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Renewable Energy Investments in Times of Geopolitical Crisis

Sustainability Research Paper

The Al-Attiyah Foundation

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Since the beginning of the 21st century, renewable energy (RE) for power generation has experienced remarkable global growth and development. By the end of 2022, global RE generation capacity amounted to 3,372 gigawatts (GW), growing the renewable power generation capacity by a record 295 GW or by almost 10% compared to 2021. However, disrupted supply chains, spiking interest rates, and an increase of input costs stemming from COVID-19 pandemic and the Russian invasion of Ukraine have reduced the attractiveness of RE investments.
What are the key reasons for the quick development of RE power generation technologies over the last two decades?
What factors could slow down or accelerate investments in RE technologies amid the current multi-crises?

SUSTAINABILITY RESEARCH PAPER

This research paper is part of a 12-month series published by the Al-Attiyah Foundation every year. Each in-depth research paper focuses on a current sustainability topic that is of interest to the Foundation's members and partners. The 12 technical papers are distributed to members, partners, and universities, as well as made available on the Foundation's website.

03 EXECUTIVE SUMMARY

- RE experienced an unprecedented growth over the past two decades with more than 80% of new power generation capacity currently coming from renewable sources.
- This growth of RE was a result of targeted policy support measures – such as feed-in-tariffs, R&D subsidies, and reverse auctions – mainly driven by Germany, China, and the US.
- The previous period of low-interest rates further supported investments in RE that are relatively more capital intensive compared to traditional fossil-fuel-based power generation.
- Technological innovation supported by public policy and increasing economies of scale resulted in a massive reduction in the cost of RE power that in recent years became competitive with power from fossil fuels.
- In the short-term, disrupted supply chains, spiking interest rates, and an increase of input costs stemming from COVID-19 pandemic and the Russian invasion of Ukraine have reduced the attractiveness of RE investments.
- In order to support and further accelerate the deployment of RE, governments may need to introduce targeted policy support mechanisms such as subsidies and public guarantees.

Renewable energy (RE) for power generation – grid-connected hydropower, wind energy, solar energy, bioenergy, geothermal, as well as off-grid renewable technologies – has experienced remarkable global growth and development since the beginning of the 21st century. By the end of 2022, according to the International Renewable Energy Agency (IRENA), global RE generation capacity amounted to 3,372 gigawatt (GW), growing the renewable power generation capacity by a record 295 GW or by almost 10% compared to 2021.[01] In 2022, RE thus represented 83% of all new power generation capacity additions and produced 30% of global electricity.[02] However, according to the International Energy Agency (IEA), by 2030 the share of electricity produced from RE will have to increase to 60% to be aligned with its 'Net Zero Emissions by 2050 Scenario'.[03]

