CReDo

OFWAT CATALYST SHOWCASE:

EXPLORING EXTREME HEAT SCENARIOS FOR THE WATER SECTOR

16 July 2024

AGENDA

Welcome

Ofwat Breakthrough Innovation Fund:
CReDo Extreme Heat

1. Project Overview
2. What is CReDo?
3. Climate Data and Asset Modelling
4. CReDo Asset Risk Tool
5. Digital Twinning
6. CReDo vision and next steps

Facilitated Q&A

Closing

Total time: 1h 30 min

WELCOME

Today's session will run approximately 1 hour 30 minutes

We are using the Zoom Q&A feature

- Please send through your questions to the host & panel
- We will aim to answer as many questions as possible during the Q&A session

For further information, please contact credo@cp.catapult.org.uk.

love every drop
anglianwater

CReDo

EXTREME HEAT

OFWAT BREAKTHROUGH INNOVATION FUND

EXTREME HEAT CLIMATE SCENARIO

Risk of asset failure due to extreme heat

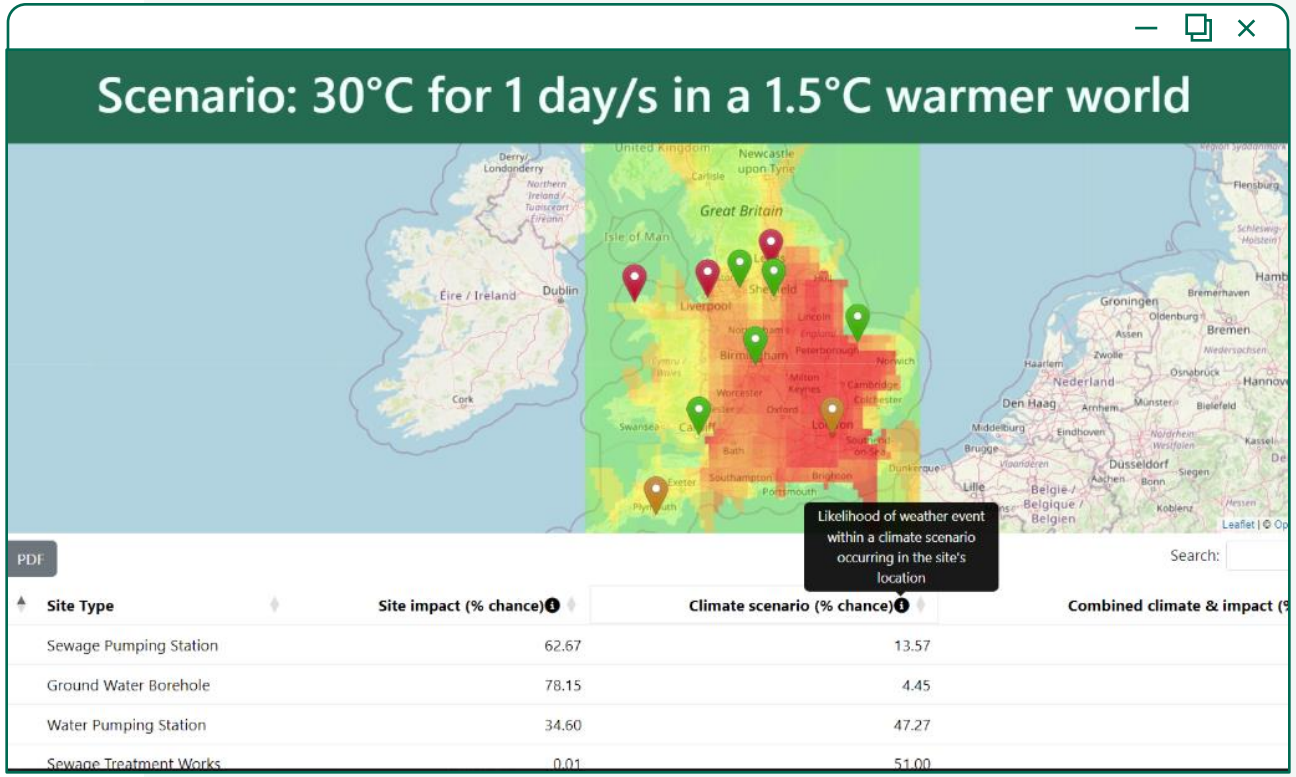
- In the summer of 2022 temperatures in the Anglian Water region exceeded 40^0 Celsius – the first time temperatures of over 40^0 Celsius have been reached in the UK
- There is an increasing frequency, duration and intensity of heat projected in climate models
- There is a lack of understanding around the risk of water industry assets failing due to extreme heat
- This risk is compounded by the obvious demand for water during periods of extreme heat
- There is a need to understand if, how and when water sector assets could fail

Science and Technology Facilities Council

THE UNIVERSITY *of* EDINBURGH

CReDo

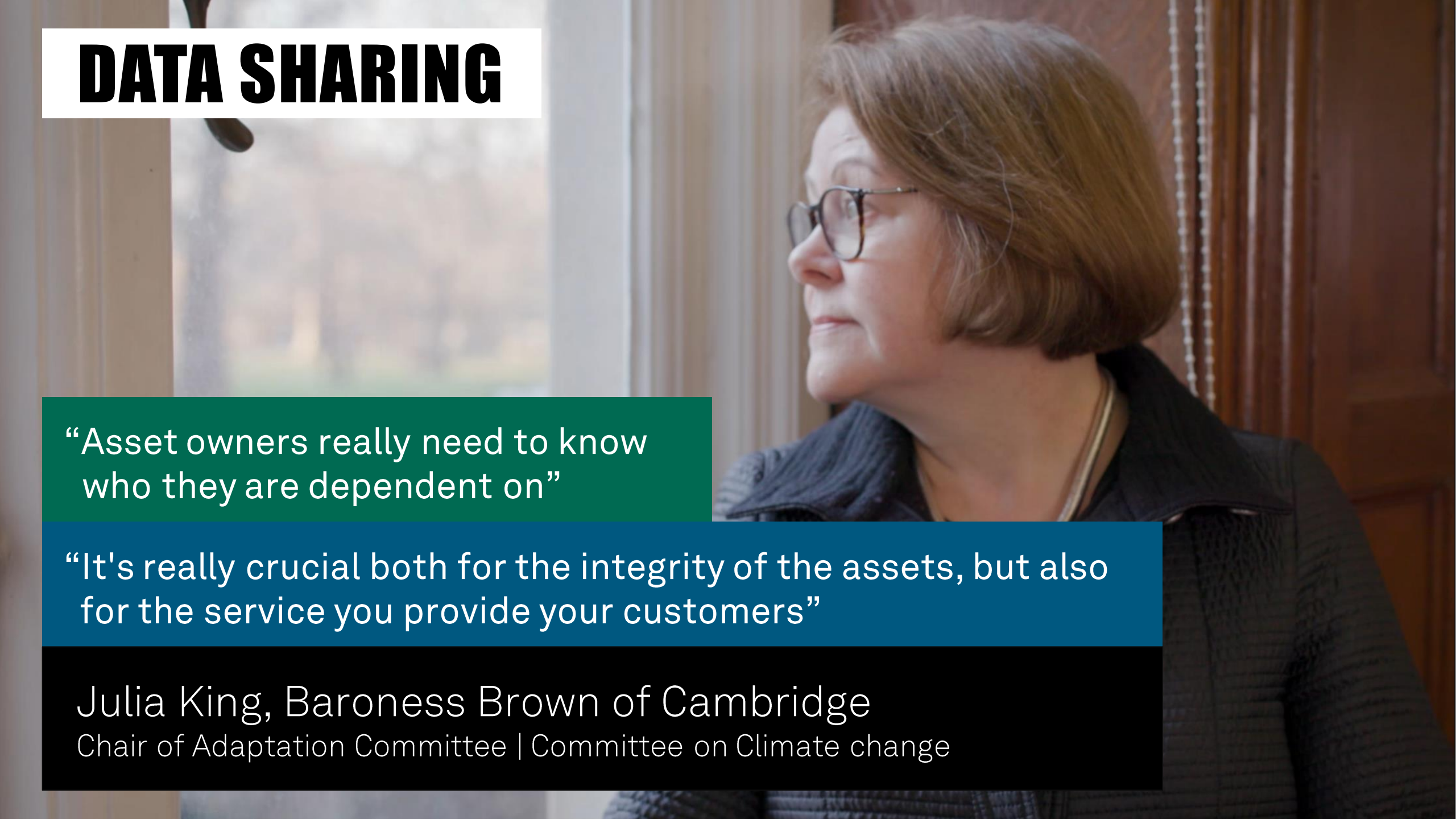
ASSET RISK TOOL



WHAT IS CReDo ?

INFRASTRUCTURE INTERDEPENDENCIES

DATA SHARING



"Asset owners really need to know who they are dependent on"

"It's really crucial both for the integrity of the assets, but also for the service you provide your customers"

