

# Climate change: Putting the heat on defined benefit pension plan funding

Singapore Actuarial Society  
2019 Life & Retirement Conference

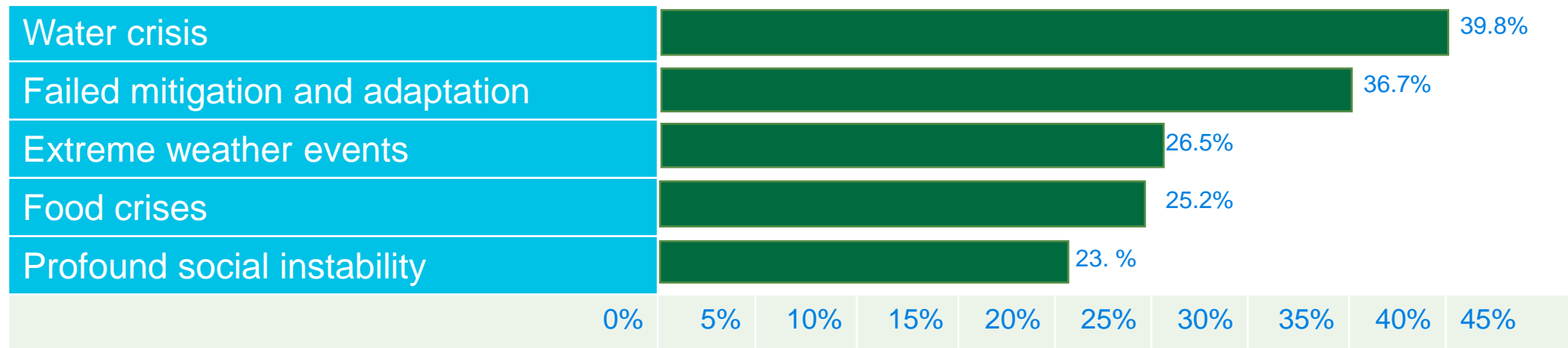
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AUGUST 2019



# Global risks – mostly associated with resource & environment

Highest concerns among 750 decision makers (business, academia, public services)



2016 World Economic Forum:

“uncertain event or condition that, if it occurs, can cause significant negative impact for several countries or industries in the next 10 years”



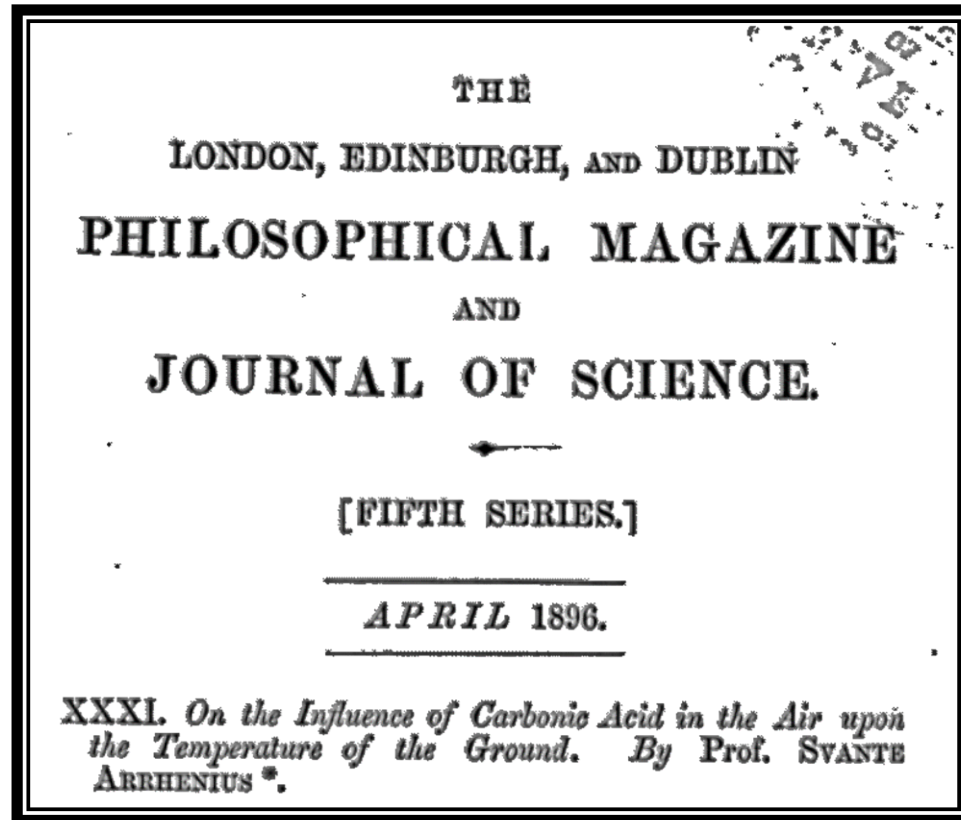
# Impact on covenant

- How do issues around resource & environment (R&E) affect the reliance that members of pension funds have in their employer/government to fund their benefits?
- Or pay them in PAYG systems?
- The impact may be seen from two perspectives:
  - Sponsor is dependent on economy to provide capital growth
    - Underperforming economy => low returns on assets (breaks the “fundamental equation”)
  - Sponsor is dependent on economy to survive as an entity
    - Underperforming economy => struggling plan sponsor (future contributions in doubt)



