Pricing Financial Market Instruments to Protect Against,

and to Speculate About,

Climate Change:

An Update

Mitigating the Effects of Climate Change

10th Conference on Weather, Climate, and the New Energy Economy

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Summary

The author, in a number of papers, has previously explored the role of financial market instruments in the area of climate variability and change.

Previous work established theoretical ‘fair value’ premiums (costs) for sets of call and put options about futures contracts related to the annual value of the global mean temperature*.

The current paper updates the aforementioned, utilising global mean temperature data up to 2017 to yield Monte-Carlo generated future scenarios, in order to establish new estimates of the theoretical 'fair value’ costs at the time of purchase.

In conclusion, the implications of establishing what might be termed a *Long-Term Global Climate Derivatives Exchange* are considered.

**Stern H (2018) The Dual Function of Financial Market Instruments in an Environment of Climate Change Uncertainty - Protection and Speculation. 9th Conf. on Weather, Climate, and the New Energy Economy, Austin, TX, 7-11 Jan. 2018, Amer. Meteor. Soc.*

A Quote*

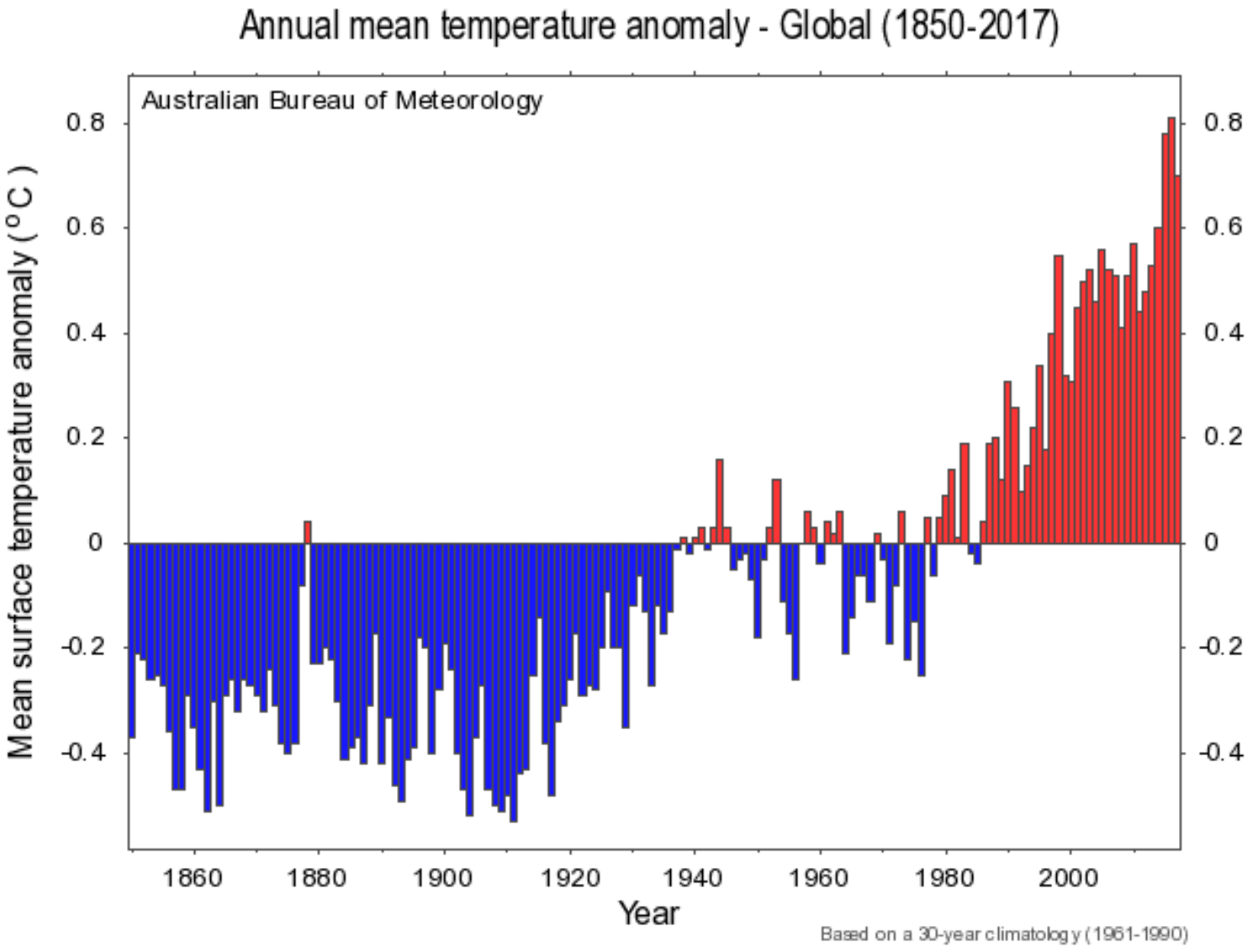
"While climate risks have been broadly recognised, they have often been seen as a future problem or a non-financial problem ... this is no longer the case.

