

# Fighting Climate Change



**20% Energy Use Reduction**

**Right Now**



**The NeoClimate Organization**

**Fairfax, Virginia**

April 2008

<http://www.neoclimate.org>

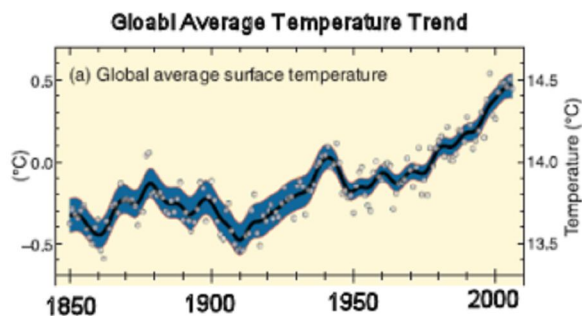
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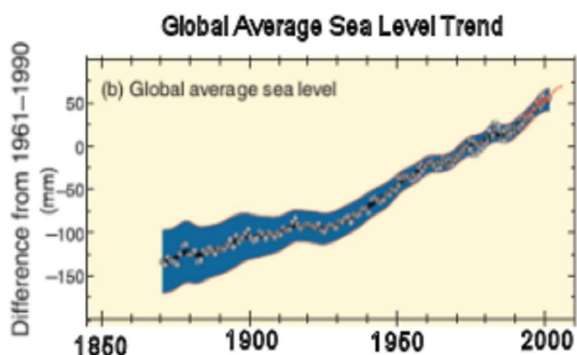
# 1. Observed Climate Changes

Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperature, widespread melting of snow and ice and rising global sea level.

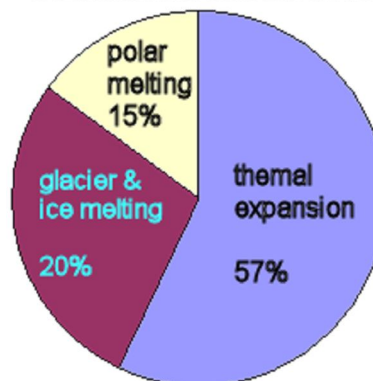
Eleven of the last twelve years (1995-2006) rank among the twelve warmest years since 1850. The temperature increase is widespread over the globe and is greatest at higher northern latitudes. Average Arctic temperatures have increased at almost twice that global average rate in the past 100 years. While land regions have warmed faster than the oceans., observations since 1961 show that the global oceans have warmed to depths of at least 3000 meters and the ocean has taken up over 80% of the heat being added to the climate system.



Increases in sea level are consistent with warming. Global sea level rose at an average rate of 1.8 mm per year over 1961 to 2003 and at an average rate of about 3.1 mm per year over the period from 1993 to 2003. Whether this faster rate for 1993 to 2003 reflects decadal variation or an increase in the longer-term trend is unclear. Since 1993, thermal expansion of the oceans has contributed about 57% to the total sea level rise, with the melting of glaciers and ice caps contributing about 28% and losses from polar ice sheets contributing the remainder.



Contribution to Sea Level Rise



Observed decrease in snow and ice extent are also consistent with warming. Satellite data since 1978 show that annual average Arctic sea ice extent has shrunk by 2.7% per decade, with larger decreases in summer of 7.4% per decade. Mountain glaciers and snow cover on average have declined in both hemispheres.

Some extreme weather events have changed in frequency and intensity over the past 50 years. For example, observations have enhanced the likelihood that:

- cold days, nights and frosts have become less frequent while hot days and nights have become more frequent.
- heat waves have become more frequent over most land areas.
- frequency of heavy precipitation events (or proportion of total rainfall from heavy falls) has increased over most areas.
- incidence of extreme high sea levels has increased at a broad range of sites worldwide since 1975.
- intense tropical cyclone activity in the North Atlantic has increased since about 1970.

Average Northern Hemisphere temperature during the second half of the 20<sup>th</sup> century were very likely higher than any other 50-year period in the last 500 years and likely the highest in at least the past 1300 years.

# 2. Effects of Climate Changes

Observational evidence from all continents and most oceans show that many natural systems are being affected by regional climate changes. Examples are:

- enlargement and increased numbers of glacier lakes.

