The Projected Impact of Energy Conservation Legislation: The Louisiana Energy Fund

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Abstract. The Louisiana Energy Fund is a public-private cooperative endeavor designed to provide publicly funded institutions with low cost, tax exempt financing to implement energy and water conservation projects in the state. The purpose of this paper is to evaluate the expected economic, energy, and environmental impact of seven performance contracts awarded during the first phase of the program. An input-output model is developed to quantify the expected total economic benefit, and based on the specifications of the performance contracts, the energy and environmental impacts for the program are estimated.

1. Introduction

The Louisiana Energy Fund is a public-private cooperative endeavor created by the Louisiana Department of Natural Resources (DNR) to provide publicly funded institutions with low cost, tax exempt financing to implement energy and water conservation projects [6]. The Energy Fund was created by DNR in partnership with the Louisiana Public Facilities Authority (bond issuer), Hibernia National Bank (credit analysis/co-underwriter), and Lehman Brothers (investment banking/co-underwriter).

The Louisiana Energy Fund serves as an interest rate reduction vehicle for energy conservation projects implemented under a performance-based energy efficiency contract and in accordance with the guidelines established by the United States Department of Energy (see [4]) and the Louisiana Legislature. According to Louisiana state law, R.S.39: 1494, a performance based energy efficiency contract is defined as a contract for energy efficiency services and equipment in which the payment obligation for each year of the contract is either

- Set as a percentage of the annual energy cost savings attributable to the service or equipment under the contract, or
- Guaranteed to be less than the annual energy savings attributable to the services or equipment under the contract.

Energy service agreements may extend up to 20 years, and annual maintenance and the elimination of deferred maintenance may be included as savings. Applications to the Energy Fund are pooled, and a revenue bond is issued backed by the Measured and Verified (M&V) energy savings associated with the projects and credit enhancement provided by DNR.

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In September 2002, the Louisiana Bond Commission authorized the issuance of \$15.3 million dollars in tax-exempt bonds to fund energy and water retrofit performance contracts for seven projects in the state: Allen Parish School System, Avoyelles Parish School System, Evangeline Parish Police Jury, Iberville Parish School System, Natchitoches Parish School System, St. Charles Parish School System, and St. James Parish School System.

The purpose of this paper is to quantify the expected economic, energy, and environmental impact of the program. Specifically, we shall determine

1. The economic impact of the program in terms of expected jobs created, taxes generated, and the multiplier effects of dollars turned over in the local parishes,
2. The energy impact of the program in terms of M&V energy savings and dollars, and
3. The environmental impact of the program in terms of reduced emissions for the three criteria pollutants SO_2, CO_2, and NO_x.

The outline of the paper is as follows. The operation of the Energy Fund is described in §2 along with a brief discussion of the projects selected for the initial phase of funding. In §3, the methodology of the study is described, and in §4, the expected economic impact for each project is presented. In §5 and §6, the aggregate energy and environmental impact of the program is summarized.

2. The Louisiana Energy Fund

The Louisiana Energy Fund operates as follows:

(1) Publicly funded institutions performing M&V energy conservation projects are pooled together through the Energy Fund. The total loan requirement of the projects is \$Z.

(2) DNR funding in the amount \$A = 0.1Z is used to "buy-down" the interest rate of the loan so that the revenue bond can be issued at the lowest possible rate.

(3) Bank writes a \$Y loan to institution for energy efficiency improvements requiring a loan repayment of \$y/year. The loan repayment includes a transaction fee to process/manage the loan.

(4) Institution contracts with ESCO at \$Y to perform energy efficiency improvements. The business models employed vary with the institution and service provider.

(5) ESCO guarantees a level of energy savings of \$z/year > \$y/year for the duration of the contract as required by state law.

(6) Guaranteed energy reduction means that the energy savings incurred by the facility pays for the efficiency improvement until the loan is repaid.

(7) DNR recoups loan amount \$A less grant amount (\$250,000) over the term of the contracts.

