



Advisory

Dr Geoff Martin
Lead - Simulation

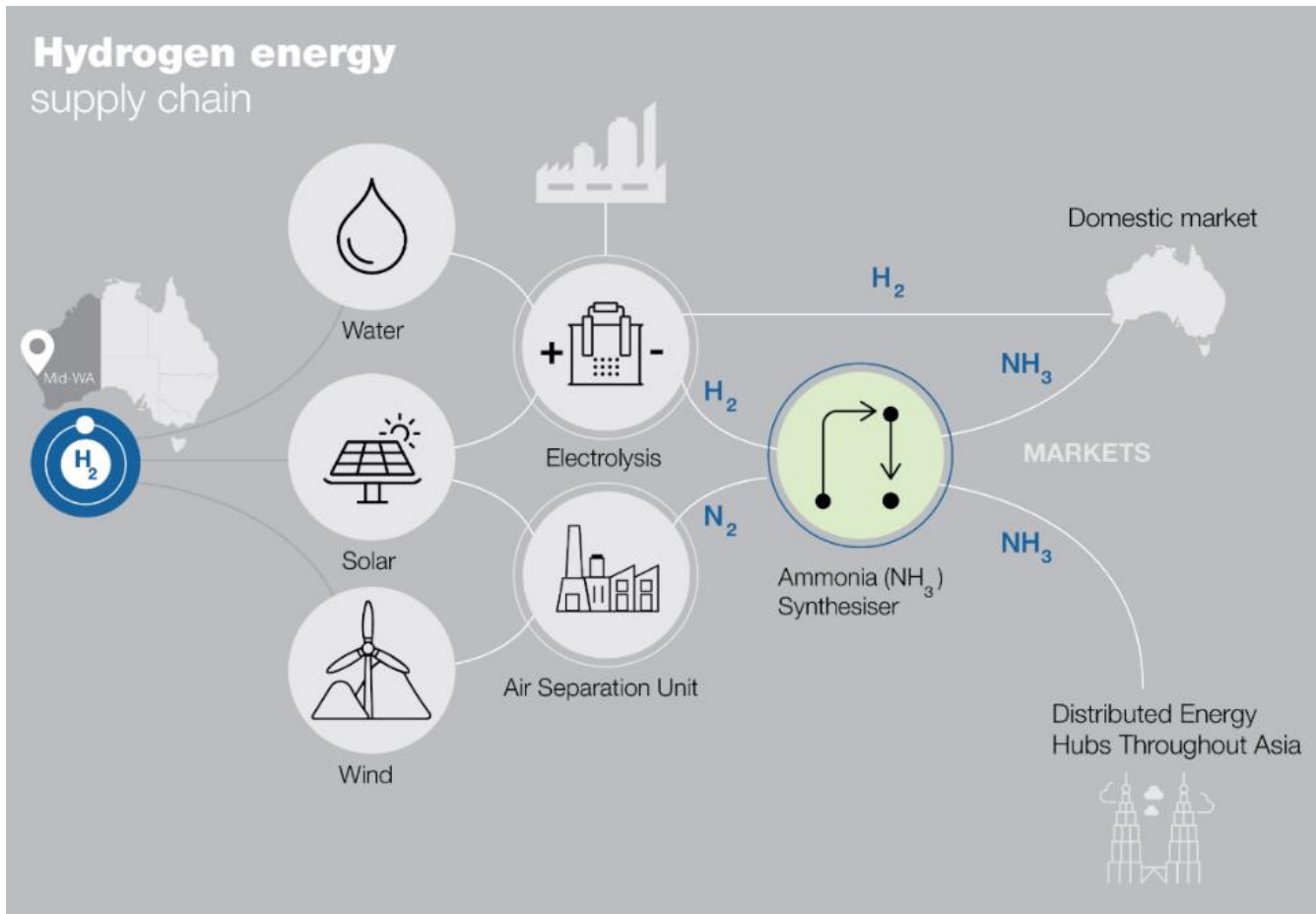
Green

Hydrogen

Supply Chains

Understanding the cost of an end-to-end green hydrogen supply chain

Green hydrogen is generated without the emission of greenhouse gases



Levelised Cost of Hydrogen (LCOH)

Measures lifetime costs divided by total hydrogen production (\$/kg)

Allows the comparison of unequal life spans, project size, different capital cost, risk, return, and capacities

“H2 under 2”



Producing clean hydrogen under \$2 per kilogram is a priority stretch goal under the Australian Government’s 2020 Low Emissions Technology Statement.

