REVOLVE

QUARTERLY INSIGHTS INTO A CHANGING WORLD

N°52 | Summer 2024



Sustainable Spaces

Housing Solutions for Social Equity p.10

The Energy Mix p.18
India's Renewables Journey p.26
Gare Maritime p.35
Nuclear Desalination p.52
Preventing Wildfires in Spain p.60
Gender & Mobility p. 68

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Navigating the Challenges of Decarbonization

The energy sector is key to decarbonizing our societies. However, the transition to a more sustainable world with the use of clean and alternative energy sources can bring societal challenges and imbalances to our communities. In this issue, we look into how to make this transition happen taking into account the inter-related environmental, economic, and societal spheres that were brought to the forefront during the European elections this June.

Mikel Landabaso, Director for Growth and Innovation at the Joint Research Centre, European Commission, opens our summer issue #52 by delving into the essence of the New European Bauhaus (NEB), an EU policy and funding initiative that aims at building a sustainable future collectively – putting people at the center.

Then, we address the housing crisis across Europe and how housing cooperatives are using new models to help reduce emissions and increase social impact. The building sector is a key contributor to greenhouse gas (GHG) emissions, representing 35% of energy-related EU emissions in 2021, according to data from the European Environment Agency.

We also highlight this topic in our VIEWS section with Gare Maritime, an award-winning project that reimagines sustainable spaces for business and leisure.

Then, off to India we go to debunk 5 myths about the energy transition there, and back to Europe for insights into how nuclear is part of the global transition – both as source of energy and for providing drinking freshwater to communities. And speaking of communities: what is the relationship between gender and mobility? You will find the answer in the next pages.

Last but not least: we invite you to discover our new series Between the Lines that is about reviewing books, movies, plays, and exhibitions that contribute to fostering cultures of sustainability.

Send us your comments and ideas:
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Thanks for revolving with us!

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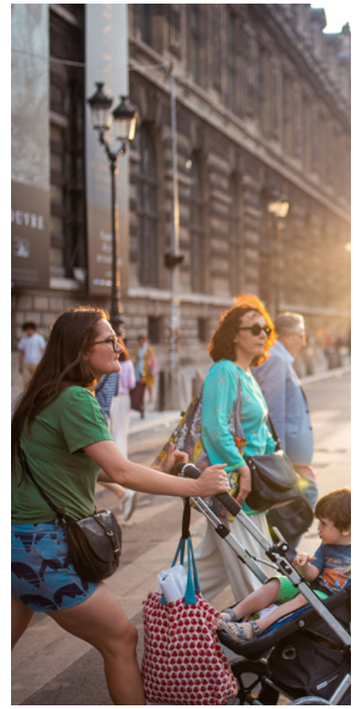
18


26


35


52


60


68

Energy

N°52 | Summer 2024

10 Sustainable Spaces
Solutions for sustainable and energy efficient housing in Europe

18 Nuclear Energy
The place of nuclear energy in modern societies and what to do with the waste

26 Coal + Renewables
Busting 5 big myths about India's energy transition journey

35 Gare Maritime
An overview of a sustainable building and how design can promote energy efficiency

52 Nuclear Desalination
A lesser-known solution for providing drinking freshwater in arid regions

60 Wildfires in Spain
The economic opportunities for local communities in Spain in wildfire prevention

68 Gender & Mobility
How gender influences on transportation and mobility options in cities

76 Food x Digitalization
How artificial intelligence, blockchain, and digital twins can help revolutionize food production



Mikel Landabaso

Director for Growth and Innovation at the Joint Research Centre, European Commission.

p.8



Areti Vlachodimou

Junior Communication Officer, REVOLVE.

p.10



Jadwiga Najder

Science and Outreach Manager at European Nuclear Society.

p.18



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Manager, Research and Diligence and Electricity Sector Lead, Third Derivative.

p.26



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p.52



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p.60



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Director and Senior Researcher, Wonderland.

p.68



Yilmaz Vurucu

Filmmaker, Artist, Communication Manager, Wonderland.

p.68



Daniel de la Puente

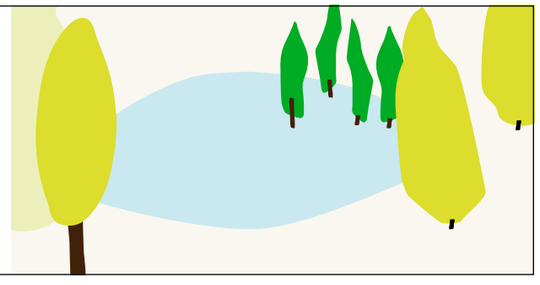
Head of EU Projects at CNTA.

p.76

REVOLVE x Sustainability

REVOLVE is committed to climate-conscious reforestation and tree-planting initiatives as part of our company's sustainability policy to mitigate the impact from our business and project travel activities.

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Cover image:

REVOLVE's co-working office space in Poble Nou, Barcelona, also know as The Nest, this original co-working space brings together diffcult elements including steel, wood, and glass, while integrating the concept of permaculture with plants, trees, and aquaponic agriculture produce. For an immersive 360-degree experience, visit the REVOLVE Youtube Channel.

Apocapoc Nest City Lab is a Urban Lab promoting regenerative habits and sustainable practices. The Nest city Lab facilitates a lifestyle that reduces our ecological footprint on a daily basis and encourages us to have a positive impact on the world.

Photo: Alicia Bastos

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People at the Forefront of the New European Bauhaus

WRITER: **MIKEL LANDABASO**
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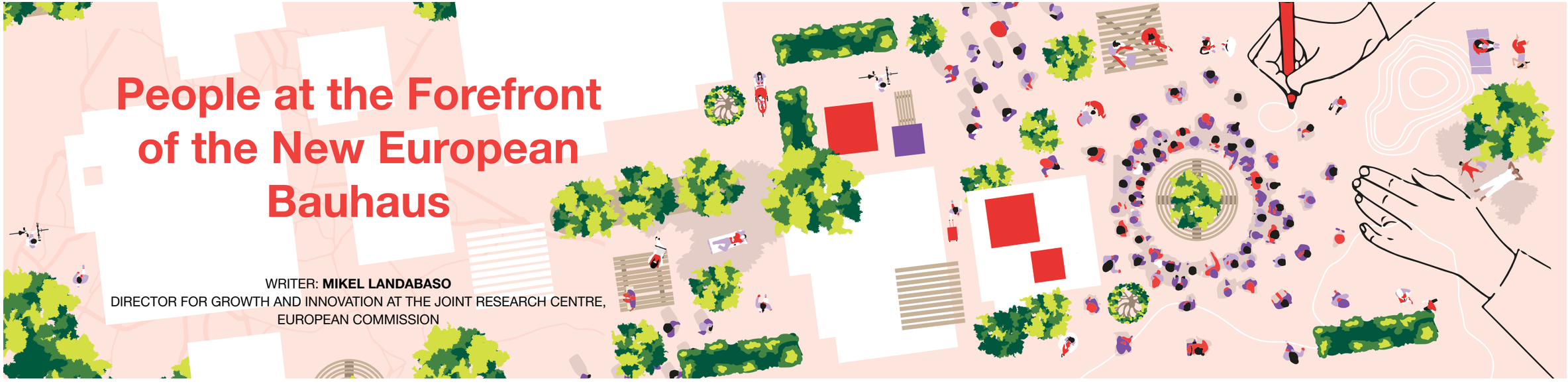


Illustration by Dariana Guevara / REVOLVE

Why we can't bring about true change without people on the ground.

The green transition will only succeed if it addresses the issues people truly care about. For meaningful change to take hold, it must resonate deeply and personally. People need to be at the forefront of this transition, and we can only achieve it together.

This is the essence of the New European Bauhaus (NEB), an EU policy and funding initiative that aims at building a sustainable future collectively by creating sustainable, inclusive, and beautiful places, products, and ways of living. At first glance, beauty might seem like an unusual concept in this mix, but it's essential. Beauty fosters a deeper connection and commitment to the green transition among people. After all, why would we embrace change if it isn't also attractive, comfortable, and beautiful?

Still, the NEB goes beyond promoting sustainability — it empowers us to become active participants in the green transition. By engaging people at the grassroots level, focusing on neighbourhoods, it gives people a sense of ownership and pride in the transformations that shape their lives. Moreover, it values local culture, heritage, and identities, recognizing Europe's diversity and helping communities develop tailor-made solutions that truly matter to them.

Look at this project in Sevilla: in the Tres Barrios-Amate neighbourhood, one of the poorest in Spain, a remarkable bottom-up initiative has brought together local creators, residents, and young people to make art and contemporary culture accessible to everyone. Through workshops, meetings, and shared celebrations, people from Tres Barrios-Amate explored their neighbourhood's resources and diversity, and collectively built a more sustainable and harmonious living space for them to enjoy.

That said, the NEB prioritizes people and the economy: it challenges industries to provide solutions that are technically feasible and tailored to local needs, promoting bio-based and locally sourced materials. This boosts competitiveness and strengthens the EU's strategic autonomy.

A movement spreading its impact on the ground

Three years after its launch, we are proud to see the NEB's impact on the ground in every EU Member State and beyond. Almost 500 projects promoting and supporting the NEB values and principles have been launched in the areas of research and innovation, cohesion, regional and urban development, skills development, and culture – stemming from remarkable ideas and concepts!

The New European Bauhaus is more than those 500 projects. There are lots of other bottom-up NEB initiatives that are financed by EU funds that are coming to life thanks to the energy and commitment of people on the ground.

A vibrant and growing NEB Community is also in place and now has reached almost 1,400 members uniting non-profit organizations, businesses, public authorities, NEB project holders, National Contact Points, and experts, reaching several millions of Europeans.

A solid future for the New European Bauhaus

And the next chapter for the NEB? A dedicated financing tool! So far, the NEB has been financed by nine EU programmes, notably Horizon Europe, Cohesion policy, and the LIFE programme, through which close to EUR 400 million have been committed to the initiative. Considering its fast evolution, though, it was clear that it's time for a standalone, multi-annual financial support instrument for the NEB.

Thus, the 'NEB Facility,' was adopted by the Commission in March 2024. This tool, active from 2025 to 2027 and anchored in Horizon Europe, aims to scale up, deploy, and implement innovative solutions to transform and revitalize neighbourhoods and to provide more beautiful, sustainable, and inclusive living spaces.

Undoubtedly, all this shows that the New European Bauhaus exists, grows, and flourishes on the ground. Looking at the speed of increase of the NEB Community membership and the expressed interest we hear from these varied community members, clearly the NEB has impact, it brings people together and there is demand for its values and approach.

NEB imbibes the vision of a future where sustainability, inclusivity, and beauty go hand-in-hand.

I can confidently say that the NEB isn't just an EU policy and funding initiative. It's a vision for a future where sustainability, inclusivity and beauty go hand in hand, making the green transition something we all can be proud of and eager to be part of.

From Housing Dystopias to Housing Utopias

WRITER: **ARETI VLACHODIMOU**

1

Millions of European citizens struggle to afford housing bills, but there is hope on the horizon

Housing and mental wellbeing are intertwined. Imagine that over 40% of your income had to go towards covering your rent and bills, which is the minimum threshold used to designate someone as being overburdened with housing costs. Well, in a country like Greece, this is particularly common. As of 2022, about 27% of urban Greeks had to cope with overburden housing cost rates, as did 24% of their rural counterparts. And yet, evictions and first property auctions are two of the government's discriminatory methods of dealing with unpaid rents.

Greek tenants are being affected by overtourism, Airbnb, Golden Visa schemes, and inflation, causing anxiety in the most vulnerable households, according to governance and public policy expert Vasilis Delis. In an interview with local media outlet News 24/7, he said that rental prices are also leaping skyward in non-touristic cities like Thessaloniki and Athens thanks to an influx of jobseekers. Even when Airbnb apartments return to the rental market, they do so at inflated prices, he adds.

"I think that if people organize and make demands, this will bring about change faster," he says, before providing an example of the eye-watering housing prices in his local Athens neighborhood: "The most tragic I have seen, as I live in and I know this region, was a 20m^2 [studio] in Neos Kosmos for 1,200 euros. [The neighborhood] has become the Athenian Manhattan!"

For many young people, this housing crisis is coinciding with a period of high unemployment. According to a recent study, young people are acutely affected by the housing crisis and as a result are having to live at the family home for longer. From 2010 to 2019, the number of people aged between 25-34 living with their families increased notably in Belgium, Ireland, Spain, Italy, Croatia, Greece, and Cyprus. This spring, thousands of Europeans took part in demonstrations calling for affordable and decent housing with movements such as Housing Action Days. However, a recent survey conducted by the Climate Reality Barometer suggested that Generation Z cares more about inflation than climate.

For many young people, this housing crisis is coinciding with a period of high unemployment.



