A HEALTH IMPACT ASSESSMENT OF THE PROPOSED NATURAL GAS PLANT IN NEW ORLEANS EAST

PREPARED BY THE LOUISIANA PUBLIC HEALTH INSTITUTE (LPHI)
AND THE ALLIANCE FOR AFFORDABLE ENERGY (AAE)

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Louisiana Public Health Institute

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Michoud Power Plant
Photo credit: Claire Kim and Yoon Hong

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New Orleans City Council

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Fauberg Homeowners Improvement Association

Village de L'Est Improvement Association

Villages of the East Coalition

Michoud Power Plan
Photo credit: Claire Kim and Yoon Hong

Executive Summary

Background

Entergy New Orleans (ENO) has proposed to build a new natural gas combustion turbine (CT) plant in New Orleans East. The proposed CT plant would be built at the same site as the Michoud Power Plant, which was decommissioned in June of 2016. According to ENO's proposal, the CT plant would fill a gap in energy services of New Orleans, principally during the hot summer months when energy demand is the highest. ENO, a vertically integrated investor-owned monopoly utility company, is regulated by the New Orleans City Council. As a regulated monopoly, in order to make large capital investments- like a new power plant or expensive infrastructure improvements- allowance for recovery of their investment through rates must be approved by the New Orleans City Council (the City Council).

The Louisiana Public Health Institute (LPHI) and the Alliance for Affordable Energy (AAE) conducted a health impact assessment (HIA) on the plan to build the proposed CT plant. An HIA is a "combination of procedures, methods, and tools by which a policy, program, or project may be judged as to its potential effects on the health of a population and the distribution of effects within the population" (European Centre for Health Policy, 1999, p. 4). This project was supported by a grant from the Health Impact Project, a collaboration of the Robert Wood Johnson Foundation and The Pew Charitable Trusts.[1] The purpose of this HIA was three-fold. First, the HIA sought to determine the potential health impacts of the proposed CT plant in order to help the City Council make a more informed decision on the proposed CT plant. Second, the HIA aimed to formulate recommendations on how to maximize benefits and minimize harms of the proposed CT plant. Third, the HIA intended to study and quantify health data and costs and create a model for how the City Council may capture health costs into the triennial resource planning process, called the Integrated Resource Plan, in order to properly account for ongoing externalized costs related to energy generation.

Context

New Orleans East faces a number of socioeconomic, physical, and mental health disparities, compared to New Orleans overall. New Orleans East was greatly impacted by Hurricane Katrina and was the last section of the city to regain basic utility services.

During community stakeholder meetings it became clear that New Orleans East residents were unaware that Michoud was located in their community, nor that another power plant decision was forthcoming. Constituents expressed confusion, anxiety, and anger over potential health effects of Michoud, and expressed interest in continued involvement in the HIA and decision-making process. They were concerned that the proposed CT plant would be providing energy for all of New Orleans, but that the immediate impacts of operating the facility would be in New Orleans East. Residents noted that the disproportionate siting of industrial activities and their related environmental hazards have an inequitable impact on their community's health and well-being.

LPHI and AAE took the community's concerns into consideration in order to narrow down the HIA's focus to eight topics of concern: energy reliability, energy resilience, air quality, climate change, subsidence, noise, traffic, and household expenditures.

[1]The views expressed in this HIA are those of the authors and do not necessarily reflect the views of the Health Impact Project, The Pew Charitable Trusts, or the Robert Wood Johnson Foundation.

Key Findings

Household Expenses ↑

The CT plant will raise energy rates and bills; higher electric bills limit available household income for food, medicine, and housing, leading to higher stress, emergency room visits, food insecurity, and loss of housing.

Energy Reliability ↑

Any local generation inside the transmission island, including the CT plant, will increase energy reliability when transmission lines go down for whatever reason. Higher reliability decreases blackout events and associated accidents, hospital admissions, and food - and water-borne illnesses.

Energy Resilience →

The CT plant will not increase energy resilience because the plant itself will be vulnerable to storms and flooding. In extreme weather events, blackout-related emergencies are equally likely with the plant as without it.

Air Quality ↓

The CT plant will emit toxic pollution to the air that would likely increase the risk of respiratory illness and asthma, cardiovascular disease, and cancer.

Climate Change Risk ↑

The CT plant will emit greenhouse gas emissions that contribute to climate change, which collectively is likely to increase exposure to extreme weather events, severe stress, widespread financial losses, and geographic displacement.

Sinking/Subsidence ↑

The CT plant will use groundwater and will likely continue to cause sinking in New Orleans East. Sinking increases risk to flooding, levee failure, mold-related respiratory illness, accidents, and geographic displacement.

Noise ↑

The CT plant is likely to add noise but only during the construction phase (12-18 months). The noise could increase annoyance/irritability, insomnia, and blood pressure.

Traffic ↑

The CT plant is likely to add traffic but only during the construction phase (12-18 months). Depending on construction traffic routes, increased traffic may increase air pollution, asthma and respiratory illness, and accidents.

Recommendations

The three central recommendations of this HIA are:

1. The City Council and ENO should ensure maximum transparency, offer outreach and education, and create more opportunities for New Orleans East community members to be included and engaged in decisions that will directly affect them.

2. The City Council should direct ENO to include externalized costs in the IRP process.

3. ENO must immediately cease groundwater withdrawals at Michoud and must use surface water for any future projects until the full scope of the impact on sinking is understood.

Introduction

This health impact assessment (HIA) focused on Entergy New Orleans' (ENO) proposal to build a new natural gas combustion turbine (CT) plant, the New Orleans Power Station, in the eastern portion of the city, locally referred to as 'New Orleans East,' following the decommissioning of the aging Michoud facility at the same site. The purpose of this HIA was three-fold. First, the HIA sought to determine the potential health impacts of the proposed CT plant in order to help the New Orleans City Council (the City Council) make a more informed decision on the proposed CT plant. Second, the HIA aimed to formulate recommendations on how to maximize benefits and minimize harms of the proposed CT plant. Third, the HIA intended to study and quantify health data and costs and create a model for how the City Council may capture health costs into the triennial resource planning process, called the Integrated Resource Plan (IRP), in order to properly account for ongoing externalized costs related to energy generation.

Louisiana Public Health Institute and the Alliance for Affordable Energy

This HIA was developed in collaboration between the Louisiana Public Health Institute (LPHI) and the Alliance for Affordable Energy (AAE). This project was supported by a grant from the Health Impact Project, a collaboration of the Robert Wood Johnson Foundation and The Pew Charitable Trusts.[2]

LPHI is a statewide, 501(c)(3) nonprofit organization founded in 1997 that serves as a partner and convener to improve population-level health outcomes. LPHI's mission is to improve the health and quality of life of all Louisianans regardless of where they live, work, learn, or play. LPHI coordinates and manages public health programs and initiatives in the areas of health systems development and community health improvement and provides an array of services to help meet the needs of local and national partner organizations.

Founded in 1985, AAE advocates for fair, affordable, environmentally responsible energy policy. As both a consumer protection and environmental advocacy organization, AAE's policy work meets at the crossroads of social justice, sustainable economic development, and environmental protection. AAE believes that developing an equitable energy future for Louisiana includes considering all costs for energy consumers, including health costs.

Proposed Decision

Replacement of Decommissioned Michoud Facility

The Michoud facility was a natural gas steam turbine power plant that was in operation since the 1950s. Originally built to burn either natural gas or fuel oil, Michoud ran only on natural gas in its final years, and provided 750 megawatts (MW) of capacity to ENO. After an extensive cost analysis of needed upgrades and repairs, ENO and the City Council decided that decommissioning the plant was in the best interest of ratepayers. The units were decommissioned on June 1st, 2016. Since the units have been taken offline, there is now a capacity deficit of 73 MW (growing to 250 MW over the next two decades) during peak times, which occur July and August from 5:00 pm to 7:00 pm.

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Proposed Plant Technology

Currently, peaking capacity is plentiful and cheap in the Midcontinent Independent Service Operator (MISO) transmission market (MISO, 2016). However, ENO's analysis suggests that this capacity will become more expensive by 2020 (Entergy, 2016b).

In order to address the forthcoming capacity deficit by the Michoud decommissioning, ENO's Application to Construct New Orleans Power Station proposes building the proposed CT plant, a new natural gas-fired peaking CT plant with a capacity of between 200-250 MW (Entergy New Orleans, 2016a). CT technology is not new, but the technology proposed by ENO has not been built in the U.S. as a single cycle, stand-alone, peaking plant in recent years. The technology has only been used in conjunction with a combined cycle plant or larger generating station (U.S. Energy Information Administration, 2016).

The New Orleans City Council

The City of New Orleans is a federally recognized utility regulator. New Orleans is one of only two cities in the country that regulates an investor-owned utility, the other being Washington D.C. The City Council directs ENO in its policies, authorizes investment decisions, and sets electric rates. In Louisiana this unusual responsibility of the City Council has allowed Orleans Parish to advance more progressive energy policies ahead of the state regulatory body, the Louisiana Public Service Commission. This has proven beneficial for New Orleans residents who have enjoyed energy efficiency programs years before the rest of the state.

Peaking Capacity:
Resources that provide electricity during "peak" conditions, like hot humid summer days.

Combined Cycle Natural Gas Plant:
A plant that uses both gas and steam to generate nearly twice the electricity with the same amount of fuel for baseload power.

Combustion Turbine (CT) Natural Gas Plant:
A plant that uses a natural gas turbine to meet peaking capacity. Less efficient than a combined cycle plant, CT plants can reach operating capacity in around 10 minutes.

HIA Process

HIA is a "combination of procedures, methods, and tools by which a policy, program, or project may be judged as to its potential effects on the health of a population and the distribution of effects within the population" (European Centre for Health Policy, 1999, p. 4). HIAs make predictions about unintended health effects and inform leaders about how their decisions might impact public health in order to maximize benefits and minimize harms. The five steps to creating a HIA are: screening, scoping, assessment, recommendations, and evaluation and monitoring (International Association for Impact Assessment, 2016). Each step involves stakeholder engagement, data collection, analysis, and report back. The process and findings for each of these steps is included in the methods section below.

Why HIA in New Orleans?

The City Council has recently made strides towards greater transparency in utility regulation and energy generation planning. The City Council passed a resolution approving a policy called Integrated Resource Planning (IRP) that requires ENO to create a forward-looking plan to meet ratepayer needs. The City Council, stakeholders, and ENO have participated in three rounds of IRP since 2008. During the 2012 IRP process, the issue of "externalities" was raised. While the City Council, ENO, and stakeholders understand that the public health costs from polluting power plants are real, these costs are difficult to quantify. Called "externalities," these costs affect people who neither knew nor chose to pay that cost (Cowen, 2002). Because there has been no policy or mechanism for capturing the costs of pollution in the IRP process, there has been no clear way to account for the externalities created by power plants.

This HIA, supported by the City Council, ENO, and community stakeholders, endeavors to bring some of these concrete health costs to the decision-making process. While this HIA does not attach dollar values to the health outcomes discussed, it does allow real public health issues to be included in the conversation and final decision-making. New Orleans began this HIA, the first HIA in New Orleans on energy production, just after the 2015 IRP process started, and its findings will be used to inform the proposed CT plant decision and beyond.

Potential Impact of the HIA

New Orleans continues to be an energy policy leader by conducting the very first HIA on energy production in the Gulf South. Though other cities and states are starting to use HIAs in their energy planning, this is a new policy arena for the nation. HIA can be a useful tool for accounting externalities in future IRP rounds. As better informed policy decisions begin to show benefits in health, other regulators in the region may begin to include health impact costs in energy planning.

Poor health outcomes discussed in this report do have a real dollar value. For example, asthma in the U.S. costs about $3,300 per person per year (Centers for Disease Control and Prevention [CDC], 2011). However, health outcome valuation would be the next phase of the planning process, after the HIA is complete. This is an important next step in preventing unintended health impacts. In utility planning, generation resources are modeled based on their capital costs and fuel costs. If health costs are attached to the fuel types associated with causing health problems, then the utility company will choose the best option for costs and health. If these impacts are not included in the planning, then these costs continue to be placed on the community, and poor health outcomes and health disparities will continue unabated.

Cumulative Impact and Community Vulnerability

Health disparities, defined by the Centers for Disease Control and Prevention as "gaps in health outcomes or determinants between segments of the population," remain a persistent issue throughout the U.S., as low-income and minority communities face unequal health outcomes for many diseases (CDC, 2013a). Low-income and minority populations also face disproportionately higher rates of environmental exposures. Industrial hazards and pollution sites have the highest concentrations in communities where low-income and minority populations live. Race is the factor that is most commonly associated with higher risk or proximity to environmental hazards (Freudenberg, Pastor, & Israel, 2011). For example, African Americans on average experience industrial air pollution levels that are two times greater than white individuals, and racial disparities remain even among African American and white individuals of similar socioeconomic status (Pais, Crowder, & Downey, 2014).

While both environmental hazards and social stressors impact health, together they amplify greater cumulative impacts on health (Morello-Frosch, Zuk, Jerrett, Shamasunder, & Kyle, 2011). Cumulative impacts are defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions" (40 CFR 1508.7). This means that existing social stressors and exposures to other environmental hazards - which work in combination to produce or worsen health disparities - should be taken into consideration when measuring the impacts of new environmental hazards.

New Orleans East, compared to New Orleans overall, faces a number of socioeconomic, physical, and mental health disparities. New Orleans East was greatly impacted by Hurricane Katrina (Katrina) and was the last section of the city to regain basic utility services. Many industries with environmental exposures are located in or near New Orleans East. Therefore, cumulative impacts are a large focus of this HIA, and equity and the distribution of potential health impacts will be considered within each topic of concern, or pathway, below.

It is essential to ask why minority and low-income populations are disproportionately exposed to environmental hazards. Research has found that these communities are often excluded from policy decisions that would impact environmental health and that they face barriers when trying to participate in these decisions (Freudenberg et al., 2011). This is certainly the case with regard to Michoud and the proposed CT plant. Community members were not aware that Michoud would be decommissioned nor that another power plant decision was forthcoming. They expressed confusion, anxiety, and anger over potential health effects of Michoud, and they expressed interest in continued involvement in the HIA and decision-making process.

When community capacity to participate in environmental health decisions is developed, the community has more power and efficacy, reduced environmental exposures, and fewer health disparities (Freudenberg et al., 2011). It is essential that New Orleans East community members are included and engaged in decisions that will directly affect them. This HIA strives to make sure their voices are heard and their interests are represented.

Methods

Table 1: The HIA process

Screening	• Determine if HIA is needed or useful • Determine if time and resources are available to conduct the HIA
Scoping	• Develop a plan for the HIA approach • Identify and prioritize the health areas to be examined
Assessment	• Identify and characterize the potential effects (both positive and negative) that are likely to be associated with the project
Recommendations	• Develop strategies to increase health benefits and decrease harms
Evaluation & Monitoring	• Measure the effectiveness of the HIA and its recommendations • Track health changes over time

Screening

LPHI and AAE started the screening phase in October 2014. The key stakeholders engaged in the screening stage of this HIA were leaders from the impacted community, the New Orleans City Council, ENO, LPHI, and AAE. Through the collaborative screening process, it was decided that the HIA was achievable, the IRP process would benefit from the addition of a HIA, and the City Council Utility Committee would consider findings from the HIA in their decision-making process.

Scoping

Scoping is a process of research, literature reviews, data analyses, and stakeholder interviews to capture potential concerns, benefits, and risks related to a decision. Scoping relies on scientific literature, local data, and stakeholder meetings to assess the relationships between energy production and health. This information together forms an evidence base to be examined more thoroughly during the next phase, assessment.

The scoping phase took place from April through August of 2015. During the scoping phase, LPHI and AAE engaged key stakeholders through a series of public meetings. Stakeholders represented a diverse group of individuals and interests including: community-based organizations, impacted neighborhood associations, Dillard University, ENO, and the City Council. A complete list of the stakeholder meetings is included in Appendix A. While explicit health pathway exercises were not conducted with the neighborhood groups (due to the time constraints of presenting at existing meetings), the HIA team was able to determine the most frequently mentioned concerns of the citizens related to the proposed CT plant and to link those to potential health impacts to be considered in the assessment phase. These pathways were later reviewed with stakeholders to ensure their accuracy and completeness. The community concerns from stakeholder meetings are provided below. Information from the review of other existing data sources is included in the assessment.

Household Expenses

The first and most frequent concern expressed by stakeholders was that the proposed CT plant would lead to a cost increase on their energy bills. Residents articulated concern that bills were already too high and expressed a desire that any new power generation should keep costs either the same or lower than current rates.

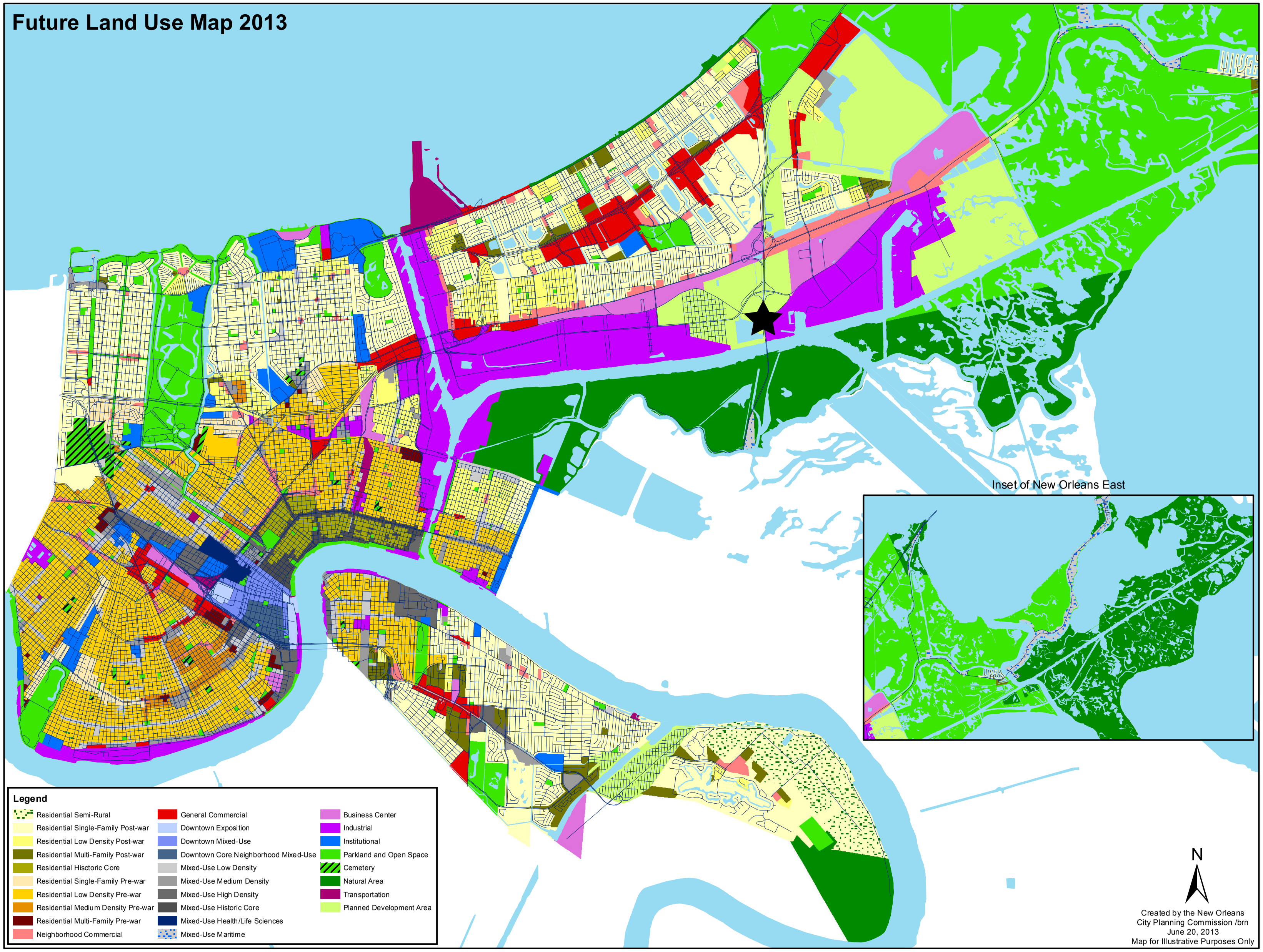
Cumulative Exposure and Community Vulnerability

Residents of New Orleans East expressed concern that the proposed CT plant would be providing energy for all of New Orleans, but the immediate impacts of operating the facility would be localized in New Orleans East. Residents cited the disproportionate siting of industrial activities and their related environmental hazards as an existing inequitable impact on their community's health and well-being. Questions were raised about why other parts of New Orleans were not being reviewed as potential sites for a replacement power plant facility. Residents expressed anxiety and anger that industrial growth in New Orleans is concentrated in their neighborhoods. A common phrase heard voiced throughout the community stakeholder meetings was, "build it somewhere else!"

