



Climate Change in Queensland: setting the scene

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Queensland Climate Change Centre of Excellence

Queensland's Climate Change Strategy



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Queensland presentations will cover...

- QCCCE climate science information base
- Climate variability
- Climate extremes
- Coastal impacts;

- Food, water, biodiversity, biosphere carbon

- Coastal planning
- Emergency management and resilience



Presentation overview

- Overview – climate science
 - climate change and climate variability
- Climate change projections
 - Regional projections
- Impacts on Queensland
- QCCCE
- Research challenges
- ClimateQ- Queensland's Greenhouse Strategy



Our climate is always changing....

Our climate is influenced by both natural variability and human induced environmental changes on differing spatial and time scales.



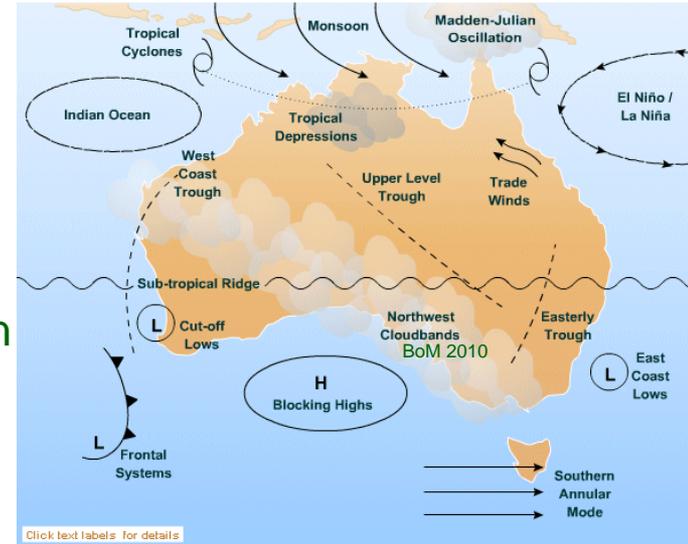
Natural variability includes....

- The annual cycle
- El Nino/Southern Oscillation, Pacific Decadal Oscillation, North Atlantic Oscillation, etc
- Volcanic eruptions
- Fluctuations in solar output
- Orbital cycles
- Ocean circulation systems
- Water vapour changes, the response of clouds and;
- Changes in snow and ice that modify how the surface reflects or absorbs sunlight



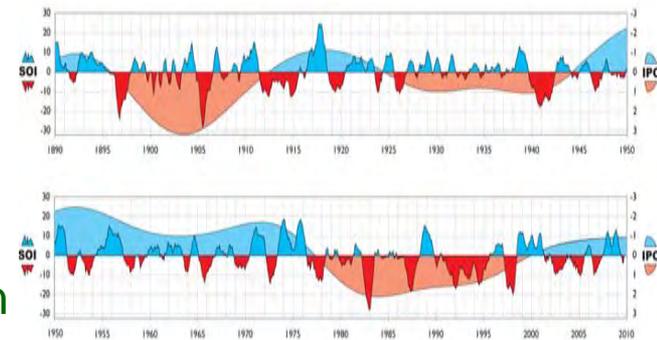
Queensland's climate and drivers

- Queensland's climate is naturally variable
 - PDO – Pacific Decadal Oscillation
 - La Niña/El Niño and the Southern Oscillation Index (ENSO)
 - MJO – Madden-Julian Oscillation (“40 day wave”)
- The “cool” phase of the PDO reinforces La Niña conditions
- The above climatic systems in addition to other drivers such as the monsoon, trade winds, east coast lows and cyclones modulate the temporal and spatial distribution of extreme rainfall events
- 2010 was the wettest year and the wettest Spring on record for Queensland. The extreme rainfall which occurred in December 2010 and January 2011 is being linked to the strength of the La Niña event



La Niña 2010/2011

- One of the strongest La Niña events on record. Wettest December on record for Queensland
- The monthly SOI for December 2010 was +27, which is the highest December SOI value on record (monthly SOI in the December 2009 was around -10)
- Sea surface temperatures off the northern Australian coast in recent months have also been at or near record levels
- Tropical cyclone numbers are typically higher during a La Niña event
- La Niña has continued to weaken over recent weeks. All available climate models suggest a further weakening



SOI and IPO (1890 – 2010)



Human influences include....

