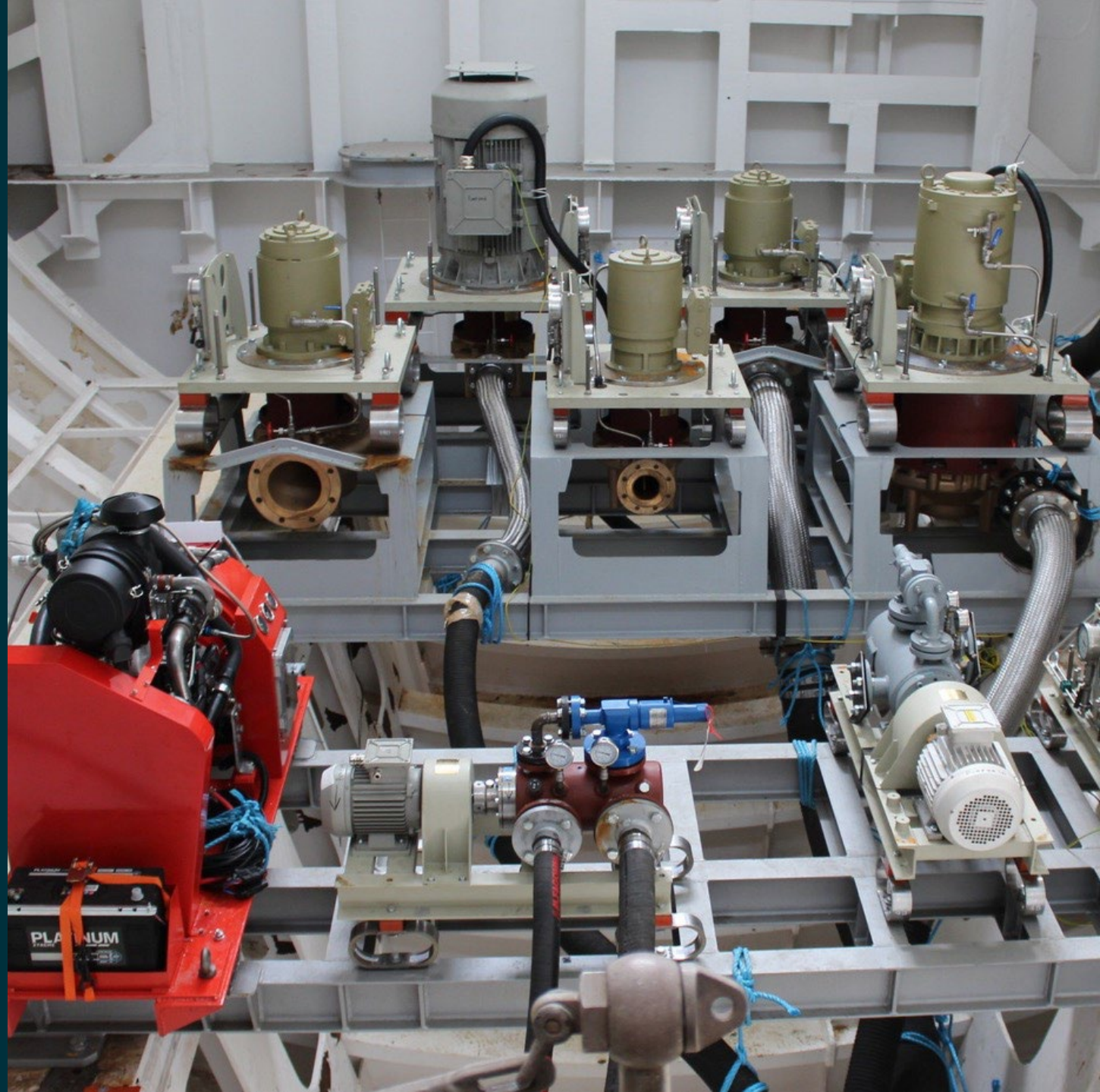


1 NOVEMBER 2023

# Energy Transition and the Multi Hazard Assessment Approach

David Dimelow  
John Evans