Julia King, Baroness Brown of Cambridge

Chair of Adaptation Committee | Committee on Climate change

CReDo IS A CLIMATE CHANGE ADAPTATION DIGITAL TWIN

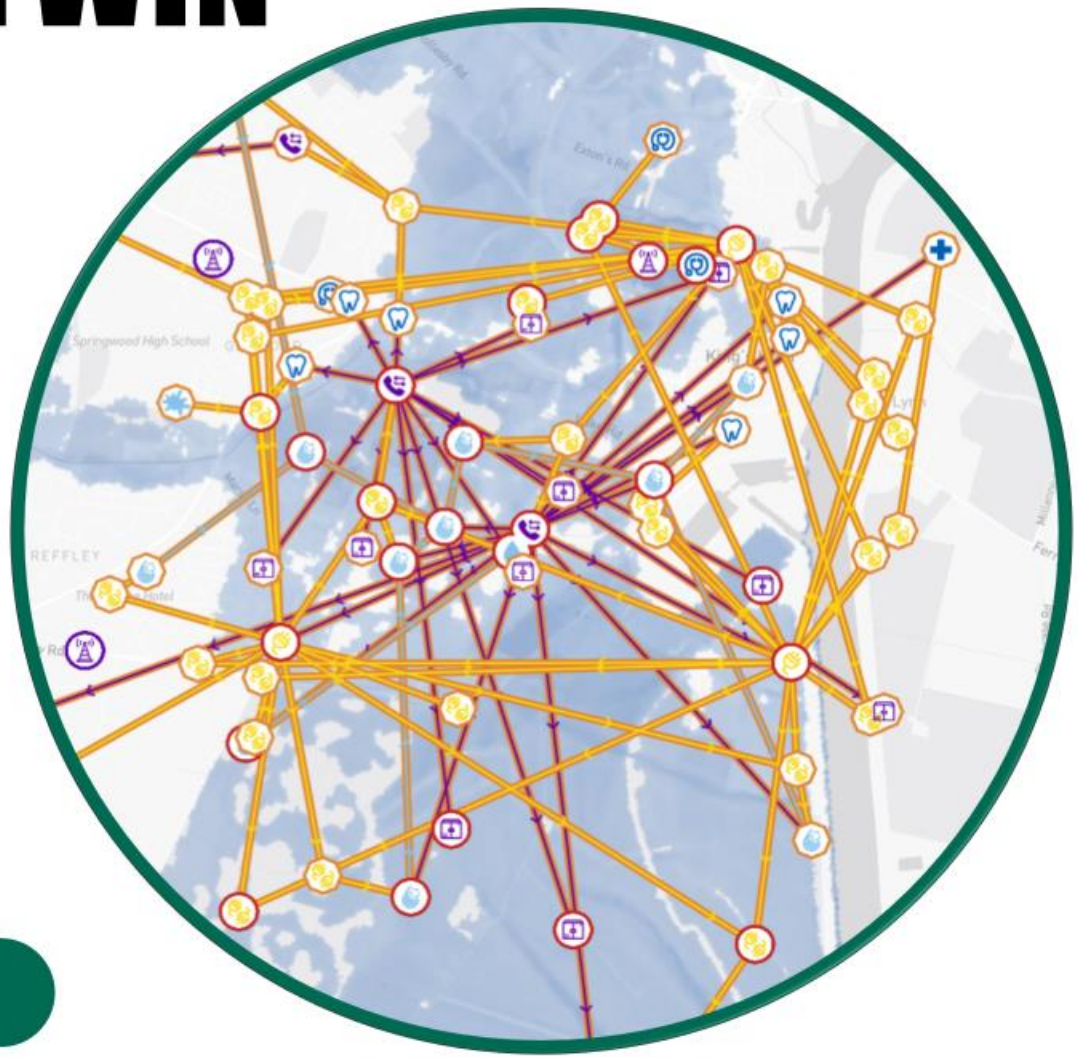
Bringing together data across energy, water and telecoms networks

- Anglian Water's water and sewerage assets,
- BT and Openreach's communication assets and
- UKPN's power network assets.

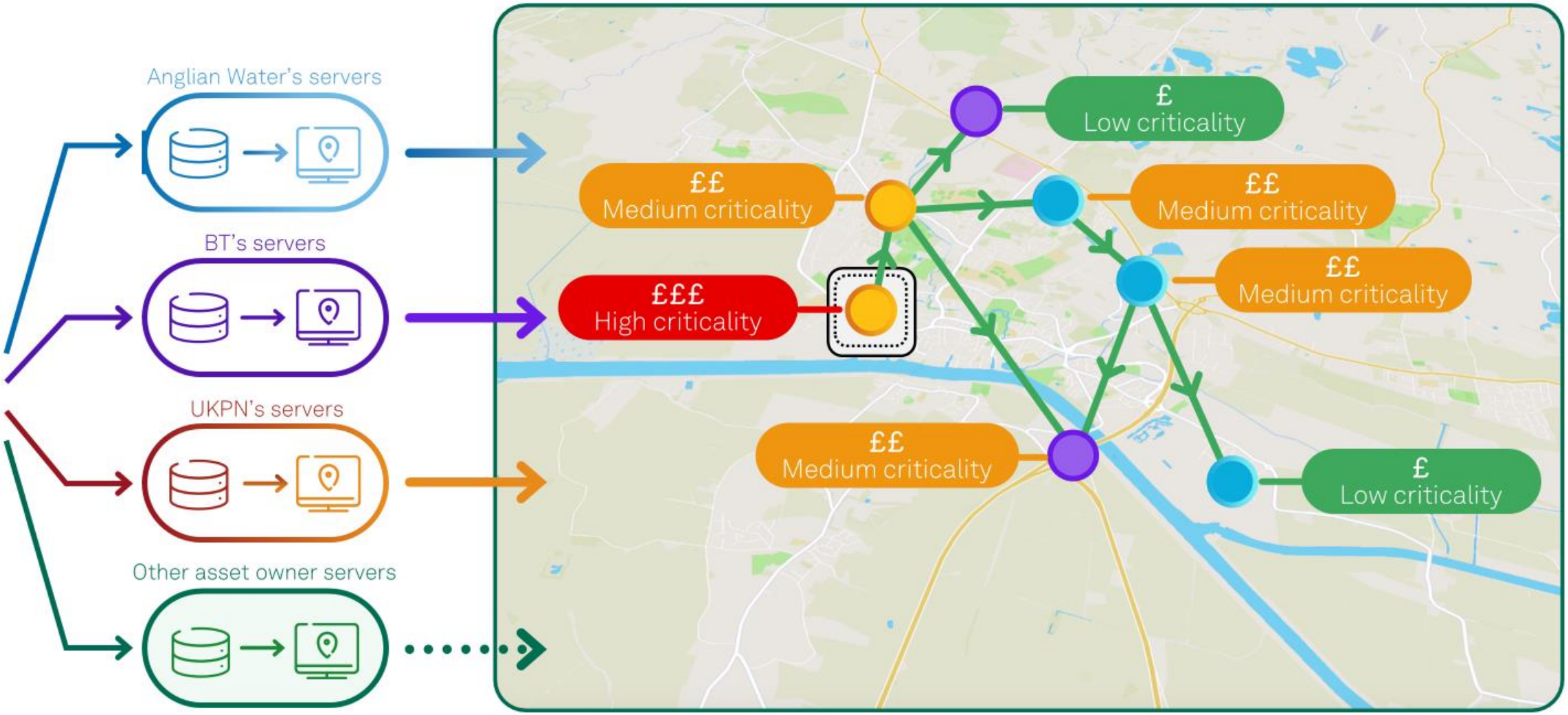
With weather data to understand...

- Infrastructure interdependencies
- Asset failure and system impact
- What can we do to prepare or respond?

HOW DO WE INCREASE SYSTEM RESILIENCE AND ADAPT?



...FOR COORDINATED RESILIENCE PLANNING



CReDo JOURNEY

IDEATION

DEMONSTRATOR

SCALE UP!

cdbb

NATIONAL INFRASTRUCTURE COMMISSION

DIGITAL TWIN HUB

CReDo film and app

COP26

NATIONAL DIGITAL TWIN PROGRAMME — CReDo Climate Resilience Demonstrator

CATAPULT Connected Places

CReDo phase 1

CReDo 2 film

CReDo

CATAPULT Connected Places

CReDo phase 2 (CPC led)

Ofgem Strategic Innovation Fund (CReDo+)

Discovery £100k

Alpha £500k

Beta Scale up!

Ofwat Water Breakthrough Challenge

Catalyst £1m

Transform Scale up!

CR&D, Innovation & Commercial funding

DEC 2017

MARCH 2020

MARCH 2021

MARCH 2022

MARCH 2023

MARCH 2024

MARCH 2025

CLIMATE DATA

MAKING EXTREME HEAT WEATHER DATA AVAILABLE

Climate data – key facts

A first estimation of how likely it is that different regions in England and Wales will experience potentially threatening heat events.

What is a heat event?

Defined as consecutive days where the maximum temperature exceeds a defined threshold (i.e. 30-35, 35-40 or 40-45°C) with durations of 1, 3, 7, or 14 days.

Three scenarios of +1.5°C, +2°C, and+ 3°C of global warming were considered for each combination of temperature and duration.

This means there is information available for 12 x 3 heat events.

Using UKCP18 data

Using the most recent iteration of the UK Climate Projections data (UKCP18)

A well-known, reliable dataset that provides an understanding of how UK climate may change in the future.

Climate data – key facts

A first estimation of how likely it is that different regions in England and Wales will experience potentially threatening heat events.

Bias corrected

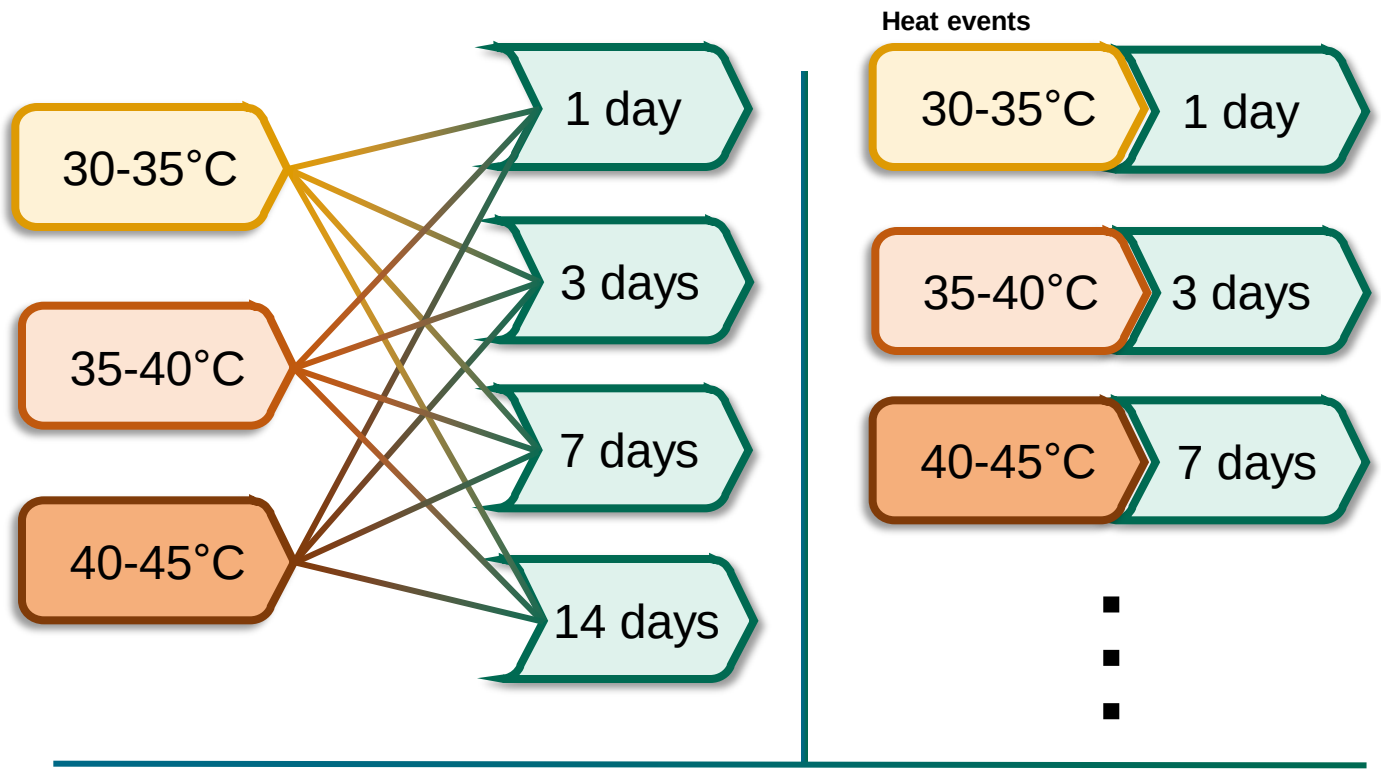
Climate models may not precisely replicate historical periods.
Bias, refers to differences between historical predictions and observations.

