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# Línte na Farráige

## Final Report



Photograph by Pekka Niittyvirta - Línte Na Farráige/Lines of the Sea - Spanish Arch, Galway, September 2022.

## Contents

<b>1. Executive Summary</b>	<b>4</b>
<b>2. Introduction</b>	<b>6</b>
<b>3. Artistic basis</b>	<b>6</b>
<b>4. Site Selection</b>	<b>7</b>
4.1. Site reconnaissance visits	7
4.2. Trial Installations	7
4.3. Final Site Selection	8
4.4. Environmental impacts	9
<b>5. Science basis</b>	<b>9</b>
5.1. Sea level rise	9
5.1.1. Global mean sea level rise predictions	10
5.1.2. Marine Ice Sheet Instability (MISI)	11
5.1.3. Marine Ice Cliff Instability (MICI)	11
5.2. Storm Surges	12
5.3. Line Height Calculations	14
5.3.1. Spanish Arch, Galway	15
5.3.2. Wexford Harbour, Wexford	16
5.3.3. Martello Tower, Dún Laoghaire-Rathdown	17
5.4. Light and tide sensor	18
<b>6. Outline of team and key participants</b>	<b>20</b>
<b>7. Outcomes and outputs</b>	<b>21</b>
7.1. Spanish Arch, Galway	21
7.2. Wexford Harbour, Wexford	24
7.3. Martello Tower, Dún Laoghaire Rathdown	25
<b>8. Public Engagement outcomes</b>	<b>28</b>
8.1. Communications objectives	28
8.2. Message of Línte na Farraige	28
8.3. Visual identity	28
8.4. Key communication channels/tools	28
8.4.1. Television and Radio Coverage	29
8.4.2. Site specific information boards	29
8.4.3. Website	31
8.4.4. Social media platforms	32
8.4.5. Illustrations	32

8.4.6. Sand mural	34
8.4.7. Promotional video	34
8.4.8. Launch events	34
8.4.9. Science talk/panel discussion at Wexford Climate Cafe	35
8.4.10. Schools outreach	35
<b>9. Project evaluation</b>	<b>35</b>
9.1. Social media	36
9.2. Website Traffic	36
9.3. Results from MaREI surveys	37
<b>10. Relevant findings</b>	<b>38</b>
<b>11. Conclusions</b>	<b>39</b>
<b>12. Project Team and Acknowledgements</b>	<b>40</b>
<b>References</b>	<b>42</b>
<b>Appendix A</b>	<b>43</b>

## 1. Executive Summary

Línte na Farraiige (Lines of the Sea) was a recipient of the inaugural Creative Climate Action fund, an initiative from the Creative Ireland Programme, in collaboration with the Department of the Environment, Climate and Communications. The programme supports creative, cultural and artistic projects that build awareness on climate change and empower citizens to make meaningful behavioural transformations.

The Línte na Farraiige installations connect the public visually and tangibly to the risks from future sea level rise and storm surges. The project consists of a set of solar powered, visual light installations, placed across Irish coastal sites in Dublin, Wexford, and Galway. The installations have been curated by Finnish artists Timo Aho and Pekka Nittyvirta, whose art seeks meaningful ways to evoke a personal response to societal challenges. At the heart of these installations is the desire to evoke an emotional reaction from the public, engaging broader understanding of the impacts of climate change and the need for collective action to reduce greenhouse gas emissions.

The LED lines of light represent future storm surge heights, based on sea level rise predictions from the Intergovernmental Panel on Climate Change (IPCC) Report AR6, and historic storm surge data. The sites collectively demonstrate that the rate and amount of future sea level rise, is yet to be determined and can be influenced by our collective societal behaviours going forward.

A collaborative team worked with the artists on the delivery of Línte na Farraiige. The team included scientists and researchers from Trinity College Dublin and Maynooth University. The wider project team also included staff from the Dublin Climate Action Regional Office (CARO), the Marine Institute, Algorithm and Native Events. The local authorities involved in the project are Galway City Council, Wexford County Council, Dún Laoghaire-Rathdown County Council and Fingal County Council.

The sites chosen for the installations are the Spanish Arch (Galway), Wexford Harbour (Wexford) and the Martello Tower, in Blackrock Park (Dún Laoghaire-Rathdown). A trial installation was also carried out at Balbriggan Lighthouse (Fingal). These sites were chosen by the project team and the artists as they are located by the coast, have a high footfall, are areas of local and/or historic importance and have suffered the effects of extreme weather events in living memory. The buildings and structures chosen are listed as both National Monuments and Protected Structures.

The scientific basis for the project was based on information and reports from the Intergovernmental Panel on Climate Change, created by the United Nations to provide policymakers with regular and up-to-date impartial information on climate change, its potential future risks, and implications. The sea level rise predictions for this project are based on the most recent assessment report, Working Group 1 AR6, which was published in August 2021. Sea level data, that was used to identify the elevation of historic storm surges, was provided by the Marine Institute and local authorities.

At each site, the installation consisted of an LED strip of light, either strapped to an existing building or structure, using a cushioned aluminium channel, or attached to a free-standing support frame. Each installation was designed to turn on when a high tide occurred during the

hours of darkness i.e., from dusk to dawn. Using a sensor, the lights were switched on for three hours before high tide and three hours after high tide.

Each installation site had its own dedicated launch event, with a broad range of invited guests in attendance, including the public, local residents and businesses, Mayors and County Councillors, the Finnish Ambassador to Ireland and Government Ministers. The artists and wider project team were also available at the launch events to engage with those in attendance. Satellite public exhibitions also took place in Galway (Galway City Museum) and Dún Laoghaire (Moran Park, dlr Lexicon) and a public Science Café event took place in Wexford. Other public events took place throughout the project, including engagement with local schools.

Strong brand identity is central to the Línite na Farraige project; this was core to public engagement and follow-up activities. A dedicated logo and website acted as the engagement hub for the project [www.lintenafarraige.com](http://www.lintenafarraige.com). Throughout the project a broad range of media interaction took place online, in printed media, on radio and on television. Project information boards were also located at the sites, at nearby Irish Rail and DART stations and on-board rail services. Promotional videos were developed to communicate the project, across a range of social media platforms and websites. The public were also invited to engage with the project team by filling out an online survey. The evaluation of public engagement activities demonstrates varying views on climate action priorities and the actions needed to combat climate change in the coming years.

The project team is working to ensure the legacy of Línite na Farraige. A final project video will be published, summarising the project outputs and public engagement activities. There is an opportunity to extend the onsite installations, to facilitate ongoing local engagement on other local authority led, climate action projects. The wider project team will also present the project at a number of upcoming events and conferences in Ireland and abroad.

The Línite na Farraige project, is a unique, yet stark reminder, that our seas are silently rising, and will continue to do so, undetectable to the naked eye. The Government's national Climate Action Plan 2023 speaks to ambition that will only work if we all come together in a strengthened 'social contract' for climate action, working towards real solutions that are meaningful, inclusive, fair and accessible. This project has served to remind us that by working together, we can all help 'lower the line'.

## 2. Introduction

Línte na Farraige engages the public visibly and tangibly with the risks associated with future sea level rise and storm surges, through a series of renewably powered light installations placed across Irish coastal locations and heritage sites in 2022 and 2023. Solar panels have been used to power all three installations. The installations were placed at sites of local significance, to promote cohesion and action among local communities. The installations provoke a dialogue around rising sea levels and demonstrate how the future is still in our hands, as the rate and amount of sea level rise depends on our future greenhouse gas emissions. Through art, the project encourages individuals to consider how collective societal action can mitigate climate change and adapt to sea level rise, to inspire a more sustainable and resilient future. They help to remind us that together, we can all help to ‘lower the line’.

The goals of the project were as follows:

1. To raise awareness of the impacts of future sea level change in Ireland and inspire a more sustainable and resilient future.
2. To mobilise community led climate action and mitigation.

## 3. Artistic basis

Helsinki based artists Timo Aho and Pekka Niittyvirta designed the installation concept. They seek meaningful ways to address topical phenomena and societal challenges, in public spaces. Their previous collaboration, Lines (57° 59' N, 7° 16' W) illuminated the catastrophic future of sea level rise, with three synchronised lines of light in 2018, at Taigh Chearsabhagh Museum and Art Center, Scotland. Their recent collaborations include: WAM Turku City Art Museum, Finland, Google Arts and Culture, UNTITLED Art / FB art, Miami.

Línte na Farraige builds on these previous works and adds a novel dimension, by including renewably powered multiple locations around the coast of a single country, with an emphasis on empowering the public to participate in climate action: through websites, television and radio engagement, drone footage of all installations, social media, school workshops and launch events. At the heart of these installations, is the desire to evoke an emotional reaction from the public, engaging broader understanding of the impacts of climate change and the need for collective action.

The installations consist of horizontal lines of LED lights showing future sea level rise and storm surge heights. Artworks are installed at coastal buildings/structures, with the mounting arrangement dependent on the type of structure and any designations in place (i.e., National Monument, Protected Structure status). In two of the three agreed locations (Martello Tower Blackrock Park, Dublin and Spanish Arch Galway), detailed designs were developed and submitted to the National Monument Service in the Department of Housing, Local Government and Heritage, for approval as the buildings were listed as National Monuments and are also Protected Structures.

## 4. Site Selection

### 4.1. Site reconnaissance visits

Prior to the selection of sites for longer term installations, site visits were undertaken with members of the project team including scientists, artists and local authority representatives, to scope out potential installation sites. These visits were undertaken between November 2021 and May 2022. Site checklists were completed at all potential sites, which were used to inform the final site selection. This was an important step, as whilst visually a site may have been deemed worthy for inclusion, other issues may have precluded installation, such as remote location with poor footfall, potential planning and regulatory issues, and health and safety issues.

### 4.2. Trial Installations

At the request of the local authorities involved, trial installations were undertaken at two potential locations, Martello Tower, Blackrock Park and Balbriggan Lighthouse, Fingal, to determine some of the issues to be considered in advance of a more temporary installation.



Figure 1: Trial installation at Balbriggan Lighthouse, Fingal - May 2022

Lighthouses are iconic in the Irish landscape and are intrinsic to local coastal communities. RTE recently aired an important series titled 'Great Lighthouses of Ireland', exploring the story of Ireland's lighthouses and their continuing importance to the country's survival. During their reconnaissance visit to Ireland in November 2021, the artists were particularly interested in Balbriggan Lighthouse, County Dublin. The opportunity arose to work with Fingal County Council on a trial installation at the lighthouse. The trial installation took place on an evening in May 2022 and generated some engagement between the project team and passers-by (see Figure 1). Whilst not one of the final sites selected for the temporary installation, the trial installation allowed the project team to consider a range of technical and installation issues, that would inform the other three sites: for example lighting and accessories, power requirements, site security, parts

requirements and health and safety issues. The long arching beach overlooking the lighthouse was selected as a location for the sustainable sand raking artwork to communicate the Línite Na Farraiige logo.

