

Climate Strategy Assessments for the U.S. Electric Power Industry: 2019 Update

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CONTENTS

1. INTRODUCTION	2
2. REVIEW OF CLIMATE STRATEGY ASSESSMENT FRAMEWORK FOR THE U.S. ELECTRIC POWER INDUSTRY	3
3. LANDSCAPE FOR CLIMATE STRATEGY ASSESSMENTS	5
4. COMPANY CLIMATE STRATEGY ASSESSMENTS	9
5. CONCLUSION	16
REFERENCES: CLIMATE STRATEGY REPORTS REVIEWED	17
ENDNOTES	18

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About Ceres

Ceres is a sustainability nonprofit organization working with the most influential investors and companies to build leadership and drive solutions throughout the economy. Through powerful networks and advocacy, Ceres tackles the world's biggest sustainability challenges, including climate change, water scarcity and pollution, and human rights abuses. For more information, visit www.ceres.org.



About M.J. Bradley & Associates

MJB&A, founded in 1994, is a strategic consulting firm focused on energy and environmental issues. The firm includes a multi-disciplinary team of experts with backgrounds in economics, law, engineering, and policy. The company works with private companies, public agencies, and non-profit organizations to understand and evaluate environmental regulations and policy, facilitate multi-stakeholder initiatives, shape business strategies, and deploy clean energy technologies.



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1. INTRODUCTION



In April 2018, Ceres published a framework developed by M.J. Bradley & Associates (MJB&A) that provides specific guidance for assessing climate change-related risks and opportunities for companies in the U.S. electric power industry.¹ Building on existing literature and consistent with the Financial Stability Board’s Task Force for Climate-related Financial Disclosures (TCFD), the framework describes an approach that includes two primary components:

- 1) Scenario analysis that reflects a) the transition in the U.S. electric power industry and across the economy that would be necessary to reduce emissions consistent with limiting global temperature rise to 1.5- to 2-degree Celsius and b) the potential physical impacts associated with climate change; and
- 2) The application of scenario analysis insights to business strategy.

Since the beginning of 2018, more than ten companies in the electric power industry have published climate strategy assessment reports, and a number of additional companies are expected to release reports throughout 2019.² At the same time, expectations from investors are growing as they learn from published climate strategy reports, the impacts of climate change become clearer and market opportunities for zero carbon resources advance.

This update reviews developments since the release of the 2018 framework, including investor interest, the publication of the Intergovernmental Panel on Climate Change (IPCC) special report on the impacts of global warming of 1.5 degrees Celsius (1.5°C) above pre-industrial levels and commitments made by companies to reduce emissions. This update also reviews assessments that companies in the electric power industry have released over the past year.

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2. REVIEW OF CLIMATE STRATEGY ASSESSMENT FRAMEWORK FOR THE U.S. ELECTRIC POWER INDUSTRY

The framework published by Ceres in April 2018 highlighted key questions and considerations for companies when conducting climate strategy assessments to support internal business planning and to meet investor and stakeholder expectations. The framework is structured around the components summarized in **Figure 1**, which include the development of scenarios, the application of those scenarios to corporate planning and, ultimately, the public disclosure of the risks and opportunities identified through the assessment process.

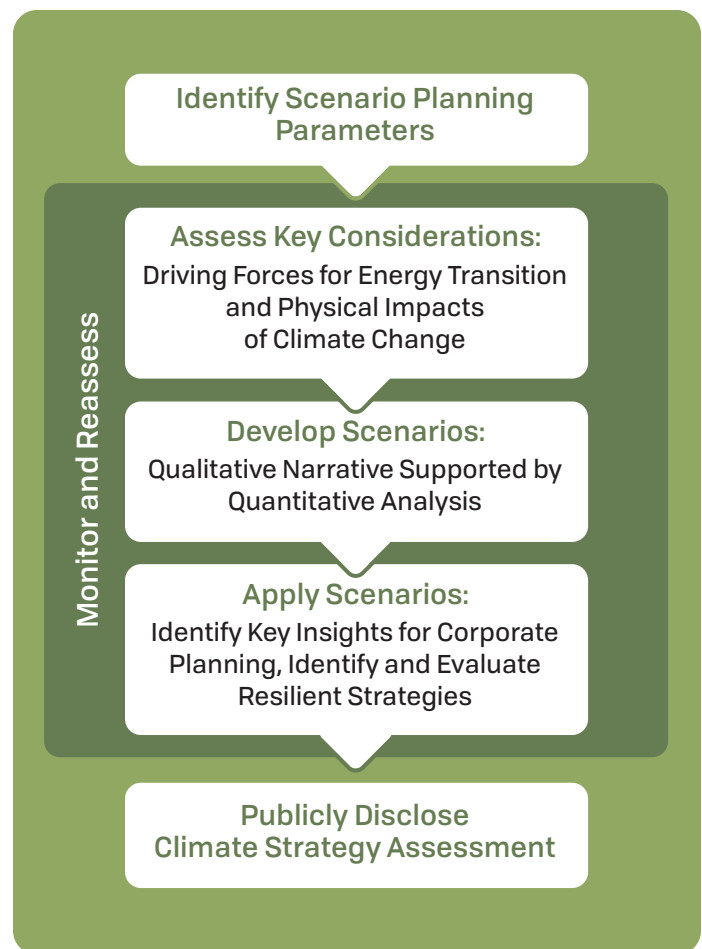
Assess Key Considerations and Develop Scenarios

A key element of the framework is the use of scenario analysis to inform business strategy and research included in public reports. Scenario analysis is a method to assess the potential implications of a range of hypothetical future states of the world. As described by the TCFD in its technical supplement on the use of scenarios³:

A scenario describes a path of development leading to a particular outcome. Scenarios are not intended to represent a full description of the future, but rather to highlight central elements of a possible future and to draw attention to the key factors that will drive future developments. It is important to remember that scenarios are hypothetical constructs; they are not forecasts or predictions nor are they sensitivity analyses.

