio logic and not individual intuition. This changes innovation from sporadic breakthrough to sustained renewal.

Scaling is intensified by globalization with cultural and regulatory aspects. Technologies may be borderless, whereas institutions are not. Enterprises need to build the ability to localize without fragmenting, to customize interfaces, governance designs, and value propositions for various environments. The difficulty is to have a consistent backbone and yet have contextual diversity—a dynamic that is parallel to the behavior of biological organisms in different environments, yet retaining genetic identity.

Ethical responsibility increases nonlinearly with scale. Technologies with millions or billions of users act as behavior shapers, market shapers, and even democratic shapers. Scalable businesses have to incorporate ethical vision in design and implementation. This is not only a compliance role but a strategic one because trust becomes critical infrastructure. Technical superiority is not as important for long-term scale as legitimacy is.

The time aspect of scaling is also not given much thought. The path of growth is not a smooth line but a series of phase transitions, which need various capabilities. Early growth strategies can deter subsequent resilience. Smart companies plan and prepare ahead of these inflection points by investing in capabilities that are not yet in high demand. By so doing, they convert scaling from reactive adaptation to proactive evolution.

Artificial intelligence is gradually becoming the driver of scalable intelligence in the firm. Machine learning systems enhance human cognition, making it possible to optimize supply chains, customer experiences, and strategic planning in real time. However, AI also introduces aspects of opacity and dependence. Responsibly scaled enterprises are those in which algorithmic authority and human oversight are inseparable, such that automation enhances judgment and not just efficiency.

Growing a technology-based business is a game of balancing speed and consistency. Growth creates centrifugal forces that tend to separate the organization, whereas governance, culture, and architecture create centripetal forces that hold it together. The skill is in ensuring an active balance, whereby growth does not diminish unity but enhances it.

Scalability transcends business metrics and tends toward institutional sustainability. The business turns out to be a domain of unending problem-solving, which could survive products, CEOs, and economic cycles. Such organizations are not just growing, but they are also developing. They are not just evaluated based on their revenue or number of users, but on their long-term ability to create knowledge, opportunity, and value in society across generations.■

فرمانِ قائداعظمؒ

ایمان ، اتحاد ، تنظیم

اصول اور تفصیلات

گاندھی جی کہتے ہیں: "ہندوستان کو جیتے جی ٹکڑے ٹکڑے کیا جارہا ہے۔"
راج گوپال اچاریہ کہتے ہیں: "بچے کے دو ٹکڑے کیے جارہے ہیں۔"
قدرت نے پہلے ہی سے ہندوستان کو تقسیم کر رکھا ہے اور اس کے ٹکڑے ٹکڑے کر رکھے ہیں۔ ہندوستان کے نقشہ پر مسلم ہندوستان اور ہندو ہندوستان پہلے ہی سے موجود ہیں، نہ معلوم اس کے متعلق اتنا واویلا کیوں کیا جاتا ہے۔ وہ ملک ہے کہاں جس کے ٹکڑے ٹکڑے کیے جائیں گے؟ اور وہ قوم کہاں ہے جس کی قومیت فنا کی جانے کو ہے؟

وہ طاقت جس کے قبضہ قدرت میں آج ہندوستان ہے، وہ انگریزوں کی طاقت ہے اور یہ جو ایک خیال دماغوں میں بیٹھ گیا ہے کہ ہندوستان ایک متحدہ ملک ہے اور اس کی اپنی حکومت ہے، وہ صرف اس وجہ سے ہے کہ انگریز اس سارے ملک پر حکمران ہیں۔

(مسلم لیگ کانفرس، بمبئی۔26 مئی 1940ء)

آوازِ اقبال

اقبال کا ترانہ بانگِ درا ہے گویا
ہوتا ہے جادہ پیما پھر کارواں ہمارا

اے ہمالہ کوئی بازی گاہ ہے تو بھی، جسے
دست قدرت نے بنایا ہے عناصر کے لئے

ہائے کیا فرط طرب میں جھومتا جاتا ہے ابر
فیل بے زنجیر کی صورت اڑا جاتا ہے ابر

تیری عمر رفتہ کی اک آن ہے عہد کہن
وادیوں میں ہیں تیری کالی گھٹائیں خیمہ زن

چوٹیاں تیری ثریا سے ہیں سرگرم سخن
تو زمیں پر اور پہنائے فلک تیرا وطن

چشمہ دامن ترا آئینہ سیال ہے
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ابر کے ہاتھوں میں رہوار ہوا کے واسطے
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حیران ہوں، دل کو روؤں کہ پیٹوں جگر کو میں

تحریر: طاہر محمود

مرزا غالب کا ایک شہرہ آفاق شعر ہے

حیران ہوں، دل کو روؤں کہ پیٹوں جگر کو میں
مقدر ہو تو ساتھ رکھوں نوحہ گر کو میں

نہ معلوم مرزا غالب کو کیا غم لاحق تھے۔ دل جگر اور مقدر کے درمیان کیا کشمکش جاری تھی۔ کن حالات نے انہیں نوحہ گر ساتھ رکھنے پر مجبور کیا۔

زمانہ اسکول میں اساتذہ کرام نے تشریح کرتے ہوئے فرمایا تھا کہ ایسے اشعار، غم عاشقی کا نتیجہ ہوتے ہیں لیکن میں یہ پورے وثوق سے کہہ سکتا ہوں کہ یہ اشعار اکیسویں صدی کے لیے، اور بالخصوص میرے لیے لکھے گئے تھے۔ لیکن باعث آزار، غم عاشقی نہیں بلکہ خدماتِ فراہم کرنے والے اداروں کی نااہلیاں اور زیادتیاں ہیں۔ مرزا غالب بھی آج کے دور میں ہوتے تو غم عاشقی سے توبہ تائب کر چکے ہوتے۔ بجلی، گیس اور پانی کے بل اور کسٹمر سروس کے تجربات کے بعد "ادارہ جاتی المیے" پر شاعری فرماتے۔ کچھ ہی عرصے میں مجنوں بنے چاک گریباں، سڑکوں پر گھومتے نظر آتے یا کسی ایجنٹ کو اپنی جمع پونجی پکڑا کر لانچ میں سوار یورپ میں داخل ہونے کی کوششوں میں جان کی بازی ہار دیتے۔ کچھ ہی عرصے قبل بندہ ناچیز نے برقی خدمات فراہم کرنے والے ایک "عظیم اور باوقار ادارے" کے متعلق ایک مضمون لکھا تھا۔

"بندر کی بلا طویلہ کے سر"

اب یہ تو علمِ غیب میں ہے کہ اس مضمون نے متعلقہ ادارے کے افسران کے دلوں میں کوئی ہلچل پیدا کی یا نہیں، ضمیر جاگا کہ نہیں، مگر اس کا ایک فائدہ ضرور ہوا۔ دوسرے محکموں کو بھی یاد آ گیا کہ وہ اس قومی خدمت میں پیچھے رہ گئے ہیں اور عوام کو آزمائش میں ڈالنا صرف ایک ادارے کی ذمہ داری نہیں۔ چنانچہ تقریباً تین ماہ سے ہمارے ہاں گیس اس طرح غائب ہوئی جیسے پنوں کی نظروں سے سسی۔ نہ کوئی نشان، نہ کوئی سراغ۔ موڈ میں ہو تو صبح سویرے ایک جھلک دکھلا کر غائب۔ بقول شاعر

اک جلوہ تھا، جس نے لبوں پر دم کیا
اک بار نظر اٹھی، تو پھر غائب ہو گیا

اب پورا دن ہم ہیں، گیس کی "شوں شوں" اور مایوسی۔

چند دن ہم نے صبر کا دامن تھامے رکھا، سوچا شاید حالات سدھر جائیں، موسم بدلے، ستاروں کی چالیں بدل جائیں، شاید گیس کا یہ خسارہ، قومی خسارہ نہ ہو۔ مگر نتیجہ؟ مایوسی ہی مایوسی۔ سونے پر سہاگا کہ جو بل موصول ہوا، اس میں کچھ "اضافی محبت" بھی شامل تھی۔ وجہ کہ سرد موسم کے باعث گیس کے استعمال میں اضافہ ناگزیر تھا، چونکہ ہم اس اضافے میں ناکام رہے، لہٰذا ہمیں مالی طور پر شرمندہ کیا جا رہا ہے۔ ادارہ یہ بنیادی نکتہ سمجھنے سے قاصر ہے کہ اگر وہ اپنی نااہلی کے سبب گیس فراہم ہی نہیں کر پا رہا تو اس نااہلی کی سزا صارف کو کیوں دی جائے؟ مگر شاید یہ منطق صرف فلسفے کی کتابوں میں اچھی لگتی ہے، محکمے کے کاؤنٹر پر نہیں۔ اسی عقدے کو سلجھانے کے لیے ہم نے ادارے کے دفتر کا رخ کیا۔ کرسی پر جلوہ افروز صاحب نے بل کا نہایت گہرا مطالعہ فرمایا، گویا کہ بل پر کوئی ریسرچ پیپر لکھنے کا ارادہ ہو اور پھر فیصلہ صادر کیا آپ کا میٹر آہستہ چل رہا ہے، اس لیے جرمانہ کیا گیا ہے۔

ہم نے نہایت ادب سے سوال کیا جناب! آپ کو کیسے الہام ہوا کہ میٹر آہستہ چل رہا ہے؟ کیا اس کا کوئی ٹیسٹ ہوا ہے؟ یونٹس اتنے کم کیوں ہیں؟۔ یہ فلسفیانہ منطق سن کر پورا سال کھائی گئی بلند فشار خون کی دوائیں رائیگاں جاتی محسوس ہوئیں۔ ضبط کے آخری کنارے پر کھڑے ہو کر ایک سیاسی لیڈر کے انداز میں عرض کیا "جب گیس آتا ہے تو میٹر چلتا ہے، اور زیادہ گیس آتا ہے تو زیادہ میٹر چلتا ہے"۔ جب گیس ہی نہیں تو میٹر کیسے چلے گا۔ اگر اس کے باوجود بھی آپ کو شبہ ہے تو براہِ کرم کل ہی میٹر تبدیل کر دیجئے۔ اور جب تک میٹر تبدیل نہیں ہوتا یہ مذاقِ بند فرمائیں۔ شاید آنے والے طوفان کو بھانپ لیا، ہماری دلیل کا وزن کچھ زیادہ محسوس ہوا، یا ہم پر ترس آ گیا فوراً لہجہ بدلا اچھا ٹھیک ہے، میں آپ کا بل درست کر دیتا ہوں۔ ہم نے اعتراض کیا یہ درستگی ہم ہر ماہ کرواتے ہیں۔ فرمانے لگے: اب لگ کر نہیں آئیں گے۔ تھوڑی سی تسلی ہوئی تو ہم نے اصل مسئلے کی طرف رخ موڑا جناب، جس جنسِ نایاب کا بل وصول کیا جا رہا ہے، اس کے درشن کی کوئی ترکیب بھی بتا دیجیے۔ فرمایا میرے بس میں جو تھا کر دیا۔ اب گیس نہ آنے کی شکایت فلاں کاؤنٹر پر لکھوا دیجئے۔

کاؤنٹر پر پہنچے، مسئلہ بیان کیا۔ صاحب نے مشینی انداز میں ہمارا بل لیا، کمپیوٹر میں اندراج کیا، شکایت نمبر لکھ کر ہمیں تھما دیا، اور ایسی نظروں سے دیکھا جیسے شادی ہال کے دروازے پر کھڑے میزبان کسی بن بلائے مہمان کو۔ ہم نے پوچھا یہ مسئلہ کب تک حل ہو جائے گا؟۔ جواب آیا میرا کام شکایت لکھنا ہے، حل کب ہوگا یہ فلاں صاحب بتائیں گے۔ ان صاحب کے پاس پہنچے مسئلہ سنا، علاقے کا نام پوچھا، ہم پر

ایک ترس بھری نگاہ ڈالی اور ایک اور صاحب کی طرف اشارہ کر دیا۔

مرتے کیا نہ کرتے۔ اس طرف روانہ ہو گئے۔ لگتا تھا محکمہ آج ہمیں تمام افسران سے متعارف کروانے کے مشن پر ہے۔ اگلے صاحب کے پاس گئے۔ انہوں نے بھی علاقے کا نام پوچھا۔ ہمارے درمیان مکالمہ ملاحظہ فرمائیں۔ میں آپ کو تسلی دوں یا سچ بتاؤں؟'' جناب، سچ بتا دیجئے' تو سچ یہ ہے کہ آپ کا مسئلہ حل نہیں ہو سکتا۔ کیوں؟'' آپ کے علاقے کی لائنیں بہت پرانی ہیں۔ ہم اب اس پر کوئی بھی مرمتی کام نہیں کر رہے۔ ہم نے عرض کیا جناب، یہ لائنیں اچانک تو پرانی نہیں ہو گئیں۔ تین ماہ پہلے انہی سے گیس آ رہی تھی، اور اب بھی صبح چھ سے سات کے درمیان جو چند سانسوں جتنی گیس آتی ہے، انہی لائنوں سے آتی ہے۔ فرمایا میں نے سچ بتا دیا۔ ہم نے ہمت کر کے کہا اچھا، مان لیتا ہوں حل بتا دیجئے۔ جواب آیا کوئی حل نہیں۔ ہم نے آخری کارتوس چلایا میرے گھر کے سامنے چھ ماہ پہلے نئی لائن ڈالی گئی تھی، اس سے کنکشن دے دیجئے۔ فرمایا یہ بھی ممکن نہیں۔ وجہ۔۔۔ علاقے کے کنکشن لگانے کے ذمہ دار ٹھیکیدار کا ٹھیکہ رشوت ستانی کی شکایتوں کے بعد منسوخ کیا تو موصوف ہائی کورٹ سے اسٹے آرڈر لے آئے۔ اب ہم بے بس ہیں نئے کنکشن دے نہیں سکتے۔ پرانی لائنوں کو ہم نے سوتیلا سمجھ لیا ہے، ہم نے پوچھا تو اب میں کیا کروں؟ جواب آیا ٹھیکیدار کے پاس علاقے کے لوگوں کو لے کر جائیے، اور کیس واپس لینے کے لیے سماجی دباؤ ڈالیں۔ وہی ناکردہ گناہ بخشوانے کا لالی پاپ جو برقی ادارے نے ہمارے ہاتھ میں پکڑایا تھا۔

عرض کی کہ ممکن نہیں تو فرمایا انتظار کریں۔ کب تک؟ جب تک عدالت فیصلہ نہ دے۔ یعنی مسئلہ اب ہمارے پوتوں کے جوان ہونے تک موخر ہو گیا۔ مسکرا کر فرمایا کہ اگر مطمئن نہیں تو افسر انچارج سے مل لیجیے۔ افسر انچارج نے بھی وہی راگ الاپا، البتہ ہماری حالتِ زار دیکھ کر ایک نیا مشورہ دیا یہ تمام معاملات ایم ڈی صاحب کے علم میں ہیں اگر آپ وہاں بھی جانا چاہیں تو یہی جواب ملے گا۔ آپ کی بزرگی پر ترس آ رہا ہے۔ آپ پہلے صاحب کے پاس جا کر میرا نام لے لیجیے، کہیے لائن میں ایک بار کمپریسر لگوا دیں۔ دوبارہ پہلے صاحب کے پاس گئے۔ انہوں نے ایک پرچی پر جس بے دلی سے نام اور مطلوبہ معلومات لکھیں، ہمیں فوراً اندازہ ہو گیا کہ ان تلوں میں تیل نہیں۔ اور یہ شکایت کنندہ کو دوڑانے کا آخری حربہ ہے۔ چلتے چلتے بڑے پیار سے دیوار پر چسپاں ایک اشتہار کی طرف اشارہ کیا کہ پریشانی سے بچنے کے لیے سیلنڈر خرید لیجیے۔ یعنی اب پیاسے کو کنویں کے پاس ہی جانا پڑے گا۔