# Climate Change

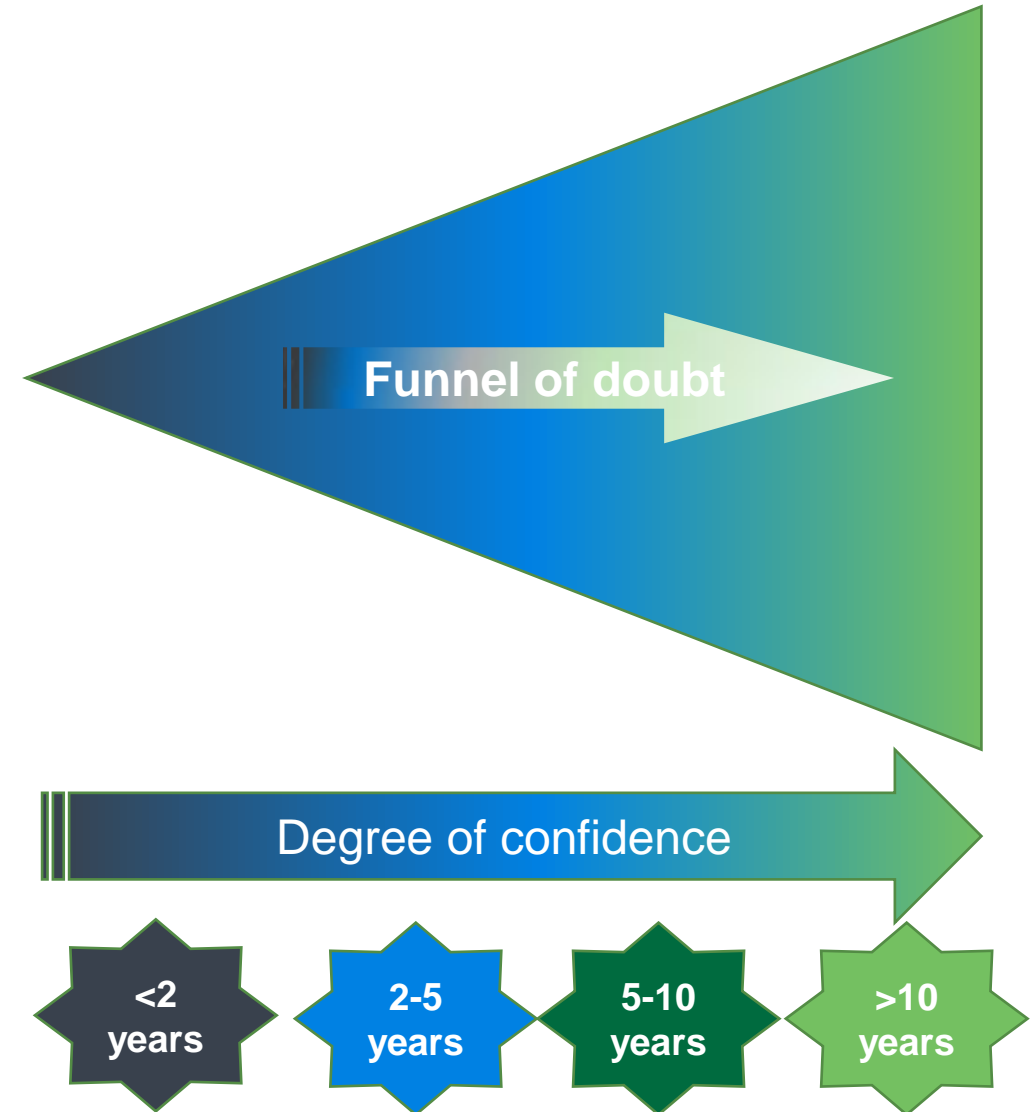
- CO<sub>2</sub> and other greenhouse gases trap the heat from solar radiation in the atmosphere.
- We've known about this for over 100 years.



