SUN'S OPEN WORK ENERGY MEASUREMENT PROJECT

A Study of Energy Consumption and Savings
White Paper
February 2009

Abstract

Sun Microsystems' Open Work platform provides the technologies, workplaces, and organizational practices that allow employees the freedom to work wherever they want or need — at home, at a flexible office, or in a coffee shop near a customer's office. At the end of December 2008, nearly 19,000 employees (more than 56% of the workforce) were working away from the office at least one or two days a week. While it was assumed that the company was saving energy and energy costs with tangible environmental benefits, no objective measurement of energy used or saved by the program participants had ever been completed. This paper describes a detailed study of Open Work energy consumption and savings, which quantified the energy used at Sun offices, at home, and getting between these locations.

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Part I

Executive Summary

Sun's Open Work Platform

Sun is recognized as a global leader in enabling a flexible, mobile 21st century workforce. The company's Open Work platform provides the tools and technologies that allow employees the freedom to work wherever they want or need — at home, at a flexible office, or in a coffee shop near a customer's office. Open Work provides living proof of Sun's vision and strategy — The Network is the Computer™. Employees are part of a network-centric workforce where employees can work anywhere, anytime, using any device.

This 14-year-old work platform encompasses an integrated suite of technologies, workplaces, and organizational practices that supports an increasingly distributed employee population. Open Work is ingrained into Sun's corporate culture, allows employees to work from anywhere they need to, expands collaboration, and builds stronger relationships and communities across Sun and with partners and customers. At the end of September 2008, almost 19,000 employees (more than 56% of the workforce) were working away from the office at least one or two days a week.

Sun continues to revolutionize the enterprise work environment to achieve great things for its business, communities, and employees.

The Question: Does Open Work Also Help Save Energy?

Sun management realized that the Open Work platform provided many benefits to the company, communities, and employees. But, they began to wonder how this shift in work practices may be impacting the environment. Was it saving energy and energy costs with tangible environmental benefits, as many hoped and guessed? Or was it just transferring the energy load and costs to employees, as others surmised?

In 2007, to objectively quantify the issue at hand, a Sun team undertook a study of U.S. employees and their habits to understand the program's environmental impact. Central to this study was the measurement of how much energy employees use for work — at the office, at home, and traveling back and forth between the two locations. Then, by comparing home and work values, the team determined they would be able to quantify the energy load shift and settle the argument.

Summary of Findings

Sun's team determined that the employee subjects tracked in the study spent an average of 2.5 to 2.8 days per week in one of Sun's facilities, and an average of 2.3 to 2.5 days per week working at home. On average, the whole Sun workforce spends less than two hours per week working somewhere other than these two locations.

The equipment that the employees used for their home office consumed about half the power that the equipment in their Sun-supplied office did. Altogether, the average employee consumed 80 to 140 kilowatt-hours (kWh) of energy per year working at home, compared to about 260 kWh of energy working in one of Sun's offices. That included estimated energy from home heating and cooling systems, as well as all the electrical and electronic equipment required to do their jobs.

As shown in Figure 1, the biggest savings by far were those resulting from reduced commuting. The average subject drove without passengers 96% of the time, and spent 76 minutes driving 45 miles round trip, using an average of 1.9 gallons of gas each time they drove from home to Sun's offices. When summed over all the times they avoided commuting, this amounted to about 136 hours of commute time avoided per year — or 2.5 weeks of "reclaimed" personal time for each participant. In addition, avoiding the commute 2.5 days per week saved about 3,720 miles and 151 gallons of fuel for each employee. Based on the study's findings, the Sun team surmised that in aggregate, Sun's U.S. employees reduce their carbon dioxide (CO_2) production by 52,000 metric tons each year.

The savings from reduced commuting was 50 to 100 times the amount of energy used by the employee working at home, and the net monetary savings could have on average easily exceeded $800 per year in fuel costs[1], and another $1,000 in vehicle deterioration. Results clearly indicate that the Open Work program does result in environmental and financial savings, and that employees benefit from "connecting to work" instead of "going to work."

