BUSINESS INTELLIEGENCE SOLUTION REPORT

BUSINESS INTELLIGENCE SOLUTION

TEAM 8

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Executive Summary

Today's world is at its peak of breakthroughs in AI and data-driven solutions. In this age, it is becoming an absolute necessity for companies to embrace data-driven solutions to leverage scale and growth. Business Intelligence (BI) is in demand for its vast range of applications and has had a growing definition. Companies in the most advanced stage, i.e. the "Sage" stage of the BI maturity model are leading in their industries using and providing efficient data-driven solutions in their operations and to their clients. There are many companies that are still in the early stages in the maturity model trying to move forward and improve on their operations. One such company is Daymark Energy Advisors, a 45-year-old energy consulting firm based in Worcester, MA. It is a small firm with 40 employees who are in the "Child" stage of the BI maturity model.

This project aims to provide a comprehensive set of BI solutions with visualization and analytics prototypes to help Daymark progress in the BI maturity model and adopt more advanced technology and data-driven solutions. Currently, Daymark uses primitive tools like excel to work on complex projects and for all analysis tasks. Daymark works on a wide range to fields and topics within the energy consulting space, giving an excellent opportunity to adopt BI solutions and leverage more efficient operations. The primary problem while studying Daymark's current state was that there are no standardized data management systems, no data warehouses and the use of very basic technology. The competitive landscape in the consulting industry has some big shots leading by example for an AI and data-driven organization. Hence, to address the above problems, our team has put together multiple BI solutions and recommendations to help implement them and transform the organization.

This project report provides a detailed explanation of the proposed BI solution to Daymark by presenting ways to store data, a star schema and a tech stack recommendation to fully utilize different aspects of business intelligence. We have also provided two dashboards, one operational and one tactical dashboard as the visualization tools to demonstrate its benefits and ease of use. Tableau is the data visualization tool used to create dashboard, which is easy to use, highly interactive and creative. To show that BI is not just about visualization but a multi-faceted package, there is a prototype demonstrating the analytic prowess of BI through a "forecasting model". By presenting these prototypes, we wanted to emphasize on the small wins achievable for the company bringing us to explain the Kotter's eight step model for an organization transformation. Through all these analyses, a brief set of recommendations and managerial implications have been proposed to address the problems of Daymark Energy Advisors and achieve their goal.

The target here is to achieve small goals to showcase the validity and benefits of transforming the organizations core values. Change is never easy and for a small company by Daymark with several limitations like scale, finance and growth opportunities, change is even more difficult. Hence it is crucial for us to ensure we provide enough evidence, understand financial limitations and chart an easy path for the transformation. The upside to it is also that since it is a small firm, we don't have to jump through many hoops to set up new systems and disturb any current processes causing harm to the company's operations and that is exactly what this project intends to do.

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I. Introduction

Daymark Energy Advisors is a successful energy consulting company that helps their clients in the environmental industry. Their consulting is specialized in energy infrastructure, regulations, and markets. They are based out of Worcester, Massachusetts, but they perform work in the electric and natural gas industries all around North America. Daymark offers many services, such as power system planning, clean energy, procurements and portfolios, regulatory economics, and utility rate designs. They are a small company made up of 40 employees. These employees work in the fields of energy consulting, executive management and energy analysis.

Daymark Energy Advisors' uses Microsoft Excel and Deltek Vantagepoint as their primary tools. To analyze their data, they use Microsoft Excel. For resource management, they use Deltek Vantagepoint as their main data warehouse. Daymark uses XML formats and small data marts for storage. Clearly, this consulting firm is not taking advantage of the most modern technology, even though their overall production would greatly benefit from modern organizational tools, such as Tableau. The company does not have a dedicated Business Intelligence team and no integrated information systems, which is most likely holding them back from reaching their true potential.

Although Daymark uses small data marts on projects, correlation with business verticals remains very limited, which hinders their ability to fully utilize business intelligence operations. In terms of the Business Intelligence model, Daymark is in stage two, or the 'child' stage. This means they have not yet integrated strong business intelligence methods and practices into their work. For the future, Daymark Energy Advisors would greatly benefit by strengthening their data warehouses, implementing strong Business Intelligence methods, and applying cross-vertical correlations. For this project we are focusing on business unit that works on client projects dealing with energy load, generation and its price.

To cite an example of what Daymark does, the below infographic (Figure 1) shows the business unit we have focused on in this project. They provide consultation to client companies on their projects to set up generators to supply energy in the wholesale market. Companies like "Eversource" and "National Grid" buy energy from the wholesale market and supply it to us.

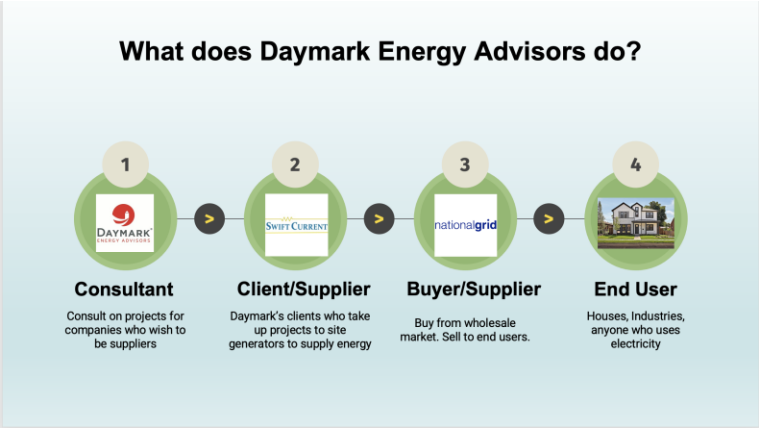

Figure 1 – Daymark's role in the industry

To understand the performance of other companies in the industry which are well known for their BI and data first approach, we examined two big shots of the consulting industry. The first case study was about McKinsey & Company, which is a global management consulting firm that was founded in 1926 by a professor from the University of Chicago. Like Daymark, McKinsey is a consulting firm that helps clients solve management problems and has become one of the most successful and widespread firms in the world. One of McKinsey & Company's distinguishing features is their artificial intelligence lab called the QuantumBlack Lab. This highly specialized lab is made up of technologists, designers, and product managers. The extensive use of QuantumBlack proves McKinsey's commitment to the use of Business Intelligence. The company's main goals with QuantumBlack are to continue advancing their artificial intelligence software, and to keep using this software to minimize the clients' risks within their companies.

Other than QuantumBlack, McKinsey & Company also uses many other tools, such as SQL, python, kedro, and databricks. This helps them for a smoother transition into the sectors of shipping, aviation, and steel. Using descriptive analytics and forecasting, McKinsey primarily helps their clients optimize their fuel usage, which is a huge concern across industries. This firm is in the fifth stage, or the 'sage' stage, of the Business Intelligence maturity model. This means that they are successfully using modern technology, comprehensive analytics, and strategic foresight to assist their clients. These reasons are why McKinsey & Company are leaders in the consulting industry.

The second case study was about Boston Consulting Group, also known as BCG. They were founded in 1963 and are also a global leader in the management consulting industry. BCG is part of the "Big Three" consulting firms, alongside McKinsey & Company. Essentially, the "Big Three" is a nickname for the most recognized and distinguished firms in the industry. Boston Consulting Group has a very large number of power users. Moreover, power users are people that use a computer with advanced features, hardware, and programs. BCG is known for utilizing innovative, data-driven tools. One of their main tools for analysis is python. With no surprise, this company is in the fifth stage, or the 'sage' stage, of the Business Intelligence maturity model. This means they are successfully using their innovative technology to assist with their clients' problems and needs. Because of their ability to turn their data-driven ideas into actionable strategies, Boston Consulting Group had made a profound impact on the consulting industry as it is today.

II. Proposed BI Solution

In this section, we will discuss the proposed BI solution, the main components and the role/value of each component for Daymark Energy Advisors. Business Intelligence (BI) is an umbrella term that encompasses the technologies, applications, and processes for gathering, cleaning, storing, analyzing, summarizing, and visualizing data to help users make well-informed decisions. The types of analytics being used are Descriptive and Predictive analytics. Getting into the finer details of BI Framework as shown below:

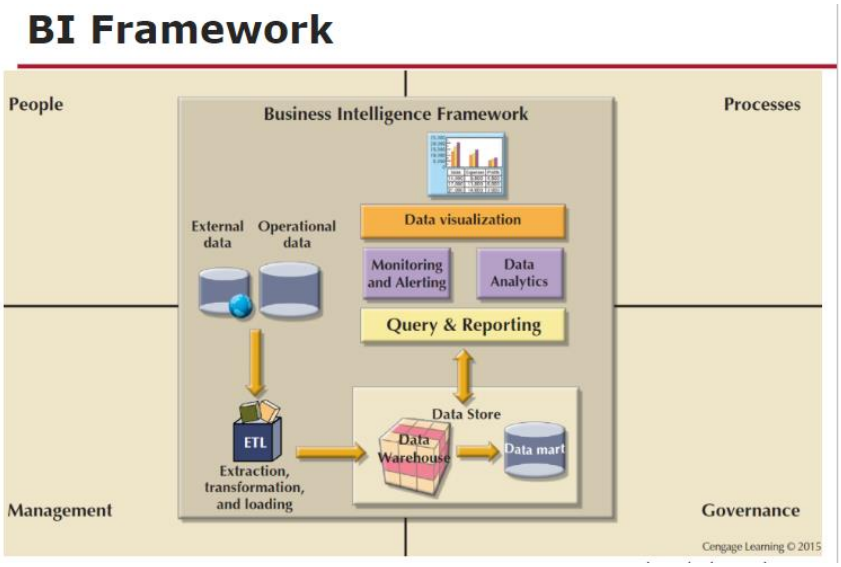

Figure 2 – BI Framework

1. People

This proposed BI solution is supposed to help people, without people the solution will have no use. The people in this framework refer to internal users (I.e. technical/ power users, front-line users and senior management). The role of the technical / power users will be to train other users, maintain and build upon this proposed BI solution.