The seven projects approved for initial funding is shown in Table 1. The total cost of the projects, which includes the sum of all materials, labor, auditing, design, engineering, project management, and outside services, is estimated at $13.7M. The total annual service cost is estimated at $530,000, and the total annual gross energy savings for the projects is estimated at $1.86M. The M&V savings is about half of the gross savings and totals $973,000. It is difficult to compare the projects on an individual basis, since the nature of the installation work is site-specific, but one useful comparison statistic is the ratio of the total cost to annual gross savings. This ratio is shown in the last column of Table 1 and ranges from 6 to 12, with an average value of 7.4. This ratio can be interpreted *loosely*[1] as the average payback time associated with the program which serves as a broad measure of the efficacy of the program.

3. Methodology

The Louisiana Energy Fund will stimulate investment and employment opportunities in the state, and the dynamics of these effects can be analyzed using input-output (I-O) models. Input-output (or economic impact) models are an analytical technique used to assess economic, fiscal, and resource impacts to an economic system from a change to one or more basic industries. The fundamental premise of the technique is that changes in the production levels of an economy's basic industries, arising from either changes in output or changes in demand, will produce an iterative process of spending, income creation, and re-spending thereby changing the production levels of other related industries [1].

Input-output models disaggregate individual economic sector changes and are represented by a set of equations describing the relationships that link the output of one industry with all other industries in an economy. The I-O model called IMPLAN, which characterizes the Louisiana economy into 528 separate industries, was employed in this analysis[2].

Impact modeling is performed for each of the seven projects separately, based on data collected from the performance contracts and interviews with project managers. Detailed estimates are performed on an individual project basis with the data coupled to parish-specific economic statistics.

Data was requested for each project on the expected activity requirements, installation cost, material and supplies, material/labor breakdown, duration of activities and equipment purchases. The total expenditures for each project was then decomposed according to the categorization

- Energy management systems,
- Lighting retrofits,
- Mechanical work, and
- Water conservation systems.

[1] The service cost is not incorporated in the projections, and so the cost/savings ratio is a lower bound estimate.
[2] Not all of these industries may be represented in any particular parish economy.

Since the technology for energy/water efficiency improvements are similar across each project, the use of a common level of categorization is not expected to introduce significant bias in the analysis.

The total amount of expenditures for each category was then decomposed on a material and labor basis, and an estimate of the amount of material manufactured in-state was performed. Louisiana does not manufacture control system units, HVAC equipment, boilers, or lighting systems, and so an adjustment is required to account for the percentage of each commodity group produced domestically versus other areas. This adjustment is made through a regional purchasing coefficient (RPC) in the IMPLAN model. An RPC = 1 indicates that the state is autonomous in its production of a commodity, while RPC = 0 indicates that an area imports all of its commodity. The value of RPC is estimated for each commodity group/industrial sector considered.

To recognize the different economic impacts that occur over the life cycle of each project, the impact models are classified into two functional categories: those impacts associated with the *implementation* of the project and those associated with the *maintenance* of the project. The implementation of a project is similar to an *impulse* event in the economy and is expected to last on-the-order of *one year or less*, while the maintenance (service) requirements associated with each project are *recurrent* events and extend for *ten years or more*.

4. Economic Impact of the Energy Fund

4.1. Empirical Estimates of the Economic Impact – Installation

The empirical results of the economic impact model for installation activities is presented in Table 2. Information is presented according to four categories:

- Value Added
- Employment
- Output
- Tax

Economic activity associated with the installation of energy efficiency improvements, including the returns to factors of production such as wages for workers and rents paid on equipment, is described as the total value added. The estimated number of jobs created as a result of the installation activity is also presented. Output refers to the total economic activity resulting from the installation of energy efficiency projects. Direct taxes paid to state and local government is presented as total taxes.

The total value added and output resulting from the installation phase of the project is estimated to be $11.7M and $16.2M, respectively. Employment is expected to increase by 297 jobs. Total state tax revenue is expected to be $2.0M.

The economic impact associated with each energy conservation project will last on the order of one year. Once the installation of the projects has been completed, the incremental economic and employment impacts will diminish rapidly, and then the impact associated with the recurrent maintenance expenses will take effect.

4.2. Empirical Estimates of the Economic Impact – Maintenance

Separate economic impact models are developed for maintenance operations. Since maintenance expenses are an order-of-magnitude smaller than installation activities, but occur over a time duration at least an order-of-magnitude larger, the overall economic impact of maintenance expenses are expected to be roughly "equivalent" in aggregate with installation activities. Service operations represent a relatively small annual cost per project, but in aggregate total $530,400 per year across a 10-15 year horizon.

