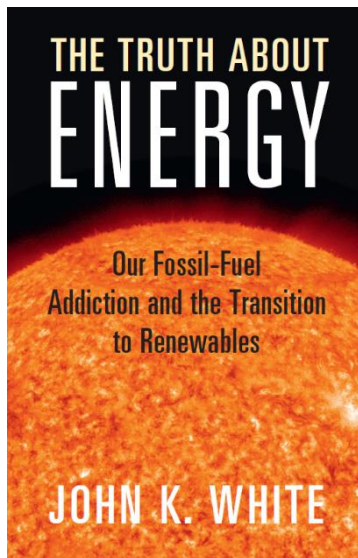


## *The Truth About Energy: Our Fossil-Fuel Addiction and the Transition to Renewables*

John K. White, Cambridge University Press, 2024



I have taken hundreds of photographs during the research for *The Truth About Energy*, mostly on my wife's and my regular travels. Energy is everywhere around us: yellow/green mail delivery vans in Gijón, falling water in Niagara Falls, solar- and wind-powered roofs (almost everywhere now), ....

Learning about energy is essential as we begin the transition from brown to green, from unsustainable to renewable. Here are a few of the pics, with captions explaining some of the story.

For more, check out *The Truth About Energy* on the [Cambridge website](#). You can also order from your local bookshop or on Amazon. Both print and electronic versions are available.

### **0 Gijón, Asturias, 2024**

*Esta furgoneta es verde* (This van is green). The Spanish post office colours are yellow and blue. One always needs a sense of humour when dealing with slow mail and slow transitions, but it is good to see they are doing their bit to reduce toxic exhaust pollution in our cities via electric vehicles and help jumpstart the revolution revolution. (Chapter 6)



### **1 Niagara Falls, New York, 2014**



I first saw Niagara Falls as a boy with my family and have been going back ever since. This is the Robert Moses hydroelectric power plant in Lewiston on the New York side of the Niagara River across from the Sir Adam Beck (SAB) hydroelectric plant on the Ontario side, renamed for Ontario Hydro's first chairperson and champion of "people's power." Niagara Falls generates about 5 GW for American and Canadian customers. Worth visiting along with the butterfly museum. (Chapter 5)

## 2 Horseshoe Falls, Niagara Falls, Ontario, 2014

“Niagara Falls was the game changer, falling water diverted from Lake Erie on its way to Lake Ontario to turn a turbine that generated alternating current in an AC induction generator. The electricity was first used to power industries in the adjacent town of Niagara Falls, New York, before being transmitted 22 miles to the nearby city of Buffalo without any significant power losses and thereafter incorporated into other types of power stations whatever the fuel: coal, oil, natural gas, or water.” (p. 65)



## 3 Kinderdijk, South Holland, 2022



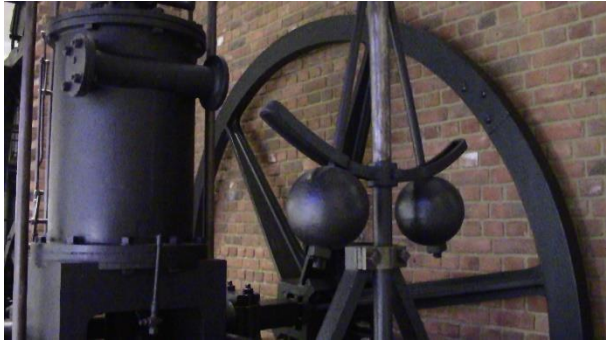
“Now a UNESCO World Heritage Site in the Albasserwaard region southeast of Rotterdam, the Kinderdijk comprises 19 windmills and three pumping stations to drain water from a lower polder to a reservoir to a higher polder via scoop wheels and then on to the River Lek at low tide.” (p. 382) If you visit, I suggest taking a boat from Rotterdam.

