



Jacobs

Enhancing Port Operation & Decarbonization Models: DAPE Pilot Project

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JACOBS

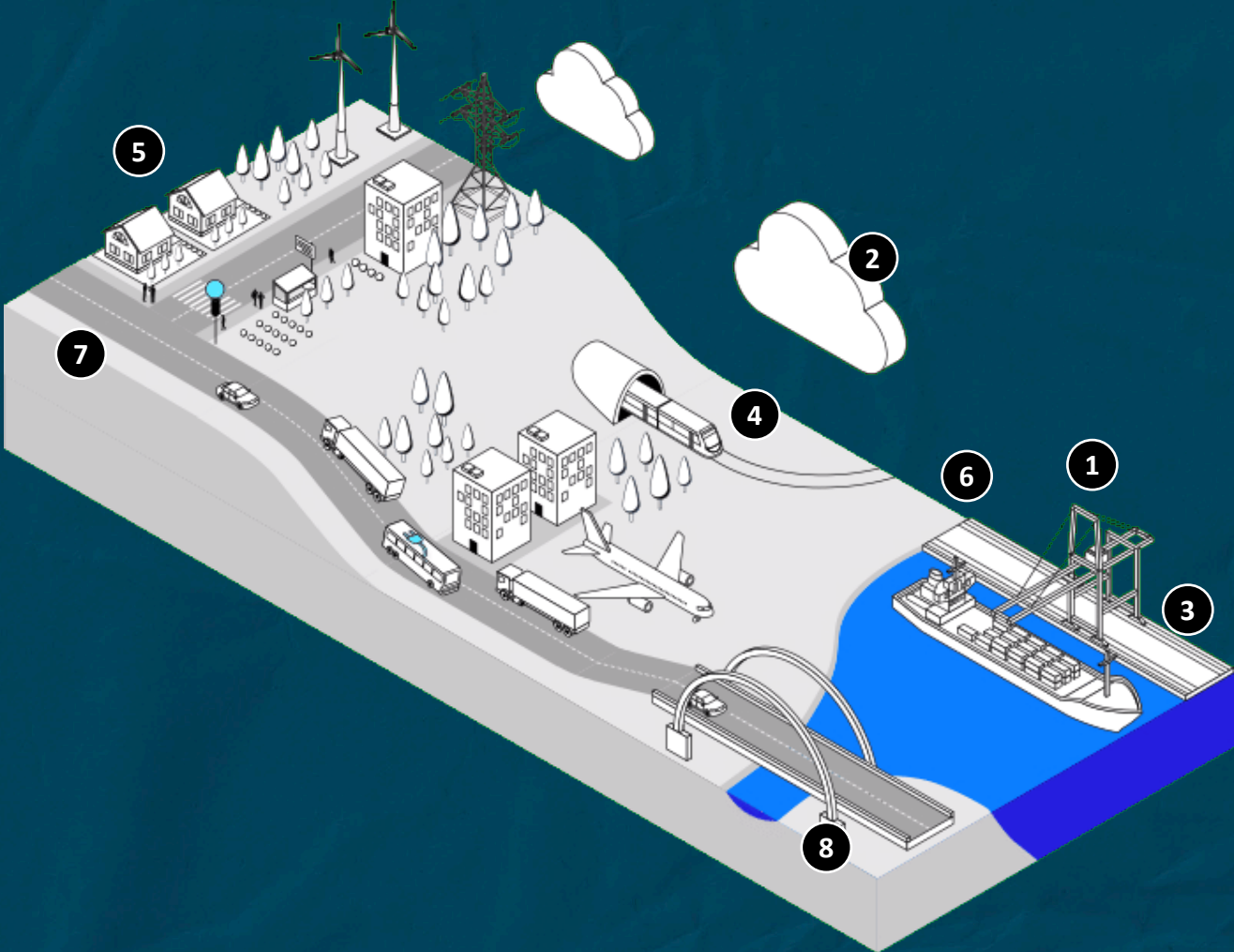
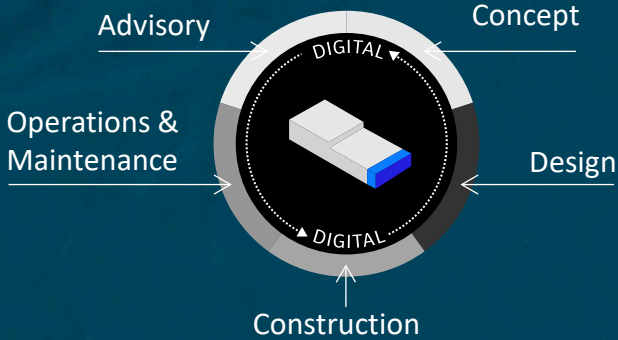


Agenda

- ✓ **The Port Ecosystem & Decarbonization as a Financial Strategy**
- ✓ **DAPE Pilot Study**
- ✓ **Operational Insights Discovered through DAPE**
- ✓ **Turning Data into Cost Savings**

