5%-95% percentile of AR5 WGIII scenarios in concentration category 7, containing 64% of the baseline scenarios assessed by the IPCC

** Greater than 66% chance of staying within 2°C in 2100. Median and 10th to 90th percentile range. Pathway range excludes delayed action scenarios and any that deviate more than 5% from historic emissions in 2010.

*** Greater than or equal to 50% chance of staying below 1.5°C in 2100. Median and 10th to 90th percentile range. Pathway range excludes delayed action scenarios and any that deviate more than 5% from historic emissions in 2010.
The trouble with planet Earth is that it didn’t come with an instruction manual

More or less said by Buckminster Fuller, American architect, 1968.
Environmental Management must evolve in an increasingly complex world
But biodiversity is in trouble...

United Kingdom

UK Biodiversity Indicators Report 2015

WWF Living Planet Report 2016
Analysis of Keeling Curve: weekly CO$_2$ concentrations from Hawaii
Northern Hemisphere ecosystems are losing ability to absorb CO$_2$ from atmosphere.
N. Hemisphere ecosystems are losing ability to absorb CO$_2$ from atmosphere

Equivalent to 30% increase in rate of CO$_2$ rise in atmosphere: another China added to inventory
• 8 municipalities within Glasgow City Region
• £40bn GVA – a third of Scotland’s Economic Activity
• 1.8m people live, work and play here
• Diverse mix of urban and rural areas
<table>
<thead>
<tr>
<th>Hazard</th>
<th>Indicators</th>
<th>Baseline (1961 – 1990)</th>
<th>Change by 2050s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface Water Flooding (Pluvial)</td>
<td>Percentage change to 10 yearly daily rainfall depths</td>
<td>TBC</td>
<td>21.5%</td>
</tr>
<tr>
<td></td>
<td>Change in frequency of return periods</td>
<td>1:100 / 1:200</td>
<td>1 in 45 / 1 in 90</td>
</tr>
<tr>
<td>River Flooding (Fluvial)</td>
<td>Increase in peak fluvial flood flows</td>
<td>TBC</td>
<td>18</td>
</tr>
<tr>
<td>Drought</td>
<td>Percentage change to river water during low-flow periods</td>
<td>TBC</td>
<td>-22%</td>
</tr>
<tr>
<td></td>
<td>Return period of 1 in 40 year drought</td>
<td>1 in 40</td>
<td>1 in 17 (1 month)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1 in 18 (3 month)</td>
</tr>
<tr>
<td>Temperature and Heat wave</td>
<td>Average number of heat waves per year</td>
<td>0.033</td>
<td>0.333 (1 in 3)</td>
</tr>
<tr>
<td></td>
<td>Average number of heating degree days per year</td>
<td>334</td>
<td>278</td>
</tr>
<tr>
<td></td>
<td>Average number of cooling days per year</td>
<td>TBC</td>
<td>+2.3 days</td>
</tr>
<tr>
<td></td>
<td>Number of days in the winter period</td>
<td>227</td>
<td>194 (-33)</td>
</tr>
<tr>
<td></td>
<td>Growing season</td>
<td></td>
<td>35 – 40 days</td>
</tr>
<tr>
<td>Extreme cold spell</td>
<td>Number of frost days per year (&lt; 0 degrees)</td>
<td>39</td>
<td>16</td>
</tr>
<tr>
<td>Sea level rise</td>
<td>Relative Sea Level Rise (m)</td>
<td></td>
<td>+0.19m</td>
</tr>
<tr>
<td>Wind</td>
<td>Increase in gust speeds</td>
<td>TBC</td>
<td>+3% (~ 1-5 m/s)</td>
</tr>
</tbody>
</table>

Sources: UK Climate Projections 2009, Arup/Clyde Marine Planning Partnership, Jacobs/ Scottish Cities Alliance
THE INCREASED RISK OF FLOODING
Flooding can already have a devastating effect on those affected. With climate change likely to alter rainfall patterns and bring more heavy downpours, we expect flood risk to increase in the future. This could impact on properties and infrastructure – with serious consequences for our people, heritage, businesses and communities.

