REBUILD 2024

DRIVING DOWN CARBON: Strategies For The Industrial Sector

October 3, 2024

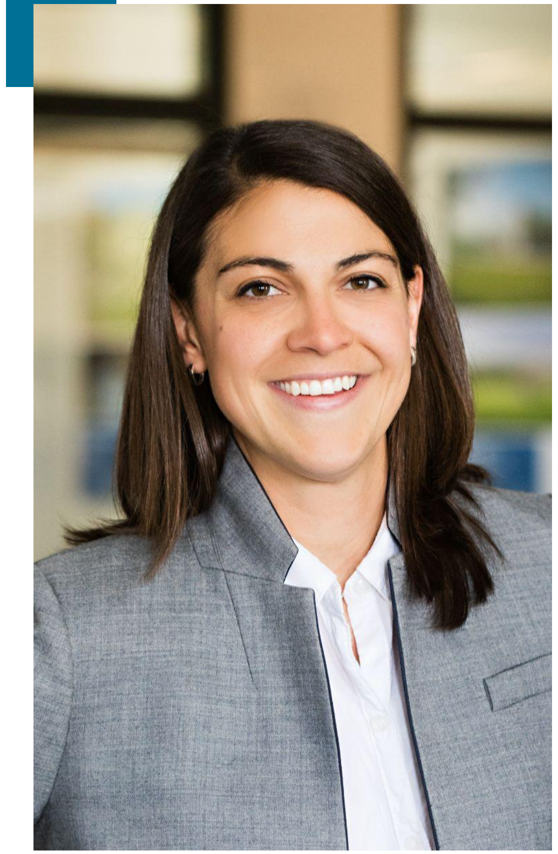
ma+ design

MOTZ ENGINEERING

Speakers

Jess Glorius-Dangelo
MA Design
Sustainability Manager +
Project Manager

Ally Balmer
MA Design
Sustainability Specialist +
Project Coordinator



Suzie Engel
Motz Engineering
President +
Mechanical Engineer

Agenda

Learning Objectives

01

Understand the definitions and differences between Scope 1, Scope 2, and Scope 3 emissions, and the key factors driving the focus on carbon emissions in the industrial sector.

02

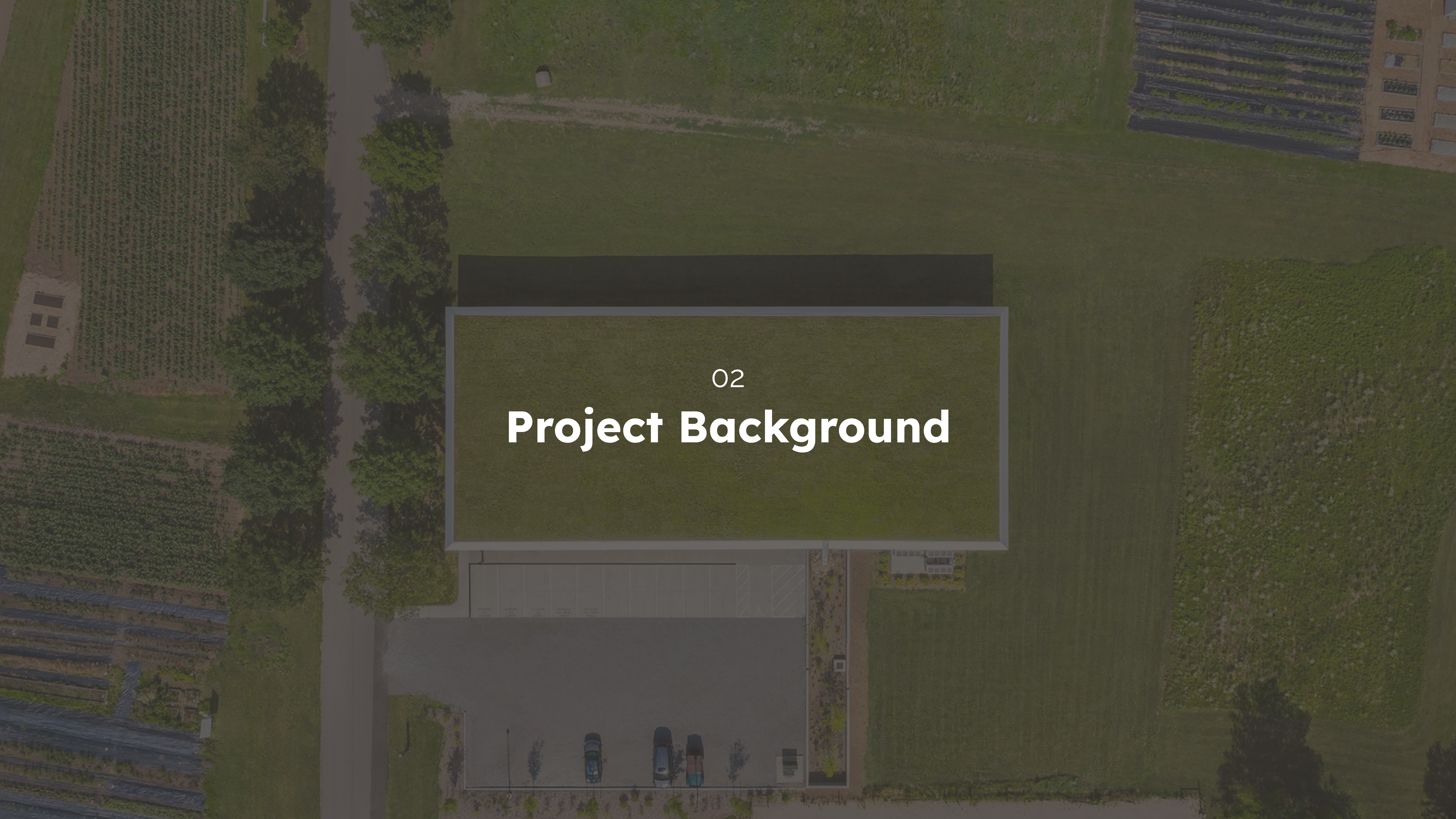
Learn how companies can begin **tracking their carbon emissions** and discover the **useful resources available** to help interpret the impacts.