The use of scenario analysis is well-suited for exploring questions associated with the potential effects of an energy transition consistent with goals to limit global increases in temperature to 1.5°C to 2°C and the physical impacts of climate change, both of which are uncertain and could follow a variety of paths. By following a structured process, a company can assess a range of factors to better understand the magnitude and variability of influences that each could have on future business conditions.

Figure 1. Climate Strategy Assessment Framework



A key assumption in a 1.5°C to 2°C transition scenario is the pace and scale of reductions in GHG emissions. Each company assessing its business strategy relative to an energy transition scenario will have to consider unique factors that could impact the speed and scope of its own transition, such as its mix of resources, its emission level, electricity demand projections in its region, and expectations of customers, policymakers and other stakeholders. As discussed in the 2018 framework, some companies may find that those factors point

toward a more ambitious energy transition (i.e. accelerated emission reductions or greater emission reductions) while others may find that those factors point toward a less ambitious energy transition than the U.S. or general industry averages. In either case, it is critical that a company disclose the basis for the emission reduction trajectory it uses to test its business strategy.

As emphasized by the TCFD and the scenario analysis literature, the goal of a scenario exercise is to evaluate outcomes based on unpredictable factors that could play out over a medium to long time horizon. In addition to identifying an emission reduction trajectory, a company will likely want to consider the role of electrification of end uses, advances in energy efficiency, pace of deployment of advanced energy technologies, policies for clean energy and electricity markets, consumer expectations and the growth of distributed energy in its energy transition scenario.

Consistent with the TCFD, the framework also encourages companies to include potential physical impacts as part of a comprehensive climate strategy assessment. Companies, investors, consumers, and other key stakeholders are interested in the financial and business-related risks of climate change. By incorporating potential physical impacts of climate change into scenarios as part of a climate strategy assessment, companies can enhance their ability to inform strategic decisions while responding to stakeholder interest. Key elements of an assessment include how a range of potential impacts (e.g. temperature and extreme heat, water availability and precipitation patterns, sea level rise, extreme precipitation and wind events, wildfires and changes

in wind patterns) may affect specific assets, overall operations and market conditions.

Apply Scenarios to Corporate Planning

Assessing the implications of a 1.5°C to 2°C transition and the physical impacts of climate change through scenario planning strengthens a company’s assessment of future business risks and opportunities, preparing a company to adapt and prosper in an uncertain future. However, the full value of a climate strategy assessment is predicated on how a company identifies and applies the insights from scenario analyses to its business planning process. Rigorous assessments ensure that a company is fulfilling its obligations to shareholders, as well as to other investors, customers, and external stakeholders. Accordingly, businesses should take the information gleaned from scenarios to identify vulnerabilities and opportunities affecting their bottom line or impacting quality of service.

Publicly Disclose Climate Strategy Assessments

Investors and stakeholders want to understand how companies apply their climate strategy assessments to inform company planning and strategies. Thorough disclosures include an objective assessment of the material risks and opportunities and an articulation of how a company manages these uncertainties. Each company should bring together the elements of its assessment, including the process steps, scenario parameters and assumptions, and risks and opportunities, into a public report. **Table 1** highlights key elements to communicate in such a report.

Table 1. Key Parameters to Communicate in Climate Strategy Assessments

ASPECT OF ASSESSMENT	PARAMETERS
Overarching	Geographic scope, macroeconomic inputs, time horizon, covered assets and process
1.5 - 2°C Transition	Emission reduction trajectory, electricity demand, energy technologies and key market dynamic, including consumers, policies and market structures
Physical Impacts	Acute impacts and chronic impacts
Business Insights	Strategy, risk management

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3. LANDSCAPE FOR CLIMATE STRATEGY ASSESSMENTS



Over the second half of 2018 and through 2019, investors have continued to express interest in better understanding the risks and opportunities for companies in the electric power industry under a scenario where the energy system shifts consistent with a warming target of 1.5°C to 2°C. Reports on the science of climate change and the challenges of reducing global emissions have reinforced investor interest and provided greater insights into the scale and scope of the challenge. In addition to publishing reports describing climate strategies and scenario analysis, a number of companies have announced or updated emission reductions goals.

Reports on the Risks and Challenges Associated with Climate Change

Two comprehensive reports published in the fall of 2018 highlighted the risks of climate change and the challenges associated with actions to address those risks. In the *Special Report on Global Warming of 1.5°C* (1.5°C Special Report) the IPCC explored the climate-related risks for natural and human systems for global warming at 1.5°C above preindustrial levels.⁴ In *Volume II of the Fourth National Climate Assessment (NCA)*, the U.S. Global Change Research Program, a multi-agency program of the U.S. Federal government, observed and projected risks and impacts of climate change on human welfare, the economy, and the environment in the U.S.⁵

The IPCC found “[a] robust feature of 1.5°C-consistent pathways...is a virtually full decarbonization of the power sector around mid-century.”

The 1.5°C Special Report found that human activities have caused about 1°C of global warming above preindustrial levels to date and that the climate-related risks associated with warming of 1.5°C include sea level rise, species and habitat biodiversity loss, extreme temperatures, Arctic melting, food shortages and droughts, and increased poverty and health issues. The significance of the climate-related risks depends on the rate, peak, and duration of warming. The IPCC notes that future risks can be reduced by increasing and accelerating climate mitigation and by both incremental and transformational adaptation. The report estimates the remaining carbon budget for a 50 percent probability of limiting warming to 1.5°C is 580 billion metric tons (Gt) carbon dioxide equivalent (CO_{2e}) (and 420 billion Gt CO_{2e} for a 66 percent probability). The report indicates that for each increment of warming between 1.5°C and 2°C (the upper limit governments committed to in the Paris Agreement), the risks are progressively higher. With a 2°C increase versus 1.5°C, water scarcity would be 50 percent higher and the proportion of the global population exposed to extreme heat would double by 2100.

