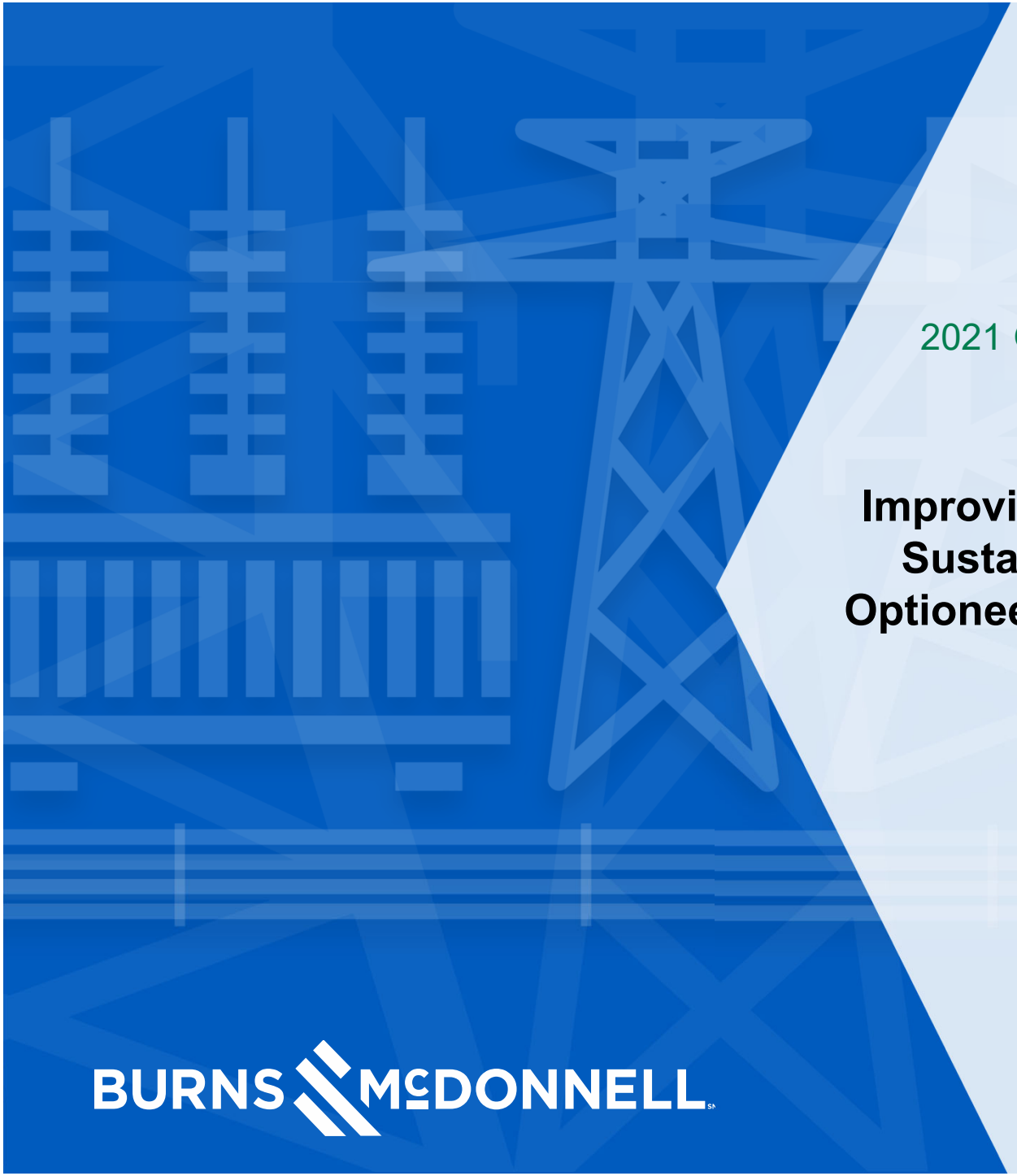


2021 Grid of the Future Symposium

Improving Grid Infrastructure Sustainability by BIM and Optioneering Design Approach

October 18, 2019

Presented By:

Lyndsey Covert

Burns & McDonnell Lineup

Impact of Extreme Events on Electrical Substation Infrastructure in Coastal Areas
Paper Session 4B // October 19th 9:45 am
Connor Bowen

