WORLD ECONOMIC FORUM

COMMITTED TO IMPROVING THE STATE OF THE WORLD

Electricity
Dynamic Briefing

Generated 28 January 2020 for Marco Antonio Gonzalez

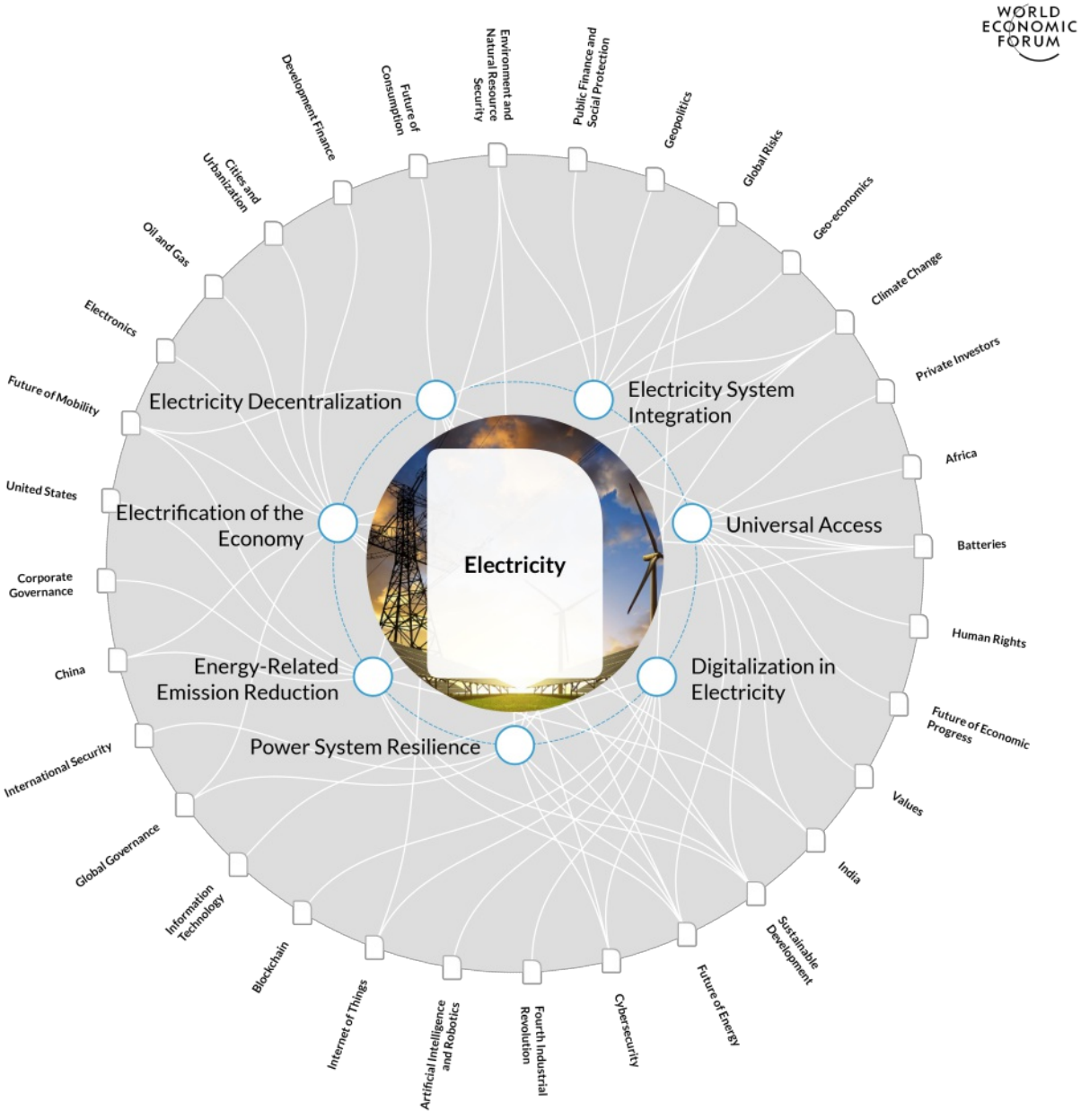
Electricity

Co-curated with **Florence School of Regulation, European University Institute**

Last review on Thu 04 January 2018

About

This dynamic briefing draws on the collective intelligence of the Forum network to explore the key trends, interconnections and interdependencies between industry, regional and global issues. In the briefing, you will find a visual representation of this topic (Transformation Map – interactive version available online via intelligence.weforum.org), an overview and the key trends affecting it, along with summaries and links to the latest research and analysis on each of the trends. Briefings for countries also include the relevant data from the Forum's benchmarking indices. The content is continuously updated with the latest thinking of leaders and experts from across the Forum network, and with insights from Forum meetings, projects communities and activities.