- increased ground instability in permafrost regions and rock avalanches in mountain regions.
- changes in some Arctic and Antarctic ecosystems.
- increased runoff and earlier spring peak discharge in many glacier- and snow-fed rivers.
- earlier timing of spring events, such as leaf-unfolding, bird migration and egg-laying.
- poleward and upward shifts of plant and animal species.
- shifts in range and changes in algal, plankton and fish abundance in high-latitude oceans.
- earlier fish migration in rivers.

### 3. Causes of Climate Change

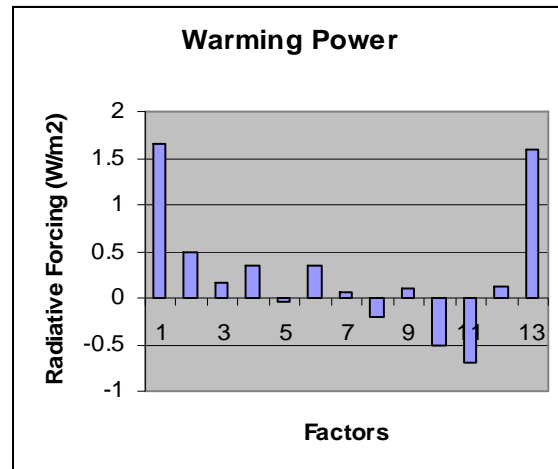
Changes in the atmospheric concentrations of greenhouse gases and aerosols, land cover and solar radiation alter the heat balance of the climate system and are drivers of climate change. They affect how the radiation is absorbed and reflected within the atmosphere and at the Earth's surface. The resulting positive or negative changes in the heat balance due to these factors are expressed as radiative forcing, and their collective effects dictate the direction of climate change.

The concentration of CO<sub>2</sub> in the atmosphere increased from a pre-industrial value of about 280ppm (part per million) to 379ppm in 2005. The annual CO<sub>2</sub> concentration growth rate has been accelerating in the past 10 years. The effect of the increase in CO<sub>2</sub> concentration on the warming, as expressed in terms of radiative forcing, is +1.66 W/m<sup>2</sup>. When combined with other greenhouse gases, such as methane and Nitrous Oxide, the warming effect is +2.3 W/m<sup>2</sup>. Furthermore, the the CO<sub>2</sub> radiative forcing increased by 20% from 1995 to 2005, the largest change for any decade in at least the last 200 years.

Human contribution to aerosols (primarily sulphate, organic carbon, black carbon, nitrate, and dust) together produce a cooling effect, with a total direct forcing of -0.5 W/m<sup>2</sup>, and an indirect cloud reflection forcing of -0.7 W/m<sup>2</sup>.

In comparison, changes in solar radiation since 1750 are estimated to have caused a small radiative forcing of +0.12 W/m<sup>2</sup>.

As shown in Table 1, the net man-made contribution to climate warming is a positive 1.60, while the contribution from changes in solar radiation is a positive 0.12. In other word, scientific calculations show that man-made warming effect is more than 13 times that caused by changes in solar radiation.



**Table 1 Contribution to Warming**

Factor #	Factor Name	Warming Power
1	CO <sub>2</sub>	+1.66
2	CH <sub>4</sub>	+0.48
3	N <sub>2</sub> O	+0.16
4	Halocarbons	+0.34
5	Stratospheric Ozone	-0.05
6	Tropospheric Ozone	+0.35
7	CH <sub>4</sub> Water Vapor	+0.07
8	Land Reflectivity	-0.20
9	Black Carbon on Snow	+0.10
10	Direct Effect of Aerosols	-0.50
11	Aerosols in Cloud	-0.70
12	<b>Solar Radiation Change</b>	<b>+0.12</b>
13	<b>Net Man-Made Changes</b>	<b>+1.60</b>

According to the most recent report by the IPCC, the observed widespread warming of the atmosphere and ocean, together with ice mass loss, support the conclusion that it is *extremely unlikely* that global climate change of the past 50 years can be explained without external forcing and *very likely* that it is not due to known natural causes alone. During the period, the sum of solar and volcanic forcings would likely have produced cooling, not warming. The observed pattern of tropospheric warming and stratospheric cooling is very likely due to the combined influences of greenhouse gas increases and stratospheric ozone depletion. It is likely that increases in greenhouse gas

concentrations alone would have caused more warming than observed because volcanic and anthropogenic aerosols have offset some warming that would have otherwise taken place.