Embracing Carbon Abatement in Concrete for the Construction of Electrical Utility Networks
Paper Session 4B // October 19th 10:15 am
Alex Pagnotta

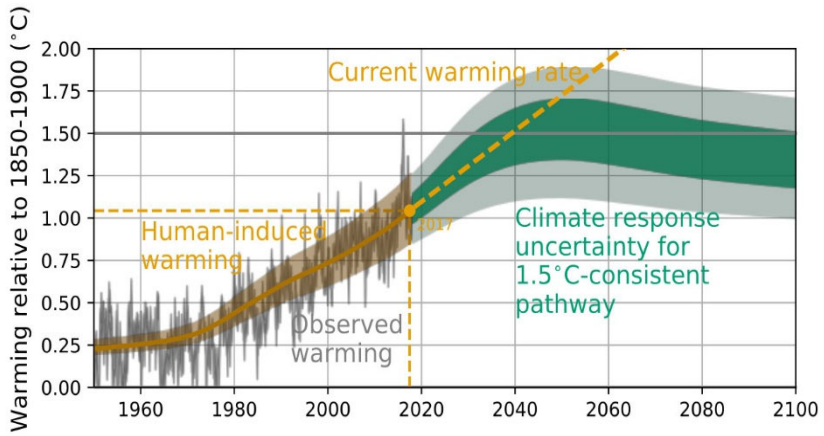
Outline

- Background
- Sustainability Metrics
- Challenges to Sustainable Design
- Building Information Modeling (BIM) & Optioneering
- Substation Design Case Study
- Summary
- Q&A

Background

Climate Change

- Human-induced rise in global average temperature
- Results in increased drought, famine, frequency and severity of weather events
- World leaders in 2015 Paris Climate Accord identified 1.5°C rise in global average temperature as limit to mitigate looming humanitarian crisis



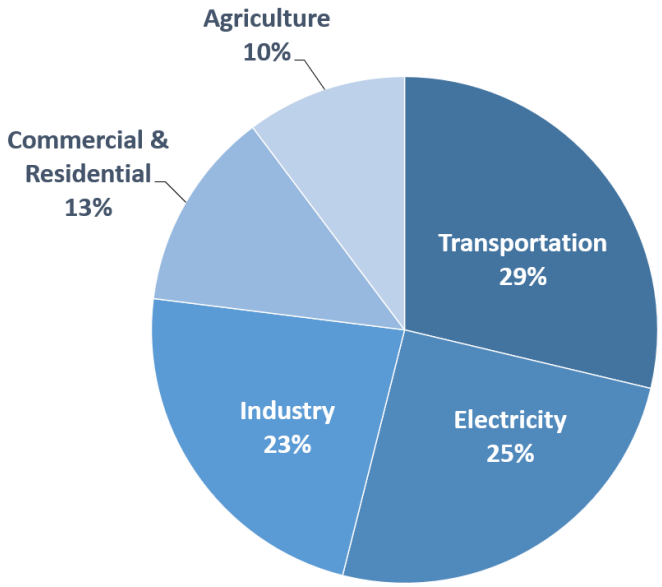
* Source: https://www.ipcc.ch/sr15/

* Source: https://www.nytimes.com/interactive/2015/12/12/world/paris- climate-change-deal-explainer.html

Background

Transmission & Distribution (T&D)

Total U.S. Greenhouse Gas Emissions by Economic Sector in 2019



* Source: https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions

- Only 62% of electricity sector emissions are attributed to burning fossil fuels, what about the rest?
- Energy generation is often the focus, but T&D also contributes to emissions
- Increasing number of utilities are making emissions reductions commitments in line with Science Based Targets
- Transitioning to renewable energy sources contributes to new development

