



Introduction to Climate Risks

Quant Strats 2025 October 2025

Dr Chris Cormack

CGFI Business Fellow



Introduction: Quant Foundry



Our Company



Quant Foundry is an established financial risk consultancy base in London, UK. We have provided bespoke modelling and quantitative services to financial institutions since 2018.

Since our innovations in climate risk modelling in 2019 and academic engagements we have helped shape the climate risk space with our ideas driven by Chris Cormack were published now influencing regulators and the risk landscape.

Our team is continuously innovating the climate risk solution from its current product to an unapparelled framework. We have built partnerships with major data providers in climate data and physical risk analytics and are poised to accelerate our business.



Our Values



Climate

We seek to improve our climate through our solutions



Action

We are committed to equal opportunities and we have built a charitable model to help fund those that are disadvantaged



Rights

A committed equal opportunities employer



Earth

Our solutions and our actions promote improvements across our planet



Sustainable

We seek to grow, we help to grow and make it last



About: Dr Chris Cormack

- Climate Risk Innovator & Entrepreneur
- **CGFI Business Fellow – Transition Risk**
- Actively involved in financial climate linked research and innovation since 2019.
- Academic Advisor to the **CFRF** (Short term scenarios / Nature)
- Active research on climate methodologies with Bank of England Policy Leads. Due to be published
- A detailed bottom up model paradigm that is now followed by nearly all model frameworks to assess climate linked risks this has shaped the way climate risks are performed



Quant Foundry has been at the forefront of innovation in climate risk modelling since early 2019. We are a team of experienced risk professionals and quantitative modellers.

[Publication link](#)



Chris Cormack was an academic contributor to the NGFS (INSPIRE) (<https://www.ngfs.net/en>) the consortium of over 120 of the World's Central Banks designing the future regulatory framework for global financial institutions.



Chris Cormack is a Business Associate Fellow in UK's national centre for climate risk management. (CGFI)



<https://www.linkedin.com/in/christophercormack/>



The image is a composite of two scenes. On the left, an offshore oil rig is visible in the middle of a vast, blue ocean under a clear sky. On the right, a large wind turbine stands against a sunset sky with orange and purple hues. A large white diamond shape is superimposed over the center, containing the text.

What Are Climate Risks and
How Can they be assessed
and implemented with a
portfolio risk assessment ?



Climate Risks and Measurement

At the core of all climate risks is the impact of increasing global temperatures, the increase in adverse weather events and the socio-economic impact.

The desire to mitigate this through policies to shift energy production and simultaneously industrial process and give rise to regional and global macro-economic risks.

No nation is immune from these systemic impacts and opportunities can only be manifest through improved a shift of capital spending and behaviourally through fiscal policy (e.g. carbon tax, mandatory emissions trading and other supply and demand side policies).

As it stands all expected emissions trajectories (that are feasible) will give rise to increased physical risk damage, degradation of natural systems, degraded agricultural production, increased physical stress on human life.

Under a number of scenarios, the Bank of England has highlighted that these pressures are sufficient to create a chronic (and acute) impact on inflation (> 2% supply side driven) that is enough to diminish the effects on current monetary policy interventions.

The implications of this shift of industrial production creates complications for the quantitative understanding all scales of finance, corporate finance impacts to firms' business models / strategy capital structure planning, how this feeds into macro-economic drivers of inflation, productivity, capital efficiency.

In the domain of finance and economics it's very clear that our conventional models (prior to 2019) are insufficient

Why? Conventional macro-economic frameworks do not have a reliable representation of the economy, to both cover the impact of transitions and address the impacts of physical losses.

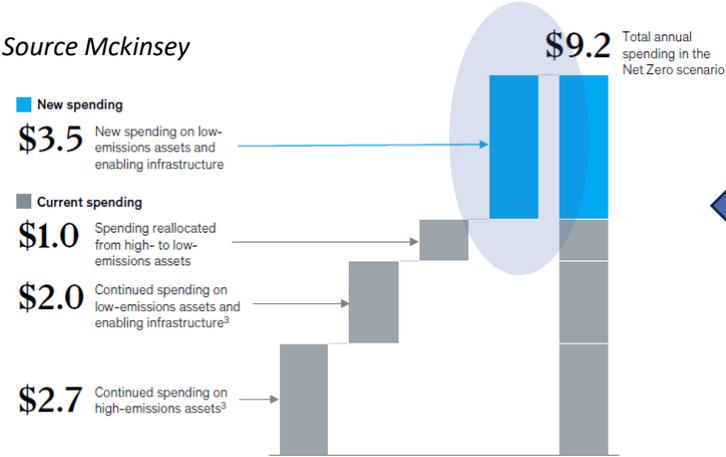
Innovation in climate modelling from micro-frameworks to macro-models are required to address the the views of risk and returns across each firm, industry and macro-economy.

This innovation requires the quantification of the risk drivers – that causal link with the physical world and a means to propagate that through to meaningful and measurable quantities, from firm fundamentals, earnings estimations, valuations models, credit frameworks through to market factors. Without such a framework – investors are operating on no more than a hunch as to the impacts and regulators and policy makers will continue to struggle with viable policy frameworks.



Context: The Current Paradigm of Climate Investment

What is this presentation about: Innovating financial policy engagement – providing insight to across the industry, academia of financial structures that have the potential to de-risk climate (or other real-world transitions)



Before this its worth reiterating the challenge posed by the climate transition and its associated set of physical risks.

At the heart of the climate transition requires the deployment of capital to **replace** current high emitting processes.

The amount of capital required is considerable, with many jurisdictions looking to raise funding through sovereign debt

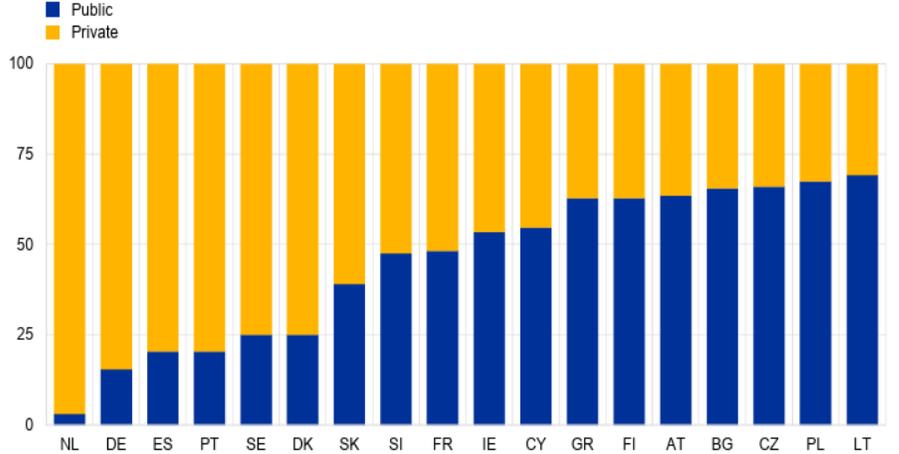
Example EU example debt funding

For the UK the required gross funding is £1.4tn over 30 years (*) ~£47bn each year ~ government pledges ~ £6bn / annum across various schemes (est.)



Public and private sources of additional green investment needs

(percentages of total, average for 2021-30)



Source: EIB (2021b), based on NECPs to reach the 40% emission reduction target. Note: In the EIB report, data for some countries are missing.

(*) "Costs of net zero by 2050", House of Lords, UK, March 2025

Implications : Impact of Climate Systemic Risks and Monetary Policy

In a recent speech given by James Talbot (Executive Director – BoE – Head of International and the impact of climate change on monetary policy)

He highlighted a number of factors that have emerged from recent studies and developments in climate risk methodology, in summary these factors are:

- Increased frequency of physical risk and the anticipated severity could give rise to persistent supply-side shocks that is there is insufficient adaptation investment risk giving rise to a persistent inflationary pressure.
- Poorly implemented transition policies ie. excessively rapid increase in carbon taxation / supply restrictions or ineffective redistribution of carbon linked taxation could further give rise to direct passthrough of costs to consumers driving short term inflation pressures with limited mitigation impact.

At first glance – we are damned if we do (too much carbon taxation) and damned if we don't (almost surely suffering increasingly disastrous physical risks)

In light of these tensions the system is in need of mechanisms to provide flexibility and adaptability to disruption and provide the ability for the system to reduce risk in a targeted way.

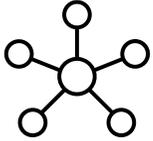
In financial terms this is a hedge. Hence the desire to build instrument that allows the mitigation of price pressure and simultaneously reduce capital costs / burden.

“First, there is evidence that the physical effects of climate change are having an increasing impact on output and inflation over monetary-policy relevant horizons. This means that monetary policymakers need to understand these risks as part of their deliberations.

Second, understanding the nature of climate shocks is important. While their impact will vary, these shocks may look similar to those that monetary policy makers have faced in recent years – large, unpredictable and potentially persistent, supply shocks. In other words, they may increasingly present difficult inflation-output trade-offs for policymakers to manage.” - James Talbot (BoE)

Challenges Facing Firms and Investors Regarding Climate Transition Risk Management

Coherence



Climate Transition Scenario Planning – has yet to be completely integrated into a coherent macro-economic framework

Across the eco-system of models for firm transitions (either academic / commercial) on aggregate there are limitations on the general investment modelled process. This has created a gap in the analysis for firms, governments and central banks.

