Reduction of Emissions and Operating Costs of GCMS Usage with a New Ecology Mode

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Introduction

For the first time in US history, the government requires greenhouse gas emissions to be reported to the EPA in an effort to reduce the United States total carbon footprint. The EPA 40 CFR 98 states that facilities that emit 25,000 metric tons or more per year of greenhouse gas (GHG) emissions will be required to submit an annual report. Not only is it the duty of large industrial leaders to reduce their GHG emissions, but reduction should also take place at all levels of industry.

One way to assist in the reduction of operating costs and emissions previously was by manually turning down temperatures, turning off unnecessary power to selected parts of analytical instrumentation, and reducing gas consumption in standby mode. In most cases, these could only be done either by downloading additional complex methods or by manually adjusting individual parameters.

A new feature in GCMS software called "Eco-mode" automatically performs the power- and gas-saving functions at the end of an analytical batch. Eco-mode is used to reduce gas flow and turn off unnecessary heated zones, projecting an estimated 35% in energy savings as well as reduction of carbon emissions by up to 1.1 tons per year.

In this work, daily electrical power consumption was measured and compared to that of typical GCMS operation. Measured power correlated to predicted energy savings and emission reductions very closely.

Ecology Simulation

Shimadzu Corporation has developed a Comparison calculator that will allow you to compare power consumption of previous GCMS systems to a new GCMS-QP2010 Ultra using Eco Mode.

http://www.shimadzu.com/eco_sim/eco.htm

For this test, we are assuming the QP will be running 20 days a month for 9 hours a day.

This calculator also asks for the CO_2 emission factor, current cost of electricity and cost of a cylinder of gas.

- In the state of Maryland, the CO_2 emission factor was calculated to be 0.558 kg-CO_2 / kWh (based on average 2009 BGE Air Emissions)
- The electricity rate in late 2010 was $0.09/kWh
- The price of a cylinder is $301 for Research Grade Helium