## 4. What Will Happen Next?

According to the IPCC report, for the next two decades a warming of about 0.2 °C per decade is projected for a range of emission scenarios. Even if the concentrations of all greenhouse gases and aerosols had been kept constant at year 2000 levels, a further warming of about 0.1 °C per decade would be expected. Continued greenhouse gas emissions at or above current rates would cause further warming and induce many changes in the global climate system during the 21<sup>st</sup> century that would be *very likely* be larger than those observed during the 20<sup>th</sup> century.

There is a risk of abrupt or irreversible changes caused by the warming. Partial loss of ice sheets on polar land and/or thermal expansion of seawater over long time scales could imply meters of sea level rise, major changes in coastlines and inundation of low-lying areas, with greatest effects in river deltas and low-lying islands. Current models project that such changes occur over very long time scales (millennial) if a global temperature increase of 1.9 to 4.6 °C were to be maintained. Rapid sea level rise on century time scales cannot be excluded.

### Risk of Delayed Action

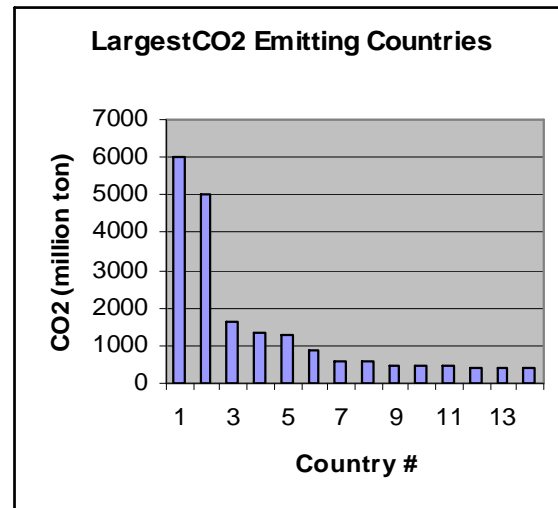
The IPCC report points out that many impacts of global warming can be reduced, delayed, or avoided by mitigation. Mitigation efforts and investments over the next two to three decades will have a large impact on opportunities to achieve lower stabilization levels. Delayed emission reductions significantly constrain the opportunities to achieve lower stabilization levels and increase the risk of more severe climate change impacts.

## 5. What Actions Are Being Taken?

### 5.1 Kyoto Protocol

Organizations and governments around the world have recognized the dangers posted by global climate change and have taken actions to reduce greenhouse gas emission. The most comprehensive measure at

the international level is the Kyoto Protocol. This international agreement sets legally binding targets and timetables for cutting the greenhouse-gas emissions of industrialized countries.



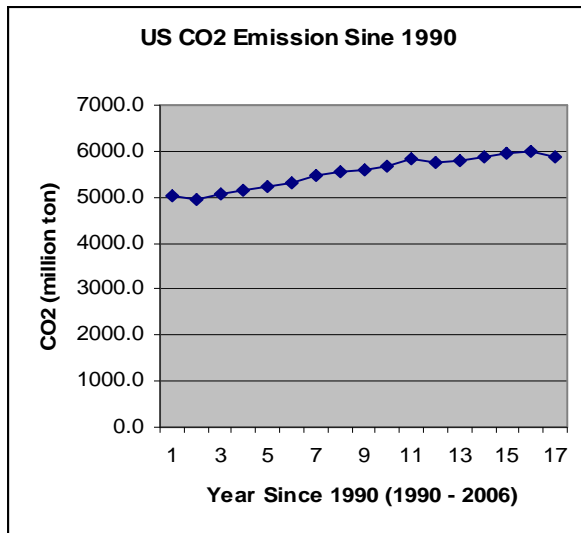
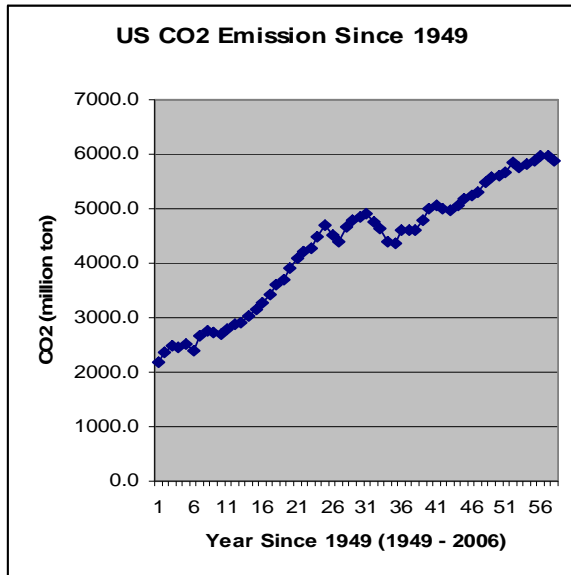
**Table 2 Total & Per Person (PP) CO<sub>2</sub> Emission**

