

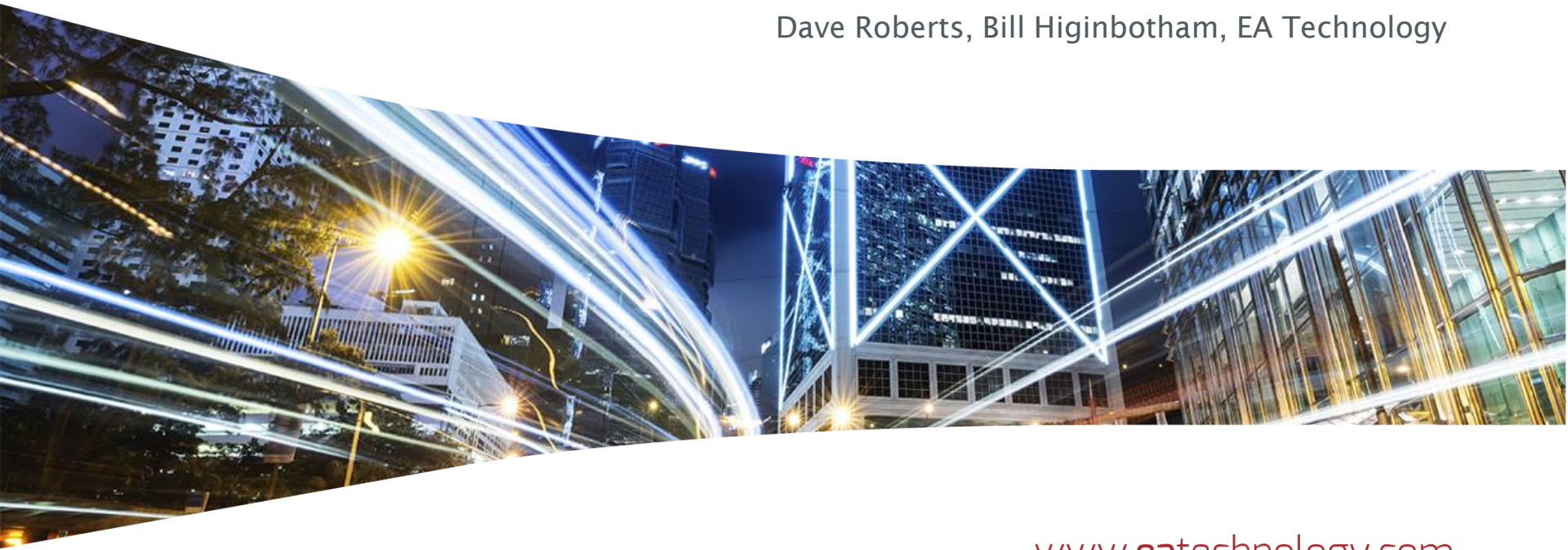


Safer, Stronger, Smarter Networks

Optimized Investment Program Using a Nationalized Asset Health and Consequence Model

CEATI Stations Conference, Tucson AZ March 2019

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www.eatechnology.com

Contents

1. Background
2. Overview of Common Network Asset Indices Methodology
3. Intervention Options
4. Investment Optimization
5. Conclusions



Background

UK Network Ownership

Electricity Transmission

- 1  Scottish & Southern Electricity Networks
- 2  SP ENERGY NETWORKS
- 3  Northern Ireland Electricity Networks
- 4  nationalgrid

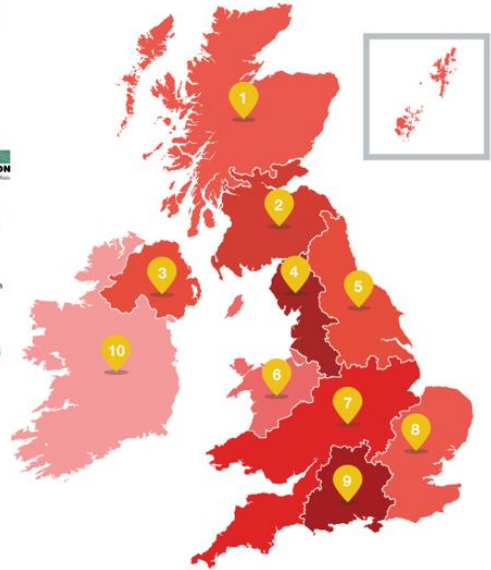
 Owns and operates the Moyle Interconnector



Electricity Distribution

- 1  Scottish & Southern Electricity Networks
- 2  SP ENERGY NETWORKS
- 3  Northern Ireland Electricity Networks
- 4  electricity north west
Bringing energy to your door
- 5  NORTHERN POWERGRID
- 6  SP ENERGY NETWORKS
- 7  WESTERN POWER DISTRIBUTION
Bringing the Midlands, East of England and West
- 8  UK Power Networks
Delivering your electricity
- 9  Scottish & Southern Electricity Networks
- 10  ESB NETWORKS

