Design of Standards and Labeling programs in Chile: Techno-Economic Analysis for Refrigerators

Authors:
Virginie E. Letschert, Lawrence Berkeley National Laboratory, +1 510.486.7683, Vletschert@lbl.gov
Michael A. McNeil, Lawrence Berkeley National Laboratory, +1 510.486.6885, MAMcNeil@lbl.gov
Mariana Pavon, Ministerio de Energía, +56-2 365 68 00, mpavon@minenergia.cl
Wolfgang F. Lutz, Energy Strategies for Sustainable Development, +31-172-605803, wflutz@energy-strategies.org

1. Introduction

Lawrence Berkeley National Laboratory is a global leader in the study of energy efficiency and its effective implementation through government policy. The Energy Analysis and Environmental Impacts Department of LBNL's Environmental Energy Technologies Division provides technical assistance to help federal, state and local government agencies in the United States, and throughout the world, develop long-term strategies, policy, and programs to encourage energy efficiency in all sectors and industries. In the past, LBNL has assisted staff of various countries government agencies and their contractors in providing methodologies to analyze cost-effectiveness of regulations and assess overall national impacts of efficiency programs. The paper presents the work done in collaboration with the Ministry of Energy (MoE) in Chile and the Collaborative Labeling Appliance Standards Programs (CLASP) on designing a Minimum Energy Performance Standards (MEPS) and extending the current labeling program for refrigerators.
LBNL used the Policy Analysis Modeling System (PAMS) to conduct the analysis. PAMS is a spreadsheet model that provides policymakers with a robust and transparent cost-benefit analysis of future energy efficiency programs[1]. It contains a built-in database of energy parameters for more than 160 countries and built-in engineering analysis for three appliances. PAMS can be used with little or no data, and can be customized to model a wide range of equipment and appliances.

2. National and International EES&L programs

2.1 Labeling Program in Chile

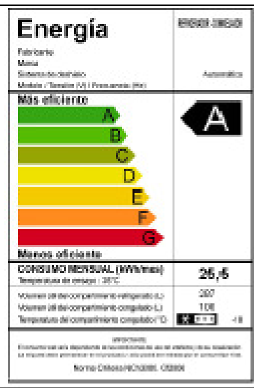
In early 2005 the government of Chile established the National Program for Energy Efficiency (PPEE) under the Ministry of Economy, its objective was to promote a more efficient use of energy. It has since then been replaced by the Chilean Energy Efficiency Agency (Agencia Chilena de Eficiencia Energética).

[1] PAMS is available for download at: http://www.clasponline.org/ResourcesTools/Tools/PolicyAnalysisModelingSystem

A program that stands out among the measures PPEE is the Energy Efficiency Labeling of electrical appliances. The goal of the labeling program is to inform the consumer of energy-using appliances about the energy performance of these, and to influence his purchase decision. Currently, the mandatory Energy Efficiency Labeling program covers: light bulbs, refrigerators and freezers, air conditioners, motors (up to 10 HP), the standby mode for microwaves, televisions, and other electronics. With the exception of motors, the products covered are mainly in the residential sector. The MoE is currently working on extending the labeling program to gas stoves and water heaters.

The labeling program follows the EU labeling scheme (Directive 2003/66/CE) with letter categories ranging from G (least efficient) to A (most efficient). Table 2 summarizes the labeling programs into effects for domestic refrigeration.

Table 1: Labeling Program for Refrigerators in Chile

Product	Date of implementation	Energy efficiency and safety standard	Labeling Standard	Energy Label
Refrigerator-Freezer	January 10, 2008	ISO 15502 IEC 60335-2-24	NCh 3000	
Refrigerator	January 31, 2008			
Freezer	August 14, 2008			

2.2 International Programs

The following section describes briefly current regulatory programs mandating energy conservation standards and labeling programs for refrigerator/freezers around the world. An extensive description of all programs can be found in the preparatory study from Ecodesign in task 1 (ISIS, 2007) and in the latest US-DOE Technical Support Document in Chapter 3 (US-DOE, 2010).

According to the CLASP online database of standard and labeling all 15 original European Union (EU) member countries, plus 18 other countries outside Chile, have mandatory energy efficiency standards for refrigerator-freezers, and 24 have a mandatory comparative labeling program.
As it is difficult to compare the standards from country to country because of the differences in test procedures, we prefer to focus on the EU programs, that have historically been a template for Chile.

The European Commission adopted a directive in July 2009 to reduce electricity consumption of refrigerators-freezers (EC, 2009). The regulation mandates a minimum Energy Efficiency Index (EEI) in three steps, as shown in the following table:

Table 2: Ecodesign Criteria

Application date	**Energy Efficiency Index (EEI)**
1-Jul-2010	EEI < 55
1-Jul-2012	EEI < 44
1-Jul-2014	EEI < 42

Following the first step of the regulation, the labeling program was extended in September 2010 to include a new label category (A+++) and eliminate the least efficient categories (Commission Delegated Regulation (EU) No 1060/2010). The following table presents the definition of the extended labeling program.

Table 3 European Labeling Program Definition as of September 2010

Energy efficiency class	Energy Efficiency Index
A+++ (most efficient)	EEI < 22
A++	22 ≤ EEI < 33
A+	33 ≤ EEI < 44/42*
A	44/42* ≤ EEI < 55
B	55 ≤ EEI < 75
C	75 ≤ EEI < 95

*The new European labeling scheme stipulates a change in the minimum EEI for level A+ in 2014 from 44 to 42.

