LOUISIANA COAL TO CLEAN ENERGY

The Case for Replacing Louisiana's Last Coal Plants With Clean Energy

October 2020

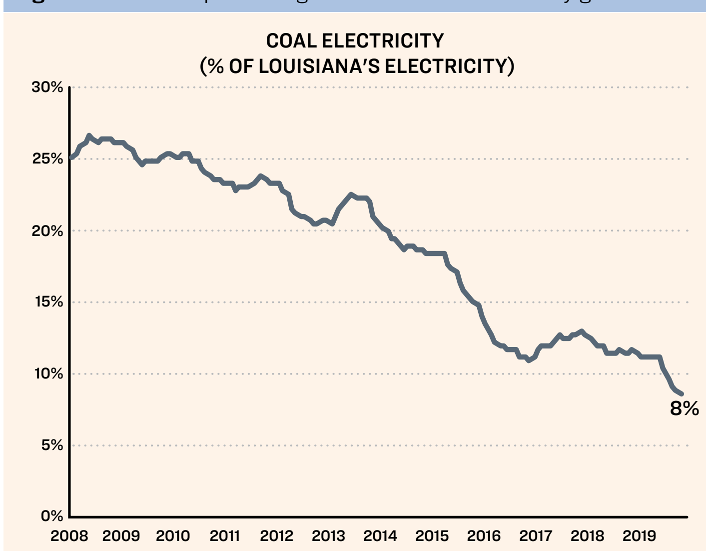
SIERRA CLUB

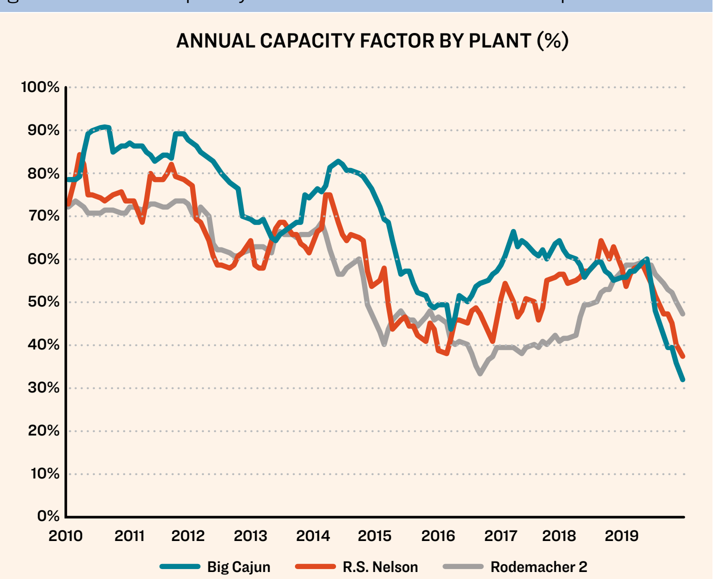
INTRODUCTION: MOVING LOUISIANA BEYOND COAL

Over the past decade, coal has gone from accounting for 25 percent of the electricity generation in Louisiana to just 8 percent. Even though coal generation is declining, it has an outsized impact on Louisiana's people. **Retiring the coal plants discussed in this paper would save $1.1 billion, prevent 349 asthma attacks, and save 51 lives annually.** In 2018, coal accounted for 42 percent of carbon dioxide pollution, 46 percent of nitrogen oxide pollution, and 99.7 percent of sulfur dioxide pollution in Louisiana's electric power plants. In this paper, we make the case that retiring Louisiana's remaining coal plants and replacing them with clean energy like wind, solar, and energy efficiency would not only reduce harmful emissions but also save Louisiana's residents and businesses money. We also discuss how a cost-effective switch from coal to clean energy is the right move for Louisiana's workforce.

Early in 2020, Cleco Power and Southwestern Electric Power Company (SWEPCO) announced that they would retire the Dolet Hills coal-fired power plant, signaling the beginning of the end for Louisiana's coal plants. Four coal-burning units now remain: Big Cajun unit 3, RS Nelson unit 6, Rodemacher unit 2, and Rodemacher unit 3 (collectively referred to as the Brame Energy Center). With the exception of Rodemacher 3, which was commissioned in 2010, these coal plants have seen declining capacity factors dropping from a weighted average capacity factor of 77 percent in 2010 to 39 percent in 2019. Generation was essentially cut in half due to rising operational costs and falling power prices. On the pollution side, none of these plants have modern pollution controls for particulates, nitrogen oxides, or sulfur dioxide.