As part of the 1.5°C Special Report, the IPCC explored mitigation pathways consistent with limiting warming to 1.5°C above pre-industrial levels. IPCC reviewed scenarios developed using integrated assessment models covering all economic sectors and regions of the globe. IPCC identified 90 scenarios representative of a 1.5°C trajectory and 132 scenarios representative of 2°C pathways. While each scenario had a unique combination of assumptions about economic growth, technology availability and policies, the IPCC found that “[a] robust feature of 1.5°C-consistent pathways...is a virtually full decarbonization of the power sector around mid-century, a feature shared with 2°C-consistent pathways.”⁶ The IPCC further

highlights the role of an increase in electrification of energy end use in other sectors of the economy as key to achieving broad decarbonization that is consistent with a 1.5°C pathway.

Volume II of the Fourth NCA focuses on the observed and projected risks and impacts of climate change on human welfare, the economy, and the environment in the U.S. It also examines impacts at the regional level and details considerations related to risk reduction and implications under various mitigation pathways. The report provides examples of adaptation and mitigation efforts to reduce the risks and costs associated with climate change. Among its findings, the report concludes, “[w]hile mitigation and adaptation efforts have expanded substantially in the last four years, they do not yet approach the scale considered necessary to avoid substantial damages to the economy, environment, and human health over the coming decades.”⁷

Each of these reports has contributed to and influenced the stakeholder discussion around the pace and scale of change that would be needed to mitigate the risks associated with climate change and the potential for disruptive climate impacts to the energy infrastructure in the U.S. and around the globe.

Investor Focus

Investors continue to engage with companies in the electric power industry to better understand published reports and data related to climate. In response, a number of companies committed to develop and publish reports assessing the risks and opportunities of a 1.5°C to 2°C transition. In addition, the electric power industry engaged directly with investors and developed a reporting template for environmental, social, governance and sustainability-related (ESG/Sustainability) topics.⁸ Initiated by the Edison Electric Institute (EEI), the ESG/Sustainability template has been adopted by EEI member companies and has resulted in constructive engagement with investors and other stakeholders. As it evolves in order to achieve better standardization and a more robust level of disclosure, this initiative contributes to options available for ESG reporting such as SASB and CDP.

To provide additional specificity on the pace and scale of the change investors are anticipating, in February 2019 a group of long-term institutional investors with \$1.8 trillion of assets under management asked the 20 largest publicly traded electricity generators in the U.S. to establish net-zero greenhouse gas emission targets by 2050.⁹ Citing the IPCC 1.5°C Special Report and the Paris Agreement, the investors asked companies to adopt governance reforms and publish “a detailed transition plan toward achieving net-zero emissions by 2050 (or earlier target), with clear near-term benchmarks and plans for 2025 and 2030.” Twenty investors signed the letter, including the California Public Employees Retirement System, Interfaith Center on Corporate Responsibility, New York City Employees’ Retirement System, Teachers Retirement System of the City of New York, the New York City Board of Education Retirement System, and Trillium Asset Management.

As a resource for investors, Moody’s Investors Service, a provider of credit ratings, research, and risk analysis for investors, has proposed a scoring framework for assessing carbon transition risk for rated, publicly traded non-financial companies. As proposed, the carbon transition assessment tool (CTA) would score companies based on an evaluation of carbon transition components, including long-term exposure to rapid low carbon transition scenarios.

Company Emissions Targets

Many electric power companies are moving forward with new or updated emissions reduction goals as they more closely evaluate climate change-related risks and opportunities. These reductions goals are being established at a time when the electric power industry is undergoing a significant transition away from higher-emitting fossil fuel-fired assets toward lower- and non-emitting assets like renewables.

Between the beginning of 2018 and July 2019, 22 companies announced new or revised greenhouse gas reduction goals. The goals are summarized in **Table 2**.

Table 2. Recently Announced U.S. Electric Power Industry Greenhouse Gas Reduction Goals