Ecology Mode

Ecology mode = Eco mode

Rather than running a traditional 'Shut-down method', we press a single button to send the instrument into a energy-saving standby mode.
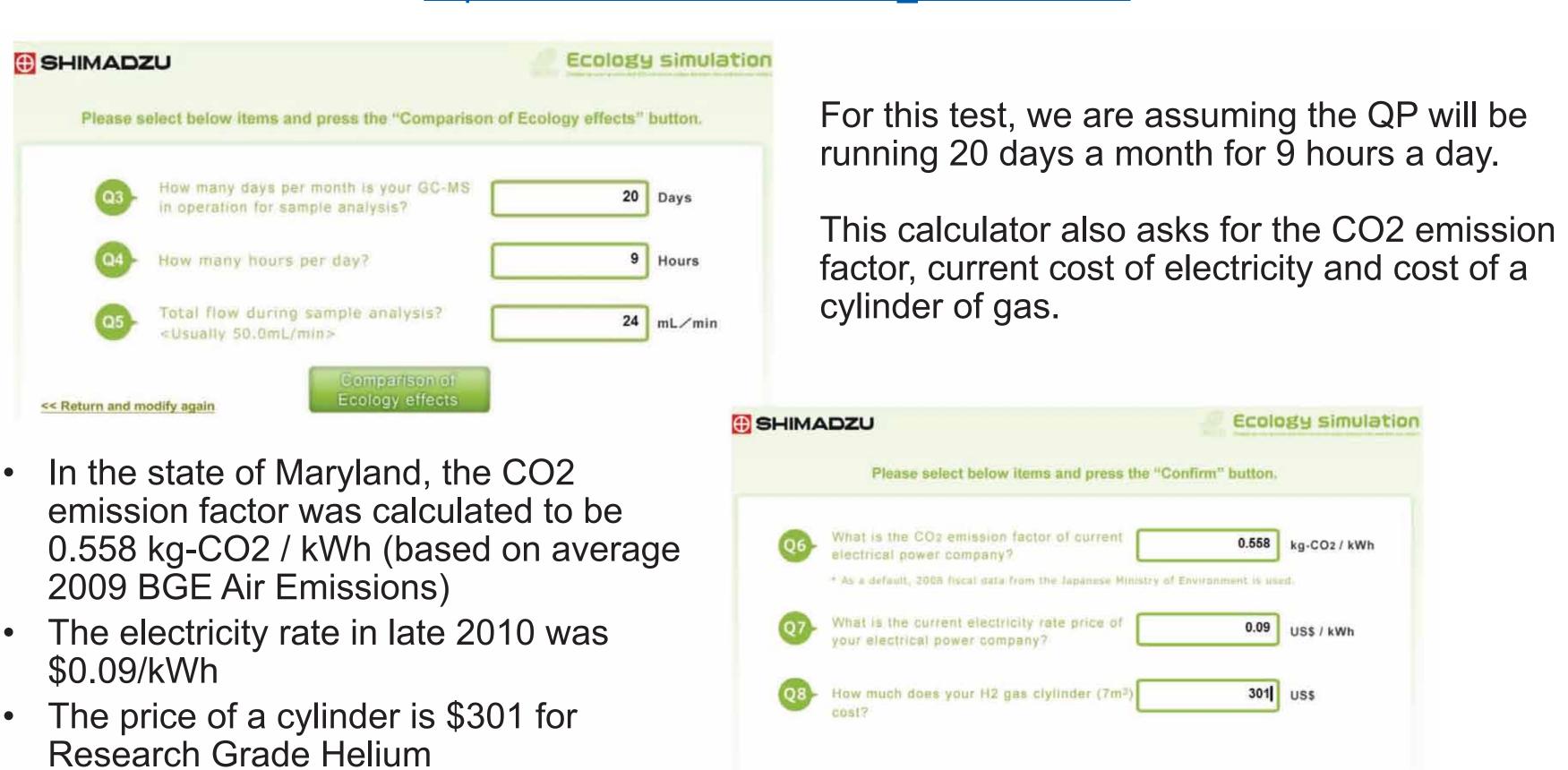
The Eco mode can be customized depending on the users' needs; however, GCMSsolution software comes with a default Eco mode method. Each of the method parameters can be adjusted to give users the maximum savings depending on the type of standby parameters they choose.

Parameters

Instrument Control

In addition to the method setup, the parameters and instrument control allow more customization.

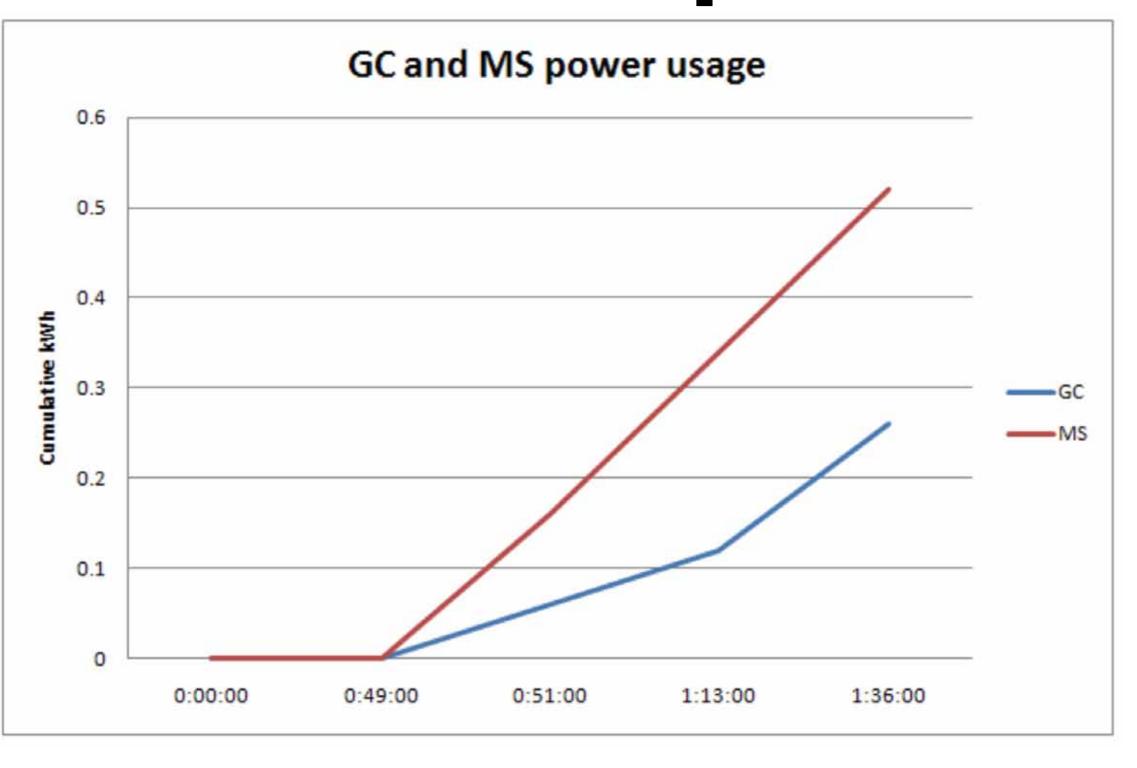Once these parameters are set, Eco mode can be manually started or can be set up to start at the end of an analytical batch.

