

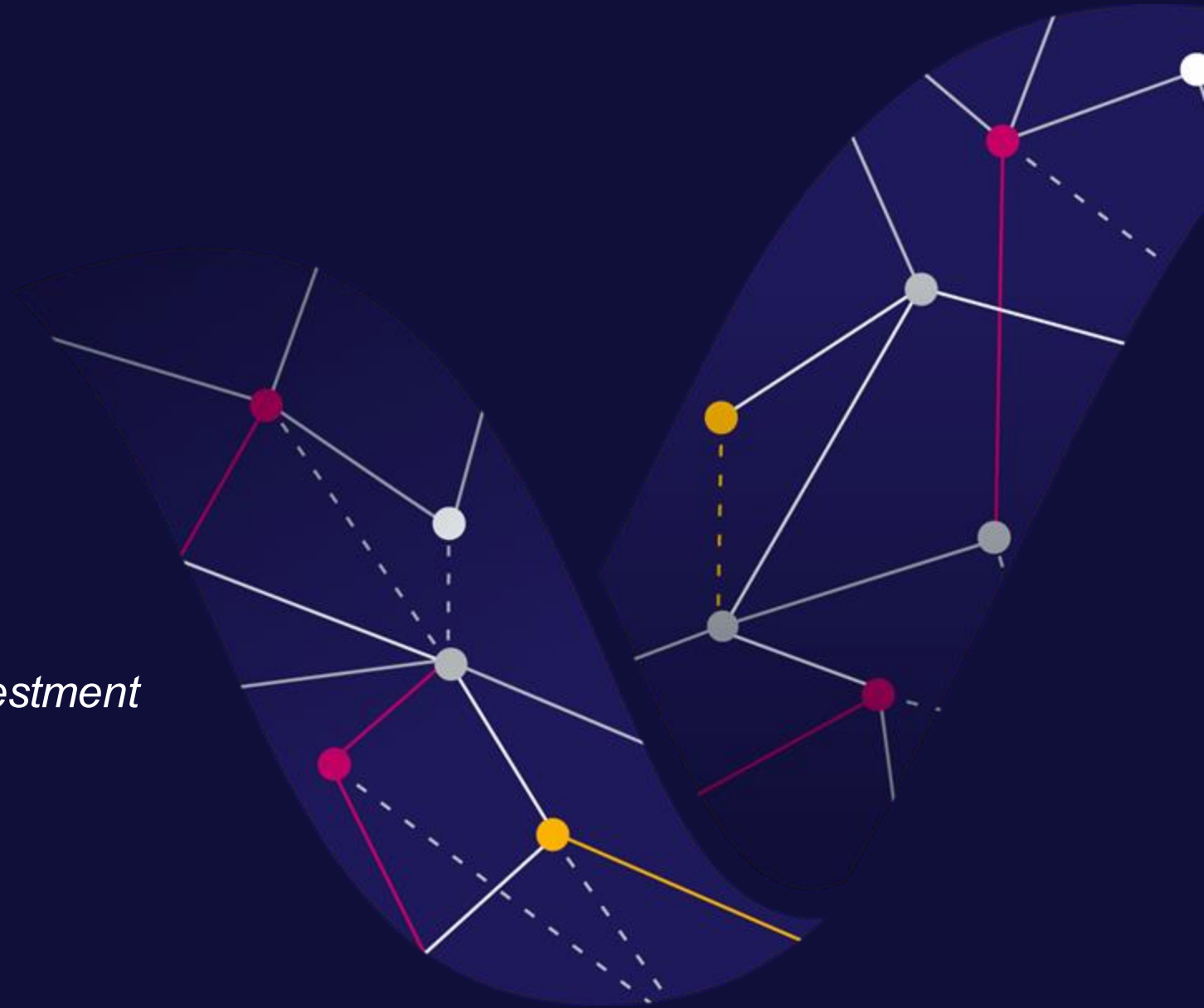


Data-driven products for infrastructure investment

Discussion on cost of capital

24 April 2025

CONFIDENTIAL



Agenda

1. Intros & objectives for today
2. Cost of capital: A case for change?
3. Online platform – demo & feedback
4. Alternative models to CAPM
5. Visions for the way forward

The Vallorii team brings together expertise across AI, data science, economics and financial analytics



Sandy Arbuthnott
Oxford/LBS, ex-Bain, engineering, sustainability & program management



Lennart Baumgärtner
Oxford, ex-McKinsey, complexity economics & physics



Anita Bharucha
Cambridge, ex-Whitehall, public sector NED, ops leadership



Cassian Burger
Bocconi/Cass, ex-investment banking



Jorge Cardenas
KIT, ex-Quantum Black, AI product leader



Cassandra Etter-Wenzel
Oxford, ex-OECD, regulatory specialist



Dieter Helm
NED, Oxford Prof of Economic Policy



Cameron Hepburn
NED, Oxford Prof of Environmental Economics



Ranjita Rajan
NED, start-up leadership, PE and sustainability expert



Robert Ritz
Cambridge fellow, ex-Vivid/McKinsey, financial economics



Jennifer Vaughan
Order from chaos

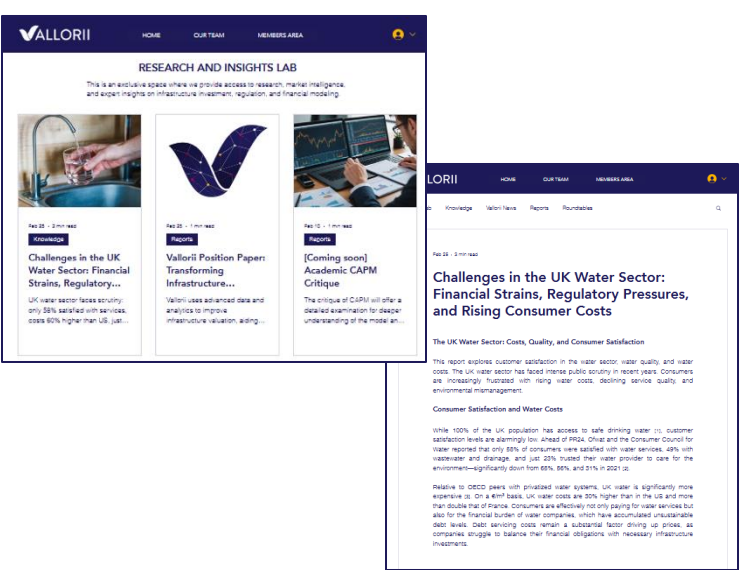


Henry Tian
LSE, Queens, ex-McKinsey data scientist

Fit-for-purpose infrastructure must be based on fit-for-purpose economics, data and models

Vallorii's progress since launching in January 2025

Events



- **Bi-monthly roundtables** with senior UK infrastructure leaders
- **Website** launched with online platform

Insights



- **Thematic paper** “*Time for a change? Cost of capital for future-proof infrastructure*” circulated
- Several shorter **working papers** circulated for comment

Platform



- **Interactive online tool** on CAPM cost of equity launched
- **Custom reports** available on demand