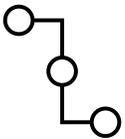
Current Limitations



Specifically, frameworks such as the IAMS (e.g. the NGFS canonical set) and other MACRO models have limited consideration in their models for investment for example:

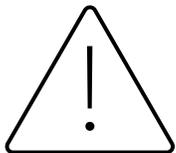
- Limited consideration for **feasibility constraints** of firms to raise funding (e.g. firm balance sheet KPIs)
- Limited firm **risk** and **return** preference modelling for investors (preferences and influence of equity holders and bondholders)

Exogenous Models



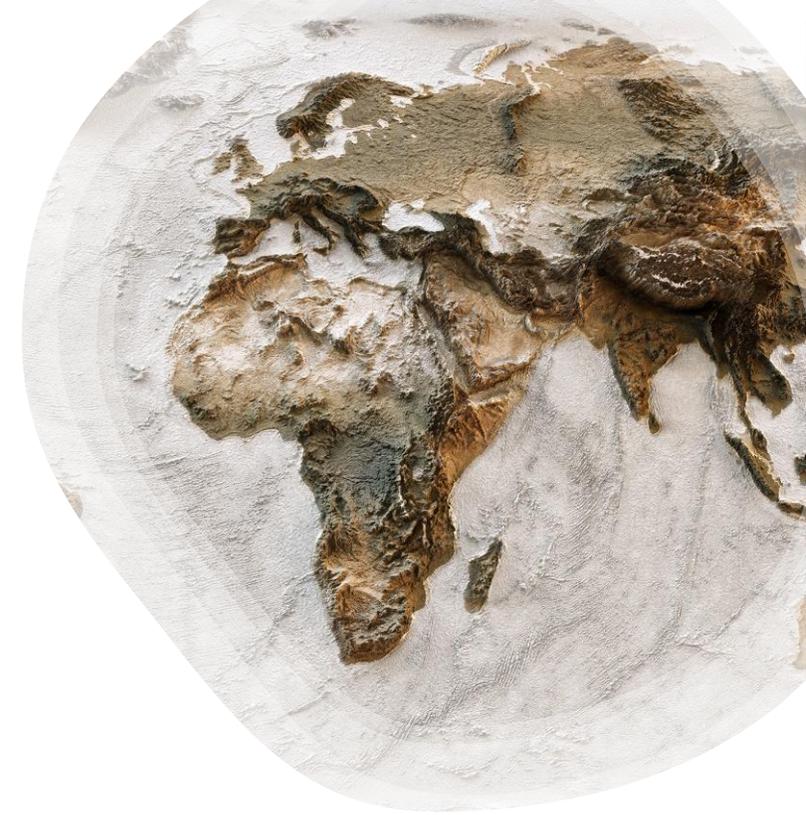
Micro level frameworks can provide these insights (e.g. the QF4CM model) utilising exogenous macro expectation. This mirrors the challenge that firms face *when using macro scenarios* as part of their planning to reach a potential viable strategy.

Risk - Completeness



Consequently – these limitations in planning and risk assessment (which can be intrinsic across many domains not just limited to climate) – can create further risks – that may not be fully represented in investment markets (asset prices)

Addressing this requires the modelling innovation but also useful market instruments to build a price for these risks and hence hedging services.



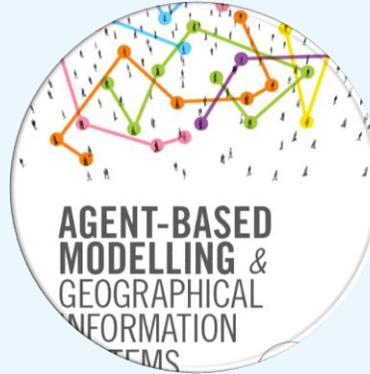
Micro & Macro Economic Agent Based Modelling

Climate Change Firm Level Agent Based Model



Detailed Agent Based Model For Firms

- Models revenue, costs, investments with fine time granularity
- Capture impacts from climate transition policies
- Impacts DEMAND and SUPPLY Factors
- CAPEX costs and how this impacts business decisions.
- Captures cash flows from operations, emissions, input / output requirements



Agent Based Decisions and Stress Testing

- **Ability** to calibrate rules to observed business data
- Provides a unique stress testing framework to assess emergent risks that have not been observed historically
- Ability to integrate Physical Risk Models for direct damage and impacts to outage from multiple factors such as XDI's infrastructure / supply chain disruption models
- Integrated in macro-economic views
- Gives rise to firm level views on the Probability of Default
- Loss Given Default estimates from simulation outcomes
- Firm value estimation
- Can run multiple scenarios and output distributions



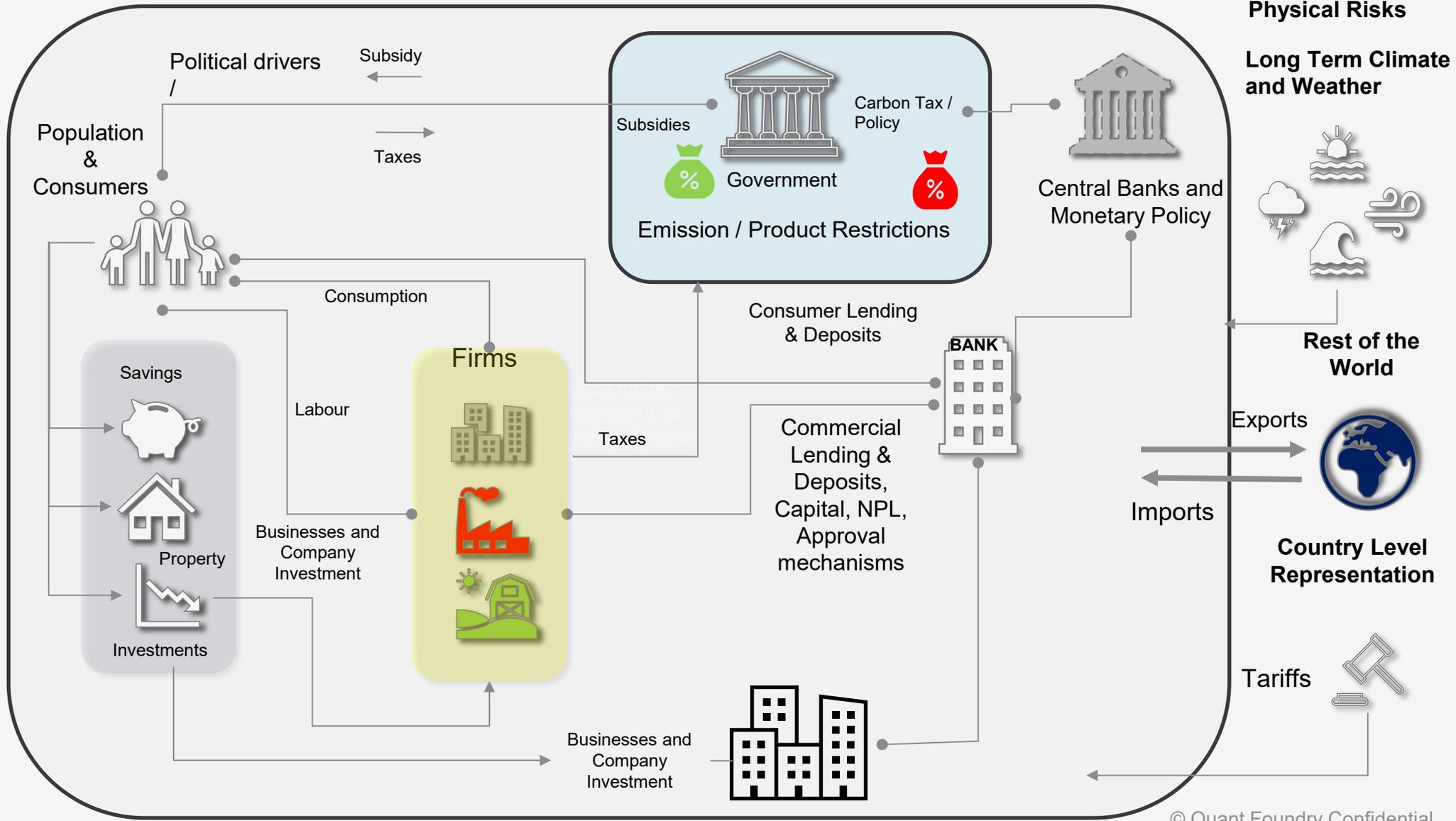
Unique Modelling for Market Impacts

- ML models for the impact to firm valuation
- Firm level market equity realised volatility
- Firm level implied volatility
- Firm level credit spreads and bond pricing