- Changing land use and land cover: Clearing of approximately 15 per cent of Australia—hotter and drier climate; exacerbated El Nino effect; longer lasting droughts
- Changing urban climates (e.g. heat islands)
- Anthropogenic sources of greenhouse gases (increase in CO₂, methane etc = increase in temperature)
- Aerosols
- Ozone



Impact of land clearing....

Impact of land clearing on hydrological cycle – clouds formation and rainfall - DJF seasonal average (1951-2003) differences

a) Total clouds

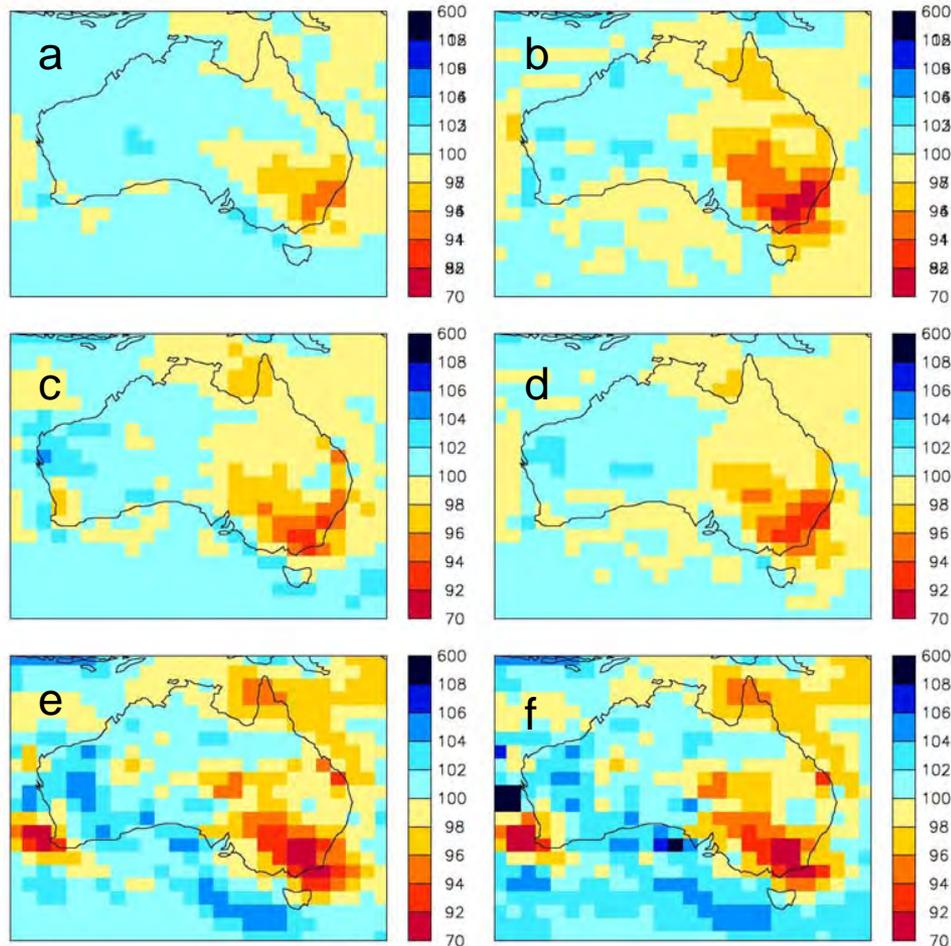
b) Low clouds

c) Convective clouds

d) Liquid cloud water

e) Total rainfall

f) Convective rainfall



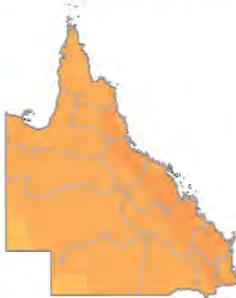
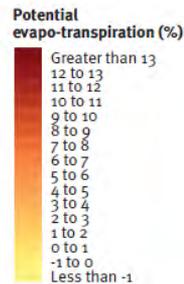
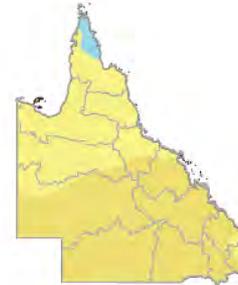
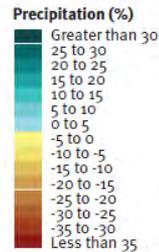
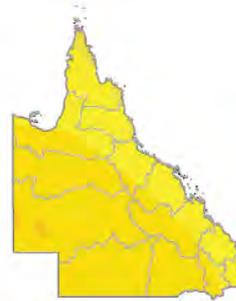
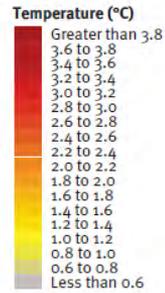
Summary of climate change projections using the new IPCC projection scenarios (i.e RCPs)

