



Issue 05 - November 2014

Cigré 2014: An Overview

New markets, promising technologies, challenging perspectives

Future Grids: Smart, Flexible, Dynamic and Inexpensive

An interview with Catia Bastioli, Chairwoman of Terna

BRICS Solutions for Growth

6th BRICS summit: an event that may design a new international order





CESI Energy Journal

EDITORIAL COORDINATION CESI - Paolo Mereghetti Allea - Communication and Public Affairs

EDITORIAL STAFF

Agnese Bertello

CONTRIBUTORS Antonio Ardito Marina Bernardi Alessandro Clerici

> TRANSLATIONS Aaron Maines

ART DIRECTION alleadesign - Gianluca Barbero

EJ - ENERGY JOURNAL CESI'S HOUSE ORGAN

Via Rubattino, 54 I-20134 Milan – Italy info@cesi.it www.cesi.it

Trust the Power of Experience

While all efforts have been made to contact relevant copyright holders with respect to the materials included in this publication, we invite any person whose rights have not been cleared as yet to contact the Publisher for necessary arrangements.



Contents

Editorial

Salvatore Machì - Chairman, CESI Matteo Codazzi - CEO, CESI

> "The electrical system is the greatest achievement of the twentieth century." This statement, based on a classification drawn up by the National Academy of Engineering in America, comes from Terry Boston, President of PJM, the largest utility company in the US, as part of the speech he gave to inaugurate the 45th edition of Cigré.

And while his statement is undoubtedly important recognition, data emerging from the international forum held each September in Paris demonstrates that the importance of the electrical system is not a thing of the past.

In the twenty-first century, interconnected electric networks will be more relevant and determinant for growth and development than ever before.

IN THE TWENTY-FIRST CENTURY, INTERCONNECTED ELECTRIC NETWORKS WILL BE MORE RELEVANT AND DETERMINANT FOR GROWTH AND DEVELOPMENT THAN EVER BEFORE.

shows no signs of diminishing. But while demand is global, supply is local. The energy sector appears to have fully embraced the "glocal" dimension of our era, physically interweaving local and global through its infrastructures and networks.

The planet's thirst for energy

Managing to take full advantage of the potential of renewable energy in those areas where supply is highest and transporting this energy, through highly efficient networks, into those areas where demand is concentrated may well be the most compelling challenge we face.

China, India, the USA, Brazil, Africa, Europe and the Middle East: in every corner of the world plans are underway to build electric lines, HVDC technology. In order to make an effective

response to today's challenges, the system has to prove it is reliable, controllable and resilient. We already possess the technological solutions we need: manufacturers (relying in part on help from independent international laboratories like the one CESI inaugurated in September in Mannheim, Germany) are currently capable of testing and evaluating the responses various networks' components provide. It is therefore possible to reproduce real life stress conditions like those that these elements face

in the field, and provide robust performance evaluations. This is an important guarantee for investors in the sector. Italy has the potential to play an important role: its position as a European hub (both for gas and for electricity) has a clear geographic advantage. It is a challenge that could become a major opportunity for Italian companies which are already well aware of what lies ahead, according to Catia Bastioli, the newly appointed Chairwoman of Terna (the Italian TSO).

| INTERVIEW |

Future Grids: Smart, Flexible, **Dynamic and** Inexpensive

An interview with Catia Bastioli, Chairwoman of Terna

ELECTRICITY GRIDS ARE STRATEGIC INFRASTRUCTURE AND PLAY A KEY ROLE FOR A COUNTRY'S ECONOMY. THEIR PRIMARY CHALLENGE IS TRANSMITTING AND DISPATCHING ENERGY AS INEXPENSIVELY AND EFFICIENTLY AS POSSIBLE, FAILING THIS, PROMOTING ECONOMIC RECOVERY BECOMES AN UPHILL BATTLE. IN THIS EXCLUSIVE INTERVIEW CATIA BASTIOLI, TERNA'S NEW CHAIRWOMAN, OUTLINES TERNA'S ROLE IN EUROPE AND IN THE MEDITERRANEAN AREA.

Energy Journal: The electricity transmission grid is a fundamental asset for any country. In Italy it supports manufacturing activities as well as commercial and residential areas. Building such grid was a major accomplishment during Italy's boom years, but if we are to return to growth as a competitive country its modernization is just as fundamental today. In your opinion, what are the main challenges Terna must face today in order to help the general economy and foster growth and competitiveness? And in your opinion it would be possible to combine, as you successfully did in Novamont, technological innovation and concern for the environment also in the "electrical-systems" industry?

Catia Bastioli: All companies, whatever their line of business, are part of society and fit into the specific social, cultural, and civic contexts in which they operate.

Their primary goal is to create wealth, fuel growth and promote wellbeing. As the recession digs in deeper and the need for change becomes more pressing in Europe and across the globe, it is essential to be able to count on a large number of dynamic, farsighted companies that set themselves the highest of standards and refuse to be satisfied with the ready economic rent that comes from market dominance, something which is only a drain on public funds and an obstacle to growth.

Identifying new approaches to economic growth in Europe has become necessary as never before. It has to start by building on the potential of local territories and their distinctive attributes and be spearheaded by companies with the courage to innovate and be drivers and agents of change. At the same time it has to be encouraged in the background by policies able to forge bridges between different sectors and cultures, so as to create widespread wealth, job quality, and a sense in both the young and the old of having a stake in efforts to expand industries, which go well beyond a pure profit

Chairwoman of Terna S.p.A. since May 2014, Catia Bastioli helped found the Fertec Research Centre on renewable raw materials, which later became Novamont S.p.A., a company in which she holds the position of CEO. She is also President of Mater-Biopolymer S.r.l.. Mrs Bastioli is a member of the Board and of the Executive Committee of Federchimica, of the Executive Committee of PlasticsEurope Italia and is President of the Kyoto

IDENTIFYING NEW APPROACHES TO ECONOMIC GROWTH IN EUROPE HAS BECOME NECESSARY AS NEVER BEFORE

and by the Italian prime minister, Matteo Renzi, in his inaugural address opening the semester of the Italian presidency of the EU. In this general framework, Terna has already done a lot. Its efforts have enabled Italy to close the infrastructure gap with other European countries and has led Terna to overtake the other major continental grid operators in terms of the pace of infrastructure development. Today, Terna is the biggest independent grid operator in Europe and the sixth biggest in the world by kilometers of grid operated.

Club Association. Author of significant scientific papers in the form of publications of international patents, she has helped to create an industrial culture that is particularly sensitive to the problems of the environmental impact and eco-sustainability of production processes. In 2013, she received the "Eureka Award" for technological innovation, and in 2007 the prize for "European Inventor of the Year" for inventions relating to bioplastics.

principle. In this context, the electron is a source of clean energy, which can be generated by a host of different fuels and technologies and can be transmitted across vast distances with minimal dispersion over grids that are becoming increasingly smart and flexible. This is why electricity grids are such strategic infrastructure. They play a primary role for a country's economy - a role that is set to grow in importance as renewable sources of energy are increasingly brought on line.

The challenge for Terna, therefore, is that of transmitting and dispatching energy at the lowest cost possible and as efficiently as possible. Without this, promoting economic recovery will be an uphill battle. Terna needs to fulfill its role to the full in interconnecting as efficiently as possible production units and delivering energy to every corner of the country and interconnecting Italy with other European nations and, in perspective, with North African countries. And it has to do that while minimizing the cost of managing renewable fuels, the cost of operations, and the cost of dispatching electricity, and assuring grid security. It is no coincidence that the European Union has identified the development of energy grids as a priority, as stressed by the new president of European Commission, Jean-Claude Juncker,

Let me stress that this investment commitment does not weigh on state coffers and accounts for only three per cent of prices—the lowest rate in Europe. And it is a commitment that is set to continue, driven by the challenges that lie ahead, first and foremost the integration of renewables, borne out by the 2.7 billion works currently underway throughout the country from north to south, keeping 750 firms and 4,000 people employed day in, day out. Without, of course, neglecting in any way the overriding importance of sustainability, by combining technological innovation with respect for the environment and local territories.

