

REVOLVE



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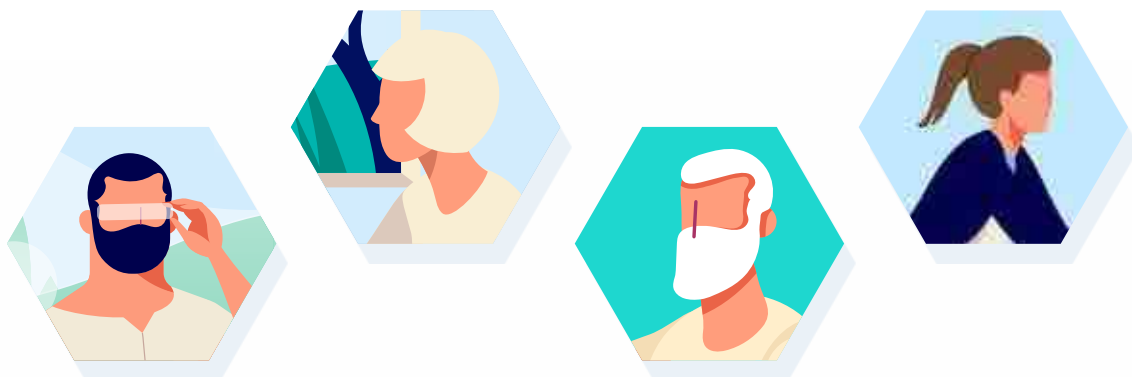
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Flashback to a similar cover feature of Tar Sands in Alberta, Canada, by Alan Gignoux in 2012.



COVER IMAGE: WORLD LARGEST EXCAVATORS AT HAMBACH MINING SITE. SOURCE: MICHEL PETILLO

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1.

Bad plastics, good plastics

WRITER:

Erik Solheim, Head of UN Environment



2.

An unfortunate consequence of our campaigning against the tide of plastic pollution is that some think the United Nations has decided to go to war with the plastics industry. That could not be further from the truth.

The fact is that plastics are a miracle material and could even be the very thing that saves humanity from catastrophic climate change. The problem in our oceans isn't plastics, it's what we do with them. Over the years, we got lazy – creating an infinite number of single-use, throwaway items like bags, drinking straws or pointless packaging. These items are often used for just a few seconds, and then cast away indefinitely to take up space in a landfill or float around the oceans.

Plastic particles have been found at the bottom of the Mariana Trench, the deepest point on earth. Lumps of polystyrene have been seen floating amid the icebergs, and starved whales have washed up in Spain and Norway with their digestive systems crippled by plastic bags. At the current rate, we're turning the seas into a plastic soup, although for some tidal convergence zones that is already the case.

The bottom line is that many plastics are not resource efficient and are a waste management nightmare. The way forward is clearly the EU's new plastics strategy and a ban on single-use plastics. In turn, we have to be far smarter, which is why, ultimately, we'll be campaigning for upstream change. We need to see smarter designs and an end to the kind of levels of planned obsolescence that we see today in so many products. In other words, manufacturers must start to think about and be accountable for the full lifecycle of their products.

This shift will also have a bearing on the clean energy revolution. Plastics will be at the center of solutions to a whole host of environmental

1. ERIK SOLHEIM, HEAD OF UN ENVIRONMENT

2. LOCAL PEOPLE FROM WATAMU WORK WITH LOCAL OCEAN CONSERVATION TO PICK UP PLASTIC ON THE BEACH, ON EACH FRIDAY. © UNEP/CYRIL VILLEMANN



ABOVE: TRASH AT A BEACH IN BALI WHERE UN ENVIRONMENT LAUNCHES THE CLEAN SEAS CAMPAIGN © UNEP/SHAWN HEINRICH.

issues – and therein is a huge opportunity for the sector to transform some of its worst practices, notably that of churning increasing quantities of single-use plastics.

Modern polymers are now a common part of fuel-efficient transportation – and famously made up much of the record breaking proof of the concept Solar Impulse plane. Plastics are finding their way into green buildings, redefining what can be achieved both in terms of innovative architecture, energy efficiency and low materials cost. And the growth of wind farms across Europe – some of them setting new production records that are shattering all expectations – are further proof that plastics are far from being a menace.

All this is proof that the best ingredient for solving our environmental challenges is innovation. This must accelerate, and our plastics problem and energy needs provide a useful intersection for ideas.

The possibilities are huge: 3D printed solar panels could ensure widespread and low-carbon panel manufacturing, with localized production further reducing the environmental footprint of shipping. The plastics to energy sector has huge scope for improvement, while reusing waste plastic or anything from roads to building insulation and integrating that into

clean power generation and storage could merge waste management with low cost but high-quality materials.

What is clear is that the clean energy transition is just starting. While clean power added to the global grid last year and outstripped new fossil fuel installations, clean energy still has a woefully small market share of the energy landscape. Unlocking the true potential of renewables and overcoming some of the stumbling blocks also means unlocking innovation and looking for solutions at the heart of some of the many global environmental problems. A new orientation for the plastics sector is certainly one of the ways forward – meaning we get the very best out of this miracle material. ☺

**The bottom line
is that plastics are not
resource efficient and
are a waste management
nightmare.**



Through its #CleanSeas campaign UN Environment addresses the root cause of marine litter by targeting the production and consumption of non-recoverable and single-use plastic. Find out more: www.cleanseas.org



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Unlocking Capital for Energy Access

WRITER:

Nico Tyabji

One of the major challenges today is how to expand access to energy to every corner of the globe, so that no one is denied the opportunities that come with being connected to a reliable source of electricity. One way to address this challenge involves using off-grid solar companies, which hold significant potential for delivering energy access to the over 1 billion people currently living without any electricity – and to the many more that have unreliable access to the grid. However, channelling capital to these companies from interested investors has been one of the key bottlenecks for achieving scale. ►

Since 2012, we've been figuring out how to create new kinds of investment products for the energy access sector. By blending together catalytic capital with private and development finance, we think scaling the SunFunder model with institutional investors is just around the corner.

RYAN LEVINSON, FOUNDER AND CEO, SUNFUNDER

- SunFunder is a specialist finance company that has unlocked \$62 million for solar enterprises from 2012-17. In doing so, it has experimented with a range of structures to increase investment – and discovered ways to help the sector scale-up to a long-term sustainable future, sourcing larger amounts of capital from commercial investors.

The Energy Access Financing Bottleneck

Today, more than 1 billion people, predominantly in rural areas, still live without electricity, and over half of which are in sub-Saharan Africa. A new ecosystem of commercial enterprises that deliver off-grid solar energy access solutions in developing countries have made significant inroads to address this access gap. For example, in 2017, these enterprises were providing improved electricity access to an estimated 73 million households comprising over 360 million people. There is an even larger opportunity for growth, with an estimated potential market of 434 million households.

The off-grid solar sector is emerging as an investment success story, with over \$550 million deployed in the last two years alone. However, working capital debt for scaling-up has been, and remains, an obstacle for off-grid solar companies year after year. Specialist intermediaries – foremost among them SunFunder, responsAbility's Energy Access Fund and SIMA, as well as broader investors Global Partnerships, Oikocredit and Developing World Markets – are actively lending capital to impactful enterprises across the sector, and beginning to tackle the capital gap which prevents scale.

But even with this progress, the larger question remains: how do we attract different kinds of investors to scale up solar energy access to its full potential?

Matching Capital To Impact

SunFunder was founded in 2012 to address this debt financing bottleneck. Through its

The larger question remains: how do we attract different kinds of investors to scale up solar energy access to its full potential?



A TYPICAL KEROSENE LANTERN



SMALLSOLUTIONS CUSTOMER

series of debt fund raises it has answered part of this question, building the most extensive track record in the sector and offering appropriate fund structures to unlock \$62 million as of the end of 2017. The result has been scalable debt financing for nearly 40 companies, including off-grid solar leaders and pioneers, directly improving energy access for over 3 million people.

Initially launched as a crowdfunding platform, SunFunder quickly moved to larger investor offerings through private debt notes. Demand from solar companies for financing exceeded supply, while the timing constraints of crowdfunding reduced flexibility. The first such note, for \$250,000, was piloted with four investors in 2013 including the DOEN Foundation in the Netherlands, an early leader in innovative energy access funding more widely, and was used to finance solar companies including early industry leaders BBOX, Fenix and SolarNow.

Building on this track record, SunFunder offered progressively larger, longer-term debt products, raising \$15 million from 2013 to early 2016. A key innovation to attract investors with a lower risk appetite was a tiered capital structure, with a first-loss junior layer offering a higher return, which reduced risk for senior investors.

In 2016, SunFunder launched a larger fund, ultimately closing \$47 million with a mix of private capital (from impact investors, foundations and high-net-worth individuals) and development finance institutions, led by OPIC, Facebook and The Rockefeller Foundation played a particularly catalytic role by providing junior capital which was critical for the fund's risk profile. The size of the fund meant ►



▲ SOLARNOW, UGANDA

GIGAWATT PROJECT, RWANDA ▼





▲ © SIMPA INDIA

SMALL KIOSK LIT UP BY MICROGRID SOLAR, INDIA © SAMEER HALAI ▼



- ▶ that SunFunder was able to deploy solar loans averaging \$1.2 million as of the start of 2018, with larger facilities in the pipeline.

The company has now started raising a new \$100 million Solar Energy Transformation fund, which will again present a significant opportunity to investors with a range of profiles — and continue to enable institutional investment for energy access.

Lessons from SunFunder's Approach

In the course of unlocking over \$62m for the energy access sector through innovative investment products, SunFunder has experimented with and learned from several approaches which could serve the industry widely.

Building Track Record to Involve Different Kinds of Investors

A key part of SunFunder's strategy was to offer different investors, with varying risk appetites, a route into the energy access sector. The profiles of these investors have changed over time as SunFunder built its track record and the sector matured more generally. For instance, foundations and impact investors paved the way for public institutional capital from development finance institutions. SunFunder's own capital was required to initiate the first riskier junior layers.

Blending Private Finance

'Blended finance' is typically used to describe the pooling of public funds to mobilize private sector capital. But SunFunder's early experience of blending was with different sources of private rather than public capital. This shows that offering aggregation opportunities to private investors who themselves have different risk appetites can be highly effective.

Catalytic Capital Has a Multiplier Effect

SunFunder's biggest constraint has been the relative lack of first-loss capital at workable



SMALLSOLUTIONS CUSTOMERS HOLDING ONTO THEIR SUN KING PRO LIGHTS, UGANDA

pricing to help deliver an overall risk profile attractive to other investors. Junior first-loss capital in SunFunder's debt funds has been fundamental to their overall success by catalyzing senior and mezzanine investors further up the capital stack while delivering appropriate fund economics. Investors that take first-loss layers in structured funds can unlock multiples of their own investment, which in SunFunder's case was best illustrated by the successive first loss grants by Facebook, which achieved 14x and (alongside The Rockefeller Foundation) 11x multipliers respectively.

Tiered Fund Structure

SunFunder achieved blending through different capital layers in its funds. This has not been static, with models adapted when needed to respond to investor interests and experience. Notably, the new \$100 million Solar Energy Transformation fund has a simpler capital structure of only junior and senior layers.

The new \$100 million
Solar Energy
Transformation fund
present opportunities
to investors with
a range of profiles

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WAKA WAKA, RWANDA

► Early Investors Willing to Innovate

SunFunder benefited from supportive early stage investors who were willing to engage with new fund structures, new products and an uncertain ecosystem. This includes both individuals who believed in the model before it was proven, as well as institutions that pioneered new innovations.

Concessional Pricing

The long-term sustainability of energy access financing relies on building a track record to enable pricing on a commercial basis— but when SunFunder started, an important feature of its initial funds was the concessional returns accepted by impact-oriented investors.

The commercial potential of the sector can prompt concessional investors to demand high returns too early, for instance through high pricing requirements or risk protection. Institutions mandated to deploy catalytic capital can be overly conservative. Concessional investors that could provide grants but expect high-interest returns from riskier debt investments should consider lower-return program-related investments as a best of both worlds.