چار دن بعد ادارے کی ایک خود کار کال آئی آپ کا مسئلہ حل کر دیا گیا ہے۔ ہم خوشی خوشی چولہا جلانے لگے۔ مگر چولہا ہماری خوش فہمی پر ہنستا رہا۔ اگلے دن انکشاف ہوا کہ جس جنسِ نایاب سے ہم محروم ہیں، وہ ہماری پچھلی گلی میں واقع کچھ خوش قسمت افراد شمول ہماری ہمسایہ شام تک میسر ہے۔ ہم نے فوراً فون اٹھایا، شکایت درج کروائی، یہاں تک کہ جذباتی ہو کر کہا یہ کوئی بین الاقوامی، بین الصوبائی، ضلعی مسئلہ نہیں، بس ہمارے اور ہمارے پڑوسیوں کے گناہوں کی سزا ہے۔ ہم توبہ کر رہے ہیں، آپ آ کر مسئلہ حل کر دیجئے۔ خاص طور پر بتا رہے ہیں کہ پچھلی گلی میں گیس آ رہی ہے۔ اب ذرا تصور کیجیے کچھ گھروں میں گیس موجود، ہم محروم، کیا کیفیت ہوگی۔ اب حالات یہ تھے کہ پورا دن آس پڑوس کے دروازے کھٹکھٹاتے گذر جاتی کہ باجی، بیٹا آپ کے گھر گیس آ رہی ہے۔ اب تو انداز دستک پہچانتے ہی اندر سے صدا بلند ہوتی ہے " گیس نہیں آ رہی" ایک بار پھر کال آئی آپ کا مسئلہ حل کر دیا گیا ہے۔ ایک بار پھر گیس ندارد۔ ایک بار پھر شکایت۔ نمائندہ بضد کہ مسئلہ حل ہو چکا ہے۔ آپ چیک کر لیجیے۔ شام کو ہمیشہ سے بات ہوئی تو بے نقط سننے کو ملا۔ معلوم ہوا کہ ہماری مسلسل شکایات کا واحد نتیجہ یہ نکلا کہ ان کے گھر کی گیس بھی غائب ہو گئی۔ محکمہ کی مہربانیوں سے گیس سے تو محروم ہی رہے لیکن محکمہ کی غیر منصفانہ تقسیم کے طعنوں سے نجات حاصل ہوئی۔ لیکن مکمل جاں بخشی نہ ہو سکی کہ اب ہمشیرہ کے طعنوں سے نجات مشکل ہے سکون آ گیا آپ کو ہماری گیس بھی بند کروا کے۔ رات کو تھکہ ہار کر سونے کی کوشش کی تو وہاں بھی سکون نہ پایا کہ عالم رویا میں غالب مرحوم تشریف لے آئے اور اپنی شاگردی میں لیتے ہوئے بے تکی "شاعری کا اذن عام عطا فرمایا۔

ہوء تاخیر تو کچھ باعث تاخیر بھی تھا
آغاز دن، چائے ناشتہ ضروری بھی تھا

ہم نے چولہا جلایا تو فقط خواب جلا
شوں شوں تو تھی مگر شعلہ ھی نہ تھا

صبح چھے کو ملی تو سات تک مر ہی گئی
یہ جو آئی تھی، گیس نہیں اشتہار ہ ہی تھا

بل جو آیا لگا، کیا ہے کوء جرم شدید
گیس نہ تھی، منطق نہ تھی، تعزیز ہی تھا

جرم یہ ٹھرا کہ جلاء کیوں نہ گیس
سزا یہ ملی کہ جرمانہ شدید تھا

تنگ آ کر ہم گئے دفتر، وہ کرسی وہ غرور
ہر شخص اپنی انجمن میں وزیر بھی تھا

پوچھا بار شبوت کہ میٹر ہے آہستہ
فرمایا کہ بل پر یونٹ حقیر تھا

گیس غائب کہ لائنیں ہیں پرانی بہت
عجب معاملہ کہ یہی کل تک اثاثہ بھی تھا

کہا کہ نئی لائن سے ہمیں کنکشن دیجیے
ٹھیکیدار کے ھاتھ میں اسٹے آرڈر بھی تھا

دکھا کر خواب کمپریسر کا، ھمیں ٹرخا دیا
کال ملی، حل ہو گیا، یہی مقدر میں تھا

پڑوس میں جو چل رہا تھا مد ہم سا چراغ
ھمارے نصیب میں فقط غصہ شدید ھی تھا

ہم نے جو بتاء بات، ایک دن سندیسہ آن پہنچا
وہ بھی ہوئے محروم، محکمانہ انصاف یھی تھا

غالب تھے اچھے کہ بس عشق میں ہوئے بدنام
ھم کو تو مارا قلت نے، کوء قصور نہیں بھی تھا

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پندرہ روزہ

انجینئرنگ ریویو

GOLDEN JUBILEE 50 ENGINEERING REVIEW 1975 - 2025

بانی: منجم الحسن بانی ایڈیٹر: ریاض الحسن

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امریکہ کا ریکوڈک میں 1.25 ارب ڈالر سرمایہ کاری کا اعلان

امریکی بینک ایگزم کے منصوبے کے تحت ریکوڈک کی تعمیر وانتظام کے لیے امریکی مشینری اور ماہرین پاکستان آئیں گے

منصوبہ کان کنی کیلئے بطور ماڈل پروجیکٹ ہوگا، امریکی ناظم الامور نتالی بیکر، ویب سائٹ ایکس پر وڈیو بیان

امریکا کا ریکوڈک میں 1.25 ارب ڈالر سرمایہ کاری کا اعلان، ہزاروں افراد کو روزگار ملے گا۔ امریکی ناظم الامور نتالی بیکر کا کہنا تھا کہ ایگزم بینک کے منصوبے کے تحت ریکوڈک کی تعمیر وانتظام کے لیے امریکی مشینری اور ماہرین پاکستان آئیں گے۔

اسلام آباد میں امریکی سفارت خانے کی جانب سے سماجی رابطے کی ویب سائٹ ایکس پر جاری وڈیو بیان میں نتالی بیکر نے کہا کہ امریکی ایکسپورٹ امپورٹ بینک نے پاکستان میں ریکوڈک منصوبے میں کان کنی اور اہم معدنیات میں تعاون کے لیے حال ہی میں 1.25 ارب ڈالر مالی سرمایے کی فراہمی کی منظوری دی۔ انہوں نے کہا کہ آنے والے برسوں میں ایگزم بینک کے مالی تعاون کے منصوبے تحت ریکوڈک کان کی تعمیر اور انتظام کے لیے دو ارب ڈالر کی اعلیٰ معیار کے امریکی معدنیات کے آلات اور در کار خدمات پاکستان کو فراہم کی جائیں گی۔

نتالی بیکر نے بتایا کہ اس منصوبے کے تحت ایک اندازے کے مطابق امریکا میں 6 ہزار اور بلوچستان پاکستان میں 7 ہزار 500 روزگار کے مواقع میسر ہوں گے۔ ان کا کہنا تھا کہ ریکوڈک منصوبہ کان کنی کے لیے بطور ماڈل پروجیکٹ ہو گا جو امریکی ایکسپورٹرز کے ساتھ ساتھ پاکستان کی مقامی کمیونٹیز اور شراکت داروں کو روزگار کے مواقع پیدا کرتے ہوئے دونوں ملکوں کی خوش حالی کے سود مند ثابت ہوگا۔

امریکی ناظم الامور نے کہا کہ ٹرمپ انتظامیہ نے ایسے ہی معاہدوں کو امریکی سفارت کاری کا بنیادی حصہ بنایا ہے اور ہم امریکی کمپنیوں اور پاکستان کے درمیان معدنیات کے شعبے میں مزید معاہدوں کے لیے پرعزم ہیں۔■

تربیلا پانچویں توسیعی منصوبے کا 56 فیصد کام مکمل

منصوبے سے بجلی پیدا کرنے کی صلاحیت بڑھ کر 6 ہزار 418 میگاواٹ ہوجائے گی

تربیلا پانچواں توسیعی منصوبہ 56 فیصد مکمل، بجلی کی پیداوار اپریل 2027 میں شروع ہوگی۔ تفصیلات کے مطابق چیئرمین واپڈا لیفٹیننٹ جنرل محمد سعید (ریٹائرڈ) نے زیر تعمیر تربیلا پانچویں توسیعی پن بجلی منصوبے کی اہم سائٹس کا دورہ کیا۔ یہ منصوبہ تربیلا ڈیم کی سرنگ نمبر 5 پر عالمی بینک اور ایشیائی انفراسٹرکچر انویسٹمنٹ بنک کی مالی معاونت سے تعمیر کیا جارہا ہے۔

پراجیکٹ کے دورے میں چیئرمین واپڈا کو بریفنگ دی گئی۔ منصوبے پر مجموعی پیش رفت 56 فیصد ہے پہلے یونٹ سے بجلی کی پیداوار اپریل 2027 میں شیڈول ہے۔ تربیلا پانچویں توسیعی پن بجلی منصوبے کی مجموعی پیداواری صلاحیت ایک ہزار 530 میگاواٹ ہے۔ منصوبے کے تین پیداواری یونٹ ہیں اور ہر یونٹ کی پیداواری صلاحیت 510 میگاواٹ ہے۔ اس منصوبے کی تعمیر کیلئے عالمی بینک 390 ملین ڈالر جبکہ ایشیائی انفراسٹرکچر انویسٹمنٹ بنک 300 ملین ڈالر فراہم کررہے ہیں۔

تربیلا پانچواں توسیعی منصوبہ ہر سال نیشنل گرڈ کو ایک ارب 46 کروڑ 60 لاکھ یونٹ کم لاگت اور ماحول دوست بجلی فراہم کریگا۔ اس منصوبے کی تکمیل کے بعد تربیلا ڈیم سے بجلی پیدا کرنے کی صلاحیت 4 ہزار 888 میگاواٹ سے بڑھ کر 6 ہزار 418 میگاواٹ ہوجائے گی۔ تربیلا چوتھے توسیعی پن بجلی پراجیکٹ کی پیداواری صلاحیت ایک ہزار 410 میگاواٹ ہے۔■

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The voice of engineering

HVACR Expo 2026: A Timely Convergence for Industry, Innovation, Climate Responsibility

The Pakistan HVACR Society is set to organize its annual conference at Expo Center Karachi from February 12, 2026—an event that has, over the years, earned a reputation as a credible and continuous platform for professionals, manufacturers, engineers, policymakers, and academia.

At a time when Pakistan's construction, industrial, and energy sectors are navigating economic pressures alongside climate commitments, this conference arrives with renewed relevance.

HVACR (Heating, Ventilation, Air Conditioning and Refrigeration) is no longer viewed as a support utility for buildings and industry; it is now central to energy efficiency, environmental sustainability, and human comfort. Globally, HVACR systems account for a significant share of electricity consumption and carbon emissions. For a country like Pakistan—where urbanization, vertical construction, data centers, hospitals, malls, and industrial units are expanding—the sector holds enormous untapped potential both economically and environmentally.

One of the key themes expected to dominate discussions is the localization of HVACR components and parts. Historically, Pakistan has relied heavily on

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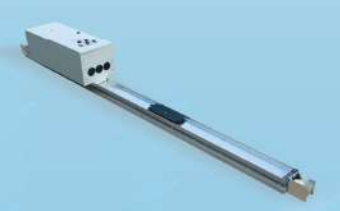

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Haier Advances Green HVACR with Low-GWP Refrigerants and Smart Technologies

Salman Saleem of Haier Pakistan highlights the company's commitment to decarbonization in the HVACR sector through the adoption of eco-friendly refrigerants such as R-32, R-1234ze, R-1233zd(E), and R-600a, along with energy-efficient technologies aligned with LEED standards. He noted rising customer awareness about environmental impact, Haier's continued investment in Pakistan, plans for IoT-enabled appliances, expanded production targets for 2026, and rapid transfer of innovations from China to Pakistan.

By Muhammad Salahuddin

Muhammad Salahuddin:
In the context of decarbonization and reducing carbon footprints, HVACR is considered a sensitive sector. What steps is Haier taking to make its products more climate-friendly?

Salman Saleem: This is a very important topic, and Haier is taking concrete steps toward decarbonization and reducing environmental impact across its HVACR and appliance portfolio.

In the past, the industry widely used R-22 (HCFC-22) refrigerant, which is harmful to the ozone layer. Haier has completely shifted away from R-22 to R-32, which has zero ozone depletion potential (ODP) and a much lower global warming potential (GWP) compared to older refrigerants.

In our chiller range, we are now using next-generation refrigerants such as R-1234ze and R-1233zd(E). These are ultra-low GWP refrigerants and are considered among the most environmentally responsible options available globally today.

Beyond refrigerants, Haier focuses on energy-efficient components, inverter technology, intelligent controls, and heat-exchange optimization to reduce overall energy consumption, which directly lowers carbon emissions.

We also align our manufacturing and product standards with international green building certifications such as LEED Gold and LEED Platinum requirements. This applies not only to commercial air conditioning but also to refrigerators, freezers, and other appliances where we increasingly use R-600a (isobutane), another low-GWP refrigerant.

At the corporate level, Haier is also engaged in plantation drives and environmental campaigns as part of its responsibility toward climate change mitigation.

MS: Consultants and companies may understand these environmental improvements, but how aware are end users about these new technologies?

SS: Awareness has increased significantly over time. When we participate in project bidding, clients and consultants now ask specific questions about the type of refrigerants, energy efficiency ratings, and environmental impact of our systems.

End users are becoming more conscious of decarbonization and climate change. Many now specifically ask whether the gases used are ozone-friendly and low-GWP. This level of awareness was not common a few years ago, but today customers are much more informed and environmentally responsible.

MS: While there is talk about foreign investment leaving Pakistan, Haier continues to invest. How do you see this in the context of Pakistan's economy?

SS: By the grace of God, Haier has shown remarkable growth despite challenging economic conditions, floods, and regional uncertainties. In 2025, Haier Pakistan crossed USD 1 billion in revenue in the home appliances segment.

This growth, during tough times, reflects Haier's long-term commitment to Pakistan. Continued foreign investment by companies like Haier demonstrates confidence in the country's market potential and economic future.

MS: What are Haier's future plans and upcoming product lines?

SS: Haier is the Platinum Sponsor of the HVACR Exhibition in Karachi, where we will showcase our latest technologies.

We are moving toward extended and enhanced warranty programs, aiming to provide customers with greater peace of mind.

In the refrigerator category, our focus is on IoT-enabled smart refrigerators, and we are about to introduce new IoT-based series in Pakistan.

On the production side, Haier plans to manufacture 3.5 million units annually by 2026 across various appliance categories. While 2025 had its challenges, we are very optimistic about 2026.

MS: China is advancing rapidly in technology and innovation. How quickly does Haier bring those innovations to Pakistan?

SS: Haier Pakistan is unique because it has a strong on-ground presence, supported by Chinese experts and local professional teams. Innovations developed in China are first implemented there and then rapidly transferred to Pakistan and other markets.