Agenda

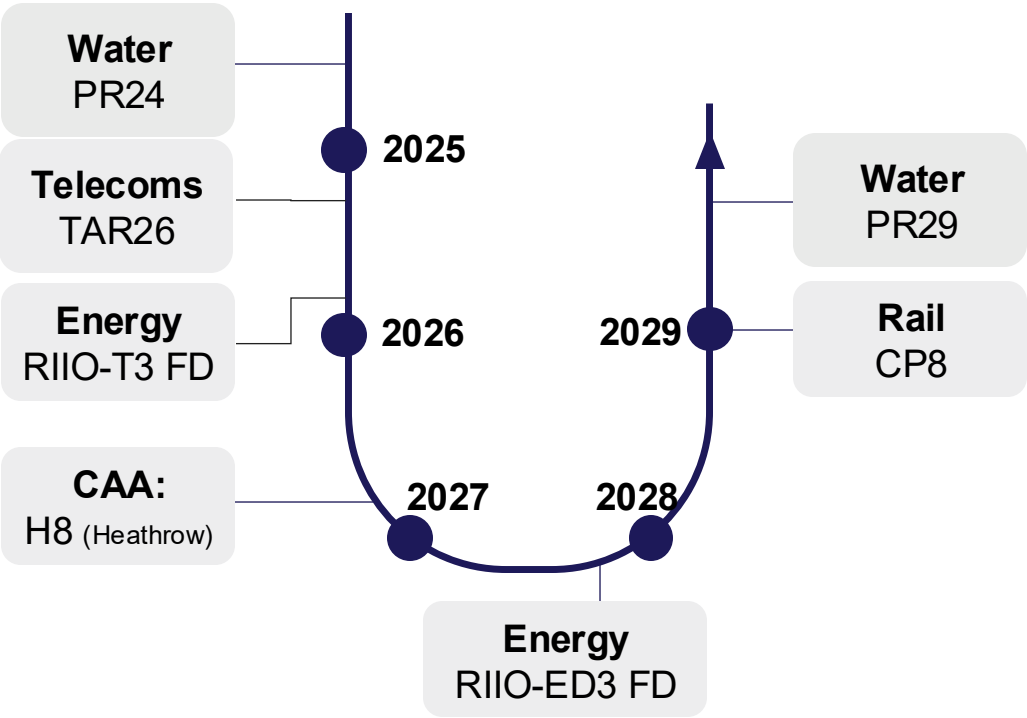
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Regulatory decisions over the coming cycle are potential opportunities to support the UK’s new growth mandate

HM Treasury’s new approach to regulation looks to boost growth and investment

Status quo	Regulatory framework built on established, formula-driven approaches Tends to prioritize consumer protection
Government mandate	New policy framework towards growth-oriented regulatory environment Urges regulators to increase focus on innovation, investment, and competitiveness
Implications for regulation	Risk assessment to more accurately reflect project-specific challenges, and encourage investability Potential implications for cost of capital

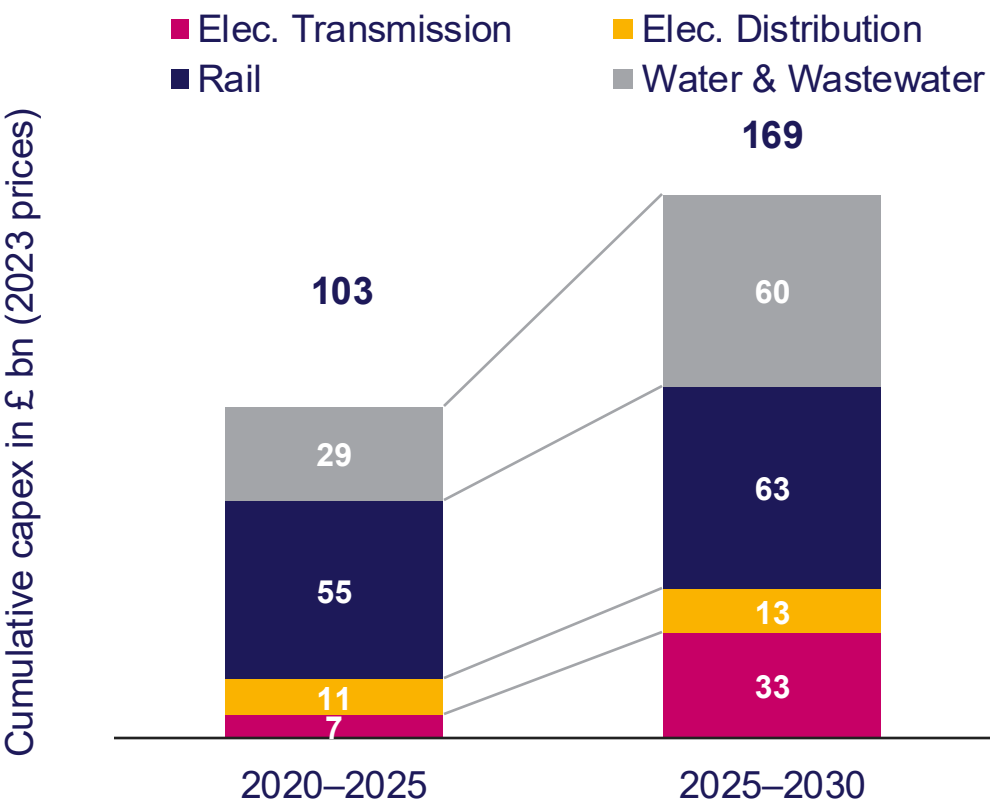
Major UK regulated sectors will have a decision over the coming 5 years



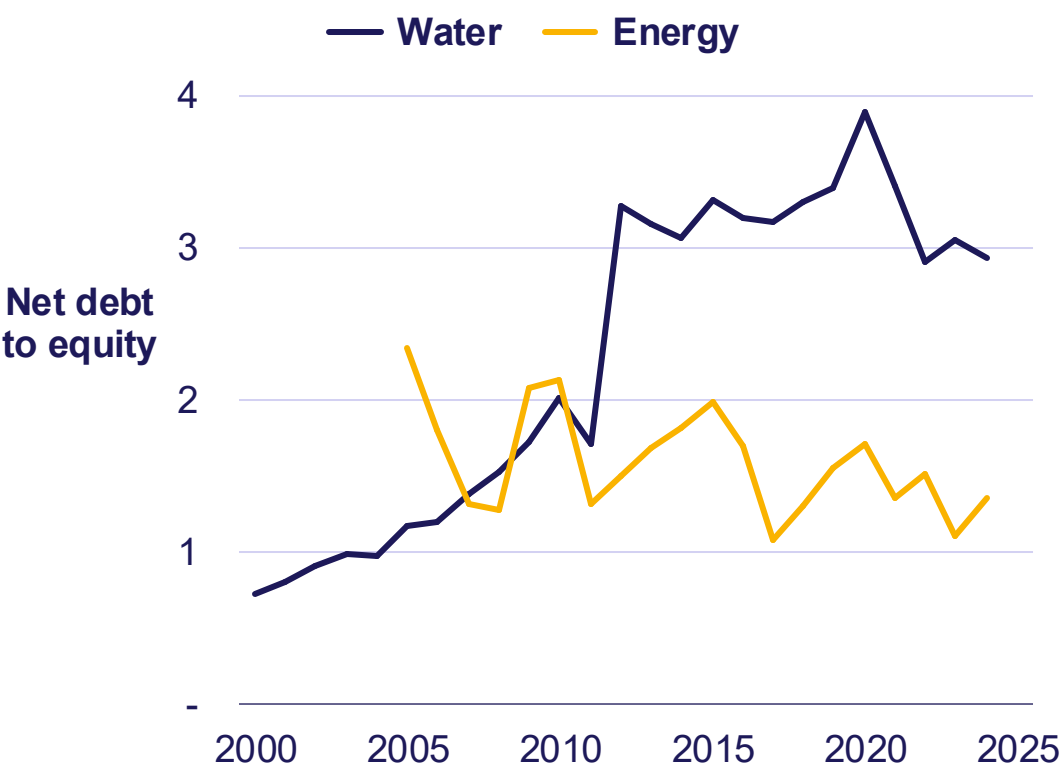
Net zero mandate will affect all determinations

Capex in key regulated sectors may rise by 63% over the next 5 years, and stretched balance sheets may make new equity raises necessary

