

Potential for Savings in China's Government Energy Efficiency Procurement Program: Preliminary Findings

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1. Background

On December 17, 2004, China's Ministry of Finance, in tandem with the National Development and Reform Commission, announced a new policy for government energy efficiency procurement. The new policy modified the National Procurement Policy, enacted 1 January 2003, to include the preferential purchase of labeled energy efficient models of products subject to mandatory procurement. The program started in 2005 and by the end of 2006 will be rolled out to all levels of government, including central, provincial, and local. In China, the "government" sector also includes schools and hospitals, and these will be subject to the same requirements as the formal government offices at each level.

The National Procurement Policy specifies a list of products subject to mandatory central procurement. In the new policy, this list was modified to include the following products for which energy- and water-efficiency performance are to be considered:

- Refrigerators
- Room Air Conditioners
- Double Capped Fluorescents for General Lighting Service
- Self-ballasted Fluorescents for General Lighting Service
- Televisions
- Computers
- Printers
- Toilets
- Faucets

This new policy grew out of 3 years of cooperation between the US and China, with technical assistance provided by the Energy Foundation and the US EPA. The program is largely modeled on the US Federal Energy Management Program, which relies heavily on Energy Star labeling to determine the list of qualified models. The China policy has adopted the same linkage; the efficiency specifications for each product are those underlying China's current energy efficiency labeling program run by the China Standard Certification Center (CSC, formerly CECP), and qualified procurement models must have received CSC certification.

2. PePS Energy Savings Tool

The PePS Energy Saving Tool is designed to help government offices, agencies, or program managers to estimate the energy and cost savings from buying energy-efficient equipment. The current version of the tool includes modules to estimate savings from some of the energy-efficient products most commonly found in government offices, including monitors, PCs, printers, copiers, fax machines, televisions, CFLs and linear fluorescent lamps and ballasts. The Tool encompasses a spreadsheet model designed to provide a general estimate of energy savings, cost savings and avoided pollution. Where a more detailed financial or engineering analysis is needed, other methods should be used.

Each sheet of the tool is color coded to distinguish between various types of inputs and outputs (Figure 1). The yellow areas include default values (with reference to US defaults) that the user can change as needed. The orange areas indicate user-defined values, while the green areas indicate calculated results based on the default and user-defined inputs.

Figure 1 Sample Unit Savings Calculation Sheet for PCs

PEPS Energy Savings Tool
(version 1.1)
Personal Computers (PCs) - Unit Savings

Language [English](#)

Click below to jump to:
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[Input Data \(Elec. prices & Emissions\)](#)

Input Area --- Input your data here:

Product lifetime: 5 **Years*** * Change the lifetime based on your local conditions.

% left on nights and non-workdays: 50% *US Default: 70%*
 % turned on per day: 75% *US Default: 75%*
 Energy-efficient unit enabling rate: 50% *US Default: 50%*

	Energy-efficient unit	Conventional unit	
Average power in "active" mode:	57.9 W	57.9 W	<i>US Default: 116 W, 116 W</i>
Average power in "sleep" mode:	7.5 W	10.0 W	<i>US Default: 13 W, N/A</i>
Average power in "deep sleep" mode:	W	W	<i>US Default: 11 W, N/A</i>
Average power in "off" mode:	3.0 W	4.0 W	<i>US Default: 4 W, 4 W</i>
# of hours in "active" mode per work day:	7.7 Hours	7.7 Hours	<i>US Default: 4 hrs., 9.5 hrs.</i>
# of hours in "sleep" mode per work day:	4.6 Hours	4.6 Hours	<i>US Default: 2 hrs., 0 hrs.</i>
# of hours in "deep sleep" mode per work day:	Hours	- Hours	<i>US Default: 3.5 hrs., 0 hrs.</i>
# of hours in "off" mode per work day:	11.7 Hours	11.7 Hours	<i>US Default: 14.5 hrs., 14.5 hrs.</i>

Calculated Results:

