An Taisce
The National Trust for Ireland

National Adaptation Framework Public Consultation,
Climate Policy Section,
Department of the Environment, Community and Local Government
Custom House,
Dublin 1

nationaladaptationframework@environ.ie

May 20th, 2016

Re: An Taisce submission on the development of Ireland's first statutory National Climate Change Adaptation Framework (NAF)

Dear Sir/Madam,

An Taisce welcomes the opportunity to comment on the development of a national adaptation framework (NAF). We ask you to carefully consider a number of aspects of concern which are outlined below.

We would appreciate notification of further discussion on the conclusions of this consultation.

Yours sincerely,

p.p. Eoin Heaney

An Taisce Climate Change Committee (ATCC)

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Submission on the development of Ireland's first statutory National Climate Change Adaptation Framework (NAF)

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1.0 Assessing Future Climate Vulnerabilities and Risks

Consideration of vulnerabilities and risk requires access to a body of reliable scientific evidence and projections for Ireland. While much progress has been achieved in this area over the past decade, there is considerably more work to be done. Incorporation of current knowledge in the Climate Ireland website is a welcome step in the right direction. Analysis from a probabilistic perspective has also been conducted (Nolan, 2015), but this will need to be made available in an accessible format for policymakers and stakeholders. The current presentation of climate projections in terms of single-value "likely" impacts is not sufficient for a proper analysis of vulnerabilities and risks. Risk assessment also requires consideration of low probability outcomes with large consequences. Such low probability events with high impacts should be incorporated in adaptation and resilience planning, and probabilities should be modified on an ongoing basis as new evidence emerges (Fealy, 2010). Earlier and stronger, 'low regret' action is mandated rather than delaying or weakening adaptation efforts (Murphy et al., 2009). In general investment in infrastructure should be subjected to sensitivity analysis under the full range of uncertainty associated with climate change (Sweeney et al., 2013).

2.0 Appropriate Time Scales for NAF

Research on climate change impacts and adaptation conducted for the EPA has focused on projections up to 2100. This is entirely relevant for assessment of vulnerabilities and adaptation actions for the current generation. However, if emissions trends are not immediately reversed, very dangerous impacts can be expected in future centuries. In the best-case scenario where the international community succeeds in reducing net emissions to zero by the end of this century, the inertia of the climate system means that surface temperatures will remain elevated for many centuries, and it is virtually certain sea level will continue to rise for several centuries (IPCC, 2014, p.13). It would therefore be appropriate for the NAF to also address these multi-century aspects to identify no-regrets or low cost options available to us now which would avoid devastating impacts for future generations. The now-urgent requirement for climate mitigation and adaptation action to address rapid climate change, despite large uncertainties and modelling limitations, inevitably means that economically 'optimal' cost-benefit analysis is not possible (van den Bergh, 2003) implying that stringent GHG reduction policies are critical to avoid breaching adaptation limits and tipping points in the Earth's climate system.

3.0 NAF Should be Based on 3 to 4° C Average Warming

The NAF must be based upon scientific evidence, and realistic projections of future climatic conditions. In this respect frequent references in the NAF briefing document to the Paris Agreement targets of 1.5° C and 2° C would have to be considered dangerously

misleading, and an unrealistic basis for a NAF. A realistic assessment based upon the scientific evidence and current emissions trends would have to be that the Paris target of 1.5°C is not achievable, and that there is a high probability that the 2° C limit will also be exceeded. According to the IPCC, for a 2 in 3 chance of limiting to 2º C, the total remaining global carbon budget is about 1010 GtCO2 (Stocker & et al, 2013, pp. 27-28), less about 150 GtCO2 emitted since 2011. At the current rate of global emissions, this will be emitted within about three decades. Even assuming that all the current indicative national determined contributions are completely achieved, this would delay the expiry of the available carbon budget by just 8 months (IEA, 2015). An Taisce fully supports the commitments made at Paris, and has consistently urged the Irish government to take urgent steps to achieve mitigation consistent with the Paris targets. Without such rapid and deep decarbonisation there is a high risk that adaptation thresholds may be breached making adaptation impossible in some parts of the globe. Regrettably however, neither at national nor international level is there any evidence of mitigation on the scale required of high per capita emitters. Furthermore, even if net GHG emissions are reduced to zero by the end of the century, there will be a committed temperature increase and sea level rise due to the cumulative emissions and inertia in the climate system (IPPC, 2014, p. 16). Consequently a temperature rise of 3 to 4 C by end of century, as mentioned on page 12 of the NAF briefing document, would have to be considered a more realistic basis for adaptation planning in the light of current knowledge.