Our local teams ensure that the latest technologies are executed and made available in Pakistan without significant delays. ■

Energy Audit & Utilities Management

A Smart Approach to Sustainable Operations

In today's competitive industrial landscape, rising energy costs and stricter compliance requirements are pushing organizations to re-think how they use and manage energy. Energy audit and energy management have become essential tools for industries looking to improve efficiency, reduce operational costs, and meet national and international standards.

An energy audit is a systematic inspection, analysis, and evaluation of energy flows within a facility. The goal is to identify areas of energy waste and recommend practical measures to improve efficiency without compromising productivity.

Energy audit and energy management are no longer optional. They are strategic necessities for industries aiming to stay competitive, compliant, and sustainable. By understanding cncrgy usagc and managing it effectively, organizations can achieve measurable cost savings and long-term operational excellence.

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Corporate Net-Zero HVAC Roadmaps Market Outlook

Market Outlook

A comprehensive market research study focused on net-zero decarbonization strategies specifically for HVAC systems. It analyses regulatory drivers, firm commitments, technological adoption paths, and growth forecasts for net-zero HVAC roadmaps across industries.

As per our latest research, the global Corporate Net-Zero HVAC Roadmaps market size is valued at USD 6.8 billion in 2024, demonstrating robust momentum driven by the accelerating focus on sustainability and decarbonization initiatives across industries. The market is projected to grow at a compound annual growth rate (CAGR) of 12.4% from 2025 to 2033, reaching a forecasted value of USD 19.3 billion by 2033. This significant expansion is underpinned by stringent regulatory pressures, technological advancements, and an increasing corporate commitment to achieving net-zero emissions, especially in the HVAC sector, which is pivotal for energy consumption in commercial and industrial spaces.

The primary growth drivers for the Corporate Net-Zero HVAC Roadmaps market are rooted in the global push for carbon neutrality and the urgent need to reduce greenhouse gas emissions from built environments. HVAC systems are among the largest energy consumers in commercial and industrial buildings, often accounting for 40–60% of total energy use. With governments and regulatory bodies instituting stricter energy efficiency standards and emissions caps, organizations are compelled to adopt advanced, sustainable HVAC solutions. The integration of renewable energy sources, smart controls, and energy recovery technologies is now central to corporate net-zero strategies. Additionally, the availability of green financing and incentives for sustainable infrastructure retrofits is accelerating market adoption, making the transition to net-zero HVAC both a regulatory mandate and a competitive differentiator for forward-thinking enterprises.

Another key factor fueling market growth is the rapid pace of technological innovation within HVAC systems. The emergence of smart HVAC technologies, such as IoT-enabled sensors, AI-driven energy management platforms, and advanced building automation systems, is transforming how organizations monitor, optimize, and reduce their HVAC-related carbon footprint. These technologies enable real-time analysis of energy consumption patterns, predictive maintenance, and seamless integration with renewable energy sources like solar and geothermal. The proliferation of energy recovery ventilation and variable refrigerant flow systems further enhances efficiency, supporting the shift toward net-zero operations. As a result, both new construction and retrofit projects are increasingly prioritizing next-generation HVAC solutions that align with corporate sustainability targets.

Furthermore, the market is benefiting from the growing awareness among corporate stakeholders regarding the long-term benefits of net-zero HVAC adoption. Beyond regulatory compliance, organizations are recognizing the financial advantages of reduced operational costs, improved employee well-being, and enhanced brand reputation associated with sustainable building practices. The convergence of environmental, social, and governance (ESG) criteria in investment decisions is prompting businesses to prioritize net-zero roadmaps as part of their broader corporate responsibility agendas. Industry associations and global initiatives, such as the Science Based Targets initiative (SBTi) and the Net-Zero Carbon Buildings Commitment, are providing frameworks and guidance, further accelerating market momentum.

Regionally, North America and Europe are leading the charge in the Corporate Net-Zero HVAC Roadmaps market, driven by progressive environmental policies, significant investments in green building technologies, and a mature ecosystem of HVAC solution providers. Asia Pacific is emerging as a high-

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Corporate Net-Zero HVAC Roadmaps Market Outlook

Solution Analysis

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growth region, propelled by rapid urbanization, expanding commercial infrastructure, and increasing government mandates for sustainable development. Latin America and the Middle East & Africa are gradually adopting net-zero HVAC strategies, supported by international collaborations and rising awareness of climate change impacts. The interplay of local regulations, climate conditions, and economic factors shapes the pace and nature of adoption across regions, but the global trajectory is unmistakably toward widespread implementation of net-zero HVAC solutions.

Solution Analysis

The solution segment of the Corporate Net-Zero HVAC Roadmaps market encompasses heating, ventilation, air conditioning, integrated systems, and other ancillary solutions designed to optimize energy use and minimize emissions. Heating solutions are evolving with the integration of renewable energy sources such as solar thermal and heat pumps, significantly reducing reliance on fossil fuels. Ventilation systems are increasingly leveraging energy recovery technologies and advanced filtration to improve indoor air quality while minimizing energy waste. Air conditioning solutions are incorporating low-GWP refrigerants and high-efficiency compressors, aligning with global environmental standards. Integrated systems, which combine heating, ventilation, and air conditioning into a unified platform, offer superior control and efficiency, enabling organizations to achieve holistic energy management and net-zero targets. The demand for these solutions is particularly high in sectors with large building footprints and stringent sustainability requirements, such as corporate offices, healthcare, and education.

A notable trend within the solution segment is the shift toward modular and scalable HVAC platforms that can be tailored to the specific needs of diverse building types. Modular systems allow for phased implementation, facilitating retrofits in existing structures without significant disruption to operations. This flexibility is crucial for organizations looking to balance sustainability with operational continuity. Additionally, the adoption of integrated building management systems (BMS) is enhancing the interoperability of HVAC components, enabling centralized monitoring and optimization. These systems provide actionable insights through real-time data analytics, supporting proactive decision-making and continuous improvement in energy performance. As a result, solution providers are increasingly focusing on interoperability, user-friendly interfaces, and compatibility with emerging smart building standards.

The competitive landscape within the solution segment is characterized by a mix of established HVAC manufacturers, innovative startups, and specialized energy service companies. Leading players are investing heavily in research and development to introduce solutions that not only meet regulatory requirements but also deliver measurable ROI for corporate clients. Partnerships and collaborations with technology firms, renewable energy providers, and construction companies are common, enabling comprehensive net-zero roadmaps that address the entire lifecycle of HVAC systems. Furthermore, the rise of sustainability consulting services is complementing solution offerings, guiding organizations through the complex process of technology selection, integration, and performance tracking.

Looking ahead, the solution segment is poised for substantial growth as organizations increasingly recognize the value of future-proofing their HVAC infrastructure. The ongoing transition to low-carbon economies, coupled with the proliferation of green building certifications such as LEED and BREEAM, will continue to drive demand for advanced, integrated HVAC solutions. The emphasis on lifecycle assessment and total cost of ownership is shifting procurement decisions away from upfront costs toward long-term sustainability and resilience. As regulatory frameworks evolve and stakeholder expectations rise, solution providers that can deliver proven, scalable, and adaptable net-zero HVAC platforms will be well-positioned to capture market share.

Technology Analysis

The technology segment is a critical driver of the Corporate Net-Zero HVAC Roadmaps market, encompassing innovations such as smart HVAC, renewable energy-powered HVAC, energy recovery ventilation, variable refrigerant flow (VRF), and other emerging technologies. Smart HVAC systems leverage IoT sensors, AI-driven analytics, and advanced automation to optimize energy consumption, reduce waste, and enhance occupant comfort. These systems can dynamically adjust temperature, humidity, and airflow based on real-time occupancy and weather data, ensuring maximum efficiency without compromising indoor environmental quality. Renewable energy-powered HVAC solutions, including solar-assisted and geothermal systems, are gaining traction as organizations seek to decarbonize their building operations and reduce reliance on grid electricity.

Energy recovery ventilation (ERV) systems are becoming increasingly popular in both new construction and retrofit projects. ERV technology captures and reuses waste heat from exhaust air to pre-condition incoming fresh air, significantly reducing the energy required for heating and cooling. This not only lowers operational costs but also supports compliance with stringent building energy codes. Variable refrigerant flow (VRF) systems offer precise, zone-based climate control, enabling individualized temperature settings for different areas within a building. VRF technology is particularly well-suited for large, multi-tenant facilities where usage patterns vary throughout the day. The scalability and flexibility of VRF systems make them a preferred choice for organizations pursuing phased net-zero roadmaps.

The technology segment is also witnessing rapid advances in digital twin and predictive maintenance capabilities. Digital twin technology creates a virtual replica of a building's HVAC system, allowing operators to simulate performance scenarios, identify inefficiencies, and test optimization strategies before implementation. Predictive maintenance, powered by machine learning algorithms, enables the early detection of equipment anomalies, reducing downtime and extending asset lifespans. These innovations are transforming HVAC management from reactive to proactive, ensuring that systems operate at peak efficiency throughout their lifecycle.

As the technology landscape evolves, interoperability and cybersecurity are emerging as key considerations for organizations adopting net-zero HVAC roadmaps. The integration of multiple technologies within a single building ecosystem requires robust data exchange protocols and secure communication channels. Solution providers are investing in open standards, API-driven architectures, and advanced encryption to address these challenges. The convergence of HVAC technology with broader smart building initiatives is creating new opportunities for cross-industry collaboration, enabling holistic approaches to sustainability that extend beyond individual systems to encompass entire campuses and portfolios.

Application Analysis

The application segment of the Corporate Net-Zero HVAC Roadmaps market covers commercial buildings, industrial facilities, institutional buildings, and other specialized environments. Commercial buildings, including corporate offices, shopping malls, and hospitality venues, represent the largest share of market demand. These spaces typically have high occupancy rates and stringent indoor air quality requirements, making efficient HVAC systems essential for both operational performance and occupant well-being. The adoption of net-zero HVAC solutions in commercial buildings is driven by regulatory mandates, tenant expectations, and the pursuit of green building certifications. Organizations are increasingly retrofitting existing buildings with advanced HVAC technologies to reduce energy consumption and align with corporate sustainability goals.

Industrial facilities, such as manufacturing plants and warehouses, present unique challenges and opportunities for net-zero HVAC adoption. These environments often require specialized climate control to support production processes, equipment cooling, and worker safety. The integration of renewable energy sources and energy recovery systems is particularly beneficial in industrial settings, where waste heat and process emissions can be repurposed to reduce overall energy demand. The complexity of industrial HVAC requirements necessitates tailored roadmaps that balance efficiency, reliability, and compliance with industry-specific regulations.

Institutional buildings, including schools, hospitals, and government facilities, are increasingly prioritizing net-zero HVAC strategies as part

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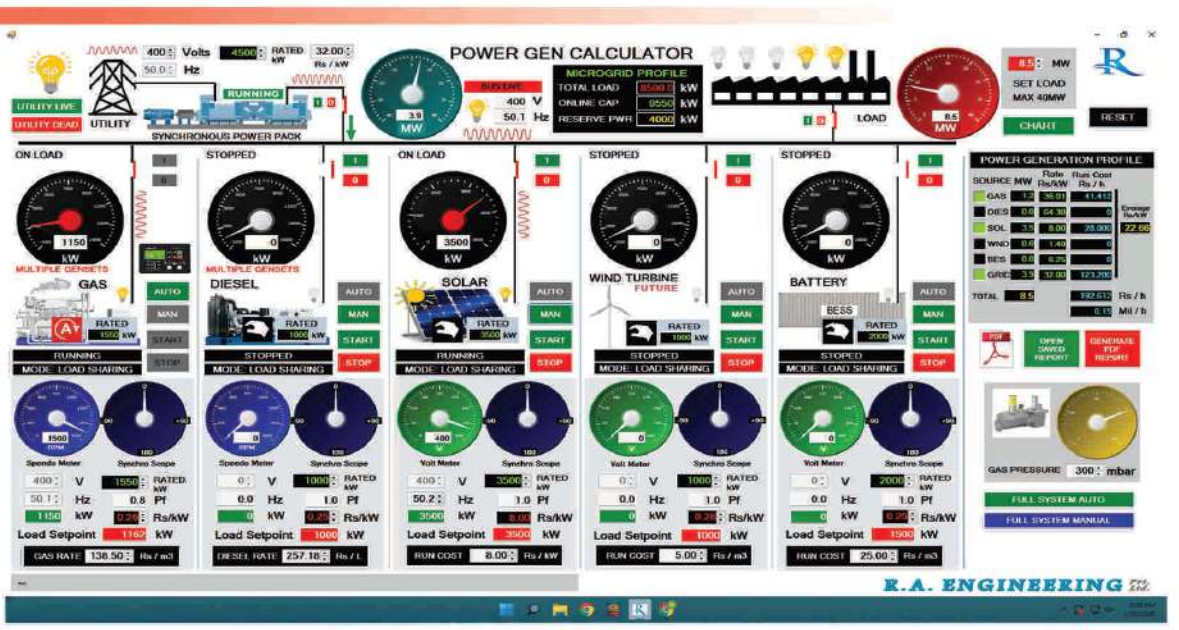

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Why Certification and Standards Are Critical for Pakistan's HVAC Industry

Navigating Pakistan's HVAC Industry: Strategies for Awareness, Certification, and Excellence

Industry leaders Khalid Rabbani (Fahim, Nanji & deSouza), Amjad Iqbal (Welkin Solutions), and Morten Schmelzer (Systemair AB) highlight that Pakistan's HVACR sector faces challenges arising from harsh climatic conditions, weak enforcement of standards, high energy costs, and limited technical capacity.

They stress that healthcare and industrial facilities require resilient, energy-efficient, and fail-safe HVAC systems tailored to local needs.

They emphasise the urgent need for stronger regulations, minimum performance standards, and greater awareness of certified products. Certifications such as Eurovent, AMCA, TUV, ASHRAE, and PEC compliance are seen as essential tools to ensure quality, energy efficiency, indoor air quality, and long-term reliability.

They argue that without strict adherence to certified benchmarks, substandard products enter the market, increasing operational costs and risking occupant safety.

Amid harsh climatic conditions and weak regulatory enforcement, stakeholders in Pakistan's construction sector underscore the importance of certifications in ensuring reliable and sustainable HVAC solutions for industrial and healthcare facilities.

As an emerging economy, Pakistan stands at a critical juncture where shifting political and economic landscapes are impacting the construction sector. Khalid Rabbani, Director of Fahim, Nanji & deSouza (Pvt.) Limited, an engineering consultancy with extensive experience across diverse projects in the country, highlights the importance of macroeconomic stability in driving industry growth.

The growth of the industrial sector has been somewhat constrained due to high utility costs and higher returns in sectors such as real estate. However, in recent years, notable advancements have occurred, particularly in the healthcare sector, driven by rising service demands.

Amjad Iqbal, Chief Executive Officer of Welkin Solutions and exclusive distributor of brands like Systemair, also notes the resilience and positive developments within Pakistan's industrial and healthcare sectors despite broader economic uncertainties affecting investment and development.

Industrial growth continues to be driven by urbanisation, government incentives, and consumer demand, while healthcare expansion is fuelled by population growth, infrastructure improvements, and increased awareness of healthcare needs. Regulations mandating compliance with international and environmental standards have also played an important role in shaping these sectors.

Designing for Local Needs: Redundancy and Resilience

There is a growing demand for HVAC solutions tailored to critical applications, according to Iqbal.

"Industries require efficient HVAC systems to maintain optimal operational conditions, ensure worker comfort, and comply with environmental regulations," he says.

"Healthcare facilities demand precise tempera-

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Jubilee Corporation: A Legacy of Excellence in Pakistan's Electrical Industry

For over six decades, Jubilee Corporation (JC) has been a pioneering force in Pakistan's electrical industry.