#	Country Name	Total	PP
1	United States	5988	20.4
2	China	5010	3.8
3	Russia	1617	11.2
4	India	1343	1.2
5	Japan	1286	10.1
6	Germany	886	10.7
7	Canada	593	18.5
8	United Kingdom	562	9.4
9	Italy	490	8.5
10	South Korea	466	9.8
11	Mexico	438	4.2
12	South Africa	437	9.2
13	Iran	434	6.3
14	France	417	6.9

**Note:** Total in million tons and PP in tons. Data are for year 2004 and based on UNSD Millennium Development Goals Indicators database.

The Protocol's major feature is that it has mandatory targets on greenhouse-gas emissions for the world's leading economies which have accepted it. These targets range from -8% to +10% of the countries' individual 1990 emissions levels "with a view to reducing their overall emissions of such gases by at least 5% below existing 1990 levels in the commitment period 2008 to 2012." Future mandatory targets are expected to be established for "commitment periods" after 2012. These are to be negotiated well in advance of the periods concerned.

The Kyoto Protocol now covers more than 170 countries globally and more than 60% of countries in terms of global greenhouse gas emissions. As of December 2007, the US and Kazakhstan are the only signatory nations not to have ratified the act.



**Note:** data from Energy Information Administration of US Department of Energy

## 5.2 US Federal Level Legislation

Currently there is no national level legislation on greenhouse gas reduction. Many bills have been introduced; the most recent one is the America's Climate Security Act of 2007 introduced by Lieberman and Warner. The bill was approved by the Environment and Public works Committee by a

11-8 vote on December 5, 2007. No timetable has been announced as to when the bill might reach the full senate for debate.

The Lieberman-Warner bill would impose emission caps on electricity utility, transportation, and manufacturing. Its staged targets include capping emission at 5200 million metric tons of CO<sub>2</sub> equivalent, which is the estimated 2005 levels from covered sources, between 2005 and 2012; reduction of 2% per year between 2012 and 2020, which would result in a 15% reduction below 2005 levels; further reduction between 2020 and 2050 would result in a 70% drop from 2005 levels.

## 5.3 US Regional Climate Initiative

In the absence of a federal climate regulation, several regional initiatives have been established to reduce greenhouse gas emission in the United States. Some prominent ones include the Regional Greenhouse Gas Initiative in the Northeast, the Midwestern Greenhouse Gas Accord in the Mid-West, and the Western Climate Initiative in the West.

### 5.3.1 Regional Greenhouse Gas Initiative (RGGI)

RGGI is a cooperative effort by Northeastern and Mid-Atlantic states to reduce carbon dioxide emissions. Central to this initiative is the implementation of a multi-state cap-and-trade program with a market-based emissions trading system. The proposed program will require electric power generators in participating states to reduce carbon dioxide emissions. Currently, ten states that include Connecticut, Delaware, Maine, New Hampshire, New Jersey, New York, Vermont, Massachusetts, Rhode Island, and Maryland are participating in the RGGI effort. In addition, the District of Columbia, Pennsylvania, the Eastern Canadian Provinces Secretariat, and the province of New Brunswick are observers in the process.

### 5.3.2 Western Climate Initiative

The Western Climate Initiative is a collaboration which was launched in February 2007 by the Governors of Arizona, California, New Mexico, Oregon and Washington to develop regional strategies to address climate change. WCI is identifying, evaluating and implementing collective and cooperative ways to reduce greenhouse gases in the region.

Current members include Arizona, British Columbia, California, Manitoba, Montana, New Mexico, Oregon, Utah, and Washington. Other U.S. and Mexican states and Canadian provinces have joined as observers.