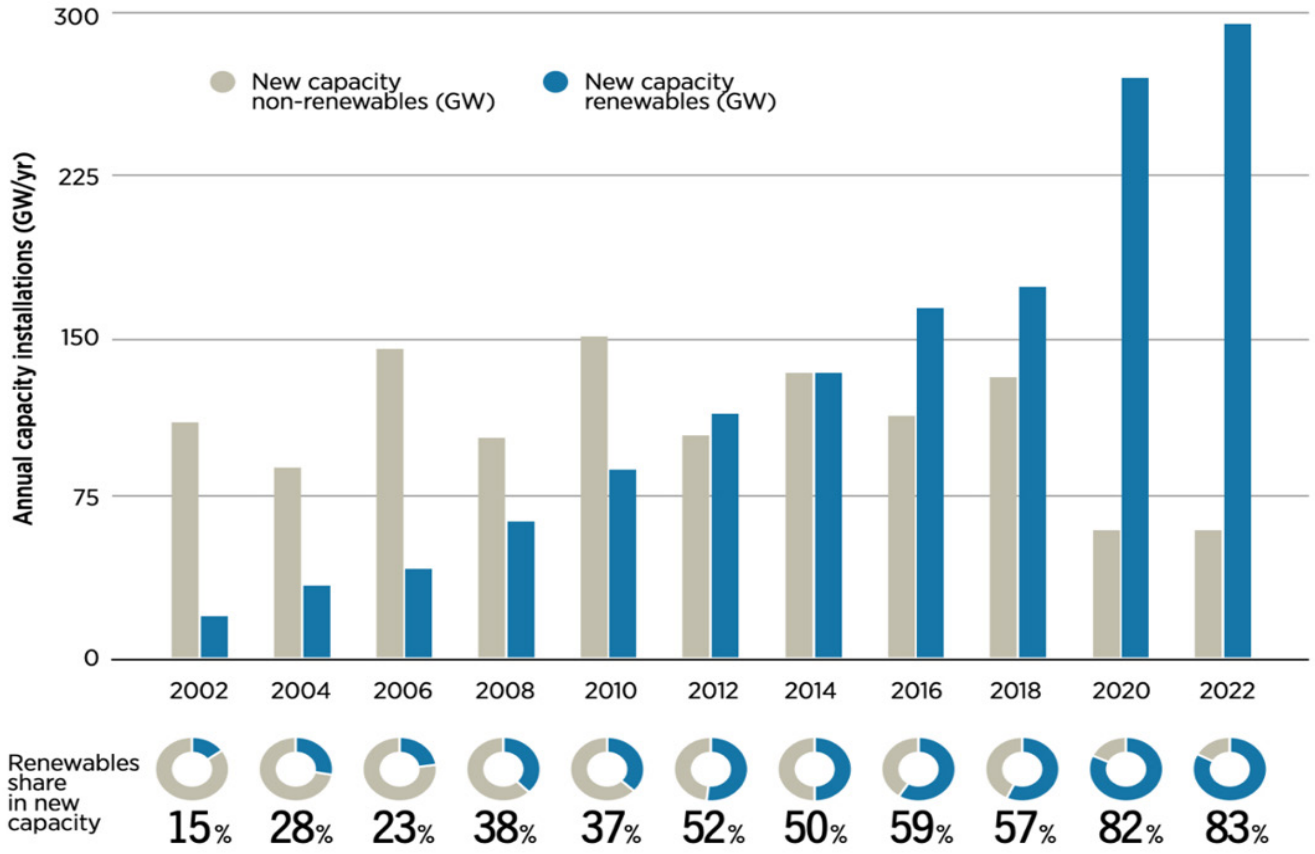
Further scaling up investments in RE will not be an easy task in the face of the ongoing global 'multi-crises'. First started by the global COVID-19 pandemic in 2020 and aggravated by the Russian invasion of Ukraine in February 2022, the disruption of global supply chains led to an increase of prices for materials, energy and food that were unimaginable for decades.[04] Moreover, rising interest rates disproportionally affect investments in RE compared to traditional power generation based on fossil fuels.[05] Nevertheless, IRENA forecasts that the share of RE in the global electricity mix will increase to 38% by 2027 and predicts that RE will surpass coal as soon as 2025 as the largest source of electricity generation worldwide.[06] In this paper we will explore the key drivers behind the growth of RE-based power generation over the past two decades, analyse the factors that may affect RE investments in the context of the multi-crises and suggest policy instruments to help ensure the accelerated growth of RE.

05 THE UNEXPECTED SUCCESS STORY OF SOLAR AND WIND POWER IN THE LAST TWO DECADES

Technologies related to solar and wind power have increased dramatically in terms of both capacity and power generation and continue to do so. Since 2000, the total installed capacity of RE increased ten-fold from 310 GW, and solar and wind account for 28% and 27% of capacity, respectively.[07] Over the past two decades, the share of RE in annual power generation capacity additions has grown from 15% to 83% (see Figure 1), rapidly overtaking non-renewables.[08] From 2010 to 2020, the growth in RE capacity accelerated further, with the annual average growth rate increasing to around 11%.[09]

The rapid deployment of RE, however, had not been widely expected; the installation of new RE generation capacity regularly overachieved national as well as global expansion targets and forecasts. For example, on the global level, until recently the IEA systematically underestimated the expansion of solar and wind power.[11] On the country level, China surpassed its 2020 target as early as 2017 to become the first country in the world to have over 100 GW of installed solar power capacity. In June 2022, China published its 14th Five-Year Plan detailing its aim for 33% of electricity generation to come from RE sources by 2030, with more than half of it expected to come from solar and wind power. According to the IEA, for these two RE technologies China is likely to reach its target of 1,200 GW by 2025 – five years earlier than planned.[12] Thus, China will likely keep contributing significantly to the global growth of installed RE capacity, which the IEA expects to increase in the next five years by as much as in the previous 20 years.[13]