Founded in 1962, JC has consistently upheld its commitment to providing high-quality, reliable, and cost-effective electrical products and solutions to its customers. With a steadfast dedication to excellence, JC has earned its reputation as a trusted supplier of electrical, electronics, and automation technology products across the nation.

Comprehensive Product Offerings

Jubilee Corporation's diverse product portfolio caters to various sectors, offering solutions in:

•Low Voltage Switchgear

The Low Voltage Switchgear offers safe and efficient power distribution across various applications. These solutions feature cutting-edge technology, providing reliability and optimal performance for both industrial and commercial use.

•Medium Voltage Solution

The Medium Voltage Solutions are tailored to meet the complexities of modern electrical systems. They provide robust performance and seamless power distribution, ensuring high reliability and safety for critical applications.

•Power Distribution

Jubilee Corporation's Power Distribution products are engineered to efficiently manage and distribute power, optimizing your electrical infrastructure. These solutions ensure a reliable and streamlined power supply, catering to diverse operational needs.

•Automation

JC's Automation solutions embrace the future of industrial processes, helping businesses streamline operations and increase productivity. They offer state-of-the-art automation components that keep you at the forefront of technological advancements.

•Energy Management

Optimize your energy consumption and enhance efficiency with Jubilee Corporation's Energy Management solutions. These innovative products contribute to sustainable and cost-effective operations by effectively managing energy resources.

•Power Quality

Ensure a stable and high-quality power supply with JC's Power Quality solutions. These products address voltage fluctuations and harmonics, guaranteeing consistent and reliable power output for sensitive equipment.

•Motion Division

The Motion Division offers a comprehensive range of advanced drives and motors engineered to improve energy efficiency, enhance process control, and ensure reliable performance across industries.

•External Lightning Protection and Earthing Systems

Safeguard your buildings with the comprehensive Lightning Protection and Earthing Systems. These solutions offer critical protection against electrical surges, maintaining the integrity and safety of your equipment.

•Pneumatics

JC's pneumatic solutions provide precision and control in various manufacturing processes. These reliable and accurate products are essential for efficient automation across diverse industries.

•Instrumentation and Controls

The Instrumentation and Control components are designed for precision and reliability, meeting the demands of modern industries. These solutions ensure accurate control and monitoring, enhancing operational efficiency.

Strategic Partnerships with World-Renowned Brands

One of JC's key strengths lies in its partnerships with over 35 globally recognized specialist manufacturers. These collaborations enable JC to offer cutting-edge products and technologies tailored to the specific needs of its customers. By aligning with industry leaders, JC ensures that its customers have access to the best engineering solutions available in the market.

Unwavering Commitment to Customer Satisfaction

At the heart of Jubilee Corporation's operations is a deep commitment to customer satisfaction. JC prioritizes its customers at every stage, from initial consultation to after-sales support. The company's team of skilled engineers works closely with clients to provide customized solutions and technical support, ensuring that JC's products deliver long-term reliability and performance.

Looking Ahead: Innovating for the Future

In an industry characterized by rapid advancements, Jubilee Corporation remains at the forefront by staying abreast of the latest trends and technologies. JC is dedicated to continuous improvement, ensuring that its customers benefit from the most advanced and cost-effective electrical solutions available.

As JC continues to innovate and expand its reach, it remains the trusted partner for businesses seeking reliable and high-quality electrical solutions.

For further details and queries, reach out to JC at info@jubileecorporation.com or UAN: +92 21 111 000 520 or visit our website at www.jubileecorporation.com

Corporate Net-Zero HVAC Roadmaps Market Outlook

Maintenance services

Contd from page 6

of broader public sector sustainability initiatives. These buildings often serve as community benchmarks for environmental stewardship, making them ideal candidates for pilot projects and large-scale retrofits. The availability of public funding, coupled with the need to ensure occupant health and safety, is accelerating the deployment of advanced HVAC solutions in institutional settings. Stakeholder engagement and transparent reporting are critical success factors, as institutional buildings are subject to heightened scrutiny from regulators, occupants, and the broader community.

Other applications, such as data centers, laboratories, and transportation hubs, are also contributing to market growth. These specialized environments have stringent climate control requirements and are often subject to unique regulatory frameworks. The adoption of net-zero HVAC solutions in these sectors is driven by the need to ensure operational continuity, protect sensitive equipment, and demonstrate leadership in sustainability. As organizations expand their net-zero commitments to encompass entire value chains, the application segment will continue to diversify, creating new opportunities for solution providers and technology innovators.

Service Analysis

The service segment of the Corporate Net-Zero HVAC Roadmaps market includes consulting, implementation, maintenance, and other value-added services. Consulting services are in high demand as organizations seek expert guidance on developing, executing, and monitoring net-zero HVAC strategies. Consultants help clients assess their current infrastructure, identify opportunities for improvement, and navigate complex regulatory landscapes. They also provide support in securing green financing, obtaining certifications, and engaging stakeholders throughout the project lifecycle. The growing complexity of net-zero roadmaps is driving demand for specialized consulting expertise, particularly in sectors with unique operational requirements and compliance challenges.

Implementation services encompass the design, installation, and commissioning of advanced HVAC systems. These services are critical for ensuring that new technologies are seamlessly integrated into existing building environments and operate as intended. Implementation partners work closely with clients to coordinate project timelines, manage supply chains, and address unforeseen challenges. The focus on quality assurance and performance verification is increasing, as organizations seek to maximize the ROI of their net-zero investments.

Maintenance services play a pivotal role in sustaining the benefits of net-zero HVAC systems over the long term. Preventive and predictive maintenance programs are essential for optimizing system performance, minimizing downtime, and extending equipment lifespans. Service providers are leveraging digital tools, such as remote monitoring and AI-driven diagnostics, to deliver proactive maintenance and rapid response to issues. The shift toward outcome-based service contracts, where providers are incentivized to deliver measurable energy savings and emissions reductions, is gaining traction in the market. This approach aligns the interests of service providers and clients, fostering long-term partnerships and continuous improvement.

Other services, such as training, performance benchmarking, and lifecycle management, are also contributing to market growth. Training programs equip building operators and facility managers with the skills needed to maximize the efficiency of advanced HVAC systems. Performance benchmarking enables organizations to track progress against industry standards and peer organizations, supporting continuous improvement and transparent reporting. Lifecycle management services ensure that HVAC systems remain aligned with evolving sustainability goals and regulatory requirements, providing a holistic approach to net-zero roadmaps.

End-User Analysis

The end-user segment of the Corporate Net-Zero HVAC Roadmaps market includes corporate offices, manufacturing, retail, healthcare, education, and other sectors. Corporate offices are at the forefront of net-zero HVAC adoption, driven by the dual imperatives of regulatory compliance and corporate social responsibility. Leading organizations are leveraging advanced HVAC solutions to reduce energy costs, enhance employee productivity, and demonstrate leadership in sustainability. The integration of smart building technologies and renewable energy sources is particularly prevalent in this segment, as organizations seek to create high-performance work environments that attract and retain top talent.

Manufacturing facilities face unique challenges in achieving net-zero HVAC targets due to the energy-intensive nature of production processes. However, the potential for energy savings and emissions reductions is significant, making this segment a key focus for solution

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Smart Energy Monitoring and Protection Key to Cutting Industrial Power Costs

Our equipment ensures the safety and protection of inverters and entire solar systems: Assad Butt

Assad Butt of Jawad Electric emphasizes that with rising energy costs in Pakistan, industries must adopt smart energy monitoring and protection systems to reduce losses and improve efficiency. His company provides panel-based solutions offering real-time energy analysis that help optimize consumption. He stresses that solar installations require proper protection devices such as DC breakers, DC fuses, and surge protection devices to safeguard costly inverters. Jawad Electric, sole distributor of Turkey's Sigma Electric until 2031, supplies certified LV switchgear with approvals from WAPDA, DHA, and housing societies. The firm also introduced Zelkon accessories, enabling a complete one-window solution built on European standards and certifications. Here is a brief Interview with him.

Muhammad Salahuddin: Energy in Pakistan is expensive, and everyone is looking for cheaper alternatives. Since you run a company in the energy sector, what solutions do you suggest for industries to reduce their energy costs?

Assad Butt: It's a very pertinent question. With rising inflation and increasing energy prices, industries must adopt smarter energy management solutions.

We provide complete energy monitoring and protection systems that help reduce energy losses and improve efficiency. Our systems are installed within electrical panels and offer real-time energy analysis and monitoring. This allows industries to identify wastage, optimize consumption, and ultimately reduce their energy costs.

These smart energy systems not only bring cost efficiency but also minimize technical losses. Many new tools and technologies are emerging that significantly help in lowering overall energy expenses.

Muhammad Salahuddin: Today, Pakistan has multiple energy sources such as solar, wind, and the national grid. How do your panel solutions integrate with these different energy sources?

Assad Butt: Last year, there was a surge in solar installations. However, simply installing a solar system does not guarantee efficiency or safety. Proper protection equipment is essential.

For example, in solar systems, DC breakers, DC fuses (DCFC), and Surge Protection Devices (SPDs) are critical. If these are not installed, the inverter, often costing Rs. 600,000 to 700,000 in a Rs. 2.5 to 3 million system, can be damaged due to surges or faults.

Our equipment ensures the safety and protection of inverters and entire solar systems. SPDs, in particular, protect systems from voltage spikes and lightning surges. These protections are essential for both domestic and industrial solar setups.

Muhammad Salahuddin: Please tell us about Jawad Electric and the solutions your company offers. What are your future plans?

Assad Butt: Jawad Electric has been operating since 1991 under my father's leadership. Initially, we dealt in Chinese and Korean products. In 2019, we partnered with Sigma Electric, a Turkish manufacturer of low-voltage (LV) switchgear, including MCCBs, MCBs, and other panel components.

We have been the sole distributor of Sigma in Pakistan for the past six years, and our contract has recently been renewed until 2031.

Our products have approvals from major institutions, including WAPDA, DHA (Lahore and Bahawalpur), and various housing societies. We are also in the process of obtaining approval from K-Electric.

Recently, we introduced another Turkish brand, Zelkon, which manufactures panel accessories such as push buttons and control components. Together, Sigma and Zelkon allow us to offer clients a complete one-window panel solution.

Muhammad Salahuddin: Do these products carry international certifications and test reports? Are there any hurdles in marketing Turkish products in Pakistan?

Assad Butt: Turkish products are designed according to European standards. Sigma products come with complete test reports and certifications from internationally recognized laboratories.

Because of these certifications, it becomes much easier for us to obtain approvals from Pakistani institutions. Whenever documentation is required, we already have all the necessary reports available.

Turkish manufacturers place strong emphasis on quality, R&D, and testing, which makes their products highly reliable and widely acceptable. As a result, we face very few hurdles in obtaining approvals from organizations such as WAPDA and other authorities.■

By.Muhammad Salahuddin

Hussain & Co.: Powering Pakistan's Industrial Future with World-Class Switchgear Solutions

For over five decades, Hussain & Co. has stood as a hallmark of reliability, innovation, and quality in Pakistan's electrical industry.

Established in 1971 under the visionary leadership of Syed Farhat Hussain, the company has evolved from modest beginnings with manual machines into a cutting-edge manufacturer and distributor of medium and low-voltage electrical solutions. Today, guided by the commitment of Raza Hussain, the legacy continues as the firm scales new heights in technology and service excellence.

Blending Local Expertise with Global Standards

Hussain & Co. does more than manufacture switchgear; it engineers reliability, efficiency, and safety into every product it delivers. With a strong presence across Sindh and Balochistan, the company has built an enduring reputation among designers, consultants, and industrial clients for its top-quality, type-tested solutions.

As an authorized licensee of ABB, a global leader in electrification and automation, Hussain & Co. leverages exclusive access to ABB's advanced technologies. This enables it to offer state-of-the-art Medium Voltage (Unisafe 2.0) and Low Voltage (System Pro E Power) switchboards that meet the highest international standards, including AFLR internal arc classification and IEC Form 1–4 designs.

Pioneers in the Utility Sector with New Technology

Hussain & Co. has taken a leading step in the utility sector by delivering fixed-type panels designed to meet K-Electric's latest specifications. This innovation is setting a new benchmark for performance and reliability in Pakistan's power sector, positioning the company as a true pioneer in bringing world-class technology to the country's utility infrastructure.

Expanding into New Dimensions

Hussain & Co. has also established itself as a leading name in kiosk-type substations, delivering integrated and dependable power solutions for diverse industrial and utility applications. Now, taking a step further, the company is venturing into new dimensions of switchgear technology, broadening its portfolio and redefining the standards of power distribution in Pakistan.

Comprehensive Product Portfolio

- Medium Voltage Panels (11 kV to 132 kV)
- Low Voltage Panels
- Synchronizing & Motor Control Centers (MCCs)
- Automatic Transfer/AMF Panels
- Process Control (PCC) and Distribution Boards
- LT Power Factor Improvement (PFI) Panels

In addition to switchboards, the company offers allied accessories such as:

- Cast Resin Dry Type Transformers up to 15 MVA/36 kV
- Insulated Busbar Trunking Systems from Gersan
- Power Quality Solutions including Active Power Filters, Static VAR Generators, LV Capacitors, and Harmonic Filter Reactors
- Automatic Voltage Regulators up to 6300 kVA

This comprehensive range positions Hussain & Co. as a one-stop solution provider for industries looking to enhance energy efficiency, power quality, and operational safety.

Driving Growth through Partnerships and Innovation

Hussain & Co.'s robust affiliate network and proactive approach enable it to handle projects of all sizes while optimizing inventory, minimizing waste, and prioritizing customer satisfaction. Its team of skilled engineers and technicians combines human expertise with technological advancement to deliver solutions that are both innovative and cost-effective.

Looking ahead, the company aims to expand its footprint nationwide, particularly into Punjab, Khyber Pakhtunkhwa, and Islamabad, to serve Pakistan's largest industrial hubs. Its long-term vision is to emerge as a global player in the switchgear market, providing sustainable and cutting-edge electrical solutions to customers worldwide.

A Legacy Built on Trust

As Chairman Syed Farhat Hussain reflects on over 50 years of excellence, he credits the company's loyal customers and dedicated workforce for shaping its journey. "Our unwavering commitment to innovation, quality, and customer satisfaction has been the cornerstone of our success," he says.

With a solid foundation and forward-looking vision, Hussain & Co. is poised to remain a trusted name in Pakistan's industrial landscape—delivering world-class switchgear solutions where innovation and excellence converge.

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World Bank Group President Meets PM

Ajay Banga, President of the World Bank Group (WBG), called on Prime Minister Muhammad Shehbaz Sharif during his first official visit to Pakistan in his current capacity.

Prime Minister Shehbaz Sharif welcomed Banga and commended the World Bank Group's long-standing partnership with Pakistan. He specifically acknowledged the WBG's commitment as outlined in its 10-year Country Partnership Framework (CPF) for Pakistan.

The Prime Minister noted the Government of Pakistan's vigorous pursuit of a comprehensive, homegrown economic reform agenda aimed at ensuring sustainable economic stability. He expressed appreciation for the World Bank's support in key sectors including resilient infrastructure, agribusiness, digital development, energy, human capital development, fiscal reforms, and initiatives to stimulate private investment for job creation and growth.

Both leaders reiterated the critical need to accelerate the implementation of ongoing projects and ensure robust oversight to deliver tangible results at speed and scale, aligning with CPF priorities. This focus will directly support the Prime Minister's initiative to resolve bottlenecks hindering development projects.

Prime Minister Shehbaz Sharif underscored his government's unwavering commitment to structural reforms designed to unlock job-rich, sustainable economic growth and bolster investor confidence.