2

Reducing emissions, increasing social impact

Michael Shank, the director of engagement at the Carbon Neutral Cities Alliance, wrote for POLITICO: "If we're going to build a political mandate for climate action, we need to prove that the process of decarbonizing buildings and cities is going to improve people's lives — especially those from low income and marginalized communities, as well as those primarily concerned with the cost of living."

The building sector is a considerable contributor to greenhouse gas emissions, representing 35% of energy related emissions in the EU. Additionally, emissions from manufacturing of construction products, material extraction and construction, and renovation of buildings are estimated to account for around 5-12% of the total GHG emissions. However, up to 80% of those emissions could be eliminated with better material efficiency. Yet there is work to be done – an estimated 75% of EU buildings are energy inefficient. A related drawback to energy inefficiency has been the fact that 41 million Europeans could not keep their homes adequately warm in 2022.

To ensure that buildings serve citizens and align with the European Green Deal, the EU building sector needs to achieve emission reductions of at least 60% for the next six years. When considering emission reductions, it is crucial to highlight the social benefits of decarbonizing construction, such as the creation of millions of new jobs.

Another advantage of energy efficient homes is cost saving and tenants' ability to cope with energy poverty. One such example is the RE-SKIN project that aims to approach holistic building renovation in existing buildings, including a Bulgarian school and a public building in Italy providing housing to vulnerable groups of people.

"If we don't articulate well this social angle, what we have already seen is that there is already a pushback… some sort of resistance from those communities, from those social classes which feel left behind," Zsolt Toth, the Team leader at BPIE said at the New European Bauhaus in April. The New European Bauhaus is an interdisciplinary initiative of the European Green Deal that brings together arts, culture and sustainability in our living spaces and experiences. During the four-day festival, multiple local initiatives embracing a different way of living were presented.

Reimagining housing affordability

One of those was Barcelona's La Borda, a cooperative providing affordable and stable housing to its residents. It is mostly constructed of wood with fire protected facades. With 28 housing and 20 solar panels on its rooftop , La Borda fulfills the objectives of the New European Bauhaus by combining social, artistic, and environmental aspects. For instance, the building embraces passive bioclimatic solutions, such as a greenhouse covered patio, which has CO_2, smoke and wind sensors to regulate air ventilation. Tenants are encouraged to embrace plant-based cooking, take care of the rooftop garden and share objects.

La Borda is the first building in Barcelona that doesn't have underground car parking following a process that took almost two years until the obsolete piece of building legislation was changed. Instead, there is a bicycle parking area



3

From Housing Dystopias to Housing Utopias



Illustration by Dariana Guevara / REVOLVE

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From an old brewery to a multifunctional space

In Berlin, an old Kindl brewery has been transformed into a livable co-working space. At a glance, the building might appear unfinished with its unpainted walls and exposed timber and hemp. But these features serve a purpose as the materials can be reused more easily in the future. The CRCLR House has been constructed based on circularity principles. About 80% of the materials were produced sustainably, recycled, or upcycled. For instance, timber was retrieved from an art installation and sinks were reclaimed from a camping site.

On top of these offices, architects constructed affordable apartments. The new floors have mostly been built with timber and insulated with straw. To enable potential future deconstruction, all building materials have been screwed or wedged. Considering that over a third of waste generated from construction and renovation ends up in Europe's landfills, the CRCLR House is a great example of a different future. It is also a significant signal for renovating empty buildings in the EU. However, this can only be done if renovation is affordable.

on the ground floor. Another important angle that needs to be considered in energy efficient buildings is teaching tenants how to adopt sustainable behaviors. "If they don't know how to use properly their house that doesn't need heating or AC (…) it will be performing in a bad way," the architect Carles Baiges Camprubí highlighted at the New European Bauhaus.

Another advantage of energy efficient homes is cost saving and tenants' ability to cope with energy poverty.

The EPBD and ideas to step forward

A recent milestone in EU policy was the adoption of the Energy Performance of Buildings Directive by the EU countries on 12 April 2024. This law addresses the critical need to phase-out fossil fuels and prioritizes funding for vulnerable households. The EPBD will also facilitate access to information and cooperative models. Another crucial target is to entail assessing and limiting all new buildings' emissions as of 2030.

Yet, Danielle Densley Tingley, expert in circular economy at the University of Sheffield, stresses that "the most sustainable building is the one you don't build." Zsolt shares the same view highlighting: "We need to increasingly look at reducing and avoiding as much as possible new construction and making use of our existing fully built buildings stock as much as possible."

The EPBD unfortunately creates some extent of flexibility for each country to decide on the implementation of these targets. This could make EU monitoring quite difficult. It is therefore critical that EU citizens hold national lawmakers accountable to ensure that the EPBD prioritises the welfare of vulnerable people and guarantees adequate financial and informational support for homeowners.

Housing Europe, the European Federation of Public, Cooperative & Social Housing, recently released a European Manifesto to lead the way out of the housing crisis. One of the policies suggested is the prevention of short-term rental platforms, which affect the affordability and availability of housing in Europe. Another one is to provide decent affordable housing to tackle increasing homelessness. The manifesto also outlines that supporting public, social, community-led, and cooperative housing should be the basis of the national housing systems.

"Housing has to be an election issue. We need to see a European Fund to provide housing in the next mandate," says Ciarán Cuffe from the Greens/European Free Alliance to Housing Europe, who is also the rapporteur of the EPBD.

European citizens have the right to choose political parties that consider addressing the multiple challenges of the housing sector. It might sound utopic, yet sustainable spaces that involve arts, and tackle social and environmental issues can exist. The New European Bauhaus showcases multiple such projects every year, and it's about taking the right decisions to make affordable housing flourish in our neighborhoods. ●

"Housing has to be an election issue. We need to see a European Fund to provide housing in the next mandate."

Ciarán Cuffe from the Greens/European Free Alliance to Housing Europe

1. La Borda housing cooperative, Barcelona, Spain. Photo: Lluc Miralles
2. *Geitonies Dikaioma Stegi*, demonstration about the housing crisis, Athens, Greece. Photo: Neighborhoods for the right to housing
3. La Borda housing cooperative, Barcelona, Spain. Photo: Lluc Miralles
4. From Housing Dystopias to Housing Utopias. Illustration: Dariana Guevara / REVOLVE
5. La Borda housing cooperative, Barcelona, Spain. Photo: Lluc Miralles
6. CRCLR House, Berlin, Germany. Photo: Angela Elbing / CRCLR



Together Is Better

WRITER: **JADWIGA NAJDER**

1

Nuclear power and its place in the energy mix of tomorrow

2 December 2023, Dubai. At the sidelines of COP28, a gathering of high-level officials representing 22 countries formalizes a declaration aiming at tripling global nuclear capacity by 2050 to reach Net Zero. This, together with the declaration of tripling renewable energy output by 2030, proves the commitment of world leaders to an accelerated energy transition globally.

Some days later, on 13 December 2023, in the text of COP28 Global Stocktake, the Conference of Parties, "calls on accelerating zero- and low-emission technologies including inter alia, renewables, nuclear, abatement and removal technologies."

In March 2024, at the global-scale Nuclear Energy Summit organized by the United Nations' International Atomic Energy Agency (IAEA) and the Belgian Prime Minister, leaders of more than 30 countries spoke about the importance of nuclear power for energy security, climate goals, and sustainable development. In her speech, European Commission (EC) President Ursula von der Leyen listed actions for the nuclear sector and government, the achievement of which would enable the nuclear sector a significant contribution to a rapid, safe, and secure net-zero future.

This rising momentum for nuclear energy, judging by the headlines, may seem rather recent, but nuclear, alongside renewable energy, has been continuously recognized by international organizations as a key source for the future global energy mix.

For instance, the Intergovernmental Panel on Climate Change's 6th Assessment Report shows 80% of analyzed scenarios corresponding to 2 degrees warming or less, need future expansion of nuclear power, while IAEA, in the likely case of nuclear electrical generation by 2050, foresees more than doubling of production. The Organization for Economic Cooperation and Development-International Energy Agency concludes that its Net Zero Emissions scenario, if



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realized with a large decrease in nuclear, would bring significant challenges and cost escalation.

Back at COP28, European Nuclear Society delegates led hundreds of discussions with policy-makers, environmental activists, and other COP participants, under the flagship of the global grassroots initiative Nuclear for Climate, aiming to raise awareness about nuclear technologies in service of climate, environment, and sustainable development. Since the initiative's establishment in 2015, reluctance has been replaced gradually by curiosity, high hopes, and remaining doubts about nuclear energy.

Nuclear, alongside renewable energy, has been continuously recognized by international organizations as a key source for the future global energy mix.

We need to achieve Net Zero and sustainable development

Targets like Net Zero by 2050 or the European Union's (EU's) 2040 Climate Target announced in February 2024, require rapid decarbonization of all sectors of activity, which is inevitably related to replacing fossil-based electric power with low-carbon ones like renewables and nuclear, electrification of as many processes as possible, and decarbonizing so-called hard-to-abate sectors, which require more gymnastics to avoid emissions.

In the face of these needs, nuclear energy has significant value, as it is the energy source with one of the lowest greenhouse gas emissions throughout

Only synergy of all clean sources like renewables and nuclear, according to the needs of each state, provides diversity and reliability, ensuring security of supply.

its whole life cycle, and the source that uses the least amount of land and critical materials per unit of energy produced. This efficiency enables the production of a large amount of electricity and heat while minimizing the impact on the environment.

Future projects of nuclear power plants (NPPs) will include not only traditionally known large reactors but also Small Modular Reactors (SMRs). Their smaller size (up to one-third of a standard reactor) and simplified, factory-based design, allows flexible implementation of one or several units, providing electricity and heat access for traditional users or remote areas and small or developing countries. SMRs and their more advanced models (called AMRs) can also produce heat for industrial use, which could help to decarbonize some hard-to-abate sectors.

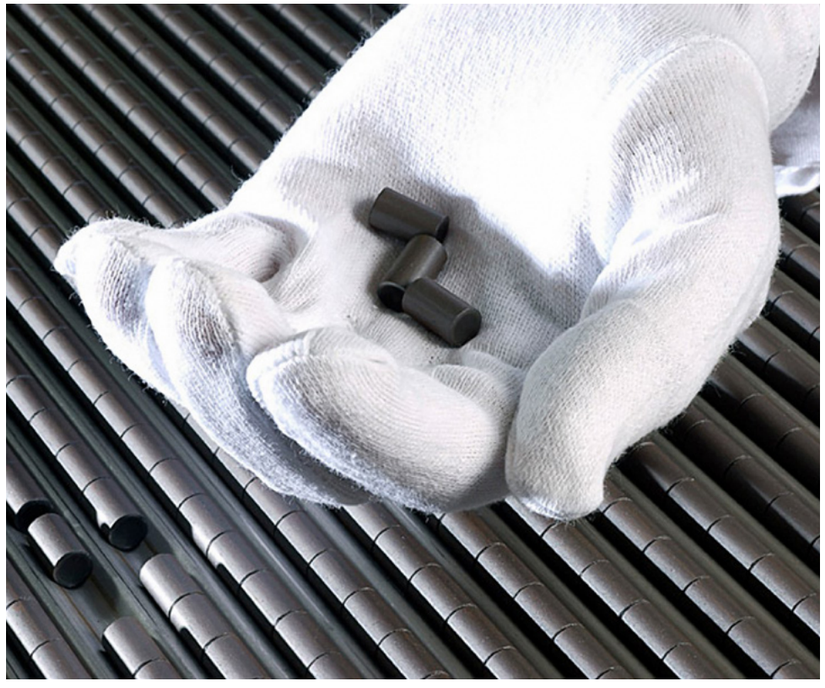
We need security of supply

The current geopolitical situation causing wide-ranging supply issues and spiking electricity prices, on top of the challenge of climate change, proves the dire need to ensure the security of the provision of clean energy for Europe.

Each energy source has its specific characteristics and mode of operation. Renewable energy sources like solar and wind, due to their variable nature, would need backup from fossil fuels or storage solutions, which do not exist now at a necessary scale or level of advancement. Hydro energy is highly dependent on localization and suffers from changing weather conditions. Therefore, only synergy of all clean sources like renewables and nuclear, according to the needs of each state, provides diversity and reliability, ensuring security of supply.



5



6

Nuclear energy provides electricity 24/7 with stops every 1–1.5 years to reload the fuel, with a long plant operating life and high resiliency against unfavorable weather conditions. Moreover, nuclear is also a dispatchable energy source – it is possible to increase or decrease the production at demand, which is practiced in France for example, or to produce hydrogen in low-demand periods. Even better flexibility characteristics will be provided with the onset of SMRs.

Thanks to these traits, nuclear power fits into modern energy systems working alongside variable renewables and can replace fossil fuel plants upon their phase-out.