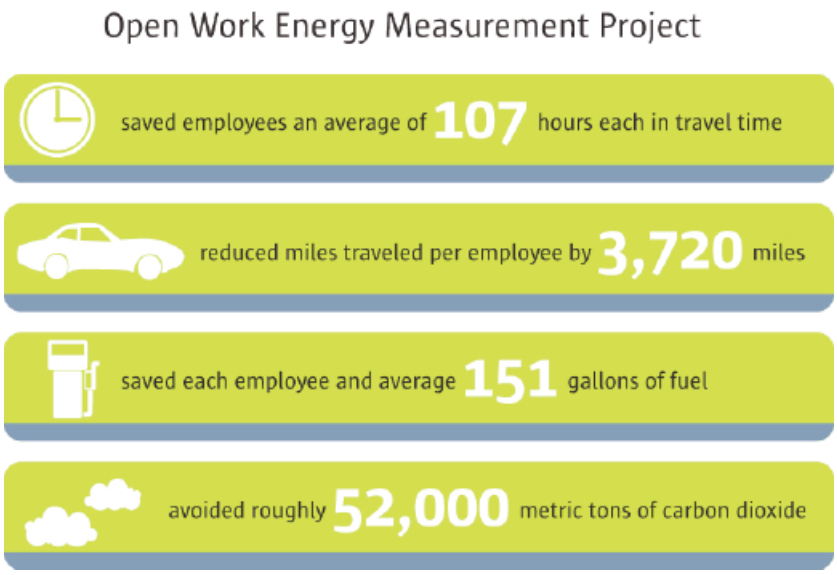


Figure 1. Employees achieved significant time and fuel savings due to reduced commuting.

1. Calculation based on gasoline prices ranging from $2.84 to $2.92 in October 2007.

Part II

Methodology

Summary of Assumptions, Sampling, Survey, and Instrumentation Techniques

Assumptions

- It was assumed that the average Sun employee works 47 weeks per year: 52 weeks minus two weeks vacation, less one week holiday shutdown, less 10 holidays.
- The U.S. employee population at the time of the study varied from 18,508 to 18,074. 18,300 was used as an average, about 1.2% away from the high or low.

Sampling

Sample selection was key to the study's success and to the ability to extend the study's results to the larger employee population. It was important to have a large enough sample to be statistically significant, while small enough to be within the Sun team's limited budget. The sample also needed to be random enough to represent Sun's broad employee population — from campus-based to field-based employees, and from global sales and services to server and software engineering.

The team made the decision to use U.S. employees, with cost and operational considerations in mind. Power strips and meters would only need to be designed and calibrated for U.S. use, and participant support would be provided in English only within U.S. support hours.

The team also decided to recruit a minimum of 100 employees for the study, a number that allowed for stratification of two to three groups within the data set, while still remaining statistically significant. These participants would be tracked for a minimum of 30 calendar days in order to cover enough time to reduce impact of vacation or holidays and provide a minimum of 20 work days of data.

To achieve the final study results:

- 1,000 employees were solicited by email
- 126 interested employees responded
- 120 measurement kits were sent to employees, along with detailed surveys
- 104 completed surveys were returned
- 85 employees recorded 1,137 data points in 33 days (9/23/07 – 10/26/07): 551 from home offices, 526 from primary offices, and 27 from secondary offices

In order to match approximate percentage breakouts of study participants to all U.S. office-assigned, flexible, and work-from-home employees as shown in Figure 2, the 85 study subjects were resampled to a group of 55 final participants, as shown in Figures 3 and 4.

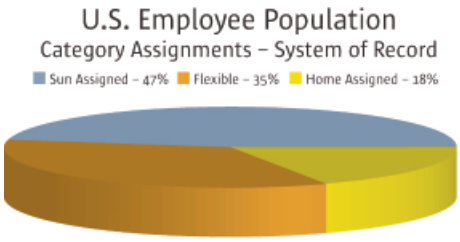


Figure 2. Category assignments for U.S. employees

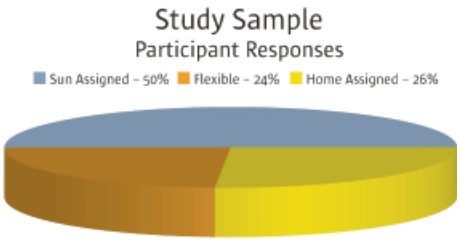


Figure 3. Category assignments for study sample

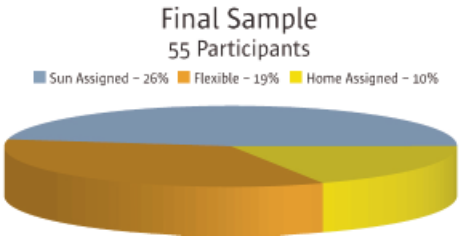


Figure 4. Category assignments for final sample

The team checked to validate that the 55 participants represented an accurate sampling of U.S. employees working in a Sun field office versus working on a Sun campus. The ±4% shown in Figure 5 was considered within range, and the final 55 participants were set.