03

Explore building-level strategies that can be implemented in industrial facilities to help lower or offset carbon emissions.

04

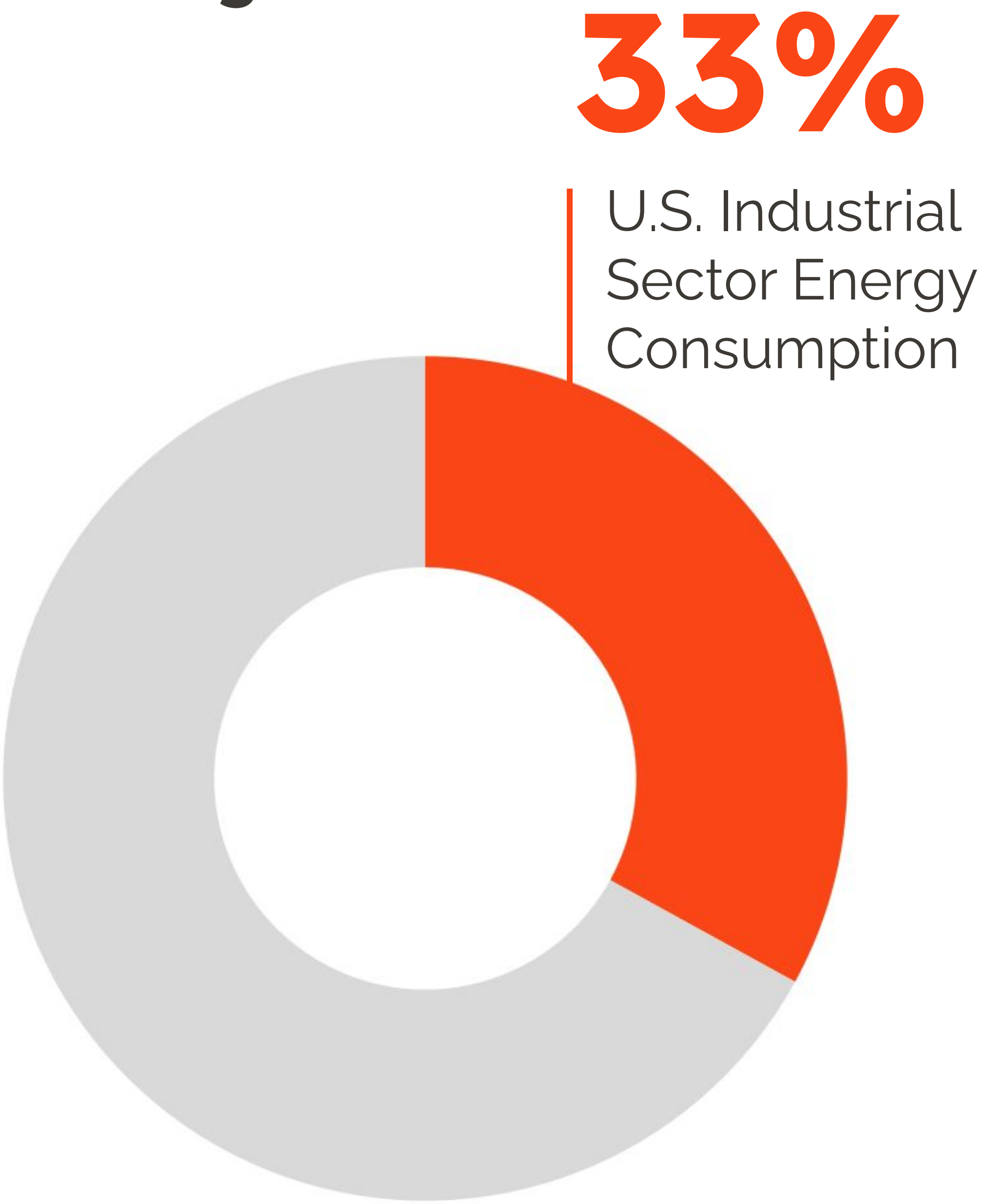
Identify key questions to ask and the relevant stakeholders to engage when starting the carbon emission tracking process.