 Independent distribution network operators



Source: www.energynetworks.org

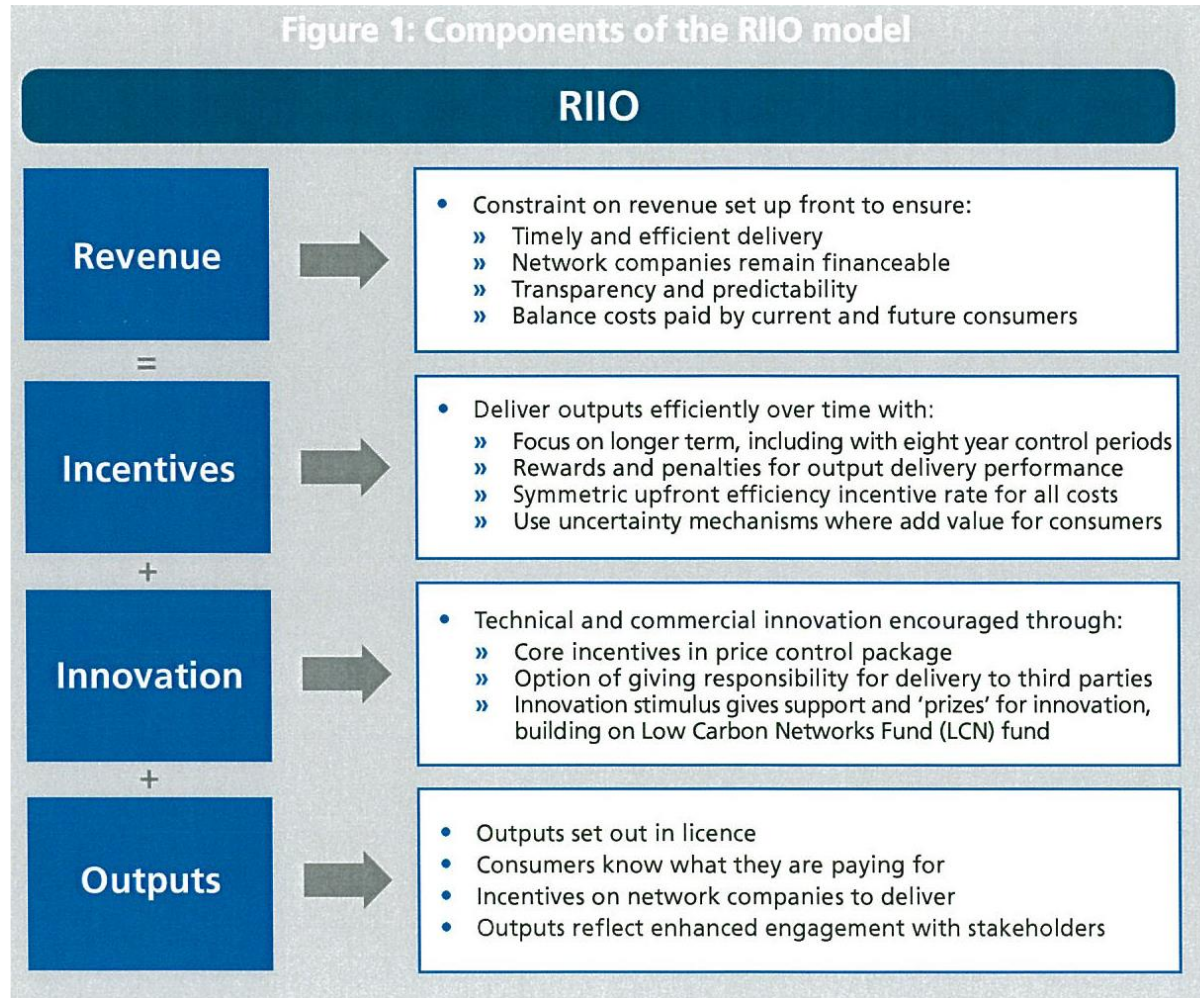
GB output-based regulation



- **ofgem** responsible for setting the price controls for the network companies
- Previous regulation (“DPCR”) was mostly about controlling **expenditure**
- Current regulation (“RIIO”) is all about delivering **outputs**

- 1. Make promises up front (in terms of asset health, performance, risk)*
- 2. Keep those promises*

RIOO – A new way to regulate energy networks



Network Asset Secondary Deliverables

Instruction to DNOs to Develop a "Common Methodology"

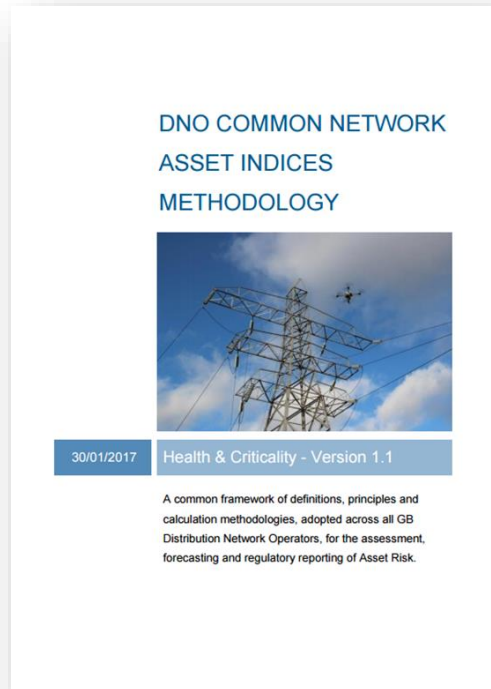


Special License Condition 51 Part D

"The Network Asset Indices Methodology is to provide a comparative analysis of performance between Distribution Network Operators covering:

- Probability of asset failure*
- Consequence of asset failures*
- Asset risk*
- Current and future asset degradation*
- Monetized asset risk*
- With and without interventions (replacement and refurbishment activities)"*

Common Network Asset Indices Methodology



- Developed by GB electricity network operators in partnership with EA Technology
- License condition for RII0-ED1 regulatory period (2015-2023)
- Common methodology for assessing **health & criticality** for electricity distribution assets
- Designed for **regulatory reporting** of electrical assets
- Governs >£1bn/year of asset investment

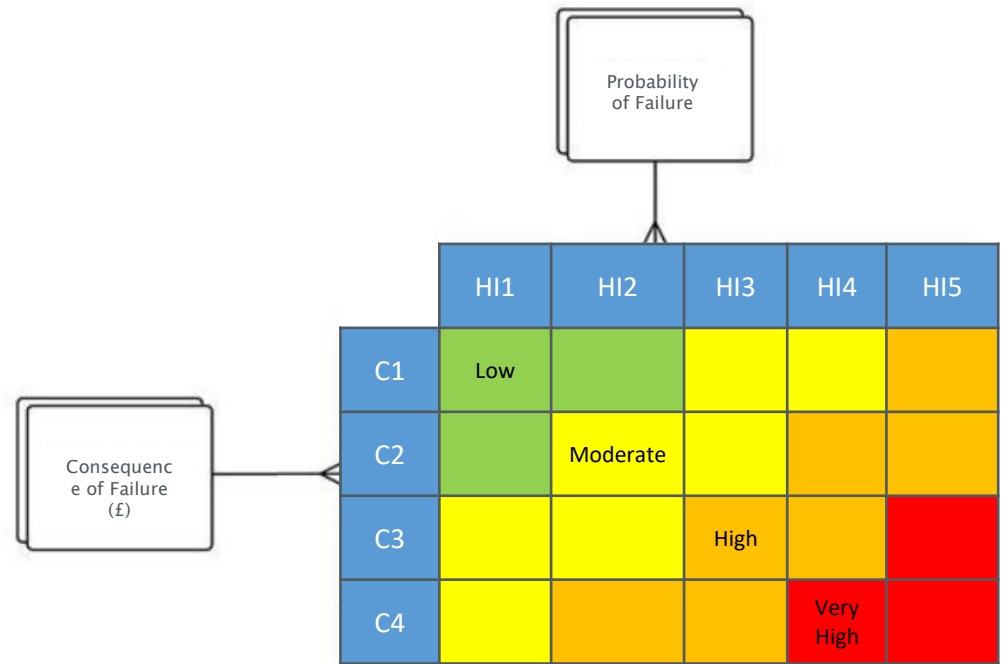
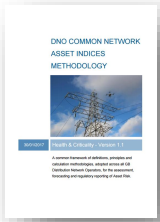
A blue decorative wave graphic that starts from the left edge, curves upwards, then downwards, and finally levels out into a horizontal bar on the right side. The text is positioned within this blue bar.

Overview of Common Network Asset Indices Methodology

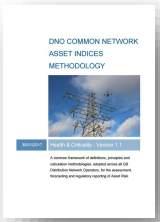
How is it used?

Regulatory reporting

- Network operators report **annually** against the targets set using the methodology
- Strong financial incentives to meet (or exceed) targets
- It's all about getting the right numbers in the right boxes for each asset class in each year of the 8-year regulatory period



Why does it matter?