	Energy-efficient unit	Conventional unit
Annual energy use per unit:	205 kWh	313 kWh
Annual energy savings per unit:	108 kWh	N/A kWh
Annual energy operating costs per unit:	¥ 123	¥ 188
Annual energy cost savings per unit:	¥ 65	N/A

If you know the initial purchase price, calculate indicators of cost-effectiveness (For most office equipment, the price is the same for conventional and energy-efficient units) :

	Energy-efficient unit	Conventional unit
Initial cost per unit:		
Simple payback time:		years
Lifetime energy cost savings (Present Value):	¥ 287	
Net Present Value (Lifetime savings - Added cost):		

Each sheet can be displayed in three languages: English, Chinese and Spanish (Figure 2.) For the purpose of this analysis, all monetary values have been changed to Chinese RMB¥, and average emissions and electricity prices set to the Chinese averages. The tool includes an extensive selection of electricity prices and emissions rates for countries around the world.

Figure 2 Sample Unit Savings Sheet for PCs, in Chinese



PePS
PROMOTING AN
energy-efficient
PUBLIC SECTOR

PEPS 节能计算器
第1.1版
Personal Computers (PCs) - Unit Savings

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语言 [Chinese](#)

数据输入——请在此输入数据:

产品生命周期: 年* * 根据具体情况改变设定值

夜晚和非工作日仍处于开机状态的显示器 (%) :	50%	美国默认值: 70%
工作日处于开机状态的显示器 (%) :	75%	美国默认值: 75%
处于节能状态的显示器 :	50%	美国默认值: 50%

	节能产品	传统产品	
"工作"状态下平均用能:	57.9 W	57.9 W	美国默认值: 116 W, 116 W
"睡眠"状态下平均用能:	7.5 W	10.0 W	美国默认值: 13 W, N/A
"深睡眠"状态下平均用能:	W	W	美国默认值: 11 W, N/A
"关机"状态下平均用能:	3.0 W	4.0 W	美国默认值: 4 W, 4 W
每工作日处于"工作"状态时间:	7.7 小时	7.7 小时	美国默认值: 4 hrs., 9.5 hrs.
每工作日处于"睡眠"状态时间:	4.6 小时	4.6 小时	美国默认值: 2 hrs., 0 hrs.
每工作日处于"深睡眠"状态时间:	小时	- 小时	美国默认值: 3.5 hrs., 0 hrs.
每工作日处于"关机"状态时间:	11.7 小时	11.7 小时	美国默认值: 14.5 hrs., 14.5 hrs.

计算结果:

	节能产品	传统产品
每台显示器年度用能:	205 kWh	313 kWh
每台显示器年度节能:	108 kWh	N/A kWh
每台显示器年度用能开支:	¥123	¥188
每台显示器年度用能开支节约:	¥65	N/A

如果你知道购买价格, 请在此输入价格以计算成本效益 (对于大部分办公室产品而言, 节能产品和传统产品的市场价格是一样的):

	节能产品	传统产品
单位购买价格:	<input type="text"/>	<input type="text"/>

简单回收期: 年

生命周期能源开支节约 (现值):

净现值 (生命周期开支节约 - 额外开支):

The results of the unit savings sheet feeds into the program savings sheet where the results are aggregated across a user-defined number of years, both in annual and cumulative terms (Figure 3). Depending on the product, the office/agency/program savings relies on either a usage rate for the product (copiers, monitors, PCs, fax machines, televisions), indicating the proportion of employees using such equipment, or the "coverage rate" (CFLs and fluorescent lamps), indicating the proportion of the floor space served by the equipment.

Figure 3 Sample Program Savings Sheet for PCs



PEPS Energy Savings Tool
(version 1.1)

PCs - Program Savings

Click below to jump to:

- [Introduction](#)
- [Summary Table](#)
- [Summary Graphics](#)
- [Input Data \(Elec. prices & Emissions\)](#)

Language [English](#)

Input Area --- Input your data here:

I want to estimate savings for 10 years of purchases. (Please select a number.)

