Employment Estimates for Energy Efficiency Retrofits of Commercial Buildings

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TABLES AND METHODOLOGY

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INTRODUCTION

This document presents estimates of spending and employment that could result from a federal program to provide incentives for retrofitting commercial buildings to increase their energy efficiency. These employment estimates were developed using an input-output model as well as data from the Energy Information Administration's April 2011 *Short Term Energy Outlook*, the 2003 Commercial Building Energy Consumption Survey (CBECS)[1], and data provided by the U.S. Green Building Council.

METHODOLOGY FOR ESTIMATING EMPLOYMENT MULTIPLIERS

INPUT-OUTPUT MODEL BACKGROUND

The input-output (I-O) model used for this analysis is the IMPLAN version 3 model with 2009 U.S. national data, the most recent data available as of April 2011. The IMPLAN model uses data from the Commerce Department's Bureau of Economic Analysis as well as additional data sources to compile input-output accounts of 440 industries. Using the I-O model, we can estimate the number of jobs that are directly created in a given industry in response to increased spending in that industry. In addition, since the I-O model captures inter-industry linkages, we can also estimate the number of jobs that are indirectly created throughout the economy in industries which supply goods and services to the industry in question. For example, if spending on the output of the construction industry increases by $1 million, we can use the I-O model to estimate the number of direct jobs that are created in the construction industry in response to that increased spending, as well as the indirect jobs that are created in lumber, hardware, trucking, and other industries which supply the construction industry. Finally, in this analysis we also include induced job creation. Induced employment results when workers in the direct and indirect industries spend their earnings, creating increased demand in industries such as retail, healthcare, and food services. For this analysis, we use an induced multiplier of 0.40. Once we measure the combined impact of the direct and indirect employment, we multiply this by 40 percent to estimate the level of induced employment.

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[1] The 2003 CBECS survey is the most recent data available.

ENERGY EFFICIENCY CATEGORIES: COMPOSITION AND MULTIPLIERS

Using the I-O model, we estimate the number of jobs created for each $1 million spent in the industries we would expect are most affected by increased demand for commercial building EE retrofits. These include the manufacturing and installation of the following types of technologies:[2]

- lighting upgrades;
- heating, ventilation, and air conditioning (HVAC) upgrades;
- water heating upgrades;
- new motors and drives for building energy systems;
- office equipment upgrades (including copiers, computers, and communications equipment);
- environmental controls (including controls for heating and cooling, circuits, and processes); and
- building envelope improvements (including windows, roofing, and insulation).

Spending $1 million on the manufacture and installation of each of these technologies results in the following employment impacts:

Table 1

EE *technology group*	Direct employment *per $1 million*	Indirect employment *per $1 million*	Induced employment *per $1 million*	Total employment *per $1 million*
Lighting	5.1	4.2	3.7	12.9
HVAC	5.3	4.2	3.8	13.3
Motors and drives	4.5	3.9	3.4	11.9
Water heating	5.0	4.1	3.6	12.6
Office equipment	3.8	3.7	3.0	10.5
Environmental controls	5.0	4.3	3.7	13.0
Envelope improvements	7.7	3.9	4.7	16.3
Straight average	5.1	4.0	3.7	12.8
Weighted average	5.7	4.1	3.9	13.6

We calculate a weighted average of these EE upgrades to commercial buildings. The weights for these were derived using data from the Lawrence Berkeley National Laboratory on energy-efficiency measures installed in ESCO projects. They are as follows:

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[2] This list was developed using information from USGBC as well as the January 2005 "Review of U.S. ESCO Industry Market Trends" by LBNL; Building STAR Survey Results from the Real Estate Roundtable; and the February 2011 report "Deep Savings in Existing Buildings" by the New Buildings Institute for NEEA.

Table 2

EE technology group	Weighting
Lighting	0.25
HVAC	0.20
Motors and drives	0.11
Water heating	0.09
Office equipment	0.03
Environmental controls	0.26
Envelope improvements	0.06

The industry composition used to generate these employment estimates in the I-O model is presented here:

Table 3

Category	Industry composition in I-O Model (direct impacts)
Lighting	70% lighting fixture manufacturing, 30% installation[3]
HVAC	24% air purification and ventilation equipment, 23% heating equipment, 23% air conditioning and refrigeration equipment, 30% installation
Water heating	35% power boilers, 35% water heaters (except boilers), 30% installation
Motors and drives	70% motor and generator manufacturing, 30% installation
Office equipment	28% photocopying equipment, 28% computer equipment, 7% telephone
Environmental controls	70% automatic environmental controls manufacturing, 30% installation
Envelope improvements	8% window manufacturing, 8 % insulation, 2% roofing materials, 2% painting and coating materials, 80% installation

The table above reflects only the direct spending on equipment and installation. In addition to the industries directly affected by these upgrades, a variety of manufacturing and services industries will be indirectly affected. These are listed in the table below:

Table 4

Category	Industries indirectly impacted
Lighting	Wholesale trade, power equipment and transformer manufacturing, truck transportation, building services, machine shops
HVAC	Wholesale trade, truck transportation, services to buildings, machine shops, ferrous metal foundries, iron and steel mills
Water heating	Wholesale trade, machine shops, truck transportation, services to buildings, business support services, architecture and engineering
Motors and drives	Wholesale trade, truck transportation, services to buildings, copper rolling and drawing, crown and closure manufacturing, iron and steel mills
Office equipment	Wholesale trade, semiconductor manufacturing, software publishers, scientific R&D, advertising
Environmental controls	Wholesale trade, scientific R&D, software publishers, services to buildings, custom computer programming, semiconductor manufacturing
Envelope improvements	Wholesale trade, truck transportation, services to buildings, accounting, maintenance and repair construction, architecture and engineering

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[3] The term "installation" is used here to represent the industry of repair and maintenance construction of non-residential buildings.