THE CHANGE AT OUR COAST
Sea level rise is already having a widespread impact on parts of Scotland’s coast. With this set to accelerate over the coming decades, we can expect to see more coastal flooding, erosion and coastline retreat – with consequences for our coastal communities and supporting infrastructure.

THE HEALTH OF OUR MARINE ENVIRONMENT
Our marine ecosystems – from plankton through to fish, mammals and seabirds – are already being affected by climate change alongside other pressures, particularly fishing. Changes will continue, with rising temperatures likely to change species and their distributions. The changes will present both threats and opportunities to our commercial fisheries and aquaculture.
THE SECURITY AND EFFICIENCY OF OUR ENERGY SUPPLY
Climate change may influence Scotland’s capacity to generate weather-dependent renewable energy. For example, varying water availability will affect hydro generation schemes. Climate change can also impact power distribution, with impacts ranging from damage caused by extreme weather events, to reduced transmission efficiency occurring as a result of temperature fluctuations. Impacts on global energy markets may also affect energy supplies in Scotland and consequently our overall energy security.

THE PERFORMANCE OF OUR BUILDINGS
Climate change will have an impact on the design, construction, management and use of our buildings and surroundings. Whether retrofitting existing or building new, it is likely that there will be issues with water management (in flood and drought), weather resistance and overheating.

INFRASTRUCTURE – NETWORK CONNECTIVITY AND INTERDEPENDENCIES
Our energy, transport, water, and ICT networks support services are vital to our health and wellbeing and economic prosperity. The effect of climate change on these infrastructure systems will be varied. They are likely to be impacted by an increase in disruptive events such as flooding, landslides, drought, and heatwaves. Our infrastructure is closely interlinked and failure in any area can lead to wider disruption across these networks.
THE RESILIENCE OF OUR BUSINESSES
Climate change and associated extreme weather may disrupt transport, energy and communication networks in Scotland and around the world. This could impact on markets, affect supply chains and raise insurance costs.

THE HEALTH AND WELLBEING OF OUR PEOPLE
A warming climate may provide more opportunity to be outdoors and enjoy a healthy and active lifestyle, while reducing mortality in winter. However, it could affect patterns of disease and other health issues. Climate change and associated extreme weather may disrupt the lives of individuals and communities, limiting access to vital services and impacting on people’s physical and mental health.

OUR CULTURAL HERITAGE AND IDENTITY
The changing climate is already altering our unique Scottish landscape and threatening our historic environment through coastal erosion, flooding and wetter, warmer conditions. The increased pace of climate change presents challenges to all those involved in the care, protection and promotion of the historic environment.
THE HEALTH OF OUR NATURAL ENVIRONMENT
Climate change may affect the delicate balance of Scotland’s ecosystems and transform Scotland’s habitats and biodiversity, adding to existing pressures. Some distinctive Scottish species may struggle and could be lost, invasive non-native species may thrive, while a degraded environment may not be able to sustain productive land or water supply.

THE SECURITY OF OUR FOOD SUPPLY
Climate change may have an impact on global food production. Although Scotland may be able to grow more food, this will not offset the impact global disruption has on us. The effects of increased volatility in the global commodity market due to exposure to extreme climatic events has an impact on supply and cost of food.

THE AVAILABILITY AND QUALITY OF WATER
As our climate warms and rainfall patterns change, there may be increased competition for water between households, agriculture, industry and the needs of the natural environment. Summer droughts may become more frequent and more severe causing problems for water quality and supply.
THE PRODUCTIVITY OF OUR AGRICULTURE AND FORESTS
A warming climate has the potential to improve growing conditions in Scotland and increase the productivity of our agriculture and forestry. However, climate change will also pose a number of threats, from more variable and extreme weather to the spread of pests and diseases, which may limit this potential.

THE OCCURRENCE OF PESTS AND DISEASE
As our climate changes, it will create new conditions that may allow existing pests and disease to spread and new threats to become established in Scotland. This may impact on the health of our people, animals, plants and ecosystems if risks are not properly managed.