- Climate change projections show significant drying in subtropical regions
- Using extreme indices projections show:
 - a) Increased frequency of consecutive dry days
 - b) Increased 5-days max precipitation in some regions
 - c) Increasing trend in warm spell duration
 - d) Decreased thermal comfort in tropics



Climate change and Queensland's projected climate...

Rainfall projections less certain than temperature



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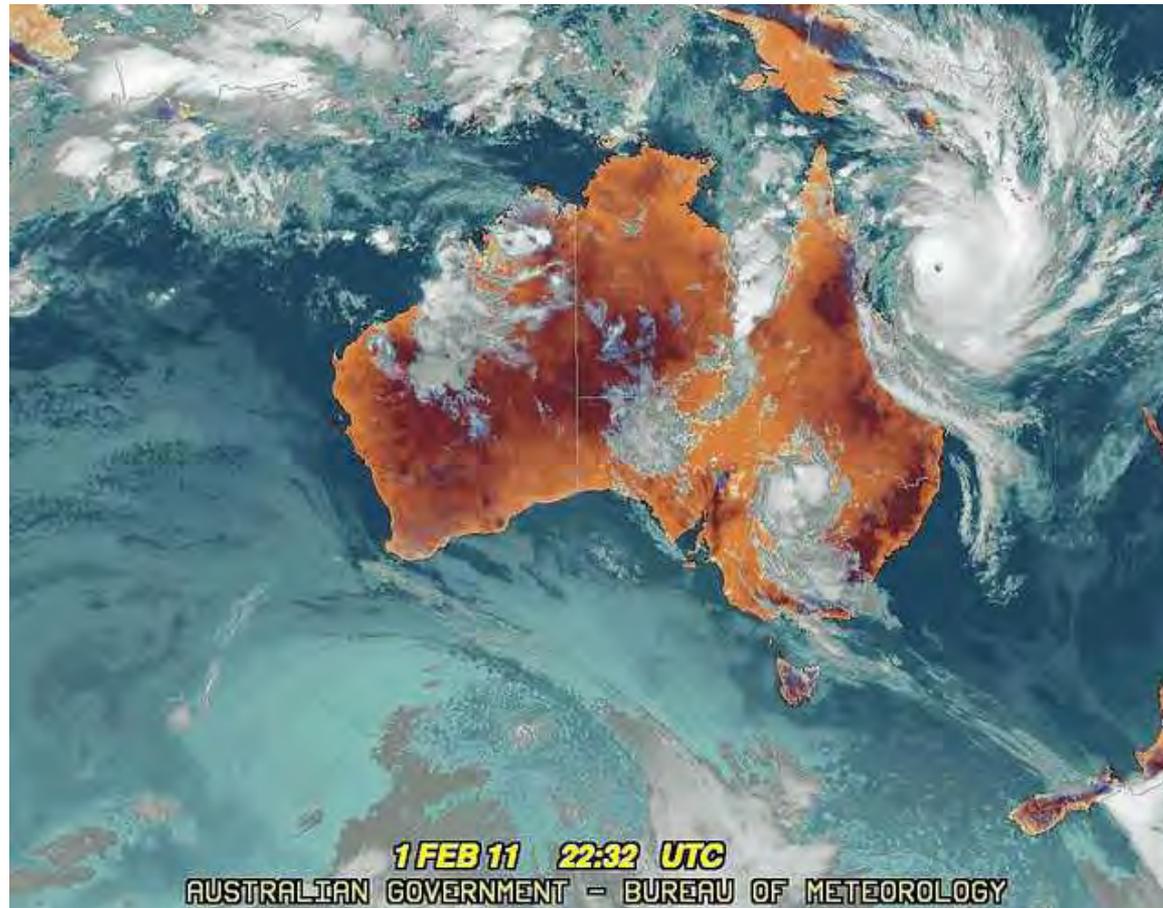
Extreme events and climate change

Extreme events under climate change means Queensland having:

- more severe cyclones
- less average rainfall, but more intense rainfall events
- sea level rise and associated risk from storm tides
- more frequent heatwaves
- more frequent droughts



What about tropical cyclones?



