

Issue 34 / March 2026

# Energy Journal

**CESI.  
Seventy Years  
of the Future**

**CESI**  
1956 - 2026  
*Inspired with innovation*

### **Energy Journal**

CESI's house organ  
Editorial coordination  
Paolo Chighine / CESI  
Luana Facciolo / CESI  
Davide Cospito / CESI

### **Project, design and translations**

Cultur-e  
[www.cultur-e.it](http://www.cultur-e.it)

# CESI

*Inspired with innovation*

via Rubattino, 54  
I-20134 Milano – Italia  
[info@cesi.it](mailto:info@cesi.it)  
[www.cesi.it](http://www.cesi.it)

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## Editorial

# Seventy Years of the Future



Nicola Melchiotti

For seventy years, CESI has worked at the intersection of energy and innovation.

Founded in 1956 to provide Italy with a major independent laboratory for testing and shaping the future of its power system, today, CESI is a technical reference point for the global energy transition, for grid security, and for the development of critical infrastructure.

In a world marked by geopolitical and environmental instability, energy continuity is no longer a given: it is an essential condition for the economic and social life of every country.

CESI's contribution — through its state-of-the-art laboratories, analytical expertise, and technical independence — is an integral part of this security. Its facilities refine and validate the technologies that enable the modernization of power networks: from direct current interconnections to major energy corridors, and from energy storage systems to the materials that power space missions.

As the technological frontier continues to advance, CESI has expanded its role across the entire value chain, consolidating its presence in a wide range of countries and addressing the most complex and critical challenges of each historical phase.

Looking back at CESI's history means retracing Italy's — and the world's — journey toward more resilient, cleaner, and more interconnected energy systems. Looking ahead means recognizing that this mission is now more crucial than ever. Because every technological breakthrough, every strategic choice, and all new infrastructure ultimately depends on a simple principle: energy changes the world only if it works.

And ensuring that it does work has been CESI's mission for seventy years.

**Nicola Melchiotti**  
Chief Executive Officer & Managing Director

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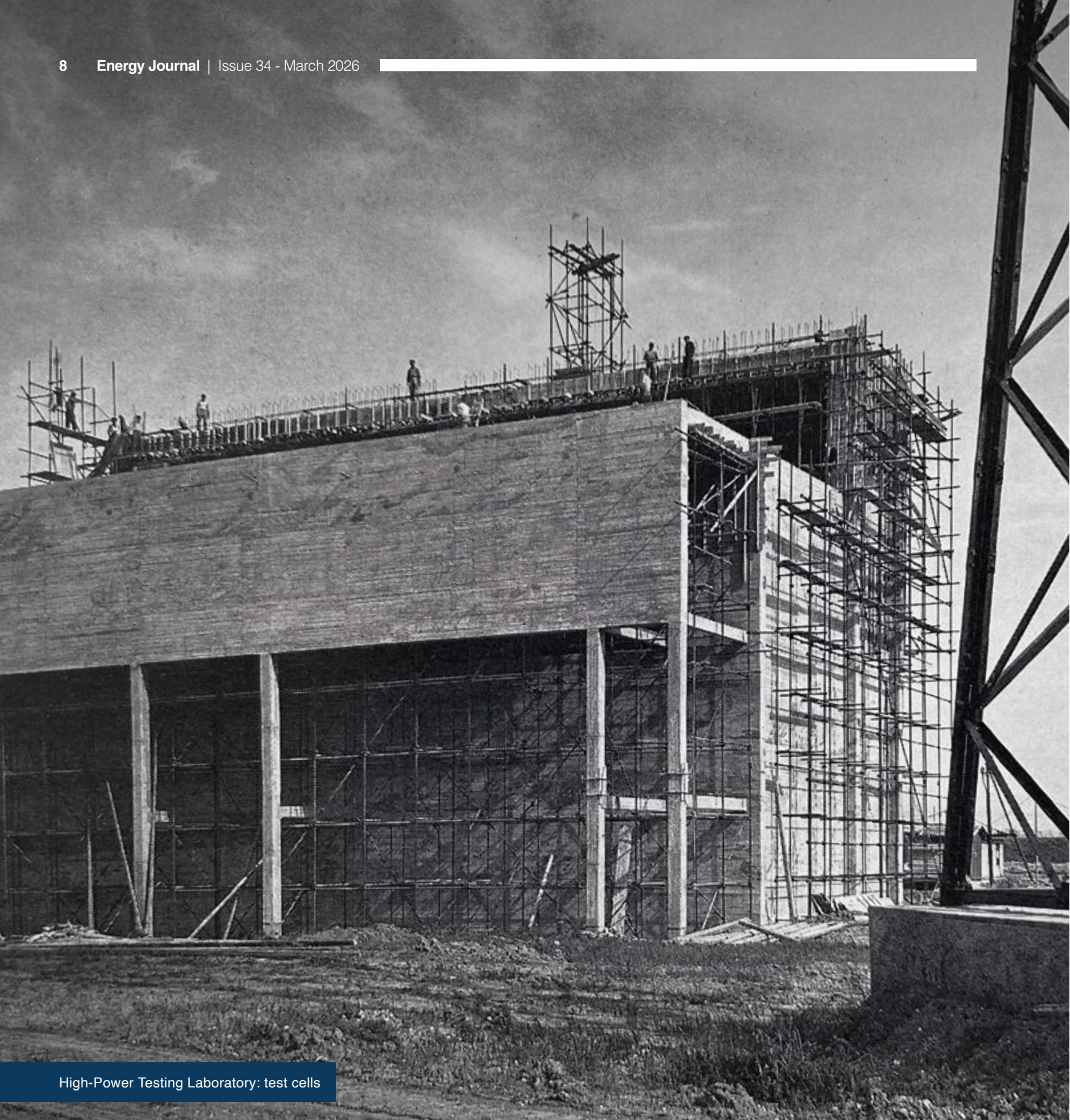
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1950 – 1962

# The Birth of Modern Energy

From the ruins of the post-war years to the emergence of a shared vision, Italy came to understand that energy is not only about production, but also about knowledge, measurement, and responsibility. Between pioneering insight and construction sites on the outskirts of Milan, a laboratory began to take shape — one destined to change the future. It was the place where the country began, for the first time, to think of itself as a single, integrated power system.

## Italy's Power System as an Archipelago

At the beginning of the 1950s, Italy was a country in a hurry to rebuild. Cities were being reconstructed, factories were reopening their gates, and construction sites were springing up everywhere. In many homes, the demand for electricity was growing: radios stayed on longer, a few more light bulbs were switched on, and the first washing machines began to appear amongst the wealthier families. Everything called for energy.

Yet, behind this wave of optimism, the national power system remained fragile and fragmented. More than a network, it resembled an

archipelago: a collection of separate technical and industrial islands, each with its own frequencies, standards, and operating practices.

Electricity did circulate, but the system remained strained.

This precarious balance could function in an Italy just emerging from the war, but not in a country determined to become modern. As factories began operating multiple shifts and cities filled with new industries, the limitations became impossible to ignore: overloaded lines, insufficient interconnections, difficulties coordinating neighboring areas.

There also was a less visible but far deeper problem. Italy had no true national laboratory

capable of testing its electrical equipment. The major tests — those that determined whether a transformer would withstand stress or whether a circuit breaker was safe — were carried out abroad in France, Germany, and Switzerland. For every important prototype, crates had to be prepared, equipment shipped across borders, and weeks were spent waiting. It was as if Italy had to ask someone else for permission to grow.

Without a place to test and verify equipment, Italian industry depended on others not only for technology, but also for the criteria used to evaluate it. This was a quiet, almost invisible dependence, but a decisive one. This is how a simple and revolutionary idea began to take shape. Even before any major

1950

Italy embarked on post-war reconstruction with a fragile and fragmented power grid. Large-scale testing was still carried out abroad, a sign of technical dependence that slowed down industrial development. Awareness grew that progress required a national center capable of studying and validating energy systems.

1956

On March 21, CESI was officially founded. Twenty-seven companies pooled resources and expertise to create the country's first independent electrotechnical laboratory. In Lambrate, energy was the subject of systematic study, laying the foundations for a new level of Italian technological autonomy.

1959

CESI became fully operational. Large laboratories began continuous activity, allowing electrical equipment to be tested in Italy. It was a decisive step: the country acquired its own tools to ensure grid safety, reliability and development.

1962

The law establishing Enel unified the national electricity system. CESI, founded a few years earlier as a technical intuition, proved to be essential. The knowledge developed in its laboratories became one of the key reference points for building Italy's new energy infrastructure.



Professor Ercole Bottani,  
founder and President of CESI  
from 1956 to 1978

➤ reform, Italy needed a place, a physical space where the country's power system could finally begin to think of itself as a single, unified whole.

## Bottani's Insight: Necessity before Institution

That idea found its natural interpreter in Ercole Bottani. An engineer, professor and consultant to the leading electricity companies, Bottani was a man accustomed to thinking ahead. He moved between universities, power plants, and construction sites; he listened to technicians and executives alike, observing the same problems recurring everywhere.

In those years, he was often seen arriving with a folder of notes under his arm, sitting beside test engineers and asking precise — almost insistent — questions. The more energy production grew, the clearer it became to him what was missing: a shared place where knowledge and tools could be brought together.

Each company did what it could with its resources, but none, on its own, could afford the complex and costly testing equipment that was necessary. Major tests were carried out outside of Italy, with long waits and high costs. Bottani viewed the issue not merely as technical, but as one of national independence.

Thus the idea of a shared, consortium-based laboratory, capable of serving the entire power system emerged. It would not be a university centre, a department within any single company, but something entirely new: a neutral

infrastructure at the service of all companies.

At first, many responded skeptically. Some said it was a dream too ambitious for Italy in those years. Bottani listened, nodded, and kept working on his idea. It was not an option for him. It was simply a historical necessity.

## “Laboratory X”: a Project Without a Name, but with a Vision

For a long time, the idea did not even have a name. In minutes and informal conversations, it was referred to simply as “Laboratory X,” a provisional label that sounded as if it had come straight out of a science fiction novel.

The objective, however, was clear: to concentrate the experimental tools required by the Italian power industry in one place, avoiding duplication and waste. It would be a laboratory capable of studying short circuits, high voltages, grid behavior, and equipment reliability.

Turning this intuition into reality was anything but simple. Companies were accustomed to operating independently, jealously guarding their own expertise. The idea of sharing investments and knowledge generated concern and resistance.

Meanwhile, looking beyond Italy's borders, the country's delay became increasingly evident. In France and other European countries, large national laboratories already existed. Continuing to ship prototypes abroad for testing was no longer sustainable. And so, step by step, Laboratory X ceased to be a vague idea and began to take shape as a concrete project.

## From Idea to Place: Lambrate and the First Building

Visions, to become real, require patient hands. In the case of what would become CESI, those hands belonged to Leonardo Maggi. If Bottani was the man of intuition, Maggi was the pragmatic engineer, capable of turning a dream into a timetable. The two were very different: one inclined toward reflection, the other toward action. Together, however, they formed a perfect partnership.

The first concrete step was almost symbolic: the purchase of an alternating



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VERBALE DI ASSEMBLEA

Repubblica Italiana

21 MARZO 1956

L'anno millenovecentocinquantesi il giorno ventuno

Marzo in Milano negli uffici della Società Edison

in Foro Bonaparte 31, alle ore 15.

Richiesto di redigere il verbale dell'assemblea

straordinaria della Società per Azioni "S.I.L.

SOCIETA' IMMOBILIARE INDUSTRIALE DEL LAMBRO S.p.A."

con sede in Milano Foro Bonaparte 31, capitale sociale

10 miliardi di Lire, divisa in 100.000.000, durata al 31 Dicembre

2000, indetta per oggi in questo luogo ed era giunto

stabilimento di convocazione pubblicato sulla Gazzetta

ufficiale del 5 Marzo 1956 Foglio 54 Pagina 5361.

Avanti a me dottor Michele Zanuso Notaio in Sen

regno, iscritto presso il Collegio Notarile di Milano

no, senza l'assistenza dei testimoni per rinuncia

della parte avente i requisiti di legge, d'accordo

e col consenso di me Notaio.

Personalmente comparso il signor

Prof. Dr. Ing. ERCOLE BOTTANI fu Carlo nato a Volpago

(Treviso) domiciliato a Milano, via Felice Bellotti

al n° 7.

Milese n° 3/6/56  
EL CANCELLIERE

Totale L. 3600

1500  
1600  
700  
100

➤ current network model: a massive piece of equipment made of coils, resistors, and capacitors, capable of simulating the behavior of the Italian power grid. A group of young technicians began to gather around that “metal monster.”

Then, came the decisive moment: finding a physical location. Lambrate, which at the time was a suburb of Milan, was chosen. Those who were there recall an area that was still countryside, with a few houses, farm buildings, and the distant sound of passing trains.

When the opportunity arose to purchase a plot of land near the new electrical substation, Maggi had no doubts. “Buy that land,” he said. With that sentence, the project became irreversible. From that day on, the laboratory was no longer just an idea. It had an address, a gate, a nameplate.

## 21 March 1956, CESI is Born

On March 21, 1956, CESI officially came into being. There were no marching bands, no official photographs: just a working table at Edison’s headquarters in Milan.

Twenty-seven companies from the Italian electricity industry decided to join forces: executives, engineers and technicians — men very different from one another, yet united by the same awareness — sat around the table.

Ercole Bottani was appointed President by acclamation, Leonardo Maggi Chief Executive Officer. After several proposals, a name was chosen: *Centro Elettrotecnico Sperimentale Italiano*, CESI, a sober, concrete acronym that was perfectly aligned with the style of those who were creating it.

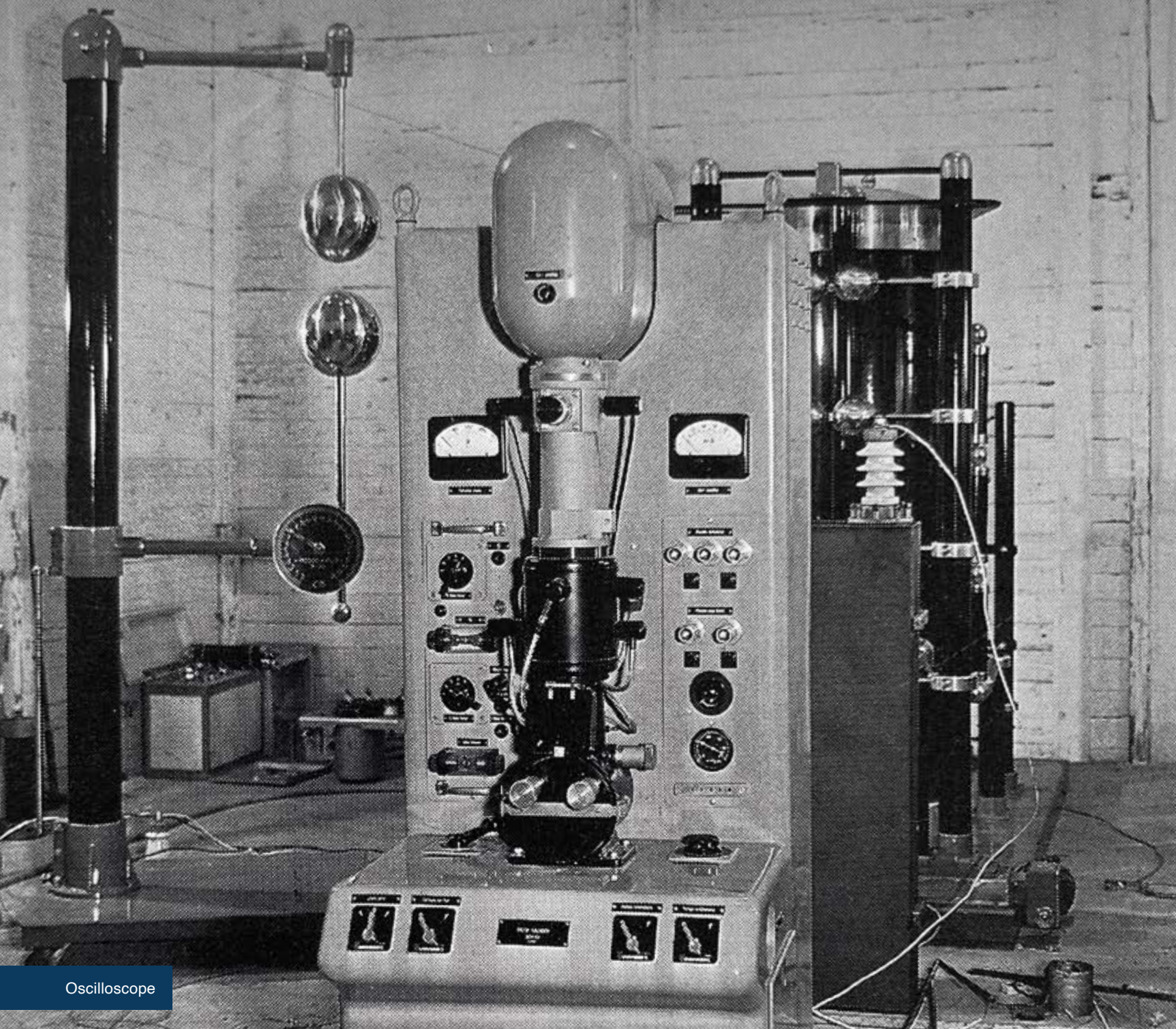
When CESI was formally established, it was already at work. The network model was operational, studies were underway, and the first technicians were already active in the Lambrate laboratory. The notarial deed did little more than give a name to an adventure that had already begun.

## The Pioneers: Working Before Everything Exists

Long before its large, modern facilities, CESI was a small group of enthusiastic and determined people. It was made up of young engineers, barely in their twenties, who every morning made their way to Via Rubattino across fields and unpaved roads. Getting there was not easy: first a tram, ➤



Control room



Oscilloscope

➤ then a stretch on foot. When it rained, it was muddy; when the fog rolled in, it felt as though they were far from everything.

Inside the small building, however, there was a special atmosphere. There were no rigid schedules and no established procedures. People studied, tested, and experimented. Some brought sandwiches from home; someone else brought a coffee pot that immediately became shared property.

It was here that the first true CESI spirit was born: curiosity, rigor, and a desire to

understand. Even before a structured organization existed, a community had already taken shape.

### The “Shack” and Learning in the Field

Before the large laboratories were erected, there was a temporary building that was destined to become legend: the “shack.” It was six meters by seven. The walls were made of

wood and tar paper. The roof let the cold in during the winter and turned the space into an oven in summer.