4.0 Sea level Rise and Coastal Flooding

There is a significant probability that global sea level rise could exceed 1m by 2100. Sea level rise will magnify the effects of storm surges and wave patterns in coastal areas (Desmond et al., 2009). The potential consequences in terms of increased coastal flooding are extremely serious. The current iteration of the CFRAM studies fails to include climate change effects. Inclusion of climate change in flood risk assessment must be an immediate priority. Based on a review of current knowledge (included in Appendix A to this submission), and adopting a precautionary principle, An Taisce is of the view that the NAF should be based on an assumed sea level rise of 2m by 2100.

On the multi-century time-scale the NAF would need to appropriately address the implications of significantly higher sea level rises. Cumulative CO2 emissions this century will commit to continued sea level rise over coming centuries. Projections by the IPCC for a high emissions scenario this century range from a 2m rise in 2200 to a 6.5m rise in 2500 (IPPC, 2014 p.74). Strauss et al (2013) found that there was already a locked-in sea level rise commitment of 1.6m due to historic emissions. Under a high emissions scenario to 2100 this could increase to a locked-in future sea-level rise of 7.1m. Over future centuries the major Irish coastal cities of Dublin, Cork and Limerick will face increasing incidences and magnitudes of flooding, necessitating population and infrastructure re-location, and significant loss of cultural heritage. This has implications for current land zoning and

planning in coastal areas. While the feasibility considerations and costs of any coastal defences would fall to future generations, we can ensure at this stage that we do not add unnecessarily to these costs. Development of new urban centres or costly infrastructure in low lying coastal areas would add to future costs when these areas eventually succumb to flooding.

5.0 Habitats and Biodiversity

Increases in temperature and changes in rainfall patterns will pose significant risks for vulnerable natural habitats, in particular sand dunes, marginal grasslands, and peatlands (Sweeney et al. 2008; Coll et al., 2012). There may be mass die off of sphagnum moss due to heat waves in summer, with risks of bog bursts and landslides in the wetter winters (Desmond et al., 2009). Ireland's bogs play an important role in absorption and regulation of surface water, but large areas are now in a degraded condition due to historic and continuing peat extraction. As owner and custodian of the remaining raised midland bogs the state has a particular responsibility to show leadership in protection of existing bogs, and in rehabilitation of degraded raised and blanket bogs, to develop resiliency to expected climate change.

As described by Coll et al. (2013) it is expected that habitat changes will accelerate in scope and scale. Some species may be able to migrate from affected habitats provided there are migration pathways, while other species may require assisted migration. Work needs to immediately begin on maintenance of habitat connectivity in the wider landscape. The existence of such a green infrastructure would help natural adaptation processes to take place. Conservation decisions will have to be made on much larger timescales than is traditionally the case. This needs to be assisted by state of the art modelling (Sweeney et al., 2013).

6.0 Adapting to Changing Weather Patterns and Extremes

There is sufficient evidence at this stage that projected increased winter rainfall, and reduced summer rainfall will pose serious risks in many areas. Increases in winter rainfall will increase the frequency of river flooding. In western regions there is expected to be increased duration of standing water on poorly drained soils in winter, which will impact on machinery mobility (Desmond et al., 2009).

Precautionary planning for infrastructure, health and agriculture needs to prepare for the high-end of the range of projected, continued changes in the likelihood of extreme weather in Ireland. Matthews et al. (2016) find:

> *Over the period (1900–2014) records suggest a greater than 50-fold increase in the likelihood of the warmest recorded summer (1995), whilst the likelihood of the wettest winter (1994/95) and driest summer (1995) has respectively doubled since 1850. The most severe end-of-century climate model projections*

suggest that summers as cool as 1995 may only occur once every ~7 years, whilst winters as wet as 1994/95 and summers as dry as 1995 may increase by factors of ~8 and ~10 respectively.

