

Climate Change: Impacts and Solutions

Jeremy Gillen

Please note: The Chief Minister's Round Table of Young Territorians is an independent advisory body. The views expressed in this report are those of the author and are not necessarily reflective of those of the Office of Youth Affairs or the Northern Territory Government.

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Abbreviations

Commonwealth Scientific and Industrial Research Organisation	CSIRO
Northern Territory	NT
Intergovernmental Panel on Climate Change	IPCC
Renewable Energy	RE

Executive Summary

In this report I have outlined the reasons why we definitively need to take action to mitigate climate change, using reliable Commonwealth Scientific and Industrial Research Organisation (CSIRO), university and/or government sources.

Given the evidence that has been found in the sources examined, it is apparent that it is imperative, for every person who has the power to take action on climate change, to take action. There have been many papers on the possible ways to mitigate climate change on global and local scales.

What the Northern Territory (NT) does in the near future will have impacts throughout the next century and beyond. It is important that the NT Government commences the process of reducing the pollution that is produced in order to increase the quality of life of future Territorians, particularly young Territorians.

Reducing the NT's greenhouse gas emissions will contribute to the mitigation of climate change, but it is also recommended that the Government commission research into how the NT may adapt to climate change. This is also important if worldwide action on emissions reduction is too slow.

It is recommended that the NT Government:

- implement a strategy to increase public science literacy on climate change.
- seek the advice of scientists and economists on the most efficient and appropriate ways to reduce the pollution produced and emitted by the NT;
- legislate a simple and long term plan for dealing with climate change both in the short and long term; and
- encourage businesses and corporations to increase their energy efficiency and reduce their greenhouse gas emissions.

Introduction

This project sets out to create a research report on climate change, and its impacts and solutions in Australia and the NT. Throughout the course of this project, young Territorians were surveyed, asking their opinions on climate change and renewable energy. The results of the survey and research undertaken will be presented in this report.

Evidence suggests that climate change is an important issue for people around the world, including Australia and the NT. It is particularly important for younger generations, as they will be the ones to experience the major consequences of a changing climate later in their lives. Through surveys conducted it was identified that most young people appear though to not think of climate change as their problem, and rather think of it as the responsibility of governments to address. I agree that this should be the case. Another group who will be particularly affected by climate change are people living in remote Indigenous communities, who will have less of an ability to adapt due to their socio-economic context (Green, 2006).

This report is also based on peer-reviewed science that is published by trusted sources such as CSIRO or university publications, and/or government websites. By doing this project the intention was to create a scientifically accurate report that gives realistic advice about what should be done about climate change. On the other hand, there are some topics in which the science is more confused and sometimes contradictory, such as on the viability of nuclear energy, or the most efficient economic policy for reducing greenhouse gas emissions.

Climate change is a difficult problem to solve, as it is a long term problem. It will not be for several decades before its effects will begin to affect society, and it will be in the next few centuries that the worst consequences of our current actions will be felt. On these timescales it is easy to dismiss it as ‘not our problem’ to solve. We are now at a pivotal point, where we have the chance to reduce the damage that could otherwise be catastrophic.

Climate change overview

The term climate change in this report is specifically referring to the enhanced greenhouse effect and the ways in which it will affect the climate. The atmosphere is composed of mostly nitrogen and oxygen, with small amounts of other gasses. It is 0.04% carbon dioxide. Without this small amount of carbon dioxide, the earth would be around 33 degrees colder than it currently is, and unsuitable for most forms of life. This is caused by the trapping of infra-red radiation within the earth’s atmosphere. We are well on the way to doubling the amount of carbon dioxide in the atmosphere. This will greatly affect the overall climate of the world, which will have many effects on our society, as outlined below (Qiancheng, 1998).

Feedback Loops

The enhanced greenhouse effect heats up the earth, which has many flow on effects. Some of these effects cause more emissions of greenhouse gases into the atmosphere. This creates a positive feedback loop. Therefore any warming of the planet will cause more warming, which will cause more warming,

and so on. These loops amplify the affect that human emissions have. (Diesendorf, 2014)

The following feedback loops are already being observed:

- Melting of arctic ice reduces reflection of sunlight from Earth;
- Melting of permafrost releases Greenhouse gases;
- Warming of the Arctic Ocean releases greenhouse gases;
- Warming soil releases Carbon Dioxide;
- A warming climate has increased the amount of bush fires that occur, which releases more Carbon Dioxide; and
- Warmer air holds more water vapor, which acts as a greenhouse gas.

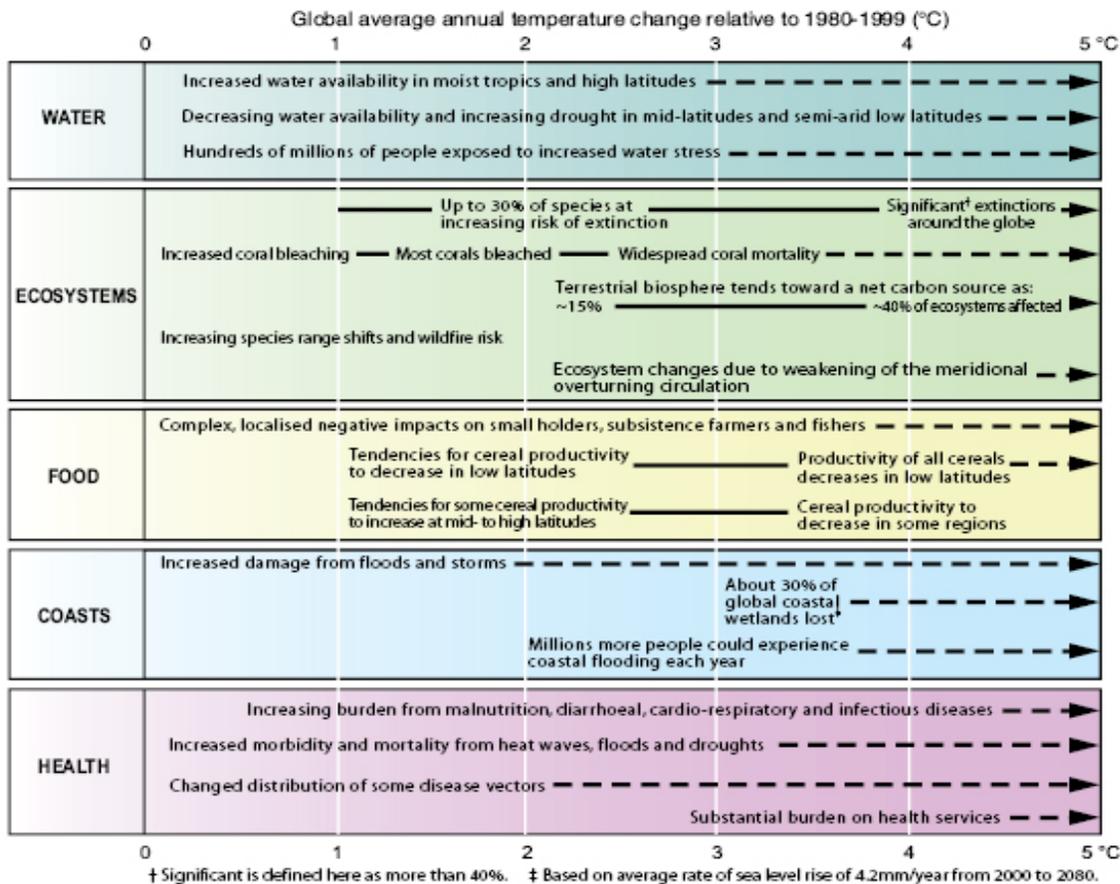
(Diesendorf, 2014)