An Accurate Representation of U.S. Employees' Workplace

	SAMPLE		POPULATION	
	Count	Percent	Count	Percent
CAMPUS	36	65%	11,927	69%
FIELD	19	35%	5,419	31%
TOTAL	55	100%	17,390	100%

Figure 5. U.S. employees working on a Sun campus versus a field office.

Measurement Tools and Methods

It was necessary to collect data using several different methods. Both surveys and instrumentation were used to gather information about the environments and work habits of the employees in the study. Surveys gathered information about participants' homes, vehicles, work and home office equipment setups, and work habits. Knowing that survey data is subject to a margin or error, every effort was made to ensure the data collected was accurate.

The detailed survey consisted of 85 questions. Once the survey was completed and returned by subjects, the Sun team set about to collect data about the work habits and energy used at the office, home, or any other work location, and the energy used traveling between these various work locations.

Each participant received a Kill A Watt meter and power strip. The Kill A Watt meter, shown in Figure 6, is designed to record the total power used and total operating time or the power consumption rate in watts per hour. Participants were provided with detailed set-up instructions and instructed to plug all office devices into the power strip, and to plug the power strip into the Kill A Watt meter. The subjects took their power meter and power strip with them if they changed offices throughout the day and received daily surveys in which to record Kill A Watt results.

Figure 6. Kill A Watt meter

Each day's energy consumption readings were converted into a row in a master database, as shown in Figure 7. The “W per Hour” column shows the rate of energy use at each location. For example, in the chart below, employee “9999” used 1.06 kWh in 9.0 hours, for a rate of 117 W per hour at her home office on 09/26/07. The same employee used 1.25 kWh in 7.8 hours for 161 W per hour at her primary office location on 09/28/07.

Sample Daily Survey Questions and Responses

Entry Date/Time	DOW	Work Category	ID#	kwh Used	Hours	W per Hour	Time of reading HH:MM	Location	Did you unplug the Kill-a-Watt without taking a reading, or experience a power interruption that may have caused the Kill-a-Watt to reset?	If you worked at home, did you change the air conditioning setting?	If YES, please describe what you did:	Did you have your Kill-a-Watt measuring power at each location the entire time you were working?	Did you commute to the office today?
###	Tue	Flexible	9999	1.06	9.0	117	18:00	Home	NO	YES	Turn on AC	YES	NO
###	Thu	Flexible	9999	1.25	7.8	161	15:20	Primary Office	NO	NO		YES	YES
###	Mon	Flexible	9999	0.85	7.5	113	15:30	Secondary Office	NO	NO		YES	YES

Figure 7. Daily surveys helped the Sun team gather data that allowed them to track rates of energy use.

Part III

Results

All participant data from the study's detailed and daily surveys and instrumentation readings were carefully recorded and analyzed. This section summarizes the data and measurements gathered pertaining to:

- Percentage of work time spent at each location
- Use of home office equipment versus Sun office equipment
- Power and heating management — home and office
- Commuting

Percentage of Work Time Spent at Each Location

Each subject was asked to estimate the percentage of time spent at:

1. Primary office: Where their mail stop was located
2. Secondary office: Another Sun office
3. Customer site
4. Other location such as coffee shop, drop-in center, hotel
5. Home office

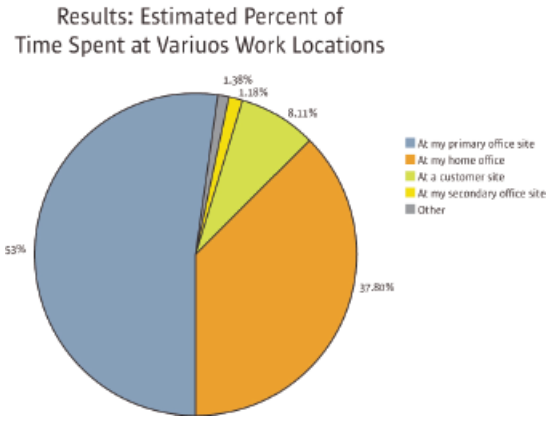


Figure 8. Survey results

Detailed survey responses as shown in Figure 9 indicated that per five-day week:

- 38% of the week, or 1.9 days, was spent working in home office
- 52%, or 2.6 days, were spent working from primary office
- 8% of week was spent at a customer site
- 1% of week was spent working from secondary office
- 1% of week at another location

In addition, the daily survey asked subjects, “Where did you work today?”