Where water supply systems are operating at close to capacity, a small change in climate could push the system past a critical threshold (Hall et al., 2012). Reductions of up to 40% in summer rain are possible in eastern and southern coasts by the 2080s (Sweeney et al., 2008). The resulting water stress in agricultural areas is likely to result in late summer feed deficits, and may require field irrigation. The water demands of an increasing population combined with the expected future demands of agriculture pose immediate planning challenges. The NRF can address this by encouraging immediate measures robust to uncertainty, such as demand reduction and leakage prevention. A coherent plan is required to ensure an adequate water supply in the long-term for the eastern region to meet the needs of the population and agriculture.

7.0 Human Migration and Global Food Price Increases

As evidenced by the Syrian refugee situation and mass exodus from Africa, Ireland needs to plan for vastly increased immigration pressures this century and beyond. The only reference to population movements in the research literature published by the EPA has been with respect to increased tourism. The prospect of large scale human migration from regions severely affected by climate change needs to be comprehensively researched, and appropriate assistance and management plans put in place to plan for this likely outcome.

Similarly, in the absence of strong 2ºC aligned mitigtion action, a likely effect is that extreme heat and drought events (such as occurred in Russia in 2010) and other extreme events will become ever more common (Fischer and Knutti, 2015), impacting on food production and food prices. Adaptation planning will need to include provision for increasing future financial assistance and aid supports to nations suffering such impacts.

8.0 Global Systemic Risk

Aside from climate induced migration, there are a number of other global systemic risks that are already being seriously amplified by climate impacts, and which should be considered explicitly in the NAP. These include regional political instability (including in the institutions of the EU), financial system instability, and international conflict. Inter alia these also have the potential to significantly (and quickly) disrupt global trade either in general or in respect of specific commodities or products.

Accordingly, the NAP needs to consider measures to deliberately enhance local resource security and resilience, particularly in food and energy supply, and precautionary deployment of robust emergency response systems (for direct management of demand on critical resources and infrastructure, local humanitarian relief etc.). Other critical dependencies on international trade should be systematically identified (e.g., fertilizer,

animal feed, pharmaceuticals, maintenance requirements for critical infrastructure etc.) and either progressively mitigated (through development of redundant localised capabilities) or contingency plans put in place to deal with supply disruptions (short or prolonged).

9.0 Governance

Adaptation to climate change will involve multi-level governance, with engagement by local and regional authorities, government departments, non-governmental organizations and citizens. To avoid fragmentation or duplication of effort, and to ensure scientifically proper guidance, there is an identified need for a suitably resourced national body to coordinate action on climate change adaptation (Desmond and Shine, 2011). In the area of coastal adaptation Falaleeva et al. (2013) have identified governance weakness included institutional fragmentation, ill-defined responsibilities and short-term planning horizons. A coherent approach integrated both vertically and horizontally will require formal structures and legislative support. Without this Ireland will remain unprepared to deal with the imminent climate change challenges (McGloughlin and Sweeney, 2012). The Climate Change Advisory Council as constituted and resourced under current legislation would not be capable of carrying out this function.

10.0 References

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11.0 Appendix A

Planning for Projected 21st Century Sea Level Rise
A briefing on the physical science and risks, and national planning responses to the science.

Note: SLR is used as an abbreviation for Sea Level Rise. IPCC is the Intergovernmental Panel on Climate Change.

Sea Level Rise Projections – Physical Science and Risk Planning

Assessing all available science on global sea level rise, Chapter 13[1] of the IPCC's Fifth Assessment Report (AR5) finds that understanding of past sea-level changes has greatly improved since the previous report, AR4. The contributions from thermal expansion of ocean water and melting land ice now agree with the observed rise. Models continue to somewhat underestimate sea level rise compared to actual observations.