“On the influence of carbonic acid in the air upon the temperature of the ground”  
Arrhenius, 1896

# How do we address the various issues?

- What are the main Resource & Environment risks:
  - Short term: Up to 2 years
  - Medium term: 2-5 years
  - Long term: 5-10 years
  - Very long term: beyond 10 years
- How to identify, assess and mitigate
- Impact on entity viability during recovery period
- Robustness under multiple scenarios



# Both sides of the balance sheet

- Our concerns over the assets:
  - Valuation
  - Robustness to change
  - Underestimating the impact of changes
- And the liabilities:
  - Drift in assumptions
  - Acceleration or deceleration of changes
  - Stability of correlations
- Ultimately the question will be speed of funding
  - Recovery plans over periods that are too long need to be challenged
  - But knee jerk reactions are potentially destructive

# Impact on demographic assumptions

- Rising temperatures
  - Milder winters – fewer cold related deaths
  - Hotter summers – more heat related deaths
  - Vicious (self fulfilling) cycle of use of utilities
- Change in environment
  - Extreme weather
  - Insect-borne disease
- Effect on behaviour
  - Healthier lifestyles
  - Efforts to reduce carbon-footprint
- Commercial impact
  - Higher energy prices – potentially unaffordable
  - Transportation costs rise – for example, distribution of healthy food harder
- Macro-economics
  - Reduction in government spending on welfare and public investment
  - Fewer prevention efforts
  - Less research

Looking backwards and extrapolating will not necessarily give us the information needed for projections

# Impact on financial assumptions

## Breaking the tragedy of the horizon<sup>1</sup>

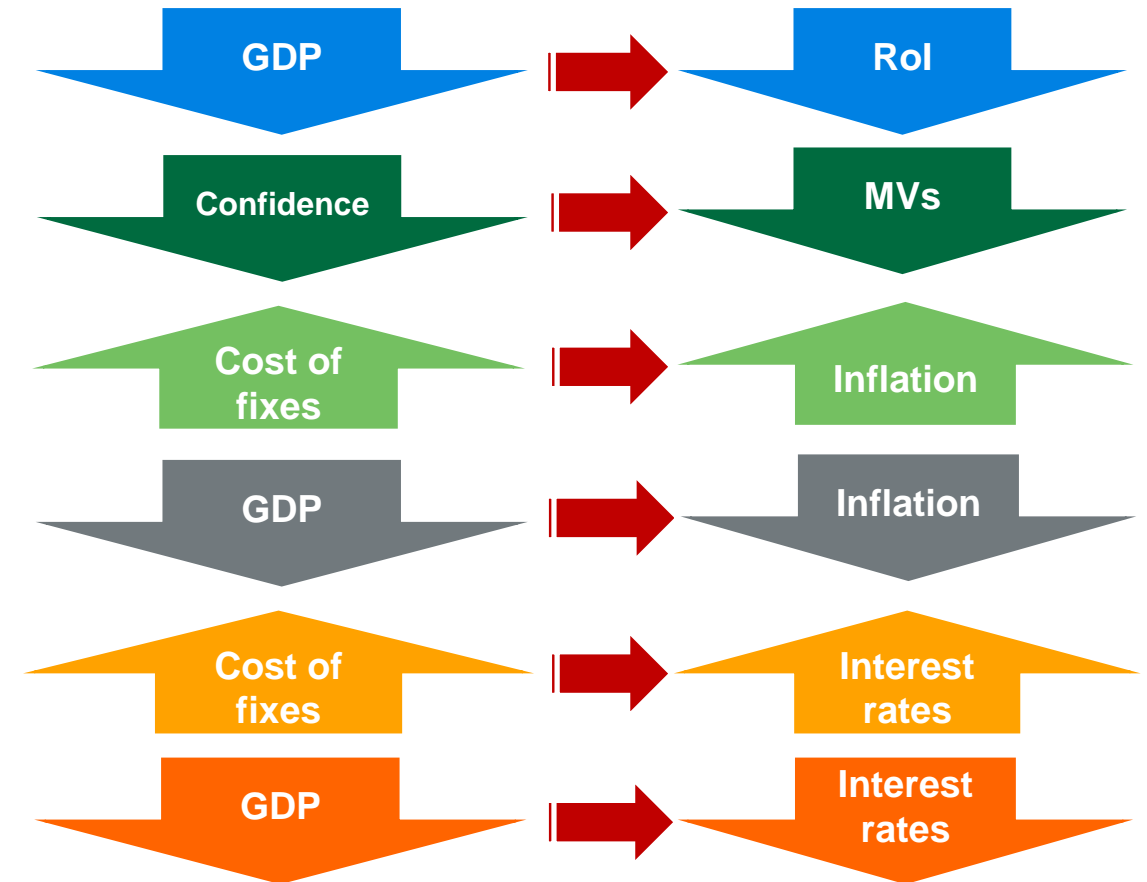
- Physical risks
  - Immediate damage
  - Longer term disruption (especially to utilities)
- Transition risks
  - Economies shift – “stranded assets”
  - e.g. Exposure of European financial sector to high-carbon assets > Euro 1 trillion (Weyzig, 2014)
- Liability risk
  - Who is to blame and who is going to pay for it

**What if climate risk per se is not included in the assumption setting, and then it is discovered that it should have been?**



# Taskforce on climate-related financial disclosures

- Lower economic growth leads to lower returns on equities, property and other assets
- Greater uncertainty in the economic outlook leads to lower asset values
- Costs of dealing with climate change lead to higher price inflation
- Lower economic growth leads to lower price inflation
- Greater investment in climate adaptation and mitigation leads to higher interest rates
- Monetary policy measures to address lower economic growth lead to lower interest rates.