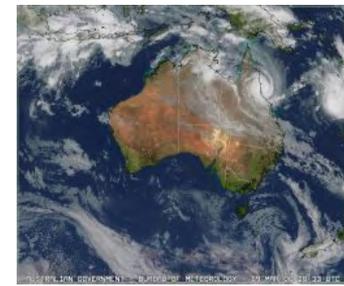
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Tropical cyclones



- Cyclones need warm water; 1.5-3.0°C increase by 2070s
- Overall expected total number of cyclones to decrease but number of long lived and severe cyclones to increase Rainfall rates likely to increase (20 percent within 100 km of the eye)
- Damage to coral reefs and coasts; reduced number of fishing days; damage to boats and ports, tourist resorts/attractions and aquaculture facilities
- TC Yasi crossed the Queensland coast near Mission Beach, south of Innisfail. It was the largest and most intense cyclone to cross the coast since 1918 and produced the third largest storm surge on record — 5.33 metres at Cardwell



The Dunk Island Resort pool before and after Tropical Cyclone Yasi



Sea level rise and impacts

- Climate change is expected to lead to:
 - a sea-level rise of 0.26–0.79 metres by 2100
 - more intense extreme weather events
 - increases in the most intense (rare/high-impact) storms
 - increases in both the mean maximum wind speed of tropical cyclones
 - increases in rainfall associated with tropical cyclones of 20 per cent within 100 kilometres of the eye of the cyclone
- Impacts of climate change on the Queensland Coast include:
 - an increased threat from storm tide
 - inundation and flooding
 - increased coastal erosion
 - risk to property and infrastructure
- Coastal Planning and monitoring; key adaptation tools



Climate change impacts on flooding

- Substantial degree of uncertainty
- Directly through alteration of rainfall intensity or indirectly due to sea level rise
- For SEQ considerable spatial variability in the projected pattern of extreme rainfall change, especially between the mountainous hinterland and the coastal floodplain
- Projections SEQ indicate increases in 2, 24, and 72 – hour extreme rainfall (Abbs 2007)
- Will contribute to developing a consistent methodology for comparing adaptation options



LGAQ Inland Flood Study

- Designed to improve Queensland's resilience to extreme flood events.
- Interim response until the revision of the Australian Rainfall and Runoff is completed in 2014

Conclusions:

- As the lower atmosphere warms, the atmospheric water vapour also increases which increases the **risk** of more intense rainfall events
- Apply a 5% increase in extreme rainfall intensity per degree centigrade increase in global temperature for flood studies

Caveats

- not for extreme (PMF) floods
- not for water supply or regular flood assessments



Extreme events and climate change

- It is clear that climate change is posing new risks beyond Queensland's historical climate variability
- Climate change studies indicate that extreme events, such as those experienced this summer, are likely to be more frequent and more intense in the future as the atmosphere and oceans warm
- Not possible to say whether climate change contributed directly to the extremely wet conditions and TC Yasi - longer term records are needed



Climate extreme deliverables: 2011-2013

•Drought projections (Dec 2011)

- Climate change projections data using CSIRO Mk3.6 climate model (CMIP5/ IPCC AR5) to derive drought index

•Climate extremes indices (2012)

- Climate change projections data using CSIRO Mk3.6 climate model (CMIP5/ IPCC AR5) to derive extreme indices (e.g. heatwaves, rainfall intensity, dry spell duration)

•High resolution climate change projection data for Qld (2012-2013)

- dynamically downscaling from CMIP5 global models to derive high resolution regional datasets



Queensland Climate Change Centre of Excellence

- Queensland is the only Australian state with its own dedicated climate science research capability.
- QCCCE works with directly leading research authorities on climate change
 - UK Met Office Hadley Centre
 - Reading University's Walker Institute
 - CSIRO
 - BOM.