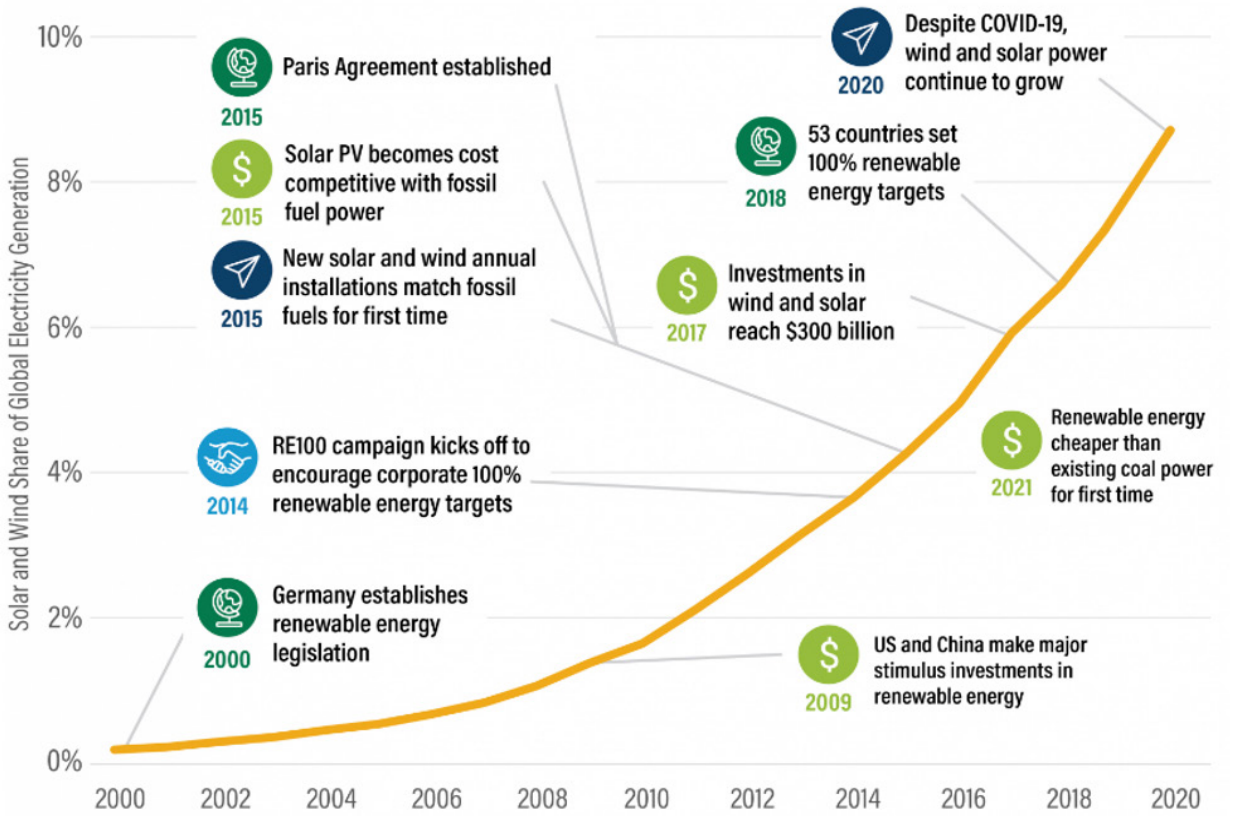
Figure 1: ©IRENA 2022: Annual power capacity expansion, 2002-2022[10]



Over the past two decades, the exponential growth of solar and wind power generation capacity passed several key milestones (see Figure 2). Most notably, the introduction of RE support policies in Germany followed by similar measures in China and the United States played a major role in driving down the costs and making RE competitive.

Policies such as public finance for research and development (R&D), tax credits, feed-in-tariffs and reverse auctions helped reduce costs of RE and further promote investments in RE technologies leading to, among others, solar photovoltaic (PV) first becoming cost-competitive with fossil fuels in 2015.[14] Below, we briefly review the key factors behind the exponential growth of RE.