This was where the first high voltage laboratory came to life: very little equipment and a great deal of ingenuity. Oscilloscopes that looked like objects from science fiction stories, salvaged transformers, and instruments that had been modified by hand.

Once, the story goes, during a particularly noisy test, a local farmer arrived in alarm, convinced there had been an explosion. In that shack, learning was real. Every test was an adventure; every mistake, a lesson. The work was hard, often physical, but enthusiasm erased any fatigue. It was here that the “CESI mindset” took shape — rigor, critical thinking, and the ability to question everything.

Years later, when the large high voltage and high power buildings were constructed, many would look back on the shack with affection: “It was our university.”

### A Laboratory before an Electrical State

By the end of the 1950s, CESI had become an operational reality, while the Italian power system had yet to become a truly unified structure. In Via Rubattino, engineers were studying problems that would only become central a few years later.

It was a paradox, but only in appearance: knowledge precedes institution. The laboratory was born before the electrical state, anticipating the needs of a country that was changing scale.

This is where the CESI story truly begins: not as a response to a political decision, but as a technical intuition turned into reality by a group of determined people.

A place where Italy learned, for the first time, to think of energy no longer as a collection of islands, but as a single, integrated system.

### Early Successes and the Birth of Enel

Between 1957 and 1959, CESI entered a new phase as the startup gave way to continuity. Departments began operating on a regular basis, tests followed one another regularly, and requests arrived from companies that knew they could find something unavailable elsewhere at

Via Rubattino. Transformers, insulators, and network equipment were tested without having to cross the Alps. It was a concrete change — silent, yet profound.

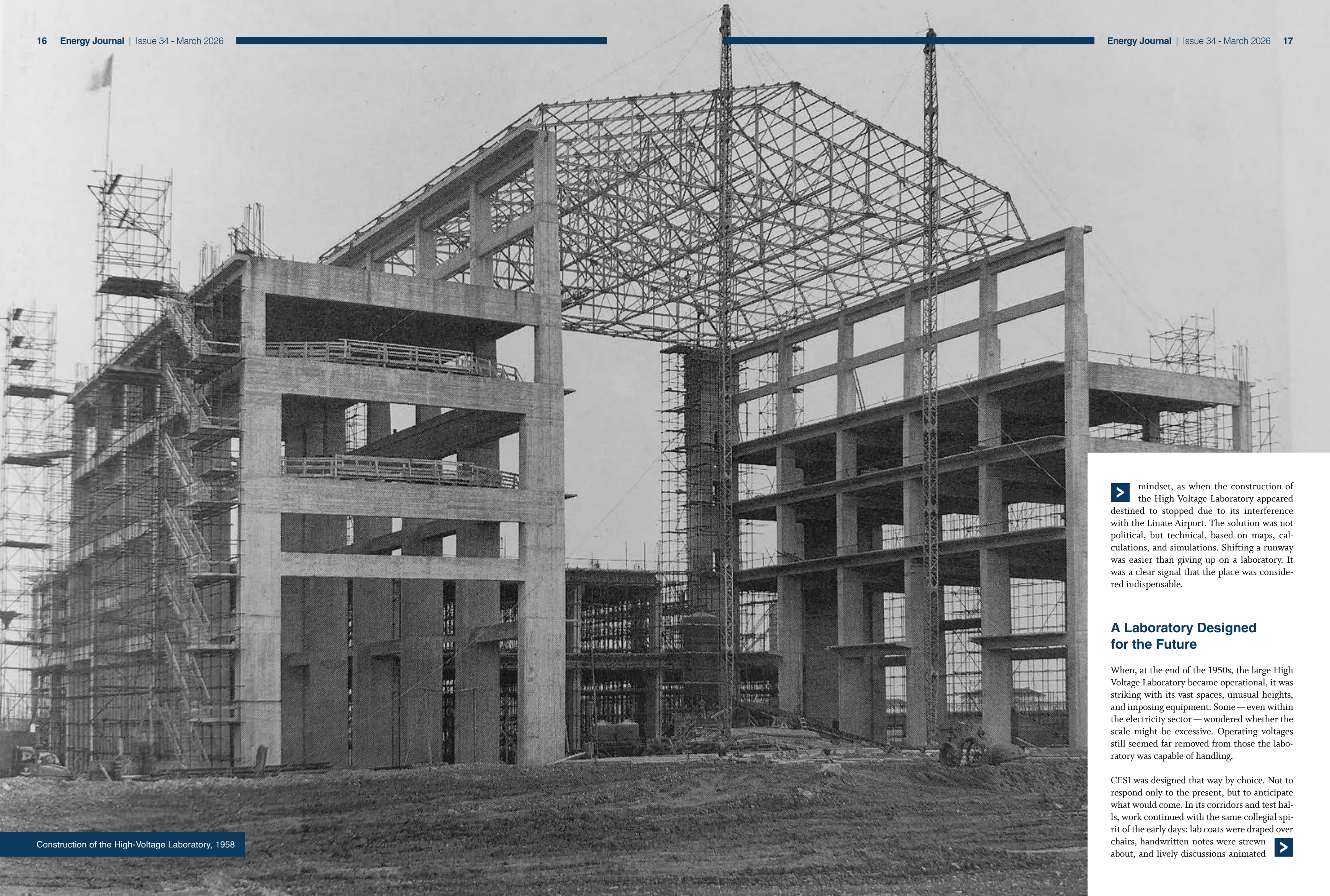
At the center, a distinctive atmosphere took hold. Work was intense, often extending late into the evening. Technicians stopped to discuss results in front of test panels, comparing findings and repeating experiments. A sense

of belonging emerged from shared difficulty: complex instruments, procedures still to be defined, electrical phenomena that did not always behave as expected.

CESI thus began to be called upon not for ideas, but for urgencies, when failures had to be understood, solutions verified, and strategic technical decisions made. External obstacles were faced with the same



Celio Gregori, CESI caretaker



➤ mindset, as when the construction of the High Voltage Laboratory appeared destined to stop due to its interference with the Linate Airport. The solution was not political, but technical, based on maps, calculations, and simulations. Shifting a runway was easier than giving up on a laboratory. It was a clear signal that the place was considered indispensable.

### A Laboratory Designed for the Future

When, at the end of the 1950s, the large High Voltage Laboratory became operational, it was striking with its vast spaces, unusual heights, and imposing equipment. Some — even within the electricity sector — wondered whether the scale might be excessive. Operating voltages still seemed far removed from those the laboratory was capable of handling.

CESI was designed that way by choice. Not to respond only to the present, but to anticipate what would come. In its corridors and test halls, work continued with the same collegial spirit of the early days: lab coats were draped over chairs, handwritten notes were strewn about, and lively discussions animated

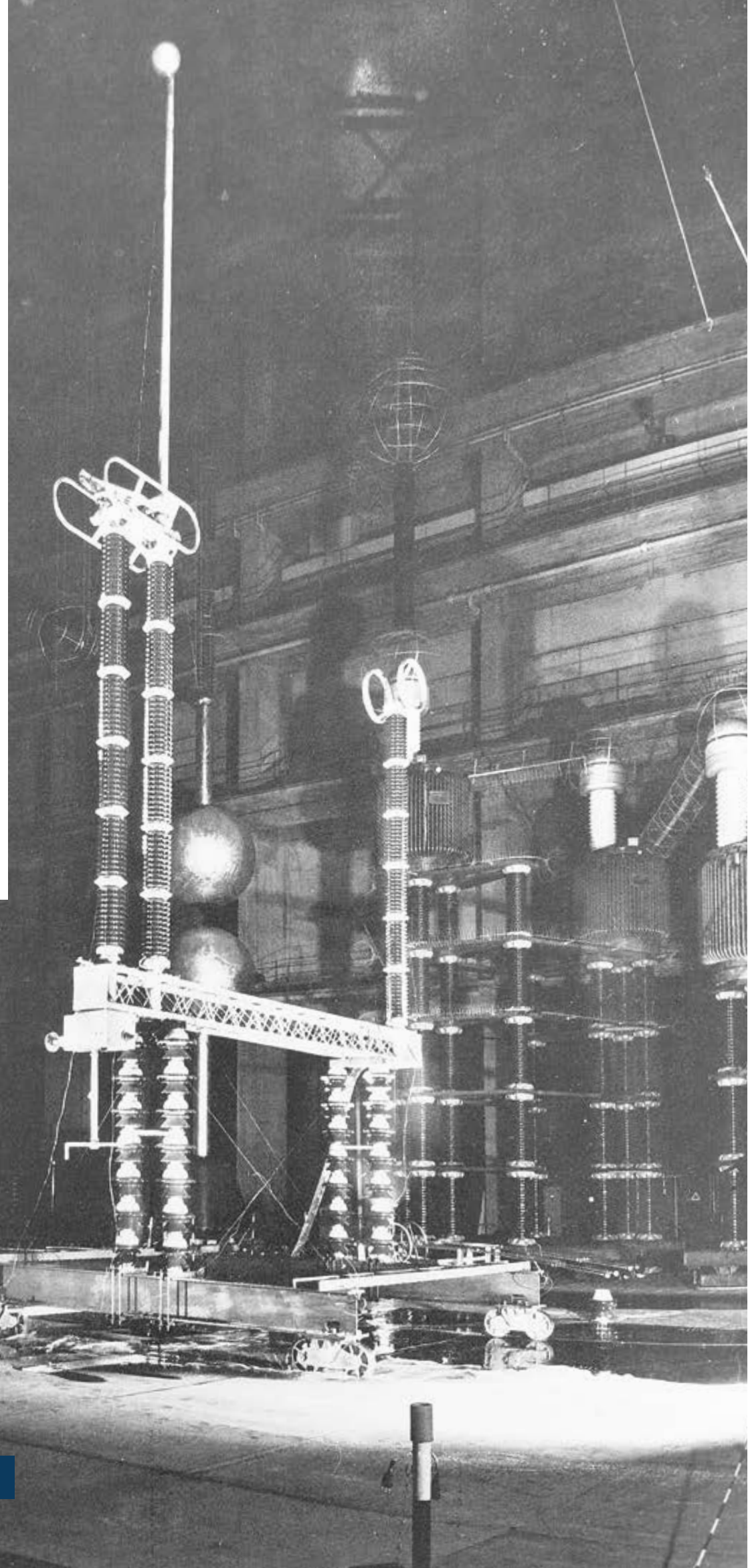


> the structure. Meanwhile, the power system continued growing, networks expanded, and power levels increased. What once seemed “too large” began to reveal itself as simply appropriate.

By the end of its pioneering period, CESI was already prepared for an Italy that had yet to organize itself. It had the skills, facilities, and methodologies that were necessary. The laboratory ran ahead of institutions and experimented solutions for a national power system that had not yet been formally defined. The gap between what was available technically and what was missing organizationally became increasingly evident. And it is precisely from here — from an infrastructure that had learned to think of energy as a whole — that the need for a new framework began to take shape. The next step would no longer be merely technical. It would be institutional.

### The Birth of Enel: Uncertainty, Work and Continuity

In 1962, the atmosphere outside of CESI was tense. For months, politics has debated, clashed, and taken positions. In early March, in the government’s policy statement, Prime Minister Amintore Fanfani announced the



765 kV ITE-Greensburg disconnector being tested

intention of presenting a measure to Parliament for the rational unification of the Italian power system. This marked the official beginning of the process that would lead to the nationalization of the power sector.

The decision arose from concrete and evident needs. As we have seen, the Italian power system was fragmented into more than a thousand companies, often of very different sizes, with networks that were not always integrated and had heterogeneous technical standards. Coordinating investments and building a modern national grid required a unified vision. The creation of a national public agency aimed to guarantee more equitable access to energy across the country, support industrial development, and ensure coherent planning for the infrastructure that would become essential to Italy’s economic and social growth.

At CESI, work continued. Tests did not stop, programs moved forward, and share capital was increased as planned, first in July and then again in December of the same year. This was not marginal activity. It was in CESI’s laboratories that the behavior of interconnected networks, short circuit currents, and coordination criteria between different installations were being studied. And this knowledge was fundamental, on the technical level, to implement the unification that was being discussed politically.

In the laboratories, voices were kept low between one test and the next. On the surface, everything seemed calm, but the atmosphere was charged with questions. What would become of the Centre? Would it remain autonomous, be absorbed, or be pushed to the margins of a redesigned system? From a technical standpoint, many saw nationalization as an opportunity: the rationalization of networks has already begun, partly thanks to CESI, and could accelerate. The real concerns centered on CESI’s very identity.

Between November and December 1962, Parliament approved the law establishing the *Ente Nazionale per l’Energia Elettrica (Enel)* that was tasked with progressively taking over electricity generation, transmission, and distribution from existing companies. The picture suddenly became clearer. The new entity had been created, but it could not establish or absorb companies such as CESI. For a moment, the Centre seemed to be suspended. Power companies, awaiting the transfer of their assets to Enel, lost interest. It was a delicate phase, experienced without clamor but with extreme attention.

In those months, Bottani and Maggi chose a precise course: preparing for any outcome by



Technicians in the network analyzer control room, 1958

strengthening CESI’s internal organization. One November afternoon, with discretion and restraint, new operational responsibilities were assigned. It was not a political move, but a way of safeguarding the work underway.

### A Sigh of Relief

At the beginning of 1963, Enel confirmed the continuation of the contracts assigned to CESI. At the laboratories, the atmosphere shifted: there was no celebration, but a collective sigh of relief. Tests continued, studies moved forward. The definitive solution arrived in the spring of 1963, with a decree authorizing Enel to acquire shareholdings in CESI. It would take time to fully complete the transition, but the direction was clear. Enel chose not to dismantle what already existed, but rather to enhance it.

And when Enel officially enters CESI’s share capital — in February 1964 — it was not merely a corporate arrangement. It was a strategic confirmation: maintaining an autonomous, flexible laboratory, that was already recognized internationally, was the most effective way to support the development of the national power system.

In those very months, while the structure of Italian energy was being redesigned, new research frontiers opened up at CESI. The first tests on switching over voltages, generated artificially, attracted international attention. In the laboratories, engineers continued to debate and experiment.

Once again, the Centre proved its ability to turn uncertainty into opportunity. And when Enel began planning major 380 kV transmission networks, CESI provided the expertise necessary to tackle such complex projects.

1960s–1970s

# Energy as Strategic Infrastructure

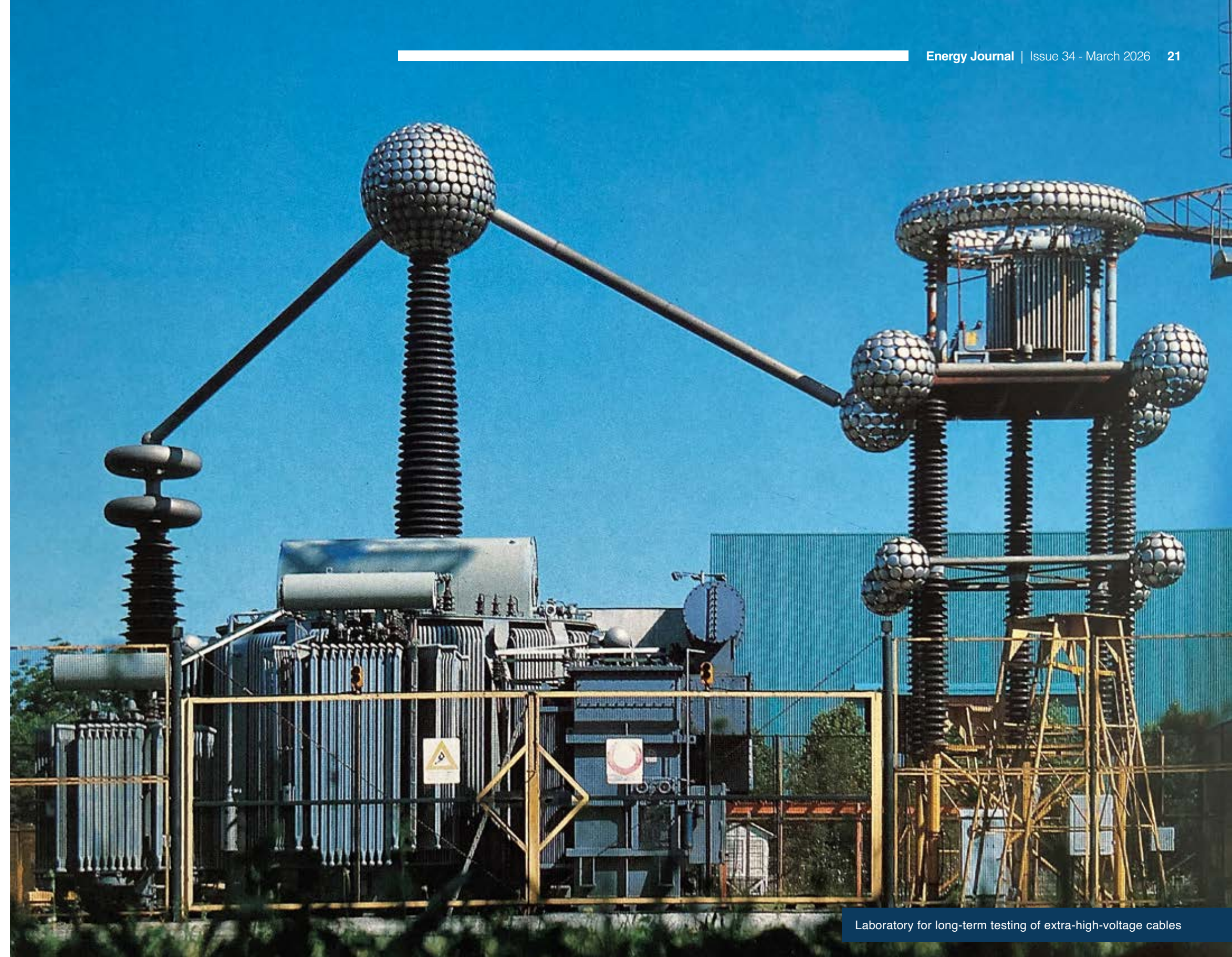
In the 1960s and 1970s, energy became the backbone of industrial development. CESI grew alongside the country, supporting the rise of the major national grids and opening up to the international stage. From the Lambrate laboratories to testing grounds around the world, a new identity took form. It was no longer just a verification center, but a key player in the modernization of Italy's electrical system.