Nuclear fuel also has a very high energy density - one uranium oxide fuel pellet, weighing less than 10 grams, produces the amount of energy of 1 ton of coal, which makes storing strategic inventory more efficient with up to 2 years' worth of fuel supply being stored at each NPP.

Uranium is a relatively abundant material spread in diverse countries. Several upcoming AMR technologies plan to use even more abundant thorium or spent nuclear fuel to power the reactor!

But what about nuclear waste?

Waste generated from the nuclear energy sector is discussed quite often in the public space. While all energy sources produce waste, nuclear power is the only sector that takes full accountability for all the items created throughout its fuel cycle, from mining to disposal of spent nuclear fuel and used materials.

Thanks to large energy density, nuclear produces correspondingly very little waste. Only 3% of it constitutes spent nuclear fuel designated as waste, for which necessary technologies for geological disposal are now available and can be deployed, as stated by the EU's Joint Research Centre in their technical assessment of nuclear energy for the needs of taxonomy regulation.

The curious thing about spent nuclear fuel is that already now, part of it is not 'designated as waste,' but is being reprocessed for reuse. In practice, only a small part of the material loaded into a reactor is used up, so after the treatment of used fuel, more electricity can be produced.



7

This circular economy of nuclear fuel will be further supported by new technologies, the breeder reactors, that allow the production of energy from spent nuclear fuel that is now considered waste.

But it will take too long to build and cost too much

After energy sustainability and security, affordability closes the triangle called the energy trilemma, a term coined by the World Energy Council.

When it comes to nuclear energy, it offers one of the most cost-effective ways of producing clean energy by keeping the currently operating plants open for longer. NPPs running now turn out to be more robust than their initial assumptions, and after performing some updates, they can keep successful operation up to two times longer in the scope of so-called Long-Term Operation, which is currently one of the cheapest available ways to produce clean energy.

In the case of nuclear energy, the largest part of the cost is the upfront investment in constructing an NPP, followed later by low costs of operation, maintenance, and fuel, with very low grid development needs (compared to sources like solar and wind) and very long lifetime of installation – with Long-Term Operation up to 80 years.

After decades of lower construction activities in the nuclear sector, triggering supply chain and workforce challenges, some of the recent projects saw cost overruns and delays, while others were completed within acceptable time and budget. Historic data shows however, that realizing several projects in sequence will drive down the cost significantly, as has been the case in France between 1970–2000, with the last reactors built in each construction campaign being up to 23% cheaper than the first ones.

This economy of scale will be particularly pronounced in SMRs – thanks to their smaller size and modularity, not only smaller initial capital is required but also through a more pronounced learning curve, the more they are built, the faster and cheaper they will be.

This circular economy of nuclear fuel will be further supported by new technologies.



8



9

1. Dukovany Nuclear Power Plant, Czech Republic. Photo: Martin Lisner / Shutterstock
2. Volunteer Julieta Romero poses in front of the Nuclear for Climate mural designed by her, Dubai, United Arab Emirates. Photo: Julieta Romero / Nuclear for Climate Initiative
3. Rafael Mariano Grossi, IAEA Director-General, adds colour to the Nuclear for Climate wall painting, 1 December 2023, Dubai, UAE. Photo: Dean Calma / IAEA
4. Nuclear for Climate Initiative volonteer, 1 December 2023, Dubai, UAE. Photo: Dean Calma / IAEA
5. Model of the SMR reactor SMART, donated to the IAEA by the Republic of Korea. Photo Credit: Dean Calma / IAEA
6. Uranium oxide fuel pellet, weighing less than 10 grams, produces the amount of energy of 1 ton of coal. Photo: Nuclear Regulatory Commission
7. Massive containers hold spent nuclear fuel at safe and secure dry storage facilities. Photo: Sandia National Laboratories.
8. Flamanville 3 Nuclear Power Plant under construction, France, 2010. Photo: Schölla Schwarz / Panoramio
9. Meeting of SMR Industrial Alliance, 29 May 2024, Brussels, Belgium. Photo: Jadwiga Najder / European Nuclear Society

Acceleration of development, demonstration, and deployment of this reactor type in Europe was recently kickstarted by the EC in the form of the SMR Industrial Alliance – an effective collaboration among all involved stakeholders that improves the chances of SMR technologies contributing soon to rapid and large-scale decarbonization of energy and other sectors of human activity.

At COP28, the pavilion of the Nuclear for Climate initiative was decorated with a mural presenting all low-carbon energy sources: renewables and nuclear, stating 'together is better.' This simple slogan underpins what science and technology show and what policy-makers start to recognize: all clean energy sources are needed to achieve net-zero and sustainable development.

To bring words to action, stable support from world leaders and a well-informed society is a must.

All clean energy sources are needed to achieve net-zero and sustainable development.

5 Myths about India's Renewable Energy Journey (and How to Break Them)

WRITER: **ALEXANDER HOGEVEEN RUTTER**



1

As a developing country, India needs to prioritize affordable and reliable power for all.

Many have been advocating for up to 60 GW of new coal power under the false belief that there is a trade-off between the environment and development. This belief is based on 5 faulty myths about India's journey down the road of renewables.

Myth #1: India has installed a lot of renewable energy

One of the main reasons cited for turning back to coal is that India has installed a lot of renewable energy and still has demand shortages, therefore needs coal. However, the fact India is an emerging economy with high demand growth is a reason to build *more* renewables, not less.

For example, over the last 5+ years, India has installed 8-15 GW of renewable energy. However, at least 50-60 GW is required to meet demand growth, as shown in Figure 1.

The second point often made is by comparing India to other countries. For example, it is often cited that India has passed Germany (or Japan) to have the third-most installed solar capacity in the world. While India does have a comparable amount of solar power installed vs. Germany, India has a much stronger solar resource (and therefore should be doing more, not less).

More importantly, India's electricity demand is 5x Germany and India's population is 20x Germany. This author believes that Indians are just as deserving of power as Germans, and therefore should be installing just as much capacity per capita, not just in absolute terms. India has been falling behind its peers in terms of percentage of electricity from renewable energy sources. In a highly competitive global environment, where manufacturers seek affordable, clean power, this puts India at a significant competitive disadvantage.

Figure 1 **MW of RE required to meet demand vs. Actual (All India)**

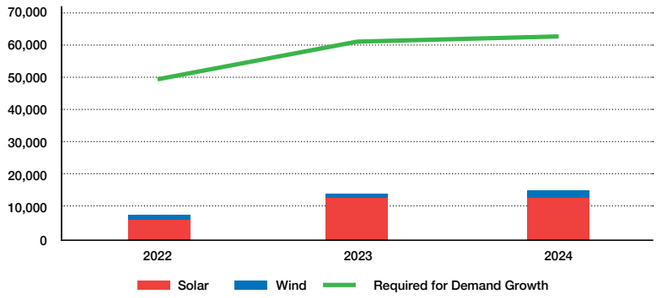
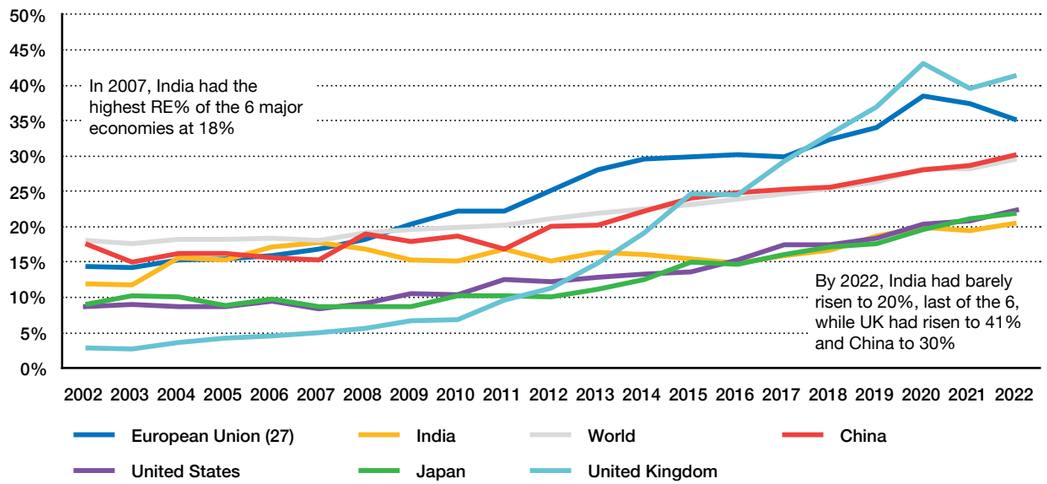


Figure 2 **Renewable Electricity as a % of Total**



It is also worth comparing the RE installations against the government's own targets. In the Central Electricity Authority's National Electricity Plan 2018, the government targeting 100 GW of solar and 60 GW of wind by 2022 (to partially meet demand growth, the NEP also envisioned substantial new coal). As of 31 March 2017, India had 12.3 GW of solar and 32.3 GW of wind, meaning the target installations was 87.7 GW of solar and just 27.7 GW of wind over 5 years, an already modest target, given India's demand growth (as shown in Figure 1).

However, India installed just 41.7 GW of solar and 8.1 GW of wind, just 48% and 29% of these already modest targets, along with just 2.2 GW of hydro (33% of planned). Note the overall *capacity* of RE has grown, but since relatively high-CUF hydro has been replaced with relatively low CUF solar, this has resulted in thermal generation roughly flat at 74%, as shown in the below figure from the CEA.

On a related note, India's 500 GW renewable energy target is often cited as "ambitious". However, given demand growth of 5-6%/year and the number of coal plants that have reached end-of-life and need to be decommissioned (for technical, not climate reasons) India needs between 720-860 GW of renewable energy by 2030. This does not include additional RE required for green hydrogen (125 GW), to displace diesel generator usage, or displace high-cost coal (see next Myth).

All India Cumulative Energy Generation (A624.47 BU)
April 2022 – Mar 2023

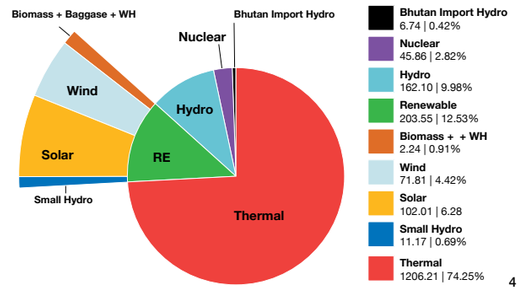


Figure 3 **Thermal Plants in India, GW by Variable Cost**

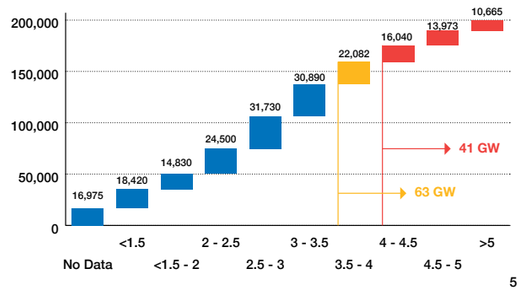
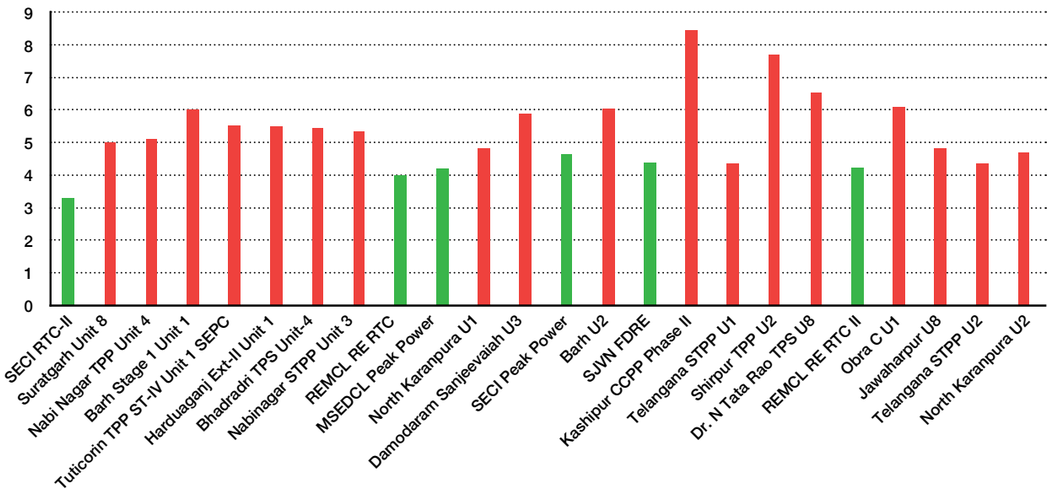


Figure 4 **Cost (Rs/kWh) of New Thermal (Red) and Firm RE (Green)**



Myth #2: Renewable energy is more expensive than coal

The second major reason cited for new coal expansion is that Indians need "affordable" power. It is certainly true that Indians need affordable power, and renewable energy is substantially cheaper than new coal. For example, new solar is about Rs. 2.5/kWh, while new wind is about Rs. 3.25/kWh. In contrast, India has 63 GW of coal with a *variable* cost higher than Rs. 3.5/kWh, as shown in Figure 3.