## 4 ECOMuseum, Mieres, Asturias (pit wheel tower)

There are 3 related museums in the Nalón Valley, commemorating over 2 centuries of the coal industry in Asturias. At ECOMuseo Minero, you can take a narrow-gauge train into a decommissioned mine (Pozo San Luis de La Nueva). MUMI (La Entrega) has an excellent collection of mining and steam-power artefacts (including a replica Watt & Bolton steam engine). MUSI (La Felguera) shows the start of the Spanish steel industry, begun by Pedro Duro, on up to ArcelorMittal in Gijón and Avilés (carbón, hierro, y acero). (Chapter 1)



## 5 Science Museum, Kensington London, 2017 (fly wheel governor)



Some cite 1776 as the start of the Industrial Revolution with James Watt's invention of the general-purpose steam engine in Glasgow. Watt's game-changing innovation was an external condenser to recycle the water more efficiently (liquid-steam-liquid-steam), allowing his "fire engine" to use a fraction of the coal as in the earlier water pumps of Newcomen, Papin, and Boyle. With partner Matthew Bolton, they built the first great "manufactory" outside Birmingham and changed the world. (Chapter 1)

## 6 Aboño coal/gas power plant, Gijón, 2022

Unfortunately, coal still provides 40% of global power, much of it in China and India. Although Western countries have closed coal plants – led by Germany's proposed complete shutdown by 2038 – many dirty coal plants are still operating (or have been restarted since the war in Ukraine). In the former bustling bituminous coal region of Asturias, lighter lignite coal is now imported to fuel thermal power plants and make steel and fertilizer. The Aboño power plant is being retooled to burn methane (a.k.a. "natural" gas) with plans to transition to green hydrogen (which burns at the same temperature as methane). We will see. (Chapter 1)



## 7 Repsol gas tanks, Gijón, 2022



Adjacent to the Roman settlement of Campo Torres and with access to the Port of Gijón, methane gas is stored for home heating distribution. Repsol is a giant of Spanish energy with 4,700 gas stations. The 290th largest company in the Forbes global 2000 list, Repsol is involved in oil and gas (exploration, production, transport, and refining), petrochemicals, liquefied gas and methane, and electricity. (Chapter 1)

## 8 Port of Gijón, ArcelorMittal steel, 2013

ArcelorMittal is the world's second largest steelmaker after Nippon Steel, producing 10% of all steel. Two of its plants are located in Asturias, in Avilés and Veriña (Gijón). Spain's only integral steelworks is in Veriña, serviced by the Port of Gijón (El Musel), the largest bulk port in Spain with 10 km of docks. ArcelorMittal may pull out of Asturias over EU plans to convert coal-fired steel plants to green hydrogen-made steel via direct reduced iron (DRI), citing concerns over the future price of electricity. (Chapter 1)



## 9 Poolbeg Generating Station, Dublin, 2016

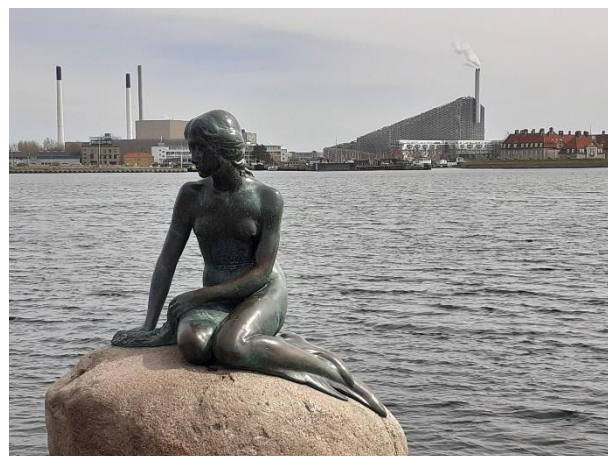


Built on reclaimed land at the mouth of the Liffey, the ESB Poolbeg power station is a 1.2-GW, six-unit oil- and gas-fired thermal plant equipped with combined cycle generating turbine (CCGT). The Poolbeg peninsula was used as a staging ground to build the Great South Wall and iconic red Poolbeg lighthouse. The view is from Sandymount Strand, where Dedalus and Bloom stroll in *Ulysses*. I recommend a