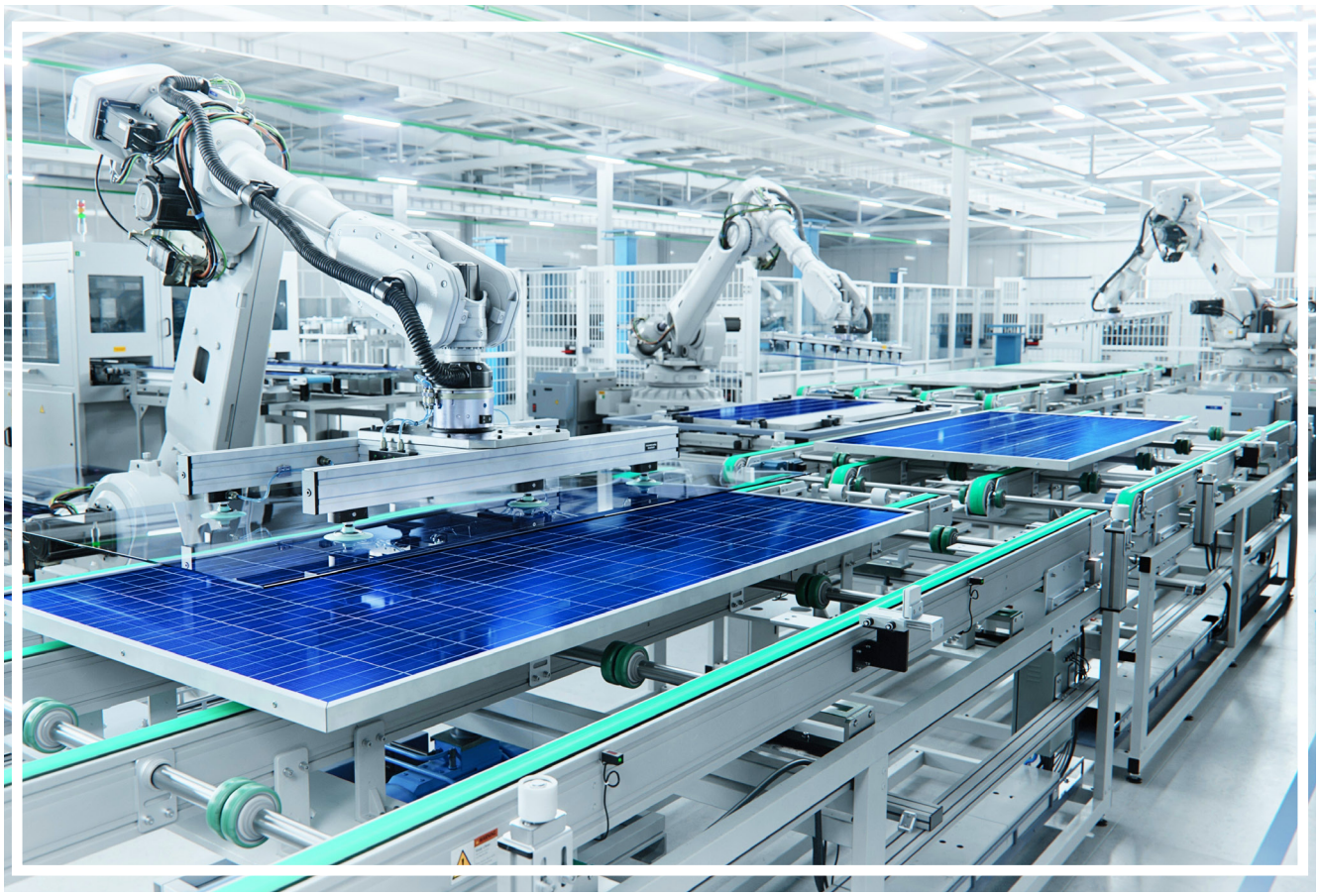
Figure 2: © World Resources Institute 2021: Key milestones in the exponential growth of solar and wind energy[14]



07 THE GERMAN FEED-IN-TARIFF

Policy instruments are important tools designed to encourage the development of and investment in RE. It is crucial to learn about whether their implementation has been a success or failure and how best we can leverage them to stimulate further growth of the sector. Feed-in-tariffs (FITs) are a specific tool utilised by governments that agree to pay above the retail or wholesale price of electricity to guarantee profitability of RE power generators and ensure flows of investment. In 1991, Germany introduced its FIT as part of the Electricity Feed-in Law, which was revamped in 2000 as Renewable Energy Sources Act (EEG), covering RE technologies such as solar, wind and biogas.

This legislation was strongly supported by various lobbies including regions facing industrial restructuring and rural areas.[16] Under the EEG programme, investors were granted a secure cash flow for 20 years which helped wind power generation to increase from 9.5 terawatt-hours (TWh) in 2000 to 113.9 TWh in 2021, making Germany the European leader in wind power generation.[17] The guaranteed funding programme ended in 2016 when a revision of the law introduced a reverse auctioning instead of a FIT for wind power. The FITs for solar PV have been continued and even expanded, and plants whose 20 year period ended have been able to continue to benefit from (lowered) FITs.[18]



Over the past decade, the manufacturing of solar PV has gradually shifted from Europe, the United States and Japan to China. Since the early 2000s, the production of solar PV cells has been an important export industry for China driven by the supportive policies available in European countries, particularly Germany. According to the IEA, China has invested over 50 billion USD in solar PV supply capacity and created more than 300,000 jobs across the solar PV supply chain as of now.19 Most notably, China's involvement helped to create large economies of scale bringing the levelized cost of electricity (LCOE) – a measure of the power generation cost over the lifetime of a project – of solar PV down by 77% and of concentrated solar power (CSP) by 46% between 2012 and 2017 alone.[20]