### **4.3. Final Site Selection**

The Línite na Farraiige team collaborated with three local authorities (Dún Laoghaire-Rathdown, Wexford and Galway) to identify the following sites for the final installations:

1. Spanish Arch, Galway
2. Wexford Harbour, Wexford
3. Martello Tower, Dún Laoghaire-Rathdown

The following criteria were used during site selection:

1. Coastal region: In order to convey the risks of rising sea level and storm surges, the team recognised the importance of selecting sites that are at risk on timescales of 100-150 years into the future.
2. Area of high footfall: The project aimed to reach as many people as possible, to increase awareness around climate change and sea level rise and to encourage climate action. In addition to this, in order to expand the project's audience, a website for the project and social media sites (Twitter and Instagram) were established.
3. Areas of local and/or historic importance: Sites with particular public significance were selected for several reasons. These areas were most likely to spark conversation around the need to increase coastal protection, in order to save structures with historic and/or cultural significance. Furthermore, areas of local/historic importance would create visually stunning imagery and videography that could be used for public engagement as a legacy for the project.
4. Areas which have suffered the effects of extreme weather events in living memory: Sites of recent significant flooding or intense erosion, would generally have a local population that are connected to the impacts of storm surges and rising seas.

### **4.4. Environmental impacts**

From project inception and application to installation, the project team has been mindful of the impact of the project on the environment. Light can be a pollutant in itself, and the locations were selected carefully to ensure they were in public locations that already had public lighting in place. Appropriate Assessment (AA) screenings were undertaken for each site, in accordance with the relevant provisions of the EU Habitats Directive. No significant impacts were determined by these assessments at any of the installation sites. A Bat Survey and Report was also undertaken for the installation at the Martello Tower, at Blackrock Park.



From a materials perspective, there was re-use of some materials due to the installation time lag between sites. It is also intended that the lights, connections, and aluminium channels will be reused in other installations after the project has been completed.

The project will contribute to a native tree planting Non-Governmental Organisation (NGO), to offset greenhouse gas emissions associated with air travel, incurred during the project.

## 5. Science basis

### 5.1. Sea level rise

Extreme coastal flooding is classed as one of the most threatening and hazardous processes which impacts human life and infrastructure (Bates et al., 2005; Padgett et al., 2008; Moussa and Bocquillon, 2009; Bhaskaran et al., 2014; Santiago-Collazo et al., 2019). The threat of coastal flooding is growing due to changes in extreme weather events and sea level rise (Nerem et al., 2018; Hendry et al., 2019), as well as rapid population growth and associated developments (Hallegatte et al., 2013; Brown et al., 2018).

The Intergovernmental Panel on Climate Change (IPCC) was created by the United Nations to provide policymakers with regular and up-to-date impartial information on climate change, its potential future risks, and implications. The Assessment Reports (AR) are a collection of comprehensive reports about the “*state of scientific, technical and socio-economic knowledge on climate change, its impacts and future risks, and options for reducing the rate at which climate change is taking place*” (IPCC, 2022). The most recent assessment report, Working Group 1 AR6 was released in August 2021. The sea level rise predictions used in this project were derived from this report unless stated otherwise.

***“Global mean sea level has risen faster since 1900 than over any preceding century in at least the last 3000 years (high confidence).” (IPCC AR6 2021)***

Table 1 shows the predicted global sea level rise under the main shared socioeconomic pathways (SSP) for 2100 and 2150, according to the IPCC AR6 report. These values span a ‘green world’ (SSP1-1.9) up to a scenario where fossil fuel exploitation and usage increases relative to today (SSP5-8.5).

	SSP1-1.9	SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
SLR 2100 IPCC AR6	0.28-0.55m	0.32-0.62m	0.44-0.76m	0.55-0.9m	0.63-1.01m
SLR 2150 IPCC AR6	0.37-0.86m	0.46- 0.99m	0.66-1.33m	0.92-1.67m	0.98-1.88m

Table 1: Predicted sea level rise for 2100 and 2150 (IPCC, 2021)

### 5.1.1. Global mean sea level rise predictions

Relative to 1995-2014, the likely global mean sea level rise by 2100 is 0.28-0.55 metres (m) under the very low greenhouse gas (GHG) emissions scenario (SSP1-1.9), 0.32-0.62 m under the low GHG emissions scenario (SSP1-2.6), 0.44-0.76 m under the intermediate GHG emissions scenario (SSP2-4.5), and 0.63-1.01 m under the very high GHG emissions scenario (SSP5-8.5). By 2150 GMSL is predicted to be 0.37-0.86 m under the very low scenario (SSP1-1.9), 0.46- 0.99 m under the low scenario (SSP1-2.6), 0.66-1.33 m under the intermediate scenario (SSP2-4.5), and 0.98-1.88 m under the very high scenario (SSP5-8.5) (Fig.2; IPCC, 2021).

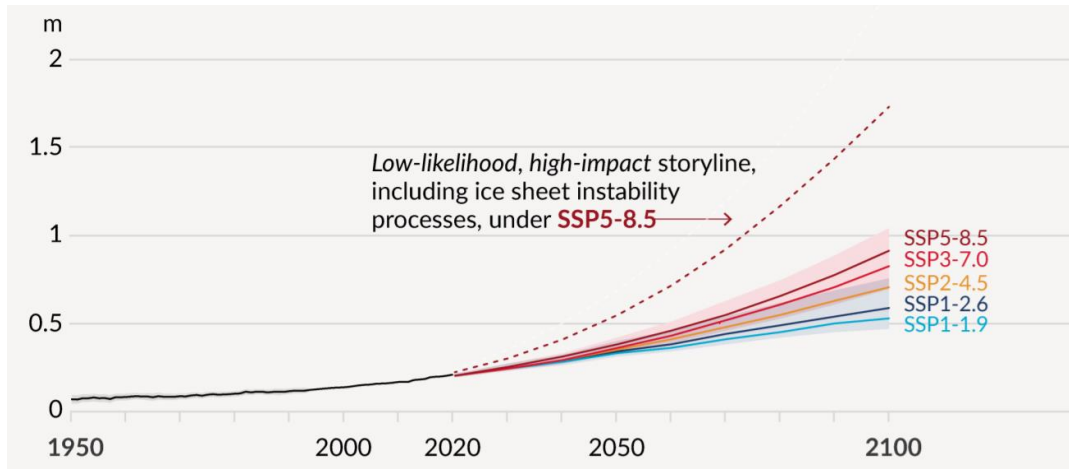


Figure 2: Global sea level change observations and predictions under different SSPs and under the low-likelihood, high-impact storyline, relative to 1900 (IPCC, 2021)

The most recent report by the Intergovernmental Panel on Climate Change, AR6, discusses the potential of an earlier-than-projected disintegration of marine ice shelves, the onset of Marine Ice Sheet Instability (MISI) and Marine Ice Cliff Instability (MICI), around the Antarctic and faster-than-projected changes in the surface mass balance and dynamical ice loss from Greenland (Fox-Kemper et al., 2021; IPCC, 2021). Currently, *likely* range projections do not include these ice-sheet-related processes due to their deep uncertainty. IPCC term this a ‘high impact/low probability’ storyline. When factoring in the MICI and MISI processes, sea level rise projections increase significantly. In a low-likelihood, high-impact storyline with a high GHG emissions scenario, such processes (MICI, MISI) could contribute more than one additional metre of sea level rise by 2100 (Fox-Kemper et al., 2021). Beyond 2100, due to continuing deep ocean heat uptake and mass loss from ice sheets, GMSL will continue to rise. MICI could drive GMSL to rise up to 5 m by 2150. By 2300, GMSL will rise 0.3–3.1 m under low GHG emissions (SSP1-2.6) (IPCC low confidence). Under high GHG emissions (SSP5-8.5), projected GMSL rise is between 1.7 and 6.8 m by 2300 in the absence of MICI and by up to 16 m considering MICI (Fox-Kemper et al., 2021; IPCC, 2021).

If this scenario were to occur, it would have devastating effects on coastal communities around the world. Globally, nearly 600 million people live in coastal areas which are less than 10 m above

current sea level (United Nations, 2017). In Ireland, major cities such as Dublin, Cork, Galway, and Waterford are all within low lying areas susceptible to sea level rise.

### 5.1.2. Marine Ice Sheet Instability (MISI)

MISI describes the potential for ice sheets which are grounded below sea level to become destabilised and retreat at a rapid rate (Fig. 3). The grounding line of marine ice sheets is the boundary where ice flowing from the ice sheet starts to float in ocean water (Robel et al., 2019). In instances where the continental shelf deepens towards the ice sheet, a small retreat of the grounding line can lead to greater ice flux and a greater retreat, creating a positive feedback cycle (Schoof, 2007; Robel et al., 2019).

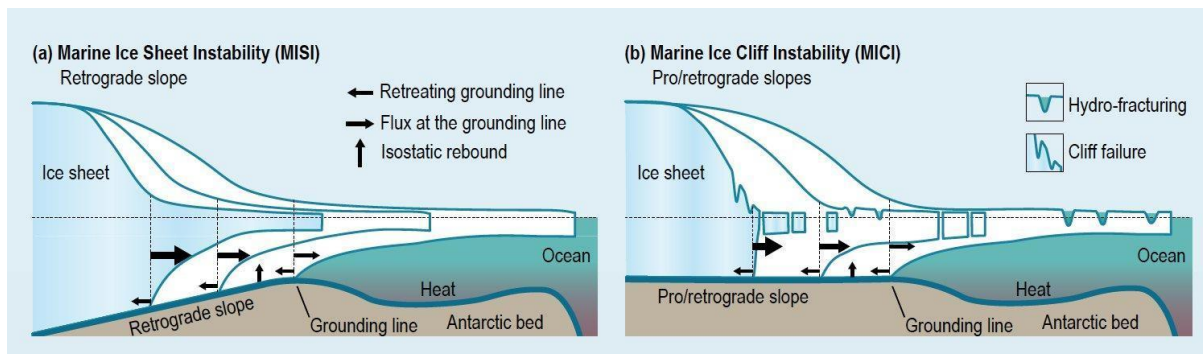


Figure 3: MISI and MICI (Pattyn, 2018; Meredith et al., 2019)

### 5.1.3. Marine Ice Cliff Instability (MICI)

MICI is a process which assumes that coastal ice cliffs can rapidly collapse after ice shelves disintegrate due to the process of surface and sub-shelf melting (Fig. 3; Pollard et al., 2015; DeConto and Pollard, 2016). There is great uncertainty on how exactly this process occurs as it hasn't been observed in the modern era. Where the ice is 100 m or more above the ocean surface it is believed that the weight of the cliff exceeds the strength of the ice causing rapid ice shelf collapse (Pollard et al., 2015; DeConto and Pollard, 2016).

## 5.2. Storm Surges

Intense cyclonic environments intensify storm surges as a result of strong winds driving water in the direction of the coast and the barometric pressure effect (Svensson & Jones, 2004; Bevacqua *et al.*, 2019). The most common cyclone experienced in Ireland is the temperate or mid-latitude cyclone which results from the rising air motion induced by waves in the jet stream (Dolan and Davis, 1994).

Ireland's climate is controlled mainly by the shape of the polar front over the Atlantic Ocean and the related weather systems that travel across the country (O'Brien et al., 2018). Storms (and subsequently storm surges) can develop due to the amplification of these weather systems which cause large scale depressions that travel north-eastwards across the Atlantic (Met Éireann, 2020).