Consequences and predictions (worldwide scale)

There are many predictions that have been made based on extrapolations of current data and computer simulations.

Without additional efforts to reduce GHG emissions beyond those in place today, emissions growth is expected to persist driven by growth in global population and economic activities. Baseline scenarios, those without additional mitigation, result in global mean surface temperature increases in 2100 from 3.7 °C to 4.8 °C compared to pre-industrial levels (median values; the range is 2.5 °C to 7.8 °C when including climate uncertainty) (high confidence). (IPCC, Summary for Policymakers, In: Climate Change 2014, Mitigation of Climate Change., 2014, p. 9)

On a worldwide and long term scale, climate change will have many effects. As shown by the diagram below, if no climate policies are implemented, climate change is likely to greatly affect water availability in many areas, damage food production in many areas, do a lot of damage to coastal areas, and greatly increase health problems. The effects of this may be varying, but research indicates that the outcome is not desirable, as there is a large probability of great economic and social impacts, (IPCC, Summary for policymakers. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability, 2014)



(IPCC, Summary for Policymakers , 2007)

Effect on the NT

The NT will be particularly affected by changes in the climate. Climate modelling indicates we will have more extreme rainfall, sea-level rise and more intense cyclones over the next 50 years. This will mean that long sections of coastline, river deltas, wetland areas and off-shore islands will be susceptible to erosion and saltwater inundation, while inland areas are likely to have more bushfires, dust storms, extremes in temperatures, flooding and droughts (Green, 2006).

Remote communities

The people most affected by these changes will be thousands of Indigenous Australians living in outstations scattered across Northern Australia from the Kimberley through to Arnhem Land, the central deserts, far north Queensland and the Torres Strait. A lack of basic infrastructure, lower social and economic status and existing chronic health problems also contribute to many of these communities having lower adaptive capacity (Green, 2006) (IPCC, Summary for policymakers. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability, 2014).

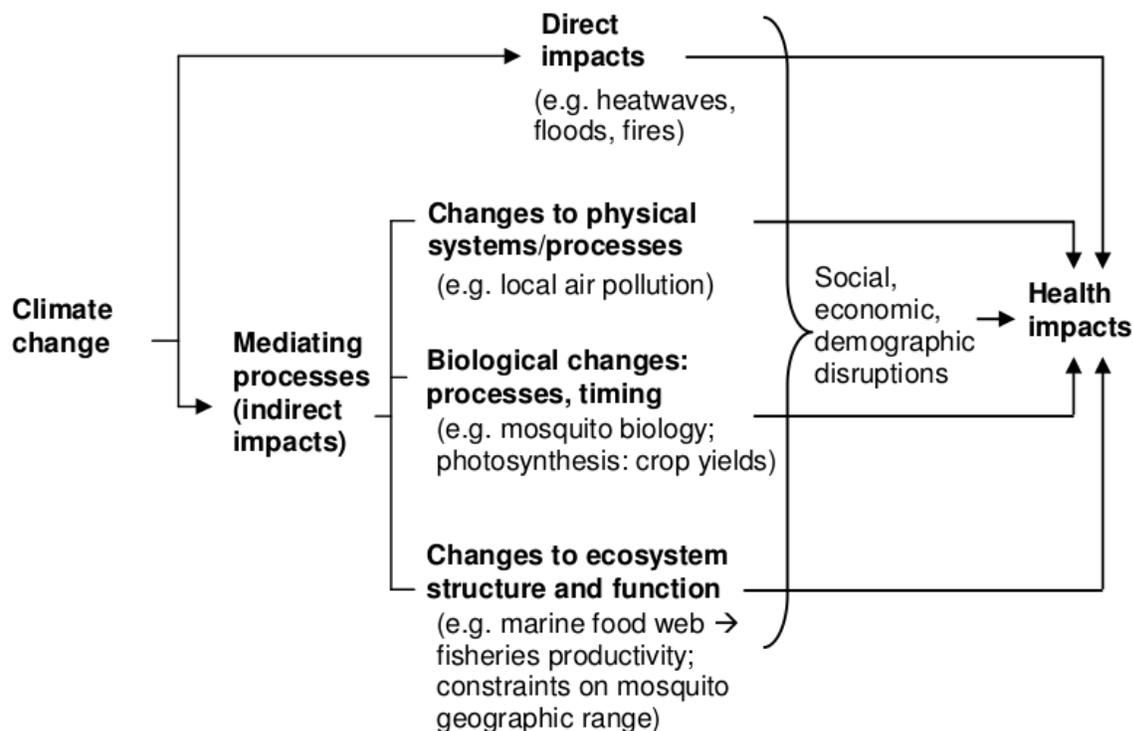


Figure 1: (Green, 2006)

Across the NT, there will be increased temperature and humidity, contributing to more frequent and intense heat waves. This is likely to cause an increase in incidence of heat rashes, heat exhaustion and even heat stroke - which can lead to death. Elderly people and those with poor cardiovascular health and low physical fitness, such as many who live in remote communities, are at the highest risk. Asthma and other respiratory problems, bacterial diarrhea, mosquito-borne diseases, Japanese Encephalitis and Dengue will all have increased effects on northern Australia, especially in remote communities. (Green, 2006)

Over the next century, middle-of-the-road estimates suggest a global average sea-level rise of about 50cm. This will mean that whenever there is a combination of high tides and strong winds, there will be flooding that could cause massive erosion, the disruption of the water supply, and an increased risk of communicable disease transmission. An increase in extreme high winds and cyclones is very likely, which would cause a larger number of injuries and deaths. The existing problem of dilapidated housing, for example, will become even more serious if more frequent extreme weather events occur (Green, 2006, pp. 10-14)

In Alice Springs, there is currently an average of 90 days over 35°C and 17 days over 40°C, but by 2070, is predicted to increase to 116-220 days over 35°C and 36-169 days over 40°C. As you can see, in a best case scenario there would simply be a greater cost of air conditioning in the summer, and more unhappy citizens, but in the worst case scenario this would mean almost half of the year would have temperatures

over 40°C, making almost unliveable conditions in Alice Springs as well as surrounding communities. This will obviously greatly affect the economy as well as the quality of life in the NT. The young people who are currently living in the NT are the people who will experience these changes in the future, when the current generation of leaders and decision makers are - gone. While the youth of the NT do not generally think of climate change as their problem, it is definitely a problem that will greatly affect their lives in the future if the problem is not addressed (K. Hennessy et al. 2004, p.8).