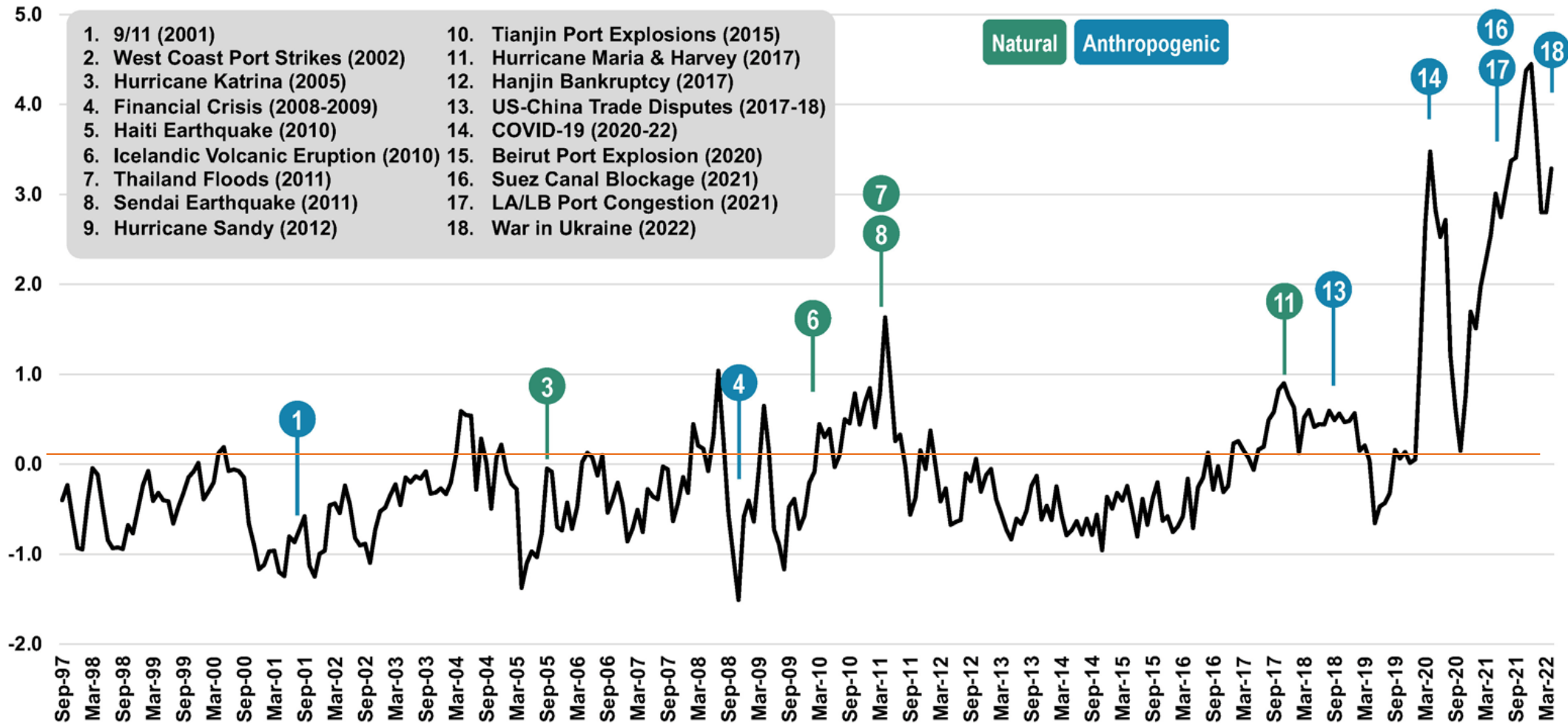
Jacobs Introduction

Working Across the Entire Port Ecosystem



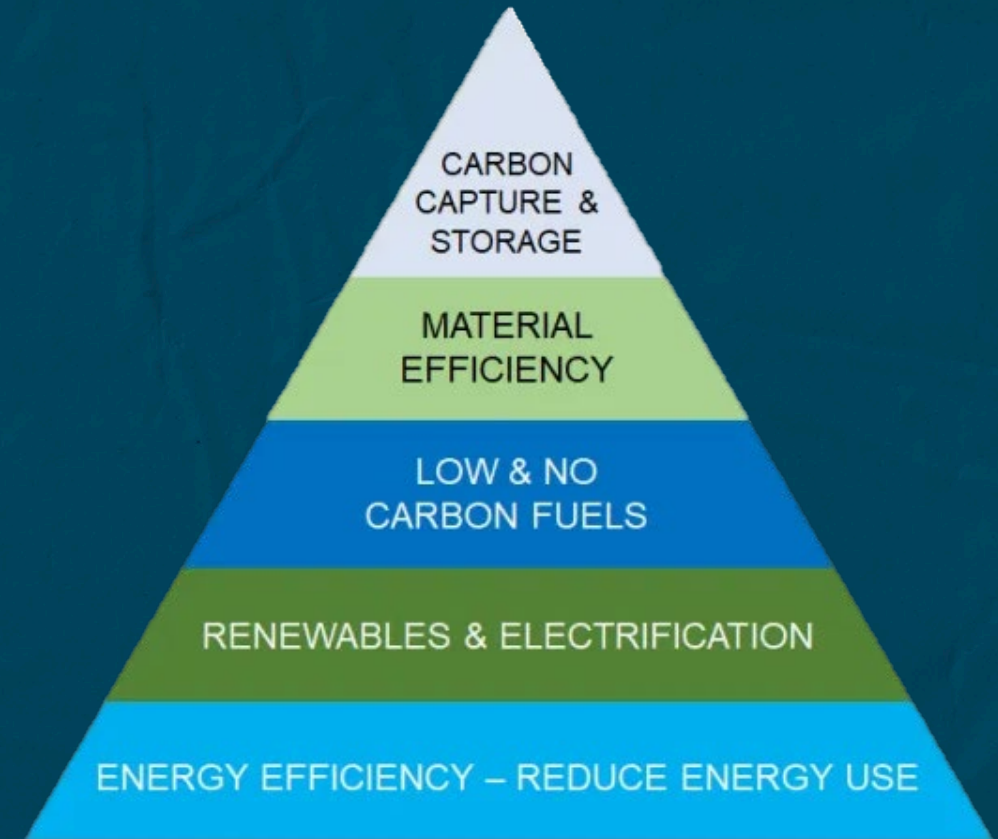
- 1 Climate Resilient Infrastructure
- 2 Digital Services
- 3 Ports, Ferries, and Related infrastructure
- 4 Intermodal - Rail
- 5 Smart Assets
- 6 Asset Management
- 7 Decarbonization of Equipment/Vehicles
- 8 Major Crossings & Complex Bridges