Projected capex requirements in key UK regulated sectors

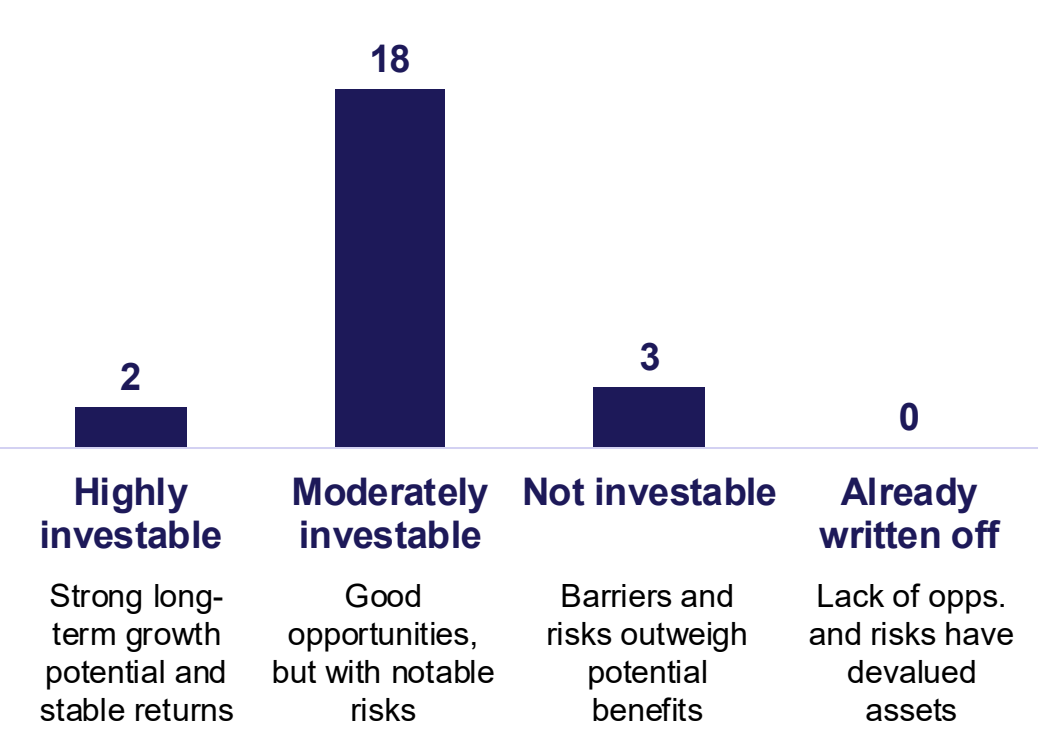


Net debt to equity ratio of UK water¹ and energy² sectors



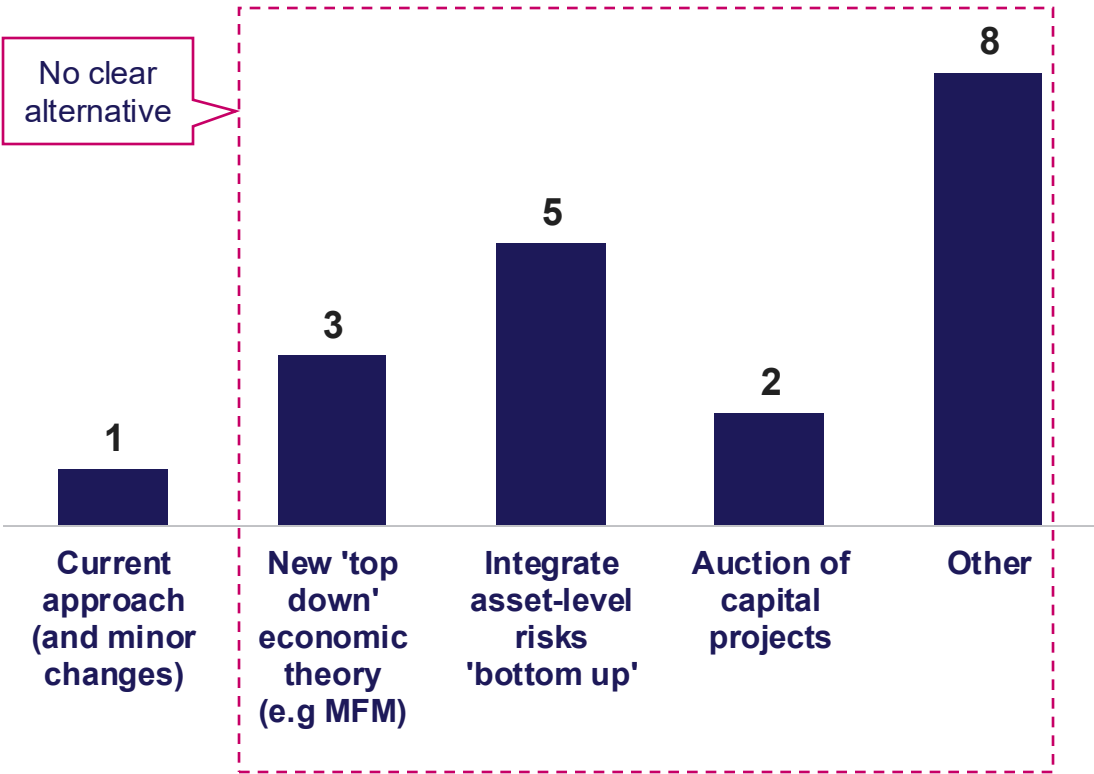
An informal survey of ~25 senior UK infrastructure leaders revealed a mixed picture on investability and little clarity on alternative approaches

“How investable is UK infrastructure?”



>90% of attendees agreed that UK infrastructure investments face moderate to significant risks

“What is the right model for sustainable investment in infrastructure?”



>90% of attendees agreed that the current model needed to change to enable a successful step change in investment

Infrastructure investment faces a wide array of traditional and new risk factors, which it is increasingly possible to quantify using AI and big data

Traditional risks, typically accounted for in today's risk analysis

- Construction/development risks
- Operational risk
- Counterparty risks
- Interest rate and financial risks
- Currency and market risks

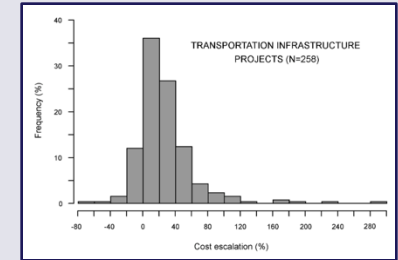
Elevated and new types of risks, often underrepresented in today's risk analysis



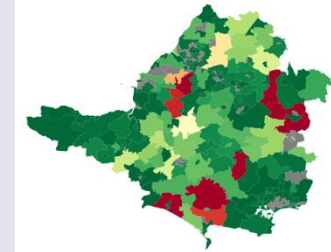
Focus using AI and advanced analytics

- Regulatory/political risks
- Cyber risks
- Natural disaster and climate change risk
- Terror-related risks
- Geopolitical risks

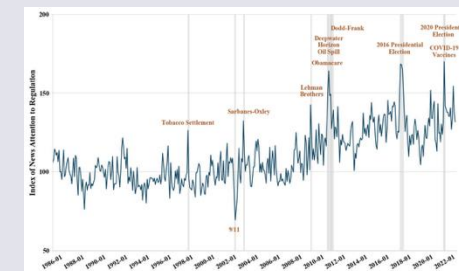
Construction risks in transport projects are fat tailed