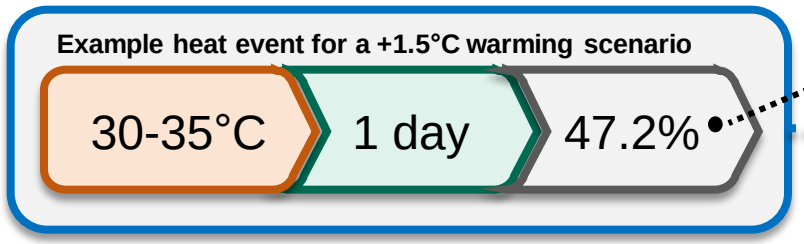
Bias correction methods are commonly employed to mitigate uncertainties in the data, aiming to bring historical and future climate projections closer. The project used bias corrected data generated by Bristol University.

Bias corrected results provide a better representation of heat extremes.

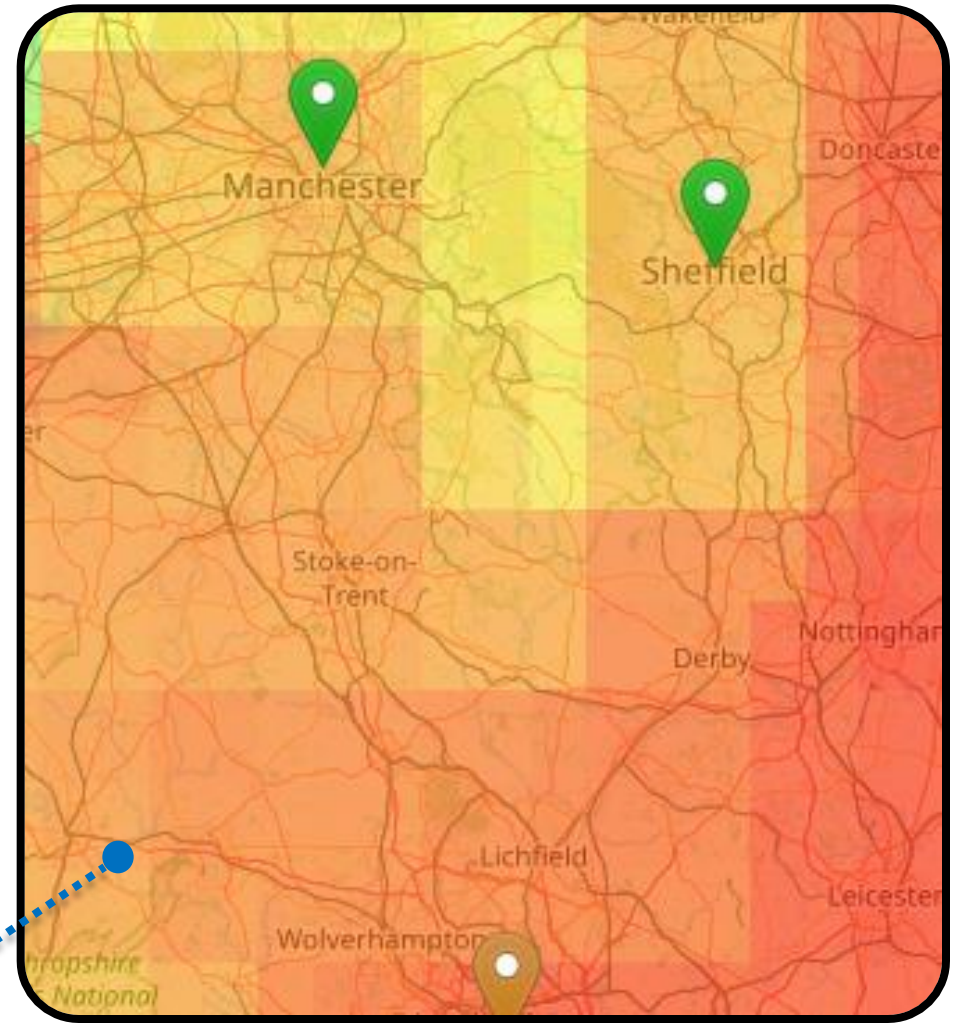
Climate data – what does it look like?

Heat events - 12 combinations of temperature and duration for each warming scenario (+1.5°C, +2°C, and+ 3°C)





Each combination has a likelihood attached to it.



Screenshot of weather data as shown in the CReDo Asset Risk Tool
Each cell on the map has a probability value for 30-35 °C 1 day duration (+1.5°C warming)

ASSET MODELLING

BUILDING AND USING MODELS TO ASSESS RISKS

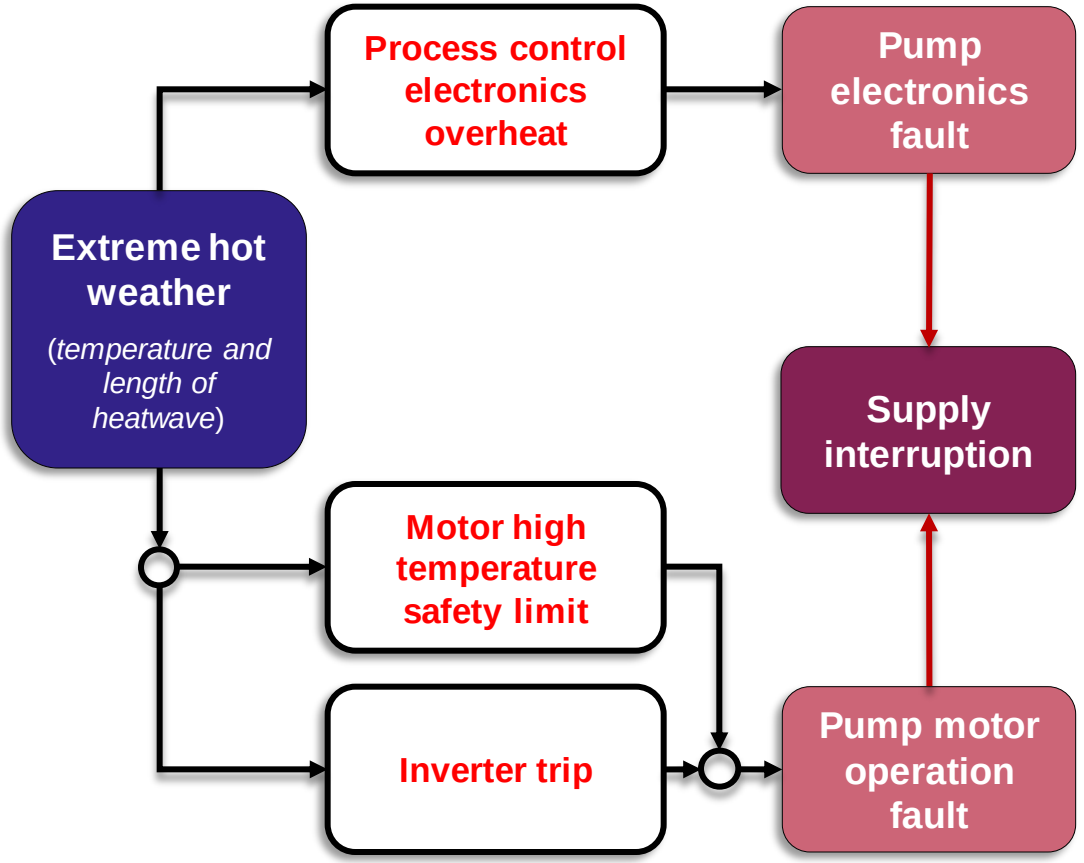
Expert elicitation – stage 1

A method to consolidate tacit knowledge from expert staff into readily usable mathematical models.

How does it work?

Structural elicitation sessions → Model structures

Captures key variables describing the behaviour of **vulnerable** assets and the **chain of events leading to impacts,** such as supply interruptions.