Executive summary

Global electricity systems are undergoing the most profound set of changes since Thomas Edison's inauguration of the Pearl Street Station, the world's first commercial power plant, in 1882. In developed economies, distributed energy resources and digital technologies are transforming system planning and operations. These technologies are also creating opportunities to bring electricity to the more than 1.1 billion individuals who still lack access to an essential commodity. The threat of climate change has initiated a push for electricity decarbonization, and spurred efforts to electrify industry and transportation. Meanwhile efforts are underway to expand regional markets and create greater geographical interconnections, and to ensure the security of supply in the face of cyber threats and natural disasters.

This briefing is based on the views of a wide range of experts from the World Economic Forum's Expert Network and is curated in partnership with Professor Ignacio Perez Arriaga (Director of Energy Training, Florence School of Regulation at the European University Institute; Visiting Professor at the Centre for Energy and Environmental Policy Research, MIT; and Professor and Director of the BP Chair of Energy and Sustainability at Comillas Pontifical University (ICADE)), and his team.

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Electricity System Integration

Regional electricity markets are sharing resources, reducing costs, and increasing the security of supply

There is a global trend towards the integration of national, state, and local electric power systems in order to create supranational or regional electricity entities. These entities are referred to as “pools,” “interconnections,” or “regional markets,” depending on their organization. While decentralized energy resources (any resource connected to a distribution system that is capable of providing electricity services) are becoming increasingly present in power systems, the systems themselves are becoming more interconnected - both physically and in terms of ownership and management structures - across vast territories. The efficient utilization of electricity generation resources that are too large for a single country, as is the case with some hydro projects, or are too intermittent, like large-scale solar or wind farms, is made possible by the creation of regional markets with enough size to exploit economies of scale and dilute intermittency. Regional markets also make it possible to extend the use of natural resources, such as wind or solar, which are abundant in some territories but not others, across larger geographical areas. Regionalization also enables the creation of liquid, efficient markets in individual provinces, states, or countries which would otherwise be too small to sustain effective competition.

Power pools in the US, created in the 1970s, were the first regional organizations of this kind, and were later turned into true regional markets. They were followed by the National Electricity Market (NEM) in Australia, the European Internal Electricity Market (IEM), the Regional Electricity Market (Mercado Eléctrico Regional, or MER) in Central America, the Southern Africa Power Pool (SAAP), and others. Some have reached an advanced level of maturity and integration, while others are still at early stages. Regional power trade, and the efficient utilization of large generation projects, require strong, cross-border network interconnections. Regional trade also requires careful market design, and clear rules for transmission investment planning, cost allocation, and congestion management. Markets must be supported by technical, economic, and institutional analyses of both current systems and likely future iterations. The creation of regional markets and the construction of expensive, cross-border interconnectors, which in some cases may deserve the classification “supergrids,” requires significant amounts of political will and the careful assessment of trade-offs; regional electricity markets are usually just one component of wider regional agreements that encompass other economic sectors.

Related insight areas: Geopolitics, Global Risks, Climate Change, Geo-economics, Environment and Natural Resource Security, Public Finance and Social Protection

Rocky Mountain Institute

Lessons from Malawi: Five Steps for Planning Sustainable Energy Investments

27 January 2020

Whole-system energy investment planning shows how countries like Malawi can reach Sustainable Energy for All goals at a lower cost, using abundant renewable resources. RMI's work in Malawi applies a few core principles to demonstrate US$500 million in savings as... Read More The post Lessons from Malawi: Five Steps for Planning Sustainable Energy Investments appeared first on Rocky Mountain Institute .