Predictive models used to show what condition each asset is in at the start and end of the spending period (8 years)

1. Defines what investment is allowed in network assets

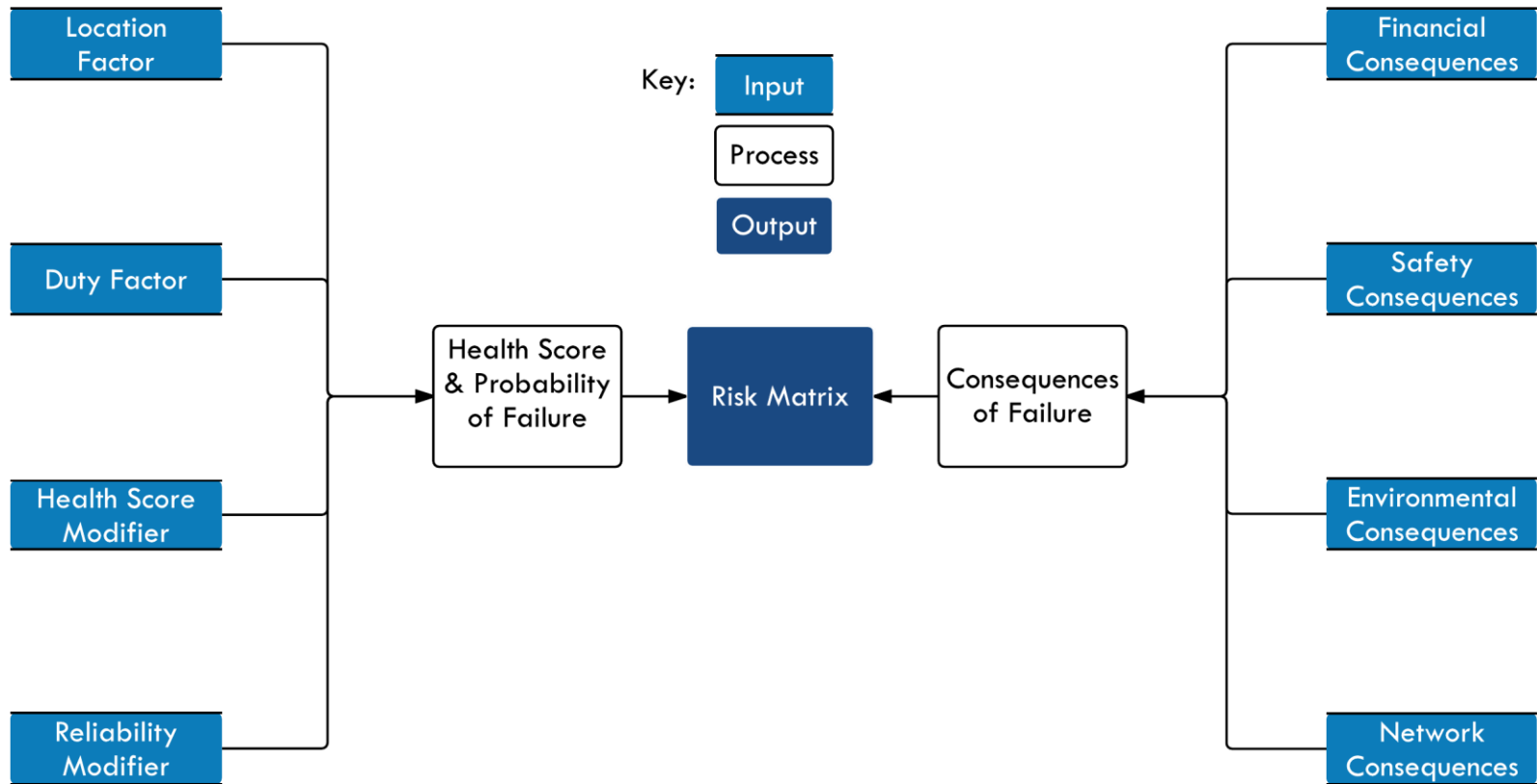
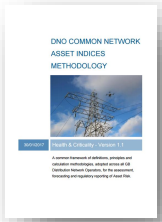
- No evidence? *No spending allowance!*

2. Defines what spending is deemed “effective”

- Spending not effective? *Penalties!*

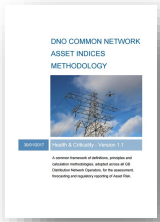
Common Methodology




How does it work?



CNAIM: What's included

Health Index Asset Categories



Distribution Voltage	Circuits  	Assets 
LV (400V)	LV overhead lines poles	Distribution boards; link boxes; feeder pillars; reclosers and circuit breakers
HV (11kV & 6.6–20kV variants)	HV cables & overhead lines including poles	Distribution transformers; switchgear (RMUs); remote terminal units; reclosers; primary CBs
EHV (33kV & 66kV)	EHV cables and overhead lines including towers and wood poles	Primary transformers; circuit breakers; voltage regulators; reactive power compensators
132kV	132kV cables & overhead lines including towers	Grid transformers; circuit breakers; voltage and reactive power controlling devices
275kV/400kV	275/400kV cables and overhead lines including towers	Supergrid transformers; circuit breakers; voltage & reactive power controlling devices

Common Methodology

Regulatory Reporting

Network Operators must report the following annually to the Regulator:



For each Asset Register Classes agreed:

- Existing asset risk (start of year)
- Future asset risk (end of year)
- Future asset risk (end of year) taking account of planned interventions

Progress against the 2023 targets set at the start of RIIO-ED1



CNAIM the good and the bad..



Pros

- It works!
- Systematic analysis of asset health and criticality
- Encourages risk-based prioritisation
- Very simple predictive models



Cons

- Significant asset classes are missing
- Commonality can mask company specific issues
- Unavoidably iterative
- Revisions and updates might take a while

Intervention Options

Intervention Options

Which Project?



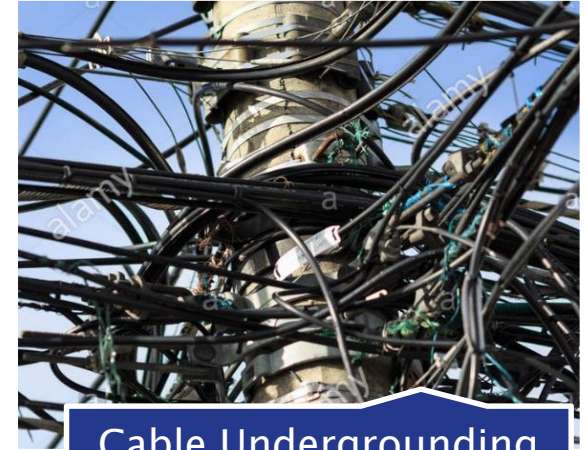
Pole Replacement

\$2m



Substation Upgrade

\$10m



Cable Undergrounding

\$20m

Intervention Options

Which Measure Matters Most?



CI/SAIFI?

Risk?

CML/SAIDI?

Speed of delivery?

Cost?



Lost Revenue?

Geography?

