Programme Area: Energy Storage and Distribution

Project: 2050 Energy Infrastructure Outlook

Title: ETI Infrastructure Cost Calculator

Abstract:

A presentation giving an introduction and overview of the infrastructure cost calculator tool.

Context:

The 2050 Energy Infrastructure Outlook project provides data on the costs associated with key types of fixed energy infrastructure as well as identifying possible ‘grey areas’ where technology development could significantly influence cost and performance. The project gathered data on different types of infrastructure associated with electricity, gas, hydrogen and heat. It also looked at infrastructure types: transmission, distribution, storage, conversion and connections. The data itself looked at costs relating to capital, fixed/variable operating and maintenance, abandonment ('infrastructure decommissioning') and repurposing ('altering existing infrastructure').

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ETI Infrastructure Cost Calculator

An introduction

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The Need

- The UK needs develop a low carbon energy network
- Different projected scenarios require different capacities for each vector (electricity, gas, heat, hydrogen)
- All scenarios require the network infrastructure to transition in some way in order to meet demand.
- There are choices to be made: which scenario to choose, when to implement it and at what scale?
- To make informed decisions, the cost implications of each choice needs to be known.
- This enables: risk mitigation, investor confidence and an ability to identify challenges and areas that would benefit from innovation.

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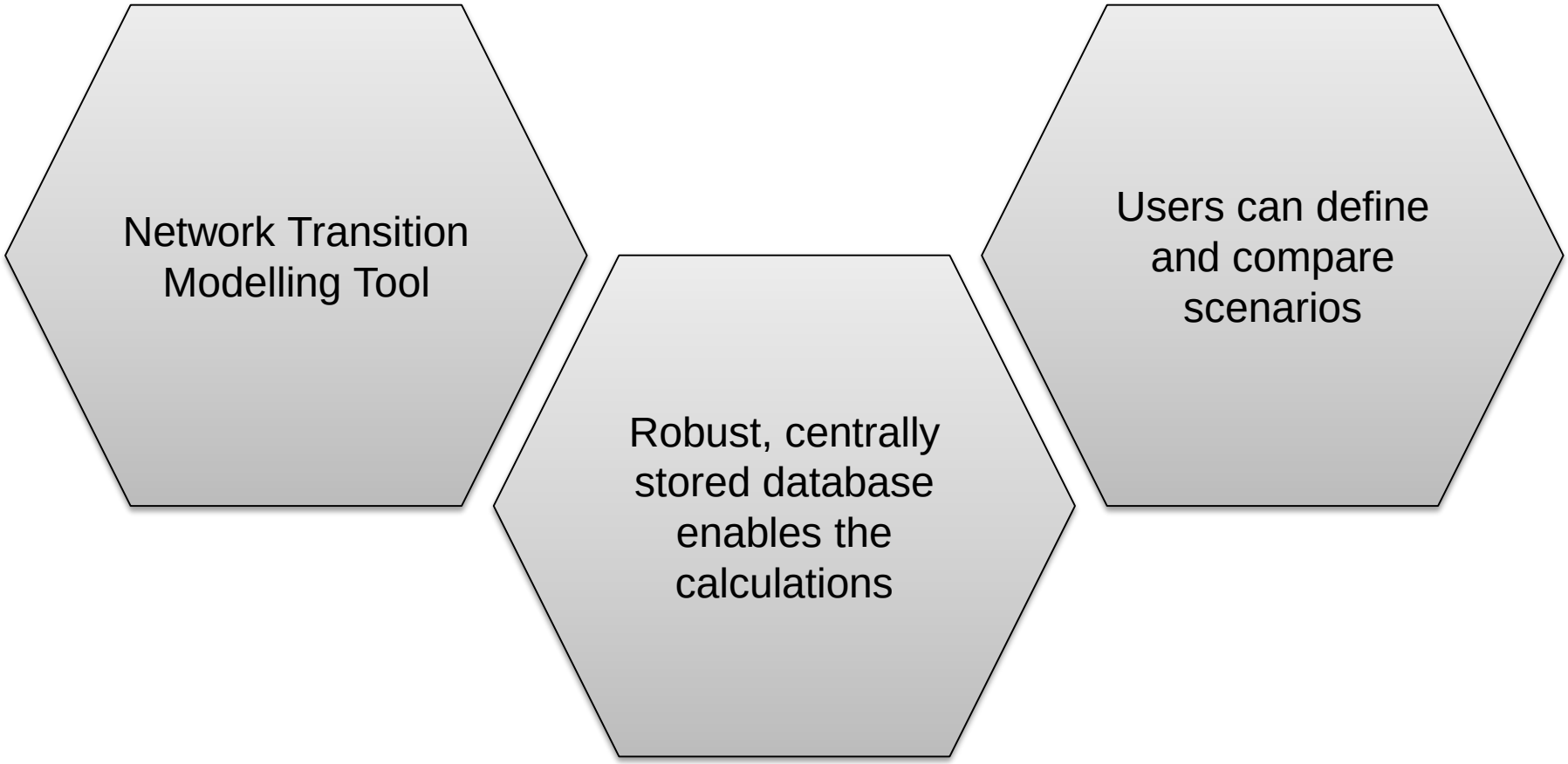
What is the ICC?



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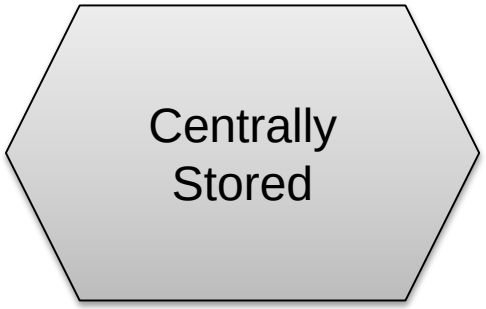
The Underlying Database

- Approximately 900 components and 200 assemblies currently included
- Transparent – data referenced and calculations explained
- Compiled in partnership with Buro Happold and Sweet Group



- All core data is centrally stored
- The ETI will be updating this data when necessary
- Requires license and password to access

- Users are able to duplicate and edit core data
- Users are able to store commercially sensitive data locally
- Potential to add more vectors

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The Purpose

1. Enable users to calculate and compare costs of different energy infrastructure systems to meet a given need.

2. Enable users to analyse the impact of various modifiers on project cost

3. Provide an understanding of the relationships between capex and opex split between projects, assemblies and components

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How does it work?

- The ICC is not to be used for designing networks but for analysing existing networks designed for different scenarios.
- To run the cost model the user needs to be able to input a Bill of Quantities for a given network. The network can be formed of multiple vectors and at any scale.
- It can span across different regions and both urban and rural areas, although different projects would need to be created for each of these.