Since July 2010, refrigerator-freezers sold in Europe have to be of level A or above. As a consequence, the labeling scheme ranges from the letters A to A+++. The Chilean Ministry of Energy is considering rescaling its labeling program in order to avoid this situation where all efficiency levels are rated with the same letter. We assume that the letter category doesn't have any impact on the consumer buying decision because the aspect of consumer impact of alternative lettering is not the subject of this report. In other words, we won't distinguish between an extension and a rescaling of the labeling program.

3. Trade flows

The Ministry of Energy provided a database of models sold in Chile in 2007, 2008 and 2009. The following figures present the origin of the refrigerators sold in Chile.

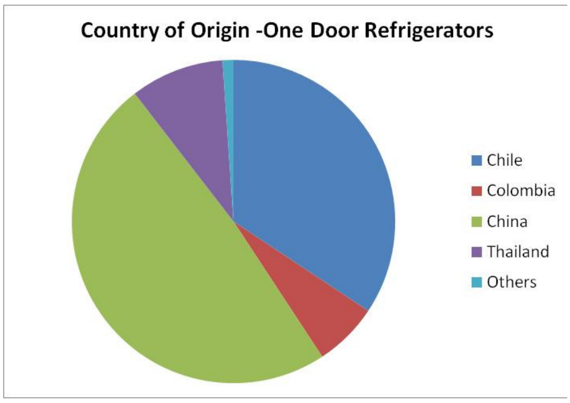


Figure 1 : Country of Origin of One Door Refrigerators (2009)

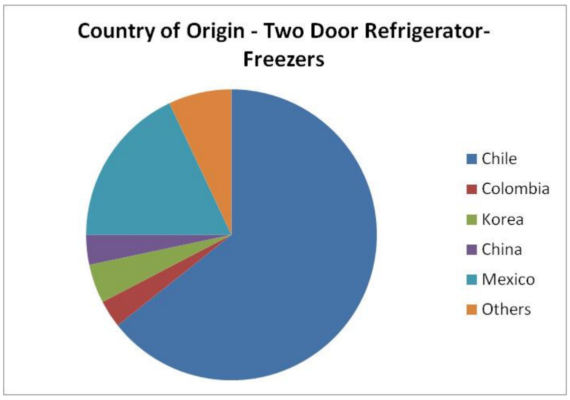


Figure 2 : Country of Origin of Two Door Refrigerators (2009)

The market for one-door refrigerator is dominated by imports from China. Two-door refrigerators are mostly produced domestically. Mexico is the first exporter of two-door refrigerators in Chile.

The following table presents the total sales of refrigerators between 2007 and 2009, for one-door and two-door refrigerators.

Table 4: Historical Sales Data

	2007	**2008**	**2009**
One-door	61,000	53,000	51,000
Two-door	220,000	280,000	325,000
All	281,000	333,000	376,000

4. Energy Use

To estimate the percentage of consumers who would be affected by a standard at any of the potential efficiency levels, we consider the projected distribution of efficiencies for products that consumers purchase under the base case (the case without new energy efficiency standards or extension of the labeling program). These efficiency trends are then used to determine the average energy consumption of refrigerators-freezers in the base case.
As shown later in section 5, one door refrigerators are expected to disappear from the Chilean market by 2014. As a consequence, it was agreed to focus the analysis on two door refrigerators.

4.1 Base Case Efficiency Distribution

To estimate the percentage of consumers who would be affected by a standard at any of the potential efficiency levels, we consider the projected distribution of efficiencies for products that consumers purchase under the base case (the case without new energy efficiency standards or extension of the labeling program).
We refer to this distribution of product energy efficiencies as the base-case efficiency distribution. The distributions of efficiencies are projected based on historical data from 2007 to 2009 provided by the Superintendence of Electricity and Combustibles (SEC). These market shares were put in perspective using historical and projected market shares found in the EU (EC,

1999 and EC, 2009). We find that the efficiency of the market in Chile has moved further than the market in Europe in 1999; pulled by the introduction of the levels A+ and A++ in 2007. In the latest year available (2009), 10% of the market is at the level A+ and A++. Using the 2007-2009 trend, we also find that the market shares of the products of lower efficiency levels B and C are phased out from the market by 2014. Because the entire market consists of A, A+ and A++ level, we find similarities between the efficiency market shares in Europe in 2009 and what we can predict the Chilean market will be in 2014.

4.2 Average UEC

The Ministry also provided UECs, and Energy Efficiency Index for 2009, whose definition can be found in NCh 3000 (2006).
Table 5 presents a summary of the data compiled by the Ministry.

Table 5 Average UEC and Efficiency (EEI) by Labeling Category

	UEC	EEI
Efficiency Category	kWh	%
A++	283	27.0
A+	349	35.5
A	380	48.2
B	423	66.4
C	451	84.9

4.3 Average Price

The MoE provided average retail prices found in 2010 in the Chilean market for every efficiency level.

Table 6 Retail Price by Labeling Category

	Retail Price	Retail Price	Sample Size
Efficiency Category	Chilean Pesos	US$*	
A++	$454,022	$904	34
A+	$392,855	$783	26
A	$343,538	$684	106
B	$231,257	$461	1
C	$169,990	$339	2

*Based on an average exchange rate of 502 Chilean Pesos per Dollars in 2010 (oanda.com).

We couldn't find any engineering data or retail prices of A+++ refrigerators (because they were not available in the market at the time of the study), so they won't be analyzed as a possible standard. Where needed (e.g. in calculating market average price), we assume the same percentage increase in price than between A+ and A++.