The time at which these storm surges hit the coast can be crucial to how much flooding might be experienced in an area. The combination of a storm surge and high spring tide can have disastrous effects (Cantwell, 2020). Storm Eleanor hit the coast of Galway during a high spring tide. The surge was 1.2 m, leading to a water level of 3.7 m Ordnance Datum Malin (ODM) and causing widespread flooding in Galway City. In contrast, the storm surge associated with Storm Ophelia was 1.5 m but didn't coincide with a high spring tide and therefore flooding was significantly reduced, with water levels peaking at 3.3 m ODM. Storm Elsa, the highest recorded storm surge for Galway Bay at ~1.56 m, didn't result in any flooding due to it coinciding with a neap tide.

Results published by Cantwell (2020) show that in Dublin, the combination of future sea level rise and more frequent and intense storm surge events will result in the exposure of over 23,000 households to flooding with a residential and commercial insurance pay-out of over €616 million. This sum is related to properties only and does not include the cost of repairing motor vehicles, infrastructure and other associated costs.

In addition to the predicted sea level rise scenarios mentioned above, the project aims to look at the potential impacts of storm surges in the future by examining historic storm surge events for each region. Examples of previous storms in the chosen locations are given in the following case studies.

#### ***Galway – Storm Eleanor – 2<sup>nd</sup> January 2018***

Storm Eleanor was a European windstorm that occurred on the 2-3<sup>rd</sup> of January 2018 affecting Ireland, the UK, France, Belgium, the Netherlands, Luxembourg, Germany Austria and Switzerland. The low-pressure system moved across Western Europe from the Atlantic bringing gusts of up to 100 mph (161 km/h) (Royal Meteorological Society, 2018). In Galway, this storm resulted in a surge of 1.2 m and water levels reaching 3.7 m ODM (Fig. 4).



Figure 4: Left: Driving through a flooded car park in Salthill (credit: Thejournal.ie), Middle: A Flooded Dominic Street (credit: McHugh and Young), Right: Storm waves in Lahinch, Co. Clare (credit: Larkin, independent.ie).

### ***Wexford – Storm Darwin – 12<sup>th</sup> February 2014***

Storm Darwin, also referred to as Cyclone Tini, was a European windstorm that affected Western Europe on the 12<sup>th</sup> of February 2014. It was named Storm Darwin in Ireland due to its coincidence with the 205<sup>th</sup> birthday of Charles Darwin. Met Eireann’s Valentia Observatory recorded violent storm force 11 winds (McGrath, 2015) and produced a storm surge reaching 1.6 m ODM in Wexford (Fig. 5).



Figure 5: John Barry Memorial Statue after Storm Darwin, 2014 (credit: Tucker, New Ross Standard)

### ***Dublin – Windstorm Christina – 3<sup>rd</sup> January 2014***

This storm, coined Windstorm Christina (Janjić et al., 2018), coincided with a series of high tides including the highest ever recorded at Malin (3.014 m) on the 3<sup>rd</sup> of January (Dublin City Council, 2014). Other factors in this particular storm reduced the flooding levels in Dublin. The wind direction was from the south to southwest resulting in Dublin City Council (2014) acknowledging that it was a lucky escape for Dublin City. The depression was recorded as 956 hPa off the coast of the west of Ireland (Janjić et al., 2018) and resulted in a storm surge in Dublin reaching 2.68 m ODM (Fig. 6).



Figure 6: Left- Clontarf, Dublin (image by John McNally); Middle- Blackrock, Dublin (image by Pat O’Shaughnessy); Right- Customs House, Dublin (image by Peter Zrinski). Credit: Thejournal.ie.

### **5.3. Line Height Calculations**

The project team surveyed the ground height of each potential installation location to accurately calculate the LED line height. The following calculation was used for the LED line heights at each location:

**Total line height (above ground level) = [storm surge height + sea level rise] - ground height**

Future sea level rise is added to the storm surge elevation. e.g., By 2150 global mean sea level will rise 0.66-1.33 m under an intermediate emissions scenario (1 m average). The storm surge and ground elevations are both relative to Ordnance Datum Malin.

Spanish Arch; Galway		Sea level rise (m)			Line height above ground (SLR + total surge height = 3.7 m)		
Elevation: 2.8 m OD		Minimum	Maximum	Average	Minimum	Maximum	Average
2100	Scenario						
	SSP1-1.9	0.28	0.55	0.415	1.2	1.5	1.3
	SSP1-2.6	0.32	0.62	0.47	1.2	1.5	1.4
	SSP2-4.5	0.44	0.76	0.6	1.3	1.7	1.5
	SSP3-7.0	0.55	0.9	0.725	1.45	1.8	1.625
	SSP5-8.5	0.63	1.01	0.82	1.5	1.9	1.7
	Storyline	83rd percentile	95th percentile				
	1.6	2.3		2.5	3.2		
2150	SSP1-1.9	0.37	0.86	0.615	1.3	1.8	1.5
	SSP1-2.6	0.46	0.99	0.725	1.4	1.9	1.6
	SSP2-4.5	0.66	1.33	0.995	1.6	2.2	1.9
	SSP3-7.0	0.92	1.67	1.295	1.82	2.57	2.195
	SSP5-8.5	0.98	1.88	1.43	1.9	2.8	2.3
2300	SSP1-2.6	0.3	3.1	1.7	1.2	4	2.6
	SSP5-8.5	1.7	6.8	4.25	2.6	7.7	5.15

Table 2: Calculations of LED line height above the ground for Spanish Arch, Galway. This incorporates a total storm surge height of 3.7 m with different IPCC sea level rise scenarios.

Harbour Wall, Wexford		Sea level rise (m)			Line height above ground (SLR + storm surge of 1.6m)		
Elevation: 1.7 m OD		Minimum	Maximum	Average	Minimum	Maximum	Average
2100	Scenario						
	SSP1-1.9	0.28	0.55	0.415	0.18	0.45	0.315
	SSP1-2.6	0.32	0.62	0.47	0.22	0.52	0.37
	SSP2-4.5	0.44	0.76	0.6	0.34	0.66	0.5
	SSP3-7.0	0.55	0.9	0.725	0.45	0.8	0.625
	SSP5-8.5	0.63	1.01	0.82	0.53	0.91	0.72
	Storyline	83rd percentile	95th percentile				
	1.6	2.3		1.5	2.2		
2150	SSP1-1.9	0.37	0.86	0.615	0.27	0.76	0.515
	SSP1-2.6	0.46	0.99	0.725	0.36	0.89	0.625
	SSP2-4.5	0.66	1.33	0.995	0.56	1.23	0.895
	SSP3-7.0	0.92	1.67	1.295	0.82	1.57	1.195
	SSP5-8.5	0.98	1.88	1.43	0.88	1.78	1.33
2300	SSP1-2.6	0.3	3.1	1.7	0.2	3	1.6
	SSP5-8.5	1.7	6.8	4.25	1.6	6.7	4.15

Table 3: Calculations of LED line height above the ground for Harbour Wall, Wexford. This incorporates a total storm surge height of 1.6 m with different IPCC sea level rise scenarios.

Martello Tower; Williamstown		Sea level rise (m)			Line height above ground (SLR + storm surge of 2.68m)		
Elevation: 3.95 m OD		Minimum	Maximum	Average	Minimum	Maximum	Average
2100	Scenario						
	SSP1-1.9	0.28	0.55	0.415	-1.0	-0.7	-0.9
	SSP1-2.6	0.32	0.62	0.47	-1.0	-0.7	-0.8
	SSP2-4.5	0.44	0.76	0.6	-0.8	-0.5	-0.7
	SSP3-7.0	0.55	0.9	0.725	-0.72	-0.37	-0.545
	SSP5-8.5	0.63	1.01	0.82	-0.6	-0.3	-0.5
	Storyline	83rd percentile	95th percentile				
	1.6	2.3		0.3	1.0		
2150	SSP1-1.9	0.37	0.86	0.615	-0.9	-0.4	-0.7
	SSP1-2.6	0.46	0.99	0.725	-0.8	-0.3	-0.5
	SSP2-4.5	0.66	1.33	0.995	-0.6	0.1	-0.3
	SSP3-7.0	0.92	1.67	1.295	-0.35	0.4	0.025
	SSP5-8.5	0.98	1.88	1.43	-0.3	0.6	0.2
2300	SSP1-2.6	0.3	3.1	1.7	-0.97	1.83	0.43
	SSP5-8.5	1.7	6.8	4.25	0.43	5.53	2.98

Table 4: Calculations of LED line height above the ground for Martello Tower, Dún-Laoghaire-Rathdown. This incorporates a total storm surge height of 2.68 m with different IPCC sea level rise scenarios.

### 5.3.1. Spanish Arch, Galway

Spanish Arch is located on the Corrib just at the edge of the centre of Galway city and overlooking the Claddagh, a historic fishing area. Built in 1584, it was an update to a pre-existing 12<sup>th</sup> Century Norman town wall. Named originally as ‘*Ceann an Bhalla*’ (Head of the Wall), the name Spanish Arch is thought to have developed due to the close trading relationship between Galway and Spain (Gill, 2020). Today, Spanish Arch is an area of high footfall (both tourist and local), located beside Galway City Museum and at the end of the popular, and very aptly named for this project, Flood Street.

The location of Spanish Arch is situated where the Corrib River meets Galway Bay. The river is reportedly the second fastest on the continent and in terms of volume of water displaced; second only to Ireland’s River Shannon (Galway Waterways Foundation). The combination of high tides and high river discharge, along with Spanish Arch being located at 2.8 m ODM (only 0.7 m above mean high spring tide) means that this area is frequently flooded when there is a storm surge. Some notable flooding events in recent history include Storm Eleanor in 2018 and Storm Ophelia in 2017.

Three locations were chosen by the Línite Na Farraige team in Galway to demonstrate the effects of sea level rise in this area: Spanish Arch, Ard Bia at Nimmos, and the Long Walk on the Claddagh Basin. The installations at Spanish Arch and Ard Bia at Nimmos were in place over several months, whilst the section installed along the Long Walk on the Claddagh Basin was in place over the launch week only.

Spanish Arch and Ard Bia at Nimmos meet all the requirements for the Línite na Farraige project; they are in a coastal region, at an area of high footfall, a location of local and/or historic importance and, as mentioned previously, they are in an area that has experienced the effects of extreme weather events in recent years. The height of this site above sea level also means that the project was able to combine a historic surge with sea level rise predictions to create a significant and impactful light height of 1.9 m.

#### Storyline

For Spanish Arch, the scientific team at Línite Na Farraige have combined the storm surge from Storm Eleanor (3.7 m OD) with an average sea level rise for the year 2150 under the IPCC’s AR6 SSP2-4.5 sea level rise scenario (1m) (IPCC, 2021) to create a line height of 1.9 m

### 5.3.2. Wexford Harbour, Wexford

Wexford, located on the south-east coast of Ireland, is an area heavily affected by coastal erosion mainly due to the combination of rising sea levels, wave activity, storms and a soft underlying bedrock of slate and sandstone. A quick Google search of ‘Wexford coastal erosion’ will throw up many examples of the devastating effects of global warming in this area; from houses dangerously close to a soft cliff edge, to farmers discussing how many acres of their land has been

lost in their lifetime alone. One farmer, Jamie Ryan has described “20ft” being taken in the last “15 years” and equates it primarily to the destructive effects of climate change and rising sea levels (Gallagher, 2021).