The main assessment findings of the IPCC are:

1. Global sea level was stable for at least two thousand years before industrialisation;
2. Sea level has been rising at an accelerating rate since 1900;

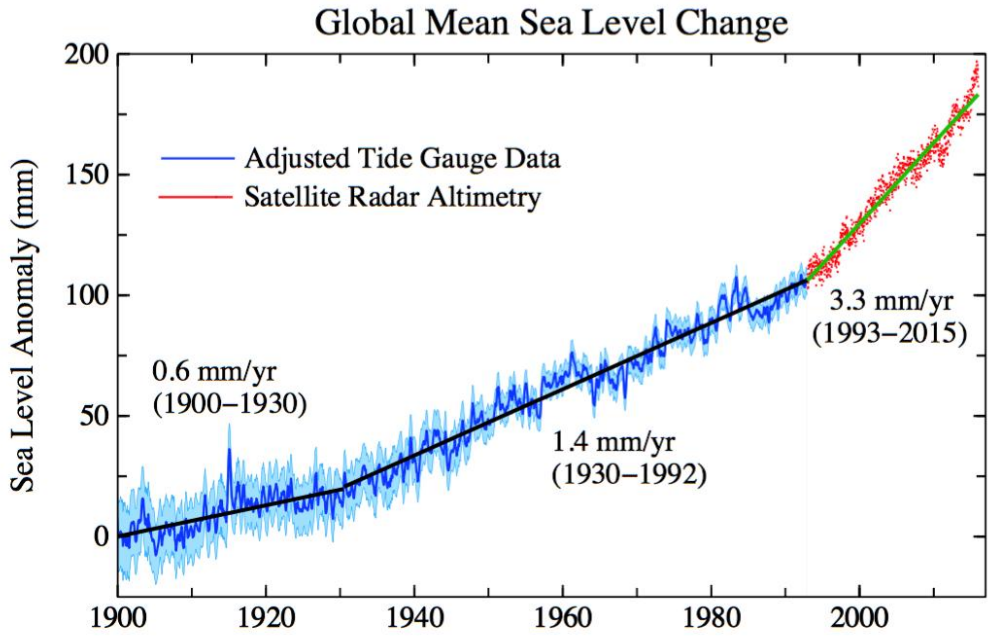


Figure 1: Global mean sea level since 1900[2]

3. The current rate of over 3 cm rise per decade is likely unprecedented in several thousand years;
4. The rate of rise will accelerate even more over this century.
5. The rate of sea level rise and changes in acceleration will depend on net human-caused greenhouse gas (GHG) emissions from now on.

[1] Church, JA et al. (2013) *Sea Level Change.* Ch. 13 In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change
[2] http://www.columbia.edu/~mhs119/SeaLevel/SL.1900-2016.pdf

6. Achieving, or failing to achieve, an end to CO_2 emissions over the next few decades will have very long-term consequences for ice sheets and sea level rise[3]. Even with low future total GHG emissions, sea level will still continue rise for centuries due to past emissions, but the rate of rise and ultimate level would be greatly limited compared to continued high emissions.