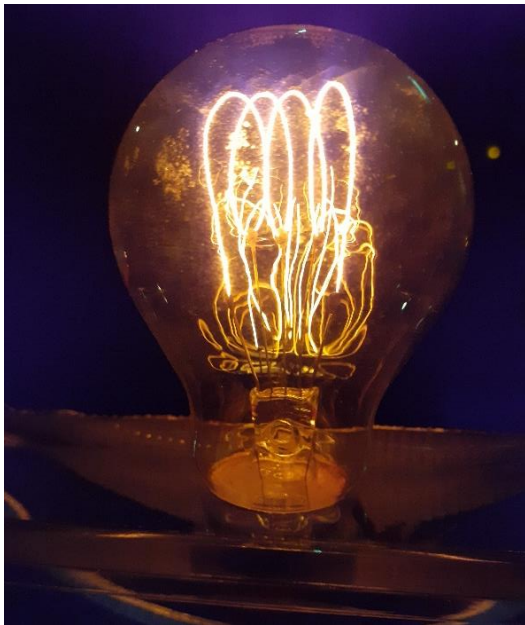
walk to the lighthouse and back. Bring comfortable shoes. (Chapter 2)

## 10 Incinerator/district heating, Copenhagen, 2022

Located across the harbour from Hans Christian Andersen's famed Little Mermaid, Amhager Hill is a waste-to-energy plant and incinerator that burns solid waste for local district heating. The plant doubles as an astroturf ski hill (a.k.a. CopenHill). Most people visit the nearby hippy village of Freetown Christiania, but CopenHill is worth a visit for the views, even if you don't ski. "Depending on your perspective, CopenHill is a novel district heating idea or a gimmick to hide an incinerator." (p. 407)



### 11 Philips Museum, Eindhoven, 2023



The Philips factory was one of the world's first major lightbulb makers, producing carbon-filament lamps for the European market. Begun in the 1880s before a grid connection was even available in Eindhoven, the electric lightbulb factory was initially lit by gas lamps. Incandescent lightbulbs were originally made with carbon threads and then longer-lasting tungsten filaments, but are now banned in the EU, replaced by more efficient LED bulbs (no burning). Now home to the excellent Philips Museum, the early years of electrical technology are on display. (Chapter 5)

### 12 Marie Curie's lab office, Paris, 2022

A founder of nuclear physics with Ernest Rutherford, Marie Curie painstakingly separated radioactive polonium and radium from pitchblende (uranium ore). Madame Curie received 2 Nobel prizes (1903 Physics and 1911 Chemistry) for explaining the “faint, fairy light” of “radioactivity” and the chemical process of elemental separation. Her office has been preserved along with a roomful of artefacts and information about the early years of radium and nuclear science. Located beside the Pantheon, where she and her husband Pierre are buried, the museum is free. (Chapter 3)



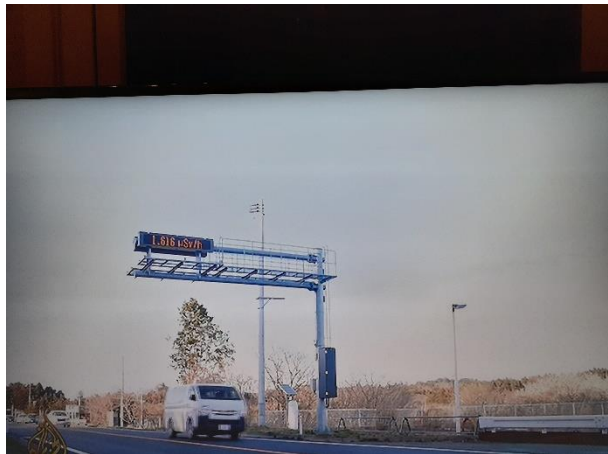
### 13 No-go area, Port Hope, 2019



“Set up in 2001, the Port Hope Area Initiative (PHAI) oversees the removal of low-level radioactive waste to a long-term, aboveground, storage site, 10 km north of [Port Hope] (already in operation for Cameco waste). There is no guarantee of future safety, but first removals began in 2018. The \$1.28 billion project aims to remove 2.5 million cubic meters of contaminated material such as uranium, thorium, radium, and arsenic, while 5,000 homes will be tested.” (p. 246)