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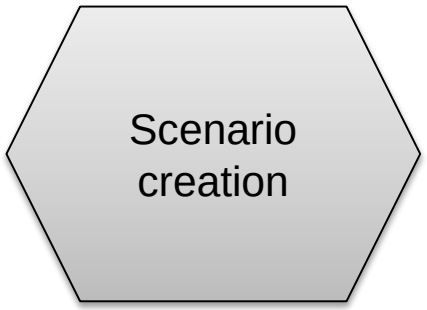

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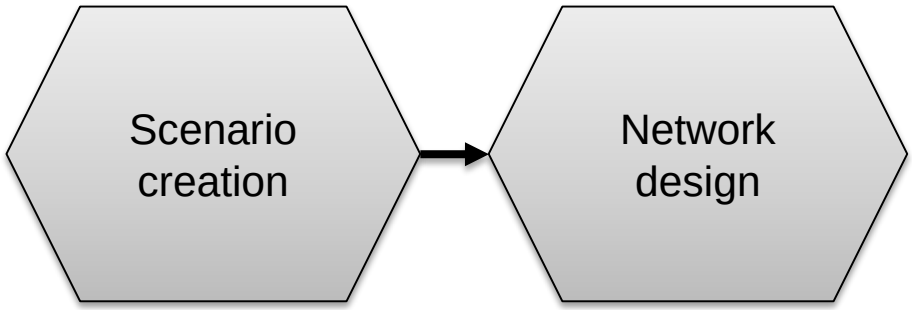

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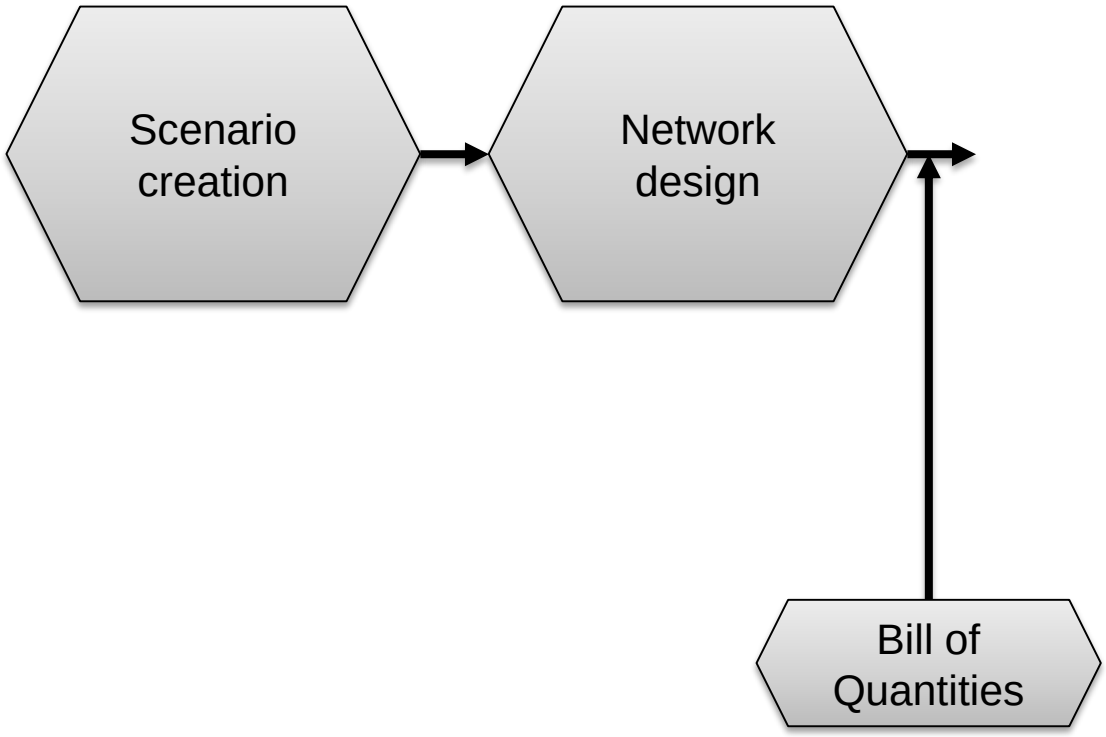

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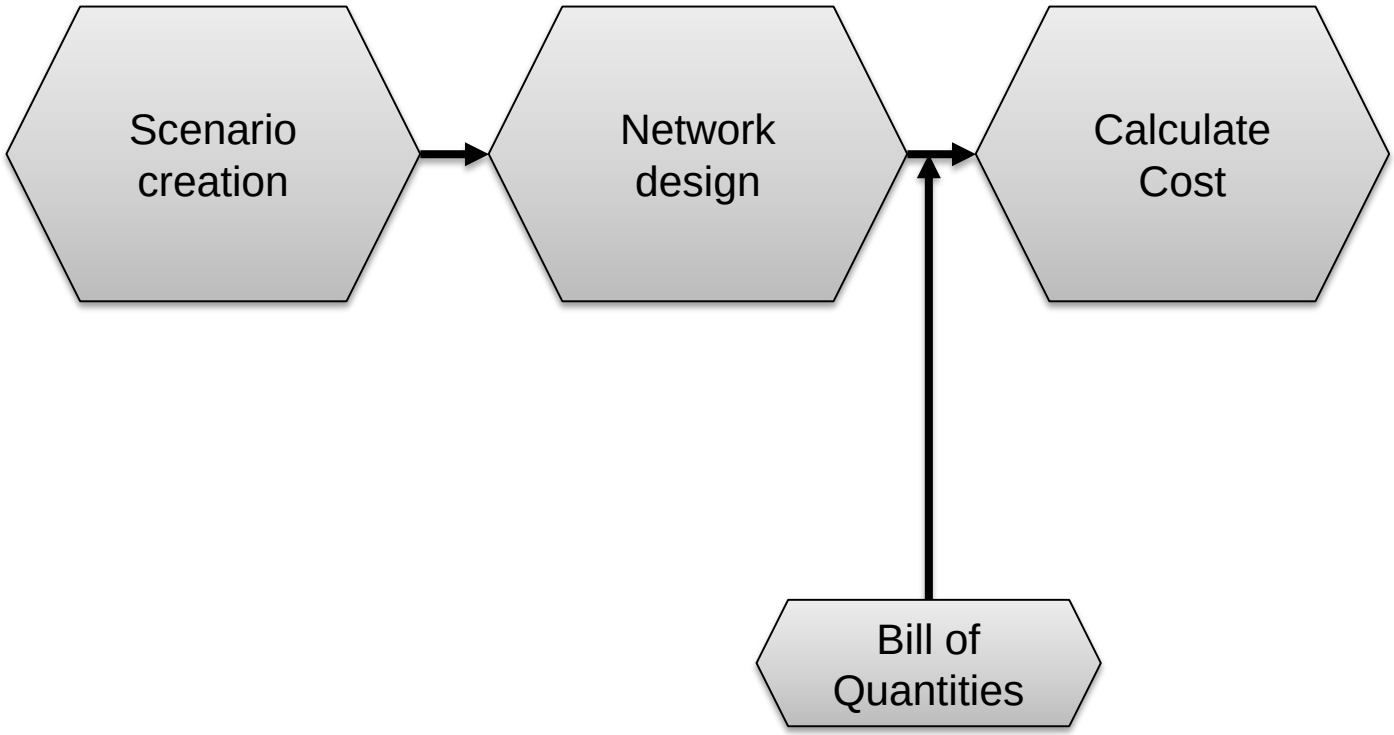