The All-India APPC (Average Power Procurement Cost) has in fact risen from Rs. 3.85 in FY22 to approximately FY 4.56 in FY23 on the back of higher coal costs. And this is the average, including legacy coal plants where capital costs have been fully amortized. New coal tends to be even more expensive. Figure 4 shows the cost of new coal plants built in the past 3 years versus the cost of "Firm" Renewable Energy (more on this in the next section).

New coal in India costs around Rs. 5.5/kWh, whereas new RE + storage at an equivalent level of reliability costs Rs. 4.0-4.5/kWh. Therefore, the 90 GW of new coal being planned will cost Indian consumers/DISCOMs 63,000-95,000 Crore ($80-120 billion) per year extra in electricity bills – a cost a developing country like India can ill afford.

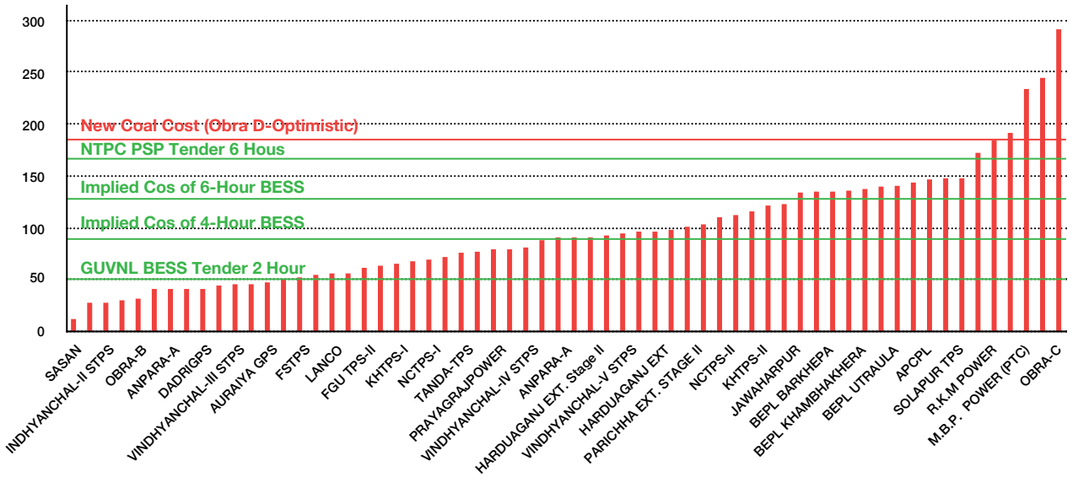
Myth #3: Renewable energy is unreliable

It is true that renewable energy is variable and uncertain, and does not provide firm power, on its own. This is why it is so crucial to deploy energy storage. Early "RTC" RE tenders (like SECI RTC-II, which was Rs. 3.30/kWh, the outlier in the above chart) were based on Capacity Utilization Factor, which just means more energy, not necessarily more "firm" power. In contrast, other tenders like REMCL RTC-I have specified an availability of 85%, the same as existing coal plants, and still have a competitive price (Rs. 4.25/kWh). Furthermore, these tenders specify a penalty (usually 200%-300% of the tariff rate). In contrast, coal plants do not have to pay a penalty to the DISCOM when they are unavailable, making these RE + storage contracts actually *more* reliable.

Furthermore, storage has additional reliability advantages over coal such as:

- can be built in 3-6 months vs. 4-6 years for new coal
- can be sited anywhere (unlike coal which requires significant land and cooling water)
- can be scaled modularly from rooftop or microgrids, to GW-scale
- can react in milliseconds, providing better grid frequency control (vs. minutes to hours for coal)
- do not suffer a partial loading and turn-off/turn-down penalty like coal

Figure 5 **Comparison of New Storage Capacity Cost vs. Existing and New Coal Capacity Cost in Uttar Pradesh, India's biggest state**

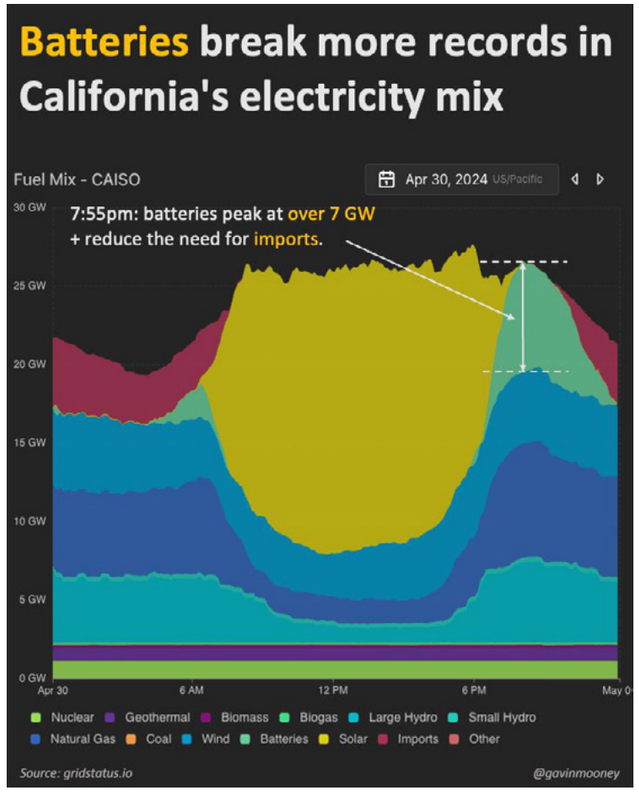


7

There has been much confusion about energy storage. In particular, many stakeholders say energy storage is expensive because they are computing an "energy" cost for storage. But the energy comes from wind and solar, which (as discussed above) is lower than the variable cost of fossil fuels. Energy storage provides the firm *capacity* to meet the variability and peaks of load (as well as low-RE periods). From a capacity perspective, new storage is substantially cheaper than new coal, as shown in Figure 5.

Another big confusion is the amount of storage required. In the long-term, LDES will be required to move to a 100% RE system. However, India only receives about 11% of its electricity from variable renewable energy (wind and solar). In places with much higher levels of VRE like California (26%), UK (35%), Germany (33%), 2-4 hours of storage has been shown to provide much higher levels of reliability as coal in India (shown in Figure 6). In fact, the only two major economies that are >70% dependent on coal (India and South Africa) have much lower reliability than economies which rely on energy storage to meet reliability requirements.

Figure 6 **Use of Batteries to meet reliability requirements in California**



8

Myth #4: Renewable energy harms energy security

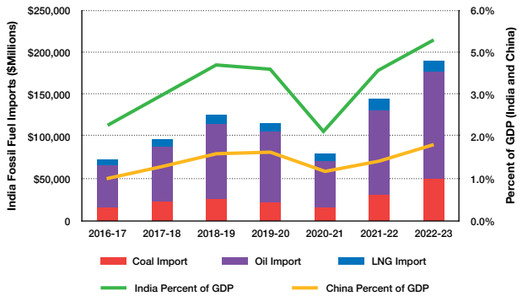
Another big myth is that India must rely on coal for "energy security" reasons. This stems from a confusion about stocks and flows and the nature of renewable energy itself. While India imports 21% of it's coal, it imports 0% of wind and solar. Yes, wind and solar equipment may be imported, but once installed it is completely energy secure, the supply cannot be cut off. In contrast, fossil fuels like coal and gas must be continuously re-imported year after year, creating a perpetual energy security risk.

In fact, fossil fuel imports reached over 5% of GDP in India last year, vs. 2% in India's largest geo-strategic rival, China. The main reason China has been able to keep its fossil fuel imports in check has been because of investments in renewables and electric vehicles, as shown in Figure 7.

In fact, between 2018 and 2023, while India has been claiming it cannot install renewable energy for "Energy Security" reasons, India imported $94 billion in thermal coal (excluding coal used for industrial processes like steel manufacturing). If that money was spent on importing cells for solar modules (India is self-sufficient in solar module production, but imports much of the components), India could have imported 1,050 GW of solar cells, over 10x actual installations, and completely eliminating India's energy security concerns (note India is largely self-sufficient in wind turbine manufacturing and battery pack assembly, though like solar, some of the component for battery packs are imported). In fact, for a typical solar, wind, and storage project, less than 20% of the components are imported, the rest is assembled in India (or goes to land, labour, and taxes). This is less than the percentage of coal that is imported and far less than the 50% of natural gas and 80% of oil that is imported.

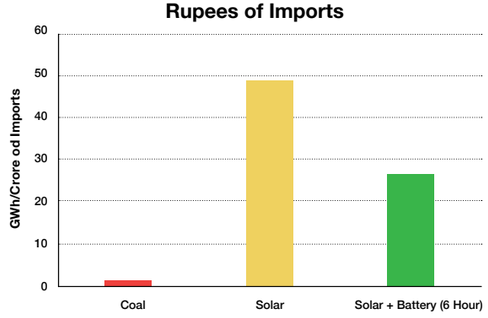
Most importantly, the amount of energy generated per Crore (or dollar) of imports

Figure 7 **Fossil Fuel Imports India vs. China**



9

Figure 8 **GWh of Energy generated per Indian Crore Rupees of Imports**



10

is substantially higher for renewable sources than fossil fuels, as shown in Figure 8. Ultimately, if India wants to reduce energy imports (and therefore improve energy security), renewable energy (even if imported) is a much strong bet.

Myth #5: Policy favours renewable energy over coal

The final myth often told is that India's policy favours RE and if it truly is economic and reliable, it will get built. This belief seems to stem from two main perks provided to renewable energy, the 'transmission waiver' and banking.

The transmission waiver means RE projects do not have to pay transmission charges, saving them about Rs 0.30-0.40/kWh. As discussed in Section 3, even if this cost is included, RE + storage would still be substantially cheaper than coal. Secondly, the transmission waiver has had the perverse incentive of pushing RE projects to the best sites (such as in Rajasthan and Gujarat), weakening local buy-in (for example, the Uttar Pradesh government would rather have a local coal plant than "imported" renewable energy). If the transmission waiver was removed, we would see much more solar and wind around the country, bolstering local engagement. Banking meanwhile exclusively benefits large corporate and industrial customers, but actually puts a burden on the DISCOM (as they must manage the time shifting and variability), discouraging them from building their own.

On the other hand, there are numerous policy-supported mechanisms for coal not available to renewable energy, such as:

1. **Government provision of land (and water) for coal plants.** This is especially crucial for wind parks, which require land in high wind-speed areas. Though India has developed <3% of its wind potential according to NIWE (a government agency) state/central government have generally not allocated land for wind parks (with notable exceptions like Khavda).

2. **Guaranteed return on equity (RoE) of 15.5% For coal plants.** In contrast, RE and storage projects are subject to competitive tendering with L1 price matching.

3. **Planning which builds coal by default.** Though India has suggested a Renewable Purchase Obligation (RPO) on states (which has not yet been enforced), it is seen by states as a ceiling rather than a floor. In most states, even if they plan to meet RPO, they then automatically build coal to meet the residual demand, rather than doing any economic or reliability analysis of coal vs. RE + storage. Similarly, at the central level, the Central Electricity Authority has taken the 500 GW target as a default, rather than determining the most optimal amount of renewable energy.

4. **Concessional tax rates for coal.** Coal has a GST rate of 5% vs. 12%, 18% or 28% for solar, wind, and storage equipment (depending on sub-category). Similarly, coal has an import tariff of 1% vs. 40%+ for solar, 22%+ for wind and 24%+ for energy storage. Furthermore, there are non-tariff barriers on solar and wind such as ALMM and RLMM which block low-cost imports and place an additional regulatory burden on small and medium domestic manufacturers.

5. **Higher availability requirement for RE + storage projects.** While coal plants have a nominal availability of 85%, there is no penalty on the generator when they are unable to meet demand due to forced outages, water stress, and coal availability. In contrast, RE + storage is often required to meet 90%+ availability and must pay a penalty for any shortfall.

6. **Minimal consideration of the externality costs of coal.** While coal pays a nominal "cess" of Rs. 400/tonne, this is a fraction of the externalities imposed by land, water, and air pollution. Air pollution from coal plants alone costs over 200,000 lives per year in India. If this were reflected in the coal cess, the coal cess would rise to at least Rs. 6,000/tonne, not to mention the additional health costs, lost agricultural productivity, and other.