World Economic Forum

How decarbonizing shipping could unlock a global energy transition

22 January 2020

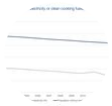
Decarbonizing maritime shipping is a huge challenge - but it could catalyze a broader switch to clean energy. Here's how.

Project Syndicate

The Best Tool to Fight Climate Change

20 January 2020

If they are serious about tackling climate change, governments must quickly establish the expectation that the price of carbon will follow a generally rising path in the future. Lofty statements from public officials and optimal calculations from climate modelers will not do the job.



World Economic Forum

Here's how the private sector can lead the global energy transition

16 January 2020

The private sector has a huge role to play in supporting the global transition to a sustainable energy ecosystem. Here's where the industry should focus its efforts.

Pew Research Center

Renewable energy is growing fast in the U.S., but fossil fuels still dominate

15 January 2020

Solar and wind power use has grown rapidly in the past decade, but as of 2018 those sources accounted for under 4% of all energy used in the U.S.

World Economic Forum

How to clear the finance and policy hurdles on the way to a clean energy future

09 January 2020

Tackling climate change will require huge shifts in policy and finance. By working together, governments and the private sector can pave the way to a clean energy future.

TED

The problem of light pollution -- and 5 ridiculously easy ways to fix it | Kelsey Johnson

06 January 2020

This stunning view is at risk of disappearing -- unless we act now, says astrophysicist Kelsey Johnson. In this fascinating, unexpectedly funny talk, she explains how light pollution affects almost every species on earth (including us) and shares five "stupidly simple" things you can do to help solve the problem.

Universal Access

Universal energy access by 2030 will not happen, based on the current electrification path

In 2015, the United Nations established Sustainable Development Goals (SDGs), one of which is to ensure access to affordable, reliable, and modern energy for all by 2030. However, as of 2016, 1.1 billion people still did not have access to electricity, and many others had an inadequate, unreliable supply - primarily in rural areas of sub-Saharan Africa, India, and Southeast Asia. According to the International Energy Agency, present electrification efforts will not keep pace with population growth in sub-Saharan Africa, and the global citizenry that is doing without will become increasingly concentrated there. A lack of investment in generation plants and network infrastructure, subsidized tariffs that do not cover the cost of supply, poor governance, and insufficient legal security have contributed to this situation. Until recently, nearly all of those who had gained access to electricity worldwide did so through new grid connections, and about 70% of those who have received power since 2000 have done so via fossil fuels. In recent years, however, large-scale renewables (mainly hydro and geothermal) have been the source of over one third of new grid connections, while decentralized resources, such as solar home systems and microgrids, have supplied an increasing amount of electricity access. This trend is expected to accelerate.

Technology improvements are creating opportunities to make progress on universal electricity access; the declining cost of solar, cheaper and more efficient lighting and appliances, and new business models that make use of digital and mobile platforms have increased the solutions available to those doing without. In order to realize the broader social and economic benefits of electrification, it will require looking beyond household connections and taking into account the electricity used for business and agriculture. The short-term impact of universal electricity access on greenhouse gas emissions and climate change is expected to be minimal, as the overall increase in demand will be relatively small (though the exact modes of electrification will determine long-term impacts). Providing electricity for all by 2030 would require annual investment of $52 billion, or more than twice what has so far been mobilized under current and planned policies, according to a 2017 report published by the International Energy Agency. Of the additional needed investment, 95% must be directed to sub-Saharan Africa, according to the report. Scaling up investment in electricity access requires the right policies and investment frameworks, and approaches that connect existing but uncoordinated initiatives will be needed.

Related insight areas: India, Sustainable Development, Africa, Human Rights, Values, Private Investors, Future of Economic Progress, Batteries, Future of Energy

Rocky Mountain Institute

New Jersey Charts a Practical, Affordable Course to a Decarbonized Economy

27 January 2020

New Jersey is planning comprehensively for economy-wide decarbonization, and putting meaningful, near-term policies in place to affordably reduce emissions This week, New Jersey released its 2019 Energy Master Plan (EMP) that shows how the state can take action today to… Read More The post New Jersey Charts a Practical, Affordable Course to a Decarbonized Economy appeared first on Rocky Mountain Institute .

World Economic Forum

A silver bullet won't solve a green problem

22 January 2020

There is no single solution when it comes to climate change. We need to take a methodical approach across every sector and industry - and understanding risk will be key to its success.

