Energy Savings Insurance

Advances and Opportunities for Funding Small- and Medium-Sized Energy Efficiency and Distributed Generation Projects in Chile

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ABSTRACT

The Energy Savings Insurance Program seeks to promote investment in energy efficiency and distributed generation in Latin America, primarily through small- and medium-sized enterprises (SMEs). It focuses on developing an innovative scheme of guaranteed energy performance that mitigates project risk and generates investor confidence (ESI Model). The Inter-American Development Bank (IDB) facilitates the development of the ESI Program in alliance with the National Development Banks (NDBs). The ESI Model includes a contract for the supply, installation, and maintenance of equipment for generating a stipulated amount of energy or energy savings over a specific time period; valida tion by an independent body; insurance coverage that backs the savings or the guaranteed energy generation; and project financing. This paper describes the main attributes of the ESI Model (the contract, the insurance, validation and financing), evaluates market potential and the most attractive technologies, and identifies the priority sectors for implementing projects in Chile. The most promising economic sectors were found to be the hospitality industry, food processing industry, grape growing/wine production, and the fishing industry, and the technologies of electric motors, boilers, air conditioning systems and photovoltaic solar generation. In each of these sectors, estimates were made of financing requirements as well as CO_2 emission reductions that could be achieved.

JEL Codes: H41, O12, O13, Q12, Q13, Q18

Key Words: Chile, energy efficiency, renewable energies, financing mechanisms, climate financing, financing, market potential, ESI Model, energy savings insurance

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EXECUTIVE SUMMARY

The Energy Savings Insurance Program (ESI) is an initiative that the Inter-American Development Bank (IDB) has been developing in Latin America to promote investments in energy efficiency. The program consists of a set of financial and non-financial instruments aimed at mitigating project risk and generating investor confidence (ESI Model). The IDB facilitates the development and implementation of the ESI Model in alliance with National Development Banks (NDBs) of countries through technical cooperation activities and access to concessional lines of credit.

The ESI Model mitigates the risks of a given project and creates confidence between the vendor (the technology provider or, hereinafter, "the provider") and the buyer (hereinafter, the client or investor) through four elements.

- ***Standard contract:*** establishes the commitments of the provider–client, including a promise of savings or energy generation associated with the project.

- ***Insurance:*** guarantees the client of the energy savings established in the contract. The insurance is purchased and paid for by the provider with the client as benefitiary and enters into effect once the commissioning of the project is validated.

- ***Validation of savings:*** consists of two parts: (i) an assessment of whether the project has the capacity to generate the savings guaranteed by the provider and confirmation that the installation meets the specifications of the contract; and (ii) provision for arbitrage should any disagreements arise between the provider and the client after the project has been commissioned. An independent technical entity is responsible for performing the validation and its results are binding for all the parties.

- ***Financing:*** support obtained from financial entities to cover the investors' requirements for carrying out a project.

Under the ESI Model, the project's energy savings are guaranteed by an insurance policy whose validity covers a time period that is sufficient for recovering the investment. The ESI Model is applicable to projects for replacement of outdated equipment with more efficient units (brownfield projects) as well as to projects in brand new facilities (greenfield projects). In brownfield projects the projected savings are quantified based on the performance of the new versus the old equipment, and in greenfield projects, based on the industry benchmark practice. Distributed generation projects, mainly for photovoltaic solar energy generation, are likewise eligible for application of the ESI Model. In these cases, the insurance guarantees the power generated. There is significant business potential for both project types in Chile, where energy tariffs are high.

In SMEs, energy efficiency and solar photovoltaic generation projects face similar barriers. First, they compete for resources with projects that are directly related to their core business, and consequently are not priority projects, since companies prefer investments whose risks and associated returns they have a better grasp of. Second, most SMEs are not well-informed of the quality of the product or technology and perceive the projects as high risk.

Third, most equipment providers work under supply and installation contracts wherein the contractual commitment concludes upon payment of the project and after equipment delivery. The client then assumes the risk of whether or not future energy savings or generation will be materialized. On the other hand, more efficient equipment requires a larger initial investment, thus the provider must convince the client to invest in more expensive equipment, with the expectation of future reductions in energy consumption and lower operating costs.

There is also substantial evidence that enterprises—especially SMEs—do not invest in improving their energy efficiency notwithstanding the attractive rates of return on such investments. This is normally due to a lack of knowledge of the high returns of energy efficient projects, a perception of risk associated to new technologies and providers, behavioral biases and the invisibility of savings. Another possible explanation is that the median high returns conceal great variability, and it is a challenge for companies to ascertain where they are exactly in the distribution of effective efficiency gains. Thus, faced by these risks, they shy away from investing. The ESI Model has answers for these problems.

The study makes an estimate of the potential market size for the ESI Model projects in SMEs in Chile by segmenting the market in four subsectors that offer good business opportunities for energy efficiency and distributed generation. These subsectors are of the greatest interest to BancoEstado: (i) the hospitality industry, (ii) agroindustry, (iii) vitiviniculture, and (iv) fisheries. The results indicate that there is a potential demand in these four subsectors for 533 projects per year, equivalent to annual investments of around US$45 million and financing requirements per year of close to US$36 million. It is estimated that these projects would generate a reduction of emissions equivalent to 50,000 tCO_2/yr and energy savings of 75 GWh/yr.

The most commonly employed energy efficiency technologies in these priority subsectors include air conditioning systems, engines, boiler systems, industrial refrigeration, thermal, and photovoltaic solar systems. The expected investments in these technologies could range from US$30,000 to US$1 million. For the purposes of analysis, investments in the range of US$30,000 and US$500,000 per project were considered. Technology investments have payback periods between three and five years for energy efficiency systems, and around eight years for photovoltaic systems.

The ESI Program has been undergoing successful development in Colombia and El Salvador and is being replicated in Chile through an alliance with BancoEstado. The IDB's intervention includes the development of the ESI Model's components: mobilization of market actors, support for the development of demonstration projects, and the scaling up of the program. The adequate operation of the ESI Model requires that the process be clear, simple and expeditious for the various participating entities—that is, the client, provider, insurer, bank, and the validating entity. The insurance companies participating in the product's development in Chile are SURA and CESCE. The Energy Sustainability Agency (Agencia de Sostenibilidad Energética, or ASE) acts as the validating entity and BancoEstado as the financing entity. The first projects receive technical support and certain incentives from the IDB to minimize the transaction costs.

This work presents the main characteristics of the ESI Model and its applicability to energy efficiency and distributed generation projects in Chile. Section 1 describes the model's attributes. Sections 2 and 3 identify the opportunity areas in Chile and characterize the priority sectors. Section 4 presents an economic analysis of the most in-demand technologies in these sectors. Section 5 examines further the nature of the market and financing requirements of the projects. Finally, the study conclusions are presented.

1.

THE ENERGY SAVINGS INSURANCE MODEL (ESI)

1 THE ENERGY SAVINGS INSURANCE MODEL (ESI)

1.1. INTRODUCTION

The Energy Savings Insurance Program (ESI) is an initiative that is being developed by the Inter-American Development Bank (IDB) to promote investments in energy efficiency and distributed generation in Latin America. The Program consists of a set of financial and non-financial instruments aimed at mitigating project risks and generating investor confidence (ESI Model). The ESI Program was successfully developed for the first time in Colombia and is being replicated in Brazil, Chile, El Salvador, and Peru with the support of the Danish government. It is also being developed in Argentina, Mexico, Nicaragua, and Paraguay. BancoEstado is the IDB's local partner for this initiative in Chile.

The IDB's Connectivity, Markets, and Finance Division (CMF) facilitates the development and implementation of the ESI Model in partnership with National Development Banks (NDBs), through activities of technical cooperation and support for access to concessional lines of credit. The objective is for the ESI Model to be self-sustainable once the IDB's intervention has finalized. To this end, the IDB supports activities such as assessments of market niche opportunities; development and adaptation of risk mitigation mechanisms; support for local financial institutions in the deployment of financial products; supporting the identification and participation in the ESI Model of interested market actors; the development of standards and mechanisms for monitoring, reporting, validating and monetizing results; and the development of events for exchanges on the lessons learned.

The ESI Model comprises the following four elements: (i) a standard contract, (ii) an energy savings insurance plan, (iii) validation of the energy savings, and (iv) financing (see subsection 1.4 for details). The ESI Model is applicable to energy efficiency projects as well as distributed generation projects, primarily of photovoltaic solar energy. For projects to be eligible for the ESI Model, the energy savings from the energy efficiency or distributed generation projects must be guaranteed through an insurance policy effective over a sufficient time period for recovering the investment, or payback time. The ESI Model applies to projects for equipment renovation, or retrofitting, as well as to brand new facilities. In renovation projects the projected savings are quantified based on the performance of the new versus the old equipment, and in new projects, based on the industry benchmark practice.

There is plentiful evidence that in both Latin America and the Caribbean (LAC) as well as in the rest of the world, companies, especially SMEs, do not invest in energy efficiency improvement even though such projects offer quite attractive rates of return and the benefit of high reductions of CO_2 emissions (Sankar and Singh, 2010). In fact, there are companies whose energy costs may be as high as 20 percent of operating costs, yet they assign a low priority to energy efficiency investments and delay them until such time as the equipment has reached the end of its useful life.[1]

[1] Interview with the authors.

This barrier on the end user side is usually owed to a lack of awareness of the high rates of return on such investments, the perception of risks inherent to new technologies and providers, to behavioral bias, and to savings invisibility. Another possible reason behind underinvestment is that, in projects involving various energy efficiency measures, the high average rates of return mask an important variability, making it difficult for companies to be certain of where they are exactly in the distribution of the efficiency gains. Thus, faced by these risks, they opt not to invest. The ESI Model offers answers to these barriers.

Energy efficiency projects require dedicated, long-term efforts oriented toward meeting commercial demand. There is currently little practical information and awareness around energy savings insurance and how such coverages should be structured and implemented. Toward the end of the 1990s, an analogous scheme was proposed for implementation in the United States, but was neither fomented nor disseminated in LAC. There is also little understanding of how big the potential market could be for this type of insurance. This study seeks to describe the key characteristics of the ESI Model and, through a case study in Chile, presents evidence that the size of the market is sufficiently large to justify implanting the Model, and that the market stakeholders needed for its implementation do in fact exist.

1.2. BARRIERS FACED BY ENERGY EFFICIENCY PROJECTS

Energy efficiency and solar generation projects have high potential for new business opportunities because they can generate predictable and sustained cost savings. However, they do face multiple barriers for their development. Aside from the commonly reported obstacles such as lack of adequate financing and poor understanding of the nature of and limited capacities for investment in these projects, the authors have identified certain patterns that lead to scant investor interest and have to do with the companies' sensitivity to the spot price of equipment and the market actors' perceptions of risk. The barriers can be divided into two categories:

From the client's viewpoint:

- Energy efficiency and solar power generation projects only partially make up the company's investment portfolio and must compete with other projects for resources. The investment opportunities directly related to the company's primary objectives tend to receive a more positive risk-return assessment on the part of the investment decision-makers, given their better grasp of the potential investment returns and of how to manage the associated risks. For instance, the milk products industry has an excellent understanding of the business opportunities and risks entailed by investing in a new production line; however, it may be more of a challenge to evaluate and manage the investment risks of replacing an old boiler system with a new, more energy efficient one.

- Energy efficient projects normally involve replacing conventional, less efficient equipment with more expensive machinery. The client must be convinced that by investing in more costly equipment they can expect to achieve greater energy and operational savings than if they were to use another equipment type. Clients are very sensitive to a project's initial cost and tend to choose less expensive technologies without considering downstream operating and energy consumption costs.

- Energy efficiency projects generate cost savings that must be enough to achieve the payback on the initial investment. Clients that lack access to performance guarantee mechanisms perceive uncertainties vis-à-vis project performance and future savings and, thus, visualize high risk. On the other hand, the investment payback periods range from three to seven years, which, with a lack of savings guarantees, mean relatively long periods of risk.

