The Global Arc Towards Renewable Energy

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December 2016

A publication of the Climate Institute
1400 16th St. NW, Suite 430, Washington, DC 20036

Introduction

Given the United States' recent election results, America's future on climate and energy policy is uncertain, but global progress on mitigating climate change will continue with or without us. We have reason to be optimistic because countries around the world have demonstrated their commitments to taking action on global warming. Already, 114 countries have ratified the Paris Climate Change Agreement, which became international law on November 4, 2016, indicating that mitigating climate change is indeed a global priority. Even before this United Nations agreement, countries like China and Germany have made huge investments in renewable energies, steadily diversifying their energy portfolios. Other countries like Sweden or Costa Rica have pushed further, demonstrating their commitment to relying fully on renewable energy sources. Whether or not the United States political landscape will advance progress towards cleaner and more sustainable energies, the rest of the world is demonstrating a shift towards renewables.

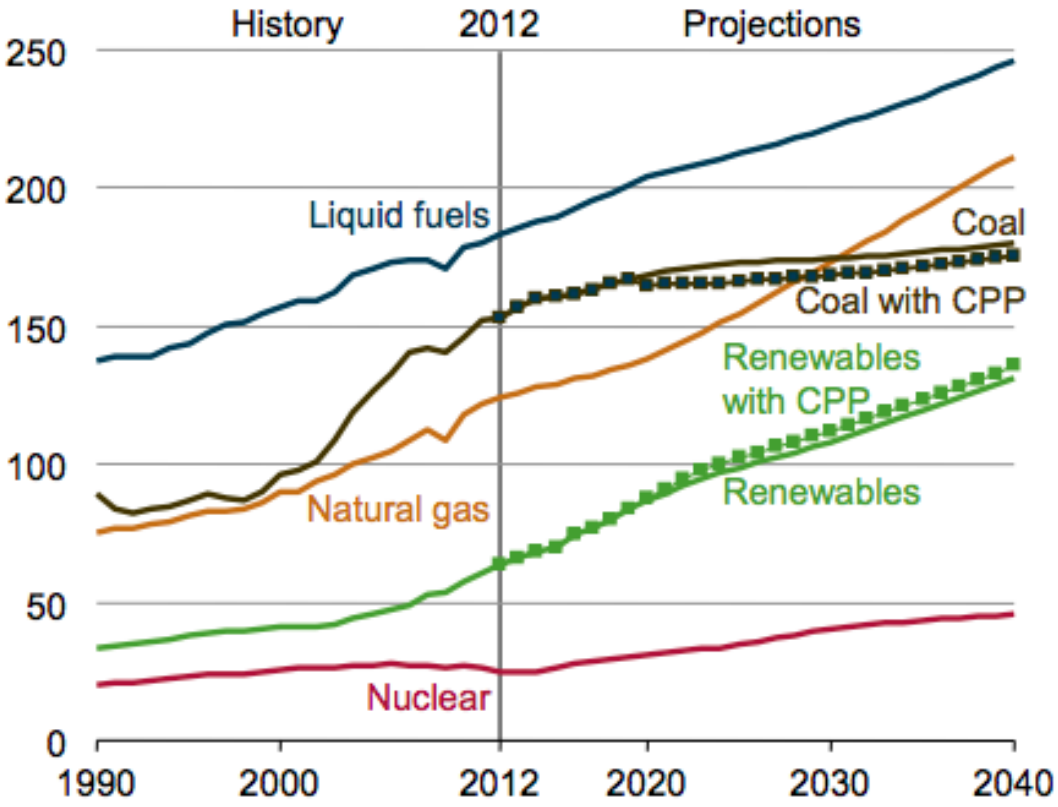
While we have yet to see the extent of the Paris agreement's impact, it is certainly a landmark deal. Each country that ratifies the agreement pledges to fight climate change through the primary goal of keeping global temperature rise to well below 2 degrees Celsius in this century.[1]
UNFCCC Executive Secretary Patricia Espinosa and President of COP22 and Minister of Foreign Affairs and Cooperation of the Kingdom of Morocco Salaheddine Mezouar praised this historic event as "a clear political signal that all the nations of the world are devoted to decisive global action on climate change." They noted that this agreement not only gives us hope that we might minimize the global impact of climate change, but it also indicates a commitment to building a global renewable energy industry, to climate resilient economies and societies, and to the continued development of climate-focused policies and technologies.[2]

This last idea, that this agreement signifies a global shift towards combatting climate change, is especially important. Around the world, we can see communities, cities, and countries transforming policies to more effectively reduce greenhouse gas emissions by investing in cleaner energy technologies. Nevertheless, this shift towards re-engineering societies and economies will continue to need significant investments. The International Energy Agency's 2015 World Energy Outlook estimates that in order to fully implement the Paris Agreement, climate pledges require investments of $13.5 trillion for energy efficiency and low-carbon technologies though 2030.[3] Sixty-percent of this amount is expected to go towards boosting renewable energy capacity.