Power Consumption Results: Start-up

A GCMS system was powered on and started.
- Power was turned on to both the GC and MS
- Auto start sequence was initiated
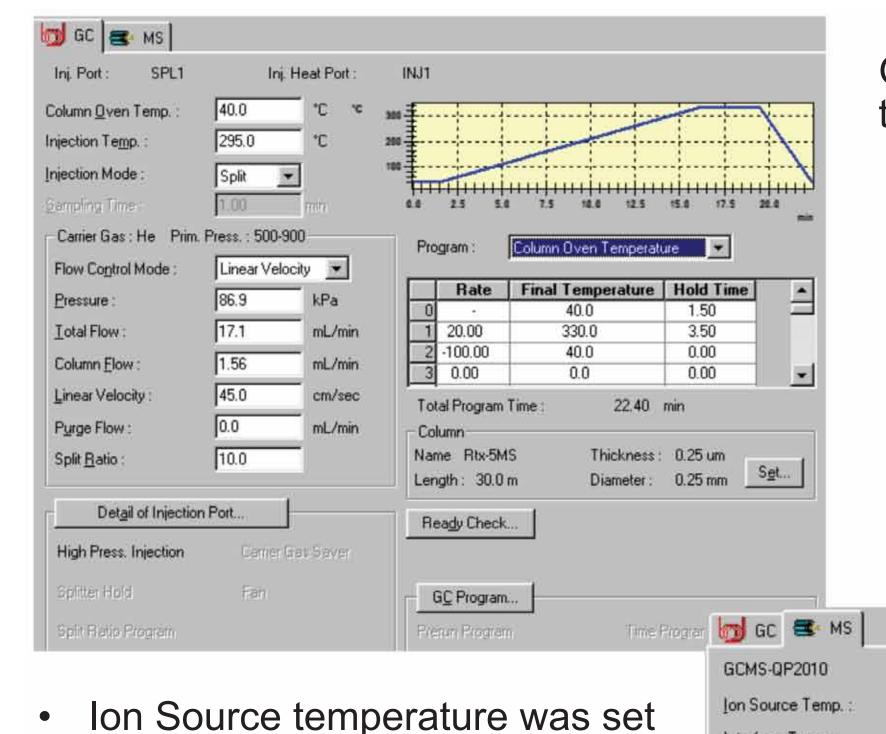- System was allowed to pump down
- Heat was turned on and method was downloaded