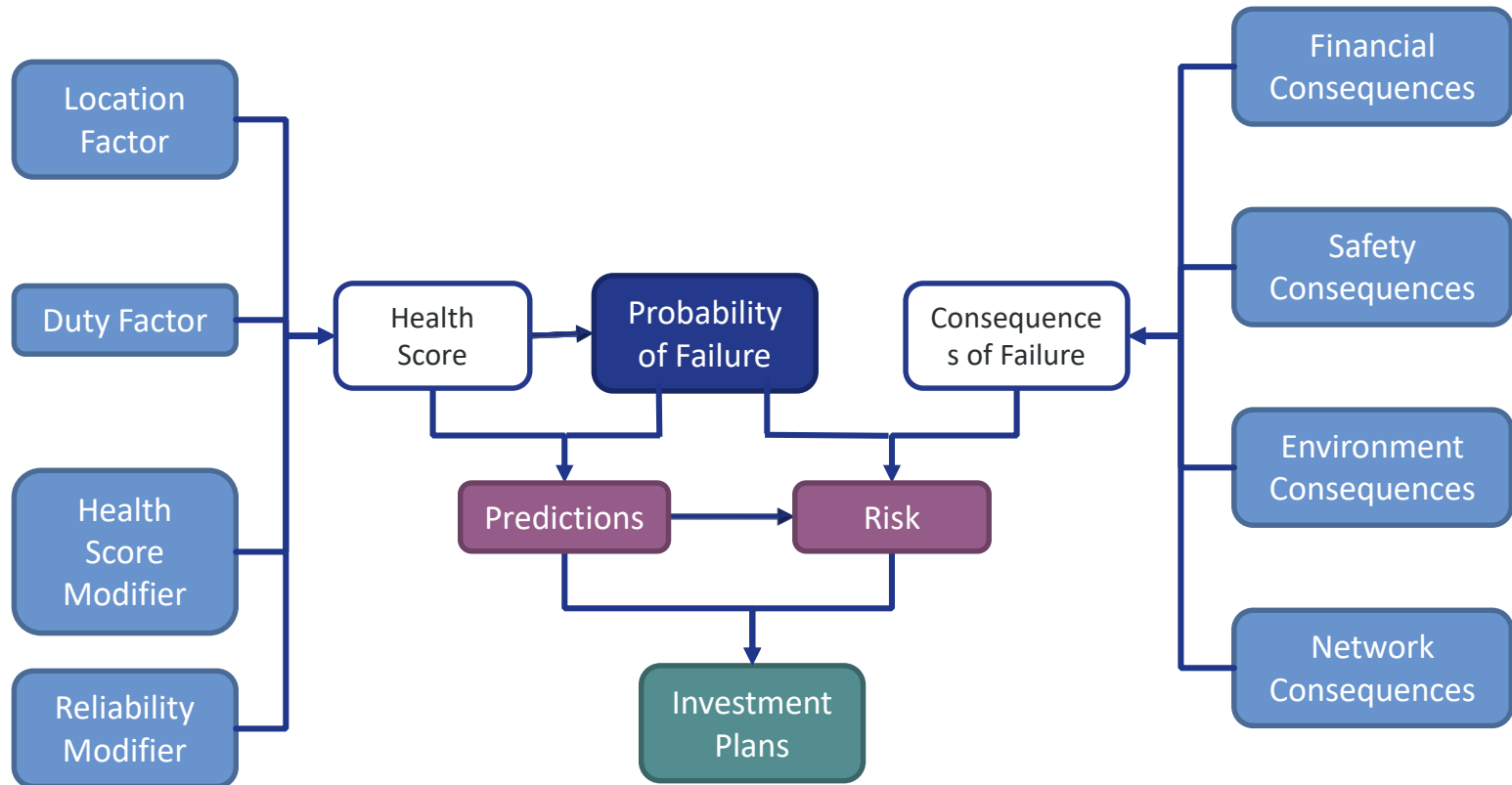
Asset type?

Economic Impact?