In response, President Ajay Banga thanked the Prime Minister for the warm reception and hospitality. He commended the Government of Pakistan's ongoing reform efforts and reaffirmed the World Bank Group's commitment to deepening cooperation through a unified 'One World Bank Group' approach.

Mr. Banga emphasized that achieving the ambitious goals of Pakistan's reform agenda will require greater leverage of private sector resources, in addition to strong coordination among all development partners.■

HVAC Hospital Design for Critical Areas, Operation Theatres and ICU's

HVAC systems in hospitals play a critical role beyond basic temperature control. They are essential for infection control, patient and staff comfort, odor management, and overall environmental safety in healthcare facilities.

Poorly designed or maintained HVAC can contribute to the spread of airborne pathogens, hospital-acquired infections (HAIs), and discomfort, while well-designed systems dilute contaminants, maintain proper pressurization, and ensure high air quality.

Key Importance of HVAC in Hospitals

Hospital HVAC systems prioritize infection prevention by controlling airborne contaminants like bacteria, viruses, and fungi. They achieve this through:

• Dilution via sufficient air changes per hour (ACH).

• Filtration to remove particles.

• Pressurization to direct airflow from clean to less clean areas (e.g., positive pressure in operating rooms to prevent contaminants from entering, negative pressure in airborne infection isolation rooms to contain pathogens).

• Humidity and temperature control to inhibit microbial growth and support healing.

These functions align with guidelines from organizations like the Centers for Disease Control and Prevention (CDC) and are integral to reducing HAIs, as highlighted in resources from the American Society for Healthcare Engineering (ASHE) and ASHRAE.

Primary Standard: ANSI/ASHRAE/ASHE Standard 170

The cornerstone for hospital HVAC design is ANSI/ASHRAE/ASHE Standard 170, Ventilation of Health Care Facilities. This standard (with the latest editions, such as 2021 and updates toward 2025) sets minimum requirements for ventilation in inpatient, outpatient, and residential care settings. It covers:

• Space-by-space ventilation rates.

• Airflow, exhaust, and pressurization.

• Filtration levels (often requiring high-efficiency filters like MERV 14+ or HEPA in critical areas).

• Temperature and relative humidity ranges.

For example:

• Operating rooms typically require positive pressure, minimum 20-25 total ACH (with a portion outdoor air), and temperature/humidity ranges that may adjust for staff needs or procedures (e.g., 68-75°F, 30-60% RH, though flexible per footnotes in the standard).

• Airborne infection isolation (AII) rooms need negative pressure relative to adjacent spaces, 12 ACH total (often with all air exhausted), and HEPA filtration on exhaust where required.

• Protective environment (PE) rooms (for immunocompromised patients) demand positive pressure and high filtration.

• General patient rooms often need 4-6 ACH total, with specific outdoor air minimums.

The standard integrates with Facility Guidelines Institute (FGI) documents and may reference ASHRAE 62.1 for non-healthcare spaces in mixed facilities. Recent updates (e.g., in 2021 and toward 2025) include clarifications on unoccupied turndown in outpatient areas, natural ventilation options, imaging room requirements, and better alignment across space types.

Design Considerations and Best Practices

Hospital HVAC differs from commercial systems due to 24/7 operation, redundancy needs, and stringent infection control:

• Air Handling Units (AHUs): Often dedicated per critical zone (e.g., separate for ORs, ICUs) to avoid cross-contamination.

• Filtration: Multi-stage, with final HEPA in high-risk areas to capture 99.97% of particles.

• Redundancy: Backup heating/cooling sources and power for essential areas (e.g., ORs, ICUs) to maintain conditions during failures.

• Energy Efficiency: Balanced with infection priorities—strategies like heat recovery or variable air volume must not compromise ACH or pressurization.

• Maintenance and Monitoring: Continuous pressure monitoring, visual indicators for differentials, and protocols for construction/renovation (per Section 10 in Standard 170).

• Special Areas: Pharmacies (e.g., USP 797/800 for compounding), sterile processing, and behavioral health spaces have tailored needs.

Additional resources include ASHRAE's HVAC Design Manual for Hospitals and Clinics (second edition),

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Corporate Net-Zero HVAC Roadmaps Market Outlook

Manufacturing facilities

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providers. Manufacturers are increasingly investing in energy recovery systems, process optimization, and renewable energy integration to reduce their environmental footprint. The alignment of net-zero HVAC roadmaps with broader sustainability initiatives, such as circular economy and resource efficiency, is creating new opportunities for innovation and collaboration in the manufacturing sector.

Retail environments, including shopping centers, supermarkets, and logistics hubs, are also embracing net-zero HVAC strategies. The need to maintain comfortable indoor conditions for customers and staff, coupled with rising energy costs, is driving investment in high-efficiency HVAC systems. Retailers are leveraging data analytics and smart controls to optimize energy use across large, distributed portfolios. The visibility of retail operations to consumers and investors makes sustainability a critical differentiator, prompting leading brands to set ambitious net-zero targets and invest in cutting-edge HVAC technologies.

Healthcare and education facilities are prioritizing net-zero HVAC adoption to safeguard occupant health, reduce operational costs, and comply with evolving regulatory standards. Hospitals and clinics require precise climate control to support patient care and infection control, while schools and universities are leveraging sustainable HVAC solutions to create healthy, productive learning environments. The availability of public funding and the alignment of net-zero roadmaps with broader public health and education objectives are accelerating market growth in these sectors. Other end-users, such as data centers, transportation hubs, and hospitality venues, are also contributing to the diversification and expansion of the market.

Opportunities & Threats

The Corporate Net-Zero HVAC Roadmaps market presents a wealth of opportunities for stakeholders across the value chain. One of the most significant opportunities lies in the ongoing wave of building retrofits and upgrades driven by aging infrastructure and tightening energy efficiency standards. As organizations seek to modernize their facilities and reduce operational costs, the demand for advanced HVAC solutions and comprehensive net-zero roadmaps is expected to surge. The proliferation of green financing options, such as energy performance contracts and sustainability-linked loans, is lowering the barriers to adoption and enabling a broader range of organizations to pursue ambitious decarbonization targets. Solution providers that can offer integrated, scalable, and proven technologies are well-positioned to capture market share in this dynamic environment.

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gence of HVAC technology with broader smart building and digital transformation initiatives. The integration of IoT, AI, and cloud-based analytics is enabling organizations to unlock new levels of efficiency, transparency, and control over their building operations. This convergence is creating opportunities for cross-industry collaboration, as technology providers, energy companies, and construction firms join forces to deliver holistic sustainability solutions. The growing emphasis on ESG criteria in investment decisions is further incentivizing organizations to prioritize net-zero HVAC roadmaps, creating a virtuous cycle of innovation and market growth. As regulatory frameworks continue to evolve and stakeholder expectations rise, the market is poised for sustained expansion and diversification.

Despite these opportunities, the market faces several restraining factors that could impede growth. One of the primary challenges is the high upfront cost associated with advanced HVAC technologies and comprehensive net-zero roadmaps. While the long-term benefits in terms of energy savings and emissions reductions are well-documented, many organizations struggle to justify the initial investment, particularly in regions with limited access to green financing or low energy prices. Additionally, the complexity of integrating new technologies with legacy building systems can create technical and operational challenges, requiring specialized expertise and robust change management processes. Addressing these barriers will be essential for unlocking the full potential of the Corporate Net-Zero HVAC Roadmaps market.

Regional Outlook

North America is currently the largest regional market for Corporate Net-Zero HVAC Roadmaps, accounting for approximately USD 2.5 billion of the global market size in 2024. The region's leadership is underpinned by progressive environmental regulations, such as the U.S. Green Building Council's LEED certification and Canada's Net-Zero Energy Ready Building Code. The presence of a mature ecosystem of HVAC manufacturers, technology innovators, and sustainability consultants further accelerates market adoption. North American organizations are increasingly leveraging public and private sector incentives to invest in advanced HVAC solutions, with a particular focus on retrofitting existing commercial and institutional buildings.

Europe is the second-largest market, valued at USD 2.1 billion in 2024, and is expected to grow at a CAGR of 13.1% through 2033. The region's growth is driven by ambitious climate targets, such as the European Green Deal and the Energy Performance of Buildings

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Corporate Net-Zero HVAC Roadmaps Market Outlook

Regional Outlook

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Directive (EPBD), which mandate significant reductions in building-related emissions. European organizations are at the forefront of adopting integrated, renewable-powered HVAC systems and are actively pursuing net-zero certifications for both new and existing buildings. Cross-border collaborations, public-private partnerships, and access to EU funding are further fueling market expansion. The emphasis on lifecycle carbon assessment and circular economy principles is shaping procurement and investment decisions across the region.

Asia Pacific is emerging as a high-growth region, with a market size of USD 1.4 billion in 2024. Rapid urbanization, expanding commercial infrastructure, and increasing government mandates for sustainable development are driving adoption of net-zero HVAC roadmaps. Countries such as China, Japan, and Australia are investing heavily in green building technologies, supported by national and regional sustainability targets. The diversity of climate conditions, building types, and regulatory frameworks across Asia Pacific presents both challenges and opportunities for solution providers. As awareness of climate change impacts grows and access to green financing improves, the region is expected to play an increasingly prominent role in the global market.

Competitor Outlook

The competitive landscape of the Corporate Net-Zero HVAC Roadmaps market is characterized by a dynamic mix of global conglomerates, specialized HVAC manufacturers, technology innovators, and sustainability consulting firms. Major players are leveraging their extensive R&D capabilities, broad product portfolios, and global reach to capture market share in both mature and emerging markets. Strategic partnerships, mergers and acquisitions, and collaborative ventures are common as companies seek to expand their solution offerings, access new customer segments, and accelerate innovation. The race to deliver integrated, scalable, and data-driven net-zero HVAC solutions is intensifying, with leading firms investing heavily in digital transformation, renewable energy integration, and advanced analytics.

Innovation is a key differentiator in the market, with companies focusing on the development of smart, connected, and energy-efficient HVAC systems. The integration of IoT sensors, AI-driven energy management platforms, and cloud-based analytics is enabling providers to deliver solutions that offer real-time visibility, predictive maintenance, and continuous optimization. Sustainability consulting firms are playing an increasingly important role, guiding organizations through the complex process of developing and implementing net-zero roadmaps. The ability to offer end-to-end solutions, from initial assessment and design to implementation and ongoing maintenance, is becoming a critical success factor in the market.

The market is also witnessing the entry of new players, particularly in the technology and services segments. Startups and niche providers are introducing innovative solutions, such as digital twins, advanced energy recovery systems, and performance benchmarking tools, challenging established players and driving competition. The increasing importance of interoperability, cybersecurity, and compliance with evolving regulatory standards is shaping product development and go-to-market strategies. Companies that can demonstrate proven performance, scalability, and alignment with global sustainability frameworks are well-positioned to succeed in this rapidly evolving market.

Key companies operating in the Corporate Net-Zero HVAC Roadmaps market include Johnson Controls, Daikin Industries, Trane Technologies, Siemens AG, Schneider Electric, Carrier Global Corporation, Mitsubishi Electric, Honeywell International, and Lennox International. Johnson Controls is a global leader in smart building technologies, offering a comprehensive portfolio of energy-efficient HVAC solutions and integrated building management systems. Daikin Industries is renowned for its advanced air conditioning and VRF systems, with a strong focus on renewable energy integration and low-GWP refrigerants. Trane Technologies is at the forefront of sustainability innovation, delivering high-performance HVAC systems and digital solutions that support net-zero roadmaps. Siemens AG and Schneider Electric are leveraging their expertise in automation and energy management to deliver holistic, data-driven solutions for commercial and industrial clients.

Carrier Global Corporation and Mitsubishi Electric are expanding their offerings through strategic partnerships and investments in R&D, focusing on smart controls, predictive maintenance, and renewable-powered HVAC systems. Honeywell International and Lennox International are driving innovation in energy recovery, building automation, and performance benchmarking, positioning themselves as trusted partners for organizations pursuing ambitious sustainability targets. The competitive landscape is expected to remain dynamic, with ongoing innovation, collaboration, and consolidation shaping the future of the Corporate Net-Zero HVAC Roadmaps market. - **DI**

Reimagining Pakistan's Urban Energy Future

By Farhan Mujeeb

Pakistan's urban centers are experiencing unprecedented growth driven by rapid urbanization, with nearly 40% of the population now living in cities and projections suggesting this could reach 59% by 2050.

This surge places immense strain on housing, infrastructure, and energy systems, a pressure compounded by climate-induced rural-to-urban migration. The proliferation of new housing societies attempts to meet this demand but often does so through inefficient design, inadvertently intensifying the urban challenges. Modern construction frequently employs materials like concrete and glass, which, while symbolizing progress, replace traditional stone and earth that were better adapted to local climates. This shift increases thermal stress, making buildings colder in winter and hotter in summer, and forces a greater reliance on active, energy intensive heating and cooling systems to maintain liveable conditions. Consequently, the residential sector has become one of the highest energy consuming domains in Pakistan, a demand that continues to climb.

The inefficiencies of this urban expansion are not merely a matter of high energy bills but are woven into a larger tapestry of systemic vulnerabilities. Cities face escalating climate risks, including intensifying heatwaves where urban heat island effects can raise temperatures by 5 –7°C compared to rural surrounds, and increasing urban flooding due to poor drainage and loss of green spaces. Simultaneously, air pollution from industrial and vehicular sources, worsened by energy inefficiency, costs the economy up to 6.5% of GDP annually. The national grid, plagued by high losses, capacity payment burdens, and unreliable supply, is ill-equipped to handle the soaring, inefficient demand from these new urban areas. This creates a vicious cycle: the pursuit of modern housing escalates energy demand, which the strained grid cannot sustainably meet, leading to higher costs and more pollution, thereby deepening the urban environmental crisis. The solution, therefore, cannot be simply generating more power but must involve a fundamental rethinking of how we manage thermal energy in our built environment at the community level.

Here, modern district heating and cooling (DHC) systems, particularly advanced ambient-temperature networks, emerge as a transformative solution for sustainable demand-side management. Unlike traditional building-by-building air conditioning, a district system is a centralized network that distributes thermal energy hot or cold water through underground pipes to multiple buildings for space heating and cooling. The latest "fifth-generation" or ambient-temperature networks operate at temperatures close to the ground, dramatically reducing heat loss and enabling the integration of diverse, low-grade energy sources like solar thermal, geothermal, and waste heat from industries or data centers. For a new housing society, this means a shared highly efficient central plant potentially powered by solar energy replaces thousands of individuals inefficient air conditioners and heaters. Studies of such systems show they can achieve a significantly higher coefficient of performance than conventional setups and reduce annual carbon emissions by over 30%. By treating heating and cooling as a managed communal utility DHC transforms the demand profile of a neighbourhood moving it from a peaky unpredictable burden on the grid to a stable, optimized load that can be managed in conjunction with renewable energy generation.

Crucially, a well-designed district energy system integrated with smart controls acts as the physical backbone for sophisticated demand-side management (DSM) relieving pressure on the national grid without sacrificing comfort. DSM refers to strategies that influence consumer energy use to optimize the overall system. A DHC network is a natural DSM tool because its central plant and thermal storage capacity can decouple energy generation from demand. The system can produce and store cooling energy at night when electricity demand is low and then discharge it during the scorching afternoon peak thus performing "load shifting". This flattens the peak demand curve for the grid, preventing blackouts and avoiding the need to activate the most expensive and polluting power plants. For Pakistan, where DSM has been a neglected strategy with the potential to save 10–15% of primary energy integrating it with DHC in new urban developments is a direct path to energy security. When a housing society's thermal demand is managed this way it ceases to be a grid liability and becomes a grid asset enhancing stability and allowing for better integration of variable renewable resources like solar PV which is already seeing massive adoption in the country.

