

**The Actuarial Profession**  
making financial sense of the future

Life Conference and Exhibition 2011  
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**Economic Scenario Generation:  
Opening the bonnet for Solvency II**

20-22 November

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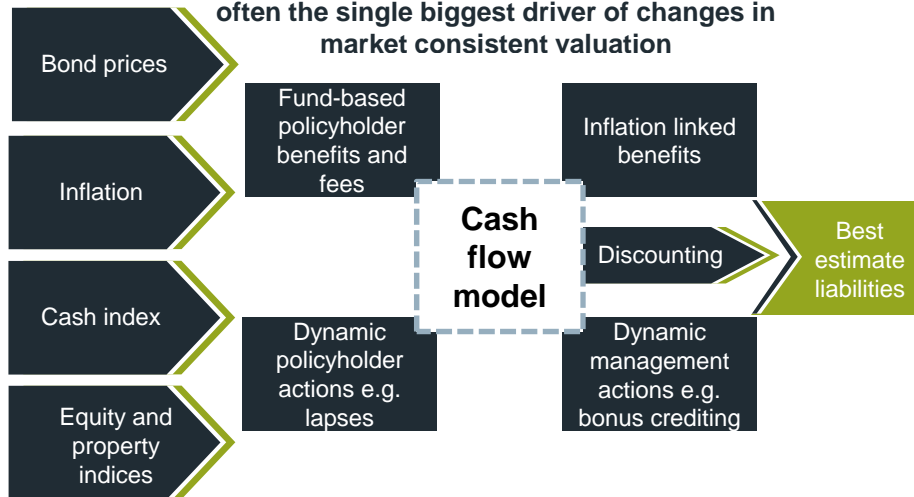


## Agenda

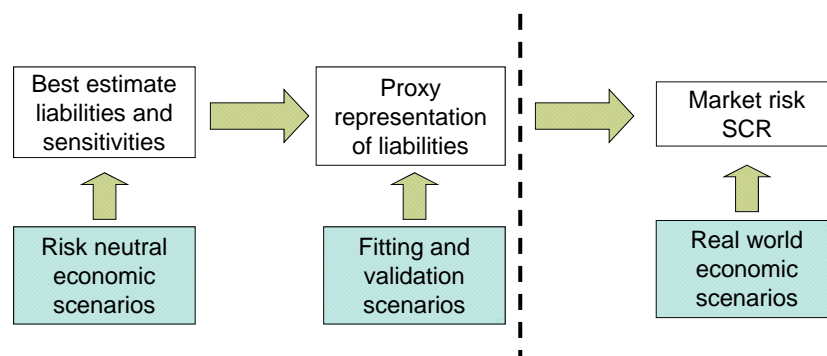
- What economic scenarios are and why we need them
- Current ESG practice
- How Solvency II is raising the bar
- Creating a robust governance framework
- How a possible SII-ready ESG process might look

## Discounted cash flow models for life business require projections of economic variables

Movements in economic assumptions are often the single biggest driver of changes in market consistent valuation

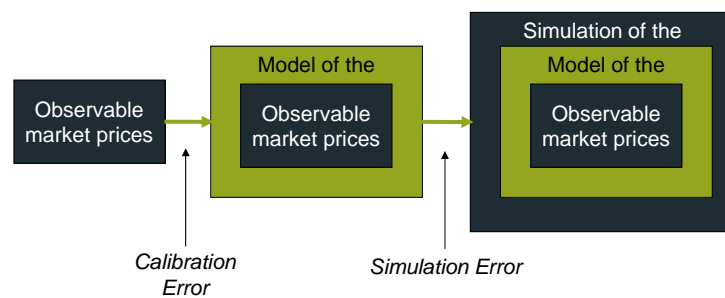


## Different types of stochastic economic scenarios are used throughout Solvency II Internal Models



## Market-consistent ESG calibration

- Three stages:
  - Market prices (or substitutes)
  - Calibrate model to the data
  - Simulate scenarios from the model