Skip this section if you know the number of units purchased each year; enter these numbers in column 1A below. (Don't forget to include replacement units as older units are retired.)
 Otherwise, use this section to estimate the number of units purchased. (Results will be shown in column 1B of the next section.)

of employees in the agency: * Generally, monitors and PCs should have the same stocks but different lifetimes.
 # of employees currently using PCs: Except for lifetime, use the same assumptions to calculate savings for
 # of employees to be added (reduced) per year in future: PCs and monitors.
 Annual increase in % of employees using monitors:

Calculated Results:

Units to be purchased each year*					ANNUAL Savings (for each year of purchase)					CUMULATIVE ANNUAL Savings (all years of purchasing)				
Year	(planned for purchase) 1A	(calculated from above) 1B	Current stock (units)	% of energy efficient purchases (0 - 100%)	Energy savings (kWh)	Energy Cost savings (\$)	Avoided CO2 emissions (Metric Tons)	Avoided SO2 emissions (kg)	Avoided NOx emissions (kg)	Energy savings (kWh)	NPV of cost savings (\$)	Avoided CO2 emissions (Metric Tons)	Avoided SO2 emissions (kg)	Avoided NOx emissions (kg)
1	757,568	696,960	3,545,408	50%	40,743,143	24,445,886	37,687	117,340	52,966	40,743,143	23,505,660	37,687	117,340	52,966
2	757,568	648,474	3,593,894	50%	40,743,143	24,445,886	37,687	117,340	52,966	73,337,658	41,586,936	67,837	211,212	95,339
3	757,568	609,684	3,632,684	60%	48,891,772	29,335,063	46,225	140,808	63,559	107,561,899	63,319,240	99,495	309,778	139,830
4	757,568	578,653	3,663,715	80%	65,189,029	39,113,418	60,300	187,744	84,746	151,238,548	91,738,406	139,896	435,567	196,610
5	757,568	553,828	3,688,540	95%	77,411,972	46,447,183	71,606	222,946	100,636	198,402,811	123,484,930	183,523	571,400	257,924
6	757,568	533,968	3,708,400	95%	77,411,972	46,447,183	71,606	222,946	100,636	236,134,221	152,851,237	218,424	680,067	306,974
7	757,568	518,080	3,724,288	95%	77,411,972	46,447,183	71,606	222,946	100,636	266,319,349	181,088,070	246,345	767,000	346,215
8	757,568	505,370	3,736,998	95%	77,411,972	46,447,183	71,606	222,946	100,636	290,467,452	208,238,872	268,682	836,546	377,608
9	757,568	495,201	3,747,167	95%	77,411,972	46,447,183	71,606	222,946	100,636	309,785,934	234,345,412	286,552	892,183	402,722
10	757,568	487,067	3,755,301	95%	77,411,972	46,447,183	71,606	222,946	100,636	325,240,720	259,447,854	300,848	936,693	422,813

*Note: In this calculation table, a statistical replacement rate is used rather than a vintage replacement. For example, with an average product lifetime of 4 years, some units may be replaced sooner than 4 years and some may last longer.

The results include annual purchases calculated from the lifetime of the product as entered by the user (or left at the default value) using a linear retirement function. This can be overridden by the user if the volume of planned purchases is known.

Savings results include the energy savings in kWh, energy cost savings in local currency, and avoided CO₂, SO₂, and NO_x emissions based on national averages.

A Summary Page then aggregates the savings from all the products selected for use in the program; these numbers are used to automatically create pie charts of the proportional annual savings of all products in the *n*th year of the program, as selected by the user. (See Table 1 and Figure 4, below.)

3. Assumptions and Results

In this exercise, we focus on the technical potential for electricity savings from the use of energy-efficient models of products as specified in the current energy efficiency procurement policy. Water efficient products (toilets and faucets) are excluded.

As is true in all sectors, very little end-use data exist about the government sector. In 2003, CECP and LBNL developed a survey form for use in a survey of a number of government office buildings (including schools and hospitals) in three provinces, and the results indicated that average energy consumption in Chinese office buildings (particularly government offices) was on average higher than other commercial or residential space. However, the survey did not provide sufficient data to calculate overall ownership patterns, usage, or energy

consumption, so we have based this exercise primarily on the size of the government work force and the floor space of government buildings.