Implementing this vision requires a concerted, multi-faceted approach that blends policy, finance, and education. Policymakers must create enabling frameworks, potentially mandating DHC feasibility studies for large new developments and reforming regulations to encourage private investment and public-private partnerships. Financial models can leverage the proven life-cycle savings; retrofits for efficiency have shown net present values of USD 750 to USD 1670 over 30 years. By marrying advanced communal thermal infrastructure with deep building efficiency and an engaged populace, Pakistan's burgeoning urban centers can convert the challenge of growth into an opportunity to build resilient, affordable, and sustainable cities for the future.

Why Certification and Standards Are Critical for Pakistan's HVAC Industry

ture and humidity control to maintain sterile environments and safeguard patient health. Reliable systems that adapt to changing circumstances are essential. With ongoing expansions, we anticipate a continued rise in demand for advanced HVAC solutions."

Rabbani adds that designing MEP systems for healthcare and industrial facilities in Pakistan presents unique challenges. Harsh climatic conditions, including extreme temperatures and humidity, demand robust and resilient designs. Limited availability of skilled labour and advanced technology can also affect execution and performance.

"Budget constraints, aggressive timelines, and a mindset focused on immediate returns often hinder optimal solutions," he says. "The lack of stringent minimum standards in certain areas can compromise system quality and efficiency."

Overcoming these challenges, he argues, requires innovative design strategies, cost-effective solutions, and a strong emphasis on quality control and certifications. He stresses resilience, maintainability, and flexibility in system design as critical factors for long-term performance.

The Role of Standards and Certifications

Efficiency, compliance, and certification are critical considerations in healthcare and industrial HVAC design.

"High energy costs and the need to reduce environmental impact make energy efficiency a priority. Certifications such as Eurovent and AMCA provide reliable benchmarks for quality and performance," Rabbani explains.

Iqbal notes that PEC regulations, ASHRAE standards, and environmental rules have helped improve market standards. However, he emphasises the need for clearer minimum standards and stronger enforcement to prevent substandard products from entering the market.

"Certified products ensure long-term operational efficiency and safety. Substandard solutions increase maintenance costs and pose risks to occupant health," he says.

He adds that Eurovent Certified Performance carries strong credibility in Pakistan due to its rigorous validation of product performance and energy efficiency. TUV certifications are also highly regarded, particularly in healthcare applications.

Understanding Certification Beyond the Label

Morten Schmelzer, Head of Group Public Affairs at Systemair AB, emphasises that certification must be properly understood.

"Certifications like Eurovent are not just labels but proof of performance and reliability," he says.

He explains that even lower-performing products can obtain certification if data is accurate, which makes it essential for buyers to understand performance ratings within certification systems.

The Eurovent Energy Label, for instance, provides a clear A+ to E rating scale for performance comparison. For healthcare applications, the Eurovent Hygienic AHU certification offers an additional 1-3 star rating aligned with international hygiene standards.

"Certification bodies must support emerging markets like Pakistan in understanding how to interpret and apply these certifications effectively," Schmelzer concludes.■

Haier

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Project: **Centaurus, Islamabad**
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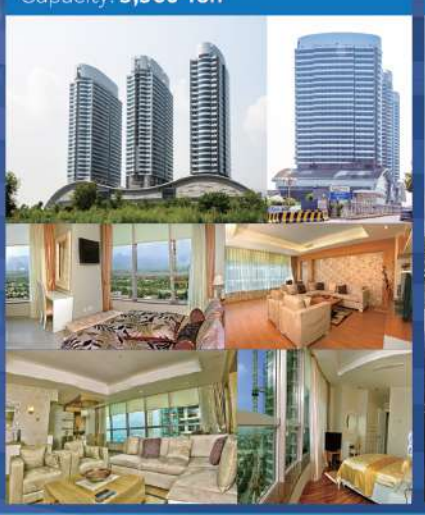
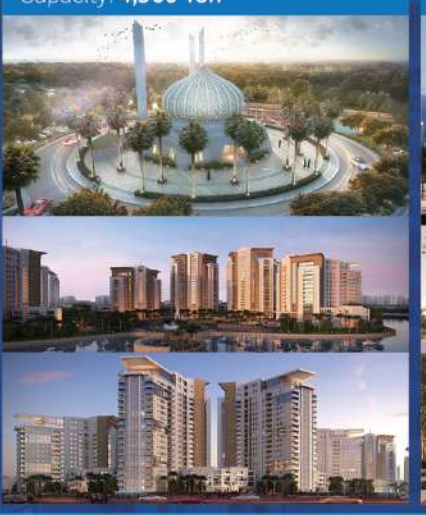
Location: **Islamabad**
Capacity: **3,500 Ton**



Project: **Bakht Tower**
Building Type: **Appartment Tower**
Location: **Karachi**
Capacity: **494 Ton**

Project: **Karakoram Greens**
Building Type: **Appartment**
Location: **Islamabad**
Capacity: **4,500 Ton**



Project: **Mall of Wah**
Building Type: **Mall**
Location: **Wah Cantt**
Capacity: **1,000 Ton**

Fiberglass Innovation Extends Industrial Air Cooler Life to 1o Years, Cuts Cost by Half

Jafar Raza Haidery of Lucky Channel International Company discusses how persistent durability issues in steel-body industrial air coolers prompted a shift toward innovation and local manufacturing. Exposure to harsh outdoor conditions often limited the lifespan of conventional coolers to only a few years, increasing replacement costs for industries. To address this, the company experimented with fiberglass bodies as a long-lasting, cost-effective alternative. The discussion highlights how this transition not only improved product lifespan but also significantly reduced costs and reliance on imports. The interview also covers the company's broader work in evaporative cooling, ventilation systems, and locally developed components that contribute to energy efficiency and foreign exchange savings.

Q: Industrial air coolers traditionally had steel bodies that posed durability issues. What innovation did your company introduce to address this problem?

Our core business is evaporative air coolers and ventilation systems. For many years, we imported cooler bodies from China, and at one point we also imported them in steel. However, steel bodies typically last only 3 to 5 years due to outdoor exposure to extreme weather conditions and other factors.

Over the last two years, we worked on developing a more durable and cost-effective solution. We experimented with fiberglass material to increase the lifespan of the cooler body. Using the same Chinese design, we produced locally produced coolers in 18,000 CFM, 12,000 CFM, and 5,000 CFM capacities with fiberglass bodies. Over the past one and a half years, these products have performed very well, and market response has been encouraging, resulting in increased sales.

In addition, we also offer high-quality industrial exhaust fans for ventilation purposes.

Q: What is the expected lifespan of the fiberglass body you now produce locally?

Based on our testing and field performance, we estimate that the fiberglass body will last 10 plus years, provided it is not physically damaged. This is a significant improvement compared to traditional steel bodies.

Q: What is the cost difference between the imported body and the one manufactured locally?

The imported steel body used to cost around Rs. 300,000 to 400,000. Our locally manufactured fiberglass body cooler is available for approximately Rs. 180,000. This makes it a highly cost-effective product with a much longer lifespan.

By manufacturing locally, we save valuable foreign exchange since imported products must be paid for in dollars. Our product is made and sold in Pakistani rupees. We have also developed six key components locally and are working on localizing additional parts.

Q: So, the cost has decreased while the product life has increased?

Yes, exactly. Previously, we offered imported units at around Rs. 300,000 to 350,000. Now, with fiberglass technology, we offer a more durable product at nearly half the price.

Q: Please tell us about your company, its products, and future plans.

Our company was established in 2011. Over time, we expanded into importing and supplying ventilation products, cold storage components, and related equipment. Today, our focus is on local manufacturing, innovation, and providing cost-effective cooling and ventilation solutions to the industry. – By Mumahhad Salahuddin

Gul Plaza: Tragedy or System Failure?

Technical Analysis & Policy Insight

Muhammad Hasan Masood

Executive Summary for Policymakers & Regulatory Authorities

The Gul Plaza incident must be understood not as an isolated fire accident, but as a systemic failure of building life-safety governance. Technical indicators strongly suggest deficiencies in Building Management System (BMS) integration, HVAC fire-mode response, smoke control systems, and emergency preparedness. This incident highlights serious regulatory and enforcement gaps relevant to SBCA, KMC, Karachi Fire Brigade, Rescue 1122, Fire Councils, and Fire Protection Associations & Forums. Immediate policy action is required, including mandatory life-safety system integration, third-party commissioning, live fire-scenario testing, periodic recertification of high-occupancy buildings, and institutionalized emergency response training aligned with NFPA 101.

Editorial Perspective: A Disturbing Reality

The Gul Plaza incident was not merely a fire. It represented a collapse of integrated life-safety systems. When alarms failed, exits were blocked, sprinklers did not activate, and HVAC systems did not respond, every second increased the threat to human life.

Key Questions That Demand Accountability

Why did the fire alarm system fail? Why did HVAC systems and dampers not switch to fire mode? Why were smoke extraction and staircase pressurization systems ineffective? These questions highlight failures in design intent, system integration, and regulatory oversight.

Technical Review: Role of BMS and HVAC Systems

Under ASHRAE Guideline 13 and ASHRAE Standard 135 (BACnet), BMS is a life-safety integration platform. During fire emergencies, it must control HVAC shutdown, dampers, smoke extraction, and emergency ventilation. Failure to do so constitutes systemic engineering failure.

Smoke Control and Life Safety: NFPA Perspective

NFPA 90A and NFPA 92 identify smoke as the primary cause of fire-related fatalities. Without proper smoke control, toxic gases accumulate and visibility is lost, often before flames reach occupants.

Policy Failure, Human Factor & Emergency Response

Beyond technical shortcomings, governance failures were evident: file-based approvals, lack of drills, compromised safety margins, and untrained occupants. NFPA 101 requires immediate egress access and decisive emergency action.

Industry Direction: A Call for Structural Reform

BMS must be treated as mandatory life-safety infrastructure. Third-party commissioning, safety audits, and inter-agency coordination must be enforced. Buildings where systems operate in silos are hazards in operation.

Conclusion

The Gul Plaza incident is a stark reminder that negligence in engineering, regulation, and preparedness

inevitably costs human lives. Responsibility begins where lessons are ignored.
– (The writer is President, MDA Development Forum & Managing Partner, Industrial Source Book of Pakistan.)

A Passion for HVAC, A Future with Shan Industries

Faraz Hameed Now in Shan Industries

Faraz Hameed joined Shan Industries as GM Sales & Marketing.

With a proven track record spanning several years, he has honed his skills in the intricate realm of HVAC systems.

During my tenure at SABRO Pvt Ltd, he played a pivotal role in driving significant growth and operational efficiency. Through strategic planning and innovative approaches, he consistently exceeded expectations and delivered exceptional results.

Now, he is thrilled to embark on a new chapter in his career with Shan Industries HVAC VRF MEP Ducting & Air Devises, a global leader renowned for its cutting-edge technology and commitment to sustainability. Shan Industries' dedication to innovation and quality aligns perfectly with my professional values, making it the ideal platform to further develop my skills and contribute meaningfully to the industry.

He is particularly drawn to Shan Industries' comprehensive range of HVAC products, including UNI AIR Chiller, AHUs, Mitsubishi VRF, CU, and FCU, MEP, Ducting & Air Devices. These solutions are designed to meet the diverse needs of commercial, residential, and industrial applications, offering unparalleled comfort, energy efficiency, and reliability.

As a dedicated professional, he is eager to leverage his experience and expertise to contribute to Shan Industries' continued success. He is confident in my ability to effectively manage projects, collaborate with cross-functional teams, and deliver exceptional customer service.

He is particularly excited about the opportunity to work with Shan Industries' talented team of engineers and technicians. Their passion for their craft and commitment to excellence are inspiring, and he looks forward to learning from their collective knowledge and experience.

He is confident that his skills and dedication will make a valuable contribution to Shan Industries. He is eager to join a company that shares my passion for innovation, sustainability, and providing exceptional customer service

4 Trends Driving HVACR Innovation

It's often said the only constant in life is change. In the HVACR industry, that phrase has been especially true.

We saw another year of transitions in 2024 that included evolving efficiency and refrigerant regulations, changing corporate net zero targets, the continued emergence of advanced heat pumps, and the impact of artificial intelligence (AI) in building management.

Smart and sustainable

Throughout these transformations, the industry continues to overcome challenges and innovate as we transform the places where people live, work, and play into smarter, healthier, and more sustainable spaces.

As we look toward 2025, we can expect to see a continued, industrywide focus on decarbonization, heat pump development, A2L refrigerants, and AI as regulations expand and new technologies emerge.

Decarbonization

Decarbonization continues to be a very high priority for both the residential and commercial sectors. This focus has transformed the way we design and install HVAC equipment and has created tremendous opportunities for those who invest in educating themselves on the evolving technologies, regulations, and incentives.

Today's building professionals and homeowners have an unprecedented number of incentives available at the federal, state, and utility levels encouraging decarbonization transitions.

Digital and net zero services

For example, tax credits such as 25C for consumers and 179D for commercial building owners were expanded under the Inflation Reduction Act (IRA) and can significantly reduce the upfront costs of high-efficiency equipment, creating a compelling offer to replace less efficient systems.

In commercial buildings, combining high-efficiency HVAC equipment like electric heat pumps with digital technologies and net zero services can help empower organizations to optimize their buildings and subsystems for both the short- and long-term.

Heat pumps

Heat pump technology has advanced significantly in recent years, providing an electrified, high-efficiency HVAC option for nearly all applications – even those operating within colder climates.

The Department of Energy's (DOE) Residential Cold Climate Heat Pump (CCHP) Technology Challenge has propelled the successful introduction of heat pump prototypes that can withstand subfreezing weather. Similarly, the DOE's Commercial Building Rooftop Heat Pump Accelerator program has helped drive packaged heat pump performance toward greater efficiency for commercial and light commercial buildings located in colder climate zones.

Water-to-water heat pumps

Innovations in commercial water-to-water compound centrifugal heat pumps are also accelerating decarbonization within building retrofits. For facilities that require simultaneous heating and cooling, such as hospitals and universities, water-to-water heat pumps can replace legacy chiller and boiler combinations without the need for major changes to the existing HVAC infrastructure.

This partial decarbonization approach can help building operators achieve their decarbonization goals while also lowering operational expenses (OpEx). In many instances, this reduction in OpEx also provides a path to funding additional decarbonization strategies.

A2L refrigerants

The EPA continues to make strides in reducing the consumption and production of hydrofluorocarbons (HFCs) under the American Innovation and Manufacturing (AIM) Act.

As part of the AIM Act, the Technology Transitions Program will usher in sector-based regulations beginning January 1, 2025, prohibiting the manufacturing of equipment using refrigerants with a GWP higher than 700.

New protocols

As a result, new equipment will continue to hit the market throughout 2025. In tandem, many contractors and technicians will begin working with A2L refrigerants for the first time.

Because these refrigerants are classified by ASHRAE as mildly flammable, new protocols for safe refrigerant servicing, storage, and transportation, and refrigerant leak detection (RDS) requirements will be necessary for some applications.

ACCA A2L refrigerant training

With these changes, it is important to become familiar with updated codes, including UL 60335-2-40, 3rd and 4th editions, ASHRAE 15 and 15.,2, and the AHRI Safe Refrigerant Transition Task Force (SRTTF), as well as local and state regulations.