SILO database



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Climate Science, information and knowledge provision

- **AR5 modelling for IPCC AR5**
- Downscaling for regional projections
- Understanding of climate variability and change
- Impact of reforestation on climate extremes under global warming
- Climate extremes & drought projections
- Generation of climate change scenarios for impact assessments
- SILO database
- DAFF: Consistent Climate Projections
- Grazing land management tools (GRASP and AussieGRASS modelling)
- Long Paddock, Seasonal climate outlook information: Monthly Climate Statement, Climate Risk Assessment Report,
- Soil Carbon



Coastal science and monitoring

- Improved coastal mapping (DEM)
- Storm tide inundation assessment mapping
- Coastal monitoring
- Storm-tide warning-response system
- Natural disaster mitigation program
- Sea level rise



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Community engagement

- Climate Change Projections for 13 regions throughout Queensland
- 'Climate Change in Queensland: What the Science is Telling Us 2010'
- 'Queensland Coastal Processes and Climate Change 2011'
- Adaptation Planning Assessment, e.g. Climate Matrix
- Climate Risk Management Matrix workshops for sectors of primary industry and regional NRM bodies
- Storm and cyclone risk regional awareness seminars latest information on cyclones, flood and storm surge to local government emergency management staff
- Consistent climate statement, monthly
- The Long Paddock website
- ABC radio
- Newspaper articles



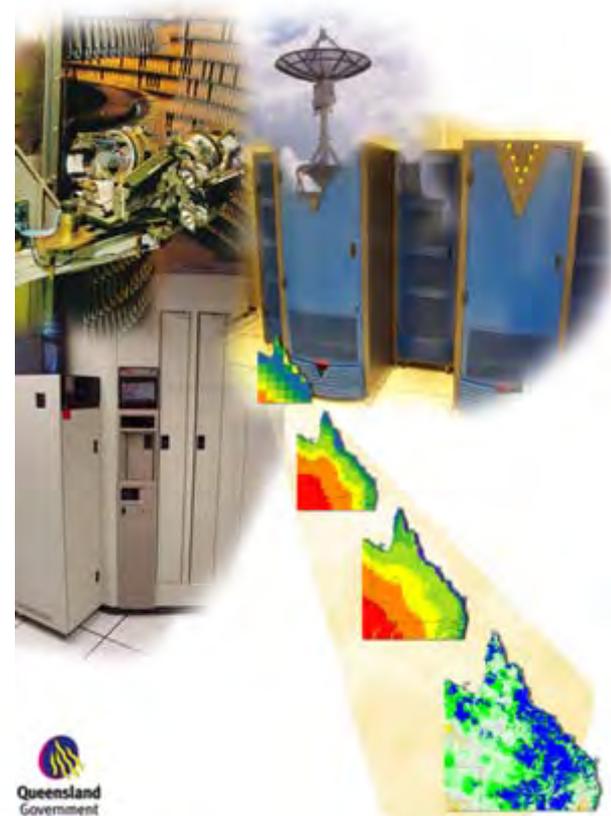
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Research challenges

Specific areas of research required to provide improved predictions of climate and its impacts on Queensland include...

- tropical cyclone generation and intensity
- frequency, duration and magnitude of extreme events
- influence of El Niño Southern Oscillation, movement of the Hadley cell, and other ocean–atmosphere interactions, East coast lows, PDO
- impact of aerosols on atmospheric circulation and rainfall
- sea-level rise and the role of the oceans
- understanding natural climate variations and the impacts of climate change on natural climate variability
- attribution of trends
- improved regional climate projections
- regional and sector-based risk/vulnerability assessments to identify adaptation options
- Impacts of ocean acidification



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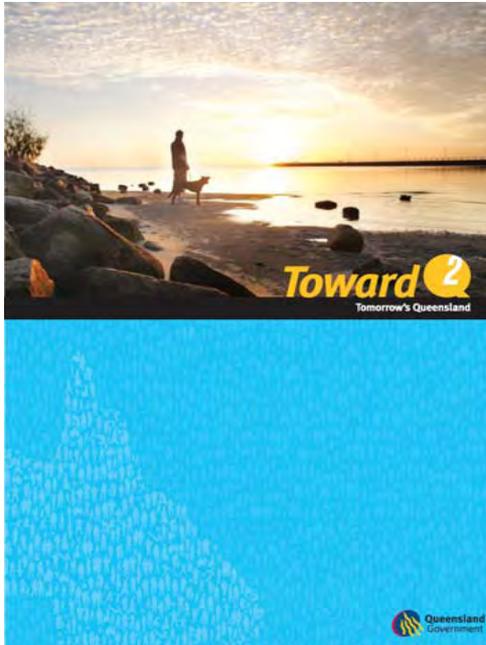
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In order to predict climate change over the next 10–30 years, we need to..

