Nuclear vs coal power plants worksheet

There’s no getting around it: The news that someone has posted open-source blueprints for a functional nuclear power plant online sounds like the evil scheme of a James Bond villain. In fact, it could turn out to be a game-changer for affordable, clean, sustainable nuclear energy. Created by Energy Impact Center, a research institute with the mission to decarbonize the global economy by 2040, the so-called OPEN100 project aims to be a one-stop-shop for everything needed for new power plant construction. That includes resources ranging from a web interface for visualizing plant and component design to detailed construction plans. It is the culmination of two years of research, including more than 1,500 interviews with experts and more than 100 site visits across 15 countries. The open-source format is intended to allow startups, engineering firms, global utilities, and capital markets to work together around a common goal. “The nuclear industry, over the last five decades, has engaged in a spiral of ever-escalating costs, where their preferred solution has been to earn more revenue by building bigger, only further exacerbating their woes,” Bret Kugelmass, managing director of the Energy Impact Center, told Digital Trends. “For the first time ever there is a clear way out: OPEN100 paves the way towards standardization, simplification, and cost-effective nuclear energy – the ultimate solution for climate change.” As Kugelmass, a former Silicon Valley entrepreneur, explained, complex and proprietary plant designs have led the nuclear industry to become niche, expensive, and slow to adapt. The goal of this project is to unite vendors, developers and other interested parties in establishing a common platform for design, construction, and financing of future plants. “We only just launched and in the last two weeks we’ve been flooded with inbound interest from individual engineers, industrial partners, and even international developers,” Kugelmass said. “Even more promising, however, is the attention we’ve been receiving from National Laboratories around the world, who are eager to build upon the precedent of the early U.S. nuclear industry when scientific institutions aided private industry in a rapid scale-up of nuclear energy.” Standardized nuclear power plants may not sound like a big deal. But, when it comes to helping fight back against climate change, it could be a massive step in the right direction. Editors' Recommendations The dream of a carbon-free fuel is driving an investment boom in hydrogen and ammonia projects. Japan, for example, has pledged to reduce its emissions in line with the Paris Agreement by 2050, and plans to generate 10% of its energy needs using hydrogen and ammonia by then.For Japan, the potential of using these fuels to generate electricity is appealing. As an island country, Japan has limited space for wind and solar farms, and is surrounded by deep waters that make importing electricity by cables difficult. Meanwhile, the 2011 earthquake that caused a nuclear plant meltdown in Japan forced a turn away from nuclear energy. The country currently depends on oil, gas, and coal imports to power its economy, contributing to it being the the fifth largest emitter of greenhouse gases, according to the World Bank.On Jan. 7, JERA, Japan’s largest power company and producer of more than 10% (pdf, p. 16) of the country’s emissions, announced that it would spend nearly $600 million to develop ammonia technologies, with 70% of the money coming from the government’s climate innovation fund.When burned, hydrogen emits only water vapor and warm air. Ammonia, which is made using hydrogen, but is denser and easier to transport, likewise emits no carbon during combustion. It does emit nitrous oxide (more familiarly encountered as laughing gas) a greenhouse gas 298 times more powerful than CO_2, though these emissions can be captured before they’re released into the air.But ammonia’s green sheen may not translate to a better way to produce electricity for Japan.Is Japan spending big on greenwashing?Two demonstration projects, which will scoop up $392 million of the funding from JERA and the Japanese government, plan to convert existing coal-fired power plants to using a combination of ammonia and coal, aiming for a 50% split between the two fuels by 2029.In a post on LinkedIn, Paul Martin, a co-founder of the Hydrogen Science Coalition, which aims to inform public investments, called the ammonia-coal projects “wasteful greenwashing” that will squander the energy that goes into producing ammonia. Martin has been sounding the alarm about the hype around hydrogen as a fuel as more industries buy into the idea of a hydrogen economy that will make carbon emissions vanish for industries as wide-ranging as steel, aviation, and two-wheeled vehicles.“The use of ammonia as a fuel is possible, but for stationary applications like power plants to be used more than occasionally as an emergency backup fuel, it’s highly questionable. Feeding it as a co-feed to inefficient coal plants? That’s just crazy.”According to Recharge, a trade publication for the renewable energy industry, it takes 14.38 megawatt-hours (MWh) of energy to produce one metric ton of green ammonia. Burning that ton produces 5.16 MWh of electricity for consumption—a third of what it took to make it. Use the ton of ammonia in a coal-fired plant, and that drops even further, to 1.96 MWh, “making it an incredibly inefficient method to produce electricity,” writes Recharge.JERA declined to comment directly on Recharge’s calculations. However, Atsuo Sawaki, a spokesperson for JERA said that, “The thermal power generation plants that JERA aims to introduce ammonia are highly efficient, and JERA believes that the power generation efficiency will not be lowered by ammonia co-firing.”Sawaki adds that the project is not greenwashing because JERA intends to use blue ammonia in the coal plants.What is blue ammonia fuel?At present, producing ammonia, which is mostly used for fertilizer, is an energy-intensive process that contributes heavily to global emissions. This is “grey,” ammonia, which is made from hydrogen produced using fossil fuels. That is why scientists