Sustainability Metrics

Measuring Emissions

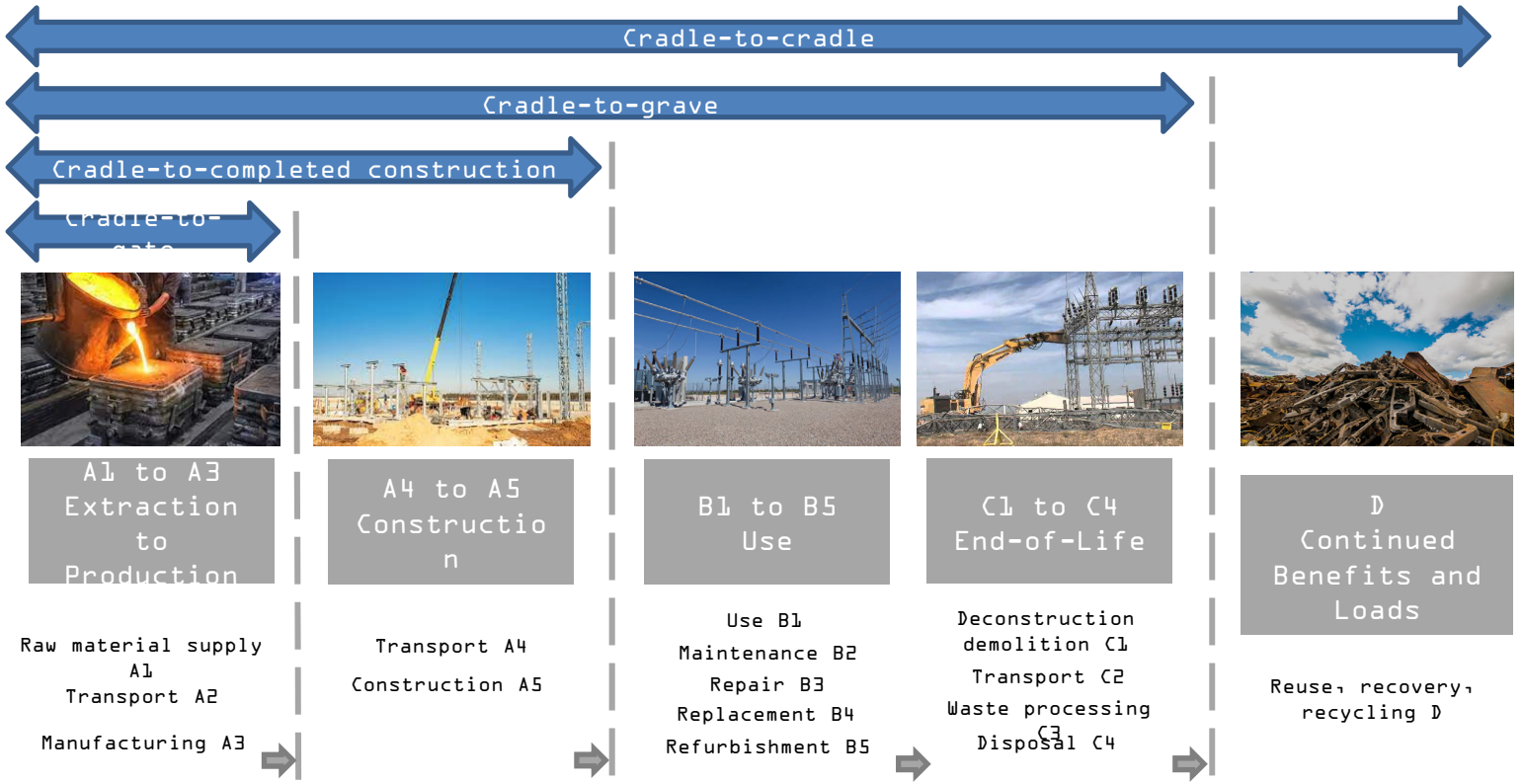
Common Chemical Name (Chemical Formula)	Global Warming Potential (GWP) (100 years)	Atmospheric Life (years)
Carbon dioxide (CO_2)	1	5-200
Methane, fossil (CH_4)	28	12.4
Methane, biogenic (CH_4)	30	12.4
Dinitrogen monoxide (N_2O)	265	121
Sulfur hexafluoride (SF_6)	23,500	3,200

* Source: https://www.epa.gov/ghgemissions/understanding-global-warming-potentials

- To understand the T&D industry contribution to emissions, we must be able to measure them.
- Greenhouse gases are calculated based on their Global Warming Potential (GWP), or the amount a given gas warms the earth over a 100-year time compared to a unit of CO_2.

Sustainability Metrics

Boundary Conditions



Sustainability Metrics

Environmental Product Declaration (EPD)

- Transparent and comparable lifecycle environmental impact reporting of products
- ISO 14025 compliant Type III environmental declaration
- Several free and publicly accessible databases (EC3, GloCoMDat, etc.)