It is evident from the above research that climate change cannot be ignored because the likely damage that is predicted is far greater than the perceived economic damage that may be caused by solving the problem. This means that in the long term, mitigating climate change using an array of different solutions is the best economic pathway that can be taken at this point in time.

Solutions

Many adaptation and mitigation options can help address climate change, but no single option is sufficient by itself. Effective implementation depends on policies and cooperation at all scales, and can be enhanced through integrated responses that link adaptation and mitigation with other societal objectives. (IPCC, Climate Change 2014 Synthesis Report: Summary for policy makers, 2014, p. 18)

Solving a problem like climate change is a multi-faceted challenge that will require reducing greenhouse gas pollution in all parts of our society. There is no one action that will do this, so a solution will require multiple initiatives to reduce pollution produced by industry, electricity production and transportation, among other areas.

Nuclear

Nuclear energy is an alternative to fossil fuels and renewable sources of energy. Nuclear power has many advantages, some being the fact that it is cleaner than fossil fuels in terms of air pollution, able to provide base load power easily, and has a relatively large supply of fuel left in the ground. It also has several disadvantages.

The IPCC Summary for policymakers has this to say about nuclear energy:

'Nuclear energy is a mature low-GHG emission source of baseload power, but its share of global electricity generation has been declining (since 1993). Nuclear energy could make an increasing contribution to low carbon energy supply, but a variety of barriers and risks exist (robust evidence, high agreement). Those include: operational risks, and the associated concerns, uranium mining risks, financial and regulatory risks, unresolved waste management issues, nuclear weapon proliferation concerns, and adverse public opinion (robust evidence, high agreement). New fuel cycles and reactor technologies addressing some of these issues are being investigated and progress in research and development has been made concerning safety and waste disposal.' (IPCC, Summary for Policymakers, In: Climate Change 2014, Mitigation of Climate Change., 2014, p. 21)

If nuclear energy were to become widespread, the small risks associated with it would become larger. The problem of storing radioactive waste would become expensive and dangerous. Radiation leaks, meltdowns and the proliferation of nuclear weapons could become more likely, creating dangers to society (Diesendorf, 2014, p. 138). Therefore, if nuclear energy is to be used, I suggest it be used only in moderation, as a small part of our energy generation system.

If most of the aforementioned barriers are overcome, nuclear energy may play a part in reducing the carbon emissions of the NT, but should not become our primary energy supply.

Energy efficiency

Efficiency enhancements and behavioural changes, in order to reduce energy demand compared to baseline scenarios without compromising development, are a key mitigation strategy in scenarios reaching atmospheric CO₂ concentrations of about 450 or 500 ppm by 2100 (robust evidence, high agreement). (IPCC, Summary for Policymakers, In: Climate Change 2014, Mitigation of Climate Change., 2014)

Energy efficiency has been shown to be the most cost effective way of reducing greenhouse gas emissions, as investments will almost always pay for themselves within a fairly short timeframe. This is therefore the most economically efficient way of reducing emissions through government policy. For example, a group of states in America have created the ‘Regional Greenhouse Gas Initiative’, which is a group of policies which have successfully reduced the pollution produced by these states while maintaining a healthy and growing economy. (RGGI, Inc, 2012, p. 4)

Energy efficiency measures are being taken by many Australians to save money and reduce pollution. While these measures should be encouraged by the government, it should only be a small part of an overall strategy to reduce emissions, as increasing efficiency on a small scale can only have a limited contribution to emissions reduction.

Renewable Energy

Renewable energy (RE) is any form of energy generation that uses a source of energy that will not run out in the foreseeable future.

Since [2007], many RE technologies have demonstrated substantial performance improvements and cost reductions, and a growing number of RE technologies have achieved a level of maturity to enable deployment at significant scale (robust evidence, high agreement) Regarding electricity generation alone, RE accounted for just over half of the new electricity-generating capacity added globally in 2012, led by growth in wind, hydro and solar power.

However, many RE technologies still need direct and/or indirect support, if their market shares are to be significantly increased; RE technology policies have been successful in driving recent growth of RE. Challenges for integrating RE into energy systems and the associated costs vary by RE technology, regional circumstances, and the characteristics of the existing background energy system (medium evidence, medium agreement). (IPCC, Summary for Policymakers, In: Climate Change 2014, Mitigation of Climate Change., 2014, p. 21)

The cost of renewable energy can range from cheaper than fossil fuels to very expensive, depending on how and where the energy is generated. The major advantage of renewable energy sources is a relatively low operating cost due to the fact that very little money is spent on fuels. According to a report by the International Energy Agency, any money spent on renewable energy now will pay itself off in fuel savings by 2025 (IEA, 2012). By 2050, they predict that fuel savings will be three times the amount spent on building the clean energy sources.

One study has shown that if Australia were to transition to 100% renewable energy in ten years, it would cost roughly \$137 billion, which would be about 3% of Gross Domestic Product over the ten years.

Though the up-front investment required by the Plan is significant, maintaining business-as-usual (BAU) is not without its costs either. BAU requires \$AU135 billion for ongoing capital investments in energy infrastructure for the period 2011 to 2020, and then continues to pay for increasingly expensive fossil fuels in later years, with \$AU300 billion in fuel costs. Although the ZCA2020 [Zero Carbon Australia] Plan's up-front investment is substantially higher than BAU, the Plan's low ongoing costs result in dramatically reduced expenditures over the long-term. Calculating net present costs on a longer timeframe (2011-2040) demonstrates that the ZCA2020 Stationary Energy Plan is about the same cost as the BAU scenario. (Matthew Wright, 2011, p. xix)

From research conducted, it is apparent that a combination of the cheapest renewable energy options and energy efficiency is the best way of reducing the greenhouse gas emissions of the energy industry with the least economic damage possible.