Currently, there are 10.56 million government employees. (CSY 2004) This includes employees at the central, provincial, and local government levels, each of which is subject to the procurement policy, and it excludes employees of schools and hospitals. The number of employees has remained fairly stable for the last 10 years, ranging from 10.27 million in 1995 to 10.91 million in 2000. It is assumed in this exercise that there will be no change in employment levels over the next decade.

No official public data exists on the amount of floor space in government buildings. However, the Energy Research Institute estimates the proportion of total non-residential floor space of 8 billion m² at about 5% for government, 17% for schools and about 4% for hospitals. (China 2020).

In the absence of actual purchase and stock figures, we have tied the calculations of computers, printers, refrigerators, air conditioners and televisions to the employee numbers, and of linear fluorescent lamps and CFLs to floor space estimates. The basic assumptions for each product are discussed below.

Computers

Computers are in wide-spread use in government offices. The current stock of computers was calculated based on assumed ownership of about 33 computers per 100 government employees. Each computer is assumed to remain in use for 5 years. Average computer energy consumption is taken from laboratory results provided to CECP, with the current energy efficiency specification providing the consumption rates for efficient models. One key to actual savings with computers is the enabling rate of the energy efficiency measures. Little is known about the situation in China with regard to enabling rates, and the one small sample survey taken found it to be fairly low, below 50%. In the model, we have assumed 50%.

Printers

The use of printers has grown as the use of computers has expanded. The assumptions for the printer analysis are connected to those of computers by specifying the number of computers connected to a shared printer. In this case, it is assumed that on average 5 computers are connected to a single printer, and lifetime of a printer is 5 years. Usage behavior is based on CECP-sponsored survey of standby-energy-consuming equipment, and energy consumption averages are derived from laboratory test results and the current energy efficiency specification.

Televisions

Actual ownership and annual purchases of televisions are not known, but televisions are typically found in most government office buildings. For this exercise, we assume that there is one television for every 50 employees and that a television has an average lifetime of 5 years. Television performance in the

calculations is based on testing data supplied to CECP on color CRT-type televisions and the current television efficiency specification.

Linear Fluorescent Lamps

Savings from the purchase of incandescent lamps is difficult to calculate, since the China procurement list includes only the lamps themselves, and not the associated ballasts (which usually account for 70% of total unit savings). In this exercise, we thus simplified the calculation to focus only on the lamp itself, based on the current minimum efficiency standard and the energy efficiency performance specification. Nonetheless, given the predominance of linear fluorescent lamps in building lighting stock, the potential savings—based on 40% coverage of 400 million m² of floorspace and an average 80% penetration of conventional linear fluorescent lamps—are quite large.

CFLs

Savings from the purchase of compact fluorescent lamps are calculated on the basis of replacing current incandescent lamp use. It is estimated that 1% of the total floorspace of 400 million m² contain incandescent lamps that will be converted to CFL usage. CFL performance is based on the current CECP requirements, including a lifetime of 6000 hours.

Refrigerators

Small refrigerators are often found in government offices. For this exercise, it is assumed that the average size is 220 liters, smaller than the most common model size purchased for households (360 liters). The estimate of current stock of about 422,000 is based on an assumed penetration of 4 refrigerators per 100 employees. The savings are based on the new 2004 refrigerators minimum efficiency standard and energy efficiency performance specifications, with a 15-year lifetime. Because refrigerators were not originally included in the PePS Energy Savings Tool, estimates of savings for this exercise were calculated using a technical model developed for the minimum energy efficiency standards program. The product will be incorporated directly into the PePS Energy Savings Tool.