Storm overflow risk can be modelled at the asset-level using AI



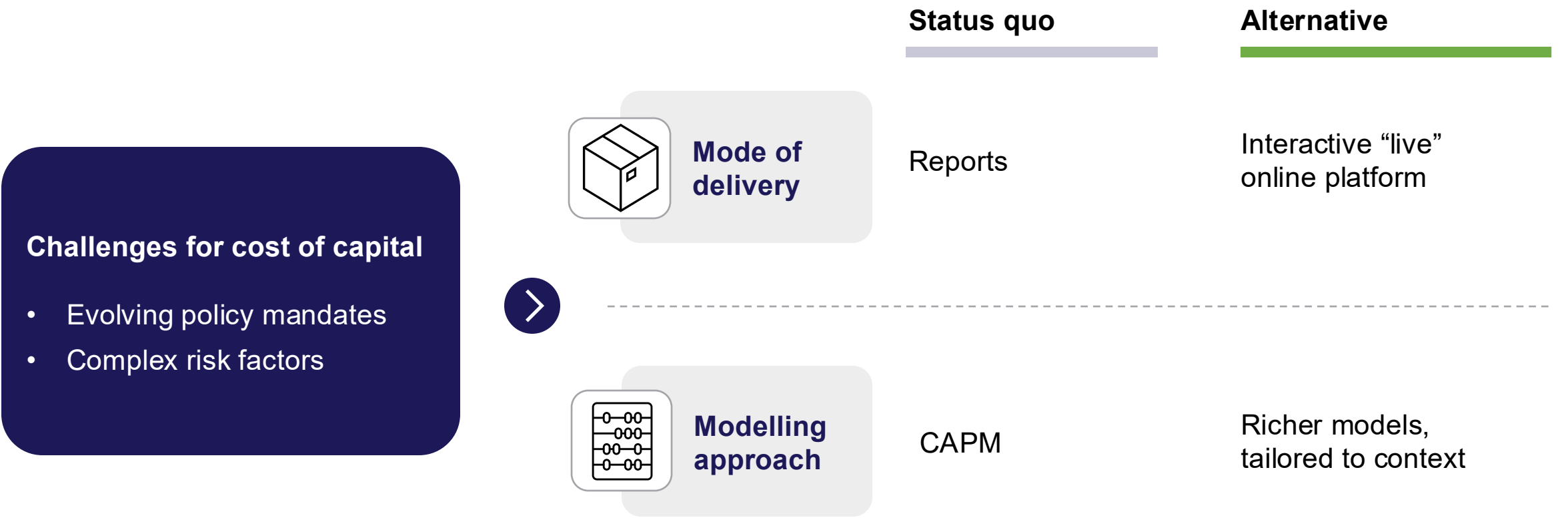
US media shows increasing attention to regulation



Some recent UK infrastructure projects have moved beyond CAPM due to concerns around speed of delivery and investability

Project	CoE model	Described rationale (not exhaustive)
ASTI	RIIO-based + risk uplift	Incentivize early project delivery while compensating fairly for higher risks
Sizewell C	Bid-based real CoE	“A key advantage of this approach is its simplicity relative to other options as well as providing clear market driven information obtained under competition”
Tideway	Bid-based real WACC	De-risked investors during construction period by providing guaranteed return, making it easier to attract capital
Cunliffe Review	“The Commission is seeking views on potential changes to the WACC at future Price Reviews. Options could include ‘aiming up’ on the WACC, as the CMA did at Price Review 2019. This would mean Ofwat set a WACC above their central estimate, to reflect the risk of underinvestment	

Today’s discussion will explore alternatives to cost of capital analytics in terms of the mode of delivery and the modelling approach



Agenda

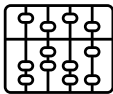
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Vallorii's CAPM modelling tool can address three pain points in cost of capital analysis

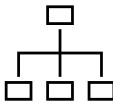
We've heard **three pain points** in current modelling



Difficult to collect raw data



Manual modelling is tedious



Difficult to test implementation choices

app.vallorii.com

Cost of Capital Lab can help



Fully automated

Weekly updates

Test scenarios in few clicks

Vote on your desired CAPM features, and let us know why it would help

ILLUSTRATIVE

1. Download raw input data to Excel¹

Download raw **split- and dividend-adjusted** stock and market index data

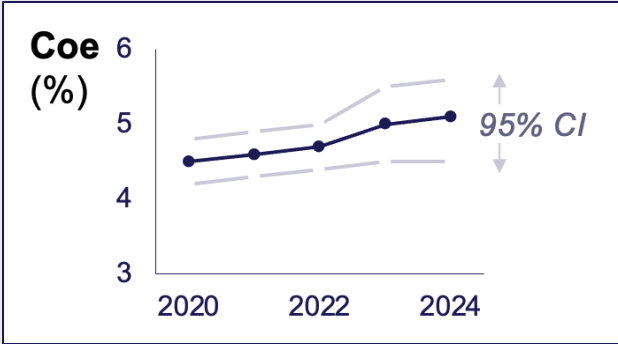
Download **company financials** (EV, net debt) for gearing calculation

2. Download results data to Excel

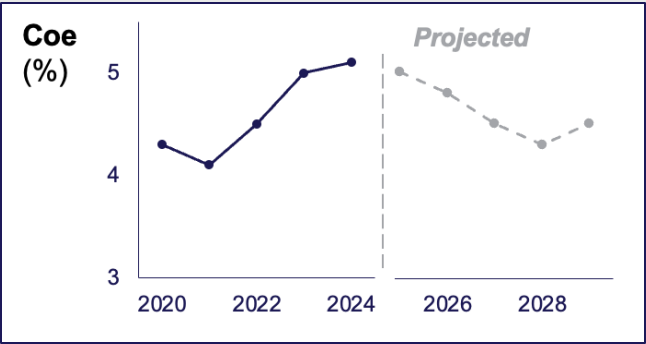
Download all results (CoE, notional beta, raw betas, etc.) to Excel for analysis

Produce shareable **PDF report**

3. Understand regression uncertainty



4. Forecast CoE given RfR projections



5. Optimal peer group selection

Rigorous and automated framework to choose **optimal comparator companies to run CAPM**