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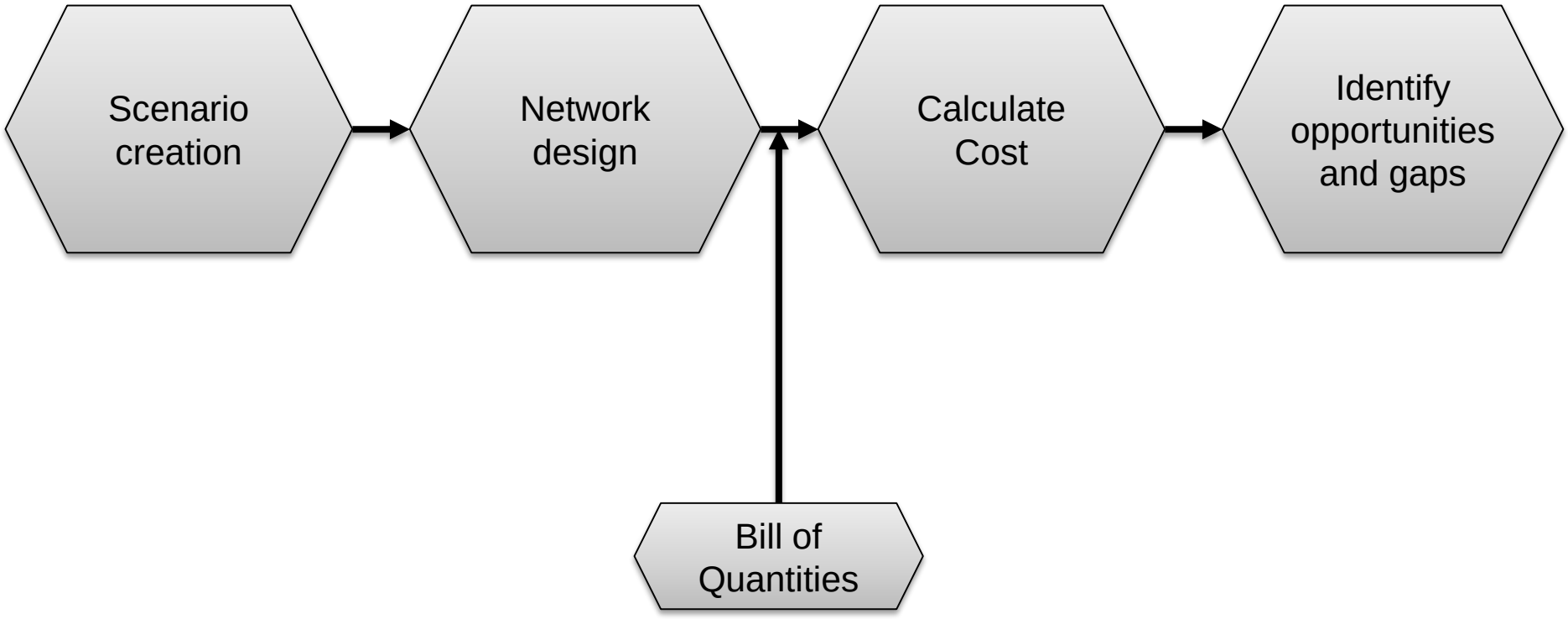

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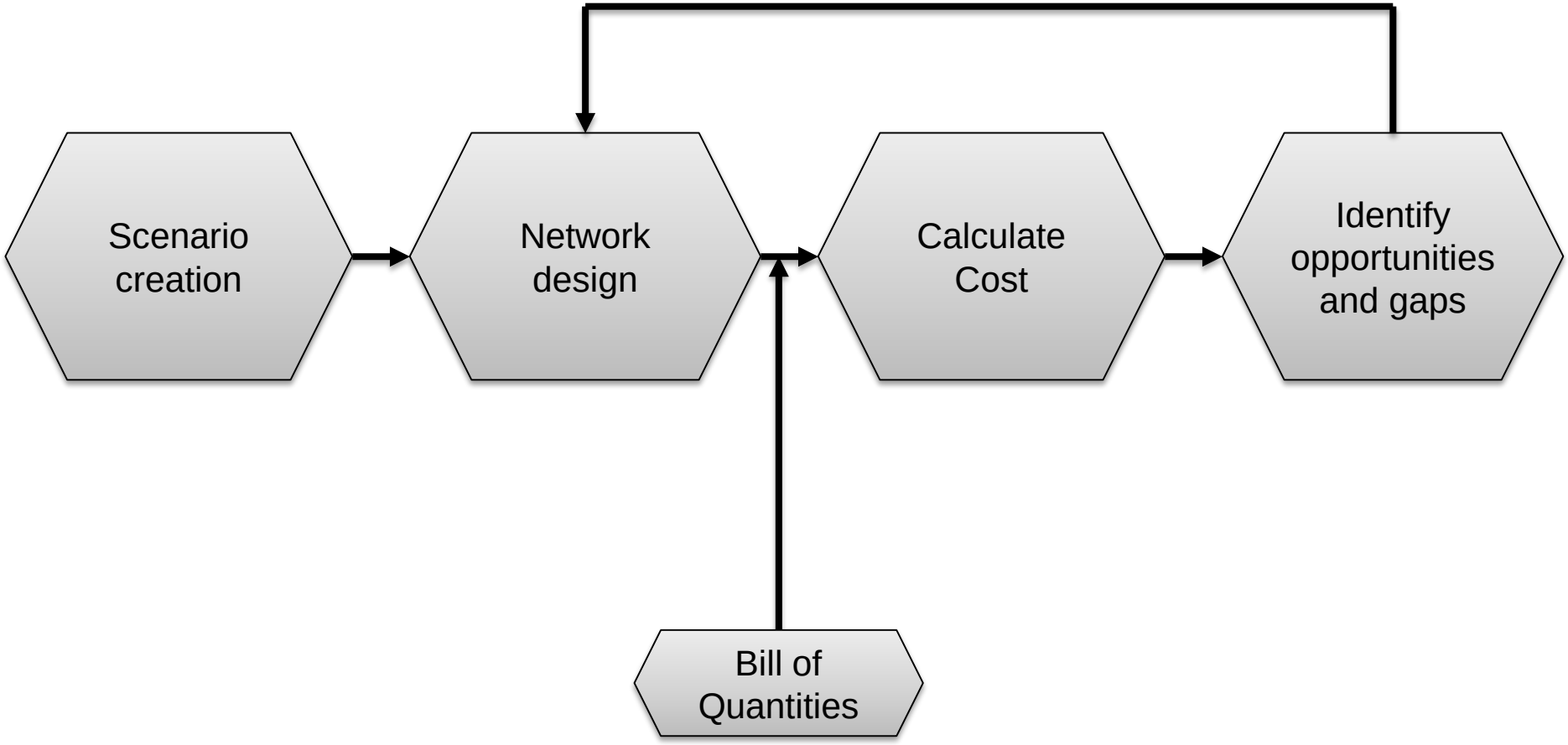

