

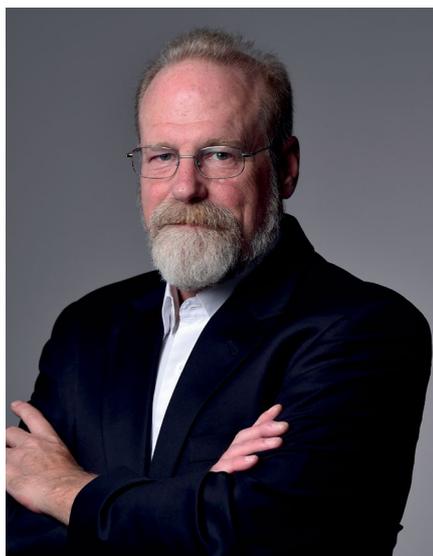
A 100% renewable energy future

A PES exclusive from Steve Sawyer, GWEC Secretary General. This is his perspective on the options for a world using 100% renewable energy, based on research and years of experience in our industry.



Wind turbine installed on the Eiffel Tower, Paris, Urban Green Energy

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Steve Sawyer

Ever since the oil shocks of the 1970s, and the early emergence of commercial wind turbines, solar hot water heaters, and the first solar PV panels, there has been speculation about what it would take to completely wean ourselves from fossil fuels.

As far back as 1975 Danish physicist Bent Sørensen published a paper looking at a 100% renewable energy system for Denmark¹. The visionary Dr. Amory Lovins came up with the term 'soft energy path' in 1976 to describe a future where energy efficiency and renewables gradually replace a centralized energy system based on fossil fuels and nuclear power.

After the emergence of the threat of human-induced climate change in the late 1980s, the discussion got a bit more serious. Both solar and wind technologies had progressed somewhat during the intervening decade and a half, but were still expensive and small. The first fossil fuel free energy scenario was published by Greenpeace and the Stockholm Environmental Institute in 1993².

But not even the most enthusiastic advocates of renewables would have

1 Sørensen, Bent: "A plan is outlined according to which solar and wind energy would supply Denmark's needs by the year 2050". *Science*, 189 (4199), 1975: 255–260.

2 <https://inis.iaea.org/search/searchsinglerecord.aspx?recordsFor=SingleRecord&RN=25025183>

imagined the rapid progress that we are seeing today. The spectacular growth of wind and solar in particular has been fuelled by rapid technology advances and dramatic cost reductions, both of which seem to be accelerating.

Mark Jacobsen of Stanford's 100% renewable³ work and the fierce reaction⁴ to it on thinly disguised ideological grounds is just one example of rapidly escalating struggle for hearts and minds over this subject. The opposition from critics is getting shriller and weaker with each passing encounter, as the future for both nuclear and CCS gets bleaker by the day.

At the end of the day, 100% renewable energy is inevitable, simply because everything else is not (renewable). The relevant question is whether we can do it quickly enough to save the climate, and whether we meet our climate goals with 100% RE or with a combination of RE and



Dorper wind farm, South Africa

other 'zero-emitting' technologies, should they emerge. Let's not forget, energy isn't the whole picture – we need to deal with agriculture, deforestation, chemicals, etc. But if we don't meet the Paris targets, then all bets will be off in the next generation or two and the question will be largely irrelevant.

A large portion of the energy establishment believes it is 'not possible' to go to 100% RE, and continue to argue for nuclear, CCS and/

3 Mark Z. Jacobsen, Stanford School of Earth, Energy, and Environmental Sciences <http://web.stanford.edu/group/efmh/jacobson/Articles/I/CountriesWWS.pdf>