Also, we note that a cost-benefit analysis based on a larger retail price database, or a component based engineering analysis would provide a more robust analysis.

5. Unit Level Cost Benefit Analysis

5.1 Considerations about Labeling Programs vs MEPS.

Calculation of differential life-cycle costs within a mandatory (MEPS) program generally assumes that consumers would not purchase high-efficiency equipment in the absence of a program. Incremental costs and energy savings are therefore calculated by comparing high efficiency appliances (policy case) to baseline units (base case). The purpose of the calculation is to ensure that government-mandated programs do not pose a financial burden to consumers. The case of a labeling program is different. While the labeling of products may be mandatory, the choice of whether to buy an ‘A’ level or ‘A+’ level is left to the consumer, as is the choice of the manufacturer to produce these products. The purpose of the label is to inform the consumer of the benefit of purchasing high efficiency equipment, while leaving the evaluation of whether the higher price is justified to him or her. In the logic of the labeling program, therefore, the purchase of high efficiency products is by definition viewed as beneficial to those consumers who choose to purchase them, and the relationship between costs and benefits determines the market shares. While this relationship is difficult to predict, past evidence from other programs (namely the European Union) implies the degree to which manufacturers are able to price high efficiency products in such a way to provide net benefits to consumers, and thereby capture a significant market share.

For this reason, in modeling the financial impacts to consumers of a combined labeling and MEPS program, we do not evaluate life cycle cost impacts for the labeling component of the program, but only consider the net impacts of the MEPS portion.

5.2 Definition and Methodology

Implementation of efficient technologies generally results in added production costs, which are passed down to the consumer in the form of higher retail prices. The Life Cycle Cost calculation analyzes the trade-off between these increased first costs, and subsequent savings in the form of lowered utility bills. The Life Cycle Cost analysis takes into account the preference for immediate over deferred gains by scaling future energy cost savings by an appropriate discount factor.

Life-Cycle Cost is given by

$$LCC = EC + \sum_{n=1}^{L} \frac{OC}{(1+DR)^n}$$

where *EC* is equipment cost (retail price), *n* is the year of operation and *OC* is the annual operating cost. Operating cost is summed over each year of the lifetime of the appliance *L*.

Operating cost is calculated by multiplying the Unit Energy Cost (UEC, in kWh) by the price of energy (*P*, in dollars per kWh) as follows:

$$OC = UEC \times P$$

Unit Energy Consumption and energy price are assumed constant from year to year. The fact that future costs are less important to consumers than near-term costs is taken into account by dividing future operating costs by a *discount factor* $(1+DR)^n$, where *DR* is the discount rate.

Because the Chilean market is not concentrated on one single efficiency level, the life cycle cost considers the distribution of efficiency when calculating the LCC.
The payback period (PBP) refers to the time it takes a consumer to recover, through lower operating costs, the assumed higher purchase cost of more energy efficient products. Numerically, the PBP is the ratio of the increase in purchase cost (from a less to a more efficient design) to the decrease in annual average operating cost. This calculation does not use a discount rate to discount future operating costs.

The equation for determining PBP is:

$$PBP = \frac{\Delta EC}{\Delta OC}$$

5.3 Additional Input Data

The following table summarizes the other input data used to calculate the life cycle cost.

Table 7 Summary of inputs into the life cycle cost analysis

Input	Average Value	Source
Lifetime *L*	15	Ecodesign Assumption (ISIS, 2007)
Discount Rate *DR*	10%	MoE
Electricity Price *P*	100Ch$/kWh Or 0.20 US$	Chilectra

5.4 Extension/Rescaling of the Labeling Program Efficiency Distribution

As in the base case distribution, we use the Ecodesign assumptions (EC, 2009) of what would happen if the labeling scheme was extended to higher levels. Ecodesign studies a case where the labeling program would be extended by 6 categories above the A level. In our case of study we match these levels to A+ and A++ and lump the higher efficiency level under the A+++ level.

Table 8 Efficiency Market Share Forecast (Considering Extension/Rescaling of the Labeling Program)

	2012	2014	2020	2025	2030
A+++			1%	5%	15%
A++	9%	22%	60%	95%	85%
A+	15%	21%	39%	0%	0%
A	57%	57%	0%	0%	0%
B	19%	0%		0%	0%
C	0%	0%		0%	0%

Source: Impact Assessment, Ecodesign

Based on the market shares and average EEI, a weighted average EEI is calculated. Based on the market shares and average price index, a weighted average price index is calculated.