## 14 Lo-go area, Fukushima, 2021

A TV screen capture of a highway in Fukushima Prefecture shows the local radioactivity ( $1.616 \mu\text{Sv/h}$ ), where 4 nuclear reactors were destroyed in the aftermath of a 2010 tsunami. A “major accident” (7 on the International Nuclear Event Scale, along with Chernobyl), the radiation release from Daiichi 1, 2, and 3 precipitated a mass evacuation of the local population. About 200 km north of Tokyo, 300,000 people were forced to evacuate from Fukushima Prefecture, two-thirds unable to return more than 5 years later. (Chapter 3)



## 15 Tesla Roadster, Amsterdam, 2022



The first electric vehicle to use Li-ion batteries and travel over 200 miles on a single charge. Only 2,450 were made, including Elon Musk’s red Roadster, employed as a unique dummy payload in a 2018 SpaceX Falcon Heavy test launch driven by a mannequin called Starman. “Based on the ground-hugging Lotus Elise body, the proof-of-concept Roadster solved many early engineering problems, successfully employing for the first time a lightweight, longer-lasting battery pack for intra-city driving that also included cell-level fusing to avoid overheating, in situ cooling in a thermal management system, and eventually a titanium safety shield between the flat-chassis battery pack and the vehicle cab.” (p. 462)

## 16 Hybrid (gas/electric) bus, Toronto, 2019

As seen in front of the TD Centre in the heart of Toronto’s downtown, this hybrid bus runs on methane and diesel gasoline, although more all-electric buses are starting to appear in Western cities as well as electric hybrids to reduce toxic exhaust pollution (carbon soot from incomplete combustion as well as CO, NO<sub>x</sub>, and PM). The Chinese company BYD now produces the most all-electric buses, including the entire 16,359 fleet of public buses (380-km range) in the city of Shenzhen, China (pop 12.5 million), “helping to free commuters from the vagaries of petroleum prices and the horrors of a smog-filled past.” (p. 492)



### 17 Solar-powered all-electric bus, Schiphol airport, North Holland, 2022



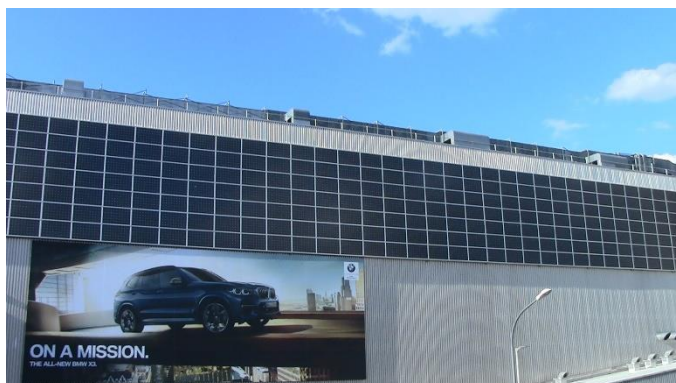
I have seen electric buses in many cities, but this is the first “solar-powered” bus. They aren’t entirely solar-powered, but are equipped with solar panels and do run on 100% green electricity (mostly abundant Dutch wind). Schiphol airport has one of the biggest electric bus fleets in Europe. (Chapter 4)