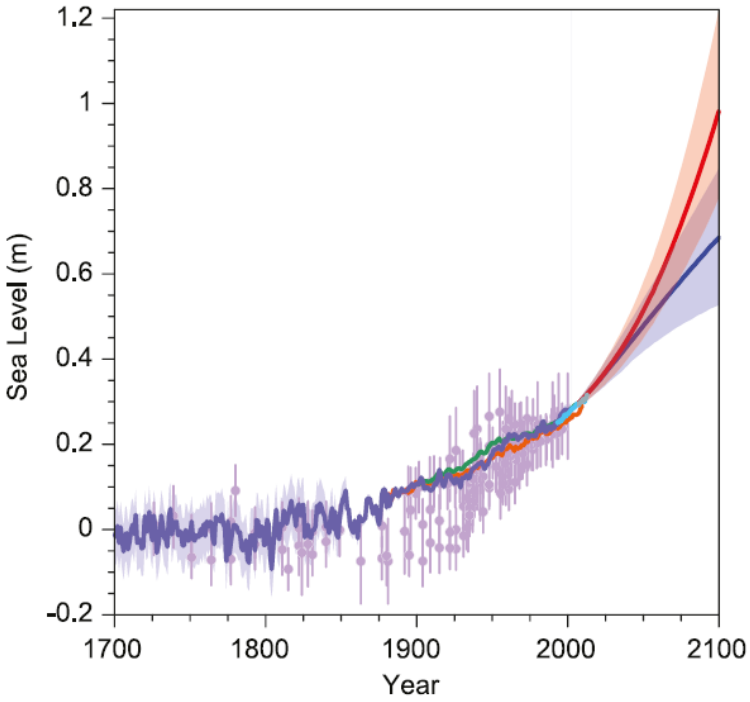


Figure 2. Past and future SLR from IPCC AR5 WG1 Fig. 13.3(d). Mid-range projections are for low future emissions in blue and high future emissions in red with 17% chance of exceedance of the ranges shown.

With high emissions (the current trajectory) the IPCC projects 52-98 cm of sea level rise by 2100, with a mean rise of 74 cm. With low emissions, the projection is 28-61 cm rise. It is very important to note that there is a 17% chance of exceeding these IPCC range by "several tenths of a metre" in the case of Antarctic marine ice sheet collapse. **This outlook implies that, even with lowered emissions, at least half a metre of sea level rise is probable by 2100 but there is also a real if small probability of a rise of 1.5 m or more.**

Hinkel et al (2015)[4] give important guidance for planners and policy-makers in regard to use of IPCC's AR5 SLR projections saying

> *the IPCC scenarios are designed from the perspective of the first Working Group of the IPCC (WGI), which aims to understand and reduce uncertainty, a viewpoint that is quite different from the one of coastal management, which aims to reduce risks.*

They find:

[3] See also: Clark PU et al. (2016) *Consequences of twenty-first-century policy for multi-millennial climate and sea-level change.* NATURE CLIMATE CHANGE | VOL 6 | APRIL 2016

[4] Hinkel J et al. (2015) *Sea-level rise scenarios and coastal risk management.* Nature Climate Change vol 5 March 2015

- *The IPCC gives a central distribution that is unhelpful for high impact risk scenario planning, with a 17% chance of exceeding the IPCC-stated range.*
- *The IPCC scenarios have not been designed or intended for use in high end risk planning appropriate to identifying and addressing unacceptable flood risks for vulnerable coastal communities.*
- *The IPCC process does not weigh expert opinion and modeling in the manner that would be appropriate to support risk management strategy in coastal flood planning.*

Looking at SLR projections for northern Europe given continued high emissions, Grinsted et al. (2014)[5] find that that "there is a considerable risk that relative sea level rise will exceed recent high-end scenarios" and this small but very real risk of large sea level rise requires a higher level of preparedness from planners.

Jevrejeva et al (2014)[6], basing their analysis directly on IPCC AR5 and the recent papers, find the low probability upper limit (taken as having only 5% likelihood of being exceeded) for sea level rise by 2100 is +1.8 m. This is the precautionary level they recommend for risk assessment for infrastructure. At the 5% probable level useful for high end future scenario planning, they find that:

> *The upper limit of 180 cm reflects our view of the present understanding of the uncertainties in Greenland and Antarctica ice loss.*

and also, in the discussion, comment that:

> *It is clear from the wide range of nationally and locally-adopted maximum rises that engineers and planners find it difficult to choose appropriate extremes for sea level rise, and we hope that our approach in this paper can help towards a methodology in this regard*

Exploring, more unlikely but non-negligible, 'tail' risks and impacts, Hansen et al. (2016) [7], contend there is some possibility of abrupt and very rapid disintegration of ice sheets, even at 2ºC warming, that could lead to sea level rise of several metres even over the next 50-150 years. Hansen et al. prescribe large sea level rise in their modelling based on their interpretation of paleo-evidence for the Last Interglacial, 120,000 years ago, that possibly points to sudden, significant and large, past sea level rise and increased storminess at approximately 2ºC warming. Other authors have found that this rate of SLR is physically untenable [8] and the conclusions of Hansen et al. are based on highly debatable evidence. Nonetheless, as an outlier extreme of high-end risks, Hansen et al. should at least be noted in discussion of the range of future SLR uncertainty.