5.5 MEPS Efficiency Distribution

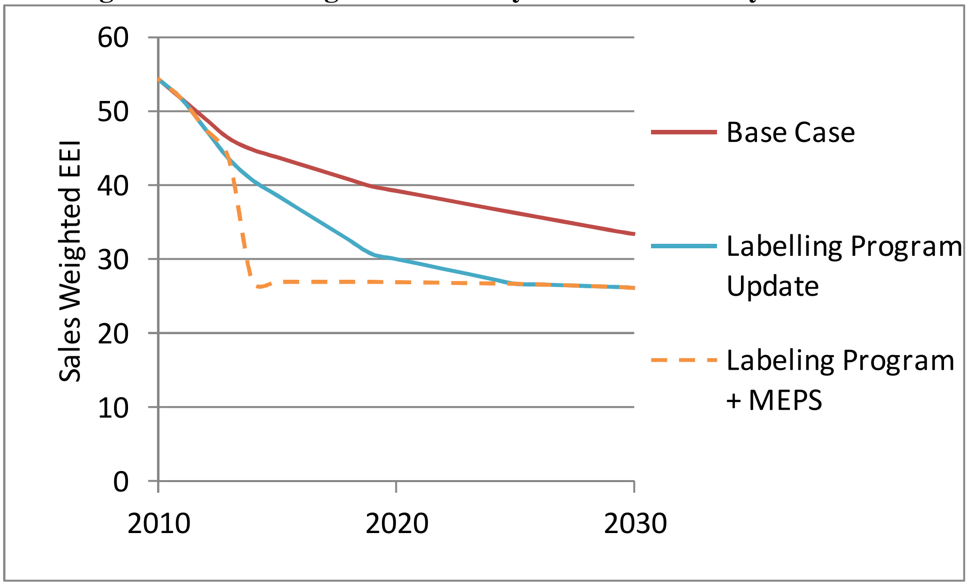
In the MEPS case, we model a roll up scenario. It means that all the market shares below the MEPS level roll up to the MEPS level, while the market shares above the MEPS stay unchanged.
The following table shows the market shares in 2014 for both MEPS levels analyzed:

Table 9 Efficiency Market Shares under different MEPS Scenarios

	Labeling Program		A+ MEPS		A++ MEPS	
	2014	2020	2014	2020	2014	2020
A+++		1%		1%		1%
A++	22%	60%	22%	60%	100%	99%
A+	21%	39%	78%	39%		
A	57%	0%				

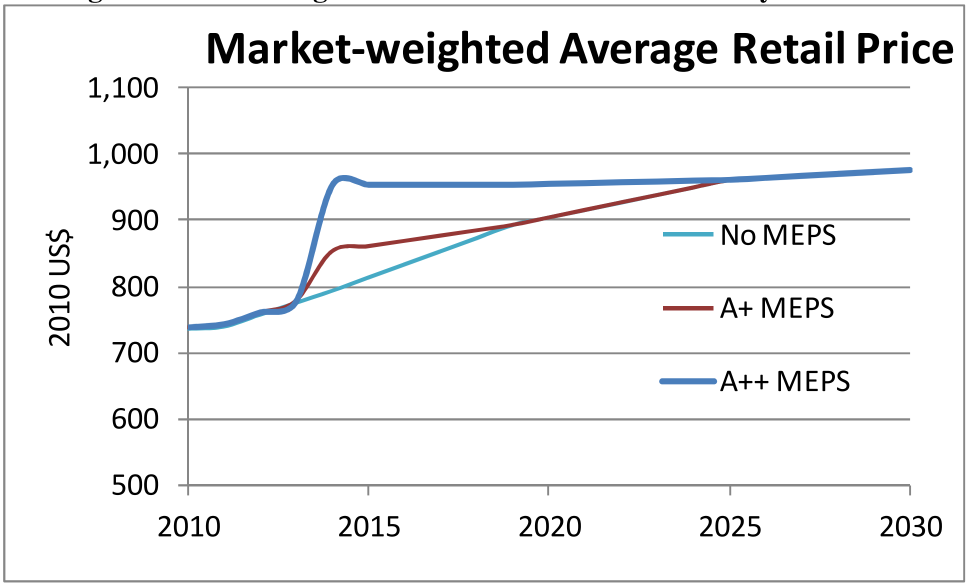
Based on the market shares and average EEI, a weighted average EEI is calculated. .
The following graph presents the EEI in the three cases (for a MEPS at level A+):

Figure 3 : Sales Weighted Efficiency in Different Policy Scenarios



Based on the cost-efficiency data described in section 4.3, an average price index is calculated using the efficiency distribution. We only evaluate the price impact of the mandatory regulation, so we only show the difference between the labeling program (that we also refer to as the no standard case) and the standard case.
Figure 4 represents the consumer retail price under different policy scenario:

Figure 4 : Sales Weighted Retail Price in Different Policy Scenarios



5.6 Results

The life cycle cost is evaluated for an average consumer, which means that it takes into account the distribution of efficiency in the market, with or without a MEPS.

Table 10 Life Cycle Cost results and Payback Period

	Purchase Price	Annual Electricity Bill	LCC	LCC Savings	PBP
	US$	US$	US$	US$	Years
No MEPS	$737	$61	$1,199	$-	
A+ MEPS	$792	$50	$1,169	$30	5
A++ MEPS	$885	$40	$1,191	$8	7.3

In every configuration, the life cycle cost of an average refrigerator in the base case is higher than the life cycle cost of an average refrigerator in the MEPS case. The consumer experiences a net financial benefit in buying a A+ or A++ refrigerator instead of a refrigerator labelled A. The period of return on investment is not negligible but always less than half the lifetime of the refrigerator. The minimum life cycle cost (which maximizes the consumer benefit) is found at level A+.

6. National Impact Analysis

In addition to the financial impacts on individual consumers, policy makers also consider the magnitude of efficiency impacts to the nation as a whole, which is where the sales and stock turnover of refrigerators are taken into account.

