Deloitte.

Risk margin in the S2
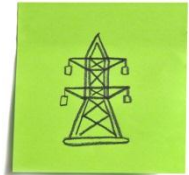## Calculation approaches

Lucie Kvardová (Deloitte CE)

Seminář z aktuárských věd v letním semestru 2011/2012

Agenda

Solvency 2 requirements

Approximations and variety of approaches

Regulation

Historical overview

Q&A

Solvency 2 requirements: How is Solvency II structured?

Solvency II is the proposed new Europe-wide framework for prudential supervision, based on three guiding principles (pillars)

Due to come in force at the start of 2014?

- The new system is intended to offer insurance organisations incentives to better measure and manage their risk situation i.e. lower capital requirements, lower pricing etc.

- The new solvency system will include both quantitative and qualitative aspects of risk, each pillar focusing on a different regulatory component; minimum capital requirements, risk measurement and management and disclosure
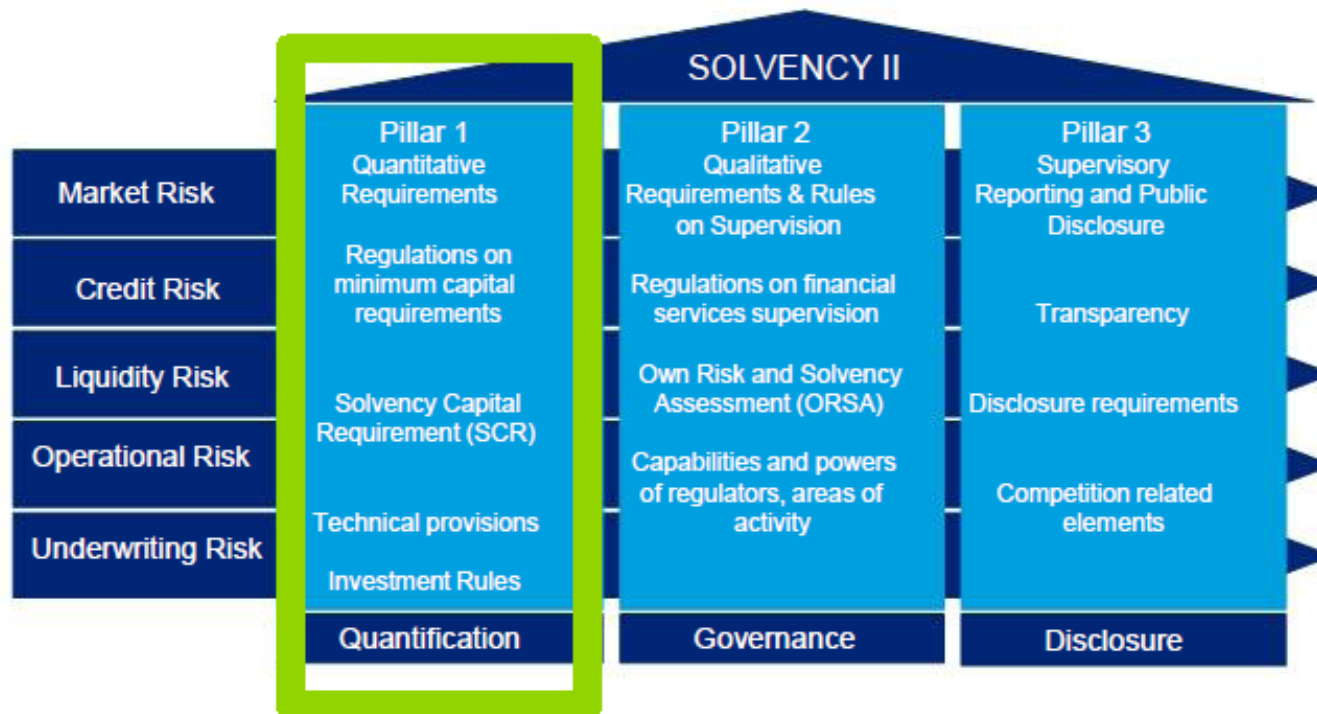
General discussions: Omnibus II Directives

Set the implementation date	Introduce transitional measures
Specify the areas for further SII legislation	Timing for further SII legislation
Align the SII Directive to the Lisbon Treaty	Incorporate new powers given to EIOPA

Originally published: January 2011
ECON only approved its final proposals: 21 March 2012
(Diverge in a number of areas)
Transposition II into national legislation: from 1 January 2013 to 30 June 2013
(Six month for re/insurers to prepare themselves)

FSA Update on the **Omnibus II Directive**: April 2012
- Vote of the EP on the final version of the Omnibus II Directive due to take place in July rescheduled to 10 September
- Trialogue discussions between the EC, Council and Parliament
- The assumptions about implementation remain and firms should continue to make progress on this basis

EC announced: proposals to delay the deadline for the transposition of Solvency II into national law until 30 June 2013

Solvency 2 requirements: Economic Balance Sheet Approach

General approach to S2

Capital requirement should be based on a **total balance sheet approach** based on **economic valuation of all assets and liabilities.**

Total balance sheet approach

- Determination of an insurer's ability to cover its obligations with the required level certainty should be **based upon its total financial position**.

Economic valuation of assets and liabilities implies

- **Assets should be valued at market value** where this is both available and provides a reliable and appropriate valuation **or mark-to-model value** where this is not the case

- **Liabilities** should be value on a **best-estimate basis (economic value of liabilities)**
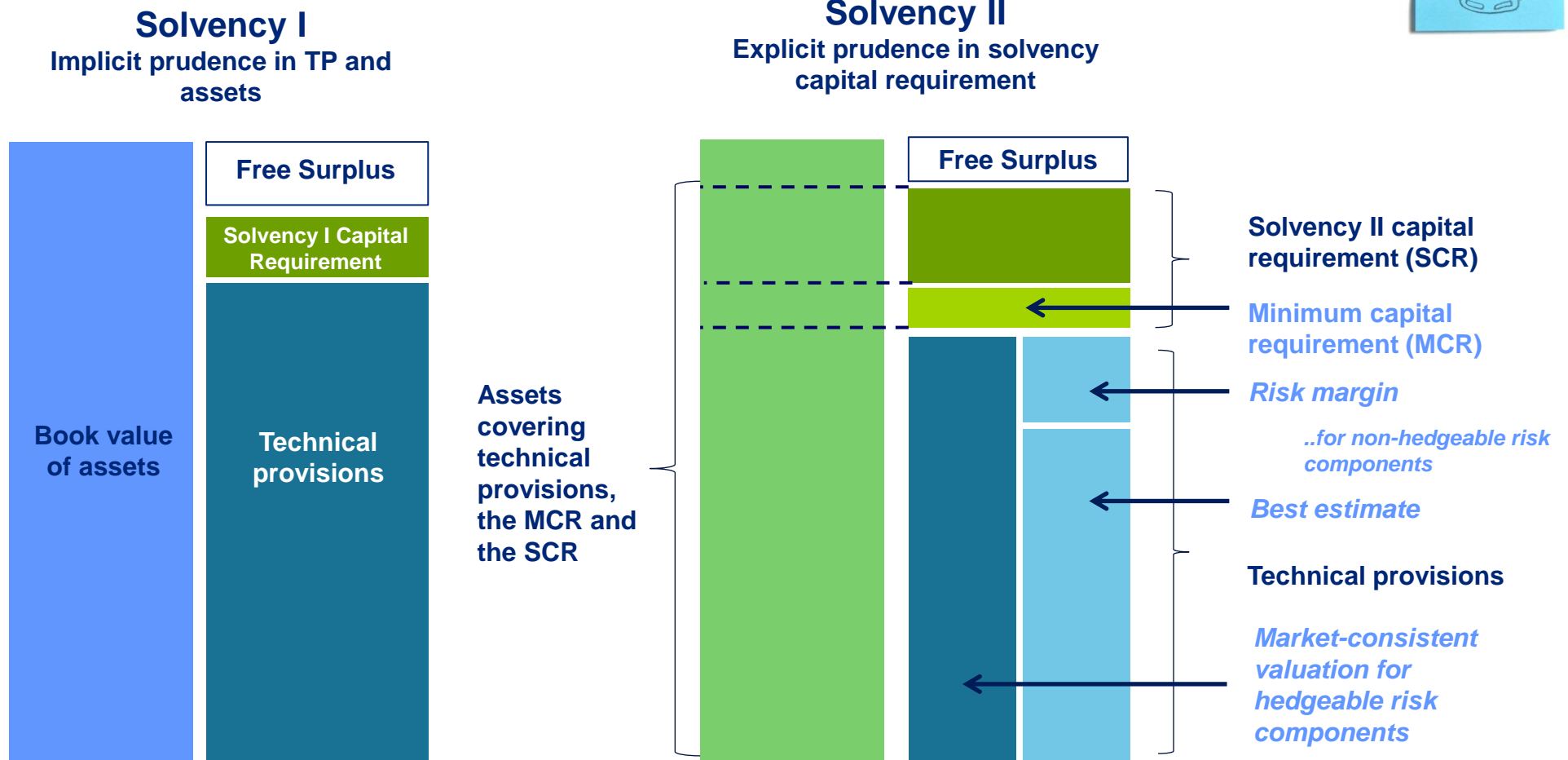
Liabilities assumptions

How should the Economic Value of Liabilities be calculated ?