Renewable energy can be used as part of the electricity grid in many different ways, ranging from entirely decentralised to one massive energy generation station, with varied complex combinations of different types of energy generation. The best system is different for every area, and is best decided using computer modeling of the electricity grid against weather and other factors that affect renewable sources.

Policy case studies

Effective adaptation and mitigation responses will depend on policies and measures across multiple scales: international, regional, national and sub-national. Policies across all scales supporting technology development, diffusion and transfer, as well as finance for responses to climate change, can complement and enhance the effectiveness of policies that directly promote adaptation and mitigation. (IPCC, Climate Change 2014 Synthesis Report: Summary for policy makers, 2014, p. 20).

Regional Greenhouse Gas Initiative

A group of states in America have created The Regional Greenhouse Gas Initiative (RGGI), which was created with the goal of making a difference for households, small businesses, farms, and industry in each of the states.

The program creates a regional cap and trade program for reducing pollution. In a cap and trade program, the government sets an overall cap on emissions and creates allowances, or limited authorisations to emit, up to the level of the cap. Sources are free to buy or sell allowances or ‘bank’ them to use in future years, (EPA, 2009).

‘The program has powered a \$617 million investment in the region’s energy future: reducing energy bills, helping businesses become more competitive, accelerating the development of local clean and renewable energy sources, and limiting the release of harmful pollutants into the air and atmosphere, while spurring the creation of jobs in the region. An independent 2011 study by the Analysis Group reported over 16,000 new job-years created in the first three years of the program.

These investments, in concert with the broader energy policies of each RGGI state, are making the region a national leader in energy efficiency, clean and renewable energy, and greenhouse gas emissions abatement.’ (RGGI, Inc, 2012, p. 3).

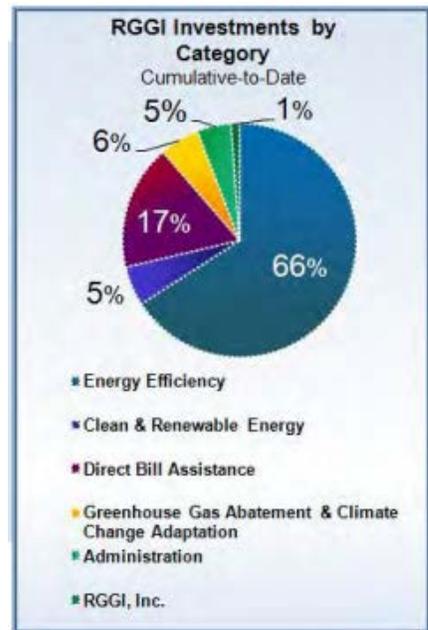


Figure 2: Breakdown of investments as part of RGGI program (RGGI, 2012)

The primary area that has been invested in was energy efficiency, with other investments in renewable energy, direct bill assistance and climate change adaption. The breakdown of their investment is shown below.

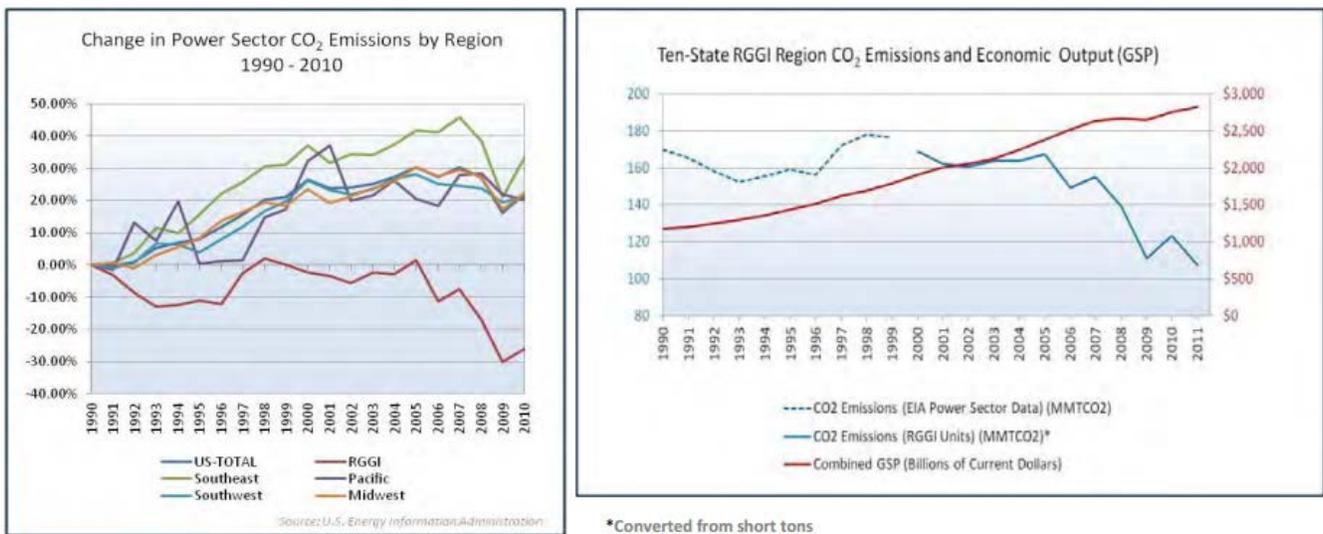


Figure 3: RGGI States show reduced emissions and a steadily growing economy (RGGI, 2012)

GOOD PRACTICE EXAMPLE

Denmark

Denmark's government has aimed to reduce their greenhouse gas emissions by 80-95% by 2050, and 40% by 2040. This is in line with the recommendations of scientists for developed countries.

The Danish government will be following a sensible, pragmatic climate policy. This means that climate change issues will be integrated into other sector policies. In so doing, climate change will be a natural part of transport policy, agricultural policy etc.
(The Danish Climate Policy Plan, 2013)

The city of Copenhagen has fostered a bicycle culture that saves 90,000 tons of CO₂ emissions annually, and makes the city far more sustainable and people friendly (Kielgast, n.d.).

