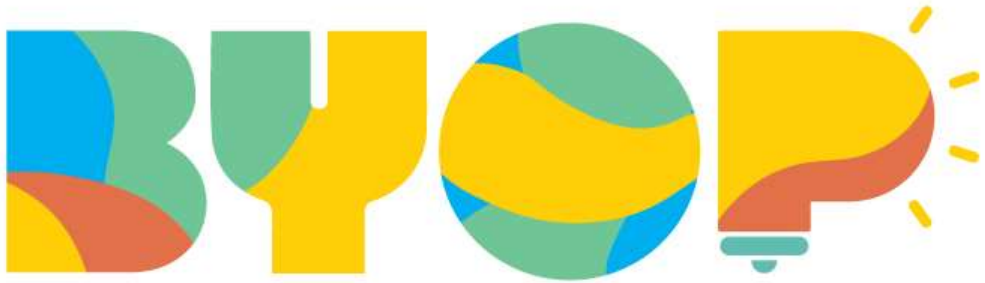


BRING YOUR OWN PROBLEM

Second Nature

ENGIE

BOSTON UNIVERSITY

BOSTON Green Ribbon COMMISSION

Agenda

11:00 am	Registration
11:15 am	Welcome
11:20 pm	The Steps in our Climate Action Plan (CAP) to Curb Greenhouse Gas Emissions Dennis Carlberg, Boston University
12:00 pm	Lunch and Building Energy Performance & Conservation: Performance Contracting vs. Long-Term Partnerships Caitlin Holley, The Ohio State Energy Partners
1:00 pm	BYOP Working Sessions
2:30 pm	BYOP Report Out
3:00 pm	Rethinking Energy Issues Michael Webber, University of Texas at Austin
3:45 pm	Closing Remarks
4:00 pm	Book Signing with Michael Webber Power Trip: The Story of Energy

The Steps in our Climate Action Plan (CAP) to Curb Greenhouse Gas Emissions

Dennis Carlberg

BU Climate Action

BOSTON UNIVERSITY

Bring Your Own Problem

July 31, 2019

Carbon Free Boston

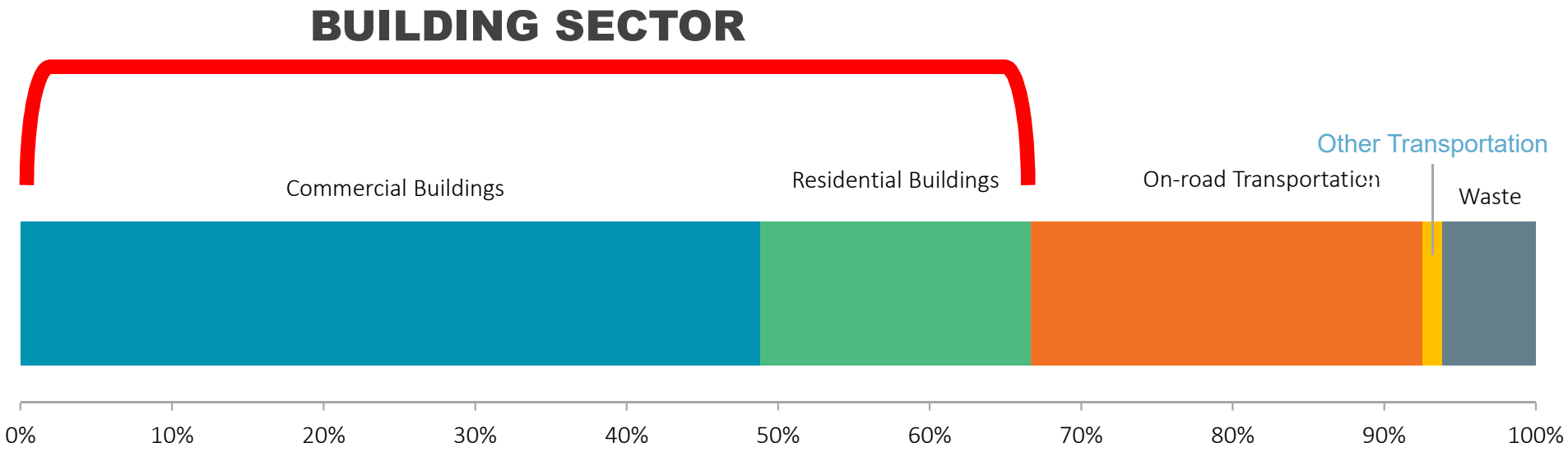
Reduce demand for energy and maximize energy efficiency

Use GHG-free electricity and fuels

Address all sources of emissions

GHG Challenge

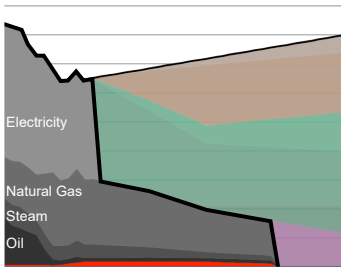
- 2015: 7.2 Million $MTCO_2e$
- 2/3s in Building Sector



#1 #2 #3 #4 #5

PREPARE BU FOR CLIMATE CHANGE

NET ZERO DIRECT EMISSIONS BY 2040



ACT ON INDIRECT EMISSIONS

CLIMATE CHANGE EDUCATION & RESEARCH

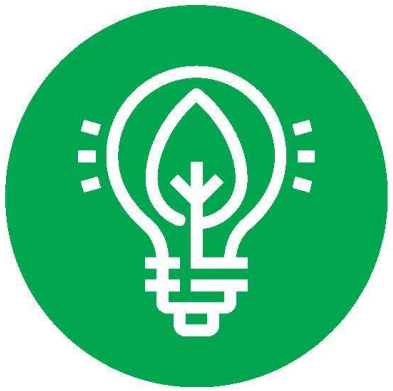
INTEGRATE THE CAP WITH BU STRATEGIC PLAN

BOSTON UNIVERSITY

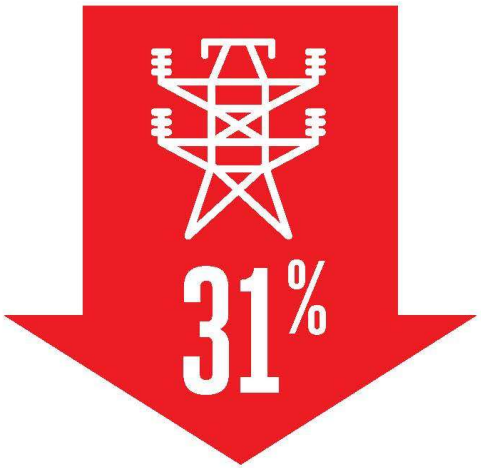
#2 NET ZERO DIRECT EMISSIONS BY 2040

ACTIVITIES

1. Organization
   - New Facility Engineering
   - Planning Design & Construction
   - Sustainability Office
2. Green Buildings
   - LEED Gold w/ Architecture 2030 energy targets
   - Electrification - Geothermal (GSHP)
3. Renewable Energy
   - BU Wind
   - On Site Solar