OUR HOPE IS FOR THE GRID TO BECOME AN ECONOMIC DRIVER FOR INTEGRATED LOCAL INDUSTRIES THAT PRODUCE INNOVATIVE, ENVIRONMENTALLY FRIENDLY GOODS

Remember that Terna's environmental footprint is seen first and foremost in the physical presence of the pylons and power stations that dot the landscape; reducing our impact on the environment, therefore, is something that informs all of Terna's operations. In this regard, in recent years the Company has worked with leading architectural firms to engineer new types of low-impact pylons, which combine an

eye for the landscape with service efficiency. One example is the pylon designed for Terna by Sir Norman Foster, a British architect and designer, installed along the high voltage "Tavarnuzze-Santa Barbara" power line in Tuscany. Then there are the "dancing" pylons designed by Hugh Dutton (led by the architect Giorgio Rosental), installed along a section of the "Trino-Lacchiarella" power line crossing Piedmont and Lombardy. Single pole pylons instead make up 70 per cent of the "Chignolo Po-Maleo" power line in Lombardy, designed to reduce the area covered by transmission lines to just one-fifteenth of its former size, along with the ground occupied by the poles, while in-depth studies of the natural marine ecosystems were conducted before laying the submarine cables for the "Sa.Pe.I." power line connecting Sardinia to the Italian mainland and the "Sorgente-Rizziconi" power line between Sicily and Calabria, two major Italian infrastructure works. Our hope is for the grid to become an economic driver for integrated local industries that produce innovative, environmentally friendly goods, able to raise industry standards and become a paragon for Europe as whole, while generating broader benefits for other sectors as well - a model of economic growth that combines profit with the well-being of the local area, the environment and workers.

Terna

EJ: The energy industry is in the midst of a deep, far-ranging transformation, and the electric sector may be one of the areas in which this transformation is most radical. The need to integrate transmission systems with renewable generation represents a huge challenge that is more than merely technological.

What are the best strategic steps to take in order to support this process?

C. B.: Industry transformations are without a doubt proving most radical in the electricity sector. We are heading towards a new energy model which will require massive investment in technology and infrastructure if it is to achieve its fullest potential.

Globally the issue of sustainable economic development first emerged in the 1990s, especially in relation to the impact that the excessive burning of fossil fuels has on the environment. In this way new energy sources, by which I mean wind and photovoltaic power, as well as solar thermal energy, biomass, and geothermal energy, began to spread - so much so that they have moved from being entirely marginal sources of power to being considered central to energy policy.

The growth of renewables has been so great, and in part unexpected, that it has placed enormous strain on the electricity systems of many countries, including Italy's. What

has happened is that supply now outstrips demand at the local level, and ample, flexible reserves need to be maintained to offset rapid fluctuations in supply - wind and solar power are intermittent by nature and so cannot be planned.

THE GROWTH OF RENEWABLES HAS BEEN SO GREAT, AND IN PART UNEXPECTED, THAT IT HAS PLACED ENORMOUS STRAIN ON THE ELECTRICITY SYSTEMS OF MANY COUNTRIES

transmission grid.

This is a new and challenging situation for Terna, which as grid operator is directly involved in the renewable energy game. In an effort to integrate renewables as best as it can and ensure the grid keeps pace with the "new system", the company invested in a series of measures designed to boost the security of the electricity system, involving the strengthening of the electricity grid, the development of automation systems, more efficient planning, control, and monitoring, and the coordinated management of distribution grids and the

Last but not least, energy storage systems have been created, which Terna is trialling as part of plans to maximize the use of renewable energy sources and improve control of high voltage and extra-high voltage transmission lines. The benefits expected from these measures lie in the stability and security of the electricity system

as a whole, which means fewer blackouts and power interruptions due to the growing but suboptimal use of renewable power plants. Renewables - together with proper infrastructure and environmental planning, emission reductions, more rational energy use, and the development of new technologies - are just one piece of a global strategy for "green growth," whose objectives are incorporated into the European Union's climate and energy package. Pushing ahead in this direction means leveraging the huge financial and environmental investment Italians have made in renewables and their commitment to changing tack for economic growth.

THE CHALLENGES FACING US IN THE COMING YEARS CALL FOR AN EFFECTIVE LONG-TERM ENERGY STRATEGY

EJ: In the US, Hurricane Sandy spurred a debate about the need to modernize and "decentralize" power systems networks. Advocates of decentralization call for increased "self-sufficient" autonomy, reinforced grid resilience and promotion of distributed generation coupled with electricity storage solutions. These topics are also becoming central to the Italian debate about the optimizing its national energy policy.

How can we develop a national energy policy which combines concern for the environment, security of supply and low costs in such a way that best serves the country?

C. B.: The challenges facing us in the coming years - energy saving and efficiency, the sustainable development of renewables, and cost reductions for businesses and households, to name just a few - call for an effective longterm energy strategy. Such a strategy will be essential for underpinning economic recovery in the industrialized nations most heavily hit by recession and, at the same time, for meeting growing energy demand in emerging economies, but it also has to take into careful consideration the impact of policy on society, employment, and the sustainability of economic growth. Given all this, Terna applauded the announcement of a new plan for steering the energy policies of which the country is in such urgent need, more than twenty years after the last National Energy Plan. Nevertheless, it has to be remembered that energy is a service and its development must be tied to broader plans for the mid/long-term social and economic growth of the country. A long-term horizon is necessary if we are to see the bigger picture, but scenarios are only of any use if they then result in concrete action.

One priority lies in finding the right mix of fuels for producing electricity, which today

relies too heavily on gas - a problem laid bare for all to see by the current geopolitical crisis. A strategic plan for national growth can more easily overcome the snags of local-level powers and help reforms simplifying governance to be understood more clearly, such as the amendment to Title V of the Constitution returning responsibility for energy policy to the central government.

Today as in the past, electricity supply is essential for shaping the present and building the future. Talk often focuses on energy production rather than its distribution, but both have to be developed in parallel with each other. One of the mistakes of the last decade has been precisely that of not planning power stations in coordination with the development of the grid. As a result new plants have been constructed not where they are needed but where building approval was easier to obtain, leaving the grid with bottlenecks and congestion in supply that have undermined the fluidity and efficiency of the electricity market. Now things have changed, however, and the electricity system we were accustomed to has become a thing of the past. Changes underway are transforming the way we think in Italy, Europe, and throughout the world. New challenges call for new answers; we need to change our approach to grids and their operation. This also means thinking of a new model for their development, in the awareness that the development of environmentallysustainable, technologically-advanced and European-wide infrastructure, as Terna's experience shows, means not just more secure and efficient electricity systems but also more cost savings and more jobs. To sum it up in one word, it means growth. The electricity grids of the future will need to be flexible, dynamic and fundamentally smart, with a crucial role played by research, innovation and technological development. Big energy highways will need to interconnect with small local grids with a view to using resources more efficiently, something that is essential for economic recovery and growth.

EJ: Terna is undoubtedly an example of Italian excellence in terms of network complexity, advanced technologies and operational performance. Do you see Terna developing its business in Italy alone, or do you believe the company can play an international role?

C. B.: We have always conceived Terna's future to lie not just in Italy, but in Europe and the

Mediterranean area - which is gearing up, in particular, to become a decisive player in the energy sector in forthcoming years. This is also because of Italy's unique geographical position, which makes it perfectly placed to be an interchange hub for the continental electricity market, and not only. We see it as an energy pivot, something which has already partially been achieved and has partially to be completed. Italy already has 22 electricity interconnections with its European neighbors (Switzerland, France, Slovenia, Austria, and Greece) and another three are under construction, one with Austria, one with Montenegro, creating a bridge to the Balkans, and one with France, connecting northern and southern Europe.