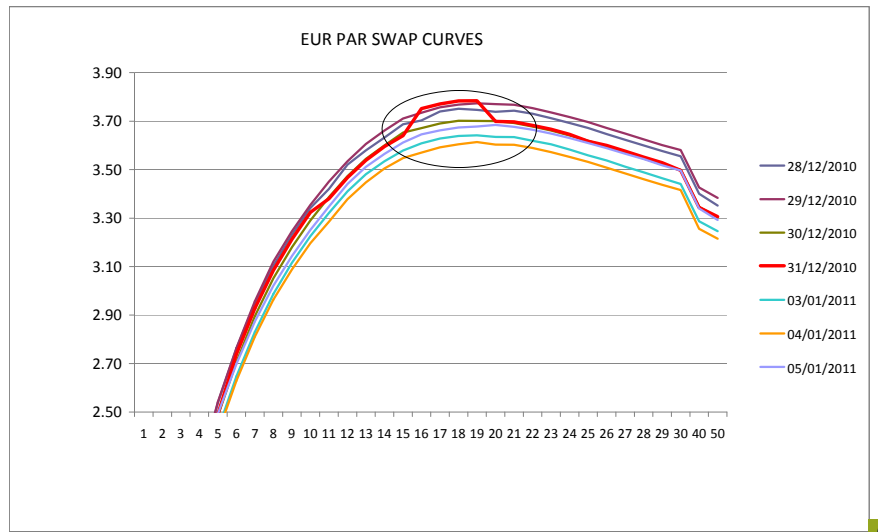
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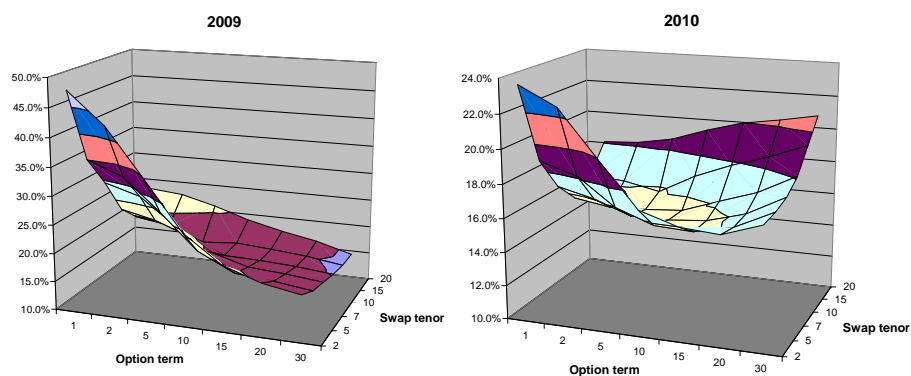
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## Accurate, complete and appropriate data



## Properly calibrated volatility

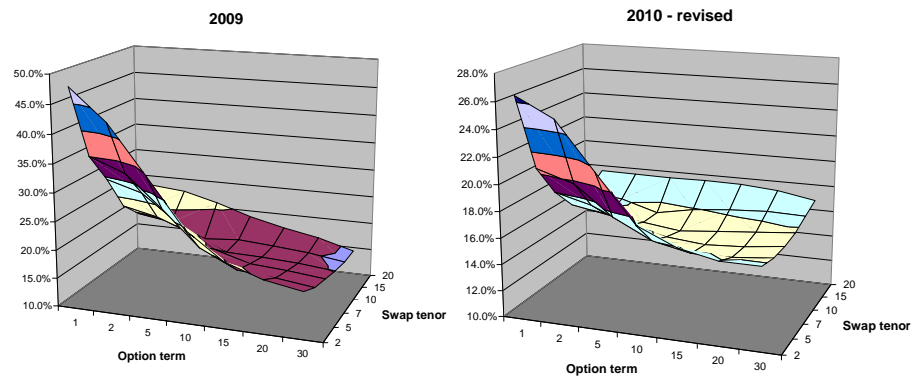


High short-term volatility and lower long-term volatility target creates reasonable swaption surface