Figure 1: Coal as a percentage of Louisiana's electricity generation Figure 2: Annual capacity factor for Louisiana's old coal plants





Over the course of this report, it will become clear that a coal-to-clean-energy transition for each of the remaining coal plants in Louisiana is better for utility customers and better for the environment. Each plant is profiled in terms of its capacity, ownership, pollution and health impacts, and community context. Additionally, we calculate a future value for each plant by comparing its projected energy market revenue to its projected costs, and we determine a clean energy portfolio that could cost-effectively replace each plant's capacity and energy.

LOUISIANA'S ENERGY BURDEN

According to the Energy Information Administration (EIA), Louisiana ranks in the top three states in the nation for both total energy consumption and per capita energy consumption. This is largely due to the fact that the state is home to much of the nation's energy-intensive chemical, petroleum, and gas industries. EIA notes that "Louisiana's 17 oil refineries account for nearly one-fifth of the nation's refining capacity." Since almost all of the energy for these industries comes from fossil fuels, it is not only energy intensive but also pollution intensive. The communities around these industries have become known as Cancer Alley.

While this industrial energy intensity is one burden, Louisiana's homeowners and renters face another type of burden: high energy bills. According to a 2018 analysis by Joe Daniel, senior analyst with the Union of Concerned Scientists, Louisiana had the second-lowest electricity rates in the country. However, even though it boasted such low rates, its average bills ranked 16th highest in the country. EIA notes that Louisiana has the second-highest per capita residential electricity use in the country. While the hot climate would account for some of this ranking, the more important reason is that the utilities have invested very little in energy efficiency for their customers. According to sales and energy-efficiency data reported to the EIA, Entergy Louisiana had 15 million megawatt hours (MWh) of sales to residential consumers in 2018, but it only reported 13,000MWh of energy-efficiency savings. That works out to an energy-efficiency achievement of one-tenth of one percent. That was all the utility could muster. It is no wonder why the American Council for an Energy Efficient Economy (ACEEE) ranked Louisiana 48th on its energy-efficiency scorecard. Finally, Daniel notes that Louisiana residents have the third-highest electricity burden (percentage of income spent on electricity bills) of any state.

Louisiana's people have to pay up twice: high health bills due to pollution burden and high electricity bills due to expensive coal plants and utility disinvestment in energy efficiency. Fortunately, retiring coal plants and replacing them with less-expensive renewable energy, and then adding more energy efficiency, could help lower electricity bills for Louisianans. Retiring coal plants would also reduce air pollution that disproportionately burdens people based on geography and access to medical resources.

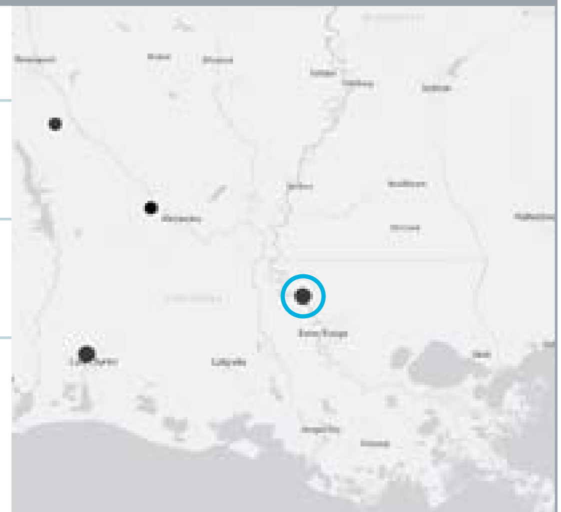
LOUISIANA'S ENERGY JOBS

According to the 2020 US Energy and Employment Report released by the US Department of Energy, there are an estimated 1,655 jobs in coal in Louisiana. This estimate includes coal extraction and processing jobs as well as jobs at power plants. Overall, about 8 percent of electric sector jobs are coal jobs. According to the same study, the wind and solar power industries account for 4,077 jobs in Louisiana across manufacturing, installation, and service segments. Additionally, energy-efficiency jobs account for 23,291 jobs throughout Louisiana. So renewable energy already provides twice as many jobs as coal in Louisiana, and there is a high potential for growth.