On August 22, 2007, WCI published its Statement of Regional Goals in which it states that The WCI regional gas emission reduction goal is an aggregate reduction of 15% below 2005 levels by 2020.

### 5.3.3 Midwestern Greenhouse Gas Accord

The Midwestern Greenhouse Gas Accord was signed by Governors of six Midwestern U.S. states and the Premier of Manitoba on November 15, 2007. Signatories to the Accord are the US states of Minnesota, Wisconsin, Illinois, Iowa, Michigan, Kansas, and the Canadian Province of Manitoba. Observers of the Accord are Indiana, Ohio and South Dakota. The accord aims to establish greenhouse gas reduction targets and to develop a market-based and multi-sector cap-and-trade mechanism to help achieve those reduction targets. It will also establish a system to enable tracking, management, and crediting for entities that reduce greenhouse gas emissions; and to develop and implement additional steps as needed to achieve the reduction targets, such as a low-carbon fuel standards and regional incentives and funding mechanisms.

## 6. A Quick, Easy Way to Reduce CO<sub>2</sub> Emission

In the absence of federal and local legislations, there is an urgent need to take actions now at the grass-root level to reduce energy use and greenhouse gas emission. And there is a great potential in our energy consumption structure to save a huge amount of energy without jeopardizing our productivity and quality of life. There is a great waste of energy in our daily habits, both in business and at home. A simple change of habits will quickly reduce our energy use by a substantial percentage and reduce our impact on the climate. Since greenhouse gases exert more impact on the climate the longer they stay in the atmosphere, the earlier we stop putting these greenhouse gases into the air, the more effective our actions will become. Because stopping wasting energy produces much less pain on our life and is relatively easier to do, and also because reducing emission right now has the best effect on fighting climate change, we call it the “low-hanging fruits.”

## 6.1 How We Waste Energy

There are a variety of ways in which we waste energy in business and at home, most of them involving lighting, cooling, and heating, or more precisely, unnecessary lighting, cooling, and heating. To save energy, we simply have to turn off the unnecessary lighting, heating, and cooling, and raise the thermostats a few degree in summer and lower the thermostats a few degrees in winter.

To show how prevalent the practice of energy waste is, we have documented the unnecessary lighting in business and at home, by surveying homes and stores in early mornings. Here are some examples of what we found.

### 6.1.1 Over-Night Lighting in Businesses

In several separate early mornings, between 2:00 AM and 5:00 AM, we surveyed stores, schools, libraries, and other locations to see how wide-spread over-night lighting, both outdoors and indoors, is practiced in businesses. The survey were conducted in the Northern Virginia counties of Fairfax and Loudoun.

Wal-Mart Store at 4:43 AM



We have noticed that almost all major stores have some lights on, both indoors and outdoors, at the early morning hours, suggesting that these lights have been kept on for all night while the facilities are closed. In contrast, mom-and-pop stores tend to turn off the lights at night.

**County Library Parking Lot at 2:59 AM**



If the owners of these facilities pay attention to this phenomenon and realize that it benefits both their bottom line and the climate to turn the lights off at night, a substantial reduction in greenhouse gas emission can be achieved instantly while the profitability of the businesses will be boosted.

### 6.1.2 Over-Night Lighting at Home

We also conducted early morning surveys in residential neighborhood to examine how widespread over-night outdoor lighting is practiced. We found that, in those neighborhoods we surveyed in the Northern Virginia Counties of Fairfax and Loudoun, about 70% of all homes have some outdoor lights on all night.

We have estimated the amount of annual energy waste due to over-night outdoor lighting for a typical home in our surveyed neighborhood to be about 876 kilo-watt-hour, equivalent to CO<sub>2</sub> emission of about 0.5 metric ton. In other words, by changing the habit of leaving outdoor lights on over-night, such a home could save about \$87.6 (assuming the cost of electricity of \$0.10 per kWh), while reducing CO<sub>2</sub> emission by 0.5 ton per year.