- Based on **expected present value of future liability cash flows** using best estimate assumptions i.e. not including prudence

- On top of the Best Estimate of liabilities is also added a **Risk Margin** (RM) for non-hedgeable financial and non-financial risks

- **Includes value of embedded financial obligations**, including options and guarantees

- **Appropriate discount rate** should be used (based on risk free curves)

- **Additional margin for prudence should not be included in the valuation of the Best estimate**. The prudence margin is expected to be included in the SCR (and risk margin) to provide protection against adverse outcomes

Solvency 2 requirements: From Solvency I to Solvency II

Solvency I
Implicit prudence in TP and assets

Solvency II
Explicit prudence in solvency capital requirement

Free Surplus

Solvency I Capital Requirement

Book value of assets

Technical provisions

Free Surplus

Assets covering technical provisions, the MCR and the SCR

Solvency II capital requirement (SCR)

Minimum capital requirement (MCR)

Risk margin

..for non-hedgeable risk components

Best estimate

Technical provisions

Market-consistent valuation for hedgeable risk components

Solvency II valuation rules

- Both assets and liabilities are to be fair-valued (market value of assets and liabilities). Assets also contain the reinsurance recoverables (after correction for default risk of the reinsurer)

- An explicit risk margin (market value margin) is to be added to the fair value of the liabilities (Best Estimate) to give the technical provisions

- This risk margin should be calculated using the Cost of Capital method

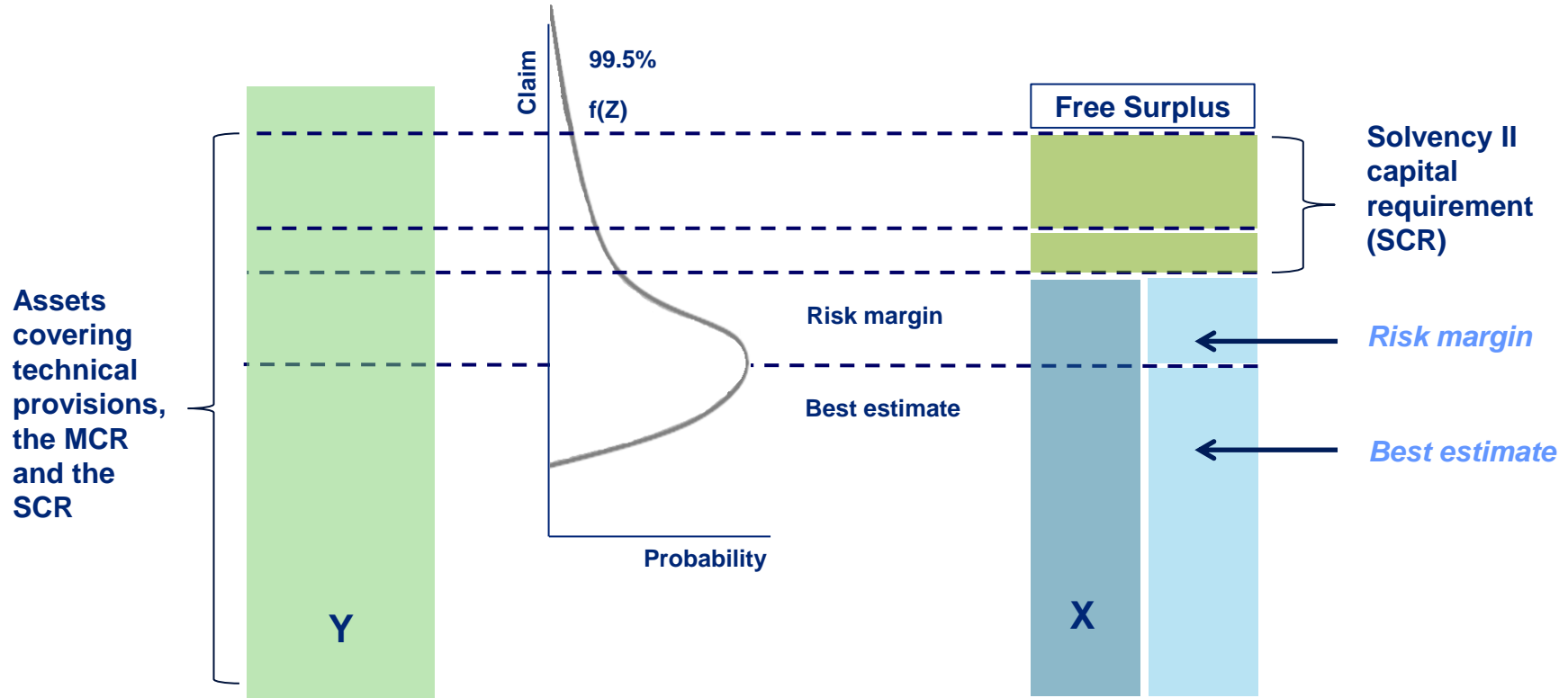# Solvency 2 requirements: Solvency Capital Requirement

Solvency capital requirement (SCR) is calibrated to achieve **99.5%** probability of survival (**value-at-risk**) over **one year time period**

There are two alternative approaches for calculating the SCR: **Standard formula x Internal model**

SCR is calculated as the difference between a function of h(X,Y) and the mean of the distribution. The distribution is a function of the X and the corresponding assets covering the liabilities (Y)

$$SCR = f(z) - \mu_Z, \quad Z = h(Y,X)$$

Solvency 2 requirements: Aim

- Adopt an **economic approach** to asset and liability valuation that is transparent and will avoid arbitrage opportunities

- Recognise **diversification** and risk concentration effects

- Recognise all forms of **risk mitigation**

- Be calibrated to provide a **balance between the protection to policyholders and encouraging efficient operations of companies** (i.e. calibrated at a 99.5th percentile over 1 year)

- Consider the range of **risks that an insurer might be exposed** to and help align regulatory capital requirements with best practice internal risk management processes

- Allow for **evolution in financial environments**, increasingly sophisticated product designs and capital markets innovation

Solvency 2 requirements: Risk margin (Requirements)

"The risk margin should be calculated by determining the cost of providing an amount of eligible own **funds equal to the SCR necessary to support the insurance and reinsurance obligations** over the lifetime thereof."

Pillar I

Requirements	Risks reflected in RM (SCR)
- Valued on a **Best-Estimate** basis - For **non-hedgeable** financial and non-financial risks - CEIOPS: - Explicit **calculation per LoB, no diversification** between LoBs should be taken into account $$CoCM = \sum_{LoB} CoCM_{Lob}$$ - Calculated using **SCR (sub)modules** per LoB, aggregating SCRs based on the correlation assumptions **RFR** for the discounting of the future SCRs **should not include** an **illiquidity premium** **No future New Business** **Non-life** No split of RM between premiums provisions and provisions for claims **Recoverables** No need to calculate a RM for amounts recoverable from reinsurance contracts and SPV = defined net of reinsurance	- Underwriting risk - With respect to the existing insurance and reinsurance - Unavoidable market risk - For NL insurance and short-term and mid-term life insurance obligations the unavoidable market risk can be considered to be zero - Credit risk - With respect to reinsurance contracts (CDR) - Operational risk

RM can be considered analogous to the Cost of Non-Headgeable risks under MCEV

Solvency 2 requirements: Risk margin (Cost-of-Capital method)

The risk margins is defined as the hypothetical cost of regulatory capital necessary to run-off all liabilities, following financial distress of the company should be determined in a way that enables the insurance obligations to be transferred to a third party or to be put in run-off

Cost of Capital approach

Step 1 Calculate the SCR at the end of each future year (excluding Market and Non-RI Credit Risk)

Step 2 Multiply each of the SCR's by the CoC rate (6% under Solvency II)

Step 3 Discount the amounts calculated in Step 2 using (Risk Free yield curve)

Step 4 Risk margin is sum of these future discounted amounts

Standard formula

$$SCR(t) = BSCR(t) + SCR_{op}(t) - Adj(t)$$

Method for CoC approach

$$CoCM = CoC \cdot \frac{\sum_{t \geq 0} SCR(t)}{(1 + r_{t+1})^{t+1}}$$

Legend:
- SCR(t)
- SCR(t) * 6% * PV(t)