The National Renewable Energy Laboratory released a pair of reports detailing the economic potential for offshore wind. The reports found that a single 600MW offshore wind project could create 4,470 construction jobs and 150 annual jobs during operation while generating $455 million in gross domestic product (GDP) during construction and $14 million in GDP during operation years. While Louisiana does not yet have a single utility-scale solar project, the state is ripe with potential for low-cost solar. Later in this paper, we propose clean energy portfolios that could cost-effectively replace Louisiana's remaining coal plants. This would lead to a boom in clean energy jobs, as Louisiana could build thousands of megawatts of solar around the state.

BIG CAJUN 2

Name, Year Built	Big Cajun 2 unit 3 1983	**Projected value**	$-303 Million
Owners	Cleco 58% Entergy LA, 24% Entergy TX, 18%	**Clean energy replacement year**	2026 (DSM) 2031 (No DSM)
Capacity	619 megawatts	**Health impacts**	22 deaths / year and 148 asthma attacks / year
Emissions (2019)	SO_2: 5,400 tons NO_x: 1,100 tons CO_2: 1.9 million tons	**Population in 12-mile radius**	~37,000



Located in New Roads on the outskirts of Baton Rouge, the Big Cajun 2 power plant was the largest single source of carbon dioxide in the electric sector in 2017 and 2018. The three units at the power plant burn a mixture of gas and coal.

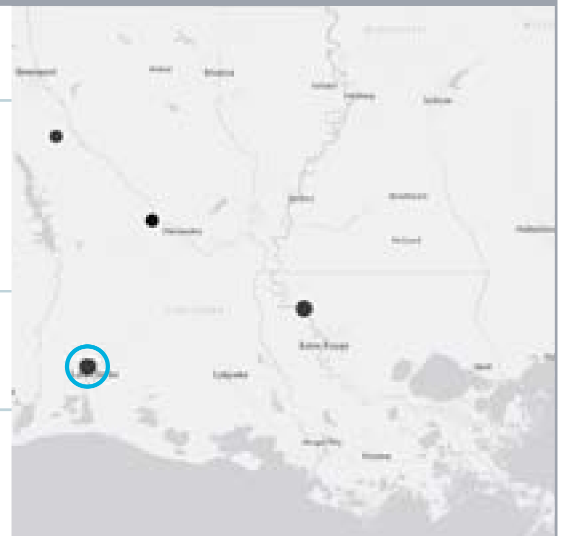
In 2018, the Sierra Club reached a settlement with Cleco Power that Unit 1 would stop burning coal no later than April 1, 2025. Unfortunately, Unit 3 still burns large volumes of coal, and the owners have no plans to transition away from this dirty fuel. Unit 3 at the Big Cajun plant is jointly owned by Cleco (majority owner at 58 percent) and Entergy's Louisiana and Texas divisions (minority owners at 24 percent and 18 percent respectively at 42 percent). According to the Clean Air Task Force, approximately 37,000 people live within a 12-mile radius of the plant. The plant is responsible for causing an estimated 22 deaths and 148 asthma attacks each year. The NAACP's *Coal Blooded* report gives Big Cajun the letter grade "D-", citing, among other factors, that people of color represent 49.5 percent of the population within a three-mile radius of the facility.

Burning coal is not only bad from a health standpoint but also from an economics standpoint. Entergy reported to the Federal Energy Regulatory Commission (FERC) that its average operating cost for the coal-burning unit was $39/MWh. The average clearing price for the Louisiana hub in the regional electricity market was only $26/MWh last year. If the unit continued to operate until 2030 with the same operating costs as the 2017–2019 period, costs would overwhelm market revenues by $303 million, a net cost that would be passed onto Louisiana ratepayers in the form of higher electric rates. As fracked gas prices remain low and increasing amounts of renewable energy come online, prices in the electricity market are not expected to rise appreciably, and burning coal will continue to be more expensive than clean energy alternatives.

