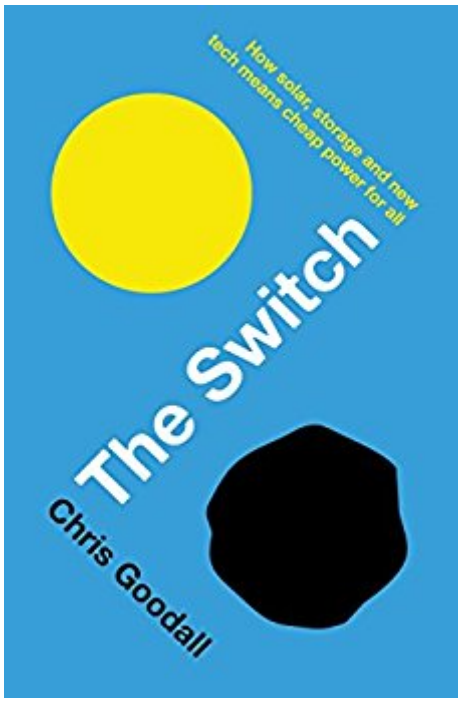
The Switch: How Solar, Storage And New Tech Means Cheap Power For All



Synopsis

How will the world be powered in ten years' time? Not by fossil fuels. Energy experts are all saying the same thing: solar photovoltaics (PV) is our future. Reports from universities, investment banks, international institutions and large investors agree. It's not about whether the switch from fossil fuels to solar power will happen, but when.Solar panels are being made that will last longer than ever hoped; investors are seeing the benefits of the long-term rewards provided by investing in solar; in the Middle East, a contractor can now offer solar-powered electricity far cheaper than that of a coal-fired power station. The Switch tracks the transition away from coal, oil and gas to a world in which the limitless energy of the sun provides much of the energy the 10 billion people of this planet will need. It examines both the solar future and how we will get there, and the ways in which we will provide stored power when the sun isn't shining. We learn about artificial photosynthesis from a start-up in the US that is making petrol from just CO2 and sunlight; ideas on energy storage are drawn from a company in Germany that makes batteries for homes; in the UK, a small company in Swindon has the story of wind turbines; and in Switzerland, a developer shows how we can use hydrogen to make 'renewable' natural gas for heating.Told through the stories of entrepreneurs, inventors and scientists from around the world, and using the latest research and studies, The Switch provides a positive solution to the climate change crisis, and looks to a brighter future ahead.

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Customer Reviews

This book covers the various renewable energy technologies, people and businesses in the world today. Renewals are ready for prime time and are being accepted around the world. Chris Goodall is a businessman and understands that a good business case must made for solar, wind, etc. in order for it become widespread for "the Switch" - and that he does convincingly. If one was to listen only to mainstream media you would think that renewals are still a fad. But in reality it is well beyond this stage and growing fast.

The Switch is the most up to date and easily readable publication that I have read on the rapidly transitioning energy economy. For anyone interested in Renewable Energy and the speed at which our now unstoppable transition to PV will occur, I highly recommend this book.

seemed very convincing - so I called for an estimate for a solar installation at my house, but it seems there is still a big gap between theory and reality

Chris GoodallÃ¢Â Â™s interesting and well-researched book is based around an optimistic premise Ã¢Â Â“ that pretty soon, perhaps by mid-century, the world is going to be run largely on solar power. This thesis is based largely on economics, which is its strength but also its weakness, and IÃ¢Â Â™m not sure I buy it 100%. Even so I liked this book, and I think it makes a good argument.Solar power isnÃ¢Â Â™t new, but for a long time its evolution was slow. According to Goodall, the initial breakthrough came in 1958 with the fourth satellite to be launched, which carried six solar panels into orbit. They produced half a watt, and cost many thousands of dollars per watt. By the mid-1970s the cost had fallen to about $100 a watt; today it is down to about 50 cents and, according to Goodall, it is still declining. Ã¢Â Âœin Britain,Ã¢Â Â• says Goodall, Ã¢Â Âœthe dramatic fall in the price of solar panels has already pushed PV [photovoltaic] almost to cost parity with planned gas-fired power stations.Ã¢Â Â• The key, he says, is the experiential curve that drives down the cost of PV generation, rather as MooreÃ¢Â Â™s Law has for digital storage.Just how fast things are moving can be seen, says Goodall, from the first weekend of April 2016, when the