THE PUBLIC DEBATE OFTEN FOCUSES ON ENERGY GENERATION RATHER THAN ITS DISTRIBUTION, BUT BOTH HAVE TO BE DEVELOPED IN PARALLEL WITH EACH OTHER

These efforts have been shaped by European Union directives aimed at encouraging the development of an integrated energy grid, a system of "energy highways" across Europe by 2020 designed to take up surplus energy supply from renewables in eastern and southern Europe (including North Africa), and support the integration and development of the European common market. Italy is involved in 22 Projects of Common Interest (PCI), of which 17 are infrastructure projects led by Terna, out of a total of 248 energy projects across Europe designed to build approximately 23,000 kilometers of electricity lines, funded to the tune of 5.85 billion Euros by Europe, divided into corridors running towards western Europe and towards central and southeastern Europe. The objective is to integrate national grids into one major European network. This common energy market is a key opportunity and need to be seized. The groundwork is already there, as we already have a sophisticated and Europeanwide integrated electricity transmission grid that connects tens of thousands of power sources and national energy operators across the continent, carrying trillions of kilowatt-hours. A highly interconnected and technologically advanced European electricity grid is a strategic factor for enhancing the security of the international electricity system and electricity supply, while boosting dynamism, flexibility of use, and energy flows, as well as minimizing costs for the community and business and reducing our environmental footprint.

| TOP STORIES |

Cigré 2014: An Overview

Antonio Ardito - Chief Engineer, Consulting, Solutions & Services Division, CESI; Alessandro Clerici - Senior Corporate Advisor, CESI Agnese Bertello

CIGRÉ IS NOTHING LESS THAN A MUST-SEE EVENT, A KEY OPPORTUNITY TO TAKE STOCK AND FOCUS ON INNOVATIVE GROWTH STRATEGIES. HERE'S A QUICK LOOK AT THE PRIMARY THEMES AND ISSUES HIGHLIGHTED AT THIS YEAR'S EDITION OF THE PRESTIGIOUS MEETING.

Held in Paris at the end of August, the biannual International Council on Large Electric Systems, or Cigré, once again proved an excellent opportunity to take stock of the general situation in the electric sector. This year the international forum welcomed representatives from 85 different countries and registered a significant increase (+20%) in visitors and exhibitors when compared with the previous edition. It was an opportunity for operators in the electric sector from all over the world to compare notes, beginning with the presentation of general themes and issues during the first days, and ultimately addressing more technical and specific aspects during subsequent days, thereby integrating different levels of interpretation concerning how the sector as a whole is doing.

What are the most promising development trajectories? Which geographical areas are the most interesting? And what technological and political challenges will the electric sector have to deal with? In this short article we'll be as a paradigm for potential change in other focusing on the messages from the first day, which opened with an explicit recognition of the importance the electric energy sector

has for the modern era: the development of electric systems can be considered the greatest conquest of the twentieth century, as Terry Boston, the CEO of PJM (America's largest utility company) reminded participants during Cigré.

WHAT ARE THE MOST PROMISING DEVELOPMENT TRAJECTORIES FOR THE ELECTRICAL SECTOR? WHICH GEOGRAPHICAL AREAS ARE THE MOST INTERESTING?

At a global level, the development of networks and access to electric energy is undoubtedly very heterogeneous: despite this, several general trends were guite clear. To begin with, a marked distinction must be made between OECD (Organisation for Economic Cooperation and Development) and non-OECD countries. In the wake of the Boston report. we'll keep an eye on evolution that has taken place in the United States over recent years Western countries, bearing in mind that the US generally anticipates what happens elsewhere by roughly a decade.

Beginning halfway through the past century and continuing until the advent of this century, electric energy consumption in the US grew at a rate roughly double that of the GDP. But in recent years things have changed radically: the growth rate of electric energy consumption has dropped progressively.

IN 2010 ELECTRIC ENERGY CONSUMPTION IN NON-OECD COUNTRIES OVERTOOK CONSUMPTION IN INDUSTRIALIZED COUNTRIES, IN 2040, THIS MARKETS WILL ACCOUNT FOR 2/3 OF ALL GLOBAL CONSUMPTION

1990 was a key year, the first year that the increase in electricity consumption proved equal to the increase in GDP. Since then, we've seen a turnaround in the trend that shows no signs of stopping, so much so that today growth in electricity consumption stands at 0.9% per year, compared to 2.4% growth in the GDP, and these values are forecast on average through 2040. Even bearing in mind

an economic recovery, it's hard to imagine significant recovery in electricity consumption within industrialized countries.

An ulterior confirmation of this trend can be found in data relative to a comparison between OECD and non-OECD countries: in 2010 electric energy consumption in non-OECD countries overtook consumption in industrialized countries. In 2040, the markets in non-OECD countries will account for 2/3 of all global electricity consumption. Concerning electric energy generation, the main element that emerged during Cigré with regards to the US was undoubtedly the increasingly important contribution made by gas with respect to coal, and by shale gas in particular. By 2035, gas will be making a more significant contribution than coal. In 2040, shale gas will account for more than 50% of total gas production. The low sale price of shale gas has undoubtedly contributed to its rapid expansion. As far as renewables are concerned, the United States has developed almost all of

| Bridging the electricity gap in West African countries |

The West African Power Pool is an International organization that aims to ensure regional power system integration and the realization of a regional electricity market.

WAPP covers 14 of the 15 countries in the area's regional economic community: Benin. Ivory Coast, Burkina Faso, Ghana, Gambia, Guinea, Guinea Bissau, Liberia, Mali Niger, Nigeria, Senegal, Sierra Leone and Togo. Today roughly 300 million people live in this African region, but only 41% of them have access to electricity. To make matters worse, there exists a significant "electricity gap" between different WAPP countries while Ghana, Senegal and Ivory Coast have the highest percentages for the area (61%), Liberia ranks far below with just 4%.

This reality appears even more contradictory when one considers how rich it is in natural resources. Guinea has an economically feasible hydropower potential of 6

GW that remains untapped; Nigeria has enormous natural gas reserves that have yet to be unlocked. Achieving universal access would require an additional 60 GW, or 3 GW per vear.

In order to strengthen growth in this corner of the world, it is fundamental to build an interconnection system that allows energy-efficient transmission from one country to another, reducing losses and permitting cost savings.

In this context, CESI won an international tender announced by WAPP for a consultancy project that aims to enhance regional electricity interconnections, and is being financed by the World Bank. The goal is to improve grid stability. In order to achieve this, the project explores several different kinds of interventions: reviewing operating procedures; updating protection and control system settings; or adding systems capable of controlling inter-area oscillations.

its hydroelectric resources, and is now betting on development in sectors like biomass, and especially wind, an area where America is second only to China.

Interesting, though perhaps a bit optimistic, data was supplied by Shri R. N. Nayak, Chairman of the Power Grid Corporation of India, concerning local development in the electric energy sector: growth in consumption is connected to a significant urbanization and industrialization process. According to Nayak's and HVDC lines (+/-500 kV) will increase from data, total installed power will pass from the current 249 GW to 425 GW in 2021; and to 778 GW in 2031. Although coal will continue to be the primary energy source, the contribution made by renewables - wind, photovoltaic and minihydro in particular – is experiencing significant growth and should

IN INDIA

9,400 km to 16,870 km. In 2016-2017 an approximately 1,200 kV line (a world record compared to China's 1,050 kV line) should become operational, as well as another +/-800 kV HVDC line, a voltage equal to the maximum currently applied in China. There will also be considerable development in

reach 100 GW by 2020. Extraordinary development has been registered in transmission lines for the short-term: today's 12,365 kilometers of approximately 765 kV will increase to 32,200 km in 2016-2017,

AN EXTRAORDINARY DEVELOPMENT OF TRANSMISSION LINES HAS BEEN REGISTERED

| CESI Research Studies at the 45th Cigré |

integration.