02

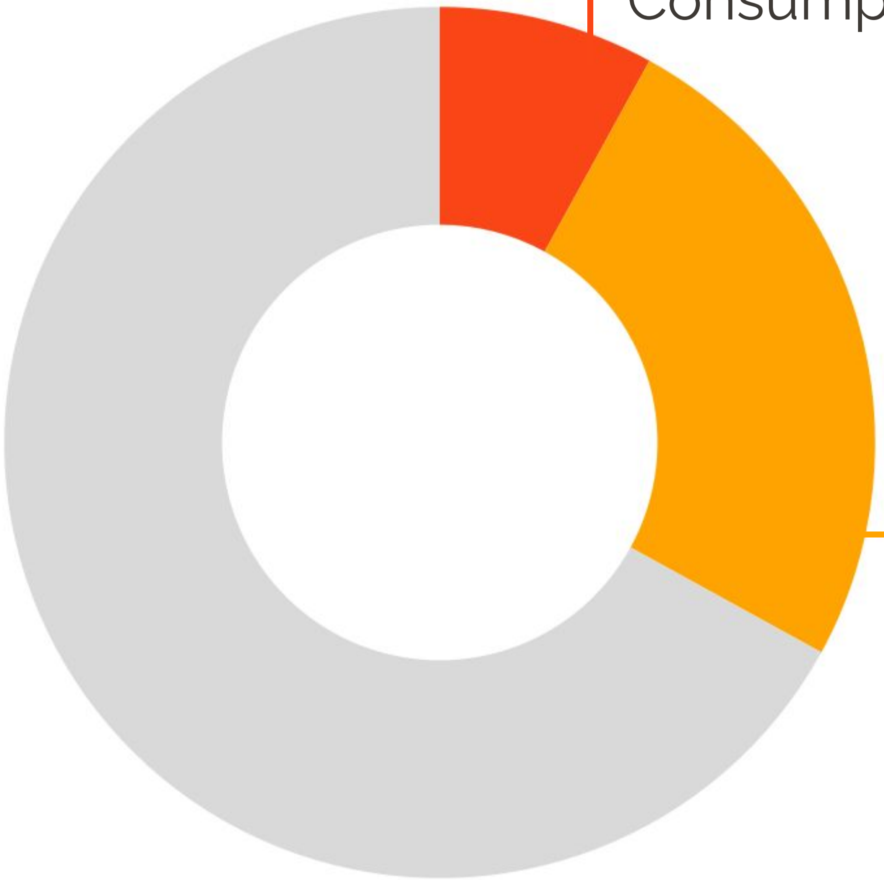
Project Background

The Big Picture



U.S. Energy Consumption

The Big Picture



33%

U.S. Industrial Sector Energy Consumption

76%

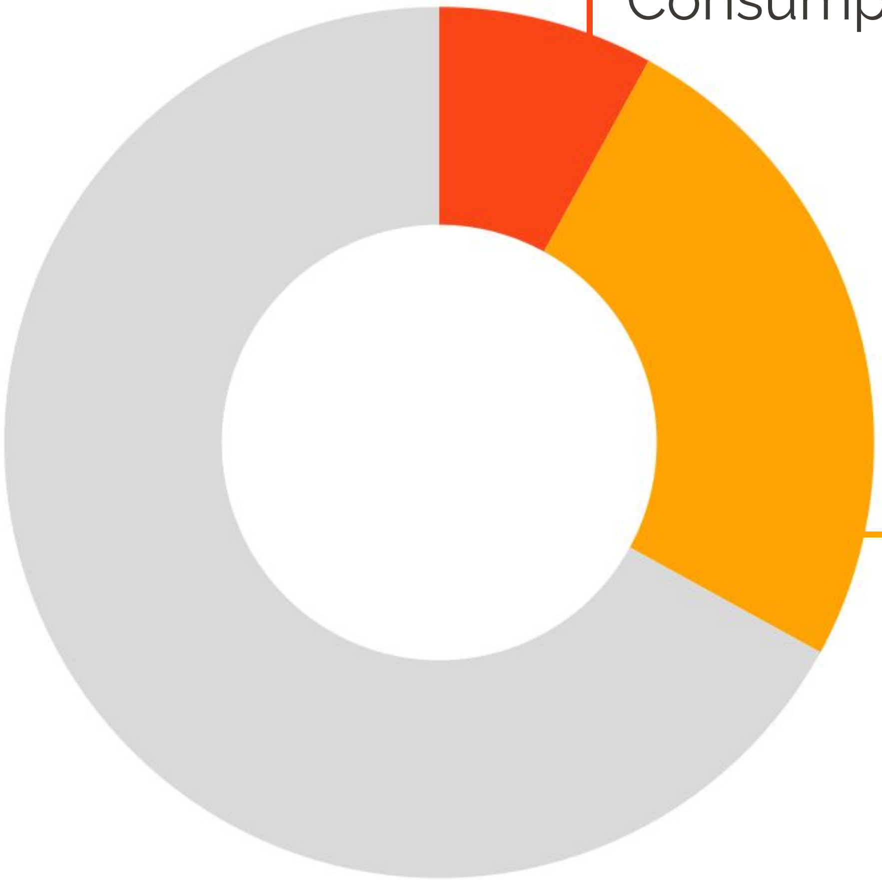
Of this is from Manufacturing

U.S. Energy Consumption

The Big Picture

33%

U.S. Industrial Sector Energy Consumption



76%

Of this is from Manufacturing

U.S. Energy Consumption

6,343 million

metric tons of CO_2e

Carbon sequestered by

7.4 billion

acres of forest

3.89

Continental United States

The Client and the Ask

- **Family-owned industrial facility in the midwest region.**
  - Existing building
  - Approx. 500,000 SF

- Asked by their Fortune 500 clients to **report to the Carbon Disclosure Program (CDP)**