Daily survey results as shown in Figure 9 indicated:

- 46%, or 2.3 days/week, at home
- 51%, or 2.5 days/week, in primary office
- 3%, or 1.4 hours, at secondary offices
- 1%, or 0.2 hours, at “other” sites

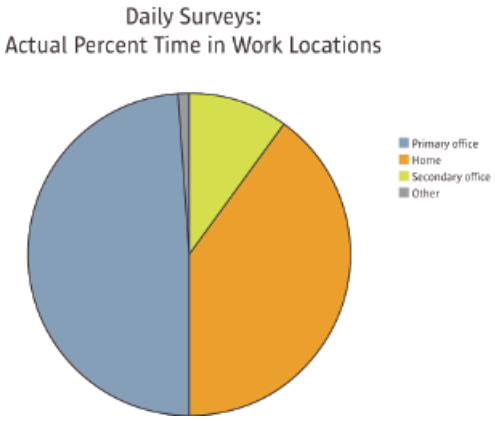


Figure 9. Survey results

Note the discrepancy between the estimates of work-at-home time in the detailed survey (38%) and the values in the daily reporting (46%). When Sun's employees are not working in their Sun office, they are most likely to be working from their home office, and only 1-2 hours, on average, at customers, hotels, or other locations.

Use of Home Office Equipment Versus Sun Office Equipment

The detailed survey asked a series of questions to determine electronic equipment used at home and in the Sun office. Results of this part of the survey are shown in Figure 10.

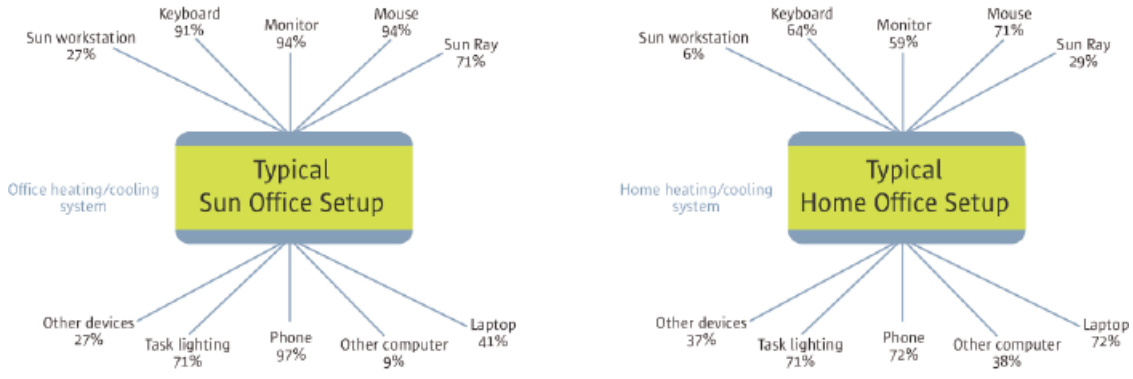
Equipment Use at a Sun Office Versus at Home

EQUIPMENT	SUN OFFICE	HOME
Sun Workstation	27%	6%
Keyboard	91%	64%
Monitor	94%	59%
Mouse	94%	71%
Sun Ray™	71%	29%
Laptop	41%	72%
Other Computer	9%	38%
Phone	97%	72%
Task Lighting	71%	51%
Other electronic devices	27%	54%

Figure 10. The percentage of electronic equipment being used in a Sun office versus at home.

Results indicated:

- 94% reported using stand-alone monitors at Sun facilities, while only 59% had monitors at home
- Only 41% reported using laptops at Sun facilities, while 72% used laptops at home
- 71% of subjects used Sun Ray terminals in a Sun office, and nearly one-third had a Sun Ray at home
- Other devices at home included coffee makers, fans, cell phone chargers, space heaters, stereos or radios, and networking devices (such as hubs, routers, switches)
- Typical home and Sun office configurations are shown in Figures 11 and 12



Figures 11, 12. Office configurations and equipment use varies at a Sun office versus a home office.

Power and Heating Management — Home and Office

Power Management

The detailed survey also asked questions about power management software or powering off of electronic devices. Results are shown in Figure 13 and indicated:

- Only 42% of Sun workstations had power management or were powered off when not in use.
- By contrast, 76% laptops and 73% of other computers used at home were powered down when not in use.

Power Management at a Sun Office Versus at Home

EQUIPMENT	POWER MANAGEMENT SUN OFFICE	POWER MANAGEMENT HOME
Sun Workstation	42%	75%
Keyboard	13%	23%
Monitor	76%	68%
Mouse	12%	22%
Sun Ray	42%	55%
Laptop	90%	76%
Other Computer	50%	73%
Phone	4%	2%
Task Lighting	76%	63%

Figure 13. The percentage of electronic equipment with power management or being powered down.