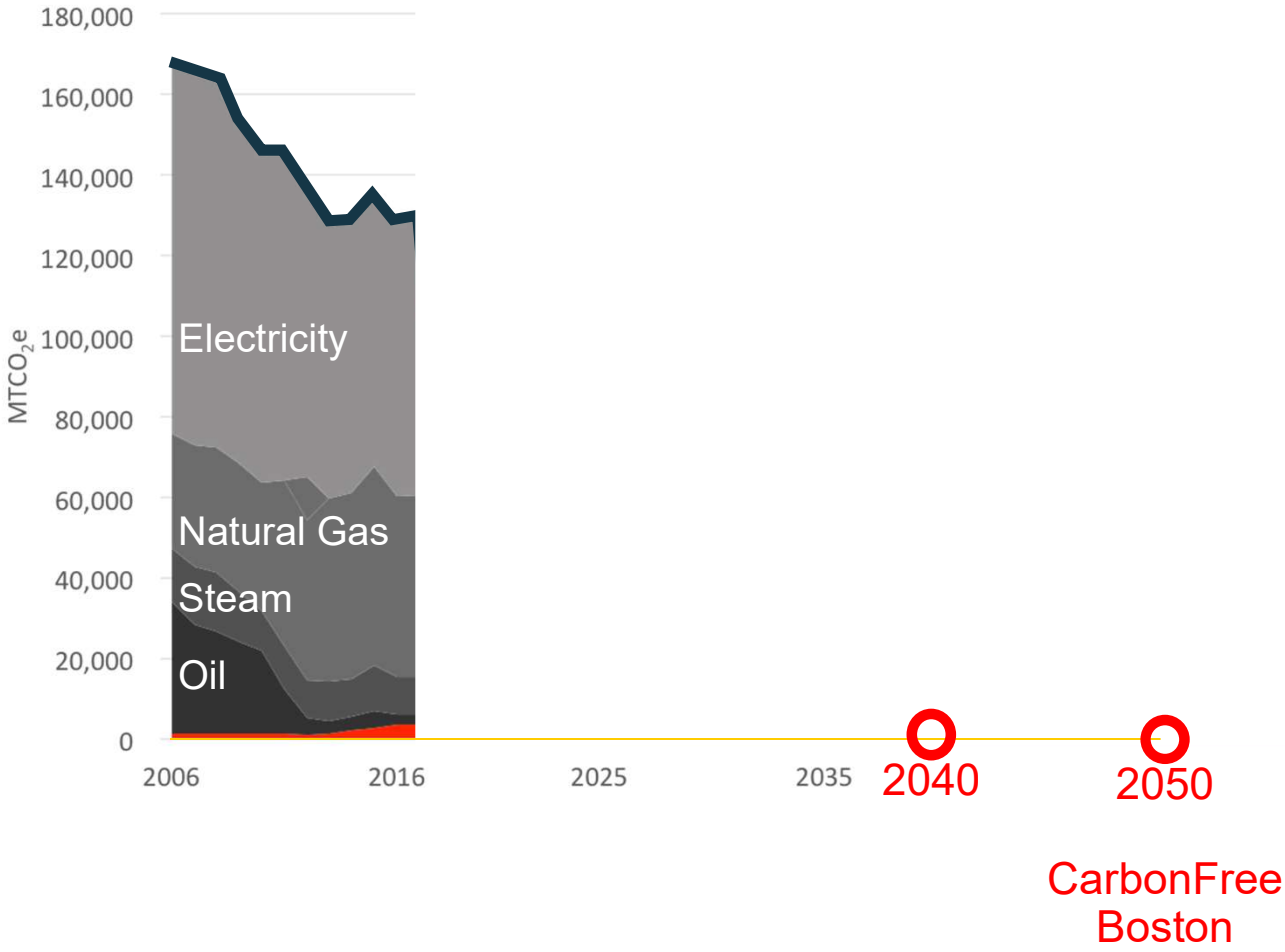


100%
RENEWABLE ENERGY



REDUCTION IN ENERGY USAGE BY 2032

Net Zero Direct Emissions by 2040



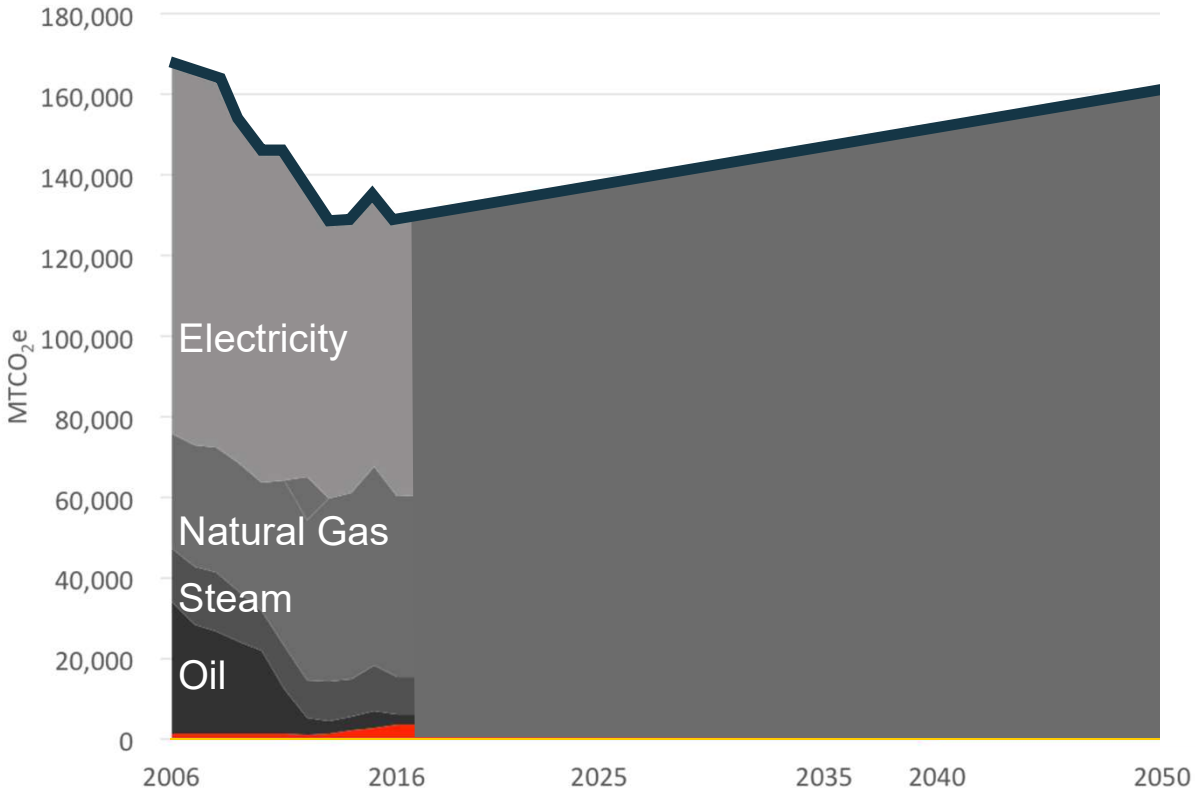
22% reduction by **2018**

Carbon Free Boston

BU Institute for Sustainable Energy

Leadership

Net Zero Direct Emissions by 2040



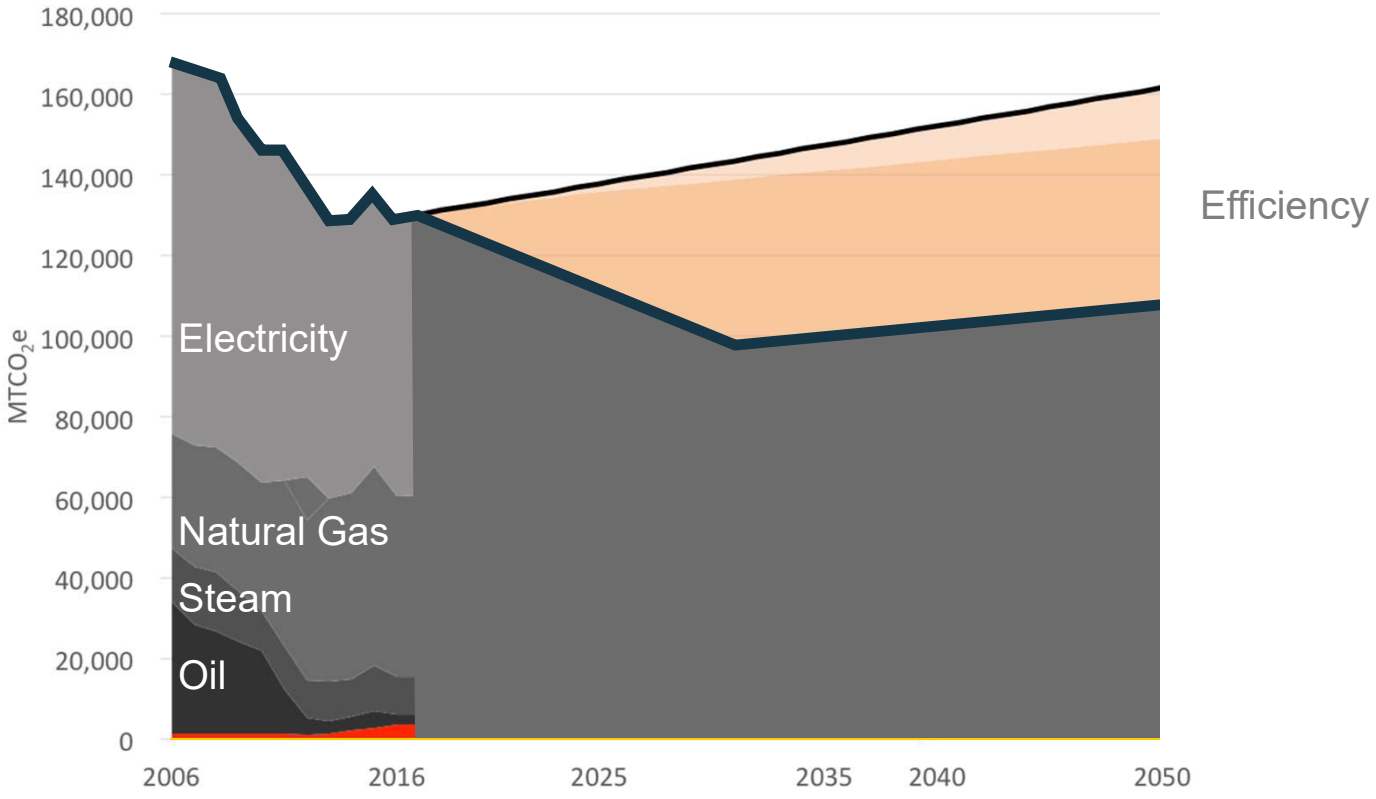
Net Zero by **2040**

Assumptions

Campus Growth

- 0.75% / year

Net Zero Direct Emissions by 2040



Net Zero by **2040**

Strategies

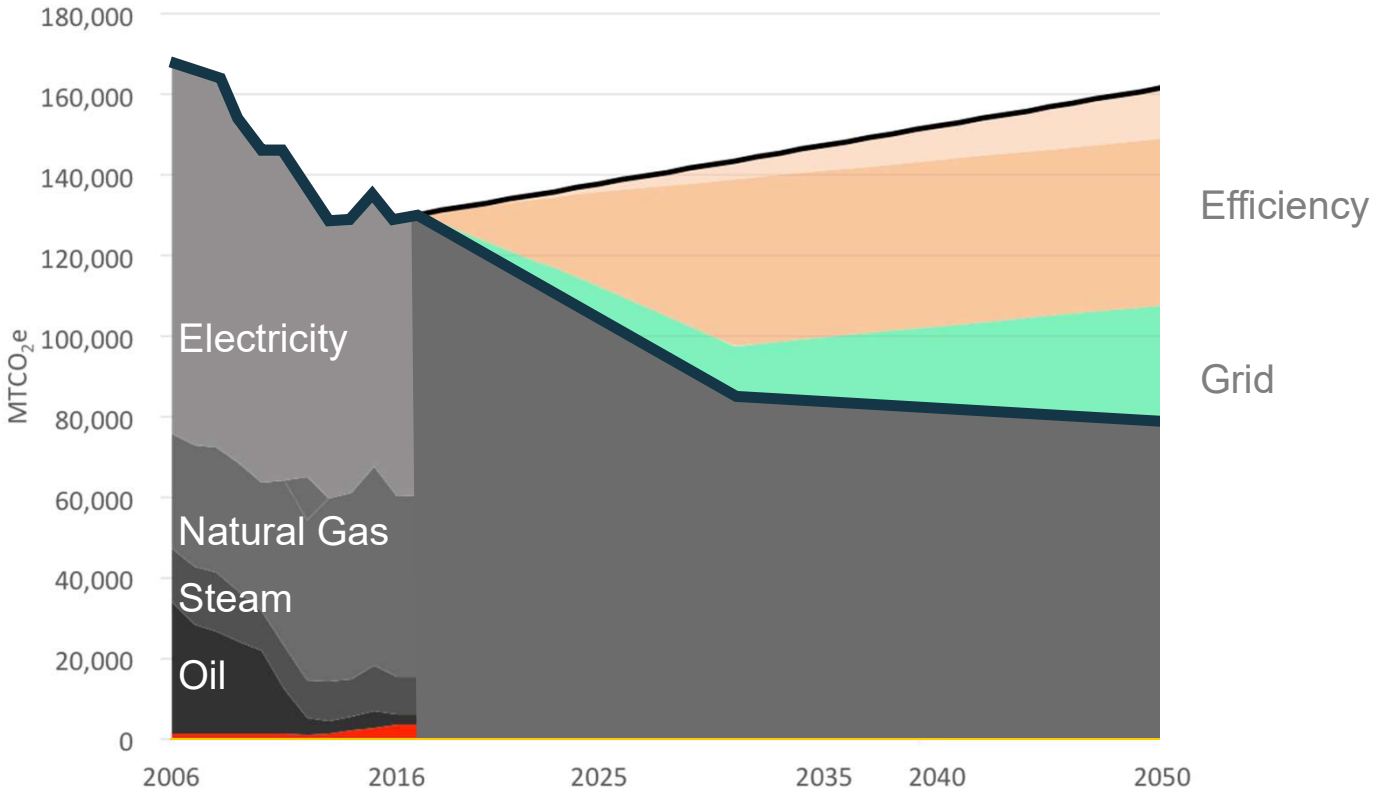
Energy Efficiency

- 31% by 2032

New Buildings

- EUI 90 kBtu/sf

Net Zero Direct Emissions by 2040



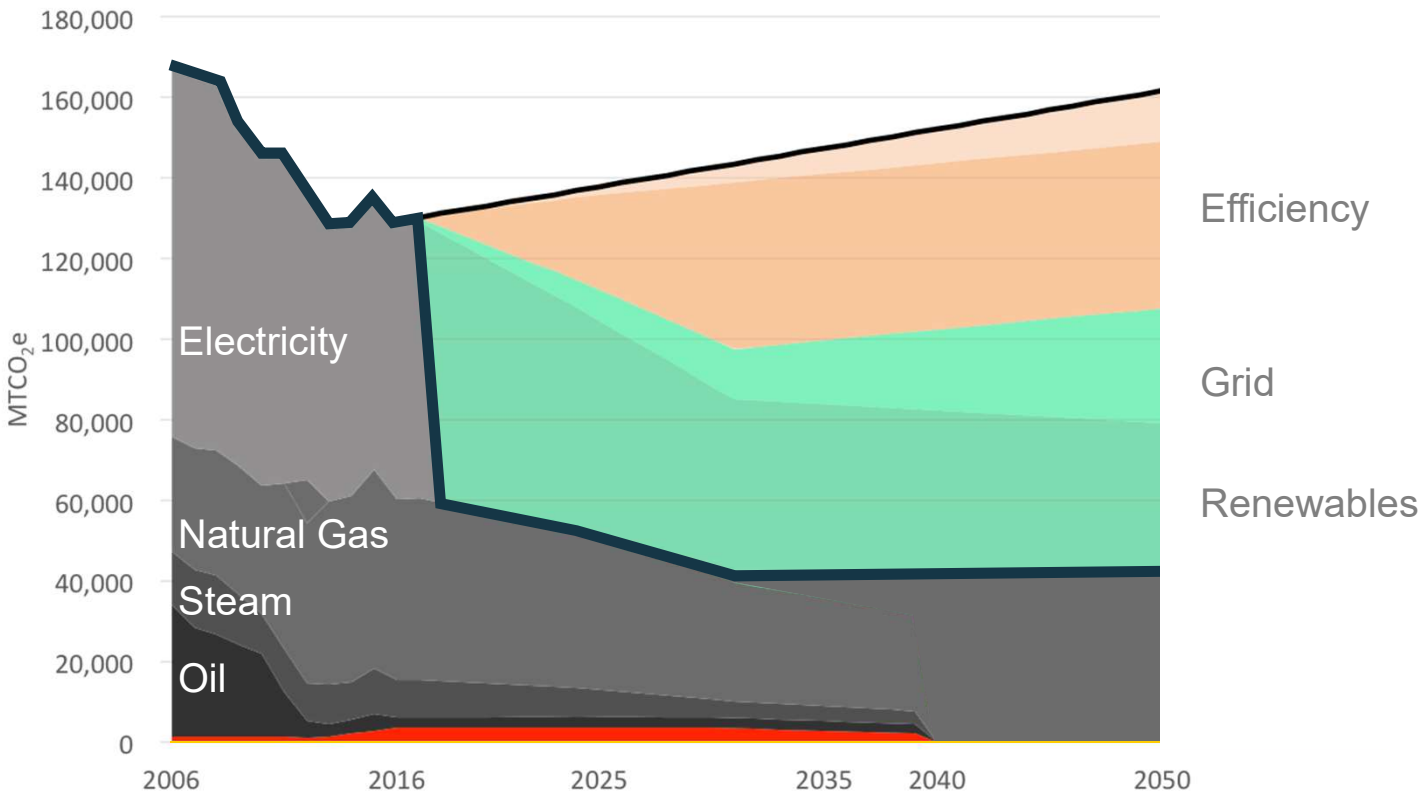
Net Zero by **2040**

Assumptions

Greener Grid

- 1.25% / year

Net Zero Direct Emissions by 2040



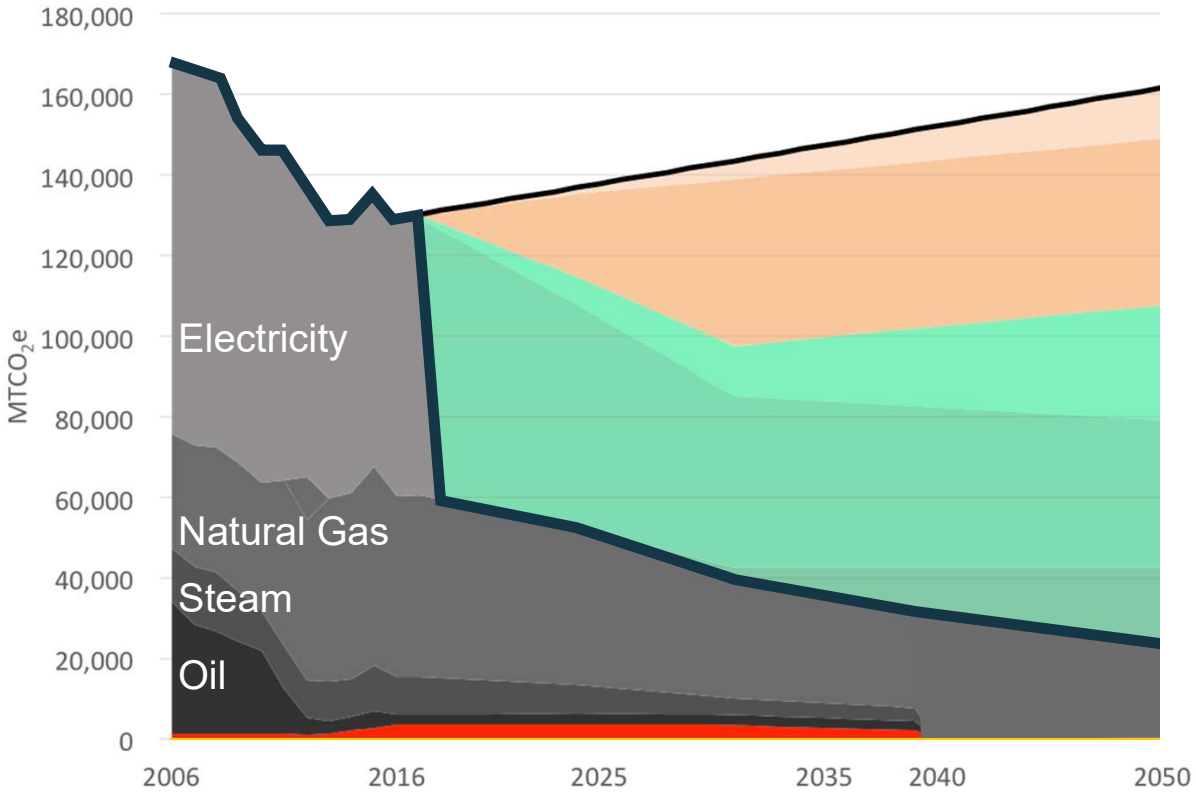
Net Zero by **2040**

Strategies

Renewable Energy

- **100%** starting in 2019

Net Zero Direct Emissions by 2040



Efficiency

Grid

Renewables

Electrification & RE

Net Zero by **2040**

Strategies

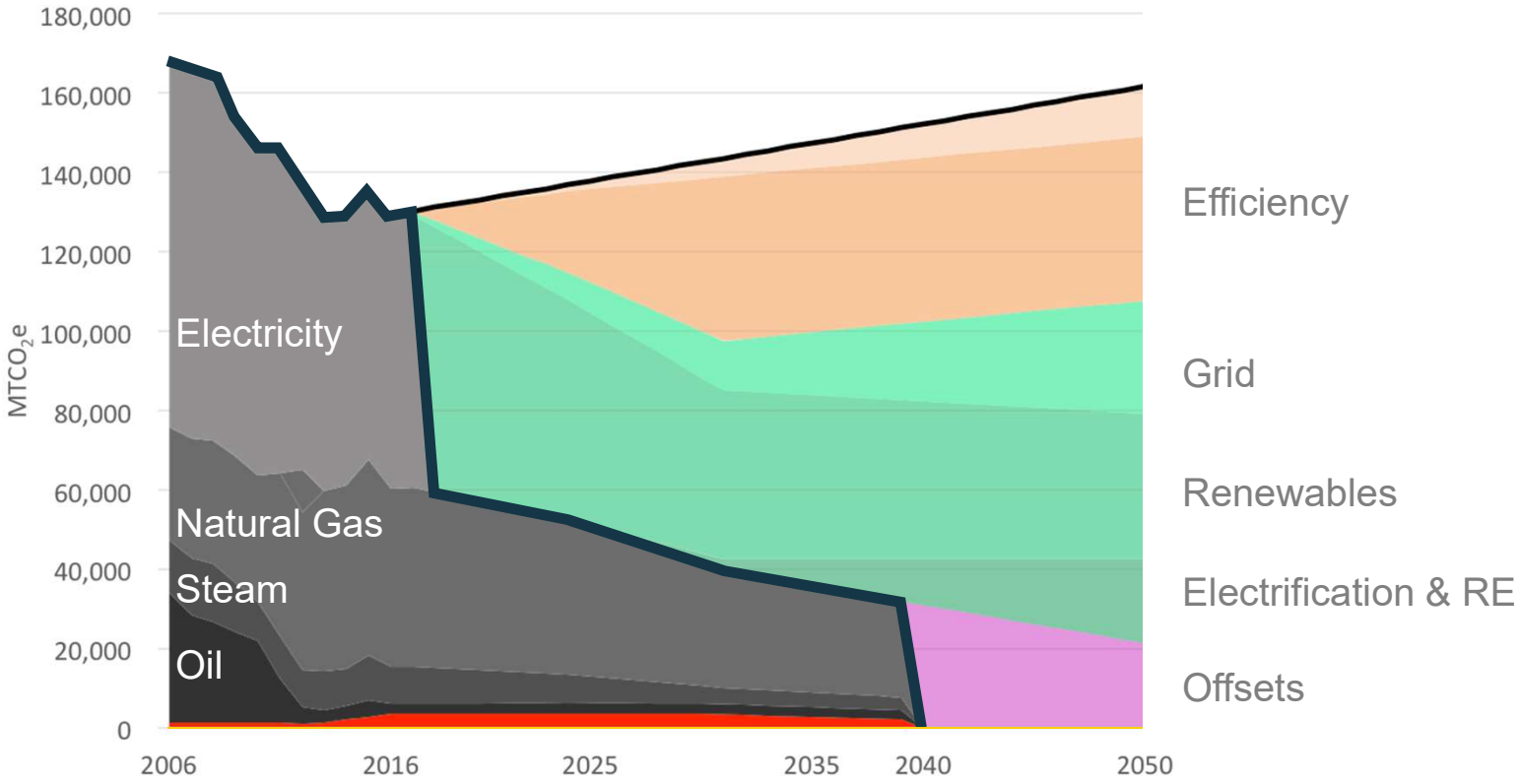
Electrify Heating

- End of Useful Life

Source with Renewables

- 100%

Net Zero Direct Emissions by 2040