Until recently, ice sheet and SLR modelling has been unable to match the large SLR response to past warming that is seen in paleo-evidence for the Pliocene (3 million years ago) and the Last Interglacial. In new research (not yet supported by other papers) combining projected high end warming with "underappreciated processes linking atmospheric warming with hydrofracturing of buttressing ice shelves and structural collapse of marine-terminating ice cliffs", Conto and Pollard (2016) [7] find that, in addition to the IPCC range to 2100:

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[5] Grinsted A et al (2015) *Sea level rise projections for northern Europe under RCP8.5.* Cli Res Vol. 64: 15–23, 2015
[6] Jevrejeva S et al. (2014) *Upper limit for sea level projections by 2100.* Environ. Res. Lett. 9 (2014) 104008 (9pp)
[7] DeConto RM & Pollard D (2016) Contribution of Antarctica to past and future sea-level rise Nature v.531 p591

> *Antarctica has the potential to contribute more than a metre of sea-level rise by 2100 and more than 15 metres by 2500, if emissions continue unabated.*

Met Eireann climate scientists[8], based on limited modeling and looking specifically at the impact of future climate change on storm surges over Irish waters, find "[by 2031 to 2060] an increase in storm surge events around Irish coastal areas in the future projection, except along the south Irish coast", and also, "a significant increase in the height of the extreme surges along the west and east coasts, with most of the extreme surges occurring in wintertime". Furthermore they find:

> *Analysis of the results shows that storm surge heights in the range 50–100 cm are increasing in frequency around all Irish coastal areas; up to 20% in the west and northwest. There is also a significant increase in the height of the extreme surges along the west and east coasts, with most of the extreme surges occurring in wintertime. Changes in extreme surge heights also appear to be related to changes in extreme wind speeds and mean sea level pressure. There are also significant changes in the return values of surge heights.*

These increased storm surge heights would be in addition to sea level rise and would be compounded by
high-tides and unusually low pressure that might be coincident with a particular storm.

Chris Field, IPCC WG2 (Impacts and Adaptation) Co-Chair, speaking in Dublin in his 2014 EPA lecture[9] was specifically asked about the upper end planning level for sea level rise in 2100 and suggested an upper limit of two metres was advisable.

Science-Based National Planning for Sea Level Rise in the USA, UK and Ireland

As noted above, engineers, planners and policy analysts require upper limit scenarios to enable precautionary design of near-coast infrastructure and preparation of adaptation strategies for possible sea level rise.

In the USA, basing their scenarios on the previous, *lower* IPCC AR4 SLR projections, the 2012 NOAA Technical Report states[10]:

> *Based on a large body of science, we identify four scenarios of global mean SLR ranging from 0.2 meters (8 inches) to 2.0 meters (6.6 feet) by 2100. These scenarios provide a set of plausible trajectories of global mean SLR for use in assessing vulnerability, impacts, and adaptation strategies. None of these scenarios should be used in isolation, and experts and coastal managers should factor in locally and regionally specific information on climatic, physical, ecological, and biological processes and on the culture and economy of coastal communities.*

[8] Wang S et al (2008) *The impact of climate change on storm surges over Irish waters* . Ocean Modelling 25 (2008) 83–94
[9] Field C (2014) *IPCC Fifth Assessment Report WGI, WGII, WGIII, Synthesis Report in EPA lecture* Video Q&A
[10] Parris, A et al (2012) *Global Sea Level Rise Scenarios for the US National Climate Assessment.* NOAA Tech Memo OAR CPO-1. 37 pp.

The UK Environment Agency's assessment also gives relevant advice for SLR risk planning in line with the recent science. The Agency gives a high end scenario (denoted H++, see p15):

> *with estimates of sea level rise increase beyond the likely range but within physical plausibility" with a high end [by 2100] of 1.9m, and sea level rise rates of: [up to] 6mm/year to 2025; 12.5mm/yr for 2026 to 2050; 24mm/yr 2051 to 2080; and 33mm/yr for 2081 to 2115.*[11]

As they note on p.25, the H++ scenario is based on the recent science showing faster melting of Antarctic and Greenland ice sheets.