Some climate risks are distinctly 'financial' in nature.

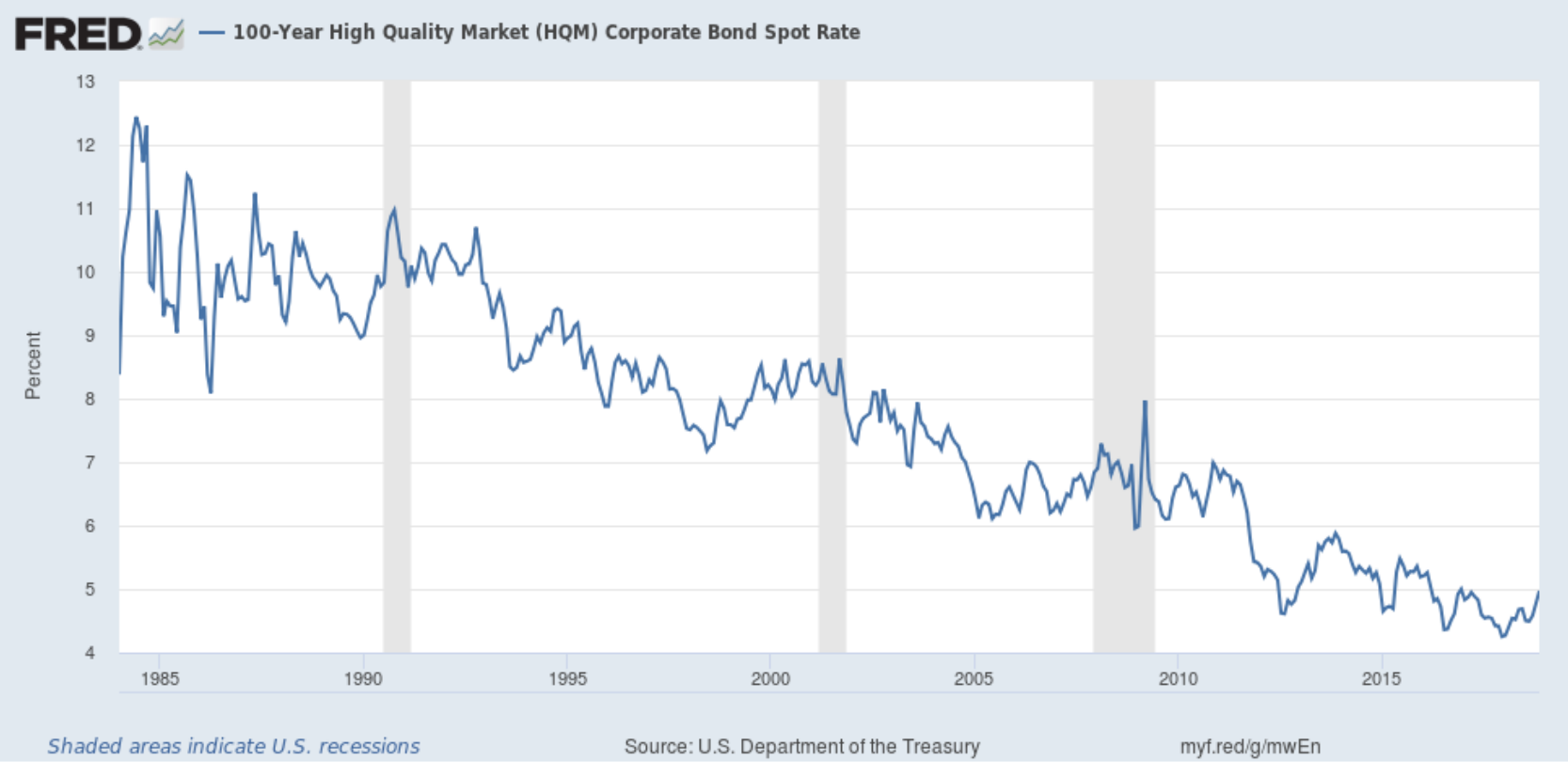
Many of these risks are foreseeable, material and actionable now".