## CESI Ten Years Later

Lambrate, mid-1960s. The streets around CESI have been paved and a few new buildings have been erected where the fields once were. The noise of the city advances slowly, without asking permission. Inside the laboratories, however, time moves quickly.

In 1966, CESI turned ten. It no longer was an experiment. However, it was not yet an insti-

tution either. It was something that worked well as was evident in the details. Familiar faces crossed paths in the corridors. Lab coats remained draped over chairs at the end of the day. Network maps were pinned to the walls with thumbtacks. Sheets filled with numbers, written in pencil, corrected, and rewritten lay on the tables. The smell of insulating oil mixtures with that of coffee passed



Laboratory for long-term testing of extra-high-voltage cables

1964

Enel launched Italy's first 380 kV transmission line, marking the country's entry into modern extra-high voltage networks. CESI actively contributed to the project, providing studies, testing, and expertise. The laboratory became a fundamental technical pillar in the construction of the new national grid.

1965

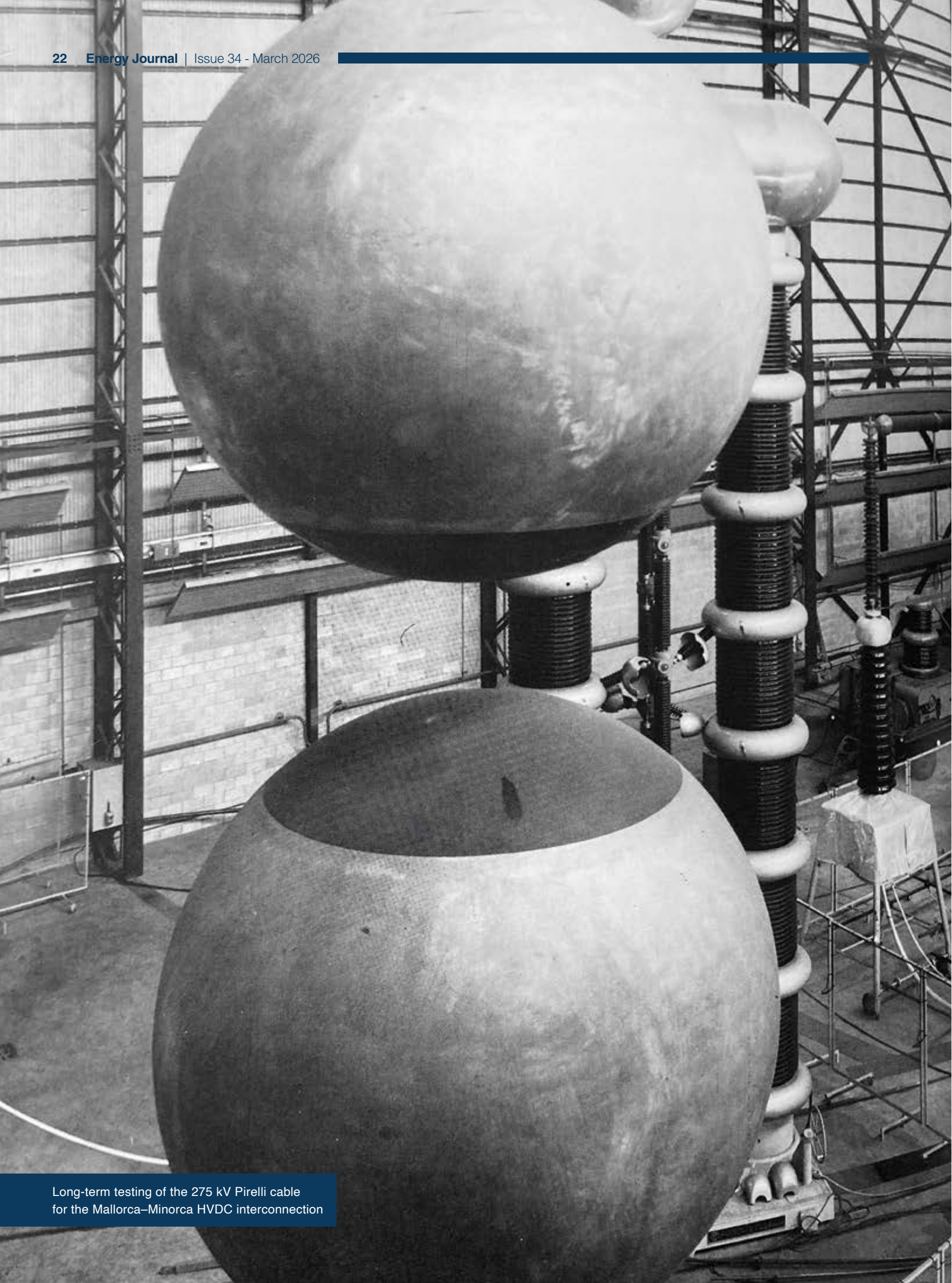
Following the sudden death of Leonardo Maggi, Luigi Tardini took over CESI's operational leadership. It was a delicate phase, yet the center continued to grow. Activities expanded, testing intensified, and CESI strengthened its role as a technical reference for the entire Italian power system.

1969

The anti-explosion laboratory, unique in its kind, came into operation. CESI addressed new challenges related to safety and certification of electrical materials. The solutions developed attracted international attention and helped define new technical standards.

1972

Experimental tests on voltages up to 1,000 kV began in Suvereto. Working alongside Enel, CESI studied the future of large-scale power transmission. The laboratory changed scale, evolving from a national structure into a key player in advanced research on ultra-high-voltage networks.



Long-term testing of the 275 kV Pirelli cable for the Mallorca–Minorca HVDC interconnection

➤ from hand to hand. Something subtle yet decisive was about to happen: the Centre stopped merely responding to questions and began to anticipate them.

The network analyzer, originally designed to observe and understand the “normal” behavior of electrical grids, was progressively modified, expanded, and extended beyond its initial purpose. At first, it was a tool for reproducing what occurred under stable conditions on a reduced scale. Then, it started to be used to explore more complex and less predictable situations, such as the over-voltages generated when lines were energized or disconnected. These were fast invisible phenomena capable of compromising the safety and reliability of the entire power system. The calculation programs developed at CESI ran on external computers, hosted in Bologna and at the Polytechnic University of Milan.

### From Spectator to Part of the Process

In 1964, Enel launched the construction of Italy’s first 380 kV La Spezia–Baggio transmission line. It was both a technical and symbolic threshold. CESI had the resources, expertise, and methodologies necessary. It was not a spectator, but a fundamental part of the project.

During the same period, the perspective began to widen beyond the Atlantic. In January 1964, Giorgio Catenacci — one of CESI’s pioneers who, years later, would become its President — set off for America to visit Montreal, Schenectady, Pittsburgh, the plants of General Electric and Westinghouse, then Oregon, Tennessee, and Chattanooga, before arriving in Buenos Aires. It was a study trip, but also an exercise in comparison.

Meanwhile, work continued at CESI, where a nearly two-kilometer test line was taking shape. Indeed, CESI was among the first in the world to carry out *défaut kilométrique* tests in which faults were simulated at varying distances from a circuit breaker. It allowed CESI engineers to observe, measure, and learn: extra-high voltage circuit breakers became a recognized field of specialization; testing activities multiplied, and the name of CESI began to circulate outside of Italy.

### “Perhaps I Should Have Become a Notary”

In 1965, shortly after returning from Argentina, Maggi died suddenly. The silence that

followed was heavy. When the issue of his succession arose, the decision came in an almost theatrical manner, as Professor Bottani would later recount: a meeting at a railway station, a glance, a phrase hanging in the air. “What about Tardini?” “Tardini.”

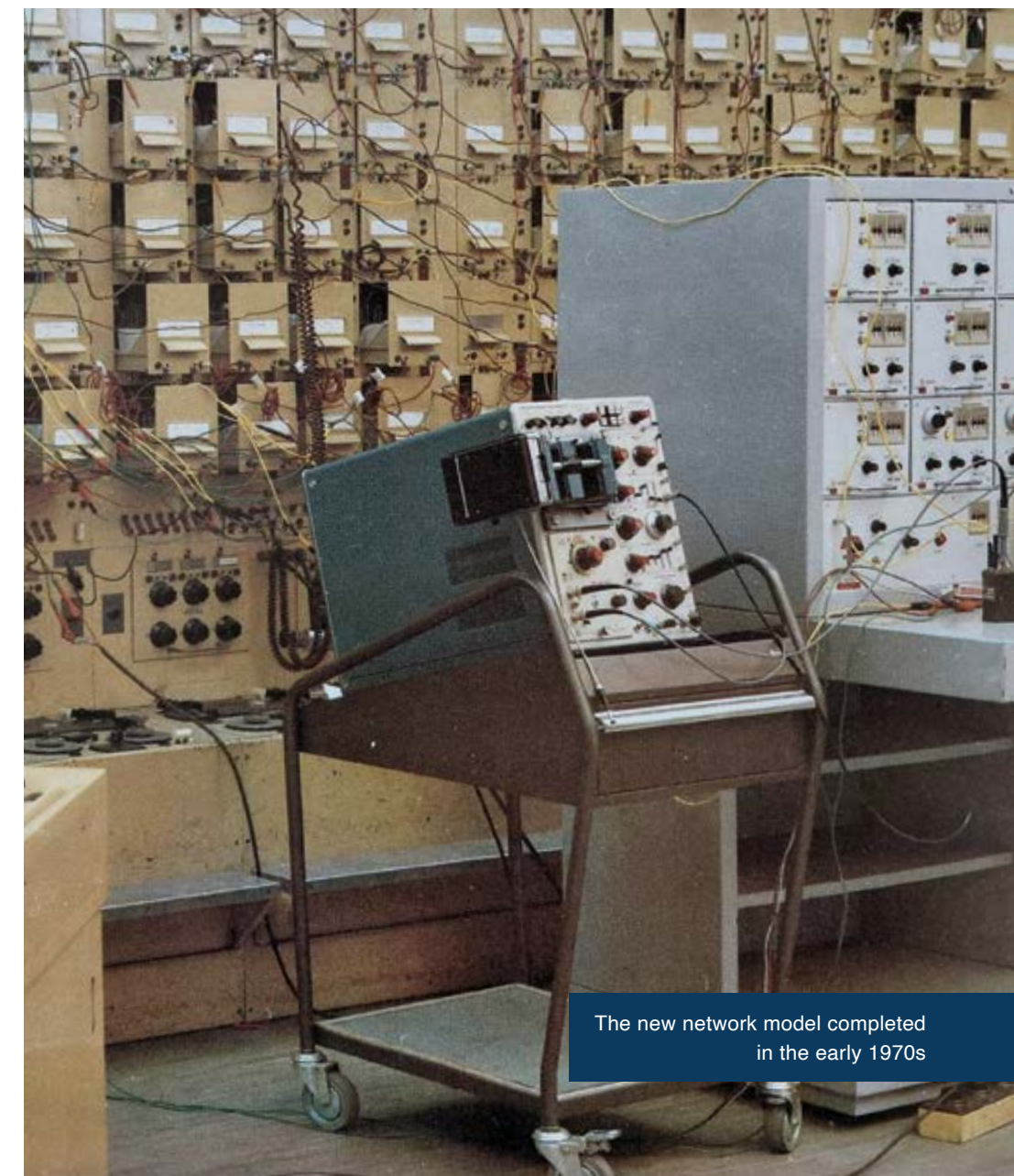
On May 20, 1965, Luigi Tardini became Chief Executive Officer of CESI. He was just over forty years old, but he knew the Centre well and moved easily between laboratories and balance sheets. From time to time, with irony, he murmured: “Perhaps I should have become a notary.” At his side, Catenacci became General Manager. It was a complementary partnership: technology and organization, vision and pragmatism. CESI continued to grow, but without becoming rigid.

### Sudden Departures

Meanwhile, technicians were often called upon to travel at very short notice: a phone

call, an urgent request, and just a few hours to prepare. In 1967, it happened in Colombia: crates of instruments were hastily loaded with Baron oscillographs, capacitors, and photographic equipment. Travel was light only in appearance, the real weight was the responsibility of understanding what had happened. Then, it was Buenos Aires. Twenty days before Christmas 1966, Giancarlo Magstris set out with two hundred kilograms of equipment. He spent the holidays far from home, amid nighttime measurements, hastily developed photographs, and notes scribbled on the margins. Time did not stop — not even at Christmas — if an electrical network continued to malfunction.

CESI now had 152 employees: not that many, but it was a closely knit group. In the high voltage and high power laboratories, work was always carried out under tension — and not only electrical. The countdown to the final command — “one, two, three... test!” — was a ritual. Loudspeakers crackled, discharges illuminated the



The new network model completed in the early 1970s

➤ hall. It was the final moment of very long days. If Lambrate was changing outside, CESI was coming of age inside.

## Expansion and a New Mindset

In 1967, something changed again. Not noisily, but decisively.

Luigi Tardini stepped down as Chief Executive Officer of CESI. He had been called to Rome and appointed Central Director of Human Resources at Enel. At CESI, his position was entrusted to Lino Richard. He came to CESI from Enel's Studies and Research Directorate, where he had served as Deputy Central Director. His appointment further strengthened the link between the Centre and its majority shareholder.

These were years in which CESI grew visibly. In 1967, the workforce totaled 157. Three years later, it would reach 242. Growth was not sudden, but steady, consistent with technical development. New faces appeared in the corridors, desks multiplied, departments reorganized without losing their habit of direct, open discussion. It was not only the number of people that grew, it was the questions as well.

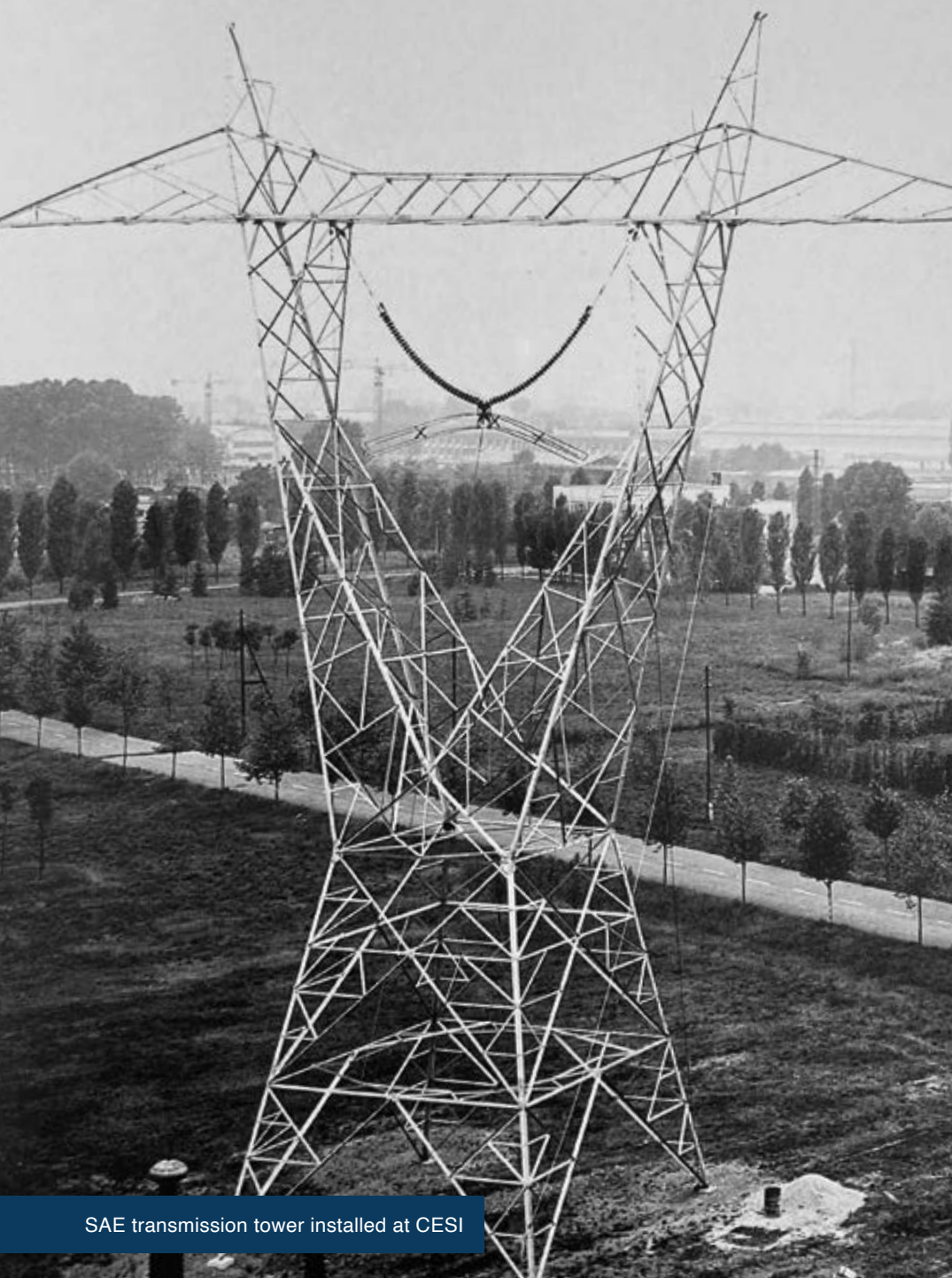
One of the most urgent concerns was safety. Electrical cables caught on fire, equipment was installed in explosive environments, conformity declarations were never truly verified. In Italy, by the late 1960s, there was no testing system and no place where explosion-proof electrical materials could be seriously studied, tested, and certified. However, the requests had been coming in for some time from Montedison, SNAM, and other major industrial players. Everyone knew the problem existed, but no one had fully addressed it, yet.

CESI decided to do so. It was a deliberate decision: not out of convenience, but out of responsibility. A country that was growing could not afford grey areas on such delicate issues.

## A Laboratory Unlike Any Other

Ottavio Zanetti, an affable engineer from the Veneto who had been at CESI for several years, was chosen to lead the project. He still recalls the moment when Catenacci summoned him and handed him a 200-page long booklet of standards. Then, he set off to visit other European laboratories and see how ➤





SAE transmission tower installed at CESI

> they were organized, what worked, and what did not. Upon returning to Lambrate, he began to implement his design.

He worked with engineer Nicola, who managed civil works, and electrical technicians Magos and Cerasi. There were many difficulties, but the laboratory began to take shape. And when the first tests were conducted at the end of 1970, one thing immediately became clear: this is not just a functioning laboratory. It is a different kind of laboratory.

