Deep Savings at Net Zero Cost?

Incentives in Subsidized Electricity Regimes: The case of Mexico

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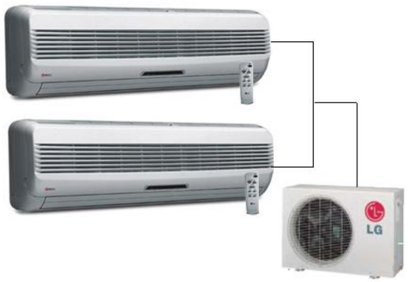

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BERKELEY LAB

OUR POLICY POSITION

- In economies where governments subsidize electricity consumption, energy efficiency is highly undervalued, making it very difficult to raise appliance standards. Any efficiency improvements, however, can result in net cash flow benefits to the government through avoided subsidies.

- In this **second-best world**, financial incentives for efficiency can achieve deep energy savings at no net cost. Hence, policies to promote incentives should be a **first-choice option** in such regimes.

RATIONALE FOR POLICIES THAT PROMOTE ENERGY EFFICIENCY

① Electricity tariffs do not reflect Long- or Short-Run Marginal Costs

② Imperfect information and myopic perspective of consumers in purchasing decisions

③ Environmental externalities

ADDRESSING MARKET FAILURES

Two most common methods for addressing these market failures are:

① Standards and Labeling

② Financial Incentives for efficiency improvements

Standards

- Set Efficiency Floor: Most inefficient products are eliminated but the Market is usually not transformed
- Little Direct Cost to the Government
- But there could be costs to consumers and manufacturers
- **Consumer cost-effectiveness needs to be proved in most countries before Standards can be raised**

Financial Incentives

- Incentives are used to achieve market transformation toward higher efficiency
  - leads back to **Strengthening Standards**
- Financial Incentives are usually provided for efficient to super-efficient products (above MEPS)
- Could be Funded by many parties: Government, Ratepayers, Banks, etc
- **Can be initiated without excessive concern for consumer cost-effectiveness**

THE EFFECT OF NET (Taxpayer Funded) ELECTRICITY SUBSIDIES

- Subsidizing electricity for consumers increases the deadweight losses from the market failures mentioned before
- Subsidized electricity makes efficiency very valuable to the Government
  - BUT makes it **very difficult** to raise **Standards**
  - Incentives can **become very valuable** to Government

MEXICAN CONTEXT

CFE Una empresa de clase mundial

SENER
SECRETARÍA DE ENERGÍA

CRE
COMISION REGULADORA DE ENERGIA

CONUEE
Comisión Nacional para el Uso Eficiente de la Energía

ELECTRICITY SUPPLY

- The state-owned electric utility, the Federal Electricity Commission (CFE), has a near-monopoly on nationwide residential electricity

STANDARDS AND LABELING

- Standards and labeling in place for many household appliances (including largest electricity consumers – lighting, refrigerators and air conditioners) since 1995
- Most recent standard, called NOM, for refrigerators: 2002; for window ACs: 2008.
- Refrigerator and AC standards are up for revision; has been politically difficult to strengthen them

ELECTRICITY SUBSIDIES

- Subsidies are calculated by the Govt as: average cost of supply minus price paid by consumers (accounting costs)
- Thus the unit cost of provision is a direct driver of the magnitude of the subsidy
- Provided to CFE by the federal government through discounting of taxes and dividends owed by CFE, and through direct cash payments

ELECTRICITY SUBSIDIES

- Subsidies lead to underinvestment in the electricity system, these long-term costs are not considered [in Govt subsidy calculations]
- Increased residential demand leads to greater generation needs, raising the MC of production (and therefore leads to higher subsidies)
- Subsidy Burden (2000)
  - **46% of electricity sales, 83% of federal budget deficit**