During the September 2014 edition of Cigré – an international convention for the electric sector held biannually in Paris – CESI presented several different papers that contributed to the global discussion on the future of the electric system and interconnection grid development. Developed in partnership with international groups, these papers detailed concrete case histories and specific technologies. The first paper was entitled Optimizing the electrical design of the Colombia-

and was written by Clerici, Research presented by Lagrotteria and Rizzo in partnership with experts Eléctrica Clombia-Panamá The presentation focused on different potential project and the strategies for optimizing the grid. Optimization would achieve two different goals: first, a more competitive electrical energy market for Panama; second. Colombia would be afforded the possibility to exploit its potential for exporting electric energy. The line would also be important for regional below sea level.

Colombo, together with Adam (Medgrid), Sim (Intertek) and Burns (Parsons Brinckerhoff) focused on the Medgrid development of submarine interconnections in the Mediterranean Sea. It outlined how, in order for projects like this one to succeed, experts need to design and produce cables that can guarantee high performance levels even in particularly stressful conditions, like those found at a depth of 2,500 meters

Salvetti and Matli (together with representatives of Terna and Swissgrid) presented a paper that addressed restoration strategies, attempting to define innovative strategies that could be implemented on the Swiss arid in order to restore electric service in the event of an emergency or blackout.

Their research details a new kind of restoration strategy based on the creation of long backbones that start in countries bordering Northern Italy, and extend down into Southern Italy.

connections with bordering countries: India will have an interconnection capacity of 70,000 MW with Pakistan, Buthan, Nepal and Bangladesh.

ASEAN COUNTRIES PRESENT SIGNIFICANTLY DIFFERENT CONDITIONS BOTH IN TERMS OF DEMAND FOR ELECTRICITY AND NETWORK RELIABILITY

Although objectives and targets are not numerically comparable, the electric energy sector in Europe is in any case undergoing an important development phase, especially as regards technological and systemic innovation. The presentation given by Klaus Kleinekorte, CEO of Amprion Germany, underlined the impact renewables are having on the functioning and dependability of the electric system and generation market. Germany is studying a number of different HVDC corridors, with the aim of integrating its significant wind power production (Germany is third in the world for installed capacity) under development in the north of the country, and therefore quite far from industrial production and consumption centers, into the system at large.

The situation in Asian countries and Oceania is undoubtedly less homogenous. Excluding China (which, as the largest consumer of electric energy in the world and with no fewer than 26 HVDC systems currently in operation, is essentially a stand-alone case), ASEAN countries (South East Asian Nations) present conditions significantly different from one another both in

terms of demand for electric energy (ranging from 84.8 kWh/person in Myanmar to 7,685 kWh/person in Singapore), and in terms of network reliability and capillarity. Rethinking interconnections is particularly important from the point of view of overall growth for the entire area and potential savings; for this reason experts are currently working on a master plan that calls for the creation of super-national network infrastructures (Asean Power Grid) that may make it possible to save up to 1.8 billion dollars. With regards to generation, it is important to remember that in 2013 the share of renewables (first and foremost hydroelectric, then biomass and geothermal) among AESAN countries rose to 19% overall.

Therefore the electric energy scenario is clearly experiencing profound movement, though this movement must come to terms with data concerning energy poverty on a global level: 1.2 billion people have no access whatsoever to electric energy. The data presented at Cigré reminded everyone that 50% of these peoples live in the sub-Saharan area. Therefore, the theme of access to energy is absolutely strategic in order to initiate any plan or path out of poverty for hundreds of millions of human beings. In order to accelerate this process, experts are currently studying an interconnection project to be set up among a number of different West African nations (WAPP).

While what we've covered up to this point corresponds more or less to the themes addressed during the inaugural day of Cigré, subsequent meetings and sessions dealt with

more specific and technical aspects of the industry connected both with critical issues in the electric sector, and with potential technological, systemic and market evolutions. HVDC took center stage as the key technology for developing transmission networks: highvoltage direct current lines continue to attract the interest of both builders and TSOs. Today HVDC is a mature, tested and dependable technology. But its intense development has also brought forth several unexpected critical areas. Up until just a few years ago, HVDC lines were isolated realities: non-contiguous lines that ran from one individual point to another. Today the convergence of more than one HVDC line on an area of reduced size (for example Shanghai) is forcing experts to face entirely new technical security problems. Some advanced solutions already exist, especially for systems that no longer have just two terminals, but are multi-terminal. Once again China has led the way, providing concrete examples

Data concerning cables was equally revealing: currently the demand for this technology is so high that producers are having difficulty meeting it. Furthermore, major investments in research and innovation in this area have led to an improvement in the performance and capabilities of both land and marine cables.

currently under construction.

There are also a number of important innovations for aerial lines, designed to increase the transmission capabilities of existing line, and to potentially transform alternate current lines into direct current lines, or into hybrid lines with both AC and DC circuits on the same pole.

security systems for ICT.

TODAY HVDC IS A MATURE, TESTED AND DEPENDABLE TECHNOLOGY. BUT ITS INTENSE DEVELOPMENT HAS ALSO BROUGHT SEVERAL UNEXPECTED NEW ISSUES

Last but not least, it became clear during Cigré that in order to plan and integrate markets there is a need to develop in Europe, much as happened for the day-ahead market, a pan-European cross-border balancing market. In order to take best advantage of the maximum potential provided by renewables, speakers underlined the importance of intensifying interconnections and creating e-highways that not only crisscross Europe, but extend to cover the entire Mediterranean and North African basin. At first these e-highways would be utilized in a north-south direction (therefore as export channels for electric energy), and at a later date they would operate in the opposite direction, thereby integrating renewable energy produced in Africa and the Middle East into European networks.

evolution of power market frameworks affects the OG.

Cabano (together with Terna), focused on how to optimize market integration and storage resources in order to mitigate the risk of over-generation from non-programmable RES in the Italian market. Their paper investigates the over-generation" (OG) phenomenon in the Italian power system, highlighting the way in which the

Last but not least, research

presented by Cova and

Continuing an analysis of the macro-trends that emerged during the convention, it should be noted that a considerable amount of attention was paid to cybersecurity. Development in this sector is closely connected with the exponential increase in access points to the ICT network: dialoguing with the consumer; managing services in remote; controlling consumption; and safely hosting distributed generation all mean opening new doors to the outside, and therefore require the definition of more refined

| INDUSTRIES & COUNTRIES |

BRICS Solutions for Growth

Agnese Bertello

IN THE WAKE OF THE FIFA WORLD CUP SOCCER CHAMPIONSHIPS, BRAZIL HOSTED ANOTHER IMPORTANT INTERNATIONAL EVENT: THE 6TH BRICS SUMMIT. BUT WHILE THE FORMER GAVE TOP PRIZE TO A STORIED EUROPEAN COUNTRY, THE LATTER APPEARS INTENT ON STRIPPING WESTERN COUNTRIES OF THEIR FINANCIAL SUCCESSES. DURING THE SUMMIT BRAZIL, RUSSIA, INDIA, CHINA AND SOUTH AFRICA SPONSORED THE CREATION OF THE NEW DEVELOPMENT BANK, DESIGNED TO COMPETE WITH THE INTERNATIONAL MONETARY FUND.

> After wrapping up the World Cup, Brazil drew back the curtains on another important event, hosting leaders from Brazil, Russia, India, China and South Africa from July 14th through the 17th for the 6th BRICS Summit.

THE 6[™] BRICS SUMMIT IN FORTALEZA, ENTITLED "INCLUSIVE GROWTH, SUSTAINABLE SOLUTIONS," MARKED A SIGNIFICANT STEP FORWARD

Held in Fortaleza, the event is an important leg in the evolving story of BRICS. Created in 2001 by Goldman Sachs economist Jim O'Neil, for a long time "BRICS" was little more than an acronym that united a group of "other" countries experiencing tumultuous growth within a global economic scenario dominated by industrialized Western countries. Brazil, Russia, India and China were considered the four primary players, with South Africa added later.

In 2006 the five states established their first formal contacts, but it was only in 2009, with the first BRICS summit in Ekaterinburg, that these meetings became politically relevant, transforming the event into a genuine summit where, year after year, developing countries can establish shared policies for growth, reinforcing cooperation, commercial and industrial exchange, as well as laying the groundwork for scientific and technological partnerships.