Short-term volatility lower, swaption surface looks less plausible

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## Properly calibrated volatility



Long-term volatility target revised, swaption surface more convincing

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## Survey – ESG practices

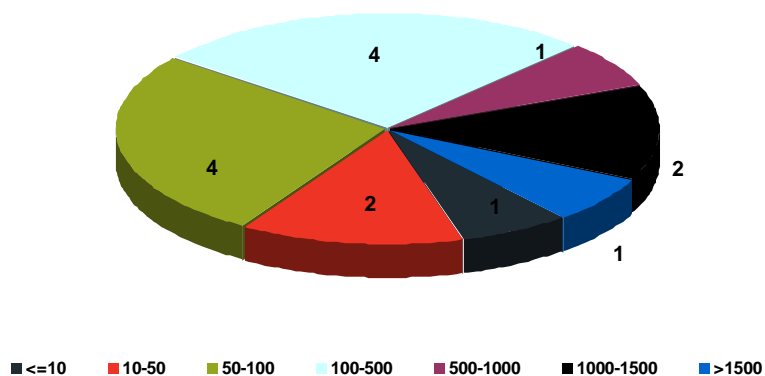
### 15 participating firms:

- Aegon
- Allianz
- AXA
- Aviva
- Co-Operative Banking Group
- Friends Life
- Legal & General
- LV=
- Munich Re
- Prudential
- Standard Life
- Wesleyan
- Zurich
- Plus two further firms

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## Number of scenario sets

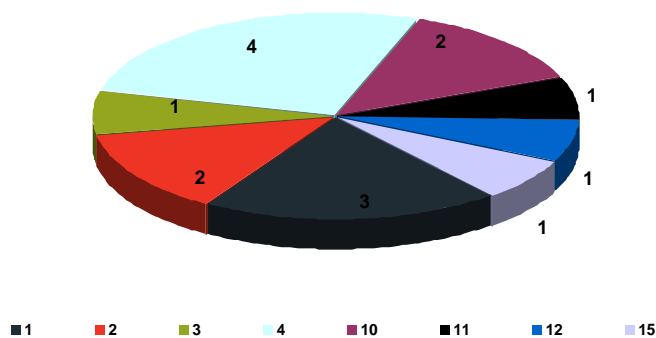
Approximately how many scenario sets do you produce each year, including sensitivities?



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## Currencies covered

How many different currencies?



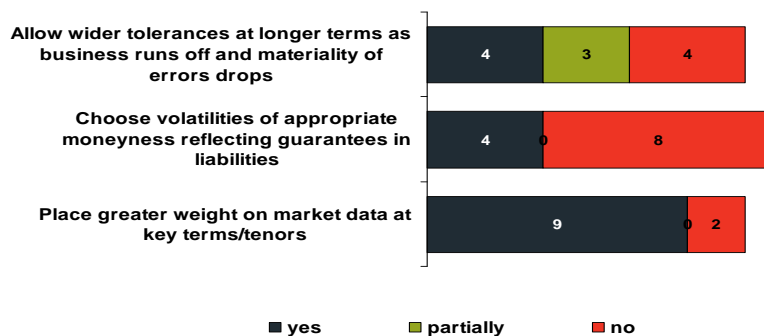
Most include at least one of GBP, EUR, USD

Other currencies: CHF, JPY, HKD, MXN, AUD, CZK, HUF, PLN, KRW, THB, TWD, SGD, INR, IDR, LKR, CAD, CNY, TRY, BRL

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## Adjusting the calibration