World Economic Forum

How to unlock the promise of electric transportation

20 January 2020

There are still some challenges involved in making sustainable mobility the global norm. The tech and the industry are ready - now it's up to governments to get EVs over the finish line.

World Economic Forum

How to power inclusive growth from the ground up

16 January 2020

By combining open-source data and insights from transaction data, a new model is helping low-income areas attract much-needed investment. Here's how it works.

World Economic Forum

Why India is the new hotspot for renewable energy investors

14 January 2020

India is now home to one of the world's largest clean energy expansion programmes - a fact that has not gone unnoticed by domestic and foreign investors.

Scientific American

Natural Gas Use Is Rising. Is that Good News or Bad News for the Climate?

09 January 2020

It’s a little of both for now, but in the long run it's bad.

Rocky Mountain Institute

The Evolution of Rural Solar: from Panel Monocrops to Multiple Land Uses

06 January 2020

Solar panels may harness the sun’s energy in the same way that plants do, but while some rural residents view them as another revenue-enhancing crop, others see them more as weed-like nuisances that threaten their pastoral way of life. Solar… Read More The post The Evolution of Rural Solar: from Panel Monocrops to Multiple Land Uses appeared first on Rocky Mountain Institute .

Digitalization in Electricity

Digitalization is creating new opportunities, but also creating cyber security risks

The power sector is becoming increasingly digitalized, as computation and control technologies are embedded in systems around the world. This is spurring value creation, while creating cyber security risks. Digital technologies make it easier to communicate the value of electricity services with greater accuracy, as consumers become increasingly price sensitive and engaged. Meanwhile sensors and metering technologies are providing new visibility into power system conditions, and digitally-enabled power electronics and infrastructure are providing grid operators with an ability to act on newly-available information. Digitally-enabled demand-side resources, such as heating and air conditioning units and water heaters, are now active participants in the PJM market, which is the largest electricity market in the US. Nearly 11 gigawatts of demand-side resources provided electricity services in the PJM market in 2015 and 2016, and were the source of roughly $825 million in revenue in 2015. Meanwhile, companies including Amazon and Google sold more than 4.5 million digital “smart” thermostats in the US and Europe in 2016, enabling home and business owners to take greater control of their electricity use; increased participation like this provides a case study for the potential impact of the Internet of Things, which strings household devices together with online connectivity.

Greater digitalization is also expanding the deployment of advanced metering infrastructure. Over 60 million smart meters now measure the consumption of more than 40% of the buildings in the US. Smart meter deployments in the European Union are expected to reach 72% of consumers there by 2020, while China alone had deployed roughly 350 million smart meters as of 2016. Digitally enabled meters, paired with mobile technologies, are enabling new payment models that help bring power to some of the least electrified parts of the world. Digital grid infrastructure and data collection are meanwhile enabling more active network management; in the United Kingdom, UK Power Networks has developed a program to actively manage the output of wind power plants, enabling it to more quickly and economically interconnect generators and demand. Increased digitalization of the power system has also created new vulnerabilities, however - as demonstrated by the 2015 cyber attack on the Ukrainian power grid. As digital technologies collect valuable data, it creates the need for rules regarding how to securely manage this data, and new regulations that ensure utilities, and other power sector stakeholders, are adequately prepared for cyber threats.

Last review on Wed 07 June 2017

Related insight areas: Artificial Intelligence and Robotics, Internet of Things, Fourth Industrial Revolution, Global Risks, Cybersecurity, Blockchain, Information Technology

World Economic Forum

Zero carbon buildings are possible following these four steps

24 January 2020

It is possible to have buildings that do not emit carbon. Here are some striking examples from around the world.

World Economic Forum

How technology and play can power high-quality learning in schools

24 January 2020

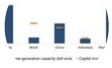
Learning through play has a critical role in education. Tech can help.

World Economic Forum

How to hasten the energy transition in the developing world

17 January 2020

The energy transition context in developing and developed regions is very different - and its success in emerging economies rests on understanding this. Here's a guide.



World Economic Forum

These innovations could keep us cool without warming the planet

16 January 2020

Driven by global warming and urbanization, demand for air conditioning is growing - and so is its impact on the climate. Could the finalists of the Global Cooling Prize have the answer?.