6.1. Definitions and Methodology

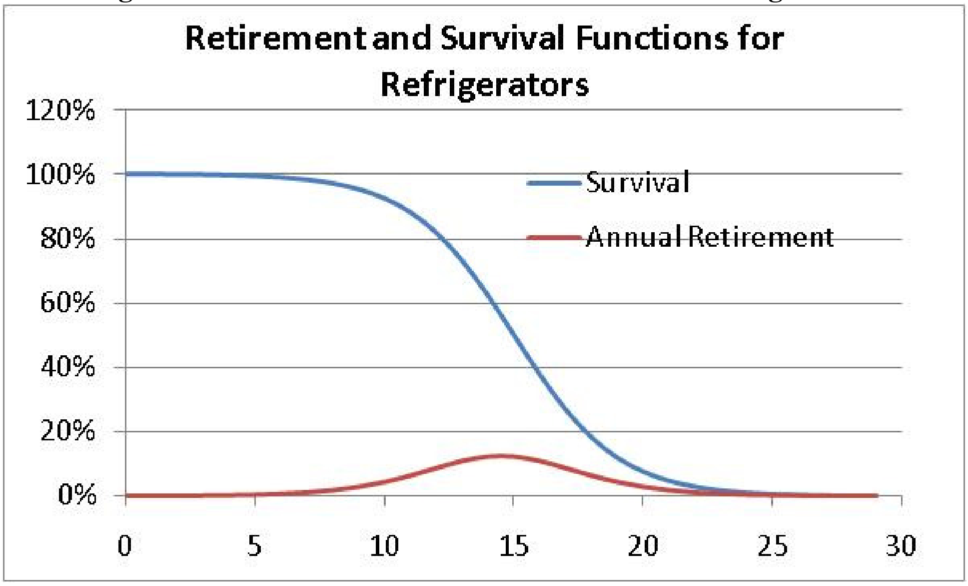
Sales are generated in PAMS based on the stock forecast. Stock is generated based on an appliance diffusion forecast described in (McNeil, 2010). PAMS takes into account the first purchase (FP) as the increase of refrigerators in the stock from one year to another (due to increase in number of households, increased penetration of refrigerators) and replacements (REP) of refrigerators which are retired from the stock, according to:

$$Sales(y) = FP(y) + REP(y)$$

Where $REP(y) = \sum_{age=1}^{L} Stock(y-1, age) \times P_R(age)$

And the probability of retirement P_R varies with the age of the refrigerator and is based on a normal distribution illustrated in the following graph:

Figure 5 : Retirement and Survival Function for Refrigerators



There are four major policy impacts that are calculated at the national level:

- Site/Source Energy Savings – In addition to energy saved in households, PAMS provides an estimate of the resulting savings in terms of site energy and input energy to power plants, including energy lost in transmission and distribution.
  In the base case and policy case, the consumption of the stock is calculated based on the past sales and the UEC of the units sold in every year.
  PAMS calculates National Energy Savings (NES) in each year by comparing the national energy consumption of the product under study in the base case to the policy case, according to

  $$NES = NEC_{Base} - NEC_{Policy}$$

  The equation given above show energy savings calculated on a site basis. National utility and environmental impacts, however are driven by primary energy consumption, that is, total inputs of fossil fuel energy. Primary energy savings (PES) is calculated from site savings by taking into account the electricity generation fuel mix, and losses through transmission and distribution (T&D). The formula for PES is:

  $$PES = \frac{NES}{1-TD} \times HR$$

  where TD is the fraction of energy lost in transmission and distribution, and HR is the heat rate.

- Emissions Reductions – Total reduction in CO_2 emissions in million tons (Mt) is calculated according to typical electricity generation fuel mix.
  Carbon dioxide emissions savings (CES) are calculated from energy savings, by applying carbon factors to site energy savings according to:

  $$CES = \frac{NES}{1-TD} \times CF$$

- National Consumer Benefits – The Net Present Value (NPV) of the policy is calculated according to total incremental equipment costs paid, electricity bill dollars saved, and the national discount rate (DR_N) applied to program evaluation.
  National financial impacts in year y are the sum of equipment (first) costs and operating costs. National equipment cost (NEC) is equal to the retail price times the total number of sales.

  $$NPV = \sum_{y} (\Delta NOC(y) - \Delta NEC(y) * Sales(y)) * (1 + DR_N)^{-(y-y_0)}$$

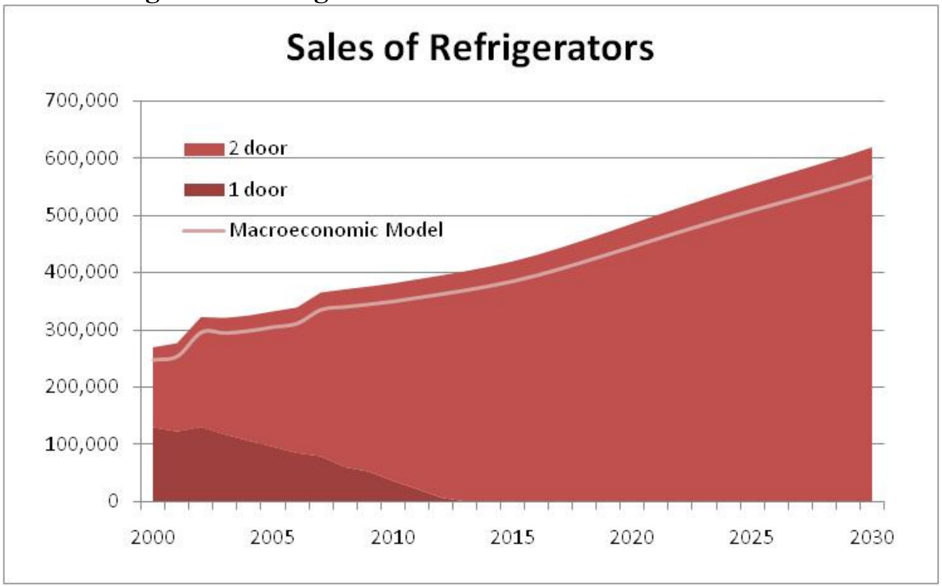
- Avoided Plant Capacity (APC) – The avoided plant capacity is the instantaneous power saved through the program. Site energy savings are translated into energy produced at the plant by taking into account the transmission and distribution losses. Then instantaneous power, or energy demand reduction, is converted into plant capacity by using the plant load factor (PLF), according to:

  $$APC = \frac{NES}{hours / year \times (1-TD) \times PLF}$$

6.2 National Stock and Sales Forecast

Sales forecast are generated in PAMS with the macroeconomic model described above. Then the modeled sales are calibrated to the latest sales data available provided by the MoE (2009). We find that the model underestimates the sales by 9%.
Market shares of one-door refrigerators vs two-door are provided by the MoE between 2007 and 2009. We use the historical market share growth rates to forecast the trends between the two product classes, and we find that by 2013 there is no one-door refrigerators sold on the market. The following graph shows the two market shares and both sales forecasts.

Figure 6 : Refrigerators-Freezers Sales Forecast to 2030



6.3 Input Summary

The following table summarizes the inputs used in the national impact analysis.

Table 11 Summary of Inputs for National Impact Analysis

Input	Average Value	Source
Heat Rate *HR*	2.0	MoE
T&D Loss Factor *TD*	8.0%	MoE
CO2 emissions *CE*	0.480kg/kWh	MoE
Plant Capacity Factor *PCF*	80%	MoE
Discount Rate DR_N	6%	MoE

6.4 Results

PAMS has been customized with the data presented above to calculate in every year the energy savings from the programs along with the incremental equipment cost and energy cost savings associated to it.

The following graphs represent the three different scenarios evaluated in PAMS.

S1: An extension of the labeling program (modeled as a MEPS at level A)-showing energy savings only
S2: An extension of the labeling program and a MEPS at level A+
S3: An extension of the labeling program and a MEPS at level A++

For the reasons explained in section 4, in modeling the financial impacts to consumers of a combined labeling and MEPS program, we do not evaluate the NPV from the labeling component of the program, but only consider the net impacts of the MEPS portion. As a results the Figure 7 only presents energy impacts in the scenario S1.

Figure 7 : Energy Savings from Extension of the Labeling Program

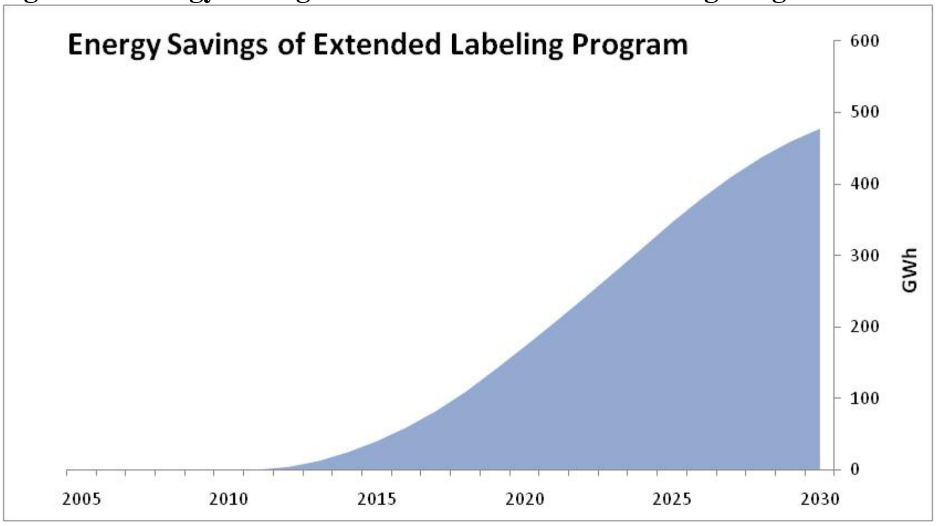


Figure 8 shows the impacts of a MEPS at the level A+ on top of the impact of the labeling program (S2). The results clearly indicate the relative contribution of both programs. Overall, the labeling program has a higher impact than the MEPS program. The effect of the MEPS is to bring the market to a higher efficiency level and faster, but in the long term, savings are driven by the labeling program. Note that the impacts from the labeling program are more speculative than the impacts from the MEPS, since the consumer still has the choice to buy an efficient appliance or not. Because Chile and Europe had a very successful program in the past years we assume that this will be the case in the future. Also, in reality, the MEPS would probably be updated every few years.

Figure 8 : Energy Savings from Extension of the Labeling and MEPS at level A+

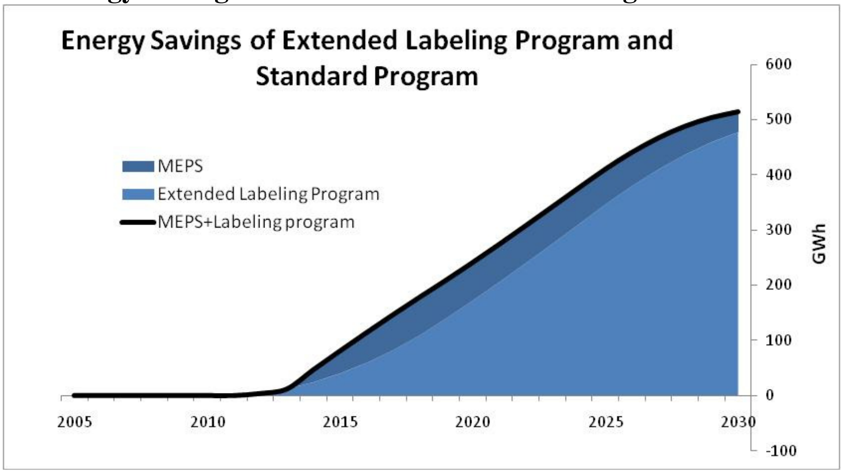


Figure 9 represents the consumer financial impacts under the S2 scenario. On average, the consumer experiences a net financial benefit after 2017, only three years after the implementation of the MEPS.. The maximum benefits of the program occur in 2017. After 2018 the market has caught up with the MEPS, which means that there is no additional costs/savings to the consumers for units bought after 2018. The savings we see after 2018 are from units bought between 2014 and 2018.