**Thornton Tomasetti**

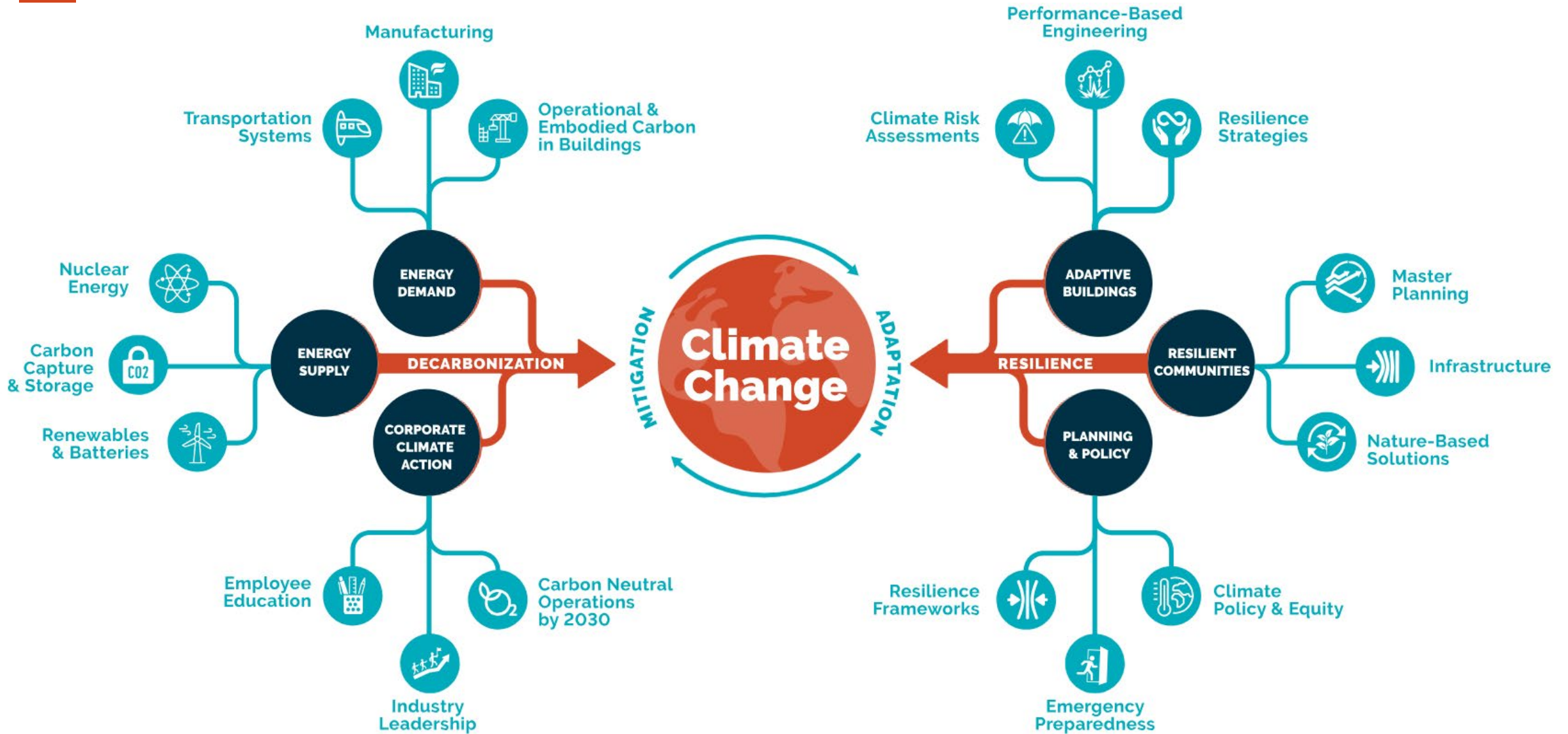


# AGENDA

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