THE QUALITY OF OUR SOILS
We rely on soils to sustain biodiversity, support agriculture and forestry, regulate the water cycle and store carbon. Soils also have an historic environment value, as a proxy record of environmental change and for the preservation of archaeological deposits and artefacts. Soils and vegetation may be altered by changes to rainfall patterns and increased temperatures - as well as the way we use the land.
Strategic case for action

To maintain and enhance City region prosperity and competitiveness, a strategic approach to adaptation is essential.
Strategic case for action

• Economic/Financial
  – Protecting what we already have: GVA of £40bn
  – Competition, inward investment and economic growth: Investors/insurers considering climate adaptation, other places doing this
  – Avoiding costs: Austerity forcing organisations to avoid unforeseen costs
  – Sector growth: Adaptation/resilience to climate change sector projected to grow at over 7% per year in UK

• Multiple benefits – opportunities for better placemaking, addressing inequality and reducing costs

• Regulation: Climate Change (Scotland) Act 2009, Public bodies’ duties, Adaptation Reporting Power

• Climate change doesn’t respect local authority boundaries – appropriate scale for ‘economic geography’ / City Region systems
Our response: Climate Ready Clyde

• A 3 year, initiative to support Glasgow City Region to meet the challenges of changing rainfall, and rising temperatures and seas.
• Aims to build a shared understanding of the risk and opportunities we face, and collaborate to implement actions and share responsibility.
• High ambition – looking to make significant changes to way City Region develops.
How we will do that

• Climate Risk and Vulnerability Assessment (CRVA) –

• Vision, Strategy and Action plan
  – Supported by Cost/Benefit Analysis and Strategic Environmental Assessment

• Tools, guidance and training to support implementation
  – Toolkit for screening climate risk in public investment
  – Guidance for Social Justice
Who’s involved?
# How it is governed

## Climate Ready Clyde

<table>
<thead>
<tr>
<th>GROUP</th>
<th>COMPRISING</th>
<th>REMIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Board</td>
<td>Representatives of each contributing organisation, with an independent, publicly appointed chair</td>
<td>• Collectively responsible for the initiative’s activities&lt;br&gt;• Set the strategic direction&lt;br&gt;• Make major financial decisions associated with the delivery of the work programme.</td>
</tr>
<tr>
<td>Secretariat</td>
<td>Manager and support officer with significant expertise in delivering adaptation.</td>
<td>• Lead development and delivery of outputs, working with stakeholders from across the City Region&lt;br&gt;• To work alongside other existing partnerships such as MGSDP, the GCV Green Network partnership and Clydeplan</td>
</tr>
<tr>
<td>Task and Finish Groups</td>
<td>Representatives from organisations with particular experience,</td>
<td>• Support the secretariat in delivering specific parts of the work programme</td>
</tr>
</tbody>
</table>

Wider city region activities and partnerships including:

- Glasgow City Region City Deal
- Research projects
- City Region planning
- Individual organisations’ adaptation activities
Outcomes

• A vision for a Climate Ready Clyde endorsed by 6 partners
• A constituted regional board with chair, secretariat and work programme
• Helped bring ECCA 2017 to Glasgow! Supported Glasgow’s successful 100 Resilient Cities bid
• £4.6m of research into climate change impacts in City Region over the next 5 years
• Developing a toolkit to screen public finance of infrastructure projects for climate risk, securing £15k of follow-on development funding
• Securing £25k for a study into the costs and benefits of adapting to climate change for the City Region economy
• Trained 20 staff from 10 organisations in knowledge and skills for adaptation
Risk and Vulnerability Assessment

- To identify the risks and opportunities from climate change for Glasgow City Region to 2050
- To highlight the impacts climate change may have on City Region priorities
- To identify the highest priority risks and opportunities for a strategy and action plan
- To identify knowledge gaps for future research
Principles of approach