FINANCIAL INCENTIVES REVENUE ANALYSIS TOOL

TOOL OBJECTIVE

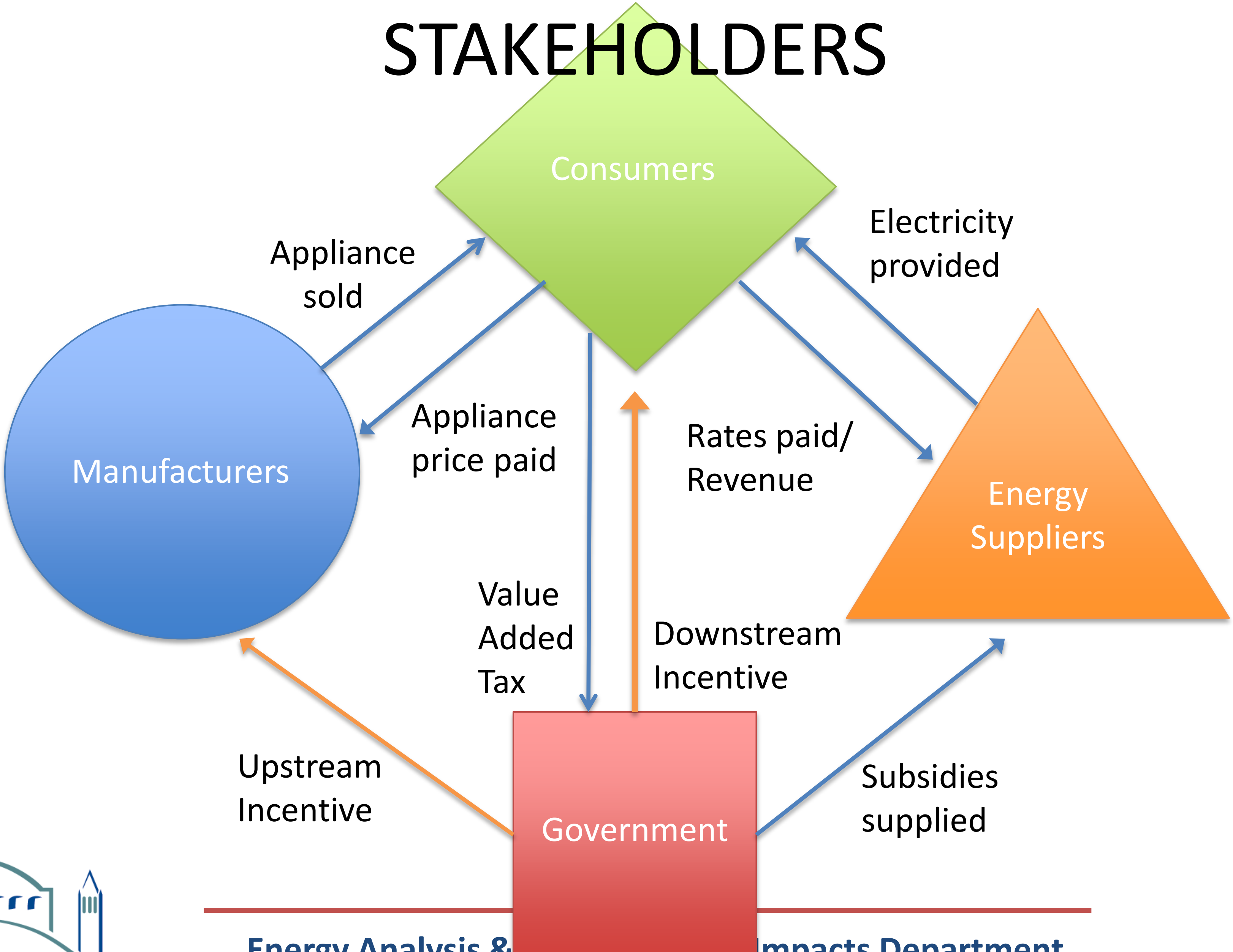
- To calculate the net change in revenue to key stakeholders from incentive programs for each appliance

Here we show:

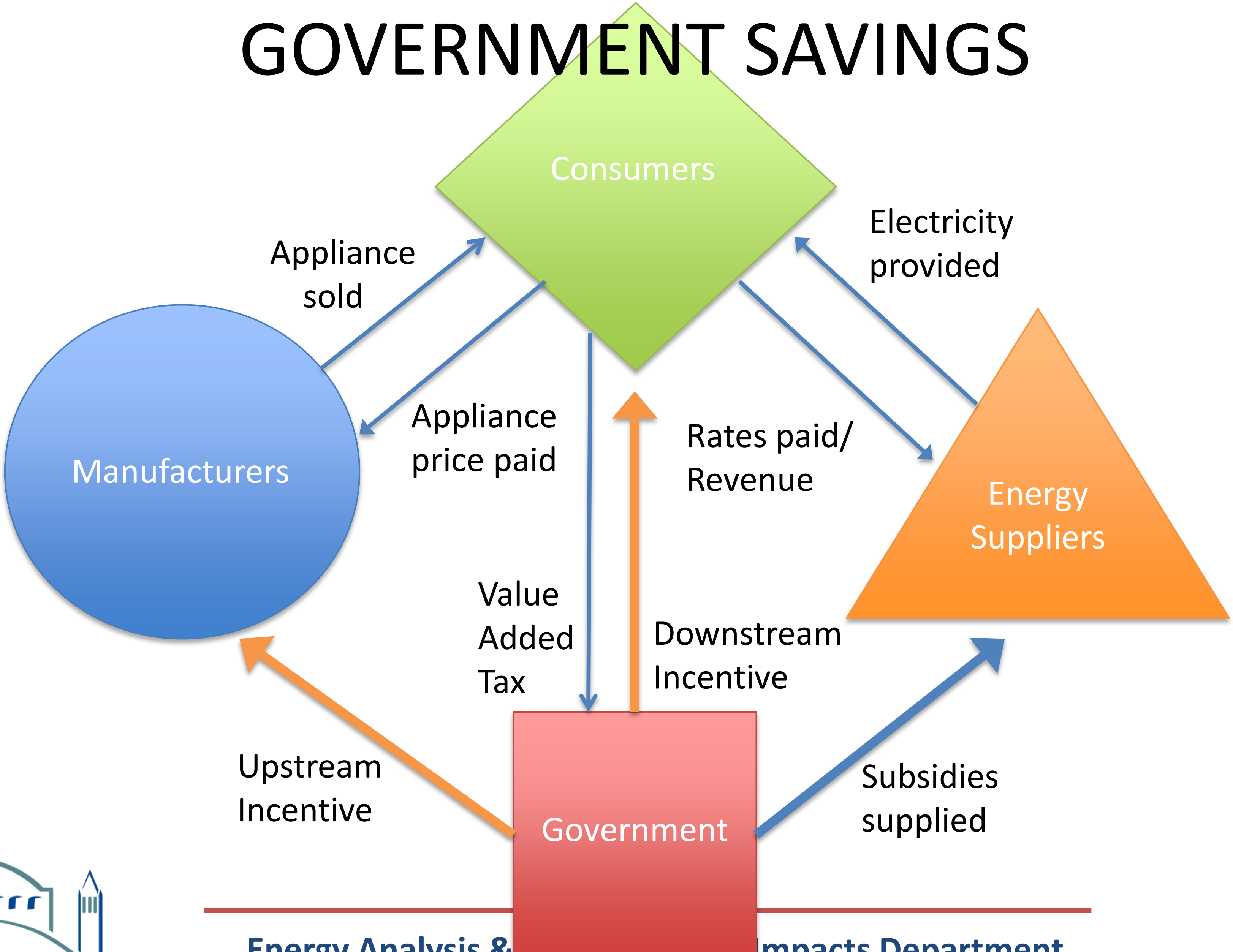
- Energy Savings that can be achieved for major appliances in Mexico if incentives are set at a level where the Government faces **zero** net change in revenue

Cost of Incentive = Avoided Subsidies

REVENUE FLOW AMONG STAKEHOLDERS



IMPORTANT FLOWS FOR GOVERNMENT SAVINGS



FINANCIAL INCENTIVES REVENUE ANALYSIS TOOL

- Government Savings
  - Present value of avoided subsidy payments due to the more efficient model v the MEPS model
- Government Costs
  - Incentive payment to cover full up-front incremental cost between MEPS model and more efficient model (costs from SEAD Technical Analysis)
  - Lost Value Added Tax payments from consumers