Commercial Investors Need Comparably Higher Yields

The comparables that commercial investors use when looking at SunFunder's fixed

income opportunities are high yield emerging market corporate bonds and Collateralized Leveraged Obligations (CLOs), which offer returns currently ranging from around 5 percent to 8 percent. Attracting commercial investors into the sector at scale means that catalytic capital will continue to be needed in the near term for intermediaries like SunFunder to remain competitive for solar borrowers, especially compared to other direct lending by concessional investors.

Long-Term Partnerships Allow Learning by Doing

Innovative long-term partnerships are crucial for supporting and testing new fund models. SunFunder benefited from having investors, like Facebook and the DOEN Foundation, who participated multiple times and were willing to innovate as they gained first-hand experience of the company's growing track record and potential for scale.

Concessional Finance Must Minimize Distortion

As the working capital needs of the leading off-grid solar companies have reached ticket sizes of interest to larger concessional investors, including but not limited to development finance institutions, there is a real risk of distortion. In several cases, SunFunder has been squeezed out of deals with solar companies by non-specialist investors offering

highly concessional rates directly—on more than one occasion by institutions that had also invested in SunFunder's debt funds. This hinders the sector moving to further maturity, and prolongs the need for concessional capital in financial intermediaries. This is even more the case going forward as intermediaries seek to unlock commercial capital through blendedfund structures—a step that will be fundamental to the sector's long-term financing needs. ☺

This article is based on SunFunder's "Scaling Energy Access with Blended Finance: SunFunder and the Role of Catalytic Capital" available at www.sunfunder.com/blending



SunFunder is a solar energy finance business with a mission to provide financing for solar assets in emerging economies, including inventory, working capital, construction, and structured finance loans. SunFunder is a well-positioned financial intermediary that has been operating since 2012.

The New Oil Green Hydrogen from the Arabian Gulf

WRITERS:

Frank Wouters

Ad van Wijk

This article builds on last summer's feature by the authors "Using Clean Cars as Power Plants" (Issue #24, pages 24-29) about hydrogen and storage. Read more here: www.revolve.media

In the early years of the 21st century, hydrogen enjoyed great industrial attention, from car-makers to developers of fuel cells, electrolyzers and storage systems, expecting a rapid market breakthrough. So far, the market uptake of hydrogen has hardly lived up to the promise, leaving many supporters and financiers disappointed, particularly with regard to transportation. In the short-term, battery electric vehicles seem to have gained the upper hand, at least for the private vehicle sector. What has changed and why should we be excited about hydrogen now? Let's look at the GCC. ►





► Hydrogen in the GCC

The 6 national economies of the Gulf Cooperation Council (GCC) – Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates (UAE) – have emerged largely on the back of oil & gas exports. But the availability of hydrocarbons has also led to heavy industry including steel-making, aluminium smelters, refineries and chemical industry. Many of those industries have been producing and using hydrogen at large-scale for decades, mainly for producing fertilizers, in refineries and to a lesser extent in the chemical industry. In the long-run, all industries need to decarbonize and there is a potential pathway for that, involving hydrogen made using renewable energy. This hydrogen has the potential to substitute oil and gas in the electricity and transport sector domestically, as well as for export.

Grey, Blue and Green

Some hydrogen is produced as a by-product in refineries and can be re-used after treatment, such as to reduce the sulfur content in transport fuels. Most hydrogen, however, is produced through steam methane reforming, and the resulting hydrogen is characterized as “grey hydrogen”, due to its fossil origin and association with CO₂ emissions. Steam conversion of one ton of methane releases about four tons of CO₂ into the atmosphere. If the production of hydrogen is less carbon-intensive, for example if the CO₂ is captured and permanently stored underground through carbon capture and storage (CCS), the hydrogen is called “blue hydrogen”, a term introduced by Air Liquide, one of the largest hydrogen producers. If the hydrogen is produced from water using carbon-free renewable energy such as wind or solar electricity in an electrolyser, the hydrogen is called “green hydrogen”. All hydrogen produced in the GCC is currently grey.

Green Hydrogen in the GCC

The process to make hydrogen from electricity, referred to as power-to-gas, is a relatively

straightforward process involving an electrolyser, which splits water (H₂O) into its two components hydrogen (H₂) and oxygen (O₂). Due to the scarcity of fresh water in the Arabian Gulf, the water will be sea water, which first needs to be desalinated using a process called reverse osmosis (RO).

Solar Energy in the Gulf

The Middle East has presented several world-record-breaking solar energy plants in Dubai, Abu Dhabi and Saudi Arabia. The GCC has the lowest cost solar electricity in the world. The Maktoum Solar Park in Dubai will house the DEWA III 800MW solar PV plant, which will produce electricity at 2.99 \$ct/kWh, immediately followed by the 1.2GW Sweihan solar PV project in Abu Dhabi, which will produce electricity at 2.42 \$ct/kWh. The 300MW Sakaka project in Saudi Arabia was even cheaper at 2.34 \$ct/kWh. The lowest bid for the Sakaka came in at 1.79 \$ct/kWh but was reportedly

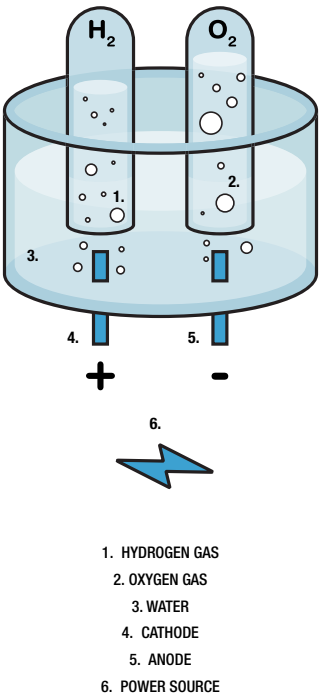
disqualified for proposing to use less proven bifacial solar modules. Nonetheless, this shows that even lower prices are possible. Given solar PV's continuous and spectacular price reduction over the last years, future solar PV projects can generate daytime solar electricity at 1.5 \$ct/kWh.

The cheapest solar power in the world		
DEWA III 800MW Maktoum Solar Park	Dubai	2.99 \$ct/kWh
1.2GW Sweihan solar PV project	Abu Dhabi	2.42 \$ct/kWh
300MW Sakaka	Saudi Arabia	2.34 \$ct/kWh

To complement daytime solar PV, concentrated solar power (CSP) with integrated thermal storage can be used to produce nighttime solar electricity. The DEWA IV CSP project in Dubai is a 700MW combination of a central tower and 3 identical parabolic trough plants with 15 hours of daily storage, producing electricity at 7.3 \$ct/kWh. The solar resource in Dubai for CSP is not the best in the GCC, Saudi Arabia's North-West has a 30% better resource. So, if we would build a similar plant now in that area, all else being equal, we could achieve a tariff for nighttime solar of around 5 \$ct/kWh. Saudi Arabia's Acwa Power is the developer of the DEWA IV project and they expect that further cost reductions are possible, so it is safe to assume that a large-scale CSP project can potentially produce electricity at 4 \$ct/kWh.

A smart combination of large scale solar PV and CSP in the Gulf could provide 24-hour solar electricity for a price of 3 \$ct/kWh. Although these numbers sound ambitious, the plan by the Saudi Crown Prince Mohammed bin Salman and Softbank's Masayoshi Son to develop 200GW of solar energy in Saudi Arabia by 2030 could make that ambition a reality. ►

Water Electrolysis





▲ THE 5GW MOHAMMED BIN RASHID AL MAKTOUM SOLAR PARK, CONTAINING THE BIGGEST CONCENTRATED SOLAR POWER (CSP) PROJECT IN THE WORLD (700 MW).



▲ THE CONSTRUCTION OF PHASE II OF THE 5GW MOHAMMED BIN RASHID AL MAKTOUM SOLAR PARK AS COMPLETED IN 2017.

► Cost of Green Hydrogen in the Gulf

To produce 1 kg of hydrogen requires 50kWh of electricity and since solar energy could cost 3 \$ct/kWh in the Gulf, the energy cost to produce hydrogen is 1.5 \$/kg. An electrolyser costs approximately \$600,000 per MW but is projected to cost \$400,000 in a few years from now. Assuming 8,000 annual full load hours, a 1MW electrolyser coupled to a solar system would produce 160,000 kg of H₂ per year. Assuming a 10-year life and linear depreciation, this would add 0.25 \$/kg to the cost of the hydrogen. The overall cost of green hydrogen made from sunshine and water in the Gulf could be as low as 1.75 \$/kg.

Can Hydrogen become the New Oil?

To make green hydrogen at competitive prices, scale and a programmatic approach is required. The ultra-low prices for solar energy will follow in the footsteps of Saudi Arabia's and the UAE's solar developments and if they can be coupled to a similarly ambitious hydrogen scheme, the GCC could become a world leader in the field. The abundance of land for large solar plants, the strong industrial and intellectual capacity in the oil and gas sector and the strategic geographical location make it a natural proposition for the Gulf countries.

The following roadmap is proposed:

- 1. Introduce green hydrogen in the ammonia sector**
- 2. Introduce green hydrogen for use in the domestic power and transport sector**
- 3. Introduce green hydrogen for export markets**

1. Ammonia

Fertilizers contain a lot of hydrogen. Ammonia (NH₃) is the foundation for the nitrogen (N) fertilizer industry and can be directly applied to soil as a plant nutrient or converted into a variety of common N fertilizers, such as urea. In 2017, the GCC countries produced 30 million tons of ammonia and urea, 90% of which was exported. Half of that production was in Saudi Arabia, where SAFCO has some of the largest ammonia plants in the world. SAFCO IV for example produces 1.1 million tons of ammonia per year. To produce that amount of ammonia, 190,000 tons of hydrogen is required, which is currently being produced through steam methane reforming.

When hydrogen
is converted into
useful energy such as
heat, electricity or motion,
it produces only water
as a by-product.

The "Power to Ammonia" (ISPT, 2017) study for the Netherlands concluded that if cost-effective baseload renewable electricity (25 EURO/MWh) is available, ammonia produced in an electrochemical way with electrolyzers and air separation units would cost 260-370 EUR/ton. The traditional steam methane reforming process using natural gas produces ammonia at 300-350 EURO/ton. Given that baseload solar electricity can be produced at that price in the Arabian Gulf, green ammonia can, by deduction, be produced competitively.

To replace the SAFCO IV plant with an ammonia facility that uses green hydrogen, a combination of a 1.3 GW solar PV plant plus a 1.3 GW CSP plant would be required to produce the required hydrogen, which is just 1.3 % of Saudi Arabia's 200 GW solar plan.

2. Hydrogen for other Domestic Purposes in the Gulf

Green hydrogen can be used to transform the UAE power and transport sector in a cost-competitive way. Large projects are required to achieve the scale and price point for a competitive green hydrogen proposition. Building on that experience, producing additional hydrogen for the domestic electricity and transport sector is straightforward. Hydrogen costing 2 \$/kg or less provides for lower costs per km in a hydrogen fuel cell vehicle and the fuel cells in these vehicles can be used to produce grid electricity when the cars are not used, which is 96% of the time.

Building a domestic hydrogen industry would also provide a zero-carbon alternative business model for the oil & gas sector. In addition to power and transport, the steel sector would be a potential market for hydrogen, as well as the oil refineries. The International Maritime Organization resolution to reduce harmful emissions in shipping will increase demand for hydrogen that is used in refineries to remove sulphur in transport fuels. If the hydrogen used for this is green hydrogen, the overall emission footprint of the sector can be reduced. But the demand for low-sulphur diesel for road transport is expected to grow globally, with associated increased demand for hydrogen.