Risk margin   t = 0   t = 1   t = 2   t = 3   ......   t = T
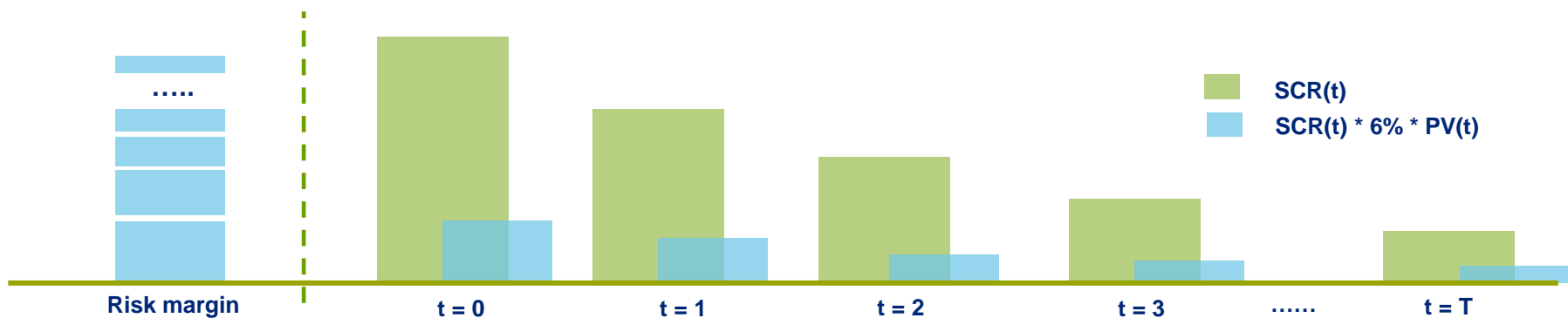
Solvency 2 requirements: Risk margin (Concerns)

Conceptually sound

Not simple to calculate

What are the appropriate simplifications for RM calculation?

What is the cost of capital rate?

- Calibrated consistently with the assumptions made for the reference undertaking
  - ! Does not depend on the actual solvency position of the original undertaking

- Should guarantee that sufficient TPs for a transfer are available in all scenarios
  - ! Long-term average rate, reflecting both periods of stability and periods of stress

  ! CEOIPS is proposing a 6% cost of capital charge (above risk-free rate). The industry has been lobbying heavily to reduce this charge

  Shareholder return models provide the initial input
  Some objective criteria may cause upward and downward adjustments of the initial input
  A final calibration of the Cost-of-Capital rate, in order to obtain risk margins consistent with observable prices in the marketplace, may be necessary

- **Equity Risk Premiums as assessed in the CRO Forum's report** page 58, 60 and 61

	CAPM		FFmF	
	European Market	Global Market	European Market	Global Market
Life	10.0 pct	5.1 pct	11.8 pct	9.4 pct
Non-life	7.4 pct	4.2 pct	12.5 pct	9.6 pct

Agenda

Solvency 2 requirements
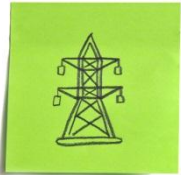
Approximations and variety of approaches
"Risk margin one of the most complicated items to revalue on the balance sheet"

Regulation

Historical overview

Q&A

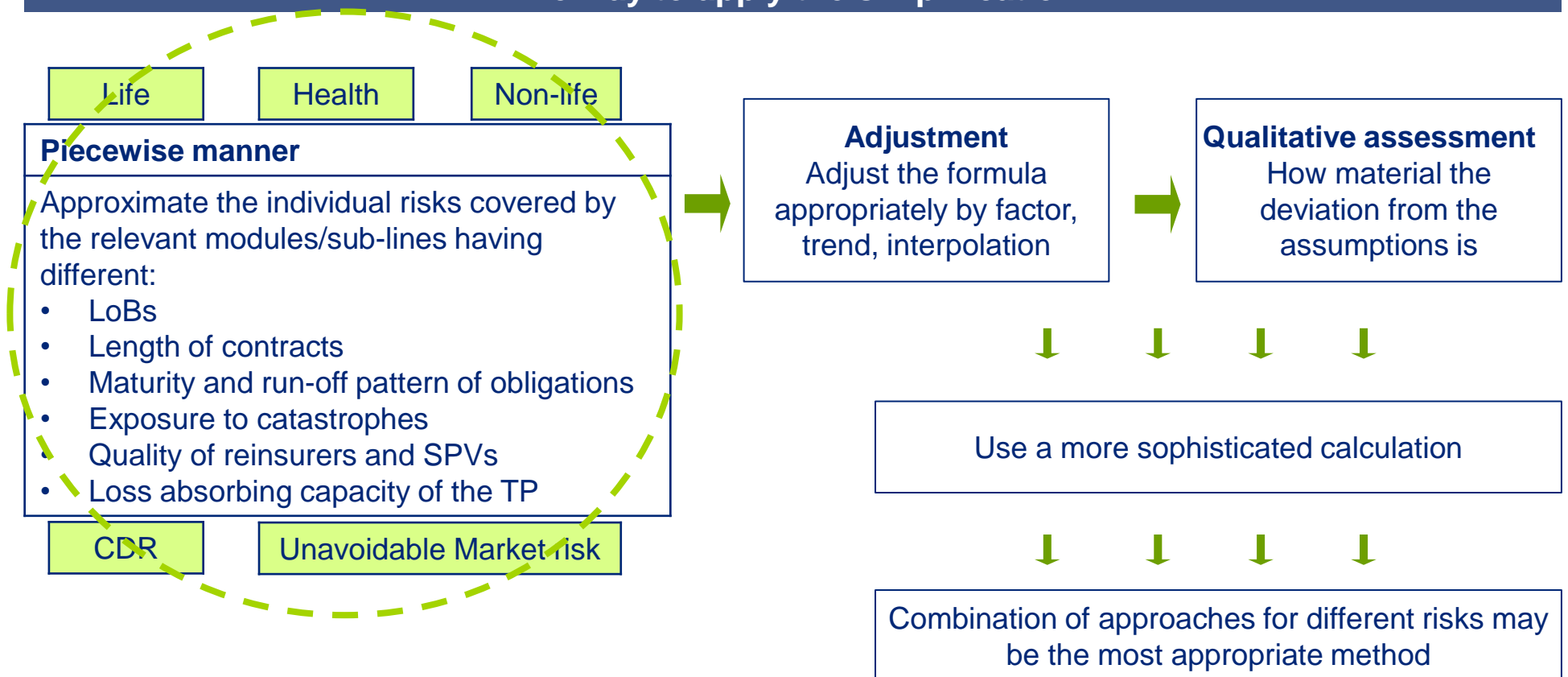# Simplification for Risk Margin: Reasonability
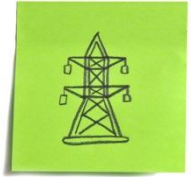
Judgement: Insurer should consider whether or not it would be appropriate to apply a simplified valuation technique for the RM
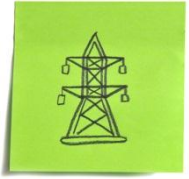
Appropriateness: what kind of simplified methods would be most appropriate for the business

Proportionality: chosen method should be proportionate to the nature, scale and complexity of the risks

The way to apply the simplification

Life   Health   Non-life

Piecewise manner

Approximate the individual risks covered by the relevant modules/sub-lines having different:
- LoBs
- Length of contracts
- Maturity and run-off pattern of obligations
- Exposure to catastrophes
- Quality of reinsurers and SPVs
- Loss absorbing capacity of the TP

CDR   Unavoidable Market risk

Adjustment
Adjust the formula appropriately by factor, trend, interpolation

Qualitative assessment
How material the deviation from the assumptions is

Use a more sophisticated calculation

Combination of approaches for different risks may be the most appropriate method

Simplification for Risk Margin: How to project SCR

Hierarchy of the decision basis for RM simplifications

Level 1   **Full calculation of all future SCRs (t=0 methodology)**

Level 2   **Approximate individual risks SCRs, e.g. proportionately**

Level 3   **Approximate whole SCR, e.g. proportionately**

$$SCR(t)_{LoB} = \left(\frac{SCR_{LoB}(0)}{BE_{Net, LoB}(0)} \right) \cdot BE_{Net, LoB}(t)$$

    ✓   Maturity and the run-off pattern

    ✗   Assumptions of risk profile unchanged over the years

Level 4   **Estimate based on initial SCR and duration:** Different formula for Life/Non-Life/Health (example for Life)

$$CoCM_{LoB} = \left(\frac{CoC}{(1+r_1)} \right) \cdot Dur_{mod, LoB}(0) \cdot SCR_{LoB}(0)$$