Port Operating Environments



Decarbonization is an Efficiency Strategy

- ✓ Emissions = Energy consumption
- ✓ Energy is one of the largest controllable cost drivers
- ✓ Efficiency gains reduce both emissions and OPEX
- ✓ Supports regional economic agendas (jobs, competitiveness, electrification)
- ✓ Particularly relevant in Washington:
 - Low-cost electricity → cost advantage



Energy efficiency is the foundation for other decarbonization strategies

Source: US EPA Energy Star Program

Those Who Fail to Plan, Plan to Pay More

Successful decarbonization requires visibility of the actual operations.

✓ Reveals Hidden Inefficiencies:

- Idle time
- Underutilized assets
- Fuel/electricity waste

✓ Enables:

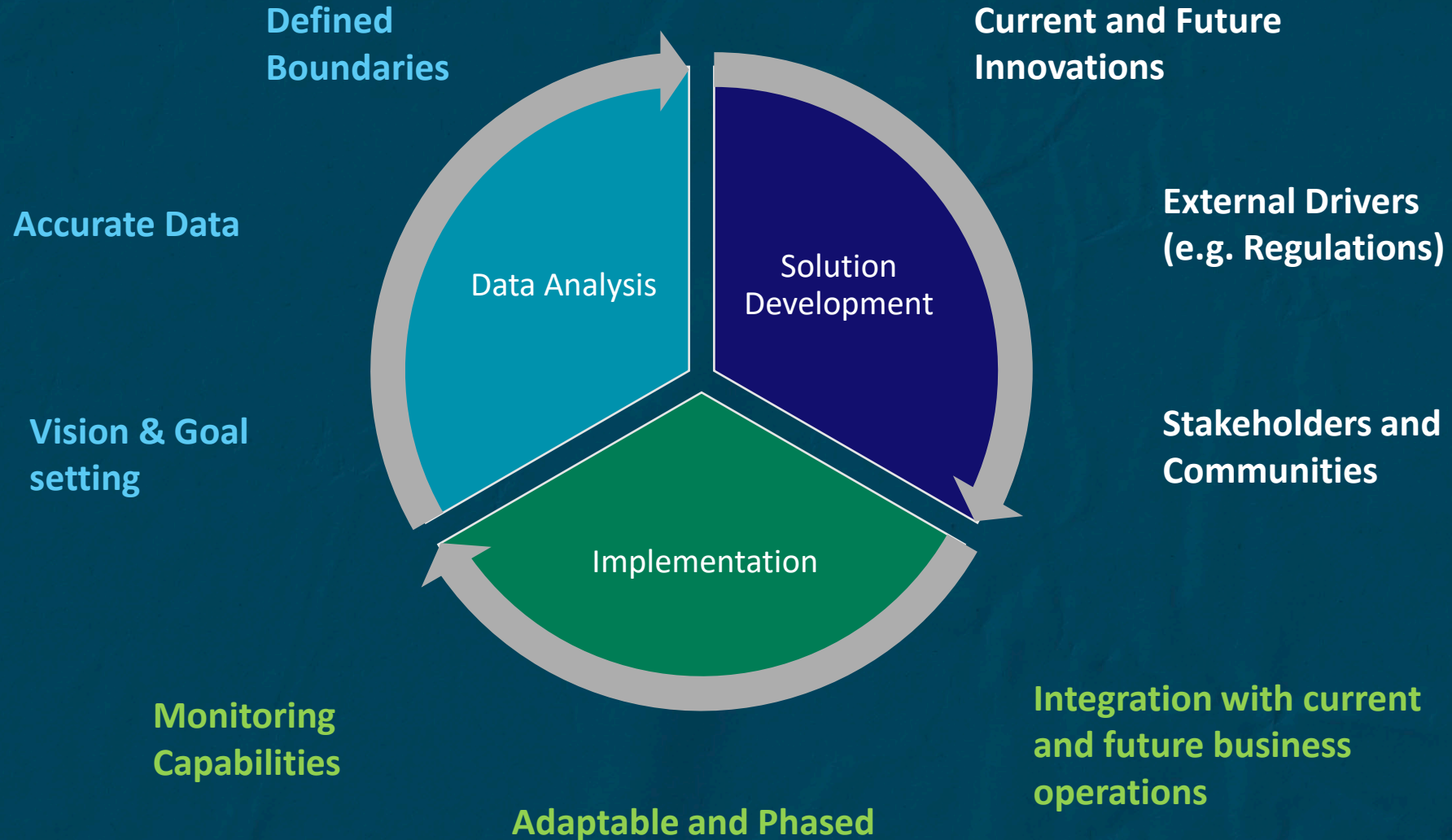
- Better capital allocation
- Smarter asset replacement timing