Figure 9 : Energy Savings from Extension of the Labeling and MEPS at level A++

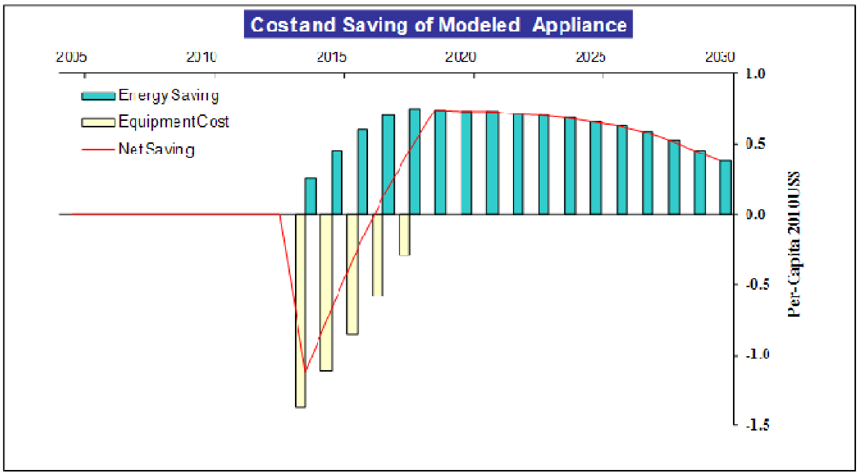
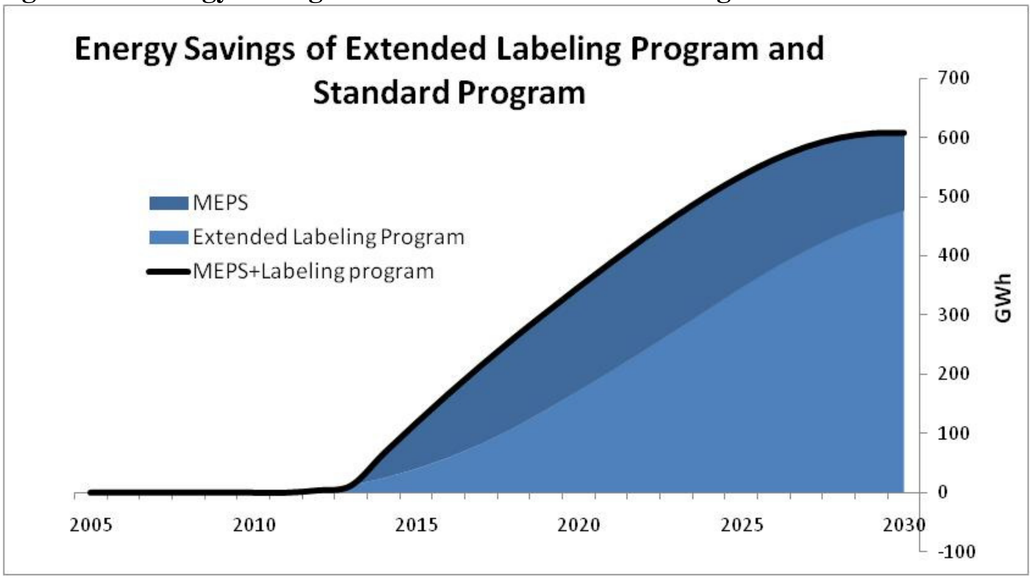


Figure 10 shows the impacts of a MEPS at the level A++ on top of the impact of the labeling program (S3). We can see that the MEPS has a higher impact than the labeling program in the first years of the program, which is until the market reaches the MEPS level, while the labeling program is assumed to keep pulling the market towards more efficient appliances until the end of the forecast period.

Figure 10 : Energy Savings from Extension of the Labeling and MEPS at level A++



As it was the case with the level A+ MEPS, figure 11 shows that the average consumer sees a net financial benefit after 2018 under scenario S3, only four years after the implementation of the MEPS. We can see that the peak of the benefit of the program occurs in 2018. After 2024 the market has caught up with the MEPS, which means that there is no additional costs/savings to the consumer for units bought after 2024. The savings we see after 2024 are from units bought between 2014 and 2024.