Unit 3 can be replaced with clean energy, however, which would save money for Cleco customers and Entergy customers. Our modeling suggests that this coal burning unit's capacity and energy could be cost effectively replaced with a mixture of clean energy technologies by 2030. Depending on the level of low-cost, demand-side technologies used (like energy efficiency and demand response), that date could be as early as 2026.

R.S. NELSON

Name, Year Built	RS Nelson unit 6 1982	**Projected value**	$-181 Million
Owners	Entergy LA 40%; Entergy TX 30%; Entergy Gas Ops 11%; Sam Rayburn G&T 10%; East Texas Coop 9%	**Clean energy replacement year**	2025 (DSM) 2030(No DSM)
Capacity	615 megawatts	**Health impacts**	20 deaths / year and 142 asthma attacks / year
Emissions (2019)	SO_2: 7,700 tons NO_x: 2,400 tons CO_2: 2.4 million tons	**Population in 12-mile radius**	~153,000



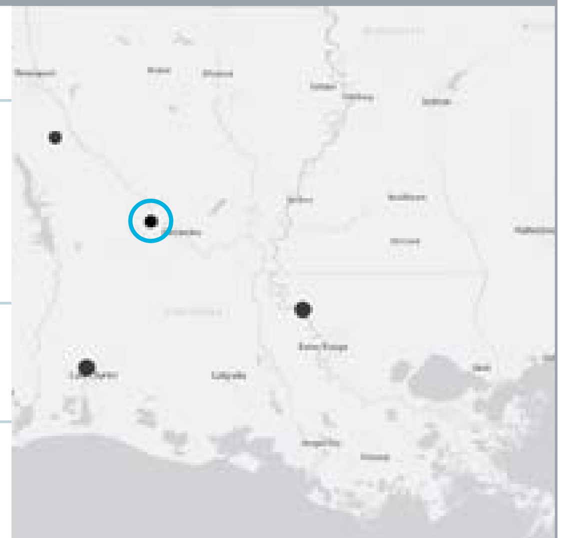
Located in Lake Charles, the R.S. Nelson power plant has four different power units. Units 1 and 2 are the oldest (built in 1959) and burn petroleum coke as their primary fuel. Unit 4 burns gas and is set to retire in 2020, while unit 6 burns coal and has no announced plans for phasing that out. Entergy is the majority owner of unit 4 (81 percent), while two power cooperatives in Texas own the remainder. According to the Clean Air Task Force, approximately 153,000 people live within a 12-mile radius of the plant. The plant is responsible for causing an estimated 20 deaths and 142 asthma attacks each year.

The NAACP's *Coal Blooded* report gives the letter grade "C+" for Nelson, citing, among other factors, that people of color represent 15.3 percent of the population within a three-mile radius of the facility. The *Coal Blooded* report was released following the displacement of a historic Black community in Mossville, which was founded by a former slave in 1790 and was one of the first settlements for free Black people in the South. The R.S. Nelson plant was constructed less than three miles from Mossville. The power plant was a major contributor of air pollution in the community, in one of the most polluted regions in the country.

The results of our economic and clean energy replacement analysis were largely similar to that of the analysis for the Big Cajun plant. If RS Nelson unit 6 continued burning coal out to 2030, operating costs would overwhelm market revenues by $181 million. The unit's energy and capacity could be cost effectively replaced by a clean energy portfolio as soon as 2025.

RODEMACHER / BRAME ENERGY CENTER

Name, Year Built	Rodemacher 2, 1982 Rodemacher 3, 2010	**Projected value**	Unit 2: $-269 m Unit 3: $-350m
Owners	**Unit 2:** Lafayette Public Power 50%; Cleco 30%; Louisiana Energy and Power 20% **Unit 3:** Cleco 100%	**Clean energy replacement year**	2023 (DSM) 2029(No DSM)
Capacity	**Unit 2:** 558 megawatts **Unit 3:** 704 megawatts	**Health impacts**	9 deaths / year and 59 asthma attacks / year
Emissions (2019)	SO_2: 4,700 tons NO_x: 3,200 tons CO_2: 5.6 million tons	**Population in 12-mile radius**	~21,000



Located on the outskirts of Alexandria, the Rodemacher coal plant (also known as the Brame Energy Center) is a sprawling complex that was responsible for 5.6 million tons of carbon dioxide pollution in 2019.