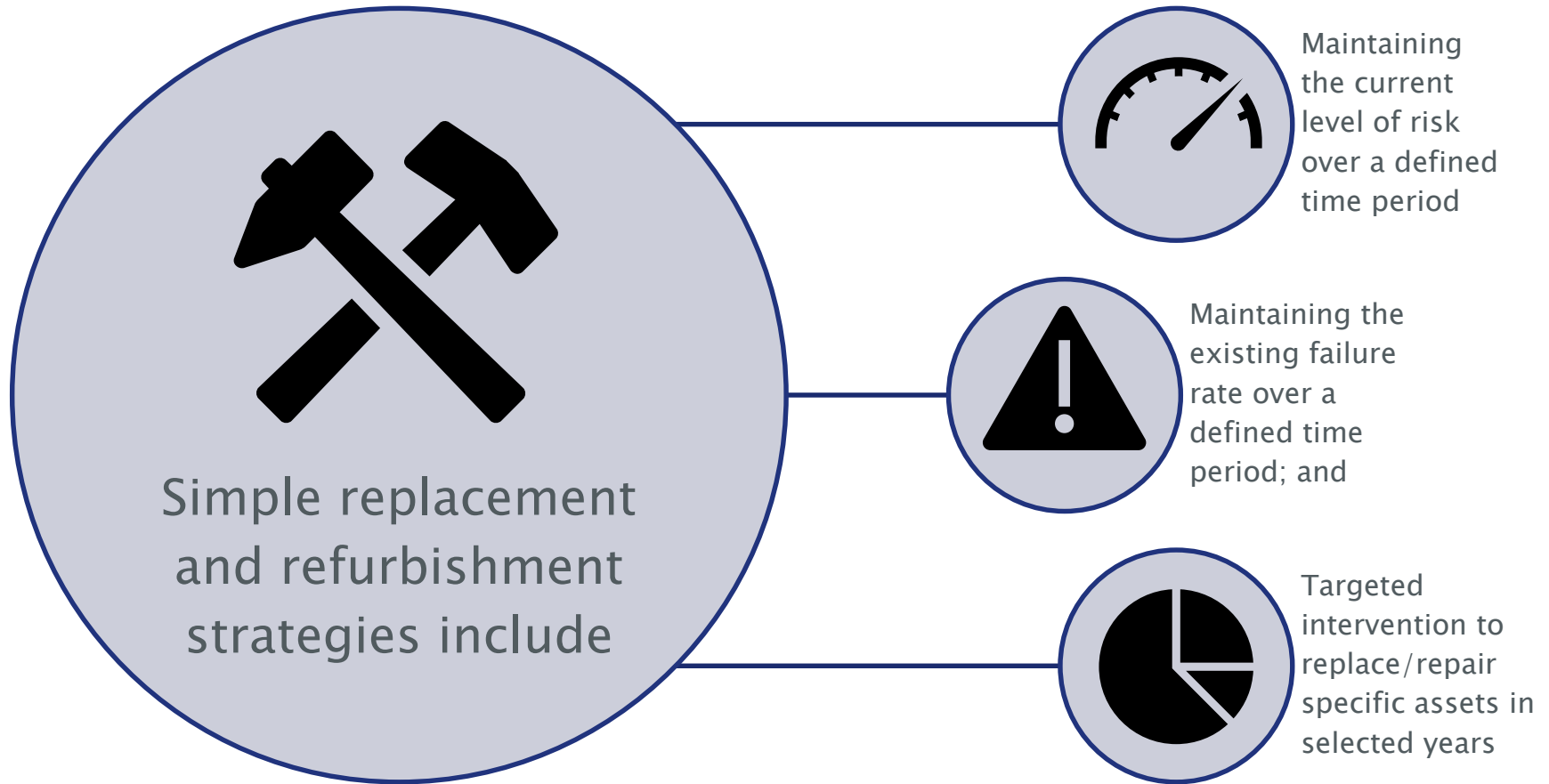
Intervention Modelling

Extension to Common Methodology



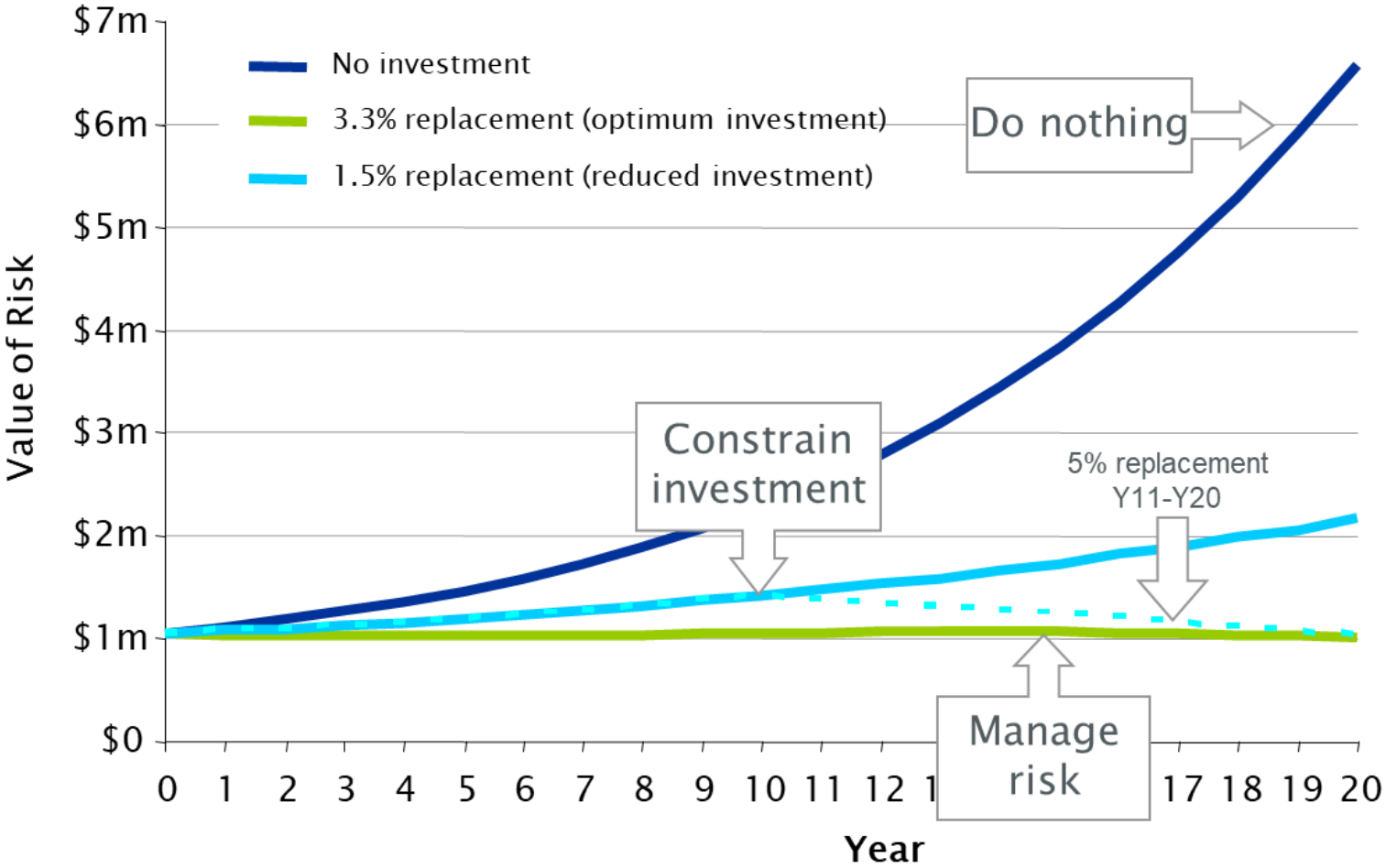
Intervention Modelling

Investment Scenarios



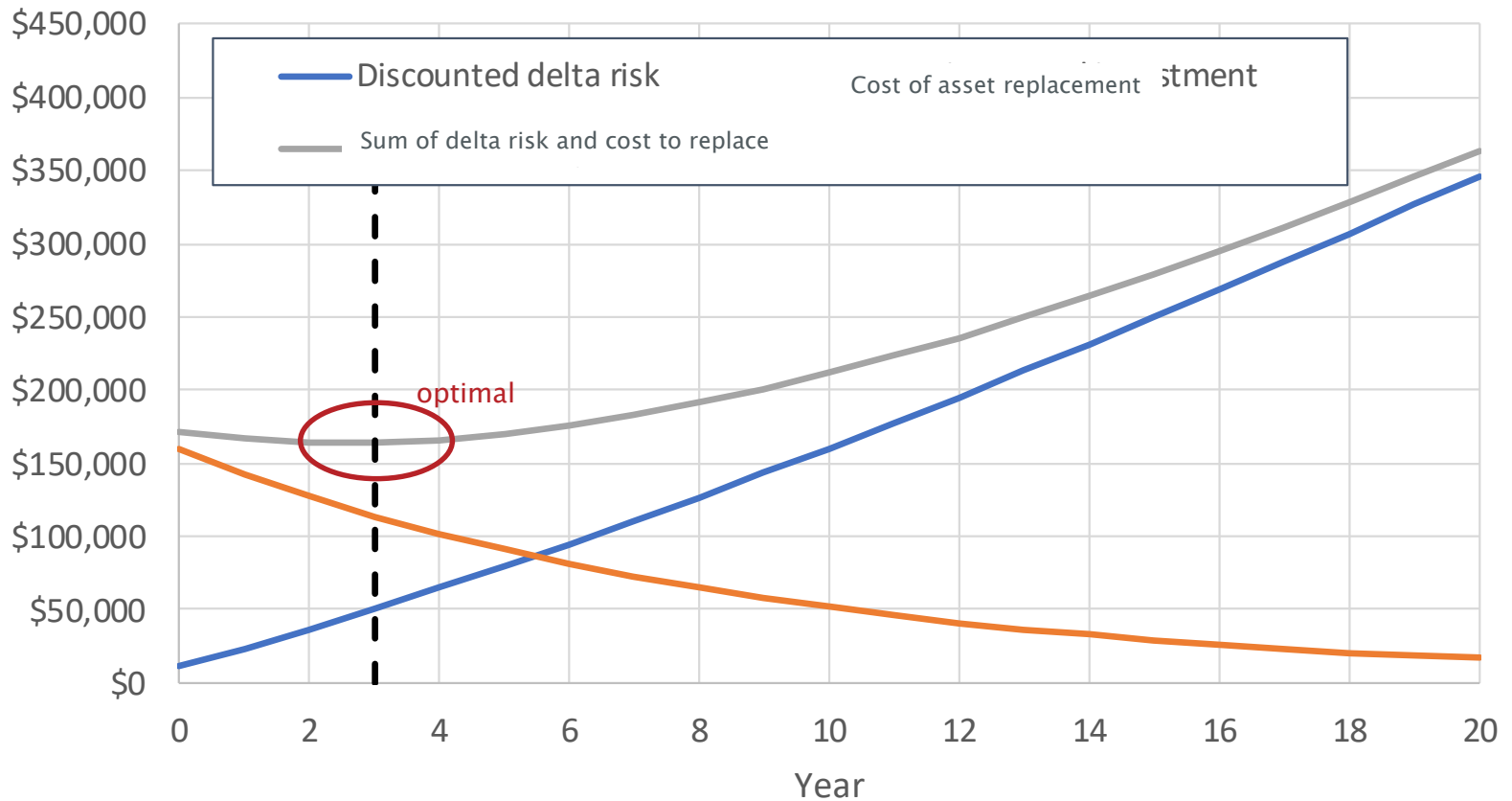
Intervention Modelling

Different Investment Scenarios



Intervention Modelling

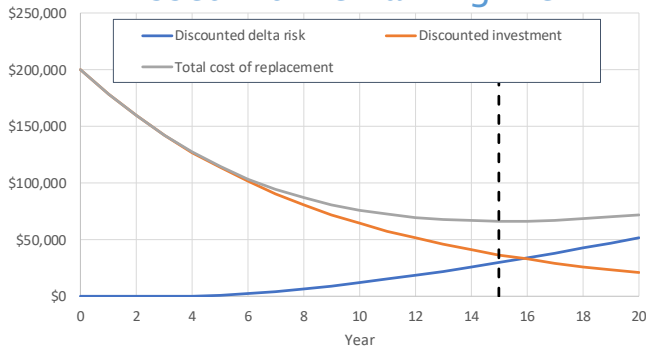
Financially Optimum Year for Asset Replacement (NPV)



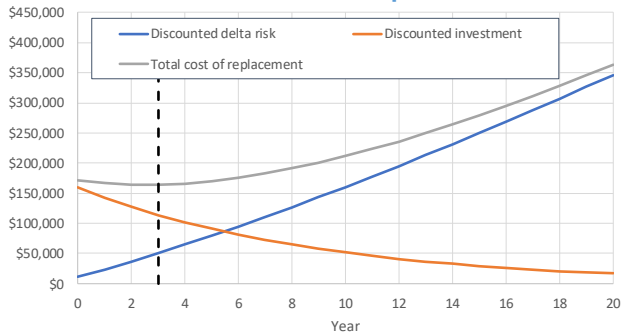
Intervention Modelling

Financially Optimized Replacement Program

