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International Renewable Energy Agency

RECORDS FORECASTED FOR 2014:

Falling costs drive record solar and wind growth

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Solar photovoltaic and wind power are set to become even cheaper and attain new heights of growth this year.

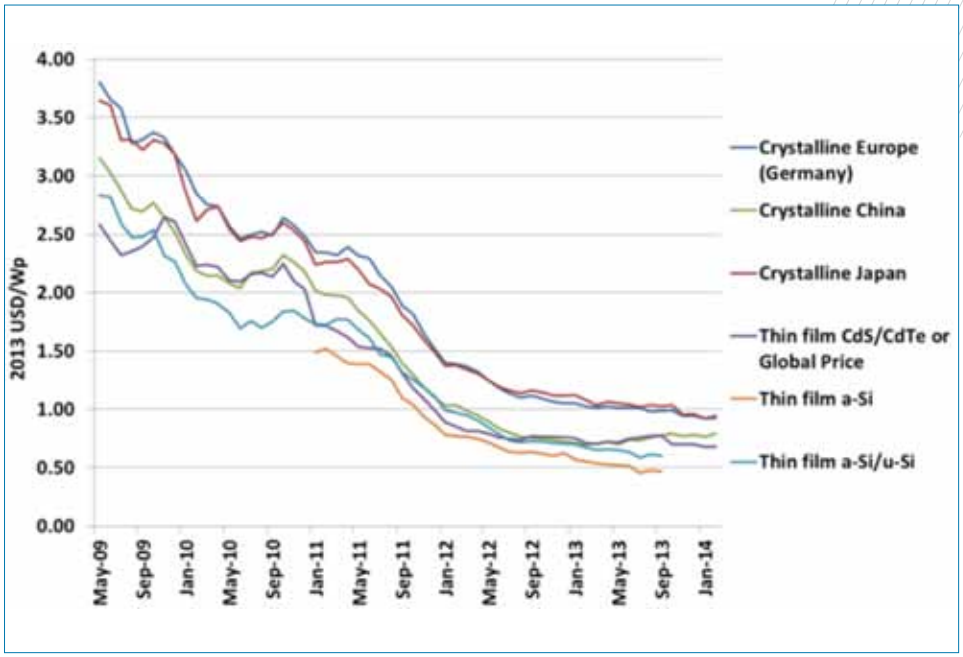
The year 2013 was a landmark one for renewables. Despite fickle policymaking and weak economic growth, overall capacity additions remained strong, with solar deployment outpacing wind for the first time. Solar photovoltaic (PV) deployment reached around 39 gigawatts (GW) for the year according to industry sources.

New wind deployment was a disappointing 35 GW, as policy uncertainty delayed projects. However, wind is set to bounce back, and 2014 looks set to be a record year for both solar PV and wind power. With firmer policy support, new solar PV installations could be 10 GW or more higher this year reaching 47-48 GW solar in 2014. Capacity additions for wind power could amount to about the same, also a new record.

Improving cost competitiveness continues to drive the deployment of both technologies. As more solar panels and wind turbines are installed, the learning effect means they become cheaper to manufacture. Renewable energy options are now the most cost effective way to obtain electricity in remote locations away from the main power grid — or in any grid using oil-fired generation — and are increasingly competitive for grid supply.

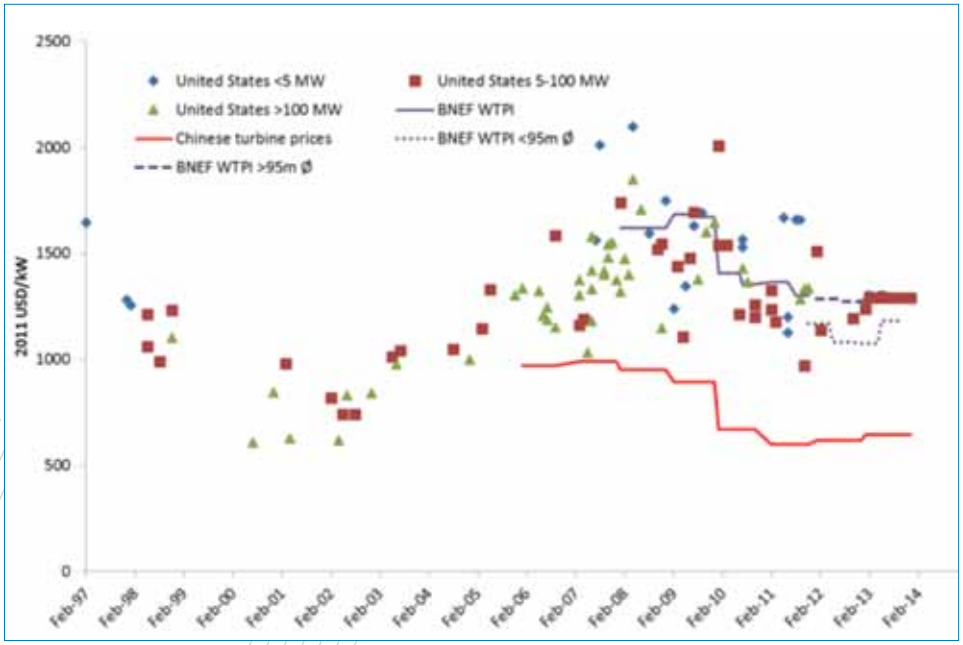
For solar PV module and wind turbine manufacturers, 2013 was a year of consolidation, when profit margins previously dented by global oversupply began to recover. Solar PV module prices declined by 65%-70% between December 2009 and December 2012, but were broadly stable in 2013. Wind turbine prices were also relatively stable in 2013, although old models are losing ground to larger, more efficient designs in developed economies like those of Western Europe and North America.

Solar PV module prices, 2009 to 2014



Source: PV exchange and Global Data, 2014.

Wind turbine price trends, 1998 to 2014



Source: Lawrence Berkeley National Laboratory (LBNL), 2013; Chinese Wind Energy Association (CWEA), 2013; Global Data, 2014 and BNEF, 2014.

Even as the solar and wind markets recover, installed costs continue to fall while the technologies keep improving. The result is lower-cost electricity from renewables. In most markets, installed costs continued to fall throughout 2013, driven by increased competition, larger-scale deployment and ongoing reductions in balance of system costs.