** 17-Feb-2017 speech by Geoff Summerhayes, Australian Prudential Regulation Authority (APRA)'s Executive Member (Insurance)*

Recent Trend: The Global Mean Temperature Anomaly

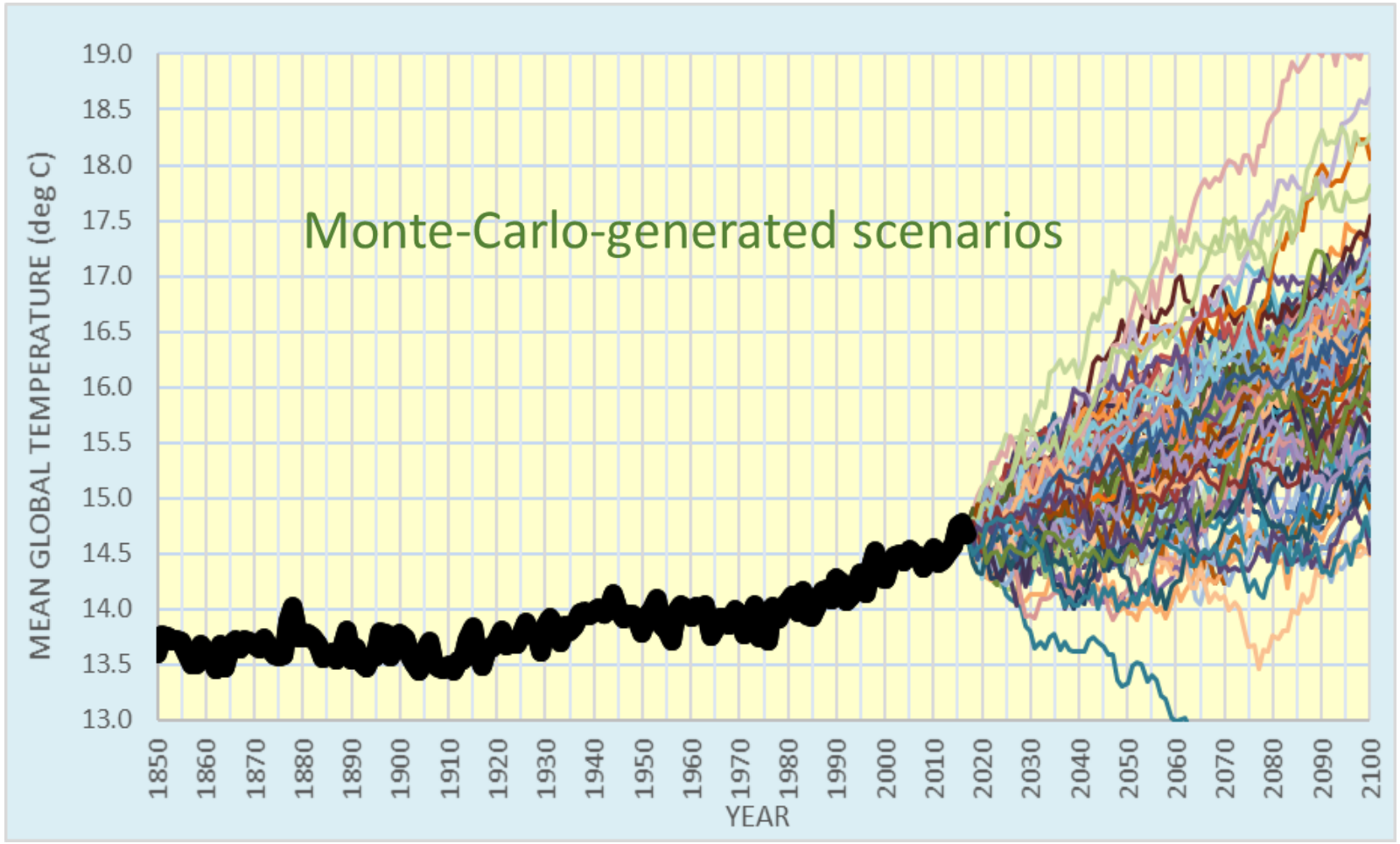