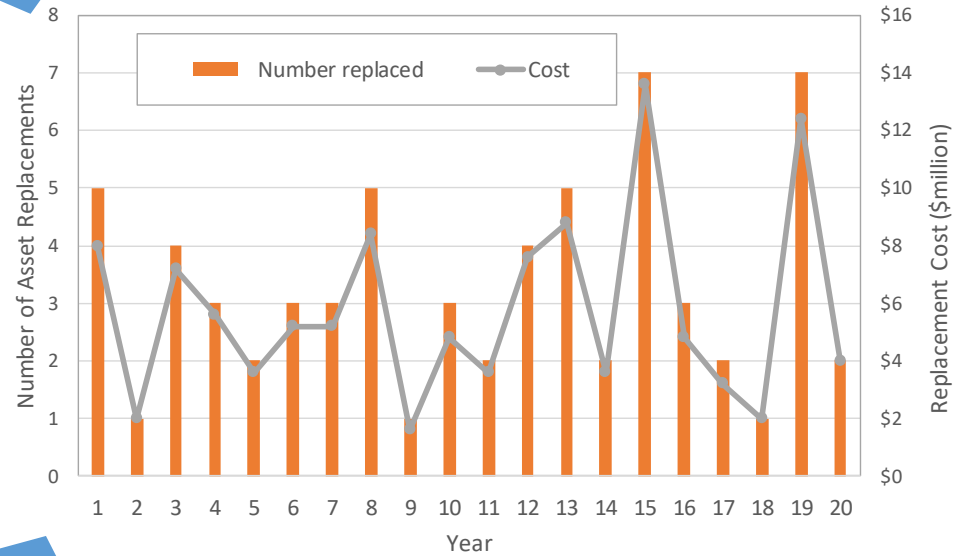
Asset with remaining life



Asset due for replacement

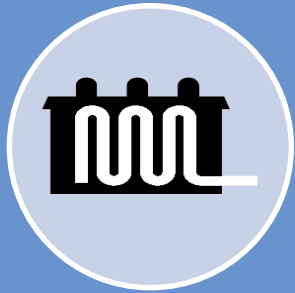


Financially Optimised Replacement Plan

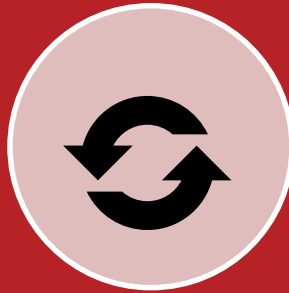


Intervention Modelling

Intervention Options



Replacement



Refurbishment

- Tapchanger replacement
- Oil regeneration
- Replacement of windings
- Replacement of bushings



Changes to maintenance practices

- Increased maintenance for assets approaching end-of-life
- Reduced maintenance for assets in good health