Air Conditioners

Mini-split air conditioners are a common source of cooling in government office buildings. The stock of air conditioners was estimated at about 1.8 million, or about 1 per every 6 government employees. Savings were estimated based on the new 2005 minimum efficiency standard and the new energy-efficient specifications and an average lifetime of 15 years. As with refrigerators, these savings were estimated using a stand-alone technical model developed for the minimum standards program, but the product will be incorporated directly in the PePS Energy Savings Tool.

Summary

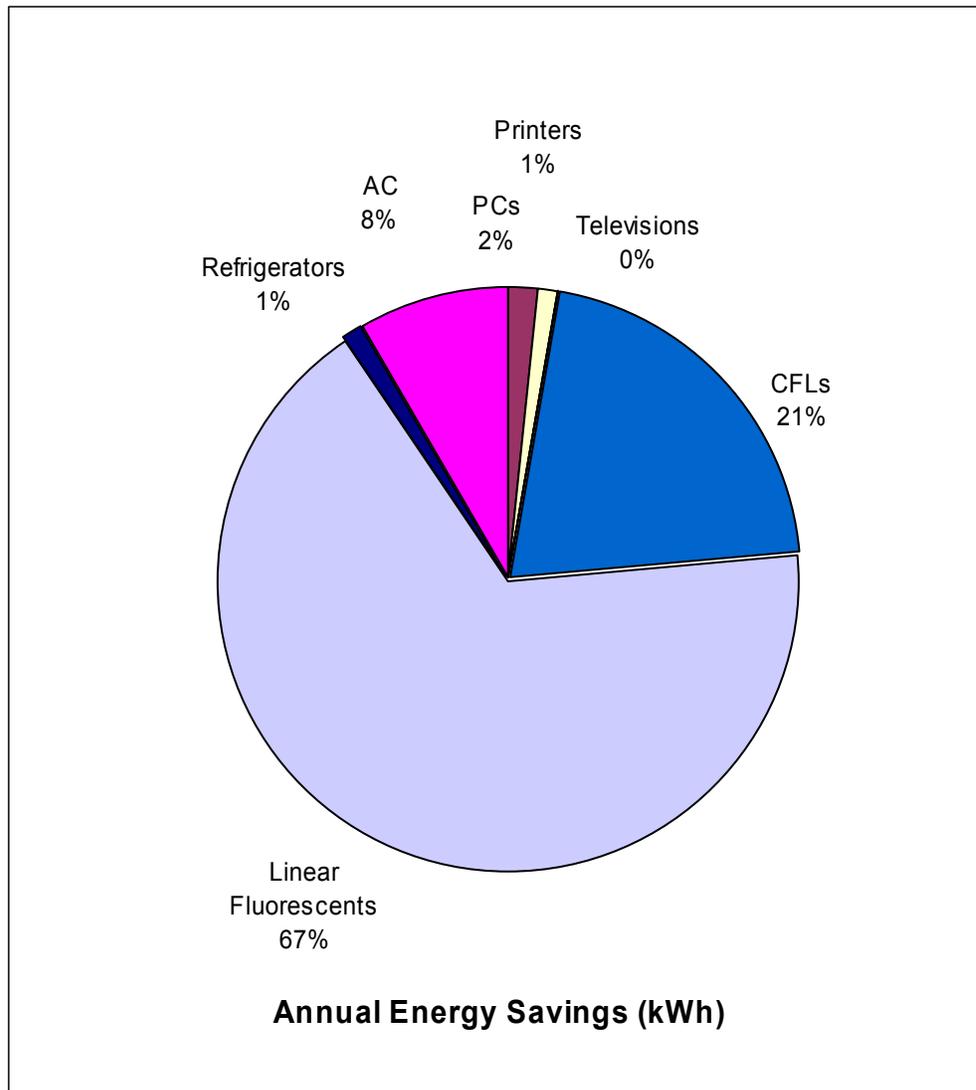
For the 7 energy efficient products currently in the Ministry of Finance procurement list, avoided electricity consumption in year 10 of the program would reach 4.65 TWh for a monetary savings of ¥2.9 billion (US\$353 million)

(Table 1). These savings are primarily derived from the use of energy-efficient lighting, as shown in Figure 1. Efficiency gains in the procurement of mini-split air conditioners provides the next highest increment, at 8% of the total. Savings from the purchase of efficient computers and printers contribute only 3% of the total and are contingent on the wide-spread enabling of the energy-efficiency features, such as auto-standby, built into the operating systems of the machines.