**A Home With Over-Night Outdoor Lighting**



## 6.2 An Online Tool for Energy Saving

As simple as it seems, people need hand-holding and pushing to change their habits. To help individual homes and businesses to control and reduce their energy usage, we have developed an online tool where any entity can

- analyze its energy bill and link its energy usage to local weather variations.
- build a quantitative relationship between its daily energy use and daily weather.
- see how sensitive or insensitive its energy is to weather variations.
- receive daily forecast of energy usage for each of the next 7 days.
- together with the daily forecast, receive specific advices on actions to take to reduce energy usage.
- evaluate the effectiveness of energy-saving actions using the online tool which quantifies the reduction by comparing the actual usage to the model-calculated usage (which is supposed to be the amount used if no action has been taken).

Because of our huge database of historical daily weather record covering all major weather stations in the entire world, anyone located anywhere can use this online tool to guide their energy saving. The system only requires the user to enter their utility bill data of the past two or three years, the energy-weather analysis will be performed instantly and a energy usage forecast formula will be built that can issue daily energy usage and corresponding CO<sub>2</sub> emission forecast for each of the next seven days.

## An Example User of the Online Tool

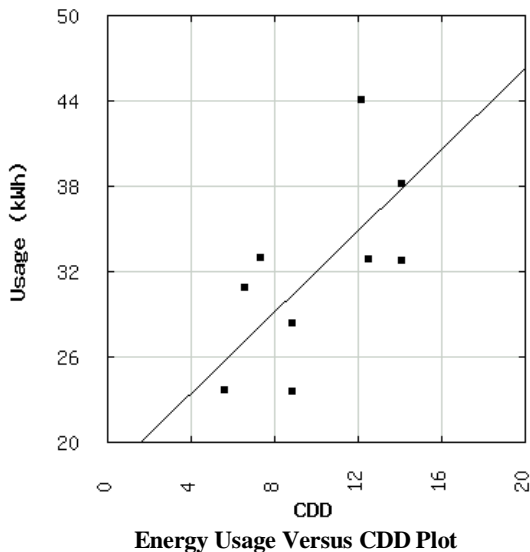
You can analyze your energy bill and build your energy use forecast model at our Website <http://www.neoclimate.org/>. Here we show an example of how one can use our tool to guide energy saving.

The example user is located in Washington DC area. She has her monthly electricity bills for the past two years ready and go online to the Website “Analyze Your Bill” section and enters the zip code of her house (or select a country if outside of US). Then she enters her bill data as follows:

2006-01-26 2006-02-23 791  
 2006-02-23 2006-03-24 757  
 2006-03-24 2006-04-25 739  
 .....

Each line represents one bill that contains three data: the start date, the end date, and the energy usage in kWh. After entering all bill data for the two years, she clicks on “Submit” and is instantly presented with the analysis results and forecast, as shown below.

First is the scatter-plot of daily electricity usage versus Cooling Degree Day (CDD) for summer:



The energy usage versus weather formula derived from this plot is:

$$E = 17.67 + (1.43)CDD$$

Where **E** is daily energy usage in kWh and **CDD** represent how hot it is in a summer day.

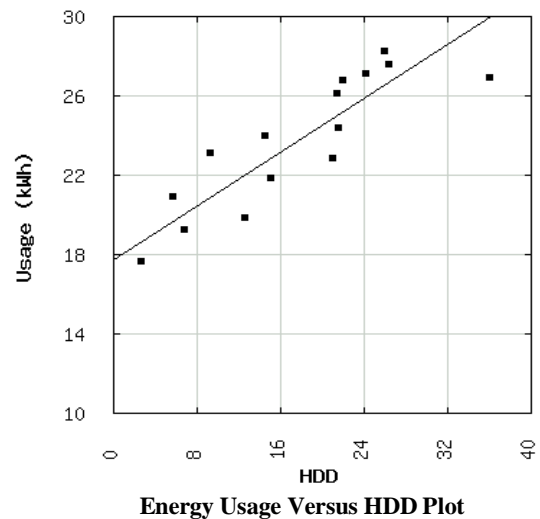
The next is the scatter-plot of daily electricity usage versus Heating Degree Day (HDD) for winter.

The energy usage versus weather formula derived from the HDD plot is:

$$E = 17.67 + (0.34)HDD$$

Where **E** is daily energy usage in kWh and **HDD** represent how cold it is in a winter day.

The number, **1.43**, in front of **CDD** in the first formula represents the sensitivity of energy usage to change in weather in the summer. It means that for each degree increase in the temperature, the energy usage increases by 1.43 kWh.