An important input: The 100-Year Bond Rate



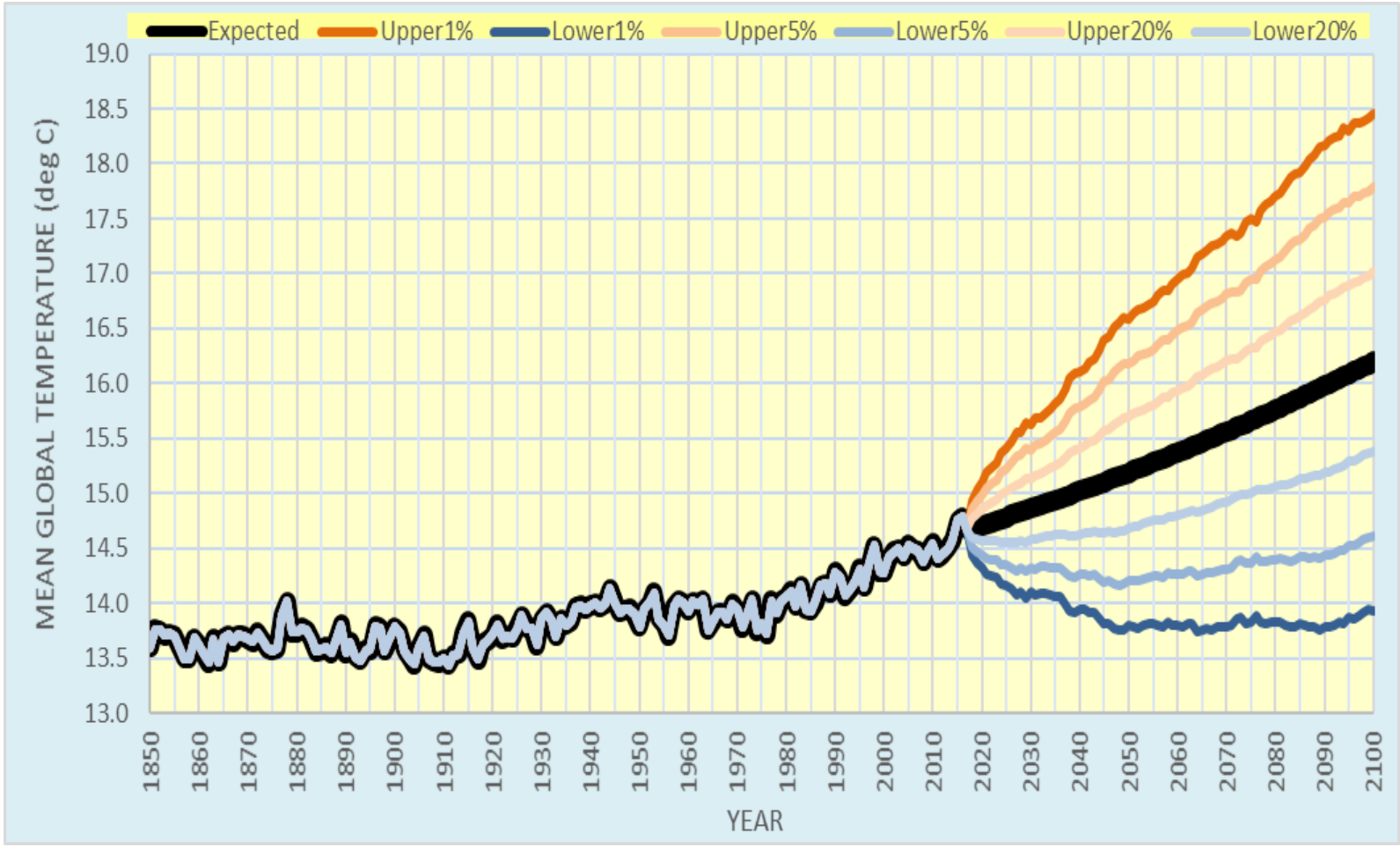
Monte-Carlo Generated Scenarios

A set of possible future trends out to 2100 of the Global Mean