Table 1 Annual Savings in Year 10

Product	ANNUAL Savings (for year n of purchase)				
	Energy savings (kWh)	Energy Cost savings (¥)	Avoided CO2 emissions (Metric Tons)	Avoided SO2 emissions (kg)	Avoided NOx emissions (kg)
Monitors	-	-	-	-	-
PCs	77,411,972	46,447,183	71,606	222,946	100,636
Printers	54,543,284	32,725,970	50,453	157,085	70,906
Copiers	-	-	-	-	-
Faxes	-	-	-	-	-
Televisions	959,983	575,990	888	2,765	1,248
Subtotal, Office Equip.	132,915,239	79,749,144	122,947	382,796	172,790
CFLs	960,660,000	594,186,000	888,611	2,766,701	1,248,858
Linear Fluorescents	3,119,353,037	1,924,782,612	2,885,402	8,983,737	4,055,159
Subtotal, Lighting	4,080,013,037	2,518,968,612	3,774,012	11,750,438	5,304,017
SUBTOTAL	4,212,928,276	2,598,717,756	3,896,959	12,133,233	5,476,807
Refrigerators	48,132,000	28,879,200	44,522	138,620	62,572
Room AC	388,125,000	232,875,000	359,016	1,117,800	504,563
GRAND TOTAL	4,649,185,276	2,860,471,956	4,300,496	13,389,654	6,043,941

Figure 4 Distribution of Annual Savings in Year 10



On a cumulative basis, avoided electricity use in year 10 reaches 10.9 TWh, with discounted savings of ¥8.7 billion (US\$1.07 billion). This is equivalent to the emission of 10 million tonnes of CO₂, 31.4 million kg of SO₂, and 14.2 million kg of NO_x. (Table 2.)

Table 2. Cumulative Savings in Year 10

Product	CUMULATIVE ANNUAL Savings (after the nth year of purchasing)				
	Energy savings (kWh)	NPV of cost savings (¥)	Avoided CO2 emissions (Metric Tons)	Avoided SO2 emissions (kg)	Avoided NOx emissions (kg)
Monitors	-	-	-	-	-
PCs	325,240,720	259,447,854	300,848	936,693	422,813
Printers	229,159,602	182,802,962	211,973	659,980	297,907
Copiers	-	-	-	-	-
Faxes	-	-	-	-	-
Televisions	4,284,529	3,848,203	3,963	12,339	5,570
Subtotal, Office Equip.	558,684,851	446,099,020	516,783	1,609,012	726,290
CFLs	1,498,483,013	1,341,644,304	1,386,097	4,315,631	1,948,028
Linear Fluorescents	6,433,181,567	5,465,309,877	5,950,693	18,527,563	8,363,136
Subtotal, Lighting	7,931,664,580	6,806,954,181	7,336,790	22,843,194	10,311,164
SUBTOTAL	8,490,349,431	7,253,053,201	7,853,573	24,452,206	11,037,454
Refrigerators	265,520,000	159,312,000	245,606	764,698	345,176
Room AC	2,141,085,000	1,284,651,000	1,980,504	6,166,325	2,783,411
GRAND TOTAL	10,896,954,431	8,697,016,201	10,079,683	31,383,229	14,166,041

The basis of this exercise was to determine the magnitude of the technical potential for savings in China's nascent government efficiency procurement program. Estimates can be better refined once better information on scope, volume of procurement, and actual distribution of products is known. Limited to just the government sector, these numbers understate the full potential, as schools and hospitals will also be subject to the new procurement rules, but details of their purchase and usage behavior is even less certain.

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China 2020. Energy Research Institute, *China's Sustainable Energy Scenarios in 2020*. Environmental Sciences Press, Beijing, 2003