2. Management

The management team will come up with the entire strategy and project plan, resource allocation and defining the key performance indicators (KPIs) to ensure a timely and successful delivery of the project.

3. Governance

Governance is an important facet of the BI framework where measures are taken to ensure high quality data management (i.e. data accuracy, data auditing and cleansing process). Compliance is also a subset of governance; this considers the legal and regulatory requirements since most of the data being used is from public data sources this is not much of a problem. Lastly, data security is an essential subset of the governance BI framework where we ensure the usage of strong encryption algorithms, access controls and confidentiality of data.

4. Process

For the Technologies used in the ***Processes*** facet are listed below:

i. Cloud hosting – Amazon Web Services (AWS)
ii. Relational Database - MySQL
iii. Data Preparation and cleaning – Tableau Prep
iv. Extract, Transform, Load (ETL) - AWS Glue
v. Visualization – Tableau Online

The entire BI solution will be hosted on cloud platform (AWS) which is scalable (can easily expand and accommodate my users and new features) and has high redundancy (.i.e. has multiple failovers to run the application in case a server goes down). The database (MySQL) will be used to store the information and various types of reports can be generated from it. Raw data received from the data sources will be extracted, transformed (i.e. manipulated to have just the needed data for Daymark energy) using AWS Glue and Tableau prep. Lastly, to view the transformed and migrated information stored in the database in a visual or graphical format, Tableau online will be used to publish the aesthetic dashboards over the internet to make it accessible to all users.

A. Star Schema Relational Database Design

A star schema is a data model with my dimensions or tables to store information in a way that can easily be understood and queried. The proposed star schema data model has 5 dimensions with one fact table, the fact table has relationships with all the other dimensions/ tables. In simple terms, you can think of the database as a workbook, with different worksheets (tables or dimensions) and all these worksheets have a master or centrally consolidated worksheet called the fact table.

1. Fact Table: EnergyConsumptionFact
Attributes/columns:

i. DateKey (Foreign Key referencing DateDimension)
ii. StateKey (Foreign Key referencing StateDimension)
iii. ProjectKey (Foreign Key referencing ElectricityProjectDimension)
iv. TemperatureKey (Foreign Key referencing TemperatureDimension)
v. EnergyPriceKey (Foreign Key referencing EnergyPriceDimension)
vi. EnergyUsage (measured in some unit, e.g., kilowatt-hours)

2. Dimension Table: DateDimension
Attributes/columns:

i. DateKey (Primary Key)
ii. Date
iii. DayOfWeek
iv. Month
v. Quarter
vi. Year

3. Dimension Table: StateDimension
Attributes/columns:

i. StateKey (Primary Key)
ii. StateName
iii. Region (if applicable)

4. Dimension Table: ElectricityProjectDimension
Attributes/columns:

i. ProjectKey (Primary Key)
ii. ProjectName
iii. CompletionStatus (e.g., Completed, In Progress, Planned)

5. Dimension Table: TemperatureDimension
Attributes/columns:

i. TemperatureKey (Primary Key)
ii. TemperatureValue (measured in Celsius or Fahrenheit)
iii. WeatherCondition (e.g., Sunny, Rainy, Snowy)

6. Dimension Table: EnergyPriceDimension
Attributes/columns:

1. EnergyPriceKey (Primary Key)
2. EffectiveDate
3. PricePerUnit (e.g., per kilowatt-hour)

Below is the graphical representation of the star schema (Figure 3):

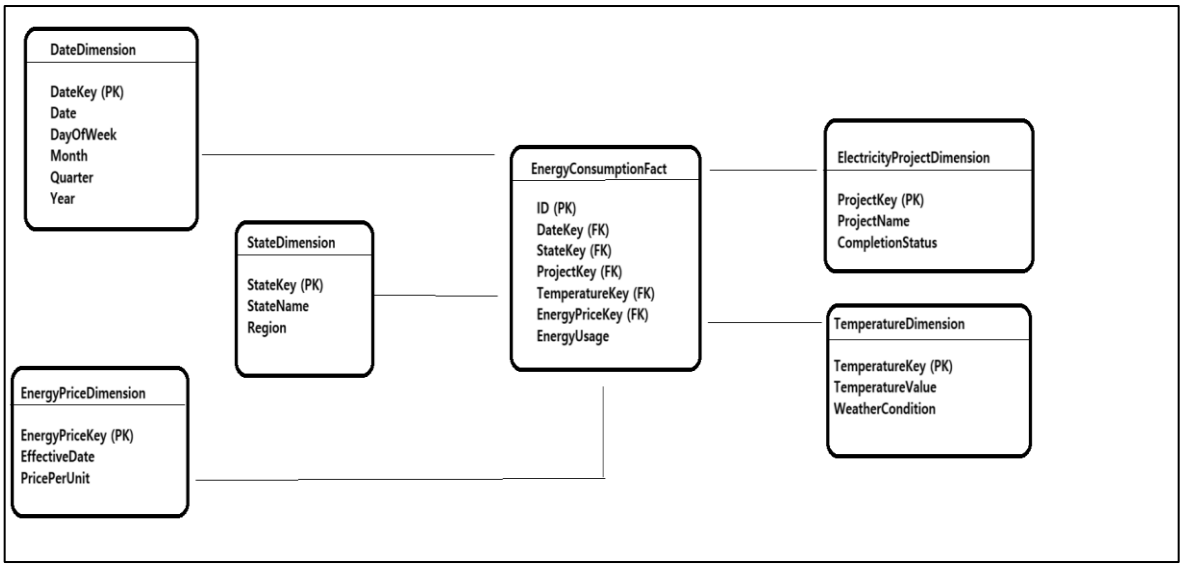

Figure 3 – Star Schema for Daymark Energy Advisors

To connect Tableau to the MySQL database locally you will need a MySQL connector to be downloaded from the Oracle website. Then later specify the IP address or URL as shown below:

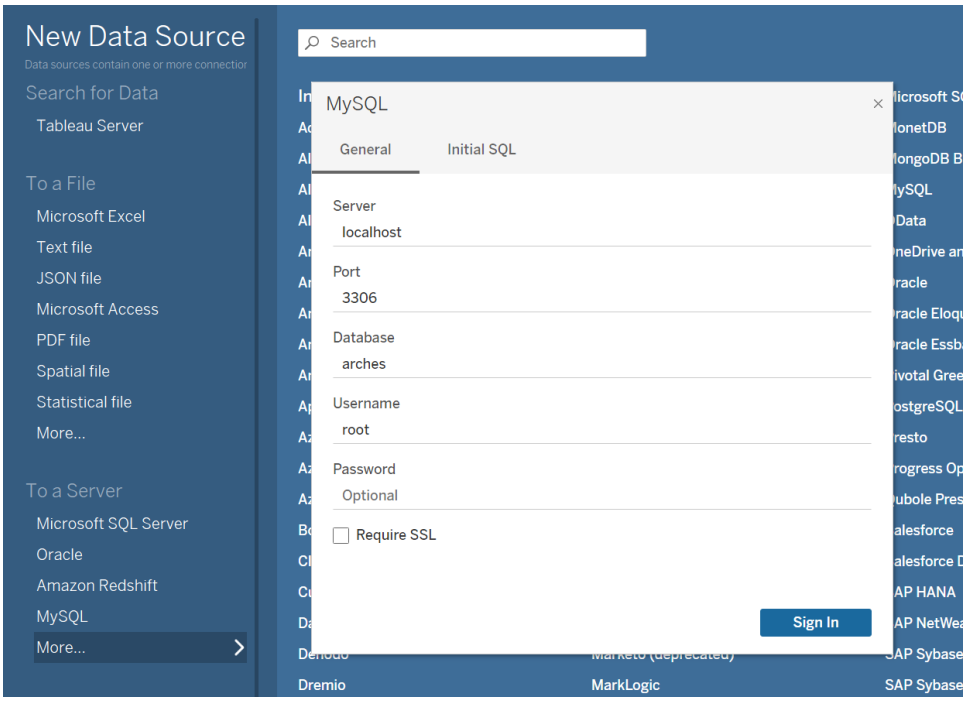

Figure 4 – Tableau set up for MySQL

III. Project Prototypes

The goal of this project is to create a BI solution for Daymark Energy Advisors to help them grow in the BI maturity model and improve the efficiency of their operations. This objective is achieved through three prototypes: two operational/tactical dashboards and an analytics solution through a forecasting model. To achieve this, three different public datasets are used, obtained from the ISO New England website and U.S Energy Information Administration website. ISO New England is an independent, non-profit "Regional Transmission Organization" that oversees the planning and operating of the electric grid in New England. The U.S Energy Information Administration is principal agency of the U.S Federal Statistics System that collects, analyzes and circulates energy related information to promote sound policy making, efficient markets and public understanding about energy. The data and information from these reports are an integral requirement for Daymark Energy Advisors to be able to consult their clients on varied projects for which these are the foundational data points to analyze and build models. Currently, the company downloads these datasets from the websites and analyze them on excel workbooks. This is done in a siloed manner and on AdHoc basis. The two dashboards and the forecasting model from this project can provide a standardized and comprehensive view of the data points, helping save time and improve efficiency in projects. The prototypes are prepared keeping in focus only one vertical of the company which works with energy load, capacity and price-based projects.