Today, 80% of global solar PV production is controlled by China – mainly in Xinjiang and Jiangsu provinces accounting for 40% of global polysilicon production, a key material for PV manufacturing.[21] In 2015, China overtook Germany in terms of installed solar power capacity, with a total of 43 GW compared to 40 GW respectively. China's success stems from the substantial government incentives that were introduced in 2011, along with policies and support measures that fortified trust in the domestic market following the global financial crisis in 2008. These included FITs, low-interest loans, electricity price refunds and multi-year corporate tax reductions.[22]

09 REVERSE AUCTIONS

Reverse auctions have flourished since 2010 and have helped to further decrease costs of RE technologies. A reverse auction mechanism is an auction approach to procurement in which sellers bid for the prices at which they are willing to sell their goods and services. This is opposite to the way a regular auction works that encourages buyers to place bids until the highest bidder wins. The reverse auction mechanism allows the competitive market to set the price for RE whilst preventing 'overpayments' that may occur in case of direct subsidies. When used properly, reverse auctions can help to stimulate competitive price setting, lower costs, broaden access to affordable energy and increase transparency within the energy procurement process.[23]

One example of successful reverse auctions for RE is Morocco. As one of the few countries in the Middle East and North Africa (MENA) region without significant oil and gas resources, Morocco remains largely dependent on importing energy (95% of its domestic energy needs). In view of the need to diversify their energy mix, the country conducted reverse auctions for solar and wind power generation in 2011 and 2012, at the time considered the largest of its kind in the MENA region.[24] The auctions consisted of a 2-phase process in which bidders were first pre-selected against a set of criteria – including financial capacity, access to finance and technical experience – before the actual auctions were conducted. In addition, the country established a specific governing agency which played an instrumental role in attracting investors and managing the CSP auction, alongside the development of a joint public-private partnership model that helped to de-risk this first-of-a-kind project and secure the required funding for scaling it. Morocco's political stability at the time undoubtedly helped support the auctioning process.[25]

The growth of RE over the past two decades was also supported by an unexpected involvement of financial institutions, including among others central banks, national, bilateral and multilateral development banks, as well as commercial banks. After the financial crisis of 2008, nominally negative interest rates were available to investors, meaning that the borrower was sometimes paid for taking a loan.[26] Given that RE investments are very capital-intensive, close-to-zero interest rates further helped to reduce the historic disadvantage of RE against fossil fuels. The bankability of RE investments further improved during the 2010s, as banks became increasingly familiar with RE technologies. Indeed, annual investments in wind power doubled from 73 billion USD in 2009 to 143 billion USD in 2019.[27]

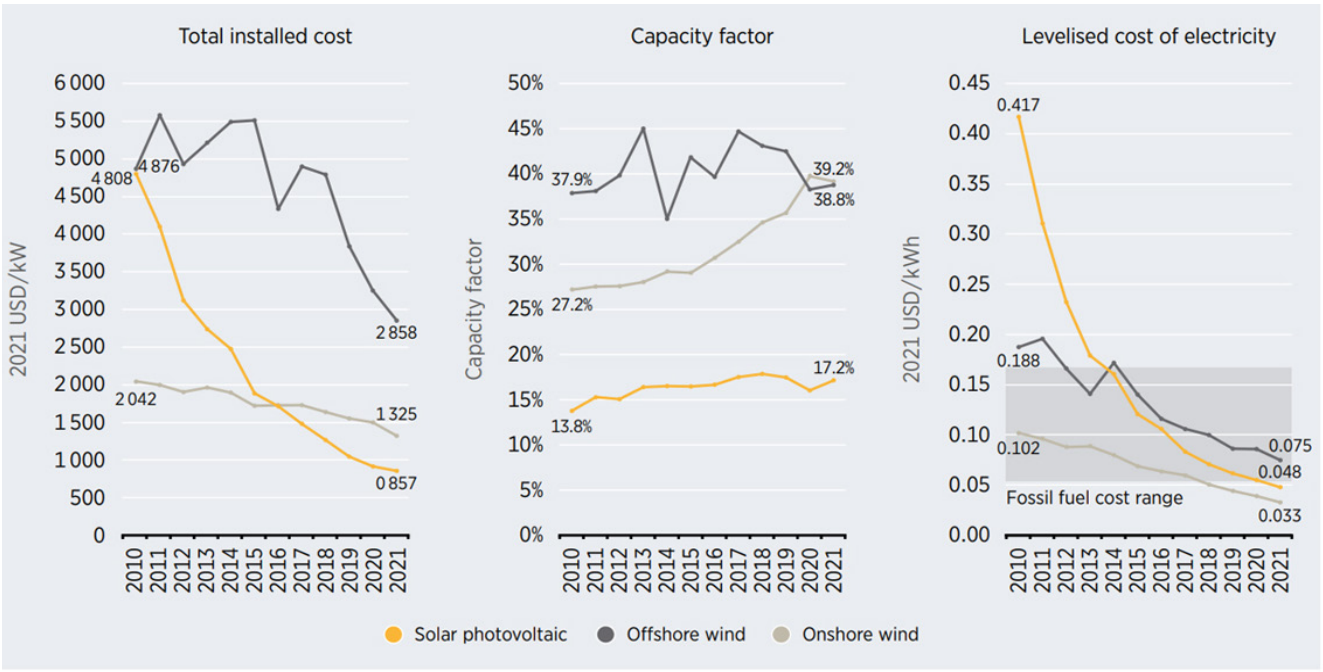
The Glasgow Financial Alliance for Net Zero (GFANZ), launched in 2021, is an example of a global coalition of financial institutions leading the way towards an accelerated decarbonisation of the economy. GFANZ seeks to mobilise the financial sector to achieve net-zero greenhouse gas emissions by 2050 or earlier, in alignment with the Paris Agreement's goal of limiting global warming to well below 2°C above pre-industrial levels.[28] With over 450 firms from 45 countries, GFANZ expects to invest a total of 130 trillion USD of 'Paris-aligned' private capital until 2050.[30] Further, in 2021 ten European countries led by France30 formed the 'Export Finance for Future Coalition' to align public export finance with climate goals, including significantly higher RE exports. These countries also committed to phase out fossil fuel export finance support,[31] though with varying ambition and progress.[32] While not sufficient by themselves, these initiatives demonstrate a growing RE support momentum within the financial sector.