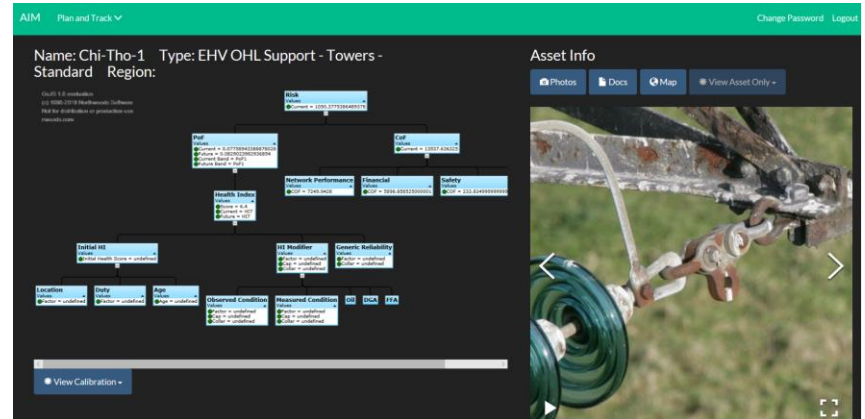
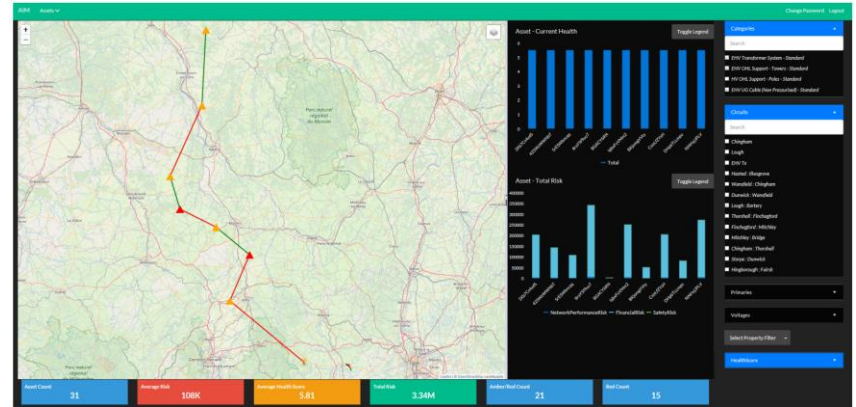


Investment Optimization

Investment Optimization 1

Combining Interventions

- Multiple activities at a single site
 - Replacement and or refurbishment activities undertaken as a single project
- Load / resilience upgrades
 - Carried out in conjunction with non-load related replacement / refurbishment activities
- Benefits in cost
 - Reduction in manpower
 - Reduced outage times



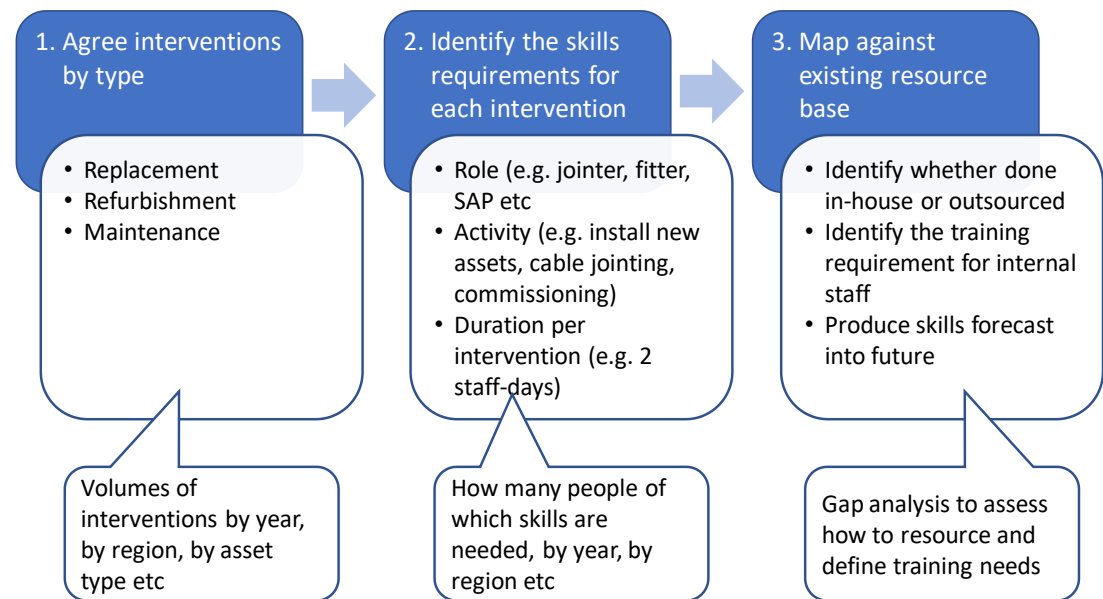
Investment Optimization 2

Resource and Skills Requirements



Understanding of the level of resource required to deliver the investment plan

- Staffing requirements
- Skills requirements
- Staffing and skills availability
- Training needs

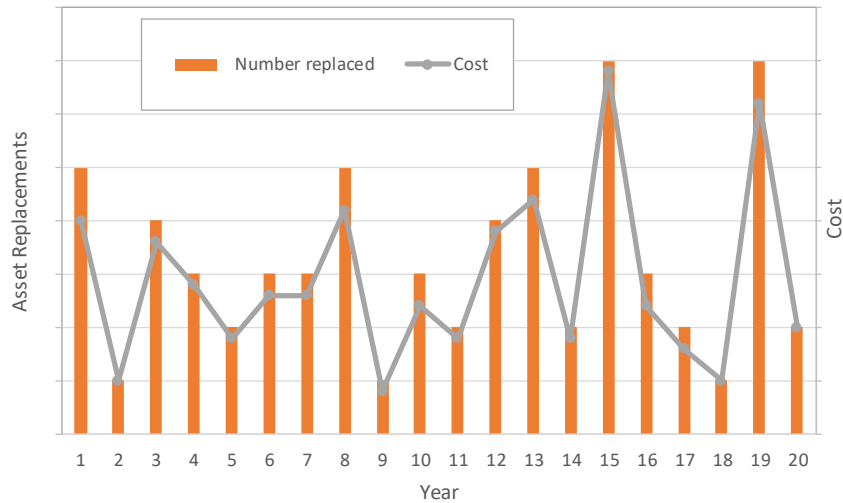


Investment Optimization 2

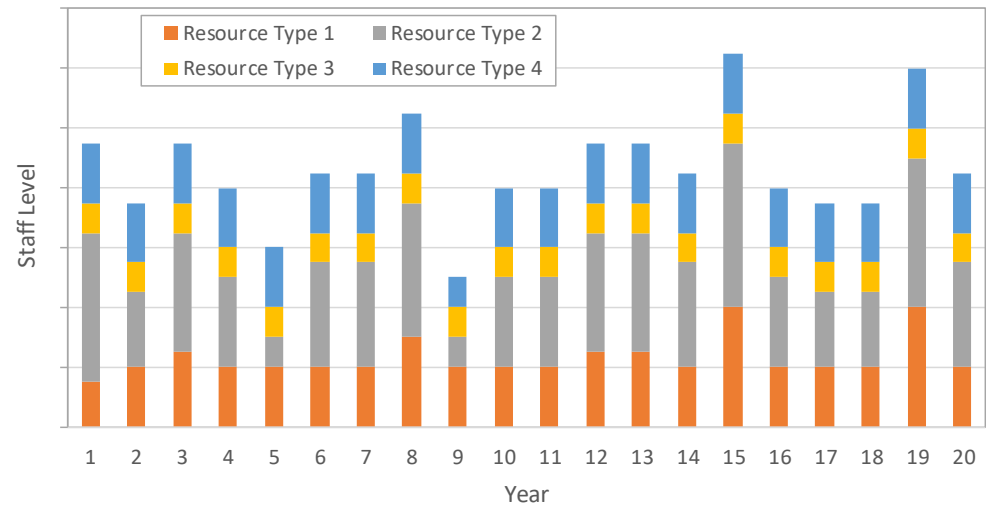
Mapping Skills Availability to Investment Plan