Environmental Social Governance

Scope Emissions

SCOPE 1

DIRECT EMISSIONS FROM OWNED & CONTROLLED RESOURCES

owned/leased vehicles, refrigeration

Scope Emissions

SCOPE 1

DIRECT EMISSIONS FROM OWNED & CONTROLLED RESOURCES

owned/leased vehicles, refrigeration

SCOPE 2

INDIRECT EMISSIONS FROM THE GENERATION OF PURCHASED ENERGY

purchased electricity, steam, heat &cooling

Scope Emissions

SCOPE 1

DIRECT EMISSIONS FROM OWNED & CONTROLLED RESOURCES

owned/leased vehicles, refrigeration

SCOPE 2

INDIRECT EMISSIONS FROM THE GENERATION OF PURCHASED ENERGY

purchased electricity, steam, heat &cooling

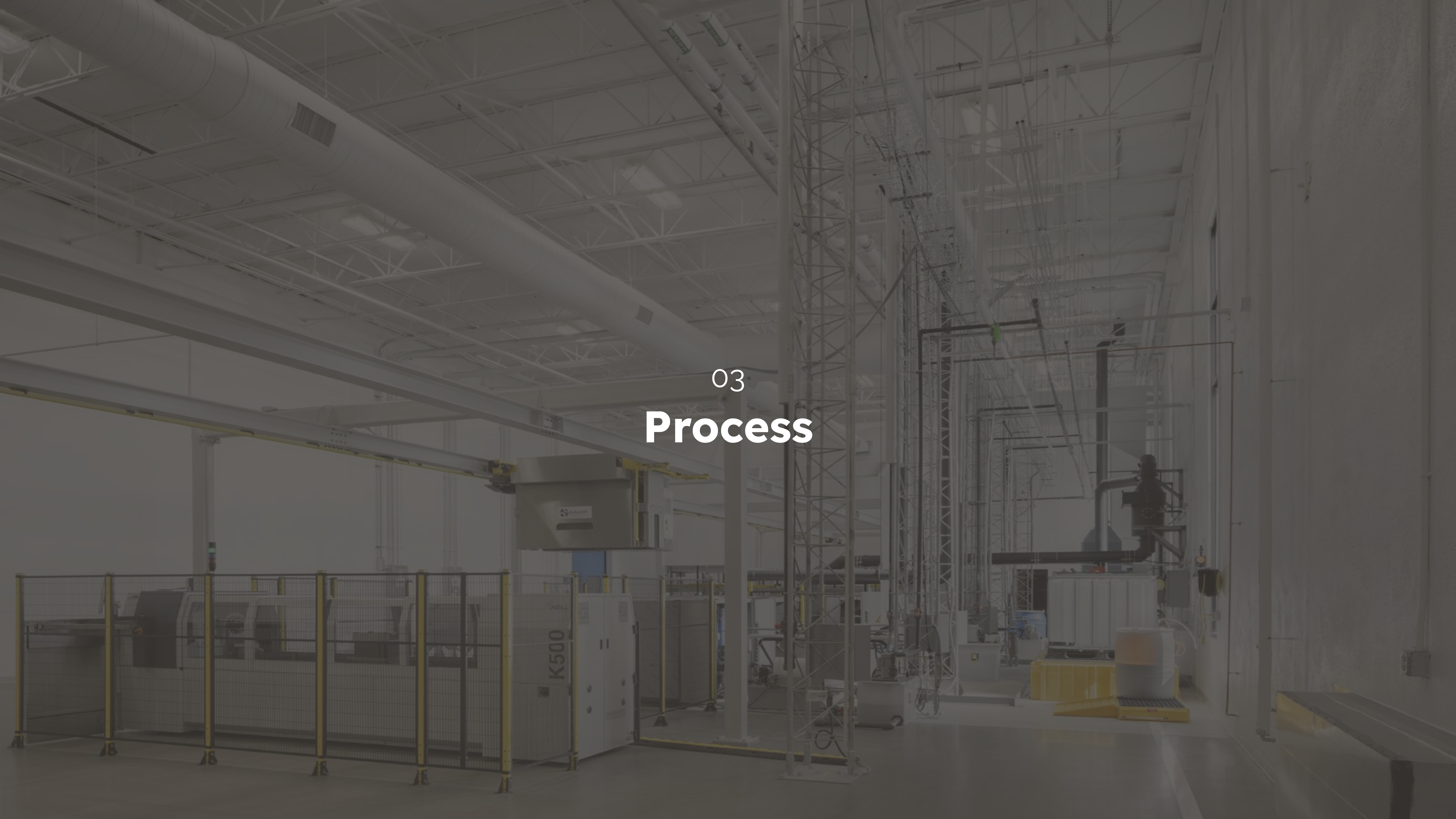
SCOPE 3

ALL OTHER INDIRECT EMISSIONS

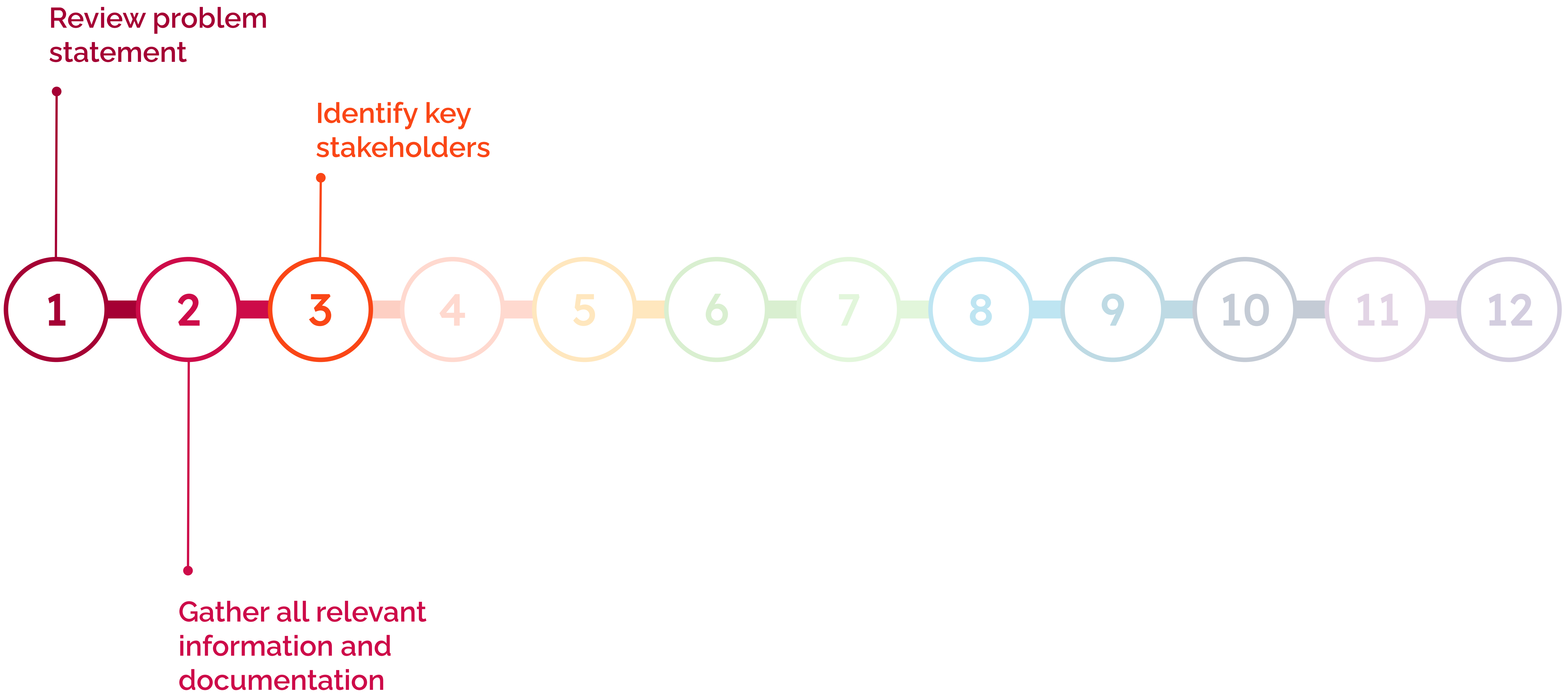
business travel, waste to landfill, purchased goods

03

Process



Process


Review problem statement
Identify key stakeholders
1
2
3
4
5
6
7
8
9
10
11
12
Gather all relevant information and documentation

Questions for Key Stakeholders

Important to have the right people at the table - decision makers, facilities managers, process experts.