# Impact on actuaries (and fiduciaries ...)

- Professional duty – we need to consider all potential factors
  - Not allowing for climate change: could face sanctions
- Examples of third party influences:
  - Regulators start to dictate DB investment guidance
  - E.g.
    - Revised EU Directive for Institutions for Occupational Retirement Provision (IORPs)
    - Proposed changes to the 2005 Investment Regulations
- Widespread interest
  - It will appear strange if we didn't mention it!

# Financial assumptions

- Climate risks are emerging risks – limited impact so far on the market return history (typically used to calibrate return forecasts and expectations)
- The contention that markets do not typically price these risks well but focus on shorter time horizons
- The potential financial impact of risks shown by modelling studies
- Potential interrelated effects, especially the impact of climate risks on investments and sponsor covenant strength within an integrated risk management framework
- The time horizon of funding objectives, recovery periods and investment strategy



# Financial assumptions (cont.)

- Climate risks may also affect annuity pricing from insurers if buy-out forms part of the scheme's targeted objective
- The degree to which climate risks and opportunities have been taken into account within the scheme's investment approach
- The suitability of the scheme's investment governance arrangements for navigating emerging risks and opportunities
- The desired level of overall prudence for the funding basis, allowing for the additional uncertainties arising from climate risks
- Suitable scenarios and stress tests to communicate the potential impact of climate-related risks

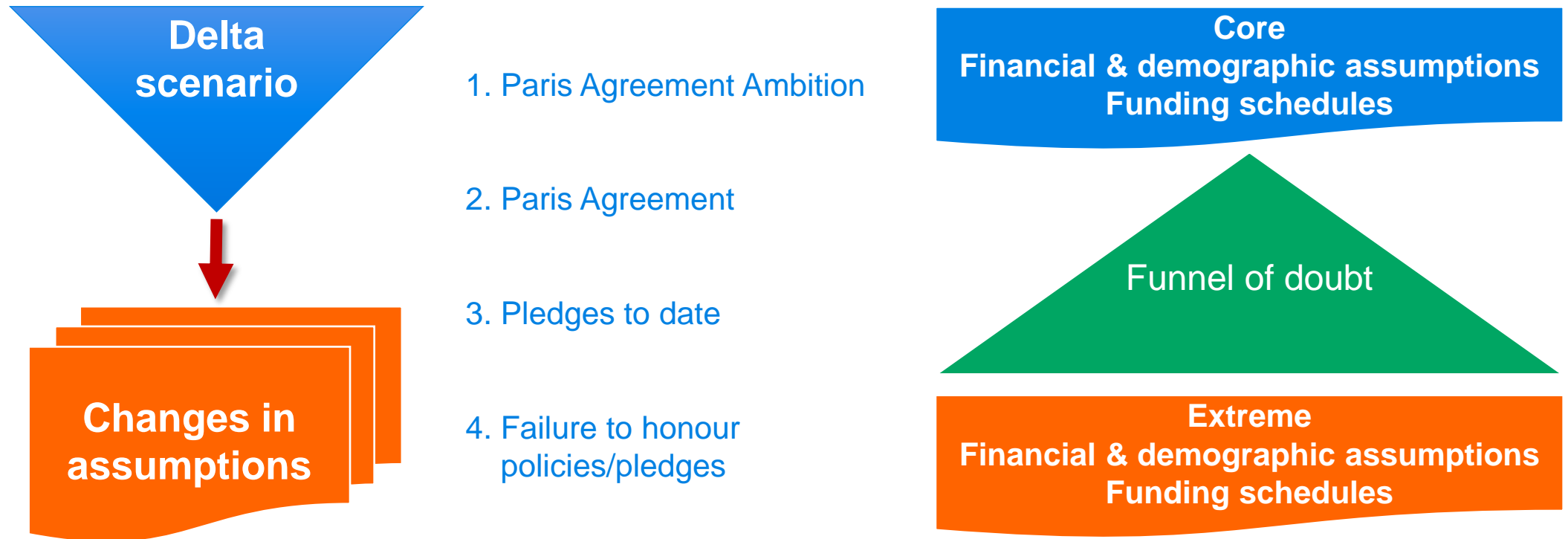
# Reflecting climate risks in financial assumptions

- Scenarios
  - Paris Agreement Ambition: +1.5 degrees increase in temperature
  - Paris Agreement: +2 degrees rise
  - Pledges to date: +3 degrees rise
  - Failure to honour policies/pledges: +4 degrees
- Critical to measure impact over time
  - Short term issues, before matters get critical
  - Longer term, when change has clearly had an impact
- Cash flow analysis is a more meaningful illustration than present value measures



# Implications of scenarios on assumptions

- Recognising the different scenarios is the first step
- Delta in assumptions as you move from one scenario to another?