11 MASSIVE COST REDUCTIONS IN THE LAST DECADE

The policy support measures mentioned above helped achieve economies of scale leading to massive RE cost reductions, especially due to the large-scale engagement of China.[33] This, in turn, helped RE achieve grid parity with non-renewable sources of electricity much earlier than expected.[34] Solar PV has become first the lowest cost source of electricity in the sunbelt of the world and then even the cheapest source of electricity in history.[35]

According to IRENA, between 2010 and 2021 the cost of solar PV fell by 88%, CSP and onshore wind by 68% and offshore wind by 60% (see Figure 3). Now, some new solar and wind projects are even cheaper than existing, amortized coal-fired power plants.[36]

Figure 3: © IRENA 2022: Total installed cost, capacity factor and levelized cost of electricity for solar and wind[37]



Increase of interest rates burdens renewables more than fossil technologies

In the aftermath of the 2008 financial crisis, central banks around the world took measures to steady and promote their countries' economies. One common measure was the reduction of interest rates to historic lows while flooding the market with money. By lowering interest rates, people and firms had an incentive to borrow and spend, helping to maintain economic growth after the financial crises. However, since the Russian invasion of Ukraine, beginning in February 2022, interest rates have dramatically increased, thereby burdening RE investments more than fossil fuel technologies. Indeed, for RE technologies the LCOE is much more sensitive to increasing interest rates compared to fossil-based electricity generation.[38] Though the LCOE for solar and wind power in many parts of the world is already lower than that of most fossil fuel-based power,[39] RE technologies tend to have comparatively higher upfront investment costs compared to fossil-based power infrastructure.[40] This is a major factor why in the context of high interest rates RE investments are likely to be paused, delayed, or overlooked, despite their much lower operational and maintenance costs.[41]

Increase of input costs

Rising input costs constitute another major barrier to investment in RE technologies. The COVID-19 pandemic emphasised the interconnectedness of international supply chains and the potential disruptions this can cause across the world. Construction material costs reached a 40-year high,42,43 coupled with rising energy and electricity costs that led governments attempting to protect population and businesses to increase fossil fuel consumption subsidies to an all-time high of 1 trillion USD in 2022.[44] Rising costs of energy have deterred investments in RE as the need to securitise cheap and reliable forms of energy – widely considered the main arguments for fossil fuels – trumps longer-term investments.[45] Moreover, the willingness to integrate electricity grids, which is crucial to enable a high penetration of RE without the need to curtail it, has been reduced. For example, the UK scrapped a large interconnection project with France, which would have been crucial to evacuate RE surpluses from Britain.[46]