The economic impact associated with the maintenance operations for each project is presented in Table 3. The total value added and output resulting from the maintenance phase of all the projects is estimated to be $490,000 and $590,000, respectively. Employment is expected to increase annually by 16 jobs. Total state tax revenue is expected to be $75,000. These are recurring impacts to be felt each year for the next 10-15 years.

4.3. Total Economic Impact

The total economic impact of the Louisiana Energy Fund is presented in Table 4. The total value added, employment, output, and taxes resulting from the installation and maintenance phases are shown in separate columns.

The overall value added and output resulting from the installation phase is estimated to be $14.8M and $19.5M, respectively. Employment is expected to increase by 416 jobs for the duration of one year. Total state tax revenue is expected to be $2.1M.

The overall value added and output resulting from the maintenance phase is estimated to be $615,000 and $724,000, respectively. Employment is expected to increase by 21 jobs. Total state tax revenue is expected to be $81,000. The impacts from the maintenance agreements are recurrent and are expected to be felt each year for the next ten years.

5. Energy Impact of the Energy Fund

An energy savings performance contract is a legal document between two or more parties, typically the facility and the energy services company (called an ESCO), where payment is based on achieving specified results. The results are typically guaranteed reductions in energy consumption and/or operating costs [2, 3]. A performance contract guarantees energy savings relative to a baseline model (see [4]), and is subject to negotiation between the client and ESCO since retrofits and upgrades may first be performed to bring the building "up to design" standards.

There are many sources of uncertainty inherent in modeling the impact of energy conservation programs, but fortunately in the case for performance contracts the actual energy conserved is not a source of uncertainty. The use of performance contracts eliminates private uncertainty since energy savings are *guaranteed* under M&V protocols. The energy savings of M&V performance contracts are "real" and "verifiable".

The value of the M&V energy savings for facility i is denoted as E_i , and in aggregate yields the program M&V savings, E_T ,

$$E_T = \sum_{i=1}^{7} E_i \,,$$

where,

E_T = Total M&V energy savings (kWh)

E_i = M&V energy savings for facility i (kWh).

From Table 1, the total M&V energy savings per year for the Louisiana Energy Fund is estimated at $973,000, which at an average electric rate of $0.05-0.08 per kWh per facility, translates to an annual savings between $(12.2, 19.5)$ MkWh per year.

6. Environmental Impact of the Energy Fund

When fossil fuels are burned in the production of electricity, a variety of gases and particulates are formed, and if not captured by pollution control equipment, will be released into the atmosphere. Electricity is one among many point sources of environmental pollutants, but because the energy reduction of performance contracts are based on M&V protocols, the electricity savings translate to a reduction in environmental pollutants which may also have market value. The pollutants released during electricity production depend upon complex relationships between factors such as fuel type and mix (sulfur content of coal, gas utilization), operational mode (combustion temperatures), technologies employed (combustion processes, environmental equipment), and regulatory constraints (nonattainment areas). Since individual electrons cannot be traced to a specific facility, statewide average emissions rates are applied in the assessment.

The total avoided emissions $AE_T(p)$ for pollutant p based on a supply-side reduction in energy consumption is estimated as

$$AE_T(p) = \varepsilon(p) E_T \,,$$

where,

E_T = Total M&V energy savings (kWh),

$\varepsilon(p)$ = Emissions reduction factor for pollutant p (ton/kWh).

The value of $\varepsilon(p)$ for SO_2, NO_x, and CO_2 is estimated based on an aggregation of all the emissions and generation by electric utilities[3] in Louisiana over a five-year time horizon. The average pollutant emissions per kWh avoided electricity generation is computed as a five-year average and tabulated as

$$\begin{pmatrix} \varepsilon(\mathrm{SO_2}) \\ \varepsilon(\mathrm{NO_x}) \\ \varepsilon(\mathrm{CO_2}) \end{pmatrix} = \begin{pmatrix} 3.13 \times 10^{-6} \text{ ton SO}_2\text{ / kWh} \\ 2.14 \times 10^{-6} \text{ ton NO}_\mathrm{x}\text{ / kWh} \\ 0.71 \times 10^{-3} \text{ ton CO}_2\text{ / kWh} \end{pmatrix}.$$

The direct environmental impact at the point of end-use (e.g., reduced air pollution from more efficient space heating equipment) cannot be realistically estimated at this level,

[3] Non-utility generators report generational data to the EIA but this data is currently treated as confidential.

and only the avoided supply-side impact, that is, the reduced air pollution from avoiding electricity generation is considered. The range for SO_2, NO_x, and CO_2 avoided emissions is shown in Table 5.