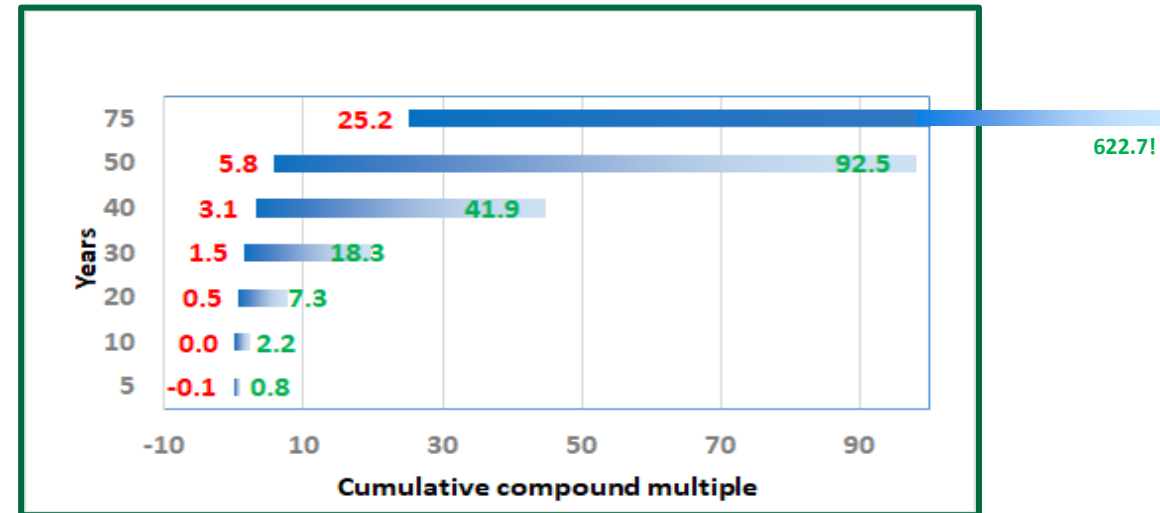


# Example of implications for discount rate or return on capital

- Sample projection of portfolio returns:



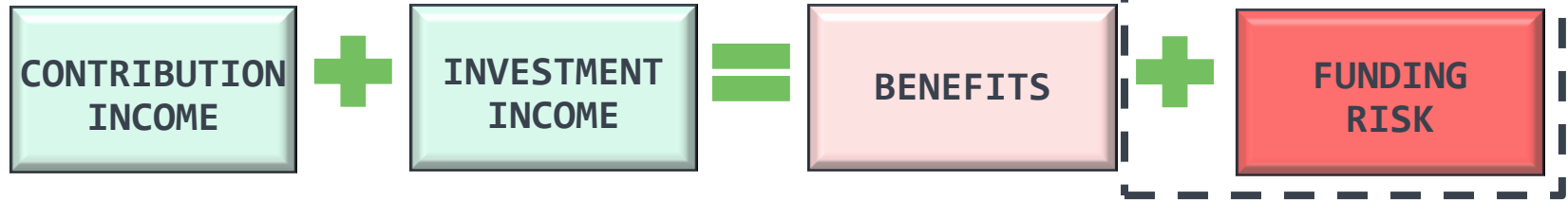
- Cumulative return on capital



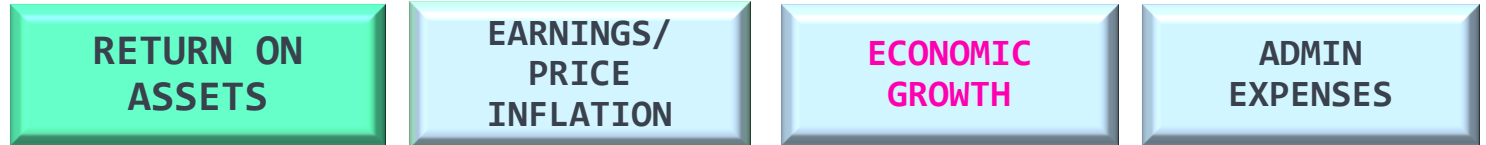
- Shorter term doubts about annualised forecasts
- Longer term: more confidence in the annualised values
- But when compounded, the cumulative amounts can vary significantly

# Slotting into the actuarial process

FUNDING PARADIGM



ECONOMIC RISKS



DEMOGRAPHIC RISKS



# Move from traditional results...

## NEAR TERM OUTLOOK

Teacher Retirement System of Texas  
Actuarial Valuation – August 31, 2015

Section A

### EXECUTIVE SUMMARY

Item	2015	2014
<b>Membership</b>		
• Number of		
- Active members	828,945	857,342
- Service retirees	355,384	341,302
- Disabled retirees	9,495	9,413
- Beneficiaries	12,859	
- Inactive, vested	91,268	
- Inactive, nonvested	161,292	
- Total	1,459,243	
• Projected Payroll for Contributions	\$ 39.620 billion	\$
<b>Statutory contribution rates</b>		
• Combined State/Employers *	7.700%	
• Member **	7.700%	
<b>Actuarial Information</b>		
• Normal cost %	9.91%	
• Unfunded actuarial accrued liability (UAAL)	\$ 32.968 billion	\$
• UAAL as % of pay	83.2%	
• Funded ratio	80.2%	
• Funding period (years)	33.3	
• Actuarially Determined Employer Contribution (ADEC) (30 Year Amortization based on the Actuarial Value of Assets) ***	7.92%	

