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Technological Black Boxing versus Ecological Reparation: From Encased-Industrial to Open-Renewable Wind Energy

Aristotle Tympas

Retrieving the historical contrast between open and closed wind energy structures

Our present perception of wind energy technology is dominated by the version of wind turbines that we find in 'wind farms' ('wind parks'), which is associated with landscape degradation and local resistance. Locals don't want these turbines installed in their back yard, we don't ever see them posing happily in front of them. Even their most ardent supporters, who promote them as an unavoidable necessity in the face of the global environmental crisis, agree that there is nothing aesthetically appealing about these wind turbines. They just charge the local opponents of these wind turbines with suffering from the 'not in my back yard' syndrome. The reference to such a syndrome is by itself an acknowledgement of the negative aesthetic impact of these wind turbines. The 'energy landscapes' produced by the installation of wind farm turbines are certainly not attractive. In fact, if the criterion for the evaluation of the merits of wind energy turbines is their impact on the landscape, wind farm turbines score no better than fossil fuel energy generation plants (Pasqualetti and Stremke, 2018).

There were, however, in the past versions of wind energy technology that people were looking forward to be in a picture with. Going through the album of pictures that T. Lindsay Baker collected in *American Windmills: An Album of Historic Photographs* leaves no doubt about it (Baker, 2012). The owners of the kind of wind energy technology that we find in this album, together with a crowd formed by their relatives and friends, posed happily in front of it on all important occasions: from a baptism ceremony that was taking place at a water tank filled through the use of a wind pump to a wedding ceremony that was bringing together a comparable crowd, which also posed in front of the wind pump and the farm house that it was right next to (or just behind of). As we see in the picture that Baker chose for the cover of his book, people could not simply pose *in front of* this wind energy technology; they could actually pose *in* it (and *on* it). We will here refer to this past farm wind energy technology as ‘open’, while we will argue that the wind farm energy technology of present day is ‘closed’.

It is estimated that about five million open wind energy structures were installed in the western part of the United States in the decades between the late nineteenth century and World War II. While most of them were wind pumps, by the late interwar period exemplary durable wind electricity generators also became available, especially after the replacement of the traditional wheel by turbine blades. They could be of a size comparable to wind pumps, like the ones used to supply with wind electricity all the lamps and the appliances of a household, thereby making them independent from the grid (transmission network). They could also be very small, like the ones used to run a radio set. Next, we see typical interwar advertisements of small wind structures for radio sets (for an introduction to the history of these structures, see Righter, 1996).

Image 23.1

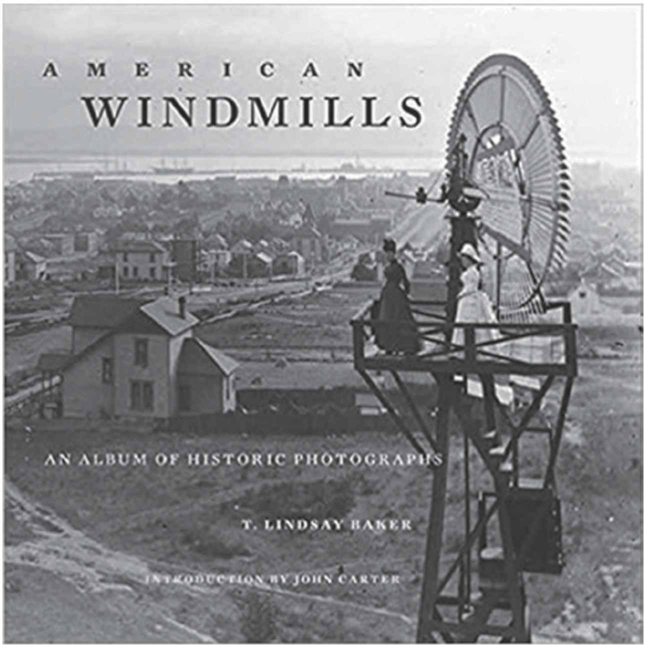


Image 23.2

Several scenes in movies of the immediate postwar period that were made by a generation of directors who had first-hand experience of the usefulness and appeal of open wind structures, are very suggestive. This is the case with a scene in the 1956 *Giant* (directed by George Stevens) – a movie that, for an historian of technology, may be read as a history of the transition from open water pumps to closed oil pumps (the screenplay was adapted by Fred Guiol and Ivan Moffat from an Edna Ferber 1952 novel). I am referring to the scene where the protagonist, played by James Dean, climbs on and stands in a wind pump. There is also the duel scene with Charles Bronson in the Sergio Leone 1969 spaghetti western *Once Upon a Time in the West*, which takes place in front of a wind pump like the ones installed by railway

Image 23.3

companies at stations along the line. Like the turning of the wheel of the traditional water mill, the turning of the wheel of this wind pump is symbolic of the unfolding of the movie narrative.