Michoud Power Plant
Photo credit: Claire Kim and Yoon Hong

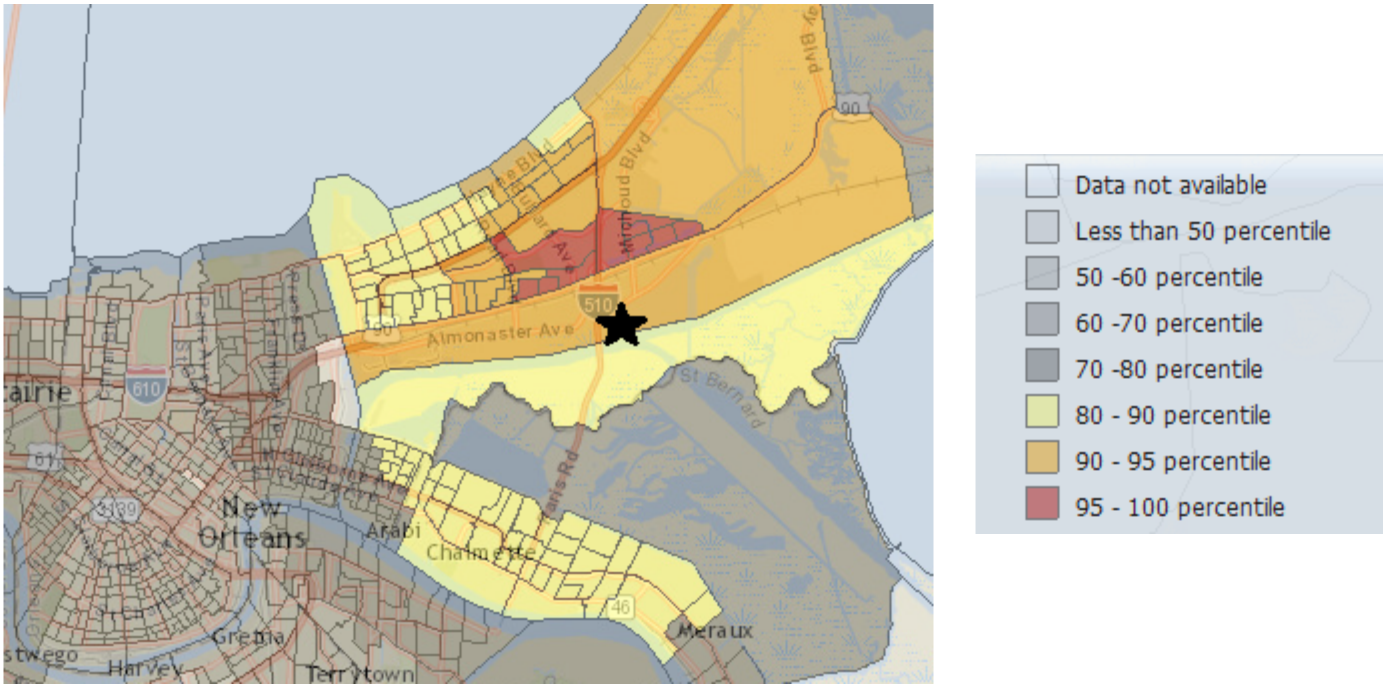
Michoud Power Plant
Photo credit: Claire Kim and Yoon Hong

Figure 1: Future land use map, New Orleans



Note: black star to the far right of the map is the location of Michoud and the proposed CT plant
Note: areas shaded in darker purple are industrial zones
Source: City of New Orleans, 2013

Figure 2: Hazardous waste proximity (national percentiles), New Orleans



Note: black star to the far right of the map is the location of Michoud and the proposed CT plant
Note: areas shaded in red and orange have the highest levels of hazardous waste
Source: Environmental Protection Agency [EPA], 2016b

Community Participation, Transparency, and Decision-Making Processes

For the majority of the community stakeholders, the HIA stakeholder meetings were the first time they had heard of either the Michoud or the proposed CT plant facilities. They expressed great concern that not enough, or any, notice had been given about the plan to build the proposed CT plant in their community. Community members expressed anger, confusion, and anxiety regarding both Michoud and the proposed CT plant, as they worried about potential health effects that they had never been informed about. The community emphasized the need for more knowledge and education about energy decisions.

Energy Reliability

The increased energy reliability from placing a natural gas plant site within New Orleans was referenced as a benefit by stakeholders, including ENO. The localized peaking resource could be run as baseload generation to provide emergency power if transmission lines outside of Orleans Parish fail. This assumes that transmission would be affected but the power plant would not be.

Energy Resilience

Stakeholders acknowledged that any facility should be able to withstand storms and flooding to ensure stable energy resilience during emergencies. Along with the facility, the ability of gas pipelines to withstand storm damage was also cited as important.

Air Quality/Pollution

Residents cited pollution as a chief concern. While some residents expressed a preference to the combustion of natural gas over coal, apprehension about fracking and its impact on Louisiana was also mentioned. Residents were concerned that New Orleans East would be disproportionately impacted by emissions because of proximity to the facility, and they emphasized the inequitable distribution of risk within the community in order to produce power for the entire city of New Orleans.

Stakeholders named greenhouse gas (GHG) emissions and climate change as a principal concern. Stakeholders expressed that the continued use of fossil fuels is problematic and that there should be collective decision-making processes to move towards more responsible power generation.

Subsidence/Sinking

Residents were emotional about the historic impact of groundwater use and related subsidence. Sinking land compounds the impact of rising sea levels and flood risk throughout New Orleans. Some community members were adamant that ENO "should pay for all of its use of groundwater in the past," and work to repair damage caused by subsidence from the Michoud facility.

Noise

Noise during the construction phase of the new plant was raised as a concern by residents. Again, the inequitable impact on New Orleans East was emphasized, as the burden of construction noise would be on nearby residents. Residents expressed frustration and anger that noise levels in New Orleans East have not been tested and they questioned why other sections of I-10 in Greater New Orleans have noise barriers, but the part running through New Orleans East does not.

Traffic

The construction impacts from building a new plant could impose more traffic upon an already strained transportation system. Of particular concern to residents was street deterioration resulting from increased industrial traffic.

LPHI and AAE took community and stakeholder concerns into consideration in order to narrow down the assessment phase areas of focus to the following eight topics of concern/pathways:

- Household expenses
- Energy reliability
- Energy resilience
- Air quality
- Climate change
- Subsidence
- Noise
- Traffic

Community participation in the decision-making process, transparency in this process, and cumulative exposure to various environmental risks were common themes that run through many of the pathways in the assessment section below.

Assessment

The assessment phase took place from September 2015 through April 2016. The assessment phase was split into two main steps. The first step was to establish a baseline for the impacted community. LPHI reviewed and synthesized data on New Orleans East's demographic and health characteristics, and spoke with community members to best describe the existing, or baseline, conditions of the community. During the second step, LPHI and AAE conducted an extensive review of scientific literature, other related HIAs, and local research studies and data to assess the potential health impacts of the decision to build the proposed CT plant, as compared with the option to not build a Michoud replacement facility.
In April of 2016, LPHI and AAE met with community stakeholders, the City Council, and ENO to present initial assessment findings, receive feedback, and ask for recommendations.

Data Limitations

Data regarding the proposed CT plant has come from ENO's Draft IRP, dated February 2016; public comments made during the regulatory process; and telephone interviews. On June 20th, 2016, ENO filed an application with the City Council to build the proposed CT plant. Many important data points including operations data like emissions, total expected water usage, and bill impacts were not released through the formal IRP proceeding or application, and therefore have not yet been made available for this HIA. This HIA uses publicly available information as of April 2016 about the Mitsubishi 501GAC CT to extrapolate outcomes.

Assessment Part I: Assessing Baseline Conditions

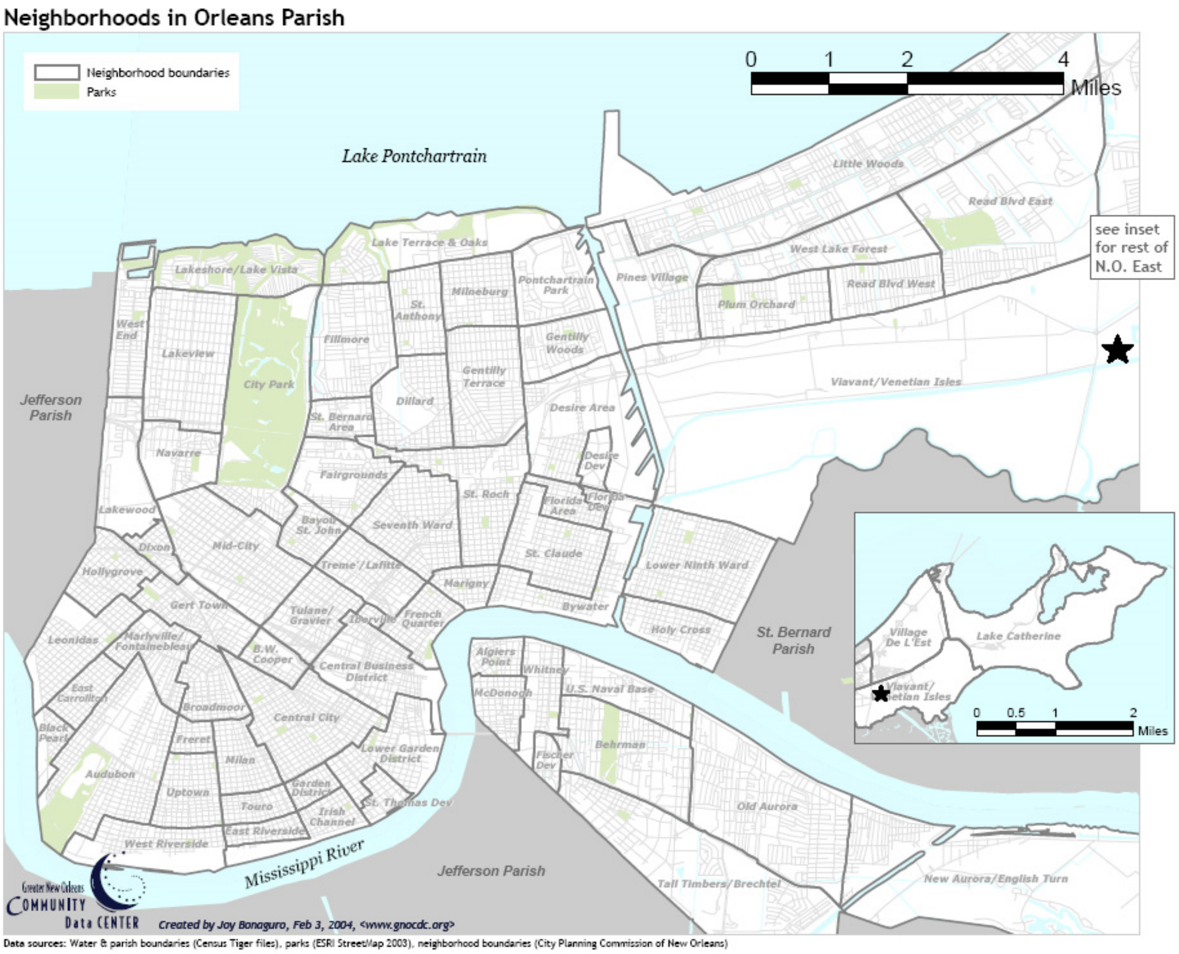
New Orleans East Neighborhoods

Michoud is in an area locally known as New Orleans East, which is made up of several neighborhoods. The boundaries of New Orleans East are the Industrial Canal to the west (where there were multiple breaches during Katrina), the Intracoastal Waterway to the south, the St. Tammany Parish line to the east, and Lake Pontchartrain to the north (see Figure 3). Michoud and the site of the proposed CT plant are located at the intersection of Old Gentilly and Paris Roads, within the Viavant/ Venetian Isles neighborhood, close to the Village de L'Est, Read East, Read West, West Lake Forest, Little Woods, Plum Orchard, and Pines Village neighborhoods of New Orleans East.

Figure 3: Map of New Orleans

Note: black star is the location of Michoud and the proposed CT plant; black line is the boundary of New Orleans East
Source: Google Maps, 2016

Figure 4: Map of New Orleans neighborhoods



Note: black star to the far right of the map is the location of Michoud and the proposed CT plant
Source: The Data Center, 2004

New Orleans East makes up over 60% of the geographical land area of New Orleans. Following Katrina, the area has experienced substantial rebuilding and new construction, including Joe Brown Memorial Park, South Shore Harbor Marina, the Lakefront Airport, 7th District Police Station, and New Orleans East Hospital. New Orleans East is home to many large companies and industries including NASA, Air Products, Folgers, Blade Dynamics, Textron, and the U.S. National Finance Center.

Neighborhood Characteristics

New Orleans East neighborhoods have poorer outcomes for several neighborhood characteristics compared to the city overall (Table 2). New Orleans East has a higher number of power outages and also a higher percentage of blighted/abandoned housing units. Blight is an important neighborhood characteristic to consider as it can decrease property values and has been linked to increased stress levels (South, Kondo, Cheney, Branas, 2015). In addition, New Orleans East has fewer acres of parks per capita than New Orleans overall. Only two of the 16 New Orleans Recreation Department Commission parks and recreation centers offering free exercise classes are located in New Orleans East. Parks and recreation centers are essential in neighborhoods as they allow opportunities for physical activity.

Table 2: Neighborhood characteristics of New Orleans and New Orleans East

Neighborhood	# of power outages reported per 10,000 people	% of all housing units which were blighted (abandoned)*	# of acres of parks per 1,000 people
Viavant**		1.5	0
Village de L'Est	251	1.7	1,608
Read Blvd East	272	2.2	22,479
Read Blvd West	267	5.4	1,417
West Lake Forest	364	2.4	0
Little Woods	194	1.8	1,144
Plum Orchard	211	4.9	1,462
Pines Village	252	3.5	1,368
New Orleans East***	249	3.0	3,736
All Orleans Parish****	230	2.1	6,663

Source: City of New Orleans
* Blight can be difficult to measure, especially since 2010 when the U.S. Postal Service deleted many addresses from its address list
**Viavant has a small population size, and therefore data was not available
***New Orleans East is a combined total of all the New Orleans East neighborhoods listed above
**** All Orleans Parish is a combined total of all the Orleans Parish neighborhoods, including New Orleans East

Neighborhood Demographics

New Orleans East has a higher proportion of African American and Asian American residents compared to other areas of New Orleans (Table 3). Individuals in poverty are more likely to live in New Orleans East compared to New Orleans as a whole. New Orleans East has a higher percentage of the population with less than a 9th grade education. The community is also more vulnerable to poor health outcomes, partially due to their higher rates of poverty and lower rates of education. Generally, low-income and minority communities face disproportionate environmental hazards and worse health outcomes (CDC, 2013a). Indeed, community members expressed anxiety about the health impacts of the industry already sited in their neighborhood.

Table 3: Demographic characteristics of New Orleans East by neighborhood

Neighborhood	% white	% African American	% Asian American	% Latino/ Hispanic	% less than 9th grade education	% at or below poverty level
Viavant	18.8	72.1	0.0	18.2	17.0	47.1
Village de L'Est	6.0	39.3	47.9	10.8	20.6	40.2
Read Blvd East	4.6	80.9	14.4	2.8	4.2	18.8
Read Blvd West	3.9	92.4	0.1	0.0	5.6	24.9
West Lake Forest	5.2	94.0	0.4	2.2	3.0	43.4
Little Woods	3.5	93.2	0.8	1.7	2.6	32.2
Plum Orchard	1.8	96.2	0.0	1.4	5.2	22.9
Pines Village	2.0	95.0	0.3	0.0	4.1	35.6
New Orleans East	4.8	82.7	8.4	2.8	5.8	31.1
All Orleans Parish	33.2	59.4	2.9	5.1	5.0	27.2
Source: American Community Survey, 2012 5 year						

Neighborhood Housing and Energy Cost Burdens

A key socio-economic indicator is housing cost burden, which is defined as spending 30% or more of income on housing costs (Schwartz & Wilson, 2007). Housing costs include utilities like energy and water. Households and families with a high housing cost burden have less income to spend on healthy food, education, and transportation, impacting their overall health and well-being, as well as their children's future economic and health potential (Cook et al., 2008; Drehobl & Ross, 2016; Hernandez, 2013; Hernandez & Bird, 2010; Liddell & Morris, 2010). About thirty-three percent of New Orleans residents who own their homes spend 30% or more of their income on housing (Table 4). Renters in New Orleans East spend upwards of 70% of their income on housing costs.

Table 4: Housing costs as percent of income

Neighborhood	% of owner-occupied households paying 30% or more of income on housing	% of renter-occupied households paying 30% or more of income on housing
Viavant**	0	65
Village de L'Est	26	59
Read Blvd East	32	73
Read Blvd West	42	73
West Lake Forest	30	74
Little Woods	35	73
Plum Orchard	38	68
Pines Village	29	87
All Orleans Parish	33	61
U.S.	28	52
Source: The Data Center analysis of data from U.S. Census 2000 Summary File 3 (SF3) and 2010-2014 American Community Survey **Viavant has a small population size, and therefore data in this table may be skewed		

Neighborhood Health

New Orleans East has poorer physical and mental health outcomes than New Orleans overall (Tables 5-7). New Orleans East neighborhoods have a slightly higher rate of low birthweight babies and substantially higher rates of hospital admissions for malignant neoplasms, asthma/respiratory distress, and diabetes/obesity. New Orleans East overall has a surprisingly higher death rate compared to the rest of New Orleans. In New Orleans East the total death rate is 20.5 per 1,000 people, compared to 8.2 deaths in all of New Orleans. New Orleans East has higher hospital admission rates for depression and post-traumatic stress disorder (PTSD)/anxiety, although the rates are likely underestimated as many individuals do not receive care due to stigma and access issues.