“Coastal erosion is the process by which coastal flooding, strong wave action and local sea level rise wear down and carry away soils, rocks, and/or sands along the coast” (U.S. Climate Resilience Toolkit, 2021). Over the past decade Courtown, an area known for its blue flag beach and popular with many local and foreign tourists during the summer months, has lost a significant amount of its sandy beach and suffered significant damage to its sand dunes. Today the beach has transformed into an expanse of rock armour in an attempt to protect the coastline (Fig. 7).



Figure 7: (credit: Murphy and Philips)

Three locations were chosen by the Línite Na Farráige team along Wexford Quay to demonstrate the effects of sea level rise in this area: Wexford Town Promenade, the John Barry Memorial Statue and Ferrybank Quay. Wexford Town has experienced several flooding events in recent history, most notably Storm Darwin in 2014.

The Línite na Farráige team chose to install a temporary installation on Ferrybank Quay. This installation was in place for a shorter period of time, than the other two installations. The Ferrybank Quay installation was visually impactful and represented the same sea level rise scenario as the promenade site.

Wexford Town Promenade and John Barry Memorial Statue meet all the requirements for the Línite na Farráige project; they are in a coastal region, at an area of high footfall, a location of local and/or historic importance and, as mentioned previously, they are in an area that has experienced the effects of extreme weather events in recent years. The height of these two sites above sea level also means that the project was able to combine a historic surge with sea level rise predictions to create a significant and impactful light height of 0.9 m.



### **Storyline**

For Wexford Harbour, the scientific team at Línite Na Farraige have combined the storm surge from Storm Darwin (1.6 m ODM) (12<sup>th</sup> Feb 2014) with an average sea level rise for the year 2150 under the IPCC's AR6 SSP2-4.5 sea level rise scenario (1 m) (IPCC, 2021) to create a line height of 0.9 m.

### **5.3.3. Martello Tower, Dún Laoghaire-Rathdown**

Williamstown Martello Tower, which lies between Blackrock village and Booterstown, was built in the Napoleonic era, offshore in Dublin Bay. Due to the general development of Dublin and the building of the Dublin and Kingston railway line in the early 1800's, the Martello tower became encased in-land. Today, it is located in a park ~15 m inland with a clear view of the Dublin Dart line. A significant amount of the tower (around 2-3m) is now underground which makes it appear shorter in height than some of the other Martello towers along the coast of Ireland (Blackrock Society, 2022).

Williamstown Martello Tower met all the requirements for the Línite na Farraige project; it is in a coastal region, in an area of high footfall, a location of local and/or historic importance and, as mentioned previously, it is in an area that has experienced the effects of extreme weather events in recent years. The height of this site above sea level also means that the project was able to combine a historic surge with sea level rise predictions to create a significant and impactful light height of 1 m.

### **Storyline**

For the Williamstown Martello Tower, the scientific team at Línite Na Farraige have combined the storm surge from Storm Darwin (2.68 m ODM) (3<sup>rd</sup> January 2014) with an average sea level rise for the year 2100 under the IPCC's AR6 'high impact low likelihood' sea level rise scenario (2.3m) (IPCC, 2021) to create a line height of 1 m.

### **5.4. Light and tide sensor**

The light installations at each site only illuminated between dusk and dawn, three hours either side of high tide. A key artistic message and design concept for the project was that the lights illuminated as the water rose on a high tide and turned off when waters receded at low tide. This is analogous to the global collective action needed to mitigate climate change and turn the tide on our increasing emissions.

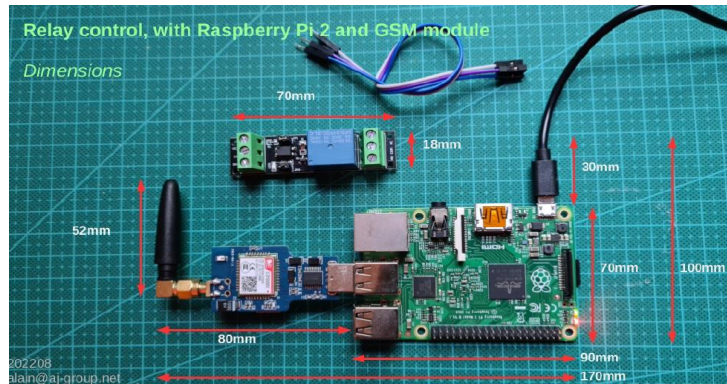


Figure 8: Relay control with Raspberry Pi and GSM Module

An innovative part of the project involved the design, testing and use of novel sensors to detect light levels, communicate with Marine Institute tide servers and, using those inputs, control the LED light strips (on/off). Figures 8, 9 and 10 show some of the sensors used at each site to ensure the lights turned on and off as designed.

A Raspberry pi programmer (essentially an inexpensive small computer) was programmed to connect with a Marine Institute tide server that communicates whether it is high tide or low tide. A light sensor was also connected, which communicated with the relay in the Raspberry Pi and only allowed the LED lights to be illuminated when light levels were above approximately 300 lux (dusk or dawn). The light sensor ensured that the installation would not illuminate during the day, when it would unlikely be seen given ambient light levels and also to prevent unnecessary power use from the solar panels and batteries. In order to connect to servers, the raspberry needed a mobile modem to ensure connection to the internet.

The concept is that the Raspberry Pi would check the value of the tide at its specific location as well as the light levels and turn on/off the relay accordingly. The raspberry connects to the Internet every hour. Every 2 minutes the device retrieves data from a server to identify local tide levels.



Figure 9: Relay (left) light sensor (middle) and Power sensors (right)



Figure 10: Relay installed at 'pop-up' section of lighting - Claddagh Basin Galway

## 6. Outline of team and key participants

Línte na Farraige is a collaborative project, with a team including scientists, based at Trinity College Dublin, Maynooth University and University College Cork, the Dublin CARO, Local Authorities, Algorithm, Native Events, the Marine Institute and Finnish artists Timo Aho and Pekka Niittyvirta.

Pekka Niittyvirta and Timo Aho are the collaborative Finnish artists responsible for designing and installing the visual LED lights at each site location and participating in the project's marketing strategies.

Trinity College Dublin is the project's leading organisation, responsible for liaising with stakeholders and Creative Ireland, project managing including budget holder, organising equipment storage and transport, providing scientific sea level data, and contributing to the marketing of the project.

The Dublin Climate Action Regional Office (CARO) coordinated with local authorities (Dún Laoghaire-Rathdown, Wexford, Galway and Fingal) and promoted collaboration between them and the Línte na Farraige project team. Dublin CARO was also involved in project management including chairing monthly meetings ahead of project installation and contributed towards the marketing of the project. The CARO also financially contributed to the project with direct and in-kind contributions of approximately €30,000.

Maynooth University is primarily responsible for providing the scientific sea level rise data for each of the installations and the website, as well as contributing to various marketing strategies, including coordinating the production of videos for the project.

Algorithm is a visual design production studio based in Dublin, responsible for creating the project's website. They helped the Línthe na Farrage project team monitor website engagement, allowing for an assessment of impact and reach.

The Marine Institute worked with the project team to provide live tidal data to the installations. The installations would turn on three hours before and after high tide, between dusk and dawn.

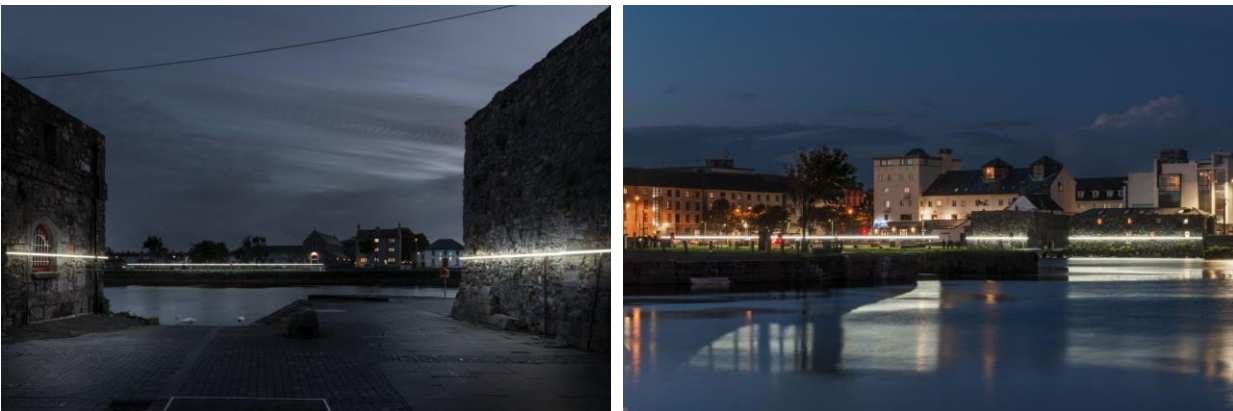
Native Events worked with the project's artists and Local Authorities to provide energy solutions for the light installations at each location. The project team powered the LED lights using solar panels and renewably powered battery packs.

The four Local Authorities (Fingal, Dún Laoghaire-Rathdown, Wexford and Galway) are key project members in assisting in site selection and installation approval, providing on-site support during installation, advertising the project through their wide networks, providing input for the site-specific narrative text on the website, encouraging public participation, working with community groups, and supporting launch events. Each local authority also contributed financially to the project in terms of materials, personnel hours, and local contractors such as electricians, welders and plant hire.

## 7. Outcomes and outputs

### 7.1. Spanish Arch, Galway

The installation, established at Spanish Arch, Ard Bia at Nimmos and along the Long Walk of the Claddagh Basin, was launched in September 2022 (Fig. 11). The light installation turned on when a high tide coincided with darkness i.e., from dusk to dawn, for three hours before and after high tide. The section of the installation on the Claddagh Basin was in place temporarily for one week, while the other sections were in place for a longer period of six months.