Teacher Retirement System of Texas  
Actuarial Valuation – August 31, 2015

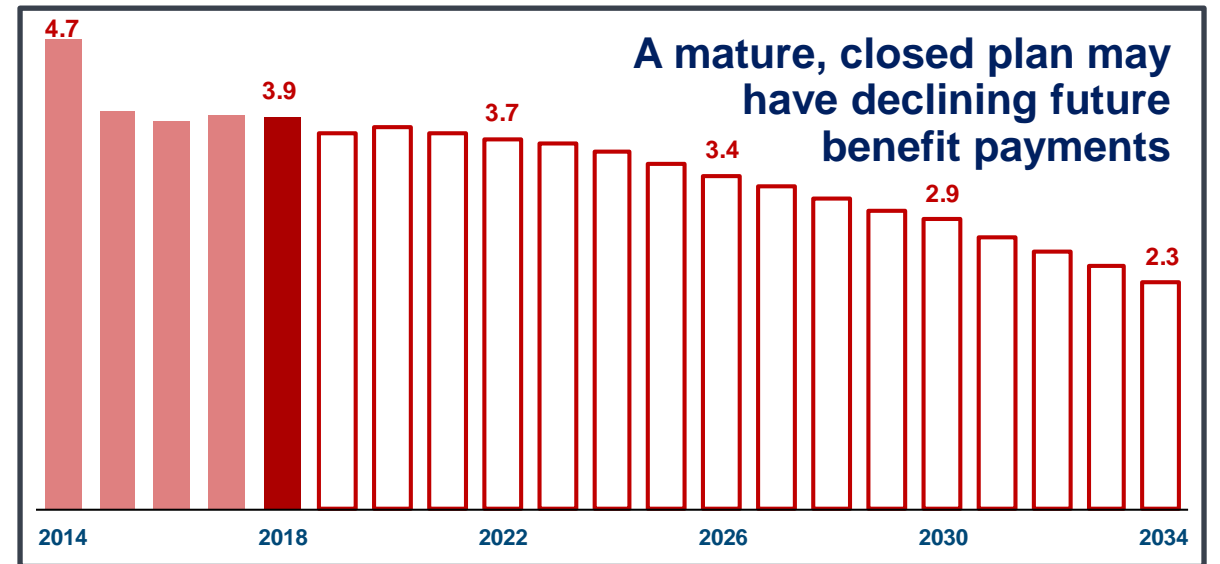
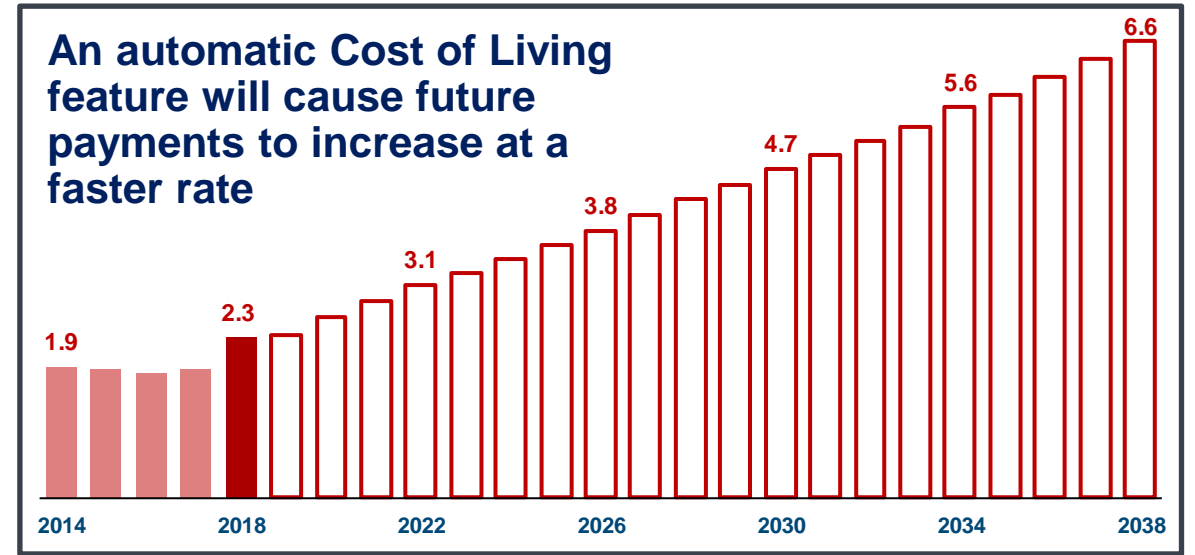
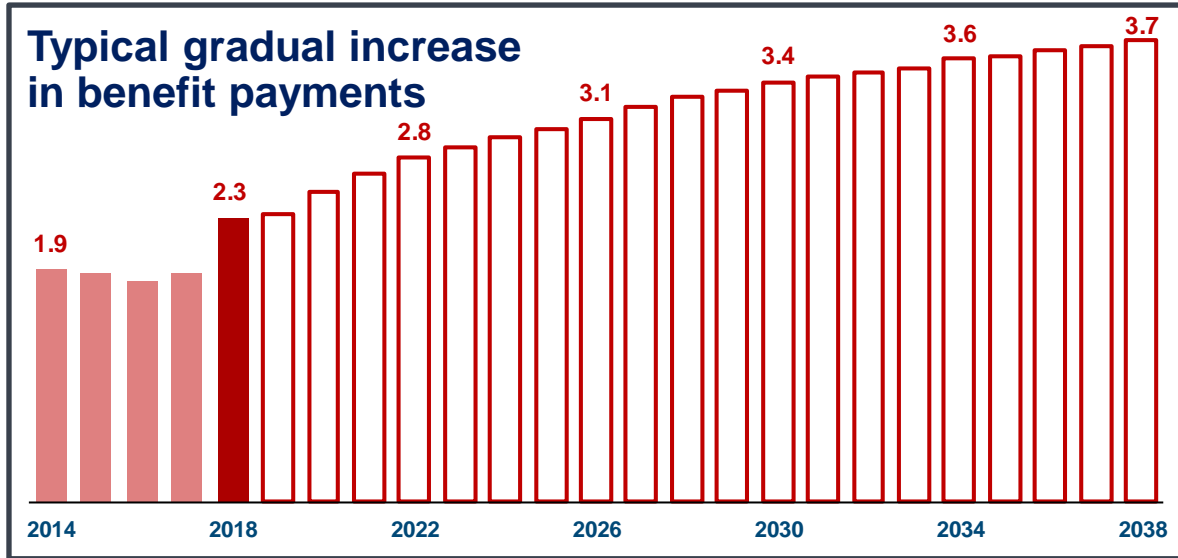
### EXECUTIVE SUMMARY