Net Zero by **2040**

Strategies

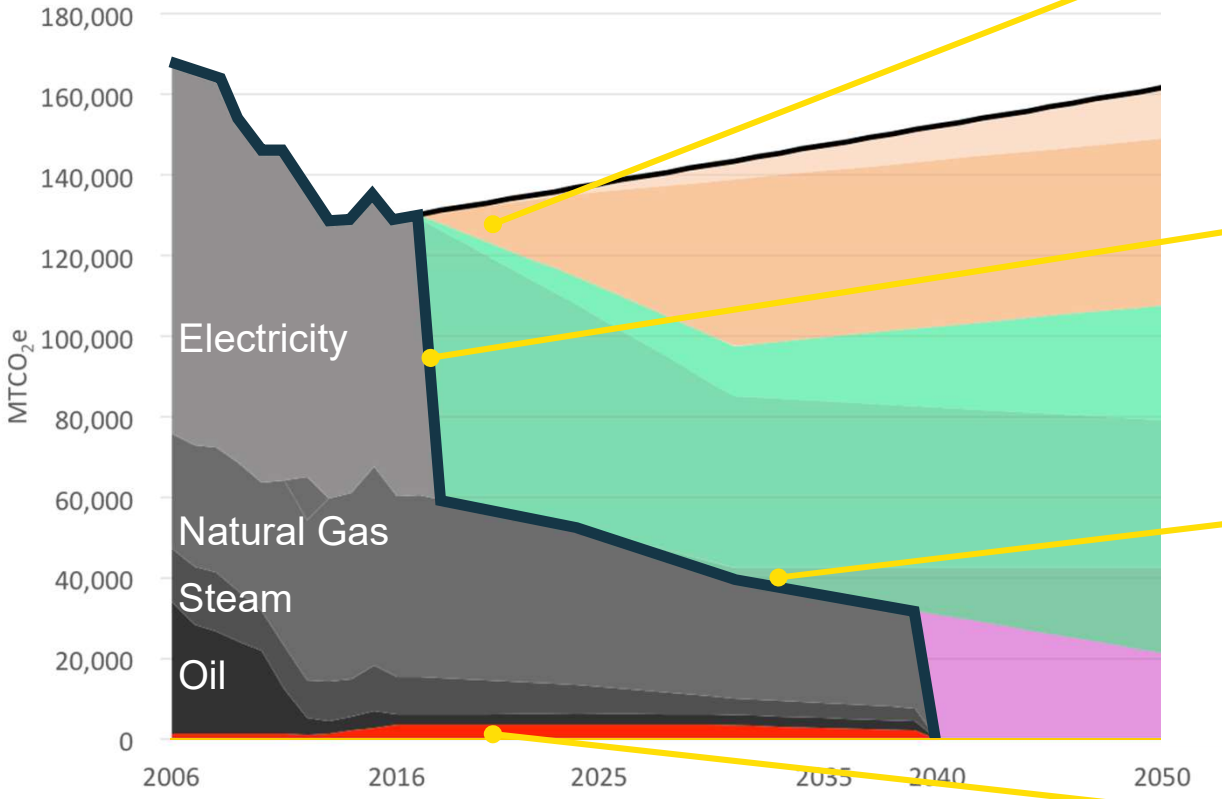
Offsets

- Shortfall to reach 100% starting in 2040

Cumulative Reduction

3,300,000 $MTCO_2e$

Implementation



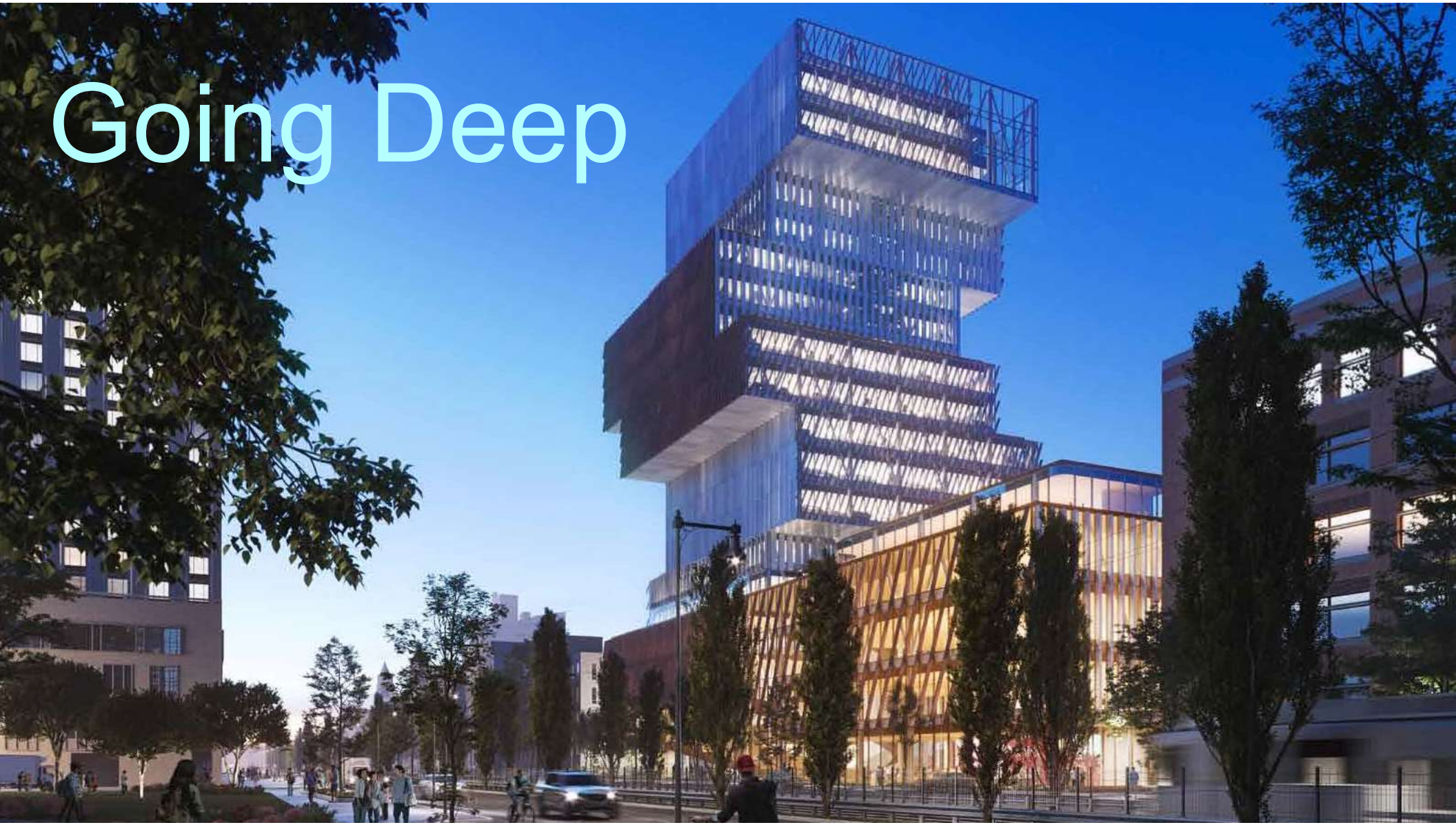
Efficiency
31%

BU Wind
53%

Geothermal
8%

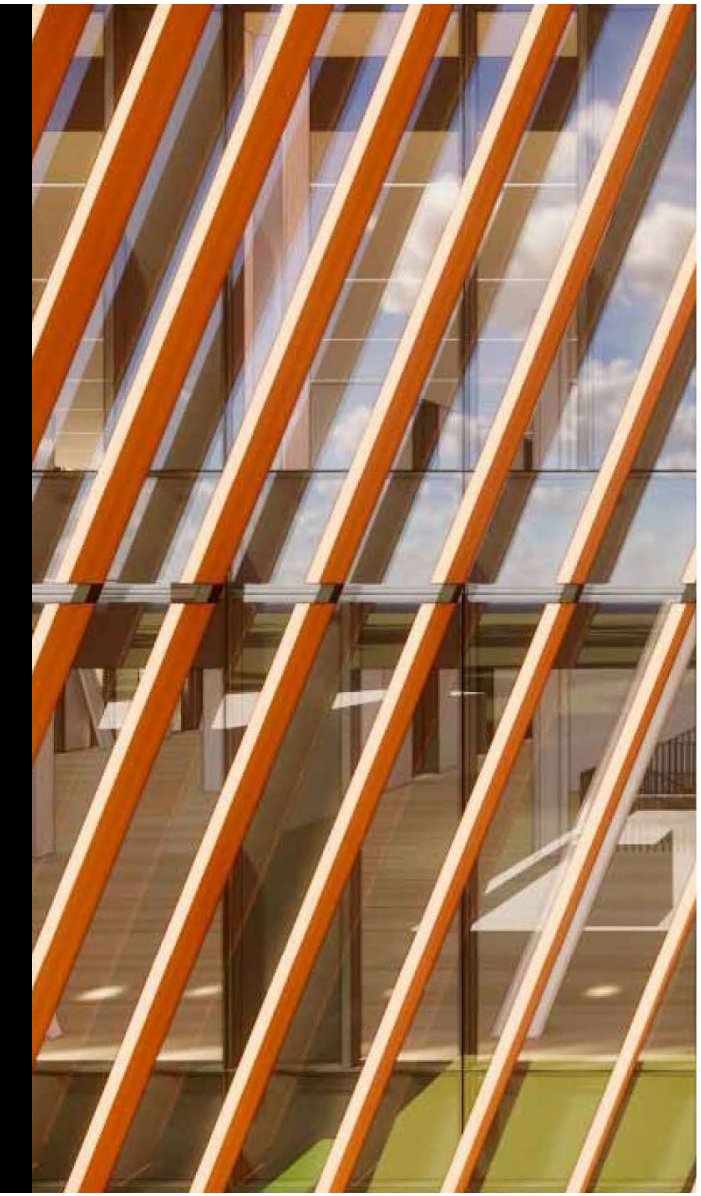
EV Transition
3%

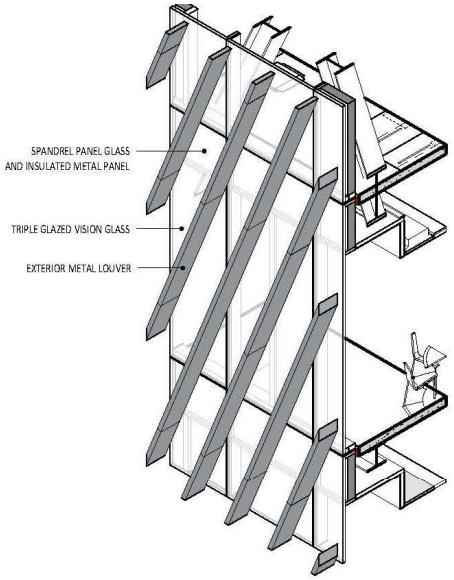
Going Deep

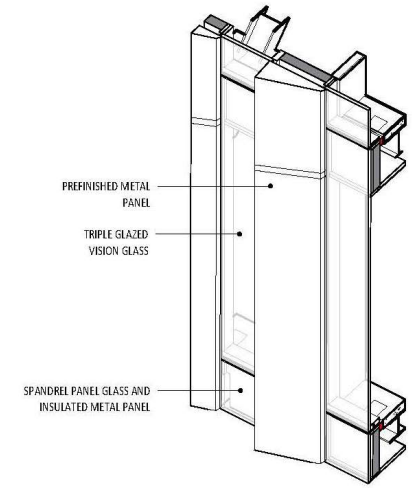


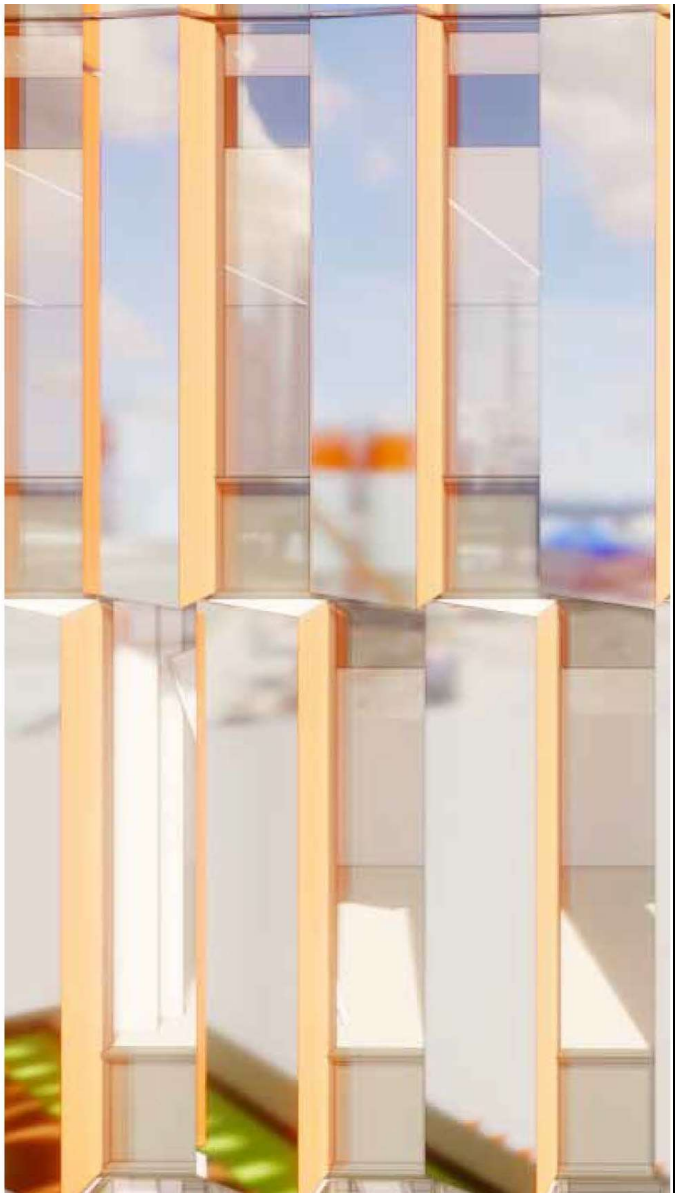
Data Sciences Center

1. 19 Stories
2. 345,000 square feet
3. Gross Site EUI 41.5
4. Net Site EUI 31.2 with solar
5. Fossil Fuel Free



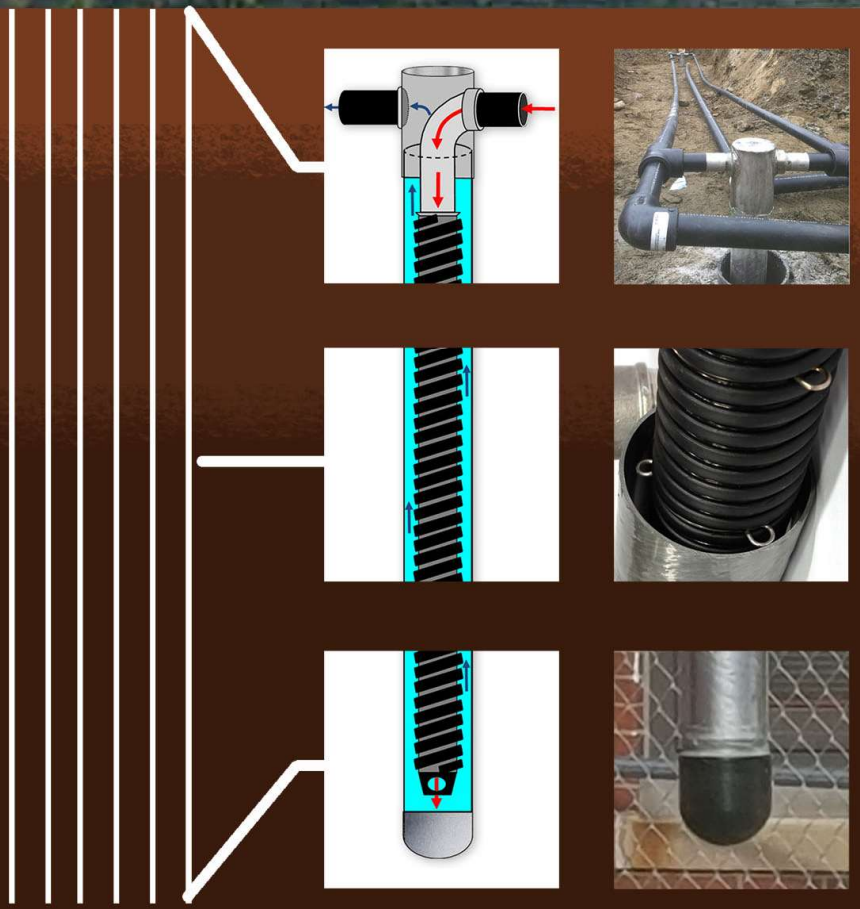

SPANDREL PANEL GLASS
AND INSULATED METAL PANEL
TRIPLE GLAZED VISION GLASS
EXTERIOR METAL LOUVER


PREFINISHED METAL
PANEL
TRIPLE GLAZED
VISION GLASS
SPANDREL PANEL GLASS AND
INSULATED METAL PANEL



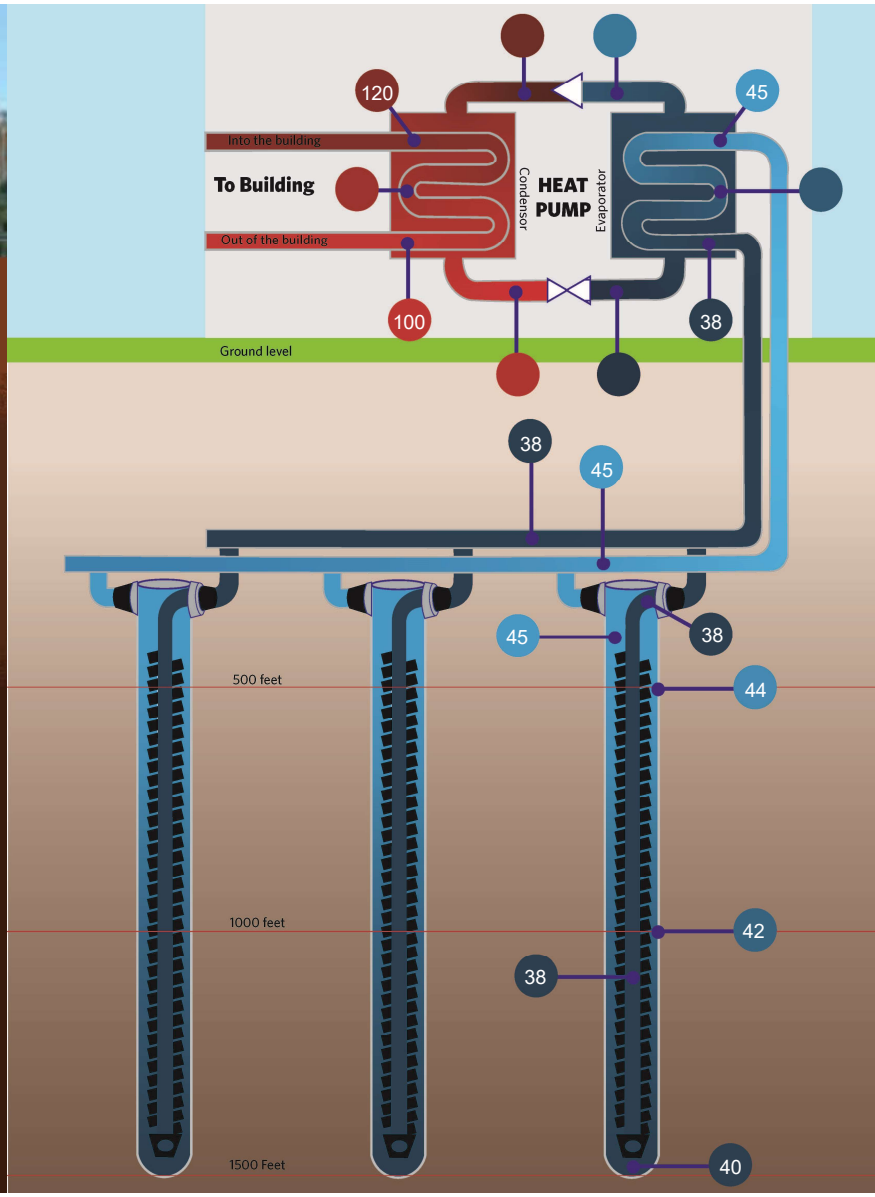
Ground Source Heat Pump

1. 31 – 1,500 foot deep wells
   - 300 ton capacity
   - 90% of heating demand
2. Rygan Closed Loop System
   - Maximize ground heat transfer
   - Minimize thermal bridging
3. Supplemental Electric Boilers
   - Peak demand
4. No gas line connection