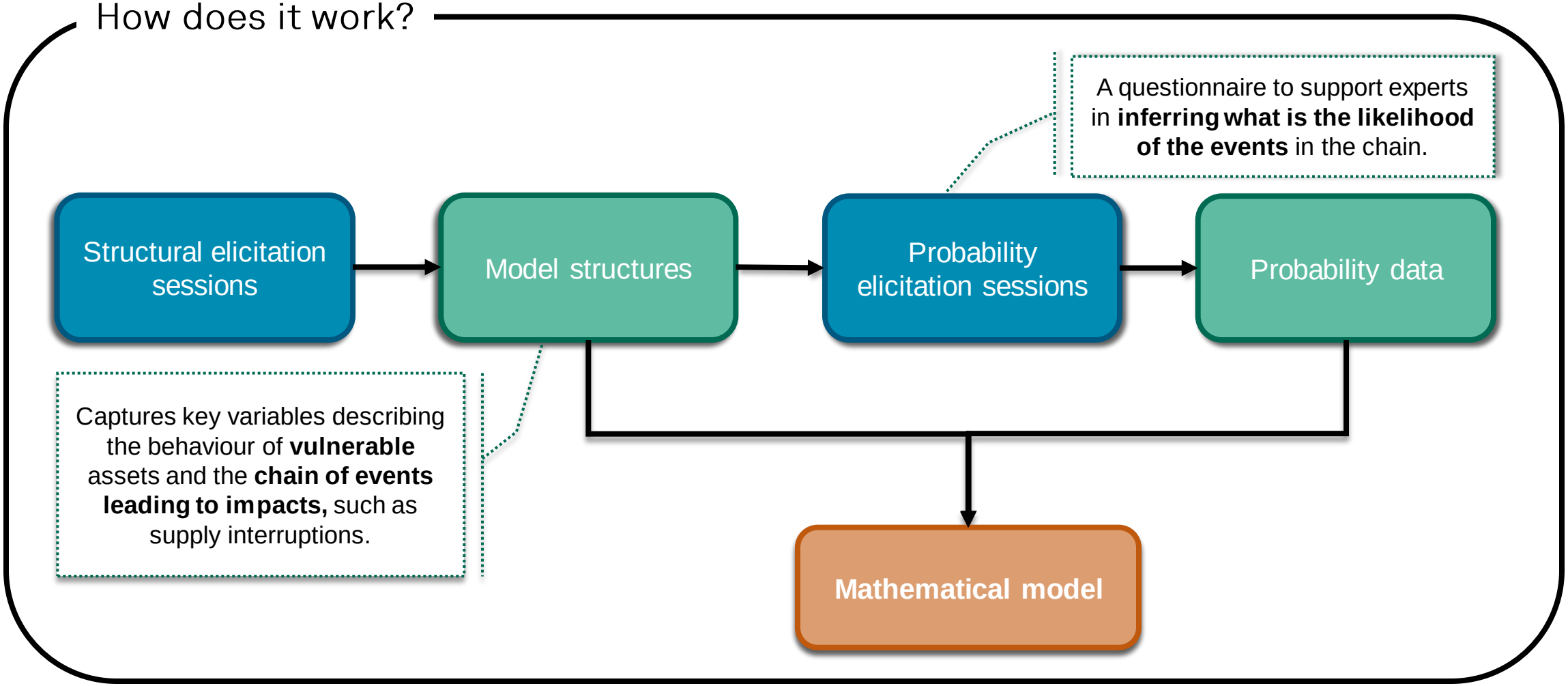


Example model structure for water pumping asset

Expert elicitation – stage 2

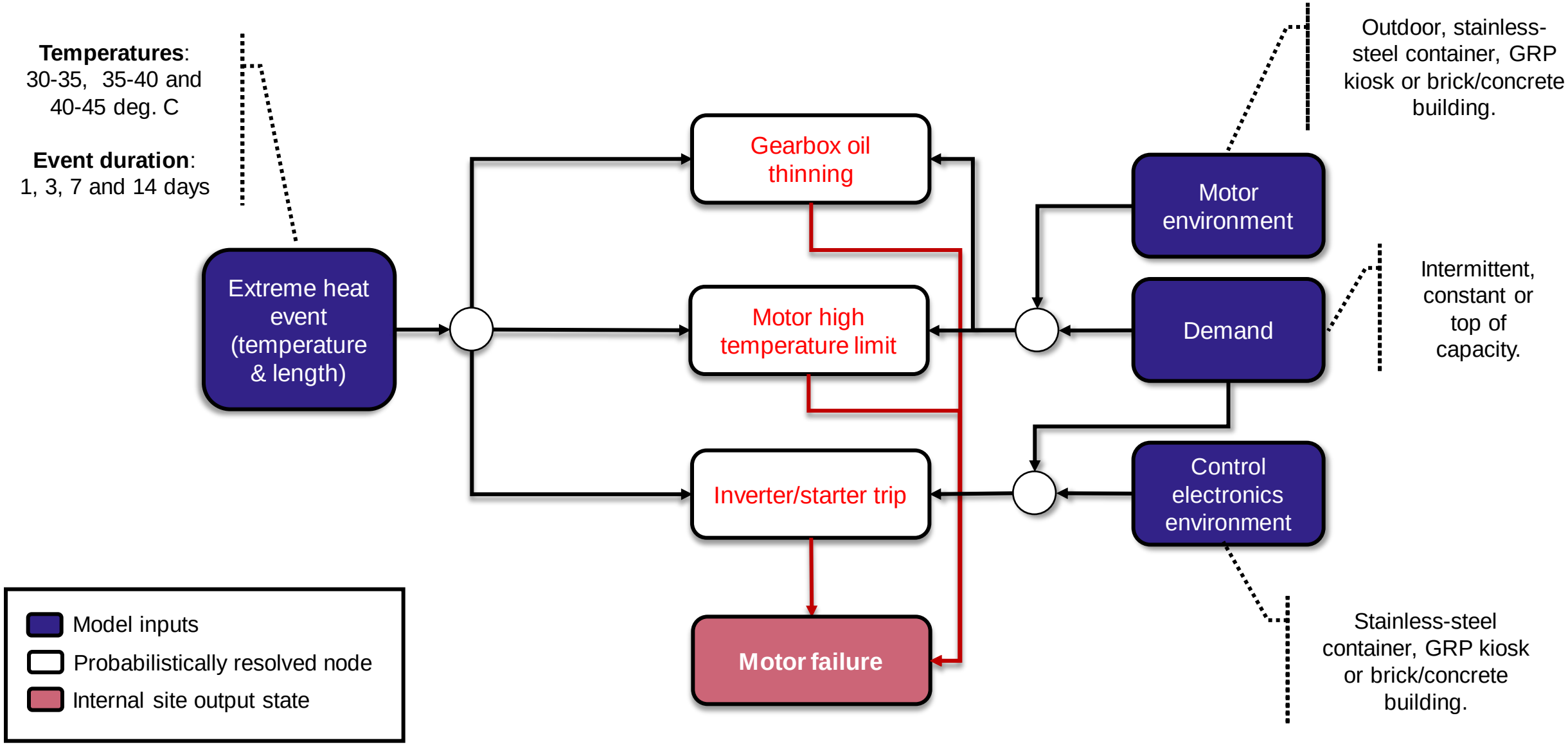
A method to consolidate tacit knowledge from expert staff into readily usable mathematical models.

How does it work?



Asset modelling – building blocks (motor)

Understanding granular behaviour of the main types of vulnerable equipment.



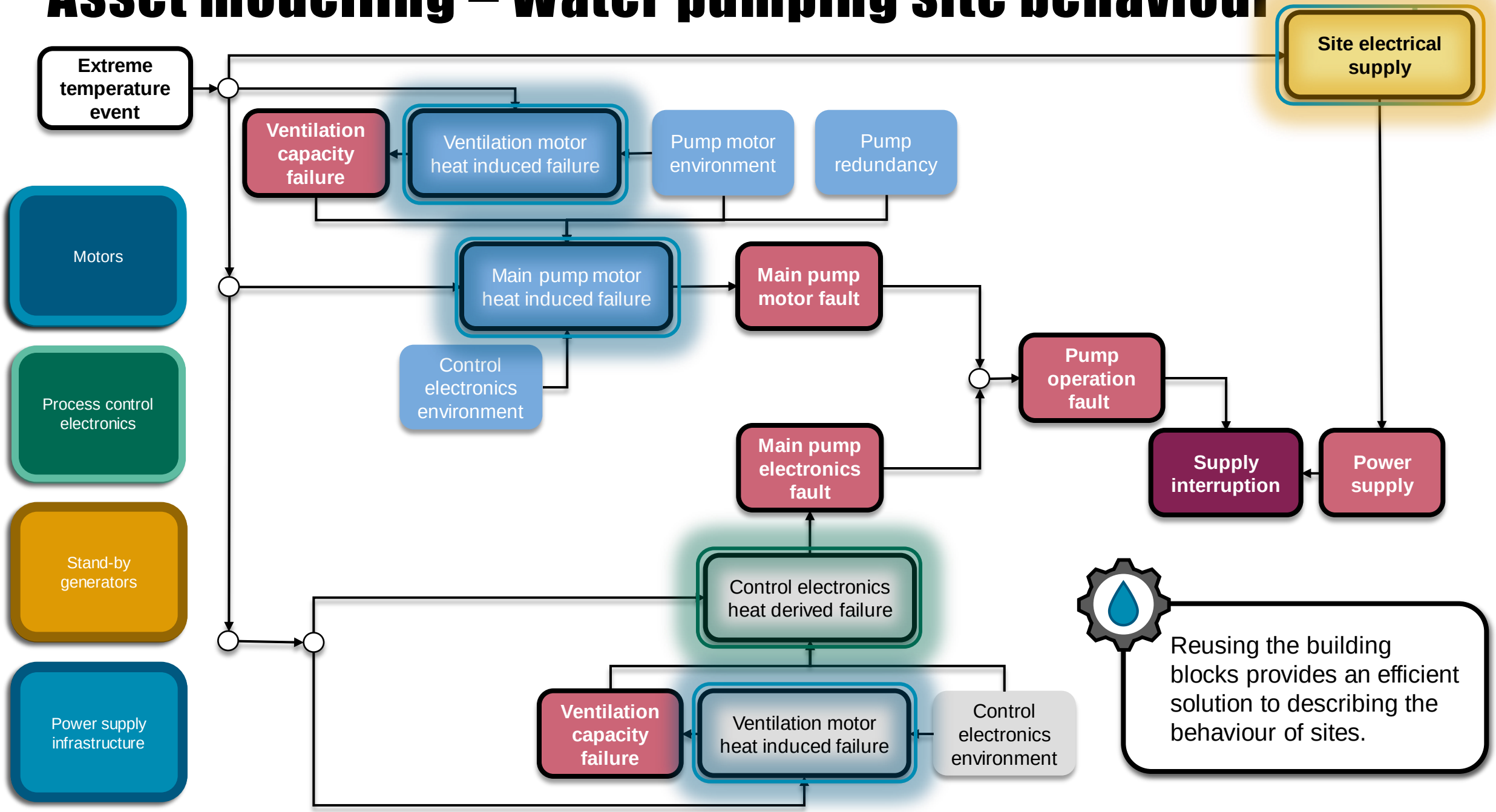
Asset modelling – building blocks

We have equivalent diagrams (model structures) for other key equipment.

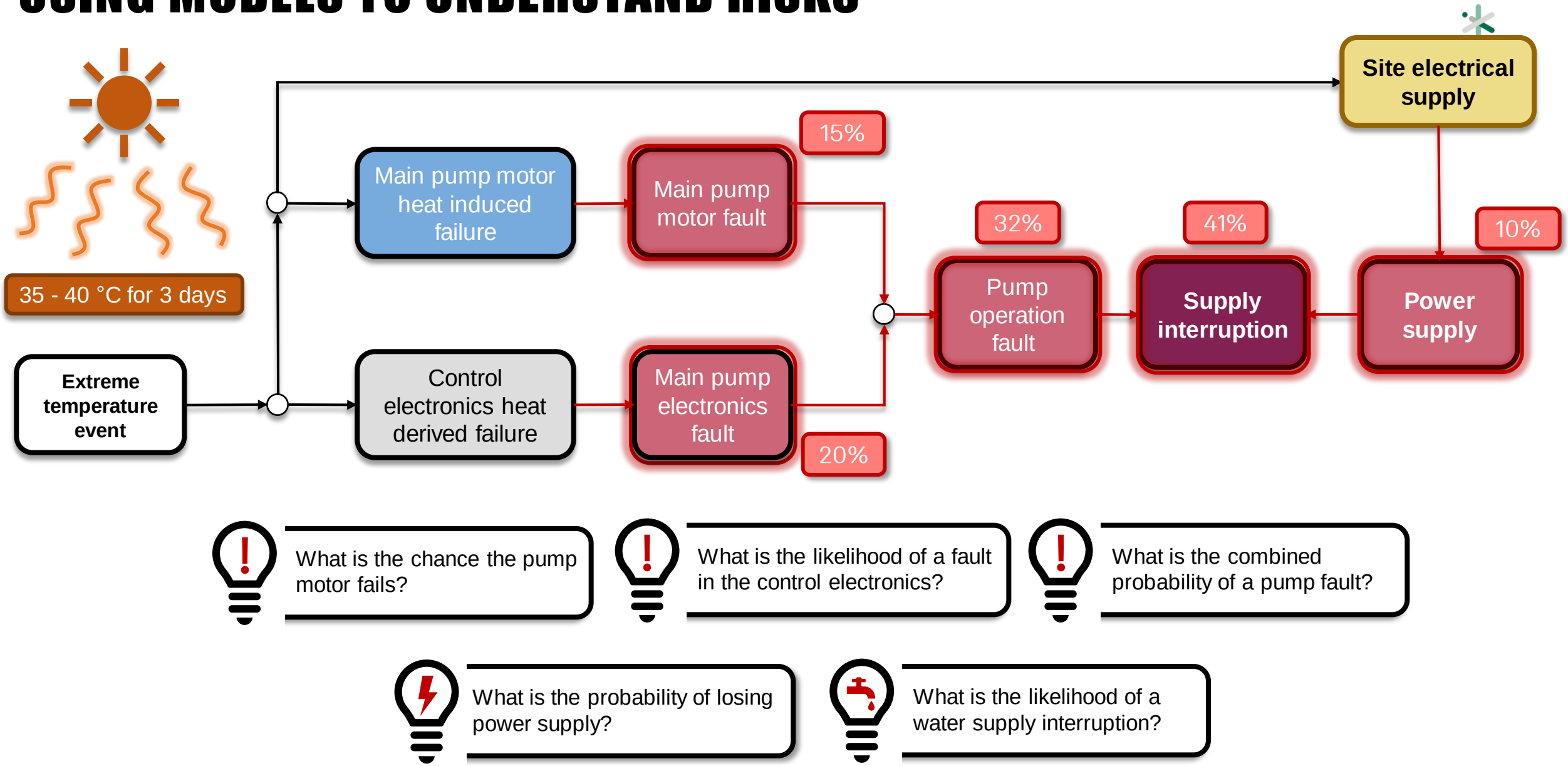
- Motors
- Process control electronics
- Stand-by generators
- Aeration / final settlement microbial populations
- Power supply infrastructure