A. First Prototype – Energy Load and Price Dashboard

The first prototype is a dashboard about the "Energy Load and Unit Price". The **"smd_hourly" dataset** used for this is from the ISO NE website, which gives data on day ahead demand which means the next day forecast of load, real time demand/load, day ahead unit price for the load, real

time unit price, dew point and dry bulb temperatures and zones. This data is hour wise data for the year 2023 and is updated on the website each day. In the data cleaning process, the zones were categorized into respective states for easy analysis and understanding and the months were categorized into summer (June – September) and winter (January – May) as per the description provided in the dataset index page. A detailed table of contents of the dataset is in Appendix A.

The first dashboard provides a comprehensive view of the above data points to provide a daily update on the changes in load and price in the wholesale energy markets (Figure 5). This is an **operational dashboard** in the sense of the data being at a granular level of each hour, data refresh happens daily, not much processing of data is required and it is used for the preliminary analysis done by the analysts (staff level). The **users** of the dashboard are mainly the **analysts and senior analysts** of the company who can be considered the staff level as per standard practice and can sometimes be used by project managers also. The **five measures**, day ahead demand, real-time demand, day ahead price, real-time price and temperature are used as **metrics/performance indicators** depicted on different dimensions in this dashboard. The dimensions used in this dashboard are the states, months, and weather. There are **two interactive filters**, "State" and "Weather" next to the dashboard title, which interact with all the charts. The "Weather" filter does not interact with the **donut charts which are equivalent to summary tiles**. The "State" filter is available on the two state charts as well. The donut charts are controlled the "Date Parameter" which allows the user to see the average load, price and temperature of any date. The default will be to show the current/latest day's snapshot. There is also a thermometer chart that provides the average temperature of the year.

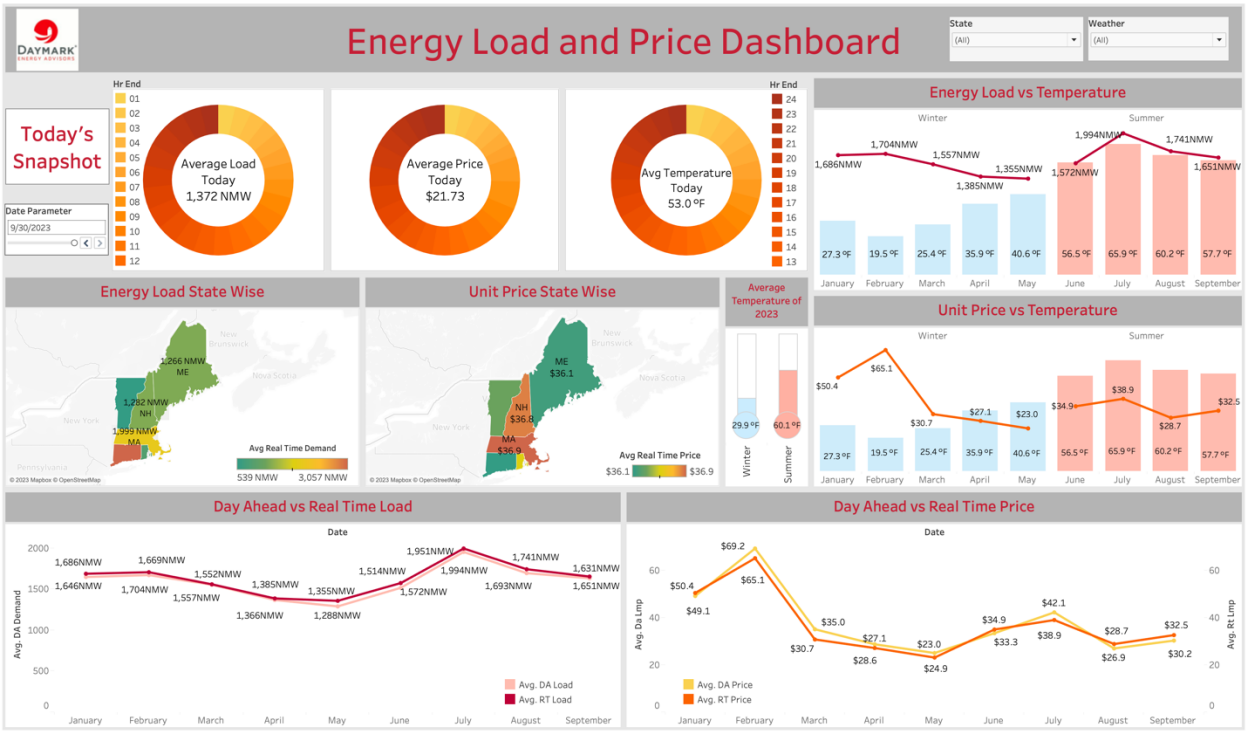

Figure 5 – Energy Load and Price Dashboard

The dashboard although is an informational dashboard, it answers some managerial questions.

1. What is the correlation between temperature and load, temperature and price?
2. How far is the real time (actual) load and price from the day head prediction?
3. How does the load and price vary in New England States? Which is the most feasible state to place generator in? Which state is most feasible to start an industry?

The **first question** is answered with the "Energy Load vs Temperature" (Figure 6) and "Unit Price vs Temperature" (Figure 7) charts. These charts show the change in average load and price with change in average temperature respectively. Through these charts it can be concluded that the load is the highest (1,704NMW & 1,994 NMW) when the temperature is the lowest (19.5 ºF) and highest (65.9 ºF). The logic behind this makes perfect sense that in winter when the temperature dips we turn on the heater and in summer when temperature rises, we turn on the AC causing the load to be high. The understanding of this correlation and variation pattern will help Daymark consult their clients on the right planning for energy generation.

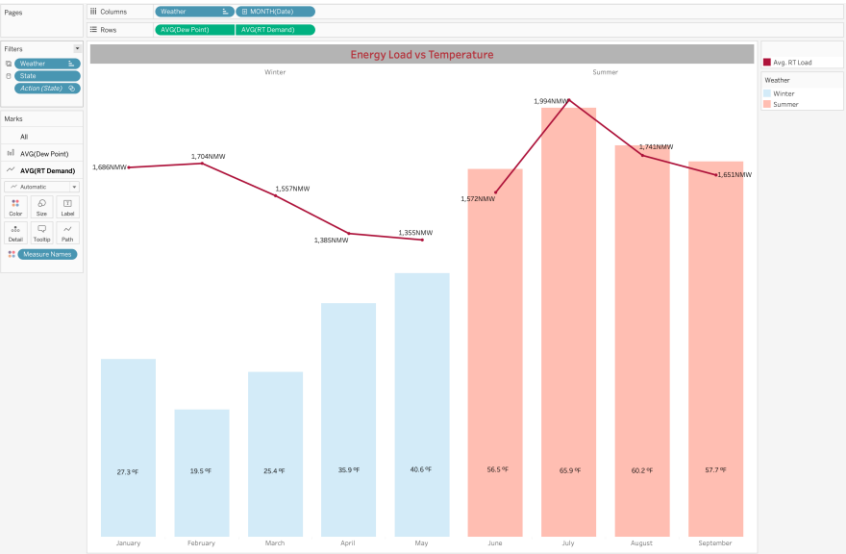

Figure 6 – Energy Load vs Temperature chart

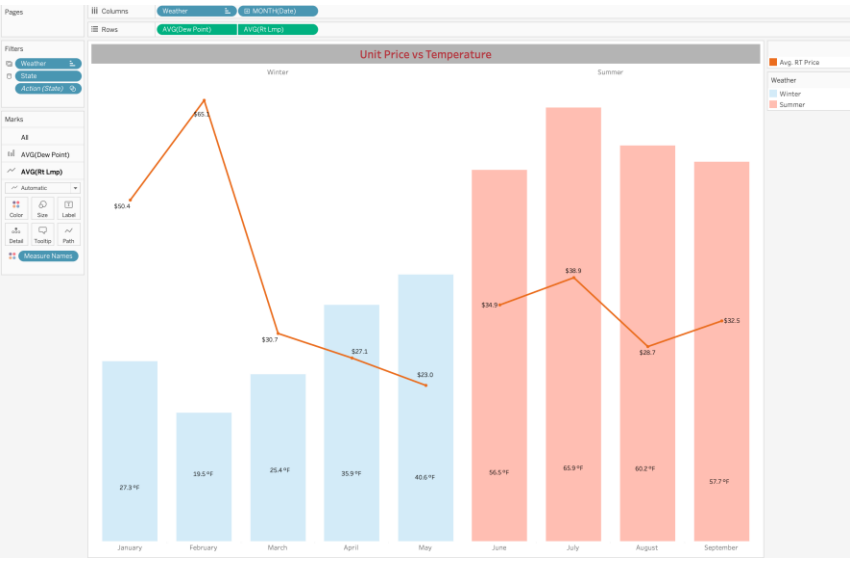

Figure 7 – Unit Price vs Temperature chart

The **second question** is answered by the "Day Ahead vs Real Time Load" (Figure 8) and "Day Ahead vs Real Time Price" (Figure 9) charts. These charts show the trajectory of the day ahead prediction and the real time utilization of load and price. The load chart shows slight variation between the day ahead prediction and real time consumption. The biggest difference is seen in May and July months, but they are not very significant. This tells us that we can expect a similar load consumption the following day based on the day ahead prediction. Whereas the price chart shows higher variations between day ahead prediction and real time price as compared to the demand. A few months in the year have seen higher variations, where generally the real time price is lower than day ahead prediction. Further analysis can be made to understand the cause for this variation. Providing these metrics and analysis to their clients as part of project reports is a necessity for Daymark.