Ground Source Heat Pump

5. 7 degree F temperature difference




BU Wind

Renewable Energy Project Criteria

- **Impact, New Build (Additionality)** – Generate new renewable energy that would not otherwise have been generated
- **Education & Research Opportunities** – Benefit student education and faculty research
- **GHG Reduction (CO2e lb/MWh) -** Strong correlation between high grid carbon intensity at time of renewable energy production; the purpose is to maximize the BU's impact on global GHG reduction
- **Green-e Certified RECs** - Project-based Green-e Certified RECs are necessary to validate the claims for the emissions reductions
- **Project Developer Financial Strength** - Long-term owner/operators have resources, experience, & financial strength to manage relationship over term
- **Project Economics (strong NPV/MWh)** - Financial strength based on risk-adjusted, projected cash flows, and impact on BU financial position and credit rating. The driver in a Contract for Differences is the margin modeled between the PPA price and the grid price/MWh. Favorable project economics are a prerequisite
- **Environmental & Health Co-benefits** - Favor projects with lower construction and operational environmental and health impacts
- **Integration with BU on-site procurement** - Integrate PPA purchases and sales into BU's energy purchasing through hedges or other mechanisms


BU Wind
Buy wind power for **100%** of the electricity BU uses every year
Match our load with new, additional renewable energy

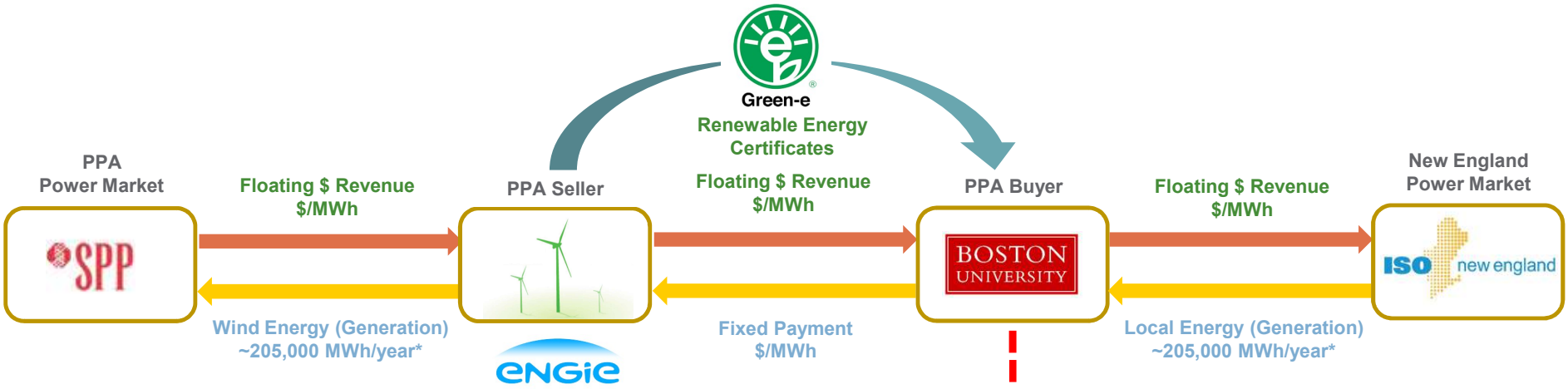
How

Buy **205,000 MWh** of wind energy through a PPA

- Power Purchase Agreement for 15 years
- BU will buy 48.6 MW of wind generation capacity annually

Credit: EdisonEnergy

Power Purchase Agreement

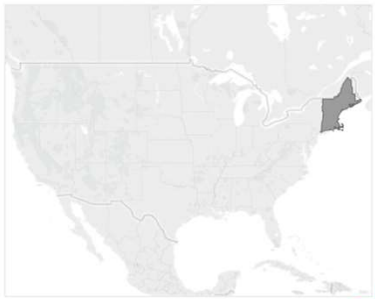


PPA Power Market

SPP Southwest Power Pool

1,482 lbs. CO_2e/MWh

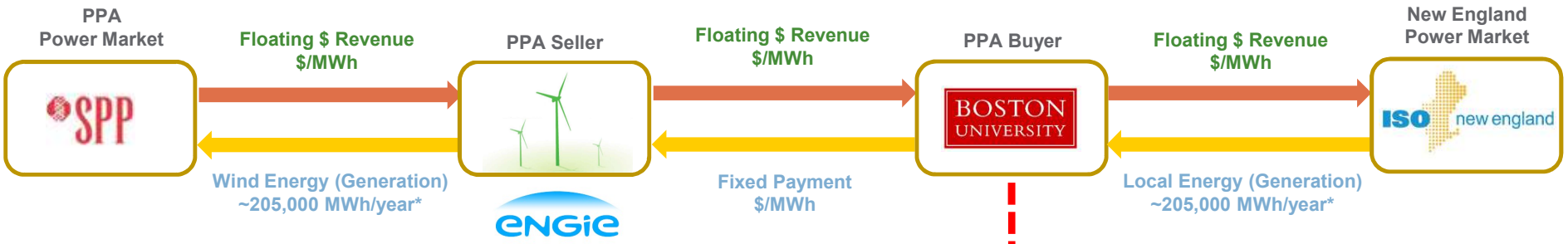
Local Power Market

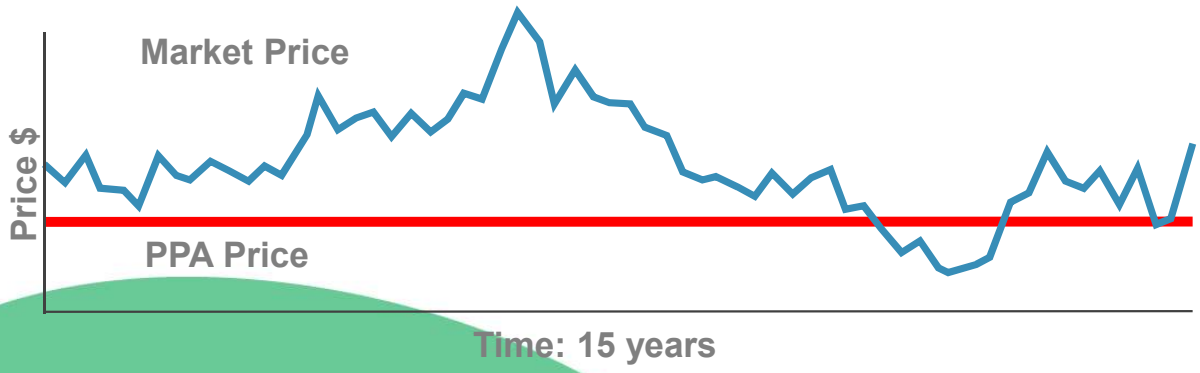


ISO new england

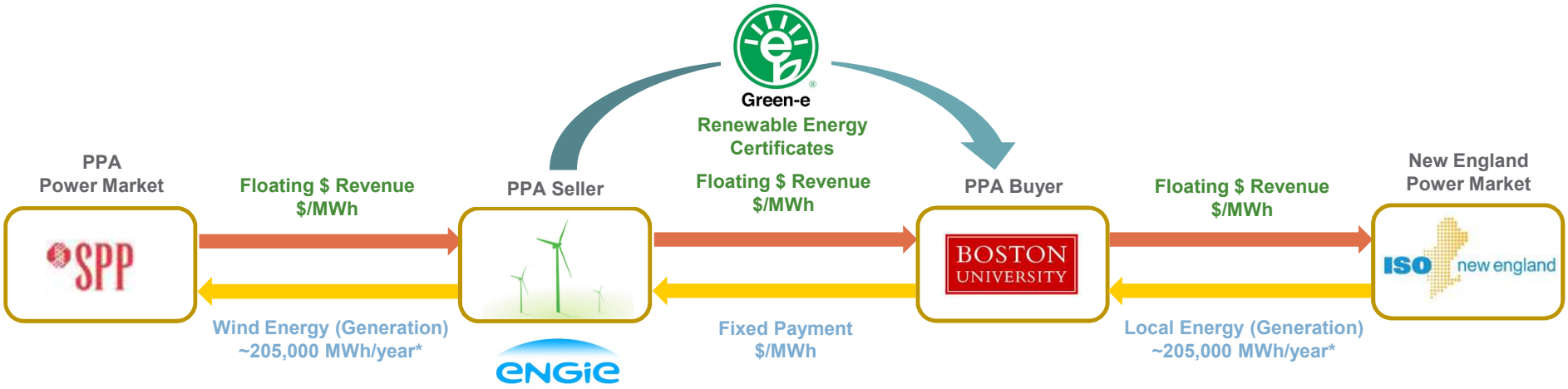
577 lbs. CO_2e/MWh

Power Purchase Agreement

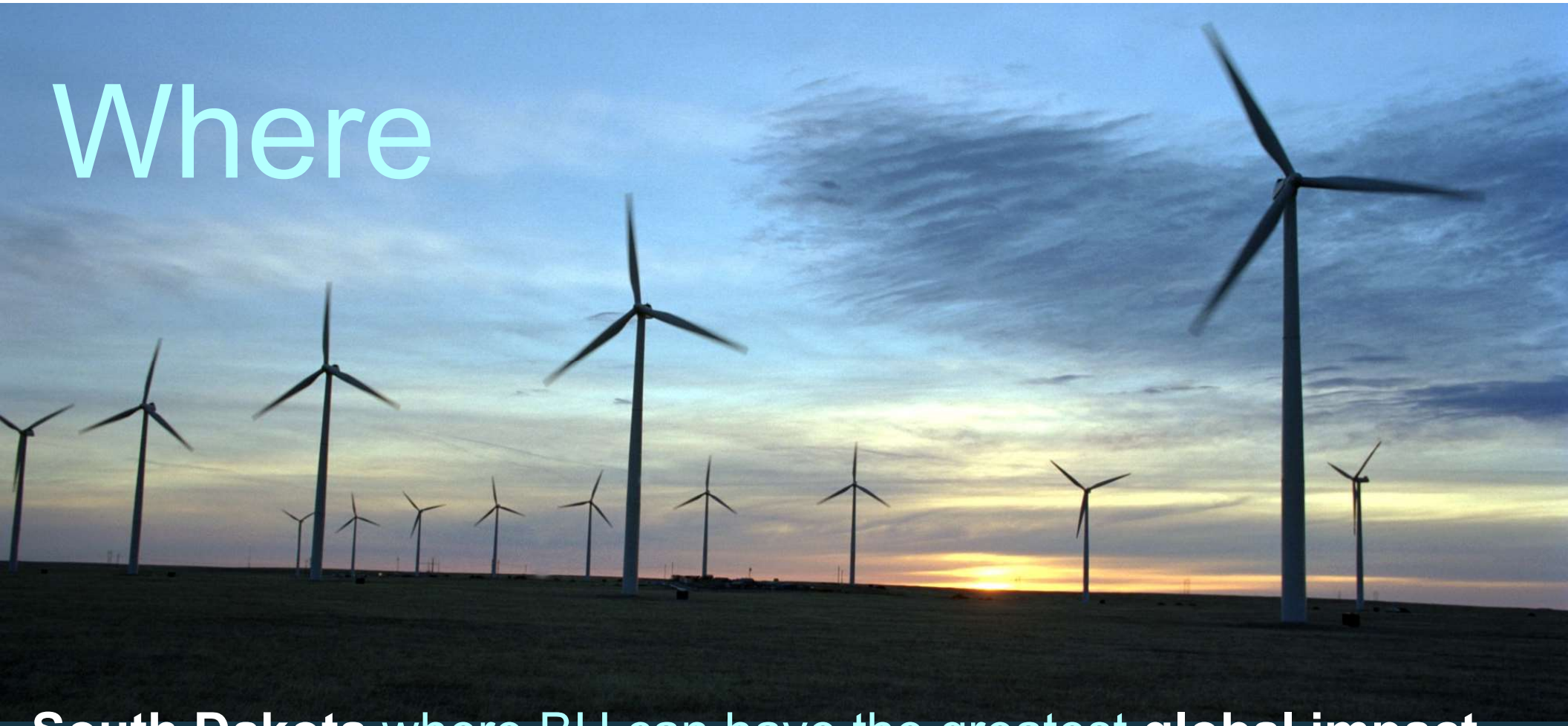




Power Purchase Agreement



Where

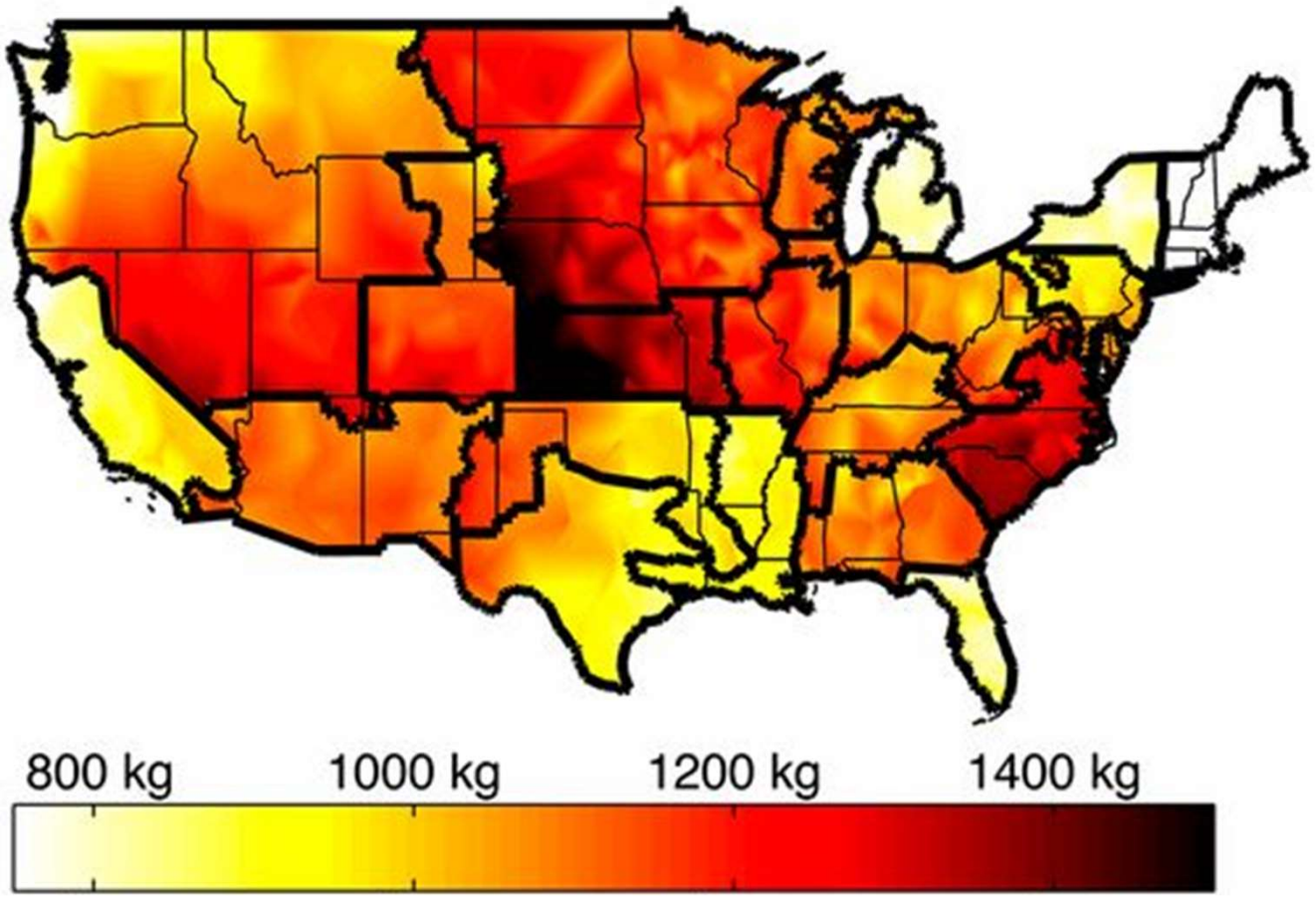


South Dakota where BU can have the greatest **global impact**

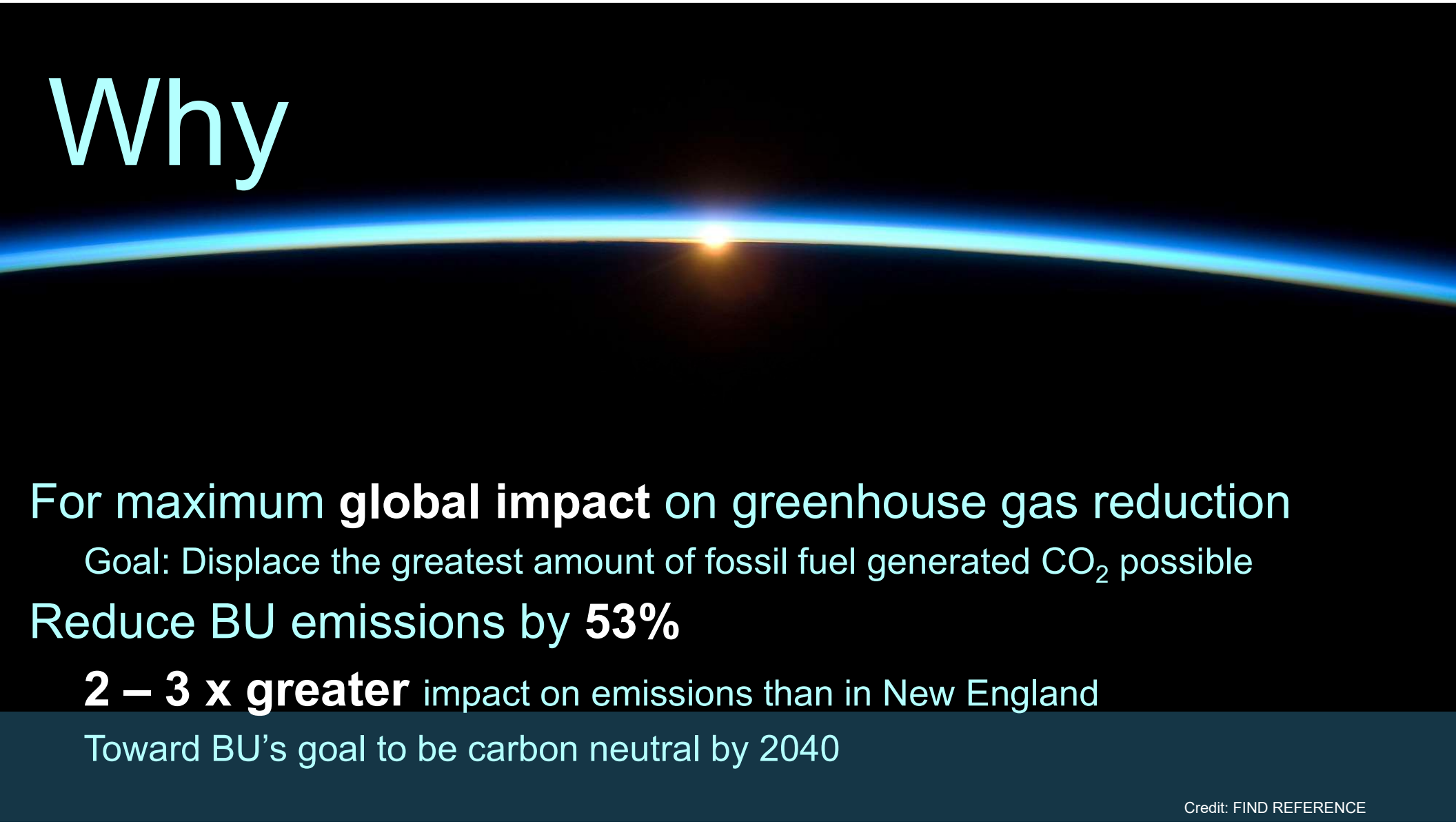
- A grid reliant on fossil fuels
- Marginal emissions best align with wind energy generation