Assessing Project Feasibility

Old Disjointed Approach

Financial Model



Engineering Feasibility Study



Modern Approach

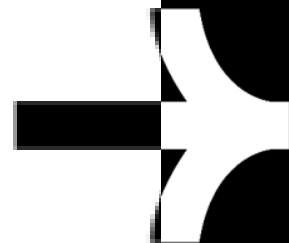
Shifting from experience based, engineering approach to business value approach

Supported by...

Financials to underpin the client business case

Dynamic simulation to understand complexity and risk

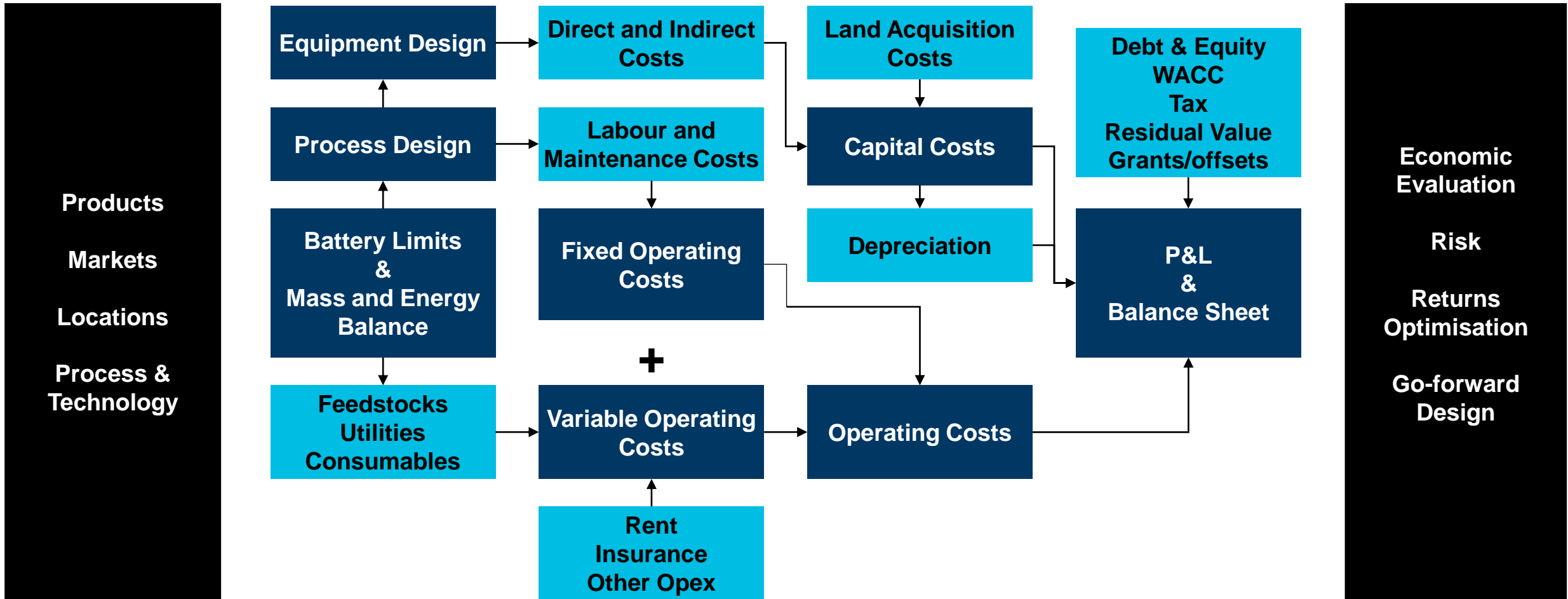
Interactive deliverables and animation to reach executive decision makers



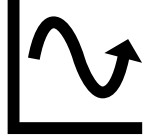
We use dynamic simulation models in AnyLogic to combine the engineering and economics of a project

Decision Variables

Business Decision



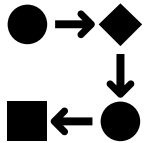
Why use AnyLogic?