The Danish Government's Climate Policy Plan also includes an outline and comparison of the climate policies of other countries:

The Danish greenhouse gas reduction target for 2020 is one of the most ambitious in the world. However, this does not mean that Denmark stands alone. Other progressive countries are moving in the same direction and have taken on national greenhouse gas reduction targets that go beyond their international obligations. Examples include:

- *Germany is aiming to reduce greenhouse gas emissions by 40% by 2020 compared with 1990 and at the same time Germany is starting to phase out nuclear power. Norway is aiming to become greenhouse gas neutral by 2050 (partly by buying climate credits from abroad). This target will be brought forward to 2030, if there is an international agreement.*
- *Sweden is aiming to reduce greenhouse gas emissions in the non-ETS sector by 40% by 2020 compared with 1990.*
- *The UK is aiming to reduce greenhouse gas emissions by 34% by 2020 nationally, without buying climate credits from abroad. In 2008 the UK adopted a Climate Change Act under which national reduction targets in terms of carbon budgets are adopted. Under the Climate Change Act the UK has adopted a conditional target to reduce emissions by around 50% by 2027 on the condition that the EU adopts common reduction targets post 2020* (The Danish Climate Policy Plan, 2013).

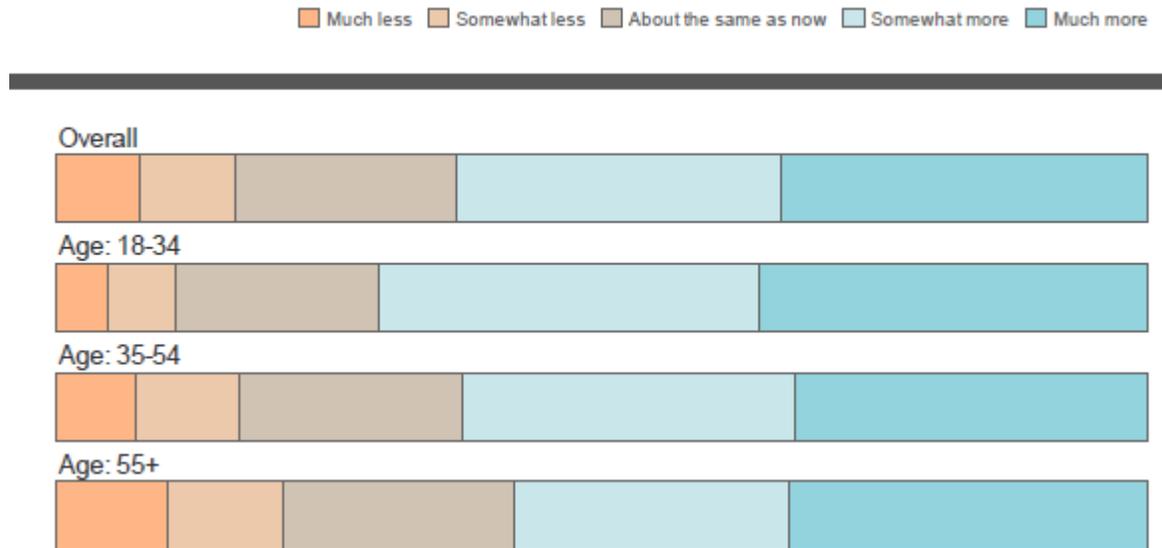
The policies of the Regional Greenhouse Gas Initiative and Denmark, as well as the policies of many other countries, can be used as examples and guides when planning how the NT should move towards a more sustainable future.

Public opinion on climate change and renewable energy

For this report a survey was conducted amongst young people aged 12 – 25 years. A total of 91% of the responses to the survey conducted for this report outlined that the NT Government should begin to transition the NT to be powered by renewable energy. This survey was, however, not statistically significant, so the following is a survey conducted by the ABC that has an effective sample size of

570,000 people. It showed that the majority of respondents thought that more should be done by the government about climate change. It also showed that younger people were more likely to be supportive of action on climate change, (ABC, 2013).

How much should the federal government do to tackle climate change?



(ABC, 2013)

Overall, this shows that 63.3% support more action on climate change, and 70.5% of people aged 18-34 agreed with more support. The above diagram also shows that the younger you are, the more likely you are to support climate action.

It appears from these results that the majority of the public are in support of action on climate change, but there is still a large percentage of people who do not think climate change is important. This is, at a guess, may be due to a lack of education about the science and impacts of climate change. It may help if the government were to place more emphasis on the issue of climate change and educate the public about the importance of taking action. This would go a long way in convincing the majority of the public of the importance of this issue.

Of the respondents to the survey conducted for this report, 64% said they wanted to learn more about climate change. While implementing strategies to address climate change, it is important to keep the public informed and educated as to why these actions are being taken, and why they are important. It would be a good idea to communicate the science of climate change to a much greater extent to children in primary and secondary school, and use mediums such as television and social media to teach the science to adults. Studies have shown that an understanding of climate science shows a strong correlation with beliefs that action should be taken to reduce climate change (Bord, O'Connor, & Fischer, 2000).

Conclusion

There are multiple mitigation pathways that are likely to limit warming to below 2°C relative to pre-industrial levels. These pathways would require substantial emissions reductions over the next few decades and near zero emissions of CO₂ and other long-lived GHGs by the end of the century. Implementing such reductions poses substantial technological, economic, social, and institutional challenges, which increase with delays in additional mitigation and if key technologies are not available. Limiting warming to lower or higher levels involves similar challenges, but on different timescales. (IPCC, Climate Change 2014 Synthesis Report: Summary for policy makers, 2014, p. 15).

Climate change is a fairly abstract and complex issue. The effects of climate change are just statistics to the everyday person. The effects will be more bush fires, more floods, more crop failures, more cyclones, greater spread of diseases, however at this stage not enough for most people to take much notice. It is easy to think that we will just be able to deal with the consequences, and it will not directly affect us.

One of the possible reasons that people have trouble understanding climate change is that very little of the danger is definite. It is all about predictions and probability. No individual cyclone can be directly linked to climate change, but an overall increase in the amount of cyclones can be. There is a small chance that climate change will not have effects worth worrying about, and on the other end of the spectrum, a small chance that climate change will do huge amounts damage to our society.

Depending on how bad climate change becomes, the health of many of the Indigenous communities around Alice Springs and elsewhere in the NT will be particularly affected by flooding, cyclones, bushfires, and the spread of disease due to changes in temperature and humidity.

Towns and cities such as Alice Springs will be affected in the same way, but will be far better equipped to adapt to these changes. While we may be able to cope with these effects, though, it would definitely be better to avoid them.

The one thing that is alarming about climate change is the chance of positive feedback loops making climate change irreversible. There are many of these effects which will create more warming, the warmer it gets. Effects like this will amplify the impact of climate change, and could make it self-perpetuating. This would lead to extreme temperature increases, the effects of which are difficult to predict, but catastrophic. It is unknown when or if this will happen, but it is a risk that should be taken into account.

The main solution that discussed in this report for climate change is to switch all our energy generation to renewable energy sources. This has its own complications, but all the problems have been studied and there are many practical solutions over time. It would, of course, be fairly expensive to convert to renewables in the short term, but overall, in economic terms, it would pay itself off many times over in the avoidance of the economic damage that climate change has the potential to do, and also in the savings gained by not having to mine or buy fossil fuels.