Temperature is derived based upon 100 Monte-Carlo-generated scenarios.



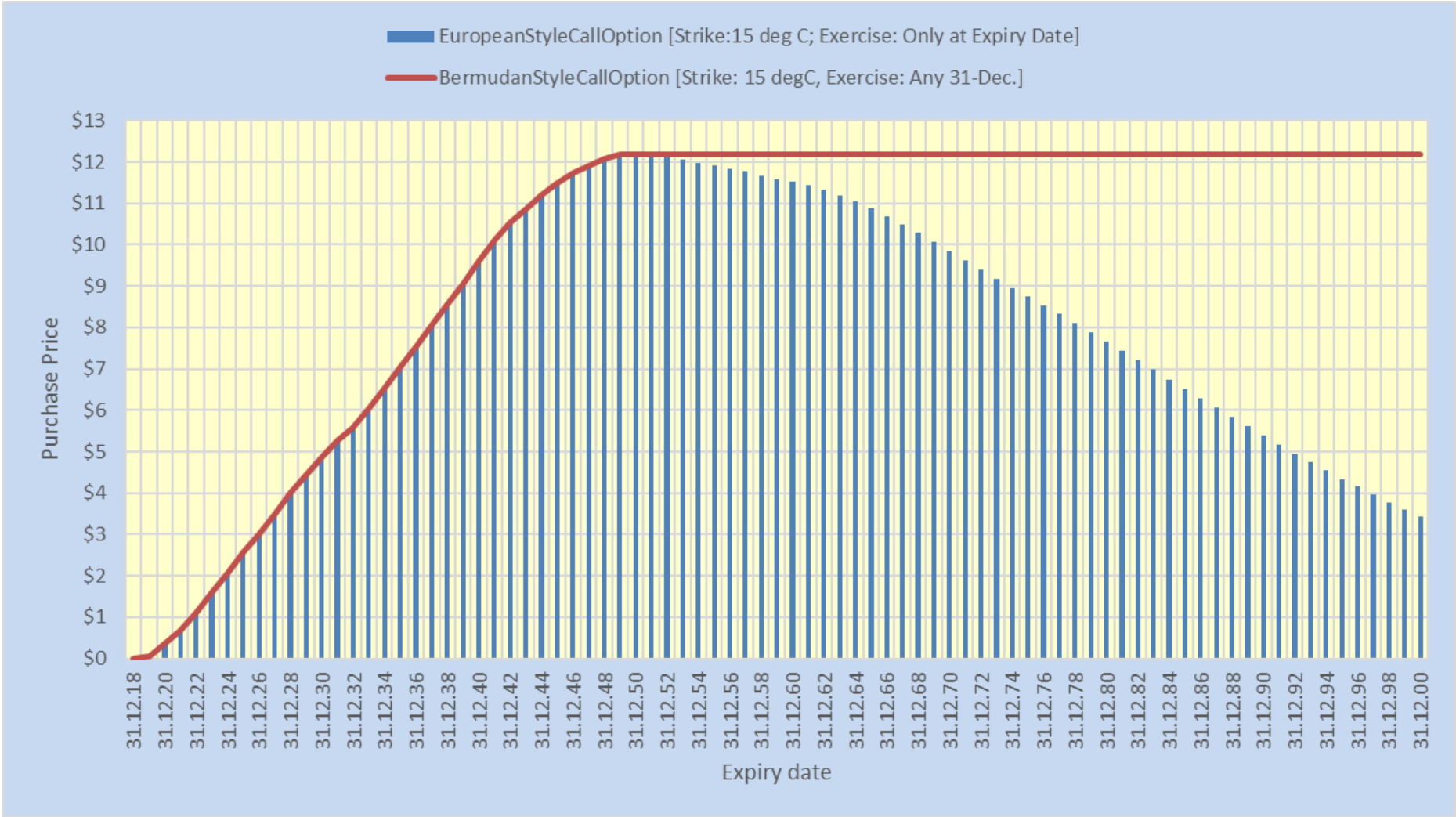
Statistical Distribution of the possible spread of future Global Mean Temperatures