- Understand how natural variability affects regional weather patterns and in turn extreme events.
- Predict how the dominant modes of natural variability will evolve over the next 10-30 years.
- We have already begun to understand how Queensland's climate varies on interannual and decadal temporal scales.
- We now need to take this through to the level of individual weather systems
- While ensuring that we continually support decision makers by communicating the latest climate science; and developing robust decision support systems for managers to allow them to develop effective mitigation and adaptation strategies



Queensland Government policy response



OFFICE OF climate change

Premier's Council on Climate Change



OFFICE OF climate change

ClimateSmart Adaptation 2007-12:

An action plan for managing the impacts of climate change



Climate change is one of the most significant challenges facing the world today. Queensland's climate is naturally variable and extreme. Climate change is likely to influence this with potentially more frequent droughts, bushfires and heavy rainfall. As the climate changes, we need to change the way we interact with the environment. Much of Queensland's natural environment and community and economic activities are climate sensitive. To ensure the integrity and survival of things that Queenslanders value is maintained into the future, we have to make adjustments to respond to our changing climate. This process is called adaptation.

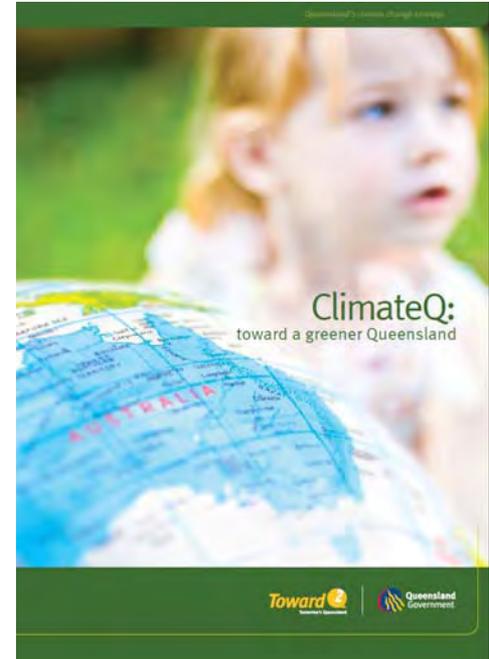
The action plan

ClimateSmart Adaptation 2007-12 is a five year plan that provides the foundation for building Queensland's resilience to climate change and a

response to public discussions and submissions about how we are prepared for climate change and better its impact. The Queensland community played an important role in developing the action plan. Discussions were held throughout the state to seek the views of Queenslanders on how proposed changes in climate might affect them, and how the state can be better prepared.

to manage their impacts. This feedback, and the best climate change advice, was used to develop the action plan. The action plan:

- confirms the Queensland Government's commitment to dealing with the issue of climate change, and provides direction for managing its impacts.



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Queensland's climate change strategies

ClimateSmart 2050

- Released in 2007
- \$1.4 billion investment
- 23 initiatives

ClimateSmart Adaptation 2007-12

- Released in 2007
- The first of its kind in Australia
- 62 actions

ClimateQ: toward a greener Queensland

- Released in 2009
- \$196 million investment
- 39 initiatives

Covers all of Queensland's key sectors

The most comprehensive platform of climate change initiatives of any Australian jurisdiction



Strategic context: key themes of ClimateQ

1. Reducing greenhouse gas emissions
2. Lowering the cost and reducing energy use to households and businesses
3. Investing in the productive future of key industries
4. **Protecting Queensland's natural wonders**
5. **Adapting to the impacts of climate change**

This approach is founded in a sound understanding of climate science



ClimateQ: Adaptation

- National Climate Change Adaptation Research Facility: NCCARF Partner
- Great Barrier Reef Protection Amendment Act 2009
- Climate Change Corridors
- Coastal Management Plan
- Improved Coastal Mapping
- Regional Land Use Planning
- The Inland Flooding Study
- Primary Producers and Adaptation
- Carbon potential
- Disaster Preparedness
- Rural Water Use Efficiency Initiative (RWUE)



Next steps.....

- Queensland's response is continually evolving and will continue to consider national and international developments
- We have the broadest suite of climate change initiatives of any Australian jurisdiction
- Building on this through consultation with other agencies and key stakeholders on initiatives such as investigating Electric Vehicles, EzyGreen and a comprehensive solar package
- We are committed to continue working with stakeholders to deliver existing, and develop new initiatives to help the State prepare for and adapt to the impacts of climate change



Thank you

Questions?

www.climatechange.qld.gov.au

www.longpaddock.qld.gov.au