- There is lack of confidence in the caliber of providers, lack of information regarding which technologies are efficient, the real guarantees or the required capital for obtaining bank financing.

From the provider's viewpoint

- Some companies sell very efficient equipment and technologies; however, not many offer or guarantee energy efficiency; they are generally accustomed to merely selling and installing the equipment. The exception are the Energy Service Companies (ESCOs), whose business it is to sell energy efficiency. There are Chilean companies with a long history and extensive technical experience in equipment sales, but the majority follow the aforementioned pattern. The service of guaranteeing savings only requires of these companies that they apply the knowledge and experience that they already have.[2]

- Most providers are representatives or distributors of international manufacturers that offer a wide range of products, from efficient technologies to unreliable, low-efficiency equipment. They do not specialize in offering high-efficiency equipment but rather they supply whatever the market demands. They also have specialized divisions for different target customers: their biggest clients, for whom energy savings is the primary investment criterion; and their small customers, for whom price is the key consideration.

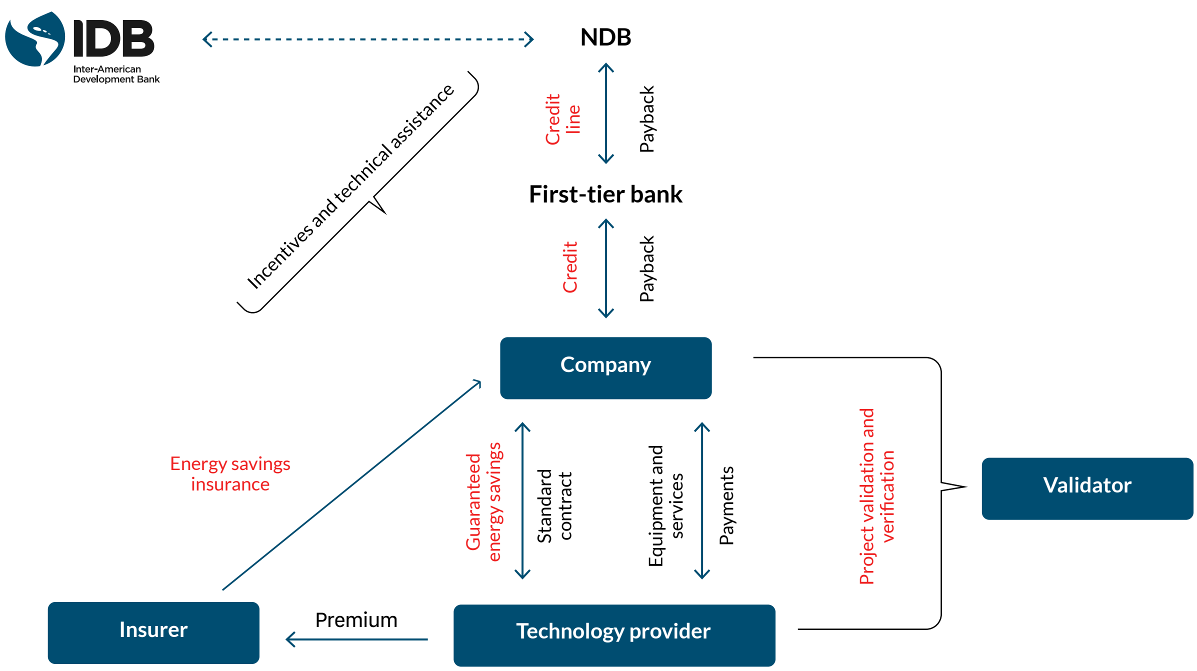
- Many providers need training to be able to present energy efficiency opportunities as business cases. In general, such proposals are highly technical in nature, and those in charge of decision making have insufficient knowledge of energy efficient technology and find the subject challenging.

1.3. COMPONENTS OF THE ESI MODEL

As mentioned above, the ESI Model includes four financial and non-financial instruments for the mitigation of project risk and the generation of investor confidence–a standardized contract, energy savings insurance, validation of energy savings, and financing. The contract guarantees a project's performance in terms of amounts of energy savings or power generation, and is backed by an insurance policy that is activated in case of underperformance. The validation is carried out by an independent body with experience in certification of energy projects, and its decisions are binding for all the contractual parties. The financial backing that investors may require to carry out a project is channeled through financial institutions interested in creating a market and a portfolio of projects of insured energy savings. The client or investor is responsible for requesting a credit from the bank to finance the project. The provider in turn takes charge of contracting the insurance coverage with the investor as the beneficiary. Figure 1 describes the operational flows of the ESI Model.

[2] Projects of guaranteed energy savings require an estimate of the system's current consumption, compare it to the consumption of the new system, establish the mechanism for monitoring the system's real performance while in operation, and apply a methodology to calculate the effective energy savings.

Figure 1. ESI Model: Flow of Operations



Source: Authors' elaboration.

The ESI Model guarantees the company of energy savings or of the project's energy generation through a client-provider contractual relationship that includes insurance coverage and independent technical validation. The company pays the provider to supply and install the equipment and to guarantee the energy savings or generation. If the project obtains bank financing, a bank-company relationship is created that is independent of the client-provider relationship. However, the two contracts have a common meeting point, which is the energy savings insurance. This tool reduces the risk of non-payment of the credit, since it guarantees the cash flow that will cover the repayment of the credit.

Contract: The contract establishes the responsibilities of the provider as far as the equipment supply and installation are concerned and their corresponding guarantees, aside from the promised savings or energy generation. The client's commitments include timely payment, the access to the facilities, and the equipment maintenance. Among the most significant features of the contract are: (i) guaranteed savings; (ii) referential energy tariffs; (iii) periodicity of measurements and the duration of the contract (normally annual and up to five years); (iv) the validation protocols; (v) the insurance activation criteria; (vi) the indemnification mechanisms for unrealized savings, and (vii) dispute resolution. The contract also includes provisions on exclusions and additional insurance.

The contract stipulates that the provider is a company dedicated to the marketing, supply, and maintenance of equipment and is specialized in the implementation of energy efficiency measures. The client is interested in acquiring equipment and generating energy savings. The company contracts the provider to develop the necessary engineering, supply the equipment and materials for the construction and carry out the installation and periodic maintenance. A Guaranteed Savings or Minimal Generation (GSMG) Agreement is formalized between the parties.

The entry into force of the contract is subject to the parties' co-compliance with several suspensive conditions, such as: (i) the validation of the project by the validating entity, accrediting the feasibility of the GSMG; (ii) the obtaining of and submission by the provider of the energy savings insurance to the company, and (iii) the obtaining by the company of the bank credit that will finance the project.

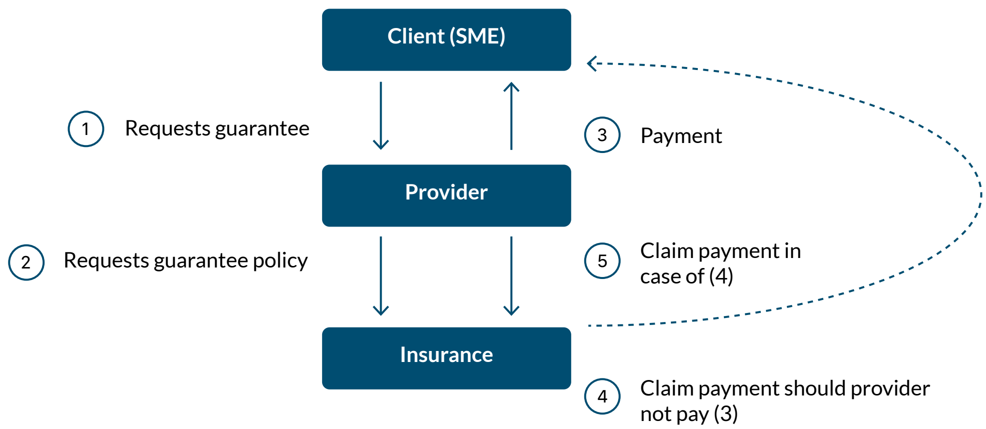
The contract stipulates that, once the provider has finalized the equipment installation, the validating entity should inspect the supplied equipment and installation. Should the validating entity detect no discrepancy whatsoever between the work performed and the work that was projected, it then issues a certificate of conformity which activates the insurance coverage. The validating entity also establishes that, in order to determine whether the GSMG has been achieved, periodic verifications of project performance should be carried out during the effectiveness period of the contract Should a negative deviation from the GSMG be detected, the provider shall pay an indemnity to the company for an amount based on an energy tariff established in the contract.

Insurance: Insurance plans are designed to protect a company from the potential financial risks that can result from events with a probability of negatively impacting on the company's income streams or assets. Typical examples are the destruction of a property by fire, or seismic event or vehicle-related loss or damages.

The insurance plan under the ESI Model is a hedging instrument issued by the provider for the client's benefit. It guarantees the client of promised energy savings or energy generation throughout the policy's validity period. If at any time the project underperforms, the insurance will cover the shortfall for the client. The provider contracts and pays for the insurance coverage with the client as the beneficiary, and the insurance is activated once the commissioning of the project is validated The insurance then becomes a contract compliance guarantee issued by the provider *vis-à-vis* the project's performance. The insurance company will seek to recover the claim amount it may need to pay the beneficiary. The flow of resources and the client-provider-insurer commitments function as follows (Figure 2):

- The client requests the insurance from the provider to cover the guaranteed energy savings.
- The provider solicits from the insurer an insurance coverage that will be the guarantee for the client.
- Should there be underperformance during the operating period of the project, the provider shall compensate the client for said underperformance (i.e., the claim).
- When the provider cannot fulfill its commitments due to the underperformance, the insurer will cover the client's loss (GSMG) on behalf of the provider.
- Should the insurer be obliged to cover the provider's commitments, the insurer will attempt to recover the funds from the provider, depending on the type of insurance policy contracted between the provider and the insurer.

Figure 2. ESI Flows of Resources and Responsibility

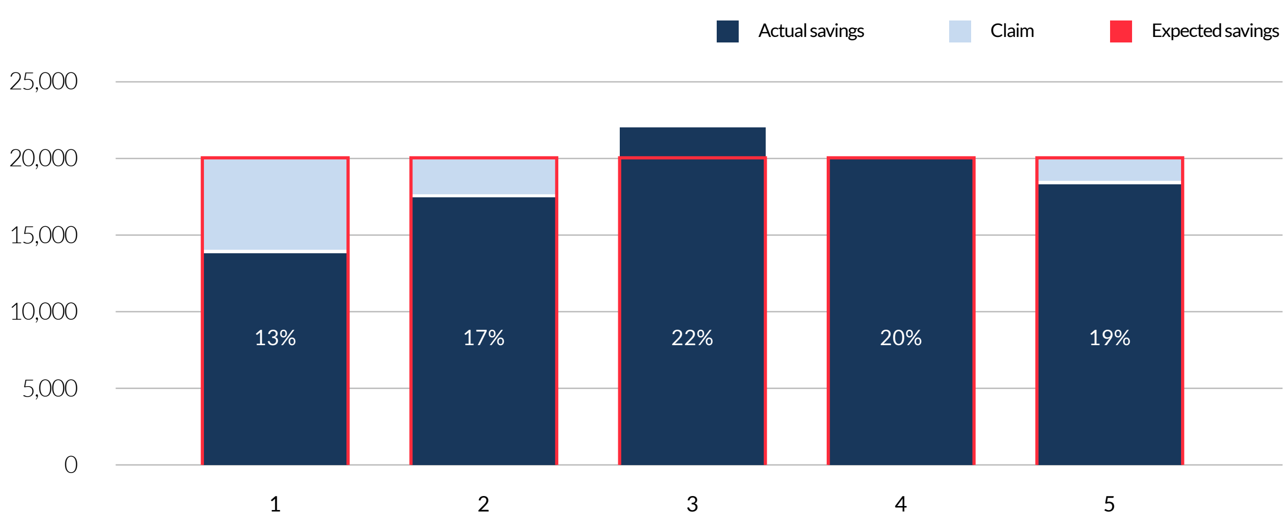


Source: Authors' elaboration.