    ✓   Maturity and the run-off pattern

    ✗   Assumptions of risk profile unchanged over the years

Level 5   **% Best estimate liability**

$$CoCM_{LoB} = \alpha_{LoB} \cdot BE_{Net, LoB}(0)$$

Simplification for Risk Margin

$$CoCM_{LoB} = \alpha_{LoB} \cdot BE_{Net,LoB}(0)$$
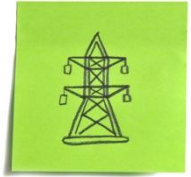
Level 5 – Percentage of Best Estimate Liability
Not recommended by CEIOPS

PROS & CONS

Pros Small companies: saving the human recourse for building advanced calculation of RM

Cons Fixed percentage based on QIS5 recommendation (i.e. restricted to the fact that proportions of the risks have not changed

Cons Difficult to set up the percentage, QIS5 report's figure for illustration ➝

✓ Depends on the LoB

✓ Calculates business is restricted to one LoB, i.e. business outside is immaterial

! Recommendation: Use at least Level 4 approach (duration of the obligation is known)

LoB for Non-life business	% of the BE
Medical expenses	8.5%
Income protection	12.0%
Workers' compensation	10.0 %
Motor vehicle liability	8.0 %
Motor, other classes	4.0 %
Marine, aviation and transport	7.5 %
Fire and other damage	5.5 %
General liability – TPL	10.0 %
Credit and suretyship	9.5 %
Legal expenses	6.0 %
Assistance	7.5 %
Miscellaneous NL insurance	15.0 %
Health business	17.0%
Property business	7.0 %
Casualty business	17.0 %
Marine, aviation and transport business	8.5 %

Simplification for Risk Margin

$$CoCM_{LoB} = \left(\frac{CoC}{(1+r_1)} \right) \cdot Dur_{mod,LoB}(0) \cdot SCR_{LoB}(0)$$
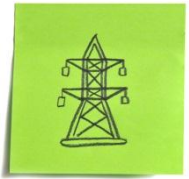
Level 4 & Level 3
Possible candidates for risk measures in life insurance

| Sub-risks	Expose measures		
Mortality	Capital at risk	×	Duration of treaties under mortality risk
Longevity	Best estimate of treaties under longevity risk		
Disability	Capital at risk	×	Duration of treaties under disability risk
Lapse	Best estimate of treaties under lapse risk		
	- Surrender values of treaties under lapse risk		
Expenses	Renewal expenses	×	Duration
Revision	Best estimate of annuities exposed to revision risk		
CAT	Capital at risk of treaties under mortality and disability risk		

✓ Each carrier will have a minimum of zero (and so a negative contribution to a risk cannot be made)
✓ Modified SCRs should be projected annually in the calculation of the risk margin

✓ **Capital at Risk per policy** = max [0, Gross Death/Disability Benefit - net technical provisions (excluding RM) - the increase in reinsurance recoverables which is directly caused by the death or disability of the insured]

Simplification for Risk Margin

$$SCR(t) = \left(\frac{SCR(0)}{Carrier(0)} \right) \cdot Carrier(t)$$
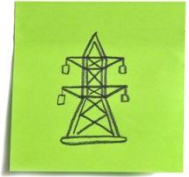
Level 3 & Level 2
Approximate whole SCR / individual risks, e.g. proportionately

Straightforward and common approach ⟶ **RISK DRIVERS/CARRIERS**

Identify the main driver which should be: at product level, net of reinsurance, gross of tax

Estimate future SCR for each risk

**Scale the initial SCR in-line with the projected value of driver**   **e.g. BEL*(1+x)^t**

It worth pointing out that the most important are the values form the initial projection periods due to the discounting effect

If the carrier at time 0 is small -> carrier deviation becomes material compared to the size of the carrier -> inaccuracies in the RM
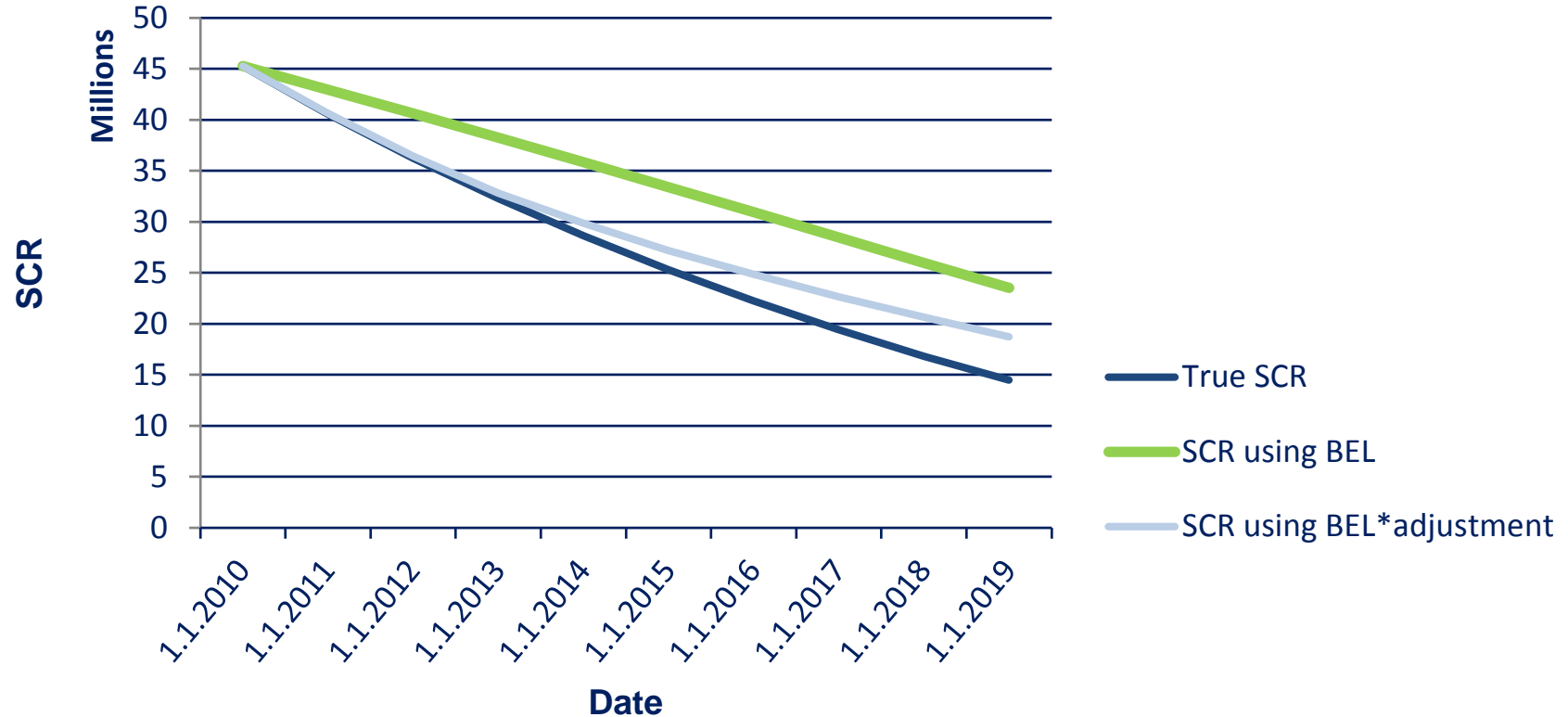
Simplification for Risk Margin

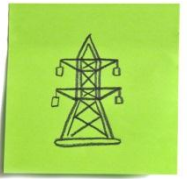$$SCR(t) = \left(\frac{SCR(0)}{Carrier(0)} \right) \cdot Carrier(t)$$
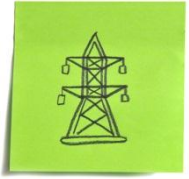
Level 3 & Level 2
Approximate whole SCR / individual risks, e.g. proportionately
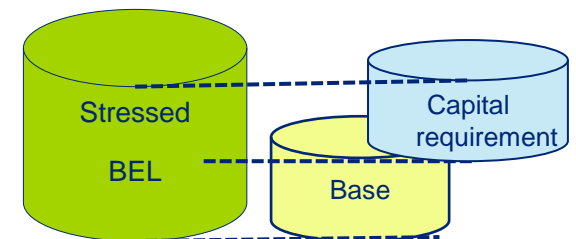
Example: Risk driver validation