Pembina Institute

Why Canada's Energy Future report leads us astray

09 January 2020

The report has real implications for federal planning and decision-making and, perhaps most significantly, the overall vision of the energy sector in this country.

South African Institute of International Affairs (SAIIA)

G20 compact with Africa: No reformers, no compact – The Zimbabwean case study

09 January 2020

As a reform strategy, the G20 Compact with Africa (CwA) framework has the potential to support Zimbabwe’s economic transformation agenda.

RAND Corporation

Deterring Attacks Against the Power Grid

06 January 2020

The Defense Department increasingly relies on electric power to accomplish critical missions. This report explores two approaches for deterring attacks against the U.S. power grid: deterrence by denial and deterrence by cost imposition.

Power System Resilience

Systems need to be hardened against threats like natural disasters and cyberattacks

Extreme weather events, a potential failure of climate change mitigation efforts, cyberattacks, and natural disasters rank among the top ten global risks in terms of likelihood and impact, according to a report published by the World Economic Forum in 2019 - and they pose specific threats to the availability of affordable energy. The tangible impacts of climate change are increasingly evident, and developing adequate responses when it comes to energy security requires new forms of cooperation between the public and private sectors; preventive measures are also needed for potential cyberattacks and terrorism. These threats pose risks to critical infrastructure, and to entire economies and societies. Over the course of the past decade, hurricanes, wildfires, flooding, and cyberattacks have amplified an urgent need to make electricity grids more resilient - to harden and smarten them, in order to blunt potentially devastating social and economic consequences. For example, a six-hour winter electricity blackout in France could exact more than €1.5 billion in related costs for households, businesses, and vital institutions there.

Meanwhile, disasters in the Asia-Pacific Region over the past 40 years have cost some $1.3 trillion, and every day the region incurs $126 million in direct physical losses because of extreme weather events and geophysical hazards like floods, according to the Asian Development Bank. The financial cost of threats such as cyberattacks is also rising (the total cost of cybercrime for businesses over the next five years is expected to reach $8 trillion). Beyond the immediate financial cost, cyberattacks such as the WannaCry ransomware attack in 2017 disrupted critical and strategic infrastructure around the world, including government ministries and energy companies. WannaCry highlighted a growing trend of cyberattacks targeting strategic industrial sectors, and raised fears that in a worst case scenario attackers could trigger a breakdown in the systems that keep entire societies functioning. Building genuine resiliency means hardening the global power system against high-impact, low-frequency events, and fostering an ability to quickly recover from these events - which can threaten lives and devastate electricity generation, transmission, and distribution systems, not to mention related systems such as natural gas pipelines and telecommunications networks, according to the Electric Power Research Institute.

Related insight areas: Global Risks, International Security, Environment and Natural Resource Security, Global Governance, Cybersecurity, Climate Change, Sustainable Development, Future of Energy

Project Syndicate

Winning the Electrification Race

27 January 2020

If governments adopt bold policies to help accelerate the production of clean electricity, the world could build a zero-carbon economy fast enough to limit climate change to a manageable degree. But without such measures, a zero-carbon economy will come much too late.

World Economic Forum

To achieve net-zero carbon cities and buildings we need systemic efficiency

22 January 2020

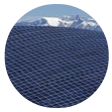
We cannot solve climate change without transforming our built environment. This will require massive efforts from the private and public sectors - but it is possible with current technology.

Social Europe

The fierce urgency of COP26

20 January 2020

Adam Tooze stresses that the critical COP26 conference later this year hinges on European unity and radical leadership.

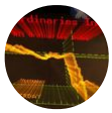


World Economic Forum

The future looks bright for solar energy

16 January 2020

The cost of solar modules has fallen dramatically over the past decade, and is expected to halve again by 2030. Could this spell the end for fossil fuels?.



The Conversation

How we consume electricity has changed dramatically in the past 20 years – and the market has failed to keep up

14 January 2020

The next 20 years of Britain's electricity policy must look very different from the previous 20.

World Economic Forum

Here's how to rebut the climate doom-mongers

08 January 2020

It's that time of year when the apocalyptic climate predictions start rolling in. It's easy to by cynical about the progress being made - but here's why you shouldn't be too disheartened.