Table 5: Physical health outcomes of New Orleans East by neighborhood

Neighborhood	% of low birthweight babies	Malignant neoplasm admissions rate per 1,000 people	Asthma and/or respiratory distress admissions rate per 1,000 people	Diabetes and/or obesity admissions rate per 1,000 people	Total death rate per 1,000 people
Viavant	17.65	14.30	0.00	211.80	20.55
Village de L'Est	7.95	6.42	0.99	39.53	5.68
Read Blvd East	13.46	6.90	0.54	45.07	5.64
Read Blvd West	18.00	7.65	0.80	50.50	5.77
West Lake Forest	9.21	16.32	2.23	110.93	5.93
Little Woods	14.56	7.87	0.82	58.62	6.53
Plum Orchard	7.41	7.95	1.15	71.28	11.11
Pines Village	13.46	8.90	2.03	89.53	10.92
New Orleans East	13.04	24.27	2.82	178.53	20.47
All Orleans Parish	11.45	9.61	0.33	22.06	8.20

Source: Louisiana Hospital Inpatient Discharge Database (LAHIDD), 2008-2009 combined

Table 6: Asthma emergency room rate of New Orleans East African American population

New Orleans East zip codes	Age-adjusted African American asthma emergency room rate per 1,000 people
70129	6.4
70128	6.0
70127	5.6
70126	8.2
All Orleans Parish	9.2
Source:American Community Survey, 2010-2014 combined	

Table 7: Mental health outcomes of New Orleans East by neighborhood

Neighborhood	Depression admissions rate per 1,000 people	PTSD/anxiety admissions rate per 1,000 people
Viavant*	22.34	6.26
Village de L'Est	3.05	1.03
Read Blvd East	2.21	1.44
Read Blvd West	3.02	1.41
West Lake Forest	10.38	3.28
Little Woods	4.63	1.30
Plum Orchard	4.12	1.82
Pines Village	6.64	1.80
New Orleans East	13.38	4.42
All Orleans Parish	6.59	2.14
Source: LAHIDD, 2008-2009 combined *Viavant has a small population size, and therefore data in this table may be skewed		

Energy Resources in Orleans Parish

Energy generation sources within Orleans Parish currently come from 33 MW of distributed rooftop solar and a 1 MW utility-scale solar project with back-up battery technology. Other energy resources for the city include nuclear, natural gas, and coal fired generation (See Table 19 in Appendices). Demand-side management programs encourage consumers to modify and reduce their level and pattern of electricity usage (U.S. Energy Information Administration, 2016). ENO currently has an energy efficiency program called Energy Smart, which offers programs and products to help reduce New Orleans' energy waste. Efficiency measures are offered to residential, commercial, and industrial customers. In addition, the City Council passed a net-metering rule that allows customers to install solar energy and receive a 1:1 credit for the energy they self-generate.

Energy Resilience and Lessons from Recent History

New Orleans East is particularly vulnerable to hurricane damage because of its location, low elevation, rate of subsidence, and both natural and human-caused coastal wetland erosion (Nelson, 2012). The five most destructive storms to hit New Orleans have occurred since 2005; these included Hurricanes Katrina, Rita, Gustav, Ike, and Isaac (Schleifstein, 2012).

Hurricane Katrina made landfall on August 29th, 2005. The 15-foot storm surge that entered the Industrial Canal overtopped floodwalls and breached critical levees along the Industrial Canal. Flooding in New Orleans East, St. Claude, St. Roch, and the 7th Ward neighborhoods was severe. Shortly after, a second 11-foot storm surge hit Lake Pontchartrain causing levee failures at the London Avenue Canal and 17th Street Canal. In total, water quickly covered over 80% of New Orleans and directly led to 1,500 deaths (Nelson, 2012).

Until Katrina in 2005, Michoud had three generating units. Following Katrina, Unit I, the oldest of the units, never came back online. Unit 2 had extensive damage from six feet of salt water flooding. It required $17 million in repairs and came back into service in April 2006, eight months after the plant flooded (ENO, 2006). Unit 3 returned to service in late 2006, a full year after the storm.

Groundwater Usage by Michoud Power Plant and Subsidence

Generating electricity with traditional fossil fuel power plants requires the use of millions of gallons of water each day. The average natural gas plant uses around three gallons of water per kilowatt-hour (kWh) generated (Union of Concerned Scientists, 2011).

Subsidence: gradual sinking of land as a result of factors ranging from underground extraction and storm water pumping to deep fault movements.

Recent research shows that subsidence in New Orleans East, specifically at and around the Michoud Power Plant site, is occurring at a faster rate than the rest of the city (Jones et al., 2016; NASA, 2016). There is evidence that the groundwater pumping at Michoud is linked with this accelerated subsidence rate, making New Orleans East more vulnerable to flood risk.

Michoud used around 464 million gallons of water per day, of which an average of 10.87 million gallons was withdrawn from the Gonzalez-New Orleans Aquifer via the operation of deep wells 631-645 feet below the plant (Table 8) (Michoud Well Registrations 1956-1983) (P. Sargent, email communication, June 6, 2016). The remaining 450+ million gallons of water was drawn daily from the Gulf Intracoastal Waterway, a canal that runs alongside the plant (United States Geological Survey [USGS], 2014). Since the late 1950s, when the first generating unit was built, power generation has been the largest user of groundwater in New Orleans, with Michoud as one of the greatest users.

Table 8: Groundwater use for energy generation

Year	Total daily Orleans groundwater use (million gallons)*	Total daily Orleans groundwater use for power generation (million gallons)*	Total daily Michoud facility groundwater use (million gallons)**	% of total daily Orleans groundwater use for energy*
1965	34.26	9.15		27%
1970	43.40	19.44		45%
1975	35.82	16.40		46%
1980	35.50	20.70		58%
1985	30.88	15.90	10.10	25%
1990	21.99	19.06	12.49	82%
1995	12.89	10.36	6.85	80%
2000	5.56[3]	12.97	10.22	
2005	5.04[3]	12.20	6.59	
2010	12.95	10.87*	10.87	84%

*Source: USGS Lower Mississippi-Gulf Water Science Center[4]
**Source: P. Sargent, email communication, June 6, 2016

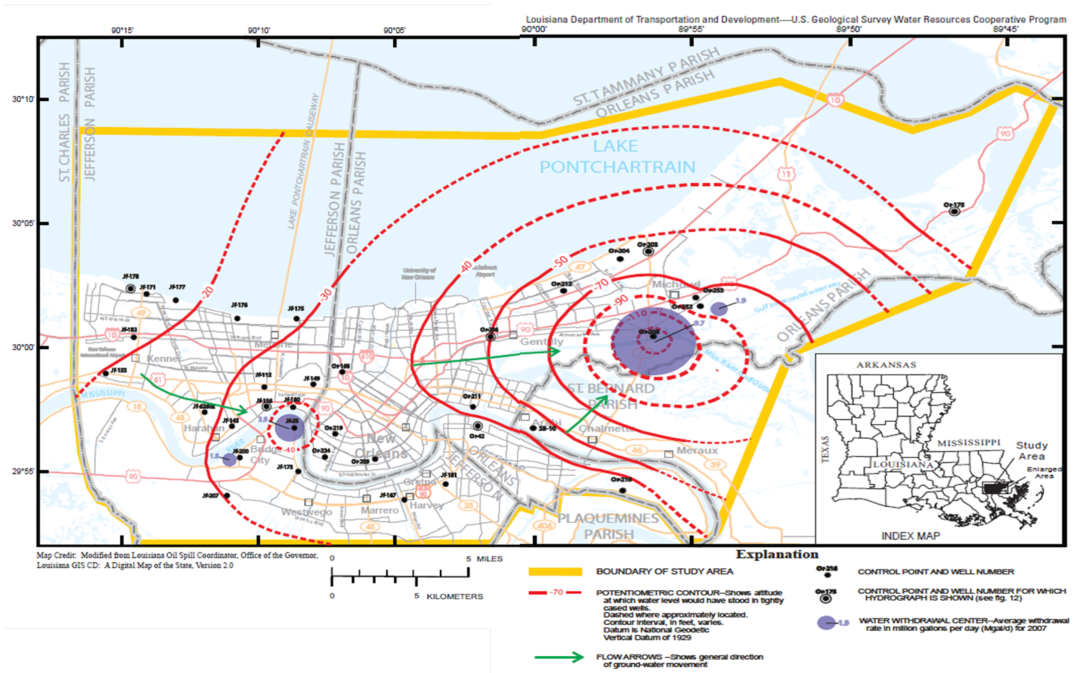
In 2010, 84% of daily groundwater withdrawals in Orleans Parish was used by the Michoud facility for energy generation. A handful of very small residential wells drew a total of 0.17 million gallons daily in Orleans. The remaining groundwater usage in the parish was industrial, also predominantly located in New Orleans East (USGS, 2014).

It is not clear why the Michoud plant has extracted so much groundwater for power generation. Nationally, on average, only 0.9-1% of water used for electricity generation comes from groundwater; the vast majority of water for electricity generation comes from surface sources (Kenny et al., 2009). In 2014, 4.5 million gallons of groundwater were withdrawn per day for power generation in Louisiana; Michoud accounted for 33% of that water use while only providing about 2% of the total electricity generated in Louisiana. Since the 1960s, Michoud has accounted for up to 54% of the entire state's groundwater use for electricity generation (Louisiana Department of Transportation and Development, 2012; USGS Lower Mississippi-Gulf Water Science Center).

Groundwater withdrawals for Michoud operations over the last six decades have averaged 12 million gallons per day. Because of these groundwater withdrawals, there has been reduced water levels in wellheads around the city. The decrease in wellhead levels has very likely contributed to the subsidence seen across Orleans Parish, and most acutely in New Orleans East (Dokka, 2011).

[3] Values in the table represents the best estimate of what was known at the time of data collection. Revisions in water use data may be made by the Louisiana Water Use Program in order to correct errors.
[4] The data in this table comes from the United States Geological Survey Lower Mississippi-Gulf Water Science Center water use chart data and are conservative estimates.

Figure 5: Pumping legend, New Orleans



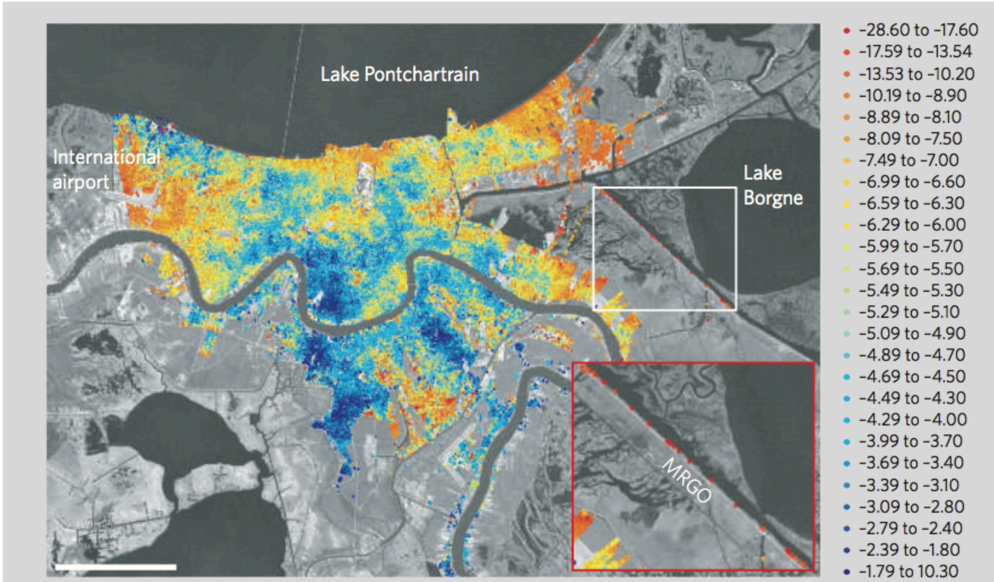
Note: Michoud and the proposed CT plant are located in the center of the largest purple circle
Source: Louisiana Department of Transportation and Development, 2012, p. 20-21

New Orleans has a very high water table; the water in the soil and aquifers is partly responsible for maintaining the land's elevation. When water is removed from underground, the soil compacts and subsides. In fact, groundwater pumping accounts for more than 80% of subsidence in the U.S. (USGS, 2014). Subsidence is one of the reasons New Orleans is sinking and becoming more vulnerable to sea level rise and flooding from major storm events (Coastal Protection and Restoration Authority, 2012). Salt water intrusion into drinking water aquifers is another consequence of groundwater pumping. According to research done for the New Orleans Urban Water Plan, salt water intrusion is currently happening in New Orleans East (R. Stuurman, personal communication, July 22, 2015). The ensuing subsidence, lower wellhead levels, and salt water intrusion lead to further soil compaction. This compaction could cause shallow surface deformations and trigger the fault line that runs through New Orleans East (Zou et al., 2016).

Other activities that lead to subsidence are storm water pumping, hydrocarbon withdrawals (such as oil and gas extraction), and tectonic shifts. However, there is evidence that the severity of deep subsidence in New Orleans is too large to be explained by these other causes alone (like faulting, storm water drainage, or sediment compaction), and points to large groundwater extraction as a major cause (Dokka, 2011).

The amount of groundwater withdrawals in Orleans Parish peaked in 1970, at around 43 million gallons per day (approximately 19 million of which were used for power generation). Since then, water levels in individual wells have somewhat rebounded. Water level gauges, at the Paris Road Bridge that runs alongside Michoud, show subsidence of around 80 centimeters (almost three feet) in the first 40 years of Michoud power production (Dokka, 2011). Research conducted in 2014 shows that this area has subsided between 1-1.3 inches per year (Jones et al., 2016). The Paris Road Bridge crosses a protective levee (that was breached during Katrina) and alongside the four deep groundwater wells for Michoud. It appears that the greatest subsidence in New Orleans Parish coincides with the largest yield water wells (Dokka, 2011).

Figure 6: Subsidence rates of Orleans Parish



Source: Dixon et al., 2006, p. 587
Note: the red and orange areas are those with the highest rates of subsidence

Comparing Figure 5 with Figure 6, a center of maximum subsidence in Orleans Parish is at Michoud at the Paris Road Bridge, and the subsidence affects levees in every direction (Dixon, et al., 2006, p. 587; Louisiana Department of Transportation and Development, 2012, p. 20-21). A recent NASA research study also found the highest rates of subsidence at Michoud, with up to two inches of sinking per year (NASA, 2016). Levees, along with storm surge protection measures, require sturdy land in order to protect New Orleans neighborhoods. As subsidence continues to push New Orleans even farther below sea level, levees follow suit, causing increased risk for the entire city.

Flooding associated with Katrina in the area around the Mississippi River Gulf Outlet Canal (to the immediate southeast of Michoud) "could be explained by the correlation we observe between the location of the breach points and the high rate of subsidence beneath these levee sections" (Dixon et al., 2006, p. 588). At a March 2016 meeting of the Coastal Protection and Restoration Authority of Louisiana, Robert Turner of the Southeast Louisiana Flood Protection Authority described the levee walls between Lake Borgne, New Orleans East, and St. Bernard Parish as being "more prone to flooding than before Katrina," and in need of "levee lifts in the near future" (Turner, 2016). These levees are directly impacted by the rate of subsidence of the land on which they are built.

Existing Environmental Hazards

Ambient air quality is recorded and maintained by the Louisiana Department of Environmental Quality (LDEQ) Assessment Division, Air Field Services Section. These data are collected to track air quality trends and to ensure compliance with the National Ambient Air Quality Standards (NAAQS). Ambient air quality data are limited, and it is not possible to access air quality for specific neighborhoods or zip codes. There are approximately 35 air monitoring sites in Louisiana (Louisiana Department of Environmental Quality [LDEQ], 2016b), with one in Orleans Parish, located in New Orleans City Park. New Orleans East has multiple sites monitored by the Environmental Protection Agency (EPA) including toxic releases to land, water, and air (Figure 7).

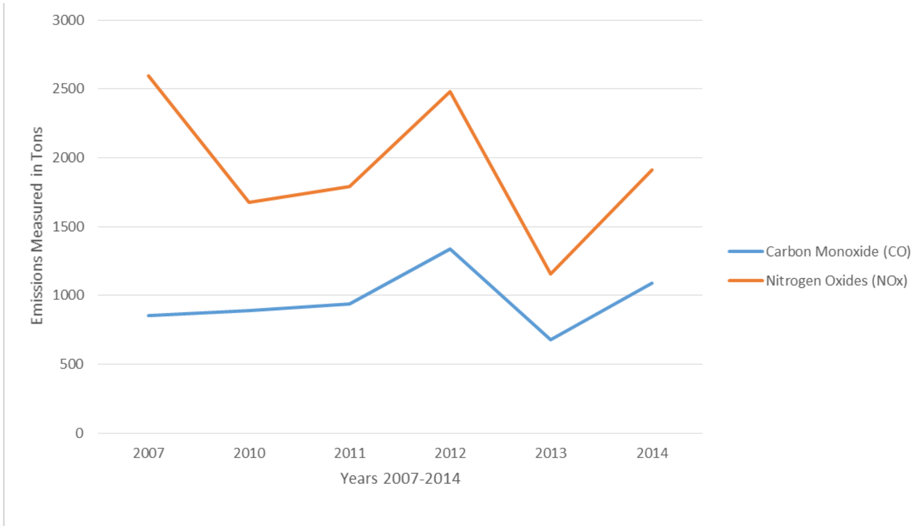
Figure 7: EPA designated sites in New Orleans East

Note: black star is the location of Michoud and the proposed CT plant
Source: EPA, 2015

Monitoring sites contain specialized instruments to measure concentrations of ozone, sulfur dioxide (SO_2), nitrogen oxides (NOx), carbon monoxide (CO), lead, and particulate matter (PM), in accordance with federal air monitoring requirements. The LDEQ Air Field Services Section also measures concentrations of volatile organic compounds (VOCs) at select sites throughout Louisiana. The LDEQ submits brief air quality reports which are included in the daily weather report when the Air Quality Index exceeds 100 parts per million (LDEQ, 2016b). This happens most frequently during warmer months. It should be noted that air below the 100 parts per million threshold may still be unhealthy for some vulnerable individuals. The LDEQ also requires industrial entities to report air emissions in accordance with federal regulations (LDEQ, 2016b).