3. Exporting Hydrogen

Contrary to hydrocarbons, renewable energy is available everywhere on the planet (although the resources differ from region to region) so green hydrogen can potentially be produced almost anywhere. However, like with hydrocarbons, there will be differences in cost structure, and geographical locations matter. The larger Gulf countries have ample low-cost land, stable economic climates, low cost of capital, existing industrial capacity and an excellent solar resource. The majority of the global population is relatively close by, especially the energy hungry Asian growth

markets, and the Gulf countries have reliably served global energy markets with hydrocarbons for decades. The demand for low- and zero-carbon energy solutions, including hydrogen, will increase dramatically in the coming years, and the Gulf countries have an excellent opportunity to be in the driver's seat of that development. Low-cost green hydrogen produced in the Gulf can be exported in pure liquid form, similar to LNG. Kawasaki and Shell are presently building a first liquid hydrogen vessel.

Another elegant and cost-effective way to transport bulk hydrogen to international markets is by transporting green ammonia. Ammonia is one of the most traded chemicals in the world and transporting it requires less energy than the cryogenic route of liquid hydrogen, which requires cooling to -254°C . However, cracking ammonia in its components hydrogen and nitrogen at the customer's end also costs energy, so comparing these options requires due consideration.

The New Oil

Using 20% of the UAE's land surface for solar plants producing green hydrogen for export would suffice to match its current oil & gas revenue. A similar premise exists for other larger Gulf countries, providing an opportunity for a future-proof economic proposition beyond hydrocarbons. The Gulf economies have for decades enabled global economic development by serving energy markets and now have an equal opportunity to contribute to a global energy system that does no harm to the environment. ☺



CONCEPTS FOR LARGE (TOP) AND SMALL (BOTTOM) LIQUID HYDROGEN CARRIER SHIPS. © KAWASAKI HEAVY INDUSTRIES



The **EU-GCC Clean Energy Technology Network** aims to catalyze partnerships between clean energy stakeholders, both in the GCC and the EU. The Network is a source of information on clean energy topics, the inclusive platform for stakeholders to meet and debate and the bridge towards cooperation on clean energy, including policy and technology aspects, among various players across the EU and GCC countries.

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www.ADVANCEFUEL.eu

The ADVANCEFUEL project (Full Title: "Facilitating market roll-out of RESfuels in the transport sector to 2030 and beyond"), has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 764799.





Kristin Sternberg

Coordinator of ADVANCEFUEL and
Advisor at the Agency for Renewable
Resources (FNR)

How has the bioenergy sector – particularly in transport – developed over the past decade?

In the transport sector, all EU countries must ensure that at least 10% of their transport fuels (including liquid biofuels, hydrogen, biomethane, “green” electricity) come from renewable sources by 2020. In this context, the average share of energy from renewable sources in transport increased from 1.4% in 2004 to 7.1% in 2016 (source: **Eurostat**). Among EU Member States, the relative share of renewable energy in transport fuel consumption varies considerably, ranging from 30.3% (Sweden) to less than 2.0% (Croatia, Greece, Slovenia).

In 2015, an amendment to the Renewable Energy Directive (EU/2015/1513) was issued, which strongly influenced the further development of the bioenergy sector, in particular regarding biofuel production, as it caps the use of conventionally-produced biofuels (based on food/ feed plants) at 7%; the directive also obliges Member States to implement a target for biofuels from non-food feedstock



Birger Kerckow

Head of Department EU and
International Cooperation, FNR

(at least 0.5% in transport energy in 2020), which started a considerable increase in corresponding R&D activities all over Europe.

How big is the market for integrating bioenergy?

Bioenergy can be integrated in all areas of conventional energy markets, such as power, heat, transport fuels. This is strongly supported and legally defined by the European targets for the reduction of fossil carbon in the European energy supply and consumption of energy. However, there are significant country-specific differences with regard to the respective shares of bioenergy in the overall energy supply.

In the transport sector, high-quality drop-in products can supplement their fossil equivalents using the existing, mature and well-functioning (global) infrastructure and fuel standards. Liquid (bio)fuels have a high energy density and are well transportable and storable. Additionally, there are no other alternatives for certain end uses such as in aviation or in the shipping sector. Keeping the

fossil-carbon-reduction targets in mind, this opens a huge market potential for renewable (bio)fuels.

Who are the main players in advancing bioenergy in Europe?

In collaboration, representatives from industry and research institutions as well as the European Union and its Member States shape, support and fund the framework of advancing the required technological development in Europe for the envisaged energy transition. Other networks like the established Technology and Innovation Platforms and Research Alliances play an important role.

There are, for instance, six European Industrial Initiatives (Ells), which bring together industry, the research community, Member States and the European Commission in risk-sharing, public-private partnerships. These are aimed at the rapid development and deployment of key energy technologies. Additionally, the European Energy Research Alliance (EERA) aligns the R&D activities of major energy research organizations with the agreed priorities (SET-Plan).

With a view to a joint programming framework at EU level, the implementation of the SET-Plan is also supported by a series of industry-led European Technology Platforms (ETPs). Another pillar of support for implementing the SET-Plan is provided by several Joint Technology Initiatives. These are public-private partnerships, funded by the European Commission, along with Member States and industry. 

Learn more about Europe's role on the global market and the future of mobility, aviation and shipping: www.advancefuel.eu

Are you interested in the future market deployment of advanced biofuels?

Participate in their successful uptake and join the ADVANCEFUEL Stakeholder Platform. www.advancefuel.eu/en/subscription

Unlocking Sustainable Fuels and Bio-Based Products

WRITERS:

James Ling

Guillaume Corradino

Making products and energy from renewable bio-resources (instead of from fossil fuels) is a key aspect to combat climate change, reduce our dependence on imported oil and stimulate economic growth in Europe. Producing cost-effective bio-butanol from sustainable feedstock is part of this transition.

The successful transition towards a more full-blown bioeconomy is dependent on the optimal use of biomass resources. Their availability is limited and the use of certain feedstocks, such as arable crops, raises concerns about their competition with food production and the greenhouse gas impacts of indirect land use change. Attention is turning to more sustainable feedstocks such as agricultural residues, biological waste and fast-growing energy crops, which do not compete with food production or contribute to deforestation. Transforming these sustainable feedstocks into high value products is technically



challenging. Research and innovation is being undertaken to develop improved production processes that are cheaper, more efficient and environmentally friendly.

The Biobutanol Potential Prize

Fermentation is a conversion method that can be used to turn biomass into valuable products. Acetone–butanol–ethanol (ABE) fermentation uses bacteria to produce acetone, butanol, and ethanol from carbohydrates such as starch and glucose. The process may be likened to how yeast ferments sugars to produce ethanol for wine, beer, or fuel. Due to the rise of cheap petroleum-based production, ABE fermentation of biomass fell out of fashion in the second half of the 20th century, but driven by technological advances and the growing demand for sustainable alternatives to fossil fuels, this old process is now being rediscovered.

The main product of ABE fermentation is biobutanol. Biobutanol is considered an exciting alternative to first generation **biofuels** such as biodiesel and bioethanol. Interestingly, it is also a building block chemical used extensively in **paints, coatings, adhesives and inks**. Given this huge potential, funds are quickly being found for biobutanol production.

Currently, converting more sustainable woody biomass remains technically challenging. On top of this, each production step is frequently developed separately, leading to difficulties in optimization and scale-up speed. To overcome this, the EU-funded ButaNexT project set out to optimize the process at value chain level. During the 3 years of the project, ButaNexT developed and demonstrated, at pilot scale, a more cost-competitive, efficient and environmentally friendly process to convert sustainable renewable feedstocks into biobutanol.

Sustainable Feedstocks

First-generation biofuels are made from sugars and vegetable oils found in arable crops, which can be easily extracted using ►

4 Types of Sustainable Feedstock for Butanol Production

A feedstock assessment carried out by E4tech considered the availability across Europe of 4 types of feedstock that could be used for butanol production: straw, Miscanthus, the biological fraction of municipal solid waste, and woody biomass residues.



Straw

The wheat stalks left behind after harvesting are generally used as bedding for livestock or left on the agricultural fields to enrich the soil. A significant straw resource exists that can be sustainably extracted and used for alternative purposes such as biobutanol production.

Potential EU availability: 58.4Mt



Miscanthus

Miscanthus (commonly known as Elephant Grass) resembles bamboo, grows over 3 meters tall, and produces a crop every year without the need for replanting. Its rapid growth and high biomass yield make it a promising feedstock for biofuels. Although it is not currently grown widely in Europe, Miscanthus can be planted on unused or underutilised land to mitigate against indirect land use change impacts.

Potential EU availability: 20.3Mt



Municipal Solid Waste

Municipal Solid Waste (MSW) consists of all the everyday items that we use and throw away. This includes organic materials such as food waste that could be used as a feedstock for the biobutanol process.

Potential EU availability: 150Mt



Woody Biomass Residues

Many different categories of woody biomass residues could be of interest as feedstocks for biobutanol, such as pruning residues (from vineyards), saw mill residues and saw dust, and primary forestry residues.

Potential EU availability: 95Mt

- conventional technology. Second-generation biofuels are made from lignocellulosic biomass or woody crops, agricultural residues or waste, making it harder to extract the required fuel. The ButaNexT project focused exclusively on the latter, which are considered more sustainable.

An Innovation Process in Action

ButaNexT partners focused on 3 main productions steps:

1. Flexible Biomass Conversion: Técnicas Reunidas, together with CENER, developed a new two-step pre-treatment process which converts different lignocellulosic biomass and wastes that provide higher yields in subsequent stages. Crucially, the new milling unit significantly reduces the biomass particle size (to less than half a millimetre). This allows for milder conditions in the subsequent thermochemical treatment, and an improved conversion rate during the hydrolysis stage. Both capital and operating costs can be reduced – the unit reduces the energy consumption up to 25% compared to the conventional technologies studied.

2. Tailor-Made Enzyme Cocktails: Metagen designed and developed tailor-made enzyme solutions for non-food lignocellulosic feedstocks. The optimized cocktails increased total sugar yield by 70-90% compared to the initial offerings, in half of the hydrolysis time.

3. High Productivity Fermentation Process: Green Biologics developed an improved clostridial strain specifically for use with lignocellulosic feedstocks. The fermentation was coupled with membrane technology developed by the Flemish Institute for Technological Research (VITO) to achieve in situ product recovery (ISPR). This hybrid fermentation concept alleviates product inhibition and leads to partial product purification and enrichment, thus improving water balances and reducing energy consumption in further downstream processing.



PHOTOS ©CENER

The innovations were combined at a pilot plant, installed at the Second Generation Biofuels Centre operated by CENER - Spain's National Renewable Energy Centre - in Navarra, Spain.

Environmental, Social and Economic Impact

It is one thing to make a process more efficient; it is another to translate this into actual social, economic and environmental benefits. In the ButaNexT project, an assessment of the impacts of producing biobutanol through the newly developed process was carried out by the company E4tech:

Environmental Impact I An assessment of a conceptual commercial-scale biobutanol plant showed that **carbon emission savings of 22% can be achieved**. This is encouraging, and large improvements are expected as the technology matures and further R&D is carried out. Specific improvements were identified that could have the biggest impact on reducing emissions.

Social Impact I The assessment examined the likely impact of a commercial-scale biobutanol plant. The results indicate that there are **substantial job opportunities**, particularly in the agriculture sector, from lignocellulosic biobutanol production.

Techno-Economic Assessment I Cash-flow modelling was used to estimate the financial viability of a commercial-scale biobutanol production plant using the ButaNexT innovations. All scenarios indicate there is a potential for the technology to be economically viable, with the main variables being how heat and power is provided to the plant, and the cost of feedstock and enzymes.

Market Applications

Advanced Fuel

While no vehicles are approved by legislation to run on 100% biobutanol, there are blends of biobutanol with traditional fuels that can work with current engines. Researchers at University of Castilla la Mancha, also



It is one thing to make a process more efficient; it is another to translate this into actual social, economic and environmental benefits.

involved in ButaNextT, found that biobutanol as a blend component does not reduce engine efficiency and is beneficial for reducing particulate emissions (up to a maximum reduction of 60% in mass and 20% in particle number).

Bio-Based Products

Biobutanol can be used as a drop-in replacement for petroleum-based butanol in almost all applications. Its ability to be used as an additive has resulted in increasing demand from the pharmaceutical industry. The uptake of ButaNextT biobutanol by those industries could help them to be more sustainable in terms of their raw material use and allow them to position themselves within the green 'bio-based' market segment.