At the first European conferences on explosion-proof materials, CESI presented studies that challenged methods for measuring pressure during explosions. The walls of the test

cells were neither vertical nor parallel, but funnel-shaped, an idea developed by Magos to prevent spurious shock waves during gas mixture explosions — a simple, yet radical solution that would later be adopted elsewhere.

Meanwhile, collaboration intensified with Enel's Studies and Research Directorate, particularly with the Electrical and Automation Research Centers. Work focused on insulation behavior in large air gaps, performance in the presence of saline and industrial pollution, and methodologies for synthetic testing. As early as 1965, using its existing facilities, CESI had set up a small pilot plant for this type of testing, but now the work could proceed systematically.

With the creation of the Enel Constructors Group for Synthetic Testing, CESI began to consider developing a true industrial synthetic testing laboratory. In 1969, the decision was taken. It did not have to be an imposing structure, but it would be sufficient to make a significant leap forward. Years later, Enel would become the first utility in the world to fully accept the validity of synthetic testing for the procurement of circuit breakers, a step that would lead to the international recognition of this methodology.

### Young Technicians and a New Mindset

Between 1967 and 1970, work intensified. Many new young technicians arrived, bringing with them a different mindset and questioning established habits. Some left, others went abroad. It was 1968. Outside of CESI, the world was in turmoil: trade union protests, Vietnam, Mao's China. And the wind reached Lambrate too — muted, but unmistakable. It was another phase, another CESI. Expansion was no longer only technical: it was human, cultural, and inevitable.

### The Development Plan and a Renewed Identity

At the beginning of the 1970s, Lambrate appeared unchanged: the building, the treelined streets, the canal running along the Centre. Yet, the atmosphere was different. The unrest of 1969 had left its mark on factories and offices alike. It was a period of change and conflict. Energy was exposed like a raw nerve. New words appeared increasingly frequently in newspapers: crisis, inflation, instability.

At CESI, however, there was work — and plenty of it. Paradoxically, however, this was misleading. Employees had the impression of an engine running at full speed: tests followed one another, requests kept coming in, and departments were in constant motion, but beneath the surface there was another story: a growth that needed oxygen and, at times, struggles to continue breathing.

### A Program to Secure Growth

Catenacci proposed the preparation of a real, forward-looking, multi-year plan to the Board, which approved it. Enel understood as well: electricity consumption >



2 MV direct current generator

was growing, both in Italy and worldwide. It was almost a competition among industrialized countries. Voltages were increasing everywhere: 500 kV, 600 kV, up to 800 kV. If CESI did not adapt, it would slowly slip out of the vanguard.

Catenacci also chose thirty-three year old Eugenio Brasca as his assistant. Since 1966, Brasca had been managing the High Power Laboratory. Under his guidance, key components of what was to be the new CESI were taking shape: an explosion-proof laboratory, a synthetic testing facility, and the renewal of medium-power tests with high current.

With his dry sense of humor, Bottani made a remark: “If there is money, a problem is no longer a problem.” He said it as a joke, but no one really laughed. Then, unexpectedly, the money arrived.

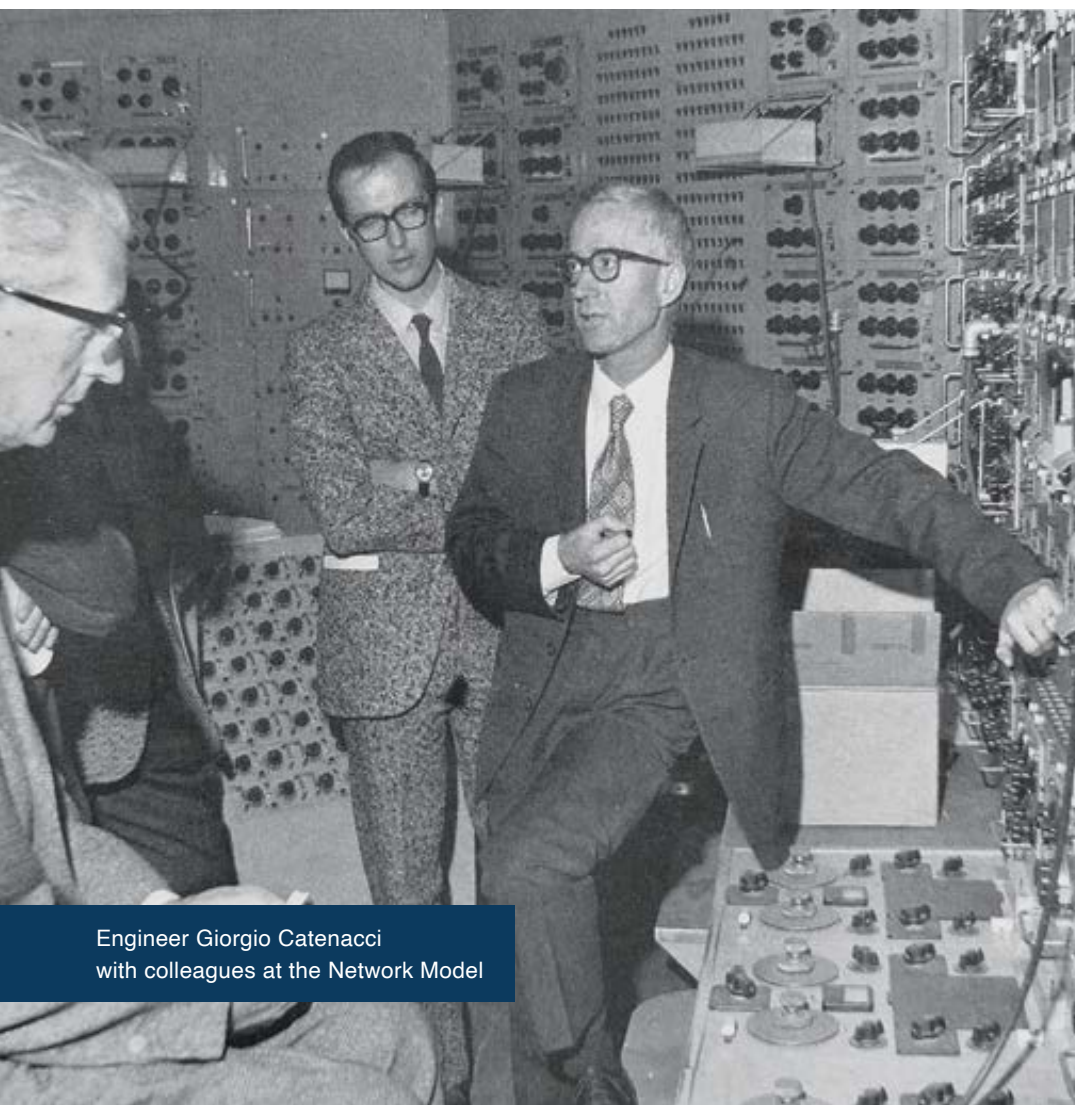
The plan — renamed the *Great Development Plan* — was based on a capital increase of 10 billion lire and an IMI loan of 15 billion; the rest would have to come through self-financing. It was a huge investment for a laboratory born among the fields and fog. And it was not only about machines and buildings. The plan came with an embedded mindset transformation, a shift from a “pure” labora-

tory to an organization that had to learn how to govern itself.

Not to deny its nature, but to avoid being overwhelmed by its own growth. Productivity entered the conversation, linking costs and revenues. It became clear that procurement could no longer be managed “by islands,” department by department, losing economies of scale and discounts. Department heads — accustomed to living by tests and technical results — were asked to look at balance sheet figures. It was a cultural transformation that some experienced as an intrusion, others as a necessity.

### Build or Wait?

The vast and multifaceted five-year plan was conceived to be flexible. And, indeed, it stretched: from five, it would eventually cover fourteen years. Reality always intervenes — with new requests, unexpected technical developments, and events that came to pass unexpectedly. One example was Pirelli. Merely a few weeks after the launch of the plan, Pirelli requested the testing of long sections of 750 kV AC cables. Another was when Enel announced a 1,000 kV Project, which at the



Engineer Giorgio Catenacci with colleagues at the Network Model



1000 kV Project, Suvereto

time was at the crossroads of science fiction and urgency.

By the late 1960s, electricity demand was growing at seemingly unstoppable rates. If it continued to increase by an average of 7% per year, in twenty or thirty years' time, the landscape risks being filled with lines and towers — at an enormous environmental cost. In order to carry more energy over greater distances, voltages had to be raised — and raising voltages meant an entirely new set of technical challenges.

This was how the 1,000 kV project took shape:

not as an isolated idea, but at the convergence of discussions, studies, and financing. Luigi Paris, a member of CESI's Board of Directors and future President, who at the time was Director of the National Centre for Studies and Projects, would later recall: “The problem was in the air.” And when IMI was tasked with managing a financing plan for industrial research, Enel decided to formalize the request. IMI inquired: who will you work with? The answer was immediate: “CESI.”

In 1972, the location was carefully selected: Suvereto, in the Province of Livorno. Open-air tests and experiments were conducted at an

experimental facility where CESI brought its most important equipment: three enormous 800 kV, 20 MVA transformers operating continuously, a six-million volt impulse generator, dividers, and measuring instruments. Technician Giuliano Ceron oversaw the installation from 1972 to 1975. Coordinating a team of technicians, he assembled equipment and people in Suvereto, in collaboration with Enel.

In 1975, when testing began, the laboratory truly resembles a film set: a green four-meter wide cylinder stood twenty-three meters high; a sixty-meter high and forty-meter wide steel portal; and gigantic towers that some descri-

bed as “towering over the Leaning Tower of Pisa,” as well as two two-hundred ton transformers, each resting on porcelain columns six meters high.

At night, bluish effluvia from energized conductors lit the air with an unreal light. And all around it, lay Tuscany. Silence, rain, wind, and moonlight; the chirping of birds continued, indifferent, while the machinery stood still or came to life. In that landscape, CESI changed magnitude without losing its nature. A laboratory born in the fog of Lambrate was now testing the future under the open sky. And history, once again, emerges from the details.



Mobile unit for environmental characterization

1970s–1990s

# CESI Becomes a Company

Between the 1970s and the 1990s, CESI underwent a profound transformation. From a center of laboratory excellence, it evolved into a technology-driven company capable of competing on the market, diversifying its activities, and expanding internationally. High voltage, synthetic testing, nuclear and aerospace applications, quality and certification: CESI learned how to manage growth without compromising scientific rigor, turning technical expertise into industrial strategy.

## CESI is Transformed into a Company

**A**t the beginning of the 1970s, it was not just the landscape beyond the gates that was changing at CESI. What also began to shift was the weight of each day. The testing continued to absorb time as it always had, but around the tests — between reports

and cost estimates — another, quieter urgency took shape: the laboratory required a company-like backbone, but without losing its soul. In 1972, as he was appointed to chair the CIGRE Study Committee on circuit breakers — a position that he would hold until 1978 — Catenacci began to introduce an idea that, at the time, sounded almost provocative at CESI: a laboratory can remain a laboratory, but it must also learn how to stand on its

1972

CESI launched an organizational transformation. It was still a laboratory, but also a self-sustaining enterprise. The Development Plan marked a cultural shift toward structured management, with major investments in high-power and synthetic testing laboratories.

1979

A new leadership structure was appointed: Luigi Paris as Chairman, Giorgio Catenacci as CEO, and Eugenio Brasca as General Manager. CESI's international vocation was strengthened, opening a phase focused on electronics, automation, and new technological services.

1986

Following experience in the nuclear sector and the LOCA facility, the center accelerated diversification. The Electromagnetic Compatibility Laboratory was established, marking CESI's first step into aerospace and advanced electronics.

1988

The IMQ agreement led to the creation of CSQ for quality system certification. CESI reinforced its role as an independent and impartial body, expanding into certification, inspection, and industrial support in preparation for the European market.

own, not out of love for balance sheets, but to avoid being dragged down by its own growth.

Brasca recalls one morning in late 1974 as if it were yesterday. Catenacci's office was thick with smoke and paper; a long table spread out in front of Luigi Paris. Numbers, rows, columns. Not an abstract chart, but a raw snapshot of activities. "Do you feel it too?" Catenacci said, inviting him to sit down. The question was asked without any particular emphasis: "Can we sustain ourselves? Can we cover our costs with our revenues?" In that room, the challenge became real. Brasca felt the uncertainty, of course, but also understood the appeal of the risk, the sense of taking a step forward "coherently" with the Development Plan.

### The Transformation of the Offices

Meanwhile, as voltages and power levels rose in the laboratories, pens moved across details that

quietly transformed the organization of the offices. Mrs Codecà — determined, brilliant, with a quickness of thought that made anything complex appear simple — worked with Brasca and the administration on a change that made no noise, yet changed everything: management accounting, budgets, an automated accounting system. The shift from manual ledgers to a new way of reading the company: not only *how much do we spend, but why, where, and with what return*. It was a different language. And like any new language, at first it felt almost like an intrusion.

Then, computers arrived. In 1979, a Digital VAX was installed, a machine that today might raise a smile, but at the time it represented a huge leap forward. It was not only about technical computation, but also about management, data, and control. A world had begun to disappear: measurements taken with rulers and protractors, oscillograms interpreted at a glance, photographs developed in haste. All these tools were replaced by a monitor, a keyboard, and a printer. Full stop: it was a completely different daily routine.



CESI computing room



Meanwhile, the transformation "into a company" was not confined to the offices. It also affected construction sites and testing labs. The most difficult issue remained on the table and weighed like a boulder: the new High-Power and Synthetic Testing Laboratory, the 2,000 MVA alternator, investments that would yield returns only slowly and with difficulty. "It was not about gigantism," Catenacci would later say. "It was about necessity." And behind that word — necessity — were the long meetings, weighed alternatives, unspoken fears. In Rome, at Piazza Verdi, Enel and CESI took a decision that carried the mark of trust. They would build both facilities, fully aware that the economic return might not be immediate.

### A New Five-Story Building

And as the organization took shape, so did the idea that until then had remained implicit: a real commercial directorate was needed, not just a "modest" office. Someone finally said it out loud, as one might state an obvious truth that no one had yet dared to mention. The internal company life was no longer that of the pioneers. There were demands, long queues in the corridors, negotiations. CESI had learnt a new grammar: that of industrial relations.

Then an episode occurred that seemed to be "just" a testing incident — a capacitor, insulating oil, fears of contamination — but instead it became a cultural turning point. It was discussed, analyzed, proven, and decided. And from that dispute, CESI emerged with a clear strategy: the decision to eliminate polychlorinated biphenyls (PCBs), move ahead of regulations, and adopt a stricter internal standard. This too is what it means to become a company: make a decision before the rules force your hand.

The most visible sign of renewal, however, was seen simply by walking around the Centre. Scaffolding stood just a hundred meters from the entrance. It was the new directorate office building. Five storeys rising amidst greenery, like a centre of gravity. "We were scattered about," Brasca would later say. "We needed a headquarters, a centre. It was psychologically important." And it was — not only for those who worked there, but for how CESI was perceived.

By the time Bottani died in 1978, the building had already become a concrete symbol. And memory took its most sober and definitive form: a name engraved on a column at the entrance, not a monument, not a speech, but a detail that endures.



CESI office building

### The Early 1980s

CESI continued to grow, although it did so without grand announcements, as it so often had. The handover may seem natural in hindsight, but at the time it carried the weight of a definitive choice.

On June 22, 1979, the shareholders' meeting appointed Professor Luigi Paris as President. A few weeks later, on July 17, the Board completed the "triad" for the new course with Giorgio Catenacci as Chief Executive Officer and Eugenio Brasca as General Manager. Via Rubattino changed its structure, but not its pace — or rather, not immediately.

"At first, nothing changed," Brasca would recall. And in part, it was true. There still was the same urgency in the test halls, the same ringing telephones, the same files piling up. Continuity acts as a form of prudence, almost as a way of not upsetting the running system. Yet, beneath the apparent tranquillity, CESI was already setting the direction it would undertake in the 1980s: electronics, automation, and digital instrumentation. Another frontier. And another wager.

It was as if the pioneering spirit of the early days had suddenly returned. It emerged where one would least expect it to: among the commercial engineers, in



Inauguration of the High-Power Laboratory  
(Francesco Corbellini, President of Enel, on the microphone)

> the departments coming back to life, in the new laboratories, and, above all, in something that has never been a theory at CESI: leaving. Many left. And they left for faraway places.

## An International Outlook

The Commercial Directorate, led by Alessandro Clerici, was organized like a compass pointing in three directions: South America, Asia, and the Mediterranean. The timing was favorable, also because a contract secured in 1978 gave CESI a role with international responsibility as a consultant and general designer for a national high-voltage and high-power testing center for Mexico's *Comisión Federal de Electricidad*.

CESI did not only bring machines and drawings to Mexico. It brought methods, measurements, and automation. It introduced a way of working *with* the client, not just *for* the client — a signature mark that would soon become highly recognizable.

Years later, at LAPEM — the *Laboratorio de Pruebas y Ensayos de México* — someone decided to name the internal roads after the world's major laboratories and the largest one is called *calle CESI*. It's a small detail, but it says a great deal. It no longer was just an Italian

laboratory "making a name for itself." It had become a reference point.

After Mexico, the journey continued to Venezuela, Southeast Asia, India, Pakistan, and Thailand; La Plata and San Juan in Argentina; Colombia, Bolivia, Paraguay, and Peru; Algeria, Morocco, Portugal, Spain, Jordan, and Turkey. It is a real list, although it does not tell all of the stories.

These dry lines conceal scenes that everyone at CESI recognized: suitcases that was not really a suitcases; crates of instruments; nights spent in hotels without air conditioning; meetings with engineers who did not know you and who had ten minutes to understand you. And then, slowly, trust, working side by side, and professional respect that turned into simple friendships.

## The Idea of the Development Plan

CESI understood that further growth was still necessary — and that it had to come through diversification. In 1982, when Paris stepped down as President, Catenacci took his place. Twenty-eight years in Via Rubattino had been long enough to see CESI be born, grow, and change its skin. Outside, meanwhile, Lambrate was no longer an Arcadia. The Lambro continued to flow, but asphalt had taken over.

The ring road above Via Rubattino was a visible sign of the passage of time. Inside, the decision was made to create a Directorate for Diversification and Development.