The choice has proven to be an effective: today commercial exchanges between countries in the world's southern hemisphere exceed exchanges with industrialized countries by roughly two trillion dollars.

The 6th Summit in Fortaleza, entitled "Inclusive Growth, Sustainable Solutions," marked another significant step forward. During the summit Vladimir Putin, Xi Jinping, Narendra Modri, Jacob Zuma and Dilma Rousseff officially underwrote the creation of a new bank for emerging countries – the New Development Bank – that establishes an alternative to the International Monetary Fund. Politically speaking, the act was essentially a declaration of independence. It recognizes of a position of strength within the geopolitical framework, one that must be played with determination. Their stance was also formed in an open contrast with the IMF that has been ongoing ever since the BRICS began pressing for a reform of the IMF's governance,

encouraging the global fund to recognize the real weight emerging countries have within the global economy. Today, in fact, although the GDP of BRICS countries represents 25% of the global economy, the voting rights of those same countries within the IMF's assembly amounts to little over 10%.

TODAY THE GDP OF BRICS COUNTRIES REPRESENTS 25% OF THE GLOBAL ECONOMY

"We remain disappointed and seriously concerned with the current nonimplementation of the 2010 International Monetary Fund (IMF) reforms, which negatively impacts on the IMF's legitimacy, credibility and effectiveness," states the Fortaleza Declaration

and Action Plan. "The IMF reform process is based on high-level commitments, which already strengthened the Fund's resources and must also lead to the modernization of its governance structure so as to better reflect the increasing weight of EMDCs in the world economy."

The New Development Bank seems set to lend form and substance to an entity – the BRICS group - that up until today has remained little more than a name on paper. With 100 billion dollars in subscribed capital and an initial, paid-up capital of 50 billion dollars (equally divided into a 10 billion-dollar share per country), the NDB will become one of the world's largest financial institutions for development. Parallel to its establishment, member states at Fortaleza also signed the

Summary of Energy on BRICS Countries

Contingent Reserve Arrangement (CRA), an agency boasting a 100 billion-dollar fund that will act as liquid reserves during times of economic turmoil or in the event of unforeseen financial shocks.

Roles will be equally divided between member states and assigned on a rotating basis. According to guidelines set during the summer, the first president of the New Development Bank will be Indian, while the Board of Governors and the Board of Directors will be run by a Russian and a Brazilian respectively. The bank's headquarters will be

located in Shanghai. The New Development Bank will be open to other member countries of the United Nations, but the share held by BRICS cannot drop lower than 55%. Despite the lower growth rates of individual economies registered during the most recent

GUARANTEEING ACCESS TO MODERN, DEPENDABLE, CONSTANT AND SECURE SOURCES OF ENERGY IS A PREREQUISITE FOR ANY POLICY AIMING AT PROMOTING IMPROVEMENT IN QUALITY OF LIFE

period, the launch of the NDB demonstrates the economic and political vitality of emerging countries, and is the kind of event destined to shake up the global status quo. The bank will support the same sustainable growth policies that the Fortaleza Declaration and Action Plan identified, aimed first and foremost at reducing poverty. Guaranteeing access to modern, dependable, constant and secure sources of energy is a prerequisite for any policy that aims to promote improvement in quality of life. For this reason, the development of partnerships in the energy sector, sharing technological know-how and reinforcing economic partnerships between member countries are all central to the Declaration.

China has been Brazil's primary economic partner for some time now: in 2013 trade between the two countries totaled 83.3 billion dollars, a 10% increase over 2012. In July the two nations signed 32 new cooperation agreements, the most significant of which is undoubtedly that underwritten by Eletrobras and the State Grid Corporation of China, the world's largest electric company.

THE LAUNCH OF THE NDB DEMONSTRATES THE ECONOMIC AND POLITICAL VITALITY OF EMERGING COUNTRIES. THEY WILL SHAKE UP THE GLOBAL STATUS QUO BY 2030

This accord, signed at the end of the BRICS Summit, covers the realization of HVDC (800 Kv) electric transmission lines that will make it possible to transport energy produced in the new Belo Monte hydroelectric plant straight to heart of Brazil's production center. Belo Monte will be the third largest hydroelectric plant in the world in terms of production capacity (11,233 Mw), behind the Three Gorges Dam in China (22,720 Mw) and the Itaipu facility (14,000 Mw), located between Brazil and Paraguay. The electric plant will be realized on the Xingu River, in the heart of Amazonia, roughly 1,300 miles from Brazil's most populous city and the country's production centers, where demand for energy is rising steadily. The decision to employ High Voltage Direct Current for this kind of project (long distances and a high energy charge) has

become commonplace: HVDC can guarantee decidedly superior efficiency and performance standards compared to traditional, alternating current networks.

For State Grid, which already acquired seven small electric transmission companies in southeastern Brazil for 1 billion dollars in 2010, this accord marks another step forward in its penetration strategies for the global market. According to statements made by Dilma Rousseff and Xi Jinping at the signing, this partnership may be extended to include other aspects relative to realizing the project.

Other, equally significant exchanges with the Russian Federation have been completed as well for a total value of 5.6 billion dollars in 2013 alone. Russian companies are enjoying an increasingly solid presence in Brazil, especially in the energy sector, where they have established important collaboration agreements to explore new oil and gas deposits.

Over recent years, BRICS countries have played an increasingly important role with other countries in the area as well: China, Brazil and India have in fact supplanted Western countries in supporting growth initiatives in poorer African and Asian countries. In Africa, Brazil has established more embassies than the United Kingdom.

Not by chance, in July Vladimir Putin and Xi Jinping were engaged in a long series of bilateral meetings with the presidents of various different Latin American countries, including Venezuela, Nicaragua, Argentina and Cuba.

Also in these cases, the NDB may eventually play a fundamental role in financially supporting the development of these territories, which would at the same time guarantee privileged access to completely new markets.

It's too early to say whether, as many analysts now believe, the creation of the New World Bank ratifies the end of the Bretton Woods accords and the collapse of the world financial system as we know it. But the 6th BRICS Summit was unquestionably an event that will produce new and unexpected reorganization within the international arena.

| TOP STORIES |

Mannheim at the center of HVDC

Agnese Bertello

HVDC TECHNOLOGY IS ACHIEVING SIGNIFICANT MARKET IN-ROADS ALL OVER THE WORLD, AND IS INCREASINGLY VIEWED AS A VALID TOOL FOR EFFICIENTLY INTEGRATING RENEWABLES INTO THE ELECTRIC SYSTEM. AS PART OF THE INAUGURATION CEREMONY FOR CESI'S NEW MANNHEIM LABORATORY, KEY INDUSTRY PLAYERS FROM ACROSS THE GLOBE WERE INVITED TO MEET AND DISCUSS THE FUTURE OF THE SECTOR.

New technology often drives social change. Innovation makes change possible, even economically sustainable, spurring previously unthinkable transformations. The same can be said for the electric sector, where HVDC, or High Voltage Direct Current, has begun achieving levels of performance, dependability and the manufacturers that produce systems, and economic viability that make it a valid solution to challenges the sector is facing. HVDC technology can convert alternate current voltage into direct current voltage at the source, reconverting it into alternate current voltage after it has been transmitted to its destined end user. It can transmit bulk quantities of energy with a reduced impact on infrastructures, and therefore may prove to be the new paradigm in managing electric networks, as well as help resolve the impasse in areas where energy demand is growing strongly but remains partially unsatisfied due to a dramatic reduction in energy from traditional fossil fuel sources and nuclear power.

In September, CESI inaugurated a new

laboratory in Mannheim, Germany where

experts are putting particular emphasis on testing HVDC systems and cables. The event provided a perfect opportunity for operators in the sector to discuss and analyze the current state of affairs, engaging in an open discussion among utilities, network operators solutions and cables for HVDC technology.