The plant has two coal burning units that have two key differences and one striking similarity. The first difference is with respect to ownership. Lafayette Public Power is the majority owner of unit 2 (50 percent), while Louisiana Energy and Power and Cleco are minority owners (30 percent and 20 percent respectively). In contrast, Cleco owns all of unit 3. The second difference is with respect to the units' age. Unit 2 was commissioned in 1982, while unit 3 was commissioned in 2010.

According to the Clean Air Task Force, approximately 21,122 people live within a twelve-mile radius of the plant. The plant is responsible for up to nine deaths and 59 asthma attacks each year. The NAACP's *Coal Blooded* report gives the letter grade "F" for Rodemacher, citing that people of color represent 66.7 percent of the population within a three-mile radius of the facility.

Despite a 30-year age difference, the units have very similar operating costs according to Cleco's FERC filings. In 2018, Unit 2 had an operational cost of $40/MWh, while Unit 3 had a cost of $37/MWh (only 9 percent cheaper). With average energy market prices in the "$20's" for the foreseeable future, the economics picture for Rodemacher is no different from that of Big Cajun or RS Nelson. If the two units at Rodemacher operated out to 2030 as they did in 2017–2019, then operating costs would be greater than revenues by $269 million for unit 2 and $350 million for unit 3. Fortunately, a transition to clean energy can help avoid the monetary sinkhole that is burning coal. We find that a clean energy portfolio of wind, solar, storage, and demand-side technologies could cost effectively replace Rodemacher as soon as 2023.

A COST-EFFECTIVE TRANSITION TO CLEAN ENERGY

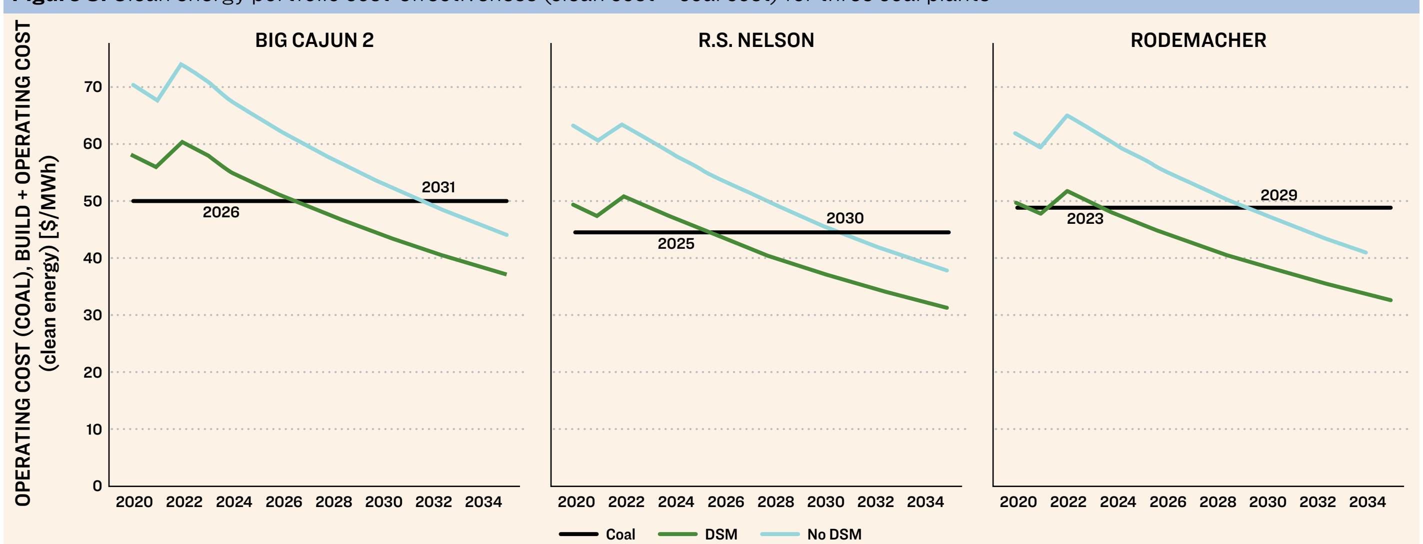
The clean energy portfolios referred to in the prior sections are a mixture of utility solar PV, wind, battery storage, energy efficiency, and demand-response technologies. We explain the detailed methodology of forming this clean energy portfolio in the appendix, but essentially a mixture of the five technologies must satisfy the monthly energy requirements and peak-capacity requirements of the existing coal plant. In the demand-side management (DSM) scenario, energy efficiency and demand-response technologies are projected to meet up to 25 percent of the energy requirements and capacity requirements, respectively. As such, pursuing energy efficiency is a way to reduce the amount of renewable energy resources utilities need to build while pursuing demand response is a way to reduce the amount of storage. Since energy efficiency and demand-response technologies are more cost-effective than large capital projects, the DSM portfolios become more cost-effective sooner, as shown in Figure 3. Given how little the utilities have invested in energy efficiency, a huge potential for customer savings remains on the table.