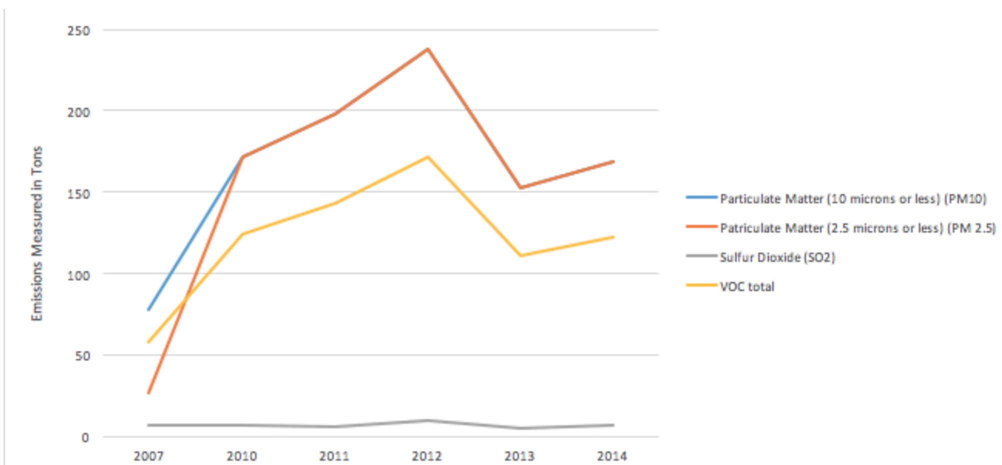
ENO was required to report criteria and toxic air pollutant emissions from Michoud per LAC:33:III:919. Criteria and toxic air pollutant emissions inventory include ozone, PM, CO, NOx, SO_2, and lead (LDEQ, 2016c). While many chemicals are regulated, carbon dioxide (CO_2) and methane, which are leading contributors to global climate change, have reporting requirements, but are not currently regulated. At this time there are no third party entities that record air quality in Louisiana. Figures 8 and 9 below show Michoud plant emissions from 2007 through 2014.

Figure 8: Michoud LDEQ reported emissions 2007-2014: CO, NOx



Source: LDEQ, 2016c

Figure 9: Michoud LDEQ reported emissions 2007-2014: PM 10, PM 2.5, SO_2, VOC



Source: LDEQ, 2016c

Assessment Part II: Evaluating Potential Impacts

To determine the potential health impacts of the proposed CT plant, LPHI and AAE established the following criteria:

1. Certainty of the health effect[5]/determinant[6]
2. Direction of the health effect/determinant
3. Magnitude of the health effect/determinant
4. Vulnerable populations

1. Certainty of the effect describes how likely the health effect/determinant is to occur. Certainty is based on a review of health data and literature and stakeholder conversations.

Levels	**Definition**
Unlikely	Health effects are not predicted as a result of the proposed CT plant
Possible	Health effects are feasible as a result of the proposed CT plant
Likely	Health effects are probable as a result of the proposed CT plant
Very Likely	Health effects are expected as a result of the proposed CT plant
Difficult to Forecast	Not enough information available to determine certainty

2. Direction describes whether the effect/determinant is expected to increase or decrease as a result of the proposed CT plant.

Levels	**Definition**
↑	An increase in the health effect/determinant will occur as a result of the proposed CT plant
↓	A decrease in the health effect/determinant will occur as a result of the proposed CT plant
→	The health effect/determinant will likely not change as a result of the proposed CT plant
Difficult to forecast	Not enough information available to determine direction

[5]For the purposes of this HIA, health effect refers to specific health outcomes/conditions and/or state of well-being.
[6]For the purposes of this HIA, determinant (determinant of health) refers to factors including social environment, physical environment, or health services that contribute to an individual's state of health.

3. Magnitude describes the severity of the health effect/determinant. Magnitude is based on a review of health data and literature.

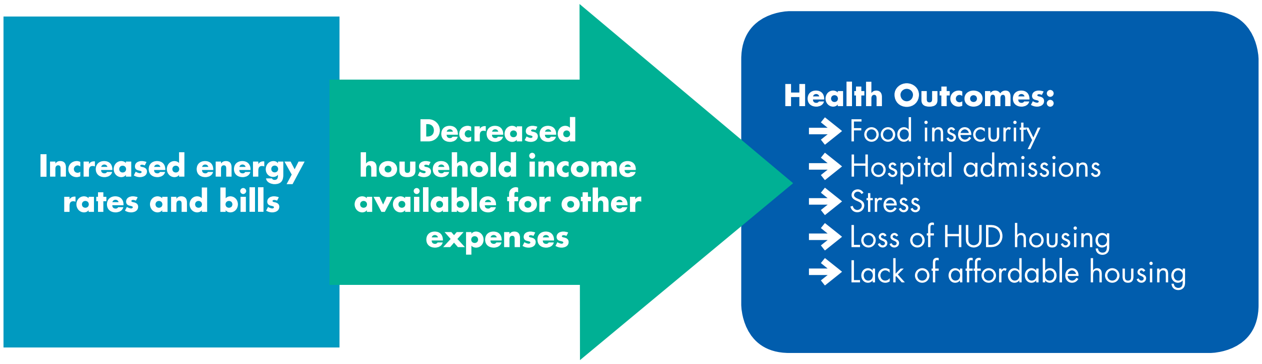
Levels	Definition
Low	Minor, non-disabling health effects
Medium	Moderate, non-disabling health effects
High	Serious, disabling health effects
Difficult to Forecast	Not enough information available to determine magnitude

4. Vulnerable populations describe sub-populations that are at greater risk for the health effect/determinant than other populations due to factors including age, physical ability, chronic health issue, or other existing conditions.

Although there might be other populations that are particularly susceptible to the health effects, this HIA focused on the following groups that were identified in the literature review as being impacted by many of the effects/determinants. A few of the pathways also specify other vulnerable populations that are of particular interest.

Levels	Definition
Children	Individuals under 18 years
Seniors	Individuals 65 years or older
Low-income	Individuals that are at or below the poverty level
Minorities	Individuals that are of a minority race/ethnicity
Respiratory	Individuals with chronic obstructive pulmonary disease and/or existing respiratory illness
Device-dependent	Individuals dependent on medical devices to live, including dialysis machine or ventilator
Existing conditions	Individuals with existing conditions including: cognitive impairments, mental illness, obesity, chronic conditions (not including respiratory illness) and physical disabilities

1. Household Expenses and Health



Energy is often unaffordable for many households in New Orleans, especially in the heat of the summer. Research conducted by ENO shows that approximately 74% of their customers who call about billing have difficulty paying their bills at least once a year (Entergy Corporation, 2015). One study of 48 of the largest US cities found that while New Orleans was among the five cities with the lowest average electricity prices, it was in the top four of "highest average energy burden" for all households (5.3%), African American households (8%), low-income households (10%), and renting households (6%) (Drehobl & Ross, 2016, p. 118).

The Home Energy Affordability Gap is defined as the "difference between an affordable and an actual energy bill" (Cook et al., 2008, p. e868). Among U.S. households at less than 185% of the poverty threshold, the average annual affordability gap nearly doubled from $639 in 2002 to $1,047 in 2006 (Cook et al, 2008). In Louisiana, households earning less than 200% of the federal poverty level saw their affordability gap increase to $744 per household in 2014, and Louisiana households earning less than 50% of the federal poverty level spent 26% of their annual income on energy bills (Fisher, Sheehan, & Colton, 2015). Households facing the largest affordability gap include homeowners who cannot afford more efficient energy upgrades, as well as renters who live in units where landlords have reduced incentives to improve energy efficiency (Hernandez, 2013).

Increasing energy expenditures limit the amount of money families can spend on other household expenses, such as housing, food, and health care. Low-income families are more vulnerable to rising energy expenditures, as energy costs are a greater proportion of their household budgets (Hernandez, 2013). Families utilizing the Housing Choice Vouchers (commonly known as Section 8 housing) are required to fully pay their utility bills. Families who fall behind on their utility bills can lose their housing as a result.

Currently, there are two programs that address housing insecurity as a result of high energy burden: the Low Income Home Energy Assistance Program (LIHEAP) and the Power to Care. Total Community Action administers LIHEAP in New Orleans and offers bill assistance twice annually. While LIHEAP helps many families, it is unable to close the affordability gap for all low-income households. In 2014, 513,832 Louisiana households earned less than 150% of the federal poverty level, but LIHEAP only covered 53,545 annual bills (Fisher, Sheehan, & Colton, 2015). For New Orleans East communities already spending a large percentage of their incomes on housing, the energy burden is an added threat to financial security (see Table 4). Power to Care is an emergency energy bill support program for senior and disabled customers, with funds collected by ENO from customers on a voluntary basis. This program is managed by the Council on Aging in New Orleans and has limited funding available.

Low-income families struggling to pay high energy bills often limit their energy usage, especially for heating and cooling. During heat waves, low-income households and seniors are more likely to limit their air conditioning use and be at-risk for heat-related illness (Hernandez, 2013). Some low-income families may also attempt to use alternative heat sources, which can lead to burns, respiratory illness, and CO poisoning (Cook et al., 2008). The periodic stress of heating and cooling the home has been found to impact the health and nutrition of children and impoverished seniors. For example, one study in Boston found that the highest proportions of children below the 5th percentile of weight for age were reported during the three months after the coldest months of the year (Frank et al., 2006).

High energy bills can also lead to food insecurity, described as the "heat or eat" effect, as families try to cut back on their non-energy expenses. One study found that the odds of food insecurity were 27% higher in the summer than in the winter in high-cooling states (Nord & Kantor, 2006). According to a 2011 Save the Children research study, 45% of parents considered cutting back on food in order to afford their electricity bills (Save the Children, 2011). According to another study, children with moderate or severe energy insecurity were more likely to have "household food insecurity, child food insecurity, hospitalization since birth, and caregiver report of child fair/poor health" than children with reliable and affordable energy (Cook et al., 2008, p. e867). These odds were even higher among children with severe energy insecurity, and caregivers were also more likely to report significant concerns regarding their children's development (Cook et al., 2008).

Low-income families often limit or go without medical services when experiencing high energy burden. A survey of LIHEAP recipients found that 35% of respondents went without medical or dental care because of high energy bills, and 32% took less of their prescribed medication dosage or did not refill prescriptions because of high energy bills (Cook et al., 2008).

Energy and food insecurity can also lead to anxiety and mental health issues. The 2011 Save the Children study found that almost 33% of the poorest families worried that they would not be able to afford electricity bills even after cutting back on essentials (like food and medical expenses), and over 50% of families worried that their children's health would suffer due to their inability to pay electricity bills and keep their homes warm during the winter. In another study, parents in food insecure households described feeling anxious and depressed because of shut-off notices and overdue bills. The parents' anxiety, depression, and frustration impacted their children's physical health and development as well (Knowles, Rabinowich, Ettinger de Cuba, Cutts, & Chilton, 2015).

The impact of the proposed CT plant on energy rates and bills is not currently clear. The rate and bill impacts are based on a number of factors including, but not limited to: the construction cost of the proposed CT plant (estimated at $216M), operating and maintenance costs of the proposed CT plant, fuel costs for the proposed CT plant, other available energy supply alternatives, ratemaking decisions, usage per customer, quality of housing units, and weather.

Due to the lack of data on the impact of the proposed CT plant on energy rates and bills, it is difficult to forecast the certainty and magnitude of health impacts from energy costs. However, stress is possible, as community members at the stakeholder meetings already expressed concerns and worries over possible bill increases.

Table 9: Household expenses pathway

Potential Health Effect or Determinant	Direction	Certainty	Magnitude	Vulnerable
Food insecurity/ hunger	↑	Difficult to forecast; dependent on amount of bill increase	Low to medium; dependent on amount of bill increase	Low-income individuals/ households, children, disabled individuals, seniors
Hospital admissions (due to not taking medication)	↑	Difficult to forecast; dependent on amount of bill increase	Low to medium; dependent on amount of bill increase	
Stress	↑	Possible	Low	
Loss of housing	↑	Difficult to forecast; dependent on amount of bill increase	Low; dependent on amount of bill increase	

Recommendations:

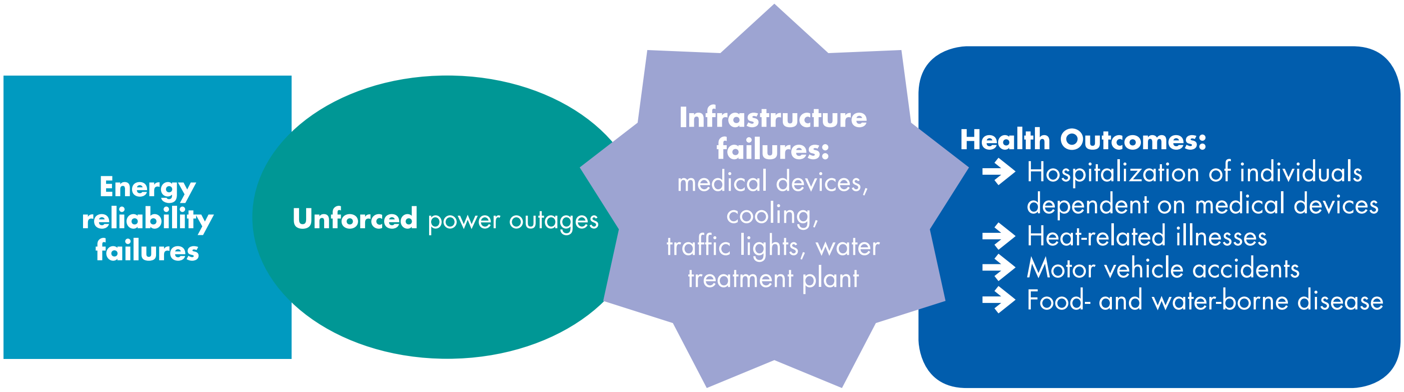
- The City Council should direct ENO to provide information on the proposed CT plant's potential billing impacts to New Orleans customers as part of the application process to the City Council. Full understanding of bill impacts should be available to the City Council and community before cost recovery is approved. This would allow for better planning for any potential changes in energy rates.

- The City Council should direct ENO to make data available on the average kWh usage and average energy bill by neighborhood. Data should be easily accessible and available to the public.

- ENO and CleaResult should connect low-income housing programs (including the Greater New Orleans Housing Alliance) and bill paying programs (including Total Community Action) with energy efficiency programs, coordinating Energy Smart with the Weatherization Assistance Program, currently administered by Quad Area Community Action Agency.

- ENO customer service representatives should be trained to provide energy burdened households with methods to reduce their electricity bills and connect callers to the Energy Smart program.

2. Energy Reliability and Health



ENO measures reliability on two scales: 1. frequency of power outages, and 2. duration of power outages. However, these measures do not capture major events like hurricanes. Industry-wide measurements of energy reliability are not standardized, making direct comparison difficult. A better understanding of power outages and impacts is needed to improve system reliability and outcomes. Utility companies around the country are adding additional indices for more granular analysis (Eto & LaCommare, 2008), including momentary power outage and interruption measures. With this data, utility companies and their regulators have a more clear understanding of the vulnerabilities in the system and how power outages affect customers, including economics and health. Transparency is vital for improved reliability, improved service and outcomes, and sustained customer confidence. For the purposes of this HIA, reliability is defined as "power is there when it is needed."

Power outages stress health care centers and hospital services. First, accidents, injuries, and exacerbated chronic conditions are more likely to increase during a power outage. Second, individuals dependent on medical equipment, respiratory treatments, and insulin have to access health care when their home systems fail (Klinger, Landeg, & Murray, 2014). Together, these incidents increase demand for health services. Outages directly impact hospitals as well. A scientific review of power outage impacts found that hospitals only had enough generator back-up for eight hours, which led to a basic failure of essential and basic services including laboratory, imaging, and sterilization services as well as access to medical records (Klinger et al., 2014). Without generator power, hospitals are forced to evacuate patients, including those dependent on life-saving equipment, even while patient demand is increasing. Changes in energy reliability would affect New Orleans' seven hospitals and 30 nursing/ assisted living facilities. One of these hospitals and two of these nursing/ assisted living facilities are located in New Orleans East.

Summer power outages are very dangerous as limited access to air conditioning can lead to heat-related illnesses that include heat exhaustion and potentially fatal conditions like heat stroke (Becker & Stewart, 2011). Individuals at greatest risk for heat-related illness include seniors and children under 15 years of age, as well as those with cognitive impairment, heart and lung disease, mental illness, obesity, physical disabilities, poor fitness, and sickle cell disease (Becker & Stewart, 2011).

Loss of electricity compromises basic infrastructure services like water, sewage, and refrigeration. Water can become contaminated when city water treatment and sewage treatment facilities lose power and water pressure. Water contamination resulted during Hurricane Rita as a result of reduced system pressure followed by power outages (Klinger et al., 2014). Lack of refrigeration can impact food and medicine storage, leading to diarrheal disease (Klinger et al., 2014). The unsafe use of generators and gas-powered heaters for electricity and cooking can lead to CO poisoning (Klinger et al., 2014).

Interruptions to basic city infrastructure, like non-functioning traffic lights, can lead to motor vehicle accidents. In addition to the direct health impacts associated with widespread power outages, there can also be mental health impacts from the protracted loss of services, contributing to depression, anxiety, and PTSD symptoms (Gros et al., 2012).

Demand Response: Customer volunteered reduction of energy usage during peak times in response to various incentives.

As a peaking plant, ENO has stated that the proposed CT plant would be used by New Orleans about 15% of the year, during the hottest and coldest days. Though not needed for the entire year, added reliability during peak times is important. When energy resources are not fully available during hot days, customers may face blackouts. In this scenario, the utility company may be forced to implement rolling brownouts in order to prevent a blackout. The proposed CT plant will likely improve energy reliability in New Orleans, decreasing the frequency and duration of blackouts, as well as associated health effects (Table 10).

While the proposed CT plant is one potential solution, it is not the only resource that can address the peak capacity deficit resulting from the decommissioning of Michoud. Increased use of energy efficiency measures, demand response, renewable generating resources, and purchases on the open market are all immediately viable options for replacing the capacity needed. These other resources do not add pollution or contribute to subsidence, and they are proven resources that respond directly to peak reliability concerns.

Table 10: Energy reliability pathway

Potential Determinant	Potential health effect	Direction	Certainty	Magnitude	Vulnerable
Blackout lasting under 3 days	Motor vehicle accidents and injuries (from traffic light and power outages)	↓	Likely	Low	Passengers, pedestrians, bicyclists
	Heat-related illness	↓	Likely	Medium	Seniors, children, existing conditions, low-income
	Medical emergencies	↓	Likely	Low	Device-dependent
	Food-borne and water-borne disease	↓	Likely	Medium	Children, seniors

Recommendations:

- The City Council should require ENO to increase data tracking and reporting on power outages by adding the following indices:

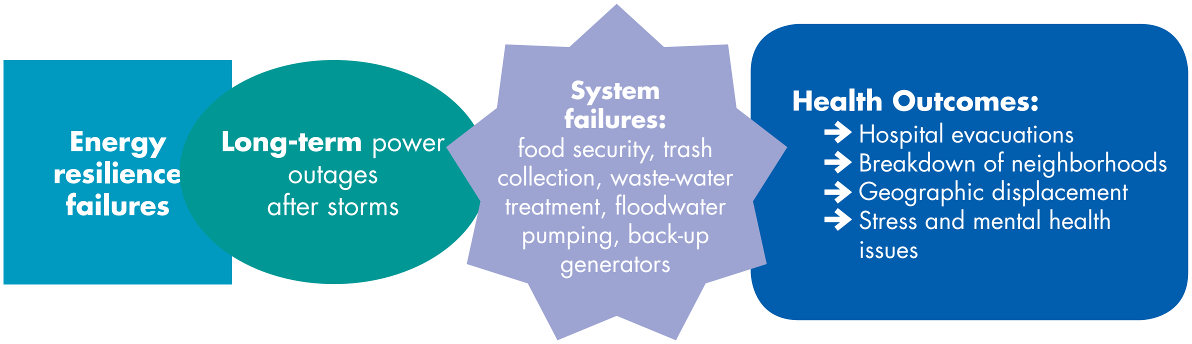
  - momentary average interruption frequency

  - customer average interruption duration index

  - customer average interruption frequency index

Reports could be submitted to The City Council and made available to customers on the ENO website.