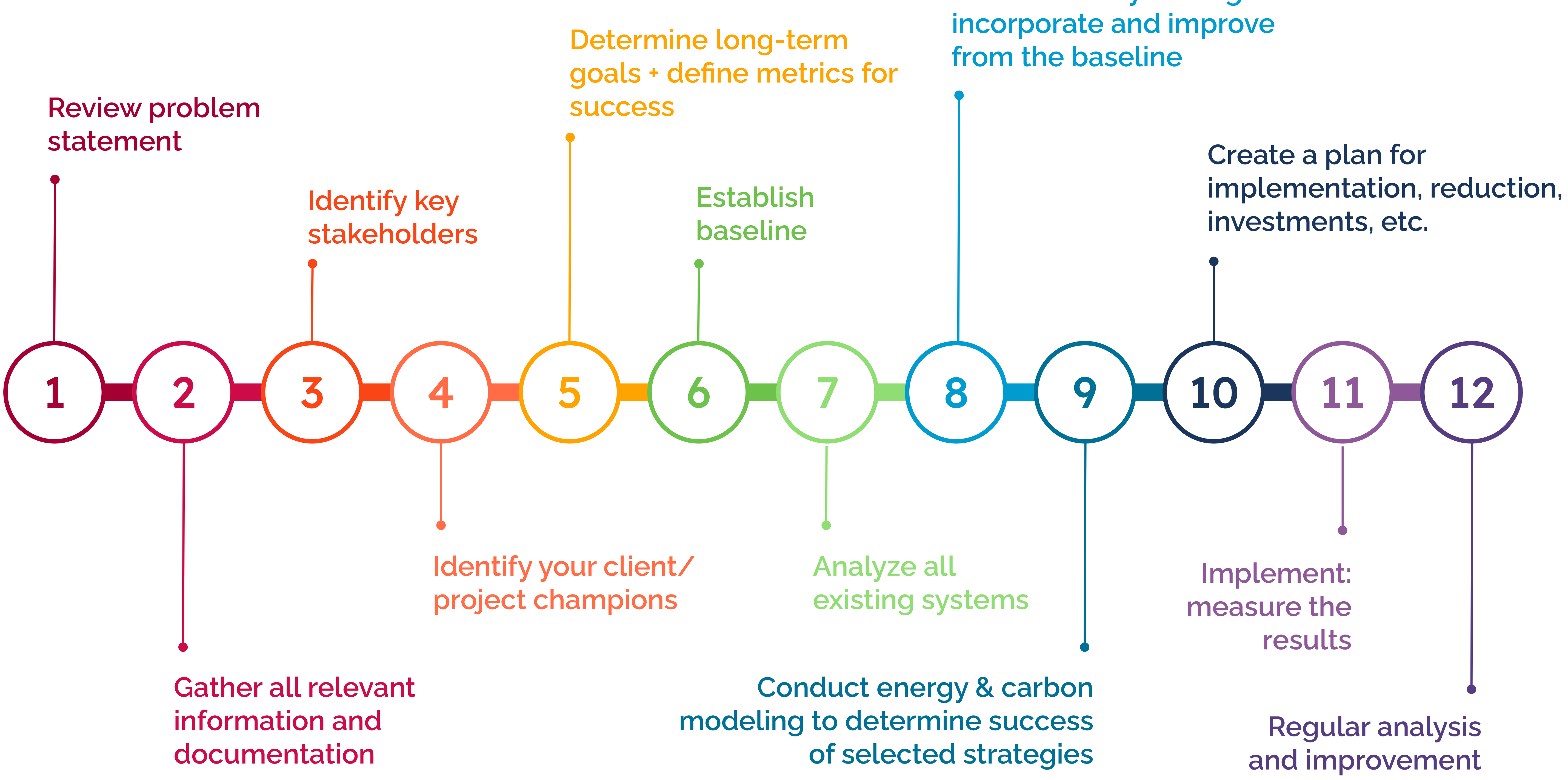
- Identify goals and drivers for project
- Anticipated opportunities and challenges to be navigated for the specific project

Asking questions and engaging staff is critical to **obtain buy-in for the success of the project.**

Process

1. Review problem statement
2. Gather all relevant information and documentation
3. Identify key stakeholders
4. Identify your client/ project champions
5. Determine long-term goals + define metrics for success
6. Establish baseline
7. Analyze all existing systems
8. Determine key strategies to incorporate and improve from the baseline
9. Conduct energy & carbon modeling to determine success of selected strategies