UKÃ¢Â Â™s power from solar exceeded that from coal. He claims that a staggering 99% of the solar capacity with which this was achieved had been installed since May 2010. If his figures are correct (and he doesnÃ¢Â Â™t cite their source), we are in the midst of a revolution. Moreover the net cost to the world economy of changing over to PV would, he says, be less than zero even at the current depressed fossil fuel prices.This should not surprise us, given how much energy the sun actually produces. According to Goodall, an average of 90,000 terawatts of solar energy hits the planetÃ¢Â Â™s surface a year. The running energy demand is 15-17 terawatts at any one time, or about 1/6,000th of the amount reaching us. So we are getting enough. ItÃ¢Â Â™s a question of capturing it, and Ã¢Â Â“ importantly Ã¢Â Â“ storing it so that we have it in hand when we need it.On the first question, weÃ¢Â Â™re getting there. Goodall claims Ã¢Â Â“ and I am not qualified to check his figures Ã¢Â Â“ that the large global companies now spend about $200bn a year on oil and gas exploration, and that already this produces less energy than would be generated from solar panels with the same spend. He could have added, but didnÃ¢Â Â™t, that we already have more carbon fuel reserves than we will ever be able to emit anyway. So ploughing these resources into solar power makes far more sense.Do we have space for all the solar panels? Goodall says that at the current rate of efficiency (which will improve), weÃ¢Â Â™d need about 1% of the worldÃ¢Â Â™s land area to meet our needs. This is, he says, Ã¢Â Âœfar from negligible but not impossibly large.Ã¢Â Â• Actually it is quite a lot, given the competing land uses, and distance that emptier areas lie from the sources of demand. Goodall could also have considered the planning constraints in (for example) the UK and Germany, where onshore wind turbines have become controversial; there seems no reason to suppose that solar panels will be different. But there are possibilities for PV generation that donÃ¢Â Â™t take up too much land, and Goodall reviews these. One is the use of a material called perovskite to replace silicon, another the use of carbon-based molecules that will be capable of being printed on sheets of flexible plastic. Both are being researched near Oxford; meanwhile a spin-off from the University of Dresden is working on carbon-based molecules called oligomers that have the potential to be printed on film so thin that it may be mounted on glass or concrete. Imagine a building that is, in effect, a power-generating organism.None of this addresses the second big question that Goodall faces, which is Ã¢Â Â“ how do we ensure the power is always available, including when it is not being generated? Germany, and Britain, are already sometimes generating more power than they need between May and August. But GoodallÃ¢Â Â™s own figures make it clear that at other times there is a theoretical gap in most northern countries, especially in the winter, when meaningful quantities of solar energy will be generated for only a few hours a day, and not those during which it is most needed (especially for heating). Goodall starts by discussing