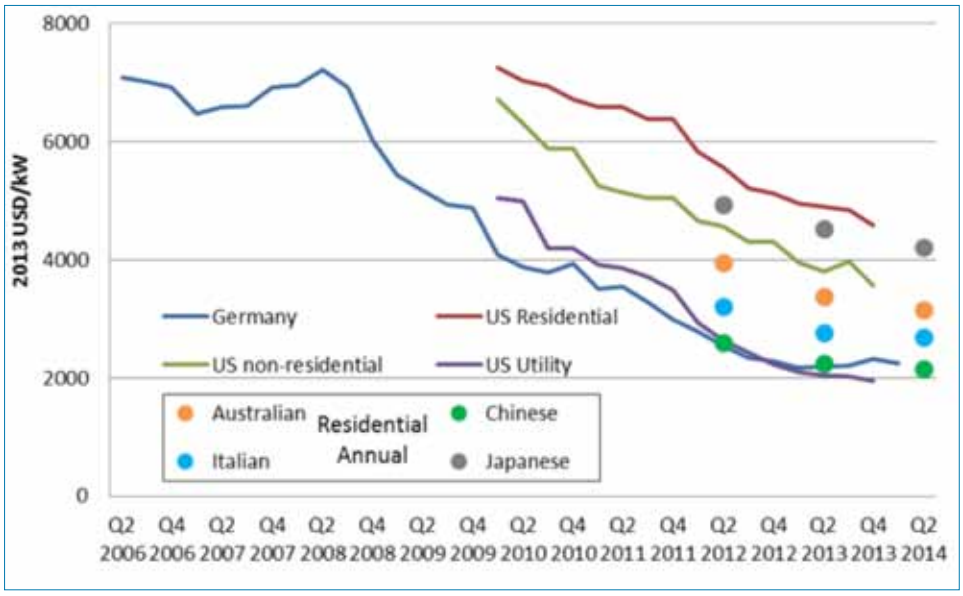
The sole exception, for solar PV at least, is Germany, the most competitive solar PV market in the world, where prices for small-scale systems reached equilibrium, while costs continued falling for larger utility-scale projects (Figure 3).

Total installed costs for wind farms have been declining since the peak in wind turbine prices in 2009. For instance, average installed wind farm costs in the United States, which dropped from an average of around USD 2 250 per kilowatt (kW) in 2009 to USD 1 940/kW in 2012, showed slight declines in 2013.

Installed costs for some United States projects were as low as USD 1 400/kW, compared to a range of USD 1200/kW to 1300/kW in China and India. In areas of excellent wind resources in the United States, wind is now competitive with gas-fired generation. Technology improvements have been the real driver of lower electricity generation cost reductions in recent years.

Higher hub heights and larger swept areas have increased the energy harvested for a given wind site, raising energy yields by 20%-30% according to Global Data (2014). As a result, onshore wind power from good resource areas is now typically competitive with, if not cheaper than, electricity from fossil-fuels.

Solar PV installed costs by country and market segment, 2006 to 2014



Source: Bundesverband Solarwirtschaft e.V. (BSW), 2014; Solar Energy Industries Association (SEIA) and GreenTech Media (GTM), 2014; and Photon Consulting, 2014.

For more information about the costs and performance of renewable energy technologies visit www.irena.org/costs.

New tools for resource assessment

The renewable energy potential in most markets is vast and largely untapped

Renewable energy systems depend on harvesting resources, including the sun, the wind and underground heat. This requires knowing when and where such resources are available, over a time span of decades.

Even so, there is no standard practice to map renewable energy potential - a headache for decision makers trying to plan long-term energy investments.

Where the analysis starts: Example of initial geospatial analysis for wind energy. The Wind Atlas of Iran highlights areas where the wind resource is above 6.4 m/s, 8.1 m/s and higher than 9.4 m/s (source: Renewable Energy Organisation of Iran). The background shows the raw wind resource from low to high wind speeds for an altitute of 50 m, ranging from blue (3 m/s), brown (9 m/s) and red (above 9 m/s). Source: 3Tier.