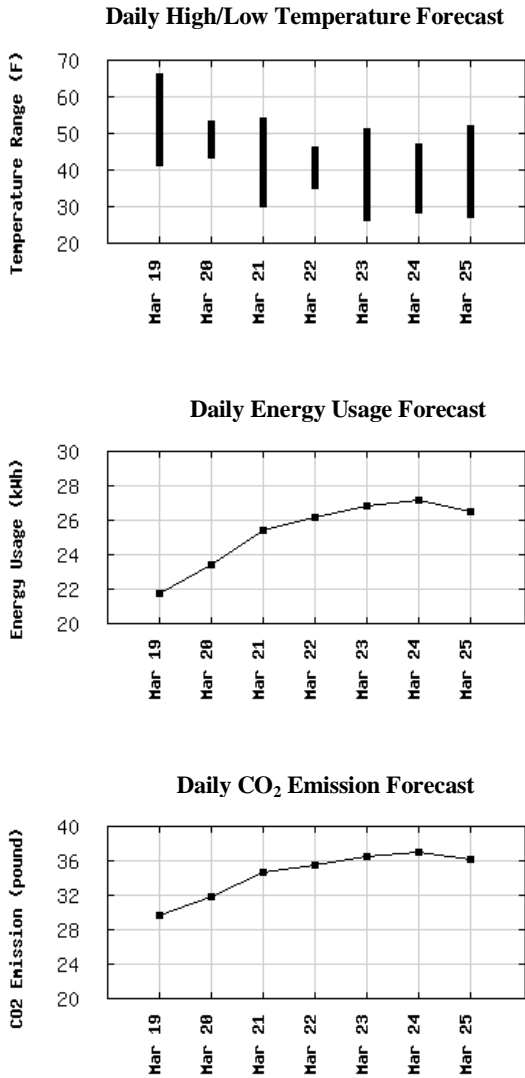


The number, **0.34**, in front of **HDD** in the second formula represents the sensitivity of energy usage to weather changes in winter. It means that during winter-time if the temperature is colder by 1 degree then energy usage would increase by 0.34 kWh.

It is interesting to note that for the same one degree change in temperature, the change in energy usage in summer (1.43 kWh) is much larger than in winter (0.34 kWh). This is because this example user’s home uses electricity for cooling in summer, but uses natural gas, not electricity, in winter for heating.

Following the presentation of formula, the user is then presented with the weather, energy usage, and CO<sub>2</sub> emission forecast based on the formula.

expected under the observed weather with previous energy use habits.



This type of daily forecasts will be emailed to the user after she establishes an account that records her bill data and formula. The daily email will contain detailed advice on what actions to take to reduce energy usage. In our advice we emphasize turning of unnecessary lighting, especially outdoor over-night lighting, and raising or lowering the thermostats by a few degrees to reduce heating and cooling usage. Such daily reminder will play strongly in changing people’s behavior.

A few months after starting the energy-saving measures, the user can use the online tool to evaluate the effectiveness by comparing the actual energy usage with the formula-based weather-normalized quantity; the later represents the amount of energy

## 7. The NeoClimate Organization

It is against the background described above that The NeoClimate Organization has been established. The mission of this new non-profit organization is to dramatically and quickly reduce the emission of greenhouse gases throughout the world by advocating energy saving and helping individual businesses and households reduce energy usage through change of wasteful habits. Our mission also includes education of the young generation on climate change science by collaboration with schools and providing them with local climate data for use in their science-related projects.

Specifically, our current activities are as follows.

### 7.1 Development of Online Energy Analysis and Forecast Tools

The objective of this activity is to develop and improve on an online tool for any individual household or business located anywhere in the world to

- Analyze and visualize their past energy (especially electricity) usage,
- Perform correlation analysis between the energy usage and local climate data
- Automatically create a customized weather-based daily energy use forecast model.
- Make daily energy usage (and corresponding CO<sub>2</sub> emission) forecast using the above forecast model.
- Receive daily forecast, together with practical advices on how to reduce energy consumption, via email or by logging in online.

This is the core technology we depend on to carry out our mission of helping every individual household and business to reduce energy use by 20%. One indispensable component is the huge climate database we have assembled that covers almost every major weather station in the world (including those on Antarctica), which allows users anywhere in the world to build the energy-climate forecast model and understand how weather affects their energy use. We have also developed and will continue to improve on

a large number of online algorithms that automatically analyze the user's energy bill data and match with corresponding local climate data and then quickly build the forecast model.