Fundamentally, in policy circles across the country, renewable energy is viewed only from a climate lens, whereas coal is viewed as essential for the development of the country. Until renewable energy and storage are treated as crucial to development, they will continue to suffer from a policy disadvantages, both formally (via taxation rates for example) as well as informally (such as DISCOM's prioritizing payments to thermal generators).

What is the path forward?

India has many phenomenal companies and individuals leading in the renewable energy space. There is ample capital both domestic and international seeking to invest in India's tremendous growth story. There are literally thousands of GW of resource potential (both solar and wind) across the country. So how can India become a greater leader in renewable energy?

1. **Put coal and renewable energy on an even playing field.** Revamp state and central planning processes to minimize cost and maximize reliability to consumers. Cancel all planned coal projects and have them bid in competitive auctions against Renewable Energy + storage, for the same level of reliability (and the same penalties for shortfalls). While some mine-mouth plants may be able to compete, recent history suggest that virtually no new coal is economic against RE + storage. It would also substantially lower costs if RE were to get some of the same benefits as coal such as lower tax rates and land allocation.

2. **Drastically scale up re in line with demand growth.** The commitment to tender at least 50 GW per year of RE is a step in the right direction. However, this must flow to both central and state level targets that are in line with demand growth. At the all-India level, this means at least 720 GW of renewable energy by 2030 (about 80 GW per year), and potentially even more to have a sufficient reserve margin, as is common practice in developed countries.

3. **Build energy storage on an urgent basis.** Despite having ~6.5% of India's electricity demand, India has installed about 0.1% of the global Battery Energy Storage Systems. Indians deserve affordable, reliable power just as much as anyone else and it is crucial to deploy firm resources like energy storage to meet peak demand and end the outages plaguing the country. Energy storage is already much cheaper than coal and can be deployed in less than a year to meet India's growing demand vs. 5 or more years for new coal projects.

From a capacity perspective, new storage is substantially cheaper than new coal.

Renewable energy is much more affordable than coal. Storage is far more reliable. Together, RE + storage can support India's development and end the ongoing power outages, improving energy access and affordability for all its citizens. But only if we dispense with the many myths holding back the renewable energy sector and put it on a level playing field with coal. ●

1. Wind farm behind historical temple, Jaisalmer, Rajasthan. Photo: Ilya Yakubovich / Unsplash
2. Source: CEA
3. Source: IEA
4. Source: CEA
5. Source: Author's analysis of CEEW data collated from MeritIndia.
6. Source: Author's Analysis from SECI and other tendering agency data, as well as tariff orders for individual states/coal plants.
7. Source: GUVNL and NTPC tender results. UPPCL FY22-23 Tariff Order
8. Source: Gridstatus.io (c/o Gavin Mooney)
9. Source: Ministry of Commerce (India); UNICOM Trade (China)
10. Source: Author's Analysis, PV Insights

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Sustainable Design in the Heart of Brussels

PROJECT: **NEUTELINGS RIEDIJK ARCHITECTS**
PHOTOGRAPHY: **FILIP DUJARDIN, SARAH BLEE, TIM FISHER**

Award-winning Gare Maritime reimagines sustainable space for business and leisure.

Gare Maritime, once Europe's largest railway station for goods on the Tour & Taxis site in Brussels, was in 2021 transformed into a covered city with a mixed program of working and shopping and plenty of public space to relax.

The Gare Maritime is now entirely energy neutral and fossil free. The glass facades on Picardstreet are provided with solar cells. On the roofs, solar panels cover an area of 17,000 m2. At all levels, far-reaching sustainability measures have been implemented, such as use of geothermal energy and reuse of rainwater, making it an important contribution to the sustainable development of the Tour & Taxis site and the Kanaalzone in Brussels.

Neutelings Riedijk Architects designed the new Gare Maritime as a city district – 'a city where it never rains.' The old station dating to the beginning of the 20th century consists of three larger and four smaller halls. Under the existing roofs of the side aisles, 12 new pavilions were added to accommodate the new program. They create a new structure of boulevards and streets, gardens and squares, that follows the existing urban context and the building structure in a natural way.

The central space in the heart of the building has been kept open for public events. It has a pleasant climate which follows the changing of the seasons. Inspired by the Ramblas, on both sides of the event space a green walking boulevard is created. The 16 meters wide pedestrian routes give enough room for spacious inner gardens, with a hundred large trees.

The new pavilions have been constructed in Cross Laminated Timber (CLT). The choice of wood also had a favorable effect on the construction process: thanks to prefabrication and the dry construction method, the construction time was considerably shorter. The Gare Maritime project was recognized by a dozen awards and shortlists, including the Prix Versailles and the shortlist of the 2022 EU Mies van der Rohe Award.

People walk through the interior of the Gare Maritime.
Photo: Filip Dujardin / © Neutelings Riedijk Architects

An interior view of the Gare Maritime.
Photo: Filip Dujardin / © Neutelings Riedijk Architects



Above: An interior view of the green spaces in the Gare Maritime. Photo: Filip Dujardin / © Neutelings Riedijk Architects

Below: A staircase inside the Gare Maritime. Photo: Filip Dujardin / © Neutelings Riedijk Architects



Above: A view of units inside the Gare Maritime. Photo: Sarah Blee / © Neutelings Riedijk Architects.

Below: A view from inside of one of the second floor units of the Gare Maritime. Photo: Filip Dujardin / © Neutelings Riedijk Architects.



An interior view of the Gare Maritime.
Photo: Filip Dujardin / © Neutelings Riedijk Architects

An interior view of the Gare Maritime.
Photo: Filip Dujardin / © Neutelings Riedijk Architects

An exterior view of the Gare Maritime.
Photo: Filip Dujardin / © Neutelings Riedijk Architects



Above: An interior view of the Gare Maritime. Photo: Filip Dujardin / © Neutelings Riedijk Architects

Below: A closer look at the architectural design features in the Gare Maritime. Photo: Filip Dujardin / © Neutelings Riedijk Architects



Above: Architectural features in the interior of the Gare Maritime. Photo: Filip Dujardin / © Neutelings Riedijk Architects.

Below: People walk through the interior of the Gare Maritime. Photo: Filip Dujardin / © Neutelings Riedijk Architects.





An interior view of the Gare Maritime.
Photo: Sarah Blee / © Neutelings Riedijk Architects



An exterior view of the Gare Maritime.
Photo: Tim Fisher / © Neutelings Riedijk Architects

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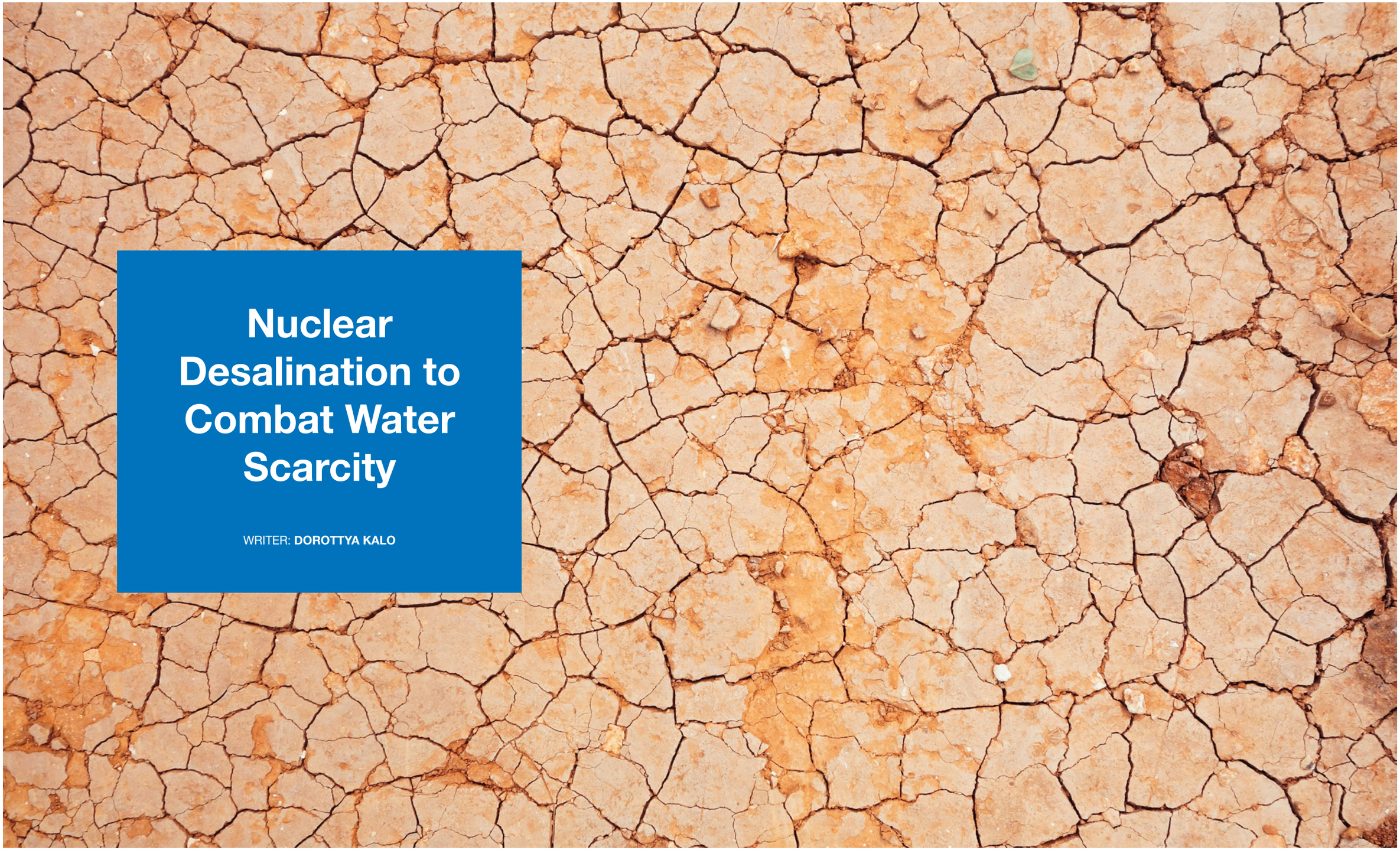
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REVOLVE

Nuclear Desalination to Combat Water Scarcity

WRITER: **DOROTTYA KALO**



1

Innovative solutions in the quest for clean drinking water

Water is scarce, even though around 71% of the Earth is comprised of it, but salinity is a grand obstacle to overcome for living beings to make use of all the benefits of water. Interest in using nuclear energy to produce drinking water has gradually increased in the past decades, especially affecting low-income communities across the globe.

Climate change and increased awareness of the impact of fossil fuel usage further motivate sectors to invest in nuclear energy, undermining the inner fear of past events where reactors caused a disturbance in millions of people's lives.

The demand for freshwater is increasing while we are also polluting, poorly managing, and misusing our freshwater resources at an alarming rate. As we look for sustainable solutions to this growing crisis, nuclear desalination emerges as a viable and promising alternative, capable of supplying freshwater with a lower environmental impact.

The mechanics of nuclear desalination

The extent to which seawater can be turned potable has likely been investigated since ancient times, and on a small scale with little return was applied for hundreds of years. Sailors and regional practices, such as those in ancient China using sea ice in irrigation, applied primitive desalination techniques to meet their water needs. During the Industrial Revolution, significant improvements led to the establishment of commercial desalination plants by the late 19th century.

The technologies and mechanisation of the process along with strategic legislative efforts caused an increase in desalination plants in many water-scarce regions worldwide. Since 1989, the International Atomic Energy Agency (IAEA) has investigated the matter, showing how it can be a technically and economically viable solution, combining the principles of nuclear energy and desalination technology to create an efficient and sustainable water source.

Seawater desalination is a good option for meeting the current and future demands of freshwater in water-stressed regions with proximity to the sea. However, it is an energy-intensive process, leading to significant differences in applicability while also depending on the arid region's abundance of fossil fuels – whose intensive use could lead to further water pollution. Also, if the distribution network of desalinised water is not sufficient, it can lead to substantial loss of water due to evaporation and seepage.

Desalination plants are currently considered one of the most expensive methods of creating drinking water, mainly due to the method that pumps large volumes of water across semi-permeable membranes in a high-pressure environment. This movement of molecules, also referred to as reverse osmosis, separates freshwater from salty water (brine) and minerals. Another method uses distillation but is even more costly.