THOMAS CONCRETE

ENVIRONMENTAL PRODUCT DECLARATION

Mix 407 • Buckhead Plant

Thomas CONCRETE

This Environmental Product Declaration (EPD) reports the impacts for 1 m^3 of ready mixed concrete mix, meeting the following specifications:

- ASTM C94: Ready-Mixed Concrete
- UNSPSC Code 30111505: Ready Mix Concrete
- CSI Section 03 30 00: Cast-in-Place Concrete

COMPANY

Thomas Concrete
2500 Cumberland Pwky, Suite 200
Atlanta, GA 30339

PLANT

Buckhead Plant
740 Lambert Drive
Atlanta, GA 30324

EPD PROGRAM OPERATOR

ASTM International
100 Barr Harbor Drive
West Conshohocken, PA 19428

DATE OF ISSUE

10/03/2017 **(valid for 5 years until 10/03/2022)**

ENVIRONMENTAL IMPACTS

Declared Product:
Mix 407 • Buckhead Plant
4000 CARBON CURE
Compressive strength: 4000 psi at 28 days

Declared Unit: 1 m^3 of concrete

Global Warming Potential (kg CO_2-eq)	359
Ozone Depletion Potential (kg CFC-11-eq)	9.5E-6
Acidification Potential (kg SO_2-eq)	1.01
Eutrophication Potential (kg N-eq)	0.49
Photochemical Smog Creation Potential (kg O_3-eq)	19.5
Total Primary Energy Consumption (MJ)	2,340
Nonrenewable (MJ)	2,240
Renewable (MJ)	100
Total Concrete Water Consumption (m^3)	3.14
Batching Water (m^3)	0.14
Washing Water (m^3)	0.05
Nonrenewable Material Resource Consumption (kg)	2,336
Renewable Material Resource Consumption (kg)	2.47
Hazardous Waste Production (kg)	0.02
Nonhazardous Waste Production (kg)	9.33

Product Components: crushed aggregate (ASTM C33), Portland cement (ASTM C150), natural aggregate (ASTM C33), fly ash (ASTM C618), batch water (ASTM C1602), admixture (ASTM C494),

The Carbon Leadership Forum PCR: Product Category Rules (PCR) for ISO 14025 Type III Environmental Product Declarations (EPDs) for Concrete, Version 1.1 dated 12/4/2013, serves as the PCR for this EPD. http://www.carbonleadershipforum.org

PCR review was conducted by: Nicholas Santero • thinkstep (formerly PE International).

Independent verification of the declaration, according to ISO 14025:2006: ☐ internal ☑ external

Third party verifier: Thomas P. Gloria (tgloria@industrial-ecology.com) • Industrial Ecology Consultants

LCA and EPD developer: Laurel McEwen (laurel.mcewen@climateearth.com) • Climate Earth