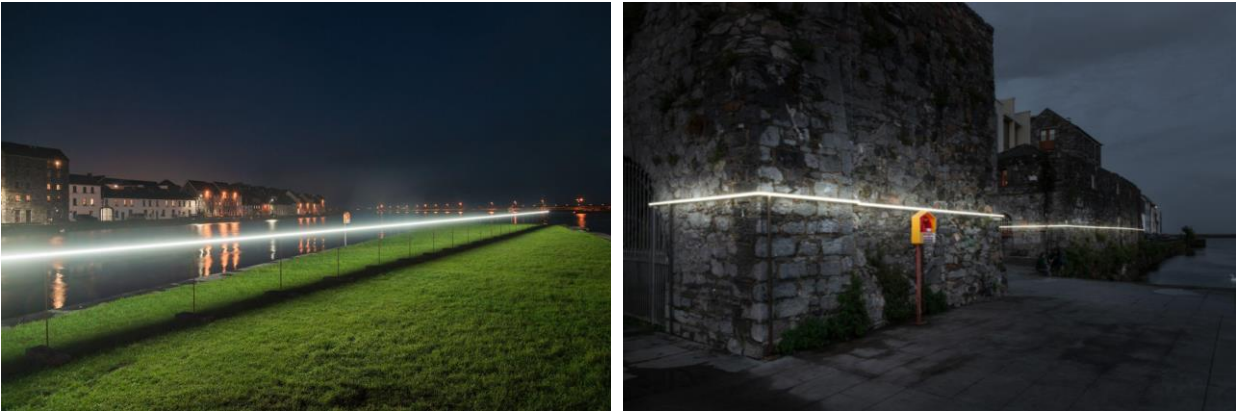


Figure 11: Galway’s light installation at the Spanish Arch, Ard Bia at Nimmos, & along the Long Walk on the Claddagh Basin (source: Pekka Niittyvirta)

**PhotoVoltaic (PV) solar panels**

This installation was powered by renewable energy, using a hybrid grid-tied solar PV system, as seen in Figure 12. This system was designed by project partners Native Events. The solar PV system has been installed on the roof of the Spanish Arch. This can be seen from the top floor of the Galway City Museum.



Figure 12: PV solar panels on the roof of the Spanish Arch

**Pop-up climate change exhibition**

Línte na Farrage, Galway City Museum, and Algorithm worked in collaboration, to produce a gallery display for Galway City Museum. These panels combine the website artwork designed by Algorithm, the website text, and science facts taken from sources including the IPCC. The exhibition is located on the top floor of Galway City Museum and looks out onto the Spanish Arch and Claddagh Basin.



Figure 13: Galway City Museum Pop-up Gallery

### Launch event

The Galway installation launch event took place on Thursday 29th September. The event started at 7pm, with speeches from Deputy Mayor of the City of Galway, Councillor Mike Cubbard and Dr Zoë Roseby in the foyer of the Galway City Museum (Fig. 14). There were refreshments and music, to allow people to socialise and engage in discussions around the project. Everyone was invited to view the exhibition in the museum, and then to walk outside to view the lights as they were turned on. The Galway launch event was attended by approximately 50 people. This included members of the public, government officials, local authority employees and media outlets.



Figure 14: Speeches and music at the launch event

## 7.2. Wexford Harbour, Wexford

### Final installation

Three locations were chosen by the Línite Na Farraiige team along Wexford Quay to demonstrate the effects of sea level rise in this area: Wexford Town Promenade, the John Barry Memorial Statue and Ferrybank Quay (Fig. 15). The light installation turns on when a high tide occurs during dark hours i.e., from dusk to dawn. The lights are on for three hours before high tide and three hours after high tide. The section of the installation along Ferrybank Quay was in place temporarily for one week, whilst the other sections were in place for several months.

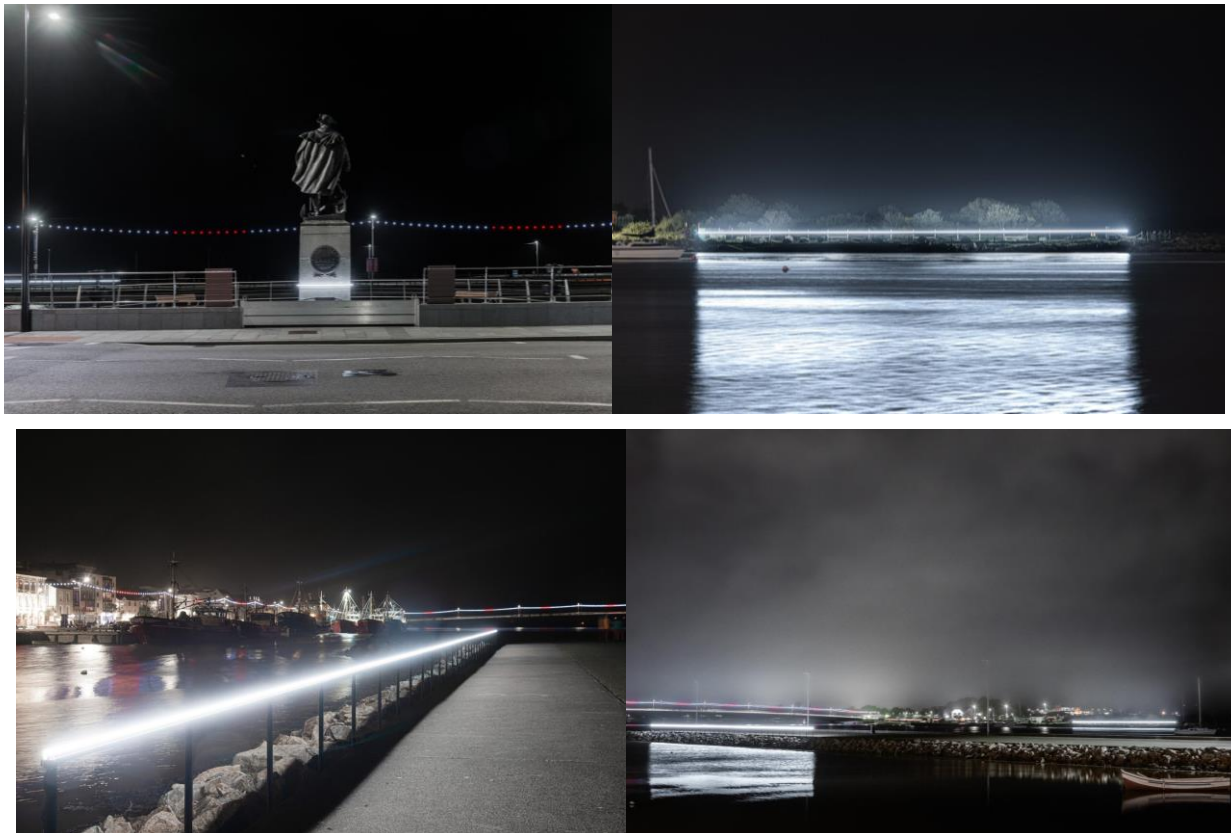


Figure 15: Wexford Harbour and The Commodore John Barry statue at Crescent Quay (source: Pekka Niittyvirta)

### PV solar panels

This installation is powered by renewable energy, using both a hybrid grid-tied solar PV system and Wattsun portable battery packs. This system was chosen by project partners Native Events to ensure that more energy is produced, than the installation uses, over its lifetime. The solar PV system has been installed on the roof of the tourist information office, see Figure 16 below.



Figure 16: PV solar panels on the roof of the tourist information office

### Launch events

The installation launch event in Wexford took place on Friday 28th October. The event started at 6:30pm, with speeches from the Mayor, Director of services, and David Dodd. The Wexford launch event was attended by approximately 30 people. This included members of the public, government officials, local authority employees and media outlets.

### Wexford Science Cafe

David Dodd, Zoë Roseby and Pekka Niittyvirta participated in a science cafe at Wexford City Library on 13<sup>th</sup> December, where they gave a short presentation on the artistic and scientific concept behind Linte na Farrage and answered questions from the 18 attendees.



Figure 17: Zoe Roseby and Pekka Niittyvirta discussing the Linte na Farrage project at the Wexford Science Cafe.

### 7.3. Martello Tower, Dún Laoghaire Rathdown

The installation, established the Williamstown Martello tower, was launched on 21<sup>st</sup> February 2023 (Fig. 18). The light installation turned on when a high tide coincided with darkness i.e., from dusk to dawn, for three hours before and after high tide.





Figure 18: Martello Tower, Dún Laoghaire Rathdown (source: Pekka Niittyvirta)

### **PV solar panels**

This installation is powered by renewable energy, using a grid-tied solar PV system and Wattsun portable battery packs. This system was chosen by project partners Native Events to ensure that more energy is produced, than the installation uses, over its lifetime. The solar PV system has been installed next to the Martello Tower.



Figure 19: Solar PV system installed next to the Martello Tower.

### Pop-up climate change exhibition

Línte na Farráige, Dún Laoghaire-Rathdown County Council and Algorithm worked in collaboration, to produce a gallery display in Dún Laoghaire. These panels combine the website artwork designed by Algorithm, the website text, and science facts taken from sources including the IPCC. The exhibition is located at dlr Lexlcon, Moran Park, Dún Laoghaire (Fig. 20).



Figure 20: Pop-up climate change exhibition at dlr Lexlcon.

### Launch event

Approximately 50 people attended the Martello Tower, Dún Laoghaire Rathdown, launch event on Tuesday 21st February 2023. The launch was addressed by Councillor Mary Hanafin, An Cathaoirleach, Catherine Martin T.D., Minister for Tourism, Culture, Arts, Gaeltacht, Sport and Medi, project artists Timo Aho and Pekka Niittyvirta and Finland's Ambassador to Ireland, Ms. Raili Lahnalampi.



Figure 21: Launch event with Speakers and project Information Board

## 8. Public Engagement outcomes

### 8.1. Communications objectives

- Communicate the risks of sea level rise and storm surges to the public
- Communicate the need for climate mitigation and coastal adaptation
- Communicate that the future is still in our hands and that we can work together to 'lower the line'
- To reach a range of stakeholders, including members of the public that would be typically hard to engage.

### 8.2. Message of Línte na Farraiqe

- Human activities have led to the warming of the atmosphere, oceans, and land
- Global mean sea level is rising
- The amount and rate of future sea level rise depends on global greenhouse gas emissions
- We need to reduce our greenhouse gas emissions
- We must adopt adaptation strategies that will help to protect our coastlines
- Local authorities have adopted Climate Adaptation Strategies and Climate Change Action Plans
- There are actions that every individual can take to lower the line

### 8.3. Visual identity

Algorithm developed a visual identity for the project which was used across project outputs:



Font:  
*GT Sectra Display Light*  
GT Sectra Display Regular

### 8.4. Key communication channels/tools

The Línte na Farraiqe project employed a number of key communication tools. These include:

- The development of the Línte na Farraiqe website ([www.lintenafarraige.com](http://www.lintenafarraige.com)).
- The establishment of the Linte na Farraiqe twitter account @lintenafarraige.
- The establishment of the Linte na Farraiqe email account [linte.na.farraige@gmail.com](mailto:linte.na.farraige@gmail.com).
- The design and production of the Linte na Farraiqe logo via sand raking at a Dublin beach.
- The design and installation of an information board at each site.
- Organisation of launch events for each of the three installation sites.
- The issuing of press releases in advance of each installation launch event to local and national media.

- The development of two videos: a promotional video in advance of the launch of the art installations and a project video summarising the project.
- Engagement in local and national media interviews (Appendix A).
- Science talk/panel discussions at Wexford Climate Café.
- Engagement with one school in each administrative area of the installations (Note: These are in development and have not been completed at the time of finalisation of this report).

#### 8.4.1. Television and Radio Coverage

A summary of the Radio and Television coverage is provided in Appendix A of this report. An unexpected output arose from RTE contacting the project team after the launch in Wexford, to collaborate on additional sea level rise visuals which were presented as part of a live studio audience discussion on the impacts of climate change. The RTE team took the 2150 sea level rise visualisation from the Línite Na Farraige project in Wexford and further enhanced them in a video to 2300, as can be seen from the screenshot below.