Item	2015	2014
<b>Assets</b>		
• Market value	\$ 128.539 billion	\$ 132.779 billion
• Actuarial value	\$ 133.485 billion	\$ 128.398 billion
• Estimated yield on market value	-0.3%	16.8%
• Estimated yield on actuarial value	7.0%	8.9%
• Ratio of actuarial to market value	103.8%	96.7%
• Employee contributions, including service purchases	\$ 2,626.1 million	\$ 2,501.2 million
• State contributions	1,612.7 million	1,550.3 million
• Employer contributions	1,378.0 million	984.6 million
• Benefit, refund, and expense payments	9,746.6 million	9,333.8 million
• Net external cash flow	(4,129.8) million	(4,297.7) million
<b>Gains/(losses)</b>		
• Asset experience	\$ (1,236.6) million	\$ 1,095.4 million
• Assumption changes/Legislative changes	(682.1) million	(2,282.4) million
• Liability experience	1,501.1 million	(357.7) million
• Total	\$ (417.6) million	\$ (1,544.7) million
<b>Actuarial Information based on Market Value of Assets</b>		
• Unfunded actuarial accrued liability (UAAL)	\$ 37.914 billion	\$ 27.256 billion
• UAAL as % of pay	95.7%	70.8%
• Funded ratio	77.2%	83.0%
• Funding period (years)	56.4	22.8
• Actuarially Determined Employer Contribution (ADEC)	8.76%	7.06%

Valuation as of August 31	Unfunded Actuarial Accrued Liability (UAAL, in Millions)	Funded Ratio	Funding Period	Actuarial Value of Assets (AVA, in Millions)	For Fiscal year Ending August 31	Projected Payroll for Contributions (in Millions)	Employer Contributions (in Millions)	Employee Contributions (in Millions)	Benefit Payments and Refunds for Following FY	External Cash Flow
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
2015	\$ 32,967	80.2%	33.3	\$ 133,485	2016	\$ 39,620	\$ 3,051	\$ 2,853	\$ 11,642	\$ (5,738)
2016	33,775	80.3%	32.2	138,038	2017	40,744	3,137	3,137	10,094	(3,820)
2017	34,287	80.9%	31.1	144,964	2018	41,886	3,225	3,225	10,563	(4,213)
2018	34,773	81.4%	30.0	152,029	2019	43,059	3,316	3,316	11,239	(4,608)
-----	-----	71.9%	29.0	159,241	2020	44,263	3,408	3,408	11,824	(5,008)
		62.4%	27.8	166,607	2021	45,509	3,504	3,504	12,406	(5,397)
		52.9%	26.8	174,150	2022	46,799	3,603	3,603	12,986	(5,780)
		43.3%	25.6	181,891	2023	48,114	3,705	3,705	13,575	(6,166)
		33.8%	24.6	189,843	2024	49,467	3,809	3,809	14,180	(6,562)
		24.3%	23.5	198,012	2025	50,852	3,916	3,916	14,806	(6,974)
		14.8%	22.4	206,397	2026	52,271	4,025	4,025	15,465	(7,415)