Advanced Processes

Most of the innovations and developments achieved in the ButaNextT project can be used for transforming lignocellulosic biomass into other biofuels and bio-based chemicals in general.

For generations the potential of bio-butanol has not been fully realized, but now the ButaNextT project has shown the path to how an advanced biofuel business can be built from sustainable feedstock. As follow-up to ButaNextT, learn more on pages 24-25 about the ongoing research and innovation of the EU-funded Horizon 2020 project called ADVANCEFUEL: www.advancefuel.eu 



 ButaNextT received funding from the European Union Horizon 2020 Research and innovation Programme under grant agreement N° 640462.

The ButaNextT project has developed highly efficient production processes using sustainable feedstocks for the next generation of bio-butanol and ran from May 2015 to April 2018. For more information, visit: www.butanext.eu

Harnessing Europe's Rivers for Power – Is It Worth It?

WRITERS:

Martina Mlinaric

Sophie Bauer

Humans have been using the forces of moving water for millennia, first with mills along flowing rivers for grinding grains, and now, since over a century, in the form of hydropower to produce electricity. Hailed as a clean renewable energy source, hydropower dams were built all across Europe to harness the natural power of rivers. Hydropower may be considered renewable but its 'green' credentials are far more questionable. Constructing and operating hydropower plants, whether big or small, always has consequences: the rivers, natural wildlife, and human communities that live alongside them who pay the price. ►

RIVER MURA, SLOVENIA © MATEVŽ LENARČIČ





- Rivers are not pipes or a series of man-made structures we can modify at the drop of a hat, but delicate, perfectly-tuned ecosystems. Just as blood vessels pump oxygen and other nutrients through our bodies, free-flowing rivers provide critical services to people, nature and economies – from supplying water for drinking, agriculture and many industries, to filtering out pollutants. They also house a rich array of fish and other freshwater species, many of which we depend on for food.

**Hydropower may be
considered renewable
but its 'green' credentials
are far more questionable.**

Myths about Hydropower's Green Credentials

The construction and operation of hydropower has only negative implications for rivers – fragmenting channels and altering the river's natural flow, destroying habitats, blocking fish migration routes (thus preventing them from spawning and reproducing), and threatening already vulnerable species. In April 2018, the University of Graz released a report which revealed that planned hydropower plants in the Balkans could result in a shocking 1 in 10 fish species being pushed to the brink of extinction (source: Save the Blue Heart of Europe).

One of the myths about hydropower is that this environmental impact is a small price to pay in the name of the greater good. But the destruction caused by the construction and operation of hydropower plants cannot be overstated. Hydropower dams are the river's equivalent of a heart attack. They put an abrupt stop to the river's natural flow, cutting off fish migration routes, and slowly

killing a once biodiversity-rich ecosystem and the services it provides. They also trap sediments that would naturally replenish ecosystems further downstream, which can result in the erosion of river banks and can cause deltas to collapse and changes to water tables (which in the worst cases can lead to drought).

Another myth about hydropower is that it is 'green' purely because it is renewable and not produced by burning fossil fuels. Studies have shown however that in warm environments in particular, the reservoirs created by dams, including from hydropower plants, are responsible for a billion tons of greenhouse gas emissions per year (source: Oxford University Press) – vegetation simply sits and rots in the water, releasing carbon dioxide and methane, which is 34 times more potent than CO₂, into the Earth's atmosphere. And that's on top of carbon emissions from building the plants in the first place, which often involves the use of dynamite, deforestation, and the building of many kilometres of pipes.

Thousands More Hydropower Dams Planned Across Europe

Despite the clear environmental implications, we are witnessing something of a hydropower revival in Europe, including small hydropower plants, which still impact heavily on rivers and freshwater biodiversity, but provide negligible contributions to overall electricity generation – even the security of supply provided by small hydropower is highly questionable.

A worrying surge in hydropower has been evidenced in parts of Central and Western Europe, where rivers have been heavily modified and degraded for centuries. This includes countries that have not relied on hydropower in the past, like the Netherlands. WWF estimates that at least 23 small hydropower plants are being explored here, which would contribute a miniscule 0.3% to national electricity production. Hydropower



developments are also planned in countries that have been wrecking their rivers with hydropower dams for generations. In Austria, WWF estimates that around 200 additional hydropower plants are on the cards. Eastern Europe and the Balkans, which hold some of Europe's last few remaining free flowing rivers, are also vulnerable to this dangerous wave – reportedly as many as 3,000 dams are planned for the Balkans alone, endangering some of Europe's most important biodiversity hotspots (source: Reuters).

**Small hydropower plants
still impact heavily on rivers
and freshwater biodiversity,
but provide negligible
contributions to overall
electricity generation.**

**This article continues
on page 52. ►**

RIVER IN LECH VALLEY, AUSTRIA © ANTON VORAUER / WWF

November 13th - 15th 2018
Barcelona

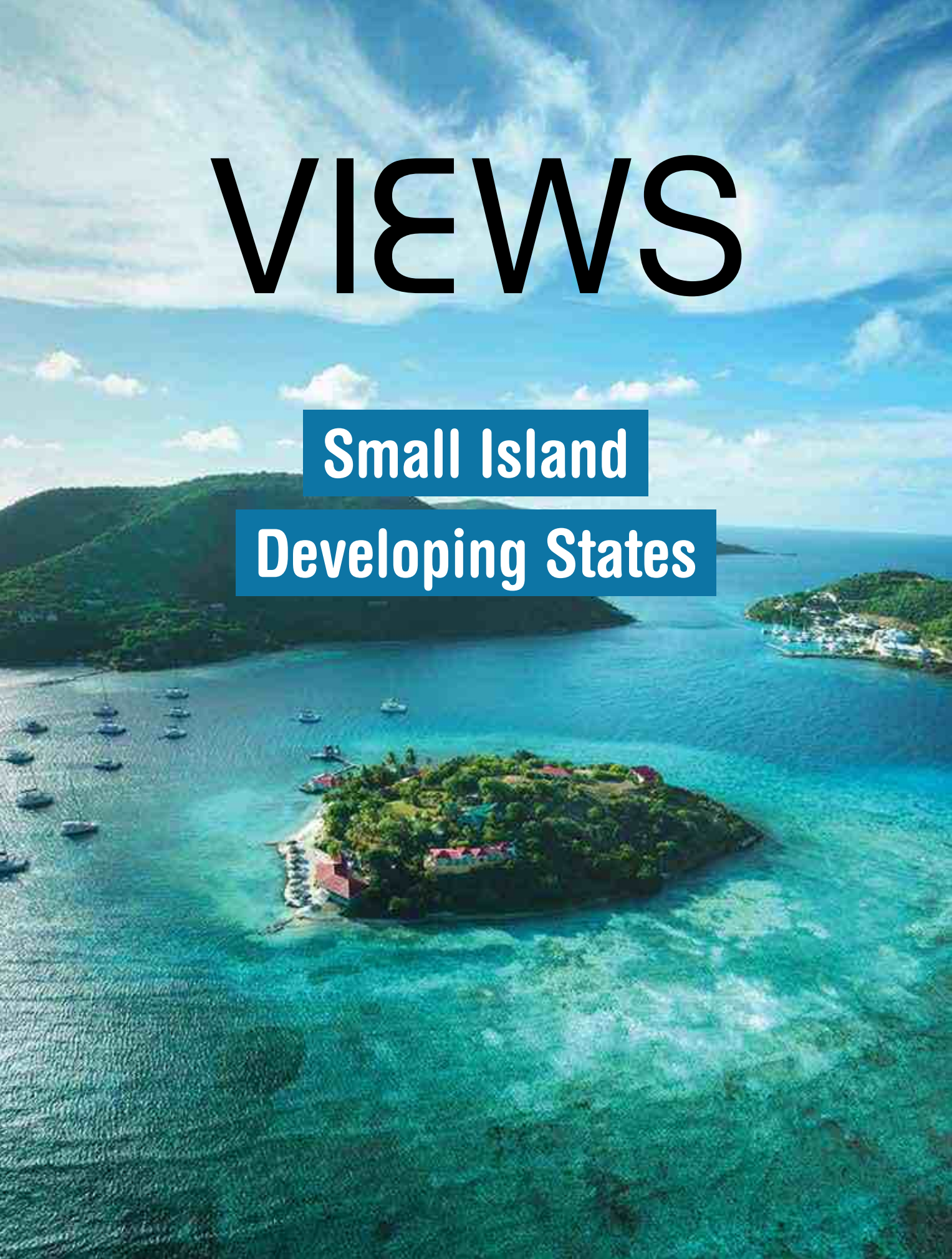


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VIEWS

An aerial photograph of a tropical bay. In the foreground, a small, lush green island with a few buildings and a dock is visible. The water is a vibrant turquoise color, showing the seabed. Several sailboats are anchored in the bay. In the background, a larger, forested island rises from the water under a bright blue sky with scattered white clouds.

Small Island

Developing States

Small, Strong and Resilient

Small Island Developing States (SIDS) are likely to be the first affected by climate change, but in their determination to strengthen resilience and embark on a sustainable economic future they are deploying renewable energy with support from the International Renewable Energy Agency (IRENA).

SIDS are on the frontlines of climate change. Despite having done little to cause it, the effects of a warming planet are already beginning to adversely affect livelihoods and security for millions who call islands around the world home. Yet islands are nothing if not resilient, and their collective commitments to renewable energy are proof of their desire to respond assertively.

Blessed with abundant renewable energy resources most, if not all islands, have an opportunity to meet their domestic energy needs through a combination of renewable energy technologies. With the costs of renewables technologies falling all the time, a unique opportunity exists for them to reduce expensive fuel imports and accelerate the transition to domestically sourced wind, solar and geothermal – lowering electricity costs, improving energy access, creating jobs, and boosting energy security.

IRENA launched the SIDS Lighthouses Initiative at the 2014 Climate Summit in New York, providing a global framework for the energy transition on islands. The Initiative facilitates SIDS resilience through coordinated support for islands to transform their predominantly fossil-based power systems to renewable energy.

The transition efforts of the current 36 SIDS from the Caribbean, Pacific, and Atlantic, Indian Ocean, Mediterranean and the South China Sea regions that have joined the Initiative are supported through partnerships with governmental, intergovernmental, non-governmental, and private stakeholder organisations. Indeed they may be small, but these 36 islands are strong and demonstrating incredible resilience in the face of climate change. ☀



IRENA is an intergovernmental organisation that supports countries in their efforts to advance renewable energy. Engaged with over 180 countries, IRENA serves as a platform for international cooperation, a center of excellence, and a repository of renewable energy policy, technology, resource, and financial knowledge. IRENA provides practical tools and policy advice, and facilitates knowledge sharing and technology transfer.
www.irena.org

PREVIOUS PAGE: A NUMBER OF SMALL ISLAND COUNTRIES AIM TO ACHIEVE 100% RENEWABLE ENERGY IN THE ELECTRICITY MIX. BRITISH VIRGIN ISLANDS © ERIC RUBENS