GC and MS power usage

Example Analysis Conditions

Basic Analysis Setup

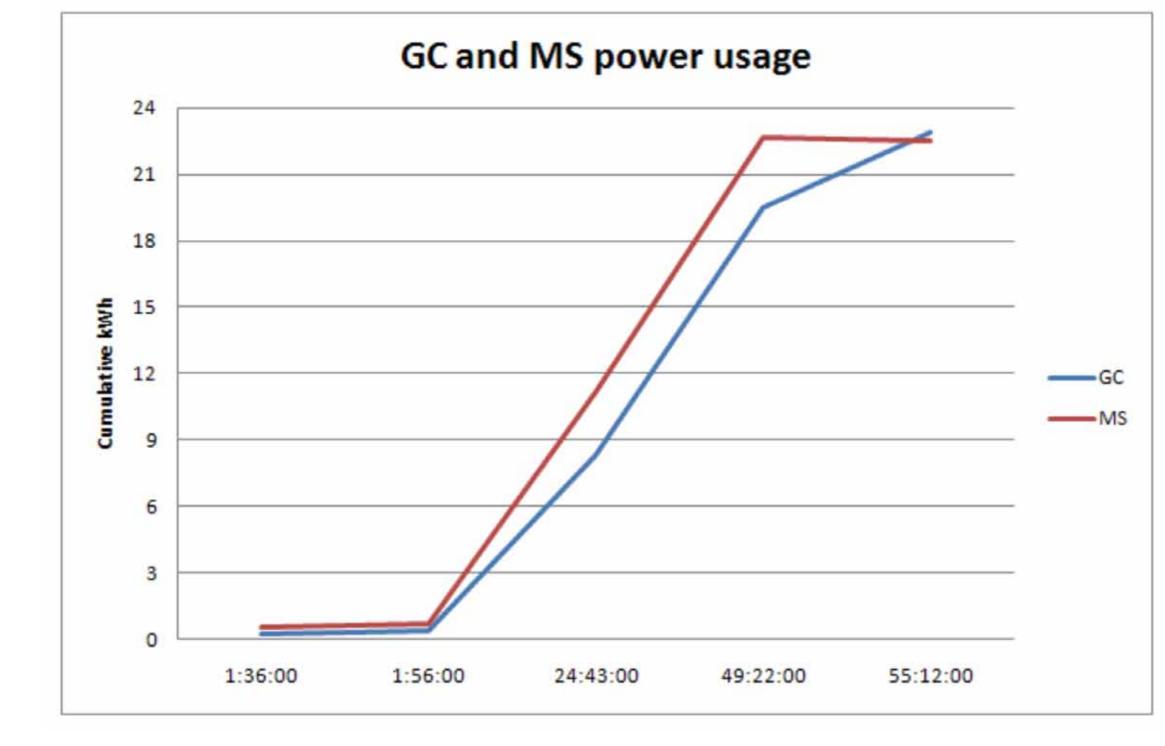GCMS parameters were set up to represent a typical analysis.
- Split injection port temperature was set at 295°C
- High-pressure injection was turned on, and the split ratio was set at 10:1
- Column oven ramp was programmed from 40°C to 330°C and back to start

- Ion Source temperature was set at 225°C
- Interface temperature was set at 300°C
- MS to start data collection after 2min. with a scan speed of 3333