The set of possible future trends is then analysed to generate a statistical distribution of the possible spread of future Global Mean Temperatures.



Global Mean Temperature Futures Call Contracts

The statistical distribution is then used to estimate the 'fair value' prices of call options on Global Mean Temperature futures set to expire on Dec-31 in each year out to 2100.



Example

Consider, for example, the 15°C Bermudan style call option's value at expiry.

That 15°C is referred to as the option's strike.

- The option expires in the year 2100 (its purchase price is $12.51).
- The option possesses a premium (value) of $100 per °C at expiry.
- *Suppose* that the global mean temperature in the year 2100 is 17.5 °C .

The value of the call option at expiry would be:

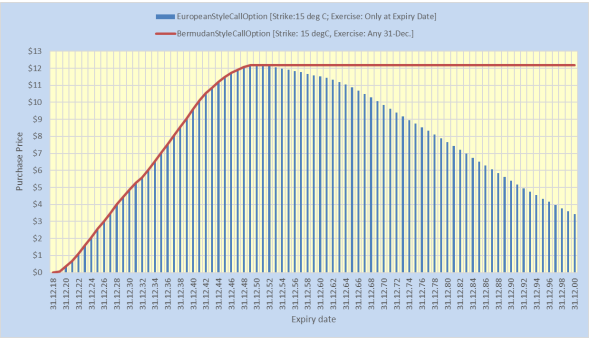
= (MAX[$ [(Year 2100 global mean temperature)-(strike)] x [premium] , 0]

= (MAX[$ [17.5 – 15] x [100], 0) = $250 (a profit of $250.00 - $12.51 = $237.49)

Note that should the global mean temperature in the year 2100 be less than 15°C, the option would expire worthless, and a loss of the premium ($12.51*) would be incurred.

With the option now worthless, the seller would keep the premium, which, with the 82-year bond interest rate at 4.42%, would have grown to $(1.0442^82)(12.51), that is, $434 in 2100 dollars, in 2100.*

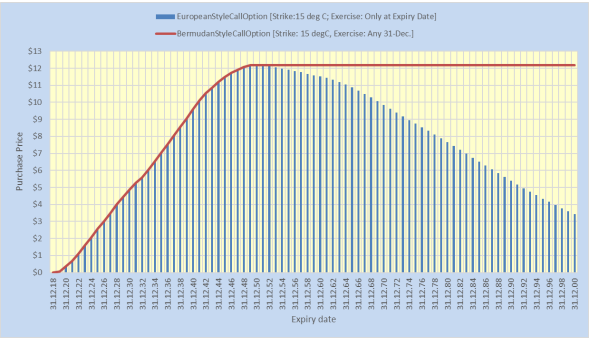
Global Mean Temperature Futures Call Contracts



Why Buy?