COMPANY	GREENHOUSE GAS REDUCTION GOAL
AES Corporation (November 2018, February 2019)	AES Corporation announced that it is “increasing [the company’s] 2030 target from 50 percent to a 70 percent reduction of carbon intensity from 2016 levels.” In February 2019, the company updated the timing of its target, saying that it “now expect[s] to achieve a 50% reduction [in carbon intensity] from 2016 to 2022.”
American Electric Power (February 2018)	American Electric Power announced “new intermediate and long-term carbon dioxide emission reduction goals” of “a 60 percent reduction from 2000 CO2 emissions levels by 2030” and “an 80 percent reduction from 2000 levels by 2050.”
Alliant Energy (August 2018)	Alliant Energy announced a “goal to cut carbon emissions 80 percent” below 2005 levels by 2050.
Avista Corporation (April 2019)	Avista Corporation announced “a goal to serve its customers with 100 percent clean electricity by 2045 and to have a carbon-neutral supply of electricity by the end of 2027.”
Consumers Energy (June 2019)	Consumers Energy announced that under its recently approved integrated resource plan, “carbon emissions from power plants will be reduced more than 90 percent by 2040.”
Dominion Energy (December 2018, March 2019)	Dominion Energy announced a commitment to reduce the carbon intensity of its generation fleet “by 60 percent by 2030” below 2000 levels. In March, the company announced supplemental emission reduction targets of a 55 percent reduction in carbon emissions by 2030 and an 80 percent by 2050, both below 2005 levels.
DTE Energy (March 2019)	DTE Energy announced a goal “to reduce carbon emissions 80 percent by 2040” and that it “has committed to a 50 percent carbon emissions reduction by 2030,” both below 2005 levels.
Entergy Corporation (March 2019)	Entergy Corporation announced a goal “to achieve a 50 percent reduction in emissions rate” below 2000 levels by 2030.
Green Mountain Power (April 2019)	Green Mountain Power announced “an ambitious energy vision to have a 100% carbon free energy supply by 2025 and 100% renewable energy by 2030.”
Idaho Power (March 2019)	Idaho Power announced a “goal to provide 100 percent clean energy by 2045.”
Madison Gas & Electric (May 2019)	Madison Gas & Electric announced a “goal of providing our customers net-zero carbon electricity by 2050.”
Mid-American Energy (May 2018)	Mid-American Energy announced that upon completing its newest proposed wind energy project, estimated for late 2020, it would become the first U.S. investor-owned utility to generate renewable energy equal to 100 percent of its customers’ usage on an annual basis.
NextEra Energy (June 2019)	NextEra Energy announced a revised “goal to reduce its carbon dioxide emissions rate by 67% by 2025, from a 2005 baseline.”
NiSource, Inc. (April 2019)	NiSource announced that “GHG emissions from electric emissions are expected to fall 90 percent from 2005 levels” by 2030.
Platte River Power Authority (December 2018)	The Platte River Power Authority announced that its Board of Directors “unanimously passed a resource diversification policy calling for a 100% carbon-free energy mix by 2030 provided key advancements are achieved that would enable goal attainment.”
PNM (April 2019)	PNM announced a “goal of ensuring all our electricity is 100-percent emissions-free by 2040.”
Portland General Electric (March 2018)	Portland General Electric is working to “meet its proportionate share of Oregon’s greenhouse gas reduction goal, which will require cutting carbon emissions in the utility’s system 80 percent by 2050.”
PPL Corporation (January 2018)	PPL Corporation “announced a goal to cut the company’s carbon dioxide emissions 70 percent from 2010 levels by 2050.”
PSEG (February 2018, July 2019)	In February 2018, PSEG announced a goal “to eliminate 13 million tons of CO2-equivalent emissions by 2030.” In July 2019, PSEG announced “it expects to cut its power fleet’s carbon emissions by 80% by 2046, from 2005 levels” and “a vision of attaining net-zero carbon emissions by 2050 assuming advances in technology and public policy.”
Southern Company (April 2018)	Southern Company announced “an intermediate goal of a 50 percent reduction in carbon emissions from 2007 levels by 2030 and a long-term goal of low- to no-carbon operations by 2050.”
WEC Energy Group (August 2018)	WEC Energy Group announced “a new long-term target: an 80 percent reduction [in carbon dioxide emissions] below 2005 levels by 2050.”
Xcel Energy (December 2018)	Xcel Energy announced a goal to “deliver 100 percent carbon-free electricity by 2050,” as well as “plans to reduce carbon emissions 80 percent by 2030, from 2005 levels.”

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4. COMPANY CLIMATE STRATEGY ASSESSMENTS



Since the 2018 framework was published, a number of companies in the electric power industry have released reports entirely or in part describing assessments of climate strategy, in many cases including the use of scenarios. Company reports followed the 2018 Ceres framework and the TCFD guidance to varying degrees. Four of the critical areas of comparison are:

- ▶ **Scope:** Which business operations are included in assessments?
- ▶ **Scenarios:** How are companies incorporating scenarios into their assessments and what scenarios are they using?
- ▶ **Physical Impacts:** To what degree are companies integrating physical impacts into their assessments?
- ▶ **Risks and Opportunities:** How are companies evaluating the risks and opportunities?

MJB&A reviewed 12 recent climate strategy assessments from companies in the electric power industry across these four areas of comparison. The 12 assessments reviewed were published by: AES, American Electric Power, Ameren Corporation, CMS Energy, Dominion

Energy, Duke Energy, Entergy Corporation, FirstEnergy Corporation, PPL, Southern Company, WEC Energy Group and Xcel Energy.¹⁰ Key features of the assessments are summarized below.

There is significant variation in how companies have integrated scenario analyses into their assessments and reports. Some company assessments are centered on specific and well-defined scenarios analyses. In these cases, companies have conducted in-house modeling, worked with consultants to develop custom assessments, or adapted publicly available scenarios to inform company-specific assessments. In other examples, companies have leveraged existing, publicly available scenarios to add context and additional information in their reports but have not conducted more specific analytical assessments to closely examine the potential implications of climate change to their assets and businesses. All of these steps help to advance a company's understanding of important climate-related issues. At the same time, there are opportunities to continue to advance this work so that companies, their investors, and their key stakeholders can be better informed and prepared for the potential changes that lie ahead.

▶ Scope: Which business operations are included in assessments?

Scope

- ▶ Covered Assets / Operational Scope
- ▶ Geographic Scope
- ▶ Time Horizon

In conducting scenario analyses, a fundamental component is defining the scope of the assessment.

For most electric companies, the scope of operations includes some combination of distribution, transmission and generation assets. A comprehensive study would include all relevant aspects of operations; however, companies may choose to focus on areas believed to have the highest risk profiles or that are of the greatest

interest to their investors. Most of the published reports focus on the implications of an energy transition to generation assets and, specifically, coal-fired generation.

Some companies clearly outline the overall framework and scope for their scenario analysis. For example, Dominion Energy states “our entire generation fleet, including merchant generation assets (which make up roughly 13 percent of generation portfolio and are 99 percent carbon-free), is within the scope of the analysis.” PPL’s report follows a similar scope. While PPL mentions power delivery branches in the U.K. (Western Power Distribution plc) and Pennsylvania (PPL Electric) in its company overview, the executive summary states that the company analyzed “the potential impacts on its Kentucky generation assets.” Entergy’s analysis focuses on the utility ownership share of generation and excludes both purchased power, which comprised about 25 percent of the company’s fuel mix used to serve retail customers in 2018, and generation from wholesale assets owned by non-regulated Entergy affiliates.

By contrast, FirstEnergy assessed all phases of its business including generation, transmission, and distribution. In line with the company’s focus on its regulated distribution business, the FirstEnergy report provides a detailed assessment for distribution operations (see *FirstEnergy Highlight*).

