

# **New Zealand's Next Top Engineering Scientist 2009**

## **Results and Judge's Report**

### **Judge's Report**

This was the very first year of this competition and we were pleasantly surprised with the number of entries, and the nationwide coverage of the schools participating. We hope that the participants all enjoyed the competition and learnt something in the process. The Department of Engineering Science has already got some good ideas together for a completely new and different problem for next year.

The problem specified was chosen, on purpose, to be very open-ended and challenging. The actual answer that each team came up with was not actually of great interest to the examiners. What was of interest was the process followed in coming up with the answer, and the ability of the teams to put their ideas together in a well structured document and develop and present quantitative arguments to support their conclusions. There were many different ways of attacking the problems, and many different questions that could have been addressed in developing each team's conclusions. It was of course not possible for all of the issues and questions to be addressed in the time available – this was all part of the challenge.

The entries were initially examined by two senior Engineering Science academics, one of which was the current Head of Department. A short list was then established and a third senior member of the Department carefully examined the entries on the short list. The examiners were unanimous in their choice of the overall winner, and runner ups. Each examiner used their own criteria to judge the quality of the entries based on their many years experience in problem solving. All judging was done using only the team ID number for reference. Only once the results were decided did the examiners learn the identity of the winning teams and schools.

Included below are some overall general comments along with the results list showing the winners, runners up and highly commended entries. This list is followed by some brief specific comments for each entry that did not make the short list.

### **General Comments**

Most teams did a very good job of describing their assumptions and writing their report. Many teams also gave a detailed qualitative discussion of various technology options but too little detail on the mathematical models they used to estimate the energy savings associated with each technology. A number of teams were prepared to accept various numbers and statistics they found on the internet without questioning or

verifying the numbers for themselves e.g numbers stating how much energy could be saved using Pink Batts were often quoted and the source of the reference was the website for the company selling Pink Batts. Many teams did not present enough detail on the mathematical model they used to integrate estimated energy savings and compare those with projected demand. Some teams did not account for the time component of the projected demand, i.e. that the number of houses (and energy demand) is projected to increase over time. Some teams did a good job of referencing sources, while for others the references were missing, not clear or not quoted at the place they were used in the report.

The best reports included good, clear figures summarising the results. Figures should always be clearly labelled (x-axis, y-axis, legend, caption) to make it very clear what is being plotted.

Almost all the teams came up with some very good possible solutions. If these students could convince their families and friends to adopt their suggestions, then New Zealand's energy footprint would be greatly reduced!

### **Overall Winner (\$6000)**

Team 1032 Kristin School

### **Runners Up (\$2500 each)**

Team 1027 James Hargest College

Team 1051 Nelson College

### **Highly Commended**

Team 1006 Botany Downs Secondary School

Team 1008 Botany Downs Secondary School

Team 1023 Hillcrest High School

Team 1039 Macleans College

Team 1047 Mt Maunganui College

Team 1057 Queen Margaret College

Team 1060 Rangitoto College

Team 1091 Trident High School

## **Specific Comments:**

1001: I would have liked to see a bit more mathematical analysis supporting the integration of energy savings to draw the final conclusions. The report did not consider the time component, i.e. number of houses (and energy demand) is projected to increase over time.

1002: The report needs more discussion of the mathematical models and analysis used (especially for quantifying the savings from any of the proposed strategies), rather than just the qualitative discussion.

1003: A good analysis and report, but did not consider the time component, i.e. number of houses (and energy demand projected to increase over time).

1004: The report is quite thorough, but the outcome of not needing a power station for 15000 years is not realistic and indicates some problem with the modeling approach. Always perform a reality check on your answers!

1005: The report needs more discussion of the mathematical models and analysis used, rather than just the qualitative discussion.

1007: A good discussion of possible energy savings solution; however, the report focused too much on qualitative measures to reduce energy without an accompanying mathematical analysis.

1009: A good analysis and report, but did not consider the time component, i.e. number of houses (and energy demand projected to increase over time).

1010: I would have liked to see more detail on the mathematical analysis performed to compute the savings of possible energy solutions and the overall mathematical model used to integrate the analysis.