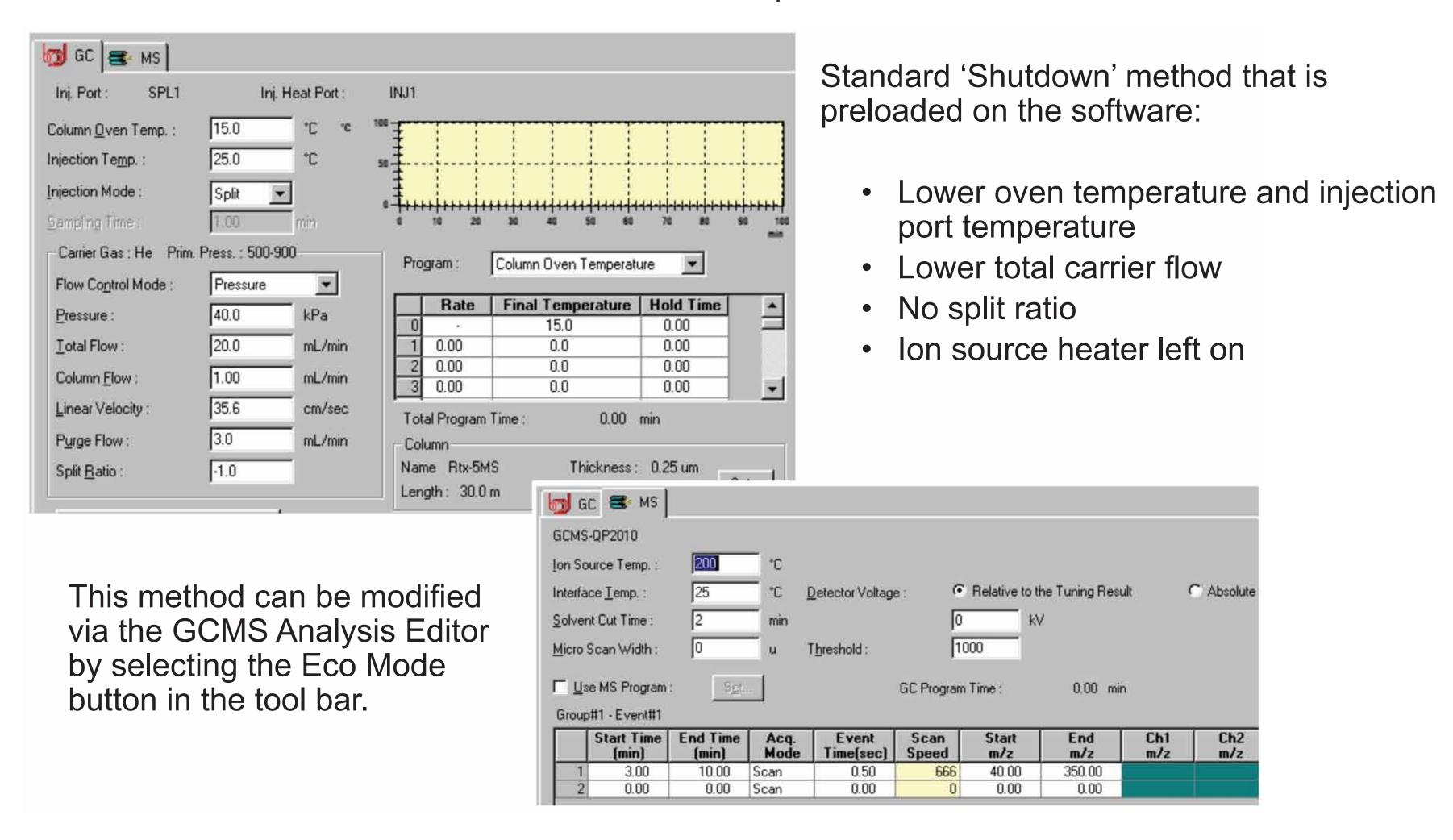## Power Consumption Results: Post Analysis

System was tuned and a method was set up to run.