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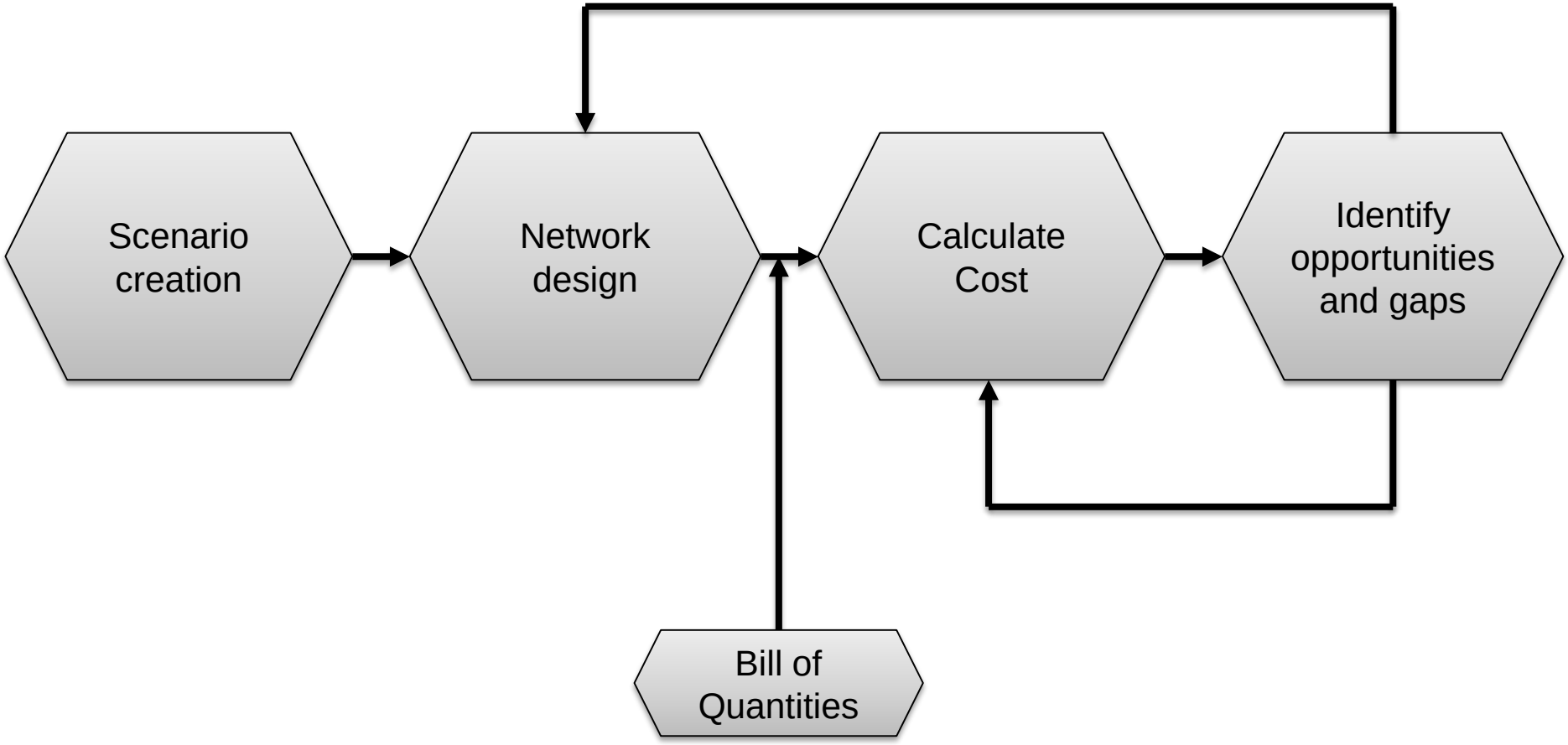

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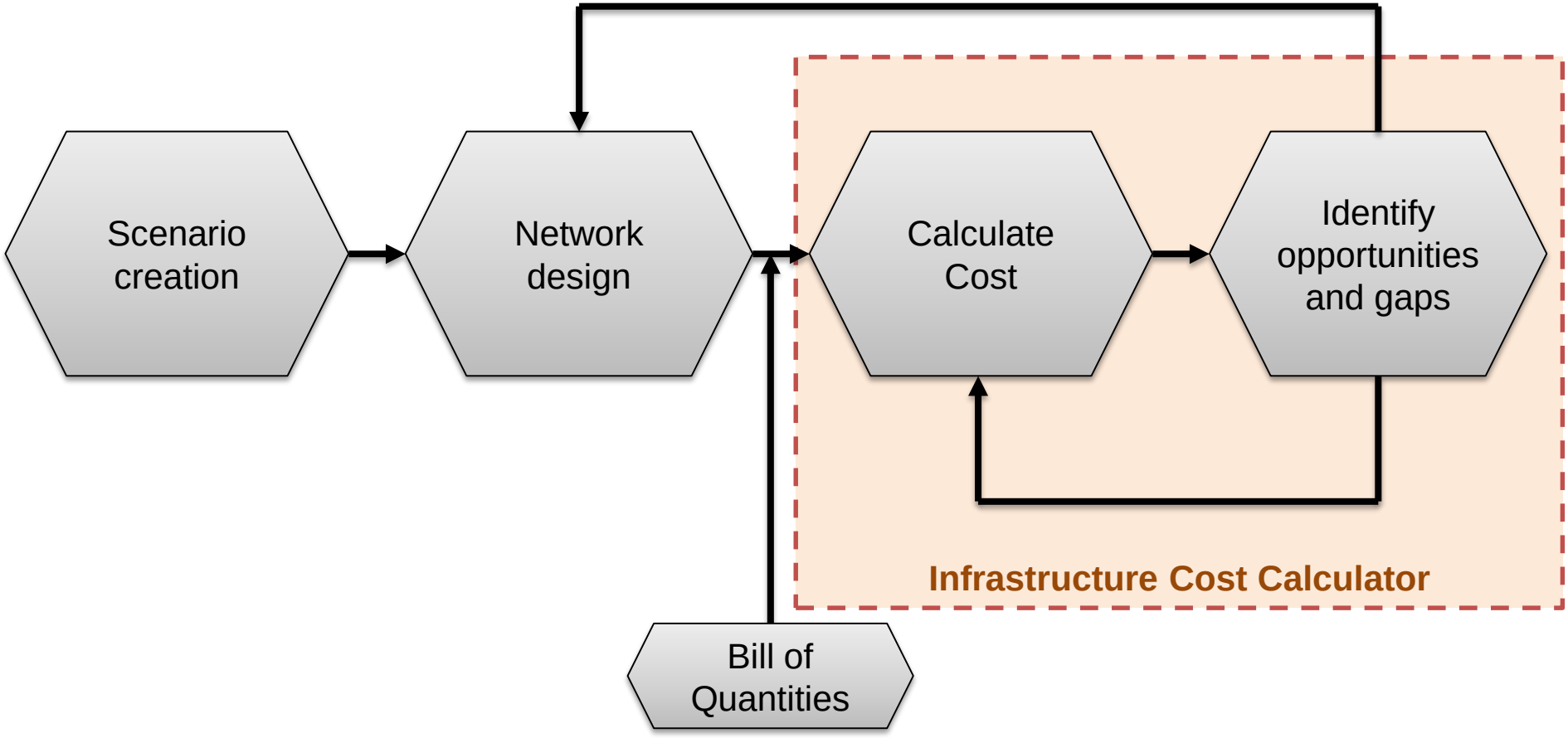