ELECTRIC NETWORKS

With respect to traditional alternate current voltage systems, the performance levels of today's HVDC solutions allow us to obtain certain advantages from technical, economic and environmental points of view. It has become a truly enabling factor, as Domenico Villani, Director of the CESI group's Testing & Certification division and host of the event, emphasized during his inaugural speech.

HVDC CAN EFFICIENTLY TRANSMIT BULK QUANTITIES OF ENERGY WITH A REDUCED IMPACT ON INFRASTRUCTURES. IT MAY PROVE TO BE THE NEW PARADIGM IN MANAGING

HVDC can transmit large quantities of energy from natural energy sources to consumption centers (usually located at great distances from one another), and do so with reduced loss. Electronic power instruments make it possible to control transmission to an even greater degree.

THE USE OF HVDC TECHNOLOGY HAS A POSITIVE DIRECT IMPACT ON THE COST OF ENERGY

Taking better advantage of the potential of renewable energy sources and efficiently transferring the energy they produce into large consumption centers completely revolutionizes the generation strategy for electric energy. The most obvious benefit is economic: use of this technology has a direct impact on the cost of energy. But it can also significantly reduce CO_2 emissions, benefitting the environment at large.

Fossil fuel and nuclear power use can be optimized, producing only what's needed to support the network. Generation from renewable sources – made available through direct current interconnections – would help satisfy what has become extremely high demand in certain specific geographic areas.

HVDC also has a far more limited environmental impact compared to traditional structures, capable of transmitting much more energy even as it reduces the impact on services.

Network reliability constitutes another advantage: HVDC shields the system from the risk of blackouts, a critical issue that has created a number of problems in recent years. The 2003 blackout that involved networks in Italy, Switzerland, Austria, Croatia and Slovenia left 55 million people without electricity; the 2012 blackout in India left 670 million people in the dark.

If we drew a map of all the HVDC projects currently being realized, studied and/or tested, we would see a world crisscrossed by a web of lines that jump national borders, cross continents and pass beneath the seas, connecting remote and isolated areas with others that are alive and pulsing with activity. It would look like a rough draft of the "Supergrid," the direct current network that overlaps traditional transmission networks and which people would like to see as the new backbone of our international electric energy network, making it possible to manage the availability of electric energy directly.

In Mannheim, CESI's symposium provided an opportunity to showcase the most important

evolutions taking place in the sector. Germany has planned a reduction in nuclear power, and is realizing the first important HVDC corridors across Europe, bringing wind energy (for a total of more than 10 GW) from the north seas to the south, where most of Germany's "high energy demand" industries are concentrated. Tennet, 50Hz and Transnet BW – three German TSOs that gave presentations during the event – underlined a few of the general advantages offered by this technology, including a "right of way" reduction, improved economic management and the possibility of exerting greater control over energy flows.

NETWORK RELIABILITY CONSTITUTES ANOTHER ADVANTAGE: HVDC SHIELDS THE SYSTEM FROM THE RISK OF BLACKOUTS

HVDC is also transforming the outlook for the Italian network, providing it with an opportunity to become a true hub: direct current connections with Greece are already operational; underwater connections are being realized for Sardinia and Corsica;

and others directed at Montenegro and France are under construction. During the symposium Terna (the company that manages Italy's network) highlighted how important this potential strategy for European growth and integration may become for Italy. ENTSO-e, the association of European transmission operators, highlighted the need for increased interconnection among countries as the best way to favor security and economically feasible energy supply throughout the region. The Ten Year Network Development Plan ENTSO-e presented to the European Commission in 2012 calls for the realization of roughly 12,600 kilometers of HVDC lines.

HVDC IS EVEN MORE SUCCESSFUL OUTSIDE EUROPE. BRICS COUNTRIES HAVE HAD A HEAD START AT IMPLEMENTING THIS TECHNOLOGY

HVDC is even more successful outside Europe, where BRICS countries have a head start implementing this technology. Following the interconnection project between Rio and Madeira, the Belo Monte dam project in Brazil (third-largest in the world in terms of production capacity) will include HVDC lines that can carry energy from the heart of the Amazon to Rio de Janeiro: this project alone will produce roughly 3,000 kilometers of high voltage, direct current line. India has implemented an interregional capacity of more than 20 GW, and there are plans to establish an HVDC connection to nearby countries including Bhutan and Nepal. The Middle East is betting this technology will provide the foundation for a project to transform its electric system that is among the most profound and far-reaching in the world. HVDC is also making headway in Africa, where there are plans to realize an interconnection project between Ethiopia and Kenya that will include a 1,040-kilometer bipolar line at +- 500 kV. China already has 26 different operational HVDC lines, and currently holds the record

for HVDC line length and voltage level. In this case, experts speak more of "UHVDC": an Ultra High Voltage Direct Current network. A representative of the State Grid Corporation of China – one of the largest TSOs in the world – reminded those attending that the Chinese experience confirms that HVDC is the best choice for tackling lengthy transmission distances.

Also during the symposium HVDC systems and component manufacturers like ABB, Alstom, Siemens and Toshiba introduced innovative solutions to reduce transmission costs and augment the stability of increasingly interconnected electric systems like those found in Europe. Experts are investigating innovative solutions aimed at raising voltage levels in order to reduce energy loss, using components that can permit network switching, as well as increase the availability of systems.

Cables are key elements in the energy transmission process, and during the symposium systems and component manufacturers including ABB, Nexans and Prysmian (among others) provided enlightening presentations on the technological progress achieved in recent years in both traditional components in impregnated paper and new solutions in extruded cable. This progress has greatly increased transmittable power levels while protecting the environment and facilitating management for the whole system.

Although the Mannheim event painted a positive picture overall, it nevertheless highlighted a few critical issues. In one example, TSOs that gave presentations during the event emphasized a lack of multi-year experience with HVDC technology, especially in the HV cable sector, making it necessary to verify solutions under extreme operational conditions. From this point of view, CESI's new Mannheim testing facilities can help conduct additional experiments, increasing the reliability of HVDC links.

From left to right

Christian Spetcht, the mayor of Mannheim; Domenico Villani, Director Testing & Certification Division, CESI; and Enrico Valvo, Chief Advisor for the Italian Embassy in Germany.

Energy Storage. Becoming Flexible and Remaining Reliable

Antonio Ardito - Chief Engineer, Consulting, Solutions & Services Division, CESI; Alessandro Clerici - Senior Corporate Advisor, CESI

THE CHALLENGE BROUGHT BY RENEWABLES BEGS FAR-REACHING TRANSFORMATION IN THE ELECTRICAL SYSTEM AS A WHOLE. TODAY WE NEED TO LEARN HOW TO TAKE BETTER ADVANTAGE OF THEIR POTENTIAL, WHILE GUARANTEEING THE DEPENDABILITY AND CONTINUITY OF SERVICE.

Roughly 130 years ago when the electrical system was first created, it was founded upon two very clear principles. The first stated that production had to be equal to load; the second that producing electrical energy in an economically advantageous manner would be possible through large production facilities and one-way, top-down loads.

The far-reaching transformation this sector is currently experiencing questions these pillars, casting doubt on fundamental tenets that have been unshakeable until now, and forcing all the various players involved to engage in a comprehensive rethinking of its organization and functioning mechanisms from technological, infrastructural, regulatory and commercial points of view.

What has happened? Several key conditions that justified the establishment of those pillars have changed. European directives for energy have driven a policy of greenhouse gas reduction, causing a substantial reduction in the share of thermoelectric power in the generation mix. This is compensated by an increase in the share provided by renewable sources – famous for their randomness – and therefore requires a profound reconsideration of the organization of security for electric systems.

We are now moving from a system based on programmed production into a system with partially random production. The gamble lies in conducting this transformation in such a way that the system doesn't suffer in terms of security and dependability, and remains capable of handling several different specific dynamics: an increase in demand; an increase in the penetration levels of production from nonprogrammable renewable energy sources; the possibility of inverted flow directions; and an increased penetration of the electric carrier (in a more long-term perspective), in order to support new applications like vehicular transportation and heat pumps for heating and/or cooling. There is another critical point that must be added to all of this. Bearing in mind the fact

that market rules give dispatching priority to renewable sources, the system has to deal with several specific problems, especially during times of low loads and high production from renewables:

- the need to maintain reserves and balance capabilities for conventional power plants;
- the difficulties conventional power plants face in responding to increasing charges due to kWh production variability from sources like solar and wind, as well as functioning at charges below half of the plant's nominal power;

- devoid of inertia).