3. Energy Resilience and Health



Energy resilience describes the electric grid's ability to withstand disruption or disaster from a storm and how quickly service is restored after the event (Willis, 2015). Extreme weather events, such as thunderstorms, hurricanes, flooding, and tornadoes, cause expensive repair costs and loss of revenue due to power outages. As climate change causes the strength and frequency of extreme weather events to rise, the resilience of local infrastructure falls. Infrastructure near the coast is particularly vulnerable; land subsidence coupled with rising sea levels have led to increased flooding, storm surges, and damage from strong winds (U.S. Department of Energy, 2015). For the purposes of this HIA, energy resilience is defined as the ability of ENO's electric grid to resist damage from extreme weather events.

Power outages during extreme weather events can impact community health and overwhelm health care systems (Klinger et al., 2014). Power outages affect people's ability to care for their own health, especially among vulnerable populations, like those with chronic conditions. A study on Hurricane Sandy found that 26.3% of patients in five outpatient centers missed their scheduled dialysis treatment following the storm (Murakami, Siktel, Licido, Winchester, & Harbord, 2015).

Individuals living alone or isolated from day-to-day community functions, including seniors and those with dementia, are particularly vulnerable to health impacts from power outages (Klinger et al., 2014). During Hurricane Sandy, some seniors living in high-rise buildings found themselves trapped in their apartments without power and food, as elevators were non-functioning. Ahead of severe storms, seniors often have to be evacuated from nursing homes to maintain access to life saving medical equipment (Klinger et al., 2014). While only 15% of New Orleans residents pre-Katrina were over 60 years of age, individuals over 60 made up over 75% of fatalities found after Katrina. The reasons for high senior mortality during Katrina included the "lack of evacuation facilities, infirmities that made evacuation difficult if not impossible, and high levels of poverty and isolation which increased their vulnerability in the face of social failure of emergency response" (Adams, Kaufman, Van Hattum, & Moody, 2011, p. 3). Many seniors had major challenges evacuating the city because they lived alone, did not own a car, were isolated, and/or disabled (Gabe et al., 2005). Seniors living in nursing homes were in extreme risk because more than 40% of nursing homes during Katrina were unable to successfully evacuate patients in spite of the mandate to have emergency evacuation plans (Adams et al., 2011).

Katrina disproportionately affected low-income and African American individuals. According to a report of the Congressional Research Service, "one-fifth of those displaced by the storm were likely to have been poor, and 30% had incomes that were below 1½ times the poverty line" (Gabe, Falk, McCarty, & Mason, 2005, p. 2). Approximately 73% of African Americans in New Orleans were displaced by flooding or damage, compared to 63% of non-African American individuals (Gabe et al., 2005). In addition, 44% of the storm victims were likely African American (Gabe et al., 2005). According to the Congressional Research Service, "Hurricane Katrina likely made one of the poorest areas of the country even poorer," as many individuals who financially "got by" before Katrina lost their home, job, and possessions (Gabe et al., 2005, p.2).

As a transmission island, New Orleans' energy grid is vulnerable to extreme weather. In the case of Hurricane Gustav, all but one of the 14 transmission lines connecting the New Orleans metropolitan area[7] to generation went down (ENO, 2008). ENO's draft 2015 IRP proposes that a new gas plant in New Orleans East would provide local baseload generation within the transmission island. According to the IRP, if New Orleans' transmission lines were disrupted by an extreme weather event or other unpredictable event, some power would still be available within the city.

However, past experiences do not indicate that local baseload generation has positively improved energy resilience within New Orleans. Power plants often suffer the same localized damage that impacts transmission lines and other city infrastructure. Figure 10 demonstrates how increasing hurricane strength has a deleterious effect on electric and gas infrastructure.

[7]New Orleans metropolitan area includes Entergy Louisiana service territory outside Orleans Parish.

Figure 10: Probability and severity of hurricane damage to liquid fuels and natural gas infrastructure

Table 2-1. Probability and Severity of Hurricane Damage to Liquid Fuels and Natural Gas Infrastructure[13, d]

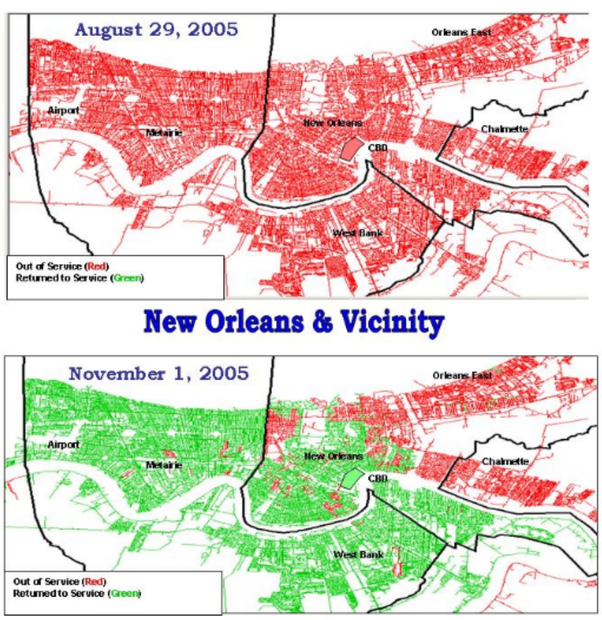
Infrastructure	Tropical Storm (39-73 MPH)		Hurricane Cat 1-2 (74-95 MPH, 96-110 MPH)		Hurricane ≥ Cat 3-5 (111-129 MPH, 130-156 MPH, >157 MPH)	
	Probability of Damage	Severity of Damage	Probability of Damage	Severity of Damage	Probability of Damage	Severity of Damage
Loss of Electrical Power	Med	Significant	Med-High	Major	High	Catastrophic
Gulf of Mexico Platforms	Low	Insignificant	Med-High	Major	Med-High	Major
Pumping/Compressor Station	Low	Insignificant	Med	Significant	Med-High	Major
Pipelines	Low	Insignificant	Low-Med	Interrupting	Med-High	Major
Rail	Low	Insignificant	Low-Med	Interrupting	Med-High	Major
Ports	Low	Insignificant	Med-High	Major	High	Catastrophic
Crude Tank Farm	Low	Insignificant	Low-Med	Interrupting	Med	Significant
Refineries	Low	Insignificant	Med	Significant	Med-High	Major
Natural Gas Plants	Low	Insignificant	Med	Significant	Med-High	Major
Product Storage Terminals	Low	Insignificant	Low-Med	Interrupting	Med-High	Major
Propane Tanks	Low	Insignificant	Low	Insignificant	Low	Insignificant
Underground Storage	Low	Insignificant	Low	Insignificant	Low	Insignificant
LNG Terminals	Low	Insignificant	Med	Significant	Med-High	Major
Local Gas Distribution	Low	Insignificant	Med	Significant	Med-High	Major
Filling Stations	Low	Insignificant	Med	Significant	Med-High	Major
SPR/NEHHOR	Low	Insignificant	Low-Med	Interrupting	Med	Significant

This table is an example of infrastructure damage from natural disasters (here showing tropical storms and hurricanes). For three ranges of intensity of tropical storms and hurricanes, the severity of probable damage was rated qualitatively using a 5-point scale (i.e., minor, interrupting, significant, major, and catastrophic). These ratings were based on the extensive review of impacts from past events and judgment of industry experts.

Source: U.S. Department of Energy, 2015, p. 2-7

Following Hurricanes Katrina, Rita, and Gustav, Michoud did not improve resilience because the power plant was also impacted by the storm. Typically, power plants within the expected path of a major hurricane close down for safety and require two to three days to "power back up once workers are able to return" (Staudt & Curry, p. 6). During Katrina, Michoud and Patterson (another energy generation facility in New Orleans East) were both taken offline well before the hurricane made landfall for safety reasons, and they both experienced severe flooding. Michoud needed extensive repairs and the Patterson plant never came back online (Javetski, 2006). From Figure 11 below, it is clear that New Orleans East was most severely impacted by the power outages and took the longest to receive service again, even though Michoud was located in that area of the city.

Figure 11: ENO customer power outage progression after Katrina



Source: U.S. Department of Energy Office of Electricity Delivery and Energy Reliability, 2009, p. 6

Based on the literature and previous experiences with hurricanes, the HIA has found that the proposed CT plant will likely not improve or impact the energy resilience of New Orleans. Therefore, it can be expected that New Orleans will still be vulnerable to the same health effects from extreme weather-causing blackouts with or without the proposed CT plant in place.

Table 11: Energy resilience pathway

Potential Determinant	Potential Health Effect	Direction	Certainty	Magnitude	Vulnerable
Blackouts (as result of extreme weather events)	Medical emergency	→	Possible	Low	Device-dependent
	Heat-related illness	→	Possible	Medium	Seniors, children, existing conditions
	Evacuation of hospitals and nursing homes	→	Likely	Medium	Hospital patients, nursing home residents, seniors
	Food-borne and water-borne disease	→	Possible	Low	Children, seniors
Geographic displacement	PTSD, depression (see climate change pathway)	→	Likely	High	Minorities, low-income, seniors, children, pregnant women, existing conditions, isolated individuals

Recommendations:

- The City Council should require ENO to report kWh usage before and after extreme weather outages to understand how blackouts impact usage- i.e. "Does usage increase after blackouts?" "Does usage remain the same as pre-blackout or does usage decline?" This data could help guide energy and resilience policy in New Orleans.
- The New Orleans Health Department could coordinate with health providers, neighborhood associations, and non-profits on emergency preparedness planning for device-dependent individuals (oxygen, dialysis, etc.) and other vulnerable populations.
- The City Council Utility Committee and the Resilient NOLA program in the New Orleans Redevelopment Authority should coordinate resilience planning in the electric grid to identify resilience strategies like smart grids, distributed energy (like solar), storage, and a city-wide energy plan including all generation within the parish. The planning should include state coastal agencies, Levee Boards, and the Army Corps of Engineers as appropriate.

4. Air Quality and Health

Power plants emit many types of pollutants, all of which directly impact air quality. The EPA regulates these pollutants through the National Ambient Air Quality Standards (NAAQS). The proposed CT power plant will emit less pollution than the Michoud units, varying from 30% to 90% lower overall, depending on how the plant is operated. According to ENO's application to the City Council, this plant is intended to run about 15% of the hours in a year (or ~1,314 hours). However, in recent updates to their application to the LDEQ, ENO amended its proposal to run a maximum of 4,000 hours per year (LDEQ, 2016a). This increase represents much higher emissions and pollutant releases than previously anticipated. Although the proposed plant will have controlled emissions levels, each of these pollutants (CO, NOx, PM 10 and 2.5, SO_2, and VOCs) contribute to overall poor air quality and have been associated with a number of different symptoms, health conditions, and diseases. Individuals, including vulnerable populations listed below, may not be sufficiently protected.

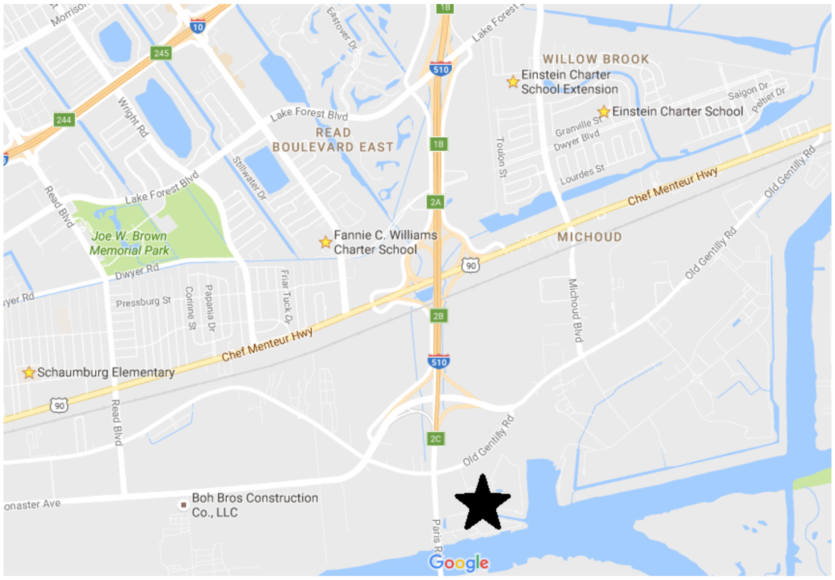
Each year, air pollution is estimated to cause approximately 800,000 premature deaths worldwide (Cohen et al., 2005). Multiple studies and institutions including the EPA, International Agency for Research on Cancer, and the American Heart Association have associated PM, NOx, SO_2, and ozone with increased likelihood of respiratory illness, cardiovascular disease, cancer, and adverse birth outcomes, especially among vulnerable groups. Studies of long-term effects of air pollution have found an increased risk of adverse cardiovascular events, while studies of short-term effects have shown "short-term mortality rates, hospital admissions, emergency room visits and symptom exacerbations" (Brook et al., 2004). In 2013, the World Health Organization's International Agency for Research on Cancer classified both outdoor air pollution and PM as being "carcinogenic to humans," due to sufficient evidence that these pollutants cause lung cancer (International Agency for Research on Cancer, 2013). A more complete list of the health effects associated with expected emissions from the proposed CT plant is in Table 12 below.

Table 12: Health effects associated with natural gas power plant emissions

Chemical Compound	Associated Health Effects	Vulnerable Populations	Sources
Carbon Monoxide (CO)	-Pneumonia -Bronchitis -Exacerbate asthma symptoms -Asthma	-Children -Seniors -Low-income -Minorities -Individuals who exercise and/or work outdoors	American Academy of Pediatrics, 2004; CDC, 2013b; Marino, Massimo, Campagna, & Richardo, 2015
Particulate Matter (PM)	-Irritation of nose, throat, eyes -Difficulty breathing -Respiratory illness -Cardiovascular disease -Cancer -Decreased lung function -Adverse birth outcomes	-Children -Pregnant women -Low-income -Minorities -Individuals with asthma -Seniors	American Academy of Pediatrics, 2004; Brown, Lewis, & Weinberger, 2015; CDC, 2013b; CDC, 2016a; Marino et al., 2015
Sulfur Dioxide (SO_2)	-Asthma attack trigger -Decreased lung function -Acute respiratory symptoms	-Low-income -Minorities -Individuals with asthma	Dales et al. 2004; Jerrett et al. 2009; Marino et al., 2015; Samoli et al., 2006;
Nitrogen Oxides (NOx)	-Asthma attack trigger -Decreased lung function -Lung & heart disease -Bronchitis symptoms -Respiratory illness -Cancer -Adverse birth outcomes	-Low-income -Minorities -Individuals with asthma	American Academy of Pediatrics, 2004 Dales et al., 2004; Jerrett et al., 2009; Marino et al., 2015; Samoli et al., 2011
Volatile Organic Compounds (VOCs)	-Respiratory tract infections	-Low-income -Minorities	Brown et al., 2015

Children and pregnant women are two of the groups that are most vulnerable to the effects of air pollution. PM exposure can lead to adverse birth outcomes, including low birthweight and pre-term birth, and can affect children's health throughout childhood and into adulthood (American Academy of Pediatrics, 2004; Brown et al., 2015). Air pollution can adversely affect children's lung function and respiratory symptoms, especially among those with asthma (American Academy of Pediatrics, 2004; Brown et al., 2015). Air pollution has also been associated with the development of asthma among children. Children's vulnerability to power plant emissions is extremely important to take into account, as there are four schools within three miles of the proposed CT plant location.

Figure 12: Map of schools within three miles of Michoud and proposed CT plant



Note: black star is the location of Michoud and the proposed CT plant
Source: Google Maps, 2016

According to the scientific literature cited above, the pollutants that will be emitted by the proposed CT plant are associated with a number of serious health conditions. There is no question that the population living in close proximity to the proposed CT plant, especially the groups most vulnerable to the effects of pollution, would remain at increased risk for a number of health effects as a result of the proposed CT plant's emissions.

Table 13: Air quality pathway

Potential Health Effect	Direction	Certainty	Magnitude	Vulnerable
Respiratory illness	↑	Likely	Medium	Low-income, minorities, respiratory, children, pregnant women, seniors, individuals who work outside
Cardiovascular disease	↑	Possible	Medium	
Cancer	↑	Possible	Low	
Adverse birth outcomes	↑	Unlikely	Low	Pregnant women
Worsened asthma	↑	Likely	Low	Children and individuals with asthma

Recommendations:

- If the proposed CT plant is approved, the City Council should require that ENO add on-site air monitoring to improve data tracking of ambient air quality in New Orleans East. The air monitoring site readings should be posted online to ENO's website.
- If the proposed CT plant is approved, the City Council should ensure the plant follows the most stringent emissions controls; for example, Selective Catalytic Reduction and NOx reduction measures.
- If the proposed CT plant is approved, community members potentially affected by increased emissions should be notified by the city or ENO when emissions levels are more likely to impact health due to peaking generation startup and shut down cycles.

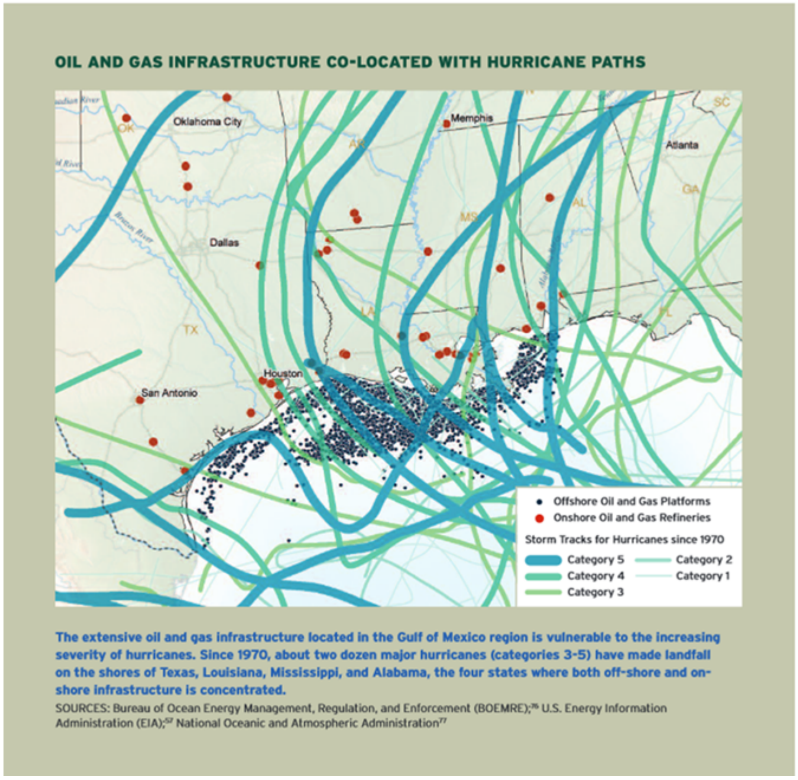
5. Climate Change and Health

Anthropogenic climate change is a known health risk. Human-made greenhouse gases (GHGs) are the leading contributor to climate change. Each phase of natural gas extraction, storage, transportation, and burning emits powerful GHGs (CO_2, methane, and NOx emissions) (U.S. Energy Information Administration, 2016). In 2012 natural gas made up 31% of U.S. electricity production and 24% of U.S total emissions of CO_2. It is estimated that natural gas will make up half of U.S. electricity by 2050 and 60% of CO_2 emissions from U.S. electricity production (Union of Concerned Scientists, 2014).