Many reports consider two key dates, 2030 and 2050, as milestones in strategy assessments. Some companies have aligned their short-term (2030) and long-term (2050) emissions reduction goals with these dates – AES, Ameren, Dominion, and Duke have set 2030 goals, PPL has set one for 2050, and AEP, Southern Company and Xcel Energy have set targets for both years. AES examines what its portfolio would look like in 2030, the date defining its goal but extends the analysis to envision operations in 2040 as well. FirstEnergy’s emissions reduction target year is 2045, but it aligns scenario planning with 2050.



Defining Scope – A Highlight from FirstEnergy’s Report

FirstEnergy released its report in April 2019. In it, the company defines a clear scope with state-level detail through 2060 for the electric sector in the five states in which FirstEnergy primarily operates: Ohio, Pennsylvania, West Virginia, New Jersey, and Maryland. Four out of the five states in which FirstEnergy principally operates are deregulated, meaning FirstEnergy’s regulated utilities do not own and operate generation in these states. In line with the company’s shift away from the competitive generation business and emphasis on its regulated utilities, FirstEnergy provides a detailed assessment for its transmission and distribution systems. In particular, the report examines the risks and opportunities associated with grid modernization efforts and emerging technology integration, including electric vehicle supply equipment and distributed energy resources.

► Scenarios: How are companies incorporating climate scenarios into their assessments?

Scenarios

- ▶ Macroeconomic Inputs
- ▶ Process for Developing Scenarios
- ▶ Energy Transition Assumptions

Companies drew on a wide array of scenarios and methods in developing climate strategy assessments. The most commonly referenced independent sources of scenarios are the International Energy Agency (IEA) and the IPCC. IEA’s scenarios include the 2 Degree Scenario (2DS) released as part of Energy Technology Perspectives, the Sustainable Development Scenario (SDS) released as part of the 2017 and 2018 editions of the World Energy Outlook (WEO), and the 450 ppm Scenario (450 Scenario), a predecessor to the SDS which was released as part of WEO prior to the 2017 edition. IPCC scenarios are based

on information in the 1.5°C Special Report and the Fifth Assessment Report (AR5).

Duke Energy based its scenario on a methodology developed by the Science Based Target Initiative and assumed that, globally, all sources of emissions in all sectors reduced emissions by the same percentage from 2010 to 2050 (72 percent). Xcel collaborated with researchers at the University of Denver to review emission reduction trajectories included in modeling that contributed to the IPCC 1.5°C Special Report.

One of the advantages to using publicly available reports by groups such as IEA and IPCC is the transparency of assumptions, including macroeconomic inputs. When using these resources, companies generally deferred to underlying documentation available for the scenarios instead of detailing macroeconomic inputs within climate strategy reports. Companies do discuss macroeconomic inputs when describing integrated resource plan (IRP) development, as both Ameren and PPL do in their reports.

Entergy analyzed a wide range of climate scenarios, including a carbon tax scenario, to inform its climate strategy assessment. The company sees the creation of a direct carbon price through a tax as the most likely policy option to be adopted at the federal level. The analysis

concludes that as one of the cleaner fleets in the nation, a carbon price may drive Entergy's dispatch up, increasing company emissions, while facilitating an overall reduction of emissions in the MISO region. The analysis examined three different levels of carbon prices, ranging from approximately \$12 to \$56 per ton through 2030, and are based on various carbon fee and tax proposals. Although it was not part of the scenario process, Xcel applies a carbon price proxy in its resource planning process.

As with any business planning exercise, much of the value is derived from the process of conducting the analysis rather than simply internalizing the final results. This point is implicit in investor requests to understand how companies are approaching climate strategy assessments. Investors want to see as much information as possible about the analyses and results, but they also want to understand how companies are managing and conducting these processes. Companies that fully embrace these types of analyses and actively integrate the perspectives and expertise of subject matter experts across a range of business units will likely gain deeper insights from this work and may be better prepared to manage risks and identify future opportunities. This first generation of climate reports represents a significant step forward and at the same time underscores opportunities for advancing best practices in conducting these types of analyses.



International Energy Agency (IEA) Scenarios

The IEA has three emission reduction scenarios that have been used in climate scenario exercises: 2DS, SDS and 450. All three utilize IEA's World Energy Model modeling platform. While the IEA has yet to make available a scenario aligned with limiting warming to 1.5°C, many stakeholders are actively requesting IEA develop such a scenario and asking companies to disclose their own assumptions regarding a 1.5°C transition.

- **2 Degree Scenario (2DS) – Published as part of the Energy Technology Perspectives (ETP) 2017:** The 2DS details an emissions pathway consistent with at least a 50 percent chance of limiting average global temperature increase to 2°C by 2100. Under the scenario, annual energy-related CO₂ emissions are reduced by 70 percent from today's levels by 2060. To achieve these reductions, CO₂ emissions from fuel combustion and industrial processes must continue their decline after 2060 with the energy system reaching carbon neutrality before 2100; the ETP also includes a Beyond 2 Degree Scenario (B2DS) modeling carbon neutrality by 2060. Both the 2DS and B2DS project global and national level emissions and energy use.
- **Sustainable Development Scenario (SDS) – Published as part of the World Energy Outlook (WEO) 2017 and 2018:** The SDS charts a path for transforming the global energy system to meet multiple long-term sustainability goals, including the Paris Agreement's objective of keeping the increase in global average temperature "well below" 2°C and achieving universal access to energy and reducing air pollution. Focusing on CO₂ emissions from the energy sector, the SDS forecasts emissions through 2040. To achieve reductions, the SDS relies on the deployment of decentralized low-carbon technologies more than other IEA scenarios.
- **450 ppm Scenario (450 Scenario) – Published as part of the WEO in 2016:** The 450 Scenario was a predecessor to the SDS scenario and included an energy transition consistent with limiting atmospheric concentrations of CO₂ to 450 parts per million (ppm), equivalent to a 50 percent chance of meeting a less than 2°C warming goal.