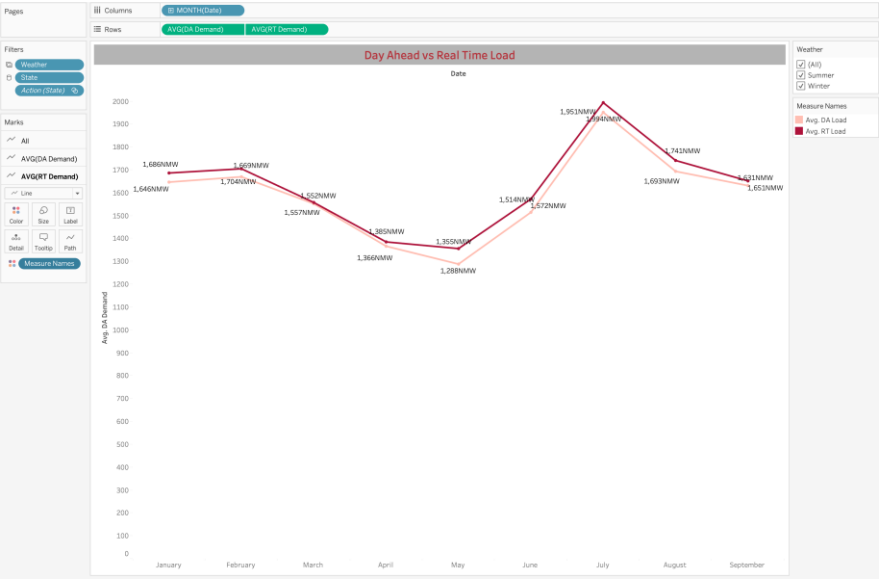

Figure 8 – Day Ahead vs Real Time Load chart

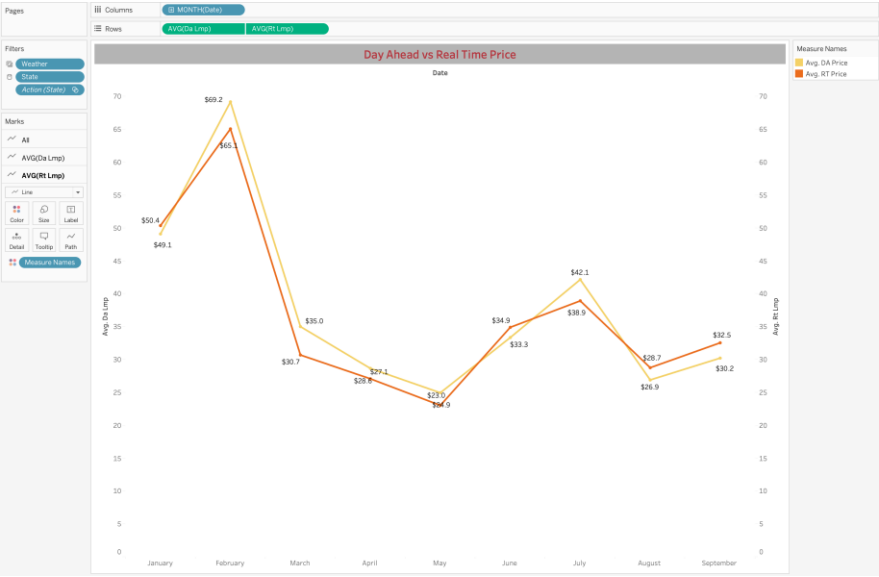

Figure 9 – Day Ahead vs Real Time Price chart

The **third question** is answered by the "Energy Load State Wise" (Figure 10) and "Unit Price State Wise" (Figure 11) charts. The charts provide load and price details state wise helping determine which state has the highest/lowest load and which state has the highest/lowest price. We see that Connecticut has the highest load (3,057 NMW) and Vermont has the lowest load (539 NMW). Whereas Massachusetts has the highest unit price ($36.9) and Maine has the lowest unit price ($36.1). The most feasible state to place a generator which is the supplier is the state with the highest load and price, hence Massachusetts would be ideal. It is the second largest in load and highest in price. Connecticut has lower price; hence it might not be very ideal. The state most feasible to start an industry would be where the price is lowest, due to the electricity charges that the industry must pay; hence Maine or Connecticut.

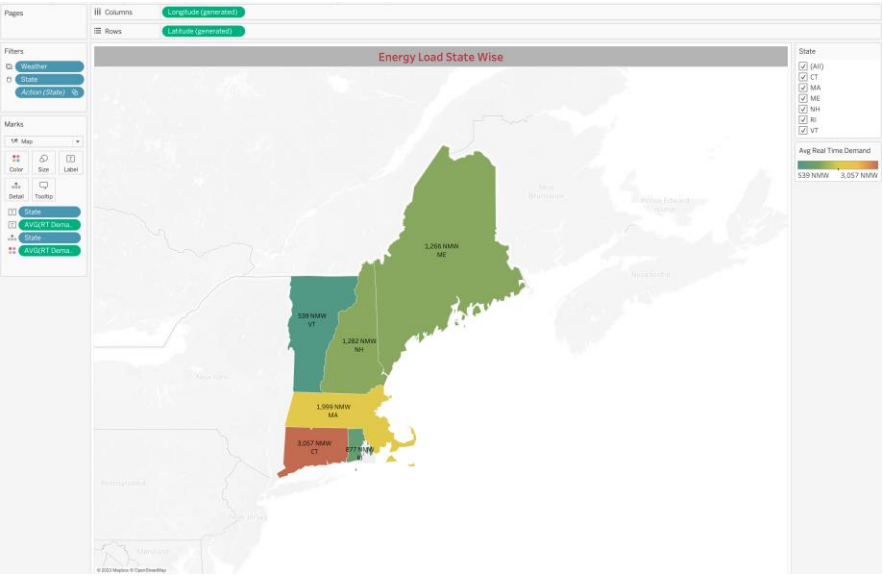

Figure 10 – Energy Load State Wise chart

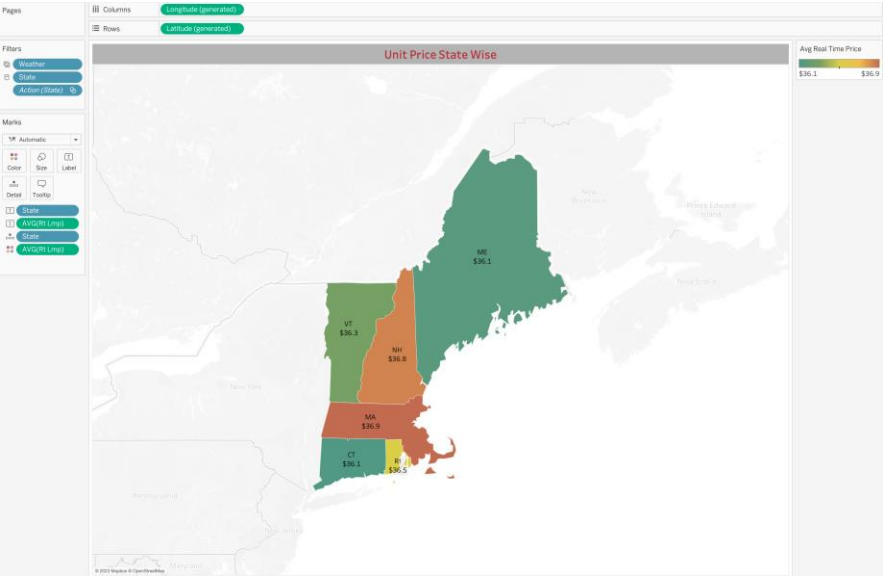

Figure 11 – Unit Price State Wise chart

This way, the "Energy Load and Price Dashboard" can help Daymark guide their clients on the various projects utilizing these data and answer the above managerial questions. These questions can majorly by Daymark's clients as they will be coming up with various projects, but it is the Daymark analysts and consultants helping them answer the questions and taking the projects towards success. To generate this load, there must be a supplier in the market. Those suppliers are the companies putting up generators in various places to generate energy through different sources. The projects generating energy are being tracked in the form of a "Queue Report" dataset, leading up to our second dashboard. The "Project Queue Dashboard".

B. Second Prototype – Project Queue Dashboard

The second dashboard is created using the **"Queue Report" dataset** from the ISO New England website. The dataset provides a summary of all the projects in queue in the New England region for the generators and their upgrades. The dataset provides details of project name, project type (Generator or Elective Transmission Upgrade), Fuel category (Solar, Hydro, Natural Gas, etc..), Capacity in Net Mega Watts, State, Operation Date, Withdrawal Date, Project Status and the Stages of the project. List of all the columns in dataset mentioned in Appendix B. For the data cleaning step, "Fuel Type" is categorized into its respective category by creating a new column, "Fuel Category". The "Project Status" column showed blank for projects that are not started, which is now imputed with "Not Started" for better analysis. Lastly all the "Null" and "N/A" rows was removed from the dataset by filtering them out in the data source in Tableau.