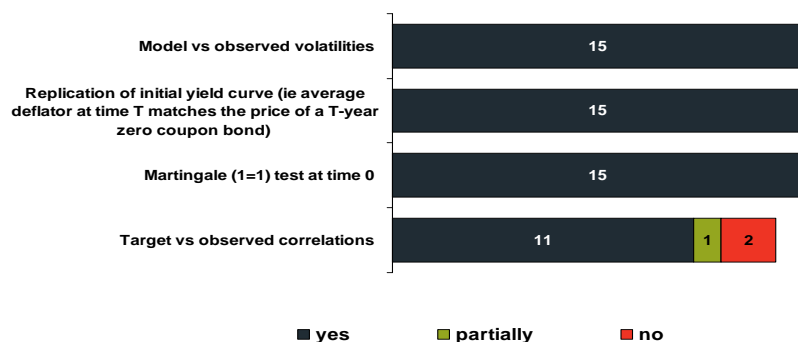
Do you adjust the calibration to reflect the nature of liabilities?



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## Validation

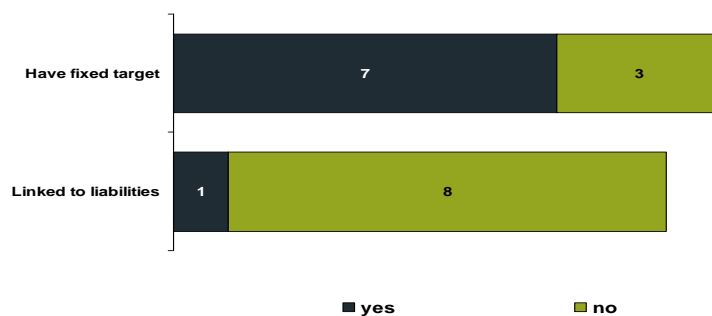
What market-consistency checks do you carry out to validate scenario sets?



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## Validation

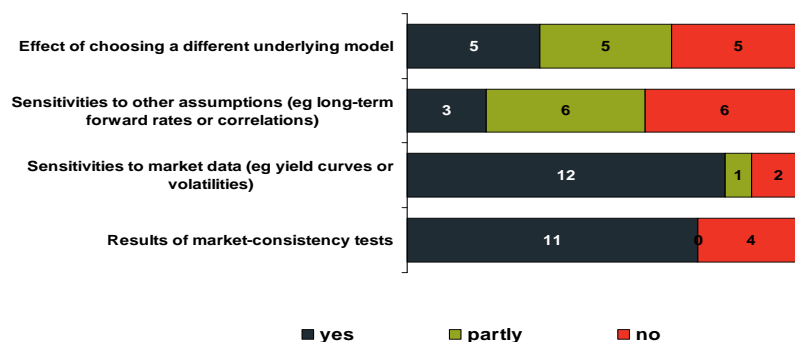
Do you have fixed targets for the maximum acceptable errors? If so, are these related to the sensitivity of liabilities to simulation error?



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## Communication

What information do you communicate to senior management?