Solar and wind power improve national energy security and public health

Even, or especially in the context of the current multi-crises, there is still an opportunity to accelerate investment in RE technologies. For example, the Russian invasion of Ukraine forced the EU to focus on the topic of energy security reducing dependence on imported fuels from Russia. In 2022, the EU introduced an embargo on the imports of Russian coal and oil.[47] By 2027, the EU – via its 'REPowerEU' plan – aims to completely end dependence on Russian gas, while increasing the share of RE in its final energy consumption to 45% by 2030.[48] Besides reducing the need for importing fossil fuels, RE has also proven to be successful in reducing air pollution, an issue of high importance both in China and India, for example.[49] Between 2022-2027, China is forecasted to hold half of additional RE capacity worldwide, while India is forecasted to double RE installations in the same period, with solar power at the forefront.[50] In the case of the US, the Inflation Reduction Act of 2022 primarily aims to drive down consumer energy costs but also to increase energy security, by allocating more than 100 billion USD to RE and grid energy storage alone, among others.[51] If other countries follow the lead of the US, the historical reduction of electricity storage costs is likely to continue apace.

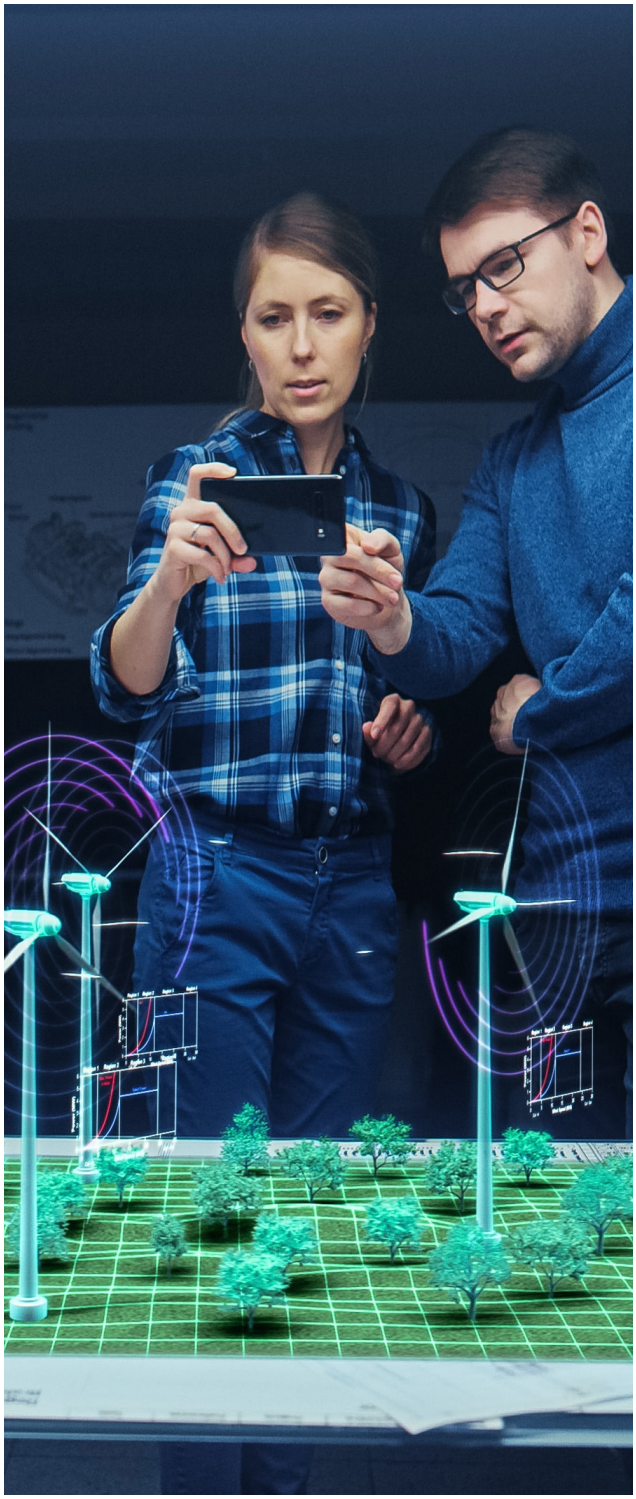
Growing economy leads to more energy consumption

During and after the global multi-crises, a growing world economy demands increased energy consumption, and RE technologies alone – so far – have not been able to support this expansion. While fossil fuel consumption is expected to rise in the short-term to meet the demands of expanding economies, RE will likely dominate in the medium-to-long term.[52] In fact, by 2050, RE technologies are expected to account for 75-80% of all new capacity in the Stated Policies Scenarios (STEPS) and Announced Pledges Scenarios (APS) of the IEA, with solar and wind leading the charge. Already by 2030, RE for electricity generation are expected to overtake fossil fuels in the STEPS and APS scenarios, while global electricity demand is expected to increase by 25-30% due to the increased utilization of electric motors, electric vehicles, heat pumps and hydrogen.[53]