But as we are faced with the interesting hypothesis of a massive insertion of accumulation systems within the electrical system, we need to ask ourselves a few key guestions. What precise needs is an accumulation system able to satisfy? What kind of service capabilities and which specific functional characteristics should such a system contain in order to guarantee a safe, effective functioning electric system? What technological and construction characteristics are necessary today and in the near future in order to respond to functional, environmental and safety requirements, as well as provide a useful lifespan and acceptable economic costs? How can we design a regulatory system and provide eventual early incentives in such a way as to favor the entrance of these systems into the market? How will their relative costs diminish?

Accumulation, yes. But how?

Accumulation systems are a "transversal" technological solution for the electric system, in the sense that they can easily be adopted by diverse players in such a way as to facilitate the economic functioning of their assets and have power/energy withdrawals from the end consumer that are flexible and can minimize electricity bill costs based on evolved tariff plans. In the past, accumulation and storage in the electric sector has been mainly utilized as a measurement unit for large-scale hydroelectric power plants. These facilities are set up to warehouse energy for long periods.

- the need both to regulate the power generated by power plants in order to maintain frequency constant, and to regulate tension levels and keep power flows reactive so as to keep the system functioning properly; - the need to deal with major perturbations (events that cause an instantaneous and profound power imbalance), bearing in mind the overall reduction of "mechanical inertia" in the system due to an increase in power generation from renewable sources (mostly interfaced between power electricity, and

Within this framework, accumulation systems represent an important opportunity to alleviate the effects of the critical issues cited here above.

WE ARE NOW MOVING FROM A SYSTEM BASED ON CENTRALLY PROGRAMMED GENERATION INTO A SYSTEM WITH PARTIALLY RANDOM GENERATION

| Accumulation and storage systems: application fields |

Sources: Eurelectric

Today, the reality of the transmission and distribution system dictates that the use of decentralized technologies and storage systems are more interesting at a local level. A storage plant can be connected directly to transmission or distribution network stations, or with conventional and/or renewable energy power plants, or even at the level of each individual consumer. Warehousing electric energy can be managed centrally or decentered; it can be a "shared good" the entire system benefits from, or a "dedicated resource" that provides advantages to a single player. Regulation will play a key role within this context.

THE USE OF DECENTRALIZED TECHNOLOGIES AND STORAGE SYSTEMS PROVIDES INTERESTING **SYNERGIES**

The most interesting functions required of an accumulation and storage system can be classified in a simple manner based on their requirements:

- systems that work in power, and exchange high power levels for brief periods of time;

- systems that work in energy, and exchange power over longer periods of time. The table on top of the page sums up the

relationships between different application fields, as well as the divisions and operating times in accumulation systems.

The Regulatory Vacuum

Clearly, the speed with which accumulation systems will develop is connected with evolution in the regulatory framework, regulations applied and a significant reduction in costs. For the moment, no complete regulatory framework for the kinds of accumulation and storage systems mentioned above has been set up. The IEC (International Electrotechnical Commission) recently created a technical committee ("Electric Energy Storage Systems") with the aim of defining regulations, as well as guidelines and technical specifications, for both accumulation systems and electric power systems, thereby filling the current

regulatory vacuum. Experts have yet to address the delicate issue of regulation capable of adequately defining business models for the services accumulation systems will provide. Even within an overall "technology neutral" regulatory framework, it appears reasonable to define a series of incentives aimed at accumulation systems, circumscribed and with certain time limits, in order to support this early development phase.

Testing Quality

A complete accumulation system, especially in the event that the performance requested for network services are particularly demanding, is an extremely complex mechanism both to build and to run.

For this reason, while testing single components and subsystems remains a priority, the functional verification of the entire, fully assembled accumulation system is of fundamental importance.

Stationary accumulation systems for network services are made up of components and subsystems that are now being assembled with the aim of guaranteeing highly driven performances, especially in terms of dynamics and how quickly they can respond. Their specifications are extremely complex, in part because the relative norms and regulations are still being drawn up, since they have not yet acquired sufficient experience in the field. Verifying performance and response to such stringent functional requirements is not easy, and relying on appropriately-equipped

STORAGE IS UNDOUBTEDLY A PROMISING TECHNOLOGY FOR COPING WITH THE PROBLEMS INDUCED BY A STRONG PENETRATION OF **RENEWABLE ENERGIES**

Conclusions There are countless potential scenarios for the integration of accumulation systems within the existing network. These scenarios depend on the diverse functionalities assigned to different systems. The future role of accumulation and storage will be determined by farsighted and efficient regulatory systems, as well as by appropriate technical norms and a reduction in the investment costs these systems require. Accumulation is undoubtedly a promising technology for dealing with the new problems introduced by a strong penetration of renewable energies. But they cannot be considered the only option, and must in fact come accompanied by other measures. These measures include improving interconnections, rendering conventional power plants and demand more flexible, and applying technologies that generally respond to smart grids.

laboratories may well provide considerable drive for the application of these technologies, shortening timeframes for certifying system conformity to specific requirements, as well as reassuring those people or groups that have to decide whether or not to invest in them.

| FUTURES & TECHNOLOGIES |

Battling the Lightning Bolt

Marina Bernardi, Engineering & Environment - ISMES Division

THE IMPACT OF LIGHTNING DISTURBANCE AND DAMAGE TO ELECTRONIC DEVICES AND THE ELECTRIC SYSTEM IS WIDELY KNOWN TO ELECTRIC OPERATORS. LIGHTNING DETECTION CONSTITUTES AN IMPORTANT TOOL FOR PREVENTING EMERGENCIES

The scientific study of lightning began with a famous experiment conducted by Benjamin Franklin, one of the founding fathers of the United States, when he tied a key onto a kite string and flew his contraption up into a thunderstorm. It developed further over the last two centuries, in parallel with the study of electromagnetism and its applications. But in spite of all the research that has been conducted, lightning remains a largely unexplored reality. Scientific knowledge of this field is still growing daily, and international research is an ongoing process.

LIGHTNING DETECTION OVER LARGE AREAS IS AN IMPORTANT INSTRUMENT FOR THE SOCIETY AT LARGE, AS WELL AS FOR OPERATORS AND INDUSTRIES

A long history of experiments aimed at simulating lightning in large, high voltage laboratories, performed in different institutes around the world (among which CESI has played an important role), has enabled us to acquire a lot of useful information about the process by which lightning discharges form. These experiments, evolving from the 1950s through the 1990s, also demonstrated the importance of studying the real phenomena, and not just "artificial" laboratory lightning. In order to do this one needs to know where a recurrent number of lightning strikes will hit. Two possible solutions include using a high tower (one tall enough to attract a lot of lightning strikes) to host measuring

instruments; or launching small rockets into a thunderstorm cloud (where the rocket will to the rocket's tail so that the "triggered" lightning will flow back to the ground where measuring instruments are positioned. Both these methods continue to be used today, but they require a lot of hardware implementation and a lot of time while researchers wait for a reasonable number of events. The only other way to study lightning phenomena is to conduct remote detection over large areas, where the number of events is less of a problem, and biases connected with the single position of a rocket or tower can be avoided. Therefore the development of a remote and dependable technique for detecting lightning has always been a key to the study of such a peculiar, unpredictable phenomenon. Over the past 30 years a few consolidated approaches to detection have been developed, allowing a vast technical community to implement regional, national or multinational lightning detection systems (LLS) that are continuously improved through feedback from the field. CESI was among the first in Europe and the world to work with lightning detectors, starting in the 1980s and culminating with the deployment of a nationwide lightning detection network in 1994 that covers all of Italy. The network is based on the most advanced technology available, currently applied all over the world and routinely used and crosschecked by international scientists, and has been the foundation for hundreds of research papers.