In Ireland, the OPW has yet to incorporate climate change into its flood risk assessments including their High End Future Scenario (HEFS) that expects only +1.0 m sea level rise. As detailed in an exchange of letters between the OPW and An Taisce's Climate Change Committee in 2015, Mark Adamson, Head of Flood Relief and Risk Management Division, OPW states[12]:

> *In early planning for review of the National Preliminary Flood Risk Assessment (due for completion at the end of 2018) and of the flood maps and Flood Risk Management Plans, the OPW has been considering a third, more extreme, scenario. The degree of mean sea level rise to be considered in such a scenario has not been decided but may be in the order of 2m.*

In general, Mark Adamson commented:

> *It is widely recognised that there is uncertainty in relation to the potential impacts of climate change. Notwithstanding this, embedding adaption to potential changes does need to be progressed across all relevant sectors, but this needs to take account of the uncertainty. Adoption of a single scenario as the basis for design or planning can lead to mal-adaptation and associated under or over-investment of state resources and/or investment in assets that may become redundant or barriers to other assets that may subsequently be required to deal with potential futures. Prudent adaptation planning, including coastal land-use planning, should take account of the full range of potential impacts of climate change.*

However, over-investment in SLR planning seems far less likely an issue than under-investment given the current trajectory of emissions that remains toward above 3ºC even if current Paris Agreement emission pledges are met. The carbon release rate currently occurring due to humans is unprecedented, being at least nine times greater than any previous global warming event due to natural CO_2 increase event for at least the past 66 million years [13]. Slangen et al. (2016) find that he dominant cause of global sea level rise since 1970 is human-caused emissions of greenhouse gases[14].

Furthermore, a basic *mathematical* reality (one which is too little-appreciated) means that:

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[11] UK Environment Agency (2014) *Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities*

[12] Adamson M (2015) Official communication from OPW to An Taisce. March 2015.

[13] Zeebe RE, Ridgwell A, Zachos JC (2016) *Anthropogenic carbon release rate unprecedented during the past 66 million years.* Nature Geoscience **9**, 325–329 (2016)

[14] Slangen et al (2016) *Anthropogenic forcing dominates global mean sea-level rise since 1970.* Nature Climate Change On-Line 11 APRIL 2016 | DOI: 10.1038/NCLIMATE2991

greater uncertainty translates into a greater likelihood that mitigation efforts will fail to limit global warming to a target (e.g., 2 °C). The effect of uncertainty can be reduced by limiting greenhouse gas emissions. ***Taken together with the fact that greater uncertainty also increases the potential damages arising from unabated emissions, any appeal to uncertainty implies a stronger, rather than weaker, need to cut greenhouse gas emissions than in the absence of uncertainty.***[15] Emphasis added.

Therefore, particularly in the absence of serious global action to reduce emissions, the large uncertainty range for SLR risk, and the potentially high SLR and increasing acceleration in rate to 2100, directly implies that infrastructure planning must necessarily plan for greater impacts and more adaptation risk than if uncertainty was low.

Conclusion

Coastal planning in Ireland regarding existing and planned infrastructure needs to account for the fact that average sea levels will certainly continuously rise in future and almost certainly accelerate up to 2100 and beyond. Due to past and future emissions of greenhouse gases, global warming has and will cause thermal expansion of ocean water and land ice melt from continental glaciers, Greenland and Antarctica. Even with low emissions sea level rise may be of the order of 0.5 m by 2100. With high emissions and less likely but plausible future responses from the Earth's climate system (depending on the climate sensitivity to the accumulating carbon dioxide and the speed of ice sheet melt from Greenland and Antarctica) this could be as much as 2 m. Given this large uncertainty there is a societal imperative to plan now for the future protection of critical infrastructure. Early and careful risk analysis is advisable for all coastal planning to account for future, ongoing sea level rise.

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[15] Lewandowsky S (2014) Scientific uncertainty and climate change: Part II. Uncertainty and mitigation. Climatic Change May 2014, Volume 124, Issue 1, pp 39-52