Overview of the Agents and the Scenario Framework

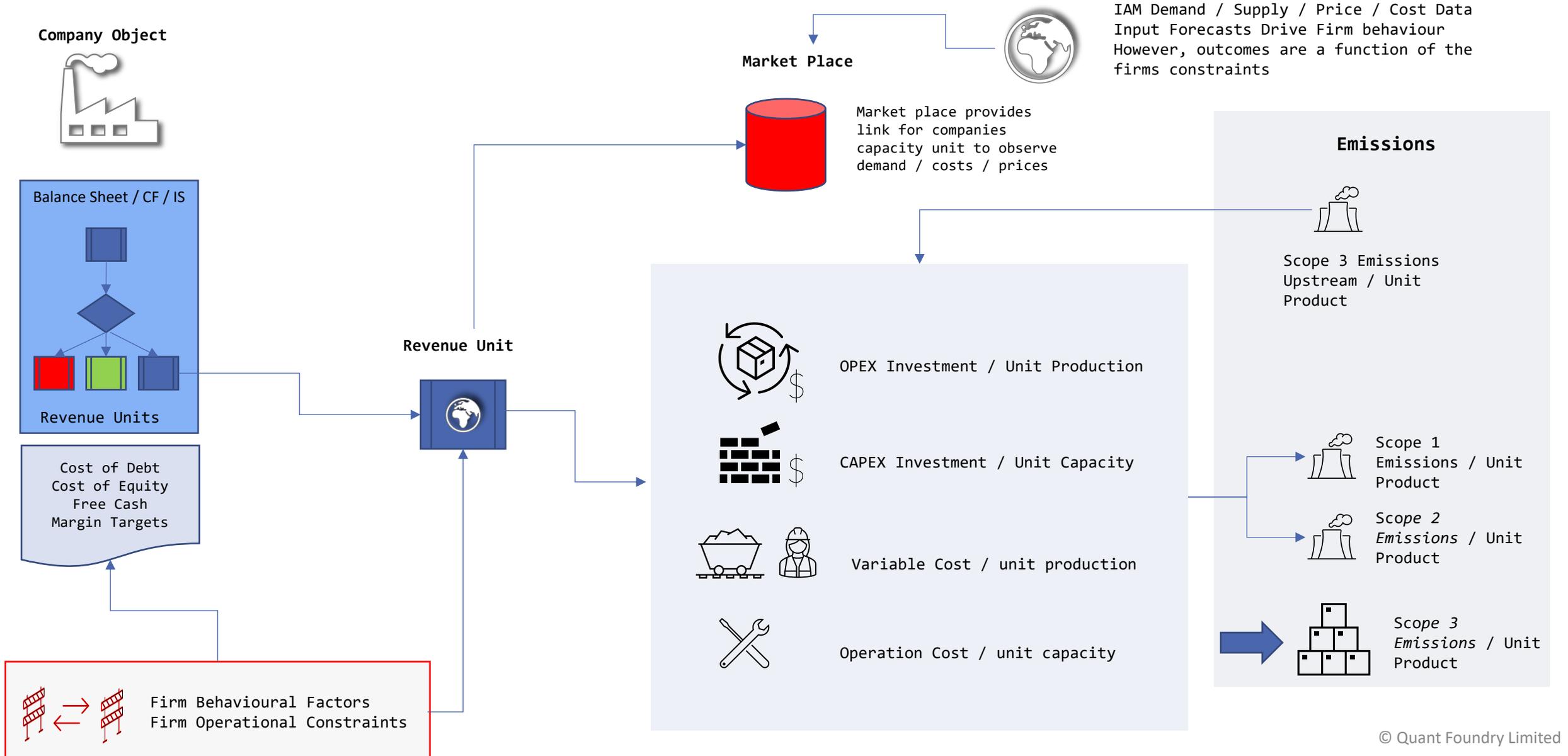
Quant Foundry is (Sep 25) at an advanced stage of development for **its agent-based climate macro model**.

- We are developing a **country level** model that captures features of the agents highlighted.
- This includes detailed representations of **firm** balance sheets fed from actual firm data, their forecasts, capital planning and rules around investment.
- For **consumers** we capture socio-economic factors, spending constraints.
- **Commercial bank** lending and lending frameworks capital allocation, NPL
- **Innovations** in goods and investment markets and market risk premia.
- Capturing **global taxes, tariffs**, with a policy and price scenario engine that will **accommodate new policy** frameworks with complete representation.



Building a Detailed View of A Business

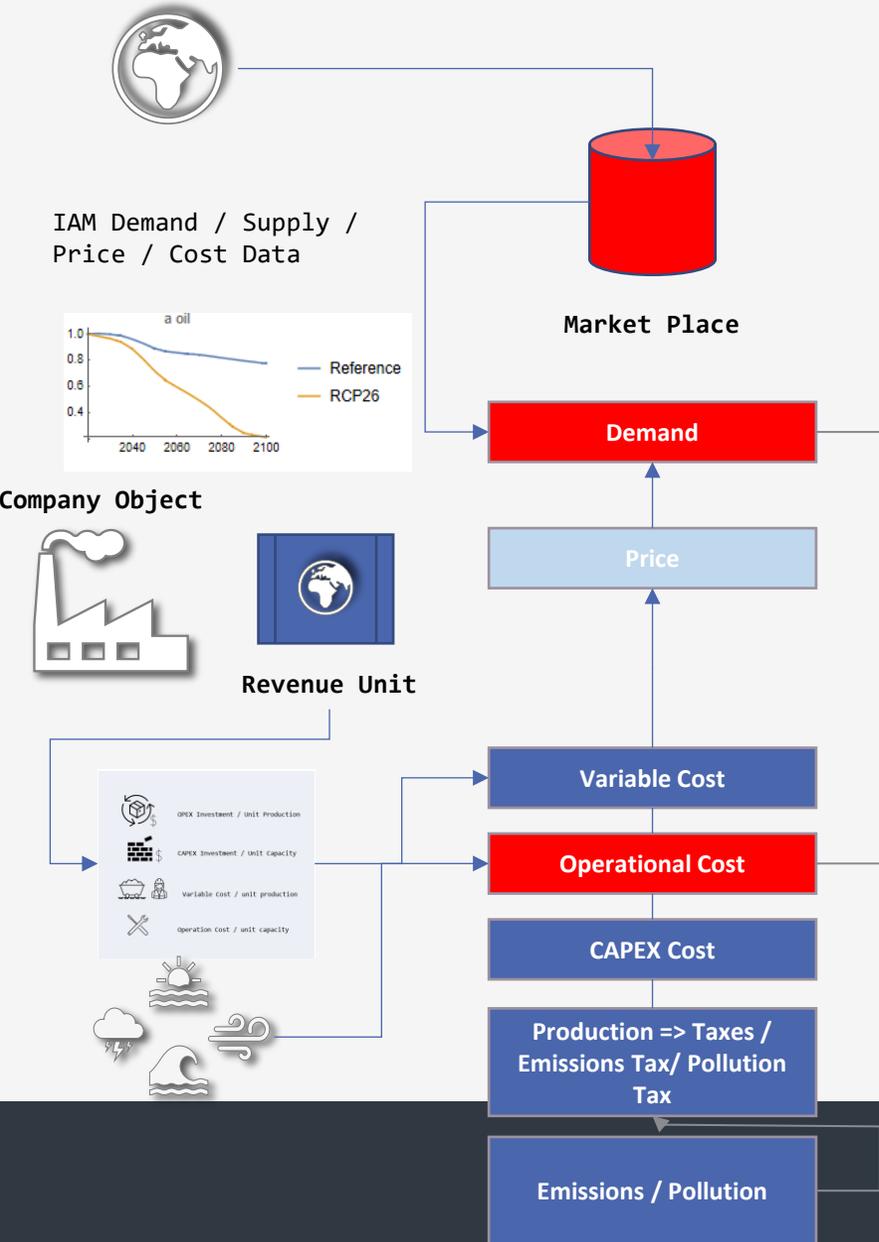
Building the Relevant Components – Capturing Behavioural Factors



Factors for Climate Credit Risk – Physical Risk (QF4CM)

Physical Risks can manifest at many geo-spatial scales for a firm; global, national, sub-regional as well as at an asset level.

For each stress scenario an exploration of the firm's sensitivities at these geospatial levels in its supply chain should be assessed – however assessing the impacts across all scales is challenged by data and integrated models..



Increasing Physical Risks will lead to increased expected costs of repairs, insurance, loss of productivity

Firm Asset Level Assessment can be performed based on features of the asset, build quality, materials, insight from insurance data.

Many physical models offer estimates of direct damage costs and estimates for productivity loss.

Scenario Modelling Guidance: A hybrid approach to address these data uncertainties needs to be performed to assess the impact non-local effects on supply / demand factors.

Why Agent Based Modelling For Macro-Economics

QF is innovating the wider model framework to integrate firm level factors with macro-economic modelling.

Climate Credit Risk Assessment integration requires a **review** of **internal credit modelling capability** to address the internal strategy and the varying needs of global regulators.

- A framework that is adaptable across these needs can provide significant savings.
- However conventional climate risk frameworks lack the **coherence** of model integration and impact or have simplified macro-economic models.
- The risk factors of climate change / nature-based factors are not reliably represented in most firm's macro models.
- Without this ability to capture the agent-level details – this will leave notable gaps in stress testing and forecasting frameworks – requiring a multitude of ad-hoc models with arbitrary time consuming error prone process.

Application of Agent Based Modelling For Macro-Economics

QF is innovating the wider model framework to integrate firm level factors with macro-economic modelling.

Improved Macro Forecasting and coherence for ICAAP / Economic Capital Planning– many CGE / Structural models are not sufficient to model climate linked factors reliability – defining the set of risk transmission channels (e.g. supply disruption, productivity loss, credit events, consumer behaviour). Conventional CGE models will not reliably capture inflation factors, investment dynamics, impacts to markets.

IAMs will not capture general inflation factors, consumer behaviour, financial market impacts.