The following is an exercise to exemplify the annual risk assumed by an insurer in a project that guarantees energy savings for a period of five years. The investment is recovered within the five-year period, which will be equivalent to annual energy savings of 20 percent over the baseline consumption. The project investment is US$100,000 and the expected savings amount to US$20,000. For the sake of simplicity, the current ESI Model, uses a fixed energy tariff at the outset of the contract, and when savings exceed the expected levels they are credited to the client.

As shown in the example, there were savings of 13 percent in the first year, 17 percent in the second, 22 percent in the third, 20 percent in the fourth and 19 percent in the fifth. For the years when the savings generated are lower than guaranteed (20 percent) —as occurred in the first, second, and fifth years— the provider is required to indemnify the client for the amount established in the claim. If the provider does not cover this amount, it falls upon the insurer to indemnify the client for said sum. Figure 3 shows the expected savings, actual savings, and the claim.

Figure 3. Example of Annual Risk in an ESI Project



Source: Authors' elaboration.

Validation: Validation is performed by an independent technical entity that must issue a technical opinion on the project and act as arbitrator, should any disagreement arise between the client and the provider regarding the savings or the energy generated in a given period. At the start of the project, the validator must evaluate the technical proposal that was submitted by the provider to the client and indicate whether the project has the potential for attaining the guaranteed energy savings. The validator must later verify in situ that the project has been delivered in accordance with the proposal specifications. This analysis helps to reduce beforehand the project's performance risk and raises the insurer's confidence. Moreover, the validator will act as arbitrator should any disagreements arise between the client and the provider with respect to the project's energy savings performance. This role is fundamental from the insurer's perspective, since the validating entity determines whether, in effect the, client has suffered any damages, and the amount of said damages based on the contractual commitment.

The functions of the validator are likewise set out in the contract, and their decisions are binding for all contractual parties. The project baselines are established through standardized methodologies developed by the ESI Program based on ISO 50001 protocols. The baseline and annual savings commitment are established by the provider, who in turn makes a commitment to achieve the estimates. The validator solely performs a preliminary validation of these values and, as indicated above, will only intervene should any difference of opinion arise between the parties within any particular period of time. It is important to point out that each year will be evaluated independently. If a performance deficit is found in a given year, the provider shall compensate the client for said deficit. If a period is identified wherein the guaranteed savings are achieved or exceed the levels pledged, the provider will be certified as compliant, but said excess savings may not be used to offset prior or subsequent years.

Financing: In many cases the company will require financing assistance to execute the project. The client applies for credit from the bank, which will mainly evaluate the client's creditworthiness, and whether the bank will need to ask for guarantees from the client. If the company applies the ESI Model to the project, the latter's performance risks will be reduced, and the bank's credit risk evaluation of the project may be more favorable. The loans that the investors may need are channeled through the bank that has formed an alliance with the IDB to implement the ESI Model.

The IDB's role is to act as the promoter of the ESI Model until it becomes self-sustaining. The IDB does this through activities of technical cooperation and by facilitating access to concessional credit lines. In Chile's case, the IDB supports such activities as the assessment of market niche opportunities, development and adaptation of risk mitigation mechanisms, assistance to BancoEstado in the deployment of financial products, assisting in identifying and enabling the participation of insurers and providers interested in the ESI Model, helping to develop validation standards and protocols, and organizing events for the purpose of sharing the lessons learned.

The entities currently linking up with the initiative in Chile include BancoEstado as the financing agency and local leader of the program, CESCE and SURA as insurers with coverages already finalized and available in the market, and ASE as the validating entity. The ESI Model projects of energy efficiency and solar generation that request financing from BancoEstado must have a performance contract plus an energy savings insurance policy. The success of the ESI Model depends to a large extent on the providers' understanding of its mechanisms as tools for creating confidence and convincing clients to invest in the projects. Thus, the first projects will receive technical support and certain incentives from the IDB to minimize their transaction costs.

The ESI Model developed with the support of the IDB has been successfully tested in Colombia and is now in an advanced stage of development in El Salvador. In both of these countries there are insurers that offer coverage for both energy efficiency projects and photovoltaic solar generation projects. In Colombia, as of June 2020, over 50 projects had been guaranteed with energy savings insurance. In both countries the cost of the five-year insurance coverage ranges from 0.7 percent to 1.2 percent of the total insured amount, and the costs for project validation and energy savings verification, from US$900 to US$1,500. This means that the minimum investment required for the transaction costs to be low impact is currently around US$100,000. The greatest demand for the product is emerging in sectors where there is strong competition between technology providers (for example, photovoltaic solar energy), thus the insurance becomes a differentiating factor between the commercial offerings. The ESI Model is also currently in the development phase in Spain, Italy and Portugal, with the support of the European Union.

1.4. PRIOR EXPERIENCES SIMILAR TO THE ESI MODEL

No evidence has been found in LAC of experiences similar to the above-described ESI Model. However, in a report of the U.S. Environmental Protection Agency featuring an analysis of various techniques of risk management for energy efficiency projects in the late 1990s, energy savings insurance was highlighted as a potential asset for the Energy Star Buildings Program (Evan, 2001). The report compared financial instruments for mitigating the performance risk of energy savings projects such as energy savings insurance, surety bonds and savings guarantees. Some benefits of an energy savings insurance that the report highlighted are the following:

- Performance risks are transferred away from the balance sheet of the project's implementing entity, thus freeing up capital that would otherwise be required for "self-insuring" the projected savings.
- It reduces the market entry barriers for small enterprises that offer energy savings services, but whose balance sheets are not sufficiently strong to enable them to self-insure energy savings.
- Project implementors are encouraged to go beyond the standard measures and achieve higher levels of energy savings.
- It supports improvements in measurement and verification techniques, as well as in the area of maintenance, thus contributing to the national energy savings objectives, and to upgrading the quality of the information available for evaluating programs.

The U.S. EPA report (Evan, 2001) presents the ESI Model as a traditional insurance coverage with a premium payment of around 2.5 percent of the value of the project's savings throughout the contract's validity period, with a deductible of 10 percent. Likewise, it indicates that the model has been most often employed in Canada and the U.S.

The ESI Model presented and discussed in this report is a hybrid product combining traditional insurance coverage and a surety bond. It is solidly sustained by validation and monitoring, it operates without deductibles, requires the concept of the validator for its execution, and is similar in cost to a surety bond.

2. ANALYSIS OF OPPORTUNITY AREAS IN CHILE

2 ANALYSIS OF OPPORTUNITY AREAS IN CHILE

At the end of 2018, before initiating the implementation of the ESI Program in Chile, the IDB held various meetings with local institutions to configure an overview of the financing for energy efficiency and renewal energy projects and the conditions required to develop the ESI Model. Included in the consultations were the Chilean Chamber of Refrigeration and Climate Control Systems *(Cámara Chilena de Refrigeración y Aire Acondicionado)*, Chilean Association of Solar Energy *(Asociación Chilena de Energía Solar,* ACESOL), Chilean Association of Renewable Energies and Storage *(Asociación Chilena de Energías Renovables y Almacenamiento,* ACERA), National Association of Energy Efficiency Enterprises *(Asociación Nacional de Empresas de Eficiencia Energética*, ANESCO), Energy Sustainability Agency *(Agencia de Sostenibilidad Energética*, ASE), Ministry of Energy *(Ministerio de Energía)*, Production Development Corporation *(Corporación de Fomento de la Producción*, CORFO), suppliers of services and equipment, and insurance companies. Among the most significant conclusions:

- BancoEstado has experience with green credits. It has implemented credit lines and parallel dissemination activities during which, with ASE, project monitoring sheets were created, albeit with results in the credit lines that did not quite match expectations. The Bank foresees that the insurance can enable the resolution of various barriers that the credit lines had met with. The fact that BancoEstado can operate like a commercial bank expedites the implementation of the ESI scheme because operational procedures can be simplified. Moreover, the Bank currently has a staff of 400 commercial executives nationwide.

- In Chile there have been recent initiatives that have synergies with the ESI Program. In 2017 and 2018 the Ministry of Energy promoted a public sector energy efficiency program in 39 hospitals a model that included diagnostics, savings contracts, savings validations by ASE *(Programa CAPE)* and savings commitments backed by bank guarantees. Nine companies participated as implementors and the investments totaled nine million Chilean pesos (around US$14 million). Of the 39 programs involving the hospitals, only three encountered problems with the expected savings. In 2019 the program was extended to another 100 buildings, applying an ESCO Model. The Ministry is providing support to the second phase through financing for diagnostics, assistance with the bidding terms and conditions and the *Programa CAPE*.

- The formats available in the *Programa CAPE* are similar to some of the ESI Program protocols and have already been tested in projects. At any rate, there is local experience in the validation of providers, projects, performance contracts and savings guarantees that can be useful for customizing the ESI instruments. For its part, CORFO is currently developing an electronic platform for sharing information on energy efficiency initiatives, and a program designed to enable banks to train loan officers in energy efficiency project lending.

- There are private sector companies currently implementing efficiency projects with guaranteed savings models and they have had successes. These companies affirm that they have viable projects suits the ESI Model and that they are willing to submit projects for the pilot phase. There are likewise associations that consider the ESI Model attractive and they have offered to promote its dissemination.

- Most equipment providers work under supply and installation contracts under which the contractual relationship finalizes upon project payment and delivery of the equipment. The large companies have no objection to advancing their investments in this area and they are familiar with such topics as energy audits. However, SMEs are moving forward slowly with their investments for lack of knowledge about the technologies and how they work, because of uncertainty or lack of confidence in the providers, the habit of basing investment decisions on which technology is lower priced, and because providers do not offer energy savings guarantees.

- CORFO does have a guarantee scheme that could be applicable to energy efficiency projects, that facilitates investor access to credit. On the other hand, there are other validator companies in the market besides ASE that could offer validation services.

- The Ministry of Energy is finalizing a study whose findings reveal an approximate market potential for energy efficiency of around US$100 million. The study also presents the results of around 300 audits. In the vitiviniculture sector there is good potential for energy efficiency projects, given the obsolescence of machinery, potential for replication, and the fact that various companies have the technical information on hand, thanks to the financial assistance for audits extended to them by the Energy Ministry.

- Three insurers have expressed strong interest in the ESI Program: HDI, CESCE and SURA. At that time, they did not have an energy savings insurance plan; however, they foresaw now major difficulties for developing one since it merely required adapting an already existing product. The existence of a provider-client contractual framework that explicitly establishes the responsibilities of both parties, and the verification of the principal milestones by a validating entity are model features that insurers find especially attractive. BancoEstado also has an established partnership with an insurance broker that will facilitate product development.

A more recent review revealed that in 2019 various public institutions opened up lines of financing with incentives for solar generation projects, such as Sercotec's “Programa Crece”, which includes a non-reimbursable subsidy for boosting the growth of micro and small enterprises, and the *Comité Solar's* (CORFO) program, “Fortalece PYME”, which provides assistance for the creation of centers with co-financing of up to 80 percent of total project cost in order to raise the productivity of smaller enterprises with photovoltaic solar energy generation.

The above diagnostic revealed that there are attractive conditions for implementing the ESI Program and that this could enable Chilean SMEs to move forward faster with energy efficiency and distributed generation investments by mitigating risk perceptions that erode client confidence and reducing financing, technical, information and market barriers. As the next step it was decided to proceed with a market study to gain a clear picture of the demand potential for financing, technologies and identify priority sectors, and assist BancoEstado and insurers with the calculation of financing and hedging requirements.