Credit: NREL/DOE

Maximizing Global Impact



Why



For maximum **global impact** on greenhouse gas reduction

- Goal: Displace the greatest amount of fossil fuel generated CO_2 possible

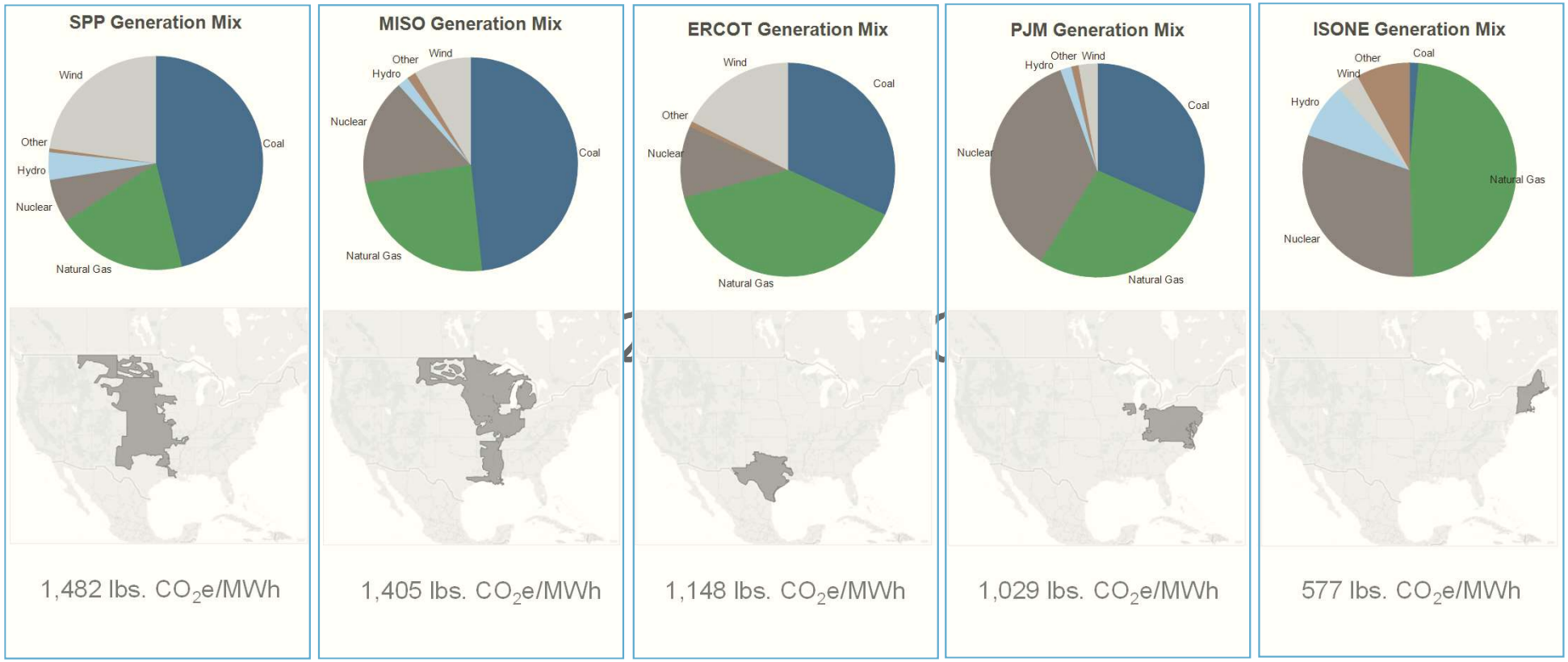
Reduce BU emissions by **53%**

- **2 – 3 x greater** impact on emissions than in New England

Toward BU's goal to be carbon neutral by 2040

Credit: FIND REFERENCE

Maximizing Global Impact

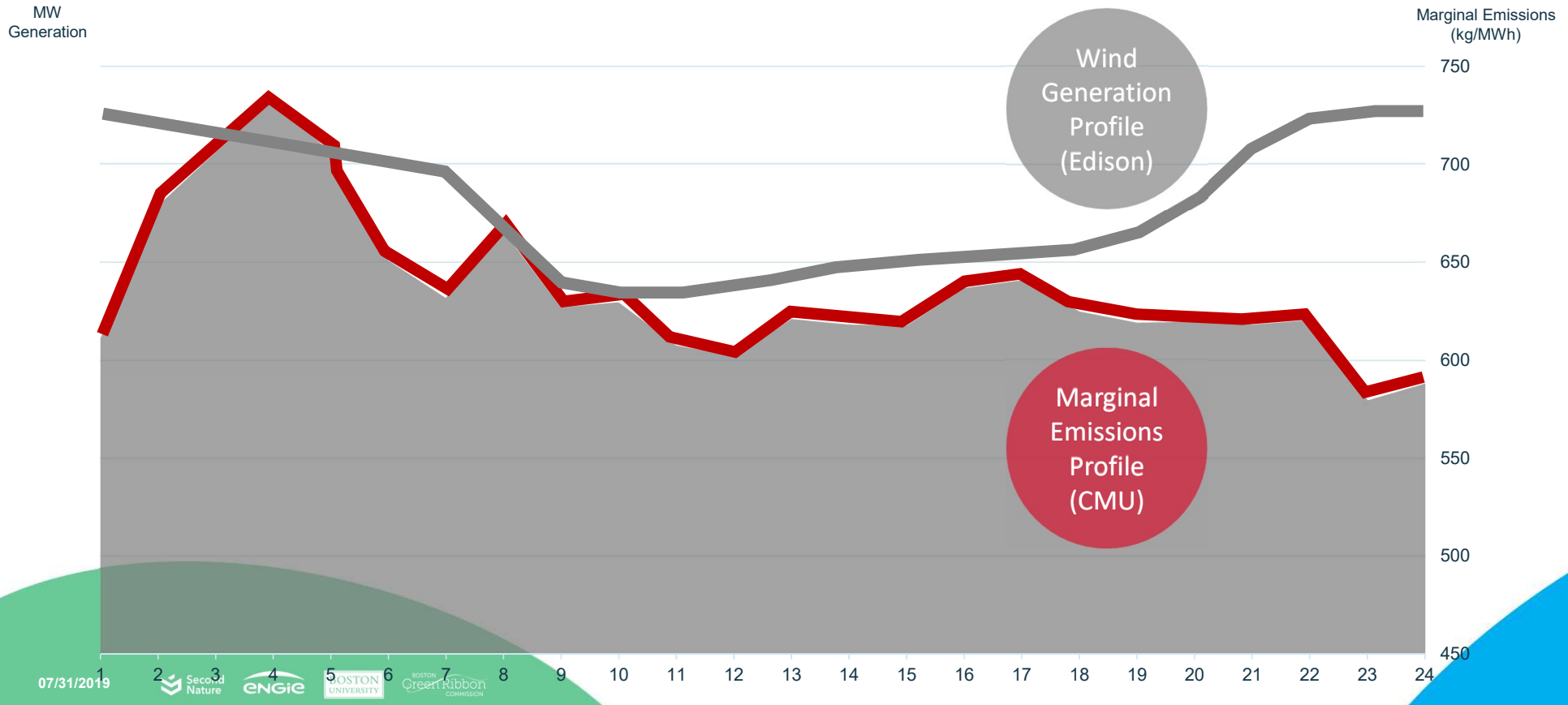


Emissions Data based on eGrid 2014 v2 Data by NERC Region: SPP represents average of SPNO, SPSO, MROW, PJM represents average of SRVC, RFCW, RFCE, MISO represents average of RFCM, MROE, MROW, SRMW
Generation Mix based on 2017 ISO Data, by MWh

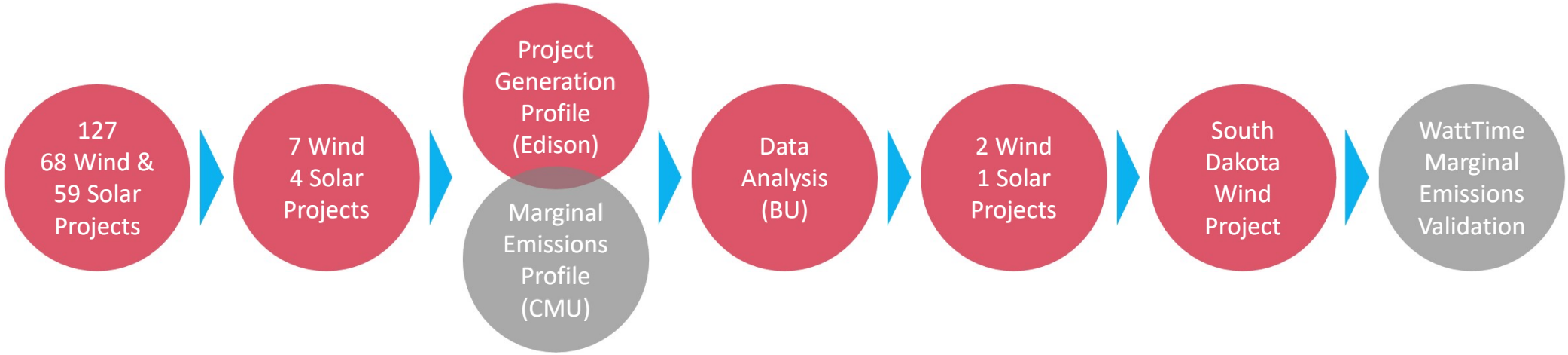
Credit: EdisonEnergy

Maximizing Global Impact

Align Generation with Marginal Emissions



Maximizing Global Impact



Economic &
eGrid Screen

Marginal Emissions
Screen

Economics & Risk
Screen

Criteria Due Diligence

Team Interviews

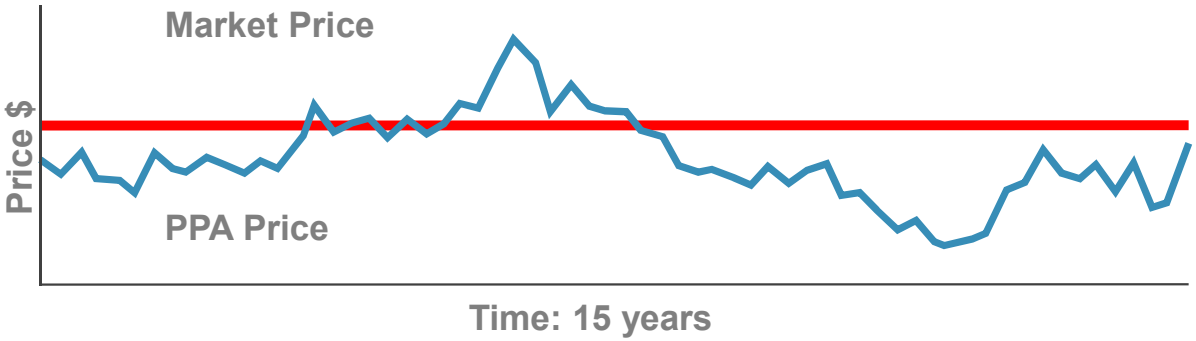
LOI / Term Sheet

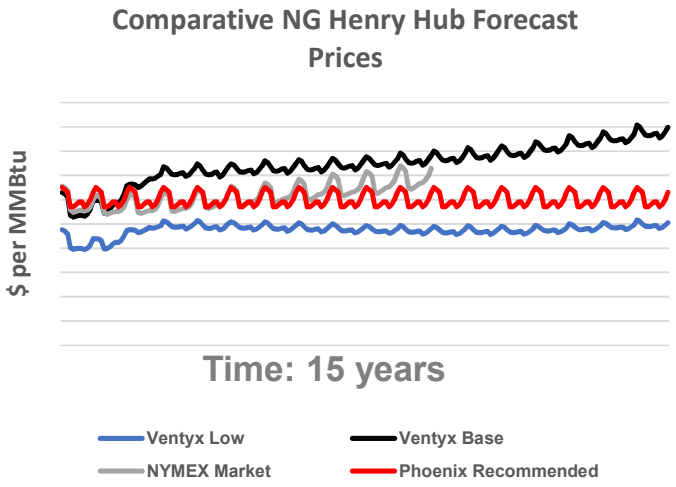
to

REPA Contract

Power Purchase Agreement (PPA)

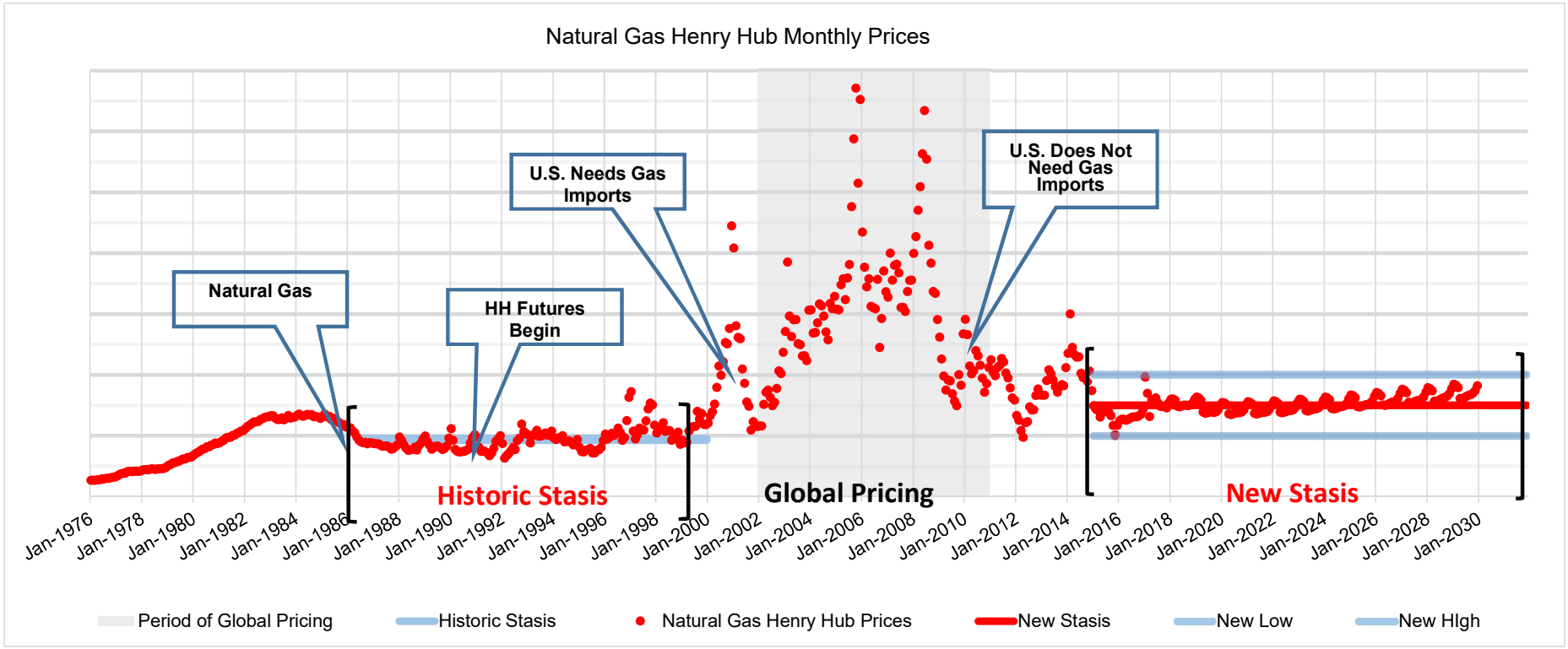
1. Market Advantage
   a. 45% lower PPA price than similar deal in 2015
   b. Contract for Differences economics work with today's low natural gas prices
   c. Provides hedge on our natural gas spend
   d. Declining Production Tax Credit
   e. Thorough Market Risk Analysis





Phoenix Energy

Stable Historic and Future Market Pricing for Henry Hub Natural Gas



- Natural gas prices are likely to stay relatively stable for the next 8-12 years as technology offsets inflation.
- After that period, prices could move higher or lower depending on demand and technology.