Facilities in Louisiana that perform M&V energy efficiency improvements could be included as participants in a market system for NO_x, SO_x, and/or CO_2 control on a state or regional basis. Since the facilities supported through the Energy Fund are publicly funded institutions, the "credit" of the pollutant emissions will accrue to the state and can be "banked" in a manner consistent with market allowance schemes [5]. To estimate the value of the emission credits, a Market Price Index[4] for pollutant k, k = {SO_2, NO_x, CO_2}, MPI(k), is assumed to be a "composite" U.S.-average price p_k and given by the "representative" values:

$$\text{MPI}(\text{SO}_2) = p_{\text{SO}_2} = \$200/\text{ton}$$

$$\text{MPI}(\text{NO}_x) = p_{\text{NO}_x} = \$1000/\text{ton}$$

$$\text{MPI}(\text{CO}_2) = p_{\text{CO}_2} = \$5/\text{ton}$$

Representative values of the three criteria pollutants is shown in Table 5.

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[4] The MPI is defined as the price at which a buyer or seller could expect to transact environmental credits and is the average of the best bid, the best offer, and the most recent transaction.

Table 1. The Louisiana Energy Fund – Revenue Bond Projects (2003)

Project	Contractor	Total Cost ($M)	Service Cost ($1,000/yr)	Gross Savings ($1,000/yr)	M&V Savings ($1000/yr)	Cost/Savings Ratio
Allen Parish School	Siemens	2.28	94.7	317	163	6.8
Avoyelles Parish School	TAC Americas	2.11	19.5	176	88	11.5
Evangeline Parish Police	Siemens	0.34	26.7	55	30	6.0
Iberville Parish School	Siemens	2.44	86.5	417	214	6.6
Natchitoches Parish School	Trane	2.55	163.0	309	90	7.9
St. Charles Parish School	Siemens	2.09	70.0	322	221	6.5
St. James Parish School	Siemens	1.88	70.0	264	167	6.6
TOTAL		13.7	530.4	1,861	973	7.4

Table 2. Louisiana Energy Fund Economic Impact by Category – Installation

Project (Parish)	Valued Added ($)	Employment (#)	Output ($)	Tax ($)
Allen	1,844,215	50.8	2,559,682	309,091
Avoyelles	1,748,002	55.8	2,433,038	304,344
Evangeline	294,643	8.8	415,420	48,973
Iberville	2,351,710	45.2	3,235,950	421,502
Natchitoches	2,200,349	58.4	3,098,724	366,449
St. Charles	1,828,207	45.7	2,448,209	309,541
St. James	1,438,237	32.5	1,962,368	256,026
TOTAL	11,705,363	297.2	16,153,391	2,014,926

Table 3. Louisiana Energy Fund Economic Impact by Category – Maintenance

Project (Parish)	Valued Added ($)	Employment (#)	Output ($)	Tax ($)
Allen	93,544	2.6	111,105	14,069
Avoyelles	19,533	0.8	23,305	3,066
Evangeline	27,482	1	33,304	4,131
Iberville	84,879	2.2	100,750	13,610
Natchitoches	168,390	6.1	205,236	25,096
St. Charles	29,580	1.0	34,991	4,627
St. James	66,526	2.5	78,173	10,556
TOTAL	489,934	16.2	589,863	75,154

Table 4. Louisiana Energy Fund – Overall Economic Impact

Impact Type	Project Year (2003)	Annual (10 years)
Valued Added ($)	14,791,000	614,514
Employment (#)	416	21
Output ($)	19,456,403	724,180
Tax ($)	2,130,971	80,937

Table 5. Louisiana Energy Fund - Avoided Emissions and Representative Valuation

Pollutant	Avoided Emissions (ton/yr)	Representative Valuation ($1,000/yr)
SO_2	(38.2, 61.0)	(7.6, 12.2)
CO_2	(8662, 13845)	(43.3, 69.2)
NO_x	(26.1, 41.7)	(26.1, 41.7)
TOTAL		(77.0, 123.1)