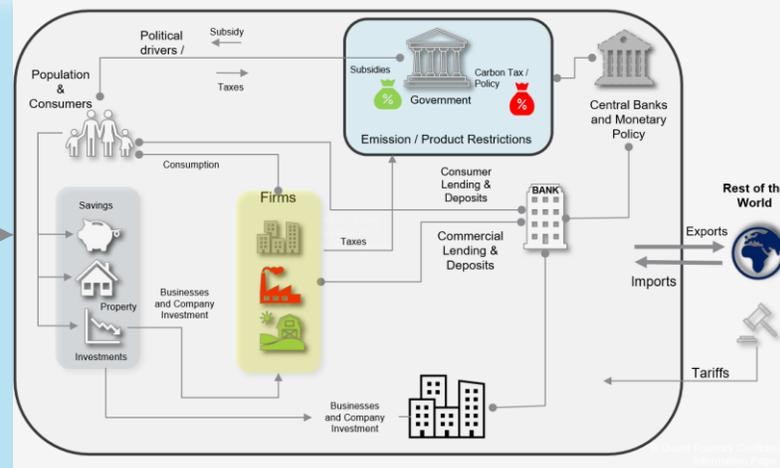
Improved market factor modelling for stress testing and advisory– many internal systems rely on historical conditional distributions to assess market risk factors – this is at odds with forward looking scenario analysis and the need for coherent risk measures across business' in a bank eg Wholesale origination, wholesale risk and market and counterparty credit risk.

For banks this must sit alongside the ability to integrate deliver the proscribed regulatory scenarios across their portfolios.

The objective is to enable not only the projection on climate risk factors into the macro domain but provide future expandability to cover nature-based risk drivers in the future.

Integrating Credit Risk Assessment Across the Bank

Macro System Model



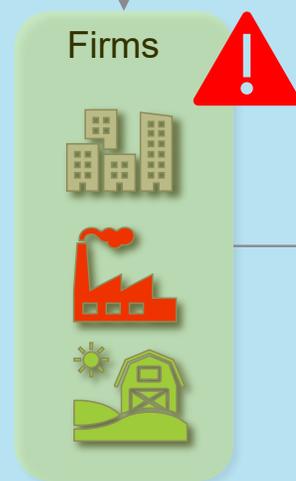
Coherence in Climate Risk Modelling integration will require integrated stress testing infrastructure. Assessments need to be performed if current empirical factors especially for traded exposures such as markets / counterparty credit risk are sufficient



Physical Risks



Policy



Counterparty Credit Risk
Wholesale Risk – PD, LGD



What is Parsimonious for Risk Model Design?

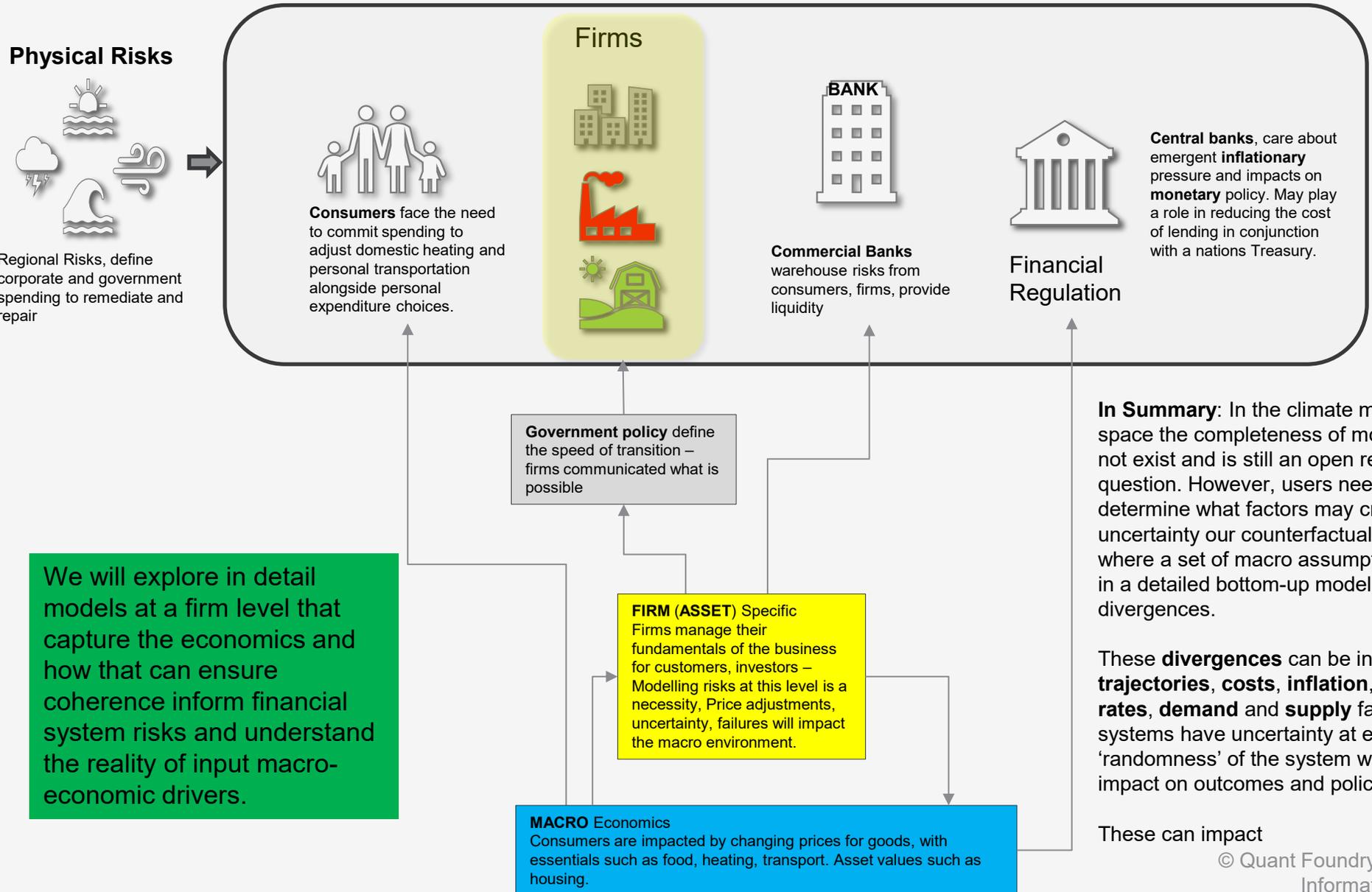
Complexity to Insight

In designing a risk framework for climate risks, one quickly runs into a complexity problem of systems modelling.

Identification of Risk Stakeholder (Domain)-> Coherence

Understanding the causal links across each stakeholder group in an economy is important. This is to ensure coherence. Hence **top-down** frameworks may produce a overview of trajectories of change but not be rich enough to capture the individual components of risk.

Bottom-up approaches provide a means of stressing systems in more detail and can capture a richer set of risks. E.g. Non-equilibria effects. These approaches provide a means to assess the validity of models that do not capture such granularity.

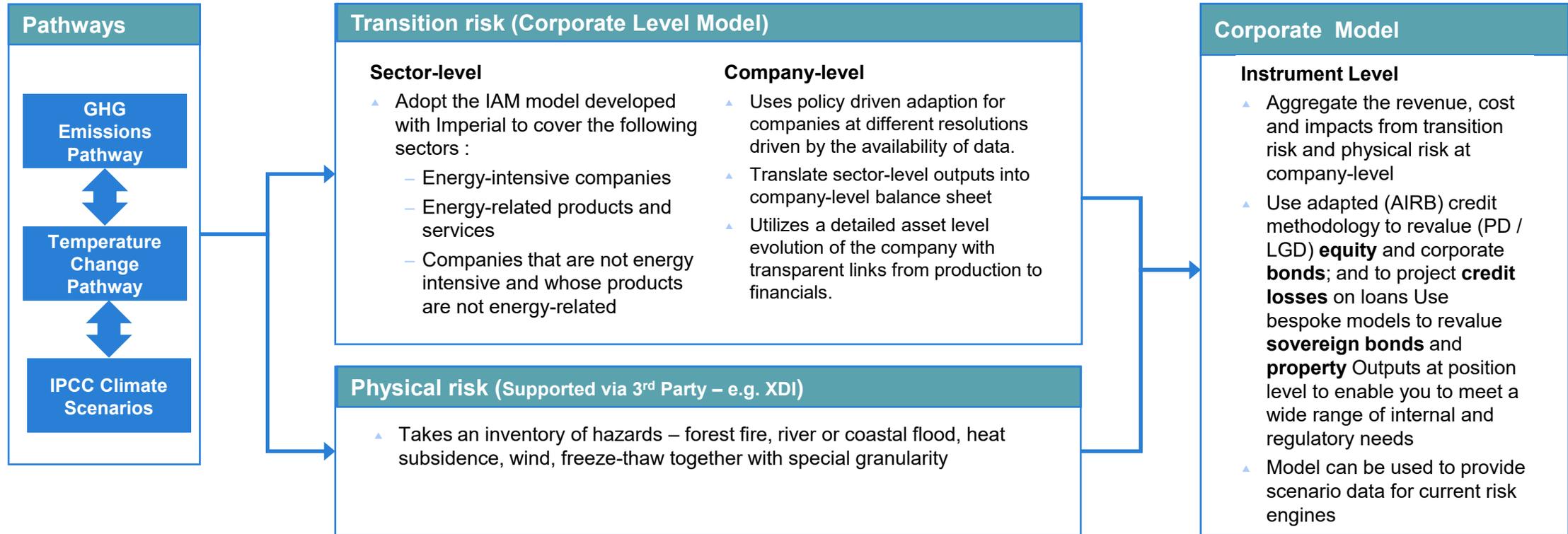
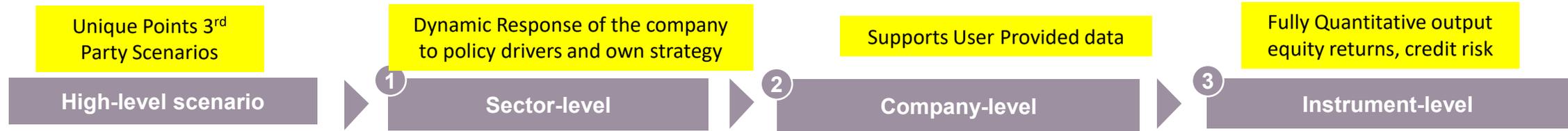


The image features a central white diamond shape with a thin white border, set against a background split into two scenes. The left side shows an offshore oil rig in a blue sea under a blue sky with light clouds. The right side shows a silhouette of a wind turbine against a sunset sky with orange and purple hues. The text 'Transition Model Overview' is centered within the white diamond.