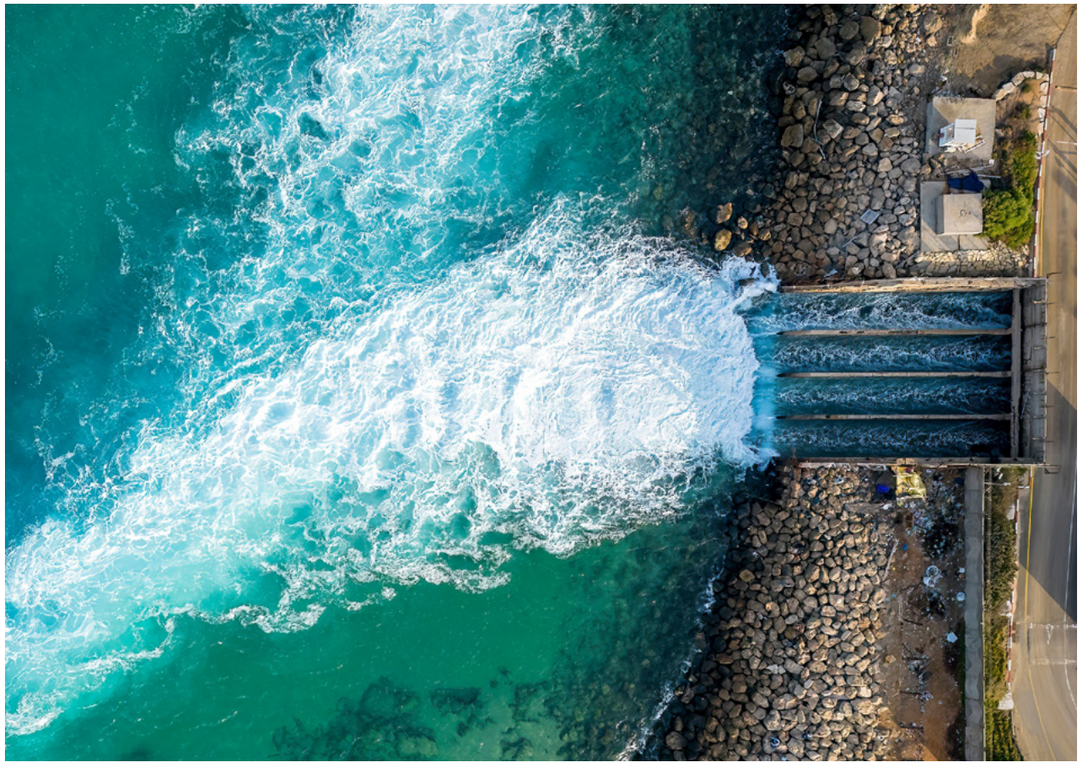
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Advantages of nuclear desalination

Nuclear desalination offers several advantages over conventional methods, particularly when it comes to economic and environmental benefits. The process can be more cost-effective in the long term, especially in regions where fossil fuels are scarce or expensive – not to mention the sheer benefits of reducing the use of such polluting energy sources. By harnessing the power of nuclear reactors, desalination plants can operate continuously, providing a reliable and consistent supply of freshwater.

One of the primary economic benefits of nuclear desalination is its potential for reduced operational costs. Although the initial investment in nuclear infrastructure is high, the long-term savings from lower fuel costs and increased efficiency could offset these expenses, with the cogeneration of electricity and desalinated water significantly reducing the overall cost of water production. Consequently, cogeneration plants, which simultaneously produce electricity

Desalination plants are currently considered one of the most expensive methods of creating drinking water.



2

and freshwater, are becoming more common due to their enhanced efficiency and dual purpose.

From an environmental perspective, nuclear desalination has a lower carbon footprint compared to fossil fuel-powered desalination plants and this reduction in greenhouse gas emissions is crucial in the fight against climate change. Additionally, nuclear power generates minimal air and water pollution if waste management protocols are properly followed. The use of advanced devices, such as water-cooled reactors, further increases the plant's environmental benefits by improving safety and efficiency.

Nuclear desalination can contribute to energy security and diversification by integrating nuclear energy into the water supply system. Therefore, countries can reduce their reliance on imported fossil fuels, enhancing their energy independence. This is particularly important for regions with limited natural resources or unstable energy markets.

Nuclear desalination offers several advantages over conventional methods, particularly when it comes to economic and environmental benefits.

Current and future projects

Nuclear desalination has been successfully implemented in several countries, with promising results. Kazakhstan, India, and Japan have accumulated over 120 reactor years of experience in nuclear desalination, demonstrating its technical feasibility and economic viability. Existing projects, such as the BN-350 fast reactor in Kazakhstan, have provided valuable insights into the practical applications of nuclear desalination. This reactor, which operated from 1972 to 1999, was used for both electricity generation and desalination, producing 80,000 cubic meters (m^3) of freshwater per day. The success of the Kalpakkam plant has spurred interest in expanding nuclear desalination capabilities by two additional desalination plants.



4



6

The success of this project highlights the potential for nuclear desalination to meet the water needs of arid regions.

In India, the Kalpakkam nuclear desalination plant has been operational since 2002. This plant uses a hybrid process, combining reverse osmosis and multi-stage flash distillation, to produce 6,300 m^3 of freshwater per day. The success of the Kalpakkam plant has spurred interest in expanding nuclear desalination capabilities by two additional desalination plants.

Japan also explored the potential of nuclear desalination, with the Oarai Multi-purpose Reactor (OMR) being used for experimental desalination studies. These studies have demonstrated the technical feasibility of nuclear desalination and have provided valuable data for future projects. have demonstrated the technical feasibility of nuclear desalination and have provided valuable data for future projects.



5

Challenges and considerations

Despite the promising potential of nuclear desalination, several challenges and considerations must be addressed to ensure its widespread adoption and success. Safety concerns are paramount, given the potential risks associated with nuclear energy; for example, the possibility of nuclear accidents, though rare, necessitates stringent safety protocols and effective risk management strategies.

Public perception and acceptance of nuclear energy are significant obstacles. Past nuclear incidents, such as those at Chernobyl and Fukushima, have left a lasting impact on public opinion, often leading to resistance against new nuclear projects. Effective communication, transparency, and education are essential to address these concerns and highlight the benefits and safety measures associated with nuclear desalination.

Regulatory and political hurdles also pose challenges to the development and implementation of nuclear desalination projects. The nuclear regulatory framework varies significantly across countries, and international cooperation and harmonization of regulations are necessary to facilitate the global expansion of nuclear desalination.

The integration of renewable energy sources with nuclear desalination could further enhance its economic and environmental benefits.

While the IAEA has extensively supported member states in testing and implementing innovations related to nuclear desalination, political will and support are crucial for the successful deployment of these projects, as they require substantial investment and long-term commitment.

Economic viability is another critical consideration. While nuclear desalination can be cost-effective in the long run, the initial capital investment is high. The integration of renewable energy sources with nuclear desalination could enhance the economic and environmental benefits of the process. However, assessing the specific needs of target regions, including both electricity and water requirements, is essential to justify the investment.

Potential impact on global water scarcity

To understand the severity of the issue, let's get back to some statistics. Seventy-one per cent of the Earth's surface is covered with water, but 97.5% of this is highly saline, and the remaining 2.5% is locked up in polar ice and glaciers. That leaves mankind with less than 1% of water which can be used for drinking, showering, watering our land—especially considering unreliable rainfall patterns—and sanitation. Of this 1%, the water is not distributed evenly either spatially or temporally. Natural water cycles can be forecasted but with an increasing population, the annual water supply per person will decrease.

A seemingly great solution could be to produce freshwater from seawater, which by applying both evaporative and membrane processes fully meets the drinking water quality set by the World Health Organization and other standards set at a supranational level. Over 300 million people depend on desalinated water globally, and in the Middle East and North Africa, around 70% of domestic water comes from such facilities.

Desalination is a safe source of water, and its quality can easily be compared to conventional water supply sources. However, long-term reliance on desalination should only occur if the required availability of water is comparable to the availability of the energy supply. Better water conservation supplies and measures such as water recycling could significantly reduce the demand for drinkable freshwater, but if these do not suffice, desalination will be an inevitable process.

Nuclear desalination is a technically feasible and promising alternative to other water sources, particularly in regions with access to seawater. It can co-generate freshwater and energy, potentially reducing the costs associated with desalination processes.

Several decades of successful operation prove that nuclear desalination could be a promising alternative to other water sources. It is technically feasible if properly managed, complies with safety standards, and, especially when built offshore, could widen the possibilities while co-generating freshwater and energy. Therefore, advancing nuclear desalination technology and infrastructure is crucial and will necessitate international collaboration, substantial investment, and continuous commitment to meet the demands of one of humankind's fundamental needs, that is, freshwater. ●

Over 300 million people depend on desalinated water globally, and in the Middle East and North Africa, around 70% of domestic water comes from such facilities.

1. Fragmented arid soil. Photo: Micaela Parente / Unsplash
2. The largest water desalination facility in the world at sunrise, Hadera, Israel. Photo: Luciano Santandreu / Shutterstock
3. Koeberg Nuclear Power Station has completed its own groundwater desalination plant, South Africa. Photo: Paul Scott
4. A Fast-Breeder Test Reactor at the Kalpakkam Nuclear Complex, India. Photo: Kirstie Hansen / IAEA.
5. The world's first nuclear desalination plant was the BN-350 fast reactor in Aktau, Kazakhstan. Photo: United States Department of Energy
6. The Ohi power plant was Japan's first major nuclear desalination project. Photo: Kansai Electric Power Co.

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Funded by the European Union

The Rural Economics of a Spanish Wildfire

WRITER: **JAKE THREADGOULD**

1

Communities in Spain spy economic opportunities in wildfire prevention

A charred pine forest runs along one side of the valley on the way to the sleepy village of Descargamaría in the Sierra de Gata. It offers a stark reminder of the perils of the summer months, when local communities in this remote corner of Spain's Extremadura region brace themselves for wildfires, which are being fanned by climate change and a rural exodus.



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Forest blazes like the one that scorched 10,000 hectares (that's 14,000 soccer fields) of pine forests near Descargamaría in May 2023 not only leave their mark on the landscape but also on the local economy and people's minds. Local residents, many of them older people, had to be evacuated from the wildfire as it encroached on the village last year. Back in 2015, another large forest fire burned over 8,000 hectares of land and forced 1,500 people to evacuate their homes.

"Last year we had a fire that came from Las Hurdes into the Valle del Arrago, but the wind changed and thanks to that and the great work from the firefighters, we were able to extinguish it, but not before it burned thousands of hectares. The year before that there was one in Torre de Don Miguel, where they had to evacuate the village," Luis Mariano Martín, former mayor of Villasbuenas de Gata and now the president of the local rural development association ADISGATA, tells REVOLVE outside his property in Sierra de Gata.

"This is the tune that plays out every day. It's a never-ending fight, and when summer comes around, we're all scared to death of what might happen," he adds.

Estimated area burned and number of fires in Spain between 2006 and 2023



Fanning the flames

Climate change will make wildfires more intense as rising temperatures make landscapes and vegetation drier for longer periods of the year. There were 371 recorded fires in Spain in 2023, which burned a total of 91,220 hectares, according to the European Union's fire monitoring satellite service EFFIS, which may also include intentional fires set for vegetation burning or agricultural purposes. The year before that there were 494 fires recorded, with a combined burned area of 306,555 hectares, the highest this century for Spain. Of those, 56 were considered large forest fires over 500 hectares.

Although it is hard to put an exact tally on the economic damage caused by a wildfire, the initial land restoration budget allocated by the Extremadura regional government for the May 2023 blaze, for example, was 15 million euros. A March 2023 report estimated annual losses caused by wildfires in regions of southern Europe to be between 13–21 billion euros. This is considerable in an area like the Sierra de Gata, where the unemployment rate sits at 12%, according to ADISGATA.

> There are wildfires because there is no local economy and there is land abandonment.
>
> Fernando Pulido

However, the core driver of intensifying forest fires in rural Spain is population decline. Between 2011 and 2021, the number of people living in the Sierra de Gata region decreased by nearly 11% from 23,056 to 20,570. People over 65 make up almost 30% of the population, well above the Spanish average of 19%. In Descargamaría, there are now only around 50 year-round residents (the census will tell you 103 due to others registering their legal address in the village), a far cry from the over 700 back in the 1960s according to the Spanish Statistical Office (INE).

When rural people pack up and leave the area, they take with them traditional jobs like livestock herding, farming, and tree cultivation, which once shaped the forests of the Sierra de Gata into a mosaic landscape. In their absence, vast expanses of pine trees have moved in, creating uninterrupted swathes of woodland and turning the region into a tinder box ripe for an out-of-control fire.

"There are wildfires because there is no local economy and there is land abandonment," says Fernando Pulido, a professor of forest science and conservation at the University of Extremadura (UEX) and well-known face in the Sierra de Gata for his work on wildfire prevention. "There is a change in social dynamics as people leave here for the



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cities. This leaves us with a forest that is unmanaged, leading to overly large forest fires," he adds in an interview with REVOLVE.

Mosaic landscapes

As part of the RESIST Project, Pulido and local partners in the Sierra de Gata are working to implement strategies that not only mitigate the risk of wildfires but also offer economic opportunities that keep local communities in the area.