When
2020 when this new project is complete and energized
Financing underway
Construction start August 2019
Credit: NREL/DOE

Who

Education & **Internship** opportunities for **BU students**

Research opportunities for **BU faculty**

Credit: Boston University

BU Renewable Energy Procurement Advisor

Edison Energy (formerly Altenex)

- An energy management firm that Fortune 1000 companies, universities and municipalities use to source clean power for their energy portfolios. We are proud to have supported engagements for the procurement of over 3GW, including clients such as: General Motors, The Home Depot, Bloomberg, University of Richmond, and Boston University.
- Key Players:
  - **Christen Blum**, Managing Director, Renewables
  - **Emily Williams**, Senior Director of Energy Markets and Sustainability
  - **Colin Schofield**, Commercial Manager, Renewables
  - **Camden Holland**, Senior Account Manager

BU Due Diligence Team

Phoenix Energy

- Independent energy purchasing consulting firm.
  Clients include: Beacon Capital Partners, Callahan Capital Partners, Hobart & William Smith Colleges, and Northeastern University
- Key player: **John Leidy**, President

Foley Hoag LLP

- Legal counsel providing renewable energy contract negotiations support.
  Clients include for wind and solar PPAs: Akamai, Partners Healthcare, American Honda Motor Company, Hampshire College, and Five Colleges Inc.
- Key player: **Adam Wade**, Counsel

Boston University

- **Gary Nicksa**, Senior VP Operations
- **Dennis Carlberg**, Associate Vice President for University Sustainability
- **Shaun Finn**, Assistant Vice President for Business Affairs
- **Jason Mahler**, Associate General Counsel

Renewable Energy Provider

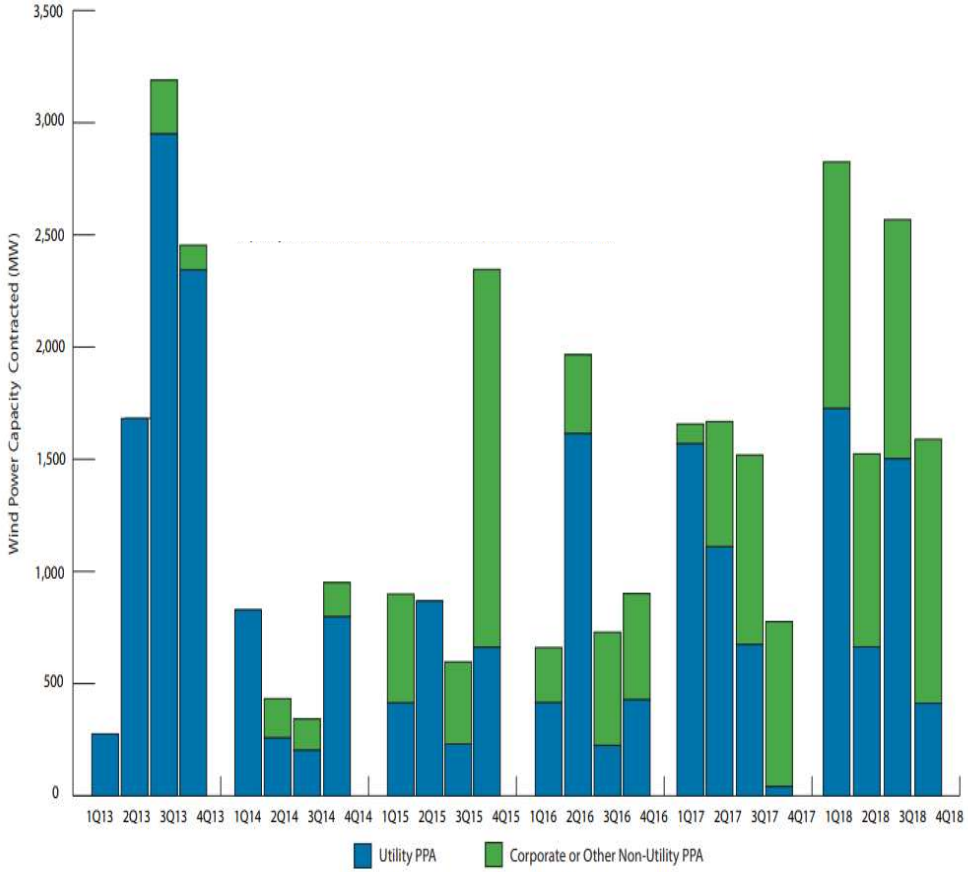
ENGIE

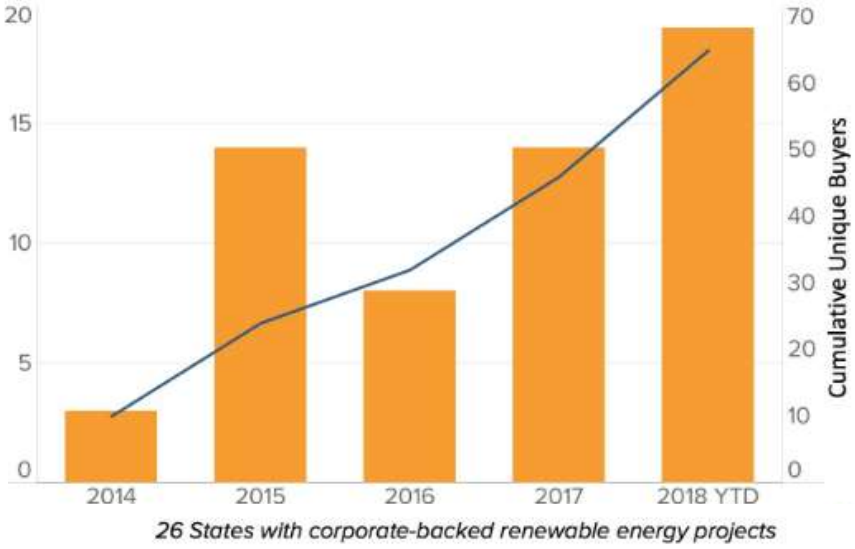
- A $76 Billion energy company operating in 70 countries around the world. ENGIE is actively selling fossil fuel assets to acquire and transition to fossil fuel free energy generation and efficiency services.
- Key Players:
  - **Emily Cohen**, VP Commercial Strategy
  - **George Nelson**, Director of Origination
- Educational & Research Opportunities:
  - **Data:** Detailed, real time data from wind characteristics, and power generation and 5 minute interval ISO marginal emissions.
  - **Site Visits**: Annual site visit for students, faculty & staff.
  - **Turbine Factory Tour:** Students, faculty & staff tour of turbine factory while turbines are being manufactured.
  - **Project & Data Display:** Project details, video feed, and data display on campus.
  - **Summer Internships:** 2 paid summer internships for BU students with a GPA of 3.5 or better.
  - **Research:** Site visits 2 times/year after Commercial Operation Date by faculty and students as agreed to in advance.
  - **Ribbon-cutting** ceremony expected for Q4 2020 with chance to meet and greet with development, construction engineering personnel responsible for bringing the 250 MW wind energy facility to operation

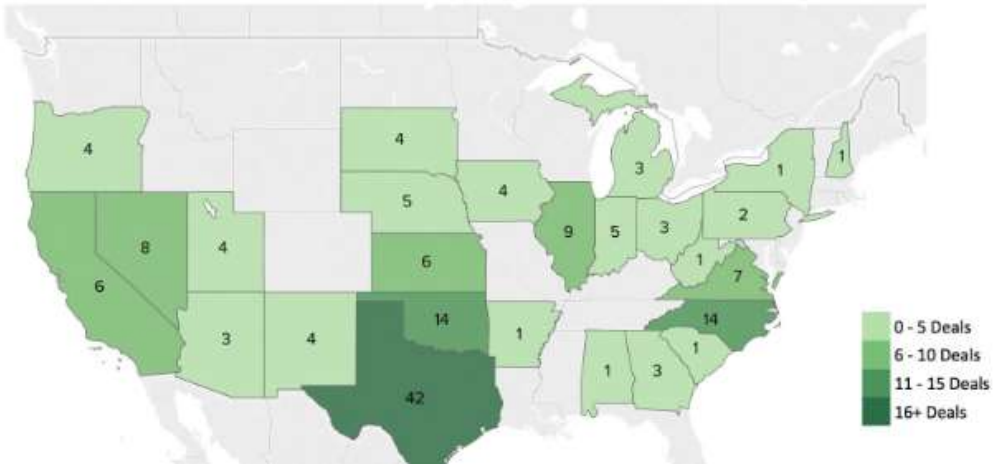
ENGIE among the leaders in North America wind since 2018

- Successfully developed over 2,000 MW of wind projects
- Over 500 MW wind brought on-line in last nine months, with an additional 500 MW expected by year-end
- To date, ENGIE wind team has secured over 1,500 MW of additional offtake that is expected to be in operation in 2020
- Over 8,000 MW of wind projects under development throughout SPP, ERCOT, PJM, and MISO
- Over 1000 MW of corporate customer VPPAs with customers such as Boston University, Walmart, Target, T-Mobile

Non-Utility Power Purchase Agreements driving growth in the wind industry

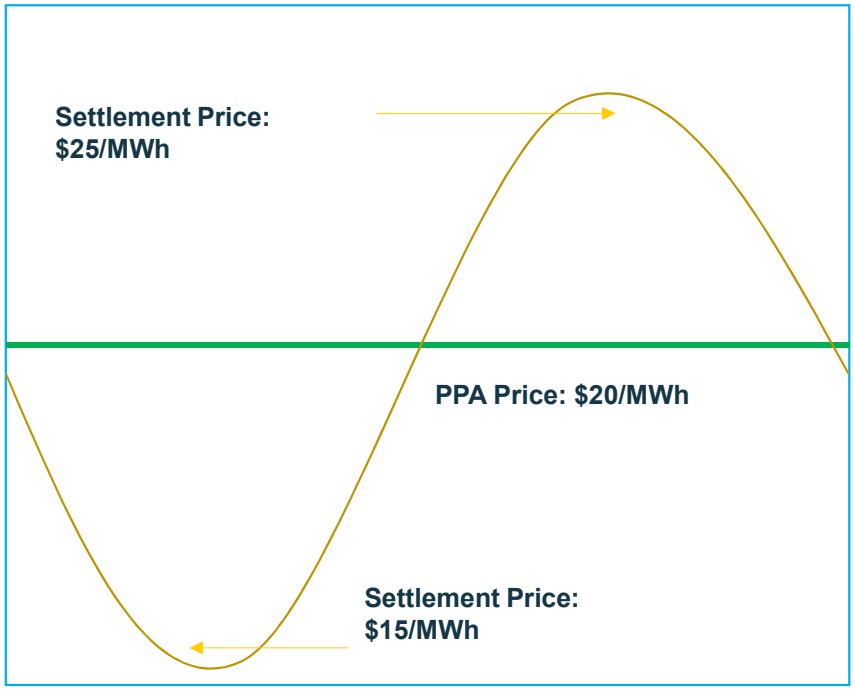






“Virtual” Power Purchase Agreements are financial instruments enabling wind project construction

- **Financially settled fixed-for-floating swap**
  - Fixed = MWh generated × VPPA Price
  - Floating = MWh generated × Real-time price @ Trading Hub
  - If Floating > Fixed, project pays Δ to off-taker; if Floating < Fixed, off-taker pays Δ to project
- **Credit requirements typically around $100/kW**
  - ENGIE will typically provide a Letter of Credit until Commercial Operation then offer parent company guaranty
  - No posting required by Campbell’s as long as investment grade credit maintained

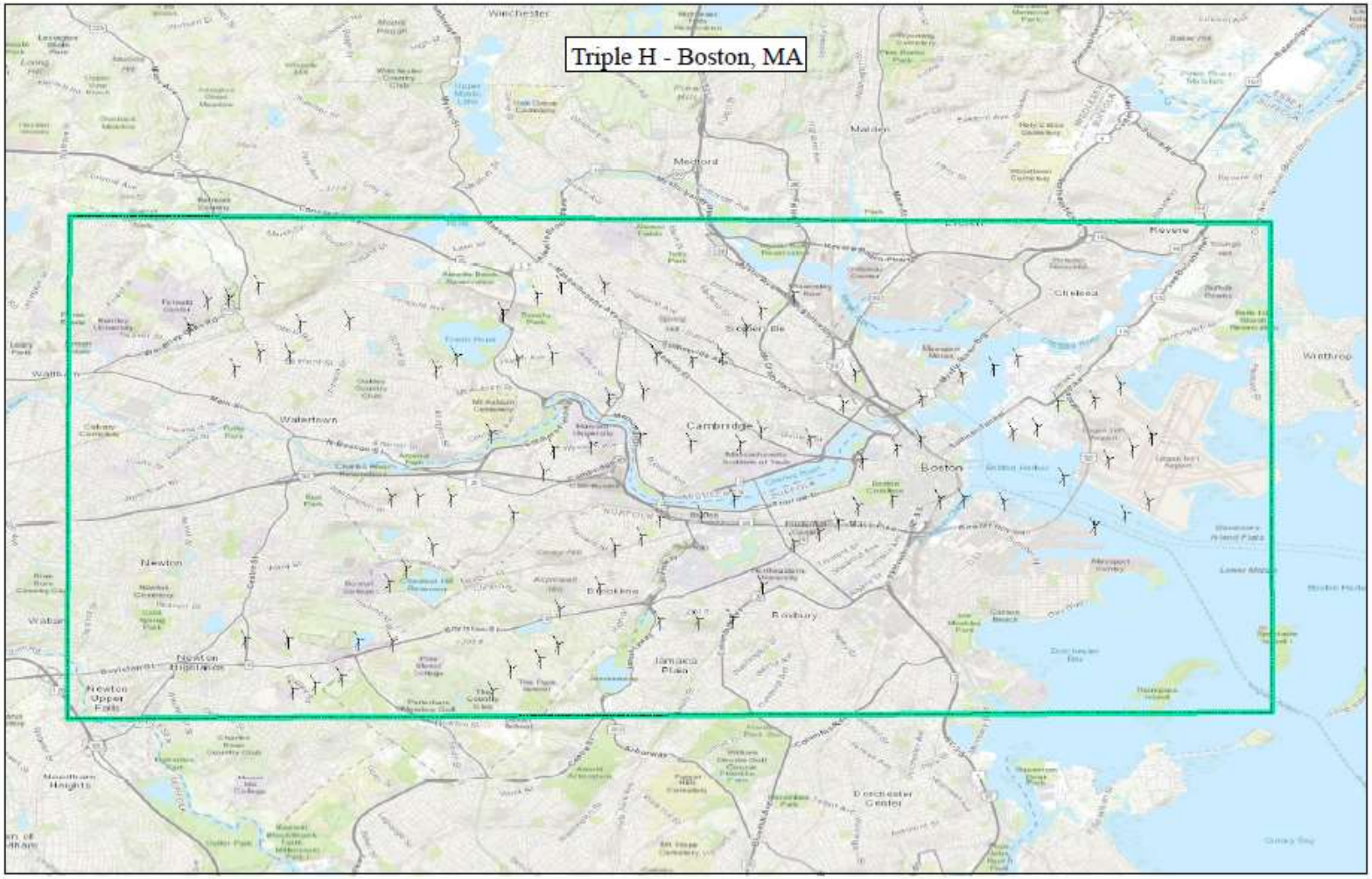


Example: VPPA Price: $20/MWh

Settlement Price: $25/MWh
Seller Pays Buyer $5/MWh

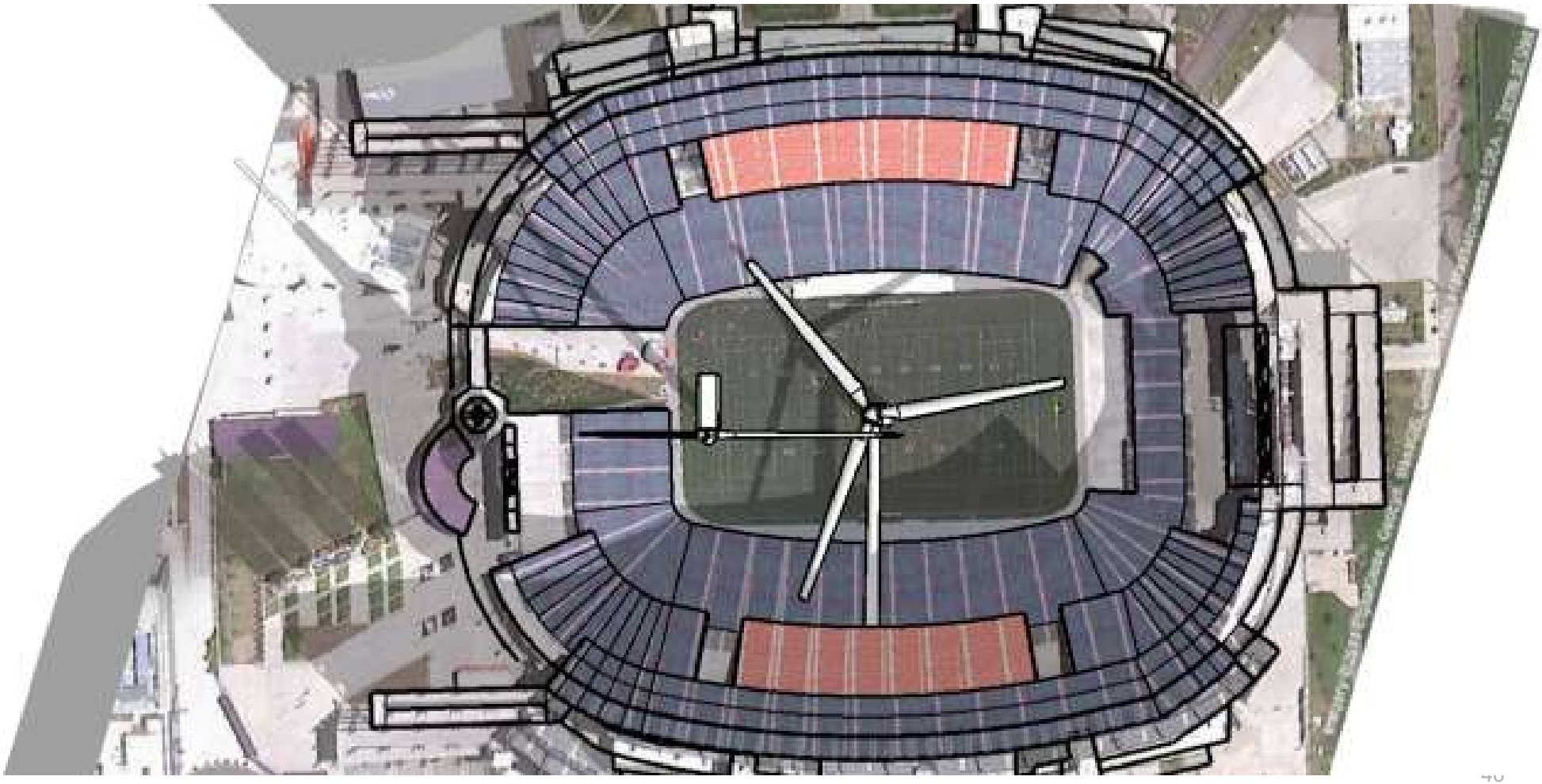
Settlement Price: $15/MWh
Buyer Pays Seller: $5/MWh