The "Project Queue Dashboard" aims to provide a synopsis of the project queue in New England and New York, helping consultants provide best advice on where the next project should come and the details of it (Figure 12). This can be classified as a **tactical dashboard** based on the information being summarized and detailed if needed, data refreshed daily, used by consultants and helps analyze data to make project management decisions. The **users** of this dashboard are primarily **consultants and senior consultants** who are equivalent to managers in standard practice and can sometimes be used by senior analysts on need basis. The **metrics/performance indicators** for this

dashboard are the **energy capacity (NMW) and the count of the projects**. These measures are displayed on various dimensions like Operation Date, Project Status, withdrawn projects, Fuel Category, State and Project Type. This dashboard consists of **five interactive filters**, "Year of Op Date", "Project Type" and "Project Status" on the top right next to the "Project Operation Summary" chart and "State" and "Fuel Category" filters in their respective charts. These filters are connected to all the charts in the dashboard to provide interactivity. The two **donut charts** representing project count and capacity status wise **act as summary tiles** as well to highlight the two metrics of this dashboard. The most **important filter is the "Project Status"** filter, which is present in the chart as well, because most times the managers would want to see the metrics for projects yet to start as that gives an estimate to plan for future projects.

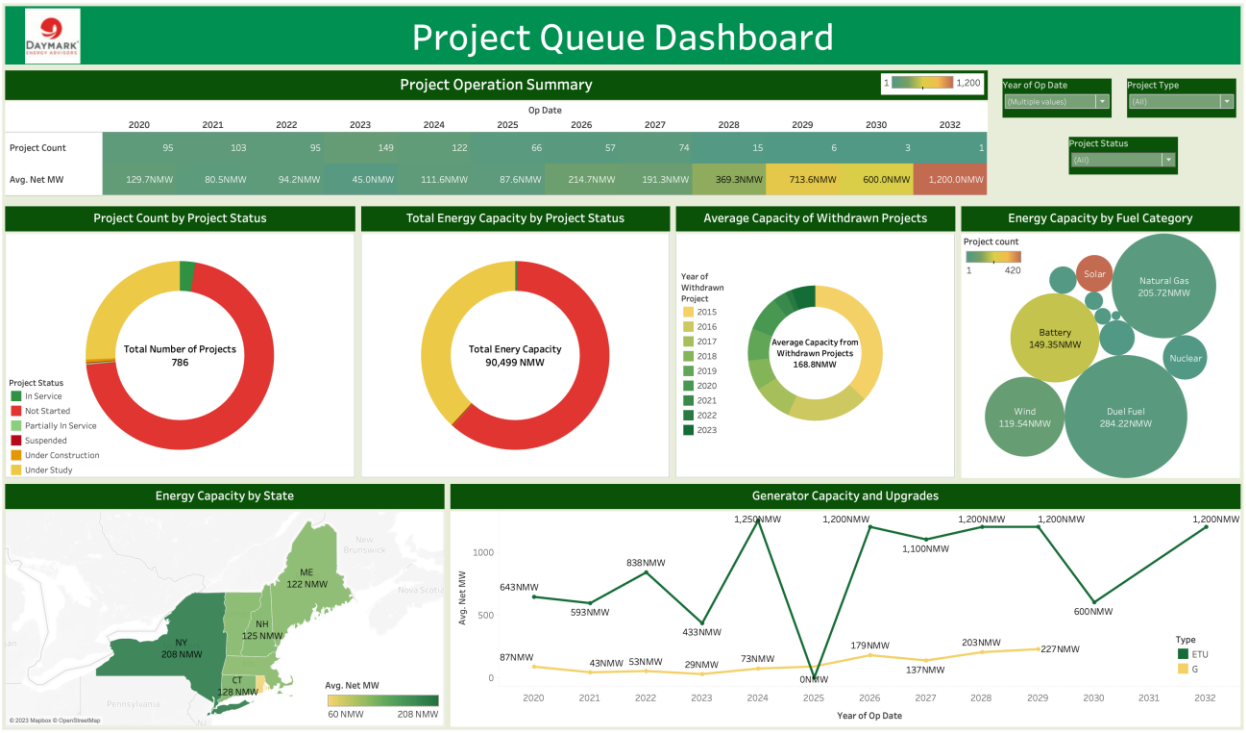

Figure 12 – Project Queue Dashboard

The managerial questions for this dashboard are:

1. Which is the most feasible fuel category to set up a generator in and in which state?
2. Which is the best location to start an interconnection project? In which year?
3. Which year is generating the highest and lowest energy? Which year would be most feasible to operate a generator from?

The **first question** can be answered by the "Energy Capacity by Fuel Category" (Figure 13) and "Energy Capacity by State" (Figure 14) charts. The fuel category chart is a bubble chart that provides the summary of number of projects through colors and average net megawatt through size, for various fuel categories like Wind, Natural gas, Battery, Solar, Diesel Fuel, Hydro, etc. It is foundational to understand the contribution of each fuel type in the total energy generation for companies to decide on their projects. The fuel category which has the highest capacity in the queue, meaning project that are yet to be started and are under study can be considered the most competitive one keeping in mind the demand to set up generators in that category. Hence, by

filtering for “Not Started”, “Under Study” and “Under Construction” in project status we can conclude that Diesel fuel (296.81 NMW) can be the most feasible fuel category to start a generation project in. Regarding the state, the chart provides energy capacity by state and the same logic as fuel category, New York can be feasible state with the highest capacity in queue, 208 NMW.

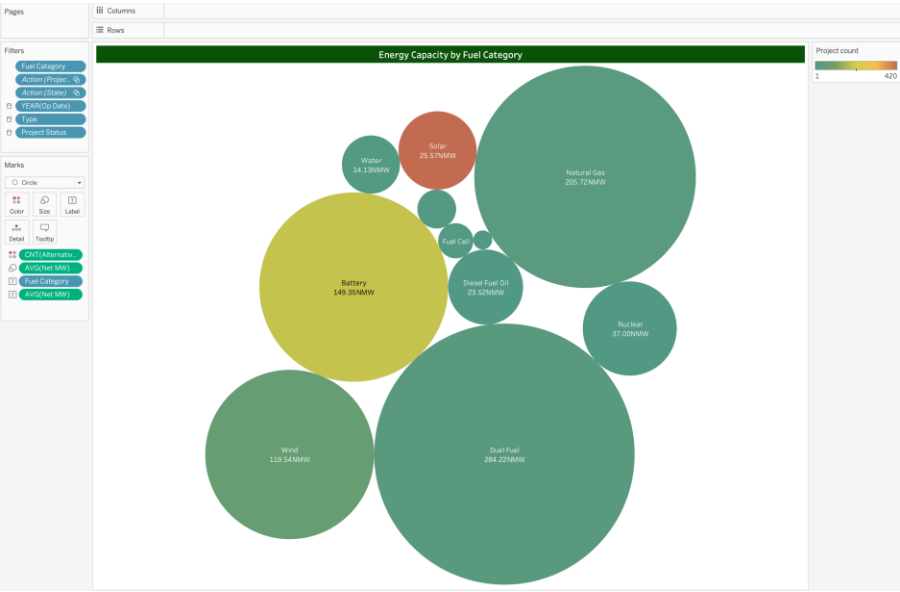

Figure 13 – Energy Capacity by Fuel Category chart

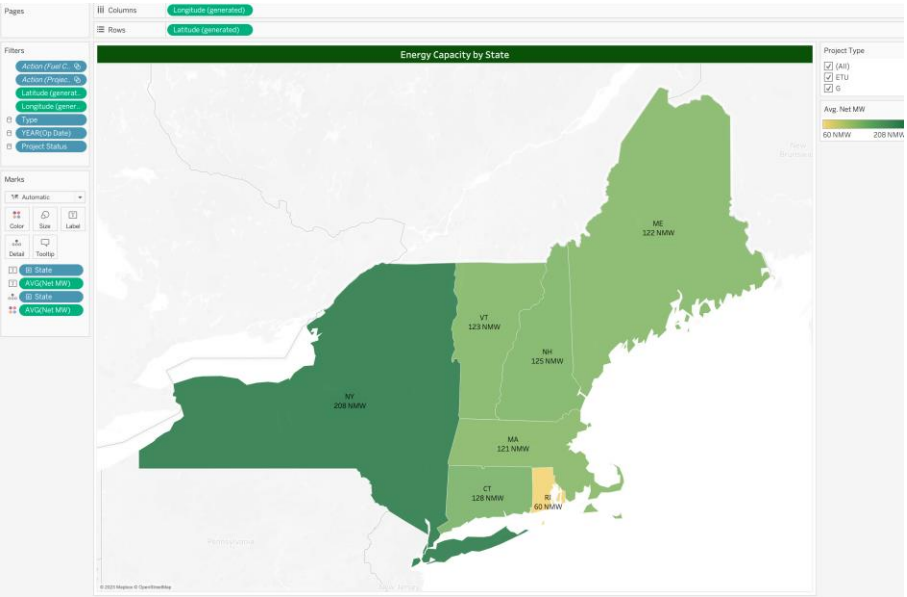

Figure 14 – Energy Capacity by State chart

The **second question** can be answered with the help of the “Generator Capacity and Upgrades” (Figure 15) chart from this dashboard, but mainly from the “Energy Load and Price Dashboard” price by states charts. In the “Unit Price State Wise” (Figure 11) chart from the first dashboard, the demand and supply difference in energy can be understood by calculating the largest delta in price between states. With this calculation, the interconnection or the transmission upgrade project can be most profitable to set up between the lowest and highest priced states, buy energy in the lowest

priced state (Maine) and sell in highest priced state (Massachusetts). From the second dashboard, we see that there is no transmission upgrade project planned in 2025. Hence 2025 might be good year to plan for a project. But with this topic there are further analysis to be done to decide, for which the above data points can be the preliminary feed.