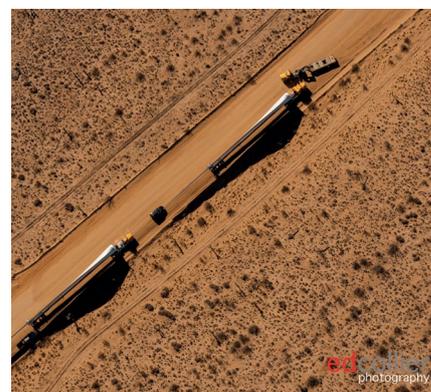
4 <https://www.nytimes.com/2017/06/20/business/energy-environment/renewable-energy-national-academy-matt-jacobson.html?mcubz=3>

or gas. While gas needs to play a role in the transition in the next few decades, the CO₂ and methane emissions from the production and consumption of gas are, at the end of the day, fundamentally incompatible with a 2°C world; never mind one which seeks to keep global mean temperature rise as close to 1.5°C as possible. Nuclear and CCS are dying in the marketplace.

In my view, therein lies the challenge: to show/convince not only the energy establishment, but policymakers and the general public not only that a 100% renewable energy future is possible, but that it is the *quickest*, *cheapest* and *cleanest* way to achieve our climate goals and ensure a liveable planet for future generations.

Although we may be winning the battle on the technology and the economics, there are still very powerful vested interests who actively mislead policymakers and the public, and who have gotten very rich off the status quo. What we are engaged in now is a battle for hearts and minds – people have to believe in 100% renewable energy and get over the notion that 'RE can't do it alone', which is still the received wisdom of the majority of energy pundits today.

The recent paper in *Nature* showing how the 1.5° C target is still geophysically possible, and its predictable and deliberate misinterpretation by the usual suspects, adds some urgency to the discussion. Whether or not *Millar et al's* paper means that we do in fact have a little bit more time



to meet the target, it outlines perhaps the most important and most overlooked question in this whole debate: time, and how little we have.

Ever since the Paris Agreement was concluded almost two years ago, it's been clear that any credible scenario that gets us close to either the 1.5° or 2° C target will



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require complete decarbonisation of the power sector at the very least, (well) before 2050. The logical consequence of that is of course that any decision to build a fossil fuel power plant today will mean either that it will become a stranded asset or we will not meet our climate targets. Not even the most ardent CCS proponents still go on about retrofitting coal or gas fired power plants.

Given the dramatic cost reductions in wind and solar over the last few years, the

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electrification of just about everything that can be electrified is becoming more and more accepted as the way to go. Look at electric cars, which just a few years ago were considered decades away from broad uptake, but are now not only growing



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exponentially in market share, but are being legislated into the mainstream in a number

of jurisdictions, and not just in northern Europe, but in China, and soon. As wind and solar deployments continue to accelerate and prices continue to go down, I would expect that this will spread rapidly to other sectors, with the kind of disruptive change that e-mobility is causing today.

One of the conceptual problems we have is that mainstream energy modellers insisting on hanging on to the notion of 'primary



Parque Gulf of El Zayt

energy'. Nobody wants primary energy; they want electricity, heat, cooling and mobility. Transformation of road transit to electric would remove about half the demand for oil, and replace it with about

20% of the equivalent in electric power, in primary energy terms. Same with removing coal and gas from the power sector, which are between 35% and 50% efficient, in terms of their primary energy inputs.

The classic absurdity of this approach is that nuclear still shows up as providing nearly twice as much 'primary energy' as hydro, which is a total nonsense when hydro produces nearly twice as much electricity globally today. The waste of 50-80% of the energy we consume up front is *NOT* something that should be 'rewarded', but measured only with a view to getting rid of it.

My contention is that if we get off the fixation on primary energy and focus on what is actually required by end users, then two things happen: the situation looks much more do-able for 100% RE; and we can focus in on the big areas where we really don't have all the answers (yet): steel, cement, airplanes and ships.

There are fixes for not using coking coal for steel production and for cement

manufacturing processes that don't release all the calcium carbonate as CO₂ - but



Dorper wind farm_South Africa

they're still experimental and should be the subject of massive, targeted R&D. The same is true for airplanes and ships: electrical options and those using biofuels and/or some form of hydrogen, perhaps with ammonia as a carrier. But again, they need a lot of work.