At first, the decision seemed theoretical — until reality arrived, right on cue. Enel had just begun construction on the Montalto di Castro nuclear power plant and needed to verify critical machinery and components. Thanks to the new Directorate, CESI was ready for the opportunity. A framework of rules and procedures was developed and a test facility designed by CISE was installed for an extreme trial. It was almost cinematic in its severity: LOCA, the simulation of a major

accident, the rupture of a primary steam pipe. The equipment had to be able to withstand such an event and continue operating.

Then history entered the room without even knocking: Chernobyl exploded in 1986. And then the referendum that abolished nuclear power plants in Italy. In 1987, work at the Montalto plant was suspended. The fully-tested LOCA facility would never be used. It was an investment that remained as a sign of how, in the 1980s, technology and politics could reshape each other's destinies.

And as the organization became more sophisticated, new directorates were created, new

mandates assigned, and new responsibilities defined. People spoke of "another CESI" being born between 1985 and 1986. In reality, however, CESI never stopped being itself. It simply began to operate in new fields, too.

## The First Aerospace Laboratory

Electromagnetic compatibility, power electronics, automation ... Aeritalia asked CESI to enter the business, and the opportunity was not turned down. In 1986, the EMC laboratory was commissioned and, within eighteen

months, it became operational. Images published by *CESINEWS* depicted a helicopter fuselage section inside the newly-built anechoic chamber. It might have seemed out of place in a laboratory born for high voltage, but it was perfectly consistent with the age.

In September 1988, when the shareholders' meeting appointed Elio Colucci as President, Catenacci stepped down, but he did not leave CESI. He became Chairman of the Technical and Scientific Committee, a role that acted as a bridge between eras. The man who guided the transition "from laboratory to company" remained with CESI to help steer its new course. >



Short-circuit testing laboratory control room



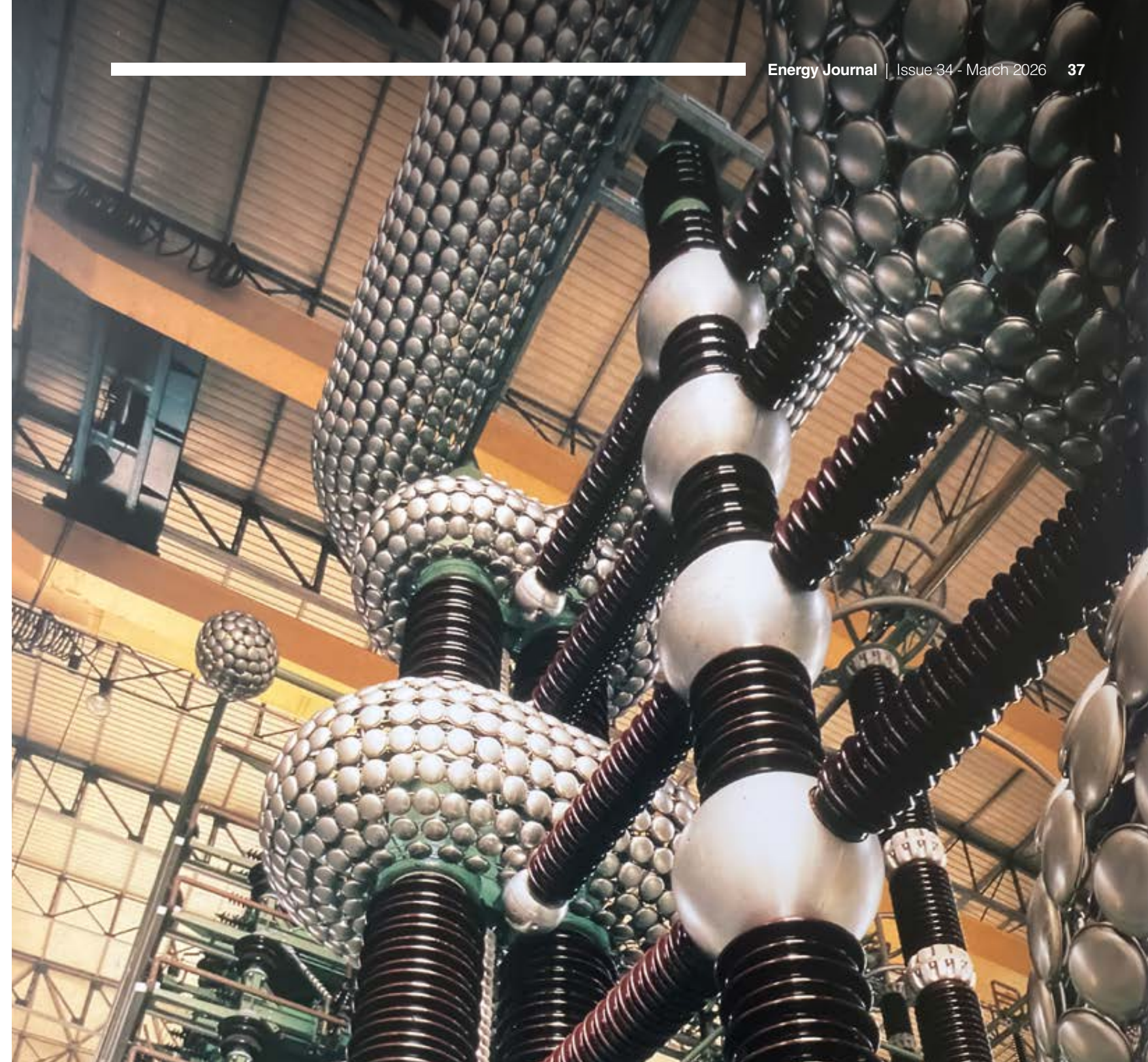
Short-circuit testing laboratory control room

mere celebration. It was a point of energy. It was still in the midst of its development, and this was clearly evident from a simple detail: its pace. With the arrival of the new President, Elio Colucci, dynamism did not slow down. It accelerated.

As soon as Colucci arrived in Via Rubattino, together with Brasca, they formalized the strategies that would guide the major decisions to come: CESI on the market as an independent and impartial entity, capable of high-level testing, certification and studies and, at the same time, an economic balance to be defended through efficiency, quality, competitiveness, transparency, and organizational agility.

On this basis, the multiyear plan for 1990–92 began to take shape. And the facts confirm that for Enel — the controlling shareholder — Colucci's presence at CESI was far from symbolic. Several Enel central directors joined the Board of Directors appointed in the autumn of 1988 and an executive committee with broad delegated powers was re-established. The impression was clear. Enel wished to “draw closer” to its research and testing companies and place them on a more decisive trajectory.

This focus, in truth, had already been felt the year before. On April 10, 1987, CESI hosted a visit that many remember as “historic.” Enel's President, Franco Viezzoli, wanted to see the company up close. He arrived with Enel's “top brass” — Alessandro Ortis, Alberto Negroni, and other senior executives — and spent the day visiting the laboratories as one might walk through a map of the future. On showcase were the high voltage systems, measurements, electronics — and alongside them, the activities of ISMES and CISE. Interdisciplinary, broad, and even fascinating, CESI did not explain itself. It revealed itself. And on

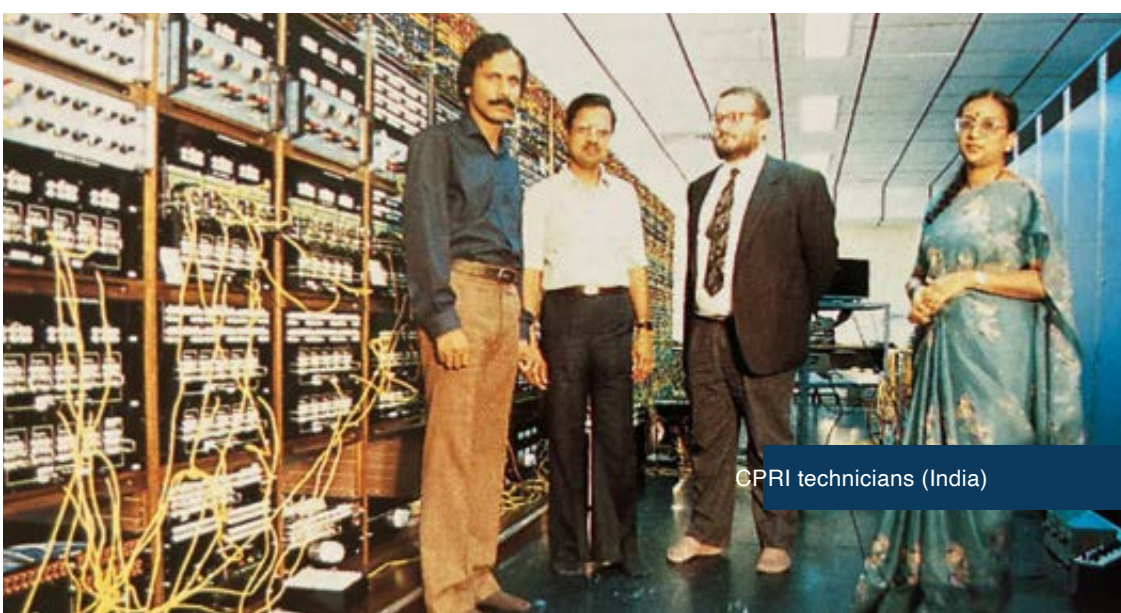


500 kV DC voltage generator

> And in the end, this is what the early 1980s tell us: CESI was opening up to the world, learning to diversify, tightening its belt through austerity, and celebrating an inauguration in the park, while at the same time carrying the weight of major investments on its shoulders.

## From the Late 1980s to the Early 1990s

CESI was thirty-five years old at this point. An age, which for a company built on testing, measurement, and responsibility, was not a



CPRI technicians (India)

that day, it did so through objects, more than words: transformers, labs, and instruments. One of the clearest directions to emerge was the CESI quality. It was an almost inevitable step: being a testing laboratory was no longer enough. It was essential to become a certification body, aligned with the criteria developing across Europe and the world.

Hence, the 1988 agreement with IMQ and the creation of the CSQ — *Quality Systems Certification*. The objective was twofold: to help industries present themselves to the European market with “their papers in order” and to support Enel's drive to qualify suppliers. And when European >

➤ mutual recognition agreements came into being, when agencies such as BSI, KEMA, DQS and TÜV recognized the system, it was not a trophy. It was confirmation.

Then there were the projects that narrate the story of the company's flexibility, its ability to change configuration without losing precision. In 1988, for example, Enel proposed an enormous task: checking the oil of all distribution transformers in Italy, hundreds of thousands of units. CESI, together with CISE, was able to perform hundreds of analyses per day within just three months. It was an industrial undertaking, not just a technical one. And it was carried out with the same mindset as a complex test: procedure, discipline, and quality.

Meanwhile, other laboratories were created in record time. It took less than a year to set up a lighting engineering laboratory capable of evaluating the technical and energy performance of light sources and equipment. A young engineer, Arnaldo Bertazzi, recalls it with genuine surprise. He had thought of CESI as a "factory of lightning" and instead found himself dealing with luminance, glare, and color rendering. Yet, CESI did not change its nature at this point either. It changed its scale and field.

Toward the end of the decade, a topic re-emerged that seemed to have arrived too early, and yet it was already embedded in the lines of the future: electrical energy storage, both stationary and vehicular. In December 1989,

Enel brought the issue back to the table and CESI organized a major research project, coordinating a broad industrial alliance. It was a different role: not only testing and measurement, but the orchestration of a complex system in which companies and laboratories converge toward a shared design. Once again, the guiding idea was the same: there was no need to wait for the future. One had to be ready for it.

And as diversification grew—electromagnetic compatibility, electronics, information technology, robotics, simulation, and diagnostics—the internal life at CESI grew as well with new buildings, new spaces, a canteen to be redesigned, and rooms for training and hospitality. This was not "luxury." It was function.

There also was a quiet task that speaks volumes about the maturity of those years: the rationalization of the technical archive, cataloguing thousands of reports, certificates, technical notes and standards, and assigning numbers, codes, and keywords.

And then there were the young employees with an average age of twenty-eight to thirty in the many new divisions. A density of energy that could be felt even in conversations in the canteen and in the corridors. These people did not require pushing; indeed, you often just had to avoid getting in their way, because "CESI people" continue to recognize themselves as such: a group with a sense of belonging and a standard of work.

## 1999–2000: CESI's New Organizational Structure

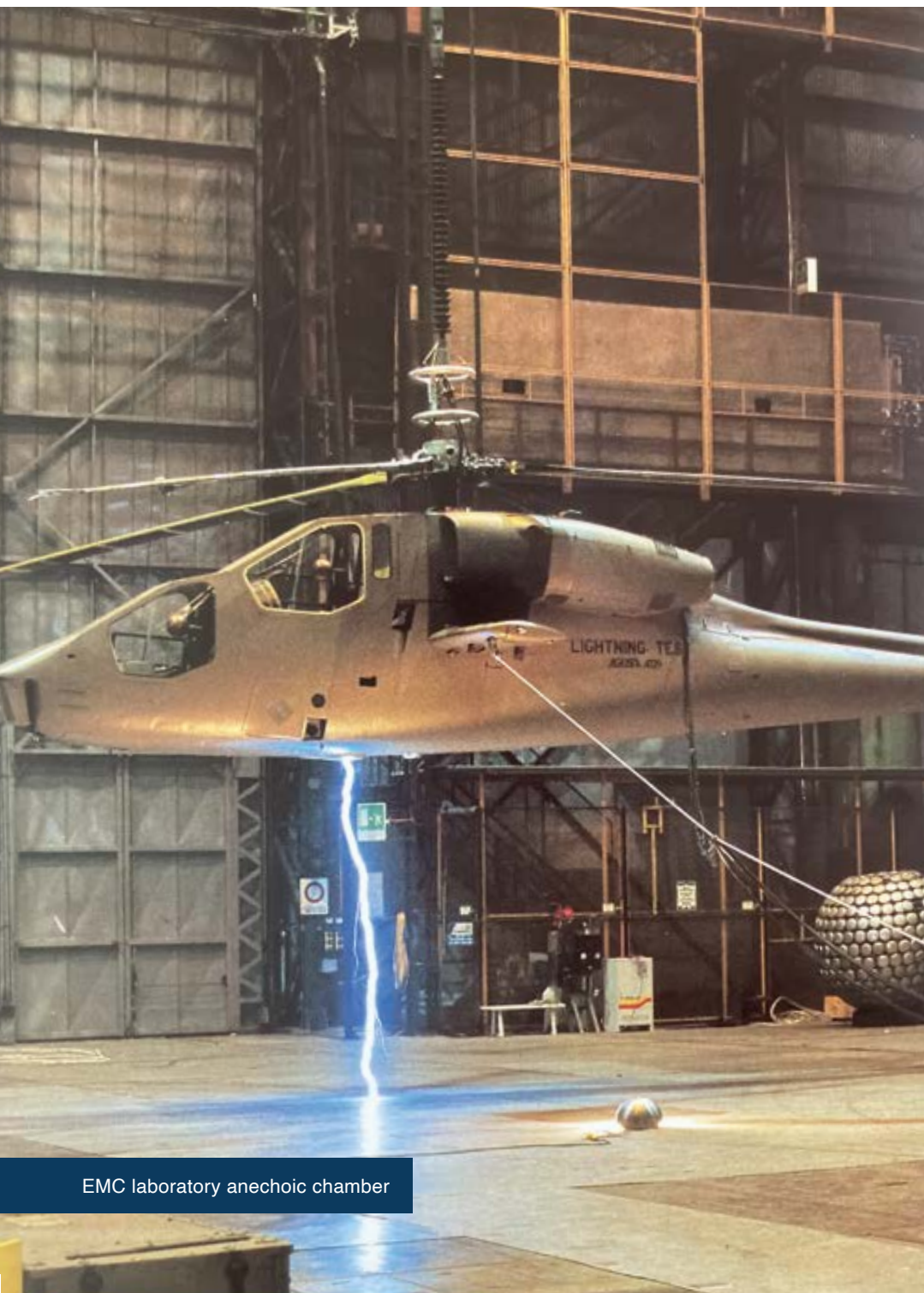
At the end of the 1990s, under the leadership of Salvatore Machì as Chief Executive Officer, CESI entered a pivotal new phase of transformation. For more than thirty years, the Centre had operated within the Enel ecosystem, making a decisive contribution to the development of Italy's electricity infrastructure. However, the context in which it had been established was changing rapidly.

With the Bersani Decree of 1999, Italy had decided to abandon the integrated model, which for decades had concentrated all functions of the electricity value chain in Enel, mandating the separation of generation, transmission, and distribution.

Within this framework, in 1999, Enel established Terna, a company created to manage



Lighting engineering laboratory



EMC laboratory anechoic chamber

the national transmission grid on a dedicated basis. Initially, Terna remained fully within Enel's shareholding perimeter, but its autonomy grew rapidly. Its stock market listing in 2004 and subsequent divestments progressively reduced the former monopolist's control. In 2005, the *Cassa Depositi e Prestiti* became its reference shareholder, marking the full independence of the new grid operator.

As the structure of the sector was being reshaped, CESI itself was entering a defining phase of its history. Since its integration into the Enel universe in the 1960s, the research centre had provided an essential contribution to the evolution of Italy's electricity infrastructure. With liberalization, however, its positioning also had to be reconsidered in order to reflect the new structure of the sector and the clear distinction between the roles of the different operators.

The decisive step came in 2000, when CESI adopted an ownership structure consistent with the newly liberalized landscape. That year, Enel and Terna jointly entered the

company's share capital with equal stakes. This created a balance in which CESI was no longer tied to a single entity, but supported by two complementary realities: on the one hand, the company that had driven the country's electricity development for half a century; on the other, the new independent grid operator, established precisely to ensure neutrality and transparency within the liberalized system.

Thanks to this new configuration, at the dawn of the 21st century, CESI presented itself as a company fully aligned with the transformation of the sector. Its mission remained unchanged, but its role was enriched with new responsibilities. It became a meeting point between tradition and innovation, a bridge between the industrial history of the electricity system and the more open and pluralistic model introduced by the reform. The new ownership structure of 2000 was therefore far more than a simple corporate choice, it represented the concrete translation of the principles that were reshaping the entire Italian electricity system.



Salvatore Machì

2000 – 2005

# Accompanying Complex Systems Worldwide

With the new millennium, energy became a public, geopolitical, and European issue. From the 2003 blackout to the launch of the electricity market, from system research to its integration with ISMES and expansion into Germany, CESI supported networks and infrastructure through a phase of increasing interconnection. It was no longer just a national laboratory, but a European player in complex systems.