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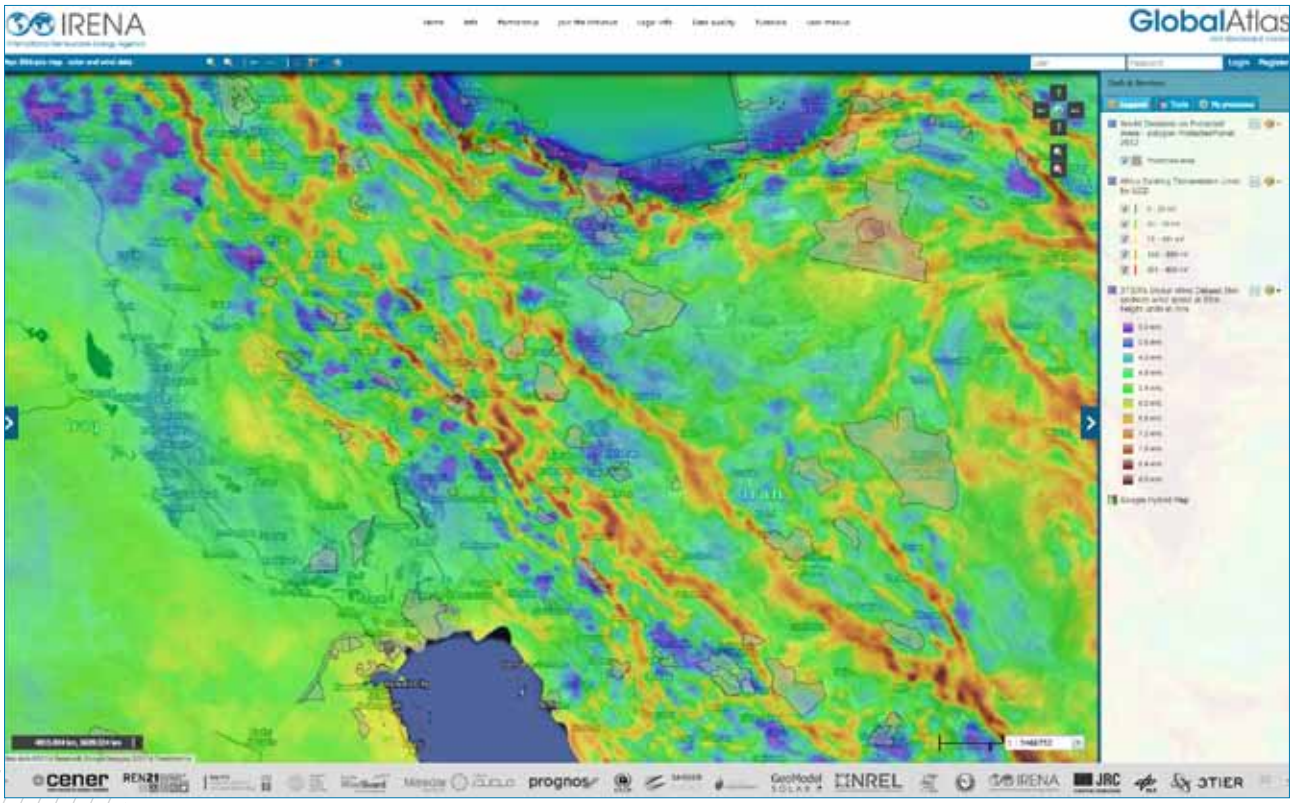
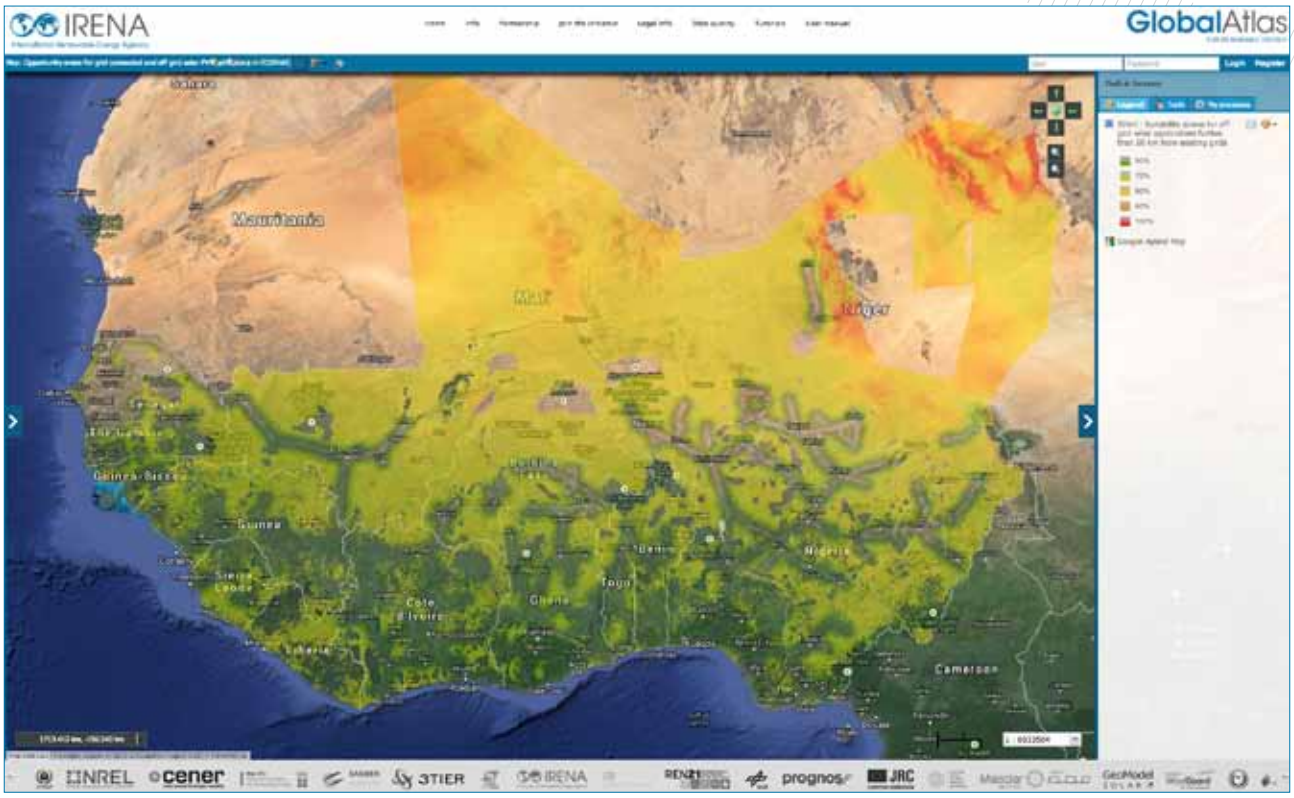


Maps indicating renewable energy potential are essential for the transition to renewable energy. They help to highlight promising zones for development, identify the most suitable technology for each location, plan infrastructure investments, and ensure an attractive regulatory framework.

In turn, transparent planning and policies at the governmental level can raise the confidence of project investors and the renewable energy industry. Lowering risk perceptions, in turn, eases access to capital. Private investors, meanwhile, also need accurate data in order to prospect new markets or propose new solutions.

To make a good renewable energy map, many factors come in to play, from current land use, topography and protected areas to technology, resources, and local laws and practices. The potential depicted, however, remains a hypothesis, open for discussion among policy makers, investors, local authorities, utilities and communities.

Example of advanced geospatial analysis: Suitability factors for off-grid wind applications further than 50 km from existing grids in ECOWAS. The scoring system takes into account the wind resource, topography, population density, slope, land cover, grid location, protected areas and altitude. Such 'opportunity-based' maps are used to initiate a discussion with stakeholders and authorities in the region in order to understand which set of assumptions best reflects the local situation. For specific areas identified as promising, more thorough investigations can be conducted.