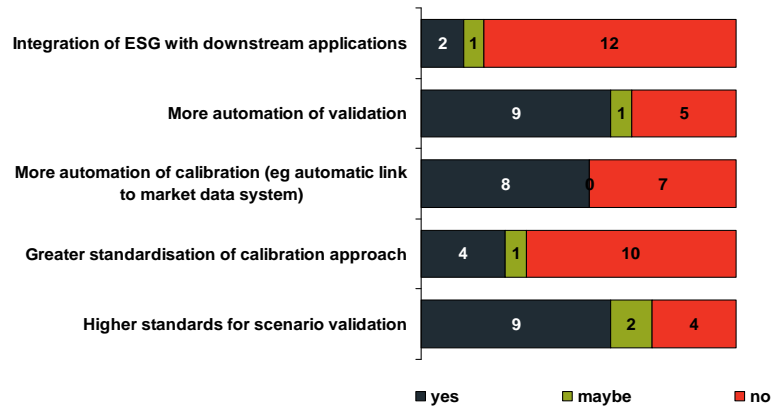


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## Future changes

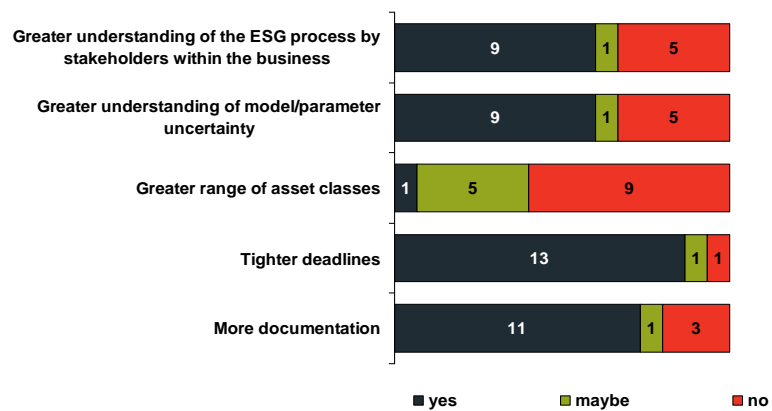
What are the main changes you expect under Solvency 2?



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## Future changes (continued)

What are the main changes you expect under Solvency 2?



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## Survey – some conclusions

- Large number of scenario sets and currencies
  - Automated calibration and validation required
- Limited tailoring of calibrations to liabilities
- Fairly standard set of market-consistency tests but tolerances rarely linked to materiality of liabilities
  - How much out-of-sample testing?
- Low expectation of adding further asset classes
  - Will RN follow the trend to greater granularity?
- Varying degree of communication to senior management
  - Is model risk made clear enough?
- Tighter deadlines, higher validation standards and greater understanding of the model and its limitations/uncertainties expected
- Also more documentation!

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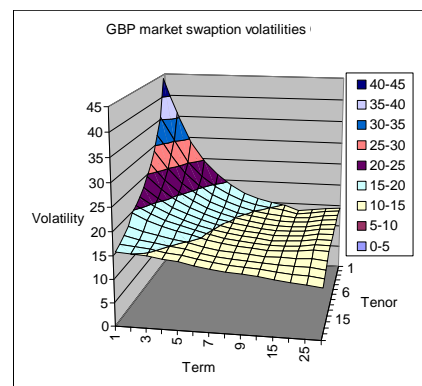
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## The central requirements for Solvency II risk-neutral economic scenarios are not new...

- Key SII asset-model requirements:
  - Reproduce market price of instruments corresponding to liabilities
  - Properly calibrated volatility measure
  - No arbitrage



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## ...but Internal Model requirements for processes and controls around ESGs are raising the bar

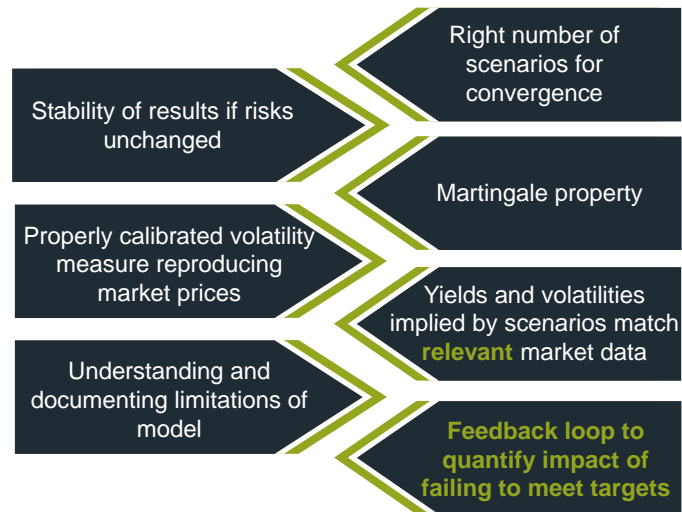
Framework directive item	Main requirements for ESG processes
Use test	<ul style="list-style-type: none"> <li>• Senior management understanding of model <b>and its limitations</b></li> <li>• Model covers sufficient risks</li> </ul>
Statistical quality standard	<ul style="list-style-type: none"> <li>• Accurate, complete and <b>appropriate</b> data</li> <li>• Consistency of assumptions</li> <li>• Stability if risks have not changed</li> </ul>
Documentation standard	<ul style="list-style-type: none"> <li>• Models and assumptions shall be documented, including design, rationale, <b>sensitivities and limitations</b></li> </ul>
Validation standard	<ul style="list-style-type: none"> <li>• Testing that requirements above are met</li> </ul>