✓ Efficiency Improvements Are:

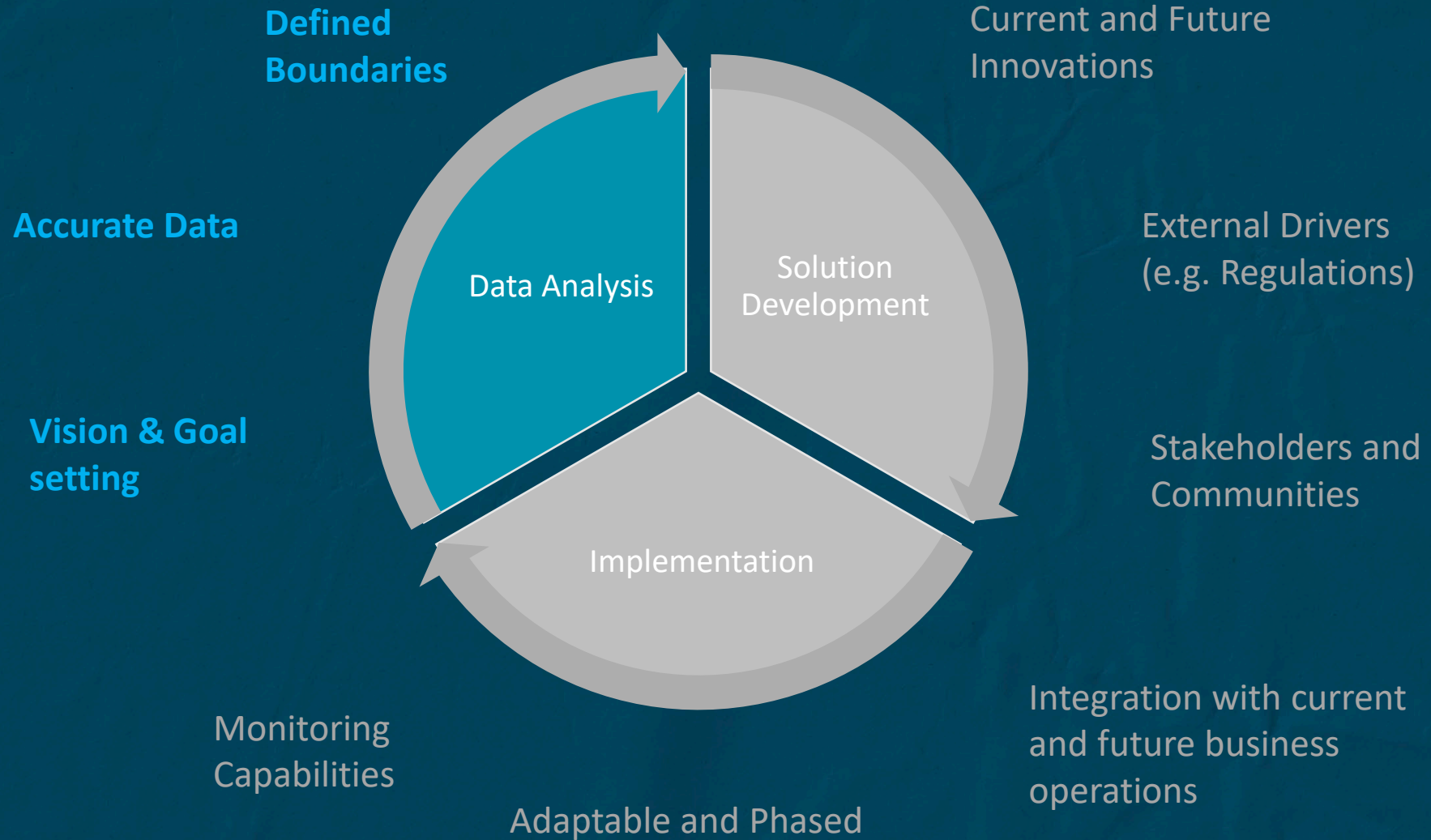
- Fuel-agnostic
- Beneficial regardless of electrification timeline



Developing a Successful Decarbonization Roadmap



Developing a Successful Decarbonization Roadmap



Decarbonization Analytics for Port Equipment (DAPE)

Port of Everett Pilot Study

About the Port of Everett



- ✓ The Port District and boundaries formed in 1918; serves nearly 100,000 people
- ✓ Not countywide
- ✓ Governed by three elected commissioners
- ✓ Special Purpose District 'economic development'
- ✓ Supports 40,000 jobs in the region
- ✓ Contributes \$433M in state & local taxes
- ✓ Operate three lines of business; Seaport, Marina, Real Estate
- ✓ Homeport to Naval Station Everett
- ✓ Largest public marina on the West Coast
- ✓ Everett's customs district ranks 2nd in the state at \$21 BILLION in exports (including airplanes)
- ✓ 3rd largest container port in the state



What is DAPE?