Table 1 shows how the technology amounts change with and without DSM technologies, while Figure 3 shows the cost-effectiveness dates of the two different scenarios for each plant. Note that Rodemacher was modeled as one plant for the clean energy portfolio. We used a weighted average cost of Rodemacher 2 and 3 to represent the going forward cost of the coal plant. We find that clean energy replacements are cost-effective between 2023 and 2031, with exact results shown in Figure 3. While wind power purchase agreements (PPAs) and solar PPAs in Midcontinent Independent System Operator (MISO), the grid region where Louisiana's remaining coal plants operate, are currently as low as $25/MWh and $29/MWh, respectively, this modeling also incorporates the cost of storage which is why clean energy portfolios start in the $50–70/MWh range. However, storage costs are falling rapidly, and it is only a matter of years before coal becomes stranded by clean energy. At that point, the cost of building and operating clean energy portfolios will be cheaper than the costs of just operating a coal plant. The utilities and communities of Louisiana need to start planning for that transition to a bright future now.

Table 1: Clean energy portfolio breakdown by technology, plant, and scenario

		(megawatts by technology)				
Coal plant	Scenario	Solar PV	Wind	Energy Storage	Energy Efficiency	Demand Response
Big Cajun 2	No DSM	1,885	306	983	–	–
Big Cajun 2	DSM	1,311	358	638	164	372
R.S. Nelson	No DSM	1,433	246	751	–	–
R.S. Nelson	DSM	1,415	–	607	423	369
Rodemacher 2 and 3	No DSM	3,864	332	1,927	–	–
Rodemacher 2 and 3	DSM	2,635	429	1,193	359	757

Figure 3: Clean energy portfolio cost-effectiveness (clean cost < coal cost) for three coal plants



SOURCES AND METHODOLOGY

Sources

The data sources for this analysis are from public sources, including data reported by Entergy and Cleco to the Energy Information Administration, Environmental Protection Agency, and Federal Energy Regulatory Commission.