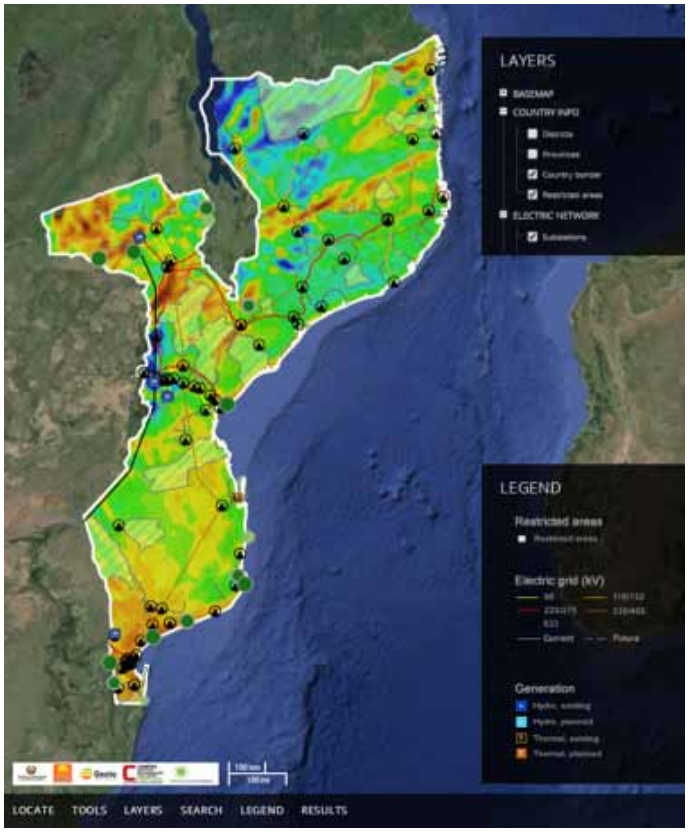
Source: IRENA, 2013.
Available at: http://globalatlas.irena.org/UserFiles/Publication/GA_ECOWAS_WIND_Web.pdf

Without validation of data, public solar and wind resource maps rarely translate into projects on the ground. Few countries have carried out a full-scale geospatial analysis, starting from validated resource maps. Often, studies are repeated needlessly with similar results.

The World Bank's Energy Sector Management Assistance Program (ESMAP) is attempting to address this challenge by investing in measurement campaigns around the world (www.esmap.org). The International Renewable Energy Agency (IRENA) hopes to direct donors to targeted measurement campaigns for selected hotspots, such as in the proposed African Clean Energy Corridor.

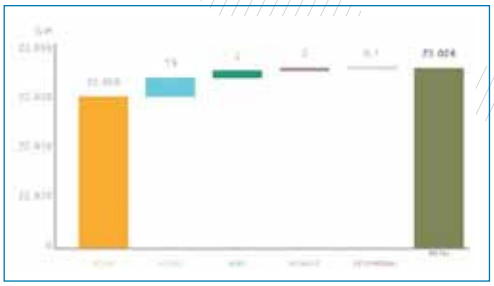
IRENA is also bringing together resource datasets from countries and institutes around the world. The Global Atlas for Renewable Energy, accessible through the IRENA website, is a free resource assessment tool that helps policy makers and investors alike appreciated the opportunities at their disposal.

Example of full-scale analysis, where geospatial analysis translates into technical potential in megawatts, and indicates possible locations for future projects.

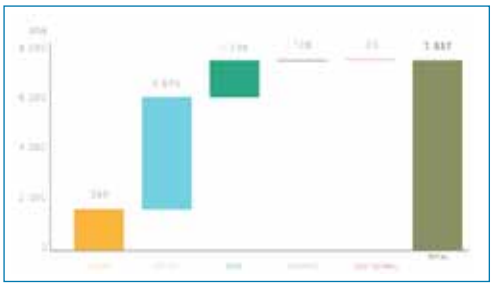


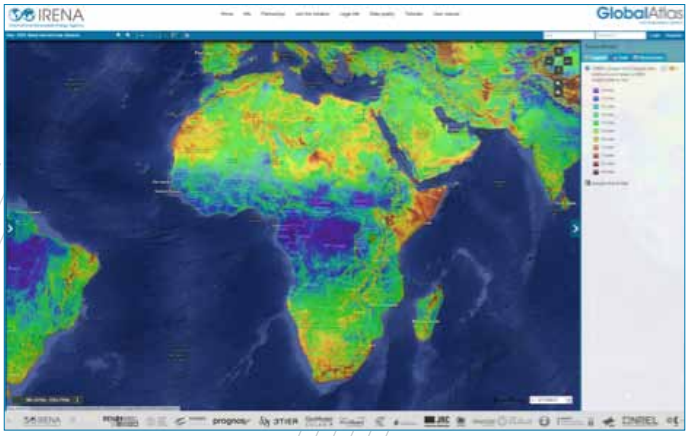
Source: Renewable energy Atlas of Mozambique: http://www.atlasrenovaveis.co.mz/en/conteudo/renewable-energy-atlas-mozambique

Renewable energy potential of Mozambique, per resource (GW)



Potential for selected key projects





Wind speed map of Africa. The simulation model provides an overview of hotspots for the continent. One average value is provided for every 5 km on this map. Private companies can sell data with much higher precision than the information available in the public domain. However the map accessible through the Global Atlas of Renewable Energy was provided by 3Tier and is the most detailed dataset available in the public domain at present.