Financially Optimised Replacement Program

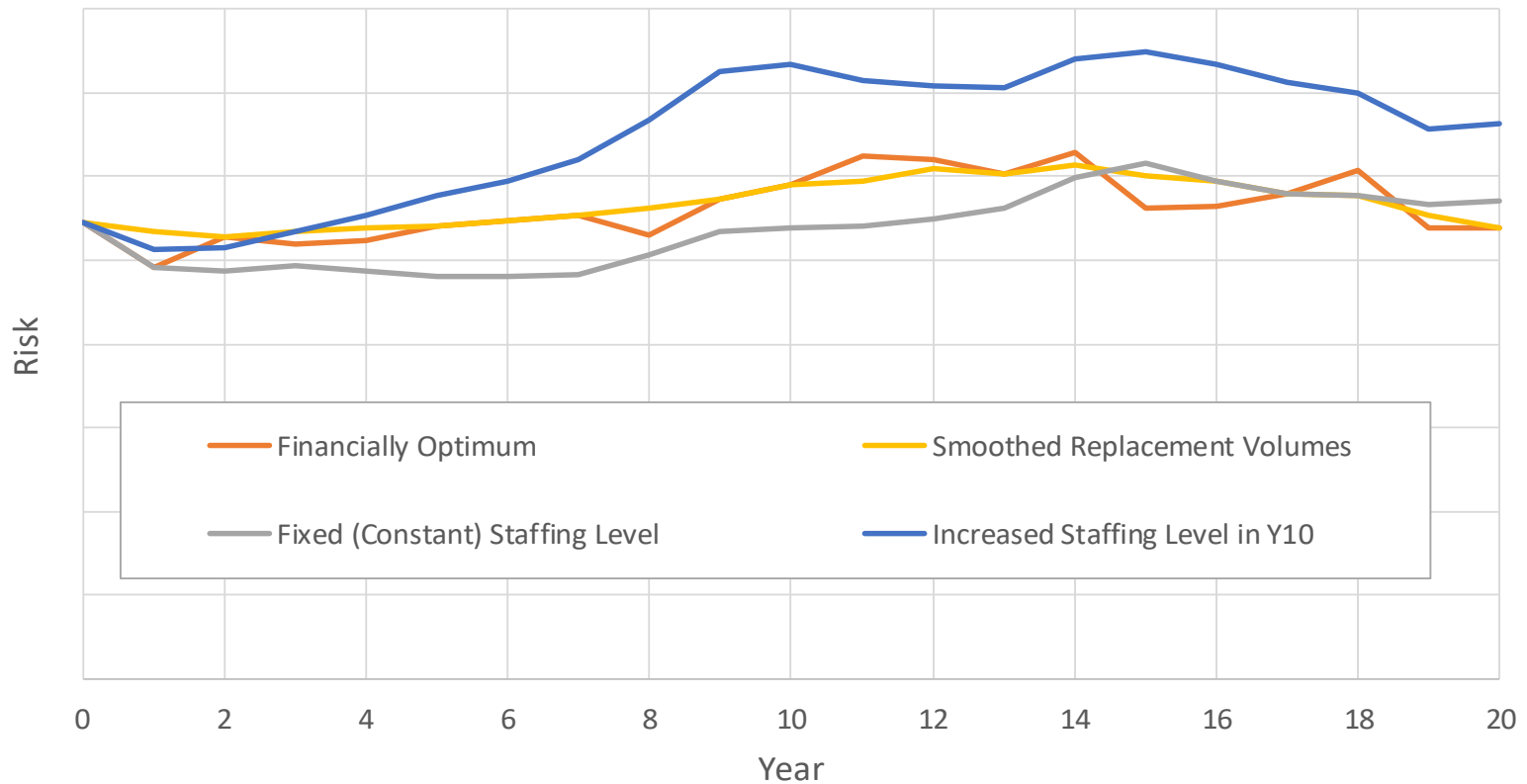


Required Staffing & Skills to Deliver Program



Investment Optimization 3

Scenario Comparison of Risk Profiles

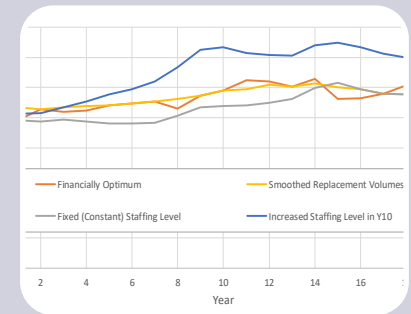
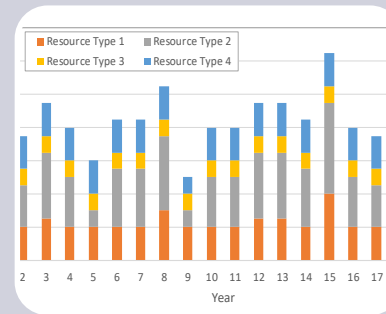
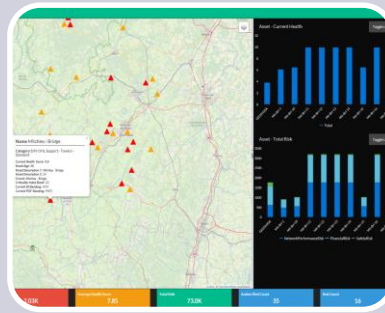
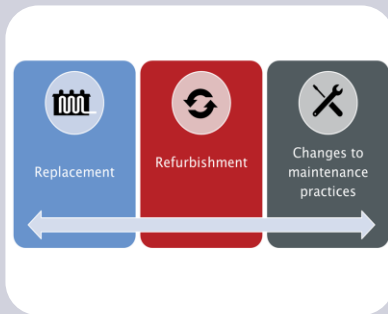




Conclusions

'Common Methodology' Enhancements

Summary



Individual asset optimization

- Cost effective timing of refurbishment and replacement options

Combining interventions

- Multiple activities – load and non-load replacements / upgrades
- Reduction in manpower requirements, outage times, etc.

Resourcing levels

- Staffing levels and skills requirements
- Identification of skills gaps and training needs

Comparison of risk profiles

- Quantified for non-optimised investment scenarios

Conclusions

GB Distribution Network Operators have a license condition to use a Common Methodology to report asset health, asset criticality and monetised risk

- It is consistent, and proven..
- ..but it's not perfect

The Common Methodology can be extended to model different intervention options

- Individual asset optimization
- 'Bundling' multiple activities into a single project
- Resources to implement intervention plans

Advantages of modelling approach

- Visibility of asset risk profile and financial costs in future years
- Effects of changing the timing of future investments can be quantified
- Enables asset risk to be managed appropriately when investment or resources are constrained



Thank you

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