## 28 September 2003: Italy Goes Dark

In March 2003, images of the war in Iraq filled television screens across the globe while oil markets reacted nervously. Caught between dependence on Middle Eastern crude and an increasing reliance on Russian gas, Europe became aware of its exposure. The word “security” began to be associated not only with defense and public order, but also with the continuity of electricity supply. In Parliament and in the press, people debated supply, environmental compatibility, and costs. Energy was becoming—without emphasis

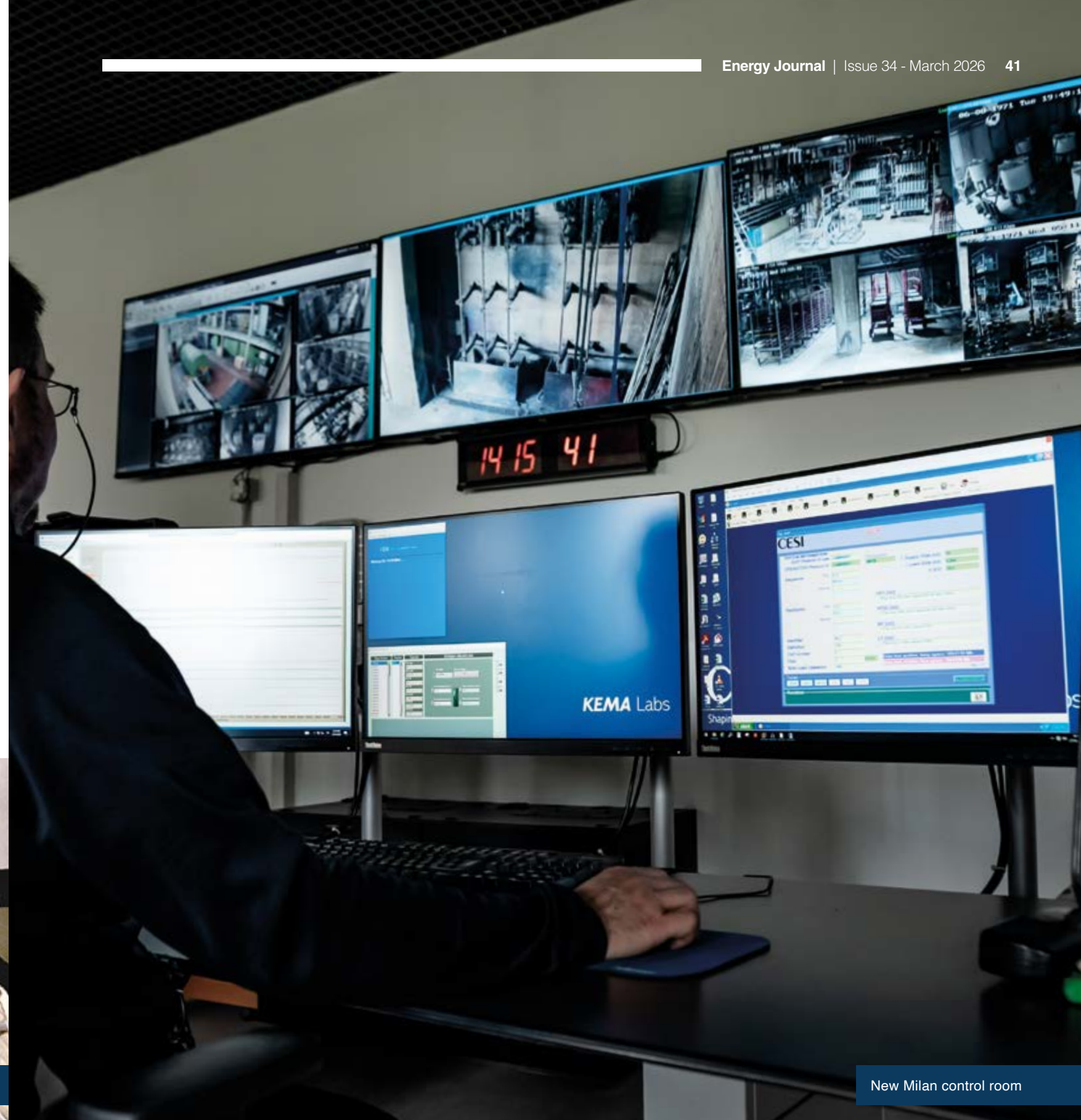
but with growing clarity—a strategic issue. In those same months, the atmosphere at CESI’s Milan offices was different from that of previous years. There was a clear sense that the power system was entering a new phase, one that was more exposed, more interconnected, and less predictable.

At that time, CESI’s top management included Giulio Santagostino as Chief Executive Officer, at the culmination of a long career within the company, and Salvatore Machì, who had meanwhile been appointed President.

Then came the night of 28 September 2003. >



Giulio Santagostino



New Milan control room

2003

On September 28, a nationwide blackout left Italy without power. The collapse of the grid highlighted the vulnerability of a system deeply interconnected with Europe. For CESI, it was a turning point: stability and security required models, simulations, and a systemic vision.

2004

The Italian electricity market became operational. Through System Research, funded by public resources, CESI strengthened its scientific role in support of the liberalized market, working on grids, renewables, and long-term scenarios.

2004

The “merger” with ISMES expanded CESI’s scope to civil infrastructure and structural monitoring. Energy and territory were interpreted as parts of a single complex system, integrating electrical expertise with civil engineering.

2005

With the acquisition of IPH in Berlin and FGH in Mannheim, CESI entered the German testing and certification market. The perspective became truly European: international standards, integrated grids, and shared responsibilities, beyond national borders.

➤ A fault on a transmission line in Switzerland triggered a domino effect of disconnections and within a few minutes Italy was plunged into darkness. Official technical reconstructions by Terna and the then UCITE spoke of approximately 27,000 MW of load lost in less than fifteen minutes. It was a total outage, unprecedented in the country's history. Cities came to a standstill; elevators were blocked, and trains stopped. For many families, it was an unexpected, almost unreal experience: the sudden absence of something that had always been taken for granted. In control rooms, by contrast, those hours unfolded as a sequence of checks, communications, and restoration attempts. The grid revealed its true nature: a complex organism crossed by flows that do not stop at administrative borders.

In CESI's offices that night, nobody panicked. The concentrated. Engineers monitored frequency trends, disconnection times, and the progression of the collapse. It was not merely an event to be recorded. It was concrete proof that the European power system was now functioning as a single body.

It was not just a technical incident. It was a collective awakening. The stability of the power system no longer depended exclusively on internal balances, but on cross-border interconnections, delicate synchronisms, and increasingly sophisticated forecasting models. Subsequent technical reports highlighted the vulnerability of a system strongly based on importing power, with high interconnection capacity but reduced safety margins under critical conditions. The blackout made visible what until then had remained confined to simulation models: the European grid functioned as a single organism. A disturbance at one point could propagate hundreds of kilometers in just a few minutes.

At a time when Italy that was completing the opening of its electricity market and moving toward competition, CESI went through one of the most intense phases in its history. This was not merely a regulatory transformation, it was a change of scale. A power system that for decades had been governed by centralized planning was beginning to operate according to a new logic, in which security, market, and environment could no longer be treated as separate chapters. The task was to accompany complexity, not to simplify it.

## System Research

The institutional response to that complexity was not only technical, but also regulatory. In 2004, the electricity exchange came into operation. On April 1, 2004, the *Gestore del*



*Mercato Elettrico* (GME) formally launched the Italian electricity market, structured into day-ahead market, intra-day market, and balancing services. Energy, which for decades had been planned and dispatched within an integrated model, began to be bought and sold on organized platforms, hour by hour. Prices were shaped by supply and demand. Interconnections with France, Switzerland, Austria, and Slovenia took on new importance, as Italy structurally remained an electricity importing country. System stability was no longer just a matter of internal balance, but the result of continuous cross-border exchanges, increasingly refined forecasts and simulations capable of anticipating complex scenarios.

In CESI's offices and laboratories, work focused on forecasting models, grid management algorithms, and scenarios for integrating renewable sources that were then taking their first steps. In a meeting room in Milan, a group of engineers debated before a wall covered with charts. The curves showed hypothetical scenarios of wind power penetration. At the time, the numbers were still modest, but the question was already clear: what happens to frequency when generation is no longer fully programmable? The simulations anticipated problems that would only become evident years later.

Together with ENEA, CESI presented Italy's

first Wind Atlas — a thorough mapping of the country's windiest areas — produced using scientific criteria and tools that combined meteorology with electrical modeling. It was a quiet, almost cartographic effort, yet it contained within it the idea of a future transformation.

The distinction between general interest research and market-oriented services reflected the new European regulatory architecture based on separation of roles and transparency. For CESI, this meant redefining internal boundaries, clarifying missions, and organizing competencies. Activities related to system research were progressively concentrated in a dedicated structure: in 2005, CESI Ricerca S.p.A. was formally established, which would later become part of RSE. This was not merely a corporate decision, but a coherent step in response to a system demanding specialization and clarity of mandate.

The projects launched in those years — GEN 21, RETE 21, SENNA, Siset — were not abstract acronyms, but real research programs on generation, grids, environmental monitoring, and advanced sensing technologies. Proposals were evaluated by expert committees and submitted to the scrutiny of the Authority for Electricity and Gas. Between 2003 and 2005, thirteen projects received approval and positive feedback. It was a rigorous

> process, exposing technical work to external verification and criteria of collective usefulness.

## The “Marriage” with ISMES

In 2004, global energy markets were moving within an unstable equilibrium. Worldwide demand for oil was growing at a sustained pace, driven by economic expansion in Asia and North America. Crude prices were rising to levels that brought energy back to the center of industrial and political strategies. In Europe, discussion increasingly focused on supply vulnerability, external dependence and the need to strengthen infrastructure and controls.

In that climate — while liberalization was redefining the boundaries between State and market — an operation that was less visible to the general public, but decisive from a technical standpoint, was taking shape between the Bergamo area of Brianza and Milan. CESI acquired the business unit known as ISMES, the *Istituto Sperimentale Modelli e Strutture* from Enel.NewHydro. To those working in civil engineering, the name evoked decades of scale testing, physical modeling and studies on major infrastructure works. The transaction, completed in 2004, brought into CESI around ninety professionals and a legacy of laboratories and expertise that had been accumulating since the 1950s in the fields of physical modeling and structural monitoring.

In ISMES workshops and laboratories, dam models were built, stresses were simulated, structural behavior under extreme loads was

observed. Concrete, steel, sensors. Test benches reproduced complex infrastructures at a reduced scale in order to understand it even before it was built. This was not theoretical calculation alone. It was engineering with hands on the material.

After the 2003 blackout and the launch of the electricity market in 2004, it became clear that energy systems and civil infrastructure could no longer be considered separate worlds. Grids are based on territories, power plants on foundations. Lines cross unstable environments. Integration enabled CESI to extend its scope from the electrical system to complex civil infrastructure, including local monitoring, and structural risk assessment. Along with it came expertise developed over more than fifty years in structural modeling, territorial monitoring, and the analysis of interaction between civil works and the environment. A dedicated business unit was created, destined to become a meeting point between electrical engineering and civil engineering.

The operation had a significance that went beyond dimensional growth. Until then, CESI had built its identity primarily around electrical systems, grids, and components.

With ISMES, it structurally joined the world of civil infrastructure: dams, bridges, major plants, and areas exposed to natural and human-induced risks.

At a time when the energy transition was beginning to take shape and European regulations were demanding increasingly rigorous standards in terms of safety and sustainability, that integration represented a coherent step. Efficiency and environmental compatibility were no longer sufficient; indeed, durability over time, continuous monitoring capability, and technical transparency also had to be guaranteed.

## Expansion into Germany

In the summer of 2005, as Europe continued to redraw its energy market and the word “integration” took on an increasingly concrete meaning, CESI took a step that marked a real shift in perspective. It established a direct presence in the industrial heart of the continent. Germany was not a

➤ neutral destination. It was the country of advanced electrical engineering, major manufacturers, and high-voltage testing laboratories that certified components destined to circulate across Europe. It was a rigorous technical system, with high standards and a deeply rooted industrial culture.

In this context, CESI acquired from Vattenfall Europe two companies specialized in the testing and certification of electrical components: IPH GmbH, based in Berlin, and FGH Engineering & Test GmbH, in Mannheim. In their laboratories, transformers, cables, and medium and high-voltage equipment were put to the test. Extreme conditions were simulated, material resistance verified, and the safety of components that would later compose European grids was certified.

Entering those centers meant engaging with a different language, different protocols, and a different way of organizing technical work,

but it also meant sharing methods, integrating expertise, and building a stable foothold in a market that was no longer merely a reference point, but a place of presence.

In the German laboratories, short circuit tests generated conditions simulating the extreme limits of operation. Before each test, a technician checked every connection; during the test, an engineer monitored current behavior on protected screens. The outcome was not a judgement, but a certified measurement based on internationally recognized IEC and VDE standards.

Berlin and Mannheim thus became privileged observation points for the accelerating grid modernization and market integration of Europe. Laboratory testing was no longer a peripheral activity. It represented the threshold through which every innovation had to pass before entering the system.

For CESI, this was a measured bet. It left an exclusively national dimension to confront some of the most demanding technical and cultural standards on the continent, not to expand geographically for its own sake, but to become a stable part of a European network of relationships involving manufacturers, grid operators, universities, and research centers.

Viewed in perspective, the three-year period from 2003 to 2005 was not merely a regulatory transition or a sequence of corporate operations. It was the redefinition of the relationship between research and market, between infrastructure and territory, between national dimension and European integration. Energy, which in the postwar years had been built as an internal system, was definitively becoming a supranational issue, intertwined with geopolitical balances and shared industrial choices.

CESI, born as a technical laboratory in an Italy that still had to be rebuilt, now found itself operating in networks that transcended borders, engaging with complex and interconnected systems, and taking on responsibilities that could no longer be contained within a single country. It was no longer a matter of safeguarding a national system, but of accompanying complex systems worldwide.

2008 – 2019

# Future Grids and the Energy Transition


From the global financial crisis to the race toward decarbonization, power grids have changed in both scale and function. HVDC, resilience, emerging markets, space, and major European laboratories: CESI supports the energy transition by testing technologies before they go into operation. The scope has become global, but the method remains the same: verify, anticipate, and ensure reliability.

## The Meeting after the Lehman Brothers Collapse

September 2008, CESI conference room: the screen stayed on a few seconds too long. There were no transformers or grid diagrams on the it, but financial charts plunging vertically. Lehman Brothers had just collapsed a few days earlier. Someone was scrolling through a list of suspended contracts, while another slide revealed the number of postponed investments. Utilities revised their industrial plans; credit markets tightened; construction sites were slowing down. In the laboratories, however, testing never stopped: grids must remain stable.

Oscilloscopes continued to trace curves, transformers were pushed to stress levels, and climatic chambers simulated extreme conditions. Outside, people spoke of a global recession; inside, the ability of a system not to collapse was being measured. It was during those months that a new, less theoretical and more concrete awareness took hold: energy is not only infrastructure. It is system integrity. It is resilience.

In 2009, world leaders debated climate change in Copenhagen. In Europe, the “2020” package set binding targets for renewables and efficiency. In laboratories, those numbers were transformed into grid scenarios: more wind, more solar, and less predictability. Simulations grew more complex and models were updated to integrate renewables into networks — and networks began to change shape.

It had by then become clear that, in order to continue fulfilling the role that had always set it apart, CESI needed not 

Three-phase transmission towers

2008

After the collapse of Lehman Brothers, investments and construction work slowed down, but power networks could not come to a halt. In the laboratories, attention to system resilience intensified, while Europe accelerated its climate and energy targets, as well as renewable integration.

2012

Expansion into the Middle East marked a new international phase. CESI supported grids, smart systems, and major infrastructure projects in desertic environments and at extreme temperatures, adapting expertise developed in Europe to different climatic and regulatory conditions.

2018

With the acquisition of EnerNex in the United States, the Group established a permanent presence on the North American market. System studies, HVDC, and renewable integration extended CESI's reach across the Atlantic, reinforcing its global role in complex networks.

2019

The integration of KEMA Laboratories in Europe and the United States consolidated global leadership in independent testing. From ultra-high-power short-circuit testing to HVDC systems, the laboratory network had become an intercontinental center, serving the energy transition.

only to accompany change, but also to anticipate it and help shape it. It was in this climate of transformation that, in 2009, a new Chief Executive Officer was appointed. At the time, Matteo Codazzi was young, but he already had a solid experience with international energy markets. He succeeded Giorgio De Panno, who had led CESI through a phase of European consolidation from 2006 to 2009.

The challenge awaiting Codazzi was clear. He had to transform CESI into a company capable of competing on a global scale, to strengthen its industrial identity, and to consolidate its position as a world leader in testing, certification, and technical consultancy. For the first time in the Center's history, its leadership was entrusted not to an engineer, but to a manager with an economic background, shaped in the electricity sector and deeply familiar with the dynamics of international markets. From the very outset, his mandate introduced a decisive acceleration, ushering in a phase during which the Center not only renewed itself, but projected itself with determination onto the global stage. During this period, the President was Salvatore Machi, who remained in office until 2021, when he handed the helm to Giuseppe Del Villano.

Laboratories themselves began to be transformed. The need to verify equipment destined for ever higher voltages opened the way to new testing platforms: next-generation impulse generators, cutting-edge synthetic testing installations, and increasingly sophisticated facilities dedicated to direct current. It was a decisive transition: every component destined for future grids had to first prove it could withstand extreme conditions without failing.

New maps appeared on the walls. It was no longer just the Italian peninsula with its 380 kV backbones, but routes crossing the North Sea, the Gulf, and Latin America. Technical specifications began to be increasingly written in English.

High voltage direct current lines (HVDC) began to appear more frequently in interconnection projects. Connecting distant systems, integrating large volumes of variable energy, stabilizing increasingly nonlinear flows, these were no longer theoretical exercises, but operational requirements.

In those months, CESI understood that acting as a reference center for a national system was no longer sufficient. Questions now arrived from elsewhere, places with different climatic conditions, different regulations, and grids growing on continental scales.

## Expansion into the Middle East

In 2012, various Gulf countries chose to invest even more heavily in infrastructure: power plants, grids, and interconnections. When CESI opened an office in Dubai, it was not just a flag planted on a map. It was a technical table shifting latitude. Reports addressed transmission in desert environments, extreme temperatures, fine dust that could penetrate everywhere. Specifications changed. Safety margins were recalibrated.