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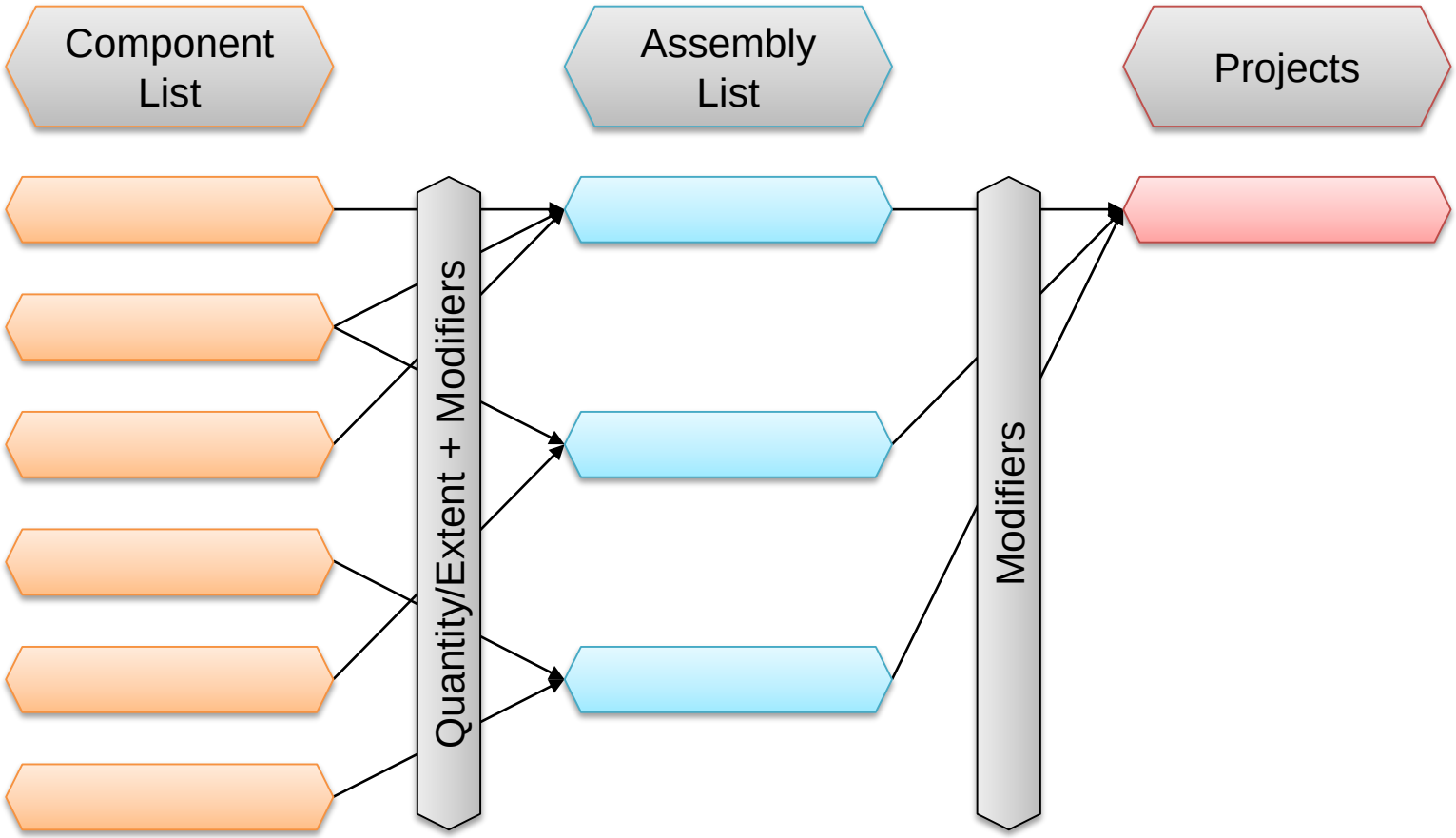
Tool Structure



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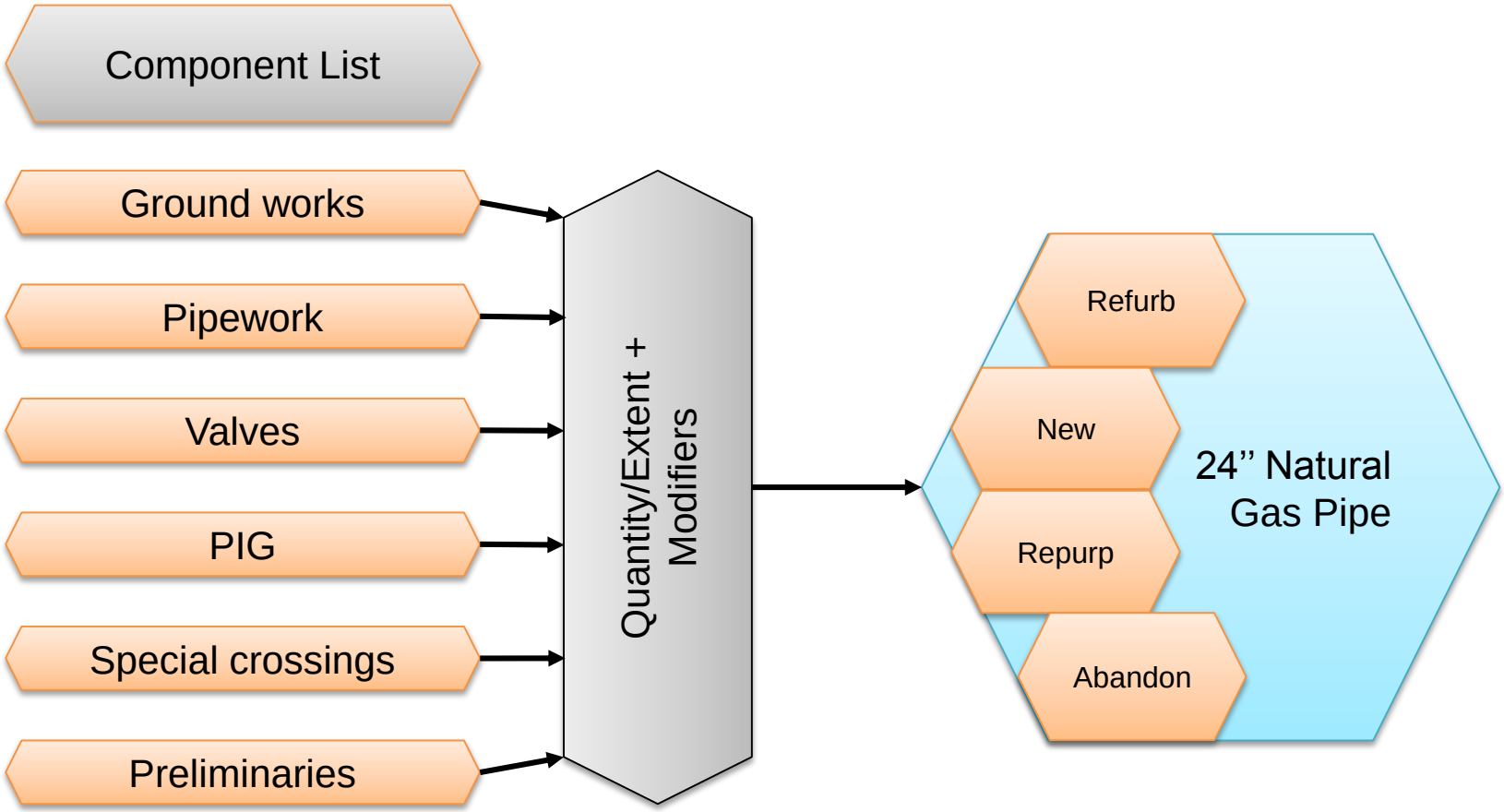
Assembly development