The purchase of a call contract insures those whose businesses might be adversely affected by a long-term significant rise in temperature.

Global Mean Temperature Futures Call Contracts

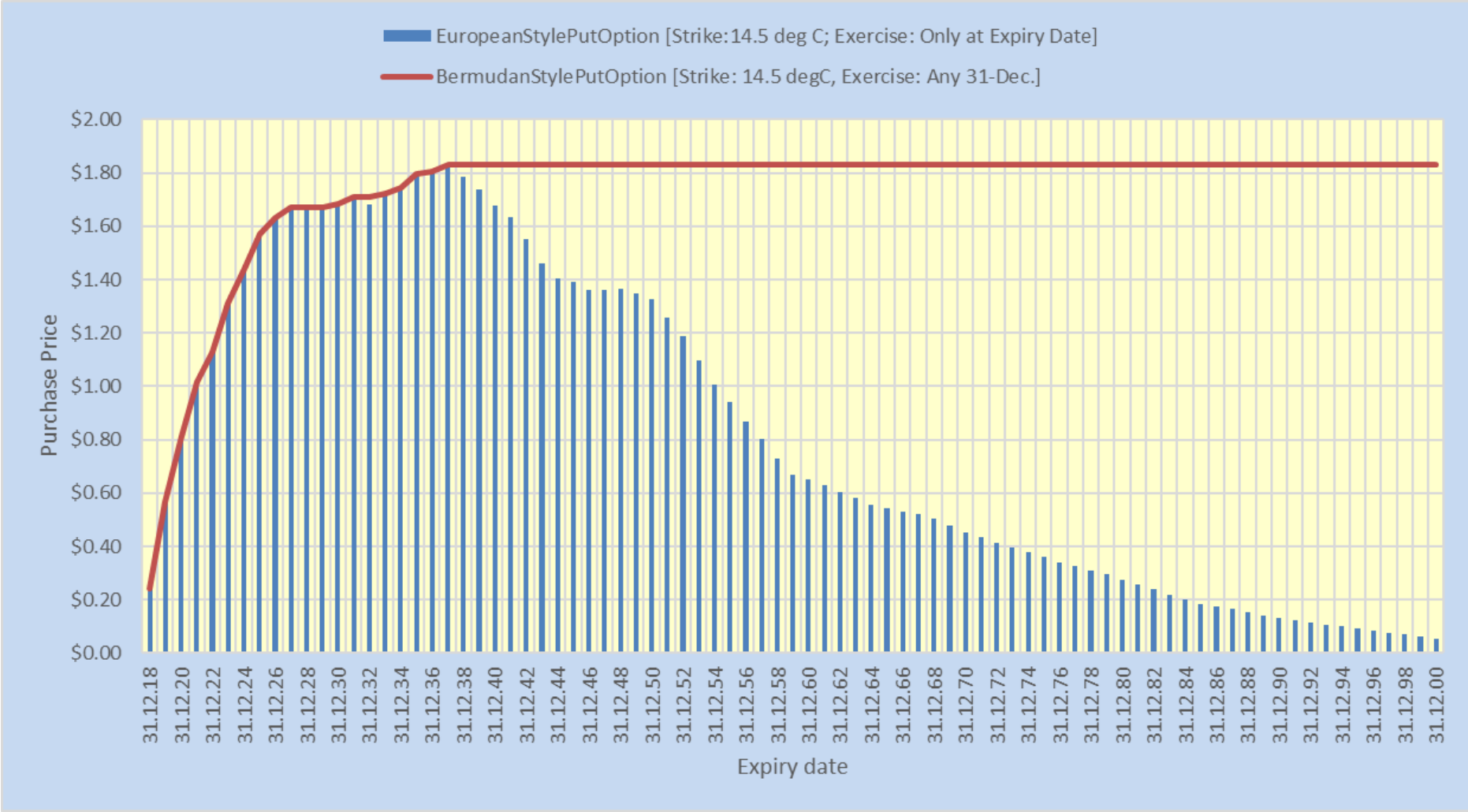


Why Sell?

The sale of a call contract provides capital (corresponding to the potential risk) for those who wish to run a business insuring those whose ventures might be adversely affected by a long-term significant rise in temperature.

Global Mean Temperature Futures Put Contracts

The statistical distribution is then used to estimate the 'fair value' prices of put options on Global Mean Temperature futures set to expire on Dec-31 in each year out to 2100.



Example

Consider, for example, the 14.5°C Bermudan style put option's value at expiry.

That 14.5°C is referred to as the option's strike.

- The option expires in the year 2100 (its purchase price is $1.83).
- The option possesses a premium (value) of $100 per °C at expiry.
- *Suppose* that the global mean temperature in the year 2100 is 14.0 °C .

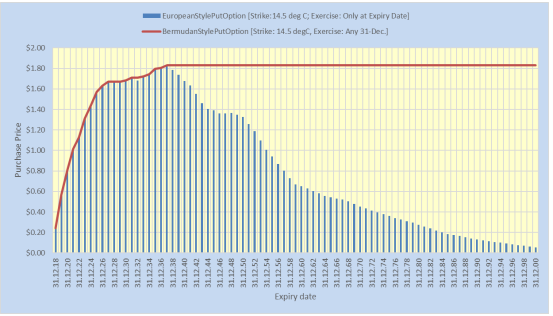
The value of the put option at expiry (the year 2100) would be:

= (MAX[$ [(strike) - (Year 2100 global mean temperature)] x [premium] , 0]

= (MAX[$ [14.5 – 14.0] x [100], 0) = $50 (a profit of $50 - $1.83 = $48.17)