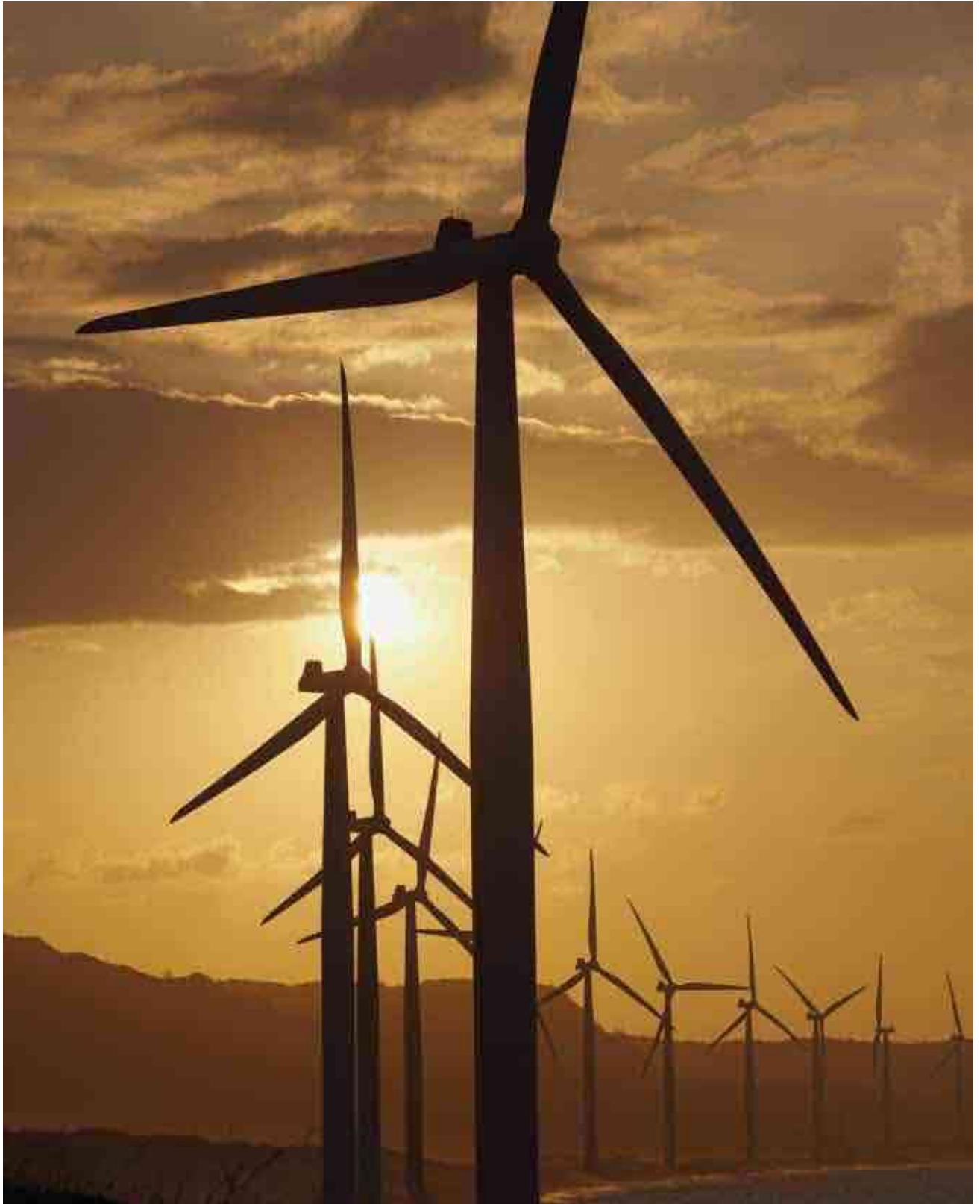




IN FIJI, RENEWABLE ENERGY HAS INCREASED ELECTRICITY SUPPLY FROM AN AVERAGE OF 15-18 HOURS TO 24 HOURS PER DAY. © RAFAEL BEN-ARI



SMALL ISLAND DEVELOPING STATES (SIDS) CONTRIBUTE LESS THAN 1% TO THE WORLD'S GREENHOUSE GAS EMISSIONS, BUT ARE FIRST TO EXPERIENCE THE WORST AND MOST DEVASTATING IMPACTS OF CLIMATE CHANGE. © SEMORK



IRENA'S SIDS Lighthouses Initiative aims to mobilise USD 500 million and install 120 MW of renewable energy capacity on islands by 2020. © PHOTOMAXX





POWER GENERATION FROM RENEWABLES WILL MEET THE ANNUAL NEEDS OF 12,000 RESIDENTS OF LE PORT CITY, REUNION ISLAND – A THIRD OF THE CITY'S POPULATION. © KARINE LAZARUS







MORE THAN 2 GW OF RENEWABLE ENERGY IS ALREADY DEPLOYED ON ISLANDS AND AT LEAST 6 GW OF ADDITIONAL CAPACITY IS PLANNED UNDER THE PARIS AGREEMENT. © MAXKATEUSA



RENEWABLE ENERGY HAS REDUCED POWER GENERATION COSTS IN CABO VERDE BY APPROXIMATELY 20% AND REDUCED OIL IMPORTS BY UP TO 20,000 TONNES. © SALVADOR AZNAR

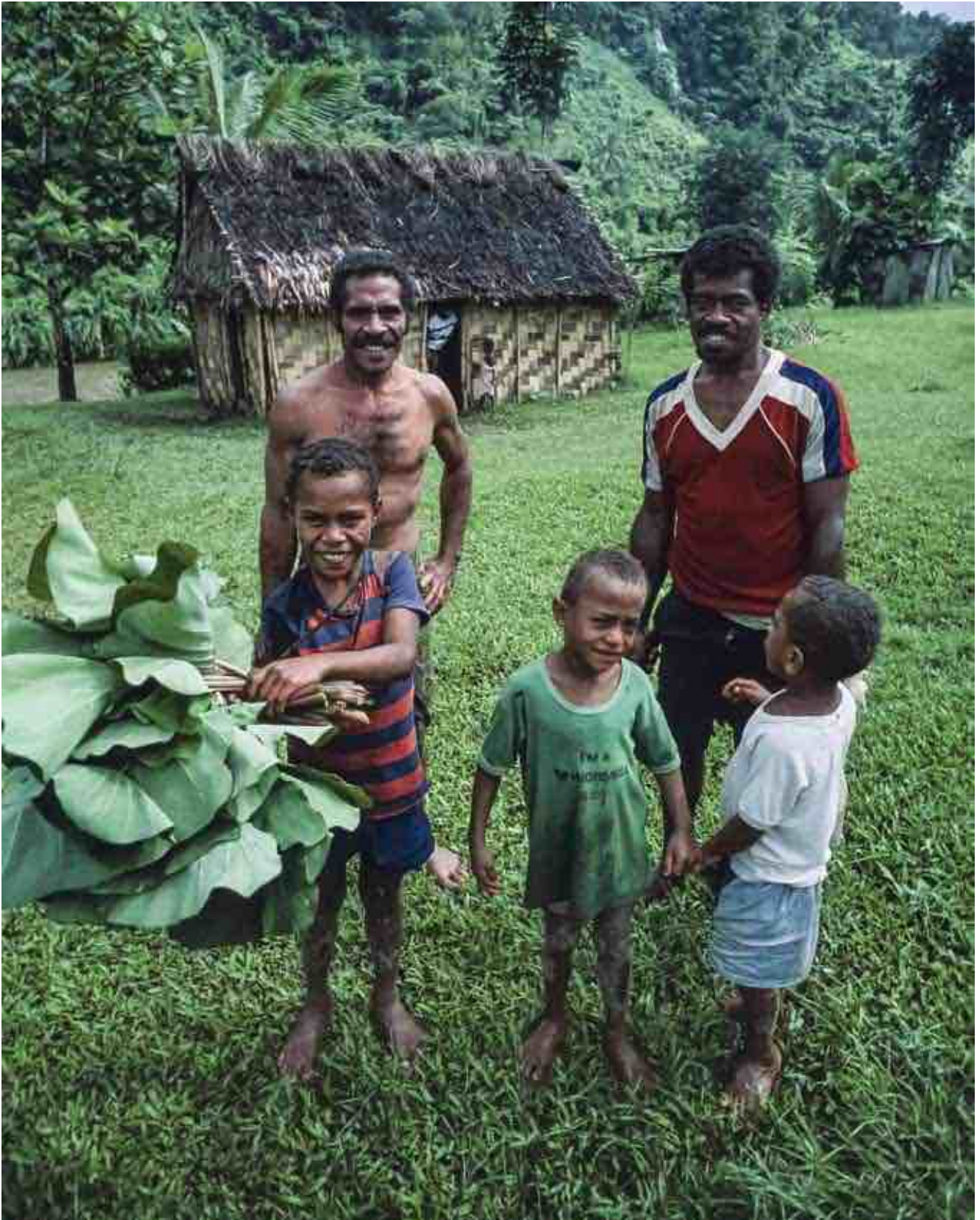




COOK ISLAND RESIDENTS ARE INCREASING THEIR EARNINGS FROM THE FISHING INDUSTRY THANKS TO RELIABLE REFRIGERATION MADE POSSIBLE BY RENEWABLE ENERGY. © JOLIA SEQUEIRA



IN MAURITIUS, ANNUAL COST SAVINGS POTENTIAL FROM ENERGY EFFICIENCY MEASURES IN INDUSTRIAL SECTORS IS EXPECTED TO TOTAL USD 3 MILLION PER YEAR. © BILDAGENTUR ZOONAR GMBH



RENEWABLE ENERGY IS IMPROVING LIVING CONDITIONS AND LIVELIHOODS IN FIJI, WHERE IT IS PROVIDING FAMILIES WITH LIGHTING, AIR CONDITIONING, DESALINATION AND REFRIGERATION. © ANGELO GIAMPICCOLO



THE FIRST-EVER RENEWABLE ENERGY-POWERED SEAWATER AIR CONDITIONING SYSTEM ON BORA BORA IS SAVING ONE HOTEL NEARLY USD 750,000 ANNUALLY IN ELECTRICITY BILLS. © WILAR



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► This article continues from page 33.

**Progress today must be where humans
no longer exploit nature for their own gain,
but learn to live in harmony with the environment.**

Looking to Alternatives

Natural, healthy rivers are fast-becoming a rarity in Europe – for years we have been destroying, polluting and altering the natural state of our rivers through agricultural pollution, over-abstraction of water, the construction of artificial flood defences, navigation and, of course, hydropower dams. All of these factors mean that fewer than half of European freshwater bodies (such as rivers, lakes and wetlands) are currently healthy and meet the environmental standards of the EU Water Framework Directive. As such, hydropower is incredibly difficult to reconcile with the conservation objectives of freshwater habitats protected under this legislation, as well as the EU Birds and Habitats Directives.

It is crucial that European governments now push back on new hydropower infrastructure, and instead invest in other ways of meeting

greenhouse gas emissions reduction targets – for instance, energy savings, demand flexibility, battery storage and other renewable technologies for example wind and solar, the costs of which have fallen dramatically in recent years. It is also important for the removal of obsolete hydropower dams be taken more seriously – demolishing these would help to restore the connectivity of rivers, bringing hope for migratory fish species, and thus be an effective way for Member States to meet their commitments under the EU Water Framework Directive.

Hydropower was long regarded as a clean, modern technology for power production, but we need to move on from this misguided understanding of 'progress'. Surely, progress today must be where humans no longer exploit nature for their own gain, but learn to live in harmony with their environment? ►

STILL OF THE DOCUMENTARY 'CONCRETE REASONS' © RISTO RUOKOLA

▶ ROMANIA

EU legislation saves the Jiu River... for now

The Jiu River in Romania is home to 1,142 different species, approximately 200 of which are protected at national and international level – such as the Romanian barbel (*Barbus petenyi*), crayfish, and loach; a fish to be found nowhere else in the world except for south-western Romania.

However, for the past 14 years the river has been the site of a legal battle over the construction of a medium-sized hydropower plant. If built, the project would divert 85% of the Jiu River's water, causing irreparable damage to the river, biodiversity loss, and destruction to the surrounding Jiu Gorge National Park.

Initially approved in 2003, the project's plans have been modified in the interim but continue

to rely on the same environmental permit. Romania then went on to become a member of the EU in 2007, and the project did not comply with its stricter environmental regulations: the area where the plant was to be built was now a Natura 2000 protected area and subject to the EU Water Framework Directive and EU Birds and Habitats Directives.

Romania is one of the countries in the EU which has been most heavily affected by hydropower.

Romania is one of the countries in the EU which has been most heavily affected by hydropower. 400 plants are already in operation,

and WWF estimates that an additional 68 plants of various sizes are in planning. The exact status of many of these existing and potential plants is unknown, mostly due to lack of data, but also because many of them are suspended due to infringement procedures for breaches of the EU Water Framework Directive and Habitats Directive.