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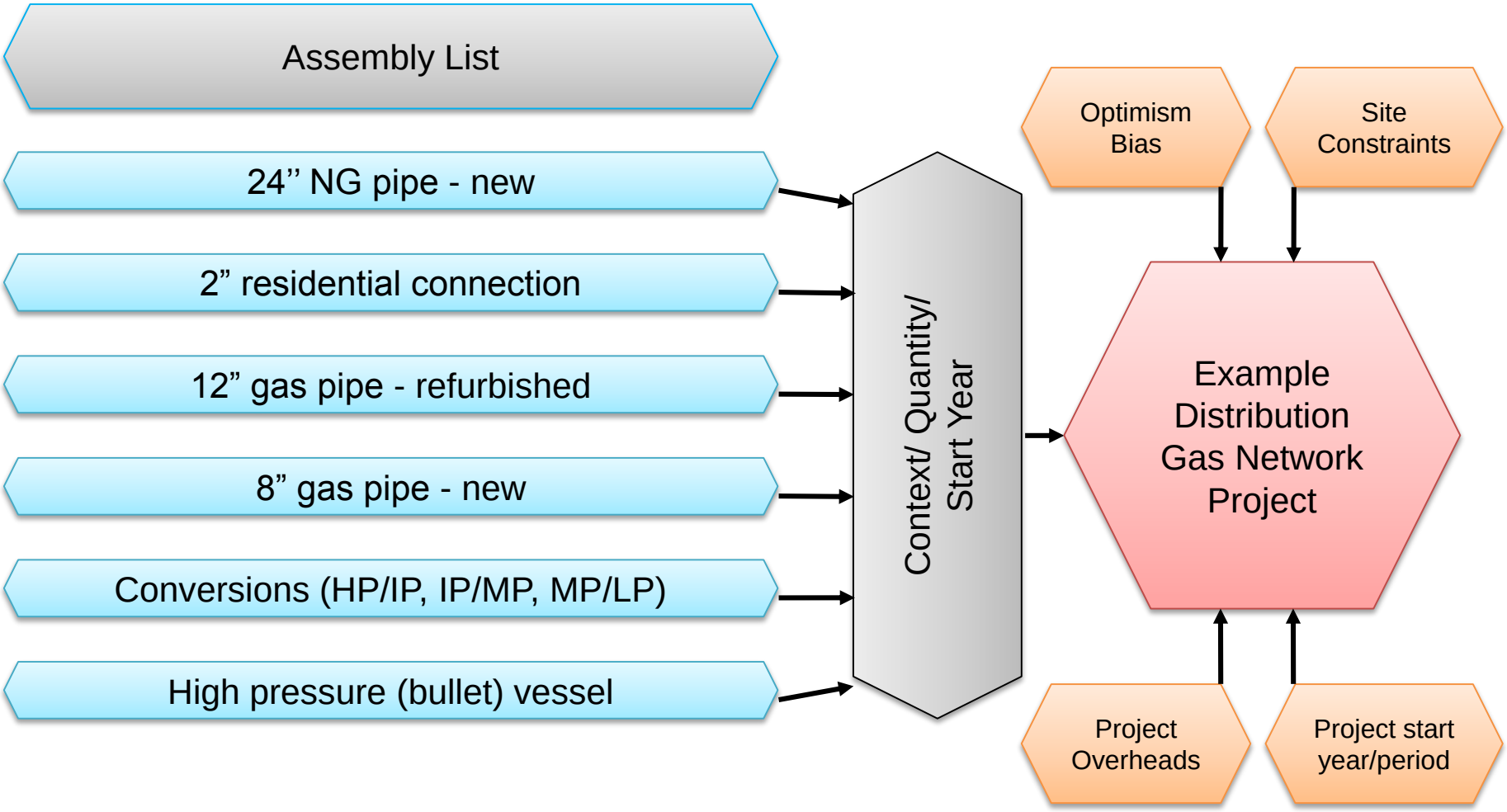
Project development