Energy demand will continue to rise over the years. Unsurprisingly, fossil fuels will continue to make up a substantial percentage of energy use – the U.S. Energy Information Administration estimates

this figure to be at 78% in 2040, with natural gas showing the greatest growth among fossil fuel types. Even so, statistics show that the transition to a clean energy economy is very much in progress. Along with the rise in certain fossil fuels, dependence on coal will continue to plateau over the next several decades, and renewables are projected to be the world's fastest-growing energy source over the 2012-2040 period.

Total world energy consumption by energy source, 1990–2040 (quadrillion Btu)[4]



Note: Dotted lines for coal and renewables show projected effects of the U.S. Clean Power Plan.

These trends indicate that the world will continue to embrace cleaner energy sources. Indeed, several countries around the world have gone above and beyond what is mandated by international law to integrate renewable energy sources into their portfolios.

International Shift Towards Renewables

In 2015, Swedish Prime Minister Stefan Löfven and Minister for Climate and the Environment Åsa Romson expressed their hope that Sweden would be world's first fossil-free welfare nation. Then in the summer of 2016, Sweden revealed a plan for 100% of their energy consumption to come from renewable energy sources by 2040. While this agenda may be highly ambitious, Sweden has already demonstrated its commitment to a sustainable future by hitting its goal of a 50% renewable energy share by 2020 years ahead of schedule, in 2012.[5]

Even if this goal is not reached within the proposed timeframe, Sweden certainly has the ability to make even larger strides towards sourcing all their energy from renewables, since it benefits from government leadership and financial support, which drives investments and policies towards sustainable goals. Already, the government has announced that 4.5 billion kronor (about $496 million) would go towards funding green infrastructure such as solar panels and a smarter energy grid.[6] Another amount of over $115 million would go towards energy storage research and making residential buildings more energy efficient. Sweden may enjoy more abundant than average resources, but it still sets a strong model of what countries can achieve.[7]

Of course, Sweden is not the only country setting an example in these sustainable efforts. Other nations around the world are taking significant strides as well. This article will feature a small sample of the many countries committing to increasing their renewable energy supplies. Three notable leaders in renewable energy include Costa Rica, Germany, and China.

Costa Rica

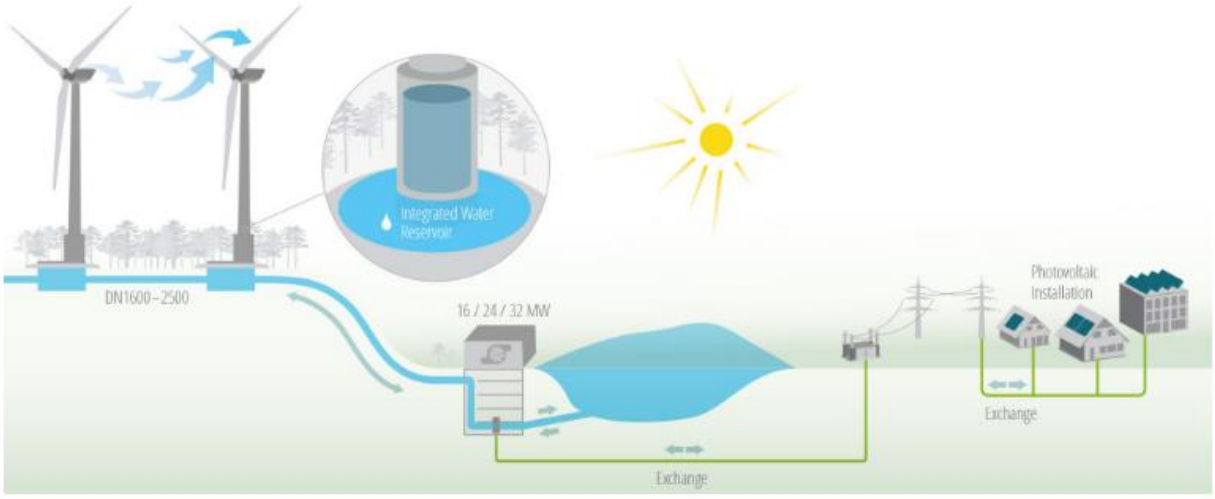
Between June and August of 2016, Costa Rica was powered fully by renewable energy for 76 consecutive days. Costa Rica's energy sources consist primarily of hydropower (making up about 80% of its energy consumption) and of a mix of other common renewable sources, including solar,

geothermal, and wind.[8] In 2010, geothermal made up about 13% of their energy use, and this is expected to increase, which could be an important balance to being overly-reliant on hydropower. Not only has Costa Rica achieved periods without the use of any fossil fuels, but they have also done so at a low cost while covering 99.4% of the country's households.

It is important to note that much like Sweden, Costa Rica has demonstrated significant progress towards relying completely upon renewable energy due its size and the fact that its main industries are not highly energy-intensive. Even so, it serves as an important indicator of the direction many other countries could follow.