Transition Model Overview

Climate Change Model – Approach – Corporate / Business

Our approach brings together transition and physical risk scenario impacts within a framework for assessing instrument-level financial impacts



Supports an Interface for first order physical risk

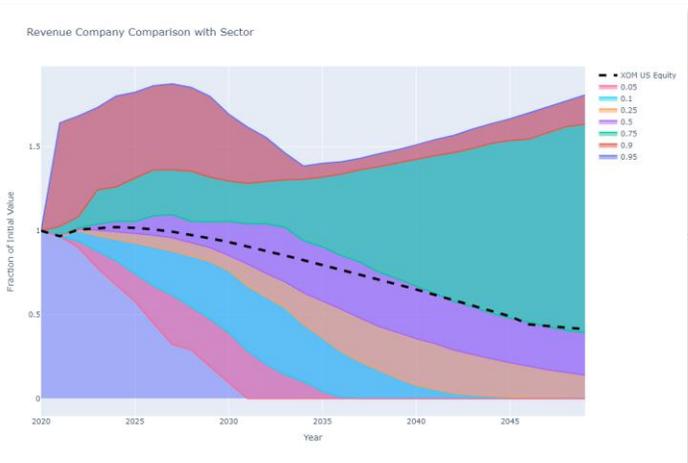
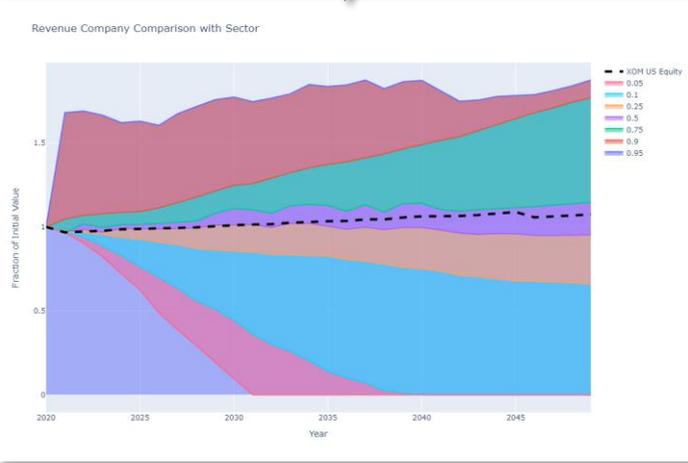


Model Output Example
NDC and Net Zero
Scenario Comparison

Comparing Firms Within a Sector – Oil & Gas

Relative Income Growth Comparison

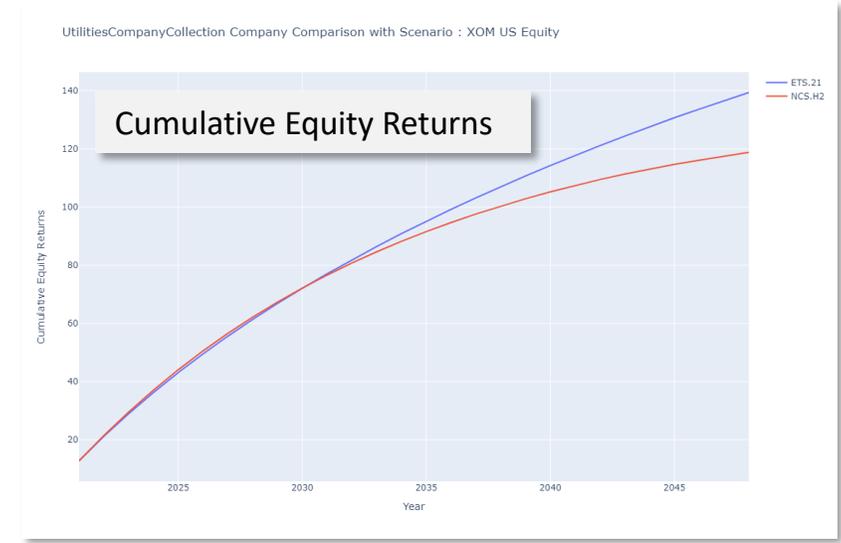
NDC Emissions Scenario – Relative Revenue Impact



Net-Zero 2050 scenario – Relative Revenue Impact



In this scenario (RED) set firms are required to meet Scope1 Emissions targets for NetZero by 2050, this is done in conjunction with a general reduction in demand for other produce this restricts Oil&Gas operations, reducing revenue CAPEX. Furthermore, the scenario imposes a need to invest in CCS technologies



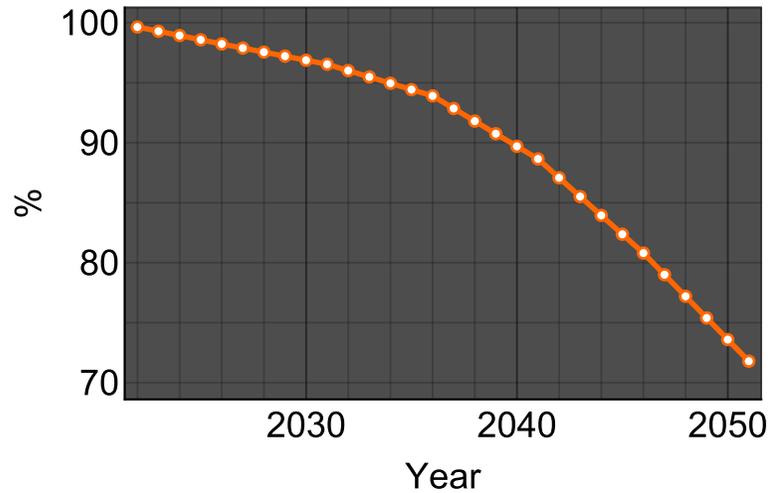


Transition Model
Example – Equinor
Modelling

Prior Model Validation – Equinor Results

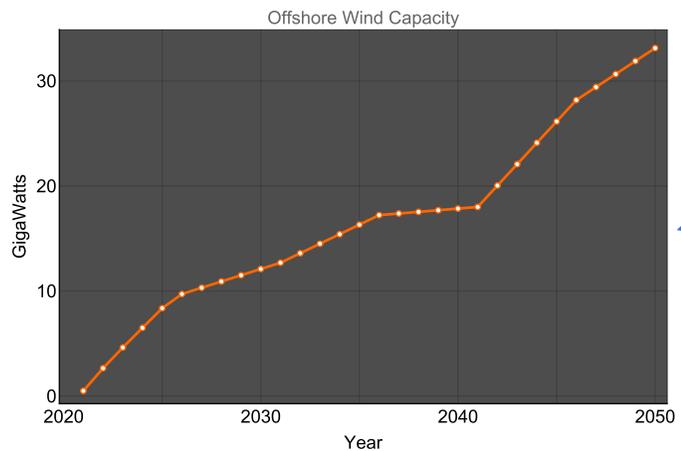
Non - Financial Results From The Simulation

Fraction of Capacity Utilised – Oil Production



Our model recommends Equinor reducing its annual oil and gas output between 5- 10%.

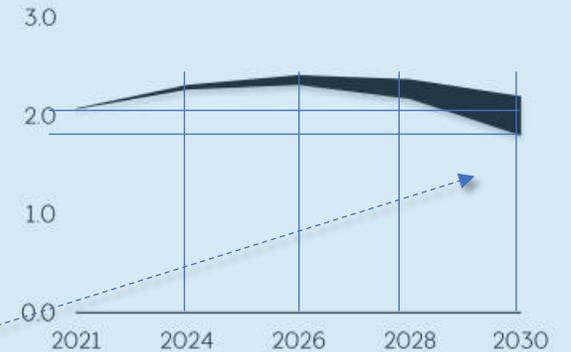
Equinor project growth in Oil & Gas Sales until 2030, with an indication of a reduction of upto 10% by 2030.