Figure 15 – Generator Capacity and Upgrades chart

The **third question** can be answered from the "Project Operation Summary" chart (Figure 16). The year with highest capacity is 2032 with 1200 NMW average capacity and the lowest capacity is in 2021 with 84.9 NMW average capacity. This is for the projects that are not already in service.

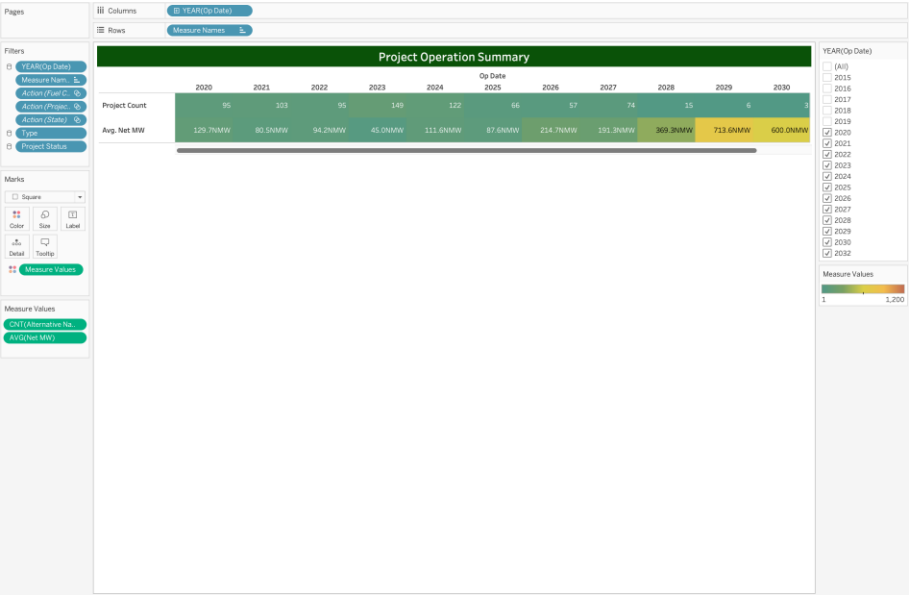

Figure 16 – Project Operation Summary chart

This dashboard provides information for preliminary analysis and becomes the foundation for many more complex analyses as per project requirements. As a future scope for dashboards in Daymark, various dashboards can be created for different verticals of the business like regulatory,

power systems, product cost modelling and most importantly for human resource management. A consulting resource plan dashboard can be of utmost importance in this company. Due to the lack of human resource dataset of Daymark, a prototype was not prepared. But we would like to list this as a recommendation and future scope.

C. Third Prototype – Forecasting Model

The third part of the prototype is the analytics. BI solution is not just about the visualization tools, but encompasses a whole range of data driven solutions, some of which we discussed in the previous section. To exhibit a prototype beyond visualization, a **"forecasting model"** has been created for the analytics section, forecasting energy prices using gas prices for the New England region. While consuming energy there is a hierarchy in fuel type from which the energy is supplied as per load. It starts with renewable energy sources and as the load increases, nuclear, gas and oil energy are utilized to meet the requirements respectively. While discussing on the topic with Daymark's point of contact for this project, we understood that majority of the times the load is in the range where gas generators set the marginal price in the market. With this information, we generated the **gas prices report** from the U.S Energy Information Administration website and **energy prices report** from the ISO New England website, used in the first dashboard. When the prices were plotted from 2020 to 2023 and compared, it came to our notice that **overall energy prices and gas prices are highly correlated** (Figure 17). The gas prices report provides a future forecasting of the prices as well, whereas there is **no report providing the energy price forecasting**. Hence, keeping the **gas prices** as the **baseline** we **forecasted the energy prices** till 2032, by fitting a **liner equation** to its historical relationship (Figure 18 & 19). This relationship is termed as "market heat rate" which is power price divided by gas price. This forecasting model is built in **excel**.

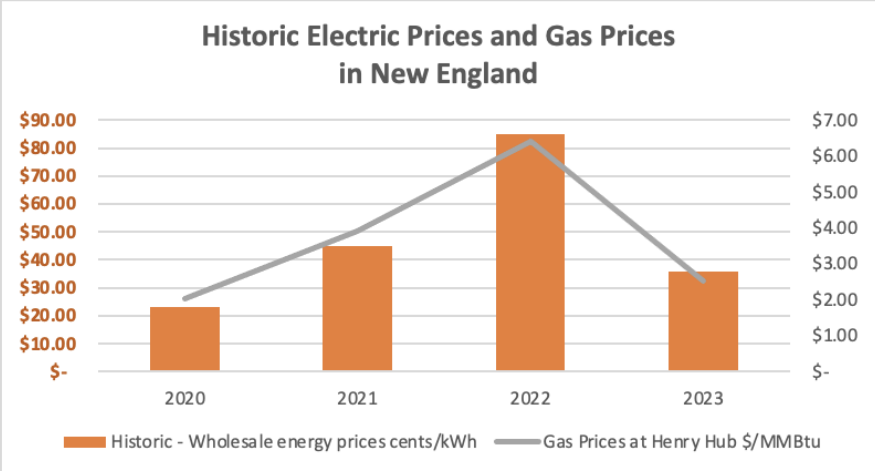

Figure 17 – Energy and Gas price correlation

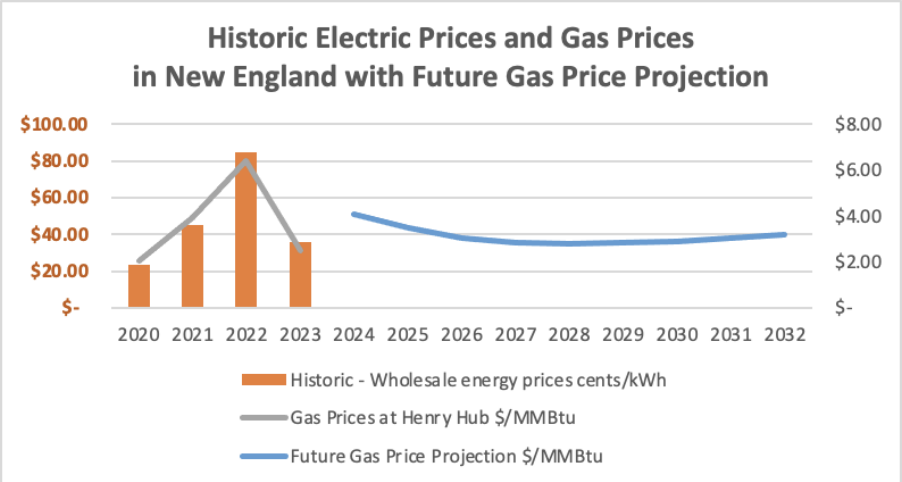

Figure 18 – Gas price forecasting

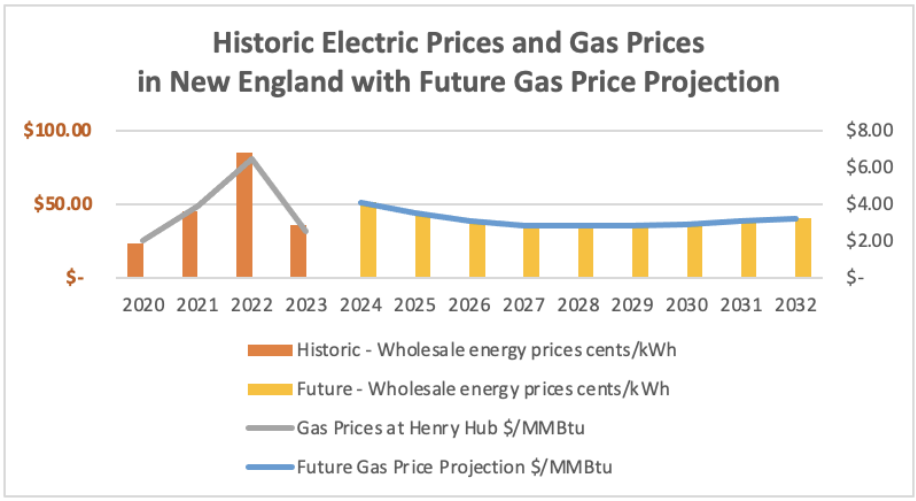

Figure 19 – Energy price forecasting using Gas prices

Year	Historic - Wholesale energy prices cents/kWh	Gas Prices at Henry Hub $/MMBtu	Future Gas Price Projection $/MMBtu	Future - Wholesale energy prices cents/kWh	Market heat rate
2020	$ 23.33	$ 2.04			11.4654
2021	$ 45.02	$ 3.91			11.5196
2022	$ 84.90	$ 6.42			13.2274
2023	$ 35.68	$ 2.52			14.1568
2024			$ 4.07	$ 51.28	12.5923
2025			$ 3.49	$ 43.94	12.5923
2026			$ 3.07	$ 38.60	12.5923
2027			$ 2.85	$ 35.93	12.5923
2028			$ 2.80	$ 35.26	12.5923
2029			$ 2.83	$ 35.57	12.5923
2030			$ 2.91	$ 36.67	12.5923
2031			$ 3.04	$ 38.33	12.5923
2032			$ 3.21	$ 40.40	12.5923
2033			$ 3.42	$ 43.03	12.5923
2034			$ 3.57	$ 44.95	12.5923
2035			$ 3.68	$ 46.36	12.5923

Figure 20 – Excel Calculation

To gather a different perspective on forecasting, we also created a new excel database by gathering the past ten years (2014 to 2023) **energy and gas prices** from the respective reports and connected it to **Tableau** to prepare a forecasting model using the **"Forecasting"** feature with additive trend and seasonality. Tableau forecasts future values in exponential smoothing model which projects values of a regular time series from weighted averages of the past values in the series. The trend and seasonality components were included as we do expect an increase or decrease in future values, i.e. the trend and repetitive and predictable fluctuations due to a scenario like temperature, i.e. the seasonality. Using the past ten years data, the next ten years of energy and gas prices are plotted in tableau (Figure 21).