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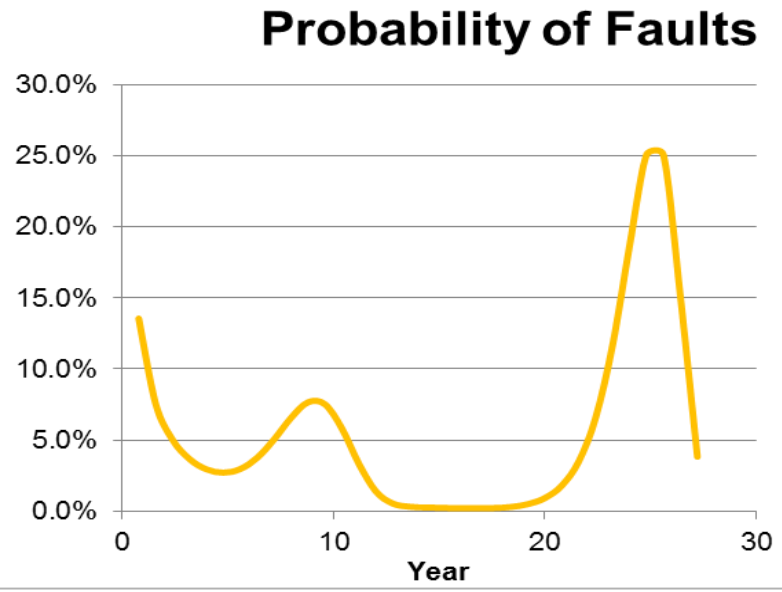
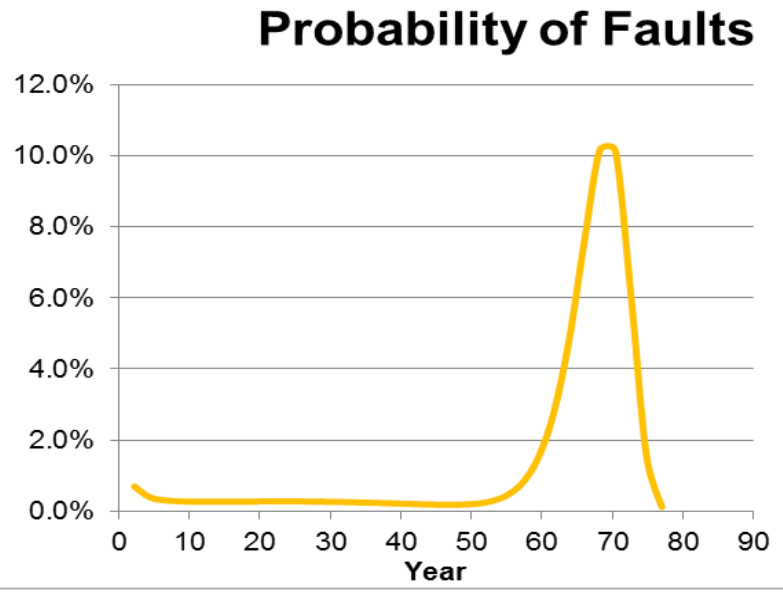
Opex calculations

Rates of failure can be represented by the “bath tub” Weibull curves. Two of these have been created by PPA to represent passive and active components. The rates of failure for an infrastructure project are then translated into a percentage of the Modern Equivalent Asset Value. However, rather than taking the area under the chart as the whole life costs, it is more representative of a large infrastructure project to replace those parts and then restart the Weibull curves for that percentage of the project that has been replaced.

Active



Passive



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Opex calculations

- After defining failure rates, in order to represent these within the ICC, they need to be converted into %cost of MEAV for a given percentage of the project life. Therefore, a number of assumptions are made to both shape the Weibull curve (alpha, beta and Scale) and account for costs associated with opex during a project.

- The added costs shown in the following slide are as a percentage of capital cost, and this capital cost will be affected by future cost trends based upon MEAV

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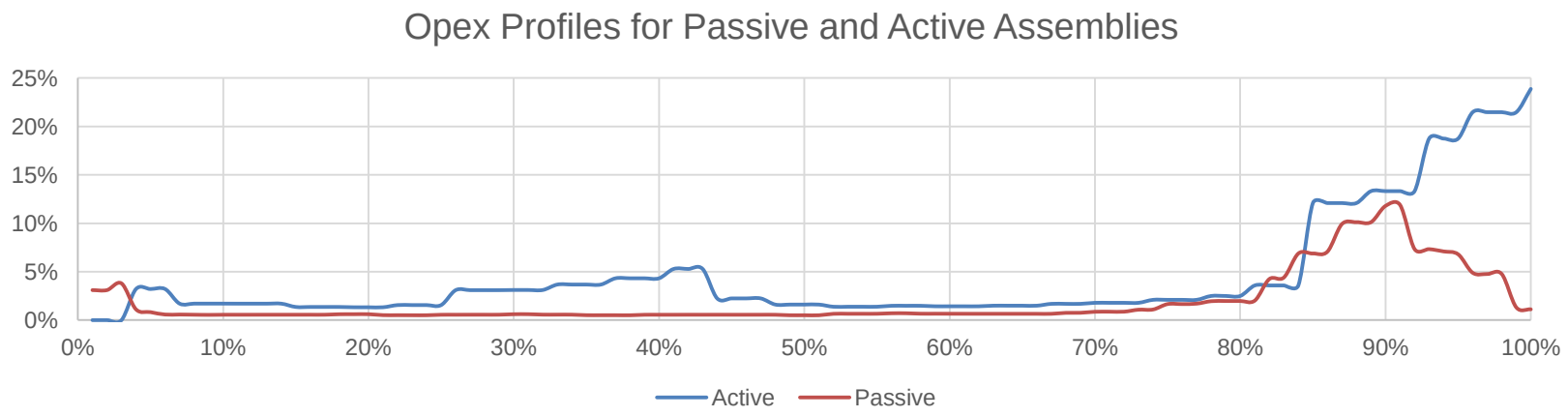
Opex calculations

	Infant	Mid	Tail
Years			
α			
β			
Scale			
Failures replaced (%)			
Opex Failure – cost (%)			
Opex inspection and maintenance – cost (%)			



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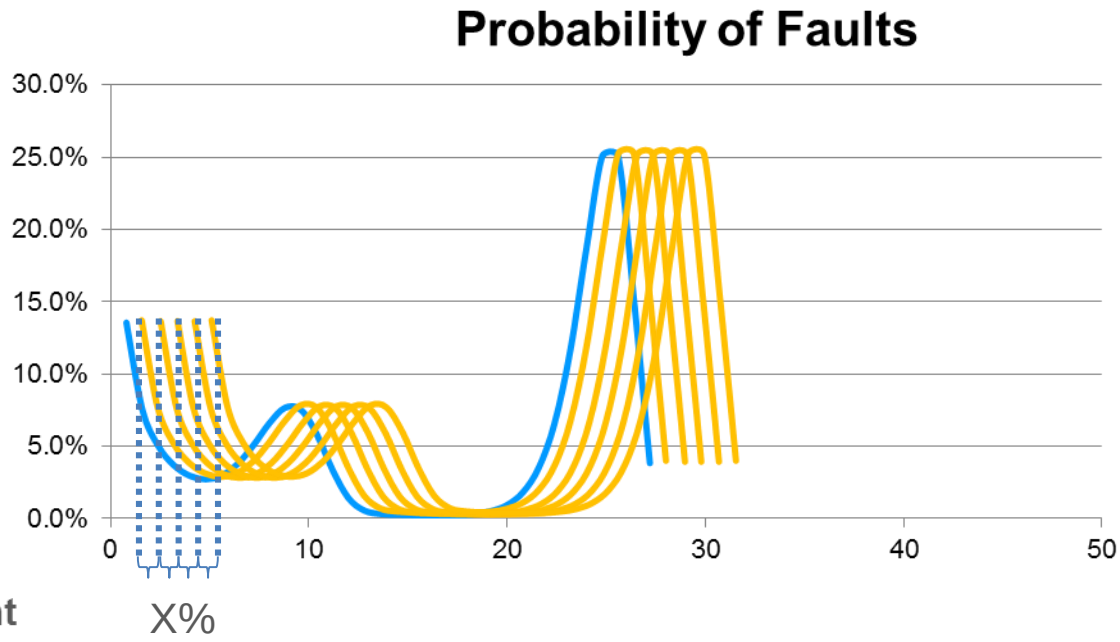
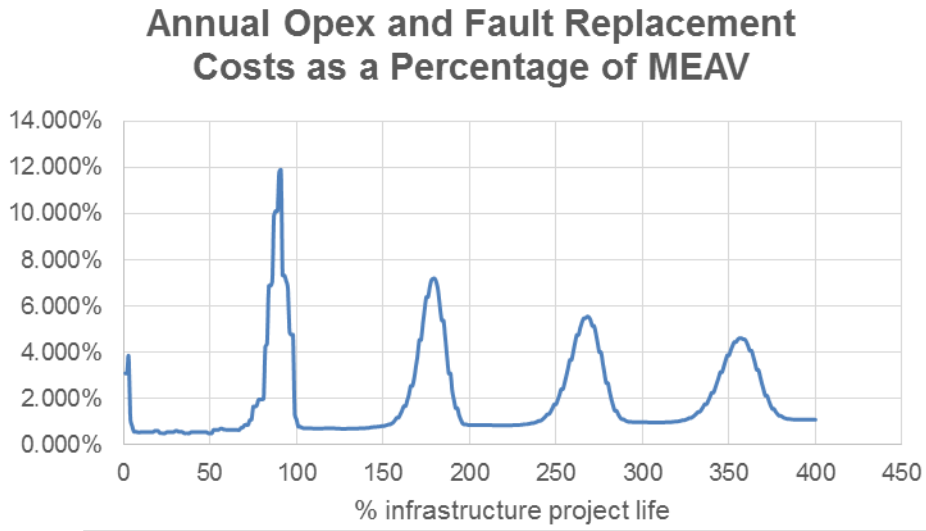
Opex calculation