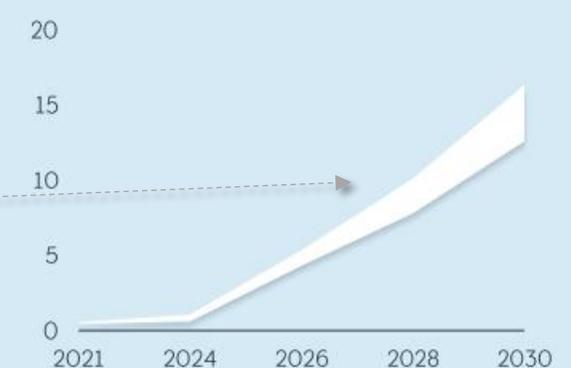
Model Shows that Equinor Can Achieve its growth in renewables and maintain its credit rating though short term by drop 0.5 notch

This has been discussed with Equinor's Head of Climate Strategy

Equity oil and gas production
Million boe per day



Equity renewables installed capacity
GW

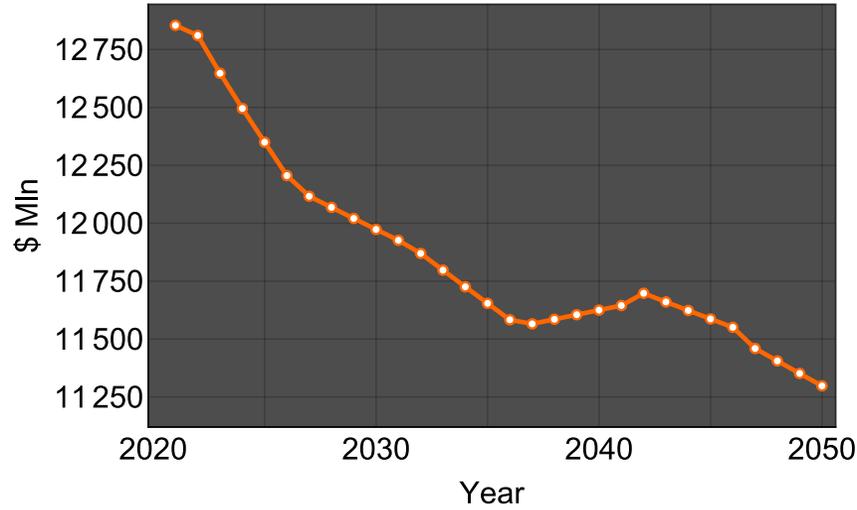


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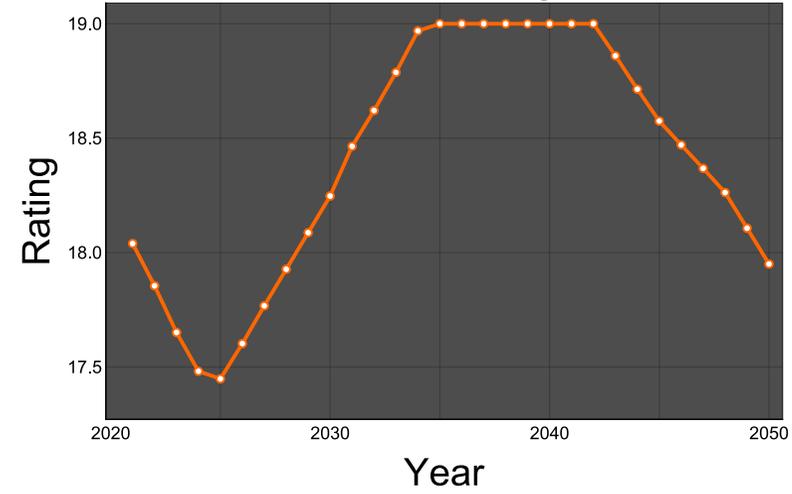
Financial Results From The Simulation

Calculation Performed in 2021 Prior to Equinor's full disclosure in 2022

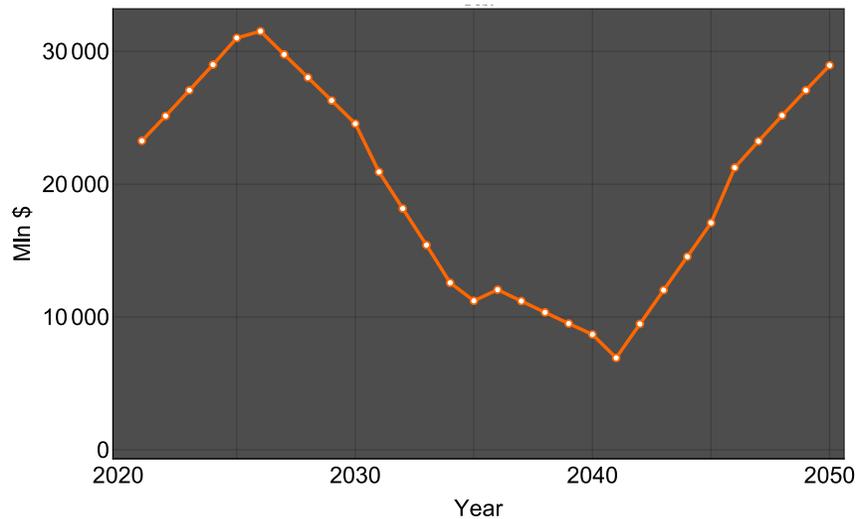
Earnings



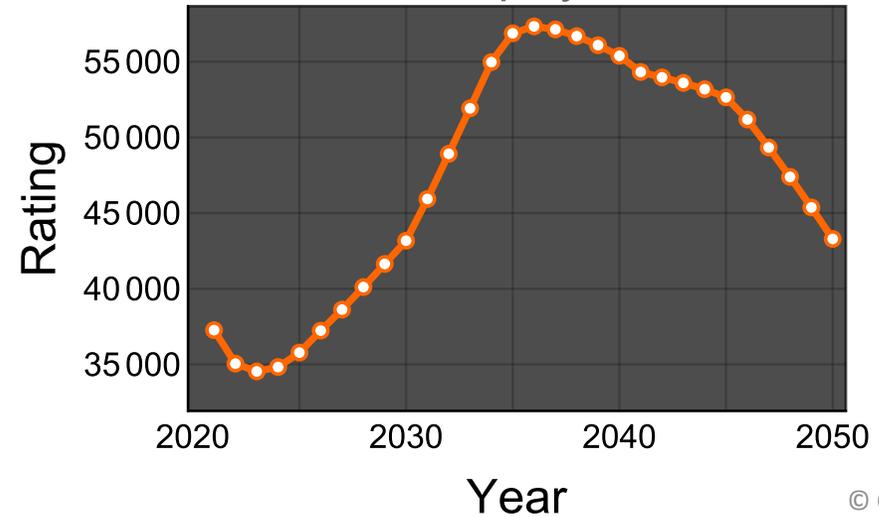
Credit Rating



Debt

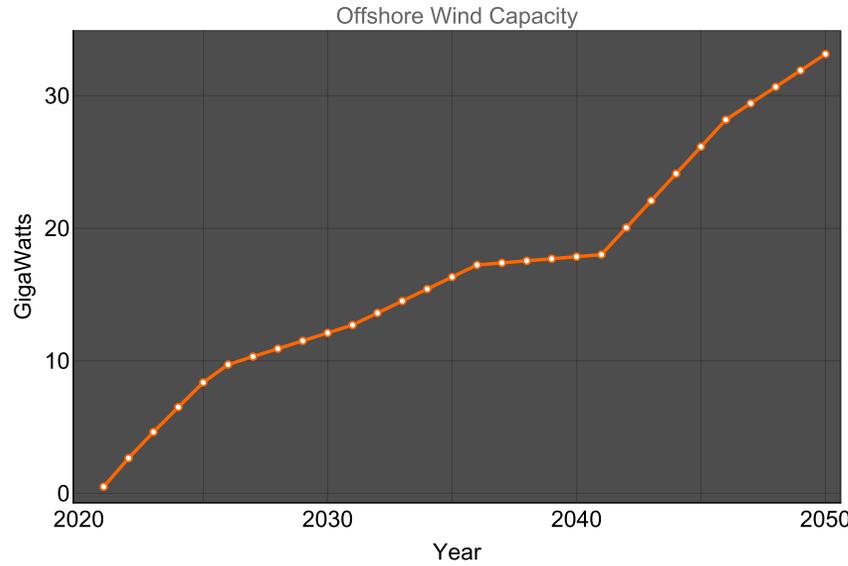


Equity

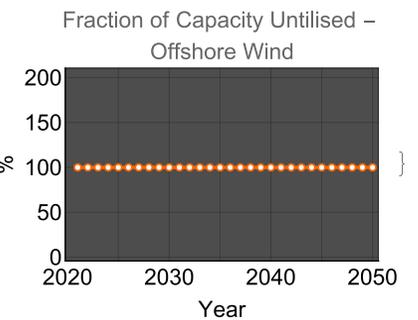
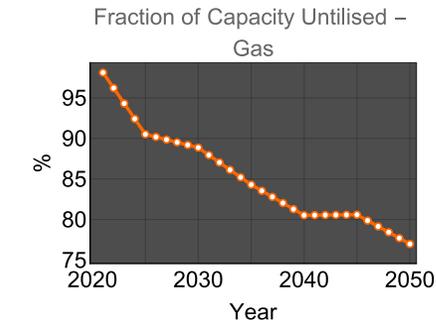
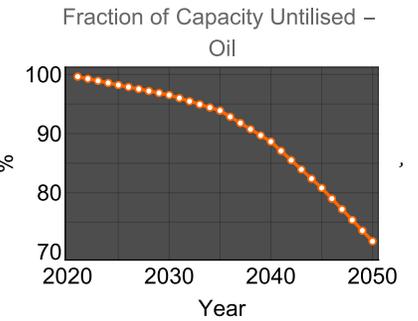
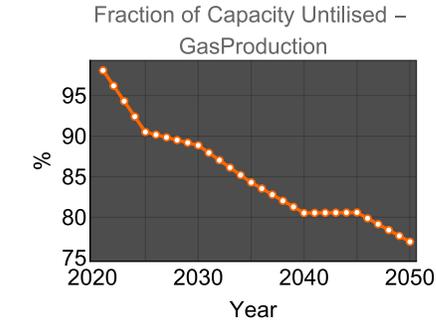
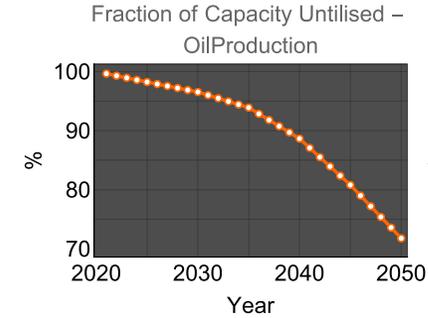