I expect that studying how Hollywood depicted these open wind structures will tell us a lot about the independence afforded by the ownership of one of these wind structures, from pumps to turbines, which will help us understand the associated attachment to them. And reversely, about how devastating the loss of such ownership could be. A wonderful scene on this central point can be found in the Arthur Penn 1967 *Bonnie and Clyde*, where the series of robberies by the infamous couple comes as a response to the 'robbery' of a farm household by a bank in the context of the interwar economic crisis. While narrating the devastating loss of the farm family house to the bank, the director zooms in on the wind structure right behind the house. This zooming suggests that the farm wind technology was a prime symbol of social independence.

Research is needed in order to learn the precise connection between the social fabric lost parallel to the loss of the ownership of wind energy technology by interwar American farmers. And, further, to learn about the involvement of the state in the unrooting of this wind energy tradition by force by the 1940s, in order to support the connection of farms to the grid (the transmission network). What we know seems to suggest that the capitalist state has been an indispensable institution in pushing towards closed wind structures. Notably, by the 1970s, when the first crisis of the fossil fuel energy economy sparked a new interest in wind electricity, the US and some major European states completely ignored the successful interwar experience with open wind structures and moved on to fund projects for the design of closed wind energy structures of the largest scale possible. The scale was so large – a historian of wind energy called it a 'hubris' – that these projects did not succeed (Heymann, 1998). Although the experimental pursuit of wind technology of the largest scale possible appeared to be a failure, it was in line with the approach that led to closed wind turbines of the large size that we find in contemporary wind farms.

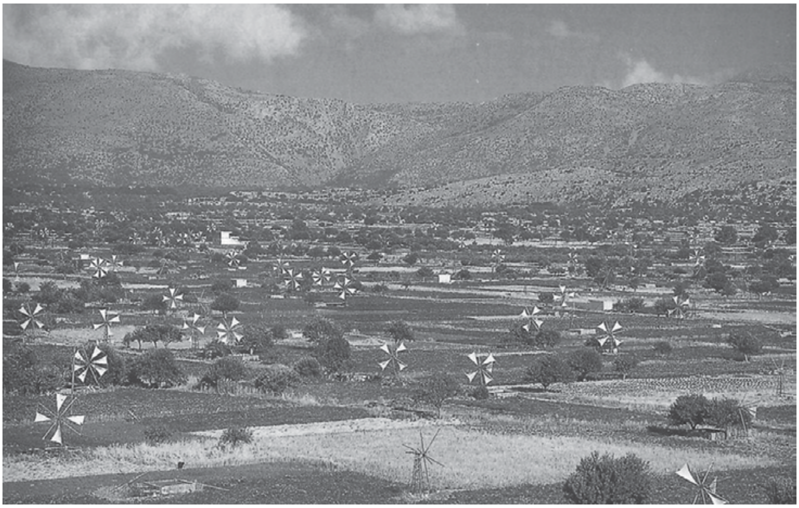
The exact opposite historical example to the state support to an extreme scaling up of closed wind turbines was community tinkering with open wind turbines of the smallest scale. I have had the privilege to work with Kostas Latoufis on the history of one such case, that of the small wind turbines constructed at the UK Scoraig community by relying on scrapped/recycled material (Latoufis and Tympas, 2020). Latoufis is an engineer who is involved in worldwide non-for-profit initiatives/networks that seek to advance a similar wind turbine design philosophy. Noticeably, the members of such networks call their turbines 'open source' because they can be improved and adjusted to concrete use through the sharing of knowledge about them.