- Incremental replacement of probably percentages of infrastructure project
- By the time 100% life has been reached for passive components, 117% will have been replaced





- With time, the variations in annual cost dampen. Tending towards a constant.
- For high level infrastructure modelling, this could become quite a useful number.

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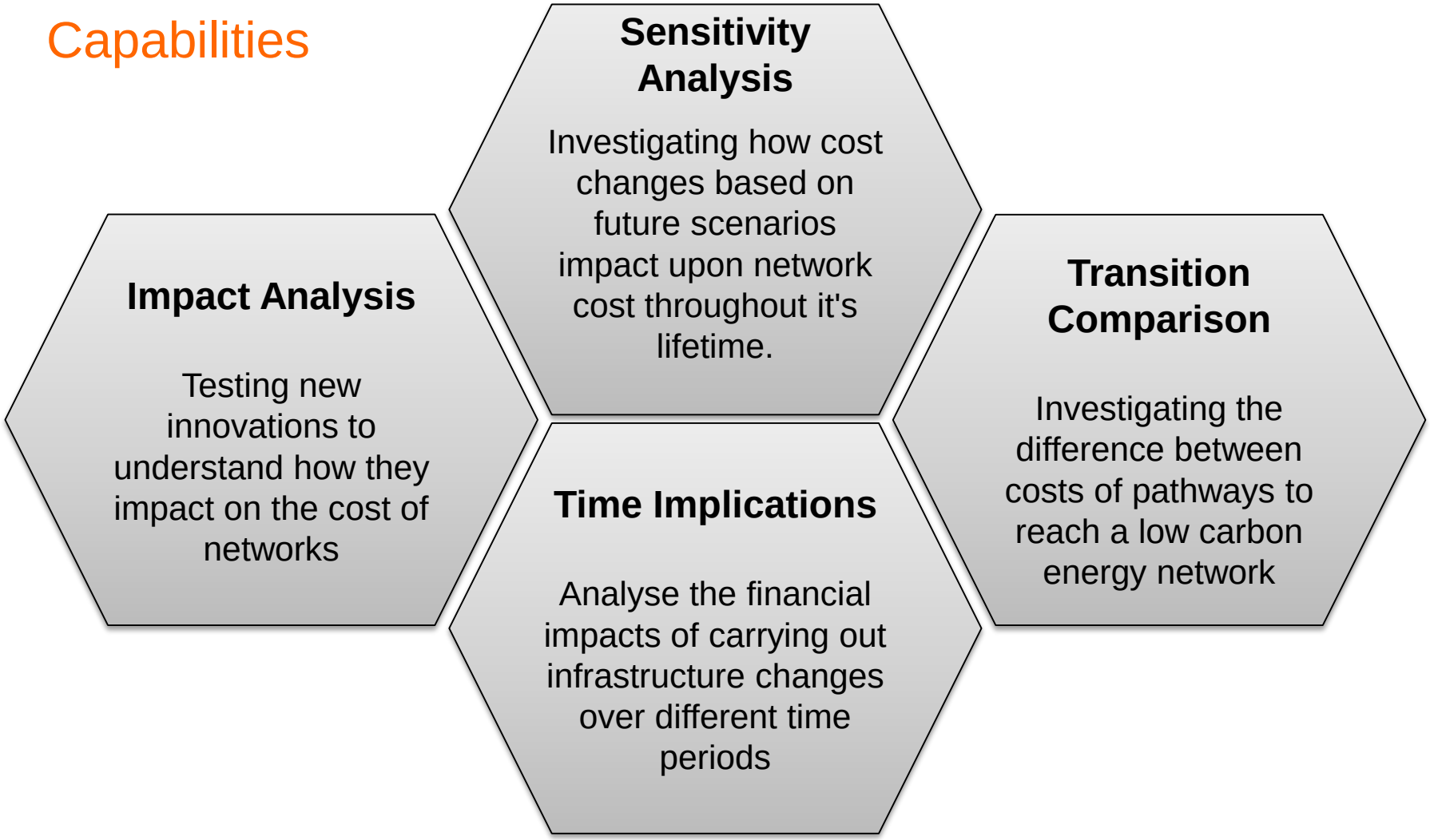
Capabilities



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Current utilisation

ETI Projects:

Heat Infrastructure Development

Consumer Vehicle Energy Integration

Energy Path Networks

Multivector Integration

Future Networks: Impact Analysis

External licences:

Strathclyde
CCC
BEIS
EDF
BP Rolls Royce
Shell
Energy Systems Catapult
Oxford University
Baringa Partners
AECOM
Element Energy
Frontier Economics
Aqua Consultants

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Limitations

- Losses not included. For any project these should be considered.
  - These could be calculated separately for each project if length and materials etc are known
- Land costs are currently low granularity with baseline costs for “All of UK” applying apart from Urban London and offshore. Offshore costs are all equal value
  - These can be modified by users within the project
- Overheads, preliminary costs, contingencies and project management costs are industry standards but can be changed depending of project and availability of more knowledge.
- This is a **strategic tool, not for project design**.
- Data is updated to the point of development. However, when designing a project, the data can be scrutinised by user to ensure it is reasonable. For example, technology maturity curves can quickly change.
- Some technologies are difficult to predict in terms of their future cost trends.

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