"We believe that we can turn wildfire prevention into an opportunity if we can approach it in a way that is participatory with local stakeholders," Pulido says. "If we revive the sustainable economic management of the land, we will be making a positive contribution to wildfire prevention. It's about tackling the root of the wildfires."

One way this is being done is by creating professional networks between people already working on the land to amplify their impact on the forest. Another is being demonstrated with a case study that will clear 10 hectares of forest in a high-fire risk area – specifically, the area that burned in May 2023 – to set up a chestnut plantation. This pilot will be financed through the project, meaning no direct costs will be incurred by local associations.

"If we generate discontinuities in the forest, something we call productive firebreaks, then we can stop the fire or at least ensure that it is smaller and less catastrophic," Pulido says, providing examples of traditional activities like goat herding and tree cultivation, which both manage the expanses of forest by reducing tree density. Human or animal activity in between the trees also helps to keep the undergrowth and scrub down. Combined, these effects on the forest make it harder for flames to spread through the canopy and the forest floor.

There is nothing new about the mosaic system in the Sierra de Gata. In fact, it marks the return of a rural system that was once prevalent in the region. The trick is to make it economically viable.

Tapping into rural talent

One person trying to do this is Javier Calzada, a Sierra de Gata native in his early 20s who has turned his hand to resin tapping, making use of the ample pine groves in the region. The resin he extracts is sold for multiple manufacturing uses, notably to make medical pill capsules.



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"I started resin tapping because I like nature, I like to work outdoors, and most of all because I get to set my own rules," he tells REVOLVE in an interview at his plot of Pinus pinaster pine trees.

Calzada explains that the resin in the trees is easier to extract when the temperatures rise above 27 C (80 F), which means most of the process takes place in the summer. But preparations begin as early as February, when he begins to make small cuts into the bark at the bottom of his trees, under which he places a funnel contraption and small black bucket to collect the resin.

As a self-employed worker, he says that price fluctuations in the resin market and precarious finances can make the job challenging but acknowledges the existence of economic help from local authorities. By choosing to be a 'resinero,' Calzada is able to work near his hometown while at the same time returning a service to his local community when it comes to wildfire prevention.

"Resin tappers are an interesting case of productive firebreaks," says Pulido. "If there are resin tappers, there are two benefits. Firstly, they move around and eliminate vegetation and shrubs. It is like there was a herd of goats in there. But most of all, the resin tapper is like a permanent watchperson in the forest because it's not in their financial interest to have a fire burn their source of income. And it's this double effect, of cleaning up vegetation and surveillance, that interests us about the resin tappers."

> A resin tapper is like a permanent watchperson in the forest because it's not in their financial interest to have a fire burn their source of income.
>
> Fernando Pulido



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Knowledge shared

The efforts to revive the local economy in the Sierra de Gata are generating knowledge that can be of use to other depopulating areas of rural Spain and farther afield. In early April, RESIST partners from Central Portugal and Extremadura took part in a two-day field visit between their respective regions, which border each other, to learn about some of the shared climate challenges being addressed in the project. Once validated, the solutions tested in these regions will be shared with others participating in the project across Europe.

But the impact of these solutions will be felt closer to home for the Sierra de Gata residents, many of whom are involved in the project activities as co-creators and beneficiaries. Equipping people with the tools and resources to make a living will ultimately shape the landscape in rural Spain.

Preventing Wildfires in Rural Spain | RESIST

Watch our video on REVOLVE's YouTube Channel to learn more about these initiatives.

1. Luis Mariano Martín engaged in conversation near his property in the Sierra de Gata, Spain. Photo: Jake Threadgould / REVOLVE
2. Fernando Pulido (L) points to a map showing historic wildfires in the Sierra de Gata, Extremadura, Spain. Photo: Jake Threadgould / REVOLVE
3. Local authorities take part in a field visit to discuss wildfire prevention methods. Photo: Jake Threadgould / REVOLVE
4. Pine forests cover the landscape in the Sierra de Gata, Extremadura, Spain. Photo: Jake Threadgould / REVOLVE
5. Javier Calzada, a resin tapper, prepares his materials at his pine grove in the Sierra de Gata, Extremadura, Spain. Photo: Jake Threadgould / REVOLVE
6. Javier Calzada during an interview at his pine grove in Extremadura, Spain. Photo: Jake Threadgould / REVOLVE
7. A resin bucket at the bottom of a pine tree in Extremadura, Spain. Photo: Jake Threadgould / REVOLVE

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The Unseen Impact of Patriarchal Mobility

WRITERS: **BAHANUR NASYA AND YILMAZ VURUCU**

1

How many women have you mobilized through your work?

The model citizen has historically enjoyed a well-balanced home-work-leisure routine, with mobility planning centered around his needs to access specific destinations at specific times. This approach has, however, restricted the exploration of alternative lifestyles and needs. As a result, the dominant mobility paradigm has focused on traveling between destinations, promoting the use of privately owned automobiles for commuting.

This approach has led to a division between residential and commercial spaces, with residential areas sprawling across wide areas, separated from buildings with other uses. This paradigm has also promoted the use of privately owned automobiles for commuting, contributing to a significant carbon footprint.

However, this model overlooks individuals with part-time jobs, caregivers, and those with multiple responsibilities. These individuals, often women, have different mobility needs and patterns. For instance, women tend to use public transportation and active mobility options like walking and cycling more frequently, making them more sustainable.

To achieve sustainability, mobility planning must consider all individuals and their needs. This includes offering a convincing reason to choose the right mode of transport, considering risks and complex destination relations. Cities have made strides in improving accessibility and mobility offers, but peri-urban and rural areas face significant challenges due to the energy crisis, exacerbating mobility inequality.

It is crucial to focus on the mobility needs of women and develop good mobility offers that enhance sustainable practices. Instead of perpetuating the existing paradigm, our work should empower women by improving the capacity of sustainable mobility offers that cover the needs of complex daily tasks.



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Embedding in fear to exclude

Individual choices are determined by individual perceptions. For women, girls, and gender minorities, fear of sexual harassment or other forms of violence is a reality. Religious, ethnic, and gender minorities also feel more exposed to all sorts of risks. This fear leads to decisions that impact their mobility such as extending the route, avoiding places or certain times, and having to choose more expensive ways of travel; and if none of these workarounds suffice, they might avoid moving around at all, which has an impact on participation in work, education, or public life in general.

Although various movements such as #metoo and the local #IspeakUpNow have successfully highlighted the plight of women and gender-based harassment and violence, the cause of fear in most areas of the world is not solely due to what happens, but on what could happen in a place where women and minorities feel vulnerable.

Given that mobility is considered an avoidable risk, this can lead to gender-based or minority-based segregation. Our current mobility strategies and offers neglect this fear and offer too few solutions, although solving the safety issue could empower citizens to move around in a more social, affordable, and sustainable way. Instilling safety to include, is as easy as creating diversity and visibility for the people moving around.

People feel safe in communities that consist of diverse people. A healthy public life requires guarding the rights of individuals and the achievement of this necessitates an understanding (by policymakers and planners) of the local dynamics and implementation of interventions that improve conditions.

Increasing the participation of women and gender minorities in jobs related to mobility is an effective way of increasing perceived safety. Currently in Europe, around only every fifth person in the sector is a woman. In rural areas, this number plummets even further. Ensuring diversity in service personnel sends positive signals and demonstrates a welcoming culture towards people who need to overcome their fears.

To achieve sustainability, mobility planning must consider all individuals and their needs.



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From shaming to exclusion

Individuals not fitting the religious, cultural, ethnic, economic, or sexual standards of society are always at risk of cultural pressure from the majority. This can even include the pressure to conform to the standards of a car-based culture.

Culturally defined roles and their associated tasks (such as the domestic chores and care activities taken on mostly by women) can define and determine the travel patterns, while the available options can chart out the radius of movement.

Women generally incorporate trips to a few locations, such as stopping by the pharmacy on the way to kindergarten or going grocery shopping in between destinations. This method of multi-destination travel within a short and limited timeframe is often overlooked and not incorporated into the definition of mobility.

The intersection of motherhood or sisterhood with mobility can carry various risks, with the caretaker being more dependent on mobility offers. The needs of such individuals often do not fit within the 'traveling to work and back' concept of orthodox mobility.

Domestic Mobility Work a concept developed by Marie Gillow, PhD in Social and Political Sciences at Université Libre de Bruxelles (ULB), needs resources, efforts, and skills to be managed. Therefore, household and family-related trips should be seen and handled as a form of labor. Innovative, flexible, and smart solutions can help enhance capacities and improve mobility for women and minorities.

The gender-pay gap

The European gender pay gap is around 12%, which makes moving around, purchasing a 'second car' to get to a part-time job, and integrating all tasks and care activities with ease close to impossible, particularly for economically disadvantaged women in rural and semi-periphery areas.

Outside Europe, significantly fewer women own a car or have a driver's licene, leaving them more dependent on walking, cycling, or public transportation. When public transportation offers are limited – whether it be due to scarcity of options or lack of affordability – overcoming longer distances becomes a near-impossible challenge, which in turn limits the radius for care activities, education options, work opportunities, well-being, and health services for women as well as the people they're responsible for.

Mobility is often a question of economic possibilities – a resident-based offer of public transportation and support for active mobility investments can help overcome economic bottlenecks, and it defines, to a big extent, the public life of individual citizens and can't therefore be left to the free market.

Free public transport or affordable subscriptions, as well as options for the last mile home, can support the mobility of women. Also, investment in car sharing, bike sharing, as well as e-mobility offers can help overcome the financial barriers.

Common gender equality strategies can improve the gender-mobility gap as well. Gender pay equality in all fields, including care and mobility jobs, gender equality in promotion and recruitment, and a guarantee of job availability despite care responsibilities can make a real difference.

Designed to exclude

Municipalities, regardless of the size, have generally been designed around men's necessities, habits, routines, and bodies, which has led to a lack of adequate infrastructure for women.

Collecting sex-disaggregated data on public transportation and mobility is simple but not a common practice, particularly in rural areas. Most research and surveys focus on 'commuters,' and people working outside of the 'norm,' including those in unpaid labor, are often overlooked by our statistics. This results in a lack of evidence of the existing inequalities.

People feel safe in communities that consist of diverse people.



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A closer look at our infrastructure can help identify who is left out. For instance, sidewalks that are too narrow or dissolve at certain points to give access to cars say a lot on the preference given in design. In other places, metro systems without elevators exclude not only people with disabilities but women carrying strollers as well.

Women are often exposed to harassment when breastfeeding their children in public, yet diaper-changing areas in public spaces are rare in most areas. A strong political will and the attention of the public can rapidly transform faulty infrastructure into sustainable means of transport.

Universal design for all public areas is the basis for ensuring widespread participation in public life. Additionally, gender mainstreaming has been internationally adopted as a key strategy towards making gender equality a reality in planning and the Gender Equal Cities EU network, for example, is highlighting achievements in this respect.

Unfortunately, most peri-urban areas and rural municipalities have vacancy activation and village-center activation on their agenda. However, combining these efforts with the mobility needs of their citizens can lead to better results and the improvement of active mobility in these areas will especially increase footfall, which is needed for the activation process.

Mobility is often a question of economic possibilities.

A just offer of mobility to increase sustainability

Justice is a matter of empowerment and we as a society need to identify and strengthen positive behavior and sustainable patterns. Regarding mobility, women and their patterns have been left out of mobility strategies and planning.

Just mobility offers accessibility for all, to cover people's needs and promote safe and secure mobility. Every place has its own dynamics, set of people, needs, and infrastructure. Therefore, a sound offer needs to investigate the working culture, gender stereotypes, built environment and design, available facilities, work-life balance, economic divide, and how the roles in the household are interchangeable when planning mobility that can appeal to all.

1. Woman waiting for the bus, Limerick, Ireland. Photo: Shalvi Raj / Unsplash
2. Woman walking in the rain, Brooklyn, New York, United States. Photo: Patrick Tomasso / Unsplash
3. Two women waiting for the bus at night, Chile. Photo: Lucas Quintana / Unsplash
4. Two women walking together. Photo: Artem Polezhaev / Unsplash
5. Woman walking with groceries in the snow, USA. Photo: Mike Cox / Unsplash
6. Woman crossing the street with stroller, Paris, France. Photo: Anna Oliinyk / Unsplash
7. Woman waiting for the bus, The Netherlands. Photo: Amel Majanovic / Unsplash
8. Woman biking in the rain, Singapore. Photo: Shawnanggg / Unsplash



8



Transformative Digitalization in the Food Industry

WRITER: **DANIEL DE LA PUENTE**

1

Harnessing the power of digital twins, AI, and blockchain to revolutionize the food supply chain

Digitalization is poised to play a significant role in transforming the food industry. Drawing parallels from a 1995 tire advertisement which famously stated, “Power is nothing without control,” the vast potential of digital technologies can only be realized through their practical application in specific, real-world contexts.