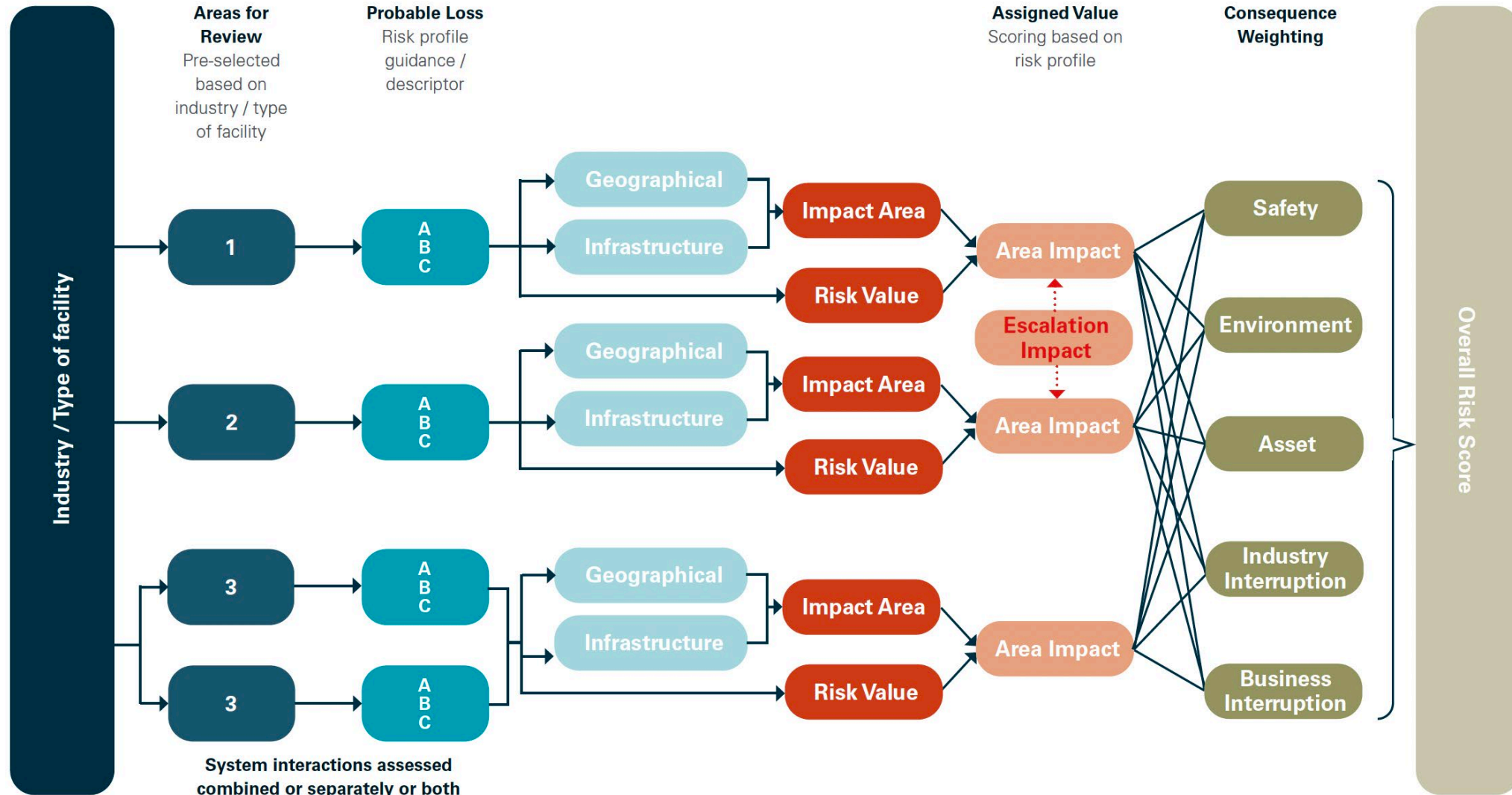
1. Overview of Multi-Hazard Assessment Tool
2. Assessment and Risk Profile
3. Failure Mode and Risk Management