A surprising result from the study indicated that home office equipment energy consumption was half that of Sun office equipment energy consumption, as shown in Figure 14.

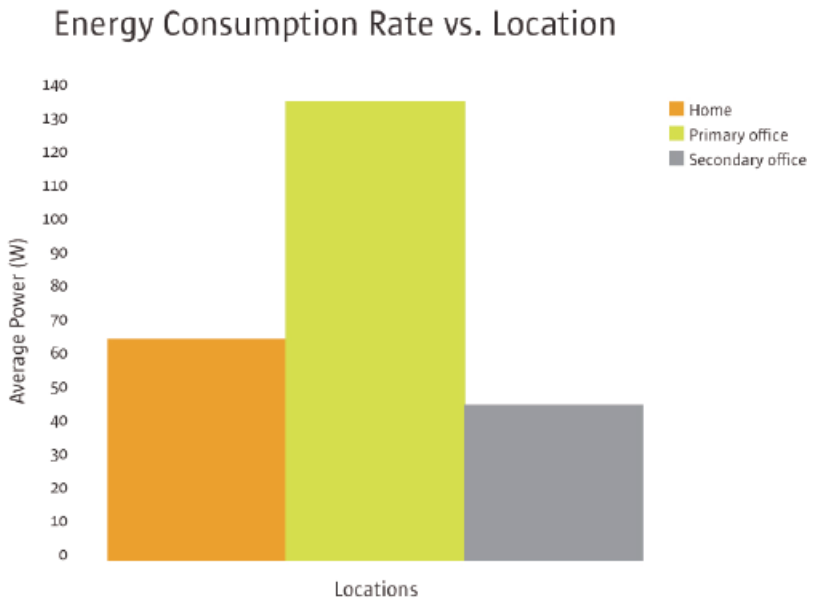


Figure 14. Energy consumption in home offices was consistently lower than in Sun offices.

Results showed that home office equipment consistently used less power than Sun office equipment, reported as an average of 65 W per hour at home versus 124 W per hour in one of Sun's offices. Secondary office or "other" locations generally consisted of a single laptop. The explanation for this can be found in the analysis of home office equipment versus Sun office equipment: more workstations and monitors were used while in Sun offices, less frequent power management reported while in Sun offices, and more laptops were used at home.

Another explanation may be found in an interactive poll taken by Sun and Harris Interactive in 2007 (results shown in Figure 15).[2] In this poll, participants were asked about energy conservation habits at home and at work. Responses indicated that people are more conscientious at home than at work, in some cases by nearly two to one. Of all survey respondents, 58% said they turn off their computer at home when not in use, versus 32% who turn off their computer at work when the device is not in use. A contributing factor to the difference in energy consumption measurements observed in this study may be that subjects were more energy conscientious at home than in a Sun office.

Sun and Harris Interactive Poll Results

CONSERVATION HABITS	HOME	OFFICE
Turn off lights?	92%	52%
Turn off computer?	58%	32%
Computer sleeps?	57%	44%

Figure 15. A poll by Sun and Harris found that people are more energy conscientious at home than at work.

Heating and Cooling

In order to determine the impact of heating and cooling systems on energy use when employees work from home, a series of questions was asked about programmable thermostats. U.S. Department of Energy studies[3] indicate that home energy is saved by setting the thermostat to a lower (or higher) temperature when occupants are not present.

Thermostat set-back opportunities will be missed if those working from home change the programmed setting and use energy that might otherwise be saved if working outside the home. The Open Work energy study focused on determining the amount of energy used because of missed setback opportunities.

The survey first asked, "Do you have a programmable thermostat?" then asked, "Do you change your thermostat when working from home?" as shown to the right in Figure 16.

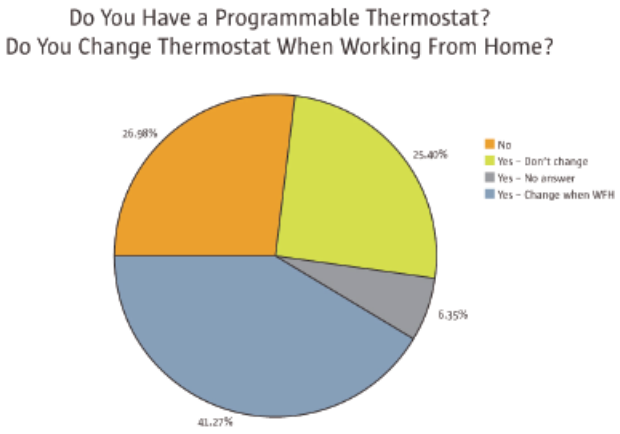


Figure 16. Survey results

2. Sun Microsystems/Harris Interactive, Interactive Poll of 1,700 Office Workers, June 2007
3. *A Consumer's Guide to Energy Efficiency and Renewable Energy*, U.S. Department of Energy, http://apps1.eere.energy.gov/consumer/your_home/space_heating_cooling/index.cfm/mytopic=12720