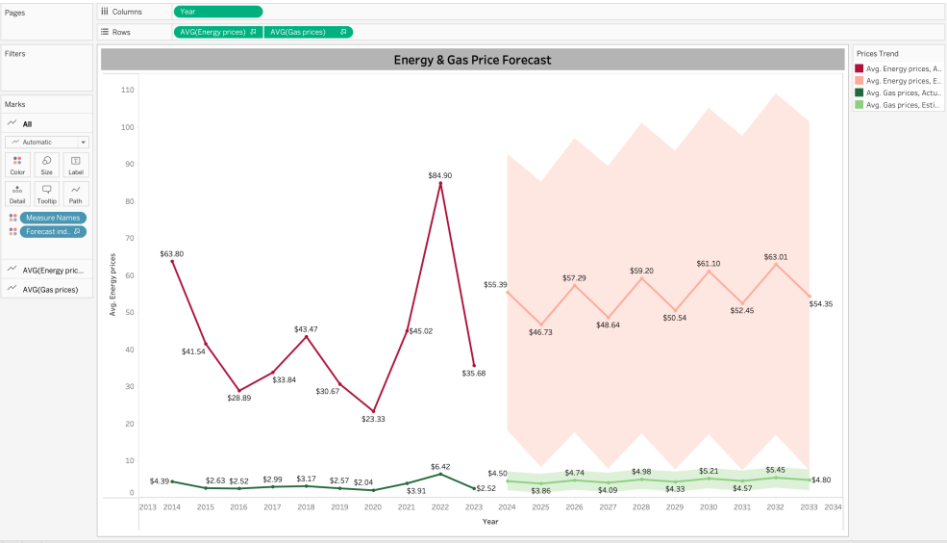

Figure 21 – Energy and Gas price forecasting in Tableau

We see immense scope for inclusion various types of BI solution in Daymark. The above prototypes are simple, easy examples to showcase the smooth transition into using new technology and tools and the benefits from them. In our opinion, these prototypes and solutions can help enhance the operational efficiency of Daymark Energy Advisors and slowly move towards crossing the chasm and progress in the BI maturity model. To make this progress and implement the BI solutions, the company needs to transform, not only in the tools they use but also in mindset and leadership. The next section discusses ways to implement our recommendations.

IV. Implementation

Daymark Energy Solutions is serving a purpose to do consulting for energy companies to help them reach their goals in building their data, management and energy efficient ways. As a business consulting team, we have several implementation recommendations for them.

A. Managerial Implications

The first is **Managerial implications**. To delve deeper into the topic it is important to discuss what are the managerial implications that we can provide to daymark. The managerial implications consist of the following:

1. **Strategic alignment** to ensure that BI implementation aligns with Daymark's overall strategic objectives. The managerial team should continuously engage with the department heads and the key stakeholders to understand the specific goals and challenges associated. This alignment will help daymark to tailor specific BI solutions to address unique needs of each team.
2. The next will be **Change Management** to recognize the shift to BI to break the chasm. Bi implementation can bring a significant organizational change and the managerial team should implement necessary change management strategies to address the employees concern to get used to the new change and foster a positive attitude towards the transition.
3. To address those change management challenges, Daymark will require to **identify skill gaps** within the current workforce to upskill employees in BI technologies and methodologies. Regular communication, training programs, and feedback mechanism will prove to be essential components to have a successful change.
4. After that, Daymark will need to **establish some clear performance metrics and KPIs** aligned with the business objective, and these metrics should be regularly monitored and evaluated. Here, managers should work collaboratively with the BI analyst to refine and adapt these metrics based on evolving business needs which will ensure continuous improvement and optimization.
5. Next, Daymark needs to foster a **culture of collaboration and cross-functional integration** between all the teams. To do so, we recommend the managerial team to encourage communication channels between different departments and ensure insights derived from BI are shared across the organization. This will help Daymark to promote knowledge sharing and enable a holistic understanding of consulting processes.
6. After changes within the teams, we will help Daymark to do a **comprehensive budgetary plan for BI implementation**, encompassing software licensing, training, infrastructure upgrades, and ongoing maintenance costs. To do so, the managerial team also should work closely with finance to allocate resources effectively, balancing the need for immediate wins with long-term sustainability.
7. We will assist Daymark to implement a **robust risk management strategy** that will help them to anticipate potential challenges associated with BI implementation which includes risk assessments, identifying obstacles such as data security concerns, technological disruptions, and so on. To mitigate these concerns for the BI adoption's overall success, appropriate risk mitigation strategies should be adopted to reduce the impact of the difficulties.
8. Finally, we recommend Daymark to foster a **clear and transparent client communication** approach. The client should be informed on the developments, advantages, and difficulties associated with implementing BI through frequent updates and feedback sessions. This will build their trust in the company and will also ensure client' alignment with the organization's business intelligence strategy will be facilitated by this.

Here is the Kotter's Eight-Step Model for Daymark's Organization Transformation –

Kotter's Eight Steps	Application to Daymark Energy Advisors
Establish a Sense of Urgency	Daymark thinks their data system is scattered. Realized moving from Excel to advanced BI stages will help to get a competitive advantage by seeing success stories from industry leaders like McKinsey & Boston Consulting Group.
Form a Powerful Coalition	Assemble a cross-functional team, including energy consulting and executive management. Partnering with farms to guide the transformation.
Create a Vision for Change	Clearly articulate the benefits of BI adoption aligning the vision with Daymark's mission and strategic goals. Set a goal for 5 years.
Communicate the Vision	Foster open communication about the BI initiative. Meetings to ensure every employee understands the vision and their role in the implementation.
Remove Obstacles	Identifying and eliminating barriers to BI adoption, including upgrading technology infrastructure, providing necessary training, and addressing resistance to adoption among employees.
Create Short-term Wins	Implement quick wins to demonstrate BI's value. Develop prototypes like operational dashboards/tactical dashboards using public datasets to showcase tangible benefits.
Consolidate improvements and build on the change	Hire BI experts. Strengthen DW, integrate BI toolsets. Encourage cross-vertical correlations. Leverage success stories to encourage further adoption
Anchor the Changes in Corporate Culture	Continuing BI practices. Recognizing and rewarding employees actively contributing to BI initiatives. Foster a data-driven mindset across all departments.

B. Technical Implications: Addressing the Data Quality Issues

Later they must address the **technical implications** to address the data quality issues. We are recommending the following strategies -

1. **Data Profiling and Cleaning**

Usage of Tableau Prep will be helpful to identify and clean inconsistencies in datasets from ISO New England and U.S Energy Information Administration. There can be challenges with integrating Tableau Prep. Our team will help Daymark with the understanding of the data structures and potential issues. Custom scripts might be needed for specific data nuances.

2. **Data Validation and Verification**

We recommend the implementation of robust validation processes with AWS Glue for ETL operations to ensure accuracy. This will not only aid in cleaning up inconsistencies, but also will

help in transforming the raw data into a polished data which is a foundation for effective analysis. There can be challenges dealing with large datasets. Our team will assist Daymark to handle data partitioning, parallel processing and implementing error handling mechanisms within AWS Glue scripts which will ensure that the inaccuracies are flagged for further review.

3. **Quality Assurance Protocols**

We advise Daymark to establish QA protocols for data entering MySQL databases. Conduction of regular audits and use of AWS Glue for seamless ETL will be helpful. This will ensure smooth data journey from the source to the database. As a BI consulting company, we will help Daymark in doing careful review of existing data structures.

4. **Trend Analysis**

Trend Analysis for social media and internet data will be fruitful to know about current energy trends, energy efficiency trends, current innovations and how the users are perceiving each energy trend and the associated complications. This will help Daymark to consult their client company in a more relevant and constructive way. Our company will help Daymark to implement advanced Natural Language Processing Algorithms and machine learning models to extract meaningful insights from unstructured texts.

C. Ethical Implications: Addressing Privacy Concerns

While Daymark will be using cloud, there some ethical concerns might arise. We will help Daymark with privacy laws within Massachusetts and other New England States and how to uphold ethical standards with compliance with the company's objective.

1. **Data Governance Policies & Customer Confidentiality**

We recommend Daymark to develop strict data governance policies that not only safeguard the client's information but also align with the Massachusetts Data Privacy Law – 201 CMR 17.00 and other relevant privacy regulations in other New England states. This will help to safeguard customer information by handling shared data securely to avoid potential client loss.

(The objectives of 201 CMR 17.00 is to ensure the security and confidentiality of customer information in a manner fully consistent with industry standards; protect against anticipated threats or hazards to the security or integrity of such information; and protect against unauthorized access to or use of such information that may result in substantial harm or inconvenience to any consumer)

2. **Anonymization & Aggregation**

We will help Daymark to implement advanced techniques such as anonymization and aggregation to protect identities in BI outputs by strictly following to the privacy principles outlined in the New England states privacy laws. This will ensure compliance while maintaining the utility of the data.