Contractors should also complete ACCA A2L refrigerant training and EPA section 608 certification. Additionally, new digital tools such as RDS calculators can help contractors navigate A2L leak detection requirements and mitigation strategies while in the field.

AI and controls

AI is positioned to continue to make a huge impact in HVAC. We're seeing more service techs using generative AI and co-pilots for troubleshooting rather than paging through manuals. At the same time, AI technology can predict if connected HVAC units may have issues, making it possible for service techs to address potential issues in their earliest stages or prevent them from happening altogether.

Both of these use cases can help technicians service equipment more quickly, efficiently, and accurately, which can increase equipment longevity and reliability while reducing downtime and total cost of ownership.

Building performance

More HVAC systems are being equipped with AI-enhanced controls and reporting. The capabilities these tools provide can give building owners greater opportunities to optimize building performance, improve occupant comfort and well-being, and more easily reach sustainability targets.

From a building management perspective, AI-powered building controls can provide a holistic view into contextualized, full-building performance, occupant experience, and sustainability.

Openness and flexibility

As AI becomes more commonplace, AI-centric building standards, such as ASHRAE Guideline 36, will also continue to emerge that balance sustainability with occupant comfort, health, and safety.

As we move into 2025, we can expect to see another year of equipment innovations, technology advancements, and evolving regulations. As an industry, we continue to face change with openness and flexibility. And it's this mindset that empowers us to meet, and exceed, expectations – now and in the year to come.- David Budzinski, President of the Bosch Home Comfort Group ■

HVAC Hospital Design for Critical Areas, Operation Theatres and ICU's

Contd from page 13

which provides "best practice" recommendations beyond minimums, covering disaster planning, energy conservation, and room-specific strategies.

In summary, effective hospital HVAC design integrates rigorous standards like ASHRAE 170 to create safer healing environments while addressing comfort, reliability, and sustainability. For the most current requirements, consult the latest edition of Standard 170 or facility-specific codes, as local adoptions vary.

ANSI/ASHRAE/ASHE Standard 170, titled Ventilation of Health Care Facilities, is the primary standard governing ventilation system design and operation in hospitals, outpatient facilities, and residential health care settings. It is updated periodically (typically on a four-year cycle) in coordination with the Facility Guidelines Institute (FGI) guidelines to incorporate new research, lessons from events like the COVID-19 pandemic, evolving best practices, and alignment with related standards like ASHRAE 62.1.

As of February 2026, the latest edition is ANSI/ASHRAE/ASHE Standard 170-2025, published in late 2025 (around December 2025). This revision builds on the 2021 edition (which incorporated 17 addenda from the 2017 version) and introduces several significant updates focused on flexibility, clarity, international applicability, and better integration with modern facility types.

Key Updates in the 2025 Edition

The 2025 edition includes the following major changes (drawn from official ASHRAE and ASHE descriptions):

• Optional Natural Ventilation: New requirements allow for the optional use of natural ventilation in suitable healthcare settings, providing designers with more flexibility in low-risk or supportive environments while maintaining infection control priorities.

• Total Outdoor Air Calculation at Systems Level: For HVAC systems serving mixed spaces (some under Standard 170 and others under Standard 62.1), the standard now provides clearer methods to calculate total outdoor air requirements at the system level, improving efficiency in hybrid buildings.

• Imaging Rooms and Nuclear Medicine: Updated requirements for Class 2 and Class 3 imaging rooms, associated non-imaging support spaces, and specific clarifications for nuclear medicine areas to better address ventilation needs in diagnostic and therapeutic imaging.

• Unoccupied Turndown Clarifications: Further refinements to unoccupied turndown strategies, particularly in outpatient spaces, allowing energy savings during low-occupancy periods without compromising air quality or pressurization when reoccupied.

• Separation Distances and Stack Discharge Heights: Enhanced clarifications for complex site conditions, including intake/exhaust separation distances and stack heights to prevent contaminant re-entrainment.

• Behavioral Health Space Types: Additional functional space types and requirements tailored to behavioral health areas, recognizing their unique ventilation and safety needs.

• Cooling/Heating Reserve Capacity and Fuel On-Site Requirements: Updates to reserve capacity provisions for heating and cooling, along with on-site fuel storage or backup requirements, to enhance reliability during outages or emergencies.

• Section 10 Reorganization (Ventilation During Construction): Major reorganization and updates to Section 10, providing clearer, more comprehensive guidance on infection control risk assessments (ICRAs), temporary ventilation measures, and system protection during construction, renovation, or maintenance.

• Filtration Testing Equivalencies: Indications of equivalent acceptable alternative filtration testing methods to facilitate easier international adoption and use of the standard outside the U.S.

• Harmonization Across Tables: Updates to align similar requirements for comparable space types across the different ventilation tables (e.g., inpatient, outpatient, residential), reducing inconsistencies.

• Bronchoscopy Clarifications: Specific clarifications on ventilation requirements for bronchoscopy procedures to support safe airborne contaminant control.

• New Space Types for FGI 2026 Alignment: Addition of new space types and coordination with the upcoming 2026 Facility Guidelines Institute (FGI) guidelines, ensuring the standard remains synchronized with evolving healthcare design standards.

Comparison to Prior Editions

• The 2021 edition focused heavily on expanding outpatient and residential sections (new dedicated tables and sections), extensive filtration revisions, new columns for unoccupied turndown and filter efficiencies, expanded AII room exhaust options, and lessons from pandemic-era airborne infection control.

• The 2025 edition refines and expands these foundations, emphasizing practical implementation, energy considerations (while preserving safety), global usability, and alignment with future FGI updates.

These changes reflect ongoing efforts to balance infection prevention, patient/staff safety, energy efficiency, operational flexibility, and adaptability to diverse facility types. For the most precise application, consult the full 2025 edition (available through ASHRAE or ASHE) or facility-specific code adoptions, as local jurisdictions may reference earlier versions or addenda. Related resources include ASHRAE/ASHE Guideline 43-2025 for operational and maintenance guidance complementing the design-focused Standard 170.

HVAC systems in operating theatres (also called operating rooms or ORs) are among the most critical and stringent in any hospital. Their primary goal is to create a sterile, controlled environment that minimizes the risk of surgical site infections (SSIs) by controlling airborne contaminants, while also ensuring thermal comfort for the surgical team (who often work under intense lights and in gowns) and patient safety during procedures.

These systems follow ANSI/ASHRAE/ASHE Standard 170 (latest edition as of 2026: 2025), which sets minimum design requirements for ventilation in health care facilities. ORs fall under inpatient surgical spaces with the highest demands for air quality, pressurization, and airflow patterns.

Key Requirements per ASHRAE 170 (Latest Editions)

• Positive Pressurization — The OR must maintain positive pressure relative to adjacent spaces (typically ≥ +0.01 inches water gauge or higher). This ensures clean air flows outward, preventing contaminated air from corridors, adjacent rooms, or less clean areas from entering the sterile field.

• Air Changes per Hour (ACH) — Minimum 20 total ACH, with at least 4 ACH from outdoor (fresh) air. Many facilities design for 20–25 ACH (or up to 30 in high-risk cases) to provide extra dilution of contaminants. During unoccupied periods, turndown is allowed (with full restoration upon occupancy) to save energy while preserving pressure.

• Filtration — Multi-stage filtration is required. Recent updates (from 2021 onward, carried into 2025) mandate MERV 16 minimum final filters (up from MERV 14). For high-risk procedures (e.g., orthopedic, transplants, neurosurgery, or burn units), HEPA filters (99.97% efficient at 0.3 microns) must be located at the air terminal device (supply diffusers) to create ultra-clean air delivery.

• Temperature Range — Design typically 68–75°F (20–24°C). This range supports patient normothermia (preventing hypothermia), staff comfort, and microbial control. Surgeons may request cooler settings, but deviations below 68°F require policy justification and case-by-case approval.

• Relative Humidity (RH) — 20–60% (often narrowed to 30–60% in practice). This inhibits microbial growth (too dry promotes static and particle suspension; too humid fosters mold/bacteria) while preventing equipment issues or condensation.

• Airflow Pattern and Delivery — Unidirectional (laminar) airflow is standard. Supply air enters through a large ceiling array of laminar diffusers (often with HEPA filters integrated) directly over the surgical table, creating a downward "clean zone" or sterile field. Air flows vertically at low velocity (typically 25–35 feet per minute) to wash over the patient and surgical site without turbulence.

• Low-level returns/exhausts (at least two, often four, placed symmetrically on walls near the floor) capture and remove contaminants near the perimeter.

• This setup creates a protective "bubble" of clean air around the incision site.

Additional Design Features

• Dedicated Air Handling Units (AHUs) — ORs usually have separate or dedicated AHUs to avoid cross-contamination with other hospital zones. Systems run 24/7 with redundancy (backup fans, power, cooling/heating) for reliability during surgeries or emergencies.

• Anterooms/Sterile Cores — Many OR suites include positive-pressure anterooms or sterile corridors to buffer the restricted area.

• Exhaust and Contaminant Control — All room air is typically recirculated through high-efficiency filters (no direct exhaust required unless anesthetic gases or specific hazards are present). Scavenging systems handle waste anesthetic gases.

• Monitoring and Controls — Continuous monitoring of pressure differentials (with alarms), temperature, humidity, and ACH. Visual/audible indicators ensure staff awareness. Building automation systems (BAS) integrate for precise control.

• Energy Considerations — While infection control takes priority, unoccupied setback strategies (reduced ACH/fan speed while maintaining pressure) help efficiency without compromising safety.

Why These Features Matter

Poor HVAC in ORs can lead to increased SSIs from airborne bacteria (e.g., Staphylococcus), dust, or skin squames. High ACH dilutes contaminants, positive pressure blocks ingress, HEPA/laminar flow protects the surgical site, and controlled temperature/humidity support healing and prevent complications like hypothermia or static sparks near flammable anesthetics.

In practice, many hospitals exceed minimums (e.g., 25+ ACH, ceiling-mounted HEPA arrays) for added safety, especially in trauma, cardiac, or transplant ORs. For the most current details, refer to the full ANSI/ASHRAE/ASHE Standard 170-2025 (available via ASHRAE or ASHE), as local codes may adopt it with amendments, and Facility Guidelines Institute (FGI) documents provide complementary guidance. Always consult a qualified HVAC engineer for site-specific design.

HVAC systems in Intensive Care Unit (ICU) rooms are designed to support critically ill patients who are often immunocompromised, mechanically ventilated, or at high risk for complications from environmental factors. The primary objectives are to maintain excellent indoor air quality, control temperature and humidity for patient comfort and healing, ensure

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Pakistan Climate Change Performance

Pakistan ranks 15th in the CCPI. The country receives a very high rating in GHG Emissions and Energy Use, low in Climate Policy, and very low in Renewable Energy.

Building climate policy on the concept of common but differentiated responsibilities, Pakistan's newly submitted NDC 3.0 includes a differentiation of the 2035 targets for greenhouse gas (GHG) emissions reductions and renewables installation alongside the condition of external climate finance supporting the transition. The CCPI country experts maintain that implementation hinges on consultation with sub-national administrations, as well as regional targets complementing national policies.

The experts are concerned that this outcome may result in a gap emerging between national policy and targets on the one hand, and actual implementation on the other. They also have concern that, without this sort of vertical partnership, enforcement mechanisms, domestic financing, and desperately needed adaptation efforts may not be put in place in time. The experts classify the limited integration of local knowledge and experiences as a weak point and demand closer cooperation between the private and public sectors.

Highly vulnerable to climate change effects and seeking L&D finance justice, committed to renewables amid implementation challenges

While overall energy use levels remain very low, policies have been introduced to increase energy efficiency and foster green electrification of key sectors. A long-term vision, however; is missing and would help reduce the use of fossil fuels. It would also add to the fight against the noxious smog the recurs regularly in cities such as Karachi and Lahore.

The experts welcome the renewed commitment to promoting rapid expansion of renewables, especially solar photovoltaics. Hydropower and wind power are also surging, but some obstacles remain unaddressed, including limited electricity grid capacity. Resulting issues with electricity transmission and distribution have been widely reported. Moreover, the experts criticise the overreliance on external finance and the lack of an established policy framework to maintain momentum in renewables installation.

Recurrent floods heavily affect livelihoods in large parts of the country's population, as Pakistan is considered greatly vulnerable and severely exposed to the climate crisis. It is, thus, no coincidence that the government has been at the forefront of the climate finance debate in recent years, demanding substantial and flexible monetary climate justice transfers to adequately address the loss and damage mainly caused by the world's major emitters. Pakistan collaborates with other especially vulnerable nations and has joined several international initiatives, including, recently, the Fossil Fuel Non-Proliferation Treaty.

Key Outcomes

- Pakistan ranks 15th in the CCPI
- The country's newly submitted NDC 3.0 includes a differentiation of the 2035 targets for GHG emissions reductions and renewables installation alongside the condition of external climate finance supporting the transition
- Key demands: stronger coordination mechanisms between national and regional levels.

CCPI Experts

The following national experts agreed to be mentioned as contributors for this year's CCPI:

- Aisha Khan (Civil Society Coalition for Climate Change)
- Zia Ur Rehman & Mahnoor Khan (Pakistan Development Alliance)
- Mirza Hamid Hassan, Faryal Qazi & Ameena Sohail (Institute of Policy Studies, Islamabad)

CCPI 2026: Target comparison

Paris compatible pathway and 2030 target compared with current development ■

HVAC Hospital Design for Critical Areas

Contd from page 23

reliable infection control, minimize airborne pathogen transmission, and provide a stable environment for sensitive medical equipment and staff.

These requirements are governed by ANSI/ASHRAE/ASHE Standard 170, Ventilation of Health Care Facilities (latest edition as of February 2026: 2025). ICU rooms (often listed as "critical care" or "intensive care patient rooms" in the standard's tables) fall under inpatient spaces with stringent but generally less extreme demands than operating rooms or airborne infection isolation (AII) rooms.

Key Requirements per ASHRAE 170 (Consistent Across Recent Editions, Including 2025)

• Air Changes per Hour (ACH) — Minimum 6 total ACH, with at least 2 ACH from outdoor (fresh) air. Many facilities design for 8–12+ ACH for enhanced dilution of contaminants, odors, and bioaerosols, especially in high-acuity ICUs.

• Pressurization — Positive pressure relative to adjacent corridors and spaces (typically ≥ +0.01 inches water gauge). This directs clean, filtered air outward from the ICU room, preventing contaminated air from entering and protecting vulnerable patients from hospital-acquired infections (HAIs).

• Note: Some specialized protective environment (PE) ICU rooms for severely immunocompromised patients (e.g., transplant or oncology) may require even stricter positive pressure and higher filtration.

• Filtration — Multi-stage filtration is mandatory. Minimum final filter efficiency is typically MERV 14 or higher (per recent editions; some updates allow equivalent testing methods for international use). In critical care, HEPA filtration (99.97% at 0.3 microns) may be added for extra protection, though not always required unless the room is designated as a protective environment.

• Temperature Range — Design typically 70–75°F (21–24°C), with flexibility for patient-specific needs (e.g., slightly warmer for neonates or hypothermic patients). The standard aligns with broader inpatient ranges (often 68–75°F or similar), prioritizing normothermia to aid recovery and reduce infection risk.

• Relative Humidity (RH) — 30–60% (or 20–60% in some contexts). This range inhibits bacterial and fungal growth, prevents dry air issues (e.g., mucosal drying in ventilated patients), and avoids excessive moisture that could promote mold or condensation on equipment.

• Airflow and Delivery —

• Supply air is delivered through ceiling diffusers (often high sidewall or ceiling-mounted) to promote mixing and dilution throughout the room.

