Modeling the Efficiency of Alternative Resources

New Mexico
Supercomputing Challenge
Final Report
April 4th, 2007

Team # 021
Bosque School

Team Members

Kelly Dickey
Livingston Maclake

Sponsoring Teacher

Thomas Allen

Table of Contents

Project Statement ……………………………………………………………….. iii

Executive Summary ………………………………………………………………iii

Background Information …………………………………………………………iii

Our Method ...……………………………………………………………………..iv

Our Results………………………………………………………………………...iv

Our Conclusions …………………………………………………………………. iv

Our Big Achievements …………………………………………………………... v

Acknowledgements ……………………………………………………………….v

Appendix I: Our Old Code ………………………………………………………vi

Appendix II: Our Old Flowchart ………………………………………….....vii

Appendix III: Our New Code ……………………………………………………viii

Appendix IV: Our New Flowchart ………………………………………………ix

Appendix V: Mathematical Model ………………………………………………x

Appendix VI: Graphs of Our Results……………………………………………xi

Resources ………………………………………………………………………….xii

Project Statement

To model the cost efficiency of an alternative resource by using the program C++ as well as other resources as the World Wide Web, books relating to our topic and other resources.

Executive Summary

With our energy crisis going on, we need to find ecologically friendly, alternative methods of producing power. Alternative resources, including wind, hydroelectric, solar, and geothermal energy among others, are more environmentally conscience than conventional means. If the country or even individual households were to set up solar panels, or windmills, the amount of energy consumed would drop significantly. We therefore are trying to show the benefits of alternative methods of energy production.

Thusly, our project is to model the efficiency of an alternative energy resource, to determine the benefits. Because we chose to model in C++, which was new to the both of us, we were only able to create one model. We settled on modeling the cost efficiency of solar power, as the price tag of these renewable resources are the most influential factor for most household.

Background Information

Alternative, or renewable, Resources are alternative methods for producing power that are more beneficial for the environment than that of the current methods. Such effects as global warming and pollution produce a call for finding more economically friendly methods of power. Many households today already use solar power, and wind turbines are becoming more and more common. Many architects design houses to use passive solar heating, which uses sunlight to heat the house directly. As for solar and other alternative resources being used as public power sources, the planet has a ways to go. More wind farms and some solar plants are popping up around our country, while technology and research on these resources continues to get better. We are now placing wind turbines in the ocean, as these plants take up a lot of space. Solar cells are still rather expensive and less widely used by public power sources.

Our Method

We began the year on what we believed was a good start. We chose a problem that we believed we could accurately model, given our skill level of coding in C++. From participating in the challenge in years past we knew not to choose a problem that was to vast. However, with our little knowledge of the program we chose to code in, we ended up spending much of the year simply learning to code. We believe however that we were able to accurately model the cost efficiency of using solar power in one household, given predicted inflation rates of energy prices.

Our Results

Our model shows that the cheaper solar cells, even with high inflation prices will take over 10 years to pay off, assuming you live in a climate with an average of 12 hours of sunlight a day. We found a one Kilowatt solar cell, at a price of 8 dollars a watt will take 15 years to pay for itself, with a 4 percent inflation rate of energy prices. Without any inflation at all, it will take around 20 years to pay for itself in energy payback. This is however, without looking at specific climates or maintenance costs over time.

Our Conclusions

Upon analyzing our results, we realized how not cost effective a solar power system in the average household may seem. Solar Cell systems are definitely a long term investment. However, looking at our country’s current energy situation, solar cells are a good alternative option. They are also environmentally friendly, and a good ecological investment.

Our Big Achievement

Our teams overall most significant achievement is having accurately modeled the basic cost efficiency of solar cell power production. Our biggest personal achievement however would be learning to program in C++ which was a new language for the both of us. We really learned a lot in the challenge this year, not only about alternative resources but a new program as well.