* Source: https://buildingtransparency.org/ec3/epds/ec38ppcy

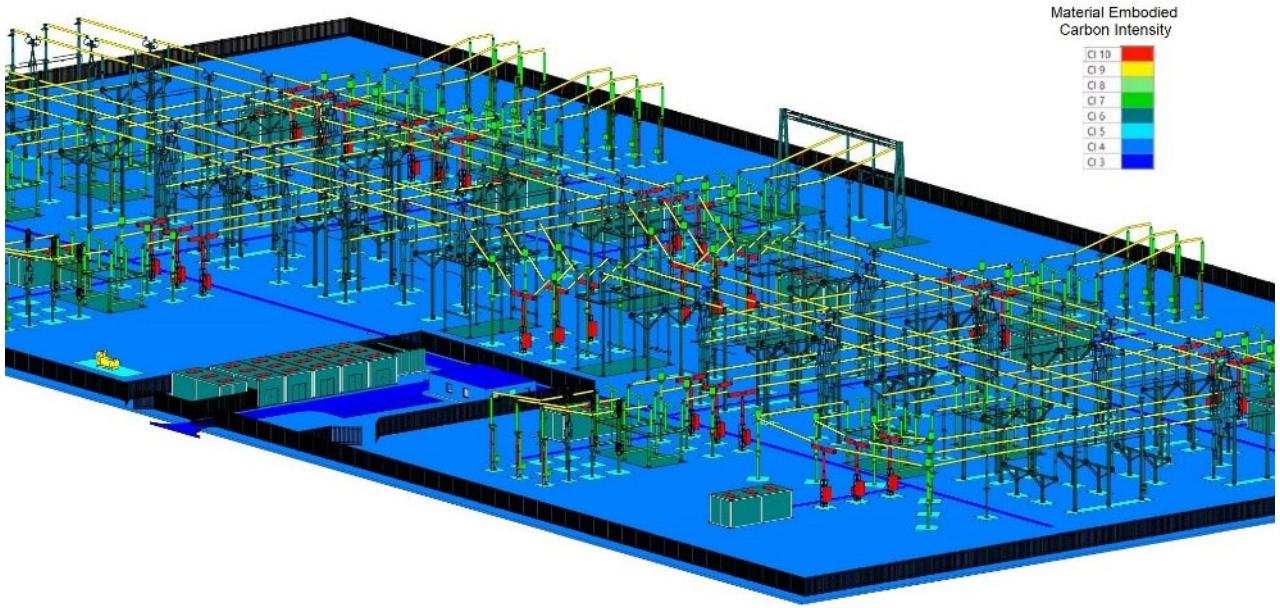
Challenges to Sustainable Design

Accessing and Leveraging Data

Goals	Challenges
• Track material and equipment embodied carbon ($kgCO_2e$)	• Large amount of new data to be tracked
• Leverage embodied carbon data as decision driver	• Assigning appropriate value to embodied carbon as decision drivers
• Weigh all possible options during early design stages	• Investigating many alternative designs instead of a couple standard layouts

Building Information Modeling (BIM)

Multidisciplinary Data Management

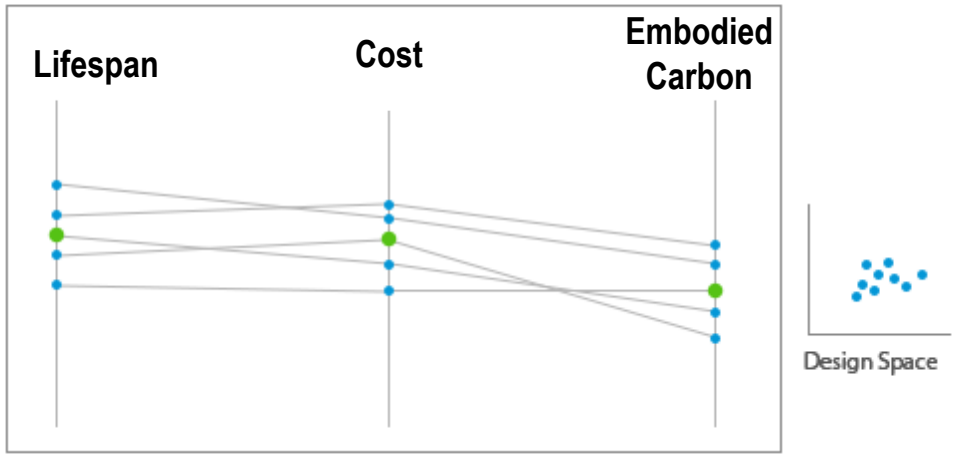


- Building Information Modeling framework can handle a large amount of data for sustainability purposes
- Input: Embodied carbon data (in $kgCO_2e$) of all individual model elements, sourced from EPDs
- Outputs: design's total embodied carbon & individual elements carbon intensity

Optioneering with BIM

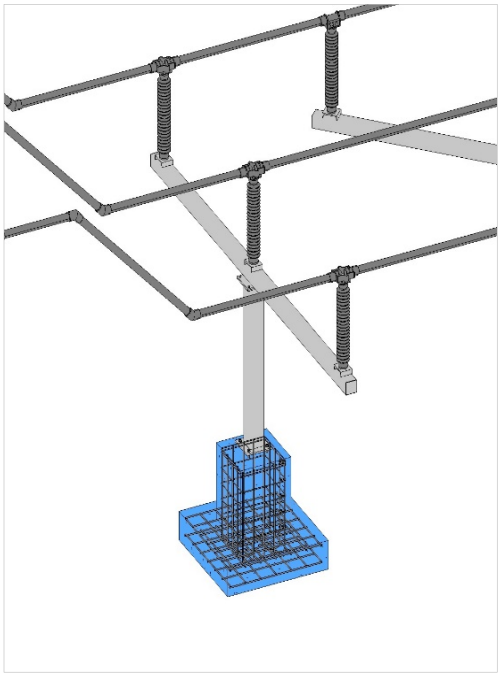
- Weigh all relevant inputs (cost, weight, embodied carbon, lead time, etc.) and select the optimal design option
- User can document their decision-making and justify their design, as well as any deviations in relevant inputs.
  - Ex: A 10% increase in cost results in a 30% carbon reduction