2.1. SEGMENTS OF INTEREST FOR THE ESI MODEL IN CHILE

Just under a million companies in Chile are potential ESI Model clients, of which 220,000 are classified by the Ministry of the Economy as SMEs. Given Chile's high energy tariffs,[3] in all of these categories of companies there are significant business opportunities for energy efficiency and distributed generation projects. However, the demand analysis focused on SMEs as the target segment of the ESI Model.

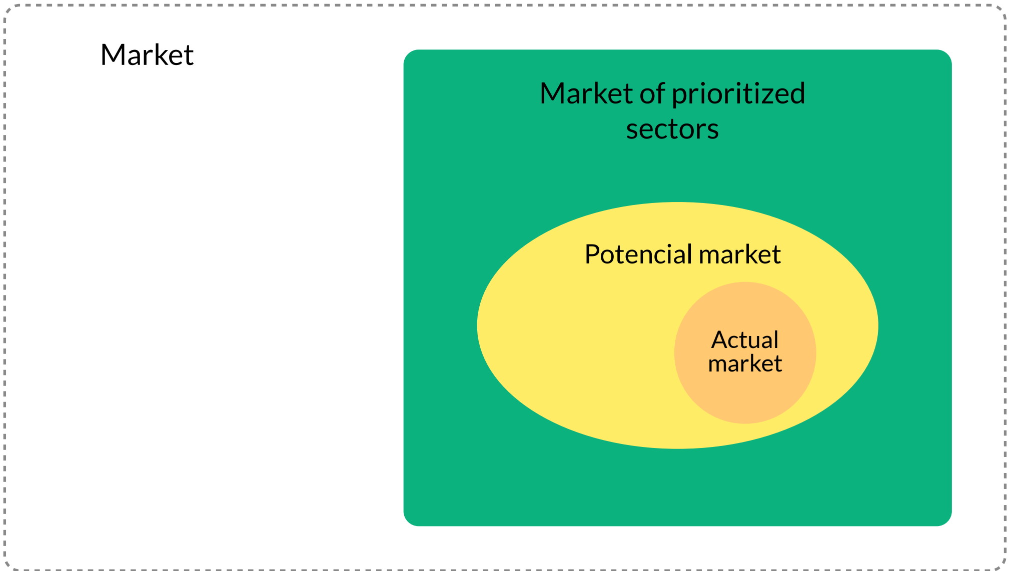
As indicated above, the barriers faced by SMEs wishing to undertake these projects are: client uncertainty concerning underperformance of the energy savings (or generation) promised by the provider, lack of confidence in the provider's capabilities and experience, and the emphasis on higher initial investment costs (CAPEX) in very price-sensitive markets, failing to take into account that operating costs (OPEX) in the long-term are actually much higher than the initial investment in energy efficient projects. No doubt the client's level of interest will rise to the extent that the risks are minimized, and acceptable returns can be assured. Strong client confidence and interest in these types of project must be generated to enable them to outweigh other investment priorities.

BancoEstado is an important actor in this process, as the financing agent and local leader in Chile of the ESI Model, which it considers a very good instrument for helping to remove the barriers to investment. From BancoEstado's point of view, the program's efficacy will largely depend on the institution's ability to coordinate the efforts of the various key actors (providers, insurer and client associations) and on whether the project assessments and financing can be accomplished within short time periods. Both factors are essential for building confidence and awakening the interest of the Chilean market. In its capacity as a public entity of Chile with a mandate to be a self-sustaining competitive member of the first-tier banking marketplace, BancoEstado was incorporated in the selection of potential sectors for ESI, to deepen its understanding of the market and help create an adequate promotion strategy for the financing of ESI Model projects.

After selection of the priority sectors, the energy efficiency technologies most often used in them were analyzed: air conditioning systems, motors, boilers, industrial refrigeration, thermal solar systems and photovoltaic systems. The analysis considered investments in the range of US$30,000 to US$500,000 per project. The referenced technologies present payback periods of three to five years for energy efficiency systems, and around eight years for photovoltaic systems. The advantage offered by these types of projects is that their cash flows are very predictable and constant, and they yield reasonable returns on investment.

[3] According to BNAmericas 2019, in Chile the residential electricity rate for consumption levels of up to 125 Kwh is US$0.15 per kWh. The lowest tariff is that of Paraguay (US$0.0279) and the highest, that of Uruguay (US$0.23).

Figure 4. Actual versus Potential Market



Source: Authors' elaboration.

2.2. METHODOLOGY FOR SECTORAL PRIORITIZATION

The initial selection of attractive sectors in the Chilean economy for energy efficiency and distributed generation projects was done through a qualitative assessment, considering the technologies associated with them and the experience of BancoEstado. Seventeen subsectors in business and industry were selected as the universe of analysis (Table 1).

Table 1. Evaluated Subsectors

No.	Subsector	PV solar	Boilers	Air conditioning	Thermal solar	Microgeneration	Lighting	Refrigeration	Ventilation	Electric motors	Cogeneration	Ovens
1	Hotels	x	x	x	x	x	x					
2	Hospitals and private clinics	x	x	x	x	x	x					
3	Supermarkets	x		x			x	x				
4	Commercial centers	x		x			x					
5	Educational centers	x					x					
6	Commercial rental properties		x	x			x					
7	Mining sector	x							x	x		
8	Winemaking sector	x	x		x			x		x		
9	Livestock sector	x						x		x		
10	Food processing	x	x		x			x		x	x	
11	Fishing industry	x	x		x			x		x	x	
12	Chemical and pharmaceutical Industry	x	x		x			x		x	x	
13	Plastics and rubber industry	x	x		x			x		x	x	
14	Leather, footwear, textiles, and clothing manufacture	x	x							x		
15	Forestry industry	x								x		
16	Construction suppliers	x								x		x
17	Cement industry	x								x		x

Source: Authors' elaboration based on CAF data (2016).

Each sub-sector was qualified using a multi-criteria matrix that included technical and marketing aspects, to help project their potential for moving energy efficiency projects forward in the short term. The qualification criteria were:

- Market size
- Energy intensity
- The existence of pertinent sectoral policies
- The sector's growth potential and whether there are trade organizations in the sector (Table 2).

Each criterion had a similar score, from 1 (low) to 5 (high), though assigned a different specific weight to enable differentiating the relative importance of the evaluation criteria.[4] The scores ranged from 30 points (less important criteria) to 100 points (most important criteria). Table 2 shows the criteria and the weighting of each one.

The purpose of the evaluation was to qualify the individual areas of opportunity with a score from 0 to 100 percent. The subsectors that got the highest scores would have the most favorable market conditions for implementing projects and would then be the focus of BancoEstado's promotional efforts. The final results would determine in which sectors it would in principle make the most sense to promote projects for energy efficiency and distributed generation, as they would be where the projects would exert the most impact and have the greatest potential for replication. These sectors could then serve as jumping-off points for driving the potential for ESI projects toward others. The sectors selected would be just a sample of what could occur in the other sectors.

Table 2. Evaluation and Weighting Criteria

Evaluation criteria	Weight
Market size (Potential number of SMEs)	100
Energy intensity	100
Regulations, guidelines, policies of subsector support (+) or subsidies (-)	50
Potential sector growth/stability	60
Associations present in the subsector	30

Source: Authors' elaboration.

The first two criteria refer to the SMEs' total energy expenditure. They enable including the SMEs that are the biggest energy consumers and would thus generate an adequate demand for financing. The first factor considers the effect of the volume of companies; the second, the importance of energy in that specific sector. The third one brings together the enabling elements in Chile for facilitating investments in energy efficiency, and the fourth evaluates the sustainability of the demand for projects. Finally, the fifth and last evaluates how easy it would be to promote and replicate investments among companies within the same sector.

The weighting criteria are, in a sense, subjective; however, they are aimed at identifying the differential effect of varied market aspects. The evaluation assigns great weight to energy intensity, not just to incorporate sectors where there can be significant levels of savings and attractive payback periods for financing entities, but in consideration of what has been revealed in interviews with investors and providers from sectors such as hospitals and hotels, where, despite energy expenditures as high as 20 percent of operating costs, investments in energy efficiency are nonetheless a low priority and are often delayed until equipments reach the end of their useful life. Regulatory aspects and potential for sector growth are assigned a similar weight, and the existence or non-existence of sectoral associations is given relatively minor importance.

Table 3 shows the evaluation results. In effect, the most promising sectors are the hospitality industry, the grape growing and wine production industry, the food processing and fishing industries. The analysis was later deepened in these sectors to perform a more quantitative evaluation of potential demand for investments.

[4] By way of example, the number of potential companies is a high-importance criterion and is weighted 100 points, while the existence of associations in the subsector is a less important criterion and receives a weighted score of 30 points.

If the subsequent analysis yielded a finding of low demand for projects and investments, the inclusion of more sectors could be considered. However, this would in itself be a red flag for markets with little appetite for ESI projects. In the contrary case—that is, were a significant number of projects and investments found in the priority sectors—there would be no need for a detailed analysis of other sectors, given the indicators of an attractive potential demand that could be even greater, and considering that all of the listed sectors would be offered financing. The fact that these sectors were singled out as priorities simply meant that the efforts for offering the ESI Model needed to be focused on them.

Table 3. Subsector Evaluation Results

Sector	Subsector	Final score (%)
Business/services	Hotels/hospitality industry	79
Industrial	Food processing Industry	79
Industrial	Vitiviniculture Sector	73
Industrial	Fishing Industry	73
Industrial	Plastics and rubber industry	71
Industrial	Chemical and pharmaceutical industry	69
Industrial	Leather, footwear, textiles, and clothing manufacture	67
Industrial	Wood industry	67
Industrial	Construction suppliers	65
Business/services	Commercial rental properties	64
Business/services	Hospitals and clinics (private)	64
Industrial	Livestock sector	64
Business/services	Supermarkets	61
Business/services	Education centers (private)	61
Industrial	Mining sector	60
Industrial	Cement industry	56
Business/services	Shopping malls	55

Source: Authors' elaboration.

It should be noted that any substantial changes to the list of criteria and weighting may lead to modifications of the subsectors selected for the detailed study. For example, the incorporation of criteria more sharply focused on social, environmental, or technological aspects could alter the order indicated above. However, this approach is considered adequate and sufficient given its orientation to a preliminary identification of subsectors where there is a sufficient and growing demand for energy projects, with regulations already in place that encourage investment in energy efficiency, and where there are established associations that might facilitate an alliance with BancoEstado for future cooperative endeavors.

3.

CHARACTERISTICS OF THE PRIORITY SUBSECTORS

3 CHARACTERISTICS OF THE PRIORITY SUBSECTORS

This section presents an overview of the four sectors that were prioritized in terms of number and size of enterprises, and the energy efficiency technologies most utilized in them. The analysis aimed at determining the potential number of SMEs in a sector that could implement energy efficiency and distributed generation projects, so as to later estimate the potential for application of the ESI Model. Companies in Chile are classified under the *Estatuto PyME*, *Ley 20.416* (SME Statutes, Law No. 20.416) based on staff size and turnover (Table 4).

Table 4. Classification of Economic Units in Chile

Category	Sales volume	No. of employees
Microenterprise	0 UF - 2,400 Ufs	0-9
Small-sized company	2,400.01 UF - 25,000 UFs	10-49
Medium-sized company	25,000.01 UF - 100,000 UFs	50-199
Large company	100,000.01 UFs and over	200 and more

Source: Ley 20.416 (Special rules for small companies), Ministerio de Economía, Fomento y Reconstrucción de Chile (2010) (https://www.bcn.cl/leyfacil/recurso/estatuto-de-las-pymes).

Note: UF = Unidad de Fomento, unit of account that is adjusted for Chile's inflation rate.

Current estimates set the number of companies in Chile at just under one million. Of these, 75.2 percent are microenterprises and 23.5 percent are SMEs, the latter numbering 220,000 in total.[5]

3.1. HOSPITALITY SECTOR

There are around 44,000 companies in Chile's tourism sector. Of these, approximately 11,600 offer tourist accommodations (*Establecimientos de Alojamiento Turístico*, EAT), i.e., resorts, motels, cottages or cabins, lodges, hotels, camping sites, apart hotels and youth hostels.[6] To focus the analysis on more energy-intensive companies and identify for BancoEstado the potential requirements for investment and financing, the study only considered lodges, hotels, hostels, and aparthotels as EATs. These number approximately 7,327 companies.