While the interwar open wind turbines of the American West were commercially manufactured and therefore relatively standardized, the Scoraig ones, also open, were idiosyncratic and constructed by a community. For an historical example of a very small idiosyncratic wind energy structure, of the kind used to run a radio but constructed by a community (as opposed to being commercially manufactured), I would refer to an artifact constructed by a group of Greek soldiers who were imprisoned in a remote north Africa desert camp by the British Army during World War II. While the Greeks and the British were allies during the war, these soldiers were imprisoned for having joined the left-leaning Greek resistance movement in the demand for the postwar democratization of Greece. Against their imprisonment, they managed to be updated on the latest news by constructing a radio set that was run by a very small wind energy arrangement. The radio was made by a wireless radio that they took from an airplane that had crushed in the desert. The wind arrangement was of their own construction. The Greek prisoners were presenting this wind arrangement to their guards as a toy by hiding its connection to the wireless radio that it run. When the guards were moving the prisoners around in order to check their stuff, the prisoners were disassembling the wireless radio into many small parts that they were placing inside their metallic water flasks. The guards assumed that the metal detector that they were using was activated by the flasks. Upon their release by the end of World War II, when asked by their guards to reveal how they were updated on the latest news, the prisoners enigmatically replied: 'we received the news from the wind' (Μακριδάκης, 2006).

I will conclude this attempt at a critical introduction to the history of wind energy technology with the case of the (approximately) 15,000 wind pumps that were constructed and used at the Lasithi Plateau of Crete, Greece, during the interwar and the early postwar decades, which is when they were dismantled. The water pumped through their use was stored in an open tank built on the ground under the wind pump so as to irrigate the land at the appropriate time. They were built and maintained by local artisans, with materials within their reach, like wood and iron, as in the case of the interwar US wind structures as just mentioned (Hoogervorst and Land, 1983). The design of this locally and easily reparable Cretan wind pump was in the 1970s and 1980s used in many locations at poor regions worldwide (Van de yen, 1977; Mann, 1979; Morgan and Icerman, 1981; Fraenkel, 1986). Interestingly, upon copying the traditional Greek windmills, their sails were made by cloth (see picture that follows, from Evangelodimou, 2018 and sketch from Van de yen, 1977; the Lasithi Plateau with the windmills operating is shown in a scene of *Signs of Life*, a 1968 movie that was directed and produced by Werner Herzog).

It was the use of cloth, a time-tested and fully repairable and recyclable material, that caught the attention of Gordon G. Brittan, Jr., a philosophy professor who has experimented with the construction of a cloth-based sails for the wind turbine of his American West (Montana) house (Brittan, 2002). This practical experimentation was inseparable from his philosophical elaboration on the difference between open and closed wind structures. Based on this, Brittan moved on to propose wind structures that contain no concealed parts. In the context of doing so, he insightfully compares wind structures with open and concealed parts from the perspective of their diverging emphasis on repair. This can be linked directly to the issue of ecological reparation, to which we shall return. In the following section, I will argue that his elaboration offers an appropriate starting point for what interests us here.

Image 23.4



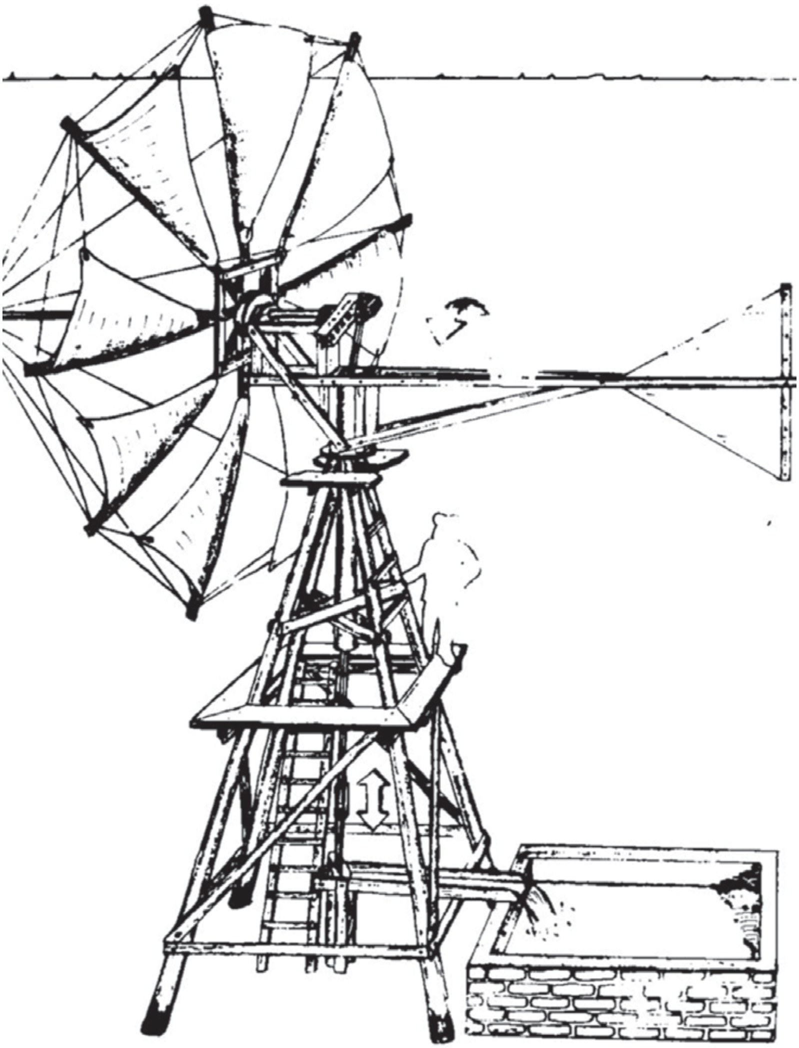
On technological black boxes: between industrial wind turbines and digital computers