Prior Model Validation – Equinor Results

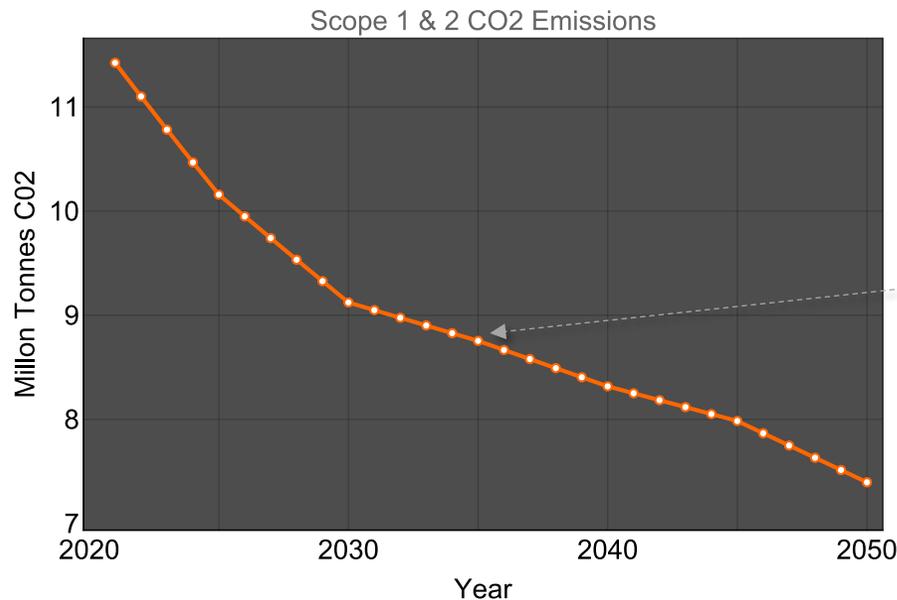
Non - Financial Results From The Simulation



Planned Capital Expenditure Looks Realistic to achieve renewable investment goals. But has a stronger reliance on Oil sales growth than the model forecast.



IAM Driven Stranding Factors. Oil and Gas under this RCP26 scenario show a modest drop in Oil and Gas

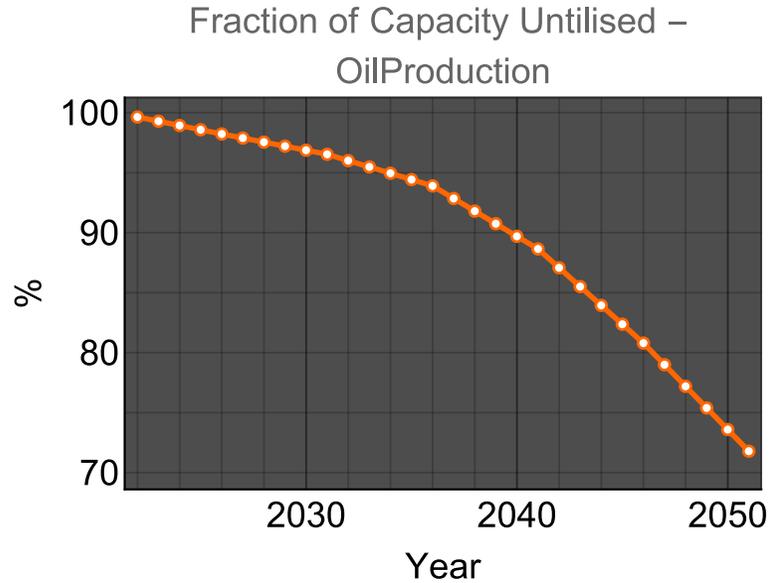


The emissions intensity indicated by the model shows a reduction of 25% in emissions by 2035.

Equinor are planning a 40% reduction. This is to be achieved with decarbonising their supply chain and some use of offsets.

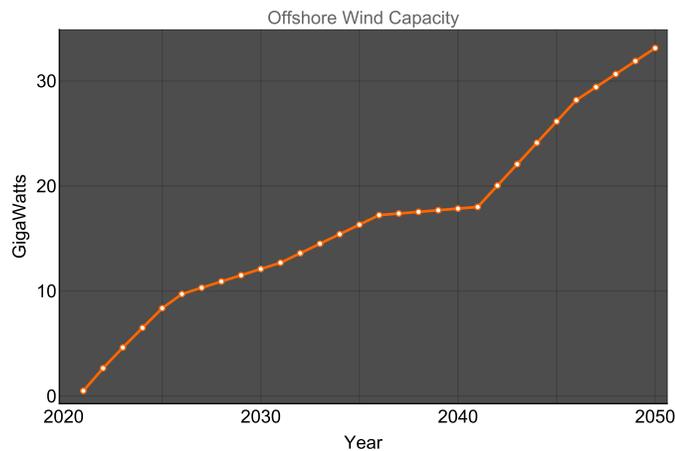
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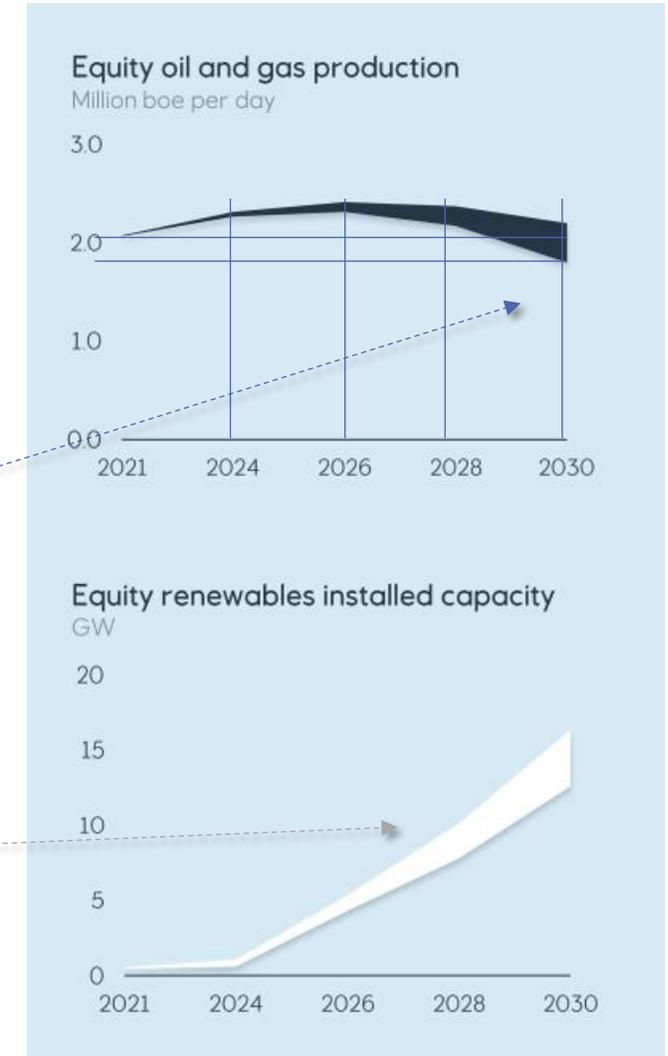