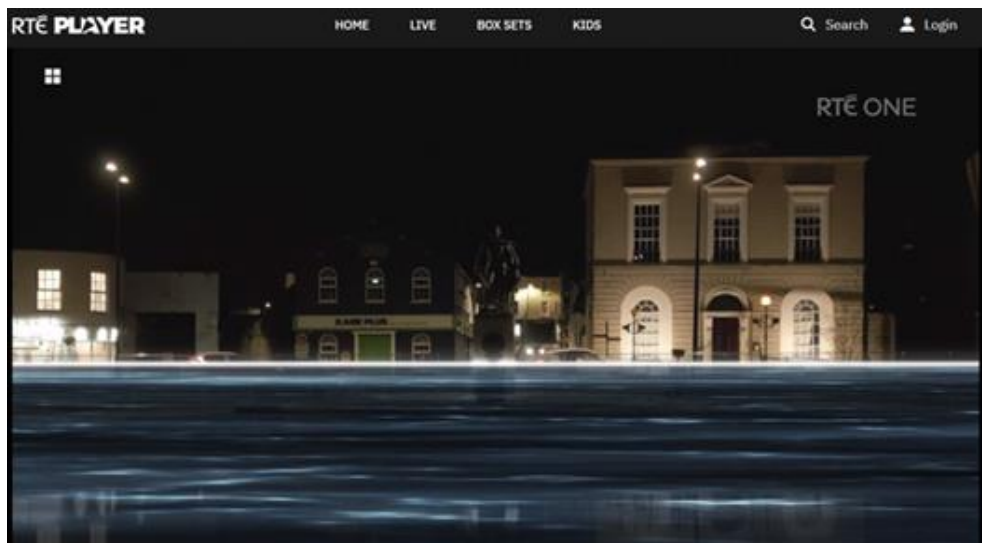


Figure 22: Project coverage on RTE News in September 2022.

#### 8.4.2. Site specific information boards

Information boards were placed at each of the installation sites, detailing the concept of the installations themselves, as well as background information relating to sea level change and climate action (Fig. 23). This encouraged the viewers to understand the impacts of rising sea levels on these locations and highlight our role as a society to reduce carbon emissions and act to 'lower the line'. A QR code on the information boards linked to the Línite na Farraige website, for viewers to get more in-depth knowledge of the project. A second QR code on the board linked to a survey conducted by UCC.



Figure 23: Final design of Spanish Arch information board (English and Irish)



Figure 24: Installed Spanish Arch information board

### 8.4.3. Website

The project website was developed by Algorithm and depicts the narrative of Línte na Farraiige (Fig. 25). The website highlights different greenhouse gas emission scenarios and their impact on sea level. These emission scenarios reflect how communities can curb the acceleration of sea level rise to protect their coastlines. Viewers can find information about project members in the ‘meet the team’ section. There is also a page where the viewer can find links to scientific

resources including the Intergovernmental Panel on Climate Change AR6 Report, climate action resources including the Environmental Protection Agency & Climate Action Region Office, and also a link to the Creative Climate Action: Experience Survey. Website link:

<https://lintenafarraige.com/>

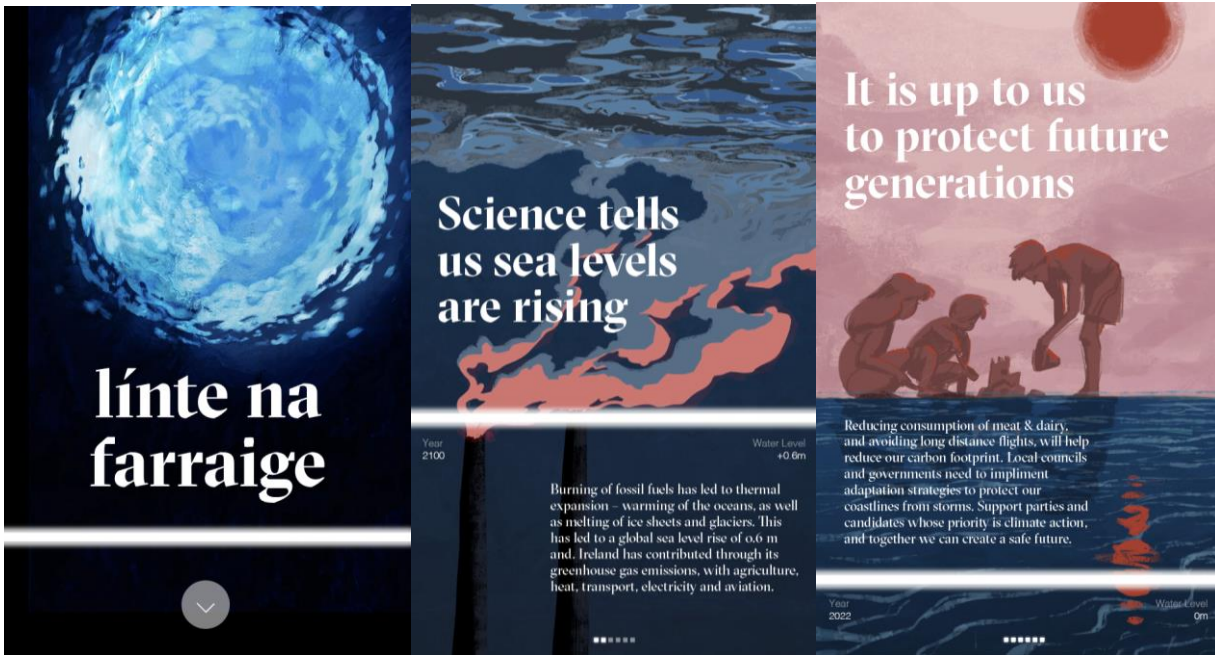


Figure 25: Website panel examples

The website’s narrative is based on Joseph Cambell’s “The Hero’s Journey”, a narrative structure that is used in an array of stories, from native american folktales to Star Wars. This simple structure resonates with the rhythm of human life and has a strong emotional impact with the audience. The goal of this emotional impact is to reignite the user’s connection with the land and encourage them to act as an advocate for coastal protection, promote and practise greenhouse gas emission reduction and become an ambassador for the climate. Notably, the emotional impact here was intended to have a positive and uplifting effect, rather than guiltig the individual into a state of aggravation and complacency.

The basic structure is simple: the protagonist starts from a place of comfort, is called to adventure, faces challenges that change them and then returns back to the place of comfort, now with new insight and appreciation. In the context of the website, the protagonist is the website user. They start at present day with 1.1°C of global warming having already occurred. They are then brought to the future along a “business as usual” emission scenario. Here they are shown the disastrous and irreversible consequences that result from an environmentally ignorant approach. They are then led away from the high emission scenario and are shown a future where emissions have been severely cut, coastal protection schemes have been implemented and future generations have been considered in today's practices.

#### 8.4.4. Social media platforms

Línte na Farráige Twitter and Instagram accounts (@lintenafarraige), were employed to generate attention for the project, through tweets, posting images and engaging with other relevant pages. They were used to notify the public of any significant dates in relation to the project, such as the launch events and science talks/panel discussions. Clips from the Línte na Farráige video were posted to these pages. Leading up to the launch events, a campaign was released on social media pages to ensure maximum visibility and engagement. The project’s social media pages have reached people globally, spreading information about the project to a larger audience. The project introduced the hashtag #lowertheline to track and monitor public engagement.

#### 8.4.5. Illustrations

The Algorithm illustrations developed for the website were also used in other areas of the project:

1. The illustrations were used on posters and displayed at Irish Rail and DART stations in Co. Wexford and Co. Dublin, as well as inside the train carriages.



Figure 26: Irish Rail Posters

2. Exhibition boards were displayed in Galway City Museum, the Lexicon Library in Dún Laoghaire and during Green Week 2023 in Trinity College Dublin.



Figure 27: Panel display boards for Galway and Dún Laoghaire

- 3. Postcards were handed out at launch events and distributed in public spaces (e.g., libraries and museums).



Figure 28: Front side of the postcards



Figure 29: Reverse side of the postcards



#### 8.4.6. Sand mural

On the 4<sup>th</sup> of September 2022, the Línite na Farraiige team spent the day at Balbriggan beach helping expert sand raker Daniel Doyle of Fleeting Sculpture created a sand mural of the project logo. The process of creating the sand mural as well as the finished product was documented through drone video footage and photographs. The drone footage was edited to create a short video clip which was posted to the project's social media pages, as well as photographs from throughout the day. This sand art also fitted with the sustainability theme of the project whereby art was created using nothing but string and garden tools and the finished artwork was documented before being washed away by the incoming tide.



Figure 30: Sand Mural at Balbriggan Beach

#### 8.4.7. Promotional video

A video was created by Maynooth University, to promote the project once work had commenced. TCD hosted this video on their YouTube channel, and a shorter clip was posted to the project's social media pages. This video was released in September 2022.

Teaser video: <https://www.youtube.com/watch?v=QrFR6H6Edfk&t=45s>

#### 8.4.8. Launch events

For each site, an installation launch event was held, which was accompanied by co-ordinated press releases by all partners and a campaign on social media. Members of the public were invited to attend these events and engaged with members of the Línite na Farraiige team. Local and national news and media outlets were contacted, and partners of the project were available for interviews. Primary press releases were coordinated by Trinity College Dublin and the Local Authorities.

#### **8.4.9. Science talk/panel discussion at Wexford Climate Cafe**

Members of the Linte na Farrage team attended the 'Climate Cafe' in Wexford Town in December 2022 to discuss the project and answer any questions from attendees. There were 18 attendees in total.

#### **8.4.10. Schools outreach**

School workshops have been planned for each of the locations of the installations. These include a summary of each installation site and the science of the line heights, a general discussion of climate action and the role of local authorities. The final section of the workshop introduces the pupils to sea level rise and coastal planning by way of an interactive climate game in conjunction with Climate Smart [www.climatesmart.ie](http://www.climatesmart.ie) developed by researchers in Trinity College Dublin. Climate Smart is an interactive game which places players in the position of Mayor of Dublin city, with players needing to make decisions on protecting the city and its inhabitants from the impacts of climate change in the future. This work commenced in Galway in March 2023 and is due for completion by the end of Quarter 2, 2023.



Figure 31: Students from Coláiste Iognáid Galway City taking part in Climate Smart gaming workshop - March 2023

## **9. Project evaluation**

The outcomes and success of the Linte na Farrage project were evaluated qualitatively and quantitatively through various activities. Those activities include the attendance at public launch events, Linte na Farrage website usage, social media platforms including Twitter and Instagram, surveys/questionnaires, walk-along interviews and science talks/panel discussions.