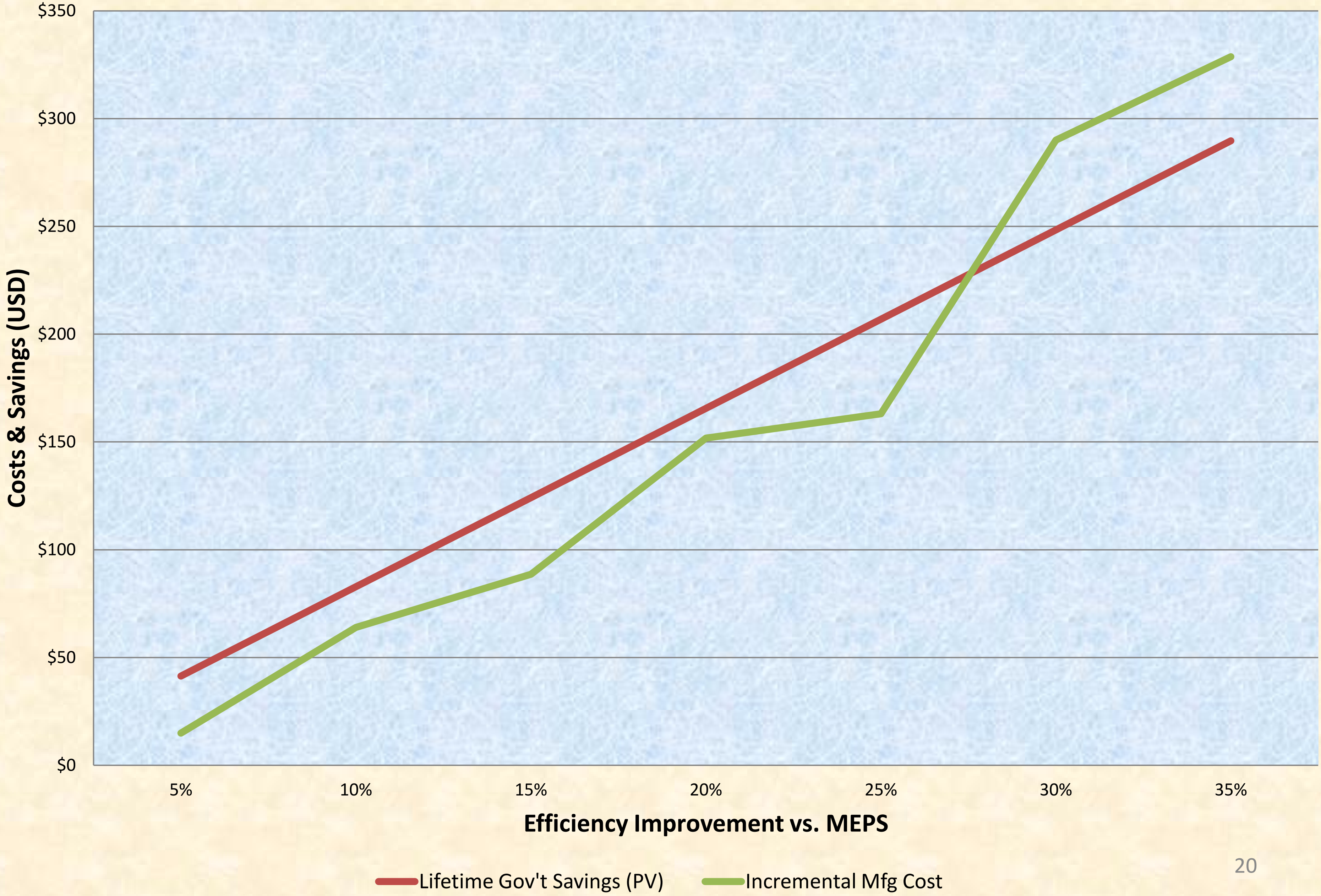
FINANCIAL INCENTIVES REVENUE ANALYSIS TOOL

- We find the **most efficient model** for which

Government Savings = Government Costs

COST AND ENERGY SAVINGS FROM A HYPOTHETICAL FINANCIAL INCENTIVE FOR WINDOW AIR CONDITIONERS IN MEXICO

Incremental Energy Efficiency: Government Subsidy Savings & Incremental Manufacturing Costs for Room Air Conditioners