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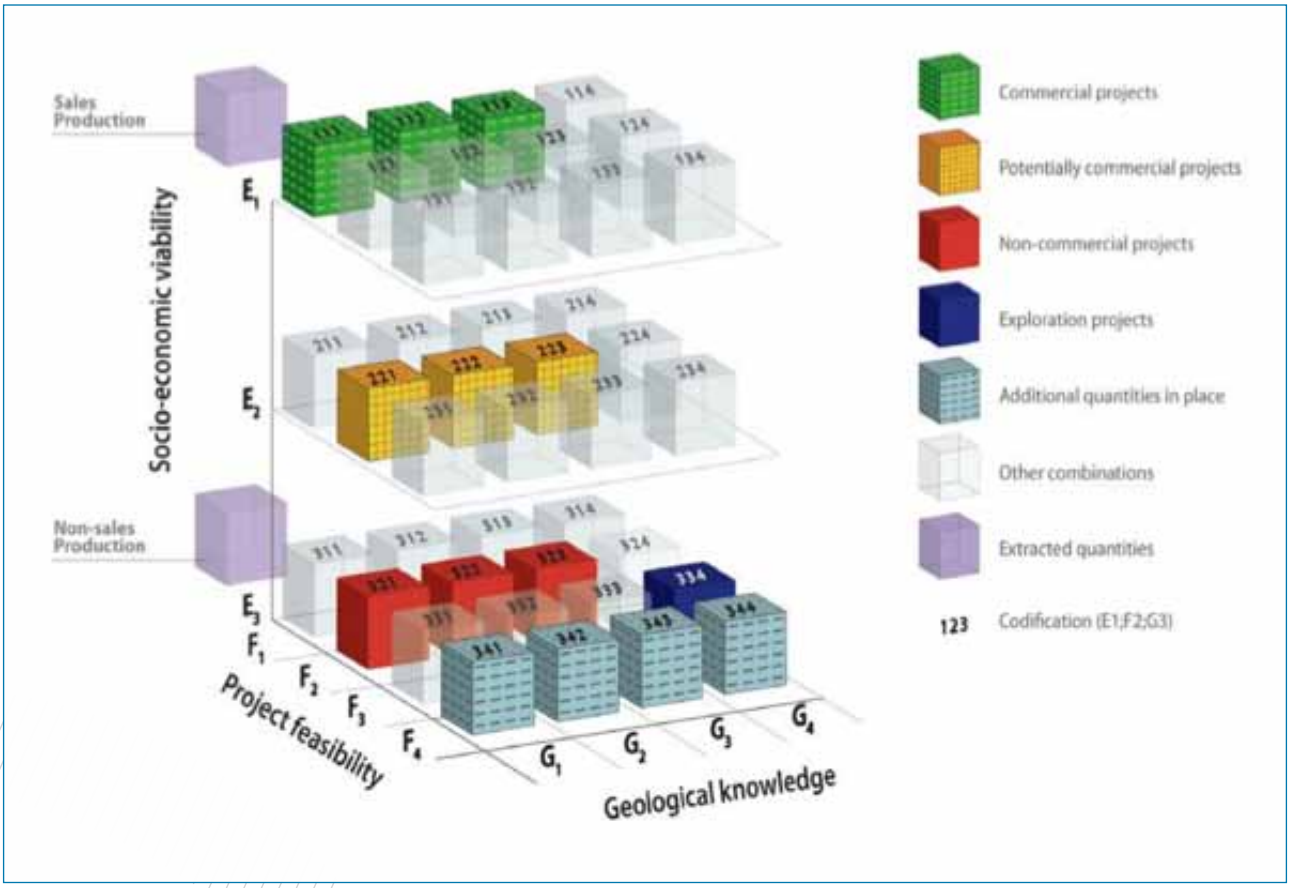
Each geospatial analysis uses different assumptions and considers different parameters. Depending on the initial assumptions and level of detail, results can be markedly different. The assumptions can also evolve with technology or cost breakthroughs.

With renewable energy developments happening worldwide, the lack of standard practices is a growing concern. International operators, financers and analysts will increasingly look for estimates and forecasts they can compare. Such estimates can also facilitate financial reporting.

Just as oil companies traditionally publish a yearly statement of their reserves, the renewable energy sector relies on estimates of potential. The United Nations Framework Classification for Fossil Energy and Mineral Reserves and Resources (UNFC) assesses conventional energy projects using three main factors: geological potential, technical feasibility and socio-economic viability. These UNFC categories are now being adapted for renewable energy projects.

UNFC-2009 categories and project classes. Extract from United Nations Framework Classification for Fossil Energy and Mineral Reserves and Resources 2009, incorporating specifications for application (ECE ENERGY SERIES No. 42)



Financing renewable energy projects

The world has enough renewable resources, even as its population swells beyond 7 billion, to meet all foreseeable energy needs. In 2013, global investment in renewable energy reached USD 214 billion, down from nearly USD 249 billion in 2012 and the record USD 279 billion in 2011, according to the latest figures from Bloomberg New Energy Finance. Still, only massive new investment can meet the needs of emerging economies and rapidly expanding cities. To reach USD 1 trillion by 2030, current investment levels need to quadruple.

Why are investors still reluctant to put their money in renewable energy, while project developers in the sector often struggle to raise upfront financing?

The International Renewable Energy Agency (IRENA) has consulted over the past two years with its member countries, as well as the private and public financial sectors. As IRENA's research confirms, the risks of investing are perceived to be higher for projects involving renewables, irrespective of the territory. Risk is the most important factor hindering private investments. Traditional energy sources, as comparatively familiar territory to most investors, are perceived as easier and more predictable.

In developing country markets, financing risks for renewables are heightened by the weakness of domestic financial markets. Financial instruments in developing countries are inadequate, especially to cover liquidity risk. Political and policy risks are even more challenging to mitigate.

In these cases, the risks apply to all energy infrastructure investments, not only renewables. Although, renewable energy projects have greater difficulty making use of the mitigation tools that already exist. Political risk mitigation, for example, often excludes or overlooks renewable energy projects, especially at the smaller scale usually found in developing countries.

Innovative solutions and instruments for mitigating policy risk are under discussion. Already, multilateral institutions have started issuing bonds in local markets, providing an alternative source of long-term local currency funding. Additionally, large private banks are coming together by providing voluntary guidelines for the development and issuance of "green bonds".

Dedicated risk mitigation facilities for renewable energy are especially effective when they focus on a specific risk type — such as exit risk, construction risk, political risk, or power off-taker risk — for a certain technology in a specific region.

Over 75% of global climate finance flows domestically, says Climate Policy Initiative. Local capital should be the key to mitigating risks, boosting local economies, and leveraging international resources for climate finance. But far more information is needed about the capacity of the local financial sector.

IRENA will continue to study investment risks and risk mitigation, seeking to stimulate renewable energy finance. For renewables to meet the world's energy needs, risk perceptions need to be addressed head on.

Samoa: Biomass gasification and biodiesel production plants on two islands


Photo: Samoa Trust Estate Corporation

Project loans open investment opportunities

For fishing communities in Mauritania, refrigeration to conserve their fish has been an out of reach luxury. However, thanks to newly available loans from the Abu Dhabi Fund for Development (ADFD), a new wind energy project will soon support ice-making to keep the catch cool, as well as provide electric lighting. The International Renewable Energy Agency (IRENA) has collaborated with ADFD to form a concessional loan facility for developing countries worth USD 350 million over seven years.

The IRENA-ADFD Project Facility selects innovative and potentially replicable renewable energy projects that can improve people's lives and livelihoods in areas lacking access to modern energy services. Projects need to demonstrate economic feasibility. ADFD provides up to 50% of total project costs, with co-finance required for the rest. The aim is to attract additional public and private finance to worthy project models that can contribute to the worldwide scale-up of renewable energy.