the different storage options in power generation itself Ã¢Â Â“ such as, for example, concentrated solar power that is used to heat salts or other solutions that then continue to generate heat and steam for turbines after dark. Syntheses with wind and biomass generation are also possible, and much may also be achieved through demand management, on which there is an interesting chapter. In the long run, however, the challenge is to replace baseline generation with sufficient grid storage so that solar generation can meet most or all of our needs. Not least of the factors forcing this upon us is (as Goodall acknowledges) that the more of our needs are taken care of by solar power, the less there will be that needs to be covered by (say) gas-fired or nuclear power stations Ã¢Â Â“ and the cost of that baseline generation per watt actually needed will skyrocket. So although Goodall does not directly say so, it would seem that, with rising generation from renewables, a migration from baseline generation to grid storage is an economic imperative.However, there are ways of using surplus energy at times of high generation to create stored reserves of energy. They include creating liquefied gases such as hydrogen Ã¢Â Â“ already being used, in a small way, to power a few cars. The production of hydrogen using conventional power sources is uneconomic, but if it could be used, in effect, to store sunlight, it might not be. Problems will remain with storage and transport. One answer to these might be to convert it to methane, which is easier to store in existing gas installations (ironically, it is itself an important greenhouse gas if emitted in ways that are not useful). Goodall also looks at experiments in production of liquid hydrocarbons using microbes. One of the most fascinating fields is the production of fuel from carbon dioxide; logical, given that fossil fuels are currently produced from another form of carbon and converted into carbon dioxide as (for example) tailpipe emissions. Why not convert them back? Carbon, after all, changes its form but not its nature. Goodall does warn that we are some way away from technologies that are economically viable on a large scale. In fact, it is one of the big strengths of this book that he doesnÃ¢Â Â™t dodge this question. Even so, he seems confident it can be done.I have some gripes with the book. Goodall is an economist, and has reviewed solar from that point of view. This does mean he has a coherent thesis (i.e. the cost of PV-generated energy is plummeting, so weÃ¢Â Â™ll adopt it). This gives the book an order and cohesion; it isnÃ¢Â Â™t just a paean of praise to solar energy. However, it also means he mostly misses certain areas, or more likely chooses not to engage with them.One is the environmental implications of large-scale battery use (although he is very good on the technology itself). Another is road transport. This is one of the keys to demand-side management, but it is largely ignored. Household consumption gets more attention, but here Goodall may be reinventing the wheel a bit; the idea of generating and consuming at different times of the day is far from new, certainly in Britain. Goodall does not mention night storage

heaters, but they were common when I was a child 50 years ago. These are still made but now in small numbers; their purpose was to store power in the night, at a cheap tariff, and release it later. This is an idea that could now be neatly reversed. Goodall does mention the pumped storage scheme at Dinorwig in Wales, but does not say that it is actually quite old (I visited it in the 1970s) and was originally intended to balance the output from nuclear plants, which could not easily be wound down at night. There is an element of Ã¢Â Âœback to the futureÃ¢Â Â• here. Also, as stated earlier, the difference in location of generation potential and consumption is acknowledged but not much discussed.Perhaps more seriously, as an economist, Goodall predicates decisions on rational behaviour. But vested interests are quite capable of restricting or penalising access to the grid by solar generators in order to protect their own capital investments. A classic example is BritainÃ¢Â Â™s Hinckley Point C nuclear power station, recently reapproved by new Prime Minister Theresa May; this will cost a mind-blowing Ã Â£18 billion and uses unproven technology that may not even work. Even if it does, its rationale is predicated on power prices that are likely to be much lower by the time it comes on-stream (especially if Goodall is right). So it will require massive subsidies. But it was approved anyway; why? According to Greenpeace, it may be because a number of senior civil servants at the Department for Energy and Climate Change had links to project developer EDF. There are quite a few other links as well, even MayÃ¢Â Â™s own husband, whose employer has an interest in the project (that does not of course mean he used improper influence). GoodallÃ¢Â Â™s book is based on logic. Politics and business arenÃ¢Â Â™t always.GoodallÃ¢Â Â™s main challenge now may simply be keeping this interesting book up to date. ItÃ¢Â Â™s a challenge IÃ¢Â Â™m familiar with; as the author of a book in a related field (climate change and agriculture), IÃ¢Â Â™m keenly aware that there is new research all the time. In solar energy there is the added drive of entrepreneurial research. Since The Switch was published, there have already been breakthroughs in (for example) perovskites, while the International Energy Agency has announced that half a million solar panels were installed every day in 2015. Goodall maintains a website (called Carbon Commentary) on which he tracks recent developments.I had my reservations about The Switch. Even so, it is a very good book Ã¢Â Â“ readable, logical and well-researched. Goodall might have missed a few points, but his summary of the key challenge Ã¢Â Â“ storage Ã¢Â Â“ seems excellent. There might be a few more barriers to Ã¢Â Âœthe switchÃ¢Â Â• than he says, but he can support his basic thesis Ã¢Â Â“ that the economics of solar energy are inarguable. The Switch isn’t perfect, but it’s an exciting glimpse into a future that isnÃ¢Â Â™t very far away.

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