# CLIMATE ACTION



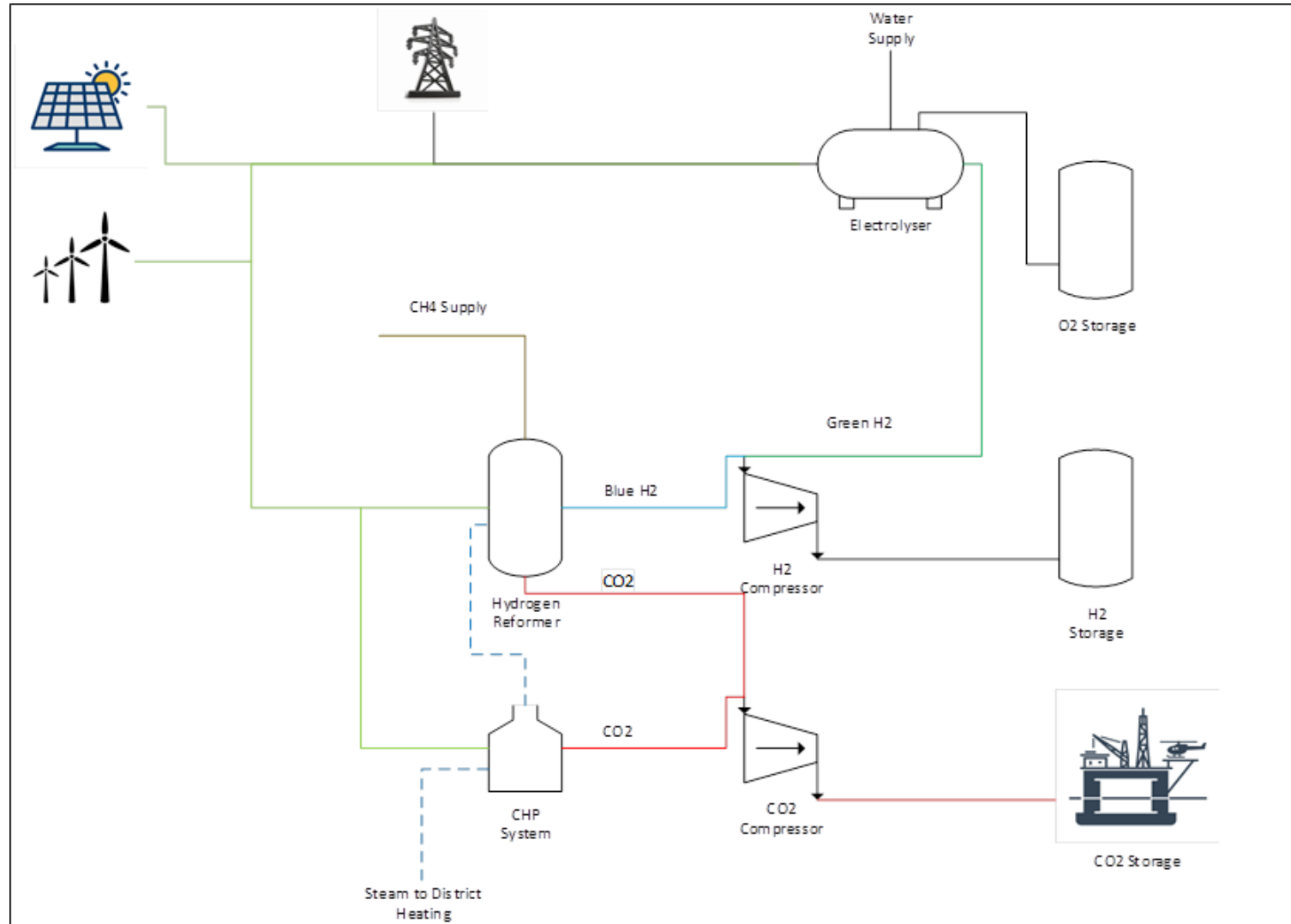


# MULTI-HAZARD ASSESSMENT TOOL



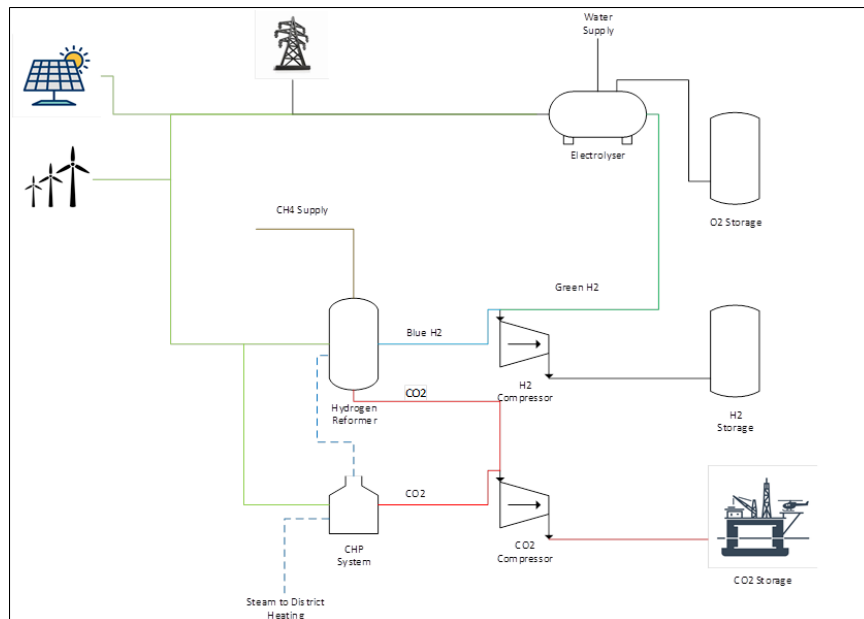


# ASSESSMENT AND RISK PROFILE



# ASSESSMENT AND RISK PROFILE

Assessment Items					
Oxygen storage	Hydrogen storage	Carbon storage	Reformer	CHP system	Electrolysis System
Pipeline to storage	Pipeline to storage	Pipeline to storage	Gas supply	Power input	Power input
Pipeline ESDV	Pipeline ESDV	Pipeline ESDV	Steam input	Heat input	Water input
Pipe to storage	Compression	Compression	Power input	Integrity of CHP system	Integrity of Electrolysis system