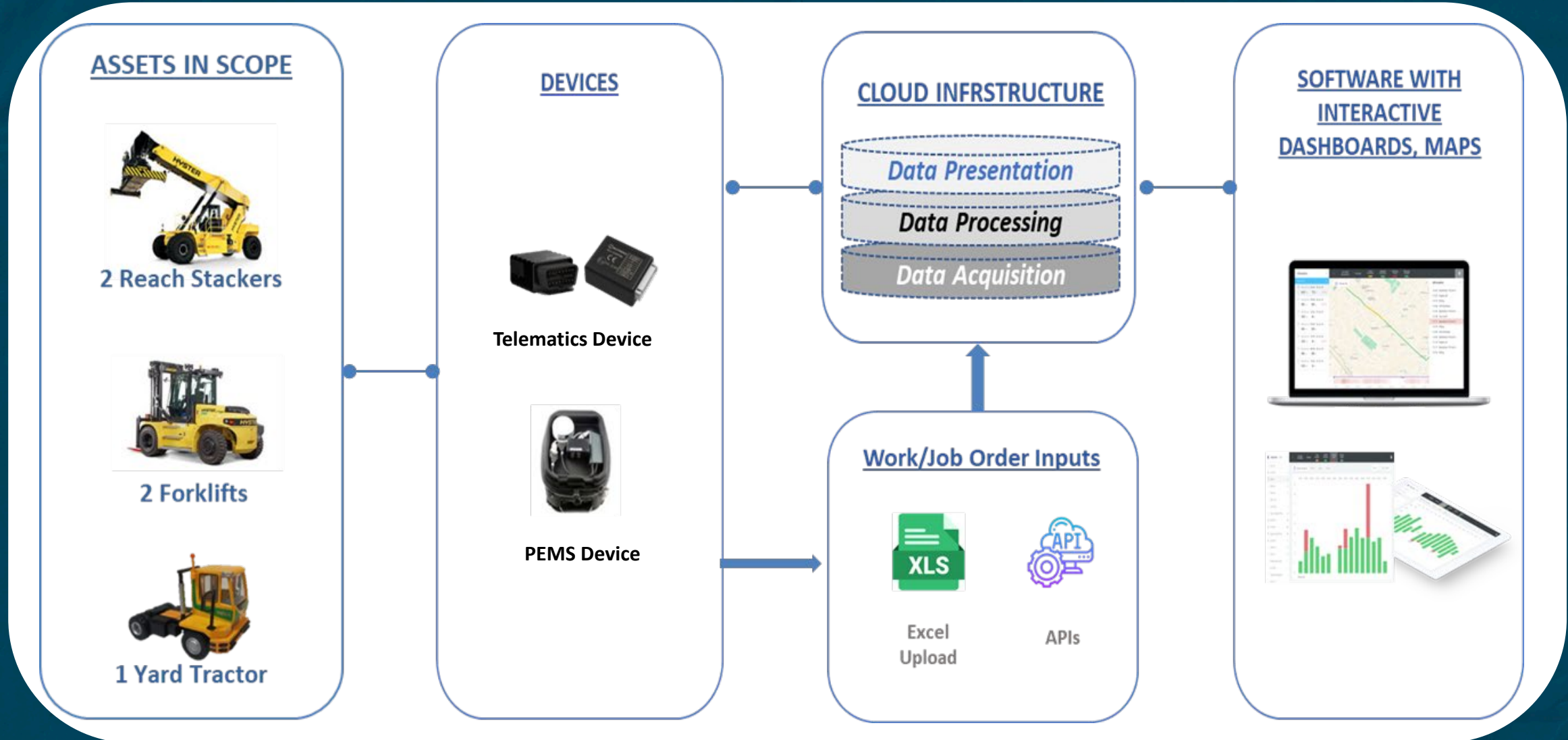
- ✓ First-of-its-kind platform which captures and analyzes real-time emissions and equipment data.
- ✓ Combines telematics + Portable Emission Measurement Systems (PEMS) data into one scalable, cloud-based dashboard.
- ✓ Provides live insights on equipment emissions, movement, and health.
- ✓ Enables data-driven decision-making for decarbonization, maintenance, planning, and operational efficiency.



2025 AAPA Lighthouse Award Environmental Excellence



How Does it Work?



Why Develop DAPE ?

- ✓ You can't manage what you don't measure.
- ✓ Challenge outdated emission inventories that overlook real-world variables unique to port equipment.
- ✓ Unlock operational insights by quantifying factors like idle time, routes, and operator behavior that drive emissions.
- ✓ Enable data-driven planning for decarbonization, smarter infrastructure investments, and operational efficiencies.