Germany

Another country at the forefront of embracing renewable energies, Germany has recently revealed that it will build the world's first wind-turbines backed up by hydropower batteries.[9] This integration of sources addresses some of the concerns over the availability of renewable energy. GE, who collaborated with a German firm on this project, addressed this in a recent report, noting that "[b]ecause the wind doesn't always blow and the sun doesn't always shine, all forms of renewable energy need some kind of backup source to ensure reliability." Even when wind does not power the turbines, the connected hydro plant would act as a backup battery to keep the turbine moving.



The turbines will stand 584 feet high when the blade is pointing straight up. The bottom will serve as a water reservoir. Illustration credits: Max Boegl Wind AG

This is just one piece of Germany's *Energiewende*, that is, a term describing the agenda for German energy transition to vastly increasing the presence of renewable energies, reducing carbon emissions to 40% below 1990 levels, and other key components.[10] In July 2016, Germany set a record for meeting 78% of its energy demands of the day through renewable energy sources. Importantly, Germany sees these targets as integral not only for fighting climate change, but for stimulating their economy through increasing technological innovation, reducing energy imports, and achieving energy security.[11]

China

By capacity, China is a global leader in renewable energy. This is not surprising given the massive energy needs of their population and industries and due to their government make up. At the end of 2015, China had installed 145.1 Gigawatts (GW) of wind power capacity, overtaking the EU as the global leader in wind power capacity.[12] China is also the world's leader for solar capacity, with a total of 43.2 GW of capacity. While this might not be a significant percentage of their total energy needs,

this is nearly a 13-fold increase in their solar capacity since 2011. This is great progress towards renewable investments, even in a country where the main industries are highly energy intensive.

While China represents 40% of renewable energy growth globally, this has not been a perfectly smooth transition.[13] The International Energy Agency notes that China faces challenges in regards to grid integration and a slowdown in electricity demand paired with electric power overcapacity. All the same, China--a country known for its smog-filled city skies and highly energy-intensive industries--represents a global trend towards increased renewable energies.

The Future of Renewables

Delivering renewable energy is complex. No single type of renewable energy – whether solar, wind, water, or other – is right for an economy, nor is relying 100% on renewable the right answer for every country, especially not without a gradual transition.

There are certainly some concerns with the efficacy and impact of renewables. In many cases, renewable energies cannot respond to real-time energy demands, but innovations in Germany, such as their solar and hydro power integrations, show that technological progress will make renewables an increasingly reliable energy source. Projects like the Clean and Secure Grid, aim to leverage existing technology and infrastructure in the United States to more efficiently transmit a mix of energy sources, with an emphasis on renewable energy.[14] Companies like Tesla are making substantial progress in developing energy storage systems that will also bring increased reliability to renewables like wind and solar. In other ventures, Tesla recently acquired SolarCity and has announced a project to help power the entire island of Ta'u in American Samoa. While this is a small island with around 600 residents, the initiative is an important indication of the business interests in renewable energy.[15] Federal governments are certainly not the only source of the transition to cleaner energy.

Of course, environmental concerns can play into the conversation as well. Hydropower, for example, can be ecologically damaging when disrupting river flow or fish breeding patterns, and in the United States, it can be controversial when dams infringe upon Native American land and water rights. Hydropower can be developed in such a way that projects are developed in partnership with affected parties. Organizations like the Hydropower Reform Coalition highlight ways in which hydropower dams can be adjusted to limit erosion and restore habitats, an important initiative when considering the expansion of river dams.

All this indicates an opportunity for growth and development but has not put a stop to the spread of renewable energy. As shown with the Paris Agreement, countries around the world are seizing the incredible opportunity to transition to a cleaner energy on a global scale. Importantly, the expansion of renewables would drive a massive reduction in greenhouse gas emissions. One IPCC assessment shows that lifecycle carbon dioxide emissions for rooftop solar (which produces higher emissions relative to concentrated solar) are one twentieth of the lifecycle emissions of coal, and one eighth the emissions of gas.[16] When paired with energy efficient technologies, shifts towards cleaner energies would help countries across the world slow climate change and mitigate further impacts of a warming planet. This is a key point of interest for so many countries that have pledged to increase their use of renewables.

Construction of the Long Island Solar Farm, by Brookhaven National Laboratory (CC BY-NC-ND 2.0)

Of course, other points of interest include reduced contamination of water sources and reduced air pollution, and consequently offering public health benefits. It can also obviate the practices drilling or mining, which have further health and environmental impacts.

Around the world, businesses and government have realized the extensive benefits of expanding renewable energy and are thus increasing their investments in this clean energy. Developed responsibly, renewables are the best energy source when it comes to minimal climate impact, making this an important consideration for so many of the countries who have signed the Paris Agreement. we can certainly expect to see the transition to more renewables. Countries like Sweden and Germany lead the way in proving the feasibility of integrating more renewables and efficient energy policy. Fossil fuels are still an important part of the world economy, but we can certainly expect to see the transition to more renewables in the years to come.

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Notes

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