**Welcome to Northland**

Northland is a small North-Western European nation with a population of around 5 million. Northland is a member state of the European Union and its economic and political structures are similar to those of other nations in the region.

**Data on Northland (provided by the Northland office of statistics)**

**Location: North-Western Europe**

**Population:** around 5 million (density about 60 per km2) – major population centres are in the south of the nation.

**Political Unions:** Member state of the European Union, NATO and UN member

**Political/Economic Structure:** Parliamentary democracy. Nation divided into constituencies with a political representative elected in each (similar to those of other EU member states in the region).

**Current energy resources:**

* Declining offshore oil and gas
* 2 nuclear power stations that the government wishes to decommission
* 2 coal and 1 gas power plant where the government has expressed an interest in to install carbon capture and storage
* Around 1.5 GW of 1st generation hydro-electric schemes
* Considerable potential for wind, wave and tidal renewables in far north of country

**Other relevant factors:**

* New N-S power lines planned
* Renewables have peak output in summer
  + Long hours sunshine, steady winds
* High per capita fuel consumption for transport and winter heating

**Carbon Footprint**

* Current Carbon Footprint 55.4 million tonnes CO2
  + Transport :14.4 MT
  + Built environment 22 MT
  + Power generation 16.6 MT, from total 10,600 MW installed capacity

**Figure 1** **Contributions to carbon footprint from transport**

* Other contributions to carbon footprint:
  + Built environment 22 MT
  + Power generation 16.6 MT, from total 10,600 MW installed capacity

**Breakdown of installed capacity:**

* 3600 MW Coal
* 1550 MW Gas
* 2652 MW Nuclear
* 1330 MW Hydro
* 1500 MW Wind

**Information on Commuting in Northland:**

* Average one way commute of 30 minutes.
* 25% of workforce have commutes of 45 minutes or more.
* 80% of urban workforce commute by car.
* 85% of rural workforce commute by car.
* The entire Northland rail network is run by a publically owned body (NorthRail). The government is in the advanced stages of planning the privatization of NorthRail which is hoped will provide an injection of cash to help modernize the nation’s aging rail network. The entire network is currently operated entirely by diesel trains.
* Under 5% of all car owners own electric cars

**To: scienceteam@northlandgreens.org.nld**

**From:** [scienceminister@northland.gov.nld](mailto:scienceminister@northland.gov.nld)

**Sent with high priority!**

**Subject: Review of grant proposals**

Dear team,

I hope you had a chance to look through the data that I sent you. We recently put out a tender for a project to develop sustainable (i.e. using a fuel which is abundant enough to generate power for at least 1000 years) power generating facilities. Please take a look at the summaries of the most suitable proposals that we have received and write a one page summary of the proposal you feel is most worthy of investment which includes figures on the impact it will have on our dependence on non-renewables and our C footprint. The chosen approach must be clean, efficient, conform to our definition of sustainable (outlined above) and must be achievable with a realistic budget.

Please make sure you include the following points in your report:

* Describe the scientific basis of your chosen proposal
* A description of the potential this project has to meet the nation’s energy demands (include any values you can calculate on how much energy this approach could produce) and the effect it will have on our dependence on non-renewables. Will it have an impact on our carbon footprint?
* The financial implications of this project – how much will it cost? What will get back in return?
* How does your chosen proposal compare to the other options?

Best wishes,

Robert Davies (Northland Science Minister)

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**Applicant 3: Northland Power**

**Title: Sustainable solid fuel for Northland**

**Project Abstract:**

The current power generation strategy of Northland makes heavy use of coal-fired power stations (current installed capacity: 3600 MW). This is partly due to our nation’s once abundant reserves of coal; of which approximately 1.4 Gt remain. We believe that coal will continue to play an important part in any future power generation strategy. Many renewable sources of power are very expensive to harness, the technologies aren’t advanced enough to make a major impact or are simply incapable of generating sufficient energy to meet the growing needs of the population of Northland.

We need to change the way we think about coal power and use this resource much more efficiently and effectively. The energy equivalent value of one ton of coal is 8000 kWh (or 29.3 GJ); if we were to use our coal reserve responsibly, we could potentially meet a significant amount of the nation’s energy requirements over a long enough period of time to consider this approach to be sustainable.

In order to address concerns about the environmental impact of continued fossil fuel combustion we propose the construction of new generation power stations which will use carbon capture and storage technology which will significantly reduce emissions of CO2 minimising the impact of this approach on the nation’s carbon footprint.

We argue that coal plays an important part in the power generation strategy of the nation alongside renewable approaches.

**Executive Summary:**

* Fossil fuels will continue to provide a vital contribution to the nation’s energy mix for the foreseeable future – ‘renewable’ energy sources alone will not meet the nation’s energy needs!
* Northland has coal reserves of around 1.4 Gt
* A new generation of coal based power stations utilising carbon capture and storage will be developed
* By working in parallel with other approaches to change Northland’s energy usage profile, we can use our existing fossil fuel resources in a sustainable manner providing energy for the next 1000 years
* See: [Carbonate chemistry for sequestering fossil carbon](http://www.annualreviews.org/doi/pdf/10.1146/annurev.energy.27.122001.083433) and [Greenhouse Gas Mitigation Policy](http://www.sciencedirect.com/science?_ob=MiamiImageURL&_cid=271090&_user=123215&_pii=S0360544296001077&_check=y&_origin=browse&_coverDate=31-Mar-1997&view=c&wchp=dGLzVlS-zSkWz&md5=ec2a46c4b2766d6a6fca8740aa262bd1/1-s2.0-S0360544296001077-main.pdf)

**Discussion Questions:**

* How does this technology work? Will carbon emissions be completely eliminated?
* How much energy does the carbon capture process use?
* What is the energy equivalent value per person per day of this process?
* The coal fired power stations in Northland produce about 12.3 Mt of CO2 each year. How much coal must they be burning to produce this? They produce about 14 TWh of electricity a year. Given the energy of combustion of coal, what does that say about the efficiency of these plants?
* How long would the current reserves of fossil fuel last at this rate of consumption?