These models and their underlying information are reused to represent the behaviour of a wide variety of equipment operating on sites.

Asset modelling – Water pumping site behaviour



USING MODELS TO UNDERSTAND RISKS



Using these types of models, it is possible obtain a granular understanding of what could happen.

CReDo

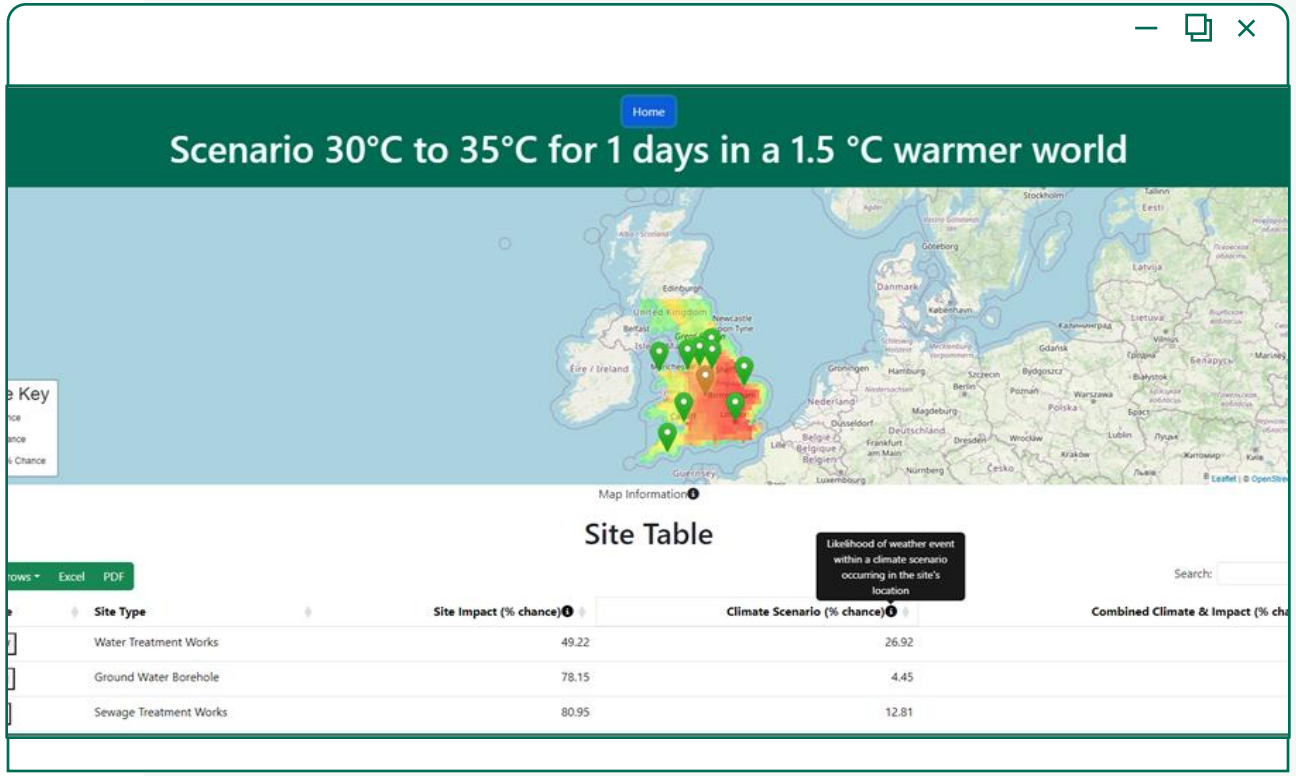
ASSET RISK TOOL

CREDO ASSET RISK TOOL: WHAT DOES IT DO?

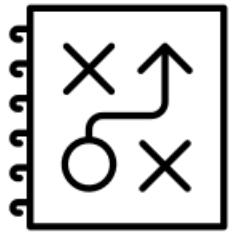
The CReDo Asset Risk Tool enables users to understand the vulnerabilities of assets to help investment decision making.

It does this by:

- Visualising the climate scenarios
- Visualising the models and risk
- Understand what parts of sites and assets are most at risk



CREDO ASSET RISK TOOL: WHO IS IT FOR?



Strategic Planner

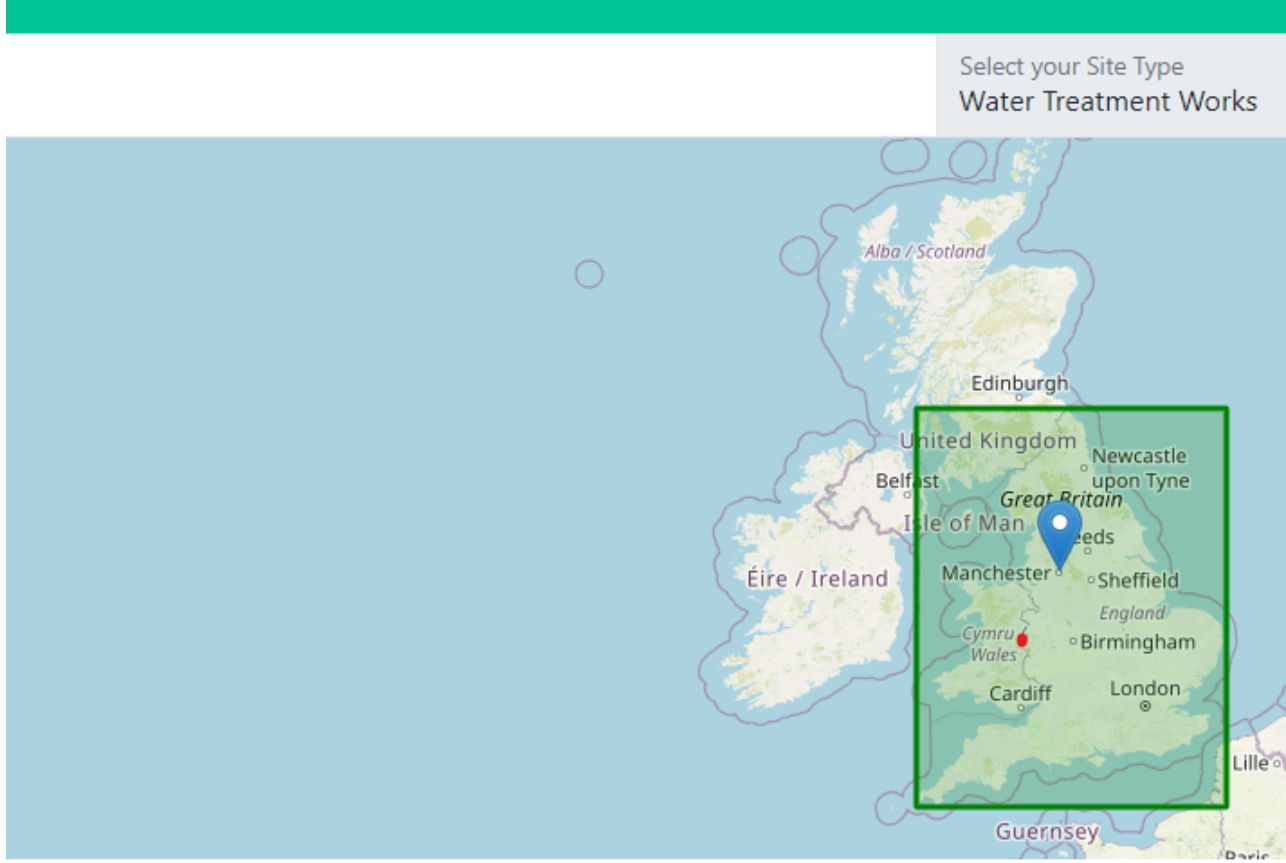
Emergency planner

Asset engineering &
Infrastructure design

CREDO ASSET RISK TOOL: TODAY'S DEMO

There are multiple use cases the CReDo Asset Risk Tool can solve for different user types. In this demo, we are going to look at the Strategic Planner user type with the following questions:

- What are the likelihoods of certain climate scenarios occurring across different parts of England and Wales?
- In a certain extreme heat climate scenario, how likely are my selected sites to fail?
- Within a site, how likely is each asset or component to fail up to 15th level of detail?
- In a collection of sites, which site is the **most** likely to fail in the selected climate scenario?
- Within a site, what component is **most** likely to fail in that selected climate scenario?
- How do different climate scenarios impact the risk of a specific site or set of sites failing, comparatively?
- Combining both the probability of a climate scenario happening and the site failing in that chosen scenario, what is the overall likelihood of a selected site failing?