Acknowledgements

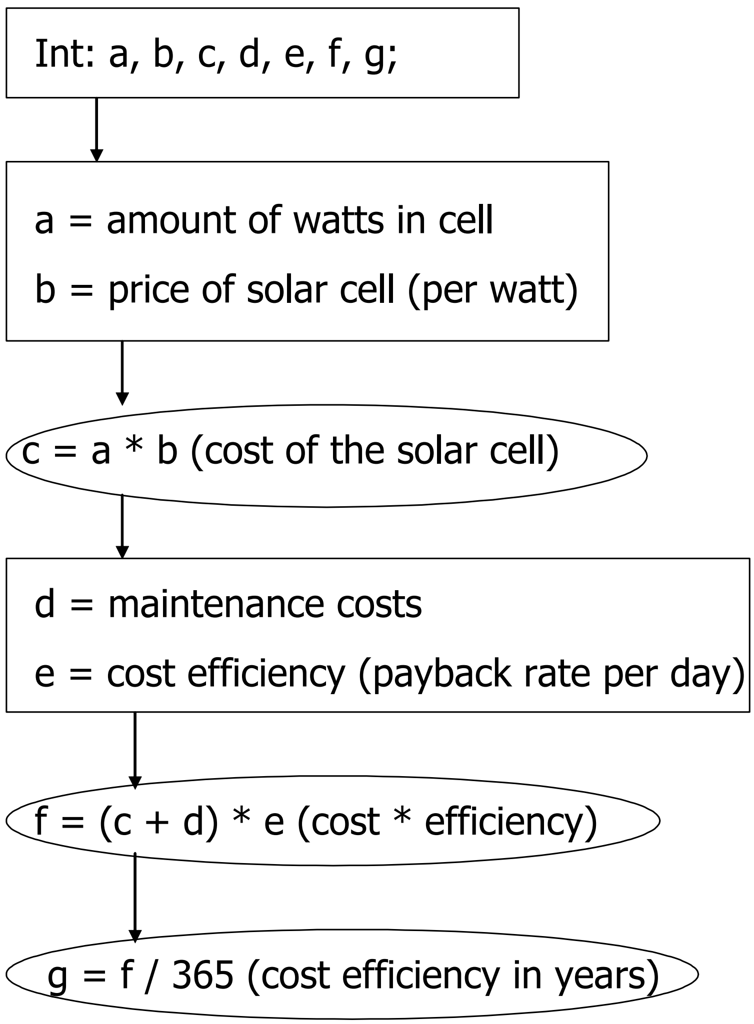
We would like to acknowledge our fellow teams from Bosque School for being such a great support system and aid for us. We would also like to thank our sponsoring teacher, Mr. Allen, for keeping us motivated throughout the year. Unfortunately we have no mentor, but we would like to thank Victor Kuhns for his feedback on our Interim report as well as his advice during our February Evaluations.

Appendix I: Our Old Code
Note: This was our code as of our February Evaluations.

```
#include <iostream>
using namespace std;

int main()
{
   int a, b, c, d, f, g;
   double e;
   int x;


   a = 1000;   //1000 watt solar cell
   b = 8;     // price of solar cell: between $7 - $9 per watt
   cout << "Price of solar cell: ";
   c = a * b;  // price of the solar cell
   cout << c;

   d = 0;      // maintenance costs
   e = 0.8;   // cost efficiency (payback rate per day)
   cout << " Time it will take to pay back the solar cell in days: ";
   f = (c + d) * e;  // the amount of days it will take to payback
   cout << f;
   cout << "  Time it will take to pay back the solar cell in years: ";
   g = f  / 365;   // the amount of years it will take to pay back
   cout << g;
   cin >> x;

   return 0;
}
```