Climate change threatens coastal wetlands, which reduce dangerous storm surge that threaten to overtop the levee protection system. Climate change and rising sea levels lead to coastal wetland loss through increasing erosion, flooding, and salt-water intrusion (EPA, 2016a; U.S. Global Change Research Program [USGCRP], 2014). In the last 50 years, coastal Louisiana has seen relative sea level rise by as much as eight inches, over twice the global rate of sea rise (EPA, 2016a). New Orleans, with half the population living below sea level, is extremely vulnerable to sea level rise and increased extreme weather events (USGCRP, 2014).

Climate change will lead to increased global temperatures and greater frequency and severity of extreme weather events (United Nations Intergovernmental Panel on Climate Change, 2013; USGCRP, 2014). Extreme weather can interrupt the reliability and resilience of pipelines, power plants, and electricity grids (Staudt & Curry, 2011). This is important to consider as the Gulf South, one of the areas most vulnerable to climate change impacts and extreme weather events, is also one of the top producers of gas and oil (EPA, 2016a). Figure 13 below illustrates the vulnerability of this industry to storm events.

Figure 13: Oil and gas infrastructure co-located with hurricane paths



Source: Staudt & Curry, p. 7

In April 2016, the White House U.S. Global Change Research Program released a report called *The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment*, which was developed by 100 experts representing the U.S. CDC, Department of Health and Human Services, EPA, Food and Drug Administration, National Institutes of Health, and the National Oceanic and Atmospheric Administration, among others. This report found that climate change will have multiple degrees of adverse health impacts. According to the report, climate change will impact health through two routes: "first, by changing the severity or frequency of health problems that are already affected by climate or weather factors; and second, by creating unprecedented or unanticipated health problems or health threats in places where they have not previously occurred" (USGCRP, 2016, p. 4).

Rising temperatures and more frequent and intense extreme heat events will adversely impact health. When temperatures soar to 95°F, air quality decreases as ozone and other harmful air pollutants form (EPA, 2016a). Heat waves can lead to hospitalization and death from heat stroke and related conditions, cardiovascular disease, respiratory illness, and cerebrovascular disease (CDC, 2016b). Infants and children, pregnant women, seniors, individuals with chronic conditions, low-income individuals, and outdoor workers are especially vulnerable to heat stress (World Health Organization, 2009). Individuals with mental health issues are also vulnerable to extreme heat (CDC, 2016b). In addition, increasing temperatures will increase energy demand and the use of air conditioning, affecting energy costs, with an expected 10% increase to electricity bills by the end of the century (Mansur, Mendelsohn, & Morrison, 2008). Increasing energy costs would disproportionately affect low-income individuals (see Household Expenses Pathway) (USGCRP, 2014).

Changes in temperature and precipitation will affect the distribution and incidence of vector-borne diseases (CDC, 2016b). Mosquitos, ticks, and flies may have increased numbers over longer periods each year and they have already started to expand to new locations (National Institutes of Health [NIH], 2013). Temperature increases have been linked with earlier seasonal activity of ticks carrying Lyme disease as well as an increased territory of ticks (USGCRP, 2016). Floods increase exposure to other vectors like mosquitos and rodents (McMichael, 2003; NIH, 2013).

Increases in extreme weather events can cause substantial property and infrastructure damage. Extreme weather causes geographic displacement, as some households evacuate their homes temporarily, while others are forced to leave permanently (USGCRP, 2014). Low-income populations are more likely to be affected, as almost 100% of the Gulf Coast's "most socially vulnerable people live in areas unlikely to be protected from inundation" (USGCRP, 2014). Low-income populations might also be forced to move because of increasing insurance costs in high risk areas, thereby increasing the overall impact of climate change on low-income populations (USGCRP, 2014).

Many studies have suggested that mental health impacts from climate change will be "widespread, profound, and cumulative" (Bourque & Willox, 2014, p. 416). The following outcomes have all been tied to short and long-term climate and environmental changes: "elevated rates of anxiety and mood disorders, acute stress reactions and PTSD, higher frequency of violence and conflicts, increased drug and alcohol abuse, [and] strong emotional reactions such as despair, fear, helplessness, and suicidal ideation" (Bourque & Willox, 2014, p. 416).

A large body of research has found that there is an increase in mental health problems after extreme weather events, both among individuals with existing mental health issues as well as individuals with no previous history. These issues can be short-term or long-lasting (CDC, 2016b). For example, some studies estimate that after Katrina, 49% developed an anxiety or mood disorder and 17% developed PTSD (Clayton, 2016). Adults over 60 years have been found to experience more symptoms of PTSD after natural disasters than younger individuals (O'Donnell & Forbes, 2016). According to research, most individuals suffering from weather-related stress do recover, but a subset will develop chronic psychological dysfunction (USGCRP, 2016.)

Based on other advanced and conventional CT power generation plants, the proposed CT plant's primary emissions will be GHGs (CO_2, methane, and NOx). While the proposed CT plant will undoubtedly contribute to global climate change, the GHG emissions from the facility alone are unlikely to make a demonstrable impact.[8] Therefore, the certainty of climate change related determinants and health effects happening as a result of the proposed CT plant is "possible" (Table 14). However, climate change is already occurring, and New Orleans, like all jurisdictions, will need to adapt to its impacts and find ways to reduce its contributions to global climate change. Because New Orleans East is at particular risk of flooding due to subsidence, escalating sea level-rise, and increasing extreme weather, the proposed CT plant would continue to exacerbate risks of vulnerable populations in New Orleans East. As communities continue to battle the impacts of climate change, it is crucial that utility companies and regulators do their part to reduce the amount of global climate change pollution.

Table 14: Climate change pathway

Potential Determinant	Potential Health Effect	Direction	Certainty	Magnitude	Vulnerable
Geographic displacement	PTSD, depression	↑	Possible	High	Minorities, low-income, existing mental illness, seniors, children, pregnant women, existing conditions, isolated individuals, marginalized populations
Extreme heat	Heat-related illness	↑	Possible	Medium	Infants, children, pregnant women, existing conditions, low-income
	Asthma and other respiratory illness	↑	Possible	Medium	
Water contamination	Food-borne and water-borne disease	↑	Possible	Medium	Infants, young children, seniors, pregnant women, immune-deficient

[8] This effect is known as the "tragedy of the commons," as each power plant and industry is judged in isolation. If judged collectively, the certainty of the effect would be "extremely likely."

Recommendations:

- The City Council could pass a resolution instituting a GHG registry for the city. This would increase transparency and foster dialogue on the impacts of energy production and consumption on climate change and health in New Orleans.

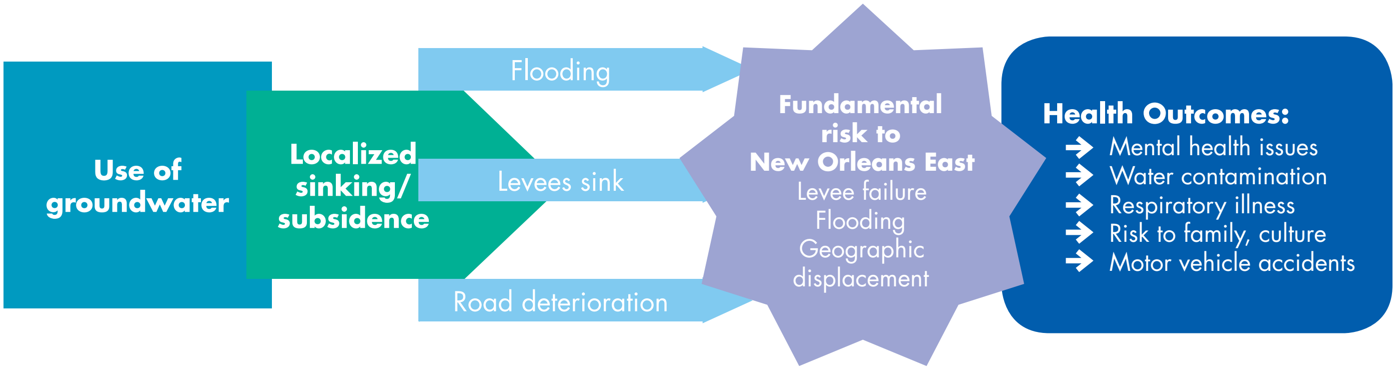
- The City Council could adopt a Carbon Emission Reduction Goal. In partnership with the city's tourism board, the city could offer carbon offsets to travelers. The funding would go to creating community solar projects, prioritizing brownfield sites or other carbon reduction projects.

- If the proposed CT plant is approved, the City Council should ensure the plant has measures in place to reduce methane leaks, a potent source of GHG emissions.

- The State of Louisiana should take steps to consider climate change and GHG emissions when developing and implementing Coastal Master Plans.

- The LDEQ should develop an equitable Clean Power Plan State Implementation Plan that accounts for realities of climate change and its impacts to coastal Louisiana.

6. Subsidence and Health



New Orleans East is distinctly vulnerable to flooding as it is subsiding at a faster rate than the rest of the city (Dixon et al., 2006). According to scientific analysis, past groundwater use at Michoud has likely contributed to substantial subsidence around the power plant (see Groundwater Usage by Michoud Power Plant and Subsidence section above). Subsidence has been shown to lead to degradation of infrastructure, like roads and home foundations, due to surface level fracturing (Yuill, Lavoie, & Reed, 2009). Subsidence that undermines the effectiveness of levees and floodwalls is the most damaging outcome for an already vulnerable population.

Levees protecting New Orleans East were fortified after Katrina, but continued sea level rise, sinking land, and reduced protections from coastal wetlands continue to put homes and infrastructure in this community at risk for extreme flooding (EPA, 2016a). The effects are not limited to New Orleans East, and also include the Lower Ninth Ward and St. Bernard Parish.

If the proposed CT plant continues to use groundwater, it is very likely that subsidence will continue. This would lead to increased vulnerability to flooding in New Orleans East, the Lower Ninth Ward, and St. Bernard Parish, all of which have large percentages of low-income individuals and children. Flooding, as previously described in the climate change pathway, and subsiding roads would lead to a number of serious health effects. Geographic displacement and homelessness from flooding can lead to stress, depression, and PTSD. Mold and humidity exposure can lead to respiratory illness (Rhodes & Chan, 2010).

Table 15: Subsidence pathway

Potential Determinant	Potential Health Effect	Direction	Certainty	Magnitude	Vulnerable
Geographic displacement	PTSD, depression	↑	Likely	Medium	Minorities, low-income, seniors, children existing conditions, isolated individuals, marginalized populations
Homes and businesses exposed to flood water	Respiratory illness, drowning	↑	Likely	Medium	Respiratory, immune deficient, seniors, children, and pregnant women
Decline in road quality	Motor vehicle accidents and injuries	↑	Very likely	Low	

Recommendations:

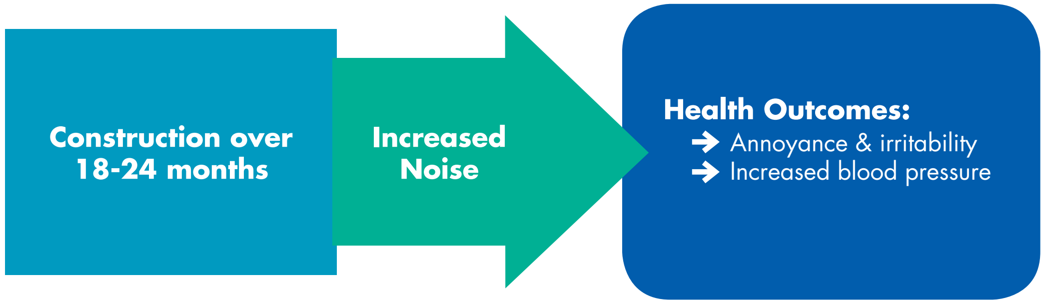
- ENO must immediately cease groundwater withdrawals at Michoud and must use surface water for any future projects until the full scope of the impact on sinking is understood.

- The City of New Orleans, through its Resilient NOLA programming, could conduct an analysis of groundwater removal and its impact on subsidence in New Orleans East.

- The New Orleans City Council and the Mayor's Office should develop equitable and responsible water rights protections for the city. Groundwater use should be reported and regulated, as in the Capital Area Groundwater Conservation Commission in Baton Rouge (see http://www.cagwcc.com/site2015/laws-regs/title56-part_v.pdf).

- ENO should be engaged in all discussions with regards to subsidence, including with city and state agencies, regional levee boards, the Coastal Protection and Restoration Authority, the Army Corps of Engineers, and the Federal Emergency Management Agency (FEMA).

7. Noise and Health



Noise is measured in decibels (dB). A-weighted dB (dBA) are used to approximate human hearing (Washington State DOT, 2015). Every increase in 10 dBA doubles the amount of sound; for example, 50 dBA is twice as loud as 40 dBA. Soft whispering at 15 feet is about 30 dBA, or very quiet; light traffic at 100 feet is 50 dBA, or quiet; a heavy truck at 50 feet is 90 dBA, or very annoying; and a pile driver is 110 dBA, or extremely loud (Noise Pollution Clearinghouse). Since sound can vary over time, it is often reported as equivalent sound pressure level, otherwise known as Leq, which provides an average over a period of time (Noise Pollution Clearinghouse).

Several variables affect how humans experience noise. As distance from the source of noise increases, the amount of noise and potential health impacts decrease. For example, if the noise levels of the proposed CT plant were 90 dBA at two meters from the plant, at 0.6 miles, or 966 meters, the noise levels would only be 36.32 dBA, slightly louder than a whisper, according to the Inverse Square Law (Nave). Traffic noise is affected by traffic volume, speed, and type of vehicle. For example, 2,000 vehicles per hour sounds twice as loud as 200 vehicles per hour, while vehicles going 65 miles per hour are twice as loud as those going 30 miles per hour, and one truck can be as loud as 28 cars combined (Klein, 2003).

Noise can impact health in three ways: 1. annoyance, nuisance, and dissatisfaction; 2. interference with activities such as speech, sleep, learning; and 3. physiological effects (California Energy Commission, 2009). Research suggests that noise in the range of 40-60 dBA can disturb sleep, noise above 40-55 dBA is likely to cause significant annoyance, and noise between 65-70 dBA may be risk factors for school performance and ischemic heart disease (London Health Commission, 2003).

Annoyance is the most common health impact of noise, and it can affect an individual's quality of life. Annoyance can cause tension, irritability, and trouble concentrating (London Health Commission, 2003). Annoyance increases with volume, pitch, duration, and intermittence (London Health Commission, 2003). Insomnia and broken sleep can lead to drowsiness and poor mood and performance over the short-term, but long-term effects have been difficult to identify. Some evidence has found an association between noise during sleep and increased blood pressure and heart rate, along with coronary heart disease (London Health Commission, 2003). Road traffic noise has been associated with a slightly increased risk of coronary problems (London Health Commission, 2003).

Individuals with physical or mental health issues and children are the most vulnerable to health impacts of noise. Individuals with existing physical health issues who are exposed to high noise levels, for example, might encounter lengthier recovery times than individuals who are not exposed (London Health Commission, 2003). Children can be affected by chronic noise, as sustained exposure can cause poor cognitive and learning performance, problems with sound discrimination and speech perception, difficulty remembering, and trouble paying attention (London Health Commission, 2003).

While detailed information on estimated noise levels of the proposed CT plant are currently unknown, the major sources of noise will likely be construction of the plant and traffic during plant construction and operations. Construction to build a simple cycle natural gas plant is typically 18-24 months, and is described along this timeline in ENO's application to construct (ENO, 2016). An environmental impact study (EIS) for a similar natural gas power plant listed sources of construction noise including: "bulldozers, trucks, backhoes, graders, scrapers, compactors, cranes, pile drivers, pumps, pneumatic tools, air compressors, and front-end loaders" (U.S. Department of Energy, & U.S. Army Corps of Engineers, 2010, p. 542). The EIS' calculations estimated that construction noise levels at the nearest residence, about 900 feet away, would be between 53-64 dBA for most construction activities, except pile driving, which would be about 68 dBA (U.S. Department of Energy, & U.S. Army Corps of Engineers, 2010). They also estimated that the highest construction noise levels would be no higher than noise from passing traffic (U.S. Department of Energy, & U.S, Army Corps of Engineers, 2010).

Although it is difficult to estimate the noise levels of the proposed CT plant, health impacts from exposure to plant construction noise on the surrounding community are unlikely given the distance from residences, schools, and businesses. If there were any impacts from this exposure, they would probably be very low. On the other hand, exposure to traffic noise is possible, depending on whether the traffic routes chosen by ENO pass through residential or commercial areas. The severity of the traffic noise impacts depends on the amount of noise, which again would depend on the chosen traffic routes and the amount of traffic. More information on traffic is available in the traffic pathway.

Table 16: Noise pathway

Potential Determinant	Potential Effect	Direction	Certainty	Magnitude	Vulnerable
Exposure to plant construction noise	Annoyance, irritability, insomnia, increased blood pressure, poor learning performance	↑	Unlikely	Low	Children, seniors, existing conditions, hospital patients
Exposure to traffic noise from construction		↑	Possible	Medium	Children, seniors, existing conditions, hospital patients, low-income

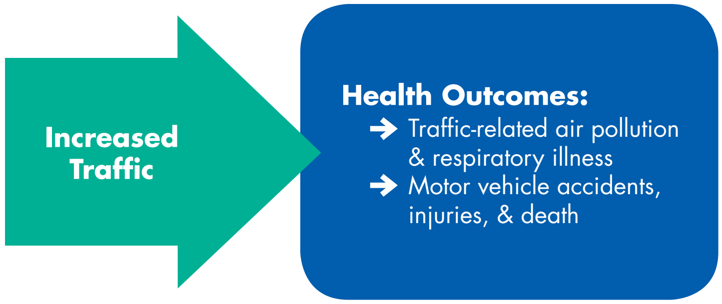
Recommendations:

- ENO should consider noise abatement measures for the proposed CT plant, as necessary, to minimize community health impacts from construction and operations. Noise abatement techniques could include: sound barriers, silencers, engine mufflers, and special landscaping. These noise abatement technologies should be considered during the planning stages of the proposed CT plant, as retrofitting noise abatement after the plant is already built can be very difficult and expensive (Saussus, 2012).