Digital transformation is not just a theoretical concept. It is a necessary evolution for improving accuracy, efficiency, and sustainability in food production. This transformation is illustrated through our work at BBTWINS, an EU-funded partnership between industry and research harnessing the power of machine learning and deep learning and using artificial intelligence (AI) algorithms analyze vast datasets to predict crop yields, optimize resource allocation, and reduce waste.

The core of the project is the digital twin technology, virtual representations of physical objects or systems that are used for simulation, analysis, and control. They are created by linking real-world data from sensors on the physical entity to a digital model, allowing for real-time monitoring and optimization. At BBTWINS, we combine AI and blockchain-based traceability in this single platform to address concrete challenges and enhance process efficiency in both pork and peach production using the power of digital innovation for a more sustainable agri-food sector.

From pigs to peaches

In the pork industry, raising animals to a given optimal weight is key. Monitoring growth also helps identify sick animals and the effect of their diet. With traditional methods like scales, monitoring is both time-consuming and prone to error.

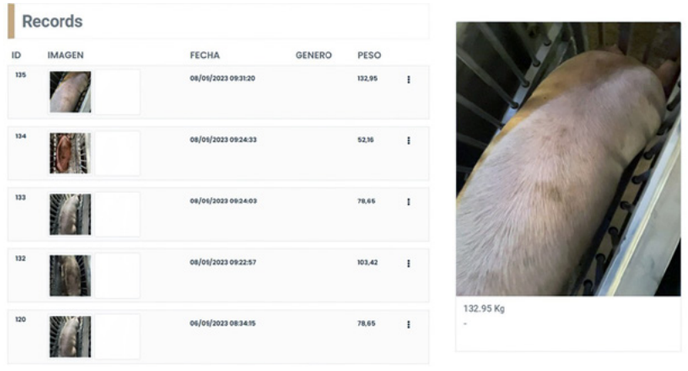
Imagine weighing a 120 kg pig. One must guide the animal out of its cage and then onto the scale for measurements before sending it back. Let’s assume the whole process takes three minutes. Now think of a medium-size farm of 200,000 heads of livestock. It would take 10,000 hours to weigh tall the animals just once in their life – more than a full year of measuring around the clock. If weights are to be monitored it would make sense to take measurements every week – it’s unaffordable.



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The industry relies today on trained workers who visually inspect animals and mark those that appear to have reached the desired size. An extremely inaccurate method, to say the least. In BBTWINS, by integrating AI with image processing technologies, cameras equipped with AI algorithms continuously capture and analyze images of the pigs.

This system not only predicts the weight of each pig with remarkable accuracy but also tracks their growth over time, reducing the variability associated with manual assessments. Such technology ensures that we maintain high-quality standards while significantly reducing the labor and time traditionally required for such tasks.

For fruit production, specifically peaches and nectarines, we face different challenges, primarily in optimizing fruit yield per tree. Picture a peach orchard blooming in spring, boasting white flowers worthy of an impressionist painting. As pretty as this may be, the farmer’s attention is likely focused on more practical matters – too many flowers mean too many small peaches, and there are only so many nutrients a tree can convert into fruit. But too few flowers may result in peach sizes over the desired caliber that are too expensive for the average consumer.

One may think that farming is pretty much just sitting and waiting, and that nature will just give you what you want, but it’s far more complicated.

Once again, the year+s harvest depends on the visual inspection of a trained eye. By mounting cameras on tractors that traverse our orchards, BBTWINS collects images that are automatically processed to assess flower and fruit count. These images, analyzed using sophisticated algorithms, help us make informed decisions about how many fruits to thin out to achieve the optimal size and quality at harvest.

This method not only enhances our yield quality but also supports sustainable farming practices by enabling precise resource management.

Blockchain guarantees

Another cornerstone of our digital strategy is the use of blockchain technology to ensure robust traceability across our supply chains. In an industry where transparency increasingly influences consumer trust, labels are simply not enough. Nowadays, labels are crowded on the containers ensuring the origins of the produce or how socially and environmentally responsible the production process was; however, the European Commission has concluded that more than half of the green claims give vague information, and more than 40% have no supporting evidence.

In an industry where transparency increasingly influences consumer trust, labels are simply not enough.

We combine AI and blockchain-based traceability in this single platform to address concrete challenges and enhance process efficiency in both pork and peach production.

What if we could rely on proven facts, rather than trust? Blockchain offers an unalterable record of every transaction and process. You can be sure of a produce origin and fully trust in the production chain.

This technology not only facilitates internal management and compliance with industry safety standards but also enhances consumer confidence in products by providing a clear, traceable path from farm-to-table. BBTWINS records data along the entire pork and peach production chain, expecting to provide QR codes for consumers to scan and know all about what they consume.

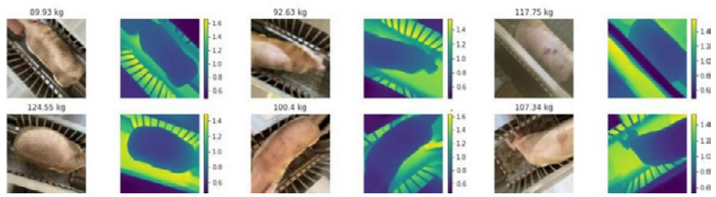
And the technology can also be used for other agricultural production and livestock, meaning that BBTWINS has the potential for revolutionizing the entire agrifood sector.

Some challenges to address

However, the integration of these technologies is not without challenges. It requires significant investment in both technology and training, as well as a thoughtful approach to data privacy and workforce adaptation. For instance, the integration of AI and blockchain technologies may pose challenges in complying with data privacy regulations like the EU's General Data Protection Regulation (GDPR), data storage can create vulnerabilities if not implemented securely, and maintaining control over data governance and ensuring that data is used ethically and in compliance with regulations can be complex.

Furthermore, as we automate more processes, we must also consider the social implications, particularly the impact on employment within the industry and the necessary skills transition for our workforce. There are several EU initiatives to address the needs of the workforce, particularly on building data literacy and also developing AI literacy so workers can understand their new role in the workplace and properly use such technologies to their own benefit.

As we look towards the future, the role of digital twins and related technologies in agriculture will continue to expand. These tools not only offer a way to optimize production but also serve as a crucial component in making the food supply chain more sustainable, resilient, and responsive to global needs. By embracing these innovations, we not only transform our business operations, but we also become part of a united effort to redefine the entire industry for the better. ●



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1. Field of peach trees in bloom, Aitona, Spain. Photo: Nadia Haniaj / Unsplash
2. Group of pigs eating at a trough. Photo: Amber Kipp / Unsplash
3. AI predicting the weight of pigs via image processing. Photo: BBTWINS
4. Records of images, dates and weights of pigs. Photo: BBTWINS
5. AI image processing predicting the weight of pigs. Photo: BBTWINS
6. AI assessing flowers and peaches count via image processing. Photo: BBTWINS

There Is No Energy Transition



REVIEW BY **STUART REIGELUTH**

Sans Transition, Une nouvelle histoire de l'energie
Jean-Baptiste Fressoz
Paris: Editions du Seuil, 2024.
408 pages. €24.00

The energy transition does not exist. This is the main point made by Jean-Baptiste Fressoz. Literally, "sans transition" in French means "without transition," which implies a continuity, a progressive and linear flow of events, moments, and in this case of energy production and consumption. In more colloquial French, 'sans transition' means 'non sequitur' as in a 'quick switch' between points in a conversation. Clever, Fressoz is saying: not only does the energy transition not exist but those that say so are missing the broader continuum point and causing a disconnected debate that disregards the much larger spectrum of energy sources.

The argument is provocative to say the least and puts on its head the staunch advocates of the energy transition at large, the *Energiewende*, as coined by the Germans, who happily announced their plans to get off coal and nuclear and to go full throttle ahead for 100% renewables by some distant date. Fressoz does not get into specific dates; he would see them as being set up for disappointment as witnessed by the climate action movement that continually sees the 'shifting goal posts' of climate targets being moved (and missed because they are moved) time and again. Pushing the responsibility of finding sustainable solutions into the future, to the next generation.

Fressoz avoids the climate action discourse entirely, and rather would say: look closely at Germany as an example, they claim to be going for renewable energy sources to replace fossil fuels but then reality kicks in and coal continues to grow: old worn-out mines are closed, but new bigger ones are opened to fuel the transition, and renewables are growing but they can be intermittent, so we need nuclear too, and nuclear remains a massive baseload for maintaining and buffering this supposed transition to clean sources of energy that will eventually be zero emissions and good for the planet and people so we may live happily after.

Red flag, Fressoz whistles loudly. We may think that supporting the 'energy transition' as a concept is good for planet-people-profit in principle, but the reality is a deeply embedded and intertwined co-dependence of energy sources that continue to destroy the very same planet we claim to be wanting to protect. While the irony is not missed, his argument is not new. There are powers at play that are much bigger than mere mortals. What is refreshing is the slap in the face that says: you are part of an economic system that is 'hooked on fossils' and on the road to self-destruction. Coupled with population growth and exponential subsequent demand, the "symbiotic relation" between energy sources is causing the continued expansion of these mutually reinforcing sources of energy. It's not either/or, it's always x times y on the matrix: there is always a co-relation of cause and effect. There was no 'quick switch' from the Stone Age to Bronze Age, or from steam to coal to fossil fuels to renewables. Fressoz's leitfmotif is that the histories of energy based on 'phases' or 'ages' are misleading and fall back on the generalized convenient transition theory.

An energy transformation with time and technology would be a more adequate description of our evolution of energy times humans. Wood is still used for coal mining. Coal is fueling the transition to electric vehicles. Cardboard is the largest packaging polluter on Earth (three times more than plastics). After 100 years, wooden oil barrels are no more; now the barrels are metal. Fossils are fueling the growth of renewables. Some windmills are now being built out of wood. In 2020, ¾ of global steel is made by burning coal. Wake up call. There is a systemic challenge that we are looking at but not really seeing properly. Malthus is turning in his grave.

Watch out for frenetic, unabated growth. ●

Hopium for Nerds



REVIEW BY **PATRICK WORMS**

Our Fragile Moment, How Lessons from Earth's Past Can Help Us Survive the Climate Crisis
Michael Mann
New York: PublicAffairs, 2023.
320 pages. $19.00 / $30.00

Why do 4 billion years of climate history leave me optimistic

For the past three decades, almost anyone paying attention has become aware that the climate of our planet is changing, that it's doing so rather rapidly, and that this is leading to all sorts of nasty outcomes - from increasingly extreme weather through rising sea levels to higher food prices, and more.

This has led to a massive effort from the fossil fuel industry to dismiss the whole thing as some kind of conspiracy by corrupt climatologists. They've been abetted, in more recent years, by false prophets of doom stating that it's already too late and that the best we can do is prepare for our collective deaths with a smile on our face.

Michael Mann became famous as the author of The Hockey Stick and the Climate Wars (Columbia University Press, 2012), which slapped the world awake. In "Our Fragile Moment," his latest book, he meticulously dissects the findings of climate science as applied to our world's history (paleoclimatology, as it's known, reaches right back to the planet's beginnings in the Hadean Eon). This is the best kind of science book; it doesn't dumb anything down, doesn't hide any of the scientific controversies, yet is diamond-clear in its writing.

The conclusions he comes to are clearly alarming: we don't have an enormous amount of leeway left to keep our planet a pleasant place for most of its inhabitants. But the conclusions are also oddly reassuring. Mann points out, with all of the science, that the doomist idea that we're all going to die thanks to a methane bomb is profoundly wrong. We can save our sorry asses – if we choose. With this in your back pocket, you'll never again fall for idiotic headlines screeching for your clicks.

He doesn't discuss it in this book, but if you combine those insights with the extraordinarily fast rollout of solar and wind energy, the rapid expansion of grid management to let renewable energy reach consumers, and the expansion of storage like batteries to keep electricity available for the days when the sun don't shine and the wind don't blow, then you begin to see a way out of our fragile moment.

Yes, we can take steps back, and these steps can come from both sides of the political spectrum. Sure, a Donald Trump destroying climate subsidies and pumping numberless billions into new fossil fuel subsidies would be bad news. But a President Biden who decides, for political reasons, to slap 100% duties on cheap Chinese electric cars, which will slow down the transition to decarbonized transport in the United States, is not exactly great news either.

But by and large, the animal spirits of capitalism are developing an extraordinary range of solutions affecting hundreds of industrial sectors, from the most basic (check out cement) to the most obscure, all pointing in the same direction: fewer greenhouse gas (GHG) emissions and lower resource use for the same, or even more, products and services.

Our Fragile Moment does not necessarily have a good outcome, but right now I'd say that is a more likely prospect than that it would end up in disaster.

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