[5] Statistics on companies classified according to economic activity (September 2016) (http://www.sii.cl/estadisticas/empresas_rubro.htm).

[6] The rest are tourism services such as restaurants, land transport, air transport, travel agencies and so on.

Considering the Tourism Yearbook *(Anuario de Turismo)* figures, the distribution of EATs based on size is as follows: 78 percent micro, 19 percent small, 2 percent medium and 1 percent large establishments (Ministerio de Turismo de Chile, 2018). It can thus be inferred that medium to large EATs number around 1,596 hotel companies, accounting for approximately 21 percent of the offering of room accommodations for tourists in Chile (Table 5).

Table 5. Distribution of EATs by Size

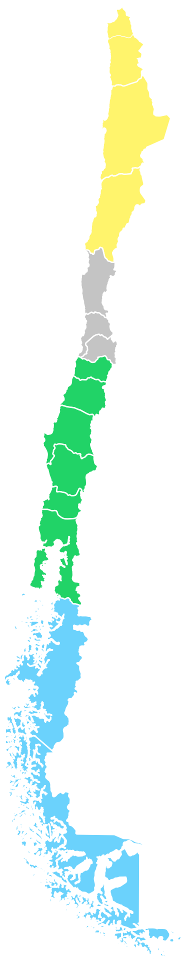
	Large	Medium	Small	Total
Hotels	63	139	1,394	1,596
Rooms	961	2,136	21,362	24,459

Source: Data on distribution by size from Department of Statistics, SERNATUR (2018) (http://www.subturismo.gob.cl/wp-content/uploads/2015/11/Informe-Nacional.pdf) and Anuario de turismo (2017) (http://www.subturismo.gob.cl/wp-content/uploads/2015/10/ANUARIO-TURISMO-2017.pdf).

Figure 5 shows hotel locations in the different regions of Chile. Note that a significant number of these establishments are located in the regions of Antofagasta, Valparaíso, Santiago Metropolitan Region, Biobío, and Los Lagos.

Figure 5. Distribution of Hotels by Region

Supply estimate at the regional level



Region	Number of EATs*	Rooms (capacity) ** and ***	Beds (capacity) ** and ***
Arica and Parinacota	128	2,207	4,340
Tarapacá	233	5,812	11,462
Antofagasta	326	8,038	14,534
Atacama	192	4,018	7,671
Coquimbo	442	6,952	15,910
Valparaíso	998	1,609	30,898
Santiago Metropolitan Region	651	19,863	32,750
Libertador General Bernardo O'higgins	387	5,669	13,863
Maule	357	5,106	10,623
Biobío	562	8,587	18,917
La Araucanía	587	5,791	17,356
Los Ríos	479	4,988	10,317
Los Lagos	1,051	11,949	23,743
Aysén del General Carlos Ibañez del Campos	517	3,517	6,852
Magallanes and Chilean Antarctic	417	5,149	10,534
Country total	**7,327**	**112,255**	**229,770**

Source: Ministerio de Turismo de Chile, 2017.

Notes: *Total establishments offering accommodations that are registered with Sernatur, Chile's National Tourism Service.
**Number of rooms refers to "units of accommodation" (including apartments and cabins/cottages).
***Considers tourism services registered with Sernatur, estimated number of rooms/number of beds in registrations that don't specify this variable.

The main technologies employed by hotels that are pertinent to energy efficiency projects include thermal energy (boilers and solar water heating systems), electricity (air conditioning, lighting and pumps) and thermoelectric energy (gas-based micro-cogeneration).

3.2. FOOD PROCESSING (AGROINDUSTRIAL) SECTOR

The food processing industry comprises companies that produce and process agriculture products (fruit, vegetables, etc.), meat (beef); milk products, eggs, cereals, and milling products, bakery products, confectionery products, and olive growing products. Agroindustry includes both primary food production and food processing. The sector is made up of approximately 73,300 companies in total. The potential market for energy efficiency projects, leaving aside the microenterprises, comprises 21,259 companies. Most of these companies are specialized in primary production (97 percent) and agricultural products (86 percent). Table 6 breaks down the company distribution.[7]

Table 6. Agroindustries according to Size

Subsector	Small	Medium	Large	Total
Agricultural products				
Primary production	14,112	2,462	1,275	17,850
Processing	334	58	30	422
Beef				
Primary production	2,307	403	208	2,918
Processing	55	10	5	69
Total	**16,807**	**2,933**	**1,518**	**21,259**

Source: Dirección General de Estadísticas and Censos de Chile (2011).
Note: Excludes the fishing and vitiviniculture industries.

Prior studies have inventoried the agrobusiness companies whose processes include packing and packaging.[8] Around 53 percent of these companies have a packing capacity of up to 500 tons per season; 27 percent from 500 to 2,000 tons per season, and the remaining 20 percent, between 2,000 and 60,000 tons per season.[9]

This study also did an inventory of agroindustry cooling chambers which are high-intensity energy consuming machinery that operates continuously for 24 hours. The regions where the most food processing facilities are located, equipped with packaging processes and cold rooms, are O'Higgins, Maule, Valparaíso, Coquimbo, Santiago Metropolitan Region, and Biobío. Over 80 percent of agrobusiness companies that are high-intensity energy users are located in these six regions (Table 7).

[7] Statistical distribution of companies by line of economic activity (September 2016) (http://www.sii.cl/estadisticas/empresas_rubro.htm).

[8] Packing refers to methods and procedures primarily for storage, preserving and transporting merchandise. Packaging refers to the wrapping that protects a product with or without an exterior container, in order to preserve the product or facilitate delivery to the consumer.

[9] https://www.ciren.cl/proyectos/catastro-fruticola-e-infraestructura-agroindustrial/.

Table 7. Companies Ranked according to Cooling Chamber Capacity

Number of companies with Cooling Chamber Capacity (m3)	O'Higgins (2018)	Atacama (2018)	Coquimbo (2018)	Metropolitan Region (2017)	Valparaíso Region (2017)	Maule Region (2016)	Biobío Region (2016)	Arica and Parinacota Region (2016)	Los Ríos Region (2016)	La Araucanía Region (2016)	Aysén Region (2016)	Tarapacá Region (2016)	Los Lagos Region (2016)	Total
0–1,000	241	84	108	80	99	201	129	1	39	26	11	2	34	1,055
1,000–2,000	320		13	91	77	214	51		3	18	1		1	789
2,000–3,000	230			44	20	272			3					569
3,000–5,000	82			27	26	141	20		3					299
5,000–10,000	21			7	5	36	2		2					73
10,000–15,000	4					7	5		4					20
Total	**898**	**84**	**121**	**249**	**227**	**871**	**207**	**1**	**54**	**44**	**12**	**2**	**35**	**2,805**

Source: Information from a report issued by each region on the infrastructure section of the Fruit Growers Cadastre and Agroindustry Infrastructure of the Agriculture Ministry (Catastro Frutícola e Infraestructura Agroindustrial del Ministerio de Agricultura) (https://www.ciren.cl/proyectos/catastro-fruticola-e-infraestructura-agroindustrial/).

The main energy efficiency technologies associated with the agrobusiness companies include boilers and thermosolar systems, motors, pumps, refrigeration, climate control, compressed air, and lighting.

3.3. VITIVINICULTURE INDUSTRY

The vitiviniculture industry is divided into two sectors: viticulture or grape growers whose produce goes to wineries or producers of other products, and viniculture, which is the production of wine (wineries). The industry in Chile is made up of around 14,413 companies, 97 percent grape growers and 3 percent winemakers. Of the companies, 68 percent are microenterprises; 30 percent are small-or medium-sized companies, and 2 percent are large companies (Mora, Schnettler, and Lobos, 2014). Table 8 details the distribution of vitiviniculture companies.

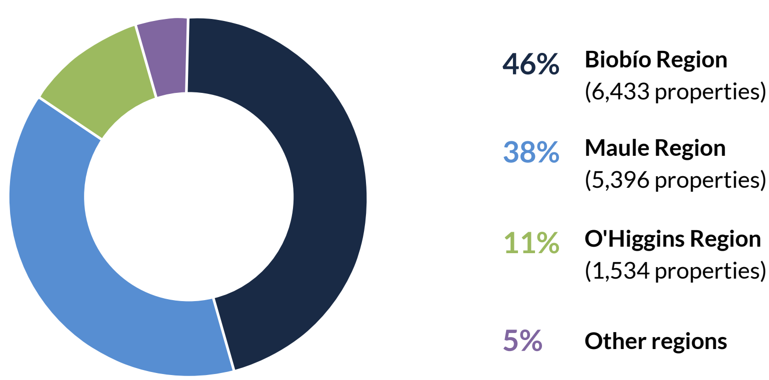
Table 8. Vitiviniculture Companies by Type and Size

	Micro	Small	Medium	Large	Total
Grape growers	9,808	2,102	1,822	280	14,012
Wineries (cellars)	-	160	201	40	401
Total grape/wine production	**9,808**	**2,262**	**2,022**	**320**	**14,413**

Source: Mora, Schnettler, and Lobos (2014).

Most grape growing companies are located in the Biobio Region (6,433), the Maule Region (5,396) and the O'Higgins Region (1,534) (Figure 6). By hectares planted, approximately 72 percent of the companies cultivate less than 5 hectares; 25 percent between 5 and 50 hectares, and just 3 percent cultivate more than 50 hectares. Most of the wineries (with cellars/caves) have storage capacity for more than 3.25 million liters. The storage capacity of the remaining companies varies from this maximum of 3.25 million liters to a minimum of 750,000 liters.