Rocky Mountain Institute

Fossil Gas Has No Future in Low-Carbon Buildings

06 January 2020

States and cities across the country are beginning to grapple with a persistent source of carbon emissions that has largely gone ignored: burning fossil fuels in buildings.

Energy-Related Emission Reduction

Full decarbonization of electricity is key for achieving a low-carbon economy

The energy consumption required to support human activity is responsible for about three quarters of the world's greenhouse emissions, which are in turn causing climate change. Energy demand grows alongside population growth, and alongside increasing standards of living; improvements in energy efficiency meanwhile act as a counterbalance. The portion of global energy demand served by electricity is already substantial, and expanding further. There is therefore a clear need to decarbonize the electric power sector itself, in order to help guarantee the sustainability of human development. How and when this is achieved will have important implications for the broader process of decarbonizing the global economy. There are good reasons to prioritize the decarbonization of electricity over other energy carriers, such as hydrogen; electricity can be more easily decarbonized, for example, and it can be produced in many different ways with low associated emissions of greenhouse gases. It is technically viable, and economically affordable, to produce electricity from renewable energy sources such as solar, wind, geothermal, hydro, and biomass. Nuclear generation of electricity is another proven and powerful alternative - though it is often associated with problems like nuclear proliferation, nuclear waste, and accidents.

Electricity is wonderfully versatile, and can replace the utilization of fossil fuels in numerous areas. Mobility is one promising example - in the form of electric vehicles including light road vehicles, and railways. Cooling or heating buildings, with the use of heat pumps, is another. Other trends, such as decentralization and digitalization, may have a significant influence on decarbonization. Disruptive advances in storage technologies such as batteries may be a key factor in full electricity decarbonization, for example, as they can mitigate the intermittency effects of some renewable energy production resources. However, the extent to which storage technologies will be required in decarbonized power systems is an area of active research. The decarbonization of economies is a global endeavour. Countries must collaborate, particularly the three that make the largest collective contribution to greenhouse gas emissions: the US, China, and India. Far-sighted policy measures, developed with adequate regulatory approaches, will be essential to guide market forces and private investment towards decarbonization, while innovative business models can contribute to this transformation process.

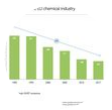
Related insight areas: Future of Mobility, Corporate Governance, Sustainable Development, Batteries, Environment and Natural Resource Security, India, United States, Climate Change, China, Future of Energy

Rocky Mountain Institute

APS and the momentum of 100 percent clean energy

25 January 2020

This week's announcement by Arizona Public Service (APS) that it will fully decarbonize the electricity it sells to its customers is a major win for a clean energy future, both in Arizona and nationally. It is also part of a... Read More The post APS and the momentum of 100 percent clean energy appeared first on Rocky Mountain Institute .



World Economic Forum

How to build a more climate-friendly chemical industry

21 January 2020

Cutting carbon emissions in the chemical sector will be hard - but the benefits could be enormous. Here's a look at where the industry is today - and where it could go tomorrow.

World Economic Forum

Why sustainability isn't just for green companies

19 January 2020

Sustainability is a business imperative. Here are tips for all companies to get there.

Rocky Mountain Institute

The Hidden Costs of EV Charging Infrastructure

16 January 2020

If you had to guess where the best opportunities are to reduce the cost of EV charging infrastructure, what would you say? The charging station hardware, perhaps? Or maybe installation techniques, like "future-proofing" by installing larger conduit and other elements of the "make-ready" infrastructure that supplies power to the charging stations? Or maybe unbundling contracts for network access fees and cellular data plans from hardware procurement?.

Frontiers

Developing Distributed PV in Beijing: Deployment Potential and Economics

15 January 2020

The building sector consumed a total of 580 million tons-coal equivalent (Mtce) terminal energy in China in 2018 including 1,888 terawatt-hours (TWh) electricity, accounting for 20.2% of total terminal energy consumption in this country. As the capital of China, Beijing is striving to improve the air quality while ensuring power and heat supply due to heavy reliance on electricity intake from other energy-rich provinces. The distributed photovoltaic, as a flexible application of renewable energy systems in urban and rural regions, can contribute to the power supply for rapid urbanization and mitigate the negative environmental impact of fossil energy use.