Decision Drivers

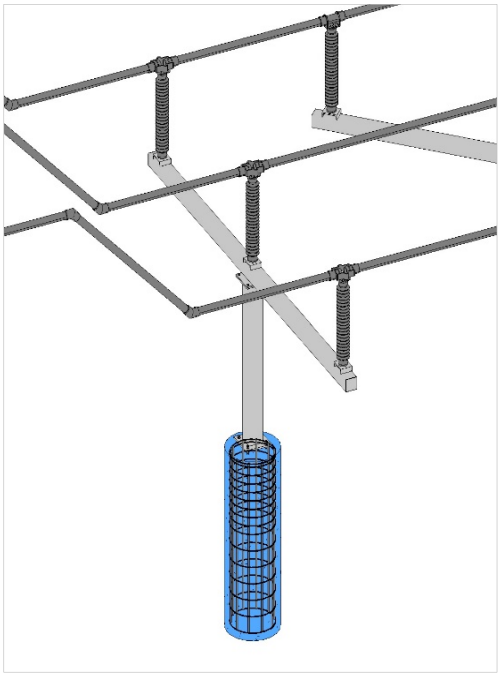


* Source: https://knowledge.autodesk.com/support/revit/learn-explore/caas/CloudHelp/cloudhelp/2021/ENU/Revit-Model