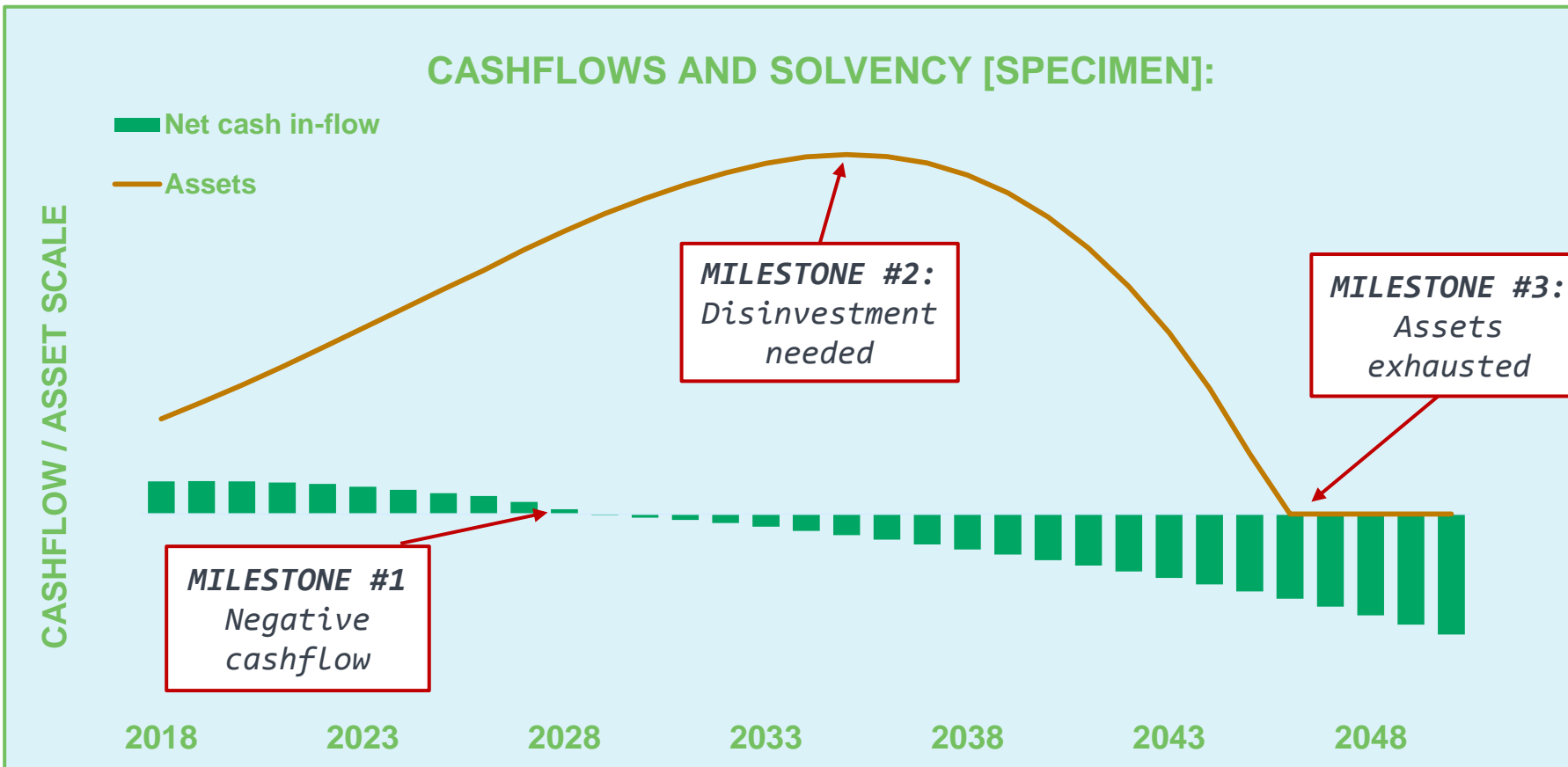
- Tabulated results provided statutory information – static and difficult to appreciate
- Cash flow statements give more – forecasts of contributions and benefits
- Scenario analysis will require a more dynamic pictorial presentation

# Reflection of what we have seen, what is now and what might be ahead





# ...to more dynamic presentation



- We see the materiality of the cash flows
  - M1 = the date when benefits exceed contributions (negative net cash flows)
  - M2 = the date when investment income does not cover the negative net cash flows
  - M3 = the date when the Fund is exhausted (the Plan is now PAYG)



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# Thank you

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