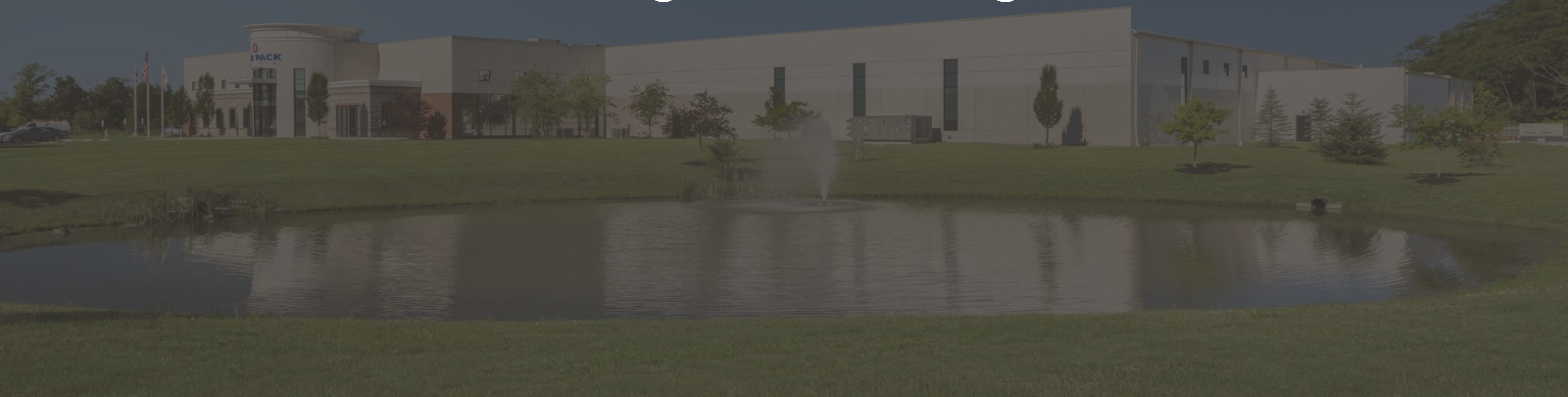
Process



1
Review problem statement
2
Gather all relevant information and documentation
3
Identify key stakeholders
4
Identify your client/ project champions
5
Determine long-term goals + define metrics for success
6
Establish baseline
7
Analyze all existing systems
8
Determine key strategies to incorporate and improve from the baseline
9
Conduct energy & carbon modeling to determine success of selected strategies
10
Create a plan for implementation, reduction, investments, etc.
11
Implement: measure the results
12
Regular analysis and improvement

04

Building-Level Strategies



Known Opportunities and Challenges

Opportunities

- Large roofs for solar and/or green roofs
- Building layout optimization
- Use industrial process by-products
- MEP system optimization
- Industrial buildings operate differently

Challenges

- Limited control over processes
- Only so many ways to position these facilities on site.
- Flexibility needed in industrial facilities limits passive strategies, site placement
- Structure is already optimized for efficiency and cost.

Strategy Development

How we developed the list of strategies:

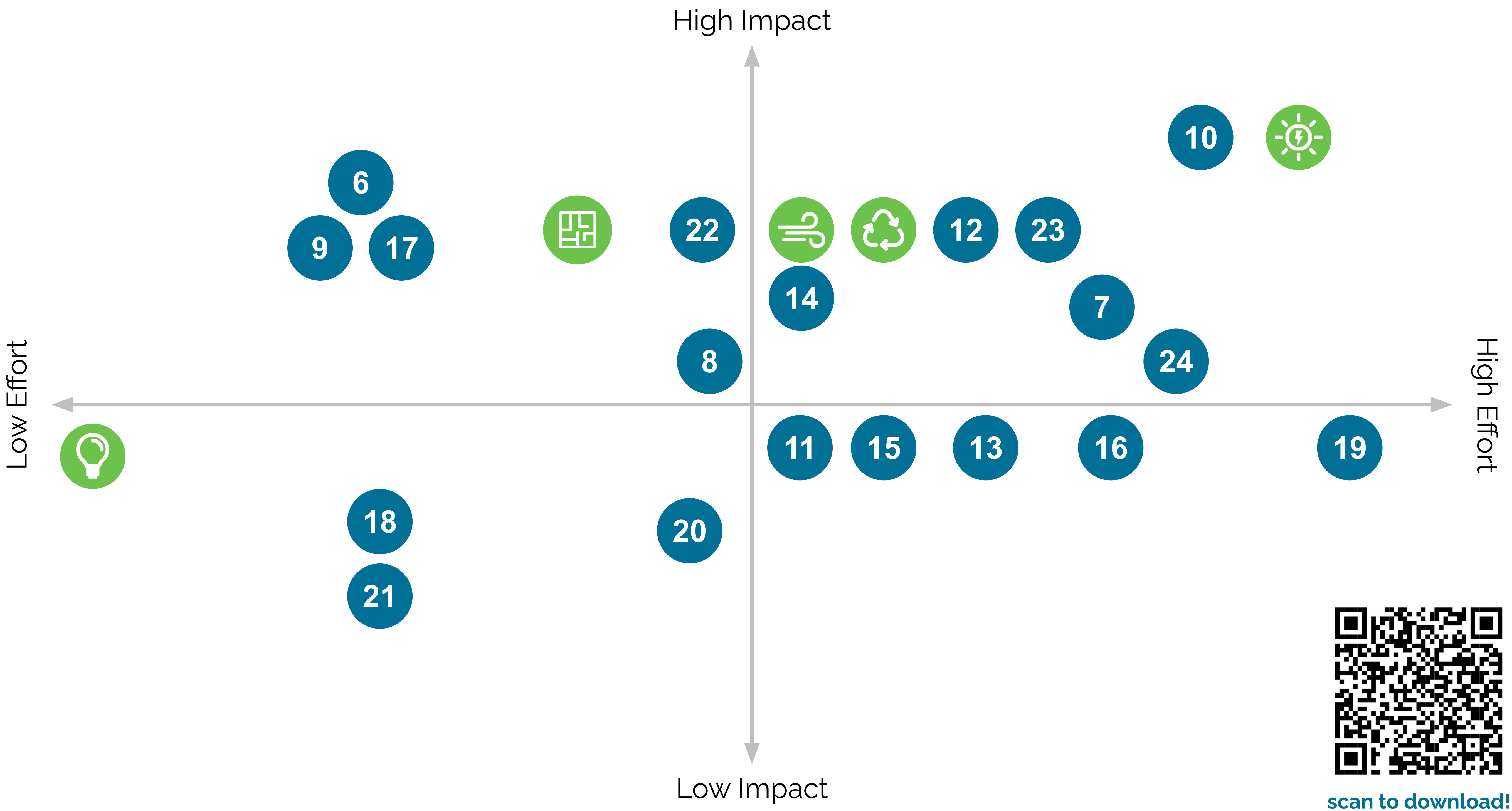
- Recognized the **opportunities and challenges** of this project type
- Investigated options from **low-hanging fruit to more intensive investments** and adjustments

List of Building-Level Strategies

- **Building Layout**
- **LED Lighting**
- **Solar Panels & Triple Net Lease**
- **VRF System**
- **Reuse Process By-Products**

6. Lighting Controls
7. Commissioning / Retro-Commissioning
8. Building Envelope Improvements / Insulation
9. Zoning
10. Geothermal
11. Material Choices
12. Mechanical Upgrades
13. Well Water
14. Process Optimization
15. Storm Water Harvest
16. Heat Generation / Mechanical Equip. Sizing
17. Sensors (Occupant & Daylight)
18. Daylight / Clerestory windows
19. Green Roof
20. Conditioning in Manufacturing Spaces
21. Native Plantings
22. Low Carbon Concrete
23. Using CLT
24. Whole Building LCA

Impact Effort Matrix



scan to download!