In addition to manufacturing and installing new energy-efficient technologies, a national program to retrofit commercial buildings will generate employment in facilities services, as building owners employ personnel to operate and monitor their building's energy system. The majority of this cost (95%) will be directly attributable to paying personnel, while a small percentage (5%) is used to purchase belts, coils, and other such equipment needed to maintain the facility's energy operations. The employment multipliers for these operations are as follows:

Table 5

Category	Direct employment per $1 million	Indirect employment per $1 million	Induced employment per $1 million	Total employment per $1 million
Facility operations	8.0	4.4	5.0	17.4
	Industry composition (direct spending)	*Industries indirectly impacted*		
	95% facility support services, 2.5% belts and hoses, 2.5% transformers, coils, inductors	Scientific and technical consulting, real estate, telecommunications, architecture and engineering		

Finally, energy efficiency upgrades will lower the total cost of energy spending in the retrofit buildings. These savings will be re-spent by building owners, creating additional demand (and therefore additional employment) in other industries. We assume here that building owners will spend the savings on energy costs according to the same pattern of non-energy purchases they currently make. These employment impacts are as follows:

Table 6

Category	Direct employment per $1 million	Indirect employment per $1 million	Induced employment per $1 million	Total employment per $1 million
Real estate establishment spending	6.5	3.4	4.0	13.9
	Industry composition (direct spending)	*Industries indirectly impacted*		
	100% industry spending (industry is all real estate establishments, including commercial)	Wholesale trade, truck transportation, services to buildings, accounting, maintenance and repair construction, architecture and engineering		

EMPLOYMENT CREATED BY COMMERCIAL ENERGY-EFFICIENCY UPGRADES

In the table below, we use these employment multipliers along with data provided by USGBC as well as data from the Energy Information Administration to model the employment effects of a national energy efficiency retrofit program for commercial buildings. The table below includes federal and private spending through various provisions in the Better Buildings Initiative. These provisions include:

- a tax incentive for commercial building retrofits;
- energy efficiency loan guarantees;
- a competitive grant program ("Race to the Green"); and
- deployment of existing state and local ARRA-funded commercial energy efficiency programs.

FEDERAL AND PRIVATE INVESTMENT AMOUNTS

The federal investment amounts for each of these categories were provided to PERI by the U.S. Green Building Council, based on expected spending for the Better Buildings Initiative[4]. In all categories of the initiative, federal dollars are expected to leverage private investment. Tax incentives are assumed here to leverage $3 of private investment for each $1 of federal spending. This leveraging amount is based on prior external estimates of the Building Star proposal for expanded tax credits and is a somewhat conservative estimate as compared to other third-party analysis.[5,6] The pilot loan guarantee program assumes a leveraging amount of 10 to 1, which is consistent with the credit subsidy for Recovery Act funded Department of Energy Loan Guarantee Programs. The "Race to the Green" leverages at a ratio of 5 to 1, which is consistent with leverage targets for DOE Recovery Act programs to state and local governments and results in $90 million federal dollars leveraging an additional $450 million from other government units. The leverage amount of the deployment of existing state and local Recovery Act-funded commercial EE programs is based upon direct feedback from Recovery Act recipients who are in the process of establishing partnerships with lenders and launching programs.[7] For each of these categories in the Better Buildings Initiative, we model the separate and combined employment impacts of federal and private investment.

EMPLOYMENT MULTIPLIERS

Tax incentives. The structure for this program is that 60 percent of the tax incentive will be received at the beginning of the program, and the remaining 40 percent will be paid after 2 years if the building meets its energy targets. Based on the leveraging amounts provided by USGBC, the federal funds ($1 billion) leverage $3 billion in private investment. We assume that of the $3 billion private funds, 90 percent (or $2.7 billion) are spent upfront, 5 percent ($150 million) after year 1 and 5 percent after year 2. The upfront combined public and private funds ($600 million public plus $2.7 billion private) are used to buy and install a variety of EE technologies. We use the weighted average employment multiplier to estimate the jobs created by this combined investment of $3.3 billion. The weighted average multiplier includes all of the technology categories listed above (lighting, HVAC, water heating, motors and drives, office equipment, environmental controls, and envelope improvements). As described above, the weights were derived using data on measures installed in ESCO projects, collected by Berkeley National Laboratory and provided to PERI by USGBC.