The facility has already disbursed USD 41 million from the first of seven funding cycles to six different projects. Besides being technically and commercially viable, the selected projects are expected to bring socio-economic benefits to local communities, including health, sanitation, education, business capacity, transport and tourism. Development banks, national governments and private investors are also involved, covering more than half of the costs of each project.

National development organisations say some of the IRENA-ADFD projects provide models for wider renewable energy uptake. For example, one project developer in Africa saw the Mauritanian wind energy project as a valuable precedent to emulate.

Mauritania: Fisherman showing part of his daily catch

Photo: Mauritanian Ministry of Energy, Petroleum and Mines

IRENA-ADFD Project Facility platform for finance

Other parties / funds are encouraged to provide applicants to the facility with:

- Grant finance for feasibility studies
- Co-finance loans/grants

IRENA would welcome partnerships with other public or private funds to support feasibility studies, co-financing and additional funding for renewable energy projects in developing countries.

For further information on the application process please view the IRENA-ADFD Project Facility web pages: *www.irena.org/adfd*

Project Country	Project Summary	Capacity	Loan	Project cost	Benefits – Including Positive Impact on Livelihoods
Ecuador	Small hydro project	3 megawatts (MW)	USD 5 million	USD 10 million	Provides energy to a community of over 7 000 people. Powers schools and medical facilities.
Maldives	Small scale waste to energy project and desalinated water output	2 MW and 62 million litres of drinking water per year	USD 6 million	USD 12 million	Model solution for waste on small islands. Produces clean electricity and drinking water. Significant health and tourism benefits for the local community of over 120 000 people.
Mali	Hybrid solar photovoltaic (PV) diesel mini-grids for rural villages	4 MW	USD 9 million	USD 18 million	Reduces costs and expands access to electricity in 30 villages. Allows for small businesses to grow. Powers homes and schools and health centres providing clean water and lighting.
Mauritania	Wind energy projects for four coastal communities	1 MW	USD 5 million	USD 10 million	Provides energy to people isolated from the grid. Allows fisherman to store their catch. Powers local schools, health centres and water desalination plants
Samoa	Biomass gasification & biodiesel production plants on two islands	3 MW and 4 million litres of biodiesel per year	USD 7 million	USD 14 million	Supplies sustainable electricity to homes and businesses. Replaces expensive imported transport fuel.
Sierra Leone	Grid-connected solar PV project in peri-urban area	6 MW	USD 9 million	USD 18 million	Supports the capital's grid expansion. Improves grid stability.

Peru fine-tunes auction design

In Latin America, Peru has been a pioneer in implementing renewable energy auctions. Three auctions awarded almost 1 400 gigawatt-hours (GWh) per year of renewable power from solar, wind and biomass and 492 megawatts (MW) from small hydro, attracting total investments of over USD 1.5 billion. However, the auction process can still be further improved.
As the country of almost 30.5 million people continues integrating renewable energy sources and technologies into the grid, questions remain about appropriate auction sizes, local content requirements, and whether auctions can be technology-neutral.

The Republic of Peru is the third largest country in South America after Brazil and Argentina. Its economy has expanded from USD 53 billion in 2000 to USD 197 billion in 2012, leading to a substantial increase in energy demand and creating opportunities to invest in energy infrastructure. Electricity demand is expected to increase fourfold by 2030, requiring additions of around 4.3 gigawatts (GW) of new capacity.
Peru's vast renewable energy resources could be help significantly to fuel economic expansion with less impact on the environment. While multiple auction rounds raised transaction costs, holding larger auctions could reduce transaction costs, create economies of scale, increase competition and attract international interest. At the same time this has to be weighed against the possibility of squeezing out local companies that would be more competitive in smaller, staggered auctions.

Local content requirements, by promoting domestic manufacturing of equipment and components, encourage reinvestment and job creation. Peru's electrical and metalworking industries have the capacity and experience to make some components for renewable electricity generation, creating the opportunity for strategic alliances with renewable energy companies.

Based on international experiences, a technology-neutral approach may be best to obtain the cheapest electricity. This way, independent power producers using different renewable energy technologies may be eligible to participate in the same auction process. The main disadvantage of technology-neutral auctions is that their purely price-based criteria fail to adequately value externalities, such as health and environmental impact. Policy objectives, such as diversification of the energy mix, or promotion of certain technologies, must be balanced against the benefits of enhanced competition.

The analysis in this article is taken from IRENA's newly published Renewable Readiness Assessment Peru.

Solar PV versus CSP: Two options for the energy mix

Over the years, the global installed capacity of solar photovoltaic (PV) power has consistently surpassed even the most optimistic projections. The installed capacity of solar PV in 2013 reached 130 gigawatts (GW), compared to just over 70 GW in 2011.

Global installations of concentrated solar power (CSP) capacity, in contrast, only reached 4 GW in 2013, from 1.6 GW in 2011. Despite dramatic cost reductions for renewable energy technologies in recent years, the total installation cost of CSP plants far exceeds the equivalent for solar PV plants, even without the added cost of storage capability for 24-hour output.

CSP plants require high direct solar irradiance, making them suitable for the Sun Belt region between 40 degrees north and south of the equator. However, for grid-connected power generation, CSP plants, unlike PV, can be integrated with up to 16 hours of low-cost thermal storage, ensuring continuous power on demand.

CSP can also be integrated with fossil fuel-based power plants using conventional steam turbines, with solar heat replacing combustion to produce the steam.

Like conventional power plants, CSP installations need cooling and condensation. Since water is often scarce in the Sun Belt, "dry cooling" is the preferred option, even though such plants are typically 10% more expensive than those that are water-cooled.

Unlike PV, CSP can even be used for steam generation to extract oil from mature or heavy oil fields, to co-generate heat and power for domestic and industrial use, and for combined power and water-desalination plants. CSP plants tend to boost local economies through component manufacturing.

Solar PV, on the other hand, can be deployed over a wider range of uses and capacities, from a few watts to multiple megawatts. It can be found in rooftop applications for home use; powering standalone appliances and devices such as transmission towers, water pumps, street lighting or remote stations; and powering kilowatt- and megawatt-size mini grids for decentralised electrification, as well as for grid-connected generation. In utility-scale generation, PV can also power water pumps that feed reservoirs to generate hydropower (*i.e.,* pumped storage hydropower).