Or, novel method to create an optimally-comparable **synthetic company**

6. Other

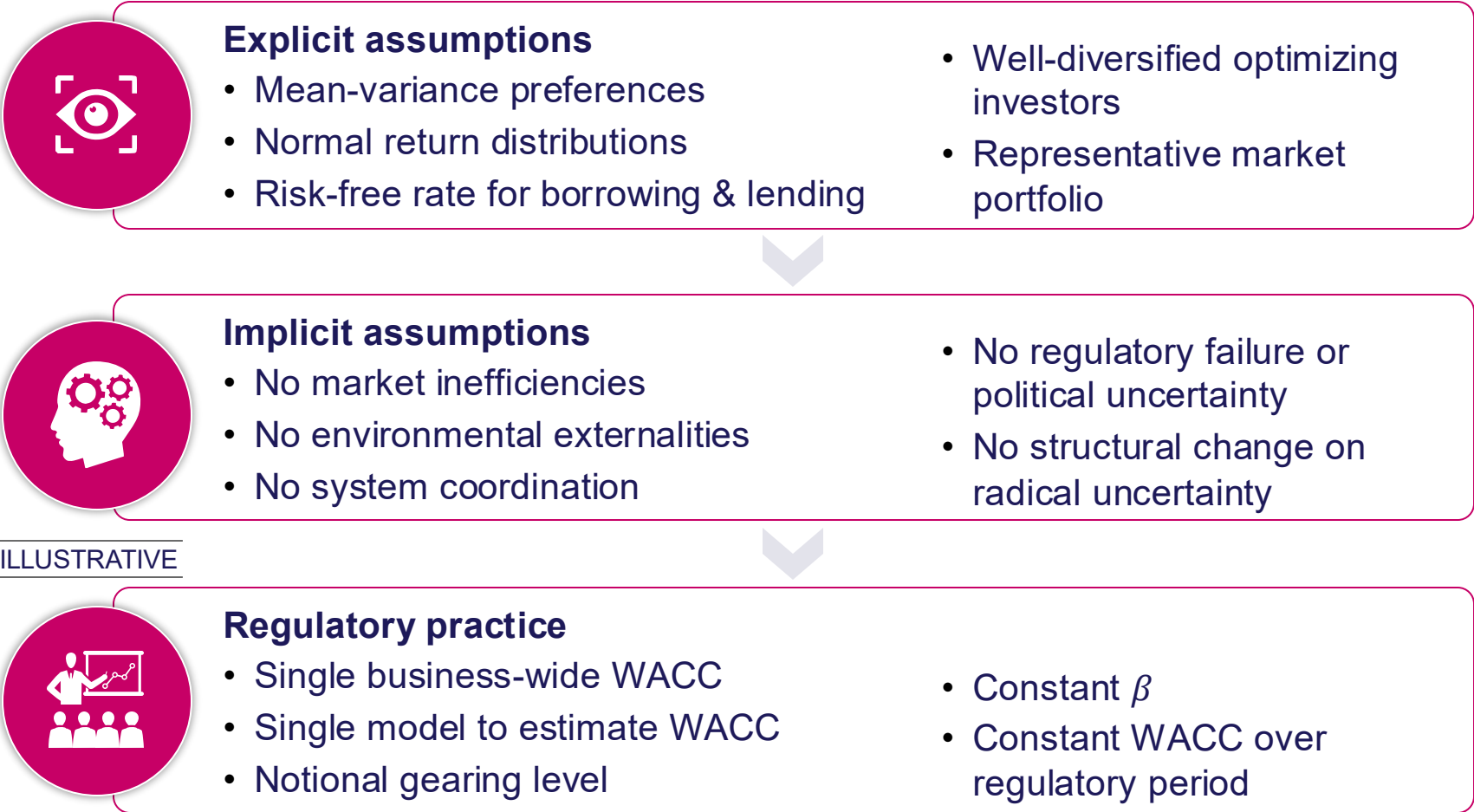
Please elaborate in the chat

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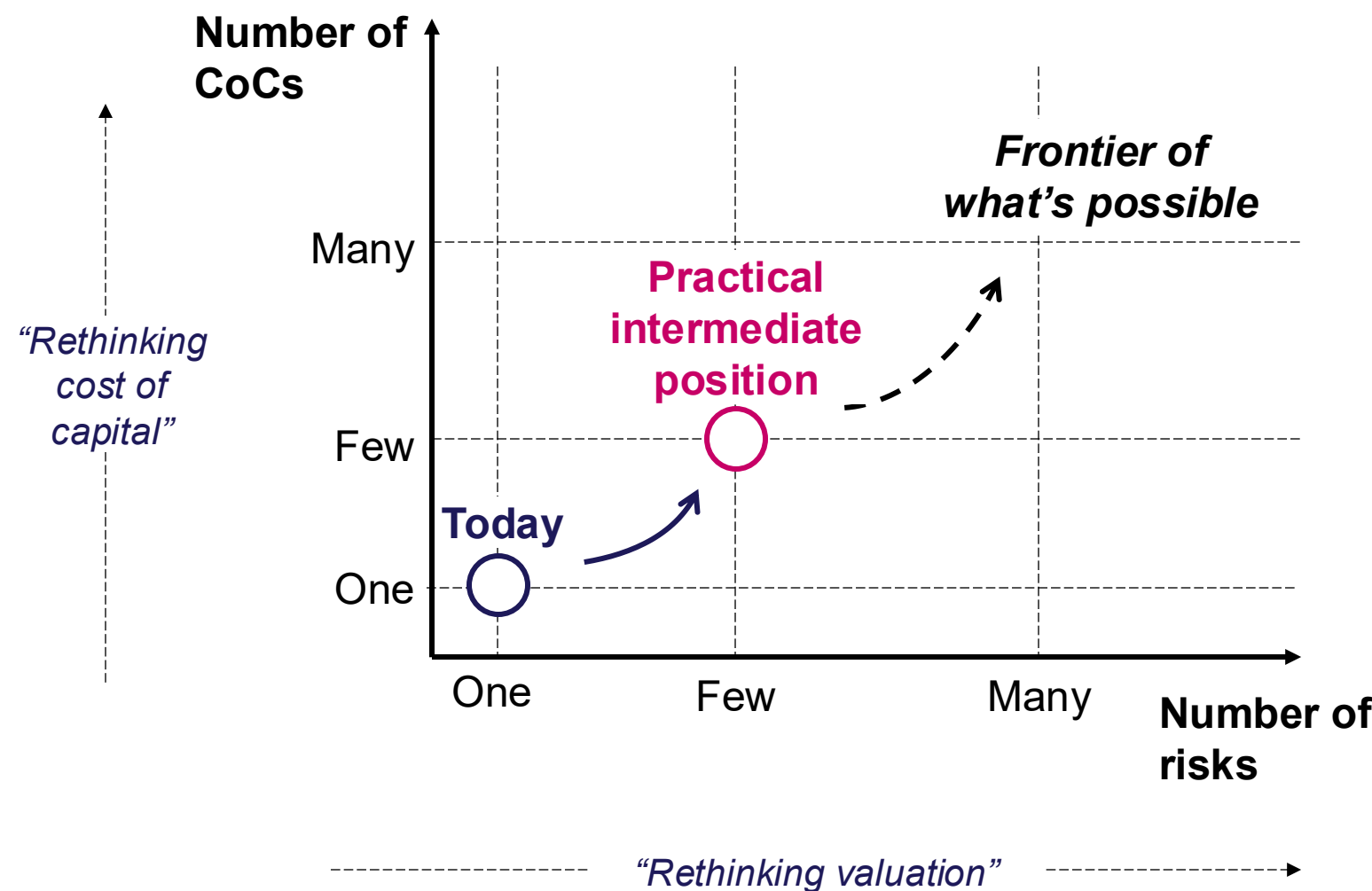
Taking CAPM into regulatory practice relies on strong assumptions



ILLUSTRATIVE



“Art of the possible” needs to be applied pragmatically and in stages to achieve progressive change

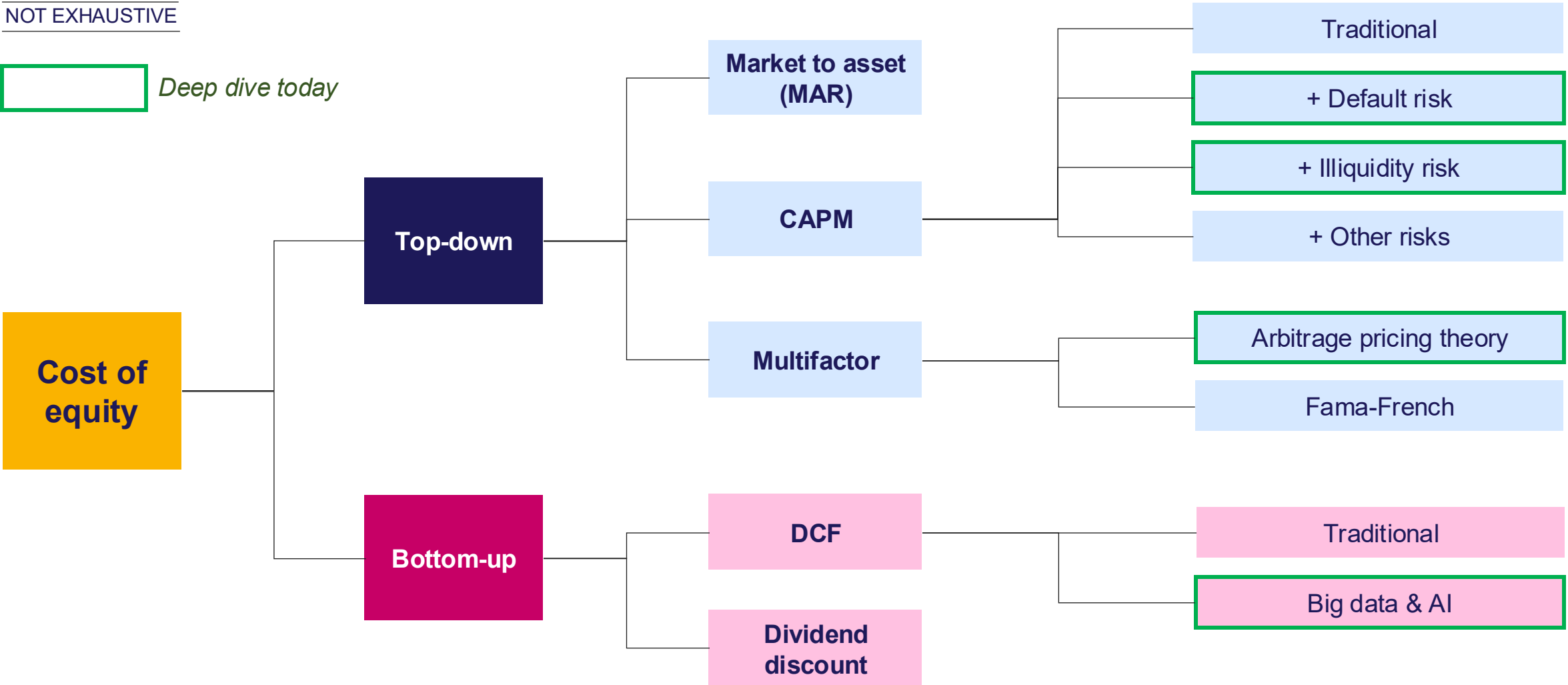


- **With rise of big data and AI,** granular assessment of every project is now possible
- But “academic rigour” must be balanced with **practical constraints on regulators and companies**