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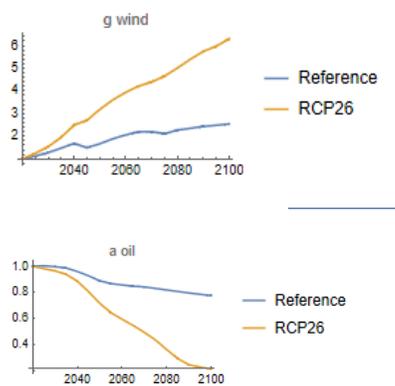
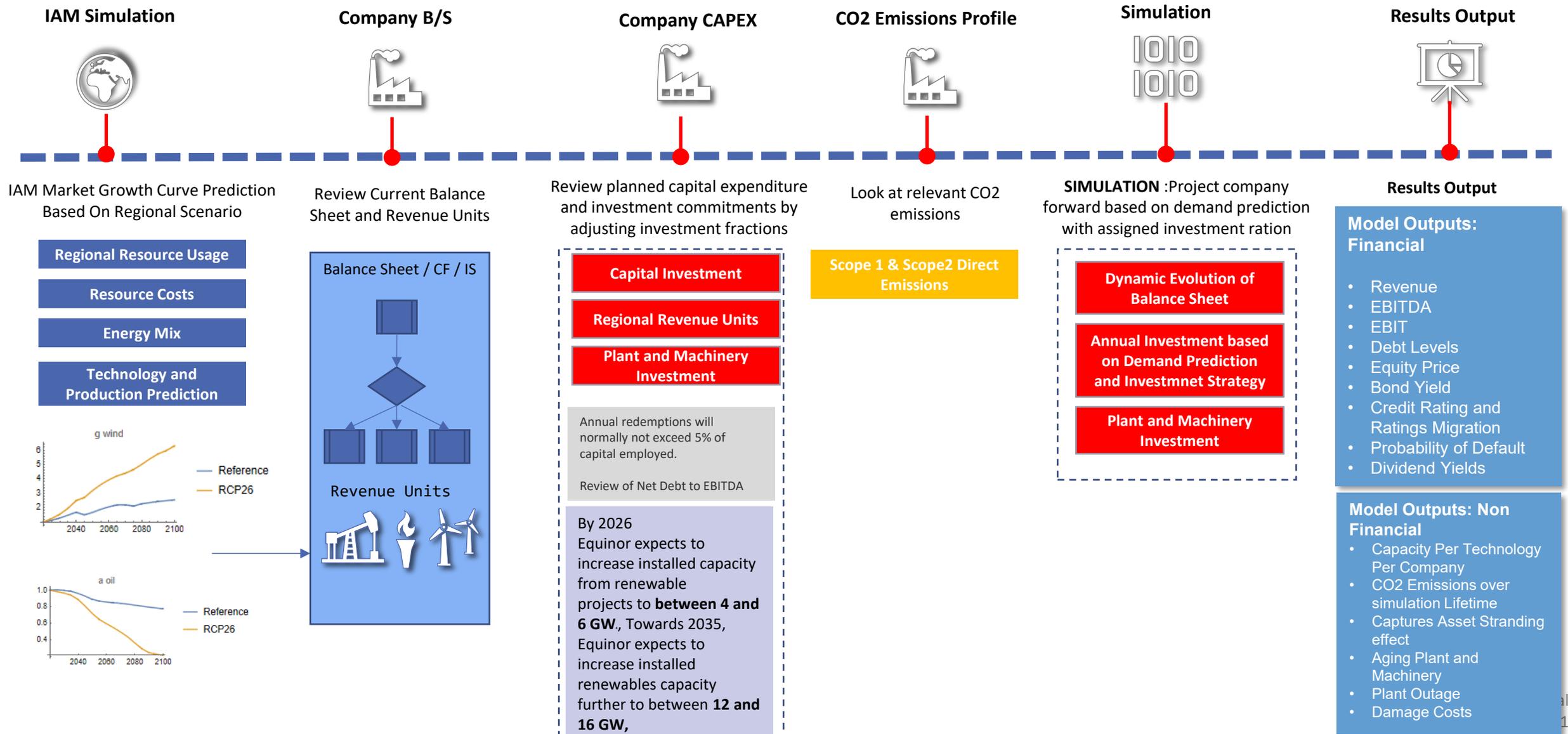




Simulation Framework

Worked Example – Energy Company

Outline of the model data flow

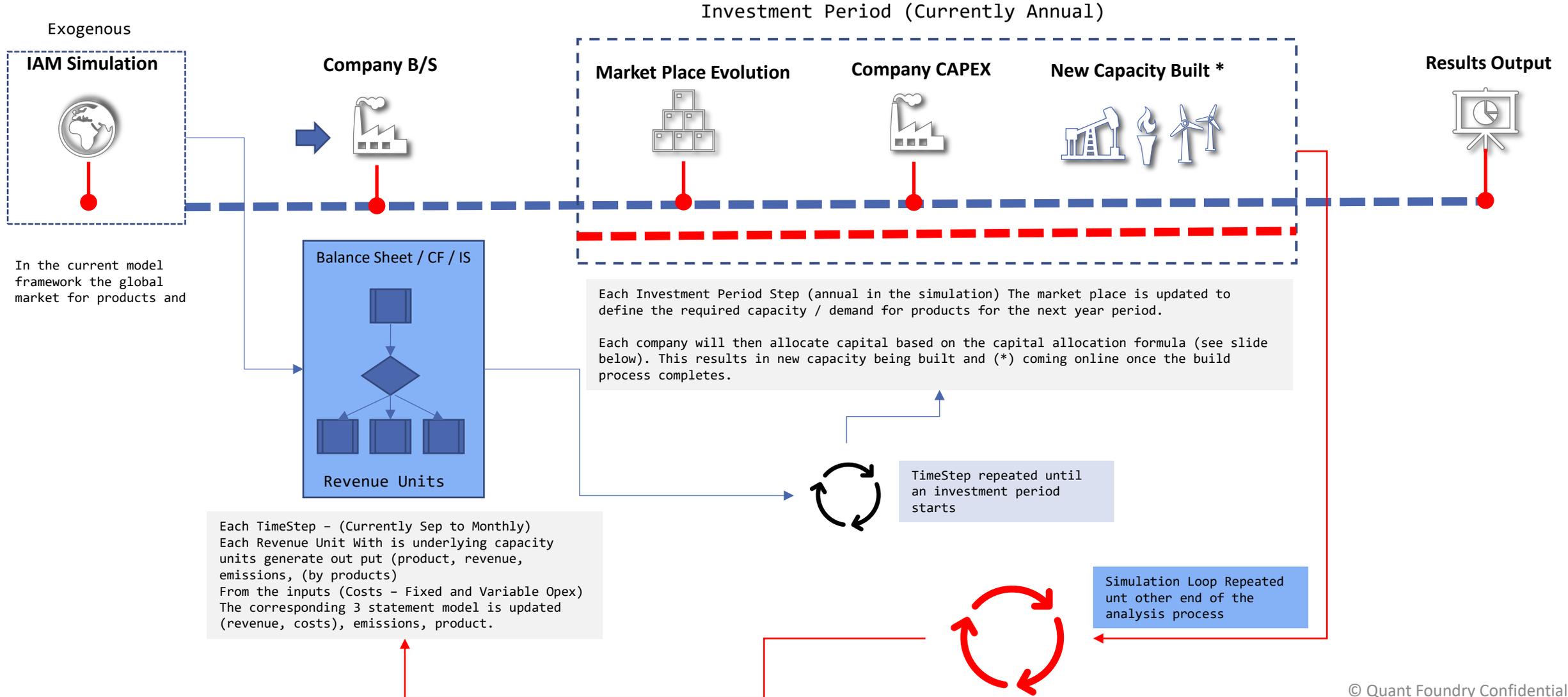


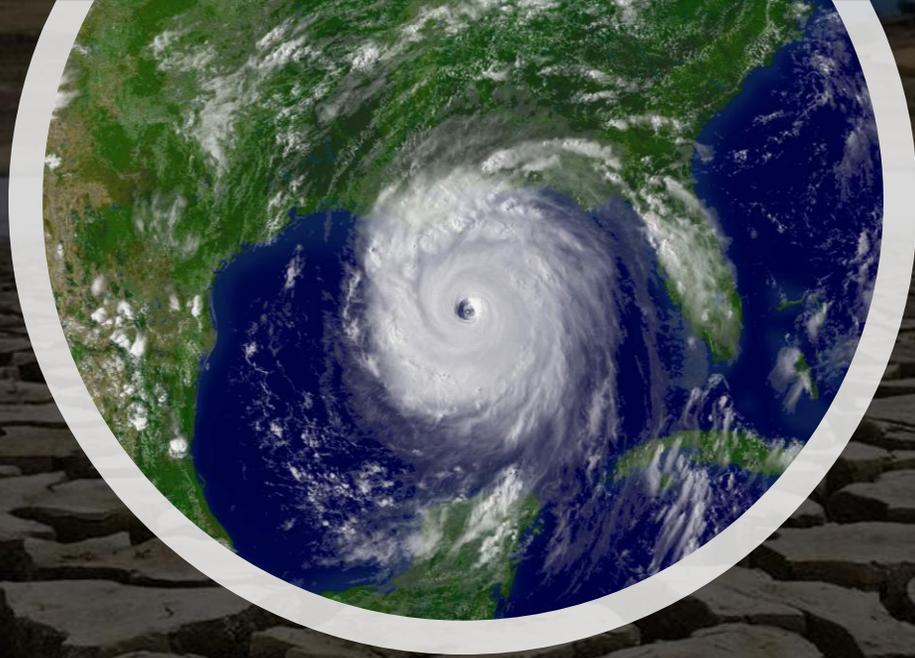


Simulation Sequence – Time Step Evolution

Description:

This slide outlines the simulation process for a company interacting with the market place. The simulation steps below are for the exogenous macro (IAM) driven companies where the supply and demand are given for each company. Uncertainty can be introduced by changing a number of the model inputs (e.g. climate scenarios, utility function parameters). To create multiple outcomes.





Physical Risk

Physical Risks

Summary of the Physical Risks

Physical risks are complicated and require sophisticated modelling

to map from the climate scenarios (IPCC) to localised impacts of weather to specific indications of damage.

Physical risks can be both **acute** (flood, wild fire) and **chronic**, rising sea levels, reduced average rainfall, increased average temperatures.

Both pose economic challenges and can incur critical failure.

Acute Risk: pose a challenge in expected losses at an economic level impacting productivity, replacement costs / insurance premia and will require significant spending on new infrastructure by companies, individuals and nations.

Chronic Risks

Pose long term challenges for nations to manage, from agricultural planning, infrastructure resilience spending, health care spending / insurance.

Sovereign Scale Risk

National failure, severe economic damage (hurricanes), Mass crop failure, mass migration, warfare.

Chronic Risk

Degradation, of agricultural land, natural and human habitats, increased spread of disease (e.g. malaria)

Second Order Risks

Disruption of supply chains, important infrastructure
A complex interplay of the impact of first order risks from direct and potential damage

First Order Risks

Direct damage to properties, assets, peoples health