Dynamic – captures variability in renewable energy generation and asset availability



Fluid Library – easy to model gas flow through the production facility



Modular – break down supply chain into components and switch on/off

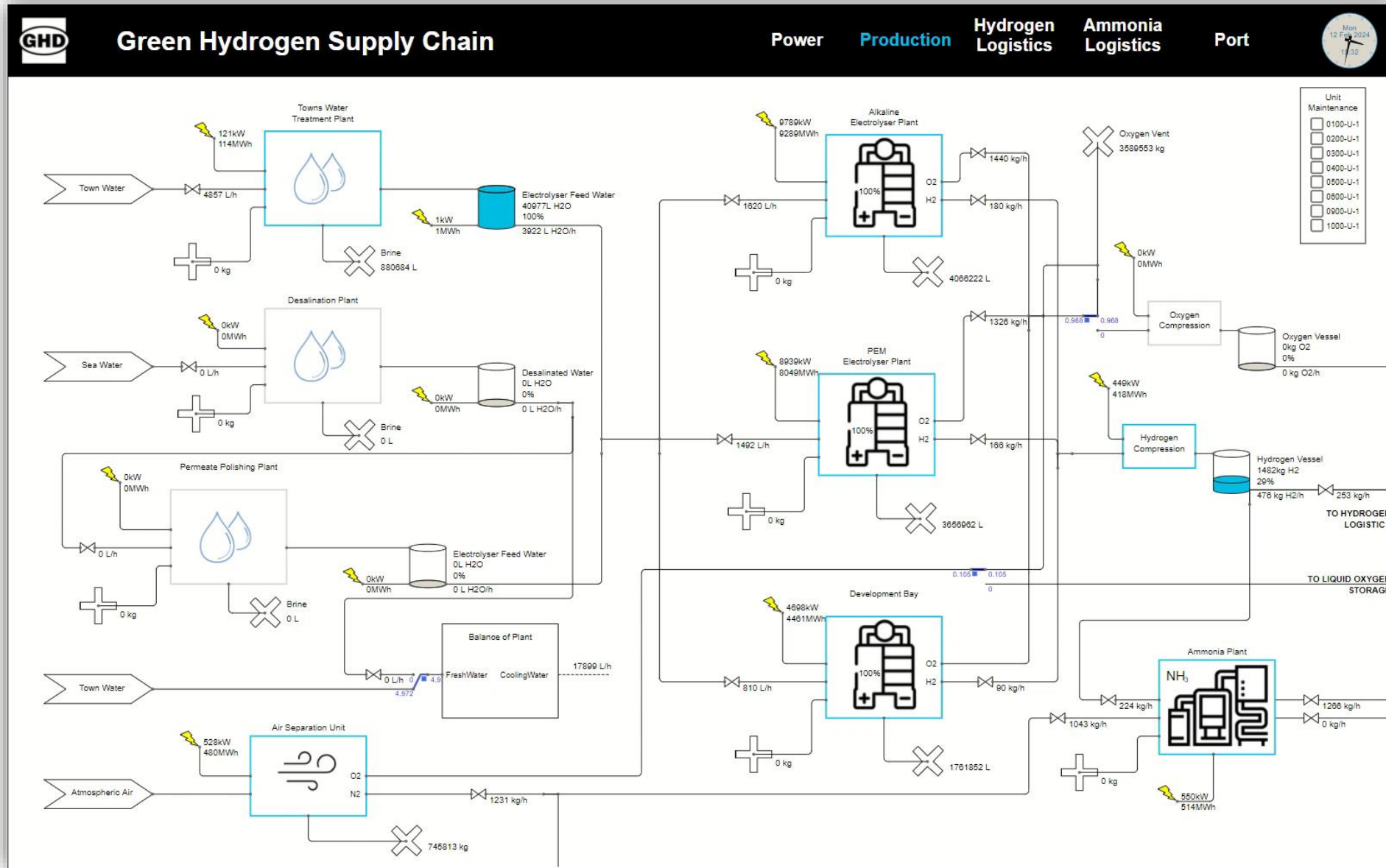