## 9.1. Social media

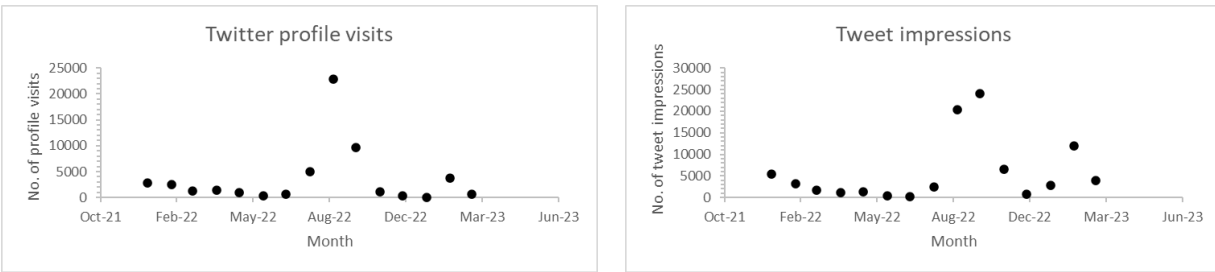


Figure 32: Twitter profile visits and impressions

Between January 2022 and March 2023, the Línthe na Farrage project posted 80 times on Twitter, earning approximately 80,000 Tweet Impressions, 50,000 profile visits and 189 mentions.

## 9.2. Website Traffic

Between September 2022 and March 2023, the 668 users visited the site. Peak engagement was on the 29th of September, the day of the Galway Spanish Arch launch. The landing page was primarily viewed in Ireland, specifically by Dubliners, followed by users from the United Kingdom. Most users viewed the site on a mobile.

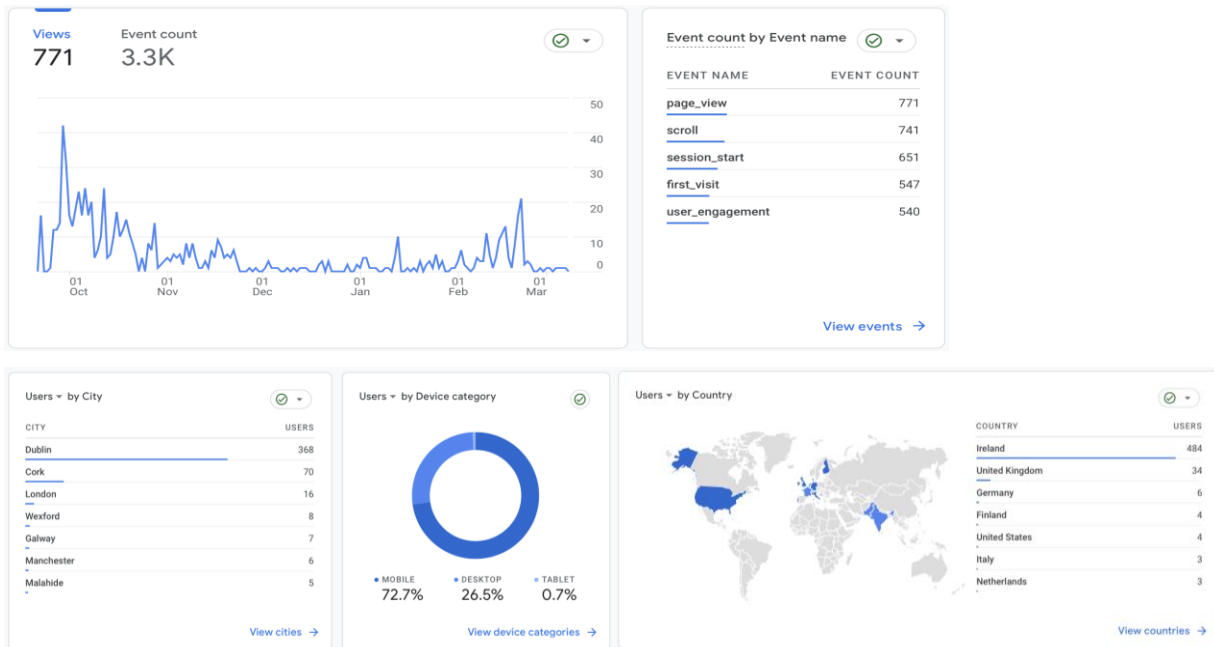


Figure 33: Website traffic

### 9.3. Results from MaREI surveys

As part of the monitoring and evaluation of the overall Creative Ireland Climate Action funding, five of the 15 projects were selected for further research and evaluation. This included Linte na Farraiige. Researchers from MaREI carried out in-person and online surveys with members of the public. Surveys were completed during the installation launch events and online, though following a link on project information boards and postcards.

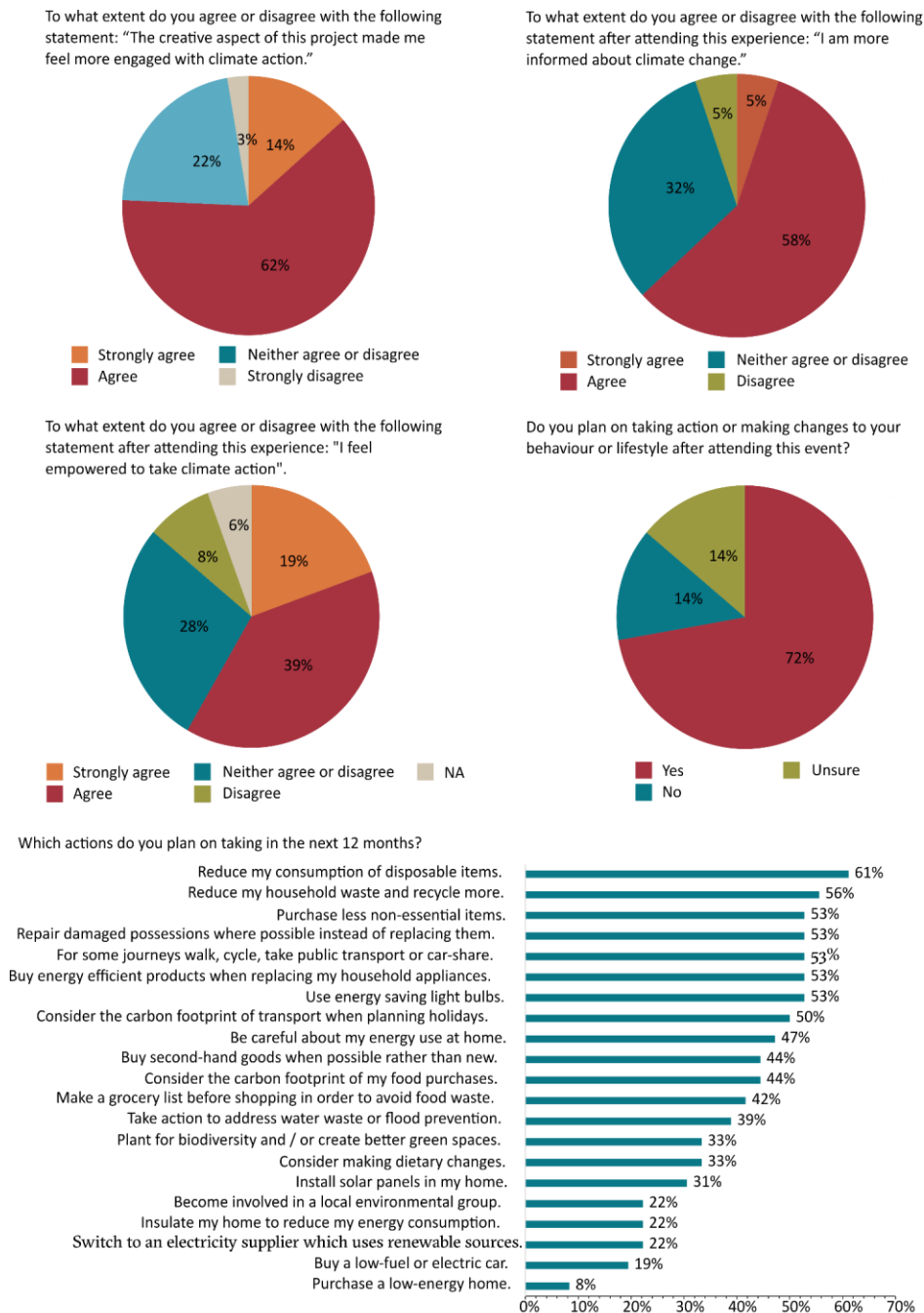


Figure 34: MaREI survey results (38 participants)

## 10. Relevant findings

- According to the MaREI research findings, the project successfully created engagement among participants, with 62% and 14% either agreeing or strongly agreeing, respectively, that the project made them feel more engaged with climate action.
- Of those that provided reasoning, it was felt that the project helped them to visualise the future impacts of climate change in a way that data or reports could not.
- 19%, 39% or 28% of participants strongly agreed, agreed, or neither agreed nor disagreed, respectively, that they felt empowered to take climate action, whilst 72% of people said that they planned on taking further climate action after attending the launch event.
- When asked what action participants would take these were the top actions:
  - Reduce my consumption of disposable items, e.g., plastic bags, excessive packaging (61%).
  - Reduce my household waste and recycle more (56%).
  - Purchase less non-essential items and consider what I really need (53%).
  - Repair damaged possessions where possible instead of replacing them (53%).
  - For some journeys walk, cycle, take public transport or car-share instead of using my private car (53%).
  - Buy energy efficient products when replacing my household appliances (53%).
  - Use energy saving light bulbs (53%).
- The most popular option: “Reduce my consumption of disposable items, e.g., plastic bags, excessive packaging” is potentially indicative of the conflation between plastic pollution and climate change (although ultimately reducing consumption, reduces production and therefore emissions). Some high-impact actions (reducing purchasing of non-essential items, biking to work) were included in top actions to take, indicating good communication of the effectiveness of these choices, whilst other high-impact actions fell down the list (supporting green organisations/groups, insulating homes, changing diet, planting for biodiversity/green spaces). These might be areas where communication could be improved. The survey largely provided actions to select that were personal to the user’s carbon footprint, future projects could look to encourage participants to engage with local authorities, the government and industry to share concerns and to encourage them to make positive changes for the environment. Actions with a high financial cost (buying low-fuel or electric cars or purchasing low-energy homes) were the least popular options, indicating that financial situation is still a barrier to some types of action.
- 58% of participants agreed that they felt more informed about climate change after participating in a Linte na Farraige launch event. However, 32% neither agreed nor disagreed, which could relate to the fact that launch events drew an audience already engaged in climate change/action.

- Although it is difficult to estimate how many people would have engaged with the installations over their lifetime, for Galway, we can estimate based on the number of Galway City Museum visitors. These visitors would have been in proximity to the installation when entering/exiting the museum and would have had the opportunity to visit the Línite na Farraige exhibition space in the museum. Between the beginning of October and the end of March, 36,000 people visited Galway City Museum and would have had the opportunity to engage with the Línite na Farraige project.