Figure 6. Distribution of Viticulture Companies by Size

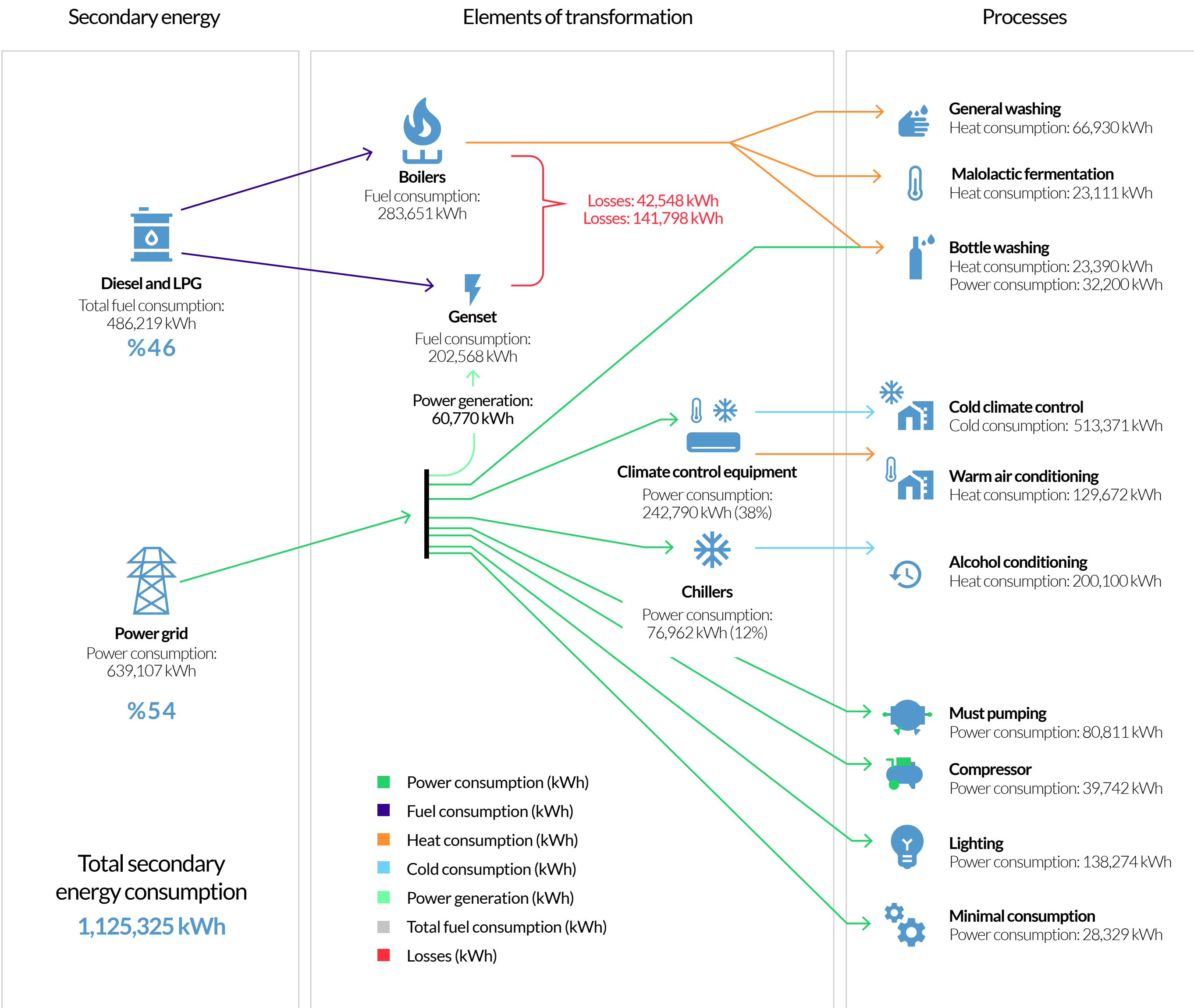


Source: Mora, Schnettler, and Lobos (2014).

The energy use is more intense in winemaking companies than in grape growing companies because of the elaborate processes required in wine production. Grape growing companies require intensive energy use for operating irrigation pumps, pruning, raking, and transport machinery, while wineries require hot and cold processes for producing wine.

Figure 7 shows the thermal and electric energy consumption of a typical wine production and storage facility. Aggregate energy consumption ranges from 10,000 kWh/month (small storage capacity) to 93,000 kWh/month (large storage capacity). On average, 46 percent of the energy consumed comprises fuels such as diesel and liquefied petroleum gas (LPG) for running boilers and electric power generators, while 54 percent is electric power used chiefly for refrigeration, chillers, must transfer pumps, compressors, and lighting.

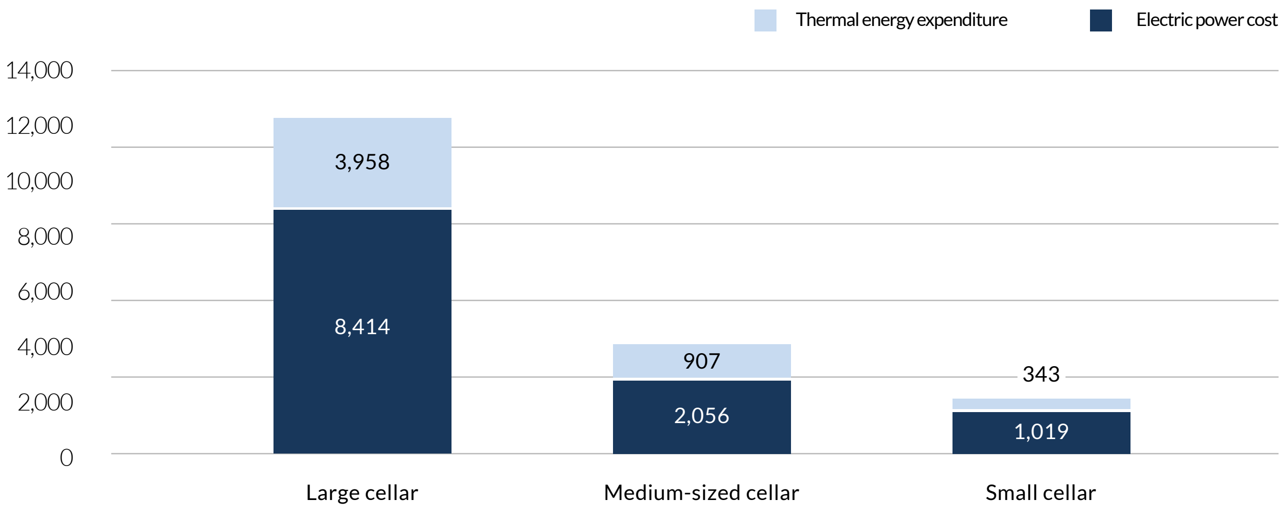
Figure 7. Wine Storage Energy Consumption by Source



Source: Harfagard et al. (2016).

Figure 8 shows the average monthly thermal and electrical energy costs of a winemaking and wine storage facility. The biggest consumers of electricity are the equipment for cooling (45 percent), heating (21 percent), winemaking (16 percent), air compressor units (8 percent); and to a lesser extent, pumping (5 percent) and lighting equipment (5 percent).

Figure 8. Average Cost of Energy per Size Storage (US$/mo)



Source: Authors' elaboration based on Harfagard et al. (2016).

3.4. FISHING INDUSTRY

The fisheries industry is comprised of three subsectors: aquaculture, industrial fishing, and artisanal fishing. Each subsector has a primary activity with related activities (for example, fishing or fish farming) and plants for processing and transformation. Most fishing companies in Chile are microenterprises although there are 3,510 companies varying from small to large in size. Table 9 provides a breakdown.

Table 9. Fishing Industry Companies by Size and Activity

Subsector	Small	Medium	Large	Total
Aquaculture				
Aquaculture centers	797	665	133	1,595
Transformation plants	188	236	47	471
Industrial fishing				
Vessels	55	69	14	137
Processing plants	284	355	71	709
Artisanal fishing				
Natural persons	-	-	-	0
Legal persons	277	231	46	554
Communities	44	0	0	44
Total companies	**1,646**	**1,554**	**311**	**3,510**

Source: Statistics of companies by economic category (September 2016) (http://www.sii.cl/estadisticas/empresas_rubro.htm).

Most of the small-and medium-sized companies in the fisheries sector run aquaculture farms[10] (59 percent) and work in industrial fishing (24 percent). A smaller number work in artisanal fishing (17 percent). The main aquaculture products are Atlantic salmon, mussels and Pacific salmon, which account for 93 percent of total fishery products. The regions of Los Lagos, Aysén, and General Carlos Ibáñez del Campo are the largest producers. Types of aquaculture farms include earthen ponds (without water flow), open circuit systems (with constant water flow), recirculating aquifer systems (closed circuit) and cage farming.

Energy consumption in industrial and artisanal fishing pertains to the fishing boats or vessels. From 70 to 85 percent of a fishing boat's fuel consumption is for propulsion and the remainder for other services such as refrigeration, lighting, pumping, cargo operations (motors), etcetera. Consumption varies depending on vessel type, operating condition, size, machine room design, and type and number of consumers (IDEA, 2009). Energy consumption in processing plants is related to the production of fishmeal, fish oil, frozen catches, and algae drying, among others.[11] The equipment for such plants includes boilers, electric power generators, cooling equipment, pumps, compressors, and lighting fixtures.

[10] Farming and reproduction of aquatic species in fresh or salt water.

[11] http://www.subpesca.cl/portal/618/articles-100275_documento.pdf.

3.5. MARKET POTENTIAL OF THE PRIORITY SECTORS

From the analysis of the previous sections, it can be inferred that the total number of enterprises in the four priority subsectors and the categories from small to large companies is approximately 31,000, of which 22,110 are small firms, 6,648 are medium, and 2,212 are large firms (Table 10). Note that these sectors have been growing at a rate of around 4 percent per year according to the Central Bank of Chile's 2018 Report on National Accounts.

Table 10. Chile Companies in Priority Subsectors by Size

	Total companies (2011)			
Priority sectors	**Small**	**Medium**	**Large**	**Total**
Hospitality sector	1,394	139	63	1.596
Agroindustry sector	16,807	2,933	1,518	21,259
Wine industry	2,262	2,022	320	4,605
Fishing industry	1,646	1,554	311	3,510
Total companies	**22,110**	**6,648**	**2,212**	**30,970**
	71%	**21%**	**7%**	**100%**

Source: Authors' elaboration.

4.

ANALYSIS OF TECHNOLOGIES

4 ANALYSIS OF TECHNOLOGIES

This section presents the preselected technologies for the ESI Model in Chile and a brief analysis of payback periods based on their standard costs.

4.1. PROJECT TECHNOLOGY TYPES

There are various technologies that can be financed under energy efficiency programs. Among the technologies with significant energy savings potential most often employed in the subsectors under analysis in Chile are: air conditioning systems, motors, boilers, cooling systems, thermal and photovoltaic solar systems. Other pertinent technologies are water pumps, irrigation systems, compressed air systems, cogeneration systems, motors for fishing vessels and heat pumps. Table 11 shows referential values of potential energy savings in yielded by high efficiency equipment, compared to low-efficiency energy technologies.

Table 11. Potential Savings in Energy Consumption per Technology

Technology type	Potential savings in Kwh consumption (%)
Air conditioning	22
Engines	6
Refrigeration chambers	20
Boiler	6
Solar thermal heater	50
Photovoltaic solar system	100

Source: Authors' elaboration.
Note: Savings from photovoltaic systems means the replacement of electric power supplied by the grid and not to the reduction of power consumption.

The added cost of more efficient technologies can be considerable. For example, the cost of air conditioning equipment and motors can increase from 15 to 50 percent depending on the type of technology, its efficiency and power. For cooling chambers cost increases can range from 10 to 20 percent, depending on the technology type and building materials; and for boilers, between 10 and 20 percent, depending on construction technology, components, and accessories.

Table 12 presents the average investment cost of efficient technologies according to their capacity or output. These costs can vary depending on the brand, technology, equipment size, efficiency level, and provider.

Table 12. Average Investment per Technology, Capacity and Equipment Size (US$)

Technology type	Small projects	Large projects
Air conditioning	US$1,500/tonne of refrigeration	US$1,200/tonne of refrigeration
Engines	US$150/HP	US$120/HP
Boilers	US$1,200/BHP (Boiler HP)	US$1,000/BHP (Boiler HP)
Cooling chambers	US$2,800/tonne of refrigeration	US$2,500/tonne of refrigeration
Solar thermal systems	US$700/$m^2$	US$550/$m^2$
Photovoltaic solar systems	US$1,500/kWp (kilowatt peak)	US$1,100/kWp (kilowatt peak)

Source: Data from providers in LAC countries where the ESI Model has been developed.

Table 13 shows case studies on three energy efficiency projects in Chile's agrobusiness sector, where the investment per project ranges from approximately US$80,000 to US$230,000.

Table 13. Case Studies

Bayas del Sur, S.A. Technology: Boiler Investment: US$230,100 Capacity: 3 tons steam Savings: 665,000 kWh/yr Savings: US$39,000/yr Simple Repayment period: < 6 years
ARIZTIA El Paico Poultry Processing Plant Characteristics: 70,000 tons of poultry meat Production Expenses - Energy: 20 percent Technology: 3 Electric motors (600, 522 & 336 kW) Investment: US$80,279 Savings: 43,319 kWh/yr Savings: US$46,223/yr Simple Repayment period: < 2 years
Agrícola El Retorno S.A, Exportadora Subsole y Joywingmao Technology: Solar PV, 63kW Investment: US$134,328 Savings: 107,600 kWh/yr Savings: US$11,768/yr Simple Payback Period: 12 years

Source: IQonsulting and Carbon Trust.