If we have the power, heating and cooling and much of the transport sector 'under control', i.e., massive electrification with the power coming from cheap wind and solar, then a real focus on the problem areas would, I believe, rapidly yield positive results.

So, to address the three criteria listed above:

- Is RE the quickest way to achieve change? I don't think we have any argument there. Relative speed of deployment has always been one of our strongest arguments, for both wind and



Vestas Lake Turkana

solar. The notoriously conservative IEA projects that wind and solar deployment in the next 5 years will equal half the coal deployed in the last 80 years.

- Is RE the cheapest way to achieve change? For electricity, I think that question has now been answered. If you don't believe me, just ask the IEA. For the rest, it's not quite so simple.

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- Is RE the cleanest way to achieve change? Heavy metals in batteries, rare-earth metals (which aren't rare) and bird strikes notwithstanding, I don't think there's any serious argument here when compared with the alternatives – climate change, and the fouling of our air, land and water which is the plague of modern industrialised civilisation.

To close, I would like to come back to the element of time. As Millar's paper points out, we CAN still solve the climate problem in time to prevent the total disruption of



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human civilisation. History would indicate that we are unlikely to do so because of political inertia and the large vested interests in the status quo.

A decade or two from now we may very well find ourselves in a feverish race to figure out how to extract CO₂ from the atmosphere. Wouldn't that energy (and money) be better spent now on solving the problems with steel, cement, ships and airplanes and the rapid electrification of just about everything else?



Im Wind Power

The time has come to accelerate the global energy transition towards 100% renewables, as the quickest, cheapest and cleanest way to meet our climate protection goals, not to mention cleaning up our air and water. More than 100 of the world's largest companies have already placed their bets on a truly clean energy future. Hopefully governments will catch up before it is too late.



South Africa

Steve Sawyer

Steve Sawyer joined the Global Wind Energy Council as its first Secretary General in April 2007. The Global Wind Energy Council represents the major wind energy associations (China, India, Japan, Brazil, Mexico, Australia, Canada, USA, Europe, France, Germany, Greece, Spain, Denmark, Italy, Korea, South Africa and Turkey) as well as the major companies involved in the global wind industry.

Steve has worked in the energy and environment field since 1978, with a particular focus on climate change and renewable energy since 1988. He spent many years working for Greenpeace International, representing the organization at intergovernmental and industry primarily on energy and climate issues.

At GWEC he is focussed on working with intergovernmental organisations such as the UNFCCC, IPCC, IRENA, IEA, IFC and ADB to ensure that wind power takes its rightful place in the energy options for the future; and with opening up new markets for the industry in Latin America, Africa and Asia.

Steve is also a founding member of both the REN21 Renewable Energy Policy Network and the IEA's Renewable Industry Advisory Board. He advised the Chinese government on the formulation of its renewable energy legislation, as well as providing expert reviewing for the IPCC's Working Group III. He grew up in rural New Hampshire and holds a B.A. in Philosophy from Haverford College, is married to Kelly Rigg, has two children Layla and Sam and has lived in Amsterdam since 1989.

About GWEC

Today the members of GWEC represent over 1,500 companies, organisations and institutions in more than 90 countries, including manufacturers, developers, component suppliers, research institutes, national wind and renewables associations, electricity providers, finance, insurance companies and law firms.

GWEC works at the highest international political level to create a better policy environment for wind power. Our mission is to ensure that wind power establishes itself as the answer to today's energy challenges, providing substantial environmental and economic benefits. GWEC works with national and international policy makers and industry associations to help open new markets for wind power. GWEC has a proven track record of success in helping to build the wind power industry in emerging markets around the world, including Argentina, Brazil, China, India, Mexico and South Africa. For more information:

www.gwec.net