In the context of arguing that 'different views of technology are embodied in different types of wind turbines', and, further, 'certain kinds of design might more naturally, and hence, aesthetically, be introduced into the landscape' (Brittan, 2001: 169), Brittan follows what philosopher Albert Borgmann has written about 'devices'. As he sees it, devices offer an exemplar of how contemporary technology conceals and, in the process, 'disengages'. 'The more advanced the device', writes Brittan, 'the more hidden from view it is, sheathed in plastic, stainless steel, or titanium'. 'Moreover', he continues, 'concealment and disburdening go hand in hand. The concealment of the machinery, the fact that it is distanced from us, ensures that it makes no demands on our faculties. The device is socially disburdening as well in its isolation and impersonality' (Brittan, 2001: 174).

I would argue that we can keep the Borgmann and Brittan point about the concealment of a version of the wind turbines without having to call them devices because the concept 'device' refers to technologies of comparative small size, which we usually find inside laboratories and homes. I find more appropriate the shifting of the emphasis to the 'black box' concept – a shift that Brittan has endorsed:

> We could summarize Borgmann's position by referring to the familiar theoretical notion of a 'black box'. In a 'black box' commodity-producing machinery is concealed insofar as it is both hidden from view

Image 23.5



or shielded (literally), and conceptually opaque or incomprehensible (figuratively). Moreover, just those properties that Borgmann attributes to devices can be attributed equally well to 'black boxes'. It is not *possible* to get inside them, since they are both sealed and opaque. It is not *necessary* to get inside them either, since in principle it is always possible to replace the three-termed function that includes input, 'black box' and output, with a two-termed function that links input to output directly. All we really care about is that manipulation of the former alters the latter. (Brittan, 2001: 175, emphasis in original)

Acknowledging the centrality of black boxing (for an update on the literal and figurative use of the 'black box' concept, see Shindell, 2020), Brittan elaborated on a follow-up text of his:

> Now I want to make a very controversial claim. Wind turbines are for most of us not things but merely devices. There is therefore no way to go beyond their conventionally uncomfortable appearance to the discovery of a latent mechanical beauty. Thinking for a moment reveals that except for the blades, virtually everything is shielded (Including the towers of many turbines), hidden from view behind the same sort of stainless steel that contains many electronic devices. Moreover, the machinery is distant from anyone save the mechanic. The lack of disclosure goes together with the fact that wind turbines are merely producers of a commodity, electrical energy, and interchangeable in this respect with any other technology that produces the same commodity at least as cheaply and effectively. The only important differences between wind turbines and other energy-generating technologies are not intrinsic to what might be called their design philosophies. In other words, although they differ with respect to their inputs (i.e. fuels) and with respect to their environmental impacts, the same sort of functional description can be given a fossil fuel plant. There is but a single standard on which to evaluate wind turbines. It should not be wondered at that they are, with only small modifications between them, so uniform. (Brittan, 2002: 69)

I follow Brittan in the argument about the functional equivalence between, and the interchangeability of, fossil fuel machines plants and a version of wind turbines/parks, on the grounds of their constitution, both, as black boxes. But, precisely because of this equivalence, I disagree with the statement that the two differ 'with respect to their environmental impacts'. To show what is at stake here, I suggest that we do not stay at what is displayed by wind turbines of the black box kind but also try to look at what is concealed by it, at what the wind-intercepting blades are invisibly connected to.