Boston land constraints prohibit utility-scale economic wind projects

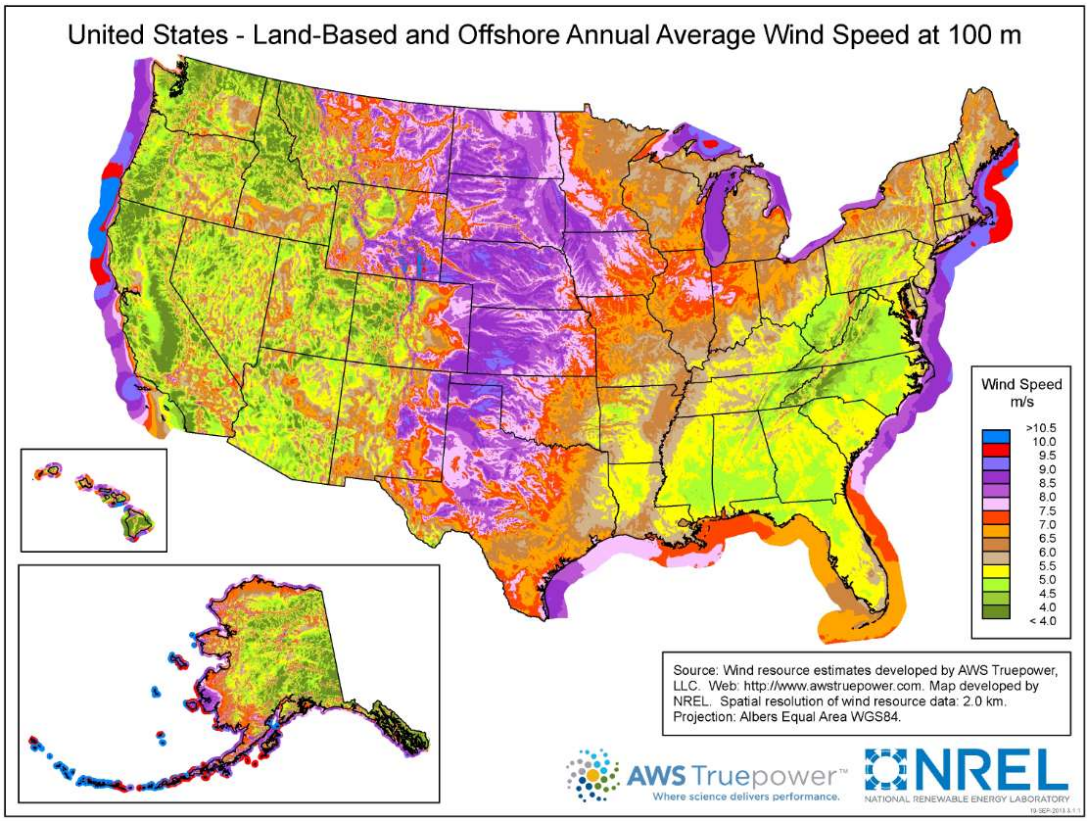


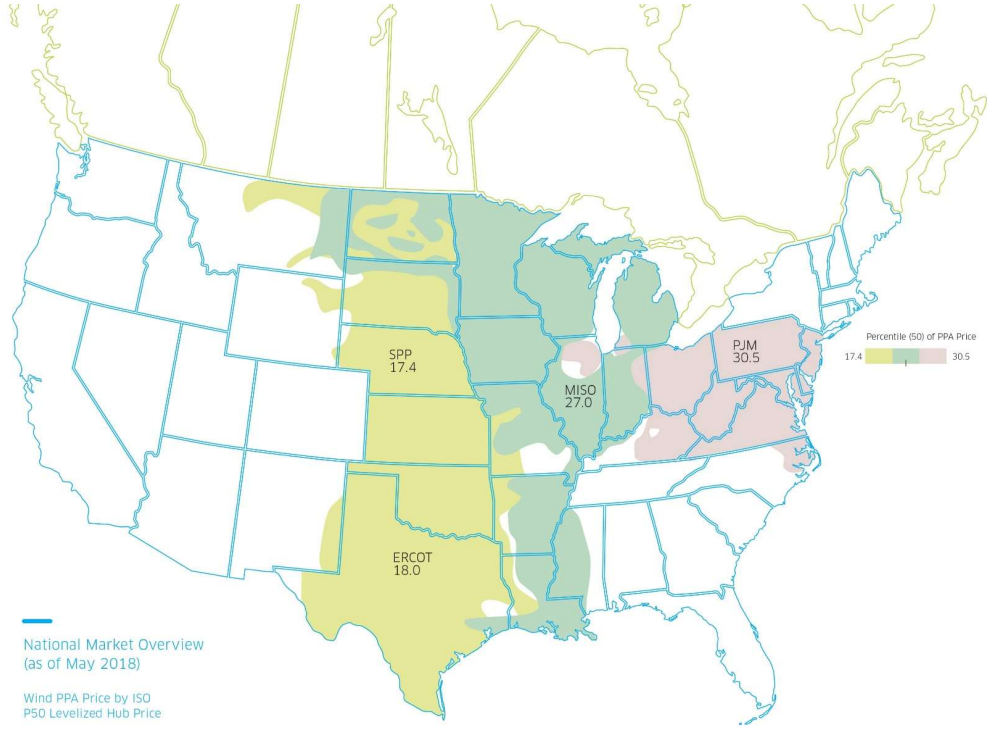
Wind turbine superimposed on Gillette Stadium

Wind turbine superimposed on Gillette Stadium



High wind speeds, open land and low cost of energy drives SPP wind market

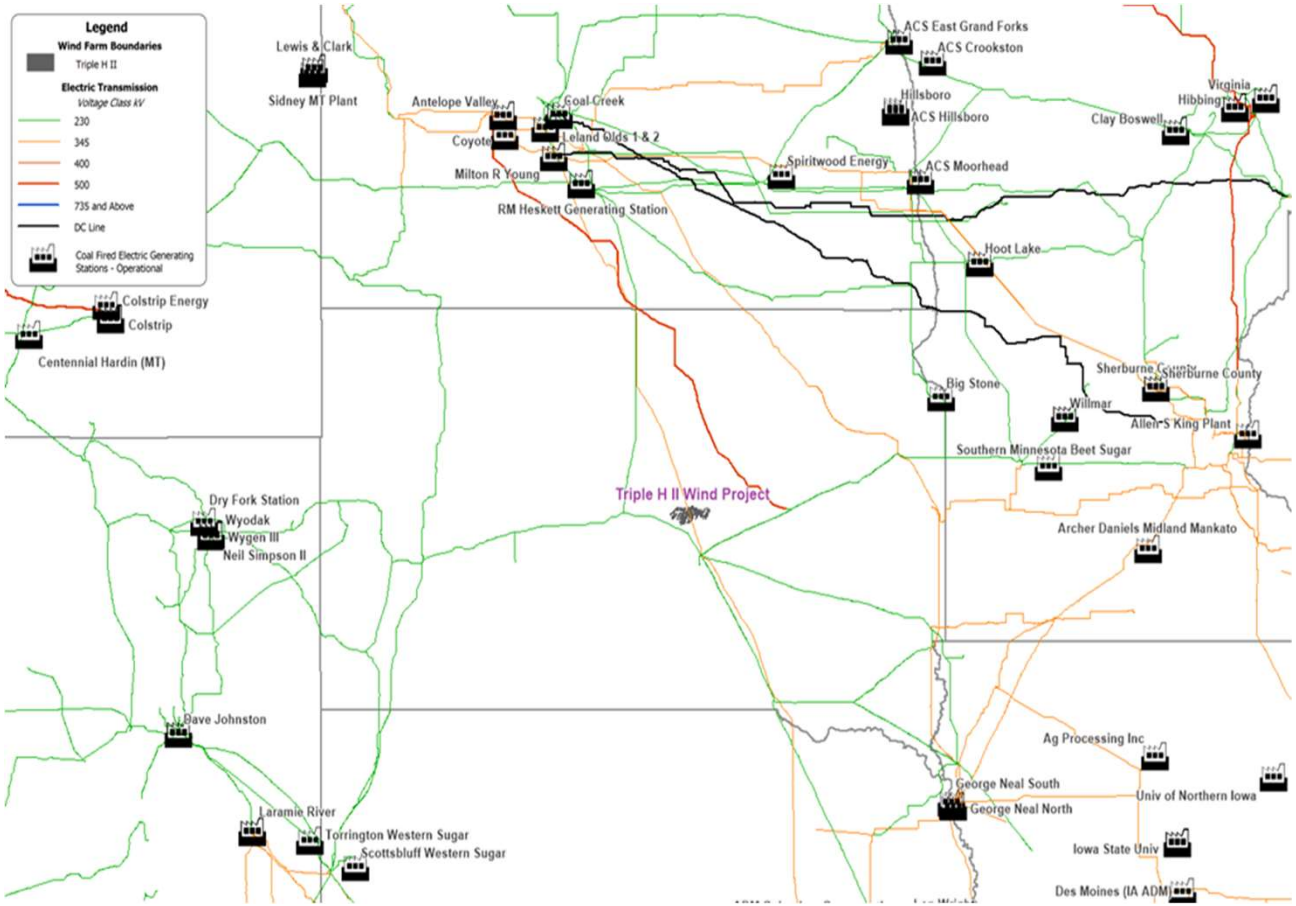




South Dakota wind projects are displacing area coal plants

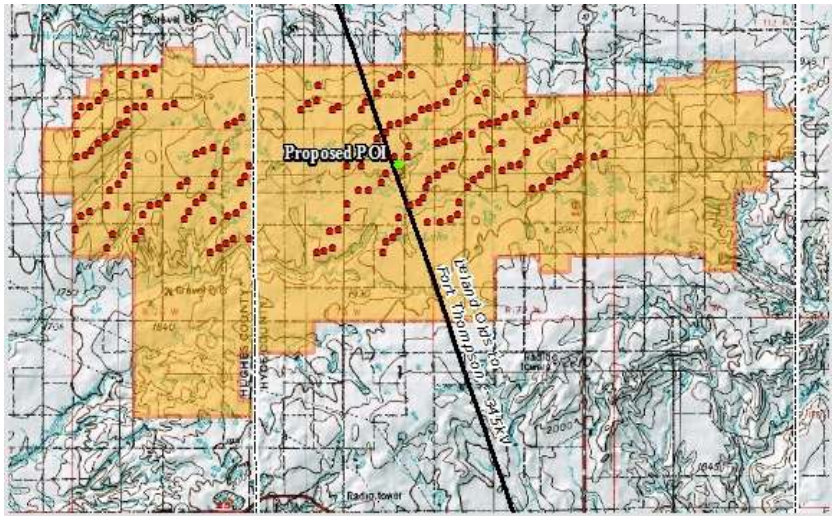
- In a carbon intensive region with a large amount of coal generation. The project shares a transmission line with several coal plants, and is well situated to displace fossil fuel generation in the region

- With project generating a total of 425 MW of clean wind power, fewer coal plants in the region will be dispatched which in turn **creates a positive impact on the region's GHG emissions, air quality for the local community, and conserves water in the region used by coal**



ENGIE: Build-ready project providing greatest environmental impact and best economics

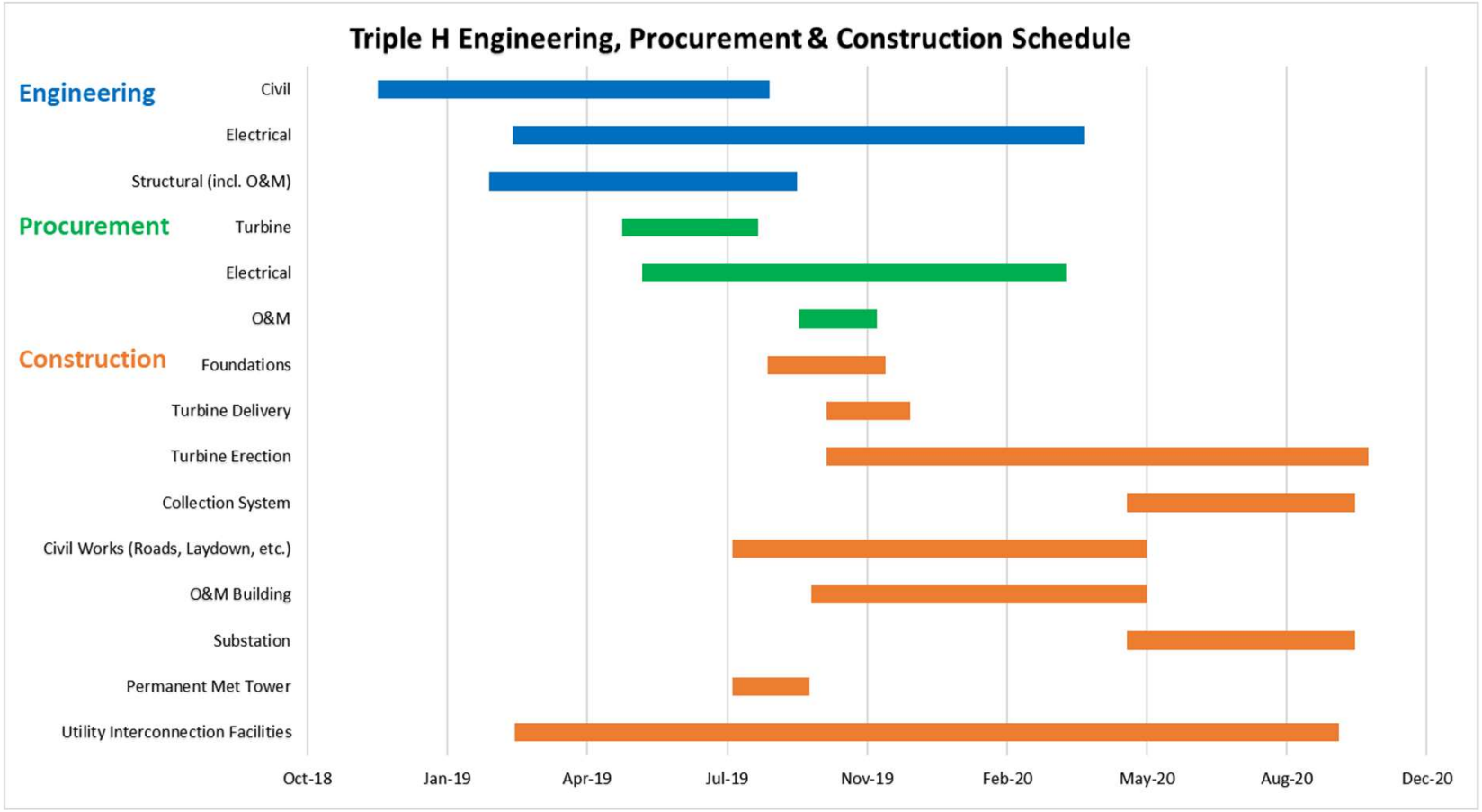
- Interconnection agreement executed in March 2019
- Construction beginning August 1, 2019
- Over two years of biological/environmental field studies have been completed
- FAA Determination of No Hazards received
- Wind data accumulated through 2006, decreasing site uncertainty
- Located in one of the strongest wind regimes in one of the strongest wind states resulting in high wind / low-cost resource
- Geotech sampling indicates suitable soil conditions
- Turbine Supply and Balance of Plant agreements signed in Q2 2019
- ENGIE wind team has successfully built and placed into operation every wind project that it has contracted



ENGIE's South Dakota wind project offers local benefits to strengthen communities

- ENGIE's wind team has been in South Dakota since 2002 developing project and creating relationships with the community
- $190 million investment in Hyde County
- $20 million of tax benefits over 25 years to the State, Hyde County, and the school district
- Approximately 200 construction jobs
- Indirect benefits related to increased use of local services, suppliers, sales tax revenue
- Predictable, stable, long-term land easement income for 100 landowners at an estimated $1 million a year during the operating life of the project, in addition to income during the development and construction periods of the project