• Returns/exhausts are low-level or strategically placed to remove contaminants near the floor (where they settle).

• No strict laminar flow requirement (unlike ORs), but good mixing and unidirectional patterns where possible help control airborne particles.

• Outdoor Air and Ventilation — Continuous fresh air intake ensures dilution of CO_2, odors, and volatile organic compounds from medications or equipment.

Additional Design Features in ICU HVAC

• Dedicated or Zoned Air Handling Units (AHUs) — ICUs often have dedicated AHUs or zones to isolate them from other hospital areas, reducing cross-contamination risk. Systems include redundancy (e.g., backup fans, power, cooling/heating coils) for 24/7 reliability—critical since patients cannot be easily relocated.

• Monitoring and Alarms — Continuous monitoring of room pressure differentials (with visual/audible alarms), temperature, humidity, and ACH. Building automation systems (BAS) allow precise control and trending for compliance.

• Special Considerations:

• Ventilated patients may require integration with med-

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Technology Transfer in Pakistan's HVACR Sector

Barriers, Realities, and the Road to Local Manufacturing

Pakistan's HVACR (Heating, Ventilation, Air Conditioning and Refrigeration) industry sits at a pivotal moment.

Demand for climate control is rising across high-rises, hospitals, malls, data centers, pharmaceuticals, textiles, and cold chains. At the same time, currency volatility, import costs, and supply chain disruptions have exposed the risks of relying heavily on imported compressors, controls, valves, refrigerants, and precision components. The case for local manufacturing is stronger than ever. Yet, meaningful transfer of technology (ToT) into Pakistan's HVACR ecosystem remains slow and fragmented.

Technology transfer is not merely the import of machinery or CKD kits for assembly. True ToT means the movement of design knowledge, engineering drawings, material specifications, testing protocols, and the capability to innovate independently. In HVACR, this includes know-how in compressor design, heat exchanger manufacturing, electronic controls, refrigerant management, insulation materials, and system optimization. While Pakistani firms have made progress in ducts, air handling units, panels, insulation, and fabrication, core engineering components still depend on foreign technology.

Why Technology Transfer Is Slow

Several structural and policy factors explain the sluggish pace.

First, Pakistan's industrial base in precision engineering is still developing. HVACR components such as compressors, expansion valves, and advanced controls require high-tolerance machining, metallurgy expertise, and sophisticated testing facilities. Many local workshops are capable fabricators but lack the advanced tooling, CNC capability, and quality assurance culture needed for global-standard production.

Second, foreign manufacturers are often reluctant to share core intellectual property. Global HVACR brands guard compressor designs, control algorithms, and refrigerant technologies as strategic assets. They prefer export markets or local assembly partnerships rather than full technology disclosure that could create future competitors.

Third, inconsistent policy and tariff regimes discourage long-term joint ventures. Frequent changes in import duties, sales taxes, and industrial policies make it difficult for foreign firms to commit to multi-year technology partnerships. Investors seek stability before transferring sensitive know-how.

Fourth, the gap between academia and industry limits indigenous innovation. Universities produce engineers, but structured R&D collaboration with HVACR manufacturers is limited. Without research labs, material testing centers, and funded applied research, local firms struggle to reverse-engineer or improve imported designs.

Fifth, limited certification and testing infrastructure slows confidence in local products. International buyers and even local consultants prefer imported equipment because Pakistan lacks widely recognized HVACR testing labs that can certify performance to AHRI, ASHRAE, or Eurovent standards.

Sixth, financing constraints play a role. Precision manufacturing requires expensive machinery, molds, dies, and testing rigs. Banks in Pakistan are often hesitant to finance engineering ventures without quick returns, whereas technology localization requires patient capital.

The Case for Encouraging Local Manufacturing

Despite these barriers, the economic logic for ToT in HVACR is compelling. HVACR intersects directly with construction, healthcare, food processing, textiles, agriculture cold chains, and data infrastructure, key contributors to GDP. Import substitution in even a few critical components could save significant foreign exchange.

Moreover, localization creates skilled jobs for engineers, technicians, machinists, and designers. It fosters SMEs in copper tubing, sheet metal, electronics, and insulation materials. Over time, this ecosystem can evolve from assembly to innovation.

Pakistan already has examples of success. Local firms manufacture air handling units, ducts, chillers' frames, control panels, and insulation. With targeted support, similar progress can be made in heat exchangers, electronic controls, and eventually compressor assembly.

How Technology Transfer Can Be Improved

A coordinated strategy involving government, industry, academia, and foreign partners is essential.

Policy stability is the first requirement. Long-term incentives for joint ventures in HVACR manufacturing, consistent tariff structures favoring local production over imports, and tax relief on machinery imports for manufacturing can attract foreign collaborators.

Second, Pakistan needs accredited HVACR testing and certification laboratories. Facilities that can test energy efficiency, airflow, refrigerant performance, and safety to international standards will build trust in locally made products and encourage design ownership.

Third, industry-academia collaboration must deepen. Engineering universities can establish HVACR research centers focusing on thermodynamics, materials, and energy optimization. Final-year projects and funded research tied to industry problems can create indigenous solutions.

Fourth, skill development is crucial. Specialized training programs for CNC machining, electronics for controls, brazing for refrigeration lines, and quality assurance can elevate the workforce to handle advanced manufacturing.

Fifth, the government and industry bodies can negotiate structured ToT agreements with foreign firms, particularly from countries seeking new markets. Instead of simple distribution rights, partnerships should include gradual localization targets—starting from assembly, moving to component manufacturing, and eventually design adaptation.

Sixth, promotion of Energy Service Companies (ESCOs) and retrofitting markets can stimulate demand for locally engineered solutions. When clients value performance and energy savings, opportunities open for domestic innovation rather than brand dependence.

Finally, access to financing for engineering manufacturing must improve. Soft loans, credit guarantees, and green financing tied to energy-efficient HVACR products can reduce the risk for investors entering this sector. - ER

HVAC Hospital Design for Critical Areas

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ical gas systems or additional exhaust for aerosol-generating procedures (e.g., nebulizers, suctioning).

• Neonatal ICUs (NICUs) or pediatric ICUs may have tighter humidity controls (e.g., booster humidifiers for 40%+ RH) and warmer temperatures.

• In outbreak scenarios or for suspected infectious cases, rooms can convert to negative pressure if needed (though standard ICU design prioritizes positive).

• Energy and Maintenance — Systems run continuously with limited turndown (unlike outpatient areas). Energy recovery and variable controls help efficiency without compromising safety. Regular filter changes, duct cleaning, and pressure testing are essential.

Why These Features Matter in ICUs

Critically ill patients are highly susceptible to HAIs from airborne sources (e.g., bacteria, viruses, fungi). High ACH dilutes contaminants, positive pressure blocks ingress, controlled temperature/humidity supports thermoregulation and wound healing, and reliable filtration removes particles. Poor HVAC can exacerbate ventilator-associated pneumonia, sepsis, or other complications.

The 2025 edition of Standard 170 refines related aspects (e.g., better harmonization across tables, reserve capacity for critical areas like ICUs, and international filtration equivalencies) but maintains core ICU parameters similar to prior editions (2021/2017). For exact values, consult the full ANSI/ASHRAE/ASHE Standard 170-2025 (via ASHRAE or ASHE), as local codes or Facility Guidelines Institute (FGI) 2026 alignments may influence adoption. Always involve qualified engineers for facility-specific design and commissioning.■

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imported compressors, controls, refrigerants, valves, and sophisticated equipment. However, rising import costs, currency fluctuations, and supply chain disruptions have pushed local manufacturers to explore indigenous production. Today, several Pakistani companies are manufacturing air handling units, ducts, chillers' components, insulation materials, copper tubing assemblies, and control panels locally. This shift is not only reducing dependency on imports but also creating skilled jobs, supporting SMEs, and strengthening the engineering manufacturing base of the country.

The conference will also highlight how HVACR is becoming a frontline sector in the decarbonization drive. With Pakistan ranked among the countries most vulnerable to climate change, reducing carbon footprint in buildings and industry has become critical. Energy-efficient chillers, inverter-based systems, thermal insulation standards, heat recovery systems, eco-friendly refrigerants, and smart building management systems are gradually entering the local market. Engineers and consultants are increasingly designing green buildings aligned with international standards such as LEED and EDGE, where HVACR design plays a decisive role in achieving energy targets.

Another major transformation underway is the shift toward low Global Warming Potential (GWP) refrigerants in line with global environmental protocols. The industry is slowly transitioning away from older refrigerants toward environmentally safer alternatives. This requires not only technological upgrades but also training of technicians, awareness among contractors, and regulatory support—topics likely to be discussed in depth at the conference.

In the backdrop of Pakistan's economic realities and its GDP composition, the HVACR sector intersects directly with construction, textiles, pharmaceuticals, food processing, cold chain logistics, and healthcare—all significant contributors to the national economy. As industries seek energy savings to remain competitive amid rising electricity tariffs, modern HVACR solutions are being recognized as cost-saving investments rather than expenses.

Moreover, the growing demand for cold storage, vaccine logistics, and food preservation has expanded the refrigeration segment, opening new avenues for local engineering firms. This evolution positions HVACR not just as a building service industry but as a strategic economic enabler.

The Pakistan HVACR Society Conference 2026, therefore, is more than a routine gathering. It is a reflection of how an engineering sector is aligning itself with economic resilience, technological localization, and climate responsibility. By bringing together stakeholders under one roof, the event is expected to catalyze dialogue, partnerships, and practical pathways toward a more sustainable and self-reliant HVACR industry in Pakistan.

Beyond technology and manufacturing, the conference is also expected to underline a critical but often overlooked aspect of the HVACR sector in Pakistan: human resource development and technical training. One of the persistent challenges faced by the industry is the shortage of properly trained HVACR technicians, system designers, and commissioning engineers. While demand for advanced systems is increasing, the availability of skilled manpower to install, operate, and maintain these systems remains limited.

Recognizing this gap, several industry stakeholders, technical institutes, and engineering universities have started offering specialized diplomas, certifications, and degree modules in HVACR design and energy management. The conference will serve as a bridge between academia and industry, where discussions will revolve around curriculum upgrades, certification standards, and hands-on training aligned with modern equipment and international practices.

Another emerging area of importance is the integration of smart technologies and automation within HVACR systems. Building Management Systems (BMS), IoT-based monitoring, predictive maintenance through sensors, and AI-driven energy optimization are gradually entering Pakistan's commercial and industrial buildings. These intelligent systems allow facility managers to

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monitor temperature, humidity, air quality, and energy consumption in real time, resulting in significant operational savings and improved occupant comfort.

As Pakistan witnesses growth in IT parks, data centers, and high-rise commercial buildings, the need for precision cooling and uninterrupted climate control has become crucial. HVACR solutions for data centers, in particular, require specialized designs that ensure energy efficiency while maintaining strict thermal conditions. This niche but growing segment of the industry is expected to gain attention during technical sessions at the conference.

The role of HVACR in public health and indoor air quality is another dimension that has gained prominence, especially after the global pandemic. Proper ventilation, filtration, and air circulation are now recognized as essential elements in hospitals, schools, offices, and public spaces. The demand for air purification systems, HEPA filtration, and fresh air ventilation solutions has grown significantly. Experts are likely to discuss how modern HVACR designs can minimize airborne contaminants and improve indoor environmental quality in densely populated urban centers like Karachi, Lahore, and Islamabad.

Furthermore, the refrigeration segment of HVACR is becoming increasingly important in strengthening Pakistan's agriculture and food supply chain. Post-harvest losses in fruits, vegetables, meat, and dairy products remain a major issue due to inadequate cold storage and refrigerated transport facilities. By expanding cold chain infrastructure, Pakistan can not only reduce wastage but also improve exports of perishable goods. This creates new business opportunities for local HVACR and refrigeration companies while contributing directly to agricultural GDP.

From a policy perspective, the conference is expected to stimulate dialogue on the need for building energy codes, regulatory standards, and enforcement mechanisms. Although Pakistan has introduced building energy conservation guidelines, their implementation remains weak. HVACR engineers and consultants believe that strict adherence to insulation standards, equipment efficiency ratings, and proper system sizing can significantly reduce national energy demand. Policymakers attending the event may find this an opportunity to engage with industry experts to develop practical regulatory frameworks.

Financing and affordability of energy-efficient systems is another challenge that will likely be discussed. While advanced HVACR solutions offer long-term savings, their initial cost is often higher than conventional systems. Banks, financial institutions, and green financing initiatives can play a role in enabling industries and builders to adopt modern solutions through soft loans and incentive schemes.

The conference also reflects the growing entrepreneurial landscape within the HVACR ecosystem. Startups and SMEs are entering the market with innovative solutions such as pre-fabricated ducting systems, energy auditing services, retrofitting of old buildings, and locally assembled climate control units. This diversification is helping the sector evolve beyond traditional contracting into a technology-driven engineering domain.

Importantly, the event offers a platform for international collaboration. Foreign exhibitors, technology providers, and experts often participate in such gatherings, introducing global best practices and opening avenues for technology transfer. For Pakistan, this interaction is vital in keeping pace with rapid advancements while encouraging joint ventures and local production partnerships.

As energy costs continue to rise and environmental pressures mount, HVACR is increasingly being viewed as a strategic lever for national energy conservation. Studies suggest that optimized HVACR systems can reduce building energy consumption by up to 30–40 percent. If adopted at scale across commercial, industrial, and residential sectors, this could significantly ease pressure on the national grid.

In essence, the Pakistan HVACR Society Conference 2026 symbolizes how a specialized engineering field is becoming central to broader discussions on sustainability, economic resilience, industrial growth, and climate adaptation. It is a reminder that solutions to some of Pakistan's pressing challenges—energy shortages, environmental degradation, industrial inefficiency, and food wastage—may well lie within the ducts, chillers, compressors, and control systems of the HVACR domain.

By convening experts, innovators, educators, regulators, and manufacturers, the conference promises to chart a forward-looking roadmap for an industry that is quietly but decisively shaping the future of Pakistan's built environment and economic landscape.

An equally important but often under-discussed opportunity for the HVACR sector in Pakistan lies in the retrofitting of existing buildings. A large portion of commercial plazas, hospitals, factories, shopping malls, and public buildings in major cities still operate on outdated and inefficient cooling and ventilation systems installed decades ago. Experts estimate that energy savings of up to 40 percent are possible simply by redesigning and upgrading these systems without major structural changes. This presents a massive market for HVACR engineers, energy auditors, and solution providers.

In this context, the concept of Energy Service Companies (ESCOs) and professional energy audits is gradually gaining ground in Pakistan. Rather than selling equipment alone, companies are now offering performance-based solutions where energy savings justify the investment. This shift reflects the evolution of HVACR from a contracting business to a performance-driven engineering service linked directly with operational cost reduction and economic efficiency.

Another crucial dimension is the impact of HVACR on Pakistan's electricity peak load, particularly during the summer months. Cooling demand from commercial and residential buildings contributes significantly to stress on the national grid, often leading to power shortages. Adoption of energy-efficient HVACR systems at scale can play a vital role in reducing peak electricity demand and easing pressure on generation and distribution infrastructure.

The public sector also presents enormous potential. Government hospitals, universities, airports, and administrative buildings often run on inefficient climate control systems, resulting in unnecessary energy waste. Modern HVACR redesign in these facilities could translate into substantial savings for the national exchequer while improving comfort and air quality for occupants.

These emerging trends indicate a structural shift in the HVACR landscape where consultants, designers, and energy engineers are becoming as important as equipment suppliers and contractors. - ER

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