Appendix II: Our Old Flowchart

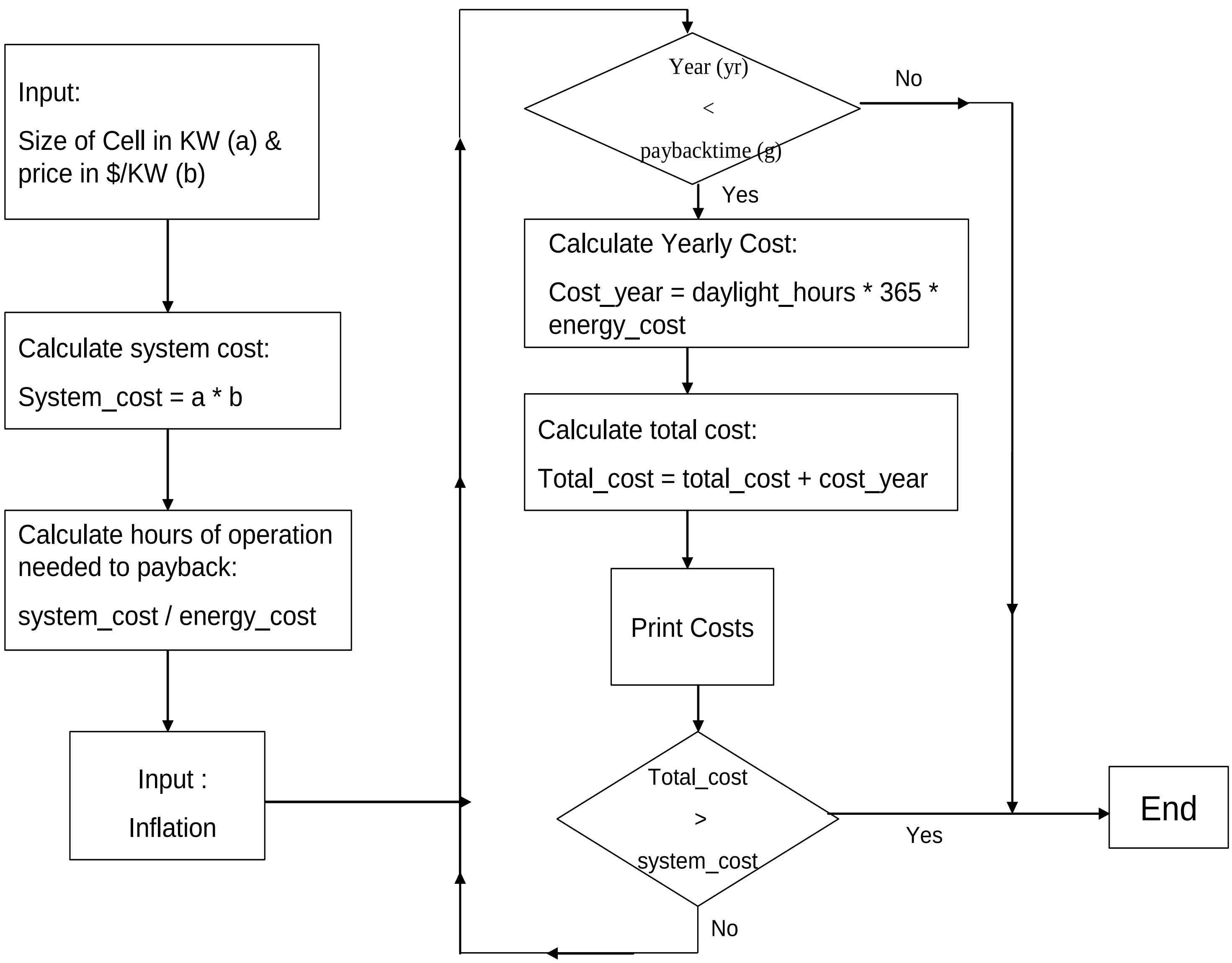
Note: This was the flowchart of our code from the February Evaluations.



Appendix III: Our Current Code

```
#include <iostream>
#include <cstdlib>
#include <ctime>

using namespace std;

int main()

{
long double a, b, system_cost, daylight_hours, energy_cost, f, g, h, I;
long double yr, cost_year, total_cost;
int x;

cout << "KiloWatts in Solar Cell:";
cin >> a;
cout << "Price of  solar cell per KiloWatt: ";
cin >> b;                                  //  between $7000 and $9000 per KW
cout << endl;
system_cost = a * b;                      // price of the solar cell: $/KW
    cout << " cost of system = " << system_cost << endl;
daylight_hours = 12;                     //average # of hrs of sunlight per day: Hrs/day
energy_cost = 0.0951;                    // cost of energy: $/KWHr
    cout << "Time it will take to pay back: ";
    f = (system_cost / energy_cost);  //Hrs of operation
    cout << f ;
    cout << " hours of operation." << endl;
        g = (f / daylight_hours) / 365; // Hrs of op. / Hrs/day / days/year
        cout << g << " years." << endl;
    cout << "Amount that has to be paid back ";
    h = (energy_cost * daylight_hours * (365/12));
    cout << h << " dollars per month." <<endl;
  cout << "Percent of Inflation per year:";
  cin >> I;                              //inflation % of energy cost
yr = 0;
total_cost = 0;
  while (yr < g){;                         //while current year less than total
        yr = yr + 1;
        cost_year = daylight_hours * 365 * energy_cost ;  // Hrs/day * day/year *
$/KWHr = cost_year
        cout << "  $ per KWHr  " << energy_cost <<  "  year = " << yr;
        cout << "  cost = $" << cost_year;
        energy_cost = energy_cost * (1 + I / 100);
        total_cost = total_cost + cost_year;
        cout << "  total cost = $" << total_cost << endl;
        if (total_cost > system_cost){;
           g = yr;
           cout << "system cost payed back in " << yr << " years ";
           cout << "with a " << I << "% energy cost Inflation" << endl;
                            }
                }
        cout << endl;

    cin >> x;

    return 0;
}
```