DAPE Dashboard

Asset #: 165

Search


154 Inactive

Type: Reach Stacker
Make: Hyster
Model: RS46-36CH
Fuel type: Diesel




165 Active

Type: Forklift
Make: Hyster
Model: H360HD2
Fuel type: Diesel




190 Inactive

Type: Reach Stacker
Make: Hyster
Model: RS46-41XD/75S
Fuel type: Diesel




223 Stopped

Type: Forklift
Make: Hyster
Model: H240XD
Fuel type: Diesel



5186 Inactive

Type: Yard Tractor
Make: SISU
Model: TT120
Fuel type: Diesel





- ### Zone events
- Enter South Terminal
2025-09-18 09:15:15
 - Exit Pacific Terminal
2025-09-18 09:15:15
 - Enter Pacific Terminal
2025-09-18 09:13:37
 - Exit Hewitt Terminal
2025-09-18 09:13:37
 - Enter Hewitt Terminal
2025-09-18 09:09:42

Statistics Insights

Total		
Engine hours 0d 13h 55m	Idle hours 1d 13h 9m	Stoppage hours 28d 20h 54m
Weekly Average		
Engine hours 0d 3h 28m	Idle hours 0d 9h 17m	Stoppage hours 7d 5h 13m
Daily Average		
Engine hours 0d 0h 27m	Idle hours 0d 1h 14m	Stoppage hours 0d 23h 5m

ECU data

Last update
2025-09-18 09:50:30

IMEI
861492068475018

Current zone
South Terminal

OBD Ignition
ON

RPM
810

Engine Hours

DAPE Dashboard - Emissions

Reach Stacker (154)

Feb 28, 2025 - Mar 30, 2025

526.3
Total CO₂ (kg)

9.1
Idle Hours

5.1
Active Hours

64
Idle %

36
Active %

Carbon Oxides

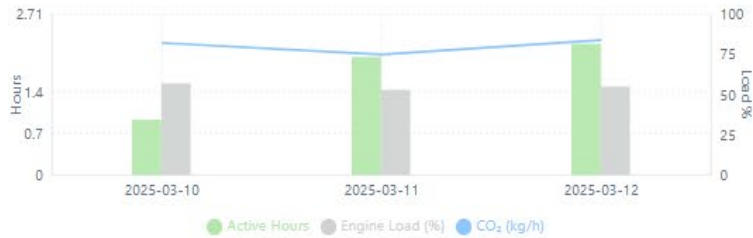
Nitrogen Gases

Particulates

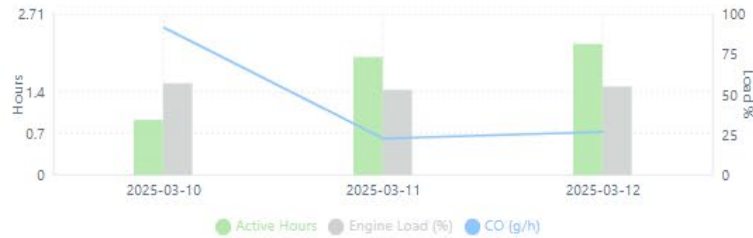
View: **Active** Idle

Show/Hide Charts (6/9)

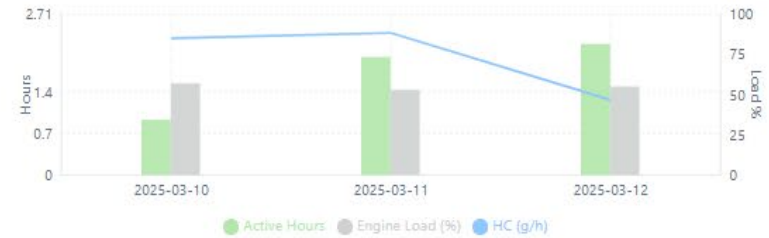
CO₂ (kg/h)



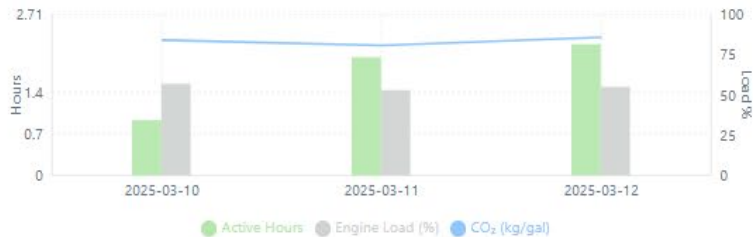
CO (g/h)



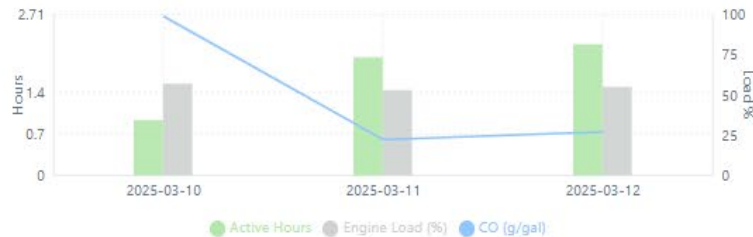
HC (g/h)



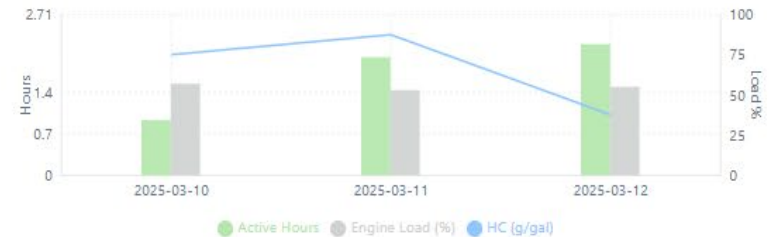
CO₂ (kg/gal)