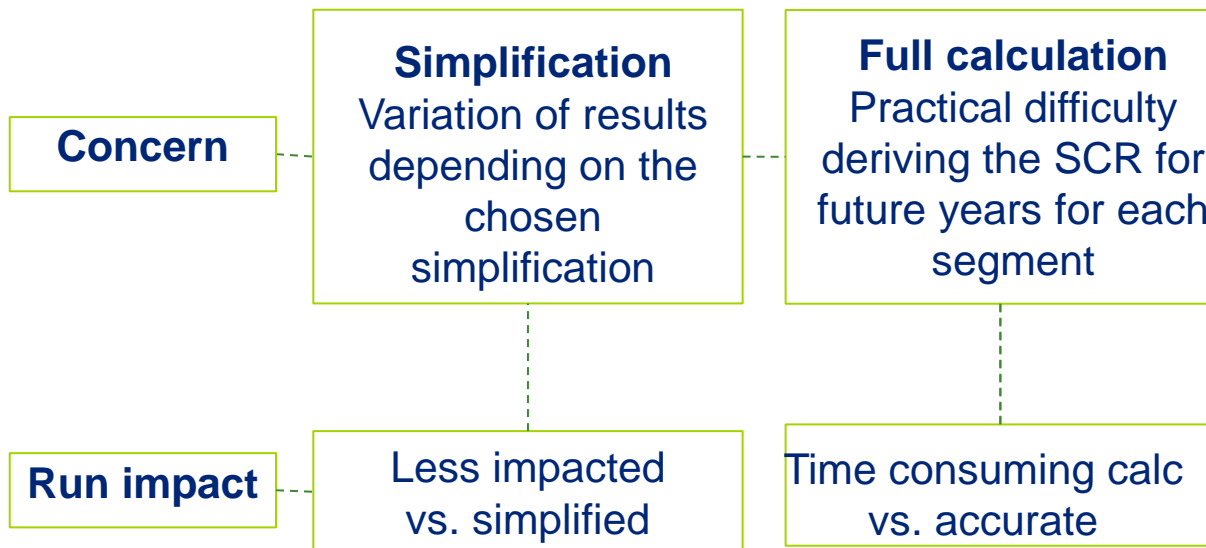# Simplification for Risk Margin

It seems likely that the majority of undertakings will not be in a position to apply the most advanced methods for calculating the risk margin as indicated by level no. 1 and 2 of the hierarchy

Level 1 Full calculation

Concern

Simplification
Variation of results depending on the chosen simplification

Full calculation
Practical difficulty deriving the SCR for future years for each segment

Run impact

Less impacted vs. simplified

Time consuming calc vs. accurate

Stressed BEL

Capital requirement

Base

Tight reporting deadlines make it important to produce runs in the most efficient manner
(Projections of the future SCRs in one step, instead of making separate projections)

Calculation looping:
✓ Significant decrease in the run time to produce results of the subsequent stresses

SUNGARD's APPROACH: New Prophet library
Using REBASE functionality
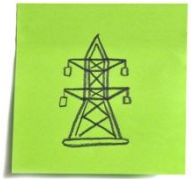
Iteration 1

- Product: Capital requirement of each shock
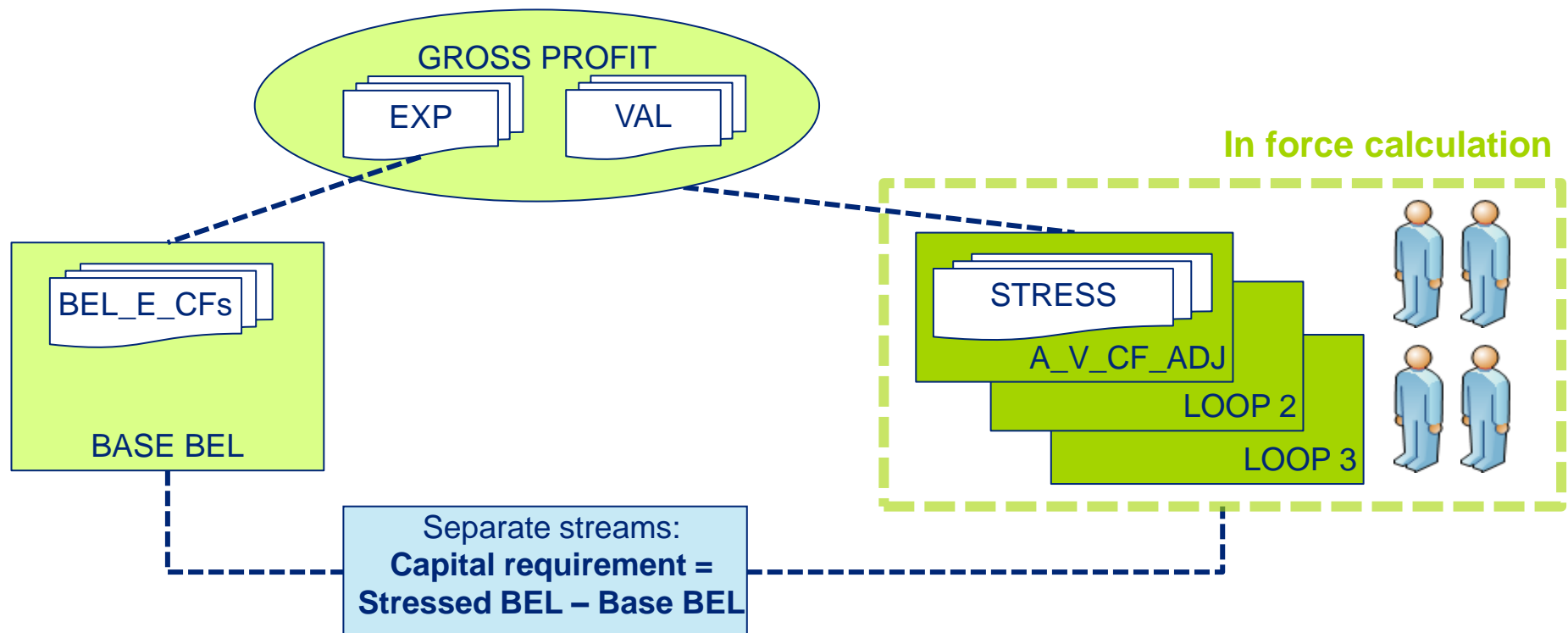 Summary: Diversification

Iteration 2
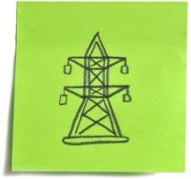
- Net basic SCR, MCR, RM

Single deterministic run
- ✓ Calculate unshocked BEL
- ✓ Apply shocks separately
- ✓ Calculate gross basic SCR
- ✓ Aggregate results

Zero profit checks (BEL_GRS_PROFIT)
- ✓ Reserving using BEL on exp basis
- ✓ Investment returns = Discount rate

GROSS PROFIT

EXP · VAL

BEL_E_CFs

BASE BEL

In force calculation

STRESS

A_V_CF_ADJ

LOOP 2

LOOP 3

Separate streams:
**Capital requirement =
Stressed BEL – Base BEL**

# ALTERNATIVE APPROACH: Prophet based

Rebase functionality: Rebase the past (unwanted stressed) value for future stress to the BE assumption to obtain correctly stressed value in the future

Offset Stress functionality: stress offset, i.e. experience basis used up to the stress point and then stressed experience thereafter (e.g. longevity under IM)