World Economic Forum

This Texan cattle rancher is turning to wind power | Pioneers For Our Planet

08 January 2020

Wind farms are a godsend for west Texans, enabling them to create sustainable lives for themselves, their communities and the planet. Over the past decade, wind power has more than tripled in the US - paving the way for a renewables revolution. Read more about the inspiring pioneers finding creative solutions to climate catastrophe here: https://wef.ch/pioneersforourplanet .

Rocky Mountain Institute

Think Distributed Solar-Plus-Storage isn't Cost Effective? Think Again.

06 January 2020

As shown in a recent RMI report, battery energy storage costs are less than a fifth of what they were a decade ago. This is enabling batteries to become cost-effective in a growing list of locations and use cases, such... Read More The post Think Distributed Solar-Plus-Storage isn't Cost Effective? Think Again. appeared first on Rocky Mountain Institute .

Electrification of the Economy

The most promising electrification opportunities are found among the largest polluters

In order to hit carbon dioxide emission targets set out in the 2016 Paris climate change agreement, it will be critical to electrify energy uses now powered by fossil fuels. According to a 2017 International Energy Agency (IEA) report, the energy sector could reach carbon neutrality (the elimination of new emissions) by 2060, through a combination of electrification and energy efficiency. Market forces alone will not push related technological development sufficiently, and will have to be complemented by public policy and clear rules. Only a few energy technologies enjoy favourable policy support, such as PV (solar photovoltaics), onshore wind, electric vehicles, and energy storage. Areas with untapped potential include energy efficiency, bioenergy, and carbon capture and storage. Increased financial support is needed in order to build stronger and smarter infrastructure, including transmission technologies. Heating and cooling in buildings, and industrial activity, currently account for approximately 40% of final energy consumption, according to the IEA report. Buildings can therefore play a major role in transforming the global energy system; increased efficiency in terms of heating, cooling, lighting, and materials could substantially ease demand, which would in turn ease the burden on the system as a whole.

The electrification of the transport sector could significantly effect the global energy system, though there is still a long way to go for it to have a real impact on the reduction of carbon dioxide emissions. Speeding up the electrification of the transport sector, through improved urban planning and increased public transportation, as well as the integration of grid edge technologies, will require major technological development, investment, and policy support. Industrial energy demand is projected to increase by about two-thirds by 2060, according to the IEA report, and particular focus should be placed on strategic sectors such as iron, steel, and chemicals. In addition to introducing electric power into industrial processes whenever possible, many opportunities exist to curb demand growth - such as bolstering manufacturing efficiency, and optimizing locally available resources and materials. Both national and global policies must support energy technology innovation at all stages, from research to commercial deployment, in order to reap the security, environmental, and economic benefits of energy system transformation. Globalization allows for the faster deployment of proven related technologies, and can enable the private sector to build sustainable business models that both boost the electrification of the global energy system, and mitigate climate change.

Related insight areas: Development Finance, India, Electronics, Future of Mobility, Oil and Gas, Global Governance, Batteries, China, Future of Energy, Sustainable Development, Climate Change, Cities and Urbanization

World Resources Institute

Watch These 4 Clean Energy Trends in U.S. Cities in 2020

23 January 2020

American cities, states and businesses have already come a long way on the road to cutting greenhouse gas emissions. Here are four clean energy trends to watch in the coming year in cities in the U.S.

Istituto Affari Internazionali

There Is No Green Deal without a Just Transition

20 January 2020

In: IAI Commentaries There Is No Green Deal without a Just Transition Issue: 20|01 There Is No Green Deal without a Just Transition Luca Bergamaschi * Since the adoption of the Paris Agreement in 2015 – whose preamble explicitly refers to the just transition – an important debate has started on how to manage the ecological transition in a fair and orderly way. The concept of “just transition” is not new. Its essence has always been at the centre of the great industrial revolutions of the past and one of the driving forces behind the birth of modern welfare systems. Without guaranteeing the conditions for social stability – through rights, sustainable working conditions and social protection – it is impossible to maintain the economic and political stability of a state.

World Economic Forum

Climate emergency: how our cities can inspire change

17 January 2020

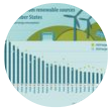
Synergy between sectors will inspire change: electricity; water and wastewater; heating; cooling and transport.