markers outside of green area will cause failure to run

fill	53.497767972931044	-2.2485774723

Site Power Supply Block

Electrical Distribution Process

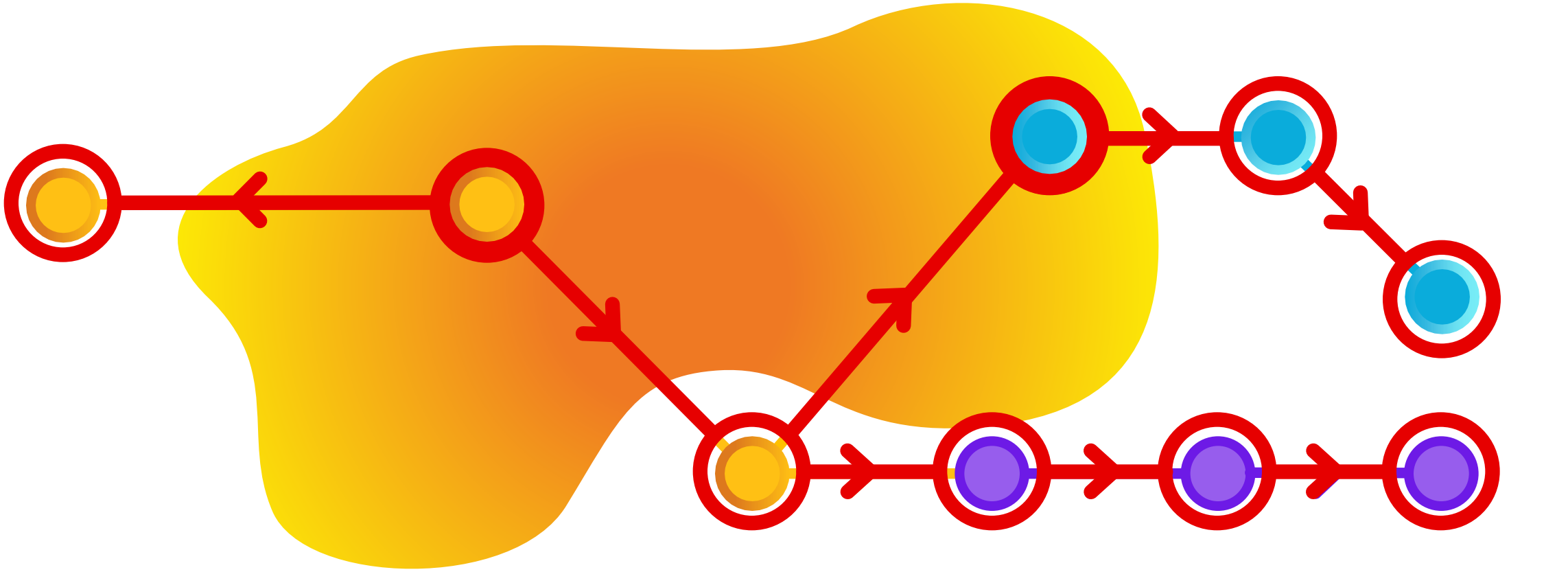
	Environment GRP kiosk	Ventilation None
	Environment GRP kiosk	Ventilation None