Exact Full Projection (t=0 stress): combination of prospective reserve calculation with unstressed experience demographic assumptions (e.g. level mortality)
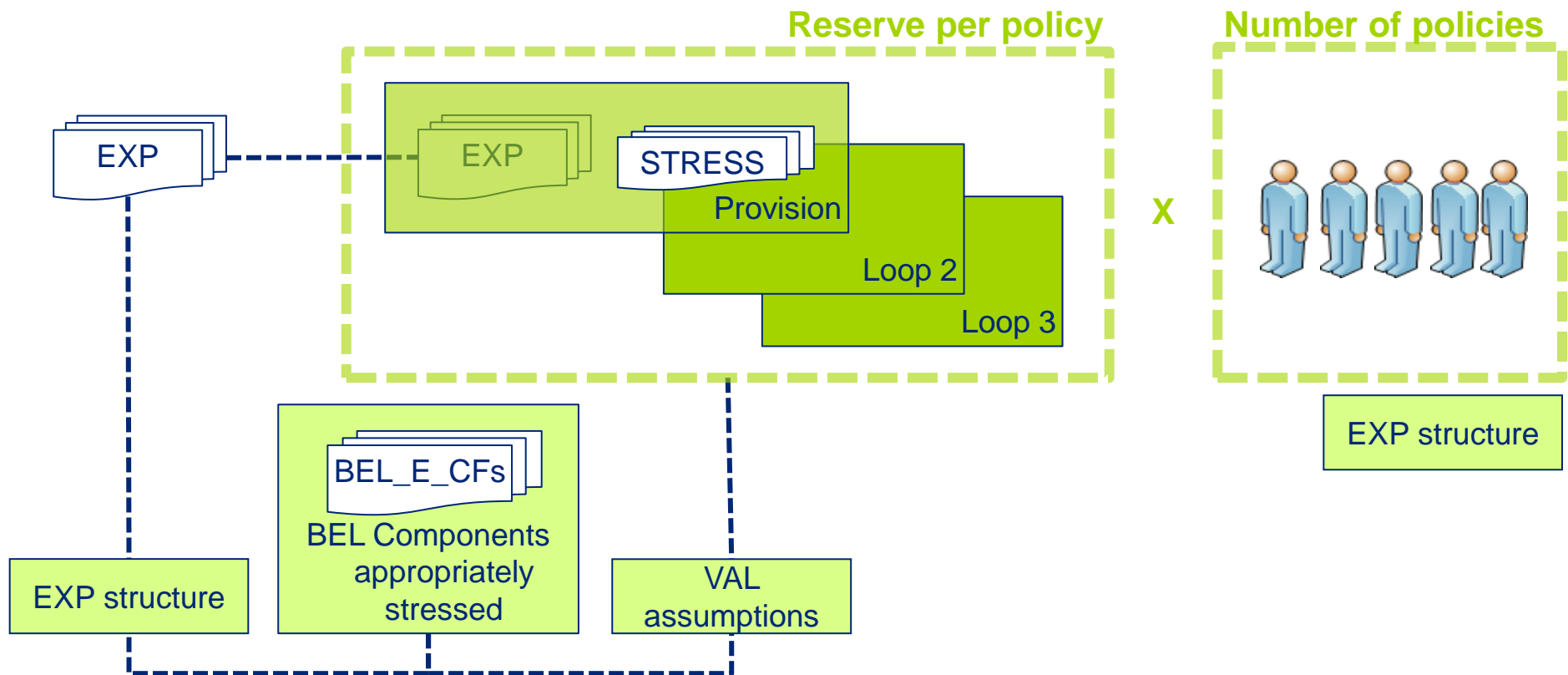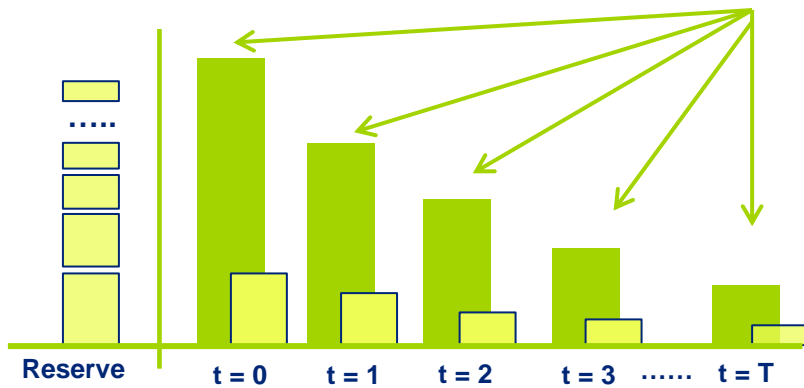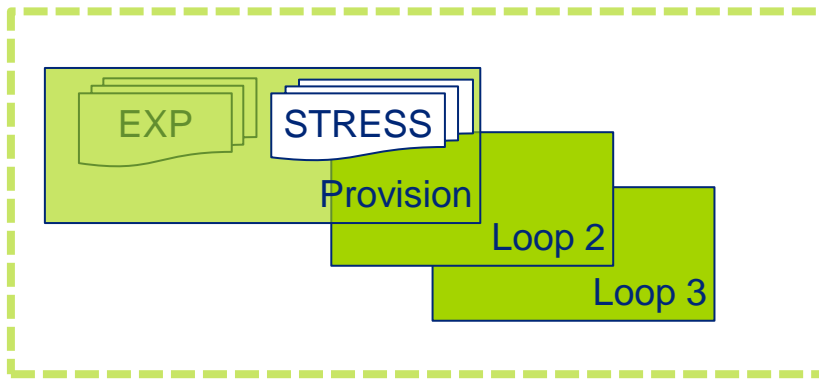
ALTERNATIVE APPROACH: Prophet based
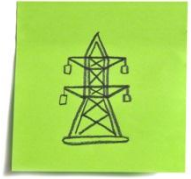
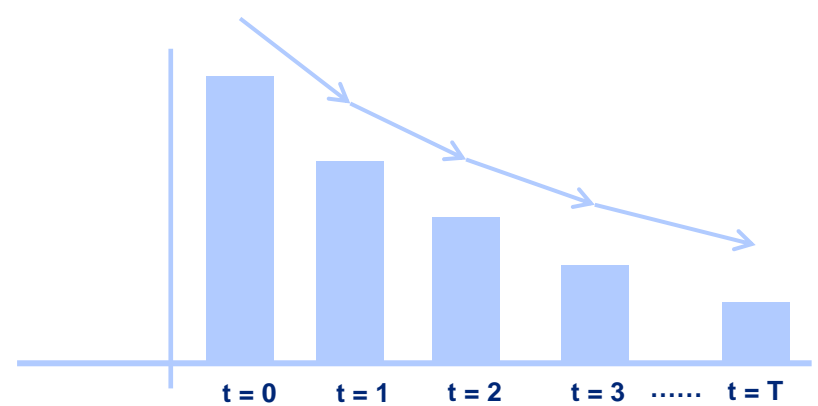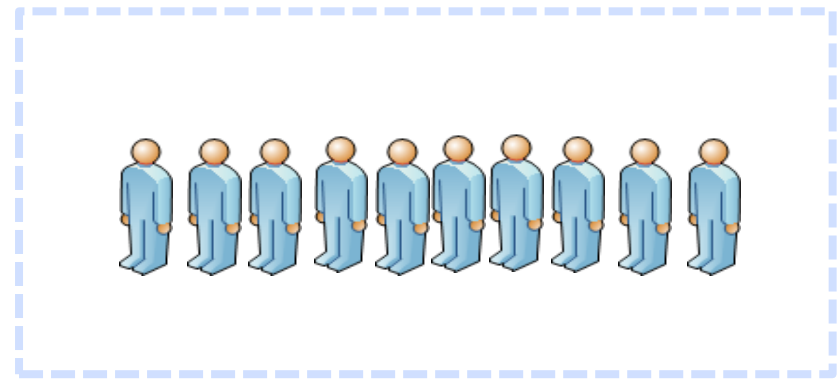## Exact Full Forward Projection (stress only at t=0)

Value of the reserve per policy is calculated in a **prospective way**
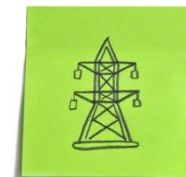
Reserve per policy

Number of policies in force is calculated based on the **ascending order**
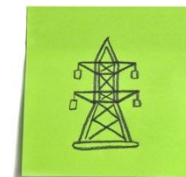
Number of policies

Stressed Reserve PP

Reserve PP

Number of policies

Simplification for Risk Margin:
Methods available to project SCR for Level 1 and 2

Deterministically modeled business		
Method	**Comment**	**Reasoning**
(1) Exact forward stress, all loops	- **Offset Stress functionality** - **Exact Full Projection** - **Rebasing**	Stress offset t=0 stress with accurately stressed future positions Sungard's approach
(2) Forward stress adjustment at time t0	Only **2 loops are required**: single stress test alongside the best estimate	Stress performed from the t = 0. The additional (unwanted) stress up to time t is adjusted by p(t)/ p'(t)… probability of survival BEL/Stress (for 1 life)
(3) Forward stress only every 5 years (save run-time)	Covered in method (1) Reduced number of calculations	Covered in method (1)
(4) Risk driver	Driver is available in the model ready to "drive" the time zero SCR, e.g. BEL **SCR(t) = SCR(0)*BEL(t)/BEL(0)**	Choose an appropriate carrier, assess the accuracy, robustness (wide range of policies/economic conditions)
(5) Adjusted risk driver	The error introduced by the risk driver is mitigated by adjustment	E.g. BEL* $(1+x)^{\wedge}t$, x is function calibrated

Stochastically modeled business – limited options		
Method	**Comment**	**Reasoning**
(1) Exact forward stress, all loops	Huge run-time implications of running nested stochastic projections	Disproportionate in the context of the degree of accuracy and materiality of the risk margin calculation
(2) Forward stress adjustment at time 0	Possible in some cases	Development and validation of this approach very difficult (absence of full forward stress to test against)
(3) Forward stress only every 5 years (save run-time)	Covered in method (1)	Covered in method (1)
(4) Risk driver	Possible to use	Validation of the carrier required
(5) Adjusted risk driver	Possible to use	Validation of the adjustment against the full forward stress

Simplification for Risk Margin:
## Methods available to project SCR for Level 1 and 2