Visual – interactive and engaging for clients and stakeholders

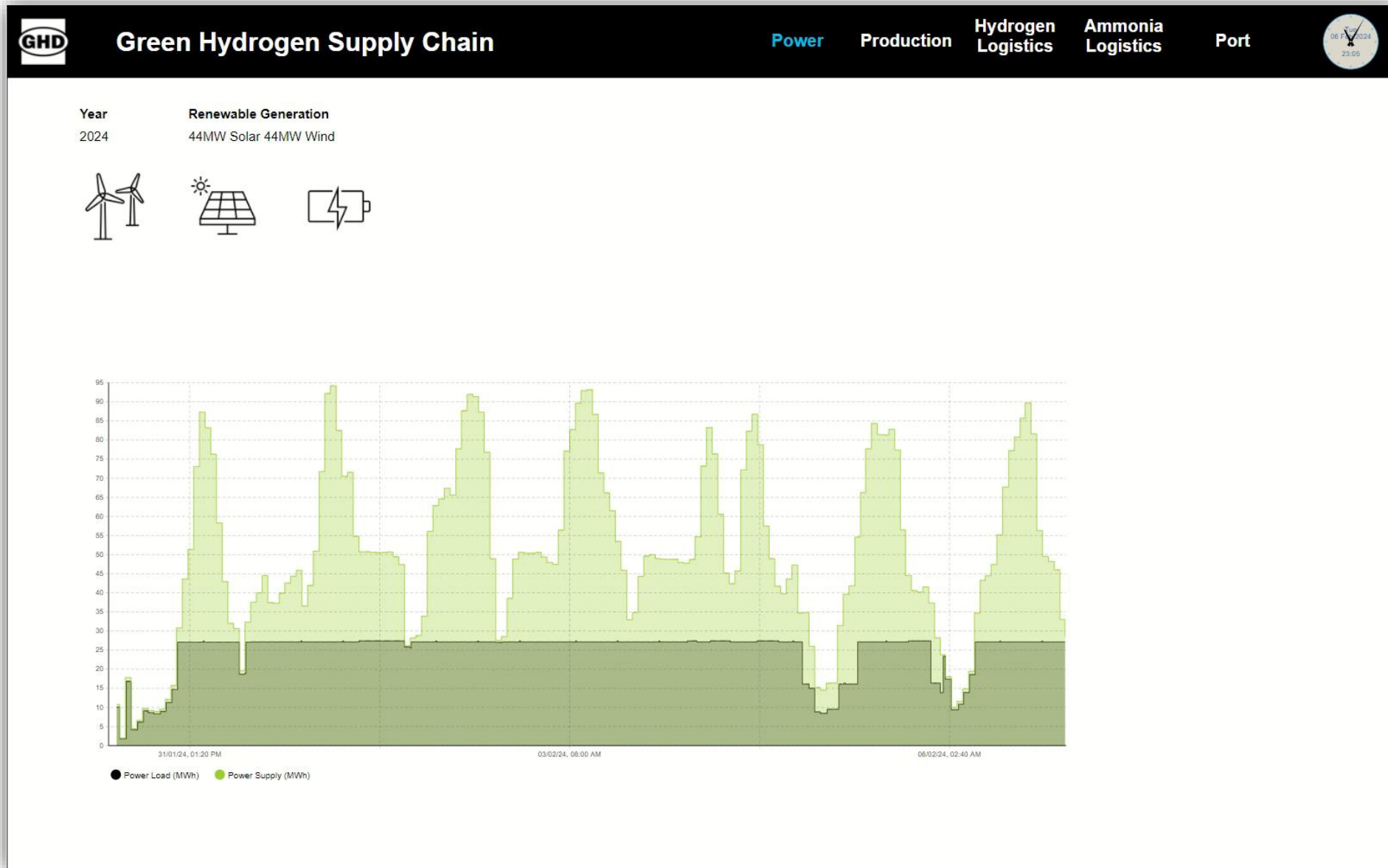


Traceable – version control, inputs separated from logic

Modelling the production facility



Responding to variability in renewable power generation

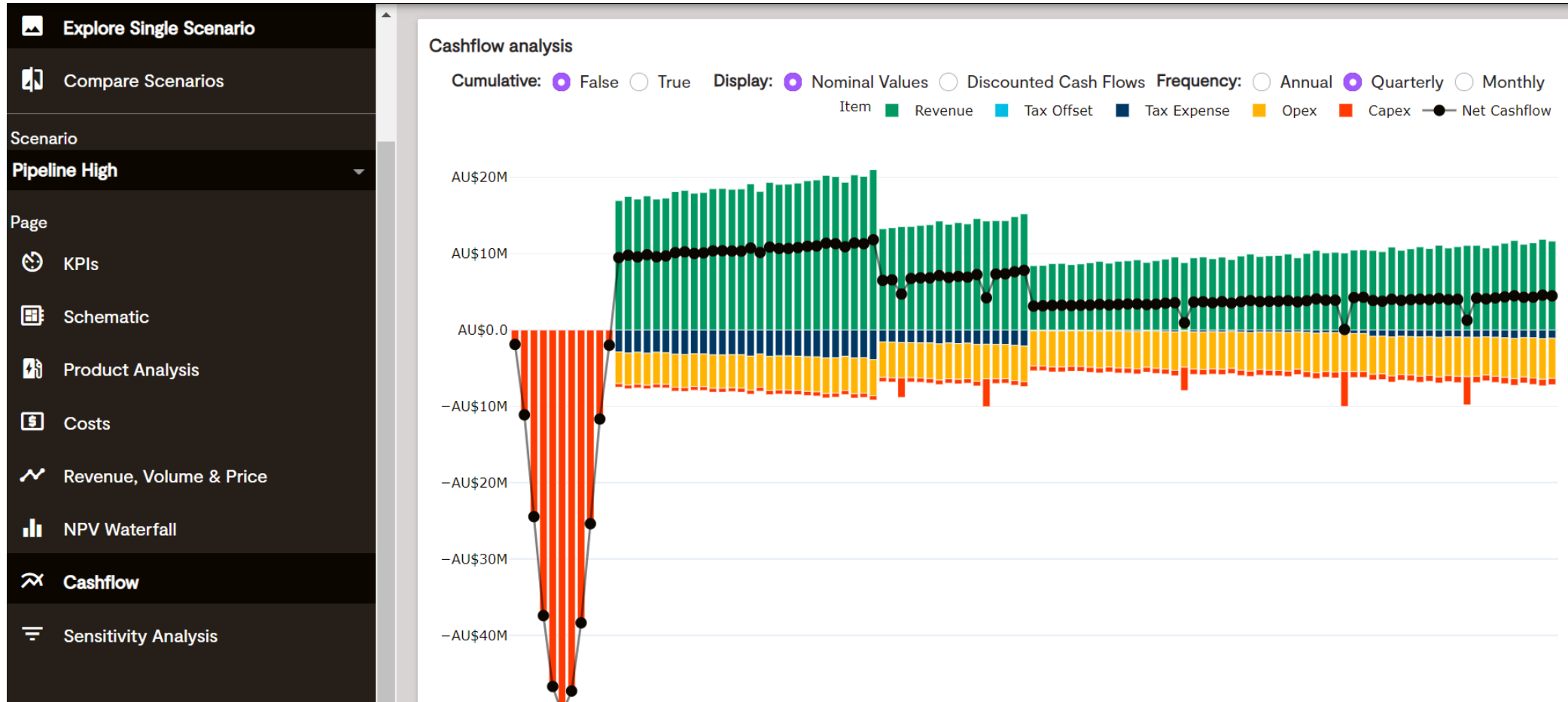


The outputs are presented as interactive financial results

Levelised Cost of Hydrogen (LCOH)

NPV

ROI



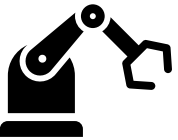
Key model uses



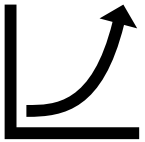
Trade-off between renewable generation cost and production plant utilization