**These requirements still apply if an external provider of economic scenarios is used**

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## SII requires increased understanding of ESG impacts for each undertaking's own business



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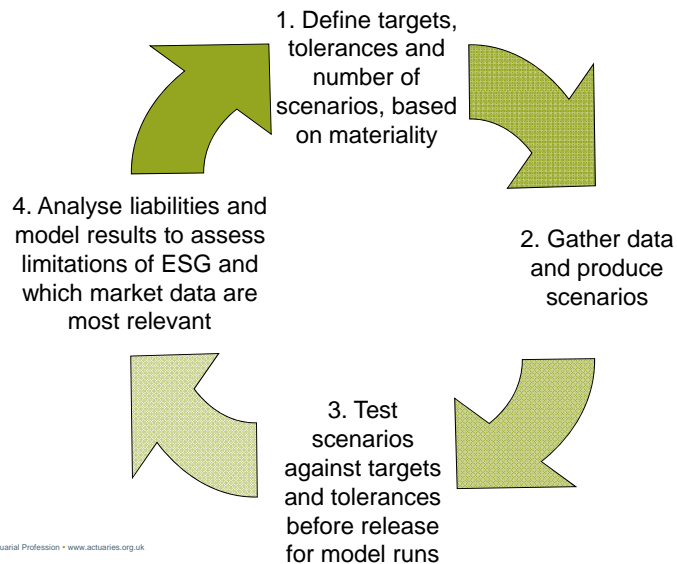
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## A feedback loop is needed to quantify materiality of impacts and define relevant tolerances



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## Case study A: quantifying the impact of leakage

- Scenarios are tested for leakage separately from model
  - Individual indices or blended
  - Setting tolerances is challenging
- To assess monetary impact model runs are needed
- Can compare initial MVA to PV (final MVA + all cash flows)
  - Difference is “leakage” error
- Analysis of leakage impact for different runs can link direct scenario test results and monetary impact
- Understanding of liabilities provides additional insight
- Together, this allows meaningful tolerances to be set

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## Case study B: quantifying the impact of failing to match market data for individual volatilities

- Replicating the full swaption volatility surface is difficult
  - Sensitivity analysis offers a high-level view of impact
  - Challenging to understand impact of individual points
- Can eliminate error “on average”
  - Impact of errors depends on run-off patterns of guarantees + dynamic policyholder/management actions
- Robust replicating portfolios could give approximate impact
  - Set tolerances
  - Communicate limitations of the model
  - Set weights for averaging

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## A potential industrialised ESG process under SII made relevant to liabilities by assessment of impacts

Timing	Action
Between runs	<ul style="list-style-type: none"> <li>Analyze model results to validate tolerances and methodology for leakage, simulation error and impact estimation</li> <li>Analyze model results / liabilities / proxy representation to validate tolerances and methodology for fit to market data</li> <li>Implement and test updates to methodology</li> </ul>
Day -7	<ul style="list-style-type: none"> <li>Management sign-off of tools, documentation and all non-market inputs</li> </ul>
Day 1	<ul style="list-style-type: none"> <li>Gather + check market data</li> <li>Overnight automated calibration + generation of base scenarios</li> </ul>
Day 2	<ul style="list-style-type: none"> <li>Management review and sign-off automated analysis of validation and estimated impact of deviation from targets for base</li> <li>Overnight automated calibration + generation of sensitivity scenarios</li> </ul>
Day 3	<ul style="list-style-type: none"> <li>Management review and sign-off automated analysis of validation and estimated impact of deviation from targets for sensitivities</li> </ul>
When results available	<ul style="list-style-type: none"> <li>Impact estimation of leakage, simulation error and failure to fit market data summarized and communicated with run results for base and each sensitivity allowing for any bias removal</li> </ul>