There are a number of different approaches to estimate the cost of equity

NOT EXHAUSTIVE

Deep dive today



Any regulatory model of the cost of capital should be evaluated against a balanced set of assessment criteria

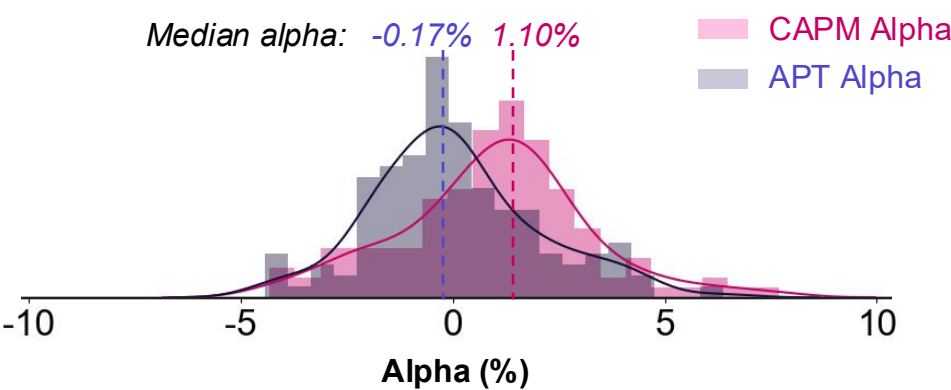
Criterion			Description	Most important to?
1 IMPLEMENTABLE		Empirically implementable	Readily usable by stakeholders and based on widely available data	Investors, regulators, utilities
2 REPRESENTATIVE		(A) Realities of regulatory framework	Represents how regulation shapes returns and risks, with mandates on net zero and social objectives	Regulators, utilities, society
			(B) Realities of capital markets	Captures investor concerns such as political risk and institutional factors such as limited diversification
3 DEFENSIBLE		(A) Theoretically defensible	Represents economic and financial mechanisms that have plausible causal interpretations	Regulators, society
			(B) Empirically defensible	Can be implemented with limited user discretion and yields results that are sufficiently robust and stable

Source: Vallorii team, [Wright, Burns, Mason & Pickford 2018](#)

Case study 1: Arbitrage Pricing Theory has been applied to regulated utilities and can outperform CAPM

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Distribution of alphas for a sample of US regulated utilities (n=129)
Alpha = gap between utility's historical return and return predicted by CAPM/APT



Insights

CAPM alphas are positive:

- Indicates underprediction of risk and CoC ($\beta < 1$)
- Suggests omitted variable bias

APT alphas are near zero:

- Indicates good model fit (on average)
- Consistent with additional risk factors being important

APT risk factors typically focus on “macro” e.g.

- GDP growth
- Inflation
- Yield curve
- Credit spreads
- Commodity prices

Benefits for regulation

Decomposes aggregate risk

- Mirrors how asset managers and financial institutions price risk
- APT CoC estimates *not necessarily* higher than under CAPM

Allows sector-specific CoE approach

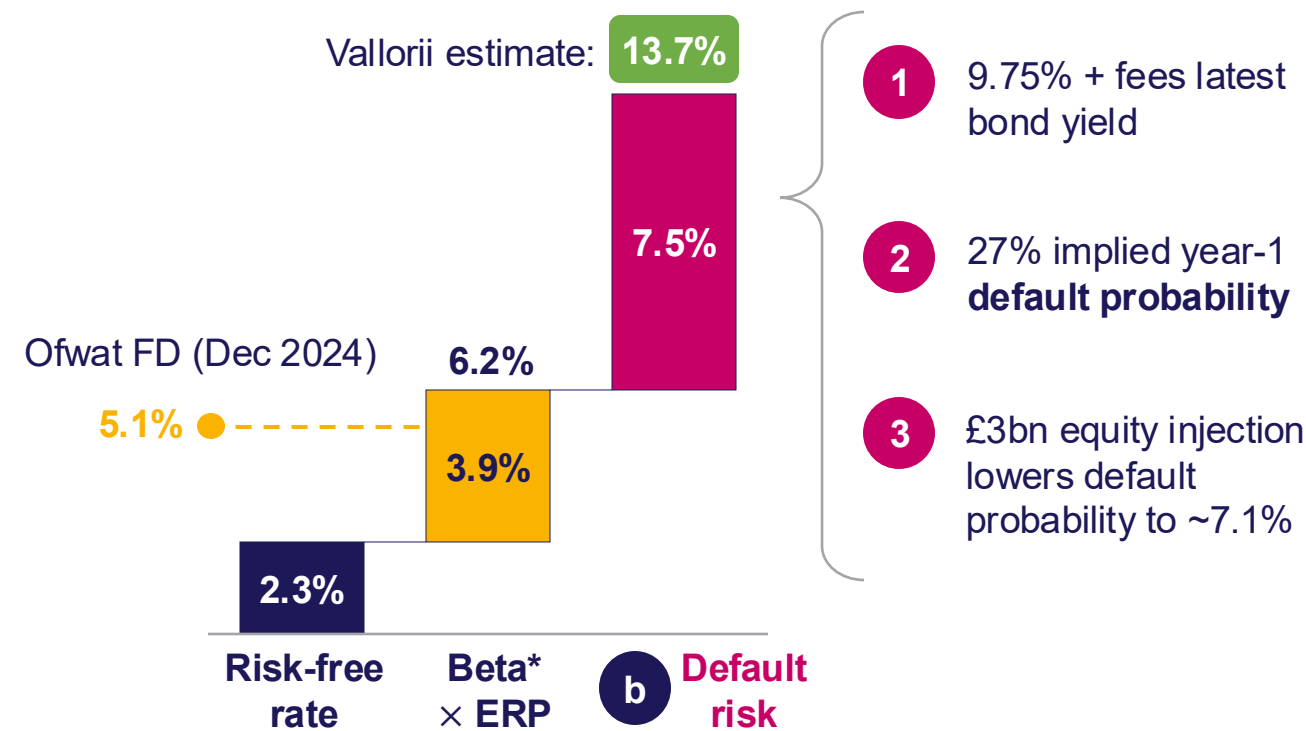
- Important as sectors face different risk factors (e.g. *transition risk for gas, ODI penalties for water, demand volatility for airports*)

Set of risk factors can be updated & extended...