CO (g/gal)



HC (g/gal)



Operational Insights – Fuel Consumption

154

Inactive

Type: Reach Stacker
Make: Hyster
Model: RS46-36CH
Fuel type: Diesel



526.3

Total CO₂ (kg)



9.1

Idle Hours



5.1

Active Hours



64

Idle %



36

Active %

- ✓ 2,080 Hours x **64%** = ~1,331 Hours per Year at Idle
- ✓ 1,331 Hours x 0.97 Gallons / Hour at Low Idle¹ = ~1,291 Gallons of Diesel
- ✓ 1,291 Gallons of Diesel at \$5.50 per Gallon = **\$7,100.50**
- ✓ 1,291 Gallons of Diesel x 10.18kg / gallon³ = ~13,142kg CO₂ (**28,973 lbs**)

223

Inactive

Type: Forklift
Make: Hyster
Model: H240XD
Fuel type: Diesel



121.9

Total CO₂ (kg)



9.3

Idle Hours



2.8

Active Hours



77

Idle %



23

Active %

- ✓ 2,080 Hours x **77%** = ~1,602 Hours per Year at Idle
- ✓ 1,602 Hours x 0.65 Gallons / Hour at Low Idle² = ~1,041 Gallons of Diesel
- ✓ 1,041 Gallons of Diesel at \$5.50 per Gallon = **\$5,725.50**
- ✓ 1,041 Gallons of Diesel x 10.18kg / gallon³ = ~10,597kg CO₂ (**23,362 lbs.**)

¹Calculated using EPA MOVES3 / Nonroad equipment fuel consumption methodology (Horsepower (261) x load factor (0.075) x BSFC (0.35lbs/hp-hr))

²Calculated using EPA MOVES3 / Nonroad equipment fuel consumption methodology (Horsepower (160) x load factor (0.075) x BSFC (0.35lbs/hp-hr))

³<https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator-calculations-and-references?lang=es>

Operational Insights – Infrastructure Planning



Operational Insights – Housekeeping



Key Takeaways

- ✓ Real-time emissions and operational data provide accuracy beyond traditional inventories.
- ✓ Idle time reduction offers immediate emissions and cost savings.
- ✓ Plug-and-play technology works across old and new equipment without major infrastructure changes.
- ✓ Data visualization tools (heat maps, dashboards) create opportunities for operational efficiency and spatial planning efforts.