1011: I would have liked to see more detail on the mathematical analysis performed to compute the savings of possible energy solutions.

1012: I would have liked to see more detail on the mathematical analysis performed to compute the savings of possible energy solutions.

1013: I would have liked to see more detail on the mathematical analysis performed to compute the savings of possible energy solutions.

1014: I would have liked to see more detail on possible energy solutions and the mathematical analysis performed to compute the savings.

1015: I would have liked to see more detail on possible energy solutions and the mathematical analysis performed to compute the savings.

1016: The mathematical model and analysis used to compute the stated energy savings from each possible technology solution was not described in enough detail.

1017: A good discussion of possible energy savings solution; however, the report focused too much on qualitative measures to reduce energy without an accompanying mathematical analysis.

1018: A good discussion of possible energy savings solution; however, the report focused too much on qualitative measures to reduce energy without an accompanying mathematical analysis.

1019: A good discussion of possible energy savings solution; however, the report focused too much on qualitative measures to reduce energy without an accompanying mathematical analysis.

1020: I would have liked to see more detail on possible energy solutions and the mathematical analysis performed to compute the savings.

1021: A good analysis and report, but did not consider the time component, i.e. number of houses (and energy demand projected to increase over time).

1022: A good analysis and good report. I would have liked to see a bit more mathematical analysis supporting how the possible solutions could potentially translate into energy savings.

1024: A good comprehensive discussion of possible energy savings solution; however, the report focused too much on qualitative measures to reduce energy without an accompanying mathematical analysis.

1025: The report focused on light bulb solutions. It would be nice to see a more comprehensive discussion and analysis of the problem.

1026: A good analysis and report. The report would have been better if some plots were included to show some of the analysis results and trends.

1028: A good analysis and report, but did not consider the time component, i.e. number of houses (and energy demand projected to increase over time).

1029: A good analysis and good report. I would have liked to see a bit more mathematical analysis supporting how the possible solutions could potentially translate into energy savings.

1030: A good analysis and report, but did not consider the time component, i.e. number of houses (and energy demand projected to increase over time).

1031: The report would be better if it included more explanation and graphs showing how some of the calculations were done (e.g. the extrapolation to compute future energy usage). The final graph is not well presented – there does not seem to be a reason to extend the x-axis so far. The shape of the plot also does not make much sense (but it could look strange because of the scale).

1033: A good analysis and good report. I would have liked to see a bit more mathematical analysis supporting the integration of energy savings to draw the final conclusions.

1034: A good comprehensive discussion of possible energy savings solution; however, the report focused too much on qualitative measures to reduce energy without an accompanying mathematical analysis.

1035: A good analysis and good report. I would have liked to see a bit more mathematical analysis supporting the integration of energy savings to draw the final conclusions.

1036: A good comprehensive discussion of possible energy savings solution; however, the report focused too much on qualitative measures to reduce energy without an accompanying mathematical analysis.

1037: The electricity consumption trends over time are different than those gathered from other sources. The single dip from 2007 to 2008 could be misleading. I would advise using multiple sources or fitting a more general trend line over a longer period. The discussion of possible solutions is good but the overall mathematical model used to integrate all the savings was not discussed in enough detail.

1038: A good analysis, but did not describe the mathematical analysis for the final step to compute the time needed until a new power station is required.

1040: The mathematical model and analysis used to compute the stated energy savings from each possible technology solution was not described in enough detail.

1041: The mathematical model and analysis used to compute the energy savings was not described in enough detail. Other technologies beyond solar water heating would likely be necessary, especially in the longer term.

1042: Provided details on possible solutions, but could have provided more mathematical analysis on how those solutions could potentially translate into energy savings.

1043: A good introduction but no executive summary and a lack of justification for the numbers used.

1045: Well laid out, lots of numbers used without justification. Incorporated some modeling into the report.

1046: References need to be cited when numbers etc are presented in the text. Some good pictures and some good use of referencing.

1048: References not tied into the text. A lack of critical analysis and a number of unjustified statements made.