Project start of construction with operations expected for Q4 2020 or sooner

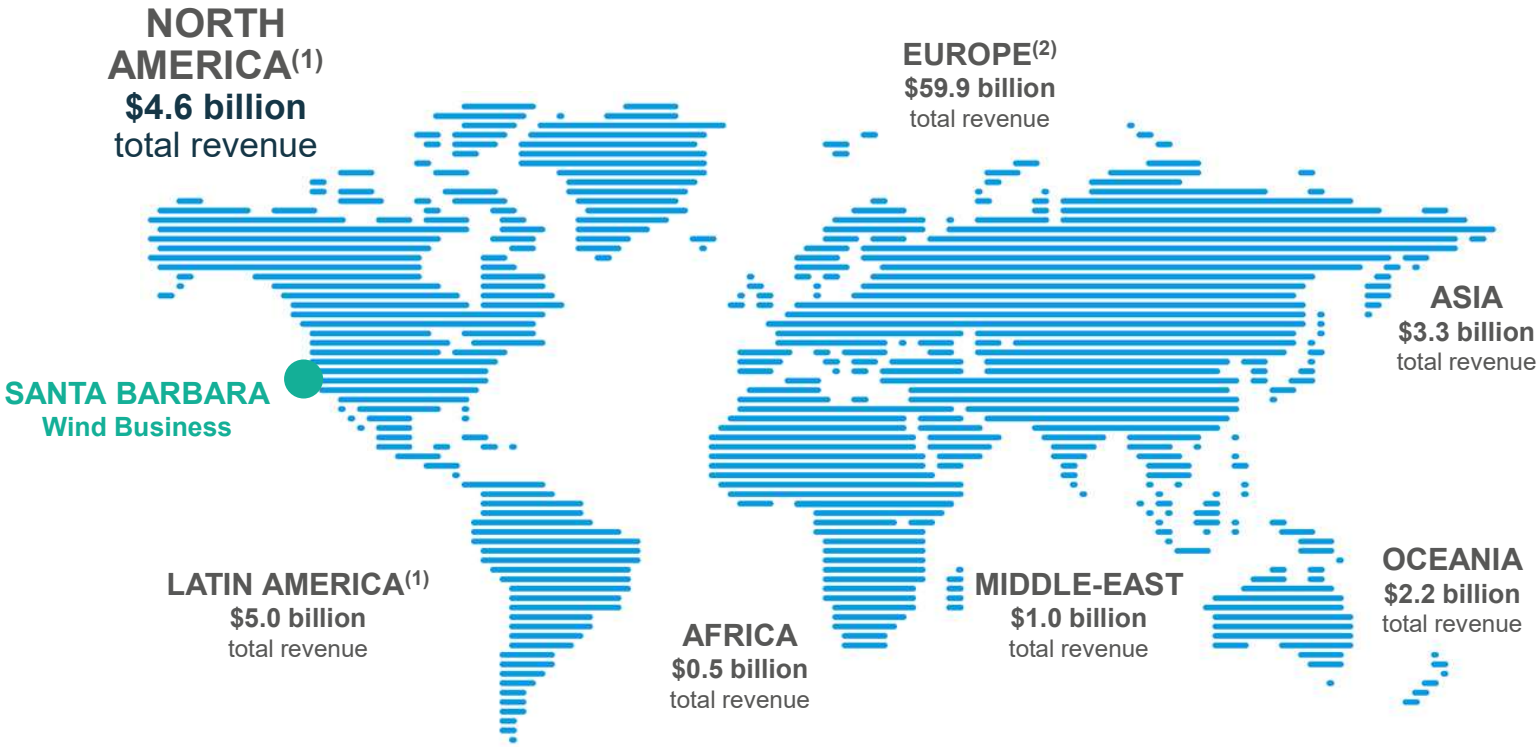


ENGIE is present in 70 countries across 5 continents

150,000
employees

$76 billion
total revenue

A- / A3
Credit ratings from S&P and Moody's



- (1) Including Mexico. (2) Including Turkey.

BU Climate Action

BOSTON UNIVERSITY

Questions

BRING YOUR OWN PROBLEM

Building Energy Performance & Conservation

Performance Contracting vs. Long-Term Partnerships

Caitlin Holley

Second Nature ENGIE BOSTON UNIVERSITY BOSTON Green Ribbon COMMISSION

Introductions

- Caitlin Holley

- The Ohio State University

OHIO STATE ENERGY PARTNERS

- Long-term Energy Management Partner

ENGIE

- Operator of The Utility

Why Energy Performance and Conservation Matter

- Each university is unique
- Sustainability and environmental impact are important
- Energy use plays a major role

To Share Today…

Energy Conservation Options for Universities

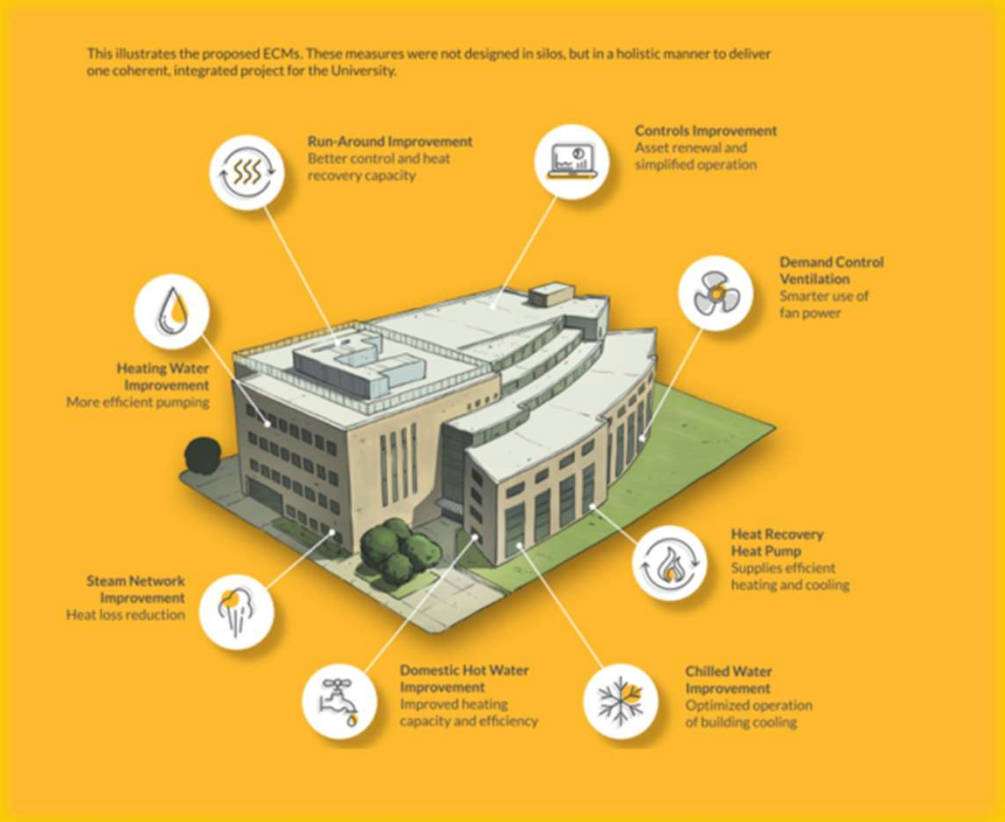
- Performance Contracting
- Long-term Partnerships

The Ohio State University Experience as a Case Study

- University attributes and energy profile
- Experience with multiple strategies
- Risks and challenges
- Results and benefits
- Perspective to share

Energy Conservation

Options for Universities



Building Energy Savings Performance Contracting

The Concept

- **Scope** the project, define how many facilities will be included in one project
- **Procure** the services, bid and award to an Energy Service Company (ESCO)
- **Perform** the audit, the ESCO performs an Investment Grade Audit
- **Execute** the Energy Savings Performance Contact
- **Understand** guaranteed savings, financing agreement
- **Oversee** implementation and verification through monitoring

Benefits	Drawbacks
Limited scope can limit risk	*Piecemeal approach may draw on resources*
ESCO finances work based on guaranteed (energy) savings	*Energy savings may not provide as high dollar savings as expected*
Audits can be reviewed and decisions made on individual build results	*Audits are based on projected (modeled) consumption; results may vary*
Relationship is short-term; ESCO is incentivized by (potential) repeat business	*Long-term accountability for results remains with the university*

Long-term Comprehensive Energy Management Program

The Concept

- **Define** the campus energy systems for management and the desired duration
- **Identify** university goals and required performance at the university level
- **Set** strong key performance indicators (KPIs) and accountability metrics
- **Partner**, through (competitive) bidding and detailed contracting with a provider of energy-as-a-service to meet financial and operational needs
- **Maintain** partnership using the contract as a basis and adapt/amend as needed

Benefits	Drawbacks
Long-term relationship governs all decision making	*Partnership must be a good fit for the needs of the university*
Program is holistic and completely covered in one contractual structure	*No contract can cover every aspect during initiation; revisions will be required*
Energy efficiency is measured through long-term energy partner accountability	*Longer payback periods may not satisfy all needs; cutoff points may be required*
Management is developed through the partnership and is established through execution	*Partnership will require more up-front legal, contractual, and leadership attention*
Performance risk shifts to the partner for the contractual term	*Control shifts to the partner for the specified energy systems*

The Ohio State University

A Case Study

The University at a Glance

The University in Energy

Electricity, gas, steam, chilled water generation and distribution systems

3 high-voltage substations

750,000 MWh of electricity

≈ $115 million annual spending

110 MW peak demand

2.9 million mmBTUs of steam (natural gas)

High reliability and resiliency requirements

Experience with Performance Contracting

5-Building Experience

Work Performed, Report Provided

Financial Benefit Constrained Growth

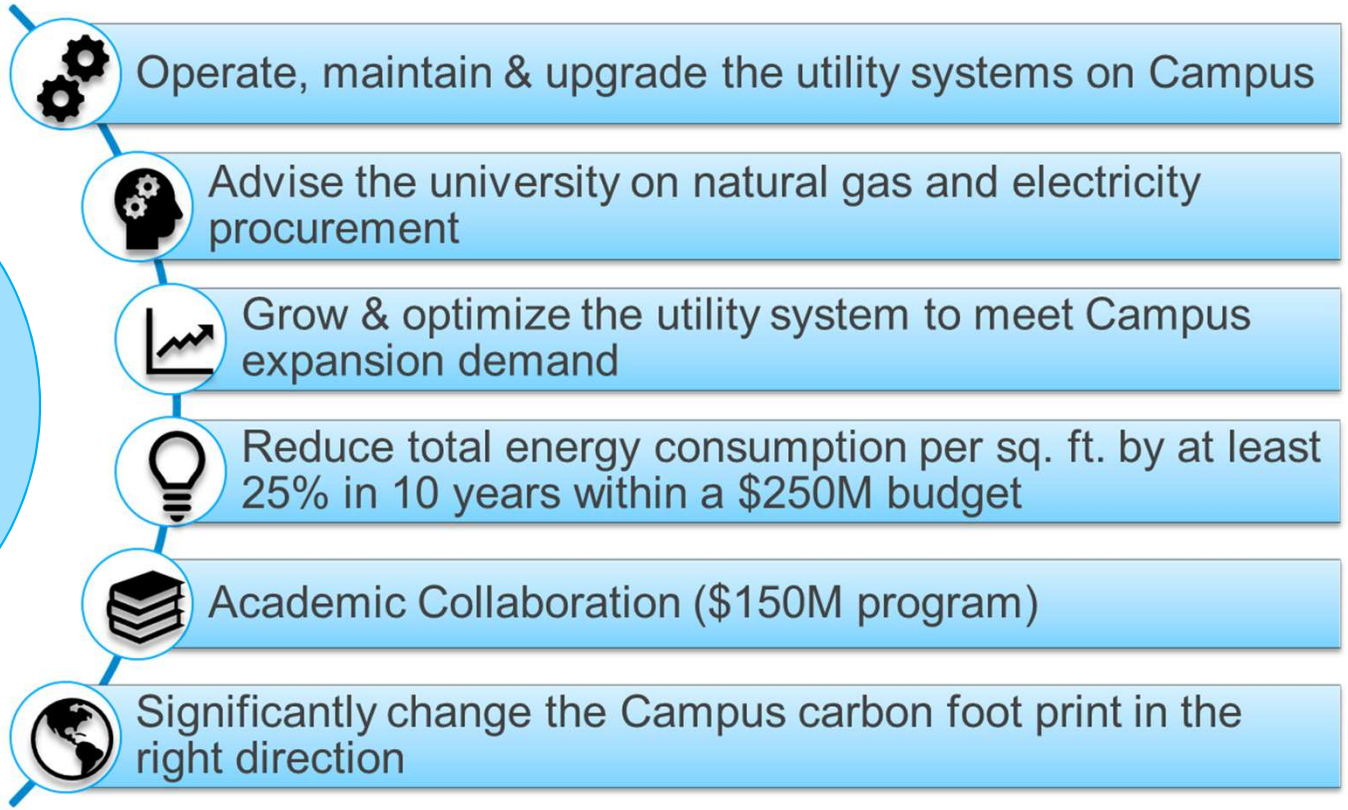
Savings: Calculated vs. Actual

Internal Expertise for Results Verification

Long-Term Results vs. Expectations

Approach for Long-term Energy Partnership

50-YEAR AGREEMENT FOR COMPREHENSIVE ENERGY MANAGEMENT



What's in it for...

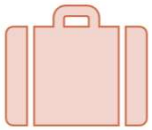
Ohio State Energy Partners

- **Stable, long-term investment in assets**
  - Positive history and forecast
  - Steady and predictable returns and cash flows
- **Distributed utility system operations**
  - Aligns with core strengths
  - District systems, single partner interface
- **Opportunity to be an industry leader**
  - Academic collaboration and Innovation
  - Showcase a energy management expertise

The Ohio State University

- **Stable, long-term investor operator**
  - Achieve efficiency and sustainability goals
  - Steady and predictable cash flows
- **Distributed utility system operations**
  - Not the university's core strengths
  - Campus systems, single partner interface
- **Opportunity to be a university leader**
  - Redirect capital to academic mission
  - Showcase a new energy management model

Lessons Learned: Risks and Challenges

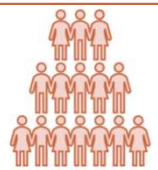


Contract language is key

- The contract should be a framework; fluidity is a necessity
- Provisions for expanding scope are recommended

Performance metrics matter

- Metrics should map directly to university's goals
- Partnership should incentivize mutual goals



Internal organization is required

- Clarity within the University about the partnership
- Internal disconnects will surface through partnership engagement

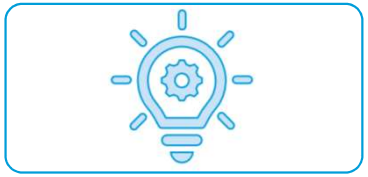
Lessons Learned: Results and Benefits

Financial value

- Financial structure can shift investment burden to partner
- Long-term stability in fluctuating markets

Performance accountability

- Shift risk and accountability of energy savings to partner
- Secure guaranteed performance through KPIs



Technical expertise

- Professional energy partner provides external technical expertise
- Continual support through changing markets, emerging technologies

Summary Perspective from the Ohio State Experience

Patience is key; development is an extended process.
Results are worth the effort.

Universities are unique; financial, contractual, and technical expertise are needed.
Build a framework work flexibly within.

Communications planning and organizational structure are required.
Bring all stakeholders to the same understanding.

A true partnership is a win-win for the university and energy partner.
Incentivize common goals; balance both sides risks and rewards.

Thank You

Questions & Answers

Bring Your Own Problem Working Sessions

Session A:

1. **Senior Leader Buy-in:** Distributing a University clear climate action vision from the highest level / Uninformed senior administrators / Lack of on-campus political will to have hard conversations
2. **Energy Retrofits:** Deep energy retrofits for out existing buildings / Decreasing Carbon in Residence Halls / Balance of promoting energy efficiency with an risk adverse staff
3. **Bigger Picture:** Integration of our sustainability problems (and solutions) with teaching and research / Aligning efforts to among competing priorities / Weaning ourselves off fossil fuels

Session B:

1. **Kickstarting a Plan:** Kick Starting a Climate Action Plan / Working toward a Carbon Neutral Goal / Climate Resilience prep / Engaging students and other stakeholders / Separating the practical and impractical expectations
2. **Financing:** Cost of capital & Off-book financing / Allocating funding NOW to start executing projects / How to lower out-of-pocket costs for new systems (heating, eVs, etc)
3. **Thermal solutions:** Planning for campus geothermal. / District scale ground source heat pump development / Solar hot water heater system to offset hot water demand in cafeteria / Decarbonization of campus heating systems

Bring Your Own Problem Working Session

Session A: 1:00 - 1:40 pm

1. **Senior Leader Buy-in:** Distributing a University clear climate action vision from the highest level / Uninformed senior administrators / Lack of on-campus political will to have hard conversations / Separating the practical and impractical expectations / How to get buy in from senior management because renewable energy programs, data, and "green" policies are disorganized.
2. **Energy Retrofits:** Deep energy retrofits for out existing buildings / Decreasing Carbon in Residence Halls / Balance of promoting energy efficiency with an understandably risk adverse operational staff / How to identify best strategy for improving efficiency of buildings located on a large campus
3. **Bigger Picture:** Integration of our sustainability problems (and solutions) with teaching and research / Aligning efforts to among competing priorities / Weaning ourselves off fossil fuels

Bring Your Own Problem Working Session

Session B: 1:50 - 2:30 pm

1. **Kickstarting a Plan:** Kick Starting a Climate Action Plan / Working toward a Carbon Neutral Goal / Climate Resilience prep / Engaging students and other stakeholders
2. **Financing:** Cost of capital & Off-book financing / Allocating funding NOW to start executing projects / How to lower out-of-pocket costs for new systems (heating, eVs, etc)
3. **Thermal solutions:** Planning for campus geothermal. / District scale ground source heat pump development / Solar hot water heater system to offset hot water demand in cafeteria / Decarbonization of campus heating systems

Rethinking Energy Issues
Michael Webber

Break

Second Nature ENGIE BOSTON UNIVERSITY BOSTON Green Ribbon COMMISSION