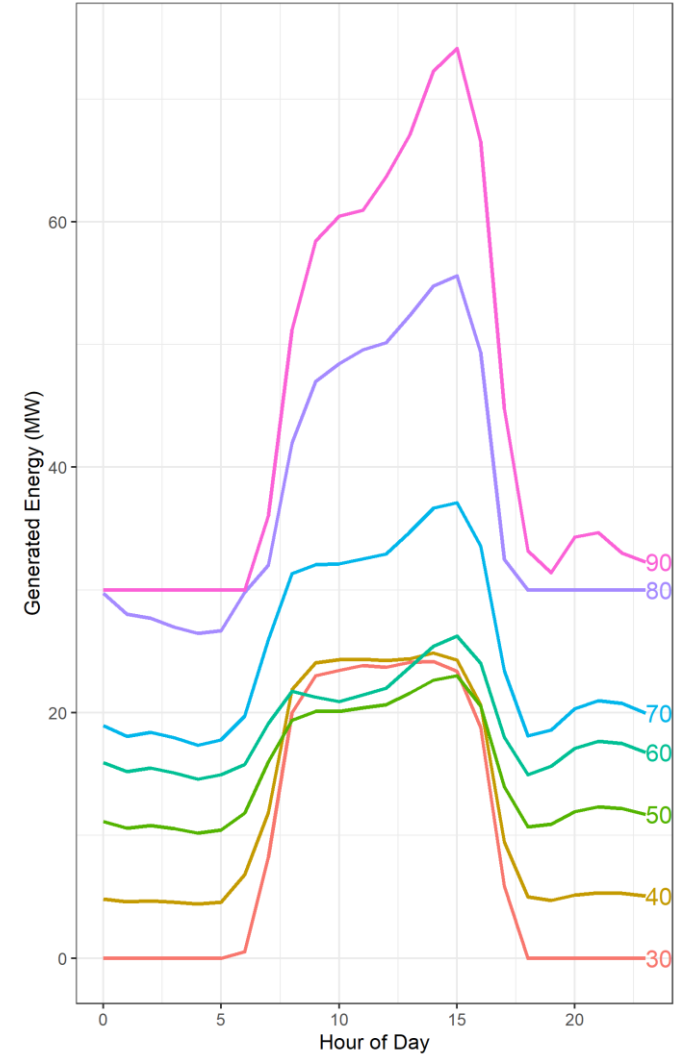
Compare market pathways



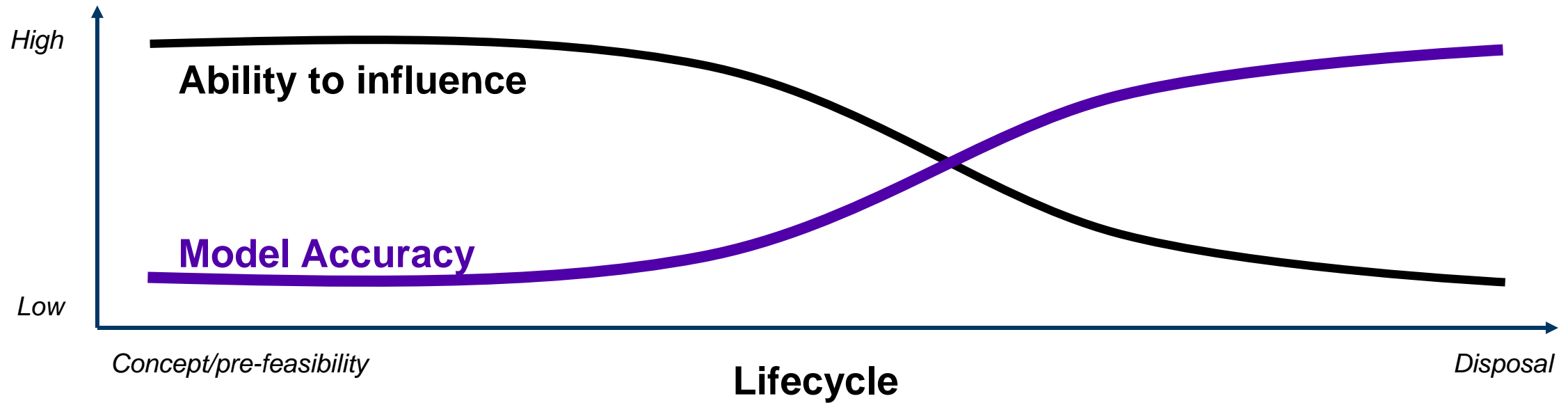
Compare vendor technology



Understand key drivers of levelized cost to understand pathway to 'H2 under 2'



Approach can apply at any stage of the lifecycle



Earlier in project or asset lifecycle

Later in project or asset lifecycle

What is the best project scale and scope for optimal economic return?

How much equity is required and what are the risks and returns?

How do we get higher throughput or yield through an existing asset and process?

What are the options for repurposing, or exiting the asset?

How sensitive is the project to price changes, market risk and competition?

Which of alternative technologies and processes gives the greatest value? Lowest risk?

How do we reduce our operating costs, carbon footprint or inventory?

What is the most cost effective and sustainable way to execute asset and site closure?

Value of our approach

The traditional approach leaves a lot of value on the table.

#01

Single source of truth

#02

Engineering scenarios linked to business outcomes

#03

Capturing uncertainty and variability

#04

Dynamic asset availability

#05

Fast iteration of scenarios

#06

Time value of money with discount rates, inflation and technology learning rates

#07

Understand required storage capacity

*** Thank You**