1050: This report needed some proofing as it contained a number of typos. A number of unsubstantiated comments made.

1052: A good initial start at the problem, but a more detailed analysis was needed. Some of the numbers used in the report were not justified.

1053: Some good points made and well justified. Well laid out. A bit light on quantitative analyses.

1054: Some good calculations/modeling/figures e.g. around the Solar Water Heaters. Some novel ideas presented. The report should have cited references.

1055: Team members examined the limitations of the question asked, and used common sense to continue. Well done. Had a well-stated list of things to find out/investigate. Report fairly well laid out.

1056: A nice summary. Poor referencing and a lack of validation of some of the numbers used. A good table of options, but a lack of modeling. The conclusion on page 9 contradicts some of what was said in the Summary.

1058: Report focused on cost, not energy. There was a lack of justification of the numbers used.

1059: A short report. References were not integrated into the text, and there was a lack of justification for the numbers used.

1061: A lack of references for the data used. Rather brief, with no summary.

1062: A good attack on the problem. A lack of justification of the numbers used, and no description of the assumptions made.

1063: A lack of justification for the numbers used, so very difficult to validate or check the analysis.

1064: A novel approach, but rather one-dimensional. Need the references to be cited where they are used.

1065: The result was not well-argued. A number of causal statements were made that lacked robustness. Variables were not defined in some equations.

1066: A lack of detail. A lack of justification for some of the statements made and numbers used.

1067: Relied on figures quoted from various references, but did not validate or critically examine.

1068: A reasonable approach to the problem. Some of the equations created were not justified at all.

1069: Lack of labels on Figures. Some incomplete sentences. Not very well laid out. It appears the team members ran out of time.

1070: Showed lots of promise with good definitions of key entities and some useful calculations. Got bogged down in a cost-focus, not an energy focus.

1071: Did not justify the final answer given very well. Numbers used were not referenced.

1072: Very brief. Outlined how to investigate the problem, but did not actually investigate the problem. Appeared to either be overwhelmed by the problem, or ran out of time once they had figured out how to investigate the problem.

1073: Showed promise and discussed lots of options. Did not calculate projected savings.

1074: Mainly focused on light bulbs. What was presented in the report was good, however the team did not go deep enough into the problem.

1075: The report had a very narrow focus. The team got a little off track from the original question.

1076: Some good diagrams. However, the team did not really discuss where the heat losses occur in a house.

1077: A good summary. A number of unjustified/unreferenced figures and numbers used.

1078: A number of arguments/statements made which were not justified. Also went off topic a bit in places.

1079: Well laid out. Would have benefited greatly from more quantified analyses. Some of the calculations not explained.

1080: A disjointed report which had a few typos. The references need numbering and citing in the correct locations in the report.

1081: Good figures but a lack of detail as to how yellow line calculated. A lack of references cited at key places.

1082: A lack of details given on how the results are calculated. Cite sources when they used.

1083: A bit brief. A lack of justification for many of the numbers used. Poor referencing.

1084: Well laid out. Reasonable analysis, but a lack of justification for the numbers used. The only report that contained a joke at the end.

1085: Well laid out with some nice calculations. An interesting conclusion. A lack of justification for some of the numbers used.

1086: Did not look at home insulation. An interesting conclusion – the only one to recommend building a nuclear power station!

1087: A focus on cost, not energy. A lack of justification of the numbers used.

1088: Interesting range of options considered. A lack of detail of where losses occur in houses now. No references and no justification given for the numbers used.

1089: Very brief. No references and no justification given for the numbers used.

1090: A bit brief. Further justification of numbers used needed.

1092: Some nice calculations and a reasonable report.

1093: Very brief with no references.

1094: A reasonable report, but it could have been laid out better. No information given on the source of data for the graphs, and a lack of labels on the graphs.

1095: A lack of detailed calculations and a lack of justification for the numbers used.

1096: Nicely laid out. It was a pity that no calculations were given to justify the answer.

1097: Very good use of references. No final numbers for the total savings given – perhaps the team ran out of time?

1098: Information given was for a single house, so not final numbers given for total energy savings or how this compares with the output of a power station.