### 18 Solar farm, near Burgos, 2014

Photovoltaic (PV) solar farms are becoming more prevalent and can be seen on the roadside in various sun-kissed locales. This one was along the highway near Burgos in Castille-La Mancha. Concentrated solar power (CSP) plants aren’t as easily seen from the road, but I saw one from a plane window just west of Seville in Sanlúcar la Mayor. If you want to see the majesty up close, check out Google Maps (Satellite mode). “The symmetric majesty is a wonder to behold.” (p. 366)



### 19 Building-integrated solar, Munich, 2017



The BMW Museum is located beside the Olympic Park in Munich and both are worth visiting. The Olympic Park requires a €1 deposit on plastic bottles, while the museum has the latest in EVs along with exhibits about the history of the internal combustion engine and German car manufacturing. The 24,000-square-foot building is covered in solar panels, producing over 100 MWh/year. (Chapter 4)

## 20 Solar roof, Gijón, 2022

If you take the train in Europe, you will see more and more solar-panelled roofs on homes and warehouses, especially in Germany and Italy. We saw thousands along the way on two particular memorable train rides: from Munich to Salzburg and from Venice to Trieste. Germany and Italy have led the way in rooftop solar in the EU, partly because of directed government support, while Spain has been slow to the game after a botched government feed-in-tariff (FIT) scheme, but is slowly catching up. This one was the first in our neighbourhood in Gijón. Another neighbour has a solar-thermal roof for hot water. (Chapter 4)



## 21 Wind farm, Copenhagen, 2022



The cooperatively owned Middelgrunden Wind Farm is a 40-MW, 20-turbine offshore installation in the shallow coastal waters of Copenhagen, the world's largest upon construction in 2000. With 10 other onshore turbines in the neighbouring seaport, the 30 turbines operate at over 90% efficiency and provide about 6% of Copenhagen's electric power. This picture was taken from the window of a plane (the CopenHill ski slope is on the left edge). (Chapter 5)

## 22 Wind farm, North Holland, 2022

More roadside wind farms are cropping up in suitable locations. This is taken from the window of a train in the Netherlands between Amsterdam and The Hague. Adapted from early sailing boats, the Dutch modified the Archimedes screw water pump in the 1400s to keep their water-logged marshlands dry and by the 1500s had “devised a crankshaft to convert the horizontal turning of the internal rotor to the vertical up-and-down motion of a saw that could cut logs into planks at a rate 30 times faster than man.” (p. 380)





### 23 Rooftop Wind Turbine, Hamburg, 2022



don't forget to visit the Reeperbahn, home to the Beatles of the early 1960s. (Chapter 5)

Today's wind turbines (WTs) come in various shapes and sizes: the usual 3-blade rotor (horizontal axis WT or HAWT), a vertical axis WT (VAWT) that catches air in horizontal foils, and even a bladeless WT (a freestanding flexible rod vibrates inside an outer tube). A VAWT doesn't need to face the wind to rotate, is virtually silent, and requires less space, but is less efficient than a HAWT. These 3 rooftop VAWTs are located in the former industrial warehouse region of Hamburg. When you are there,

### 24 Recycling waste, Gijón, 2020

Different cities provide different recycling systems and bin colours. “In Spain, paper is blue, plastic yellow, glass green, and food brown, while unsorted garbage is light green or gray. ... In the Netherlands, citizens put their refuse into dedicated collection containers located on street corners (blue paper, yellow glass, orange plastic) with limited organic recycling, ... Care is required to put things in the right bin whatever the color code. Wrongly sorted materials and food scraps can literally clog up the system and ruin a perfectly good recycling batch.” (p. 571)



### 25 Recycling oil, Gijón, 2022



More and more cities are offering organic recycling to convert waste to energy. In the Netherlands, “restaurants, supermarkets, and industrial producers are required by law to recycle organic waste and cooking oil, deposited in large plastic bins (food) or sealed kegs (oil), regularly collected by private handlers and converted into green electricity or biofuel, a.k.a. second-generation” energy. In some cities in Spain, used cooking oil can be dropped off at recycling points or deposited in curbside boxes, the recycled oil converted to biofuel.” (p. 571) In Seville, they now collect the famous oranges for biofuels, while in Toronto curbside organic waste fuels the same trucks that pick up the waste. (Chapter 7)