Turbines of the black box kind, the kind that we find in wind farms/parks, industrial wind turbines, are connected to a long-distance transmission network. It is this network that links them to the consumers of the electricity generated by them. Noticeably, this is the same network that links consumers to electricity generating plants based on fossil fuels. Someone in, for example, Athens, Greece, can consume electricity transmitted through this network that represents a mix of electricity generated at fossil fuels plants and industrial wind parks. The mix can actually include electricity generated at nuclear plants, including ones located at a country different from that of consumption (see Tympas et al, 2013) – incidentally, this explains why industrial wind parks and nuclear energy plants can be part of the same corporate portfolio. If industrial wind turbines and fossil fuel plants are interchangeable as a commodity at the point of their consumption, it is the sharing of the transmission network that makes this interchangeability possible.

Fossil fuel plants cannot be replaced by industrial wind parks because when there is no or little wind they need to be in operation. This means that industrial wind parks are added to the total of fossil fuels plants, they are not replaced by them. Moreover, the available fossil fuel plants have to operate in addition to industrial wind parks because they represent a huge capital investment that cannot remain idle. For as we know very well from the study of the availability of mass production machinery, once available it must operate, with its production inducing consumption (Hounsell, 1985). In the case of mass production of electricity through fossil fuels electricity generators, this is known as the 'load factor' imperative: new consumption must be encouraged so as to match the generating capacity of production machinery (the long-distance transmission network is here of constitutional importance, see Cohn, 2017). This is why national and transnational drives that target the increase of the percentage of electricity generated by wind do not assume that the overall consumption of electricity – not to say the overall consumption of energy – will decrease. Suggestively, while the increase in electricity consumption that was generated by industrial wind plants was impressive in Europe between 2012, when the '2020 target' for a green energy transition was adopted, Europe consumes more energy in 2020 today than in 2012 (Sanchez-Nicolas, 2020).

The black boxing of industrial wind turbines is critical when it comes to isolating the wind-intercepting turbine from the rest of the technological materialities involved in making the wind energy available to a consumer. More specifically, it conceals the long-distance transmission network that starts right behind the wind-intercepting turbine blades of wind farms. This transmission network is connected to (and is, therefore, inseparable from) the turning of the turbine blades by the wind. This connection to the transmission network starts right behind the blades, where there is an apparatus that is supposedly self-regulatory (self-controlled, automatic), and continues throughout the long-distance transmission line, which is also loaded with apparatus of this kind. More precisely, it starts right behind the blades with regulatory mechanisms based on feedbacks between the wind and the transmission line. Differently put, the black boxing allows for the display of all this as a two-termed function, as if there is only the wind, as the source of electricity, and the electricity switch on/off button at the consumption. It conceals from a consumer that this is actually a three-termed function, the invisible function being the one where wind and fossil fuel electricity become mixed in the drive for the dynamic reproduction of a growth of energy consumption. It follows that whatever the environmental impact of this kind of (black boxed) wind farm turbines may be, it is part and parcel of the environmental impact of fossil fuel plant turbines.

As I suggested elsewhere (Τύμπας, 2018, chapter 7; Tympas, 2005), relying on the transmission network and the multitude of feedbacks mechanisms (now falling under what is called 'smart grids'), all the way from the generation of electricity currents and signals (strong, as in electric power, or weak, as in electric communication) to their consumption, is not actually all that automatic. It requires skilful labour to maintain the balance in the transmission network, to keep the network functional. And it is precisely this social labour that is concealed through black boxing. To elaborate on this, I may refer to the functional equivalence of energy and computing black boxes. Brittan has insightfully prepared us for this by writing that the 'wind in – electricity out' function of black boxed turbines, which is the only one visible, 'is roughly the same kind of comprehensibility that is involved when we note the correlation between punching numbers into our pocket calculators and seeing the result as a digital readout' (Brittan, 2002: 70). I have had the opportunity to argue that displaying the digital input and output of numbers at the exterior of a black box, while encasing at its interior the social labour required to produce the output for a certain input based on the production of an appropriate computing analogy (between the computer and the computable), defines all computing technology, from the emergence of capitalism to the present (Tympas, 2017, 2020). Brittan had correctly pointed to the technical similarity between black boxed turbines and pocket calculators. I suggest that the similarity is more general: black boxing wind energy is technically similar to computer digitalization, present-day industrial wind turbines and digital computers are products of the same socio-technical drive.