Building Layout

For industrial facilities, **the building layout is going to be a large determinate for what strategies will have an impact and what will not.**

- LED lights with controls
- Occupant and Daylight Sensors
- Zoning
- Building envelope
- Movement of people & materials

Industrial Lighting

Start

01

Assess Situation

Need to **effectively illuminate a Industrial Facility** for plant safety, efficiency, and productivity.

02

Analyze Data

- 141,000 SF Facility
- 256 fixtures in three (3) zones
- Lights on 8 hrs/day x 365 days
  - **Incandescent:** 1,700 MWh, $208K annually
  - **LED:** 320 MWh, $39K annually

03

Implement Strategy

Integrate zoning and occupancy controls > potential 41% decrease in lighting usage

Industrial Lighting | Impact

Energy

BEFORE
LED Option

320,000
kWh

AFTER
LED with Zoning & Controls

185,000
kWh

Industrial Lighting | Impact

	Energy	Carbon
BEFORE LED Option	**320,000** kWh	**133** metric tons CO_2e
AFTER LED with Zoning & Controls	**185,000** kWh	**77** metric tons CO_2e

	Energy	Carbon	Operational Cost
BEFORE LED Option	**320,000** kWh	**133** metric tons CO_2e	**$39,000**
AFTER LED with Zoning & Controls	**185,000** kWh	**77** metric tons CO_2e	**$23,000**

Equipment Electrification & Renewable Energy

- Establish **list of existing equipment** with tonnage / Btu / cfm
- **Be ready to electrify** - heat pumps, electric water heaters.
- Use **renewable energy sources to offset**.
    - Geothermal effectiveness
    - Solar - triple net lease, right size, tax credits.

Equipment Electrification & Renewable Energy

Start

01

Assess Situation

Want to **take advantage of available roof square footage** for solar power generation.

- How much power can we generate? Offset costs?

02

Analyze Data

- 25,000 SF of empty roof
- **Offset (4) 50-HP chilled water pumps** - running 8 hrs X 365 days
  - 480V-3PH-65A => 216kW total
- Cincinnati's solar ratio = 1301 kWh/kW

03

Implement Strategy

Install a solar array on roof. Utilize variety of federal and state credits and indirect subsidies to offset cost of solar array.

Equipment Electrification & Renewable Energy | Impact

Energy

BEFORE Utility Power

630,700
kWh

AFTER Solar Power

0
kWh

Equipment Electrification & Renewable Energy | Impact

	Energy	Carbon
BEFORE Utility Power	630,700 kWh	263 metric tons CO_2e
AFTER Solar Power	0 kWh	0 metric tons CO_2e

Equipment Electrification & Renewable Energy | Impact

	Energy	Carbon	Operational Cost
BEFORE Utility Power	**630,700** kWh	**263** metric tons CO_2e	**$95,000**
AFTER Solar Power	**0** kWh	**0** metric tons CO_2e	**$0**

VRF System

Start

01

Assess Situation

Want to re-use part of existing 100T chiller, new AHU, and new electric-reheat VAVs.

- What could a VRF system do with such diversely used loads?

02

Analyze Data

- 15,000 SF offices, lab spaces, misc. Packaging spaces
    - Existing gas-fired RTU
- **Analyze occupancy, daily demand needs and how spaces can share loads**.

03

Implement Strategy

Implement VRF system - the diverse type of spaces, occupancy, and daily demand can lend itself perfectly to a VRF system which **shares the load**.

VRF System | Impact

Energy

BEFORE
Chilled Water, Elec reheat

529,000
kWh

AFTER
VRF System

270,000
kWh

VRF System | Impact

	Energy	Carbon
BEFORE Chilled Water, Elec reheat	**529,000** kWh	**221** metric tons CO_2e
AFTER VRF System	**270,000** kWh	**113** metric tons CO_2e

VRF System | Impact

	Energy	Carbon	Operational Cost
BEFORE Chilled Water, Elec reheat	529,000 kWh	221 metric tons CO_2e	$80,000
AFTER VRF System	270,000 kWh	113 metric tons CO_2e	$41,000

Harvesting Process Heat/ Water For Reuse

- Some important information is needed early on:
    - **Flow diagrams** of all process products & by-products
    - Identify process **performance vs design**, and **system locations vs need location**.
- **Analyze heat recovery** to offset any heating load needs.
- **Analyze rainwater capturing** for water heavy processes.

Free Cooling

Start

01

Assess Situation

Process requires year-round cold water. **300 T chiller has to initiate operation in winter for 50T load.**

- Can we do this and cut down on chiller usage in winter?

02

Analyze Data

- Existing system utilizes **cooling tower and heat exchangers** to provide chilled water
- Needs 5.46MBTH of heat in winter
  - Original HEX = 4.86MBTH
  - Requires 0.6MBTH extra energy exchanged

03

Implement Strategy

Review the size and effectiveness of your systems' heat exchangers to **determine viability of free cooling in the winter for process systems**.