Thanks to pressure from citizens and civil society – as well as a public request from WWF for the Romanian Ministry of Environment and the EU Commission to intervene – the Bucharest Court of Appeal withdrew the building permits for the hydropower plant on the Jiu River in December 2017, declaring further work on the plant to be illegal. But the struggle continues – after the court ruling, there has been political pressure to find alternative means of going ahead with the construction work, despite the project having been declared dead.

LIVEZENI DAM, ROMANIA © CĂLIN DEJEU





FINLAND

Old Hydropower Destroying Fish and Livelihoods

In the wake of the Second World War, Finland experienced a hydropower boom which left the country with a multitude of old hydropower plants that did not take fish passes or other environmental measures into consideration. Many of these plants (and the environmental permits required to build them) date back over a century and are responsible for pushing migratory fish species to the brink of extinction and shattering the local communities that lived alongside the river.

The construction of 21 hydropower plants alongside the Kemijoki River continues to cast a dark shadow over the people living along the river, many of whom witnessed the construction first-hand. The construction and operation of these plants has disrupted the aquatic environment, surrounding landscape,

and how the river is used by human communities. The Kemijoki River used to have one of the biggest salmon runs in the whole of Europe, but these plants were the kiss of death for their migration, and for the livelihoods of many people.

**The Kemijoki River
used to have one of
the biggest salmon runs
in the whole of Europe.**

Despite the impact these plants have had and of the environmental targets Finland must meet under the EU Water Framework Directive, the Finnish government has so far failed to review the lifespan and outdated permits of many of the country's hydropower plants – and further construction is still in

the pipeline. There are plans to build a new hydropower plant (Sierilä) on the last free-flowing part of the Kemijoki River. This is despite the fact that more than 70% of Finnish citizens would save the country's remaining free-flowing rivers from hydropower, and approximately 150 out of the existing 220 hydropower plants in Finland are small, and therefore have a negligible contribution to national energy production.

A new documentary by Risto Ruokola and Toni Kinnunen, sponsored by WWF Finland, Concrete Reasons, unveils the truth behind the impact these hydropower plants have had on the state of Finland's migratory fish and communities. 🌐

To view the film, visit:
vimeo.com/ondemand/concretereasons

HYDROPOWER DAM, FINLAND © HENRI SIVONEN, UNDER LICENSE FROM CREATIVE COMMONS



WWF is one of the largest conservation organisations with a presence in over 100 countries in the world. WWF works to stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature. The European Policy Office helps shape EU policies that impact on the European and global environment. www.wwf.eu



Reality Check on the Energiewende

WRITER AND PHOTOGRAPHER:

Michel Petillo

During the UN climate negotiations at the 23rd Conference of the Parties (CoP) in Bonn last November 2017, over 15 countries and several USA states such as California and Washington, plus 58 private companies joined the Powering Past Coal Alliance. Carbon pollution from coal is considered a leading contributor to climate change. The Alliance's charter states that to meet the 2015 Paris Agreement to keep global temperature increases "well below 2°C" and to pursue efforts to limit it to 1.5°C, traditional coal power needs to be phased out by no later than 2030, and no later than by 2050 in the rest of the world. ►

Coal-fired power
plants produce almost
40% of global electricity
but generate per unit
of electricity twice
as much CO₂ as gas.

SOURCES: ALJAZEERA, WORLD COAL ASSOCIATION, THE NEW CLIMATE ECONOMY.

A VIEW ON LOGGED AREA READY TO BE MINED NEAR A SETTLEMENT AND BARRICADE FACING NORTH. IN THE DISTANCE WE CAN SEE AN EXCAVATOR AT WORK.

Climate Action vs. Coal Energy

- In the European Union, almost 1/5 of CO₂ emissions come directly from coal power plants, with Germany and Poland responsible for half of it. Despite Germany's claims to transition away from coal, 77 coal power plants – more than in any other country in Europe – remain operational. The newest units of the lignite-powered facilities are even expected to operate until 2055.

The health effects of air pollution due to coal-burning, including respiratory diseases and premature deaths, result in massive costs in human and economic terms. According to Europe's Dark Cloud report by the Health and Environment Alliance, Climate Action Network Europe, WWF's Europe office and Sandbag, 3,630 Germans died of carbon-related diseases in 2013.

Annually, on a global scale, more than 800,000 people die prematurely from pollution generated by coal-burning.

The 2018 Environmental Performance Index (EPI) by the Yale Center for Environmental Law and Policy in collaboration with Earth Institute of Colombia University finds that air quality is the leading environmental threat to public health. According to **Endcoal.org**, annually and on a global scale, more than 800,000 people die prematurely from pollution generated by coal-burning. Within the EU, an analysis of 257 of the EU's 280 coal plants found that their emissions contributed to the deaths of 22,900 people. Tens of thousands more suffer from illnesses, including heart problems and bronchitis, directly related to coal-burning. The corresponding health cost is estimated to exceed €60 billion. With 6.5 million victims annually worldwide the issue of air pollution starts to rank very high on the policy ladder and it will drive the World



1 ▲



2 ▲



3▲



Health Organization's first global conference on air pollution and health on 30 October – 1 November 2018 in Geneva.

So why is Germany, considered one of the pioneers in the fight against global warming, reluctant to sign this charter for cleaner power sources?

Is coal really being phased out?

Despite the surge in renewable energy in Germany, coal still supplies about 40% of the country's total energy. Half of that supply is lignite or brown coal, considered the biggest CO₂ pollutant of all. Rhineland-Palatinate is considered a pioneer state in the 'Energiewende', however it imports most of its 30% of electricity from North Rhine-Westphalia's coal power stations.

"There's no bigger impact on the environment than brown coal mining, and we're the world champion," says Dirk Jansen, a leader of the local chapter of Friends of the Earth in Germany's coal heartland of North Rhine-Westphalia. "If we want to stop climate change, we have to start here."



1. A 19TH-CENTURY VILLAGE CATHEDRAL IN WESTERN GERMANY WAS RAZED TO THE GROUND TO MAKE WAY FOR THE EXPANSION OF COAL MEGA MINES.
2. RWE COAL TRANSPORT TO LIGNITE POWERPLANTS IN THE REGION.
3. WEISWEILER POWER STATION IS A 1,958-MEGAWATT (MW) COAL-FIRED POWER PLANT IN NORTH RHINE-WESTPHALIA, GERMANY.
4. GALLIEN IS ONE OF SEVERAL BARRIOS OR NEIGHBOURHOODS WHERE ACTIVISTS OCCUPY THE REMAINING HAMBACH FOREST AGAINST FURTHER EXPLOITATION BY RWE. EVERY BARRIO HAS ITS OWN PARTICULARITIES. THE ONE IN THE PHOTOGRAPH IS 100% VEGAN AND FREEGAN ORIENTED.
5. THIS EXCAVATOR WAS USED IN LORD OF THE RINGS AND IS ONE OF WORLD'S LARGEST. ONE SCOOP ON THE GIANT WHEEL CAN HOLD A 5 DOOR CAR.

Climate Action vs. Coal Energy

- With the last underground mines closing next year, Germany appears to reconvert. But then again, there is lignite that continues to be mined at one giant open pit located in the Rhineland, a petrified 30-million-year-old swampland. Its extraction is easier (read: cheaper) but of lower quality and dirtier to burn compared to hard coal. Together with the relatively low price of carbon under Europe's emissions trading system, there appears little financial incentive to give up this brown coal all together.

"There's no real economic incentive to phase out coal," says Ottmar Edenhofer, chief economist at the Potsdam Institute for Climate Impact Research. "To stimulate clean innovation, we need a minimum price for CO2."

Germany is already getting out of the nuclear energy business. Following Japan's 2011 Fukushima disaster, Merkel decided to close

**About 40 million
metric tons of lignite
are produced annually,
and an estimated
1.660 million tons
of lignite are still
available for mining.**

SOURCES: RWE, CNN.

all nuclear plants by 2022. Simultaneously leaving behind coal, say critics of a quick exit, would leave the country without the necessary resources to ensure it has the energy it needs. RWE AG, with its headquarters in Essen and responsible for power generation of a gas, hard coal, hydropower and biomass, reiterated during its last shareholder gathering 26 April 2018 that to meet energy demand lignite remains a viable solution at least until 2045. It claims embracing its role as good corporate citizen by investing in green energy sources and community development. At the same time, RWE seems to take a more complacent role for the future while urging other industries do their homework in terms of 'greenovation'. Remarkably, according to a visitor to the shareholder meeting, one of the attendants stated that RWE's commitment to renewables is about 13% and below average as compared to the national observed 33% in green energy supply.



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This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement N° 768921.

Costs, Benefits and the Environment

When visiting the RWE Weisweiler brown coal power plant near the town of Eschweiler it appears that that investments in green energy are restricted to a scattering of wind turbines in the Rhineland's landscape couple with a few acres of solar panels around the power plant's site. Meanwhile over 8,000 hectares of the adjacent 12,000 year old Hambach Forest have been reduced and will continue to be reduced to a 500 meter deep coal pit large enough to hold the entire inner-city of Cologne. This is the result of approximately 45 years of mining. Weisweiler is not the only powerplant in the region. Niederaussem Power Station is another lignite-fired power plant in the Bergheim Niederaussem/Rhein Erft circle, owned by RWE. It is the second-largest brown coal power plant in operation in Germany, with a total output

capacity of 3,864 MW and a net capacity of 3,396 MW. According to EURACTIV Slovakia, the Neurath RWE coal power plant, not so far from the lignite mining site in Hambach, ranks second in the EU in terms of both installed capacity and CO2 emissions.

Apart from the disastrous impact on health and nature, coal exploitation has yet another human cost - the internal displacement of people. Villages need to be evacuated, demolished and reconstructed to give way the world's largest excavators. One such village up for demolition is Immerath – a former farming village home to 1,200 people in the fertile countryside near Hambach - about 40 kilometers from the RWE mine.

One inhabitant who was willing to give a short statement mentioned that they knew for over 25 years that RWE would demolish their village to accommodate mining activities in the

region now. Over the last 7 years, villagers have been given a new home in Neu (new) Immerath, 20km down the road. Although inhabitants have been compensated for the move, according to some sources, they were advised to accept the resettlement deal. Another remaining inhabitant was unwilling to comment and merely stated that their deal with RWE prevents them from commenting publically on the matter. ►

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The ZERO BRINE project (www.zerobrine.eu) has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 730390.



- Excavation of the Hambach site (commonly known locally as “Mordor”) began in 1978 when mining operator RWE acquired the land. The first lignite was extracted January 1984. The surface mine is approximately 450 meters deep with the total area of 85 square kilometers designated for mining. About 40 million metric tons of lignite are produced annually, and an estimated 1.660 million tons of lignite are still available for mining. The extracted lignite is transported via the Hambachbahn to Bergheim - Auenheim and from there transported via the north-south railway to the power stations Niederaussem, Neurath, Frimmersdorf and Goldenberg near Hürth-Knapsack.

Fighting for Hambach Forest

Protests have been ongoing against the excavations and subsequent forest destruction since 2004 when Greenpeace activists demonstrated against the use of lignite. They flew over the open pit with a hot air balloon, occupied an excavator for several days and painted it partly pink. The number of complaints against further excavations grew due to possible damages to the hills in the Elsdorf-Heppendorf area. In 2008 this led to the establishment of the Bergschaden Braunkohle NRW reclamation service for damage victims in the Rhenish lignite mining area.

On 13 May 2009, Friends of the Earth Germany (BUND) and a local action group launched a court procedure to halt the relocation of the A4 motorway deemed necessary for the planned extension of the mine, on the grounds of noise pollution and the possible threat to the protected Bechstein bat and other species. This was unsuccessful. Protected animals threatened by the mining include: the mid-woodpecker, the dwarf bat, the Bechstein's bat, the brown long-eared bat, the greater mouse-eared bat, the dormouse, the cross toad, and a little bat known as the “lesser noctule”.

From 2012 an area of 200 hectares of the remaining Hambach Forest has been ‘occupied’





by environmental activists trying to prevent further RWE exploitation. The activist presence now includes a number of self-sufficient settlements or “barrios” with around two-dozen tree houses and numerous road barricades to prevent the RWE mining company and police vehicles from entering. Activists who have been caught trespassing by RWE have been given a written ultimatum not to come back to the forest or face a heavy fine of several thousands of Euros.