## **7.2 Survey of Energy-Wasting Practices**

The objective of this activity is to establish the evidences that a lot of energy is being wasted through our wasteful habits of energy use, and a substantial saving in energy can be achieved by changing those habits. One of the most obvious sources of energy waste is the unnecessary overnight lighting both in individual households and in businesses.

This survey is to document such practice of overnight lighting by visiting stores and homes at early morning hours, from about 2:00 AM to about 5:00 AM. We have estimated the percentage of homes with outdoor lighting left on overnight in the surveyed neighborhoods and photos of some of such homes have been taken as examples to be shown on our website. We have also documented such practices by stores, schools, and libraries, and photos have been taken and shown on our website in the section of "How We Waste Energy".

This survey has been conducted in Northern Virginia region, specifically Fairfax County and Loudoun County. Two rounds of early morning survey have been completed and more are scheduled for the future.

## **7.3 Campaign Targeting Individual Households**

This campaign involves delivery to individual households of a brochure that advocates energy saving. The message is that saving energy is good to both the your wallet and the climate. The message also tries to convince the audience that energy saving of 20% is possible by avoiding unnecessary energy waste in our daily life without affecting our quality of life. The message further persuades the audience that it is easy to engage in the energy saving activity by using our free online energy-climate analysis tool.

This activity will be conducted continuously first in the Greater Washington DC area (where our office is located) by our employees and volunteers, and subsequently in all parts of the country and throughout the world by local volunteers and via online distribution of our campaign brochure.

This activity comprises a major part of our purpose of helping reduce energy usage and hence reduce the greenhouse gas emission, since the residential use of energy accounts for a significant percentage of total energy consumption (and greenhouse gas emission).

## **7.4 Campaign Targeting Businesses**

Another group of users that can contribute greatly to the reduction in energy usage includes businesses, government, and other organizations. Our recent survey reveals wide-spread practice of energy waste, such as over-night indoor and outdoor lighting in most locations such as stores, schools, and libraries. Similar to the campaign targeting individual households, this campaign focuses on delivery of business-oriented brochures to stores and other entities that have been identified as being the most energy wasting. The message emphasizes the economical benefit of energy saving to the audience, with an accompanying call to the urgency of greenhouse gas reduction. The message also tries to convince the audience that it's easy to start taking action by using our free online energy analysis and forecasting tool.

This activity will be a continuous campaign to penetrate ALL business and public entities in order to achieve our short-term, immediate goal of 20% reduction in energy usage across the nation and across the world. We will start locally in the greater Washington DC area with delivery of brochures to store fronts, company headquarters, and public organizations by our employees and volunteers. Concurrently, this activity will also be carried out in other parts of the world by local volunteers, and brochures are also being distributed world-wide via our website.

This activity, similar to our individual household-oriented campaign, comprises another major part of our purpose of reducing energy use and greenhouse gas emission as the commercial energy consumption accounts for another major percentage of the total energy usage.

## **7.5 High School Climate and Energy Project**

Reducing greenhouse gas emission is a long-term task. Many states with climate legislations, for example, mandate that the greenhouse emission be

reduced to a certain percentage of the 1990 level by the year 2020 and 2050. This means that in the future we will depend on our current young generation to tackle the climate issues. A population with a well-balanced, scientifically based knowledge on climate and its dynamics is crucial.

This project will strive to collaborate with any school that is interested in using climate data in its science education. Using actual local climate data in class is beneficial in many ways. Students learn how to perform complex statistical analysis on daily temperature, rainfall and other weather elements, looking for patterns such as long-term trend and extreme values. Students can also perform correlation analysis between climate data and other variables such as daily or monthly energy usage, by which they

learn how sensitive or insensitive energy consumption is to weather variations.

As important and useful as climate data is in school science-related project, local climate dataset is not easily obtained by individual schools. This is where The NeoClimate Organization comes into the picture. Using our extensive world-wide climate database, we are capable of quickly providing local historical daily weather data to any school in the world. Our online algorithms can also create customized data, such as Heating Degree Days for a specific period, to meet the requirements of different science projects.

We are inviting interested schools to participate in this program. We'll start with schools in the greater Washington DC area then expand to cover the entire country and across the world.