Pros & Cons		
Method	**Pros +**	**Cons -**
(1) Exact forward stress, all loops	+ Gives exact future stresses	- Some **Model development** - Loops so **longer run-times** - Maybe "over-accurate" if industry standard moves toward simplications - Different approach likely to be needed for AoC
(2) Forward stress adjustment at time 0	+ Gives exact future stresses + No extra loops + Can generate AoC	- Some **Model development** - Maybe "**over-accurate**" if industry standard moves toward simplications - Only works for certain stress "structures" - Works for sample products but may need additional testing to ensure works for all policies
(3) Forward stress only every 5 years (save run-time)	+ Captures most of "shape" of future stresses	- Some Model development - Loops so longer run-times but less than (1) - Need to develop interpolation - Different approach likely to be needed for AoC
(4) Carrier	+ Reasonable approach, particularly for non-market risks + Easy implementation + Can be intuitive if simple drivers used + Can generate AoC	- More inaccurate - **Back-testing to test robustness**: Even if shown to work for sample policies not guaranteed to work for all policies: Difficulty in verifying the appropriateness of the driver unless option (1) developed - Depending on materiality threshold, adequate **carriers may not exist** - Difficult to apply new stress calibration at future point in time
(5) Adjusted carrier (i.e. fit parameter(s) to the best available carrier to improve its fit)	+ Relatively easy to implement + More accurate than unadjusted carrier approach + Can generate AoC	- Loses some of the simplicity of the (unadjusted) carrier - Even if shown to work for sample policies not guaranteed to work for all policies (unless full validation using forward stresses is used).

Simplification for Risk Margin: How to project SCR
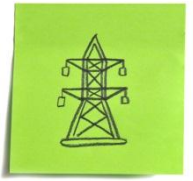
What needs to be fulfilled by the model?
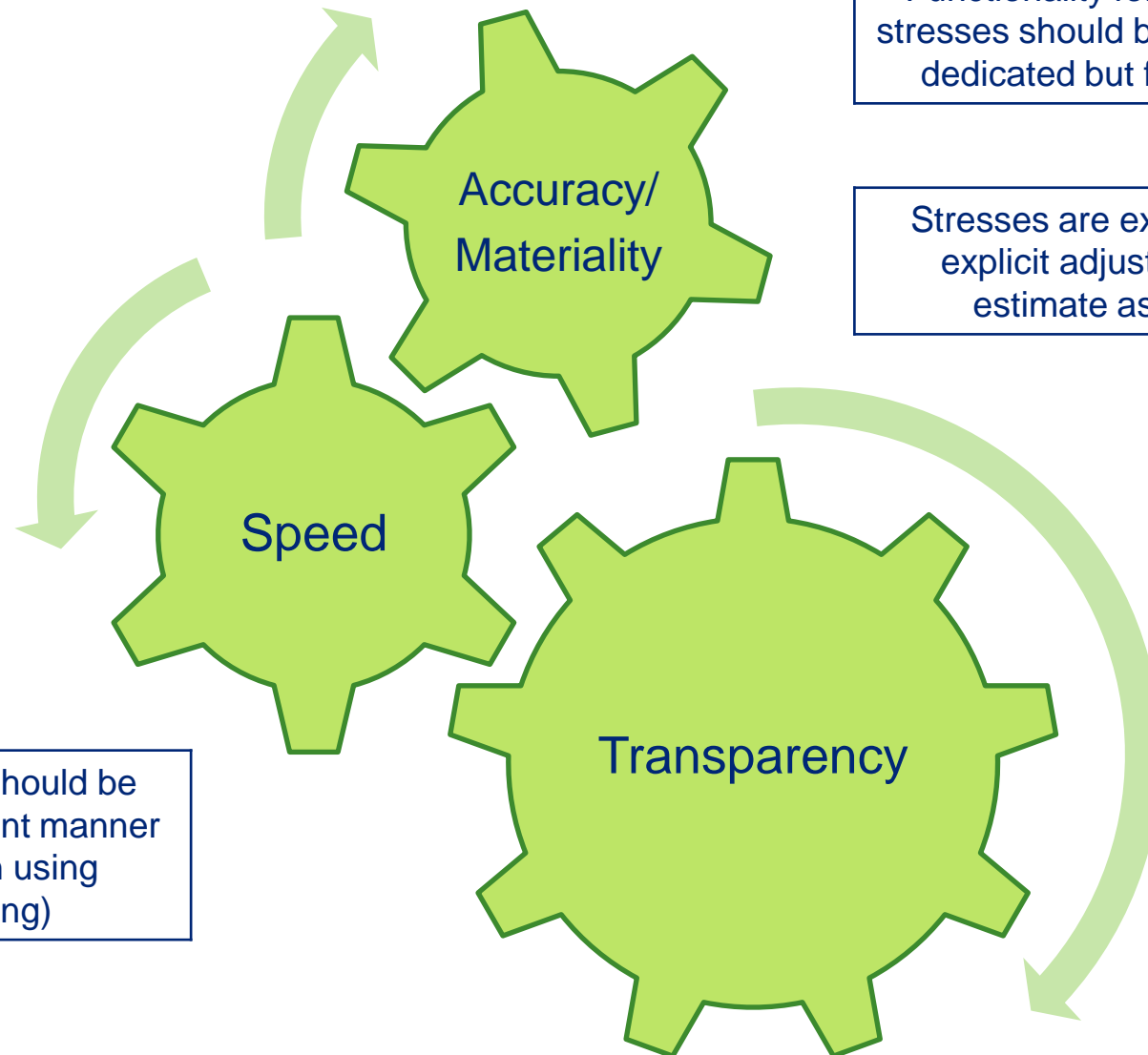
Functionality for all Solvency II stresses should be provided using dedicated but flexible coding
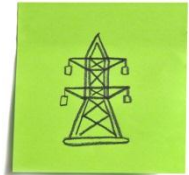
Accuracy/ Materiality

Stresses are expressed as an explicit adjustment to best estimate assumptions

Speed

Transparency

All forward stresses should be performed in the efficient manner (e.g. in a single run using calculation looping)

Agenda

Solvency 2 requirements

Approximations and variety of approaches

Regulation

Historical overview

Q&A

Regulation: Pillar 3 Disclosure

Narrative RSR and SFCR reports need to be produced within 14 - 20 weeks of year end. Quantitative templates within 5 - 8 weeks annual reporting, 14 -20 weeks for quarterly reporting

| Pillar III				
	QRTs	**SFCR**	**RSR**	**ORSA Supervisory Report**
Target group	Public and supervisory BS – C1 report TP – F1 report	Public	Supervisory	Supervisory
Frequency	Partial quarterly and partial annually	Annual and ad hoc	Annual or at least every 3 years and ad hoc	Annual and adhoc
Submission deadline solo	Quarterly: 5 – 8 weeks Annually: 14 – 20 weeks	14 – 20 weeks	14 - 20 weeks	Two weeks after completion of the internal process and sign off
Submission deadline group	See above	+ 6 weeks (if no single SFCR)	+ 6 weeks	See above
Formal requirement	Report templates	Structure and content given, freedom in terms of design		Minimal content given. Internal ORSA report can be used

TP – F1
• RM must be reported separately from TP • Detailed (by LoB) • It is not needed to allocate the RM separately to the products with or without options and guarantees

Agenda

Solvency 2 requirements
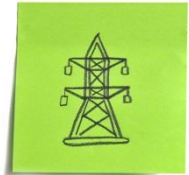
Approximations and variety of approaches

Regulation

Historical overview

Q&A

Historical overview (1 of 4)

Initial works – solvency research for insurance undertakings

Cornelis Campagne

:-:	
1940's	

Campagne, C. (1961): Standard minimum de solvabilit´e applicable aux enterprises d'assurances.Report of the OECE, March 11. Reprinted in Het Verzekerings-Archief deel XLVIII, 1971–1974

Teivo Pentikainen

Available Solvency Margin (ASM)

- ASM > TCR (Theoretical capital requirement): Ongoing concern
- MCR < SCR <= ASM

1952

Pentikainen, Teivo (1952): On the net retention and solvency of insurance companies, Skandinavisk Aktuarietidskrift