3. **Ethical Training**

Providing ethical training in form of workshop, emails, meetings to employees who will be involved in BI implementation is necessary because there are associated confidentiality and legal

compliance to consider with respect to Massachusetts and other New England privacy regulation. We will help Daymark in the training content to address specific provisions in each state.

4. **Continuous Monitoring**

After training, it is necessary to establish an effective and continuous monitoring process of the BI processes. We will help Daymark to find ways to mitigate the risk of privacy breaches across the region by adhering the privacy laws.

5. **Threats from Within**

There is a chance of internal leaks, to prevent that we will consult Daymark for the technical safeguards and ethical responsibility to maintain the BI implementation process that resonates with regional legal expectations.

6. **Data Security**

There might be a possible risk of weak encryption or third-party attack risks. Daymark will need to ensure to adhere to the General Data Protection Regulation (GDPR), California Consumer Privacy Act (CPPA), and other regional privacy laws in New England. This will ensure a comprehensive approach to data security which will meet international, state and regional standards.

7. **Regulatory Compliance**

Adherence to GDPR, CPPA, and New England regional privacy laws will protect Daymark to meet the legal requirements associated with its cloud and online presence across different regions.

Laws: GDPR, Chapter 3, Article 12 (Transparent information, communication and modalities for the exercise of the rights of the data subject). CPPA, Right to Limit.

D. Mitigation Approaches

1. **Customer Confidentiality Agreements**

We recommend Daymark to establish legal documents mentioning rules, regulations, and consequences for confidential information disclosure for a smooth BI implementation process.

2. **Privilege Control & Data Encryption**

To mitigate the encryption and attack risks, we will help Daymark to build secure encryption algorithms and implement access control to data marts and lakes. It is very important that employees get access to the data only using systems within the company.

3. **Robust IT Infrastructure**

Investing in intrusion detection systems, secure cloud, and on-premises environments with firewalls and up-to-date security patches are recommended.

4. Data Retention and Destruction Policies

It is very common to face a potential data loss. We recommend Daymark to define the polices clearly for data retention and destruction to minimize the risk of storing data for an extended period.

V. Summary and Conclusion

Transforming an organization involves multiple hurdles and limitations to overcome to achieve the goal. But it needs to start somewhere. With this project we aimed to create that starting point of change and map out a set of business intelligence solutions and implementation recommendations which are simple and easy to begin with. The star schema and tech stack recommendation prepared for Daymark helps the company with a customized plan to break into the new ways of operations. Focusing on one business vertical that deals with energy load, capacity and price datasets for their projects, we have tailored our star schema and prototypes. The operational and tactical dashboard prototypes provide a complete picture of the multiple data points to be utilized in consulting on projects. These dashboards primarily act as an informational dashboard to help the company stay on top of the daily changing scenario but also are very specifically used in projects utilizing this analysis predominantly. The "Energy Load and Price" dashboard gives an overview of the day ahead and real time load and price and the temperature data in different dimensions like states, months and weather. The "Project Queue" dashboard provides and overview of all the projects in queue and in service to site generator or add transmission upgrades in the New England plus New York region. This provides all the details of the projects on different dimensions like states, project status, fuel category and years. The third prototype is the analytics section for which the energy prices have been forecasted using gas prices until 2032 by fitting a linear relationship in excel. There is also the ten-year forecast of both energy and gas prices using the past ten-year data done in tableau. Tableau is an easy and interactive tool to utilize for various analysis and visualization. There is a huge scope of improvement on the types of dashboards and analytics that can be created for Daymark using their incredible data availability.

In conclusion, we would like to recommend the implementation of these prototypes to gain experience in this skill and build on it to become proficient. The Kotter's eight step model tailored for Daymark helps as a step-by-step guide to implement these solutions and transform. We recommend that the company should utilize its few power users or hire a business intelligence analyst to look after these tasks. Since it is small firm, there is no need for a huge BI team, hence there is no HR cost to be incurred. All the tools suggested are financially feasible to help lessen the companies burden in this transition process. Daymark currently adheres to strict regulations on the ethical aspect in terms of maintaining confidentiality, encrypted files and more. Some of those recommendations act as a reminder to continue the work on ethical and privacy related aspects with the transition. By acting on the recommendations, and guidelines, we believe Daymark Energy Advisors can successfully implement BI, elevate its maturity level, and enhance efficiency in energy consulting services.

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Appendix A

ISO New England Public

Explanation of 'YYYY' SMD Hourly.xlsx File

The data in this file comprise hourly Day-Ahead (DA) and Real-Time (RT) demand, DA and RT locational marginal prices, weather data, system load, and regulation market clearing prices for the ISO New England Control Area (ISO NE CA) and its eight wholesale load zones.

Column Heading	*Description*
Date	The calendar date of the provided data
Hr_End	The hour of the observation, in hour ending and 24-hour convention
DA_Demand	Day-Ahead Cleared Demand, in MW, is comprised of cleared fixed and price-sensitive demand bids plus the net of cleared virtual activity (decrement bids and increment offers); The ISO NE CA value is the sum of the load zones and the Hub values
RT_Demand	Real-Time Demand, in MW, is Non-PTF Demand for wholesale market settlement from revenue quality metering, and is defined as the sum of non-dispatchable load assets, station service load assets, and unmetered load assets. Starting on June 1, 2018, this total also includes the grossed up demand response value.
DA_LMP	Day-Ahead Locational Marginal Price (LMP) in $/MWh by load zone; 'ISO NE CA' tab contains values for the Trading Hub
DA_EC	Energy Component of Day-Ahead LMP in $/MWh by load zone; 'ISO NE CA' tab contains values for the Trading Hub
DA_CC	Congestion Component of Day-Ahead LMP in $/MWh by load zone; 'ISO NE CA' tab contains values for the Trading Hub
DA_MLC	Marginal Loss Component of Day-Ahead LMP in $/MWh by load zone; 'ISO NE CA' tab contains values for the Trading Hub
RT_LMP	Real-Time Locational Marginal Price (LMP) in $/MWh by load zone; starting on March 1, 2017, this is the hourly average of the five-minute LMP in the hour; 'ISO NE CA' tab contains values for the Trading Hub
RT_EC	Energy Component of Real-Time LMP in $/MWh by load zone; 'ISO NE CA' tab contains values for the Trading Hub
RT_CC	Congestion Component of Real-Time LMP in $/MWh by load zone; 'ISO NE CA' tab contains values for the Trading Hub
RT_MLC	Marginal Loss Component of Real-Time LMP in $/MWh by load zone; 'ISO NE CA' tab contains values for the Trading Hub
	Note concerning weather data: *For each load zone, a representative weather station's data is presented as outlined in the table below, and should not be construed as an observation's applicability to the entire load zone. The data on the 'ISO NE CA' tab is a weighted value, derived from historical electricity sales data, as outlined below.*
Dry_Bulb	The dry-bulb temperature in °F for the weather station corresponding to the load zone or Trading Hub (see below). The summer period is June-September, while the winter period is October-May.
Dew_Point	The dewpoint temperature in °F for the weather station corresponding to the load zone or Trading Hub (see below). The summer period is June-September, while the winter period is October-May.

Weather Station	Station Code	State	Load Zone	NE Summer Weight	NE Winter Weight
Boston	BOS	MA	NEMA	20.1%	21.4%
Bridgeport	BDR	CT	n/a	7.0%	7.5%
Burlington	BTV	VT	VT	4.6%	4.0%
Concord	CON	NH	NH	5.8%	5.5%
Portland	PWM	ME	ME	8.5%	8.2%
Providence	PVD	RI	RI, SEMA	4.9%	4.8%
Windsor Locks	BDL	CT	CT	27.7%	27.7%
Worcester	ORH	MA	WCMA	21.4%	20.9%

System_Load	(ISO NE CA tab only) is the actual New England system load in MW as determined by metering, and is used for planning and reporting purposes, not for settlement; System Load is the sum of metered generation and metered net interchange plus demand from pumped storage units. Starting on June 1, 2018, this total also includes the grossed up demand response value. Beginning on April 1, 2019, this value excludes demand from energy storage devices.
Reg_Service_Price	(ISO NE CA tab only) is the Regulation Market Service clearing price in $/MWh
Reg_Capacity_Price	(ISO NE CA tab only) is the Regulation Market Capacity clearing price in $/MWh
Min_5min_RSP	The lowest pool level five-minute Regulation Service Price in $/MWh within the hour
Max_5min_RSP	The highest pool level five-minute Regulation Service Price in $/MWh within the hour
Min_5min_RCP	The lowest pool level five-minute Regulation Capacity Price in $/MWh within the hour
Max_5min_RCP	The highest pool level five-minute Regulation Capacity Price in $/MWh within the hour
	Note concerning Daylight Savings Time (DST): *In March, the switch to DST necessitates the averaging of the hour ending '01' data and the hour ending '03' data to create the hour ending '02' data. In November, the return to Standard Time is handled by averaging the data for the two hour ending '02' observations.*
	Hourly settlement values are subject to re-settlement by the ISO. Revised data may be posted at any time.

ISO New England Public

Appendix B

Interconnection Requests for New England Control Area As of: 11/8/2023 12:00:00 AM **ISO-NE Public**

Generation, Elective Transmission Upgrade and Transmission Service Requests

Jurisdiction: All **Status:** All

Position
Updated
Type
Requested
Alternative Name
Unit
Fuel Type
Fuel Category
Net MW
Summer MW
Winter MW
County
State
Op Date
Sync Date
W/ D Date
Interconnection Location
Serv
SIS Complete
I39
TO Report
Dev
Zone
FS
SIS
OS
FAC
IA
Project Status