Case study 2: Vallorii estimates Thames Water cost of equity around 13.7% based on currently high default risk

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Default risk premium raises CoE to 13.7% (real)



a *Based on UKRN guidance, Ofwat’s uses a ‘through the cycle’ interpretation of CAPM. Here, we use a ‘in the cycle’ interpretation that is more appropriate for new equity and allows for the inclusion of additional risks

a ‘In cycle’ interpretation ERP

For new equity raises (not necessarily for existing equity)

$$CoE = \beta * ERP + r_f$$

Long-term equity risk premium (ERP) over risk-free rate reflects risk and opportunity costs for new investors more accurately

ERP estimates: Low = 5.5%, High = 6.5%
Based on DMS data for long-term UK equity returns and $\pm 0.5\%$ uncertainty (in line with Oxera estimates)²

b CAPM does not consider default risk

- Under CAPM, assets do not default
- In reality, default risk is costly

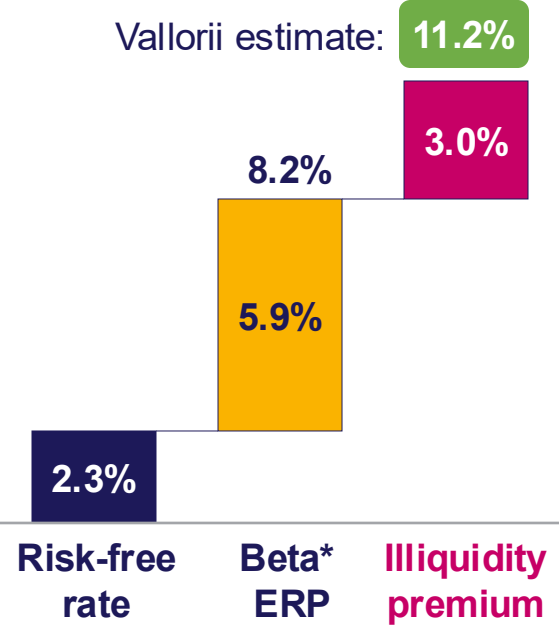
Source: Ofwat PR24 FD, Bank of England, Vallorii Analysis

1. Beta*ERP calculated using a 6% ‘in-cycle’ equity risk premium (ERP)
2. Arithmetic mean of ERP relative to bills since 1900 - 6% per DMS

Case study 3: While CAPM can not capture illiquidity risks, Vallorii estimates up to 300bps illiquidity premium for Sizewell C

ILLUSTRATIVE

Illiquidity risk premium raises CoE to 11.2% (real)



* 'in the cycle' interpretation

Large infrastructure investments face illiquidity risks which CAPM neglects

CAPM assumption

CAPM assumes **infinite liquidity** (trade any volume with zero transaction cost)

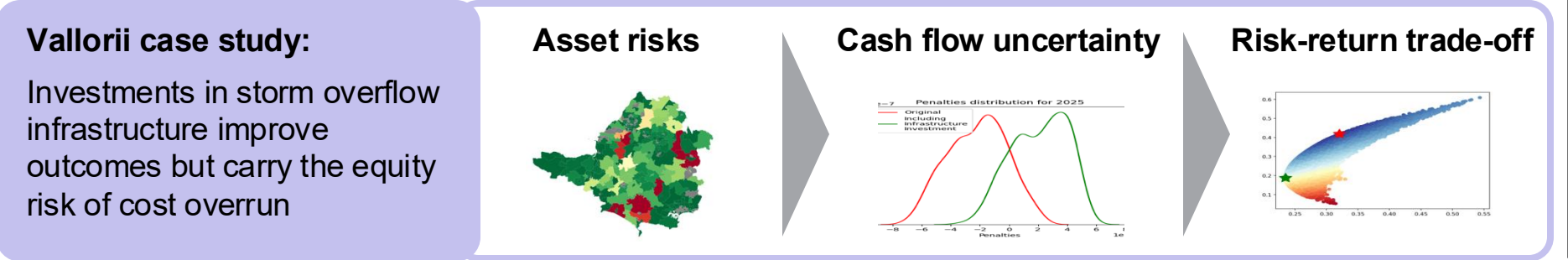
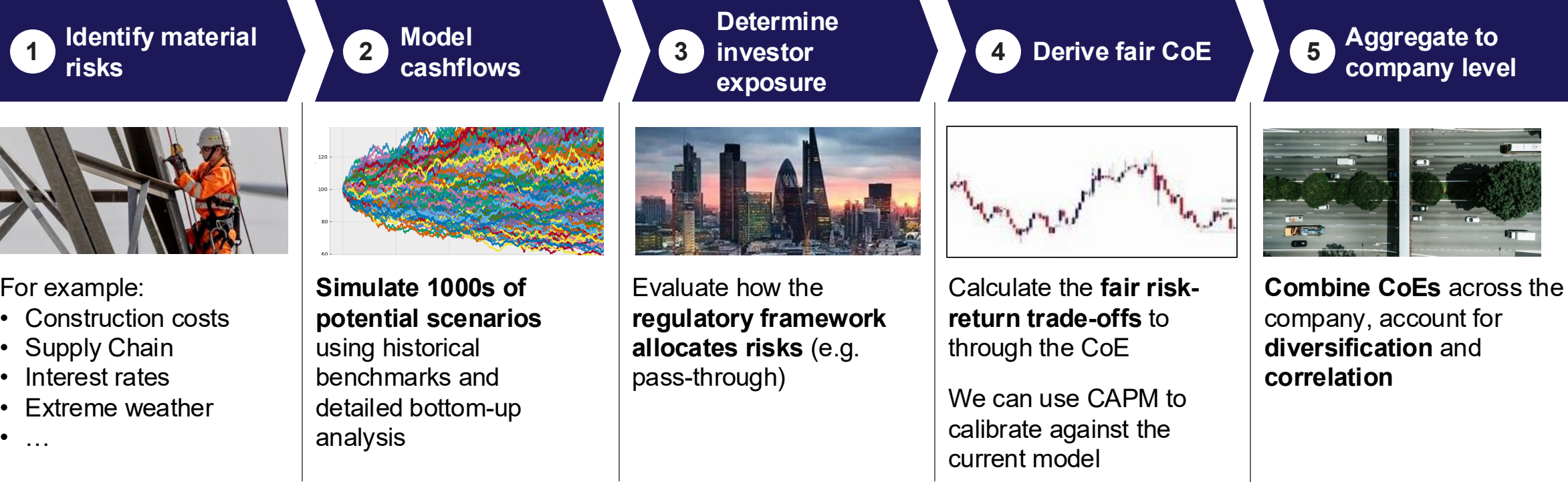
Market reality

Large infrastructure projects often face **multi-decade holding periods** with no/minimal exit possibilities