The context was different from Lambrate, but the logic was the same: testing before commissioning. Meanwhile, flights multiplied at CESI. Schedules took time zones into account; phone calls began when it was evening in Italy. The maps on the walls were no longer decorative. They marked real construction sites, deadlines, and contracts.

If — as some argue — the energy transition is an equilibrium to be built between oil and the future, Codazzi's CESI found a new role as a technical interlocutor in areas where energy was a strategic issue. The Center born in the



HVDC test area – Berlin



Matteo Codazzi

fog of Milan now worked under the sun of the Gulf without changing its craft.

## The Brazilian Market and the First Steps Toward Space

Rio de Janeiro looks out over the ocean, but in technical reports the horizon is composed of lines crossing forests, plains, and dams hundreds of kilometers away from consumption centers. When CESI opened an office in Brazil, it did not enter a simple market. It accessed

a continental-scale power system, one of the largest and most complex in the world.

Major infrastructural investments were underway. The 2014 World Cup and the 2016 Olympic Games accelerated construction sites and modernization programs, while recurring droughts put pressure on hydroelectric generation, which in Brazil plays a greater role than almost anywhere else. Reservoir levels fluctuated, load curves became less predictable, and the integration of wind and solar power became necessary.

On construction sites, discussions focused on long distance transmission, grid stability over

thousands of kilometers, and interconnections with remote areas. Local regulations required adaptation; climatic conditions imposed specific checks. Know-how developed in Italy could not be applied automatically to these new areas, it had to be adapted.

It was during these years that grid analysis was joined by even more delicate activities: verifying and improving the safety conditions of the country's older hydroelectric dams. CESI became involved in Enel Green Power's multi-year program for the historic Paranapanema and Torixoreu plants — installations that appear modest on paper, but were exposed to hydrological conditions altered by climate chan-

ge. At Paranapanema, where a bridge crosses the dam and affects its stability, technicians studied new-design spillway flows, devised an additional gate to manage extreme floods, and validated three-dimensional models of the structure through static and dynamic testing. It was work that combined hydraulic engineering, structural engineering, and risk management. It was far from the spotlight, yet essential to the reliability of the entire system.

## Solar Cells and Satellites

Meanwhile, on a much smaller table in Via Rubattino, work was underway on



➤ something that had nothing continental about it: thin compact multi-junction solar cells designed to leave the Earth's atmosphere. InGaP/InGaAs/Ge: acronyms that sound familiar in laboratories, yet remain incomprehensible to everyone else.

In India, ISRO entrusted Italian technicians to supply high efficiency cells for satellite panels. The discussion revolved around low-Earth and geostationary orbits, LEO and GEO qualifications, efficiencies exceeding 30 per cent. Numbers that do not carry the weight of a multi-thousand MVA alternator, but that convey another form of responsibility: components meant to operate for years, without maintenance, in a vacuum.

From the deserts of the Gulf to the forests of Brazil and into Earth's orbit, the scale changed continuously. Yet, the technical gesture remained identical: study, design, test, qualify, ensure reliability before technology is entrusted to a grid — or sent into space, where error is not an option.

## Mannheim Did Not Emerge from Nothing

This expansion was based on the patient construction of a coherent industrial geography, grounded in technology and the quality of infrastructure — a geography whose most visible symbols included the Mannheim laboratories. Situated southeast of the city, between the Neckar and the Rhine, the first impression

upon arrival is silence: orderly industrial halls, functional infrastructure, and controlled access points. Only once inside does one grasp what truly happens here: direct current is pushed up to 1,200 kV; cables are energized as if they were to cross entire continents; equipment is driven to its limits to verify what, once in operation, must never fail.

Mannheim did not emerge from nothing. As we have seen, CESI's story in Germany began in 2005 with the acquisition of IPH in Berlin and FGH Engineering & Test GmbH in Mannheim. These were organizations with a proven experience in high, medium and low voltage testing, embedded in one of Europe's most advanced power systems. The German grid is complex, highly interconnected, and strongly industrialized. Testing requirements are stringent and technical culture is deeply rooted.

It is therefore understandable that expansion here did not fall into the same pace of construction sites in the desert or the vast scale of Brazilian networks. It was more structured. Work took place in a mature infrastructure and integrated existing expertise. Spread over seventy thousand square meters, the Mannheim site was an operational platform connected to one of the most powerful nodes of the German grid, capable of supplying tests that would be impossible to conduct anywhere else.

In the following years, this European platform would be further strengthened. The Group's HVDC laboratories — in Mannheim, Milan, and Arnhem — certify cables destined for



Astronaut in space

the continent's major electrical backbones: including pre-qualification tests simulating forty years of operational life, thermal loads, and extreme stress. In some cases, such as the cables required for Germany's "Energy Corridors," direct current is brought to a steady state in tests requiring months of uninterrupted, controlled operation.

## Europe's Largest Independent HVDC Laboratory

The HVDC Laboratory, which was inaugurated in 2014, marked a further step forward. It was not only the first and largest independent European laboratory for direct





Glass insulators

➤ current, but also a solution to the technical requirements that were emerging forcefully across the continent.

Severe operating conditions were simulated, phenomena analyzed to ensure they never occurred in service. “It is meticulous, almost invisible work that precedes field installation,” those involved explain. CESI’s tests had by now become opportunities for exchange among designers, manufacturers, and managers responsible for ensuring the safety of future grids.

The site dates back to 1956, when the first high-voltage and high-power laboratories were built. Since then, Mannheim has grown along

side Europe’s power system: alongside pollution tests, the definition of pre-qualification protocols for AC and DC cables, and progressively more sophisticated infrastructure. HVDC fits into this continuum as a natural evolution. It is here that one truly understands that CESI’s international expansion is not just a series of acquisitions, but the progressive construction of a coherent geography.

## Crossing the Atlantic: EnerNex

In July 2018, we crossed the Atlantic. In a meeting room in the United States, CESI completed a transaction that brought it onto the North American market with the acquisition of EnerNex, a U.S. company providing engineering and consulting services for the development and implementation of new and emerging electrical technologies. It was not a sudden merger, but the convergence of two technical experiences that had matured in different contexts, yet moving in the same direction.

EnerNex focused on complex system studies, renewable integration, HVDC infrastructure design, and the planning and operation of networks in one of the world’s most complex energy markets.

## The Acquisition of the KEMA Laboratories

One year later, 2019 marked one of the pivotal moments in the Group’s history, and certainly the most important during Codazzi’s long tenure. CESI acquired KEMA from DNV GL, together with its laboratories in Arnhem, Prague, and Chalfont.

In the field of electrical testing, KEMA had represented an international benchmark for decades. Arnhem hosts the world’s largest high power laboratory with a short circuit capacity of 10,000 MVA. In Prague, components for extra-high voltage networks are tested; while Chalfont conducts advanced testing and certification activities for different operational contexts.

These are places where generations of engineers have helped define the very criteria of verification and reliability for electrical equipment. Their integration into CESI did not mark a break, but the meeting of kindred technical traditions, united by a shared vocation for independence, rigor, and service to the development of power systems.

Beyond mere geography, the integration of Italian, German, U.S. and Dutch laboratories was methodological. Procedures were harmonized, databases shared, and testing platforms coordinated. The result is a distributed independent testing system spanning multiple continents.

The energy sector continued to undergo profound transformation. The 2015 Paris Agreement set binding climate targets, while investments in renewables grew and gas market volatility brought energy security back to the forefront. Every political decision translated into new technical specifications: wider operating temperature ranges, climate resilience requirements, integration with smart grids.

CESI’s KEMA Labs simulate extreme conditions: intense cold, high heat, mechanical stress produced by wind, earthquakes, and vibration. Equipment is pushed to its limits before entering the market. It is work that precedes the construction of power plants and transmission lines to determine their reliability.

With the acquisition of KEMA, CESI did not change its mission. It extended it, becoming the world leader in independent testing activities for the electrical sector. With operational platforms in Europe and the United States — and a stable presence in China for inspection activities — CESI’s scale became global. However, the logic never changed: test before installation, verify before commissioning.



Transformer – Berlin

2020 – 2025

# Resilience, Sustainability, and New Frontiers

Amidst pandemic, wars, and an accelerated transition, energy has once again moved to the center of global stability. Grid resilience, the geopolitics of interconnections, the security of critical infrastructure and new space frontiers: CESI operates in the invisible space where the future is tested before becoming real infrastructure, connecting territories, digital systems, and systems in orbit.

## Infrastructure Requires Human Capital

**M**ilan, March 2020. The streets are empty, shop shutters are pulled down, and trams are running almost without passengers. However, the lights remain on at the CESI laboratories.

It is not a symbolic image, it was an operational choice. As the country entered its first national lockdown, announced on March 8, and Italy became the European epicenter of the pandemic, some activities could not be interrupted. And not out of industrial pride, but out of systemic necessity. Electricity does not recognize quarantines. Grids continued to deliver power to

High-voltage test structure with ceramic insulators

### 2020

During the pandemic, laboratories remained operational to ensure continuity to electrical infrastructure. New remote testing solutions were developed, reinforcing a key awareness: there can be no technical resilience without human capital.

### 2022

Russia's invasion of Ukraine brought energy back to the center of European geopolitics. HVDC interconnections, strategic corridors, and system simulations became essential tools to strengthen security and energy autonomy.

### 2023

With the "Fabbrica dello Spazio" (Space Factory) agreement and the launch of CESI Space, the Group strengthened its production of solar cells for satellites. From terrestrial grids to orbit, reliability remained the guiding principle.

### 2025

Power networks became digital and deeply interconnected. Energy storage, e-mobility, data centers, and large offshore corridors redefined the system. Independent testing supported the transition, ensuring stability before real-world operation.



Domenico Villani

been perceived as almost self-evident. Now, it emerged as a matter of national security: infrastructure — normally invisible — reappeared as exposed nerves. It was at this point of tension, between invisibility and centrality, that CESI operated as part of the mechanism that kept the system running.

Kilometers of high voltage lines, control centers, and testing laboratories make no headlines as long as they work. However, 2020 clearly indicated that resilience was not an abstract concept. It is the sum of skills, procedures, and daily responsibility. The pandemic made a structural link evident: infrastructure requires human capital. Technologies may be sophisticated, but continuity is guaranteed by people.

In those same weeks, alongside the indispensable physical presence in laboratories, CESI also developed new operating modes. Remote testing solutions were introduced, allowing clients to remotely witness tests in real time through monitoring systems and secure connections. Born out of emergency, these practices were destined to consolidate as a new operational model, one capable of ex-

tending access to laboratory expertise beyond physical and geographical limits.

And so, while testing continued inside the laboratories, the company moved on the social front, as well, outside. Computers were delivered to schools to allow distance learning. CESI employees organized fundraising initiatives for Milan's Luigi Sacco Hospital and local Caritas organizations. In those months, a new awareness took root: energy security is not only a technical variable, but an element of democratic and geopolitical stability. In practice, during that period, CESI — like many other organizations — acted as a kind of civic backbone.

## The Geopolitics of Energy

February 24, 2022 marked a clear breaking point. Russia's invasion of Ukraine brought energy back to the center of European geopolitics at a speed not seen in decades. Gas — until then an essential component of the continent's

energy mix — became a tool of strategic pressure; reliance built over time was revealed to be a political vulnerability.

"Bills explode, governments convene emergency meetings, energy-intensive industries fear production shutdowns," headlines reported. Europe rediscovered that energy security is not a purely technical variable to be left to grid operators alone, but a pillar of economic sovereignty. Within a few months, it accelerated the diversification of sources, renewables, electrical interconnections, and storage. The REPowerEU plan was conceived in this climate of urgency. Its cornerstones included the reduction of dependence on Russian fossil fuels, strengthening strategic autonomy and accelerating the transition towards clean sources. Behind the scenes, feasibility studies intensified — system analyses and complex simulations had to translate broad policy directions into real infrastructure.

Meanwhile, during this complex and challenging context, Domenico Villani took the helm of CESI at the end of 2022, serving as Chief Executive Officer until 2024. During his tenure, he guided the Group through a crucial

phase, consolidating its global activities and strengthening its business divisions.

In October 2021, Guido Bortoni became President, succeeding Giuseppe Del Villano. Bortoni had previously served as President of ARERA (from 2011 to 2018) and brought extensive regulatory and institutional experience to the position.

In 2024, Domenico Villani handed CESI leadership to the current Chief Executive Officer, Nicola Melchionti, while Guido Bortoni was confirmed as President. With Melchionti's appointment, CESI further reinforced its growth and innovation-driven strategy. His vision is contributing to strengthening the company's role as a strategic technical partner for institutions and major stakeholders across the energy sector.

## Electrical Infrastructure Changes its Nature

It is in this operational space that CESI's role has become even more firmly establi-

shed. High voltage direct current (HVDC) networks returned to the centre of European planning, because they allow large volumes of energy to be transported over long distances with lower loss and greater control. Scenario studies have become decisive tools to assess how to integrate growing shares of renewables without compromising system stability.

In simulations, the grid does not exist as physical infrastructure. It exists as a sequence of equations, nodes, and parameters. Engineers change the conditions, introduce load variations, and observe the system's response. Stability is not an acquired fact. It is a behavior that must be verified. This is where infrastructure begins its existence: as models that must prove they can withstand the future.

This is work that supports concrete projects. In Germany, for example, the energy transition required the construction of large HVDC corridors to carry electricity produced on the North Sea to its southern industrial centers. Before these corridors became operational, cables had to prove their reliability over time. CESI conducted pre-qualification activities on HVDC cables destined

> hospitals, intensive care units, telecommunications hubs, and the servers that supported remote work for millions of people. Every digital flow, every video call, every hospital shift rested on a silent infrastructure that had to be kept operational. At laboratories in Milan, Berlin, Arnhem, Mannheim, Chalfont and Prague, CESI's employees reorganized their shifts to ensure safety distances and new procedures. Transformers were driven under stress, protection systems were verified, certifications continued without interruption. While the world stopped outside, testing continued at CESI.

During the most difficult days of the emergency, KEMA Labs technicians ensured continuity of operations, fully aware that every completed test contributed to keeping the electrical infrastructure reliable — an infrastructure on which hospitals, telecommunications providers, and essential services depended. It was not merely about ensuring business continuity, but about concretely and discretely supporting the very operation of power systems.

"We don't see ourselves as heroes," witnesses of those days recount, "but as responsible people. Operational continuity is a condition of social stability: if energy stops, everything else stops." In the surreal silence of cities around the world, electricity became visible once again. For decades, it had



Spherical electrodes for high-voltage generators

for the so-called **German Corridor**, subjecting them to prolonged cycles of voltage and thermal stress. At KEMA Labs, technicians connected a cable section to the test systems, verified the connections, and activated the prescribed voltage sequence. These tests do not last hours, they last weeks. Every day, parameters are checked, behavior is verified against expected conditions, and variations are recorded. The question is not whether the cable works, but whether it will continue to work for decades.

In a rapidly shifting geopolitical context, electrical infrastructure changes nature: from an industrial asset it has become a lever for regional cooperation and political stability. It is no longer only lines and transformers, but strategic corridors. The **Black Sea Submarine Cable Project** was born within this new awareness. More than **1,100 kilometers** of submarine cable between Georgia and Romania, in addition to **95 kilometers** on land, cross the Black Sea, creating a direct link between the South Caucasus and Southeastern Europe. It is a complex engineering work: infrastructure that redraws energy relationships and reduces critical dependencies. Moreover, an optical fibre runs alongside the power cable. And this is the sign of an increasingly structural integration between energy and data. When European Commission President Ursula von der Leyen underlined that the agreement “will bring the European Union closer to our partners in the South Caucasus region and help both our regions to achieve the transition to clean energy,” she was describing a geopolitical corridor.

CESI participated in this project as a technical partner, carrying out feasibility and engineering analysis. In the office, engineers analyzed system behavior under different

operating conditions, verified how the new link would interact with existing networks, and assessed its overall stability. On paper, the route is a thin line, but its reliability depended on these preliminary checks and analyses carried out long before any cable was laid on the seabed. It is a silent, but a decisive phase.

Similarly, in the Baltic region, the **LASGO** project connects Latvia, Gotland, and Sweden, creating a strategic axis to integrate offshore and onshore wind in an area that has become crucial following the energy crisis. Here, interconnections have become instruments of industrial and climate policy. CESI contributed to LASGO with engineering and the technical design of the HVDC connection. In digital models, the new interconnection was introduced as a new element of the system. Simulations showed how energy flows changed, how power was redistributed, and how the grid absorbed electricity produced by new offshore wind plants. Infrastructure is not only a physical link. It modifies the grid’s overall behavior.

The same approach is reflected in major new Italian generation projects such as the **Tyrhenian Link**, the HVDC interconnection that will connect Sicily to Campania and Sardinia. Before converters become operational and cables are laid on the seabed, the network has been studied under simulated conditions. The new connection is activated virtually in a dynamic model. Flows change direction. Power is redistributed. The grid reacts. It is at this stage that one verifies whether the infrastructure will be able to fulfill its role: supporting renewable integration and increasing the resilience of the Italian power system. CESI supports Terna through system studies, simulations and technical verifications.

A similar path accompanied the **Italy–Montenegro interconnection**, one of the first HVDC links between the two shores of the Adriatic Sea. Here, too, before energy began to flow, the system had already been verified digitally. A sequence of simulations verified operating conditions to anticipate every possible behavior. The physical line came later. Its reliability, in a sense, had already been ascertained.

The same approach also extends to other strategic projects, such as the **EuroAsia Interconnector** between Israel, Cyprus, and Greece — one of the longest and deepest submarine links ever designed. CESI provided technical design and route analysis, assessing operating conditions and integration with existing systems. Here too, the work took place before the infrastructure was built. A sequence of simulations

verified that the system could operate safely, even if pushed to its limits.

In these processes, CESI acts as a technical partner, translating geopolitical choices into engineering assessments, simulation models, and feasibility analyses. It is work that does not make the front page news, yet determines the practical possibility of building networks that are more interconnected and less vulnerable. Between 2022 and 2023, as Europe redefined its energy priorities, a new awareness took hold. Security is not an alternative to the transition. It is its pre-condition.