Free Cooling | Impact

Energy

BEFORE Existing HEX & Chiller

600,000
kWh

AFTER New HEX, No Chiller

0
kWh

Free Cooling | Impact

	Energy	Carbon
BEFORE Existing HEX & Chiller	**600,000** kWh	**250** metric tons CO_2e
AFTER New HEX, No Chiller	**0** kWh	**0** metric tons CO_2e

Free Cooling | Impact

	Energy	Carbon	Operational Cost
BEFORE Existing HEX & Chiller	**600,000** kWh	**250** metric tons CO_2e	**$7,500** per season
AFTER New HEX, No Chiller	**0** kWh	**0** metric tons CO_2e	**$0**

Heat Recovery

Start

01

Assess Situation

Facility uses five (5) Unit Substations, which creates. a lot of heat year round.

- Could you **utilize a Heat Recovery System** to preheat outdoor air during winter season?

02

Analyze Data

USS produce 290,500 BTH of heat

- Adjacent Warehouse requires 312,000 CFM OA
- Warehouse exhausts 280,000 CFM

03

Implement Strategy

Tie together exhaust from warehouse and unit substation room. **Utilize an HRV to condition incoming OA with combined exhaust**.

Heat Recovery | Impact

Energy

BEFORE
No HRV

26,540,000
kWh

AFTER
Utilize HRV

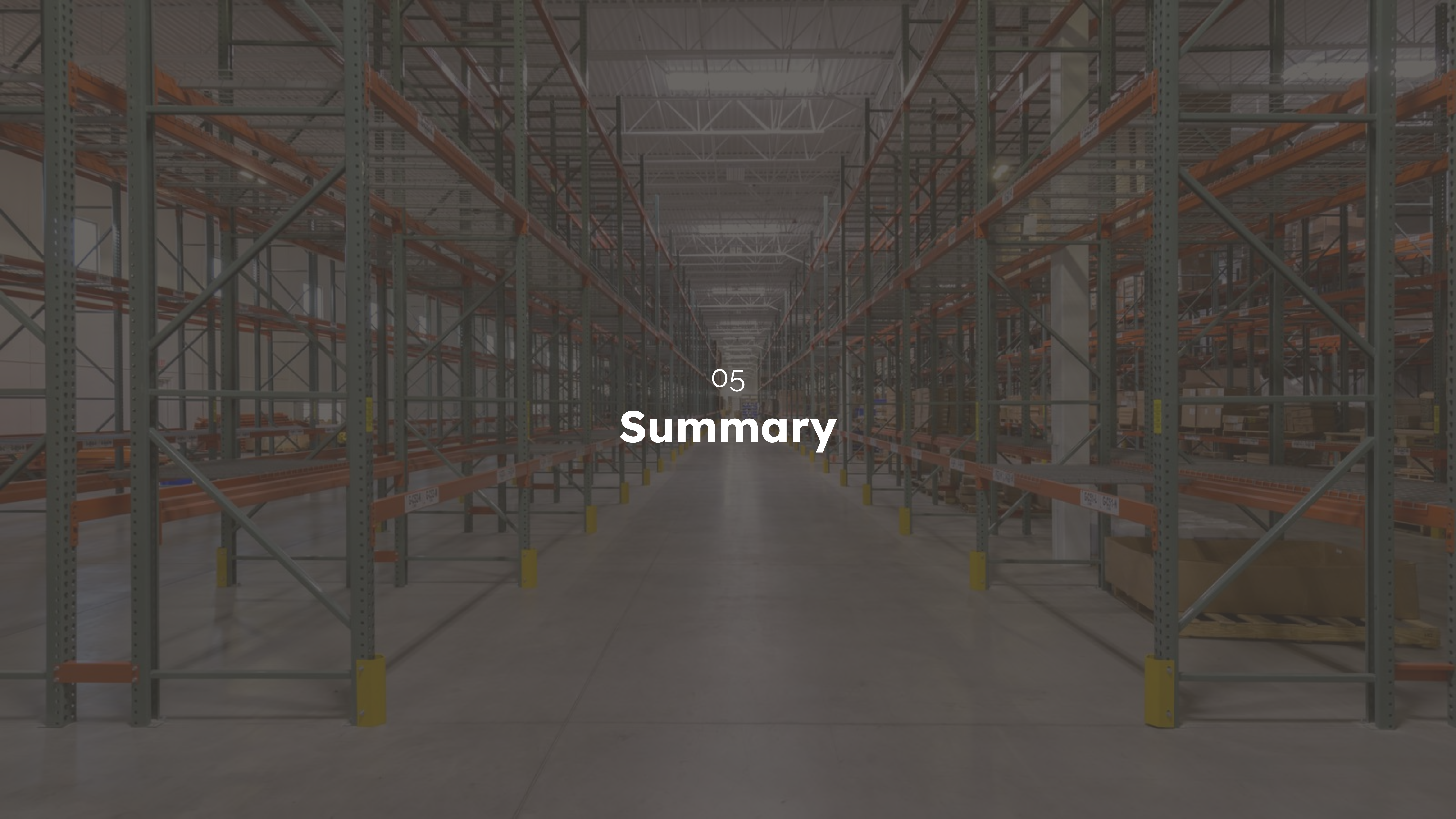
11,274,000
kWh

Heat Recovery | Impact

	Energy	Carbon
BEFORE No HRV	26,540,000 kWh	11,065 metric tons CO_2e
AFTER Utilize HRV	11,274,000 kWh	4,700 metric tons CO_2e

Heat Recovery | Impact

	Energy	Carbon	Operational Cost
BEFORE No HRV	**26,540,000** kWh	**11,065** metric tons CO_2e	**$700,000** per season
AFTER Utilize HRV	**11,274,000** kWh	**4,700** metric tons CO_2e	**$300,000** per season



05

Summary

Download Building-Level Strategies Handout

Takeaways

- **Understand definitions and differences** of Scope Emissions
- **Key factors** driving the focus on carbon emissions
- The **process** for companies to track their carbon emissions
- **Identify key questions** to ask & relevant stakeholders
- **Building-level strategies** and the impact they can have

Thank You!

What questions can we answer?

Jess Glorius-Dangelo - jessicagd@designwithma.com

Ally Balmer - allyb@designwithma.com

Suzie Engel - suzie@motzengineering.com