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## Standard communication proportionate to materiality for each set of scenarios

- Some key questions to answer:
  - **Are the scenarios fit for purpose?**
  - **What was the impact of judgement? Has it changed?**
- Large quantity of information to summarise
  - Stable, standardised templates beneficial
  - Focus needed: less can be more
- Transparency where judgement made
  - Judgement made in advance is simplest to communicate
  - Clear tolerances help
- Needs of diverse stakeholders vary

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## A potential ESG documentation framework under SII giving transparency around accuracy of models

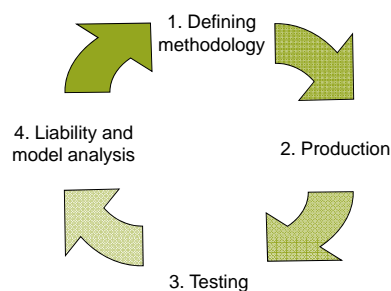
Document	Key contents
<b>Methodology document</b>	<ul style="list-style-type: none"> <li>High-level outline of models including rationale and limitations / impact of model choice</li> <li>Reference might be made where relevant to material provided by external providers</li> <li>How scenarios should be used</li> </ul>
<b>Data and assumptions manual</b>	<ul style="list-style-type: none"> <li>Sources for market data and other assumptions</li> <li>Checks to be applied</li> <li>Estimated sensitivities to most material inputs</li> </ul>
<b>Process manual</b>	<ul style="list-style-type: none"> <li>Overview of process</li> <li>Checklist for review</li> <li>Step by step description of automated processes and any manual steps to run them</li> </ul>
<b>Audit trail package</b>	<ul style="list-style-type: none"> <li>Record of complete set of input assumptions for each set of economic scenarios</li> <li>Sign-offs including review check lists and reasons for acceptance for any deviation from tolerances</li> </ul>
<b>Results communication package</b>	<ul style="list-style-type: none"> <li>Automated estimation of leakage impact and simulation error confidence interval could be provided for every model run</li> <li>Estimated impact of any failure to fit to market data should also be included though this is per scenario set rather than per run</li> <li>Allowance should be made for any bias removal applied</li> </ul>

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## Conclusion: benefits of an SII-ready, industrialised “ESG feedback loop” go beyond compliance

- Better understanding of accuracy of models clarifying inputs into business decision making
- Materiality based tolerances relevant to the business to focus attention where it makes most difference
- Increased engagement between providers and users of scenarios so users' needs should be better met
- Increased automation to give more time to understand results rather than produce them
- Better documented processes for easier maintenance



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## Questions for discussion

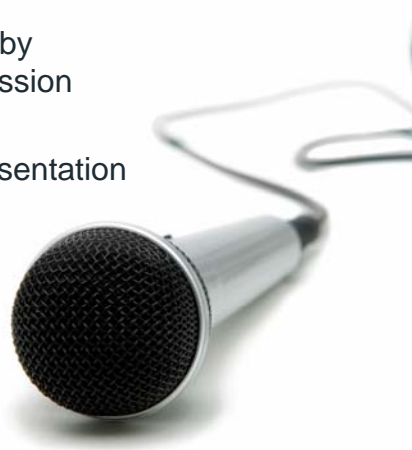
- Can an “industry-standard” approach survive SII?
- What level of senior management understanding is appropriate?
- How will counter-cyclical measures for risk-free yield curves impact ESG processes?
- What should be done when volatilities spike upwards?

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## Questions or comments?

Expressions of individual views by members of The Actuarial Profession and its staff are encouraged.

The views expressed in this presentation are those of the presenters.



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