LINK TO DEMO

CReDo

DIGITAL TWINNING

Infrastructure interdependencies



Key

Water

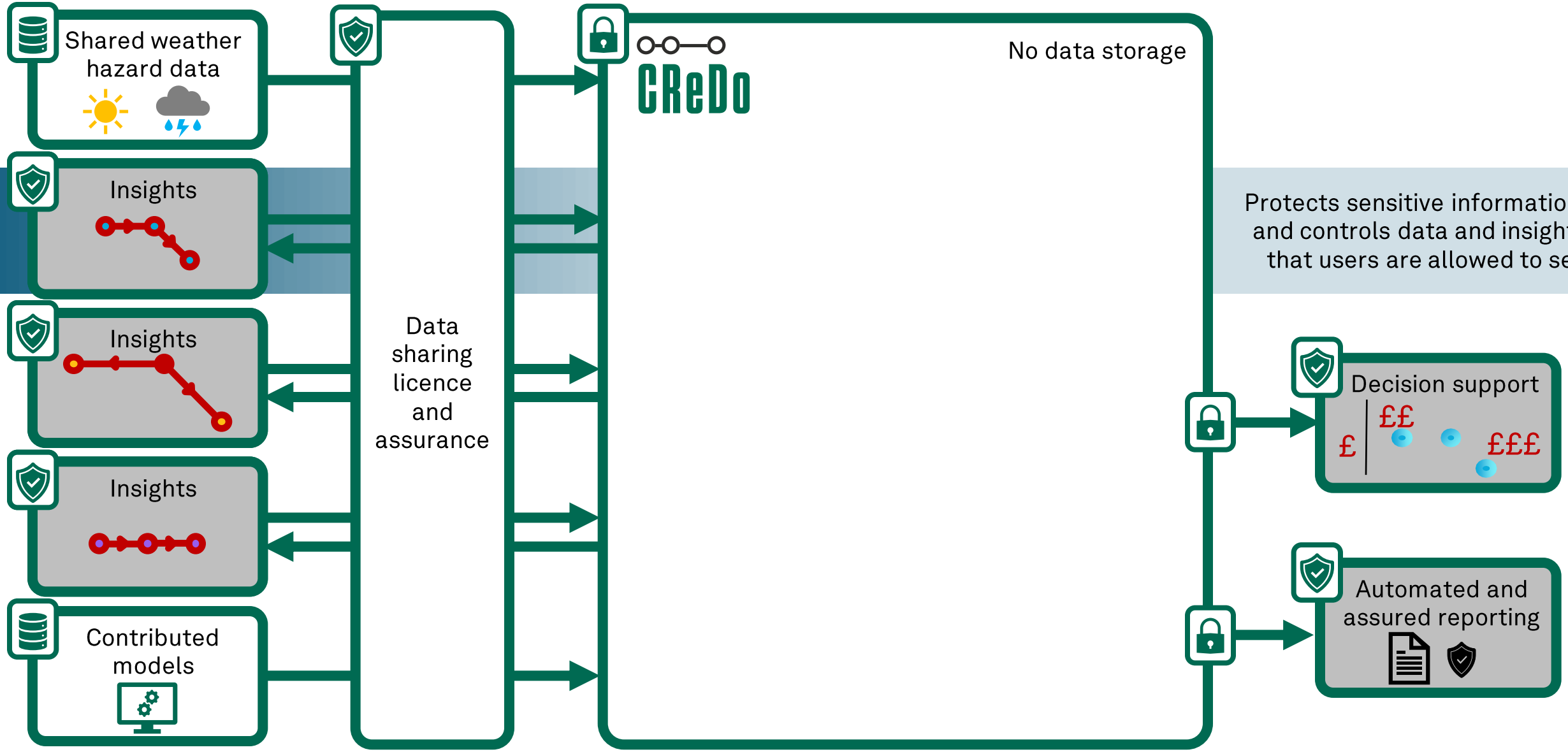
Electricity

Telecoms

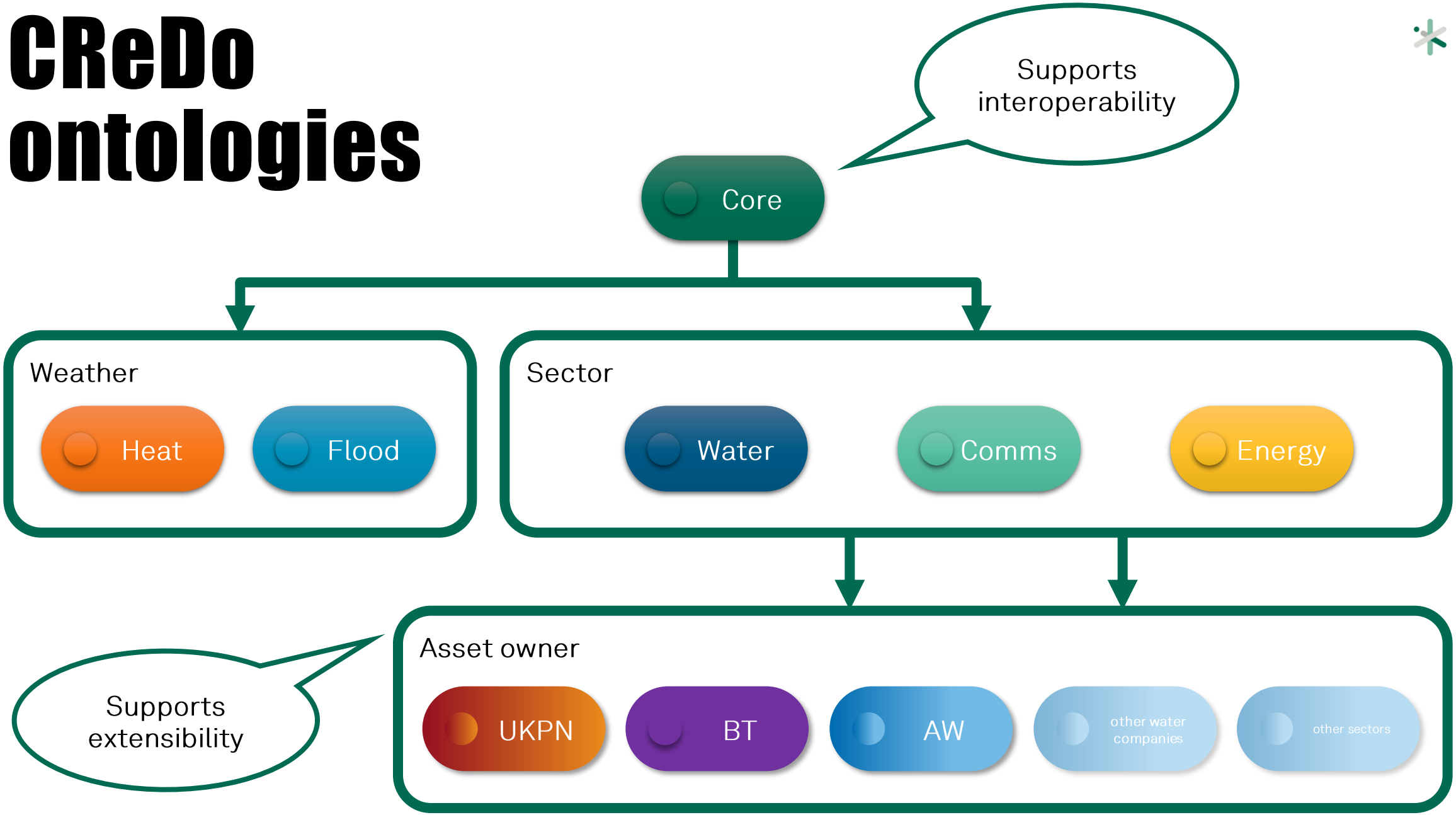
Failure

Cascading failure

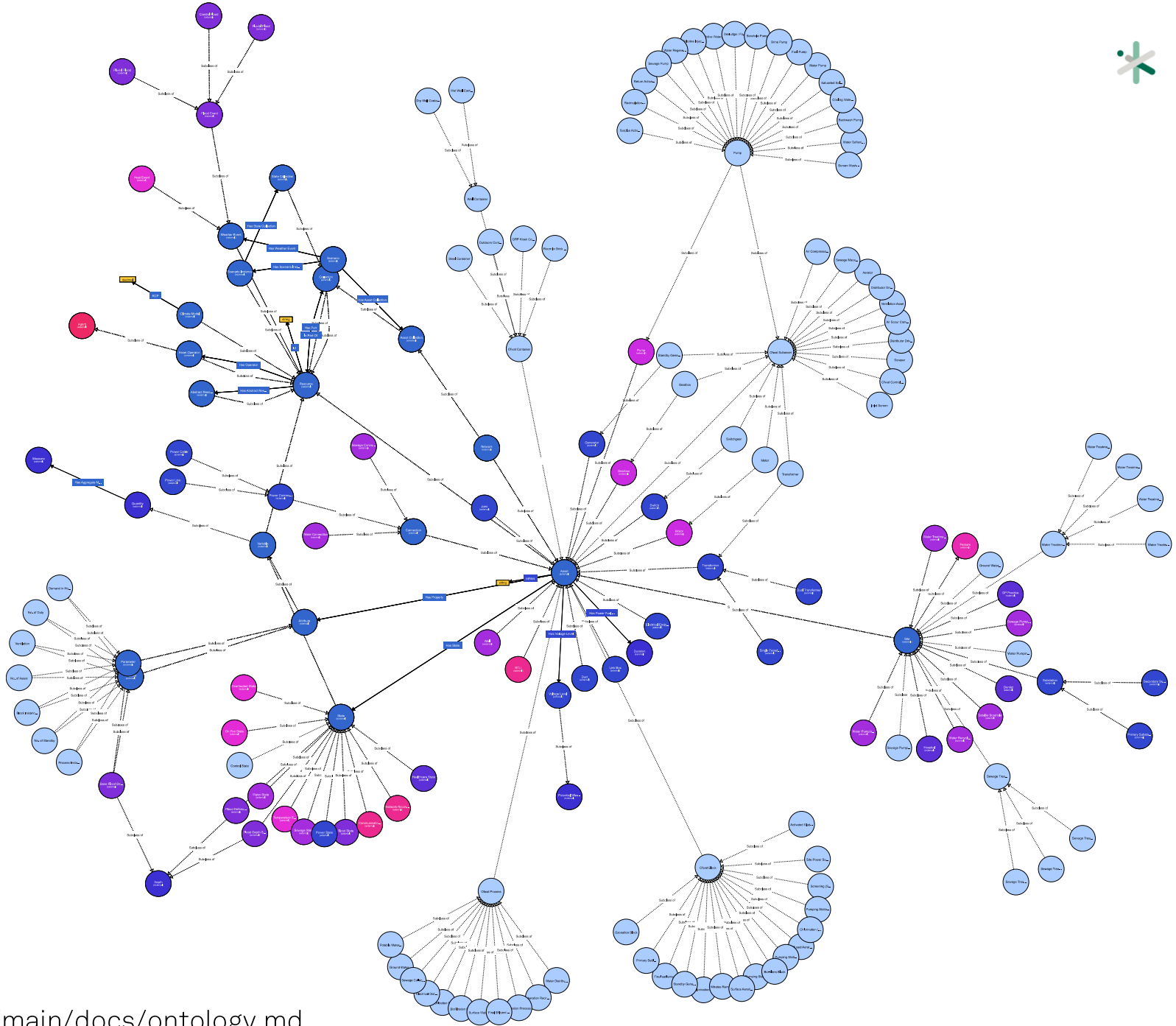
Data sharing in CReDo



CReDo ontologies



CReDo ontologies



https://gitlab.stfc.ac.uk/credo/phase2/-/blob/main/docs/ontology.md

The Climate Resilience Demonstrator

CReDo was established as a pioneering climate change adaptation digital twin project to provide a practical example of how connected data can improve climate adaptation and resilience across systems of systems.

What does it do?

Select a scenario: Refresh

Phase 2 Coastal Flooding (2070, 1-in-1000 Year Flood, RCP8.5)

This is a scenario in which the power, water, and healthcare systems experience a 1 in 1000 year coastal flood event calculated using the Fathom-UK 2070 RCP8.5 model at 10m resolution.

CLICK

Ofwat Extreme Heat (35-40°C for 3 Days)

This is a scenario in which the power, water, and healthcare systems experience a 3 day, 35-40°C extreme heat event for +1.5°C warming.

CReDo

About CReDo
Learn about the development and timeline of CReDo

Acknowledg
Discover the CR...

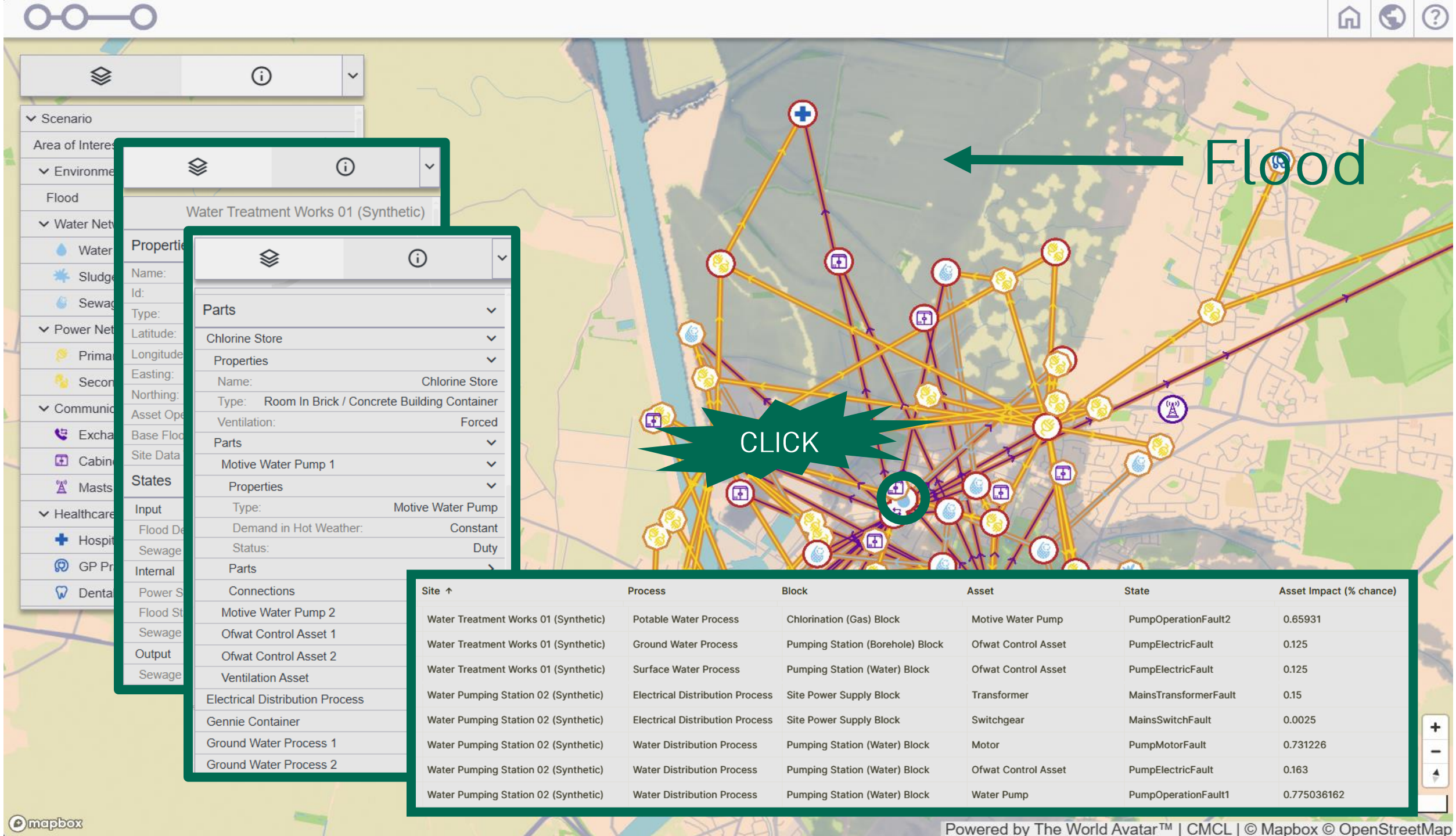
CLICK

Open Scenario View
Use CReDo to understand the climate resilience of your infrastructure network

CReDo Help
Get help with the CReDo app

Get Involved
Visit the Digital Twin Hub if you are interested in getting involved with CReDo

Powered by The World Avatar


Scenario
Area of Interes
Environme
Flood
Water Net
Water
Sludge
Sewag
Power Net
Prima
Secon
Communic
Excha
Cabin
Masts
Healthcare
Hospit
GP Pr
Denta
Water Treatment Works 01 (Synthetic)
Properti
Name:
Id:
Type:
Latitude:
Longitude
Easting:
Northing:
Asset Ope
Base Floo
Site Data
States
Input
Flood De
Sewage
Internal
Power S
Flood St
Sewage
Output
Sewage
Parts
Chlorine Store
Properties
Name: Chlorine Store
Type: Room In Brick / Concrete Building Container
Ventilation: Forced
Parts
Motive Water Pump 1
Properties
Type: Motive Water Pump
Demand in Hot Weather: Constant
Status: Duty
Parts
Connections
Motive Water Pump 2
Ofwat Control Asset 1
Ofwat Control Asset 2
Ventilation Asset
Electrical Distribution Process
Gennie Container
Ground Water Process 1
Ground Water Process 2
Flood
CLICK
Site
Process
Block
Asset
State
Asset Impact (% chance)
Water Treatment Works 01 (Synthetic) Potable Water Process Chlorination (Gas) Block Motive Water Pump PumpOperationFault2 0.65931
Water Treatment Works 01 (Synthetic) Ground Water Process Pumping Station (Borehole) Block Ofwat Control Asset PumpElectricFault 0.125
Water Treatment Works 01 (Synthetic) Surface Water Process Pumping Station (Water) Block Ofwat Control Asset PumpElectricFault 0.125
Water Pumping Station 02 (Synthetic) Electrical Distribution Process Site Power Supply Block Transformer MainsTransformerFault 0.15
Water Pumping Station 02 (Synthetic) Electrical Distribution Process Site Power Supply Block Switchgear MainsSwitchFault 0.0025
Water Pumping Station 02 (Synthetic) Water Distribution Process Pumping Station (Water) Block Motor PumpMotorFault 0.731226
Water Pumping Station 02 (Synthetic) Water Distribution Process Pumping Station (Water) Block Ofwat Control Asset PumpElectricFault 0.163
Water Pumping Station 02 (Synthetic) Water Distribution Process Pumping Station (Water) Block Water Pump PumpOperationFault1 0.775036162
mapbox
Powered by The World Avatar™ | CMCL | © Mapbox © OpenStreetMap