- Louisiana state energy profile: EIA updated March 19, 2020 https://www.eia.gov/state/?sid=LA
- American Council for an Energy Efficient Economy, The State Energy Efficiency Scorecard, 2019 https://www.aceee.org/state-policy/scorecard
- How Affordable is Your Electricity? Comparing Electric Rates, Bills, and Burden – Joe Daniel, Union of Concerned Scientists, Oct 26 2018 https://blog.ucsusa.org/joseph-daniel/state-electricity-affordability-rates-vs-bills-vs-burden
- The 2020 U.S. Energy & Employment Report https://www.usenergyjobs.org/
- Gulf of Mexico offshore wind energy potential reports: National Renewable Energy Laboratory https://www.nrel.gov/news/program/2020/studies-find-gulf-of-mexico-well-positioned-for-offshore-wind-development.html
- Level Ten Energy Q1 2020 PPA Price Index - April 23, 2020 https://leveltenenergy.com/blog/ppa-price-index/q1-2020/
- Annual Electric Power Industry Report, Form EIA-861 sales and energy efficiency data for 2018 – released Oct 1, 2019 https://www.eia.gov/electricity/data/eia861/
- State level monthly coal generation: EIA – Electric Power Monthly – released Feb 26, 2020 https://www.eia.gov/electricity/monthly/
- Coal plant health impacts and population: Toll From Coal sponsored by Clean Air Task Force https://www.tollfromcoal.org/#/map/(title:6055//detail:6055//map:6055/LA)
- Coal and gas price forecasts: EIA Annual Energy Outlook 2020 Reference case: https://www.eia.gov/outlooks/aeo/
- Variable and fixed operations and maintenance: FERC Form 1 2018 filed by Entergy and Cleco
- Capital expenditures: EIA Annual Energy Outlook https://www.eia.gov/outlooks/aeo/assumptions/pdf/electricity.pdf (p. 14)
- Clean Energy Portfolio algorithm: Rocky Mountain Institute https://rmi.org/insight/clean-energy-portfolios-pipelines-and-plants/

Future Performance

In order to estimate the net present value of Big Cajun unit 3, RS Nelson unit 6, and Rodemacher units 2 and 3 for the period 2020–2030, we constructed a model to project future costs and revenues. All of the assumptions and projections are derived from publicly available information. As we note in several places below, many of these estimates are conservative, and the actual performance of the plants may be less favorable to customers than our estimates. We created starting assumptions or built projections for the following values:

- Capacity factor: The capacity factor stays fixed for the ten-year period at the following levels, which are representative of average generation levels from 2017–2019: 48 percent for Rodemacher 2, 61 percent for Rodemacher 3, 51 percent for Big Cajun 2 unit 3, and 51 percent for RS Nelson unit 6
- On- and off-peak generation: on-peak generation was assumed to account for 45 percent of operating hours, representative of 9am-5pm weekdays. The remaining generation was assumed to be off-peak.
- Fuel costs: 2018 fuel costs as reported on EIA 923 for these plants were used as a starting point. From there, the costs were inflated in line with the EIA AEO 2020 reference coal price forecast for the east north central region. The following heat rates were used: 11,333 btu/kWh for Rodemacher 2, 10,036 btu/kWh for Rodemacher 3, 11,020 btu/kWh for Big Cajun 2 unit 3, and 11,570 btu/kWh for RS Nelson unit 6.
- Variable operating and maintenance (O&M) expenses: 2018 variable O&M costs were used as a starting point and inflated by 2 percent per year, in line with standard inflation.
- Fixed O&M expenses: 2018 fixed O&M costs were used as a starting point and inflated by 2 percent per year, in line with standard inflation.

- Annual capital expenses: Ongoing annual capital additions were calculated according to an equation sourced from EIA's Annual Energy Outlook methodology. EIA found a generalized equation (listed below) that describes how much coal plant owners spend on capital expenditures (CapEx) on average per year, as a function of coal plant age and whether or not the coal plant had flue gas desulphurization (FGD). For coal plants across the US, the range for ongoing CapEx is $19–30/kW-year. For the Louisiana coal units, the average ongoing CapEx is on the lower end of the range at $21–23/kW-year (2017 dollars). From here, we inflate this figure by 2 percent per year to account for normal inflation.
- $CAPEX = 16.53 + (0.126 * age) + (5.68 * FGD)$ *where* $FGD = 1$ *if a plant has an FGD,* 0 *if a plant does not have FGD*
- On- and off-peak prices: In order to forecast on- and off-peak power prices between 2020 and 2030, we multiplied EIA's forecast (from *Annual Energy Outlook 2020*) for gas delivered to west south central (an EIA census region which includes Louisiana) electric sector customers by the implied heat rate of each unit, since gas is commonly the marginal, price-setting resource in most markets today. The implied heat rate for each plant was calculated by looking at historic on- and off-peak prices (monthly average day ahead on- and off-peak strips) for the relevant market hub and dividing by the average monthly delivered gas price at the Texas Gas Z1 hub. The average of those implied heat rates during the years 2016–2019 was then taken to represent the heat rate going forward. The resulting on-peak prices ranged from $24–53/MWh, while the resulting off-peak prices ranged from $17–38/MWh across the ten-year period.