Results showed that:

- 73% of subjects had programmable thermostats and were candidates for changing settings as a result of working from home.
- A few subjects with manual thermostats changed their thermostats when working from home, but this data was not collected as part of the survey, thus not included in the analysis.
- Only one in three subjects made any change to their thermostat when working from home. The other two-thirds did not miss any setback opportunities, since the heating system operated in the same manner whether the employee was working from home or from another location.
- 25% of all employees made changes to their thermostat as a result of working from home.

Even with this rough calculation, the impact of missed setback opportunities is estimated to be somewhere in the range of 32 to 97 kWh per year per employees, much lower than the impact of commuting energy saved.

Commuting

According to the detailed survey results, 87% of respondents commuted at one time or another and 13% never commuted. Of the 87% who commuted, 96% said they commuted without passengers. Less than 5% carpooled, bicycled, or bussed to work. In a 2006 study of Sun employees who commuted to the Burlington, Massachusetts, campus, the Massachusetts Department of Environmental Protection (DEP) determined that 93% of commute trips were Drive Alone Commute Trips (DACTs)[4], very similar results to the percentage outcomes from the Open Work energy study.

Subjects in the Open Work energy study reported an average distance commuted of 45 miles round trip per day with an average total time of 70-80 minutes for the round-trip commute. The Massachusetts DEP report noted median round-trip commute time of 80 minutes and an average commute distance of 48-54 miles per round trip.

Vehicle models and years information was also collected from subjects in the Open Work energy study. The daily survey asked participants to record their average mileage, not U.S. Environmental Protection Agency (EPA) estimates. Results indicated:

- An average fuel economy of 26 miles per gallon, ranging from 12 mpg (2004 Hyundai Santa Fe with an 8-mile, 30-minute round trip commute) to 59 miles per gallon (2001 Honda Insight hybrid with a 48-mile, 60-minute round trip).
- Model year average was 2002, ranging from 1991 to 2007
- Vehicle types were 90% gas-engine, 2% diesel-engine, 7% hybrid-engine

Conclusion

The results of the Open Work energy measurement project make it clear: there is significant personal, environmental, and economic value to telecommuting programs. Sun's Open Work platform has enabled tens of thousands of employees to experience these benefits for more than 14 years. Though other companies have implemented tele-working programs, this is one of a few detailed studies that shows tangible benefits.

With quantifiable energy, carbon, and monetary savings for companies and their employees, it is likely that many more voluntary programs will flourish, and that governments and regulators will look toward technological solutions that may provide relief for crowded commuter highways.

4. *2006 Rideshare Regulation Report*, Massachusetts Department of Environmental Protection, 12/31/06

Part IV

Appendix

Open Work Energy Measurement Project Analysis and Conclusions

There are a number of important conclusions we can draw from the results of this study. The calculations and estimates in these Appendices support the findings in the main body of the paper.

These findings can be divided into four categories:

1. Energy savings and carbon reduction from reduced commuting
2. Employee cost savings
3. Reduced energy usage from office equipment
4. Impact of home heating/cooling

Energy Savings and Carbon Reduction from Reduced Commuting

A 2006 study conducted by the Massachusetts Department of Environmental Protection documented traffic savings resulting from flexible or work-from-home employees based on Sun's Burlington, Massachusetts, campus. The report noted that 39% of the 1,472 subjects reported telecommuting at least two days per week, including 193 (13%) who reported working from home every day. The Open Work program was credited with eliminating more than 173,000 vehicle trips per year.[5]

The overwhelming finding in the Open Work energy study was the amount of energy saved by avoiding the commute to a Sun office two to three days a week. In fact, the Sun team measured commute energy consumption as 15 to 110 times the amount of equipment and heating energy consumption combined.

The study's detailed survey data showed that the average employee subject avoided commuting 2.3 days per week. Commute time avoided averaged 76 minutes round trip per day. Avoiding 76 minutes of commute time on 108 days of the year provides employees with 136 hours per year of additional personal time. This is the equivalent of three weeks of vacation that the average employee avoids in commute time — time that they get back as a result of the Open Work program.