and engineers are first looking at ammonia’s potential as a carrier for other zero-emissions fuels, such as hydrogen, or for specific uses such as shipping—rather than using it as a fuel at the kind of scale that power plants would require.For one plant where it’s already carried out a demo, JERA is expecting to have to source about 40,000 metric tons of ammonia in the next four years. The Japan Times estimated that if all of the country’s power plants were to shift to ammonia for 20% of their needs, Japan would require 20 million tons of ammonia—about 20 times what the country uses now. Japan presently imports about 20% of its ammonia, currently made from fossil fuels, from Malaysia and Indonesia. It is also looking at sourcing blue ammonia from Saudi Arabia for power generation.Blue ammonia is made with the same process as grey ammonia, with hydrogen made from using fossil fuels, but in this case the carbon dioxide emissions are captured and stored during the process rather than being released into the air. There’s a lot of skepticism about the green credentials of blue hydrogen—and therefore the green credentials of ammonia made from it—because of low capture rates and other issues. Captured carbon likewise raises challenges about what to do with and how to store carbon, and Saudi Arabia’s blue ammonia project looks set to beget more carbon emissions. Aramco, the oil company generating some of Japan’s blue ammonia, plans to use some of the carbon it captures to extract more crude oil from its fields.Green ammonia, a truly zero-carbon fuel, is made from hydrogen that is produced using renewable energy, and so far only produced in tiny quantities, mostly in labs and pilot projects. The power firm is also looking at developing ammonia synthesis technologies, presumably greener ones, but for now these projects will have to rely on ammonia made in ways that generate emissions. JERA says they will consider using green ammonia if the price falls below that of blue ammonia. Often referred to as a nuclear power plant, a power reactor is a facility that produces electricity by a nuclear reaction, which is the continuous splitting of uranium atoms. Ohio has two nuclear power plants, both located along the shores of Lake Erie in the northern part of the state. They are the Davis-Besse plant in Oak Harbor, near Sandusky, and the Perry Nuclear Plant, east of Cleveland. (A third plant, in Piqua, Ohio, closed in 1966.) A company called FirstEnergy owns both plants as well as one in Pennsylvania. Due to financial struggles (i.e. competition from natural power sources), the company will decide by 2018 whether to close or sell the power stations. FirstEnergy has reached out to the Ohio and Pennsylvania Senates to change regulations, which would then make them more competitive. 01 of 03 The Davis-Besse Nuclear Power Plant is located on a 954-acre site 10 miles north of Oak Harbor, Ohio, and 21 miles east of Toledo. The plant opened in 1978, making it the first in Ohio and the 57th commercial nuclear power plant in the United States. It was originally co-owned by Cleveland Electric Illuminating Company and Toledo Edison and is named for the chairmen of both companies, John K. Davis and Ralph M. Besse.Davis-Besse is a pressurized water reactor and produces 40 percent of the electricity used in northwestern Ohio. The plant contributes over $10 million a year in local and state taxes; its license expires in April 2037.Two-thirds of the Davis-Besse land is used as protective wetlands called the Navarre Marsh, which is the home of several American Bald Eagle nesting sites as well as a major migratory pathway for birds. 02 of 03 Gregory Barum/WikiCommons Davis-Besse has a long history of safety incidences, starting from before the plant even opened: September 24, 1977—the plant shut down due to a problem with the feedwater system, causing the pressure relief valve to stick open. The NRC still considers this to be one of the top safety incidents in the U.S. June 24, 1998—the plant was struck by an F-2 tornado, causing damage to the switchyard and the external power to shut off. The reactor automatically shut down until the plant's generators could restore power. March 2002—damage from corrosion of the steel reactor pressure vessel was found by staff. The damage, about the size of a football, was caused by a leak of water containing borax. Repairs and corrections took two years and the plant was fined more than $5 million by the NRC, which called this incident one of the top five in nuclear incidents in U.S. history. January 2003—the plant's private computer network was infected by a computer virus called the "slammer worm," causing the safety monitoring system to be down for five hours. October 22, 2008—a tritium leak was discovered during an unrelated fire inspection. It was indicated that the groundwater outside the plant was not infiltrated by radioactive water. March 12, 2010—two nozzles on a reactor head did not meet acceptance criteria during a scheduled refueling outage. After inspection, new cracks were discovered in about one-third of the nozzles, including one that could potentially leak boric acid. October 2011—during routine maintenance, a 30-foot-long crack was found in the concrete shield building around the containment vessel. June 6, 2012—while inspecting the reactor coolant pump, a pinhole spray leakage was discovered from a weld in the seal. May 9, 2015—FirstEnergy operators declare an "unusual event" due to a steam leak in the turbine building. 03 of 03 The Perry Nuclear Power Plant sits on 1100 acres in North Perry, Ohio, about 40 miles northeast of Cleveland. The plant, which opened in 1987 was the 100th power reactor to be built in the US.Perry is a boiling water reactor, one of the largest such units in the U.S. It was originally built as a two-unit plant, but, although you see two cooling towers, there is only one reactor. The plant's license runs until 2026.In 1993, 1,100 acres were designated as an urban wildlife sanctuary, which is home to the heron as well as an orchid rare to the state of Ohio. There are also wetlands, the habitat for the spotted turtle and endangered species. There have been no major safety issues in the history of the Perry plant.