We calculated the sum of energy revenues minus the costs (fuel, variable and fixed O&M, capital) for each year. The net present value (NPV) of those annual sums was calculated using a discount rate of 8%, which is a typical rate used by utilities across the US in integrated resource planning. The levelized cost of energy (LCOE) was calculated by taking an annualized payment of the net present value of all costs (also using a discount rate of 8%) and dividing it by annual generation.

Clean Energy Portfolio

Given that continuing to run these coal units would be a net cost to ratepayers compared to the energy market, the next step in the analysis is to investigate whether they can be cost effectively replaced with clean energy and on what timeline. For this analysis, we used Rocky Mountain Institute (RMI)'s clean energy portfolios (CEP) algorithm to identify a suite of clean energy technologies (wind, solar, storage, energy efficiency, and demand response) that could replace the services of Louisiana's coal plants. We used the algorithm and methodology developed by RMI in Dyson, M., G. Glazer, and C. Teplin's September 2019 report *The Growing Market for Clean Energy Portfolios*.

A clean energy portfolio, or CEP, is a combination of renewable energy, storage, and demand-side management (DSM) projects that meet the needs of the grid and a utility's customers. We use the term DSM to collectively refer to energy efficiency projects (which lead to a reduction in load) and demand response projects (which lead to the shifting or temporary reduction of load). The use of CEPs differs from traditional resource planning, which at times focuses on a specific technology. Instead, a CEP looks at how a range of available clean energy resources contribute in each hour of the year and finds the combination that meets the unique needs of customers at the lowest feasible cost. In this study, the CEPs are constructed to match the energy, peak capacity, and ramping characteristics of each of the three coal plants. Portfolios are optimized to satisfy these needs at the lowest cost possible.

The CEPs are conservatively designed to meet peak capacity needs in the top 50 hours of capacity need of the year in MISO, the grid region where Louisiana's remaining coal plants operate. Some of the 50 peak hours are in the summer, when solar output is high, and some of the hours are in the winter, when solar output is low. As such, the CEP must not rely on solar alone, but rather a complement of wind, solar, storage, and demand-side management technologies. The CEP also must meet the average monthly energy requirement of the coal plant's total generation in each month of the years 2017–2019. The CEP algorithm errs on the side of caution, in the sense that other grid resources (like existing gas plants or market purchases) play no role in the replacement. Instead, those resources are typically included in system dispatch or capacity expansion models that utilities typically utilize in portfolio analysis. In other words, the CEP algorithm accounts for a complete energy and capacity replacement of the coal plant without the benefit of any other existing grid resources. In the DSM case, we assumed that energy efficiency and demand response could comprise up to

25 percent of the replacement energy and capacity of replacement portfolios, respectively. In the “no DSM” case, only wind, solar, and battery storage were used to replace the coal plant.

We populated the RMI model framework with storage and renewable cost assumptions from Lazard’s *Levelized Cost of Energy v11* and BNEF’s *New Energy Outlook 2018*, both industry-standard reports. In addition, the modeling includes the solar investment tax credit, excludes the wind production tax credit, and excludes an investment tax credit (ITC) for storage (even though many storage projects qualify for the ITC by pairing with solar). Any excess energy that renewables produced above and beyond the coal plant was valued at $27/MWh, which was the off-peak average price in MISO in 2018. The levelized costs of the CEPs were compared to the average LCOE calculated for the coal plants to arrive in a year when the “crossover” for clean energy happened. At that point, building and operating new clean energy facilities would be cheaper than operating existing coal plants.

Sierra Club National
2101 Webster Street, Suite 1300
Oakland, CA 94612
(415) 977-5500

Sierra Club Legislative
50 F Street, NW, Eighth Floor
Washington, DC 20001
(202) 547-1141

facebook.com/SierraClub
instagram.com/SierraClub
twitter.com/SierraClub

EXPLORE, ENJOY, AND PROTECT THE PLANET. **SIERRACLUB.ORG**

SIERRA CLUB