A recent court decision overruled a previous ruling that had halted RWE from further logging Hambach Forest. The court concluded, according to the local activists, that the

remaining 200 hectares of forest was now too small to protect any of the species living there, thus refuting the argument that logging should be halted for the species’ benefit. The destruction will, as a result, continue as of October this year, aiming to cut down another 100-150 hectares. The activists are committed to protect it. However, they are unsure of what will happen to them or what is left of this 12,000 years old mixed forest, home to number of protected species and with a unique blend of English oak trees, hornbeams and lilies of the valley. Ironically, the site is situated 50 kilometers from last year’s CoP23.

*

On the road to CoP24 in Katowice, Poland - another neighboring coal-powered country that has trouble moving beyond the conventional dirty sources of energy - the fate of Hambach Forest in western Germany indeed represents the tensions of trying to meet growing energy demand and attempting to integrate environmental considerations. For this equation to be sustainable, for society and nature to prosper, the business as usual scenario needs to change. Poland and Germany belong to the wealthiest countries in the world and on the road to CoP24 in December 2018, they must prove that the darker ways of energy production are indeed part of the past. ☯

ABOVE: PANORAMIC VIEW ON A TYPICAL BARRIO THAT HAS DIY TREEHOUSES, SOLAR PANELS AND IMPROVISED RAINWATERCOLLECTION SYSTEMS.
BELOW: THIS IS THE RESULT OF APPROXIMATELY 45 YEARS OF EXCAVATION. PANORAMIC VIEW ONTO THE MINE FROM TERRA NOVA VIEWPOINT.



Buildings as Material Banks Towards a Low-Carbon Capital Region

WRITERS:

Hélène Dekker

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Julien Berry

Brussels Environment

The Brussels Region is not a territorial entity that can exploit massive larger sources of renewable energy such as wind or solar power. The optimal solution towards sustainability is to follow an ambitious policy aimed at improving the energy performance and environmental impact of buildings. In this context, Brussels Environment, the regional administration of the environment and energy, is at the helm of an EU-funded innovation project, called 'Buildings as Material Banks' (BAMB), and is preparing a "Low-Carbon Strategy" that will be advanced at a forum to be held in Brussels on 22 June 2018.



A Circular Economy Vision

To consider buildings as “Material Banks” is to see them as repositories for or stockpiles of valuable, high quality materials that can easily be taken apart and recovered. By harvesting materials and individual components during the deconstruction and renovation of buildings, these materials can be reused in the construction, operation or refurbishment of other buildings, thus reducing waste and primary resource use.

The term ‘Buildings as Material Banks’ refers to a materialized investment; it implies much more than investing money in property funds: the building itself is considered as a materialized savings account for material resources, through which building materials, products and components are temporarily ‘deposited’ into a functional element or part of the building. When socio-economic conditions are favourable, (a part of) the materials, products and components may be retrieved for other investments, such as another building or another high-quality application.

Seeing material resources as a temporary way of materializing investments opens the door to a wide range of circular business models in which economic and environmental value is conserved and created through the reuse of materials, products, components and buildings, while (performance-based) services are provided to support the daily life of (end) users.

Introducing the One-Stop-Shop

A powerful new tool for materials banking across Europe was launched at the end of 2017 and made accessible via: www.bamb2020.eu/topics/materials-passports

This new **BAMB Material Passports Platform** fills a gap in the marketplace by providing a ‘one-stop-shop’ to describe circular economy values across the building cycle, especially for using and re-using components and materials, and reducing the generation of waste. The main goal is to support the transition of the building industry from a linear economy to a circular one by letting users identify value potential throughout the building cycle, from planning and construction through occupancy, repairs, renovations, repurposing and decommissioning, and by making it possible to track component and material quality and modifications.

The platform also connects individual products to their use in buildings, and it includes an option to describe the health status of materials. A large body of studies suggests that healthier buildings improve productivity, which is one of the main economic benefits of knowing what is in your building.

An Interactive & Itinerant Exhibition

In January 2018, BAMB launched the largest travelling exhibition of circularity in the built environment: the **Reversible Experience Modules (REMs)** exhibition consists of more

than 70 building materials and products, all optimized for healthy use and reuse. Together, they form an exhibition space that resembles parts of actual buildings, with a hallway, an office area, a home area and an outside area. Visitors use the Materials Passports to dismantle and rebuild parts of the exhibition themselves. They experience the benefits of building for reuse and see what Material Passports can make possible.

Material Passports record and reveal the often-hidden potential for re-use and the future value of products and materials. In the REMs exhibition, all showcased products and materials will be represented in the BAMB Material Passports Platform. The platform can be accessed in an interactive way at the exhibition. In January 2018, the REMs exhibition started its year-long road trip. The exhibition of circular building materials will be built and rebuilt 6 times and go to 6 locations in one year. More information and the REMs travelling schedule is available at www.epea.nl/rem ▶

The Material Passports Platform, now a prototype forming the core of a materials passport system, is ready for testing by industry partners!

Contact
materialspassports@bamb2020.eu
to set up your Materials Passport Platform account and get online guidance by BAMB members.

For more details on the BAMB vision:
www.bamb2020.eu/topics/blueprint/vision



► Circular Building Assessment (CBA)

In the second half of 2018, BAMB will test an integrated assessment web-based **Circular Building Assessment (CBA)** tool on building projects in the Brussels Capital Region and beyond. The objective of this tool is to help decision-makers, such as architects and their clients, understand the benefits that could be derived when modelling circular building scenarios versus the linear, or 'business as usual', equivalents. The assessment encompasses environmental and economic aspects, alongside social and health indicators where data provision makes this possible.

The underpinning methodology has been tested manually at both building and system levels using existing buildings in Brussels and the UK, and with a new concept of a building demonstrating high reuse potential and transformation capacity in the Netherlands. These examples show that are quantifiable carbon benefits from the adoption of circular building scenarios when compared to the usual situation. More examples, across a wider set of building types and countries, will be available by the end of 2018 as the second stage of testing is completed. This second testing phase will use the CBA prototype tool and there may still be opportunities for readers of this article to get involved and volunteer a project for assessment. 🌐



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 642384.

Coordinated by Brussels Environment, the EU-funded Horizon 2020 **Buildings As Material Banks (BAMB)** project includes 16 partners from 7 European countries to enable a systemic shift in the building sector by creating circular solutions. For more information, visit: www.BAMB2020.eu

IMAGES: REMS EXHIBITION, BRUSSELS, JANUARY 2018



DECARB BRUSSELS CAPITAL REGION

Sharing Ideas for a New Governance

Brussels
22 June 2018

According to the United Nations, cities will host more than 2/3 of the world's population by 2050 and will be responsible for most of global carbon emissions. As part of the European commitment to reduce greenhouse gas emissions by 80-95% in 2050 compared to 1990 levels, the Brussels-Capital Region is committed to developing a low-carbon strategy to meet the 2050 goals.

The Brussels Low Carbon Study (February 2017) provided the Region with a tool and scenarios to establish its low-carbon strategy and evaluate its impact on the inhabitants and the socio-economic context of the region. Brussels now has a more detailed vision of the behavioural and technical implications of various trajectories to conduct a long-term policy in each sector.

To trigger the transition to a more sustainable society, it is essential to mobilize all the resources that make up the richness of an urban territory, such as in Brussels. Cities face multi-dimensional and cross-cutting challenges, only a coordinated multi-level approach



engaging various areas of expertise is likely to be successful.

In light of these considerations, Brussels is examining various forms of governance that would enable this city to achieve its low carbon goal by 2050. It is essential to carry out an in-depth thinking on the evolution of the role and working methods of public authorities while taking into account the potential of citizen involvement to catalyse and perpetuate the energy transition.

In this perspective, Brussels Environment, the administration of the Environment and Energy in the Brussels-Capital Region, will be holding a forum on 22 June 2018 on the following question: What governance is most suitable for a low-carbon city?

Amongst the speakers, **Elisabeth Lullin** will provide insights into the evolution of the public services and methods to activate the



REVOLVE + Brussels

potential of citizen groups to tackle the climatic challenges. **Olivier De Schutter** (UCL), and **Simon De Muynck** (Centre d'écologie urbaine) will talk about citizen empowerment and collaborative ways to transform our city.

The forum will be introduced by the Brussels' Minister of Environment & Energy, **Celine Fremault**.

The workshops and debates will be animated by the **Civic Innovation Network**, a Brussels-based lab facilitating the co-creation of joint ventures and developing systemic tools for urban resilience:

www.civicinnovation.network

WHEN:

22 June 2018, from 8:30 AM to 5 PM.

WHERE:

BEL, Brussels Environment's Auditorium, Avenue du Port 86c
1000 Brussels
www.bel.brussels

WHO:

Local, regional, international stakeholders:

- Citizens associations & civil society
- Public authorities
- Private actors
- Academics

LANGUAGES:

French, Dutch, English

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Bioenergy: An Asset to European Forests

WRITER:

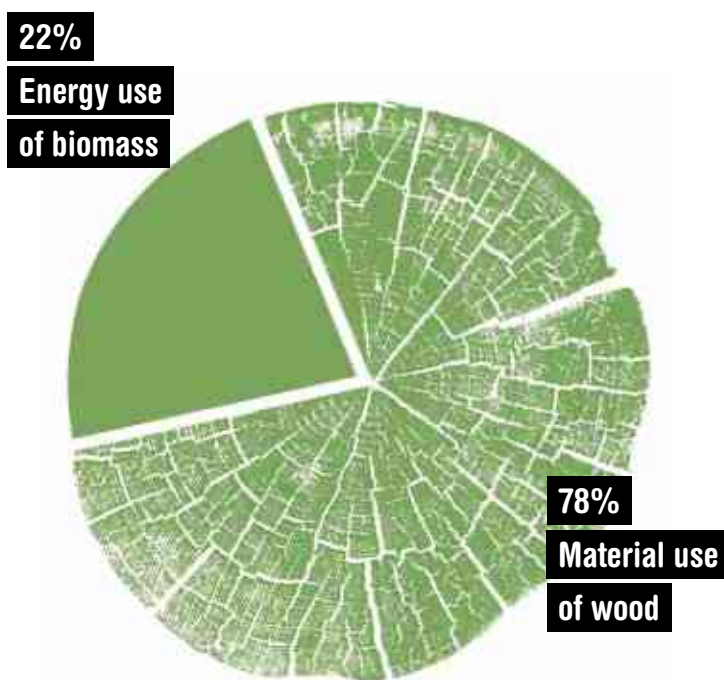
Jean-Baptiste Boucher

Of all biomass, wood has always been the most popular source of energy used in Europe. We all know someone in our family that has a traditional chimney or a modern, wood pellet stove in their home. In 2014, more than 69% of bioenergy consumed in Europe was sourced from forests, referred to as “solid biomass” under its fuel form and “solid bioenergy” when converted into energy. Bioenergy is the EU-28’s largest source of renewable energy, making up over 60% of the share of renewables and 10% of total energy on aggregate. Bioenergy is also the only renewable energy capable of providing energy in the 3 primary forms required by society: heat, electricity and transport fuels. One might say that woody biomass is a key driver of Europe’s energy transition, while forests are an essential source of biodiversity and carbon storage. Understanding the strong synergies that exist between the production of bioenergy and the management of forests is therefore crucial. ►



► Woody biomass: a European success story

Solid bioenergy is above all a European success story – a sector in which Europe is a clear leader both in terms of production and consumption. The first developments of a modern bioenergy industry occurred in the 1970s with the production of efficient stoves, boilers, and new fuels such as pellets and briquettes. Yet it was not until the early 2000s, with the enforcement of the EU's objectives on renewable energy, that the bioenergy sector established itself as a key player in the wood industry alongside traditional sawmill and paper industries. In 2015, more than 300,000 people were either directly or indirectly employed by the solid bioenergy sector, equalling the number of people working for the wind industry. This is largely due to the length and complexity of the bioenergy supply chain, which reaches remote and rural areas, where jobs are needed most. The bioenergy sector is shaped by hundreds of SMEs that are deeply embedded in the local and regional social fabric, creating an interesting dynamic between groups like forest owners, municipalities and fuel suppliers. To showcase these synergies, AEBIOM launched a campaign in late 2017 dedicated to the “**European Bioenergy Day**” (November 21) featuring success stories from across Europe to highlight bioenergy developments.