Consequently, there are many things that need to be talked about regarding climate change such as what policies work best and how much warming we can deal with. However, what has already been talked

about and well and truly settled, is the fact that climate change is happening and that we need to do something about it.

For more detail I suggest the reading of the International Panel on Climate Change 2014 report, which can be found on the IPCC website. The book 'Sustainable Energy Solutions for Climate Change' will also provide more detail on the many possible solutions to climate change. It also analyses different policy options that could be taken.

Based on this report, I recommend that the NT Government:

- implement a strategy to increase public science literacy on climate change.
- seek the advice of scientists and economists on the most efficient and appropriate ways to reduce the pollution produced and emitted by the NT, both in the short and long term;
- legislate a simple and long term plan for dealing with climate change; and
- encourage businesses and corporations to increase their energy efficiency and reduce their greenhouse gas emissions.

7. Do you think Australia should transition to 100% renewable energy?

YES NO

WHY/WHY NOT?

8. Do you believe nuclear power is a viable option in the future?

YES NO

WHY/WHY NOT?

9. Do you think renewable energy too expensive to be used to supply the world's energy?

YES NO

10. Do you believe traditional fossil fuel power stations are less or more expensive than renewable energy power stations?

MORE EXPENSIVE LESS EXPENSIVE

11. Do you believe the NT Government should begin to transition the NT to be powered by renewable energy?

YES NO

WHY/WHY NOT?

12. Would you pay more for renewable electricity?

YES NO

All queries should be directed to the Office of Youth Affairs on 8999 3890.

Please send completed surveys to:

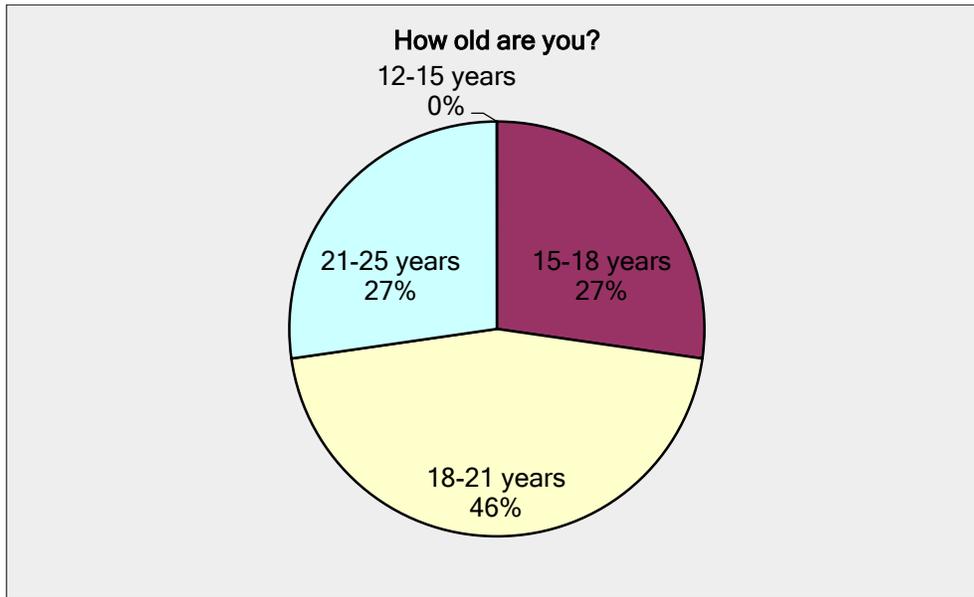
Office of Youth Affairs OR
GPO Box 4396
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Email: oya@nt.gov.au