Figure 11 : Cost and Energy Savings from Extension of the Labeling and MEPS Programs (level A++)

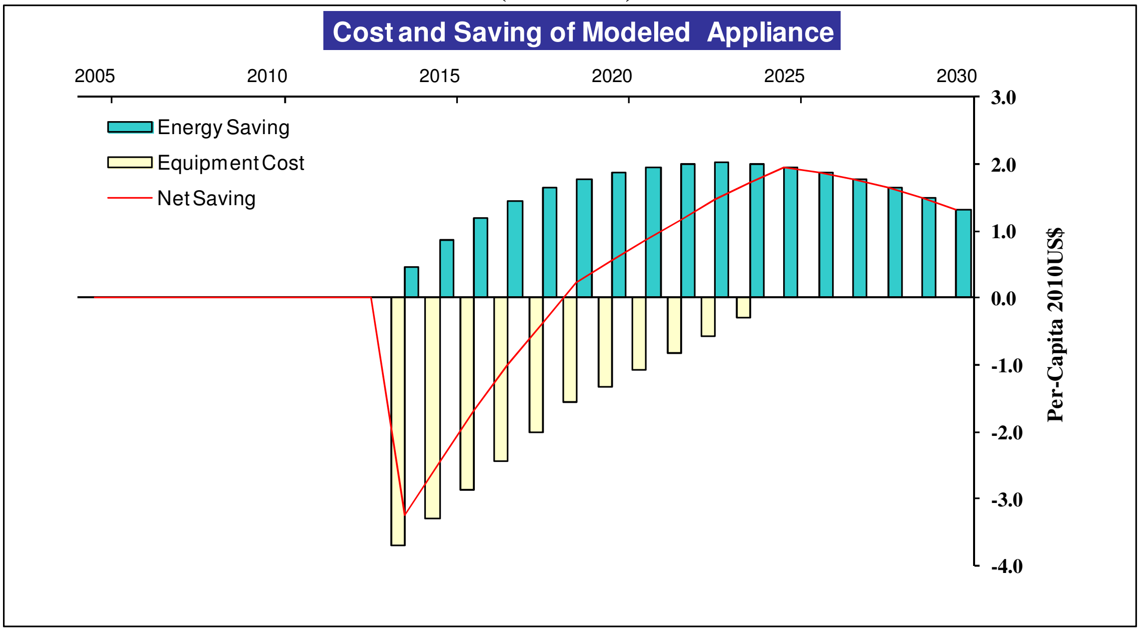


Table 12 summarizes the finding of the study in terms of potential energy savings under different scenarios.

Table 12 Summary of National Energy Impacts from Extension of the Labeling and MEPS Programs at Different Efficiency Levels.

	Minimum EEI	Site Energy Savings in 2030	Cumulative Site Energy Savings through 2030	Cumulative Source Energy Savings through 2030
		GWh	GWh	Mtoe
Labeling Program (S1)	NA	477	4180	0.78
A MEPS (S1)	55	477	4180	0.78
A+ MEPS (S2)	42/44	515	5159	0.96
A++ MEPS (S3)	33	608	6778	1.27

Table 13 Summary of National Economic Impacts from Extension of the Labeling and MEPS Programs at Different Efficiency Levels.

	Minimum EEI	Total Incremental Cost	Electricity Savings	Cost Benefit Ratio	NPV
		Million US$	Million US$		Million US$
Labeling Program	NA	$0	$0	NA	$0
A MEPS	55	$0	$0	NA	$0
A+ MEPS	42/44	$59	$118	2	$59
A++ MEPS	33	$256	$311	1.22	$55

The maximum financial savings to the consumers are achieved through a A+ MEPS (S2), while the maximum energy savings with no penalty for the consumer are achieved through a A++ MEPS (S3).

Table 14 Summary of CO2 Emissions Reductions and Avoided Plant Capacity

	Minimum EEI	Avoided CO2 Emissions through 2030	Avoided Capacity
		Mt	MW
Labeling Program	NA	2.2	74
A MEPS	55	2.2	74
A+ MEPS	42/44	2.7	80
A++ MEPS	33	3.5	94

7. Conclusion

The results of the study allow for evaluation of the overall impacts of the various options for MEPS and labeling programs for Chilean refrigerators. In particular, we show that a MEPS harmonized with the EU Ecodesign MEPS (Ecodesign Directive N° 643/2009) is cost-effective in Chile. The overall impacts of harmonization with the Ecodesign target would save consumers 59 Million US$ over the next 20 years. Combined with an extension of the labeling program, it would save over 5 TWh and avoid 2.7 Mt of CO_2e emissions during the same period of time. Since this study, the MoE has published the "Regulation for establishing minimum energy performance standards and the procedure for these applications" in the Journal Official, which requires the analysis of the impact of MEPS on the consumer and the national level. Currently, the MoE is working on developing a MEPS for refrigerators.

8. References:

- European Commission (EC), Directorate General Energy, Impact Assessment for Refrigerator-Freezers, TREN Lot 13, SEC(2009)1020
- Commission Regulation (EC) No 643/2009 of 22 July 2009 implementing Directive 2005/32/EC of the European Parliament and of the Council with regard to Ecodesign requirements for household refrigerating appliances http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32009R0643:EN:NOT
- Commission Delegated Regulation (EU) No 1060/2010 of 28 September 2010 supplementing Directive 2010/30/EU of the European Parliament and of the Council with regard to energy labeling of household refrigerating appliances http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32010R1060:EN:NOT
- European Commission/ DG TREN (2000): COLD II, The revision of energy labeling and minimum energy efficiency standards for domestic refrigeration appliances
- SEC, NCh 3000 of.2006, Eficiencia energética de los Refrigeradores, congeladores y refrigeradores-congeladores de uso domestico. Clasificación y etiquetado.
- McNeil and Letschert, Modeling diffusion of electrical appliances in the residential sector, Energy and Buildings, 41, 6, 783-790, June 2010
- Diario Oficial, Reglamento que establece el procedimiento para la fijación de estándares mínimos de eficiencia energética y normas para su aplicación