4.2. ECONOMIC ANALYSIS OF THE TECHNOLOGIES

An important factor to consider in the economic analysis is the frequency of use of these technologies, as it determines how quickly the machinery can be amortized. If the equipment is not in use, it does not generate savings, and the payback period is longer, compared to machinery that is used intensively. For example, the use of cooling chambers is double that of other technologies since they are in continuous operation 24 hours a day, each day, to conserve product freshness, while other technologies operate only during work shifts or, in the case of solar systems, during daylight hours. Equipment is normally more intensively used in large companies, in industry and commercial operations, where there can be up to two or three continuous work shifts. Another factor to include in the economic analysis is maintenance cost, which is directly related to the age of the equipment. These costs vary according to equipment type and can account for a significant percentage of operational expenses. In PV solar systems, equipment maintenance can equal 6 percent of the equipment's net value, while the cost of annual maintenance for a boiler can amount to around 2 percent of its value.

The other important factor is undoubtedly the cost of electric power, which varies depending on the contract type, installed capacity, energy demand, and the time of day the electricity is consumed. In general, energy tariffs in Chile for the target companies are approximately US$0.1580 per kilowatt-hour.[12] Regarding fuels, as of March 2019 it was found that the boilers used by companies mainly ran on propane gas and, to a lesser extent, on diesel fuel, which are priced at US$0.72/lt and US$0.88/lt, respectively.[13,14] Based on these numbers, an economic analysis was carried out on five project types in LAC, with data on investment, maintenance, and operating costs (Table 14).

Table 14. Energy Efficiency: Economic Characteristics, Technology Costs

	A/C (300 tonnes)	Motors (230HP)	Boilers (130 BHP)	Industrial refrigeration (90 TR)	PV solar (150 KW)
Investment (US$)	303,000	35,770	152,700	249,684	177,375
New equipment maintenance (US$/yr)	5,000	2,170	2,700	2,684	5,321
Old equipment maintenance (US$/yr)	7,500	5,880	5,400	6,710	-
Energy savings - new versus old equipment	**20%**	**6%**	**6%**	**24%**	**100%**

Source: Authors' elaboration.
Note: The data on capacity and power output of each equipment unit were taken from regional SME project case studies.

Profitability and investment payback periods were calculated for each of the projects. The analysis was carried out in two scenarios: (i) with 80 percent project financing, and (ii) without financing (solely the investor's own capital). The base assumption was for project financing to cover a period of five years at an annual rate of 10 percent. Other variables were a 10 percent discount rate, 4 percent annual inflation in energy tariffs, an income tax rate of 25 percent, and a five-year accounting depreciation on the equipment. Calculations were made of the internal rate of return, net present value and payback period. Since the objective was to evaluate the profitability of ESI Model projects, a validation charge of US$1,500 per project and an insurance premium averaging 1.5 percent of the total project cost were included as transaction costs. Table 15 provides the results of the analysis.

[12] Electricity tariffs as of March 15, 2019 (http://www.cge.cl/wp-content/uploads/2019/03/CGE_TARIFAS-SUMINISTRO_-MARZO_2019.pdf).

[13] National Energy Commission (Comisión Nacional de Energía). Web portal for price queries (March 2019) (www.gasenlinea.gob.cl).

[14] Comisión Nacional de Energía. Web portal for price queries (March 2019) (www.bencinaenlinea.cl).

Table 15. Economic Analysis of Energy Efficiency Projects that Apply the ESI Model

Subsector	A/C	Motors	Boilers	Industrial refrigeration	PV solar
IRR					
No financing (%)	19.91	20.62	26.23	18.73	6.87
80 percent financing (%)	36.31	38.93	42.68	22.62	12.55
Payback period (yrs)					
No financing (yrs)	4.6	4.9	4.1	6.1	8.5
80 percent financing (yrs)	4.0	4.1	3.4	5.4	7.6

Source: Authors' elaboration.

The economic analysis demonstrates that projects that apply the ESI Model can have a payback period of between three and eight years. As mentioned previously, these values are sensitive to frequency of use. For example, the use assumption for a boiler was 14 hours/day; however, this frequency of use is higher in hotels and hospitals (approximately 20 hrs/day), in which case the payback period would be shorter—less than three years for a project with financing. Figure 9 shows the cash flows of the projects analyzed.

It is important to identify the investment amounts that are most affected by ESI transaction costs (i.e., validation and insurance). Table 16 presents a sensitivity analysis of project profitability and payback periods, comparing when transaction costs are included versus when they are excluded. Transaction costs have a significant impact on project investments under US$30,000 and, in contrast, the impact is minimal on project investment higher than US$100,000.

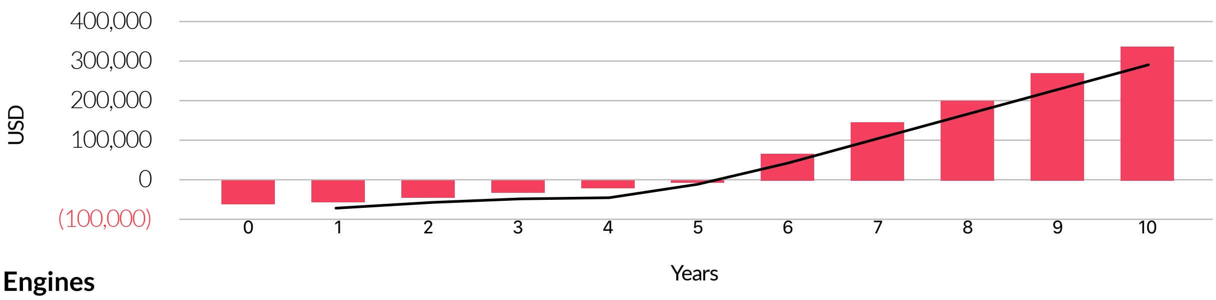
Table 16. Sensibility Analysis With/Without Transaction Costs

Project technology	Investment (US$)	Internal rate of return/payback	With transaction costs	With transaction costs
A/C	303,000	IRR (%)	37.76	38.55
		Payback (yrs)	4.4	4.2
Engines	35,770	IRR (%)	38.93	46.49
		Payback (yrs)	4.1	3.0
Refrigeration	249,684	IRR (%)	33.87	34.76
		Payback (yrs)	5.1	5.0
Boilers	152,700	IRR (%)	42.68	44.31
		Payback (yrs)	3.4	3.2
Photovoltaic solar	177,375	IRR (%)	6.87	7.68
		Payback (yrs)	8.5	8.3

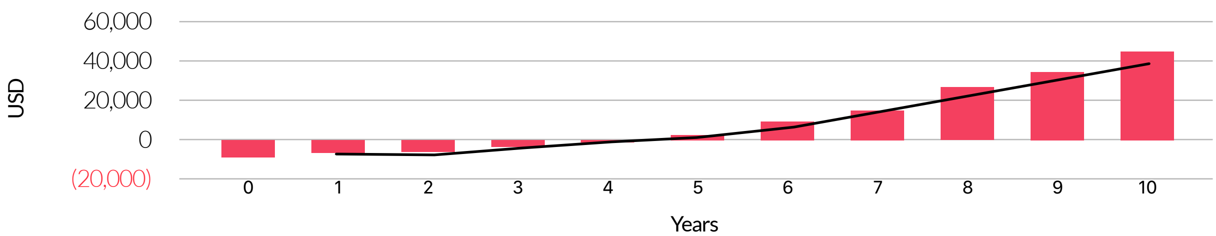
Source: Authors' elaboration.

Figure 9. Cash Flows in Energy Efficiency Projects

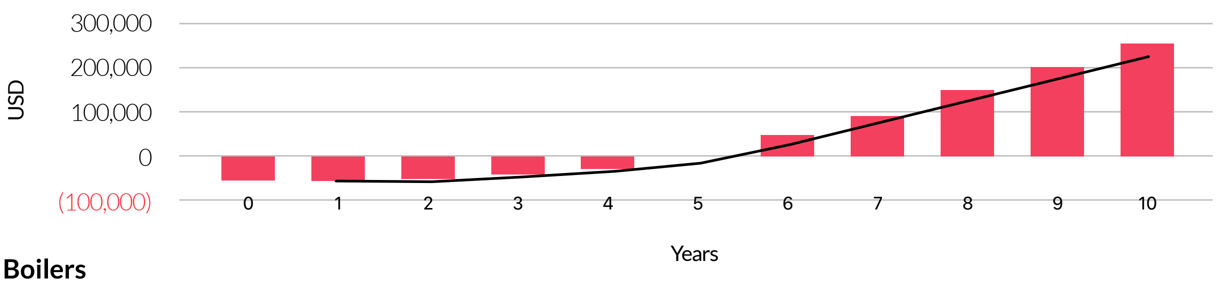
A/C



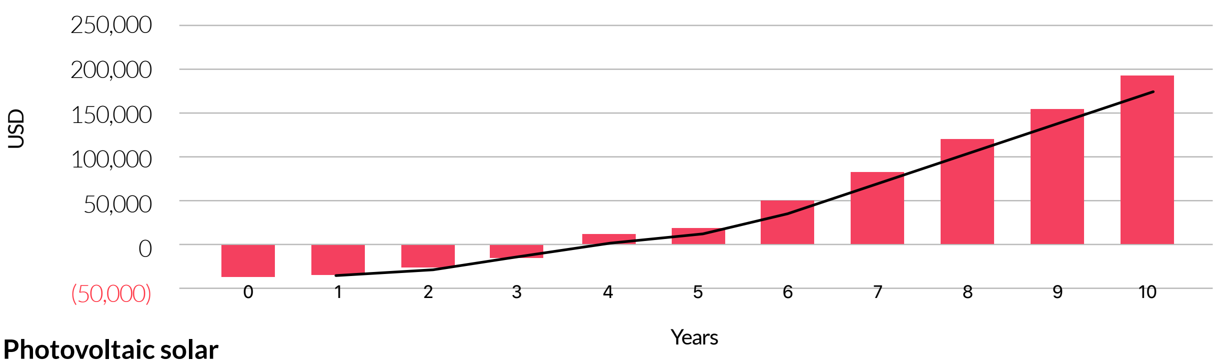
Engines



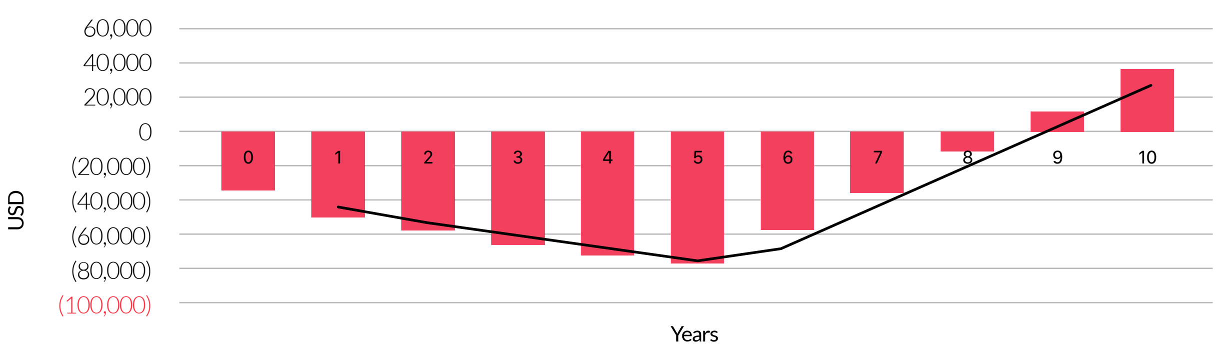
Refrigeration



Boilers



Photovoltaic solar



Source: Authors' elaboration.

5.

MARKET POTENTIAL OF ESI PROJECTS

5 MARKET POTENTIAL OF ESI PROJECTS

5.1. FINANCING MARKET ESTIMATES

This section estimates the potential market size for financing projects that apply the ESI Model. The 30,970 companies with potential for implementing energy efficiency projects were taken as the starting point (Table 3). Out of those , the number of companies that seek financing and require retrofitting were identified, whether due to equipment obsolescence or because they wish to expand production or services.