2.3 days/week avoided **X** 76 minutes/day **DIV** 60 minutes/hour **X** 47 work weeks/year = 136 hours/year avoided

Avoiding 108 commutes per year leads to avoiding a significant number of Drive Alone Commute Trips (DACTs):

108 round trips avoided/year **X** 2 DACTs/round trip **X** 18,300 employees = 3,950,000 DACTs/year avoided

Similarly, we can estimate the commute energy saved per employee and extrapolate to the entire Sun U.S. workforce. According to the detailed survey results, the average fuel economy of subjects' cars was 26 miles per gallon. When fuel economy is combined with the length of commute reported, gallons saved can be computed:

45 miles round trip/day **DIV** 26 miles/gallon = 1.73 gallons/day

1.73 gallons/day **X** 2.3 days commute avoided/week **X** 47 work weeks/year = 187 gallons/year avoided

5. *2006 Rideshare Regulation Report*, Massachusetts Department of Environmental Protection, 12/31/06

Because there was a wide range of commute distances reported, from a minimum of four miles to a maximum of 120 miles per day, the average commute had a standard error of ±5 miles round trip, or 11%. This indicates the actual average savings could be as low as 166 gallons per year, or as much as 207 gallons per year.

In order to better comprehend the energy savings, the Sun team converted fuel to energy equivalents. According to the EPA, the average gallon of gasoline has approximately 113,000 BTU of energy[6], which equates to approximately 33 kWh of energy. This means the average annual energy savings from avoiding an average of 2.3 days per week of commute is:

187 gallons/year **X** 33 kWh/gallon = 6,171 kWh equivalent/year commute energy avoided

Again, because of the wide variation and small sample size, the actual savings could range from 5,492 kWh per year to 6,788 kWh per year.

The carbon equivalent of this reduction is significant. Burning a gallon of gasoline in an automobile produces 19.4 lb of CO2, according to the EPA.[7] Total CO2 emissions avoided are therefore:

187 gallons/employee per year **X** 19.4 lb CO2/gallon = 3,628 lb CO2/employee per year = 1.49 metric tons/employee per year

1.49 metric tons/employee per year **X** 18,300 employees = 27,200 metric tons/year avoided

An individual's carbon footprint reductions are also significant. Saving 187 gallons of gasoline per year saves the equivalent of 1.49 metric tons of CO2 per employee per year.

Employee Cost Savings

With gasoline prices ranging from $2.84 to $2.92 in October 2007, study results show that the average employee could realize estimated annual fuel cost savings of $471 to $604.

Employees also receive the benefit of reduced vehicle deterioration as a result of the avoided commute. The Internal Revenue Service's allowance for vehicle expense in 2007 was $0.48[8], which includes fuel, maintenance, and depreciation costs. Backing out the fuel savings calculated above, it appears that employees may save additional money on these nonfuel items:

$0.48 dollars/mile **X** 45 miles round trip/day **X** 2.3 days avoided/week **X** 47 weeks/year = $2,335 per year

$2,335 IRS allowance — $538 fuel per year = $1,797 nonfuel savings per year

Thus, employees could realize average cost savings of more than $2,000 per year in fuel, vehicle deterioration and maintenance, and depreciation costs ($1,400-$1,600) as a result of avoiding commutes 2.3 days per week.

6. *Fuel Economy Impact Analysis of RFG*, Environmental Protection Agency, http://www.epa.gov/oms/rfgecon.htm
7. *Emission Facts: Greenhouse Gas Emissions from a Typical Passenger Vehicle*, Environmental Protection Agency, http://epa.gov/otaq/climate/420f05004.htm
8. *IRS Announces 2007 Standard Mileage Rates*, IRS, 10/01/06, http://www.irs.gov/newsroom/article/0,,id=163828,00.html

Reduced Energy Use from Office Equipment

Comparing home to Sun office power usage produced surprising results as well. Home offices averaged half the power usage of a Sun office — the result of differences in office configurations and energy management protocols.

There are more Sun workstations and large monitors in the Sun offices, as well as more devices in general. In addition, employees are almost twice as likely to use energy management at home than they are in a Sun office.