So, as technological advances continue, as costs fall further and as new applications emerge, both technologies will have their uses.
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Solar PV panels

Corridor of power for Africa

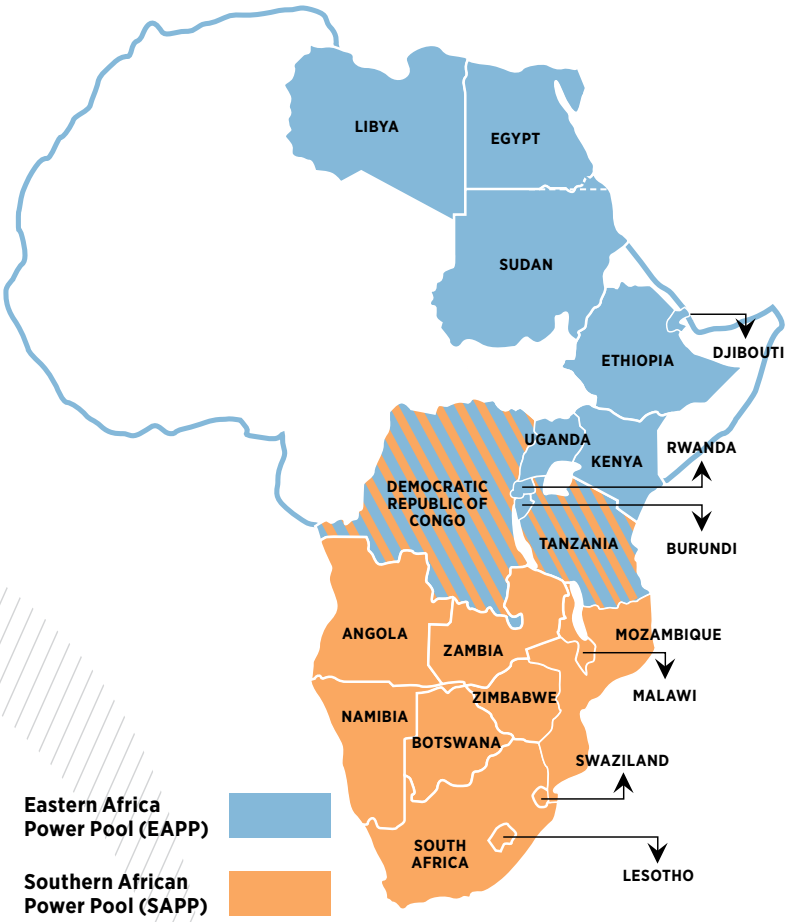
Eastern and Southern African countries have committed to upgrading their renewable electricity infrastructure.

Africa is changing fast. By 2050, its 54 countries will be home to 2 billion people, of whom three out of five will live in cities. As economies expand, electric output will triple in the south and quadruple in the east within 25 years. Sub-Saharan economies have grown 5.3% per annum in the past decade. But to sustain this growth, they will need clean, grid-connected power.

The Africa Clean Energy Corridor is an initiative to develop clean, indigenous, cost-effective power based on the continent's vast renewable energy resources. As renewable power technologies decline in cost, they are increasingly competitive with fossil-fuelled power. Clean renewable energy sources can be deployed comparatively fast, meeting growing power needs, expanding access to electricity and creating new jobs, while reducing fossil fuel consumption and carbon emissions.

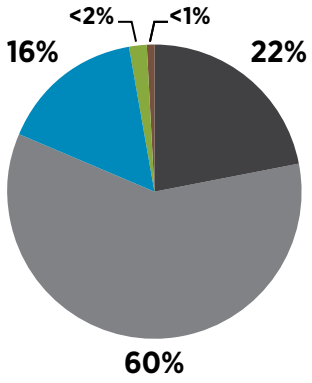
Ministers and heads of delegation from 19 countries in the Eastern Africa Power Pool (EAPP) and the Southern African Power Pool (SAPP) endorsed the initiative in January 2014.

Countries in the Africa Clean Energy Corridor



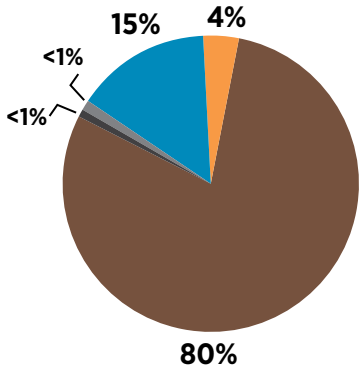
The term "country" as used in this material also refers, as appropriate, to territories or areas

Eastern Africa Power Pool Electricity Mix



172 TWh

Southern African Power Pool Electricity Mix



309 TWh

Coal
Hydro
Oil
Nuclear
Gas
Non-hydro renewables

TWh = Terawatt-hour
Sources: International Energy Agency, EAPP, SAPP
Based on 2012 averages

Today, four-fifths of Africa's electricity is generated from fossil fuels: mainly coal in the south, gas and oil in the east. Hydroelectric, geothermal, biomass, wind and solar resources could be developed to reduce this fossil fuel dependency.

Through regional power pools, African countries are moving step by step towards an integrated energy market. Regional regulatory bodies are being strengthened, to better govern the sector and harmonise policies, legislation, standards and practices. Still, the bulk of regional power development plans involve large scale thermal or large hydroelectric plants, with little consideration for the vast potential of non-hydro renewables.

The International Renewable Energy Agency (IRENA) is working with stakeholders, namely countries, power pools, utilities and other regional partners, to address the continent's rising power needs through the Africa Clean Energy Corridor. To expand the range of renewable power options, IRENA, together with such stakeholders, is identifying developable zones in areas with high wind, solar and geothermal resource potential, as well as existing transmission infrastructure.

Key projects could enable Eastern and Southern Africa to enjoy affordable renewable power, with solar and wind being the fastest types to bring into service. Financing for renewable power projects must be expanded and facilitated. Investments by independent power producers (IPPs) and building owners will be essential.

Variable renewable sources entail particular challenges for grid operators. IRENA is developing a practitioner's guide for grid integration, to help utilities and power pools increase renewable power generation.