Storage system	Pipe to storage	Pipe to storage	Integrity of reformer	Carbon export	Hydrogen export
not used	Storage system	Storage system	Heat exchanger	District heat export	Oxygen export
not used	not used	not used	Carbon export	Grid power export	not used
not used	not used	not used	Heat output	Energy export	not used
not used	not used	not used	not used	not used	not used



# ASSESSMENT AND RISK PROFILE

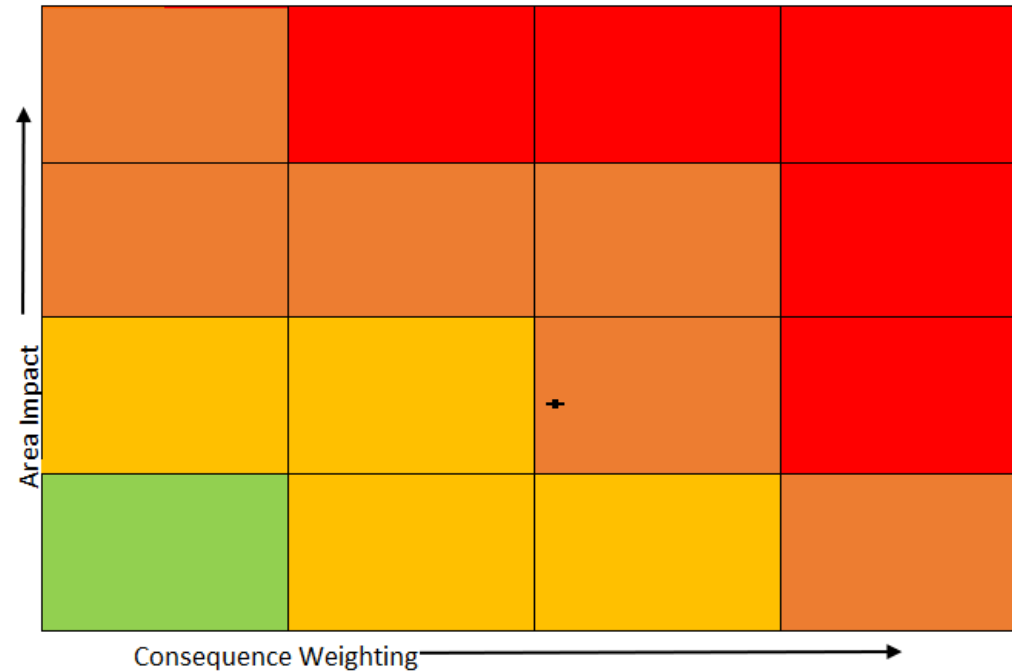
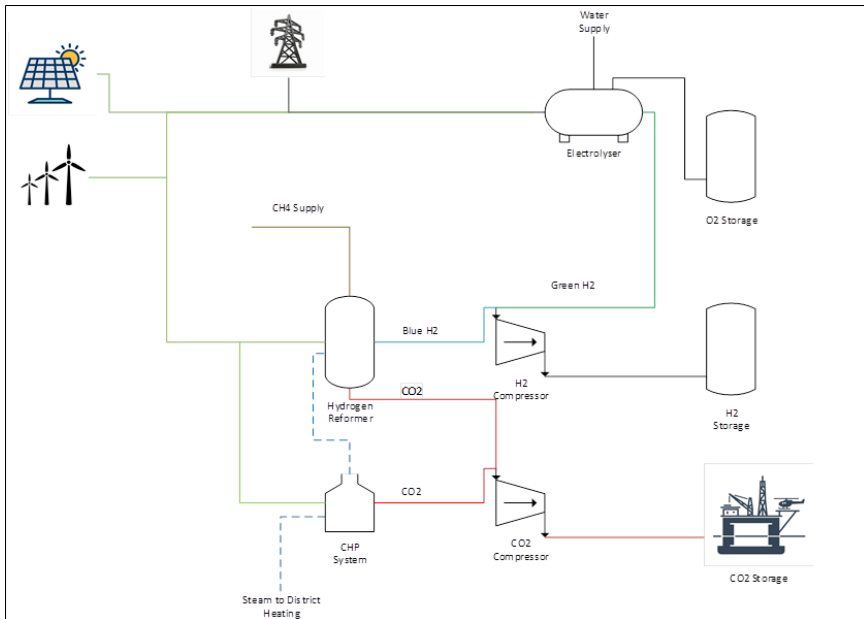
Factor in:

Probable Loss  
Geography  
Infrastructure

Risk Value  
Impact Area

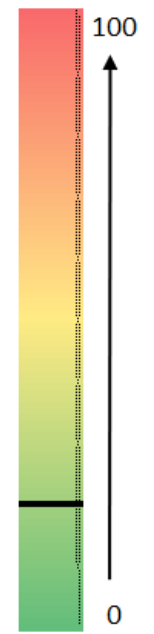
System Interactions  
Consequence Weighting

Overall Risk



Total Risk Score 20

- Made up of:
- Safety 3
  - Environment 3
  - Asset 5
  - Industry Interruption 3
  - Business Interruption 5





# ASSESSMENT AND RISK PROFILE

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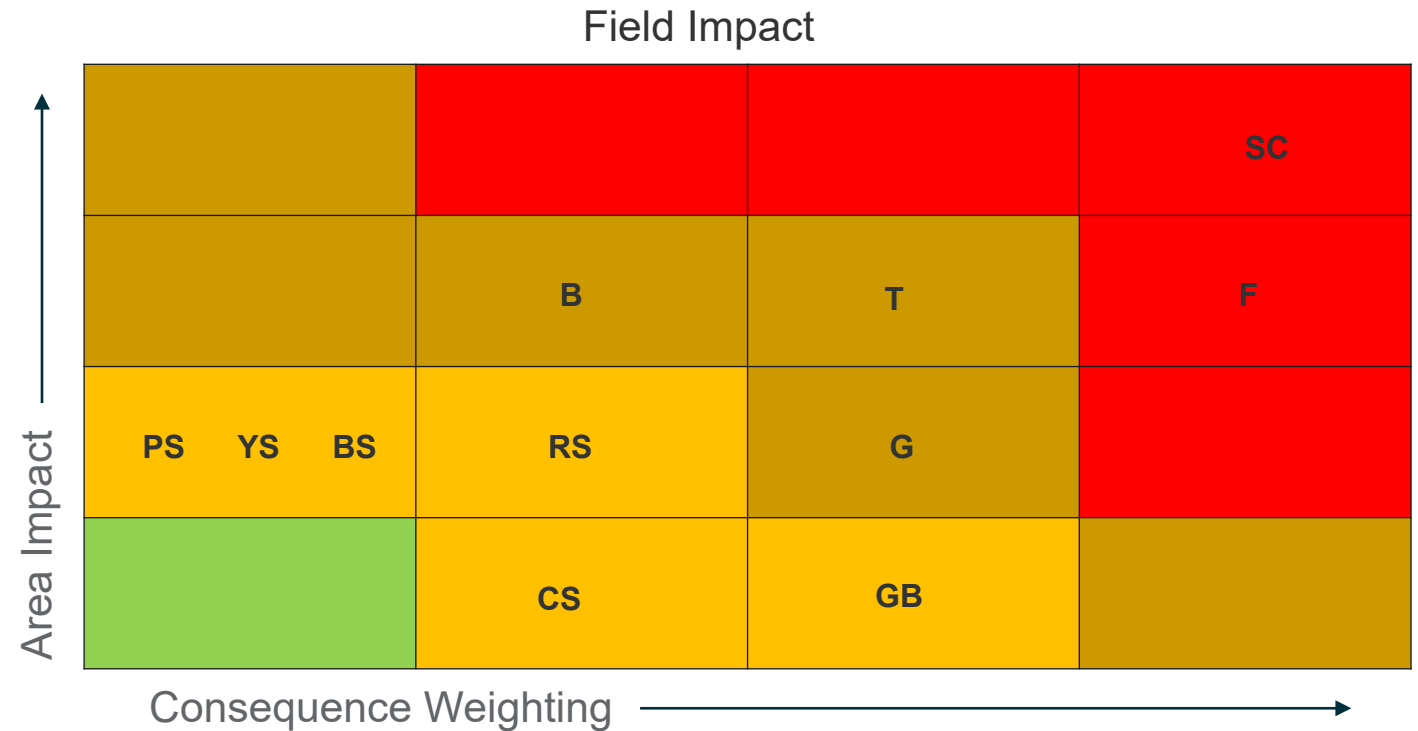
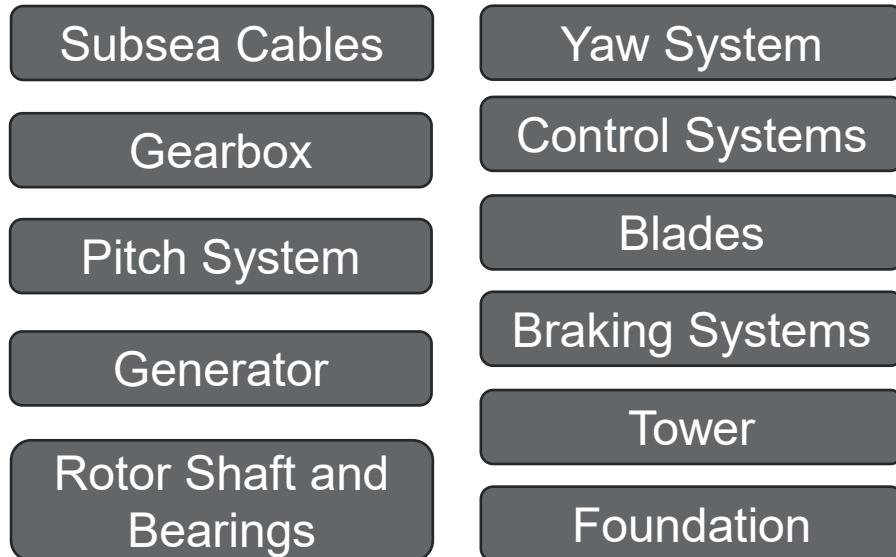
Ability to drill down into individual items and consider specific risks

# ASSESSMENT AND RISK PROFILE

Ability to drill down into individual items and consider specific risks

Consider an offshore wind turbine.

Failure modes:-



# FAILURE MODE AND RISK MANAGEMENT

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Fire Damage



# FAILURE MODE AND RISK MANAGEMENT

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## Generator Failure



# ROTOR

---



Photo by

**Thornton Tomasetti**



# FAILURE MODE AND RISK MANAGEMENT

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## Tower Failure





# FAILURE MODE AND RISK MANAGEMENT

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**Gearbox Failure**

# FAILURE MODE AND RISK MANAGEMENT

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Gas Turbine Fire

# FAILURE MODE AND RISK MANAGEMENT

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## Foreign Object Damage





# FAILURE MODE AND RISK MANAGEMENT

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## Blade Failure



# FAILURE MODE AND RISK MANAGEMENT

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## Flood Damage



# FAILURE MODE AND RISK MANAGEMENT

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## Fire Damage





# FAILURE MODE AND RISK MANAGEMENT

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## Solar Panel Theft



# THANK YOU

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