- System was auto tuned
- A method was started
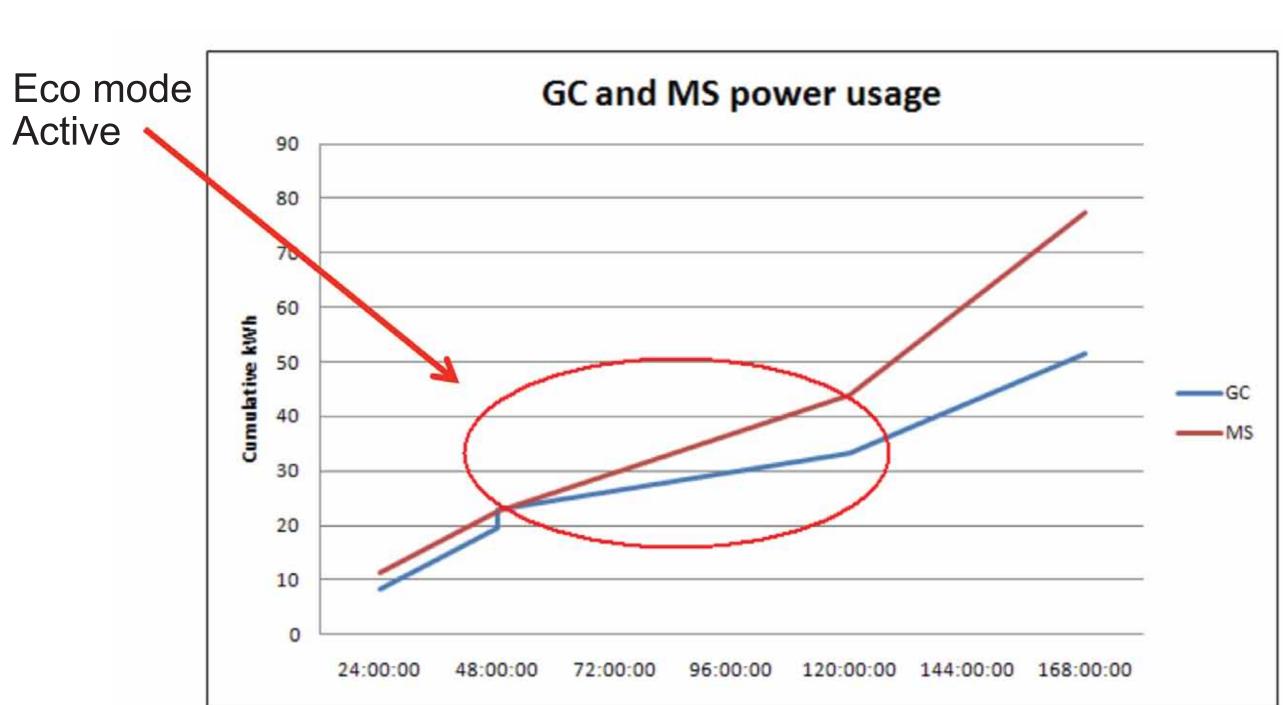- Seventeen samples were run over the course of two days

GC and MS power usage

Eco Mode Conditions

Default Eco Mode Set-up

Standard 'Shutdown' method that is preloaded on the software:
- Lower oven temperature and injection port temperature
- Lower total carrier flow
- No split ratio
- Ion source heater left on

This method can be modified via the GCMS Analysis Editor by selecting the Eco Mode button in the tool bar.

Power Consumption Results: Post Eco Mode

Eco mode was set up to be in effect all weekend.

- Default 'Shutdown' method parameters were used
- Eco mode was started Friday afternoon
- Eco mode was stopped Monday afternoon (roughly 3 days)
- System was returned to standard settings and allowed to run

Eco mode Active

GC and MS power usage

Conclusions

The new GCMS-QP2010 Ultra's Eco mode is a valuable tool in today's economy. The system's ability to automatically enter a standby mode upon the completion of a batch allows for maximum savings. The flexibility of customized settings allows for turning on Eco mode at any time; therefore, the QP2010 Ultra saves energy more efficiently.

It was estimated that the overall consumption of electricity is 6,370 kWh/yr, and CO_2 emission is 3,554 kg/yr.

After checking the power usage in start-up, stand by, sampling and Eco mode, it was determined you will save on the energy consumption and overall operating costs.

CO_2 emissions	3,554	kg / year
Electricity consumption	6,370	kWh / year
*Including a PC	573	US$ / year
Gas consumption	1.56	Cylinder / year
	468	US$ / year

The GC used three times less power while in Eco mode verses normal operation, while the MS used one and a half times less power during a weekend Eco mode state.