## 26 “Waste isn’t waste until we waste it,” Utrecht, 2022

“It wasn’t always easy to recycle. A 1955 LIFE article ‘Throwaway Living’ sang the praises of our ultra-modern, disposable lifestyle, although a few people questioned the massive amounts of waste being generated, such that basic recycling is now standard across much of the globe. Each item not discarded in a dump/landfill saves on the environment and processing costs to handle all the used material, packaging, and garbage we discard to the tune of about 500 kg per person per year, roughly our own weight every 2 months. (p. 570)



## 27 The Great Bubble Barrier, Amsterdam, 2022



You wouldn’t know to see it, but this simple idea uses an angled curtain of bubbles, emanating from a perforated pipe on the canal bottom, to guide plastic to a collection bin on the bank. Boats and ducks can easily pass, but the plastic waste is captured. The oxygen-laden bubbles also add to the water quality of the canal. (Chapter 7)

## 28 Car sharing, Madrid, 2023

More people are forgoing expensive car ownership in the city, especially where public transport is widely and cheaply available. On occasion one needs a car, available at city hubs across the world. We have a Guppy account here in Gijón. (Chapter 7)



### 29 Scooter sharing, Brussels, 2022



For some inner-city fun and freewheeling, one can rent a scooter by the minute. The scooters are stored in dedicated hubs or free-standing, although scooter anarchy is a worry. I haven't been bold enough to try. (Chapter 7)

### 30 Bike sharing, Gijón, 2018

Here I am trying out a city bike in Gijón, free for half an hour with a citizen's card (*tarjeta ciudadana*). Or at least they were free before they changed the pedal bikes to electric. Why can't they leave well enough alone? (Chapter 7)



### 31 Book sharing, Paris, 2022

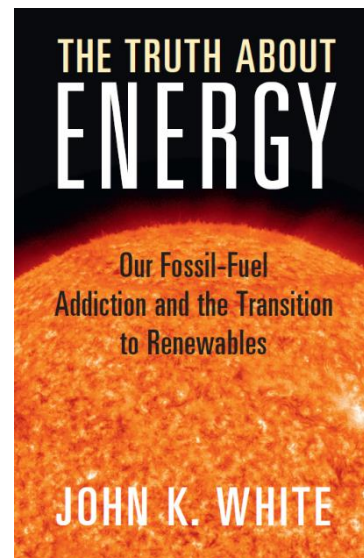


Gotta book, leave a book, need a book, take a book. Hours of reading fun! (Chapter 7)

32 [The Truth About Energy](#), John K. White, Cambridge University Press, 2024

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The transition to renewable energy is vital and fast-paced, but how do we choose which technologies to drive this energy transition? This timely book provides everyone interested in the renewable energy transition with an introduction to and technical foundation for understanding modern energy technology. It traces everyday power generation through history, from the Industrial Revolution to today. It examines the use of wood, coal, oil, natural gas, hydro, and nuclear to produce energy, before discussing renewable energy sources such as biomass, photovoltaics, concentrated solar power, wind, wave, and geothermal. The book examines to what extent and how each technology can contribute to a clean, green infrastructure. *The Truth About Energy* explains the science and engineering of energy to help everyone understand and compare current and future advances in renewable energy, providing the context to critically examine the different technologies that are competing in a fast-evolving engineering, political, and economic landscape.

John K. White is a physicist, writer, and educator, who has worked in the engineering, science, and education fields in Canada, the Netherlands, Ireland, and Spain. He is the editor of the website E21NS (Energy in the 21st Century News Service) and author of *Do the Math! On Growth, Greed, and Strategic Thinking* (Sage). He was a lecturer in the School of Physics, University College Dublin, and the Department of Education, University of Oviedo, where he taught courses in atomic physics, optics, and science education.