Increasingly, lightning detection over large areas is an important instrument for the society at large, as well as for operators and industries. Electric operators have been aware of the impact lightning disturbances can have on the electric system and electronic devices for some time, but today the general public is becoming increasingly aware of this phenomenon as well, thanks to the omnipresence of electronic and telecommunication devices in domestic environments. For over two decades CESI has been using its LLS technology to supply efficient and reliable services to both operators and public institutions.

Lightning detection is actually a very fast response system, able to show lightning detected in just a few seconds; this makes it a unique tool for monitoring large- and smallscale thunderstorms, making it possible to dispatch "now-casting" (short term forecasts), information and alerts. Lightning is also an excellent indicator of heavy rain, hail and fast winds, meaning that now-casting can be used to follow these kinds of events as well. Archived data can be used to correlate insurance damages, electric faults, and help evaluate protection measures. Recently the CEI (Comitato Elettrico Italiano, or the Italian Electric Committee), which is responsible for electric standardization rules in Italy, used CESI's LLS data to create a homogeneous map of the number of flashes that strike per square kilometer each year in every individual Italian territory.

LLS A UNIQUE TOOL FOR MONITORING LARGE-AND SMALL-SCALE THUNDERSTORMS, MAKING IT POSSIBLE TO DISPATCH "NOW-CASTING" INFORMATION AND ALERTS

In 2000, the expansion of LLS presence in almost all European countries allowed CESI and other co-founders to create the European Cooperation for Lightning Detection, which integrates all technology, data and experiences from individual national LLS systems in order to create a uniform, reliable European lightning detection system.

In keeping with other forms of mutual collaboration among European Countries, and with the aim of exchanging important technological and scientific information. during the 1990s an annual convention for all LLS operators across Europe was established: the ELDW, or European Lightning Detection Workshop.

CESI hosted the most recent ELDW convention at its headquarters in Milan in September 2014. Representatives from all European countries and from almost all LLS operators in Europe were present. Various performance studies were presented, demonstrating how the LLS technology involved (Vaisala) is both extremely efficient and reliable when compared to other kinds of networks or to tower measurement and electric field mill data. Meteorological behavior for lightning across Europe, compiled using the past ten years of

available EUCLID data, was presented and for the first time allowed to clearly highlight a number of interesting lightning-related weather trends in different seasons for the whole continent. It also identified the areas most exposed to lightning strikes. During the second half of the workshop experts discussed the use of LLS data to help start safety procedures in dangerous areas (airports, construction sites, camping grounds and playgrounds), minimizing time delays for the suspension of risky activities and maximizing personnel safety thanks to precise and fast alert data. Examples provided by several different countries (France, Italy and the US) provided strong support for the use of LLS for these applications. The convention closed with discussion of fires ignited by lightning strikes, a problem that continues to afflict different regions despite its familiarity for both experts and the public at large.

| Italian System for Lightning Detection |

SIRF (the Italian System for Lightning Detection) is the name given to Italy's national lightning detection network. Established by CESI in 1994, this year SIRF is celebrating 20 years of activity and research. The network is based on the best technology available on the market, providing extremely precise and accurate identification of lightning data, and covers the entire Italian territory and neighboring seas. The fundamental elements of the

SIRF network include detectors, a transmission grid and an operating center. Data the network collects is stored in a central archive and made available upon request

SIRF provides powerful services for real-time tracking of thunderstorms, as well as extremely precise data for different kinds of analyses, meteorological studies, fault correlations or statistical lightning evaluations.

| REVIEW |

The Quest: Energy, Security and the Remaking of the Modern World

Daniel Yergin

A master storyteller as well Daniel Yergin continues book, The Prize. In The political and economic change and conflict, in a on which our civilization to replace them.

The Quest tells the inside stories, tackles the tough questions, and reveals surprising insights about change became a great issue and leads readers through the rebirth of independence, and the return of the electric car. *Epic in scope,* The Quest

An engaging, informative and entertaining story about the future of our way of life, but this book is also about deep conviction and human passions, in other words it is also very much about people.

"THE SEARCH FOR SUFFICIENT, CLEAN ENERGY REPRESENTS THE DEFINING CHALLENGE OF THIS GENERATION. DANIEL YERGIN HAS MASTERFULLY CONNECTED THE FORCES OF ECONOMICS AND GEOPOLITICS WITH THE COMPLEX SCIENCE OF ENERGY PRODUCTION AND CLIMATE CHANGE. THE QUEST PROVIDES A LUCID GUIDE THROUGH THE FOREST OF ISSUES THAT STANDS BETWEEN US AND A SUSTAINABLE ENERGY FUTURE."

as a leading energy expert, the riveting story begun in his Pulitzer Prize-winning Quest, Yergin shows us how energy is an engine of global story that spans the energies has been built and the new energies that are competing

coal, electricity, and natural gas. He explains how climate renewable energies, energy vividly reveals the decisions, technologies, and individuals that are shaping our future.

In The Quest people and personality loom large: scientist and innovators, some politicians and statesmen, some entrepreneurs and risk taker, some visionaries... Reading their stories we will see the importance of creativity and the impact of think differently. But also the importance of other human quality: for exemple sheer determination and willpower.

"The size of what need to be done in energy is very large, and so are challenges and risks," writes Yergin, "but what we have on our side is the most important resource of all is human creativity and for the first time in history we are going to see it deployed on a truly global scale."

Biography

Dr. Yergin serves on the US Secretary of Energy Advisory Board and chaired the US Department of Energy's Task Force on Strategic Energy Research and Development. He is a Trustee of the Brookings Institution, on the Board of the New America Foundation, and on the Advisory Board of the Massachusetts Institute of Technology Energy Initiative. Dr. Yergin is Vice Chairman of IHS and Founder of Cambridge Energy Research Associates and serves as CNBC's Global Energy Expert. He received the Pulitzer Prize for The Prize: the Epic Quest for Oil Money and Power. In October 2014 he received the first Schlesinger Medal for Energy Security.

| NEWS & EVENTS |

World Energy Leaders' Summit (WELS)

Date> 21- 23 October 2014Venue> Cartagena, Colombiahttp://www.worldenergy.org/

CESI participates to the World Energy Leaders' Summit as Global Partner of the World Energy Council and member of the Executive Committees.

Aspen Institute Roundtable

Date> 23 October 2014Venue> Milan, Italiahttp://www.aspeninstitute.org/

Matteo Codazzi, CESI's Chief Executive Office, holds a speech at the roundtable organized by the Aspen Institute on the theme "Smart cities, technologies and sustainability. The challenge of Expo 2015."

XXI SENDI, Seminário Nacional de Distribuição de Energia Elètrica

Date> 8 - 13 November 2014Venue> Santos, Brazilwww.cpfl.com.br/sites/xxisendi/

CESI do Brasil will be attending the event with its own booth. SENDI 2014 is one of the most important events in Latin America for electricity distribution.

Shaping a Better Energy Future

CESI is a leading global technical consulting and engineering company with over 50 years experience in several areas including: Transmission and Interconnections, Smart Grids, Power Distribution, Renewables, Testing, Certification and Quality Assurance. CESI also develops and manufactures advanced multi junction photovoltaic solar cells for both space and terrestrial (HCPV) applications.

With an annual turnover of more than €120 million, CESI operates in more than 40 countries around the world, with a total network of 1,000 professionals. The company's key clients include Governmental Institutions, Regulatory Authorities, major Utilities, Transmission System Operators (TSOs), Distribution System Operators (DSOs), Power Generation companies, Manufacturers, Financial institutions and International electromechanical and electronic manufacturers. CESI is a fully independent joint-stock company with main premises located in Milan, Berlin, Mannheim, Dubai and Rio de Janeiro.

www.cesi.it Milan • Berlin • Mannheim • Dubai • Rio de Janeiro

Testing • Consulting • Engineering • Environment