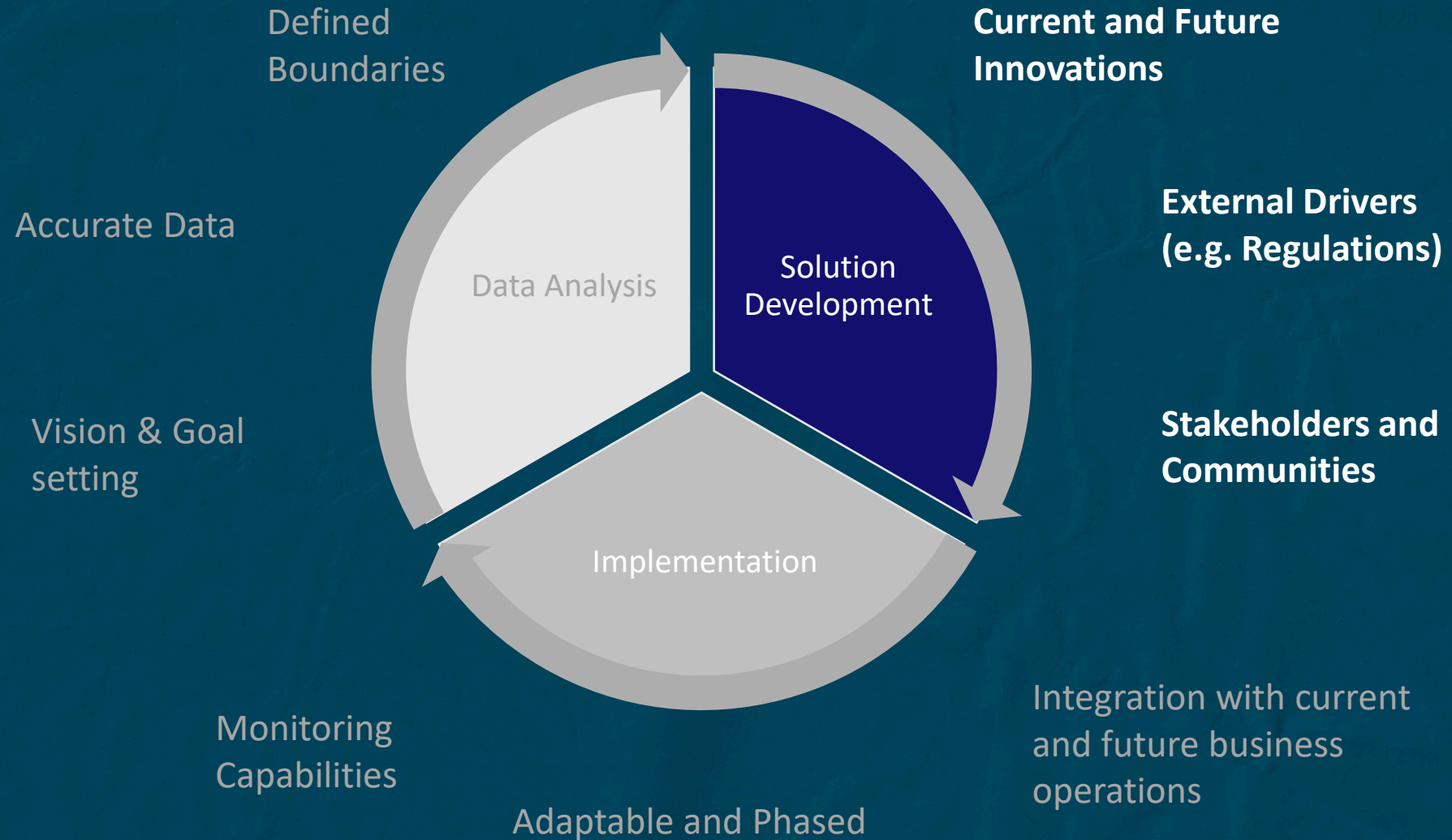


What's Next?

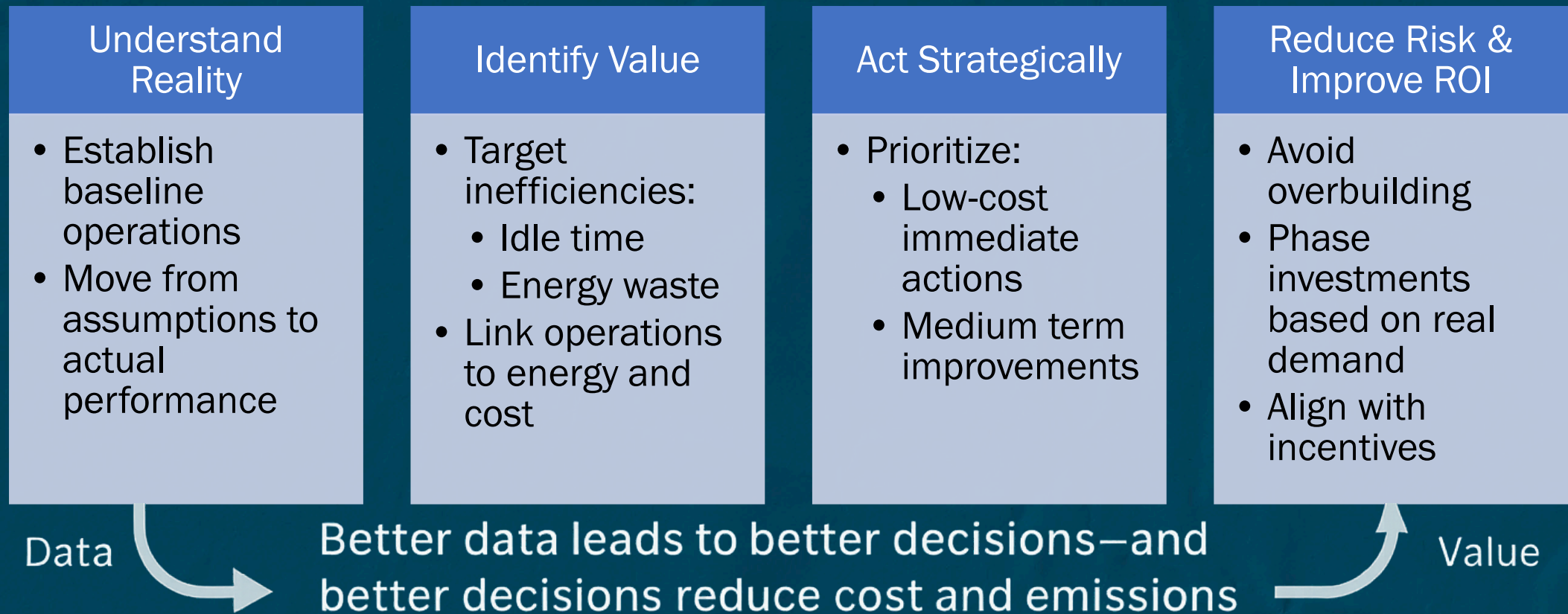
- ✔ **Utilizing DAPE Technology to Inform EV Yard Truck Procurement & EV Charging Infrastructure Deployment**
 - Understanding typical CHE operations, cycle times, impacts of cargos (heavy breakbulk vs containerized), etc.
 - Projecting future energy demands of CHE and fleet transitions
 - Infrastructure planning – where does it make sense to build our charging infrastructure?

- ✔ **Continued Development / Extended Application of DAPE**
 - Cargo handling equipment maintenance cycles
 - Real time alerts for equipment failure
 - Known operating conditions increase safety
 - Apply AI for operational planning, maximizing routes, etc.

Developing a Successful Decarbonization Roadmap



Closing the Loop: Turning Data into Cost Savings



Thank you!



Jacobs

PORTS

PEOPLE | OPPORTUNITY | RECREATION | TRANSPORTATION | SUSTAINABILITY

PEOPLE

OPPORTUNITY

RECREATION

TRANSPORTATION

SUSTAINABILITY