In the light of the current multi-crises, investments in RE may diminish as their attractiveness could be hampered in the short-term due to the reasons outlined above. This 'cold' of the RE industry, however, does not have to turn into a 'pneumonia' if policy instruments aimed at addressing short-term barriers to RE investments are deployed. Most importantly, governments can provide direct financial support for RE projects, such as grants, tax credits, or FITs. These measures can help reduce the currently increasing upfront costs and risks associated with RE investments, making them more attractive for investors. Governments can offer low-interest loans or loan guarantees to RE projects, reducing the cost of borrowing and making it easier for projects to secure financing amid higher interest rates during times of crisis.

Governments can also encourage investments in RE by committing to purchase a certain amount of electricity from renewable sources or by establishing favourable long-term power purchase agreements, ensuring a stable demand and revenue stream for projects. By simplifying and expediting required permitting and regulatory processes, governments can reduce the time and costs associated with developing RE projects, making them more attractive to investors. Governments can also support the RE supply chain during times of crisis by providing targeted assistance, such as funding for R&D, workforce training, and infrastructure upgrades, as well as implementing policies to promote local manufacturing and sourcing of RE components. Finally, implementing policies and financial mechanisms that help mitigate risks associated with RE investments, such as insurance instruments or guarantees against policy changes, can make investments more attractive during times of uncertainty.

By implementing these policy measures, governments can help support and accelerate investments in RE during times of crisis, ensuring continued progress toward a low-carbon energy future.



15 CONCLUSION

Electricity generation from solar and wind has seen a widely unexpected, dramatic growth over the last two decades due to ever-lower technology costs, a long period of low-interest rates, and favourable investment incentives encouraged by governments. RE technologies keep outperforming their targets and are highly likely to continue to do so, despite the ongoing global 'multi-crises'. At the same time, in the short-term, disrupted supply chains, spiking interest rates, and an increase of input costs stemming from the COVID-19 pandemic and the Russian invasion of Ukraine result in the RE industry 'catching a cold' that risks evolving into 'pneumonia' without targeted policy support measures. Further RE installation growth requires targeted support measures such as subsidies and public guarantees. If the right decisions are taken now, ambitious policy frameworks put in place and investments in RE further increased, the global RE industry can quickly overcome its current 'cold' and emerge stronger from the global multi-crisis.

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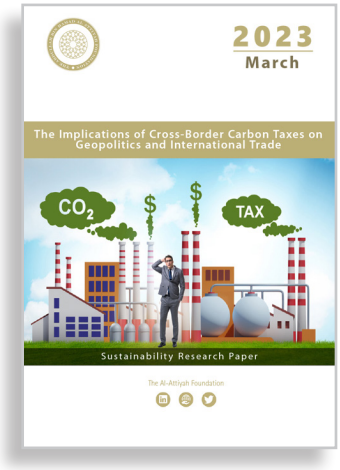
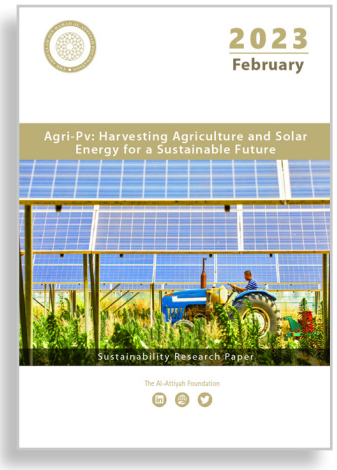


March – 2023

The Implications of Cross-Border Carbon Taxes on Geopolitics and International Trade

Climate change mitigation through greenhouse gas (GHG) reduction or removal from the atmosphere is a global public good that requires significant investments by governments and businesses.

(QRCO.DE)



February – 2023

Agri-Pv: Harvesting Agriculture and Solar Energy for a Sustainable Future

Several challenges prevent the widespread uptake of Agrivoltaics (Agri-PV) including existing farming practices, high initial investment costs due to low market penetration and awareness, lack of government incentives and limited technical knowledge of best practices for adoption.

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January – 2023

The impact of high interest rates on sustainable investments

- How sensitive are sustainable investments to interest rate changes compared to non-sustainable investments?
- What role did low interest rates play in the growth of sustainable investments in the past decade?
- Do rising interest rates pose a threat to further growth of sustainable investments and the low-carbon transition?
- What policy measures can be implemented to cushion the effect of rising interest rates on sustainable investments?

(QRCO.DE)

Our partners collaborate with The Al-Attiyah Foundation on various projects and research within the themes of energy and sustainable development.

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