- Once the construction traffic routes are selected, ENO should develop noise models associated with the expected traffic, and use these models to analyze the magnitude of impacts on annoyance and sleep disturbance.

- Operating permits should limit the hours of construction and route construction vehicles away from homes, schools, and other community facilities.

8. Traffic and Health



Increased traffic causes vehicle emissions and greater likelihood of motor vehicle accidents, both of which affect health. Motor vehicles release pollution including CO, CO_2, PM, NOx, hydrocarbons, and other air toxics- through tailpipe exhaust and fuel evaporation; ozone and aerosol are additional by-products (Health Effects Institute [HEI] Panel on the Health Effects of Traffic-Related Air Pollution, 2010). Road dust and tire and brake wear also lead to PM emissions (HEI, 2010).

Exposure to traffic-related air pollution can range up to 1,500m from highways and major roads, depending on the pollutant and meteorological conditions (HEI, 2010, p. viii). The exposure zone most affected is typically within a range of up to 300 to 500m from a major road. It is estimated that 30% to 45% of people in large North American cities live in this range (HEI, 2010). Low-income populations and minorities are disproportionately exposed to traffic-related air pollution, as they often live closer to major roads (Pratt, Vadali, Kvale, & Ellickson, 2015).

Increased emissions and poor air quality can lead to increased morbidity and mortality for residents, especially those living near major roadways (Zhang & Batterman, 2013). Traffic-related air pollution can cause exacerbation of asthma, "non-asthma respiratory symptoms, impaired lung function, total and cardiovascular mortality, and cardiovascular morbidity" (HEI, 2010, p. xv).

Children and pregnant women are especially vulnerable to the impacts of traffic-related air pollution. There is now evidence that in addition to exasperating existing asthma symptoms, there is actually a causal relationship between traffic-related air pollution and the onset of childhood asthma (HEI, 2010). Children living near high traffic density, especially truck traffic, have increased respiratory tract complications including "wheezing, chronic productive cough, and asthma hospitalizations," (American Academy of Pediatrics, 2004, p. 1702) and proximity to traffic has been linked to several childhood cancers (American Academy of Pediatrics, 2004). Long-term exposure to traffic-related air pollution has also been associated with change in lung function among children and young adults (HEI, 2010). Exposure to traffic-related air pollution during early stages of pregnancy may lead to lung defects in children (Marino et al., 2015).

Diesel exhaust has been associated with an increased likelihood of lung cancer. Fine particles in diesel exhaust might worsen symptoms in individuals with allergic rhinitis and asthma, and might lead to the development of new allergies (American Academy of Pediatrics, 2004).

Increased traffic, especially trucks and heavy vehicles, also leads to street deterioration. During the community stakeholder meetings, New Orleans East residents expressed concerns regarding already deteriorating streets in their neighborhoods. In 2014 Louisiana ranked 48th in the country for condition of pavement on urban interstates (Samuels, 2014), and in 2015, New Orleans ranked 25th among cities of at least 500,000 for percentage of roads in disrepair (Shaw, 2015). During the last city survey of streets in 2004, "32% of the streets needed major rehabilitation or total reconstruction and another 34% were in need of immediate maintenance" (Bureau of Governmental Research, 2008, p. 3). Deteriorating roads compromise vehicle safety, cause motor vehicle accidents, and put pedestrians at risk as drivers attempt to swerve over potholes and craters (LaScala, Gerber, & Gruenewald, 1999). The average cost of deteriorated roads to drivers in New Orleans is $713 per-capita annually (Shaw, 2015).

The estimated traffic routes, traffic type, and amount of workers and vehicles of the proposed CT plant are currently unknown, but EIS of other plants suggest that there will be increased traffic during both plant construction (likely 24 months) and operations (ongoing). Larger equipment for construction will need to be delivered, which could cause delays and re-routing of traffic, and there will likely be a large volume of trucks (Public Service Commission of Wisconsin, 2015). Workers and trains or trucks making deliveries or hauling waste off-site are possible sources of traffic during plant operations (Public Service Commission of Wisconsin, 2015).

While the exact amount of increased traffic is unknown, the breadth of literature on the effects of traffic suggests that traffic-related air pollution and motor vehicle accidents are possible. The magnitude of traffic-related air pollution would likely be low or medium, depending on the amount of traffic and the traffic routes chosen by ENO. It could be assumed that in order to take the most direct route, trucks would likely take I-10 to Almonaster Avenue or I-510. I-10 and I-510 are both interstates, while Almonaster Avenue is largely industrial. It is also possible that trucks could take I-10 to Chef Mentour Highway, which is adjacent to many neighborhoods, businesses, and schools. If the trucks were to take I-10 to Almonaster Ave or I-510, there would likely be less exposure and therefore lower magnitude than if the trucks took Chef Mentour Highway or another residential road.

The magnitude of motor vehicle accidents is more difficult to forecast because it is dependent on the amount of traffic and the preferred routes. There would likely be more pedestrian injuries and deaths if trucks took a residential route like Chef Mentour Highway than Almonaster Avenue or I-510.

Table 17: Traffic pathway

Potential Determinant	Potential Health Effect	Direction	Certainty	Magnitude	Vulnerable
Traffic-related air pollution	Asthma, chronic cough, lung defects in infants, lung cancer	↑	Possible	Low/ medium; dependent on traffic volume and routes chosen by ENO	Children, pregnant women, respiratory, individuals that live by and/or use the affected roadways
Motor vehicle accidents	Injury, death, stress	↑	Possible	Difficult to forecast; dependent on traffic volume and routes chosen by ENO	Individuals that live by and/or use the affected roadways

Recommendations:

- ENO should specifically designate construction and truck routes for the proposed CT plant that will be limited to major roadways and do not pass through residential neighborhoods. Designated routes should also minimize the distance from schools, parks, and pedestrian crossings.

- ENO should consider using more energy efficient trucks and vehicles to reduce emissions.

- ENO should mostly limit construction and truck traffic to low traffic periods of the day in order to reduce risks of motor vehicle accidents and to minimize truck idling.

Other Recommendations

As discussed earlier in the report, there is a great need for increased community participation and transparency in the decision-making process, as the majority of the community members at the HIA stakeholder meetings were not aware of the CT plant proposal. The community emphasized the need for more knowledge and education about energy decisions. The HIA therefore makes the following recommendations:

- ENO should increase transparency, education, and engagement with New Orleans East community members, so that they may be included in decisions that will directly affect them.
- The City Council could hold public hearings where community members may speak directly to the City Council members.
- The City Council should direct the Council Utility Regulatory Office (CURO) to be forthcoming with public documents and to post public documents to the City Council website.
- The City Council should require ENO to host a series of listening sessions with New Orleans East communities. Community engagement regarding the proposed CT plant should happen early in the process before the decisions are made in order to keep community members informed.
- The City Council Utility Committee public hearings should be added to the City Council website calendar and filmed.
- The City Council members could include updates on utility matters in the City Council email communications, if not already doing so.
- The City Council could commission an environmental justice study to look at the placement of industrial facilities within vulnerable and minority communities in New Orleans.

Conclusion

LPHI and AAE analyzed the potential health effects of ENO's proposed CT plant, in New Orleans East, a predominantly African American, Asian, and Latino community that already faces a number of socioeconomic, physical health, mental health, and environmental exposure disparities. In response to community stakeholders' greatest areas of concern, LPHI and AAE focused on health impacts associated with household expenses, energy resilience, energy reliability, air quality, climate change, subsidence, noise, and traffic.

One of ENO's stated reasons for building the proposed CT plant is to improve energy reliability and resilience. The proposed CT plant is one potential solution to increasing energy reliability, but it is not the only resource that can address the peak capacity deficit resulting from the decommissioning of Michoud. A new natural gas plant located in New Orleans may not increase energy resilience, as a natural disaster is unlikely to simultaneously affect all of the outside power sources and transmission lines without impacting a generating unit located in New Orleans East. In the extremely unlikely event that this were to occur, the proposed CT plant still may not improve resilience as the facility would most likely be taken offline prior to the disaster and, once back online, would be an inefficient way to supply 226MW of the energy supply needed for emergency baseload electricity for the city. Peaking power plants are not designed to run continuously, and are inefficient users of fuel, compared to a baseload plant.

This HIA is intended to be a tool for the City Council to make a more informed decision regarding the proposed CT plant. This HIA provides a synthesis of data on potential health impacts, as well as a number of recommendations, in order to reduce potential negative health impacts and maximize benefits. It is LPHI and AAE's hope that HIAs become a regular part of the New Orleans IRP process in the future.

Bibliography

Adams, V., Kaufman, S. R., Van Hattum, T., & Moody, S. (2011). Aging disaster: mortality, vulnerability, and long-term recovery Among Katrina survivors. *Medical Anthropology*, *30*(3), 247-270.doi:10.1080/01459740.2011.56 0777

American Academy of Pediatrics. (2004). Ambient air pollution: Health hazards to children. *Pediatrics*, *114*(6).

Becker, J. A. & Stewart, L. K. (2011). Heat-related illness. *American Family Physician*, *83*(11), 1325-1330. Retrieved from http://www.aafp.org/afp/2011/0601/p1325.html

Bourque, F. & Willox A. C. (2014). Climate change, the next challenge for public mental health?. *International Review of Psychiatry*, *26*(4), 415-22. doi:10.3109/09540261.2014.925851

Brook, R. D., Franklin, B., Cascio, W., Hong, Y., Howard, G., Lipsett, M. . .Tager, I. (2004). AHA Scientific Statement: Air pollution and cardiovascular disease; A statement for healthcare professionals from the Expert Panel on Population and Prevention Science of the American Heart Association. *Circulation*. doi:10.1161./01. CIR.0000128587.30041

Brown, D. R., Lewis, C. & Weinberger, B. I. (2015). Human exposure to unconventional natural gas development: A public health demonstration of periodic high exposure to chemical mixtures in ambient air. *Journal of Environmental Science and Health*, Part A, *50*(5). 460-72. doi:10.1080/10934529.2015.992663

Bureau of Governmental Research. (2008). *Street smarts: maintaining and managing New Orleans' road network*. Retrieved from http://www.bgr.org/files/reports/Street-Smarts.pdf

California Energy Commission. (2009). Mojave Solar Project HIA. Retrieved from http://www.energy.ca.gov/sitingcases/abengoa/documents/applicant/afc/volume_01/5.8_Noise/5.8_ Noise_final.pdf

Centers for Disease Control and Prevention. (2011). *Asthma in the U.S.* Retrieved from http://www.cdc.gov/vitalsigns/asthma/

Centers for Disease Control and Prevention. (2013a). CDC health disparities and inequalities report- United States, 2013. *Morbidity and Mortality Weekly Report*, *62*(3).Centers for Disease Control and Prevention. (2013b). Outdoor air. Retrieved from http://ephtracking.cdc.gov/showAirContaminants.action

Centers for Disease Control and Prevention. (2015). *Childhood obesity causes and consequences.* Retrieved from http://www.cdc.gov/obesity/childhood/causes.html

Centers for Disease Control and Prevention. *Air quality*. (2016a). Retrieved from http://www.cdc.gov/air/default.htm

Centers for Disease Control and Prevention. *Climate and health.* (2016b). Retrieved from http://www.cdc.gov/climateandhealth/default.htm

Centers for Disease Control and Prevention. *Water, sanitation, and hygiene (WASH)-related emergencies & outbreaks.* (2016c). Retrieved from http://www.cdc.gov/healthywater/emergency/index.html

City of New Orleans. (2013). A plan for the 21st century: New Orleans 2030, adopted August 2010 [as amended through 2012] executive summary. (2012). Retrieved from http://www.nola.gov/city-planning/master-plan/

City of New Orleans. *City of New Orleans Open Data*. Retrieved from https://data.nola.gov/

Clayton, S. (2016). *Climate change and mental health: psychosocial impacts* [PowerPoint slides]. Retrieved from https://www.apha.org/~/media/files/pdf/webinars/2016/climate_changes_mental_health_clayton.ashx

Coastal Protection and Restoration Authority. (2012). *Louisiana's comprehensive master plan for a sustainable coast.* Baton Rouge, LA: State of Louisiana.

Cohen, A. J., Anderson, H., Ostro, B., Pandey, K. D., Krzyzanowski, M., Kunzli, N., . . . Smith, K. (2005). The global burden of disease due to outdoor air pollution. *Journal of Toxicology and Environmental Health*, *Part A, 68*(13-14), 1301-1307.

Cook, J. T., Frank, D. A., Casey, P. H., Rose-Jacobs, R., Black, M. M., Childron, M. . . Cutts, D. B. (2008). A brief indicator of household energy security: Associations with food security, child health, and child development in U.S. infants and toddlers. *Pediatrics*, *122*(4). doi:10.1542/peds.2008-0286

Cowen, T. (2002). Public goods and externalities. *Library of Economics and Liberty*. Retrieved from http://www.econlib.org/library/Enc1/PublicGoodsandExternalities.html

Dales, R. E., Cakmak. S., Jude,. S., Dann, T., Coates, F., Brook, J.R., & Burnett, R. T. (2004). Influence of outdoor aeroallergens on hospitalization for asthma in Canada. *Journal of Allergy and Clinical Immunology*, *113*(2):303-306. doi:10.1016/j.jaci.2003.11.016

The Data Center. (2015). *Facts for features: Katrina impact*. Retrieved from http://www.datacenterresearch.org/data-resources/katrina/facts-for-impact/

The Data Center. (2016). *Neighborhood statistical area data profiles*. Retrieved from http://www.datacenterresearch.org/data-resources/neighborhood-data/

The Data Center. (2004). *Reference maps*. Retrieved from http://www.datacenterresearch.org/maps/reference-maps/

Dixon, T. H., Amelung, F., Ferretti, A., Novali, F., Rocca, F., Dokka. . . Whitman, D. (2006). Space geodesy: Subsidence and flooding in New Orleans. *Nature, 441*, 587-588. doi:10.1038/441587a

Dokka, R. K. (2011). The role of deep processes in late 20th century subsidence of New Orleans and coastal areas of southern Louisiana and Mississippi. *Journal of Geophysical Research*, *116*. doi:10.1029/2010JB008008.

Drehobl, A., & Ross, L. (2016). *Lifting the high energy burden in America's largest cities: How energy efficiency can improve low income and underserved communities*. American Council for an Energy-Efficient Economy.

Entergy Corporation. (2015). *Billing and payment research project results* [presentation].

Entergy New Orleans. (2006). *Entergy New Orleans' Michoud Power Plant Returns to Service* [Press release]. Retrieved from http://www.temp.entergy.com/News_Room/newsrelease.aspx?NR_ID=824

Entergy New Orleans. (2008). *Entergy Provides Hurricane Update* [Press release]. Retrieved from http://www.entergy.com/news_room/newsrelease.aspx?NR_ID=1310

Entergy New Orleans. (2016a). Application to construct New Orleans Power Station submitted June 20th 2016.

Entergy New Orleans. (2016b). Entergy New Orleans integrated resource plan draft, February 1, 2016

Eto, J. H. & LaCommare, K. H. (2008) *Tracking the reliability of the U.S. electric power system: An assessment of publicly available information reported to state public utility commissions*. Berkeley, CA: Ernest Orlando Lawrence Berkeley National Laboratory. Retrieved from https://www.smartgrid.gov/files/eto_oct_2008.pdf

European Centre for Health Policy. (1999). *Gothenburg consensus paper: Health impact assessment: main concepts and suggested approach*. Brussels: European Centre for Health Policy, World Health Organization Regional Office for Europe.

Fisher, P., Sheehan, M., & Colton, R. (2015). *The home energy-affordability gap*. Retrieved from http://www.homeenergyaffordabilitygap.com/03a_priorYearAffordability/03a_affordabilityData14.html

Fitzgerald, G., Mandel, J., Morris, J., & Tounati, H. (2015). *The economics of battery energy storage: How multi-use, customer-sited batteries deliver the most services and value to customers and the grid*. Boulder, CO: Rocky Mountain Institute. Retrieved from http://www.rmi.org/electricity_battery_value

Frank, D. A., Neault, N. B., Skalicky, A., Cook, J. T., Wilson, J. D., Levenson, S. . . Berkowitz, C. (2006). Heat or eat: The Low Income Home Energy Assistance Program and nutritional and health Risks among children less than 3 years of age. *Pediatrics*, *118*(5). doi:10.1542/peds.2005-2943

Freudenberg, Pastor, & Israel. (2011). Strengthening community capacity to participate in making decisions to reduce disproportionate environmental exposures. *American Journal of Public Health*, *101*(S1), S123-S130.

Gabe, T., Falk, G., McCarty, M., & Mason, V. W. (2005). *Hurricane Katrina: Socio-demographic characteristics of impacted areas*. CRS Report for Congress. Washington, D.C.: Congressional Research Service, the Library of Congress.

Google Maps. (2016). New Orleans. Retrieved from https://www.google.com/maps/place/New+Orleans,+LA/@30.0091683,-90.0363197,12z/data=!4m5!3m4!1s0x8620a454b2118265:0xdb065be85e22d3b4!8m2!3d29.9510658!4d-90.0715323

Gros, D. F., Price, M., Stauffacher Gros, K., Paul, L. A., McCauley, J. L. & Ruggiero, K. J (2012). Relations between loss of services and psychiatric symptoms in urban and non-urban settings following a natural disaster. *Journal of Psychopathology and Behavioral Assessment, 34*(3), 343-350. doi:10.1007/s10862-012-9290-9

Health Effects Institute Panel on the Health Effects of Traffic-Related Air Pollution. (2010). *Traffic-related air pollution: A critical review of the literature on emissions, exposure, and health effects*. HEI special report 17. Boston, MA: Health Effects Institute. Retrieved from http://pubs.healtheffects.org/view.php?id=334

Hernandez, D., & Bird, S. (2010). Energy burden and the need for integrated low-income housing and energy policy. *Poverty & Public Policy*, *2*(4), 5-25.

Hernandez, D. (2013). Energy insecurity: A framework for understanding energy, the built environment, and health among vulnerable populations in the context of climate change. *Am Journal of Public Health*, *103*(4), e32-e34. doi:10.2105/AJPH.2012.301179

International Agency for Research on Cancer. (2013). *IARC: Outdoor air pollution a leading environmental cause of cancer deaths* [Press release]. Retrieved from http://www.iarc.fr/en/media-centre/iarcnews/pdf/pr221_E.pdf

International Association for Impact Assessment. (2016). *Health impact assessment*. Retrieved from http://www.iaia.org/wiki-details.php?ID=14

Javetski, J. (2006). Preparation keyed Entergy's responses to Katrina, Rita. *POWER*. Retrieved from http://www.powermag.com/preparation-keyed-entergys-responses-to-katrina-rita/?pagenum=1

Jerrett, M., Burnett, R. T., Pope III, C. A., Ito, K., Thurston, G., Krewski, D., . . . Thun, M. (2004). Long-term ozone exposure and mortality. *The New England Journal of Medicine*, *360*:1085-1095. doi:10.1056 NEJMoa0803894

Jones, C. E., An, K., Blom, R. G., Kent, J. D., Ivins, E. R., & Bekaert, D. (2016). Anthropogenic and geologic influences on subsidence in the vicinity of New Orleans, Louisiana. *Journal of Geophysical Research: Solid Earth*. doi:10.1002/2015JB012636.