Olkaria Geothermal Plant, Kenya

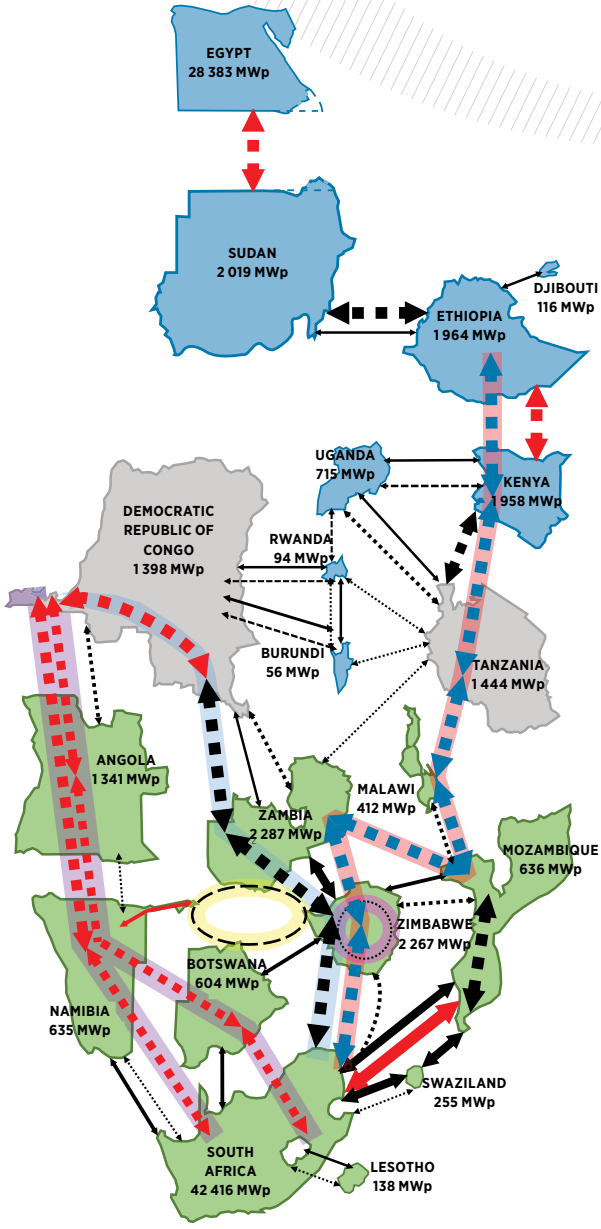
Renewable energy sources could potentially meet 40%-50% of power needs in Eastern and Southern Africa by 2030, with half of this coming from non-hydro renewables. In contrast to a business-as-usual scenario, the benefits would include reduced carbon dioxide (CO_2) emissions, diversified power generation, attractive opportunities for large-scale investment and intensified regional electricity trade. Furthermore, renewable power deployment, potentially exceeding 120 GW by 2030, will help to develop local skills and support millions of new jobs (approximately 8.7 million job years according to IRENA estimates).

The commitment to corridor development was outlined in an IRENA communique, endorsed on 17 January 2014 by energy ministers and heads of delegations from Angola, Botswana, Burundi, the Democratic Republic of Congo, Djibouti, Egypt, Ethiopia, Kenya, Lesotho, Malawi, Mozambique, Namibia, South Africa, Sudan, Swaziland, Uganda, the United Republic of Tanzania, Zambia and Zimbabwe.

Along with encouraging renewable power generation and enhanced transmission, the Corridor initiative will help to develop the human skills to build, plan, operate, maintain and govern power grids and markets with higher shares of renewable electricity generation.

It will also reinforce the political will to develop renewables, highlighting the benefits of secure, sustainable and affordable electricity.

EAPP-SAPP Transmission Infrastructure



< 500 MW
500 - 999 MW
1000 - 1999 MW
> 2000 MW
AC
HVDC
Existing
Commited
Proposed

Regional projects:

ZIZABONA (2015)
765 kv
WESTCOR
Central Transmission Corridor
PIDA North-South Power Transmission Corridor

*Peak capacities for SAPP include a 15% target reserve margin

Recent publications

Adapting Renewable Energy Policies To Dynamic Market Conditions

High learning rates and rapid cost decreases for new technologies in recent years have combined with effective support policies to accelerate the spread of renewable energy around the world. However, this dynamism in the market creates new challenges for policy makers seeking to promote the long-term transition to renewable sources and technologies. IRENA's latest policy report provides an overview of the challenges arising from the rapidly changing global market, along with various possible policy responses.

Renewables Readiness Assessment: Niger

This report, based on country-led consultations, presents a holistic evaluation of conditions and identifies the actions needed to accelerate renewable energy deployment. Solar energy could be harnessed extensively in Niger, but a suitable investment model needs to be established. Now available in French: ***NIGER: ÉVALUATION DE L'ÉTAT DE PRÉPARATION AUX ÉNERGIES RENOUVELABLES***

REmap 2030: A Renewable Energy Roadmap

REmap 2030 provides a plan to double the share of renewable energy in the world's energy mix by 2030. The analysis, covering 26 countries that represent three quarters of total final energy consumption, determines the realistic potential for the world to scale up renewables in order to ensure a sustainable energy future.

Pan-Arab Renewable Energy Strategy 2030: Roadmap of Actions for Implementation

The Pan-Arab Renewable Energy Strategy adopted in 2013 represents a regional consensus on pursuing a sustainable energy future, starting with large-scale development of renewable power potential by 2030. *Pan-Arab Renewable Energy Strategy 2030: Roadmap of Actions for Implementation*, published by IRENA in partnership with the League of Arab States and the Regional Centre for Renewable Energy and Energy Efficiency (RCREEE), highlights the actions needed to attract investments in the sector.

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About IRENA

The International Renewable Energy Agency (IRENA) is an intergovernmental organisation that supports countries in their transition to a sustainable energy future, and serves as the principal platform for international cooperation, a centre of excellence, and a repository of policy, technology, resource and financial knowledge on renewable energy. IRENA promotes the widespread adoption and sustainable use of all forms of renewable energy, including bioenergy, geothermal, hydropower, ocean, solar and wind energy, in the pursuit of sustainable development, energy access, energy security and low-carbon economic growth and prosperity.
www.irena.org