According to the studies and surveys conducted in Chile, the annual effective potential for energy efficient projects in industry and services ranges from 3.2 percent to 4 percent of the companies (Aets Sudamérica S.A. and Econoler, 2010). This means that, of every 100 companies, just three or four would need to make an annual investment in energy efficiency. On the other hand, only 50 percent to 60 percent of SMEs have access to credit for this type of project (Ministerio de Economía, Fomento y Turismo, 2017). The remaining companies self-finance because they are not creditworthy, their borrowing capacity is already committed, or they have no interest in applying for loans. Upon weighing these variables, it was found that the real market for energy efficiency projects in the priority sectors would consist of around 533 projects per year (Table 17).

Table 17. Estimate of Actual Market for Energy Efficiency in the Priority Sectors

	Total companies	Companies with energy efficiency potential (per yr)	Companies requiring energy efficiency (per yr)	Companies with credit potential
Hospitality sector				
SME	1,534	4.00%	61	31
Large companies	63	4.00%	3	2
Agroindustrial sector				
SME	19,740	3.20%	632	316
Large companies	1,518	3.20%	49	29
Wine industry				
SME	4,284	3.20%	137	69
Large companies	320	3.20%	10	6
Fishing industry				
SME	3,200	4.50%	144	72
Large companies	311	4.50%	14	8
Total companies	**30,970**		**1,049**	**533**

Source: Authors' elaboration.

The projects in each subsector may use different technologies, for example, air conditioning, photovoltaic solar energy, boilers, or a combination of two or more technologies. Table 18 presents a possible project distribution scenario for each technology and sector, in conjunction with the average expected investments in each technology.

Table 18. Numbers of Projects and Average Investment in Actual Priority Sector Markets (per yr)

Scenario of projects per sector		A/C	Motors	Boilers	Industrial refrigeration	Thermal solar	PV solar
Hospitality Sector							
SME	Projects	12	0	6	2	6	5
	US$	99,000		72,000	70,000	21,000	90,000
Large	Projects	2	0	0	0	0	0
	US$	300,000		208,000	305,000	55,000	110,000
Agroindustrial sector							
SME	Projects	0	32	111	32	63	79
	US$		30,000	60,000	140,000	21,000	150,000
Large	Projects	0	3	10	3	7	6
	US$		60,000	300,000	500,000	55,000	330,000
Wine industry							
SME	Projects	0	0	0	28	17	24
	US$		15,000	48,000	70,000	21,000	150,000
Large	Projects	0	1	0	2	2	2
	US$		24,000	150,000	250,000	55,000	330,000
Fishing industry							
SME	Projects	0	58	0	14	0	0
	US$		15,000		56,000		
Large	Projects	0	6	0	2	0	0
	US$		60,000		375,000		
Total	**Projects**	**14**	**98**	**127**	**82**	**96**	**116**
	(Millions of US$)	**1.6**	**2.3**	**10.2**	**10.1**	**2.3**	**18.5**

Source: Authors' elaboration.

5.2. INVESTMENT AND FINANCING REQUIREMENTS

In the above scenario, the demand for investments is approximately US$45 million/year, the maximum requirements being for photovoltaic solar energy, boilers, and refrigeration, mainly concentrated in the agroindustrial sector (Table 19). Assuming a financing requirement for 80 percent of the investment, the capital required by the priority sectors in the actual market would be US$36 million/year. Were the analysis performed for the potential market, the 30,970 companies in the priority sectors would require an investment of around US$3 billion.

Table 19. Energy Efficiency Investment Requirements (actual priority sector markets) (in millions of US$)

Sector	Required investment - scenario of projects/ sector/year	Financing	Own capital	Emission reduction ($tonCO_2$/yr)	Energy savings (GWh/yr)
Hospitality sector	2.8	2.3	0.6	2,915	4.5
Agroindustry sector	32.2	25.7	6.4	34,180	53.2
Vitiviniculture sector	7.2	5.7	1.4	6,906	9.3
Fishing industry	2.9	2.3	0.6	5,216	8.5
Annual Total	**45.0**	**36.0**	**9.0**	**49,217**	**75**

Source: Authors' elaboration.

These projects could generate significant energy and environmental benefits. Energy savings would be equivalent to 85 GWh/yr, which, considering the emission factors of Chile's electric power grid[15] and the fuels used (diesel and LPG), would imply annual emission reductions of 49,217 tons of CO_2.

Energy efficiency projects exert a long-term positive impact on the environment. Most of the equipment has a lifetime of 10 years, after which it is recommended that they be replaced. The lifetime of photovoltaic systems can be as long as 20 years, approximately.

[15] Grid emissions in Chile: 0.0006140 $tonCO_2$/KWh; LPG emissions (incl. CH4, N20): 66,66 $tonCO_2$ eq./TJ (https://pub.iges.or.jp/pub/iges-list-grid-emission-factors).

Table 20. Environmental (tonCO_2/yr) and Energy (GWh/yr) Benefits of Energy Efficiency Projects in Actual Priority Sector Markets

Projects	Number of projects/yr	Energy savings (GWh/yr)	Emission reduction (tonCO_2/yr)
Air conditioning	14	2	1,310
Motors	98	6	3,600
Boilers	127	27	13,418
Industrial refrigeration	82	23	14,120
Solar thermal preheating	96	2	7,722
PV solar	116	15	9,047
Annual total	**533**	**75**	**49,217**

Source: Authors' elaboration.

5.3. PROJECTION OF ESI MODEL IMPLEMENTATION

Developing the ESI Model and educating the market takes time. However, Colombia's experience shows that as soon as the market attains understanding of the Model and the first technology providers begin to develop it, other providers will try to replicate the experience and clients will start to require the use of its proposed mechanisms. Table 21 is a hypothetical financial projection for the first five years, prepared for BancoEstado, that may be useful for anticipating financial and human resource requirements in preparation for the expected demand for projects. It is estimated that these projects will generate a demand for financing of US$200 million within the initial five-year time period.

Table 21. Project Investment and Financing Projections in Priority Subsectors

	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Projections	20%	40%	60%	80%	100%	**100%**
Number of projects	107	213	320	426	533	**1,599**
Investments (millions of US$)	9.0	18.0	27.0	36.0	45.0	**135.1**
Financing (millions of US$)	7.2	14.4	21.6	28.8	36.0	**108.1**

Source: Authors' elaboration.

5.4. THE MARKET OPPORTUNITY FOR INSURANCE COMPANIES

The main incentive for an insurer to participate in the ESI Model is that it will provide them with an opportunity to grow the demand for contract compliance guarantees or surety bonds. In Chile, surety bonds issued by insurers are a relatively new market offering. They are increasingly used in public works contracts, although in most cases a bank guarantee is the primary instrument for contract compliance.[16]

The main disadvantage of the bank guarantee is that the bank retains the funds otherwise required by the contractor to comply with their contract commitments over the guarantee period. For example, if the client requires a surety for an amount equivalent to US$100,000 for a period of one year after the work has been delivered, the bank can issue the guarantee (as its guarantor) and freeze that same amount in the contractor's account for one year. The advantage of a surety bond issued by an insurer is that the latter does not have to retain the funds as a condition for issuing a guarantee policy. The insurer performs a financial assessment to evaluate whether the contractor is in a position to meet its commitments.

Some barriers and risks associated with the surety bond have to do with the provider's capacity to demonstrate to the insurer that they have the requisite financial solvency to follow through on the guarantees established in the contract. This factor limits the type of provider eligible to apply for the instrument. The condition for the insurer to issue a surety bond is the certainty that the provider will meet their commitments and, if necessary, will have the financial capacity to reimburse the insurer. For obvious reasons, insurers prefer to work with large and reputable providers; this does not mean, however, that smaller providers cannot have access to these products. Normally the risk potential of a company is reflected in the cost of the premium that a provider must pay to be eligible for a surety bond.

The cost of the insurance coverage is set by the insurer and depends on the risk assessment it performs on the provider applicant. In general, the cost of a surety bond should be around 1 percent of the guaranteed amount (which is equivalent to the project's net value). However, this amount can vary depending on the insurer's risk assessment of the client. The higher the risk, the higher the premium. The premium cost may also be lower if the provider is extremely reputable. It has been estimated that the cost of this policy in Chile will vary from 0.5 percent to 1 percent of the insured value.

According to insurers in Chile, the type of guarantee required to providers is a promissory note that commits the provider to reimburse the payments that the insurer may be forced to make in case of underperformance—that is, non-achievement of the promised energy savings, which then activates the insurance.

5.5. BANCOESTADO'S FINANCING OFFER

As part of its sustainable strategy, BancoEstado has established the generation of green financial products. These products finance investments favorable for the mitigation of and adaptation to climate change. The Bank currently has a green credit line that targets end users, project developers, and Energy Service Companies (ESCOs). The credit line provides assistance to third parties for the development of projects for energy efficiency and non-conventional renewable energies, and provides financing for supplies, merchandise, and labor. Said financing has the following characteristics:

[16] According to conversations with CESCE, the market for surety bonds in Chile is around US$20 million (data from 2018).

- Loan repayment periods of up to 12 years
- Financing of up to 80 percent of the project's net worth
- Financing in pesos or UFs
- Payment schedule in accordance with the borrower's business cycle
- State or real guarantees

The BancoEstado credit line is designed for the needs of SMEs and has an operational flow somewhat similar to that of the ESI Model. The client must provide a technical feasibility sheet and a savings estimate that can be downloaded from the webpage of the Energy Sustainability Agency (*Agencia de Sostenibilidad Energética*, ASE).[17] The form must be duly filled out by the provider and subsequently validated by the ASE. An account executive manages the interactions between ASE and the investor. Given the operational similarities between this credit line and the ESI Model, BancoEstado has provided for the use of this infrastructure for the management of projects that apply the ESI Model.

[17] https://www.acee.cl/.

6. CONCLUSIONS

6 CONCLUSIONS

Projects of energy efficiency and distributed generation that SMEs take on in Chile face investment barriers, mainly because of the perception of risk associated with the technologies and technology providers. These risks can be mitigated or eliminated through the application of the ESI Model, which makes provision for client compensation in case the minimum energy savings guaranteed within a specified time period are not achieved. The ESI Model is applicable to projects for equipment renovation as well as for brand new facilities. In retrofitting projects, the projected savings are quantified based on the performance of the new versus the replaced equipment, while in the second case they are calculated based on the industry benchmark practice.

The implementation of the ESI Model in Chile is making good progress at this time. Through the IDB and Danish government's technical cooperation activities, the potential demand for investments has been evaluated, the performance contract has been adapted to local regulations, and insurance policies have been developed with the insurers CESCE and SURA. The ASE has been designated as the validating entity. These initiatives have all been carried out within the framework of an alliance with BancoEstado, the banking institution that will provide financing for the projects. This structure will strengthen the client-provider relationship and enable the materialization of a series of investments in energy efficiency and renewable energies in Chile.

Chile has one of the highest electricity tariffs in South America, which translates into attractive prospects for high rates of return on investments in energy efficiency and renewable energy projects and short payback periods. This study identified four subsectors in the Chilean economy as opportunity areas for the ESI Model, given their energy intensity and the characteristics of the companies in them, namely: hotels, agrobusinesses, the vitiviniculture industry and the fishing Industry. It is estimated that, once maturity has been attained in these subsectors, their market potential could yield a yearly average of 533 projects and investments of around US$45 million per year.

The technologies with the most favorable investment prospects in these selected sectors are: air conditioning systems, boiler equipment, motors, industrial refrigeration, solar thermal systems and photovoltaic solar generation. The economic analysis demonstrates that through application of the ESI Model, projects can attain payback periods of three to eight years, making them an attractive option for investors in Chile. Aside from the prospect of significant savings for the companies, investments in these technologies can generate environmental benefits through reduced carbon emissions of 50.000 tCO_2/year and energy savings of approximately 75 GWh/year.

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