• UKCP09 Medium Emissions Scenario
• Strategic approach, but also context-based (How could climate change affect City Region priorities?).
• Part of developing consensus on what we address, and when
• Attempting to consider ALL hazards, but many gaps
• Will also acknowledge broader societal trends – e.g. decarbonisation, aging population
• Compliant with a range of global reporting initiatives (C40, CDP, Covenant of Mayors on Climate and Energy)
Our Climate Risk and Vulnerability Assessment
Seeking to address the following questions:

- **How** is climate change going to affect the Glasgow City Region?
- Which **areas and sectors of activity** will potentially be more affected?
- Which are more **vulnerable**?
- To what extent is the Glasgow City region **capable to cope** with it and react?
## Structure of assessment

<table>
<thead>
<tr>
<th>Natural Environment</th>
<th>Buildings and Infrastructure</th>
<th>Society</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Agriculture and Forestry</strong></td>
<td><strong>Infrastructure</strong></td>
<td><strong>Business and Industry</strong></td>
</tr>
<tr>
<td>• Productivity of land and seas</td>
<td>• Energy generation and distribution</td>
<td>• Access to capital</td>
</tr>
<tr>
<td>• Growing</td>
<td>• Transport (Local/Trunk Road, Rail, Ports and Ferries, and Aviation)</td>
<td>• Site locations</td>
</tr>
<tr>
<td>• Forestry and tree-planting</td>
<td>• Canals</td>
<td>• Supply chains and distribution networks</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Natural Environment</th>
<th>Built Environment</th>
<th>Communities and Health</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Land Management</td>
<td>• Existing\ and new construction</td>
<td>• Community resilience and vulnerability</td>
</tr>
<tr>
<td>• Marine planning</td>
<td>• Historic/traditionally constructed buildings</td>
<td>• Societal Health and Wellbeing</td>
</tr>
<tr>
<td>• Biodiversity and Ecosystem Services</td>
<td>• Residential, commercial and industrial</td>
<td>• Emergency rescue services</td>
</tr>
<tr>
<td>• Coastal Erosion</td>
<td>• Public Realm, Blue/Green space</td>
<td></td>
</tr>
<tr>
<td>• Tourism</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Cross cutting & international** - migration, food, disease, climate justice, local government, planning

- Migration
- Food
- Disease
- Climate justice
- Local government
- Planning

- Energy generation and distribution
- Transport (Local/Trunk Road, Rail, Ports and Ferries, and Aviation)
- Canals
- Telcoms (Broadband, Cable, Mobile)
- Waste
- Water supply, drainage & treatment

- Access to capital
- Site locations
- Supply chains and distribution networks
- Labour and productivity
- Products and services

- Community resilience and vulnerability
- Societal Health and Wellbeing
- Emergency rescue services
Questions & Discussion

Kit England
James Curran

www.sniffer.org.uk/climatereadyclyde
@ClimaReadyClyde
Average Daily Temperatures in Glasgow by Month, Against LCLIP Reported Weather Events 2009-2016

January 2010:
- Schools & Nurseries closed
- Disruption to railway services
- All six SPL football matches called off
- Tow vehicle worker died

June 2016:
- 25 people with severe sunburn sought help at A&E
- Health Warnings Issued
Glasgow Rainfall by Month (2009-2016)

- September 2010:
  - 25mm of rain in 12 hours
  - 117 Calls to Strathclyde Fire & Rescue
  - Train services disrupted

- June 2012:
  - Roadworks on M8 Cancelled
  - Train disruptions
  - Glasgow Green Concert expecting 2,000 attendees, only had 200 show up

- November 2012:
  - 54 flooding incidents on roads
  - 5 Gully clearing vehicles and 9 hand cleaning squads worked to clear drains to deal with flash flooding
  - Falling masonry in city centre - roads closed
Process

2017
• Jun - Collate existing evidence on risks, opportunities and regional priorities
• Oct - First drafts of assessment
• Nov – Sectoral workshops to review

2018
• Feb – Second draft
• Mar– Expert peer review
• May - Discuss findings with senior management and politicians
• Jun - Public consultation
• Sep – Publish and begin work on action plan