Electrical infrastructure has become tangible geography. Links connect countries, systems integrate different sources, and technologies must prove reliability before becoming

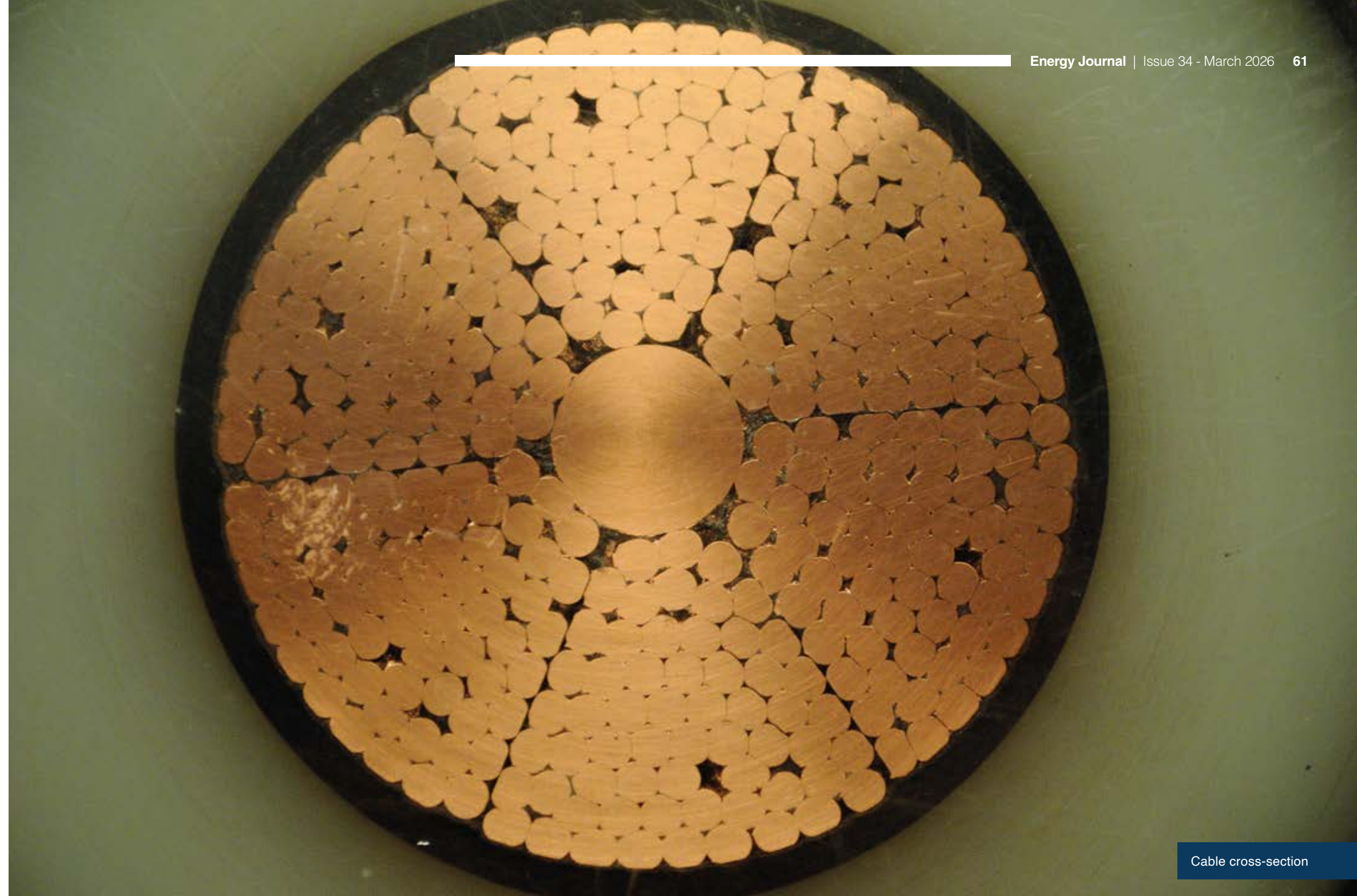
operational. In this scenario, CESI’s role is to make this transformation possible on the technical level. It does not build the infrastructure; however, it verifies that it will work and continue to do so, once it becomes part of the real physical system.

These activities point to a continuity that spans decades. From the first analogue simulations to today’s digital platforms, the principle remains the same: understanding grid behavior before it is constructed. This work, which is carried out far from public visibility, accompanies every phase of the energy transformation. All new infrastructure is designed and verified before becoming reality. CESI operates in this intermediate space, where the future of the power system is defined before it becomes visible.

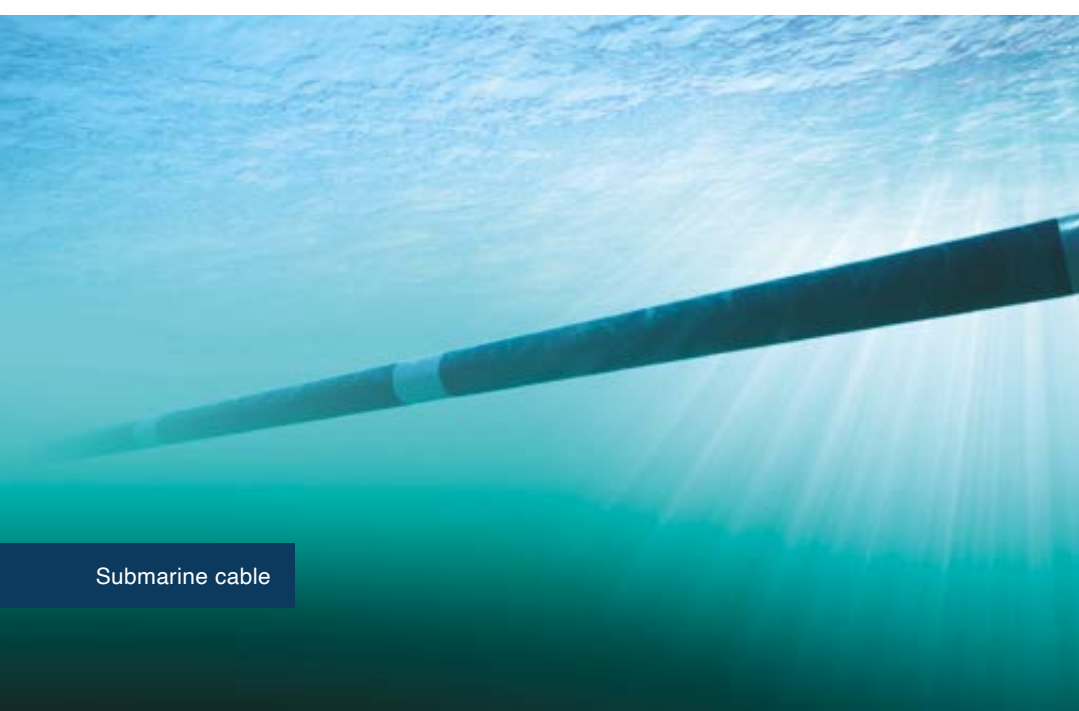
## Safety of Critical Infrastructure and the Environment

As the energy system has continued to undergo transformations and the effects of climate change have become increasingly evident, the focus has returned on infrastructure. Dams, bridges, viaducts, and power grids are engineering works that are designed to last for decades. However, they are now exposed to new, more variable and complex conditions. Their safety can no longer be taken for granted. It, too, must be verified, observed, and understood over time.

At CESI, this commitment does not begin today. As early as 2004, with



Cable cross-section



Submarine cable





Wafer loading into the evaporator

the acquisition of ISMES — a historic centre of applied engineering for major civil works — the Group had extended its expertise beyond the electrical system to include the study of infrastructural behavior and its interaction with the environment. In the following years, these activities were progressively strengthened and integrated with further capabilities, including laboratory facilities for material characterization, also developed through ISTEDIL.

Today, these competencies allow CESI to follow infrastructure throughout its entire life cycle. In laboratories, concrete and steel samples are subjected to tests to reveal their strength and limits. In the field, monitoring systems record micro-variations. These deformations, if correctly interpreted, make it possible to understand how a structure will evolve over time. In a control room, engineers check the sequence of data transmitted by sensors installed on dams and viaducts. The values scroll slowly, apparently unchanged. In such cases, stability is not an event, but a daily confirmation.

It is work carried out far from public visibility, yet it contributes to ensuring the safety and reliability of essential assets. In this way, CESI's role is further consolidated: not only in the development and verification of energy

systems, but also in the solidity of the infrastructure on which those systems depend. Indeed, every grid, every plant, and every connection ultimately relies on the stability of the structures that make it possible.

And while structures, steel, and cables are studied, another important task concerns the monitoring of the ground, aquifers, and hydrogeological dynamics. This dual perspective is paramount in a country like Italy, where dams, bridges, tunnels and transport infrastructure are often located in areas with a complex seismic or climatic condition.

From large Alpine dams to motorway interchanges, from viaducts to urban mobility works, CESI's integrated approach addresses infrastructure not as isolated objects, but as systems embedded within a natural and social context. Each engineering work becomes a point of intersection between human activity, technology, and the environment.

These activities have also been extended to architectural heritage and works of art — fields in which CESI is recognized as one of the leading national reference points. Its advanced monitoring systems have been applied to cultural assets, such as the Leaning Tower of Pisa, Brunelleschi's Dome, and Giotto's Bell Tower, to observe infinitesimal deformations, oscil-

lations, and micro-geotechnical variations in real time through high precision sensors. This approach not only detects any potential structural criticalities at an early stage, but also allows the planning of conservation operations in a predictive manner. Thus, CESI helps protect our historical heritage with the same tools it employs for the most complex energy and civil infrastructure.

In a chapter devoted to new frontiers, this attention to the environment is particularly significant. While the world debates space, satellites, and artificial intelligence, an essential part of resilience is still played out on the ground — foundations, supporting soils, and slopes must be studied before they are crossed.

## From the Ground to Orbit: CESI Space

While soils, foundations, and structures are being analyzed in laboratories, an altogether different kind of environment has gradually entered the Group's horizon: space. It is a trajectory that began far back in time. For many decades now, CESI's Milan laboratories have been carrying out work on solar cells designed to operate where humans are

not present. These cells are not composed of traditional silicon, but rather are III-V semiconductors, made with gallium arsenide and indium gallium phosphide. These materials are engineered to withstand intense radiation, extreme thermal excursions, and continuous cycles of light and darkness. More than 200,000 such cells have been produced to power over one hundred civil satellites, with customers in twenty-five countries. It is a niche, yet strategic sector.

CESI's solar cell technicians work on surfaces that reflect light differently from metal or concrete. They wear thin gloves, examine cells under optical microscopes, and check the continuity of electrical contacts. Every component is designed to operate for years without any possible maintenance. Reliability is not a requirement — it is a condition of existence.

August 2023 marked a fundamental turning point. CESI signed an agreement worth over €13 million with the Italian Space Agency as part of the PNRR-funded *Space Factory* program. The objective was to strengthen the national small satellite supply chain, increase production capacity, and introduce digitalized Industry 4.0 processes.

In 2025, this journey acquired a face and name: **CESI Space**. The decision came at a time when space was no longer perceived as the exclusive domain of large governmental agencies, but as a field of development for commercial activities as well. Indeed, an increasing number of essential functions now depend on private satellite constellations: communications, climate observation, security, and global connectivity.

In mid-2025, the CESI Space production line officially comes into operation. The total investment approached €20 million, while production capacity increased by 200% — significant figures, but what has truly changed is the scale. The same competencies developed to ensure reliability for terrestrial infrastructure — quality control, stress testing, and independent validation — are now applied to components destined to remain in orbit for years without any possibility of maintenance. In space, errors cannot be corrected. They must be prevented.

## Technology that Reduces Weight and Increases Efficiency

Meanwhile, a five-year contract worth over €100 million with Germany's Space-Tech calls for the supply of hundreds of



Thin and flexible solar cell



Part of an MOCVD reactor

> thousands of cells to equip up to eight satellites per month and guarantee global connectivity even in the most remote areas. Here, CESI's proprietary **Integral Assembly** technology reduces weight and increases efficiency. In space, every gram launched has a cost, and every improvement translates into economic and environmental sustainability.

Production now follows a different rhythm. Technicians monitor operational sequences, verify that each cell meets the required specifications, and confirm performance continuity. The new line supports higher volumes, but the principle remains unchanged: every component must be verified before it leaves the laboratory.

There also is another, less visible, yet decisive dimension. Satellites are now fundamental tools for what is referred to as **climate intelligence**: monitoring fires, glacier melting, emissions, and droughts. More than three hundred satellites and thousands of sensors contribute to building predictive models that help gover-

nements and companies make informed decisions. Once again, resilience simply changes scale: from the foundation of a bridge to the trajectory of a satellite.

## The Energy Transition: A System Learning to Connect

While the pandemic made the fragility of infrastructure visible and war brought energy back to the centre of European sovereignty, the present is about transforming the power system: making it cleaner, more interconnected, and more adaptive. In the early 2020s, renewable sources reached unprecedented shares in the electricity generation mix of many European countries. At times, even surpassing production from fossil fuels and marking a transition that was not only symbolic, but also structural. The direction is clearly set: less dependence on imported resources, greater inte-

gration of sun and wind power, and electricity as the central vector for decarbonization.

Nonetheless, the transition is not linear. The sun does not always shine and wind does not blow on demand. Renewable energy is distributed, intermittent, and widespread. Designed for a one-way flow from large power plants to consumers, grids must now learn to manage a multiplicity of injection points, exchanges, and storage solutions. The key word has become **connection**.

Connection between countries is enabled by HVDC interconnectors capable of transporting energy over long distances with less loss and greater stability. Connection between production and consumption is enabled by digital systems that analyze increasingly complex data in real time. Connection between mobility and electricity means that electric vehicles are no longer merely means of transport but active nodes in an intelligent network.

## A Technical — but above all Digital — Transformation

At KEMA Labs, batteries and charging systems are subjected to extreme tests to verify their safety and durability; in Berlin, DC components are tested up to **1,500 VDC**; in Pennsylvania, testing capacity reaches **600,000 volts**. These figures describe a technical transformation, but behind them lies a simpler principle: every innovation must prove reliable before entering the system.

Storage has become a strategic element, as has the ability to integrate large offshore wind parks through meshed grids capable of linking different hubs within a single intelligent architecture. In the North Sea, European targets aim for hundreds of installed gigawatts by 2050. Transporting this energy will require the construction of submarine corridors and the validation of technologies

that until a few years ago were still considered experimental.

At the same time, the digital dimension continues to grow. Sensors, smart meters, digital twins, and machine-learning algorithms support grid operators in demand forecasting, anomaly detection, and asset management. The adoption of security architectures such as **SASE** reflects a new awareness: a smart grid is only as effective as it is secure. The exponential growth in data processing demand — driven by cloud services, artificial intelligence, and global streaming — has introduced new challenges for the power system: continuity of service, redundancy, and integration with renewable sources. Through its KEMA Labs Division, CESI conducts technical analyses and collaborates with industry operators to identify more sustainable energy integration models, recognizing that data centre reliability has become an integral part of overall power system resilience.

## Sustainable Mobility Enters the Equation

Mobility has become part of this fabric, too. In Italy and other European countries, business models for charging infrastructure deployment and the potential role of electric vehicles in grid integration services are being analyzed. Parked cars that, through bidirectional charging, can feed energy back into the system during periods of peak demand — an idea that until a few years ago seemed futuristic — have become a subject of concrete study.

Beyond the technological shift, however, the energy transition also represents a new cultural paradigm. Resilience no longer coincides solely with the physical robustness of infrastructure. It now entails the ability to anticipate behavior, analyze data, coordinate diverse actors, and integrate distributed generation with interconnected markets. >



Remote testing activities

➤ Today, CESI operates as a **distributed laboratory**. It does not generate energy, nor does it operate grids, but it verifies their reliability by studying their evolution and testing their limits. From the foundations of a dam to solar cells orbiting the Earth, the thread connecting these years is that stability must be measurable.

And if between 2020 and 2025 the global energy system passed through crises, realignments, and accelerations, infrastructure has become visible again precisely because the context is unstable. However, it is within this instability that we have understood that the transition is not separate from security. It is its natural development. And as the world redraws political and technological balances, energy continues to flow—silently—in increasingly complex networks.

## CESI: The Future of a Long History

CESI's trajectory spans nearly seventy years of transformations, but its perspective has remained remarkably consistent. In 1956, the challenge was to understand and implement a national electricity system that was still fragmented. Today, the context is radically different: energy flows through continental networks, integrates with digital systems, and connects with civil infrastructure, industrial platforms, and even space. The scale

has changed, but the principle guiding CESI's work remains firm: addressing complex technical challenges and turning them into operative solutions.

Over time, this role has taken different forms. At certain stages, it meant developing the knowledge and technologies required for the expansion of electricity networks; at others, supporting major industrial and infrastructural transformations that demanded interdisciplinary expertise: from energy system modeling and the safety of large-scale projects to new applications in the space sector. What consistently emerges is not a single activity or technology, but a broader capability: CESI interprets complex systems and enables them as technical, economic, and geopolitical conditions evolve.

Looking ahead, this capability has become even more relevant. The energy transition, the digitalization of infrastructure, and the growing interconnection between energy, data, and mobility are reshaping the systems that underpin modern economies. In this evolving landscape, CESI will continue to operate at the intersection where technological innovation meets practical application. Its history shows that major transformations in energy do not occur through new technologies alone, but through the ability to understand them, integrate them, and make them operate in real systems. In this role—interpreting and solving complex challenges—lies the deepest continuity of CESI's journey, and likely the key to its contribution in the decades ahead.



# Shaping a Better Energy Future

CESI is a multinational Italian group headquartered in Milan. Founded in 1956, it is now one of the world's leading technical consulting and engineering firms specializing in innovation, digitalization, and testing for the electrical sector, as well as in civil and environmental engineering. Through its KEMA Labs business unit, CESI is the world's leading independent provider of Testing, Inspection, and Certification services for the electrical industry. Additionally, through its CESI Space business unit, the Group also develops and manufactures solar cells for space applications.

With nearly 70 years of expertise, CESI operates in more than 70 countries worldwide. CESI collaborates with key global players in the energy sector, including utilities, transmission system operators, distribution system operators, power generation companies, system integrators, financial investors, and manufacturers of electromechanical and electronic components. The company also works with governments and regulatory authorities, maintaining close cooperation with major international financial institutions.

CESI is a fully independent joint-stock company headquartered in Milan, Italy, with operational facilities in Arnhem (Netherlands), Berlin and Mannheim (Germany), Prague (Czech Republic), Dubai (UAE), Knoxville and Chalfont (USA), Rio de Janeiro (Brazil), and Santiago de Chile (Chile).

[www.cesi.it](http://www.cesi.it)