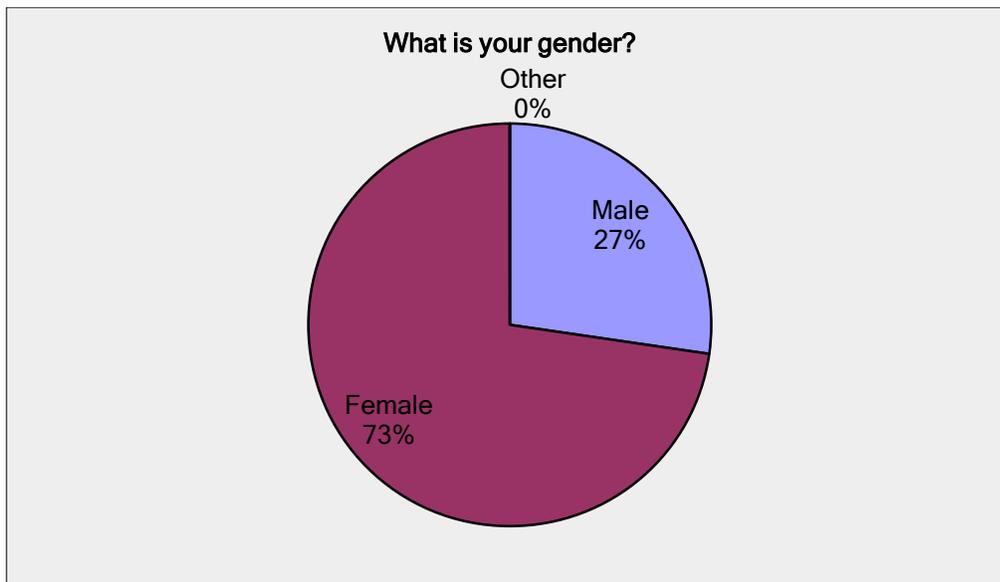
Appendix B

Survey Results

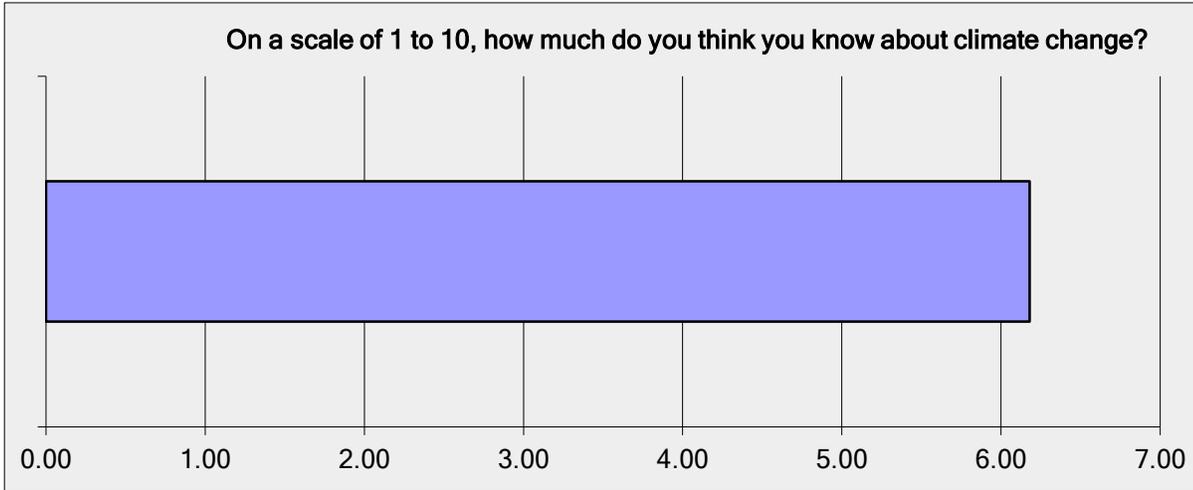
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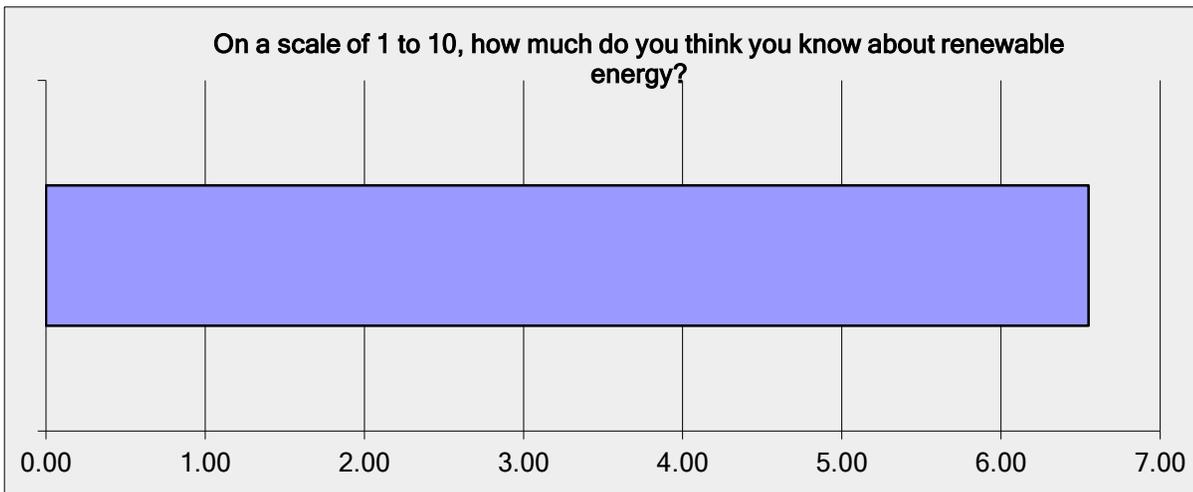
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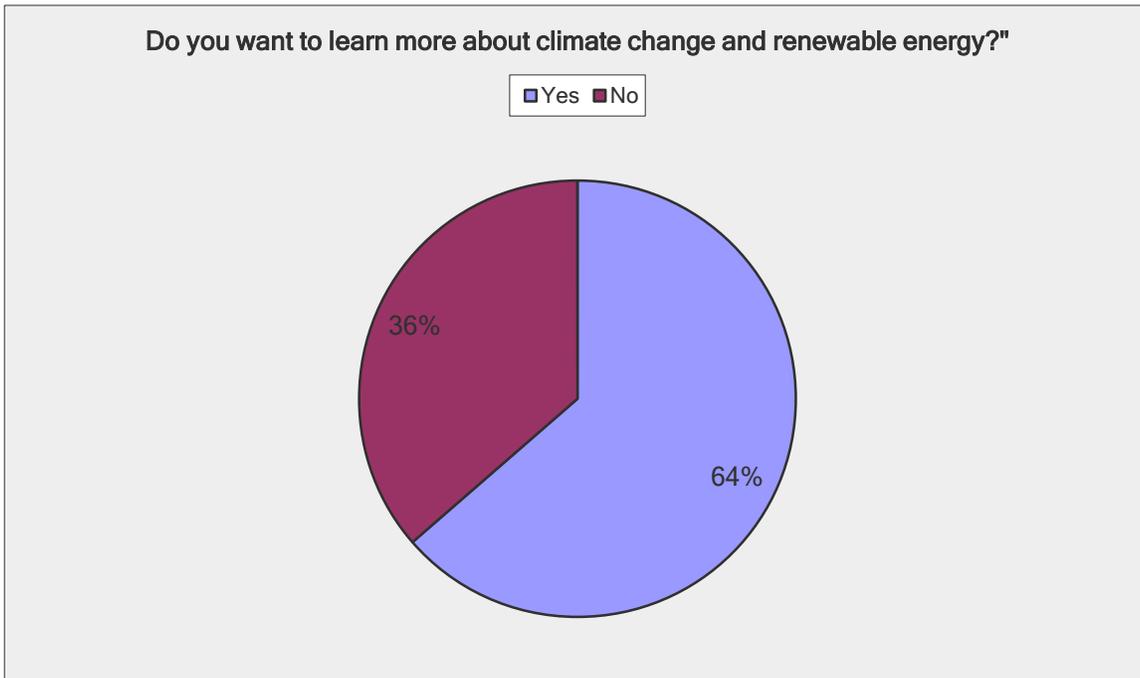
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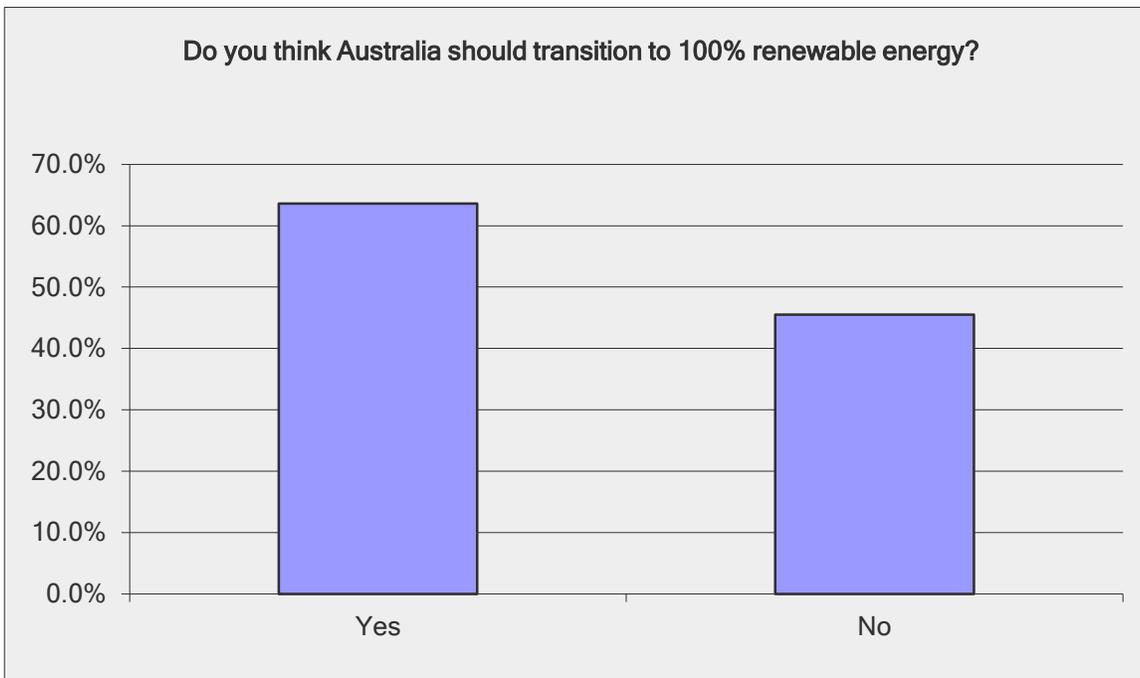