Appendix IV: Our Current Flowchart

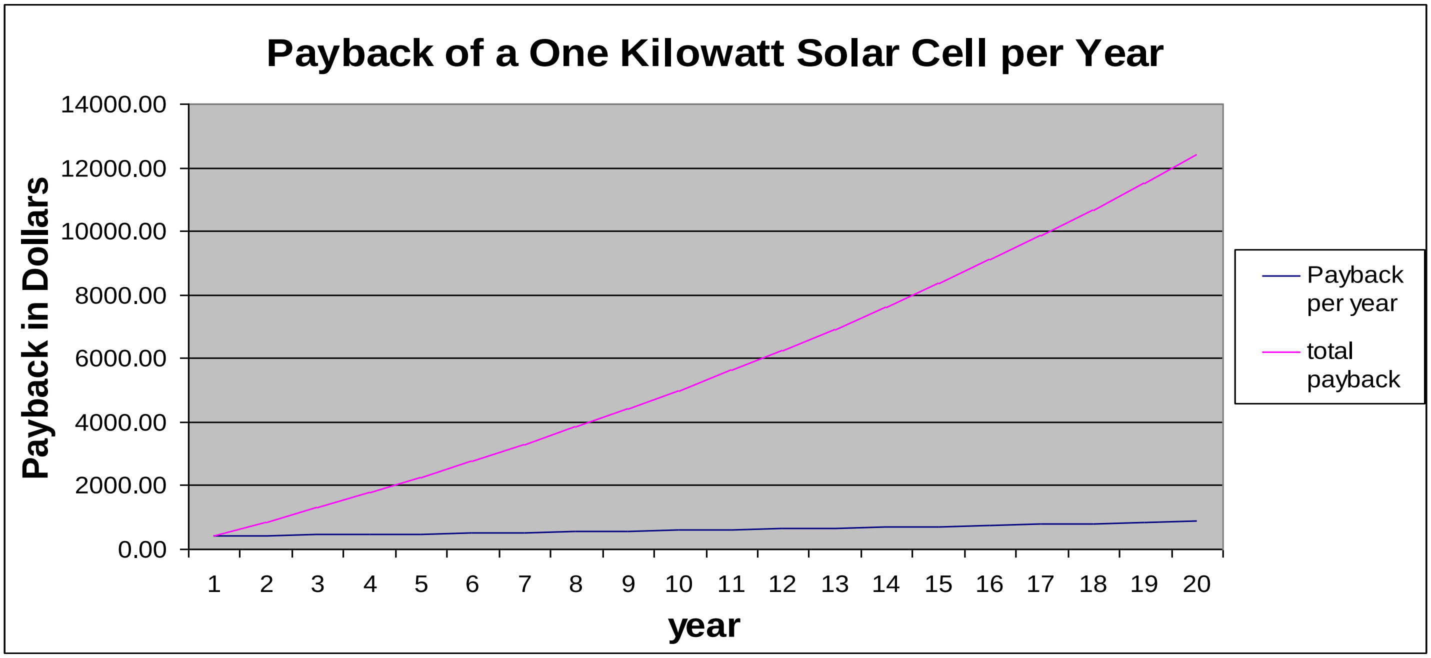


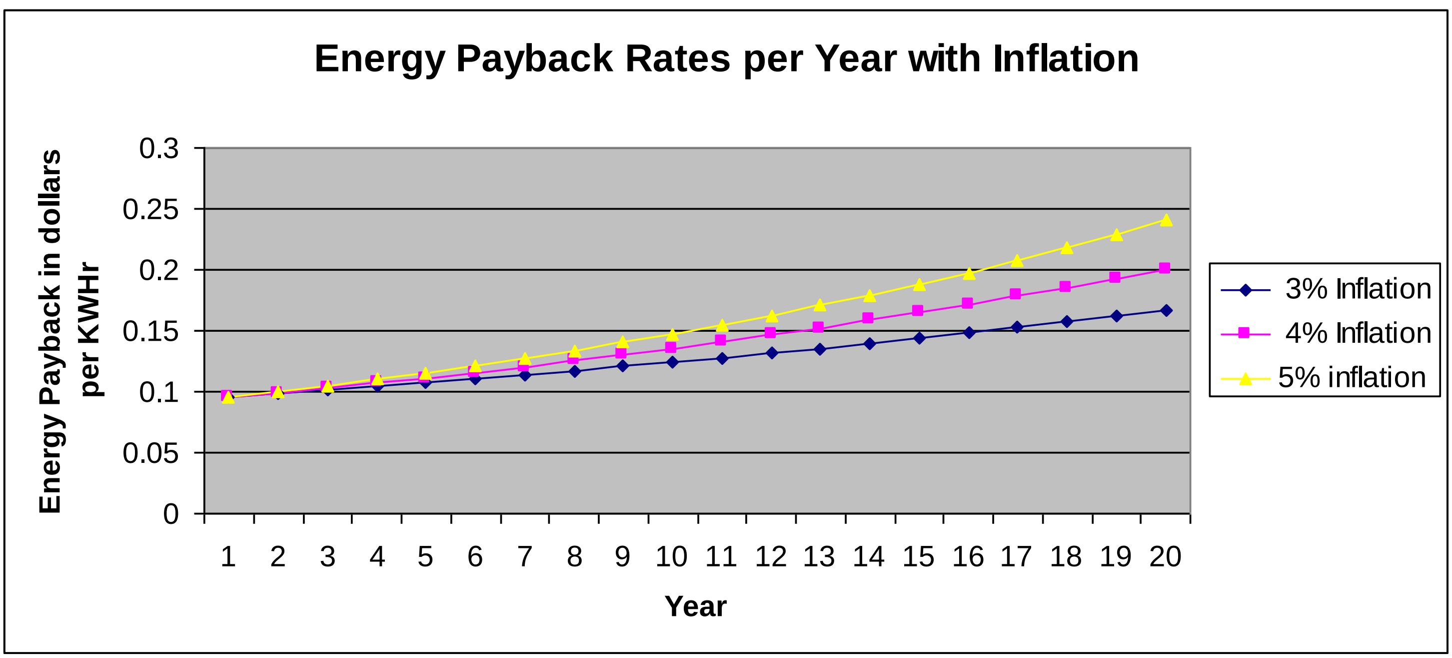
Appendix V: Mathematical Model

inflation rates (%):	1.0500	
	1.0400	daylight hours: 12
	1.0300	

year	3% Inflation	4% Inflation	5% inflation	Payback per year	total payback
1	0.0951	0.0951	0.0951	416.54	416.54
2	0.097953	0.0989	0.0999	433.20	849.74
3	0.10089159	0.1029	0.1048	450.53	1300.27
4	0.103918338	0.1070	0.1101	468.55	1768.81
5	0.107035888	0.1113	0.1156	487.29	2256.10
6	0.110246964	0.1157	0.1214	506.78	2762.89
7	0.113554373	0.1203	0.1274	527.05	3289.94
8	0.116961005	0.1251	0.1338	548.14	3838.08
9	0.120469835	0.1302	0.1405	570.06	4408.14
10	0.12408393	0.1354	0.1475	592.86	5001.00
11	0.127806448	0.1408	0.1549	616.58	5617.58
12	0.131640641	0.1464	0.1627	641.24	6258.82
13	0.13558986	0.1523	0.1708	666.89	6925.71
14	0.139657556	0.1583	0.1793	693.57	7619.28
15	0.143847283	0.1647	0.1883	721.31	8340.59
16	0.148162701	0.1713	0.1977	750.16	9090.75
17	0.152607582	0.1781	0.2076	780.17	9870.91
18	0.15718581	0.1852	0.2180	811.37	10682.29
19	0.161901384	0.1927	0.2289	843.83	11526.12
20	0.166758426	0.2004	0.2403	877.58	12403.70

Appendix VI: Graphs of Our Results





Resources

Unknown, author."Solar System Costs." Solar System Basics. Febuary 23, 2006. Northern Arizona Wind and Sun. 27 Nov. 2006 <http://www.solar-electric.com/solar_system_costs.htm>.

"Frequently Asked Questions." About Renewable Energy. American Solar Energy Society. 1 Dec. 2006 <http://www.ases.org/aboutre/faq.htm>.

"Operation and Wind Costs for Wind Turbines." wind power. May 12, 2003. Danish Wind Industry Association. 6 Dec. 2006 <http://www.windpower.org/en/tour/econ/oandm.htm>.

"Sustainability Report 2005." My Environment. 2005. Power New Mexico. 4 Dec. 2006 <http://www.pnm.com/environment/sustain_report_05.htm>.

"Solar Power." Alternative Energy Sources. University of Utah. 30 Nov. 2006 <http://home.utah.edu/~ptt25660/solar.html>.