Kenny, J. F., Barber, N. L., Hutson, S. S., Linsey, K. S., Lovelace, J. K., & Maupin, M. A. (2009). Estimated use of water in the United States in 2005. *U.S. Geological Survey Circular 1344*, 52 p.

Klein, R. D. (2003). How to win land development issues: A citizens guide to preserving & enhancing quality of life in developing areas through responsible growth management. Retrieved from http://ceds.org/pdfdocs/HTW.pdf

Klinger, C., Landeg, O. & Murray, V. (2014) Power outages, extreme events and health: A systematic review of the literature from 2011-2012. *PLoS Currents*. doi:http://dx.doi.org/10.1371%2Fcurrentsdis.04eb1dc5e73dd1377e05a10e9edde673

Knowles, M., Rabinowich, J., Ettinger de Cuba, S., Cutts, D. B. & Chilton, M. (2015). "Do you wanna breathe or eat?": Parent perspectives on child health consequences of food insecurity, trade-offs , and toxic stress. *Maternal and Child Health Journal*, *20*, 25-32. doi:10.1007/s10995-015-1797-8

LaScala, E. A., Gerber, D., & Gruenewald, P. J. (1999). Demographic and environmental correlates of pedestrian injury collisions: A spatial analysis. *Accident Analysis and Prevention*, *32*(5), 651-8.

Liddell, C., & Morris, C. (2010). Fuel poverty and human health: A review of recent evidence. *Energy Policy*, *38*(6), 2987-2997.

London Health Commission. (2003). *Noise and health: Making the link*. Retrieved from http://hiaconnect.edu.au/old/files/Noise_and_Health.pdf

Louisiana Department of Environmental Quality. (2016a). *Application for modification of part 70 operating permit, acid rain permit, Michoud Electric Generating Plant*. Update packet # 3, July, 2016.

Louisiana Department of Environmental Quality. (2016b). Data collection and evaluation, criteria and air pollutant emissions certification statement 2007-2014 [data file]. Retrieved from http://www.deq.louisiana.gov

Louisiana Department of Environmental Quality. (2016c). Entergy New Orleans criteria & toxic air pollutants emissions certification statement, 2007-2014 [data file]. Emissions inventory reports. Retrieved from http://business.deq.louisiana.gov/Eric/EricReports

Louisiana Department of Health. (2008-2009). Louisiana Hospital Inpatient Discharge Database [data file]. Retrieved from http://dhh.louisiana.gov/index.cfm/page/2192

Louisiana Department of Transportation and Development. (2012). *Water use in Louisiana, 2010*. Water resources special report no. 17 (revised). By Sargent, B. P. Baton Rouge, LA: Louisiana Department of Transportation and Development.

Macak III, J. J. (2002). Evaluation of gas turbine startup and shutdown emissions for new source permitting. *Mostardi Platt Environmental*, Paper #546, session no. EI-2a. Retrieved from https://www.environmental-expert.com/Files/6709/articles/5647/evaluationofpermitting.pdf

Mansur, E., T., Mendelsohn, R., &Morrison, W. (2008). Climate change adaptation: A study of fuel choice and consumption in the U.S. energy sector. *Journal of Environmental Economics and Management*, *55*, 175-93. doi:10.1016/j.jeem.2007.10.001.

Marino, E., Massimo, C., Campagna, D., & Ricardo, P. (2015). Impact of air quality on lung health: myth or reality?. *Therapeutic Advances in Chronic Disease*, *6*(5), 286-298. doi:10.1177/2040622315587256

McMichael, A. J., Campbell-Lendrum, D. H., Corvalan, C. F., Ebi, K. L., Githeko, A., Scheraga, J. D., & Woodward, A. (2003). *Climate change and human health*. World Health Organization.

MISO. (2016). 2016/2017 *Planning Resource Auction Results*. Retrieved from https://www.misoenergy.org/Library/Repository/Report/Resource%2AdequacyAuctionResults/2016-2017%20PRA%20Summary.pdf

Morello-Frosch, R., Zuk, M., Jerrett, M., Shamasunder, B. & Kyle, A. D. (2011). Understanding the cumulative impacts of inequalities in environmental health: implications for policy. *Health Affairs*, *30*(5), 879-887. doi:10.1277/hlthaff.2011.0153

Murakami, N., Siktel, H. B., Licido, D., Winchester, J. F. & Harbord, N.B. (2015). Disaster preparedness and awareness of patients on hemodialysis after Hurricane Sandy. *Clinical Journal of the American Society of Nephrology*, *10*(8), 1389-96. doi:10.2215/CJN.10181014

NASA. (2016). *New study maps rate of New Orleans sinking*. Retrieved from http://www.nasa.gov/feature/jpl/new-study-maps-rate-of-new-orleans-sinking

National Institutes of Health. (2013). *Health effects of climate change*. Retrieved from https://report.nih.gov/nihfactsheets/ViewFactSheet.aspx?csid=44

Nave, R. Estimating sound levels with the Inverse Square Law Inverse. Retrieved from http://hyperphysics.phy-astr.gsu.edu/hbase/acoustic/isprob2.html

Nelson, S. (2012). Why is New Orleans vulnerable to hurricanes: Geologic and historical factors. Retrieved from http://www.tulane.edu/~sanelson/New_Orleans_and_Hurricanes/New_Orleans_Vulnerability.htm

Noise Pollution Clearing House. *Sound Levels chart*. Retrieved from http://www.nonoise.org/resource/educat/ownpage/soundlev.htm

Nord, M. & Kantor, L. S. (2006). Seasonal variation in food insecurity Is associated with heating and cooling costs among low-Income elderly Americans. *The Journal of Nutrition*, *136*, 2939-2944.

Office of Community Services. (2016) *About LIHEAP*. Retrieved from http://www.acf.hhs.gov/programs/ocs/programs/liheap/about

O'Donnell, M. L. & Forbes, D. (2016). Natural disaster, older adults, and mental health- a dangerous combination. *International Psychogeriatrics*, *28*(1). 9-10, doi:10.1017/S1041610215001891

Pais, J., Crowder, K. & Downey, L. (2014). Unequal trajectories: Racial and class differences in residential exposure to industrial hazard. *Social Forces*, *90*(3), 1189-1215. doi:10/1093/sf/sot099

Pratt, G. C., Vadali, M. l., Kvale, D. L., Ellickson, K. M., (2015). Traffic, air pollution, minority and socio-economic Status: Addressing inequities in exposure and risk. *International Journal of Environmental Research and Public Health*, *12*(5). 5255-72. doi:10.3390/ijerph120505355

Public Service Commission of Wisconsin. (2015). *Environmental impacts of power plants*. Retrieved from http://psc.wi.gov/thelibrary/publications/electric/electric15.pdf

Rhodes, J., & Chan, C. (2010). The impact of Hurricane Katrina on the mental and physical health of low-Income parents in New Orleans. *American Journal of Orthopsychiatry, 80*(2), p. 237-247.

Rousseau, R. (2014 May 8). Pothole peril: The cost of commuting in New Orleans. *WDSU*. Retrieved from http://www.wdsu.com/news/local-news/new-orleans/pothole-peril-the-cost-of-commuting-in-new-orleans/25883300

Samoli, E., Aga, E., Touloumi, G., Nisiotis, K., Forsberg, B., Lefranc, A., . . . Katsouyanni, K. (2006). Short- term effects of nitrogen dioxide on mortality: An analysis within the APHEA project. *European Respiratory Journal*, *27*:1129-1138. doi:10.1183/09031936.06.00143905

Samuels, D. (2014). Louisiana's highways rank 40th in nation, get bad marks for pavement condition. *The Times-Picayune*. Retrieved from http://www.nola.com/traffic/baton-rouge/index.ssf/2014/09/louisianas_highways_rnk_40th.html

Saussus, P. (2012). Major noise sources and mitigation cost estimates for gas-fired power facilities. Retrieved from http://www.powermag.com/major-noise-sources-and-mitigation-cost-estimates-for-gas-fired-power-facilities/?pagenum=1

Save the Children. (2011). *Rising energy costs: The impact on low-income families*. Retrieved from http://www.savethechildren.org.uk/sites/default/files/docs/Rising-energy-costs-briefing.pdf

Schleifstein, M. (2012). Hurricanes: The Times-Picayune covers 175 years of New Orleans history. *The Times-Picayune*. Retrieved from http://www.nola.com/175years/index.ssf/2012/02/hurricanes_the_times-picayune.html

Schwartz, M. S., & Wilson, E. (2007). *Who can afford to live in a home?: A look at data from the 2006 American Community Survey*. Washington, DC: U.S. Census Bureau. Retrieved from https://www.census.gov/housing/census/publications/who-can-afford.pdf

Sequoia Foundation. (2012). A health impact assessment of the proposed Cabin Creek Biomass Energy Facility in Placer County, California. Retrieved from http://www.placer.ca.gov

Shaw, A. (2015). Bad roads cost New Orleans drivers $713 yearly, study says. *The Times-Picayune*. Retrieved from http://www.nola.com/traffic/index.ssf/2015/07/bumpy_roads_cost_new_orleans_d.html

South, E. C., Kondo, M. C., Cheney, R. A., & Branas, C. C. (2015). Neighborhood blight, stress, and health: A walking trial of urban greening and ambulatory heart rate. *American Journal of Public Health*, *105*(5), 909-913.

Staudt, A. & Curry, R. (2011). *More extreme weather and the U.S. Energy Infrastructure*. Retrieved from https://www.nwf.org/pdf/Extreme-Weather/Final_NWF_EnergyInfrastructureReport_4-8-11.pdf

Turner, R. (2016). Southeast Louisiana Flood Protection Authority, East Regional update [presentation notes]. Coastal Protection and Restoration Authority Board Meeting, March 16, 2016. Retrieved from http://cims.coastal.louisiana.gov/RecordDetail.aspx?Root=0&sid=14979

Union of Concerned Scientists. (2011). *Freshwater use by U.S. power plants- electricity's thirst for a precious resource: A report of the Energy and Water in a Warming World Initiative*. Retrieved from www.ucsusa.org/electricity-water-use

Union of Concerned Scientists. (2014). *The climate risks of natural gas*. Retrieved from http://www.ucsusa.org/sites/default/files/legacy/assets/documents/clean_energy/Climate-Risks-of-Natural-Gas-Full-Infographic.pdf

United Nations Intergovernmental Panel on Climate Change. (2013). Fifth Assessment Report Climate Change 2013 The Physical Science Basis. Retrieved from https://www.ipcc.ch/report/ar5/wg1/

United States Census Bureau. (2010-2014). *American Community Survey* [data file]. Retrieved from https://www.census.gov/programs-surveys/acs/

United States Department of Energy Office of Electricity Delivery and Energy Reliability. (2009). *Comparing the impacts of the 2005 and 2008 hurricanes on U.S. energy infrastructure*. Retrieved from https://www.oe.netl.doe.gov/docs/HurricaneComp0508r2.pdf

United States Department of Energy & United States Army Corps of Engineers. (2010). *Kemper County IGCC Project final environmental impact statement*. Retrieved from http://energy.gov/sites/prod/files/nepapub/nepa_documents/RedDont/EIS-0409-FEIS-01-2010.pdf

United States Department of Energy. (2015). *Quadrennial energy review report: Energy transmission, storage, and distribution infrastructure.* Retrieved from http://energy.gov/sites/prod/files/2015/04/f22/QER-ALL%20FINAL_0.pdf

United States Energy Information Administration. (2016). *Energy explained.* Retrieved from http://www.eia.gov/Energyexplained/index.cfm

United States Environmental Protection Agency. (2015). MyEnvironment. Retrieved from https://www3.epa.gov/myenv/MyMap.html?minx=-97.96&miny=26.4&maxx=-98&maxy=26.43&ve=14,,&cLat=&cLon=&pSearch=&players

United States Environmental Protection Agency. (2016a). *Climate change.* Retrieved from http://www3.epa.gov/climatechange/

United States Environmental Protection Agency. (2016b). EPA's environmental justice screening and mapping tool. Retrieved from https://ejscreen.epa.gov/mapper/

United States Geological Survey. (2014). Water resources of Orleans Parish, Louisiana. Fact sheet 2014-2017.

United States Geological Survey Lower Mississippi-Gulf Water Science Center. Water Use Chart Data 1965-2010

United States Global Change Research Program. (2014) *Climate change impacts in the United States: The third national climate assessment.* By Melillo, J. M., Richmond, T. C., & Yohe, G. W. Washington, D.C.: U.S. Government Printing Office. doi:10.7930/J0Z31WJ2

United States Global Change Research Program. (2016). *The impacts of climate change on human health in the United States: A scientific assessment.* By Crimmins, A. J., Balbus, J. L., Gamble, C. B., Beard, J. E., Bell, D., Dodgen, R. J., . . . Ziska, L. Washington D.C.: U.S. Global Change Research Program. Retrieved from http://dx.doi.org/10.7930/J0R49NQX

Washington State DOT. (2015). *Construction noise impact assessment.* Retrieved from http://www.wsdot.wa.gov/NR/rdonlyres/448B609A-A84E-4670-811B-9BC68AAD3000/0/BA_ManualChapter7.pdf

Willis, H. H., & Loa, K. (2015). *Measuring the resilience of energy distribution systems.* Santa Monica, CA: RAND Corporation. Retrieved from http://energy.gov/sites/prod/files/2015/07/f24/QER%20Analysis%20-%20Measuring%20the%20Resilience%20of%20Energy%20Distribution%20Systems.pdf

Willox, A. C., Harper, S. L., Ford, J. D., Edge, V. L., Landman, K., Houle, K. . . Wolfrey, C. (2013). Climate change and mental health: an exploratory case study from Rigolet, Nunatsiavut, Canada. *Climatic Change, 121*, 255-270. doi:10.1007/s10584-013-0875-4

World Health Organization. (2009). *Protecting health from climate change: Connecting science, policy and people.* Retrieved from http://www.who.int/globalchange/publications/reports/9789241598880/en/

Yuill, B., Lavoie, D., & Reed, D. J. (2009). Understanding subsidence processes in Coastal Louisiana. *Journal of Coastal Research*, *54*, p. 23-36. Retrieved from http://www.jcronline.org/doi/pdf/10.2112/SI54-012.1

Zhang, K. & Batterman, S. (2013). Air pollution and health risks due to vehicle traffic. *Science of the Total Environment, 307*(16), 450-451. doi:10.1016/j.sciotenv.2013.01.074

Zou, L., Kent, J., Lam, N. S.-N., Cai, H., Qiang, Y., & Li, K. (2016). Evaluating land subsidence rates and their implications for land loss in the Lower Mississippi River Basin. *Water*, *8*(1). doi:10.3390/w8010010

Appendices

A. Stakeholder Engagement

LPHI and AAE engaged with various stakeholders to determine the possible health impacts related to the construction and operations of the proposed CT plant. Stakeholders included industry, community-based organizations, advocacy organizations, community health centers, neighborhood associations, ENO, and the City Council. The team presented at a total of 13 community stakeholder meetings (listed in Table 18 below). The majority of the meetings were existing gatherings that LPHI and AAE presented at, gaining valuable feedback through the questions and discussions that occurred.

Table 18: HIA stakeholder meetings

Meeting	Meeting focus	Date	Location	Type of attendees
HIA Training	HIA 101	3/20/2015	The Healing Center	Community members, community-based organization representatives, the City Council representatives, ENO
Eastern New Orleans Neighborhood Advisory Commission (ENONAC)	Scoping/ identify pathways/ community's concerns	6/9/2015	St. Mary Goretti Community Center (New Orleans East)	Neighborhood association representatives
Entergy New Orleans (ENO)	Scoping/ identify pathways/ ENO's concerns	7/7/2015	LPHI	ENO staff
Center for Environmental Justice Community Advisory Board Meeting	Scoping/ identify pathways/ community's concerns	7/16/2015	Dillard University	Community members
Fauberg Homeowners Improvement Association	Scoping/ identify pathways/ community's concerns	7/21/2015	7th District Police Station (New Orleans East)	Community members
Village de L'Est Improvement Association	Scoping/ identify pathways/ community's concerns	8/4/2015	Einstein Charter School Extension (New Orleans East)	Community members
Academy Park Association	Scoping/ identify pathways/ community's concerns	8/18/2015	St. Mary's Academy (New Orleans East	Community members
HIA Assessment Community Meeting	Debrief of initial assessment findings	4/6/2016	East New Orleans Regional Library	Community members, neighborhood association representatives, community-based organization representatives
ENONAC	Update on HIA process	4/12/16	St. Mary Goretti Community Center (New Orleans East)	Neighborhood association representatives
Council Utility Regulatory Office (CURO)	Debrief of initial assessment findings	5/3/2016	CURO Office	CURO staff
ENO	Debrief of initial assessment findings	5/5/2016	ENO Office	ENO regulatory/legal staff
ENONAC	Update on HIA process	5/31/2016	St. Mary Goretti Community Center	Neighborhood association representatives
Villages of the East Coalition	Update on HIA process	6/1/2016	VAYLA New Orleans office	Neighborhood leaders

B. Power Resources for ENO

Table 19: Power resources for ENO

Source	Location	Type
Nine Mile Point	Westwego, LA	Natural gas
Waterford	Killona, LA	Nuclear
Riverbend	St. Francisville, LA	Nuclear
Little Gypsy	Montz, LA	Natural gas
Grand Gulf	Port Gibson, MS	Nuclear
Union	El Dorado, AR	Natural gas
Acadia	Eunice, LA	Natural gas
Buras	Buras, LA	Natural gas
Independence	Newark, AR	Coal
White Bluff	Redfiled, AR	Coal
Arkansas Nuclear 1	Russellville, AR	Nuclear
Sterlington	Sterlington, LA	Natural gas
Oxy-Taft	Hahnville, LA	Natural gas
Vidalia	Vidalia, LA	Hydro
Toledo Bend	Toledo Bend, LA	Hydro

C. Glossary of Acronyms

AAE: Alliance for Affordable Energy

CO: carbon monoxide

CO_2: carbon dioxide

CT: combustion turbine

CURO: Council Utility Regulatory Office

dB: decibels

dBA: A-weighted decibels

EIS- environmental impact study

ENO: Entergy New Orleans

ENONAC: Eastern New Orleans Neighborhood Advisory Coalition

EPA: Environmental Protection Agency

GHGs: greenhouse gases

HIA: health impact assessment

IRP: integrated resource planning

kWh: kilowatt-hour

LDEQ: Louisiana Department of Environmental Quality

LIHEAP: Low Income Home Energy Assistance Program

LPHI: Louisiana Public Health Institute

MISO: Midcontinent Independent Service Operator

MW: megawatts

NAAQS: National Ambient Air Quality Standards

NOx: nitrogen oxides

PM: particulate matter

PTSD: post-traumatic stress disorder

SO_2: sulfur dioxide

VOCs: volatile organic compounds