Note that should the global mean temperature in the year 2100 be > or = 14.5°C, the option would expire worthless, and a loss of the premium ($1.83) would be incurred.

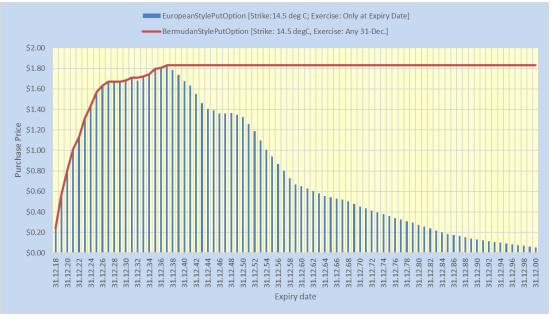
Global Mean Temperature Futures Put Contracts



Why Buy?

The purchase of a put contract allows those sceptical about the likelihood a long-term significant rise in temperature to speculate on that outcome.

Global Mean Temperature Futures Put Contracts



Why Sell?

The sale of a put contract provides capital to those wishing to invest in businesses dedicated to the development of renewable sources of energy.

Concluding Remark

The establishment of what might be termed a *Long-Term Global Climate Derivatives Exchange* would facilitate the trading of financial products related to long-term trends in the world's climate, and thereby readily allow for:

- The implementation of protection strategies;
- The raising of capital for relevant ventures; and (of course),
- Speculation.

An interesting side benefit, might be the emergence of an *unbiased* consensus view about the future climate.

On this subject, Little *et al*. (2015)* somewhat bluntly suggest that parties "should either put up their capital … or not".

**L.R. Little et al. Funding climate adaptation strategies with climate derivatives / Climate Risk Management 8 (2015) 9–15*

Thank You

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