Wood removal from EU forests

Bioenergy is the EU-28's largest source of renewable energy, making up over 60% of the share of renewables and 10% of total energy on aggregate.

Solid bioenergy and European forests

In debates on the revision of the EU Renewable Energy Directive, criticisms were presented on the pressure that solid bioenergy could put on European forests in the decades to come. However, a closer look and deeper understanding of the bio-based economy reveals shortcomings in this view. Observing the current rate of wood removals sourced from EU forests every year, 78% goes to the wood industry for the material use of wood. Only a fraction of wood removals, around 22%, are destined for energy, mostly comprised of tops, branches, and low-quality wood unfit for most material uses.

For economic and environmental reasons, bioenergy providers in Europe do not use any type of wood indiscriminately. Other than primary forest residues, which are obtained from harvesting or thinning operations, woody biomass can be sourced from wood industry residues such as sawdust from sawmills. Historically, the European bioenergy sector has evolved to work in synergy with other wood-based industries to give value to previously unused and/or low value biomass. As a result, energy is one of the many services provided by European forests to its citizens, yet no forest in Europe is managed or harvested solely for energy purposes. On the contrary, bioenergy often provides an additional source of income for forest owners, which can be used to maintain dynamic and healthy forest holdings.

Bioenergy producers do not use high quality timber. This would be irrational and economically illogical, as doing so would make the price of energy generated entirely uncompetitive for end consumers. For example, in Belgium for the winter season 2016-2017, the price of 1 m³ of lumber (€100-€120/m³) was almost 10 times higher than the price of 1 m³ of wood for energy (€6-€13/m³). As such, bioenergy players would not be able to match the prices offered by the timber industry. Based on this price index, using Belgian lumber to produce 1 MWh of electricity would range between €833-€1,000. Instead, the price of electricity during that same period ranges from €108-€235.

Naturally, exceptions to the abovementioned practices exist; for instance, when timber presents irregularities or odd shapes that disqualify it from material uses, or in cases in which it is rotting or effected by diseases (fungi) and pests (insects). ►



► Keeping European forests well managed

Contrary to common belief, forests in the EU-28 have been growing steadily for the past decades. In 1990, European forests represented a total amount of 19,7 billion m³. In 2015, EU forest reached 26 billion m³, meaning that forest stock (the total amount of wood available for harvest in forests) increased by 32% over the last quarter of a century. This growth is due to the increase in forested areas and the growth of standing volumes. According to Eurostat, the EU's forest coverage gained 322,800 hectares every year, meaning that European forests are increasing by the size of a football field every minute. On average, about 62% of the annual forest increment in Europe is actually felled, meaning that 38% of this annual increment remains in the forests. The situation can vary from country to country, of course. Forest spreading is more common in the Mediterranean region, in countries like Italy, France, Spain, and Slovenia, where at least 40% of the annual increment remains untouched.

The fact that forest stock keeps increasing is positive news for Europe because forests can act as sinks which sequester carbon. This also creates challenges for an increasingly urbanized Europe to maintain and mobilize the full potential of its forests. According to the latest State of Europe's Forests Report, 3% of the total forest area in Europe is damaged, most

commonly by biotic agents such as insects and pests. The amount of deadwood, particularly standing deadwood, has increased slightly in most of Europe's regions over the past 20 years. A lack of control or management can generate additional concerns and result in natural disasters such as forest fires, especially in the Mediterranean region. In 2015 alone, there were over 58,000 forest fires in Europe, spanning a total surface of more than 256,000 hectares. Bioenergy can play a major role in preventing forest degradation thanks to the extra income it provides forest owners, municipalities and governments, to manage their forests sustainably in the long-run.



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In addition to creating local jobs, woody biomass provides a fuel that is made for local communities, providing a de facto solution to one of Europe's key problems: its underlying energy dependency. With the economic downturn of the early 2010s, some might have assumed that the peak of European energy imports had been reached; however, history proved them wrong. In 2017, Europe's energy dependency reached 72% – almost 7% higher than in 2015 – and in February 2018, fossil fuel operators such as the Russian gas company, Gazprom, announced historic records in terms of volumes exported to Europe. Bioenergy offers a strong and reliable renewable alternative, with only ►

The European forest stock (the total amount of wood available for harvest in forests) increased by 32% over the last quarter of a century. European forests are increasing by the size of a football field every minute.

SOURCE: EUROSTAT, CALCULATIONS BY AEBIOM

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Bioenergy & Forest Management

- ▶ 4.85% of woody biomass for energy imported from outside the EU. This means that 95% of the EU's bioenergy consumption is locally sourced. Woody biomass fuel prices are also more stable than gas or oil prices. At a time when energy poverty is becoming a key topic in many EU Member States, solid bioenergy could provide price security and reliability to consumers.

What about the future?

The potential for sustainable woody bioenergy development is subject to debate, as it depends on many variables and assumptions. Simple estimates on forest biomass potential that could be mobilized for energy can be derived from the current size of forests, forest

removals and forest bioenergy sector of a given country. The International Energy Agency (IEA Bioenergy) estimated the potential for forest biomass mobilization for energy use: 180,000 ktoe* of forest biomass can be mobilized for energy if current mobilization logistics are optimized, the proportion of sustainably-managed forests are increased, and the quality management of mobilized biomass is improved. The primary energy production of forest biomass in the EU-28 was 85,278 ktoe in 2015, indicating there is still room for an increase in forest biomass mobilization. Had forest biomass mobilization reached 180,000 ktoe, it would have replaced 67% of the gross inland consumption of solid fossil fuel used in 2015. ☺

*KTOE = KILOTONNE OF OIL EQUIVALENT. A UNIT OF MEASURE OFTEN USED TO COMPARE ENERGY CONTENT ACROSS FUELS RATHER THAN VOLUMES

**95% of the EU's bioenergy consumption
is locally sourced... and biomass fuel prices
are more stable than oil and gas prices...**



The **European Biomass Association (AEBIOM)** is the common voice of the bioenergy sector with the aim to develop a sustainable bioenergy market based on fair business conditions. AEBIOM is a non-profit, Brussels-based international organization, founded in 1990, that brings together around 40 associations and 90 companies, academics and other associations from across Europe.







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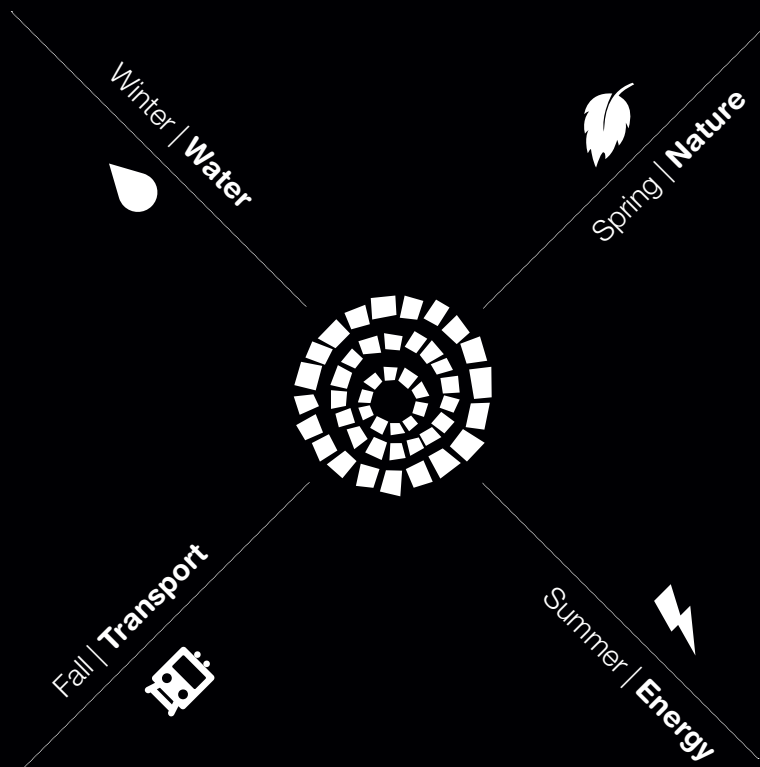
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REVOLVE transmits impactful and inspiring messages and projects from its partners to communicate sustainability more visually and effectively. Previous REVOLVE partners include:



One of the ways we do this is by designing and curating large-scale outdoor exhibitions at strategic locations. But we do more! — In line with the values we share with our clients we minimize waste through REPURPOSING.

Here's how we do it:



1

PURPOSE #1

REVOLVE designs and curates large outdoor exhibitions. We support partner projects and communication campaigns as well as our own. We work with local suppliers to print and install the exhibitions in public spaces, like the Cinquantaire Park in Brussels or along boulevards in Barcelona.

Hundreds of thousands of passersby see the messaging of our exhibitions.



2

REPURPOSING

REVOLVE recuperates the canvases after the exhibition and ships them to a small company in Germany that integrates physically-challenged people in the work force.

About 30 employees are giving each month a new life to up to 1000 square meters of products from banners and flag fabric.

The workers clean, cut and sew the canvases into new bags and folders. We give our partners the option to choose the product they prefer.

3



4

PURPOSE #2

The final products are messenger bags, shopping/beach bags and document folders that are branded by our partner's logo. They can reuse the canvases for their own events, meetings and promotion.

Repurposing has a history as long as the human kind but is today a valuable practice towards sustainable living and key to the circular economy.

Learn more about inspiring initiatives around the world: revolve.media/repurposing

Contact us today to make your zero-waste exhibition: info@revolve.media | +32 2 318 39 84

Interview with Ariel Booker, Co-Founder of CanO Water



After helping to bring the idea and concept of CanO Water to life, Ariel decided to leave his job as a headhunter to focus full time on CanO Water after he and his fellow co-founders noticed a gap in the market for an attractive, plastic alternative. Ariel was most eager to educate people on the benefits of choosing aluminium over plastic and to highlight the impact our current plastic consumption and waste was having on the planet.

How and when did CanO Water emerge?

The idea to use aluminium cans to package our spring water came in 2015, after we saw the sheer amount of plastics polluting the beaches and oceans in my visit to Thailand. Together with Josh and Perry, we decided to come up with a solution by launching CanO Water. We use aluminium because it's infinitely recyclable. Only 5% of plastic products are recycled typically, while approximately eight million tonnes of plastic ends up in the ocean each year. Whereas with aluminium, 75% of the metal produced since 1888 is still in circulation. A can can go from the recycling bin back to a shop shelf in six weeks. To make our cans as practical as a water bottle, we created a resealable lid, so our cans can be carried on the go.



Why it is important for you to target young generations?

Younger generations are inspired and influenced by what they see online, and by their peers. They're educated and clued up, and they're more aware of the environment than previous generations have been. With that in mind, we think it's still important to give them options. As more shops and sites are deciding to remove single-use plastic bottles, I think young generations will be minded to choose a sustainable product so long as the design and quality isn't compromised. ☺



SPECIAL EDITION CAN FOR THE 2017 LONDON PRIDE.



SPECIAL EDITION CAN FOR #WORLDWATERDAY, MADE IN COLLABORATION WITH CHRISTOPHER RAEBURN. THE CAN WAS DESIGNED FOR ZSL LONDON ZOO, TO REPLACE THEIR PLASTIC WATER BOTTLES.

Besides keeping you hydrated, CanO Water was created in response to the damaging impact that plastic bottles have on the environment. With approximately 8 million tons of plastic ending up in the ocean each year, CanO Water offers a highly recyclable alternative. Our aluminium cans have the highest recycling rate of any drink on the market; recycle your can and it could be back on the shelf in as little as 6 weeks. (The resealable lid doesn't affect the recyclability of our aluminium cans.)

www.canowater.com

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