Black boxing versus repairing: on ecological reparation

Based on everything said so far, in this section I will move on to argue that the black boxing that we find in both industrial wind turbines and digital computers devaluates, through its concealment, the need for social labour. In the case of computing, this is the skilled labour to produce and modify, maintain and repair so as to have a proper analogy between the computer and the computable (Tympas, 2017, 2020). What is it that is concealed in the case of industrial wind turbines? To answer this question, we may rely on a comparison between industrial-closed wind structures and the open ones introduced in the first section.

It is not enough to invite attention to the long-distance transmission network that is concealed by the black boxed version of wind energy technology; we also need to place the emphasis on what is not concealed by the wind energy structures that are not black boxed. Here the Lasithi Plateau case can help us, but not only because of the use of a more inviting materiality at the interception of the wind that captured Brittan's attention, the wheel with reparable cloth sails. In the case of the Lasithi Plateau wind energy structures, I find extremely important the visible low-tech water tank at the basis of each of these structures, which was functionally equivalent to the (also visible) water tank attached to the wind pumps of the American West wind pumps introduced earlier. These water tanks, for local energy storage, represent the direct opposite to the long-distance energy transmission.

If we want a direct comparison, which involves wind electricity, at the opposite end of the long-distance transmission network of black boxed industrial wind turbines I would place the batteries at the basement of the late interwar American farm household, which were completing the circuit of its wind energy technology. The key here is that the batteries and the wind turbine were connected through a local circuit, not a long line, as in the case of industrial wind parks and fossil fuel plants. Research on details is here necessary. I would suggest that it ought to start from the fact that this local wind electricity circuit was operating at an electric tension and a current that was as low as possible, thereby placing the emphasis on flexibility, adaptability, maintenance, repairability. Virtues privileged by the case that we know more about, that of the wind electricity advanced by the community tinkering that we find in the aforementioned history of the UK Scoraig community (Latoufis and Tympas, 2020), and, in the present, in the 'open source' of Latoufis and the like-minded members of his global networks.

The closed versus open (and long-distance transmission versus local storage) wind electricity contrasts are actually coupled by many more ones: large versus small size, highly synthetic versus more natural materials, centralization versus decentralization, business and ownership schemes that favour the big capital/corporations versus privileging the immediate producer, commodity versus need, use versus exchange value, profit versus care. And, last but not least, here agreeing with Brittan, black boxed wind electricity machinery is distant from anyone save the mechanic Brittan, 2001, 175); black boxed technological design by a distant expert is the opposite to technical repair by everybody. A machine designed by the scientifically trained engineer, which can only be abandoned when it stops functioning after a limited time versus something defined by its ongoing susceptibility to local reparation. The news regarding what happens with industrial wind farm turbines after they run the course that they are designed for confirms the centrality of ongoing-local-open reparation, an ecological reparation: from the start to the end, from mining for wind farm turbines (Sonter et al, 2020) to burying them when they die (Martin, 2020), the technology of black boxed industrial wind turbines reproduces the cause of the environmental crisis.

There is by now a sense that there is a problem somewhere with the dominant version of present-day wind energy technology, with relying on it for a transition to renewable energy and environmental sustainability (Rumpala, 2017; Siamanta, 2021; Sovacool et al, 2021). This invites a rethinking/reconceptualization of what such transition may actually require, what renewable energy may actually be. The chapter sought to contribute towards such rethinking. We may now state fully its argument, an argument for pursuing openness as a prerequisite of ecological reparation. One could only pose *in* wind structures like the one in the cover of the Baker book, because, unlike present-day industrial wind turbines, they had no interior and exterior, no inside and outside, no surface and back, no concealed and displayed part. Differently put, through black boxing (typical of the dominant version of present-day technology, from industrial turbines to digital computers), we are presented with an environmental-friendly energy 'source', a 'renewable energy source', the wind, while the destruction of the environment through the machine (the long-distance transmission network) that follows is concealed.

Without the black boxing, there would actually be no reason to talk about the 'environment' in the first place (while we lack a history of the concept 'environment', we now know enough to argue that it emerged in the context of historical capitalism, see, for example, Benson, 2020). What is actually concealed by the black boxing is that there is not just the wind-intercepting blades and the button at the other end. We should not then talk about renewable energy sources, as the wind (and we could argue the same about the sun) by itself does not guarantee renewability. The black boxing makes the reproduction of an environmentally destructive energy machine invisible by allowing a view only to the source of energy. It is on the grounds of the black boxing that we see the source and not the machine, we see the exterior, an environmental source, but not the interior, the machine destruction of the environment. It is this that makes it look as if renewability is possible by a mere digital click (switch on) of a button by an energy consumer.

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