Having measured consumption rates of office equipment for 30 days, the Sun team was able to estimate annual home and Sun office energy use. Average home office energy use was measured as 65 W per hour. Total energy used by office equipment in the home is therefore:

65 W/hour **X** 8 hours/day **X** 2.3 days at home/week **X** 47 work weeks/year = 56 kWh hours/year

Similarly, Sun office energy use and net savings can be calculated. The average Sun office energy use was 124 W per hour. Total Sun office equipment energy use is therefore:

124 W/hour **X** 8 hours/day **X** 2.8 days at home/week **X** 47 work weeks/year = 131 kWh hours/year

Had the employees been working in a Sun office five days per week, they would have used more energy:

124 W/hour **X** 8 hours/day **X** 5 days at home/week **X** 47 work weeks/year = 233 kWh hours/year

Thus, by having U.S. employees work at home, Sun could save 233 – 131 = 102 kWh per employee per year, or about 1.9 million kWh for the entire U.S. employee population. In addition, because employees use less energy working in their home offices than at Sun offices, there would be a net energy reduction of 102 – 56 = 46 kWh per employee per year, or 842,000 kWh for the entire U.S. employee population.

Impact of Home Heating and Cooling

Home heating and cooling is also a factor in the amount of energy used by employees at home. Some employees change thermostat settings when they leave their house. Changing the setting is known as a “setback,” and a chance to change the setting would be a “setback opportunity.” An example of a setback opportunity would between the hours of 8 a.m. and 5 p.m. local time on weekdays, when a house would typically be unoccupied. A missed setback opportunity would occur when the employee stays home to work on a weekday, and adjusts the thermostat instead of taking a setback opportunity. The Open Work energy study attempted to quantify the number of missed setback opportunities, then estimate the energy impact of these missed opportunities.

According to U.S. Department of Energy (DOE) research, programmable thermostats can save 5-15% of annual heating/cooling energy if the temperature is set back 10-15oF for eight hours or more.[9] To determine the amount of lost savings, compare the baseline to the work-from-home

2 **X** 8-hour setback per workday: 11PM - 7AM and 8AM - 5PM

1 **X** 8-hour setback per workday: 11PM - 7AM

1 **X** 8-hour setback per workday: 11PM - 7AM

2 setback opportunities/day **X** 5 days/week **X** 47 work weeks/year **=** 470 setback opportunities

1 setback opportunity/day **X** 52 weekends/year **=** 52 setback opportunities

1 setback opportunity/day **X** 7 days/week **X** 5 vacation weeks/year **=** 35 setback opportunities

470 **+** 52 **+** 35 **=** 555 setback opportunities per year, baseline

Employee subjects in the study averaged 2.3 days per week at home, so:

2.3 work-from-home days/week **X** 47 work weeks/year **=** 108 potential setback opportunities

108 of 555 or 19% of the savings resulted from setbacks or set ups. If the DOE's cited 5-15% savings apply, then the additional heating/cooling energy used as a result of Open Work's flexible work program might be 1-3% of the total heating and cooling energy used in the home (1-3% = 19% x (5 to 15% savings))

The DOE research[9] also provides an average for the amount of energy used in U.S. homes for heating and cooling:

1. Overall average energy use for heating/cooling for U.S. homes in 2001 was 43.9 million BTU per year. 1-3% of this would be 439,000 to 1,317,000 BTU, equivalent to 128-386 kWh. This is the potential energy impact per employee if an employee changes the thermostat setting when working from home.

2. Returning to the Open Work energy study survey data, 41% of subjects stated that they made no change to the thermostat when working from home, so no setback opportunities are missed. Another 27% said they didn't have programmable thermostats, and would need to be studied further to determine if they are missing setback opportunities. 6% of respondents stated that they had programmable thermostats but did not indicate whether they changed the setting or not.

3. Only 25% of employees stated that they changed the thermostat setting when working from home. This statistic allowed the Sun project team to calculate the total impact of home heating and cooling energy. For the population of Sun's U.S. employees participating in the study:

   128 to 386 kWh per employee **X** 25% employees who change settings **X** 18,300 U.S. employees **=** 586,000 to 1,766,000 kWh

9. *Thermostats and Control Systems*, U.S. Department of Energy, http://apps1.eere.energy.gov/consumer/your_home/space_heating_cooling/index.cfm/mytopic=12720

If averaged across all of Sun's U.S. employees, this would result in roughly 32 to 97 kWh per employee per year, or somewhere between $3.00 and $10.00 for heating and cooling costs per employee at $0.10 per kWh. Of course, this number can't be precisely averaged: employees who don't change the setting have no impact, while employees who change the setting average $13 to $39 per year for heating and cooling costs as a result of working from home — using between 128 kWh and 386 kWh per year.

The highest estimated combined equipment/heating energy impact on an employee would be approximately 450 kWh, which would cost less than $50 per year. Typical employee energy use would be closer to 120 kWh per year, or an annual expense of $10-$15.

To learn more about Sun's Open Work program, visit sun.com/openwork .

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