Finland

- Special equalization reserve

1953

Campagne's work for assessing an extra minimum reserve

NON-LIFE Directive

- Retained premium be 100%
- Average expense ratio fixed at 42%
- Value-at-Risk of the loss ratio at 0.9997% as 83%
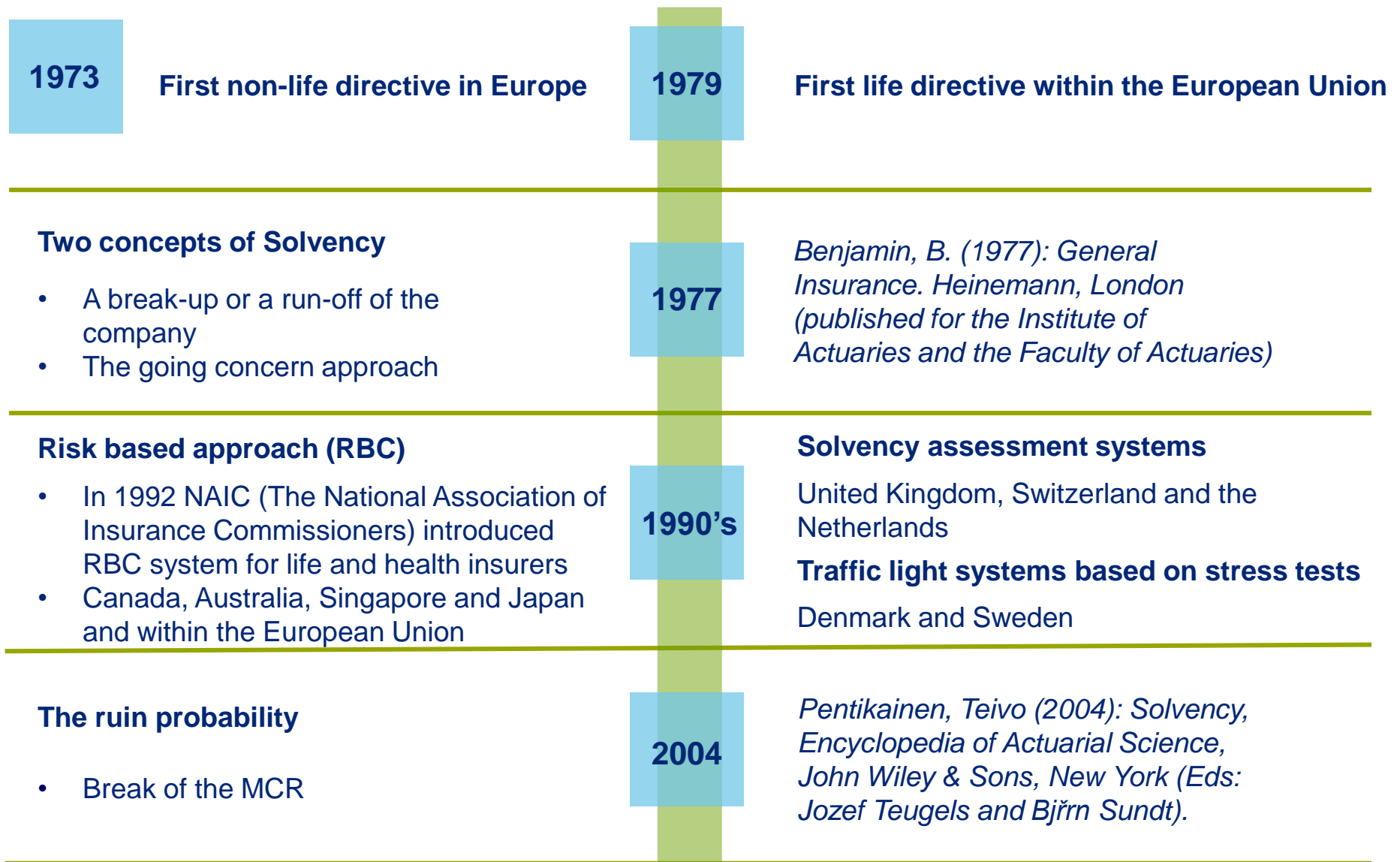- Combined ratio will be 42+83=125%

1961

LIFE Directive

- MCR as a % of TP
- Extra 6 % of TP with probability 99%
- Extra 4 % of TP with probability 94%

Solvency directives within European Union (1970s, 1980s, 1990s)

1973 **First non-life directive in Europe** **1979** **First life directive within the European Union**

Two concepts of Solvency

- A break-up or a run-off of the company
- The going concern approach

1977

Benjamin, B. (1977): General Insurance. Heinemann, London (published for the Institute of Actuaries and the Faculty of Actuaries)

Risk based approach (RBC)

- In 1992 NAIC (The National Association of Insurance Commissioners) introduced RBC system for life and health insurers
- Canada, Australia, Singapore and Japan and within the European Union

1990's

Solvency assessment systems

United Kingdom, Switzerland and the Netherlands

Traffic light systems based on stress tests

Denmark and Sweden

The ruin probability

- Break of the MCR

2004

Pentikainen, Teivo (2004): Solvency, Encyclopedia of Actuarial Science, John Wiley & Sons, New York (Eds: Jozef Teugels and Bjřrn Sundt).

Historical overview (3 of 4)

	Risk-based systems	

EU Parliament

- Adopted revised directives, Solvency I

2002

RM: Quantile method

- Introduced by the Australian regulators for P&C companies

IAA
- Total balance sheet approach

2004

IAA (2004): A Global Framework for Insurer Solvency Assessment. IAA, Ontario.

Risk margin

- Covering the uncertainty linked to future cash flows over their whole time horizon

2005

Mourik, Teus (2005): Market value margin versus economic capital, Working Paper, KPMG, the Netherlands.

EU Commission
Economic value

- Market values where they exist or market consistent values

2006

EU Commission (2006): Amended Framework for Consultation on Solvency II, MARKT/2515/06, April 2006. European Commission, Internal Market and Services DG, Financial Institutions, Insurance and Pensions.

Story of the risk margins underwent an evolution

At the beginning

- Transfer value risk margin

The idea was that a second insurer will be compensated to take over the liabilities at the end of the year, when the initial insurer is minimally capitalized

Later

- Fulfillment value
- (also approach in **IFRS4 Phase 2** - cost of fulfilling the liabilities

The RM is sufficient to allow a run-of the liabilities with a minimal capitalization. The run-off is assuming no new business, and the transfer occurs at the end of the year (t=1), while the insurer has been writing new business during the year

**In S2**

- Is stuck with the transfer value methodology (written in Directive)
- Transfer to an empty company
  - Any ins./reins. Obligations and any own funds before the transfer takes place

The whole portfolio of ins./reins. obligations of the ins./reins. undertaking that calculates the RM (original undertaking) is taken over by another insurance or reinsurance undertaking (reference undertaking)

Questions & Answers
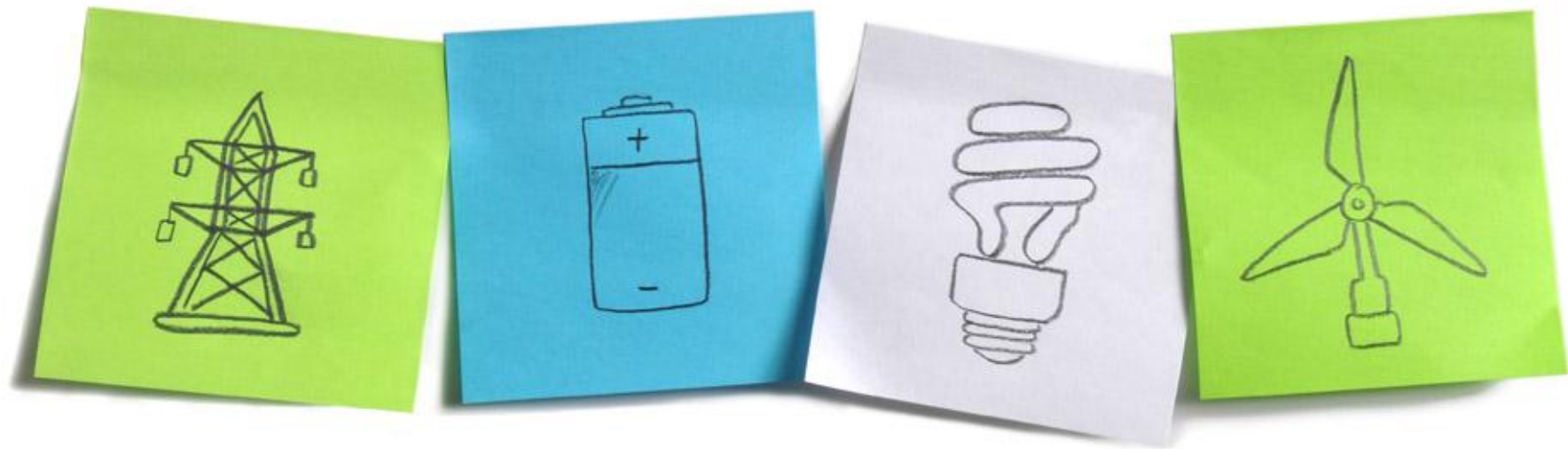
Thank you for your attention

Deloitte.