## 11. Conclusions

Línite na Farraige, funded by the inaugural Creative Climate Action Fund, is a set of visual light installations placed across Irish coastal sites in Counties Dublin, Wexford and Galway in 2022-2023. The renewably powered lines of light represent future storm surge heights, based on predictions from the Intergovernmental Panel on Climate Change report AR6, and historic storm surge data. The sites collectively demonstrate that the rate and amount of future sea level rise is yet to be determined and can be influenced by our collective societal behaviours going forward. Línite na Farraige is a collaborative project, with a team including scientists, based at Trinity College Dublin, Maynooth University and University College Cork, the Dublin CARO, Local Authorities, Algorithm, Native Events, and Finnish artists Timo Aho and Pekka Niittyvirta. The Línite na Farraige team collaborated with three local authorities (Dún Laoghaire-Rathdown, Wexford and Galway) to produce three installations:

- For Spanish Arch, the scientific team combined the storm surge from Storm Eleanor (3.7 m ODM) with an average sea level rise for the year 2150 under the IPCC's AR6 SSP2-4.5 sea level rise scenario (1 m) (IPCC, 2021a) to create a line height of 1.9 m
- For Wexford Harbour, the scientific team combined the storm surge from Storm Darwin (1.6 m ODM) (12<sup>th</sup> Feb 2014) with an average sea level rise for the year 2150 under the IPCC's AR6 SSP2-4.5 sea level rise scenario (1 m) (IPCC, 2021a) to create a line height of 0.9 m.
- For the Williamstown Martello Tower, the scientific team combined the storm surge from Storm Darwin (2.68 m ODM) (3<sup>rd</sup> January 2014) with an average sea level rise for the year 2100 under the IPCC's AR6 'high impact low likelihood' sea level rise scenario (2.3 m) (IPCC, 2021a) to create a line height of 1 m.

Over three launch events ~130 people heard from members of the project team, local councillors, the Cathaoirleach and, in the case of Dún Laoghaire Rathdown, Catherine Martin T.D., Minister for Tourism, Culture, Arts, Gaeltacht, Sport and Medi, project artists and Finland's Ambassador to Ireland, Ms. Raili Lahnalampi. Members of the project had further opportunities to engage with the project through the website, social media pages, gallery spaces in Galway City Museum,

dlr LexIcon and Trinity College Dublin, Irish Rail stations and trains, information boards at each site, local science talks and promotional videos. As the installation were in place over several months, there were opportunities for thousands of people to experience the work. Between the beginning of October and the end of March, 36,000 people visited Galway City Museum and would have had the opportunity to engage with the Linte na Farraige project. The project had great reach through the press, with interviews on RTE Morning Ireland, RTE Six One and RTE Nine O'clock News and pieces in the Irish Times and the Independent among others.

MaREI carried out in-person and online surveys with members of the public (38 participants). The project successfully created engagement among those surveyed, with 62% and 14% either agreeing or strongly agreeing, respectively, that the project made them feel more engaged with climate action. Of those that provided reasoning, it was felt that the project helped them to visualise the future impacts of climate change in a way that data or reports could not. 19%, 39% or 28% of participants strongly agreed, agreed, or neither agreed nor disagreed, respectively, that they felt empowered to take climate action, whilst 72% of people said that they planned on taking further climate action after attending the launch event.

The project team is working to ensure the legacy of Linte na Farraige. A final project video will be published, summarising the project outputs and public engagement activities. There is an opportunity to extend the onsite installations, to facilitate ongoing local engagement on other local authority led, climate action projects. The wider project team will also present the project at a number of upcoming events and conferences in Ireland and abroad. This includes the upcoming 6th European Climate Change Adaptation Conference, taking place at Dublin Castle in June 2023.

## **12. Project Team and Acknowledgements**

### **Artistic Team**

Pekka Nittyvirta and Timo Aho

Alain Ryckelynck and Jonathan Hilden - Artistic support including sensor design and graphic design

### **Academic team**

Dr. Zoë Roseby - Trinity College

Dr. Gerard Carthy - Maynooth University

Maeve Upton - Maynooth University

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### **Climate Action Regional Office**

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### **Local Authorities - Lead contacts**

Galway City Council - Damien Redington, Michal Curran

Galway City Museum - Eithne Verling, Damien Connellan, Angela Carlin

Wexford County Council - Brendan Cooney, Gerry Forde, Eoin Kinsella, Leonard Poole, Cliona Connolly

Dun Laoghaire Rathdown County Council - Anthony McNamara, Deirdre Black, Paul Kennedy, Jimmy O' Sullivan, Dara O'Daly, Julie Craig, Martina Kehoe

Fingal County Council - Christine Baker, Ronan O'Reilly, Janice Butler, Aoife Fitzpatrick, David Storey, Chris Rooney

### **Website, Power and Media Team**

Native Events - Stefano Sempirini, Jonathan Gasparto, Kyle Martin, Megan Best, Michael Soro, Bonnie Diamond

Algorithm - Daniel Staines, Talma O'Sullivan, Nick Linders, Muirín Goulding, James Blair, Anna Lawlor

1 minute 40 - Paul Michel Ledoux and Sean Hannon.

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## Appendix A

Date	Press/Media	Link to article
29th September 2022	RTE Morning Ireland	<a href="#">Light installations to indicate projected rise in sea levels   Morning Ireland - RTÉ Radio 1 (rte.ie)</a>
29th September 2022	RTE online	<a href="https://www.rte.ie/news/regional/2022/0929/1326108-galway-lights-storms/">https://www.rte.ie/news/regional/2022/0929/1326108-galway-lights-storms/</a>
29th September 2022	RTE Six One	<a href="#">Six One News (Web) (rte.ie)</a>
29th September 2022	RTE Nine o'clock News	<a href="#">Nine News (Web) (rte.ie)</a>
29th September 2022	Irish Times	<a href="https://www.irishtimes.com/environment/climate-crisis/2022/09/29/science-and-art-combine-to-shed-light-on-threat-of-rising-sea-levels-due-to-climate-change/">https://www.irishtimes.com/environment/climate-crisis/2022/09/29/science-and-art-combine-to-shed-light-on-threat-of-rising-sea-levels-due-to-climate-change/</a>
29th September 2023	TG4 Nuacht	<a href="https://ne-np.facebook.com/NuachtTG4/videos/nuacht-29-09-2022/831781338007138/">https://ne-np.facebook.com/NuachtTG4/videos/nuacht-29-09-2022/831781338007138/</a>
29th September 2022	Independent	<a href="https://www.independent.ie/news/environment/light-displays-around-irish-coast-highlight-sea-level-rise-due-to-climate-change-42026426.html">https://www.independent.ie/news/environment/light-displays-around-irish-coast-highlight-sea-level-rise-due-to-climate-change-42026426.html</a>
3rd October 2022	Connacht Tribune	<a href="https://connachttribune.ie/spanish-arch-project-to-highlight-dangers-of-rising-sea-levels-and-flooding/">https://connachttribune.ie/spanish-arch-project-to-highlight-dangers-of-rising-sea-levels-and-flooding/</a>
29th September 2022	Afloat	<a href="https://www.afloat.ie/port-news/galway-harbour/item/56393-illuminated-light-display-showing-sea-level-rise-opens-in-galway">https://www.afloat.ie/port-news/galway-harbour/item/56393-illuminated-light-display-showing-sea-level-rise-opens-in-galway</a>
29th September 2022	Silicon Republic	<a href="https://www.siliconrepublic.com/innovation/climate-science-ireland-coasts-galway">https://www.siliconrepublic.com/innovation/climate-science-ireland-coasts-galway</a>
30th September 2022	TheMayor.eu	<a href="https://www.themayor.eu/en/a/view/light-installation-in-galway-shows-terrifying-rising-sea-level-projection-for-the-next-150-years-11042">https://www.themayor.eu/en/a/view/light-installation-in-galway-shows-terrifying-rising-sea-level-projection-for-the-next-150-years-11042</a>
30th September 2022	Galway Pulse	<a href="https://galwaypulse.com/2022/09/30/galway-light-installation-highlights-rising-sea-levels/">https://galwaypulse.com/2022/09/30/galway-light-installation-highlights-rising-sea-levels/</a>
30th September 2022	Ireland Before You Die	<a href="https://www.irelandbeforeyoudie.com/light-displays-show-predicted-sea-level-rise-in-galway/">https://www.irelandbeforeyoudie.com/light-displays-show-predicted-sea-level-rise-in-galway/</a>
29th September 2022	Trinity College Dublin	English: <a href="https://www.tcd.ie/news_events/articles/science-and-art-collide-to-open-eyes-and-minds-to-impact-of-climate-change-on-storm-surge-levels-around-irish-coastline/">https://www.tcd.ie/news_events/articles/science-and-art-collide-to-open-eyes-and-minds-to-impact-of-climate-change-on-storm-surge-levels-around-irish-coastline/</a>
29th September 2023	Trinity College Dublin	Irish: <a href="https://www.tcd.ie/news_events/articles/linte-na-farraige-chun-suile-agus-intinni-a-oscailt-do-thionchar-an-athraithe-aeraide-ar-leibheil-borrthai-stoirme-ar-fud-chosta/">https://www.tcd.ie/news_events/articles/linte-na-farraige-chun-suile-agus-intinni-a-oscailt-do-thionchar-an-athraithe-aeraide-ar-leibheil-borrthai-stoirme-ar-fud-chosta/</a>
3rd October 2022	<a href="#">Lovin.ie</a>	<a href="https://lovin.ie/news/galway-shows-off-new-light-installations-that-showcase-future-sea-level-rise">https://lovin.ie/news/galway-shows-off-new-light-installations-that-showcase-future-sea-level-rise</a>
7th October 2022	Wexford Independent	<a href="#">Mayor of Wexford gets to the bottom of mysterious new railings erected at harbour - Independent.ie</a>

28th October 2022	South East Radio	Morning Mix with Alan Corcoran, clip unavailable
2nd November 2022	Kildare Now	<a href="https://www.kildarenow.com/news/home/954656/kildare-art-installation-shines-light-on-future-coastal-storm-surges.html">https://www.kildarenow.com/news/home/954656/kildare-art-installation-shines-light-on-future-coastal-storm-surges.html</a>
8th November 2022	Monday Night Live, RTE	<a href="https://www.rte.ie/player/series/monday-night-live/10000135-00-0000?epguid=IH10000134-22-0005">https://www.rte.ie/player/series/monday-night-live/10000135-00-0000?epguid=IH10000134-22-0005</a>
7th December 2022	Independent (Wexford)	<a href="https://www.independent.ie/regionals/wexford/news/this-wont-be-solved-by-us-planting-trees-wexford-environmentalists-call-on-local-tds-to-address-code-red-situation-42200453.html">https://www.independent.ie/regionals/wexford/news/this-wont-be-solved-by-us-planting-trees-wexford-environmentalists-call-on-local-tds-to-address-code-red-situation-42200453.html</a>
18th February 2023	Afloat	<a href="https://afloat.ie/port-news/dublin-bay-news/item/57893-linte-na-farraige-to-be-installed-at-dublin-s-blackrock-martello-tower-on-dublin-bay">https://afloat.ie/port-news/dublin-bay-news/item/57893-linte-na-farraige-to-be-installed-at-dublin-s-blackrock-martello-tower-on-dublin-bay</a>
1st March	Near FM	<a href="#">Northside Today: Rising Sea Levels – Near FM – Listen Again</a>
27th March	Grantham Institute	<a href="https://granthaminstitute.com/2023/03/27/linte-na-farraige-shedding-light-on-rising-seas-and-what-it-means-for-us/">https://granthaminstitute.com/2023/03/27/linte-na-farraige-shedding-light-on-rising-seas-and-what-it-means-for-us/</a>