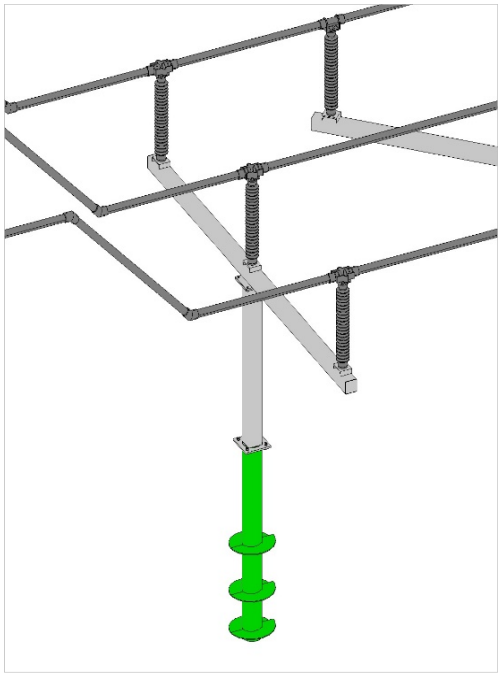
Substation Design Use Case



FDN: Option 1
Spread Footing FDN

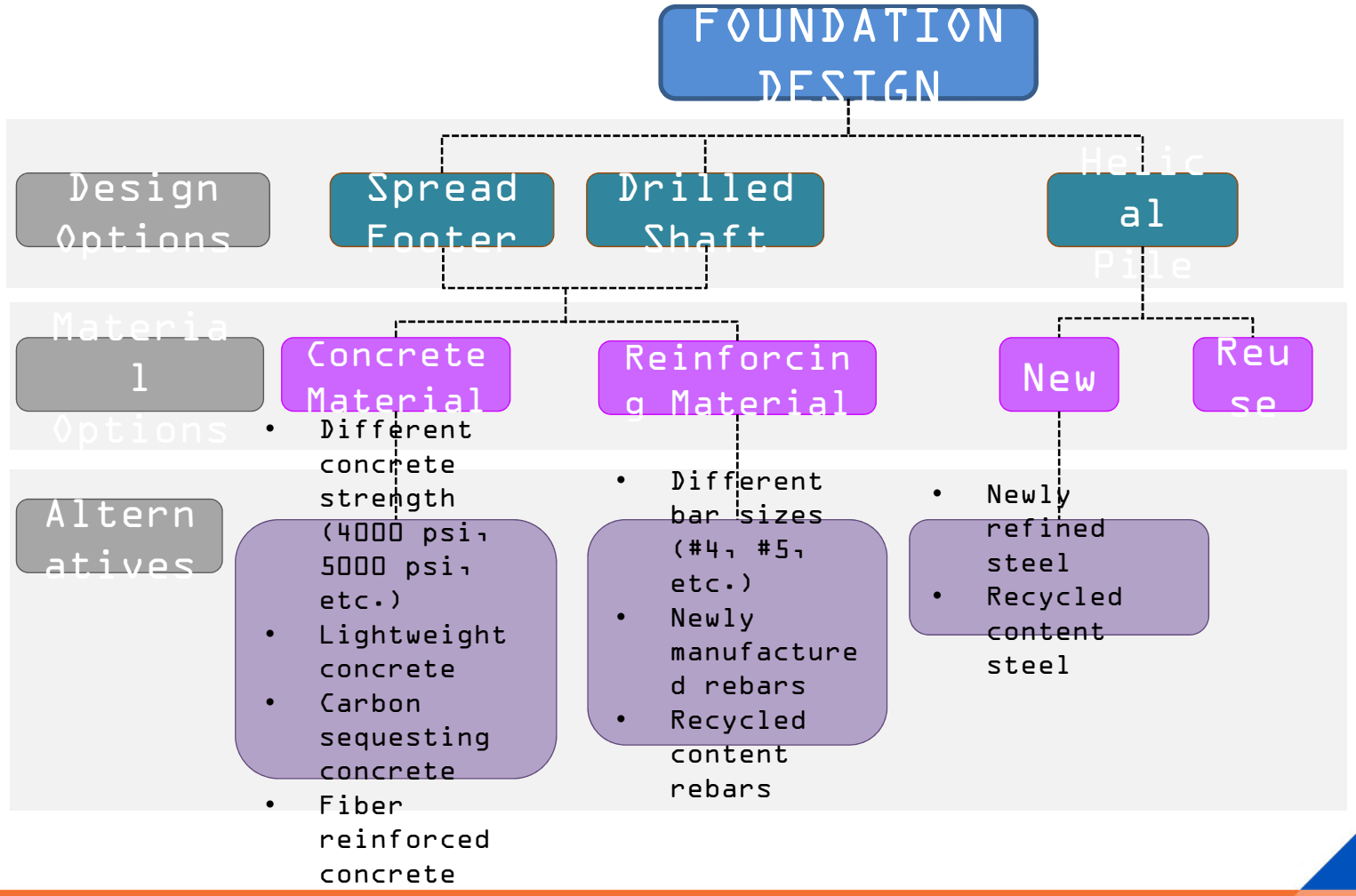


FDN: Option 2
Drilled Shaft FDN



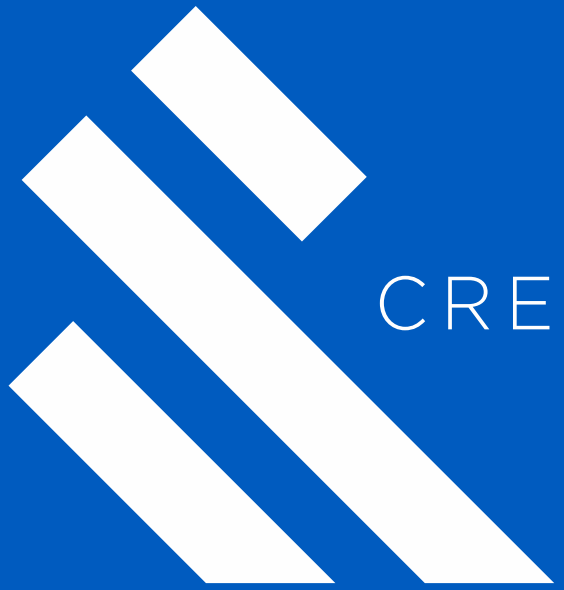
FDN: Option 3
Helical Pile FDN

Substation Design Use Case



Summary

- 25% global GHG gas emissions from electric power industry
- Increased adoption of Science Based Targets
- Challenged with data management for more sustainable design
- Leveraging BIM technology to effectively manage data
- Document and justify design decision-making for optimized sustainable result



CREATE AMAZING.

Thank you!