From the Laboratory

QP-2010 Ultra:
GC on average draws: 360 W in stand-by
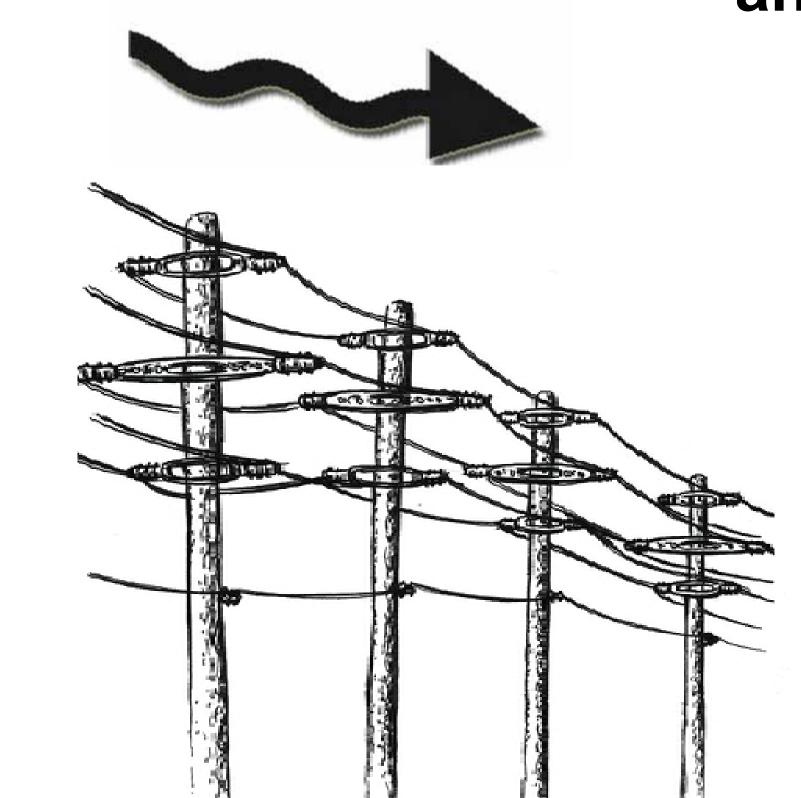1000 W while heating up
90 W in Eco Mode

MS on average draws: 450 W in stand-by
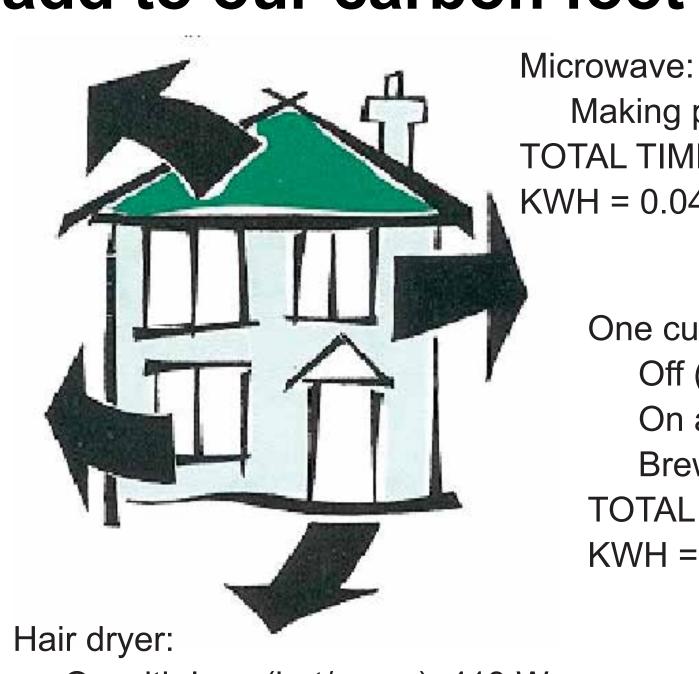500 W while Tuning
420 W in Eco Mode

Normal operation TOTAL TIME: 163 HR
KWH (for GC): 60
KWH (for MS): 77

VS

Eco mode operation TOTAL TIME: 90 HR
KWH (for GC): 8
KWH (for MS): 38

to the Home

all electronics consume power and add to our carbon foot print

Microwave:
Making popcorn on High: draws 979 W
TOTAL TIME PLUGGED IN: 10 MIN
KWH = 0.04

One cup coffee maker:
Off (clock on): draws 4.7W
On and heating up: 1376W
Brewing (dispense hot water): 461W
TOTAL TIME PLUGGED IN: 2 HR
KWH = 0.12

Hair dryer:
On with Low (hot/warm): 413 W
On with High (hot/warm): 914W
TOTAL TIME PLUGGED IN: 15 MIN
KWH = 0.13