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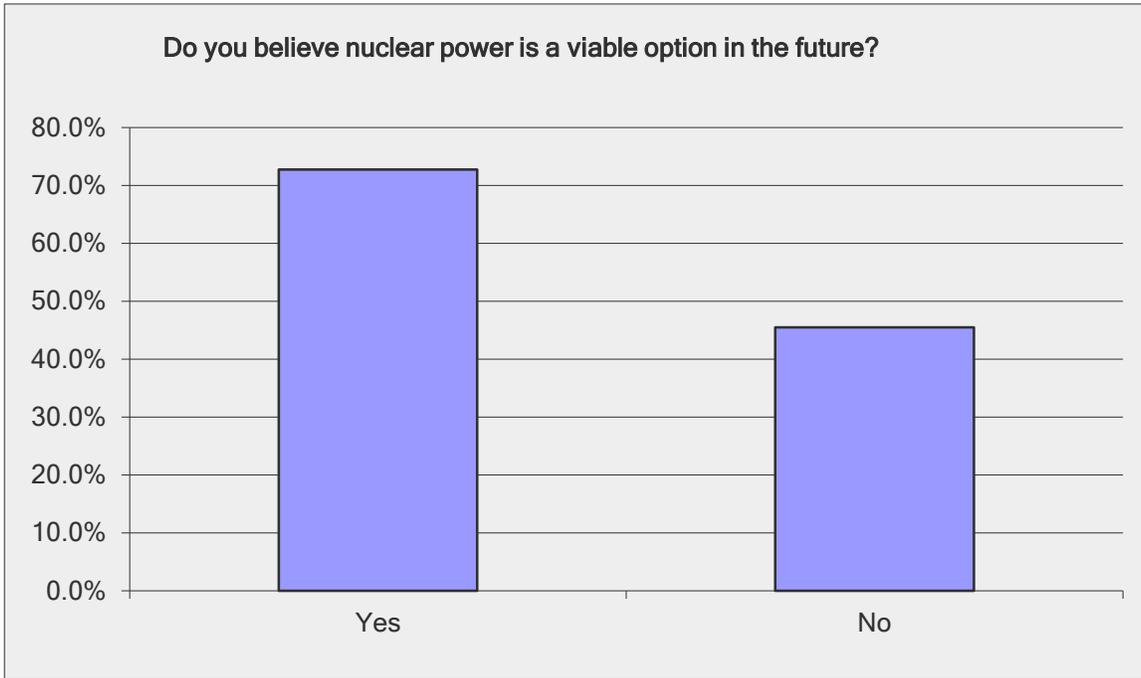
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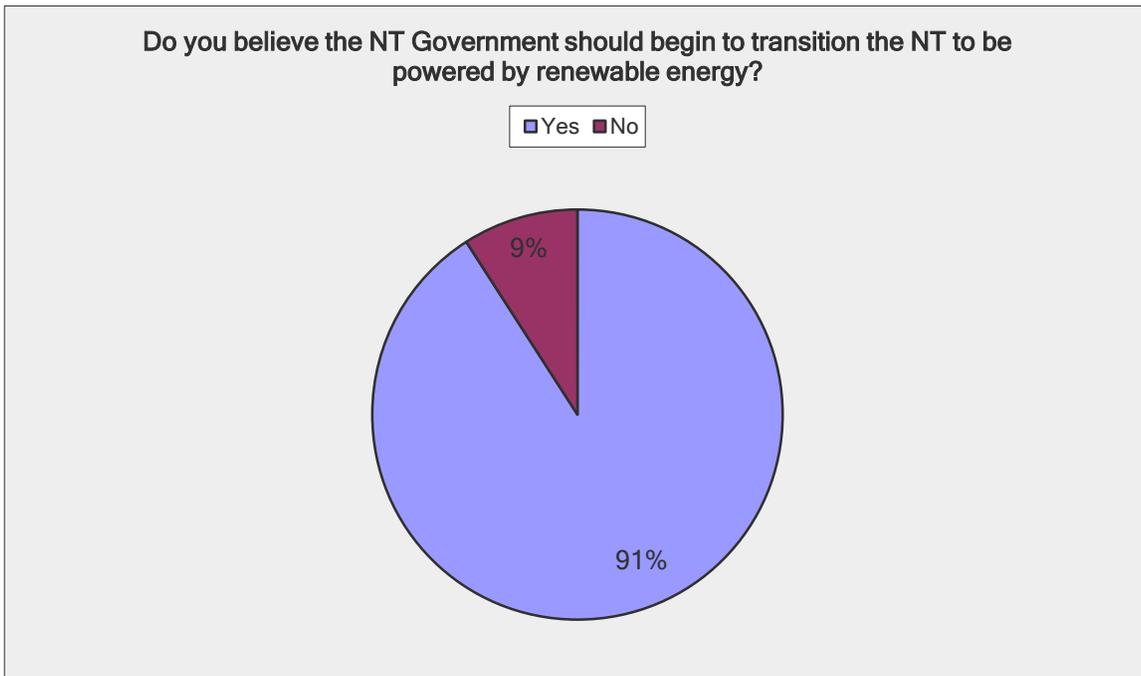
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Q8



Q11



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