Table 3. Scenarios Referenced by Companies in Climate Strategy Reports

COMPANY	SCENARIO
American Electric Power	Carbon pricing based on Clean Power Plan modeling (Intended to be consistent with the ambition of the Paris Agreement)
AES	IEA World Energy Outlook (WEO) 2017 (Current Policies Scenario, New Policies Scenario, and IEA's Sustainable Development Scenario (SDS)) (Transition Risk) and IPCC's Fifth Assessment Report (AR5) (RCP 8.5, 6.0, and 2.6) (Physical Risk)
Ameren	Calculated Ameren's "pro-rata" share of emissions for the global electric sector scenarios from Electric Power Research Institute (EPRI) analysis "Grounding Decisions: A Scientific Foundation for Companies Considering Global Climate Scenarios and Greenhouse Gas Goals"
CMS Energy	Internal analysis and scenarios submitted as part of IRP process. The scenarios include a Clean Energy Breakthrough Policies scenario with emission reductions of 80 percent below 2005 levels by 2050, intended to reflect IEA and IPCC guidance.
Dominion Energy	Two-degree framework put forth in the Paris Agreement and the UNFCCC and IEA's WEO 450 ppm Scenario
Duke Energy	Science Based Target Initiative (Overall reductions in "Pro Rata" Scenario intended to align with IPCC 2-degree trajectory)
Entergy	Internal analysis and scenarios. Also applied IEA SDS to inform analysis
FirstEnergy	IEA 2DS, also considered other third-party produced scenarios like the "beyond 2-degree" scenarios consistent with the IPCC's Special Report on Global Warming of 1.5°C (SR15)
PPL	IEA 450 ppm (Interpreted as a global, economy-wide target of 50 percent reductions by 2050)
Southern Company	Internal analysis that aligns with IEA 2DS
WEC Energy Group	Internal analysis with EPRI using U.S. Regional Economy, Greenhouse Gas, and Energy Model (US REGEN) for more than 100 model runs
Xcel Energy	Commissioned analysis by the University of Denver to compare company emissions targets against publicly-available scenarios consistent with the Paris Agreement



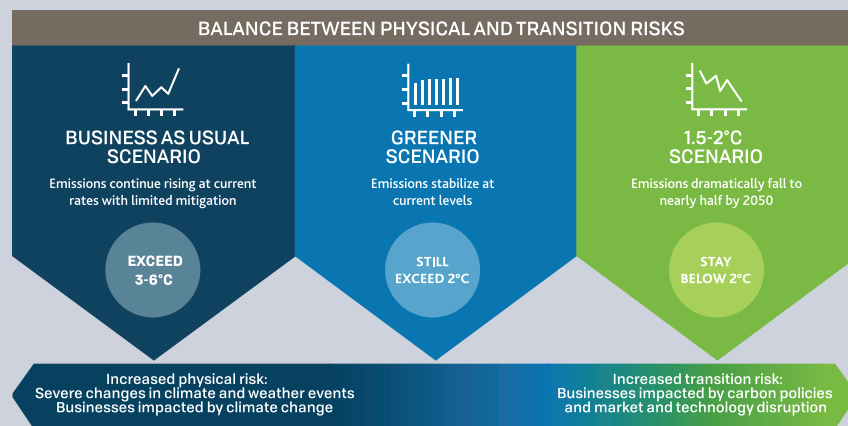
Comparing Carbon Reduction Goals with Existing Climate Scenarios – A Highlight from Xcel Energy’s Report

At the close of 2018, Xcel Energy announced new goals to reduce its carbon emissions 80 percent by 2030 from 2005 levels and deliver 100 percent carbon-free electricity to customers by 2050. Four months after this announcement, Xcel released its scenario report, “Building a Carbon-free Future.” Unlike most other scenario analyses that consider how business operations will be affected by a range of climate scenarios, Xcel’s report hinges on how its ambitious climate goals compare to electric sector carbon dioxide emission scenarios consistent with limiting warming to both 2°C and 1.5°C.

Working with researchers at the University of Denver, Xcel Energy reviewed 416 scenarios in a database developed in support of the IPCC 1.5°C Special Report and identified scenarios that would be likely to stay below 2°C and scenarios that would be likely to stay below 1.5°C. Xcel Energy excluded scenarios that assumed the availability of significant negative emissions in the electric power sector, deeming such technologies to not be commercially available. As a result, the scenarios selected by Xcel Energy and the University of Denver researchers required more significant near-term emission reductions to compensate for the lack of negative emission technologies. From the identified scenarios, the researchers extracted results for CO₂ emissions from the electric power sector in industrialized countries and compared them to Xcel Energy’s goals. While this analysis was applied to Xcel Energy’s electric business, it did not include Xcel Energy’s gas distribution business. Ultimately, Xcel Energy concluded “our trajectory from today to 2030 falls below all but one of the scenarios for both temperature goals. Our aspiration for 2050 lies well within the range of emission scenarios for both temperature goals.”

Unique Analytical Framework – A Highlight from AES' Report

AES produced a report based on a comprehensive analytical framework, considering three pathways: Business as Usual (3-6°C warming), Greener Scenario (2°C warming), and 1.5-2° C Scenario (staying below 2°C warming). These scenarios fell on a spectrum of physical and transition risk utilizing recent scenarios for both risk categories, IEA's WEO 2017 and IPCC AR5, respectively (see image). AES reviews each scenario detailing global electricity demand, global carbon levels, the role of carbon prices, what the world on a 2020 trajectory looks like (i.e. values for the concentration of CO₂, temperature increase and sea level rise), generation mix and important technologies (i.e. electrification of emerging economies, strong energy efficiency measures and electric vehicle deployment). AES also includes the simulated gross margin across the three scenarios, illustrating the shift from primarily conventional power gross margin to the four Clean Energy Growth Platforms at the core of their strategy: renewables, energy storage solutions, liquified natural gas and energy efficiency.