Valuation approach

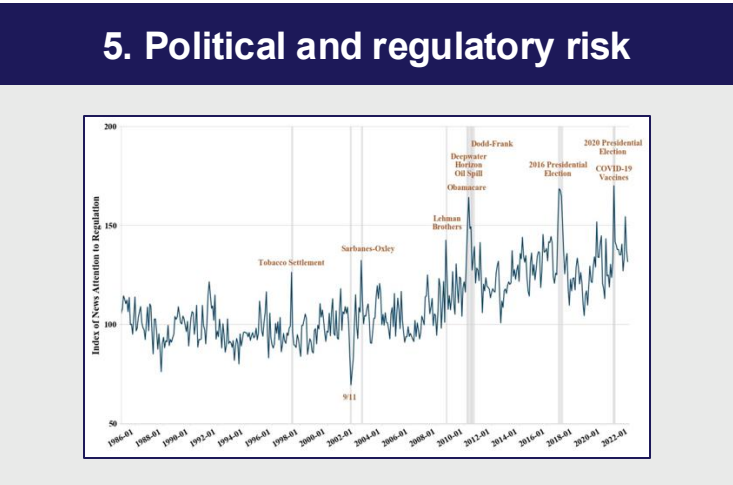
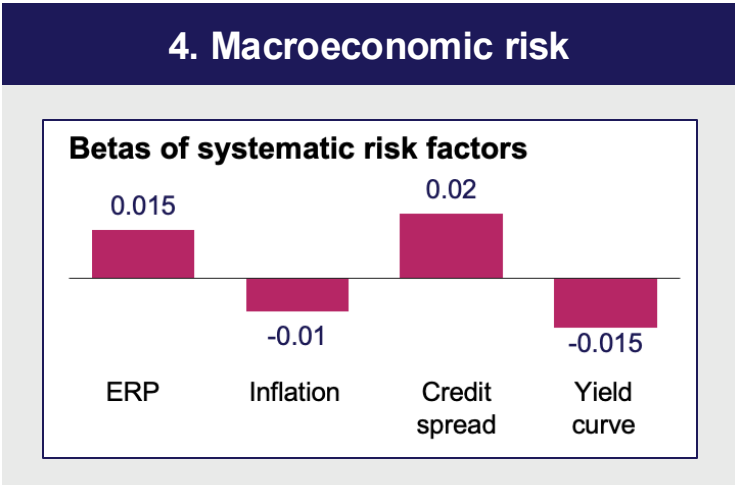
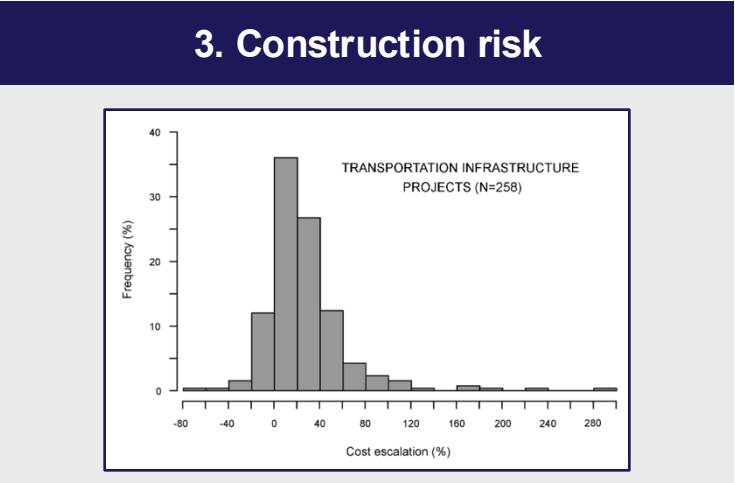
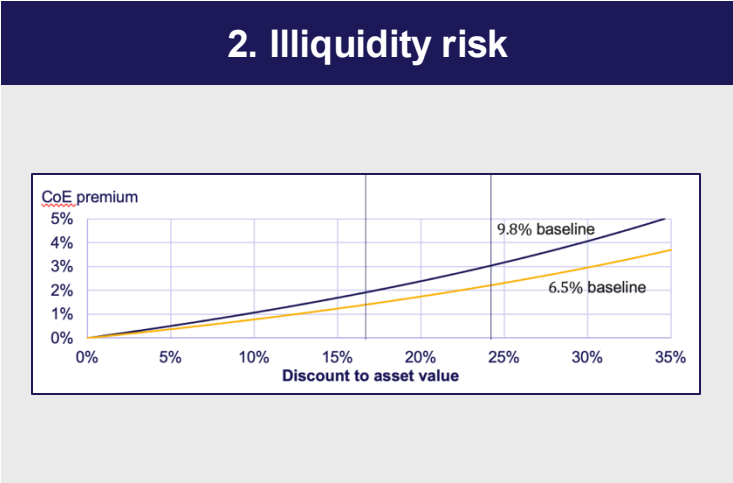
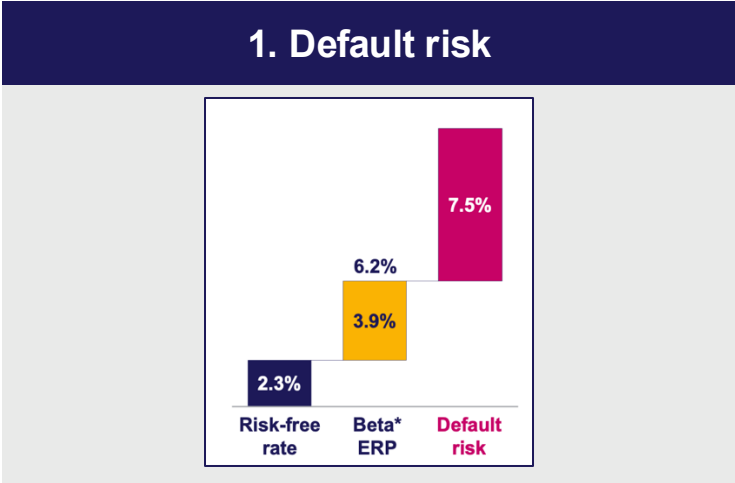
Illiquidity premium can be estimated using an application of **financial options** theory

Case study 4: A bottom-up approach can model investor exposure explicitly and set a fair compensation for risks via the cost of equity



Vote on desired risk factors to model, and let us know which are most salient

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6. Other risk factors

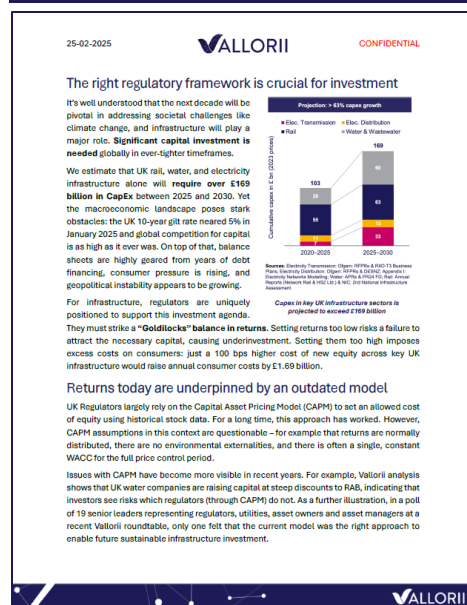
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Three visions for reform around cost of capital have emerged in conversations with UK regulated infrastructure leaders

Vallorri thematic paper details three visions



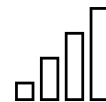
CAPM revamp

Use CAPM as foundation, with refinements

Improved peer group selection

Actual company gearing level rather than notional gearing

Using a long-term equity risk premium

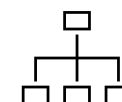


CAPM+

Augment CAPM with risk factor modelling

Build a richer set of risk factors, either systematic or at company-level

Acknowledges that systematic risk for infrastructure can be multidimensional



Bottom-up pivot

Asset-level analysis for risk premia

Asset-level modelling based on big data and AI, distinguished by project, technology, geography etc.

Aggregate over all assets to generate a company-level cost of capital

Vallorii's product roadmap can help CAPM modelling and in moving beyond CAPM – we welcome your feedback!

Cost of Capital Lab



Current features (CAPM)

- Online CoE modelling
- Customize methodology
 - Choose precise components (e.g. type of RfR, market return)
 - Select comparator companies in peer group

Data/results updated weekly

Features roadmap (CAPM)

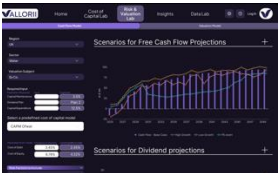
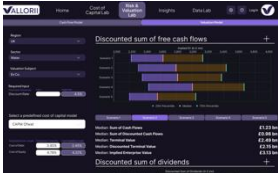
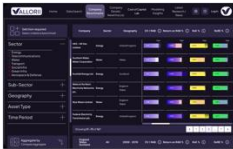
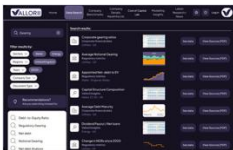
1. Download raw data
2. Download results data
3. Statistical uncertainty
4. CoE forecast given RfR
5. Automated/optimized peer group selection
6. Other

Roadmap: Alternative models

- Risk premia toolbox, including
1. Default risk
 2. Illiquidity risk
 3. Construction risk
 4. Macroeconomic risk
 5. Political and regulatory risk
 6. Other risks

Prioritized based on your feedback over the coming weeks

Vallorii's Labs increase modelling flexibility, accuracy, and transparency

Product	Cost of Capital Lab	Risk & Valuation Lab	Research & Insights	Data Lab
User interface	 CoC Modelling  Scenario analysis  Model Comparison	 Cash Flow Modelling  Valuation Modelling	 Latest Research Access  Research Search	 Benchmarking  Company Deep Dives  Data Search
User benefits	- Automated delivery - Customizable risk factors - Model comparisons	- Automated delivery - Standardized methods - Uncertainty drivers	- Thematic research insights - International scope	- Single source of information - Granular non-financial data