The additional $400 million in federal funds are paid after two years, and ten percent of the private funds ($300 million) are spent over these two years. We assume that this is the value to the building owner of meeting the energy target, and that the owner will spend up to this amount in employing personnel to operate and maintain the building energy system. Thus the employment multiplier that we use for this combined amount of $700 million is the multiplier for 'facilities services'. While the federal government would pay this amount at the end of two years, we assume it will be treated as reimbursement to building owners, and that these owners spend up to this amount within the first two years of the program.

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[4] http://www.energy.gov/news/10049.htm

[5] See the Building Star Fact Sheet at
http://www.energyfuturecoalition.org/files/webfmuploads/Fact%20Sheet%20for%20Building%20Star%203.4.10.pdf

[6] See the Architecture 2030 Fact Sheet at http://www.architecture2030.org/downloads/BBI_factsheet_FINAL.pdf

[7] This information was provided to PERI by the National Economic Council on May 27, 2011.

For the category "Respending of Energy Savings" we first estimate office building energy costs and then estimate the savings to building owners achieved through this program. First, using the 2003 CBECS we find the percentages of energy consumption types used by office buildings. These data show that office building energy consumption is 63.4% electricity, 23.7% natural gas, and the remainder fuel oil and district heat. Using the EIA's April 2011 *Short Term Energy Outlook*, we identify commercial building energy use and energy prices, and find that commercial buildings in total use about $200 billion (in $2010) of energy each year. This total spending applies to all commercial buildings. The portion expected to be touched by this EE program, 1.667 billion square feet, represents 2.32% of this total square footage. This percentage of $200 billion is $4.685 billion. Since USGBC expects energy savings of 31%, the dollar value of savings is then $1.45 billion. We then assume that these energy savings will be spent according to the current purchasing patterns of the owners of these buildings, which are typically Commercial Real Estate firms, and use this multiplier to estimate employment effects of respending energy savings.

Table 7

Energy Savings Levels*	Distribution*	Square Footage	Total Incentive Amount
20-24%	30%	500 million sq ft	$300 million
25-29%	30%	500 million sq ft	$300 million
30-34%	10%	167 million sq ft	$100 million
35-39%	10%	167 million sq ft	$100 million
40-44%	10%	167 million sq ft	$100 million
45-50%	5%	83 million sq ft	$50 million
50% or more	5%	83 million sq ft	$50 million
TOTAL	100%	1.667 billion sq ft	$1 billion
Weighted average savings	31%		

*Data provided to PERI by U.S. Green Building Council

Energy efficiency loan guarantees. The loan guarantee program is a credit subsidy which is used to stimulate private lending. In terms of job creation, only the private funds will generate employment. The federal funds would only be used in the case of default, which implies an unsuccessful project that does not generate ongoing employment. Thus there is zero employment creation for the federal funds held in reserve. For the private funds we use the weighted average employment multiplier for installed EE technologies.

"Race to the green" grant program. Here both federal and private dollars lead to job creation and we use the weighted average employment multiplier for installed EE technologies for this program area.

Deployment of existing recovery act commercial energy efficiency loans. This category includes various measures to support commercial energy efficiency programs, including credit enhancements, the State Energy Program, and the Energy Efficiency and Conservation Block Grant Program. We make the conservative assumption that federal funds will be used to guarantee loans and thus do not directly create employment. Job creation results from the private funds leveraged through this program, for which we use the weighted average employment multiplier for installed EE technologies.

Table 8

		Employment impacts (full-time-equivalent job years)			
Funding Category	*Funding amount (in $millions)*	*Direct*	*Indirect*	*Induced*	*Total*
TAX INCENTIVE					
Federal upfront	$600	3,404	2,435	2,336	8,175
Private investment upfront	$2,700	15,320	10,958	10,511	36,789
Sub-total upfront	$3,300	18,724	13,393	12,847	44,964
Private investment after year 1	$150	1,200	660	744	2,604
Private investment after year 2	$150	1,200	660	744	2,604
Federal payment after year 2	$400	3,200	1,760	1,984	6,944
Sub-total spending over first 2 years	$700	5,600	3,080	3,472	12,152
Respending of energy savings	$1,452	9,438	4,937	5,808	20,183
Combined total	$5,452	33,762	21,409	22,127	77,299
PILOT LOAN GUARANTEE PROGRAM					
Federal investment	$200	--	--	--	--
Private investment	$2,000	10,291	8,000	7,317	25,608
COMPETITIVE GRANT PROGRAM					
Federal investment	$90	463	360	329	1,152
Private investment	$450	2,316	1,800	1,646	5,762
Total	$540	2,779	2,160	1,975	6,914
DEPLOYMENT OF EXISTING RECOVERY ACT COMMERCIAL EE					
Federal investment	$150	--	--	--	--
Private investment	$350	1,801	1,400	1,280	4,481
TOTAL BETTER BUILDINGS INITIATIVE					
Federal investment	$1,440	7,068	4,555	4,649	16,272
Private investment and spending of energy savings	$7,252	41,566	28,414	28,050	98,031
Total, all funds and programs	$8,692	48,633	32,969	32,699	114,302