CReDo VISION

CREDO LARGER VISION

CReDo
Asset Risk Tool

Climate scenario modelling

- Model how climate scenarios and weather events are likely to occur

Asset risk modelling

- Model how sites and assets are impacted b y climate scenarios

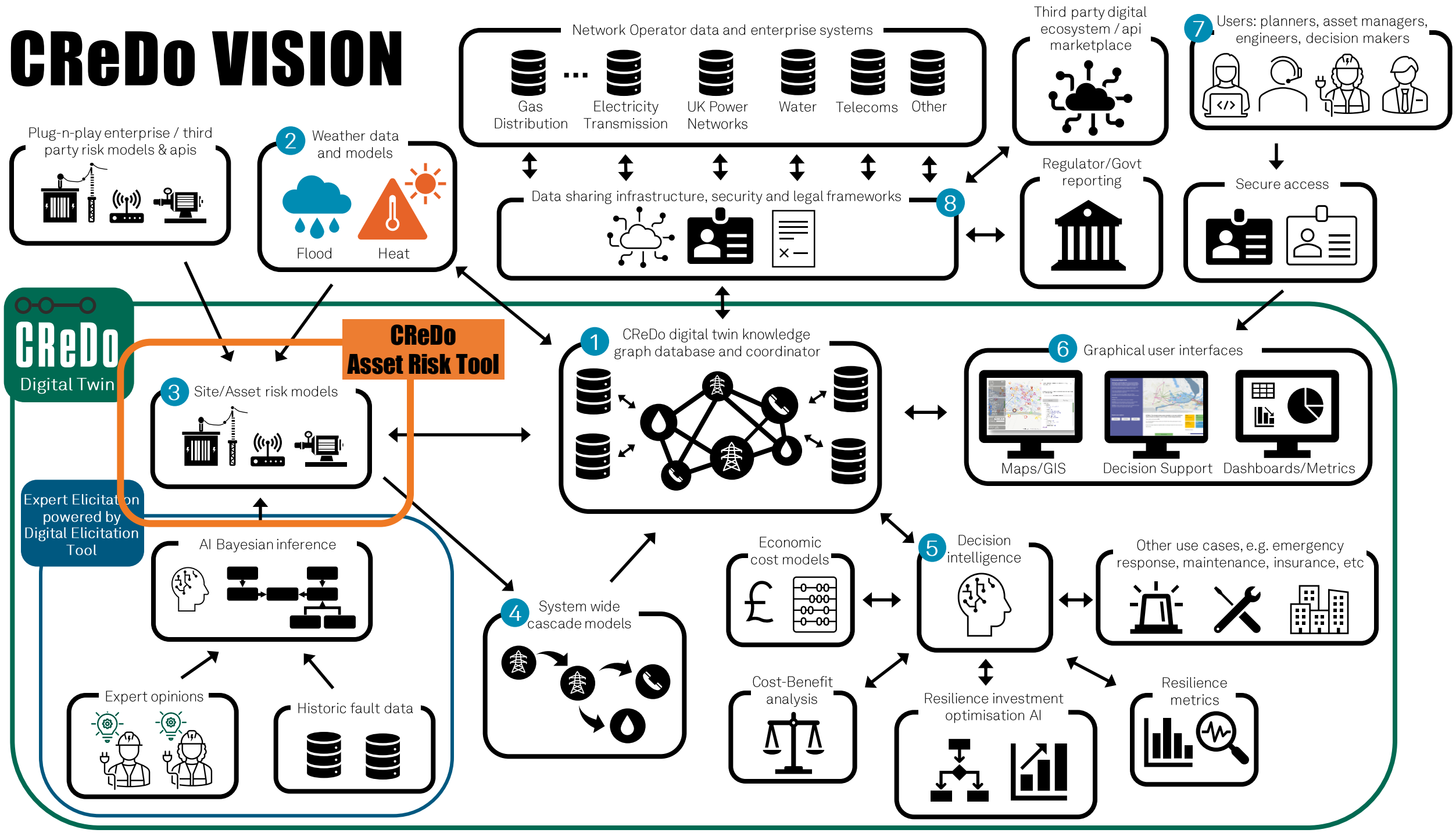
Cascade risk modelling

- Model the connections a nd dependencies of sites and assets both within the same infrastructure sectors and across different infrastr ucture sectors
- Model the risks of cascading failures across the whole system from climate sce narios

Decision support

- Based on the individual asset failure risk as well as the resulting cascade failure risk, how should investment be spent to improve the resilience of the whole system?

CReDo VISION



CReDo MISSION, USP & OBJECTIVES

Climate Resilience Demonstrator → Climate Resilience Decision Optimiser

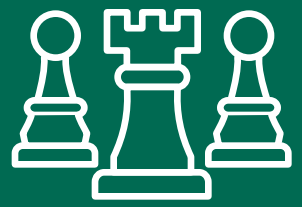
MISSION

- Enable coordinated decision making and efficient investment
- Understand infrastructure interdependencies and cascading risk
- So that together we can increase resilience to extreme weather and adapt to climate change

USP

- Connect data across siloed organisational boundaries
- Enable a whole system approach to risk modelling
- Allows users to see who they are dependent on to support better decision making and reporting

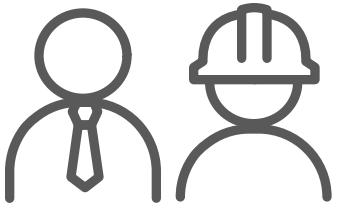
Showcase the power of bringing siloed data together



Enable and improve strategic resilience planning

Benefit economy and society

CReDo's USERS AND USE CASES



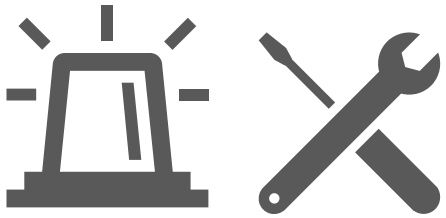
Asset Operators, Managers, and Planners

Regulators and Government

Insurers, Finance, and Investors

Cost Benefit Analysis and Resilience Investment Optimisation

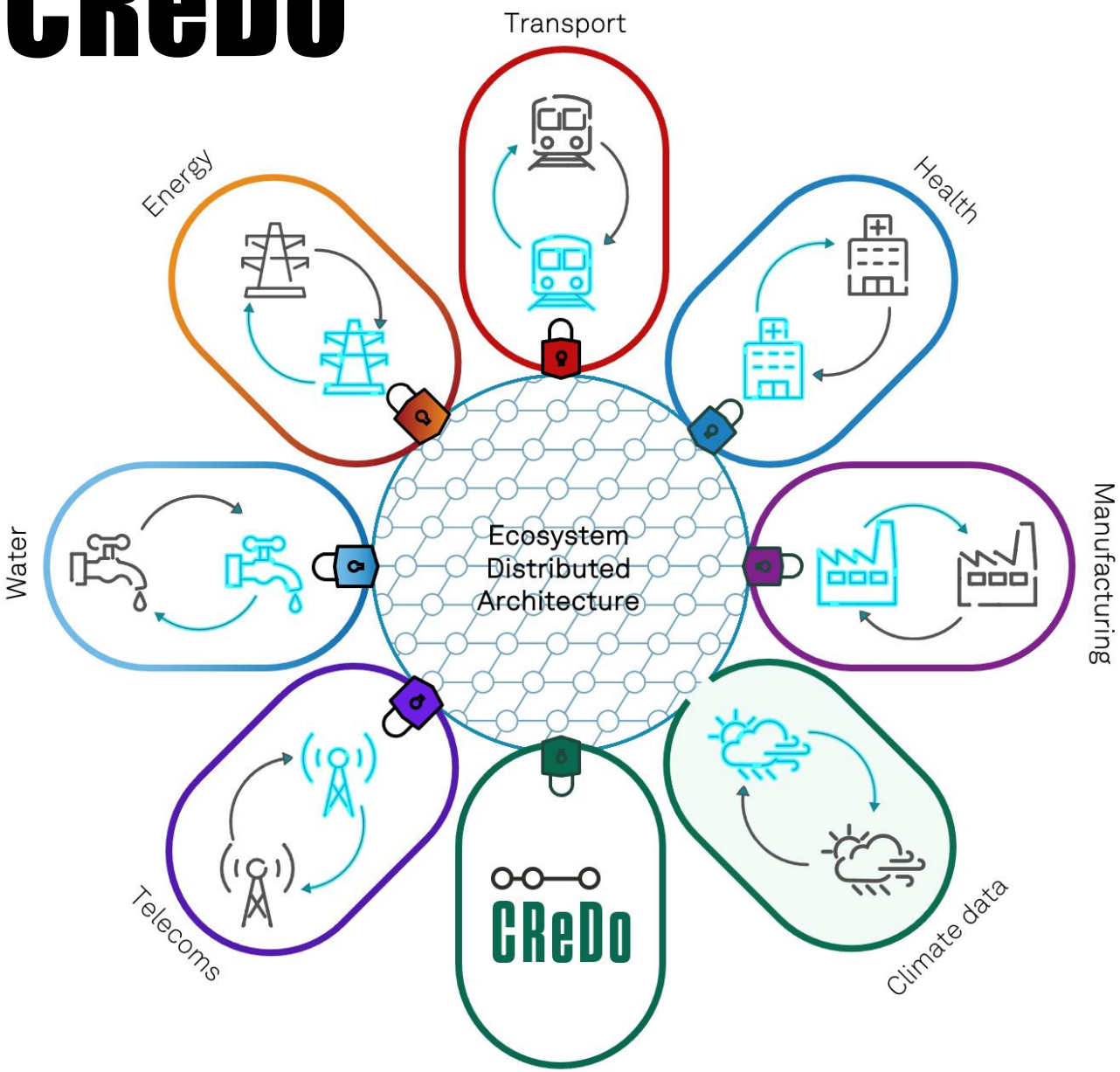
Resilience Metrics, Regulatory and Governmental Reporting



Emergency Response, Asset Maintenance, and Underwriting

EXPANSIONS TO CReDo

- Sector and asset type expansion
- Geographic expansion
- Climate event expansion
- Digital Twin and Dynamic Knowledge Graph core technology
- Risk modelling and decision intelligence
- Data sharing and security infrastructure



FACILITATED Q&A

FINAL THOUGHTS

THANK YOU FOR JOINING US

To register for access to the CReDo Asset Risk Tool, please visit:

- Digital Twin Hub: https://digitaltwinhub.co.uk/climate-resilience-demonstrator-credo/credo-extreme-heat/

- Anglian Water Innovation Hub: https://awinnovationhub.co.uk/project/credo-extreme-heat/

For further information about CReDo, please contact credo@cp.catapult.org.uk.