► Physical Impacts: To what degree are companies integrating physical impacts into their assessments?

Physical Impacts

- ▶ Extreme temperatures with ice storms and severe heat days
- ▶ Water availability and precipitation patterns
- ▶ Sea level rise
- ▶ Extreme precipitation events, hurricanes, tropical storms, and coastal surge
- ▶ Wildfires
- ▶ Changes in wind patterns
- ▶ Vegetation management

Similar to the analysis of the energy transition, the process of evaluating and integrating physical impacts into climate strategy assessments continues to evolve. In the reviewed climate reports, many companies outline the ways in which they are protecting their business operations against physical impacts. However, the existing climate reports generally give limited attention

to the direct assessment of *future* physical impacts associated with climate change. The key point is that historical trends in weather patterns and climatic conditions may not, in many cases, provide a sufficient basis for anticipating and preparing for future climatic conditions. This is a challenging topic to address, but one deserving more attention given the magnitude of potential impacts going forward.

To guard against the detrimental effects, companies recognize that it will be critical to invest in “system hardening” or proactive resilience. A common measure used by companies is the strategic undergrounding of powerlines by burying lines that are most vulnerable to weather-related damage. Companies also explore service-territory specific threats; for example, Xcel Energy reviews its vegetation management program and Mountain Hazard Tree program to protect against Colorado’s Mountain Pine Beetles. Companies discuss participation in coalitions focused on system hardening, like the Grid Assurance program, which provides spare parts for critical transmission equipment during extreme weather situations.

Measures to address acute physical impacts include emergency response efforts, both within and beyond service territories, and learning how past weather events have affected service.

Many companies have both internal and external systems to review weather data and projections. Due to recent droughts, companies like Duke Energy and Xcel Energy have set up Drought Mitigation teams and water resource planning partnerships, respectively.



Mitigating Physical Impacts – A Highlight from Ameren’s Report

Ameren Corporation, an investor-owned power company serving parts of Illinois and Missouri, released its report “Building a Cleaner Energy Future” in March 2019. Under the *Risk Management and Governance* section, Ameren identifies the four critical climate-related risks that affect the company: policy and legal, physical, reputational, and financial. Within each risk, Ameren identifies key mitigation strategies. Ameren goes beyond physical preparation through system hardening and elaborates upon a holistic approach to physical risk management:

- **System Hardening:** Enhancements that improve reliability and protect against a changing climate include burying lines most susceptible to weather-related damage and selecting material that neutralizes the destructive effects of wind and moisture. With regard to changing water patterns, Ameren has not only enhanced structural protection in flooding-prone areas but has also commissioned a Water Resilience Assessment Report.
- **Emergency Planning:** Ameren stores spare transformers, switchgear, and other substation-related equipment across its service territory. Regional preparedness measures include the MISO transmission scenario planning process, membership in the Midwest Mutual Assurance Group (a consortium of electric utilities that provide emergency support for one another in events following extreme weather events), and transformer-sharing agreements.
- **Situational Awareness:** Ameren’s monitoring and forecasting of disruptive events included the formation of a Watch Center and incorporation of real-time weather prediction information.
- **Emergency Response:** In addition to proactive measures, Ameren utilizes an Incident Command and Control structure for emergency management, which enables a coordinated immediate response to a disruptive event.

► Risks and Opportunities: How are companies evaluating the risks and opportunities?

While the descriptions and terminologies vary from report to report, companies generally identify three main risks: operational, policy and financial. As summarized in **Table 4**, other risks identified are reputational, strategic and technological. In conducting climate strategy assessments, companies work to develop greater insights into the risks they may encounter due to rapid adoption of clean energy technologies and a changing climate in order to be better prepared for unexpected events.

Many companies identify a shift towards electrification of the transportation, building, and industrial sectors as

providing new opportunities. Companies identify the potential for environmental, economic, and health benefits that accompany electric power company support for electric vehicle adoption, charging infrastructure investment, and efficient use of electricity. Greater investment in and development of distributed energy resources (DERs), which include microgrids and battery storage, could create a more dynamic, modern, and resilient grid. In addition to commitments to increase both large-scale renewable energy resources and smaller on-site connections, companies are exploring lower-carbon resources such as advanced nuclear.



Asset Outlook – A Highlight from Southern Company’s Report

While all reports touch on risks and opportunities to some degree, Southern Company’s report includes a unique outlook table of its asset portfolio in GHG-constrained futures, including whether it facilitates GHG reductions, the influence on demand outlook, and potential opportunities to address emissions reductions pressure and demand outlook. For each asset category, the table includes pros and cons, as well as whether the asset is rate regulated and has long-term contracts. Southern goes beyond detailing potential opportunities, as many reports do, in renewable energy integration, transportation electrification, and grid modernization to detail pros and cons by asset category in this succinct table.