World Resources Institute

8 Environment and Development Stories to Watch in the New Make-or-Break Decade

15 January 2020

2020 will inevitably be a turning point for the environment. Key decisions on climate change, the ocean and biodiversity will determine if it is a turning point for the better or for the worse.



World Economic Forum

What’s good for the planet is good for business. Here's why

10 January 2020

The green future we all need will unlock markets and opportunities for European businesses. Here are some practical steps to help businesses begin this process.

World Economic Forum

To build cities fit for the future, we need to think differently

07 January 2020

We have the knowhow to build the resilient, sustainable cities we need - but grasping this opportunity will require a new approach to collaboration between all stakeholders.

The Conversation

Britain's electricity since 2010: wind surges to second place, coal collapses and fossil fuel use nearly halves

06 January 2020

Britain greets a new decade with substantially cleaner electricity, but challenges lie ahead to decarbonise its transport and heating.

Electricity Decentralization

Distributed energy resources are transforming the ways electricity systems are planned, operated, and used

Distributed energy resources such as solar photovoltaics (PV) that turn light into power, energy storage units, electric vehicles, and microgrids are transforming electricity systems. While these resources still play a relatively minor role in the provision of electricity services, their deployment is increasing and their impact is being felt. Germany's power system is one of the most striking examples of decentralization; 98% of the country's solar PV resources are connected to the distribution grid there, according to a report published in 2017 by the research organization Fraunhofer, and 85% of this capacity comes from installations that are smaller than 1 megawatt. Meanwhile one in five customers in Hawaii, and one in 10 homes in California, now have a rooftop solar PV system. As of 2016, distributed solar PV accounted for nearly 13% of all US generation capacity additions, according to the US Energy Information Administration. Decentralized power is not always clean, however; the same trends driving the deployment of distributed solar affect other energy sources. Natural gas-powered combined heat and power units and fuel cells, for example, accounted for 8% of all US generation capacity as of 2015, and provided more than three times the capacity of solar in the country, according to GTM Research.

Distributed energy storage resources are being used to defer investments in transmission and distribution networks, replace natural gas- and petroleum-fired "peaker" power plants, and reduce customer bills. Decentralization is not limited to the developed world; microgrids and off-grid energy resources are electrifying areas of India and sub-Saharan Africa that centralized utilities cannot reach. Decentralization enables consumers to better express their preferences, improves the production and delivery of power, and brings electricity to communities that are in dire need. However, if not deployed with care, distributed energy resources can result in dramatically increased power system costs, and foster inequality among resource owners and non-owners. In addition, due to the power lost when charging and discharging, energy storage resources may actually increase emissions. This calls for a sound regulatory framework, which includes a system of pricing and charges that accurately reflects the value of consuming or producing power at different times, and locations - and which also changes the way distribution utilities are remunerated, enabling them to take full advantage of distributed energy resources. Organized electricity markets must be reformed, in order to enable these resources to compete effectively and to reflect the new power sector reality.

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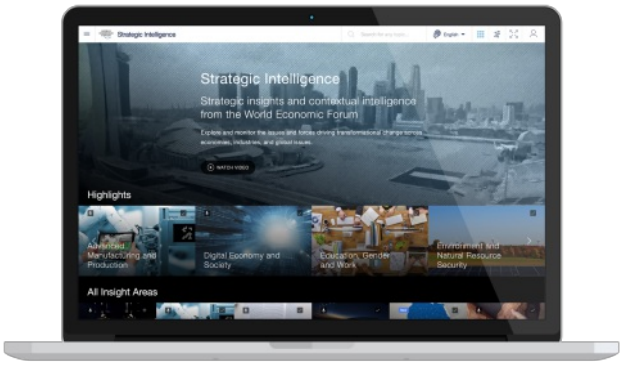

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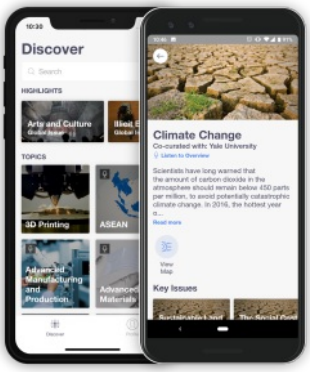

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