Table 4. Summary of Commonly Reported Risks and Opportunities

COMMONLY REPORTED RISKS	COMMONLY REPORTED OPPORTUNITIES
Operational	Potential for increased demand
<ul style="list-style-type: none"> · Severe weather · Compromised grid resiliency and changes reliability · Divided into Physical and Transition risks 	<ul style="list-style-type: none"> · Transportation – notably through electric vehicles and charging opportunities · Buildings – with a focus on energy efficiency in appliances, heating ventilation and air conditioning technologies (HVAC), smart thermostats · Industrial
Policy	Distributed energy resources (DER)
<ul style="list-style-type: none"> · Developing carbon pricing regulations and mechanisms – state, regional or federal · Changes in governmental oversight · Renewable portfolio standards · Energy efficiency regulations 	<ul style="list-style-type: none"> · Energy Storage – energy management, backup power, load leveling, frequency regulation, voltage support, grid stabilization · Microgrids – maintain reliability and resilience in storm-prone parts of service territories; also serving as DERs · Increased customer interest in onsite solar
Financial	New generation opportunities in response to market demands and policy drivers through utility scale renewable energy and other clean energy sources, including advanced nuclear
<ul style="list-style-type: none"> · Prices of natural gas and other fuels · Tax incentive changes · Pace of economic growth · Failure of low-carbon technologies (i.e., wind, solar, battery storage) to achieve cost reductions considered in scenarios · Economic decline reduces electricity demand 	Grid modernization
Reputational	<ul style="list-style-type: none"> · Advanced metering infrastructure; intelligent grid devices
Strategic	Growth of rate base
<ul style="list-style-type: none"> · Risks affecting long-term and overall business goals and ability to achieve them 	<ul style="list-style-type: none"> · Through transmission and clean technology investment
Technology	Strategic alliances for research and development
<ul style="list-style-type: none"> · Complications in technology integration 	

CONCLUSION

In a short period of time, the TCFD recommendations have advanced the way companies, investors and stakeholders are evaluating and discussing the risks and opportunities associated with climate change. Emphasizing the benefits of developing and using scenarios, the recommendations provide a structured framework for evaluating key uncertainties associated with climate change along with a systematic approach for understanding how companies manage these risks through their organizational structure and business processes.

The framework published by Ceres for assessing climate related risks and opportunities helped to inform the use of scenarios and adoption of the TCFD recommendations in the U.S. electric power industry. As summarized in this update, a number of companies released assessments that included the application of scenarios to corporate planning. Additionally, since early 2018, more than 20 companies in the U.S. power industry adopted or updated long-range greenhouse gas emission targets, typically with 2030 and 2050 goals.

The U.S. electric power company climate assessments reflect a range of approaches by companies across four critical areas:

- ▶ **Scope:** Most companies focused on the impact of an energy transition on generation assets, particularly coal-fired assets. A notable exception was AES, which stress-tested its entire business portfolio against a “well below 2-degree” climate scenario.
- ▶ **Scenarios:** There is significant variation in how companies have integrated scenario analysis into assessments. Some companies used or adopted publicly available third-party scenarios while others relied on in-house modeling, or other modeling conducted specifically for the assessment.
- ▶ **Physical Impacts:** Reports to date have given limited attention to the direct assessment of future physical impacts associated with climate change. Most have highlighted ongoing work to prepare for extreme weather events.
- ▶ **Risks and Opportunities:** Companies generally identify three main risks: operational, policy and financial. Many companies identify a shift towards electrification of the U.S. economy as providing new opportunities for investment in new infrastructure to meet growing demand.

Ceres and MJB&A hosted a workshop with electric power companies to share insights with investors from their experiences undertaking climate assessments and applying scenarios. During the workshop, companies reflected on benefits that may not be fully reflected in the published reports. The process of applying scenarios and integrating the climate assessments into corporate planning facilitated constructive engagement across different parts of the organizations. Companies also discussed the use of structured disclosures to facilitate constructive engagement with investors. This engagement helps companies better understand investors’ interests and questions.

The first generation of climate reports from the U.S. electric power industry represents a significant step forward and underscores opportunities for advancing best practices. At the same time, investor expectations are evolving as more information becomes available on the risks and opportunities associated with climate change. Balancing the progress made over the past year with advancing expectations, there are a number of observations that emerge from this framework update:

- ▶ With the IPCC 1.5°C Special Report, investors are increasingly focused on 1.5°C and “well below 2-degrees” as important components of scenarios analysis and business planning. More detailed analytics by third parties will help inform company planning and address investor questions.
- ▶ Investors are encouraging companies to look at risks and opportunities across business units, not just generating assets.
- ▶ Companies should continue to work on approaches to incorporating physical risks into climate assessments. Investors will increasingly be interested in how companies evaluate physical risks and build business cases for addressing them.
- ▶ The themes of energy efficiency and electrification are prominent throughout the scenario discussion, but there is an opportunity for companies to further explore the scale of these opportunities and how they relate to policy and commercial opportunities.

As additional companies undertake climate strategy assessment and more tools are released by TCFD and others, there is an opportunity for continued refinement of company approaches to conducting climate strategy assessments.

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ENDNOTES

- 1 LaCount, Robert, Tom Curry, Peter Hansel, Grace Van Horn (MJB&A). *Climate Strategy Assessment for the U.S. Electric Power Industry: Assessing Risks and Opportunities Associated with a 2-Degree Transition and the Physical Impacts of Climate Change*. April 2018. Available at: www.ceres.org/Electric2DS
- 2 The electric power industry includes a range of different business structures, including independent power producers, investor-owned utilities, municipally-owned utilities and cooperative utilities. Throughout this document, the term “company” is used to describe the entity conducting the analysis, which can refer to any of the different business structures, including municipally-owned utilities and cooperative utilities.
- 3 Financial Stability Board Task Force on Climate-related Financial Disclosure. “Technical Supplement: The Use of Scenario Analysis in Disclosure of Climate-related Risks and Opportunities”, June 2017. Available at: <https://www.fsb-tcf.org/publications/final-technical-supplement/>
- 4 Available at: <https://www.ipcc.ch/sr15/>
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- 8 Edison Electric Institute (EEI). *ESG/Sustainability Template*. Available at: <http://www.eei.org/issuesandpolicy/finance/Pages/ESG-Sustainability.aspx>
- 9 Available at: <https://comptroller.nyc.gov/wp-content/uploads/2019/02/Utilities-NetZero-2050-Institutional-Investor-Statement-28Feb2019-Signatories.pdf>
- 10 Bibliographic information for each company’s report is included in the References section of this framework. Disclosure: Entergy, FirstEnergy and WEC Energy Group retained MJB&A as a consultant in the development of their climate strategy reports.