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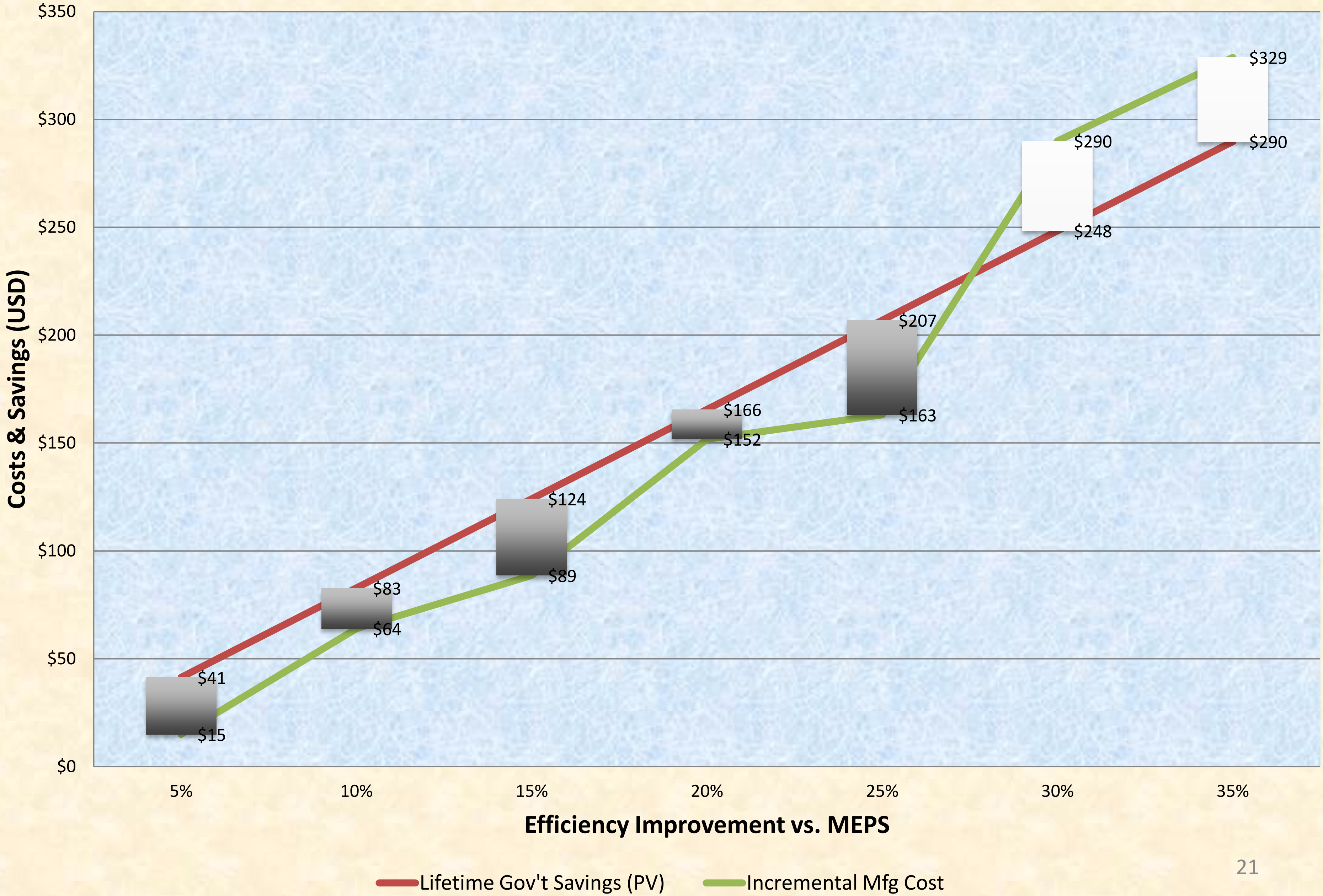

COST AND ENERGY SAVINGS FROM A HYPOTHETICAL FINANCIAL INCENTIVE FOR LED TELEVISIONS IN MEXICO

Incremental Energy Efficiency: Government Subsidy Savings & Incremental Manufacturing Costs for LED TVs

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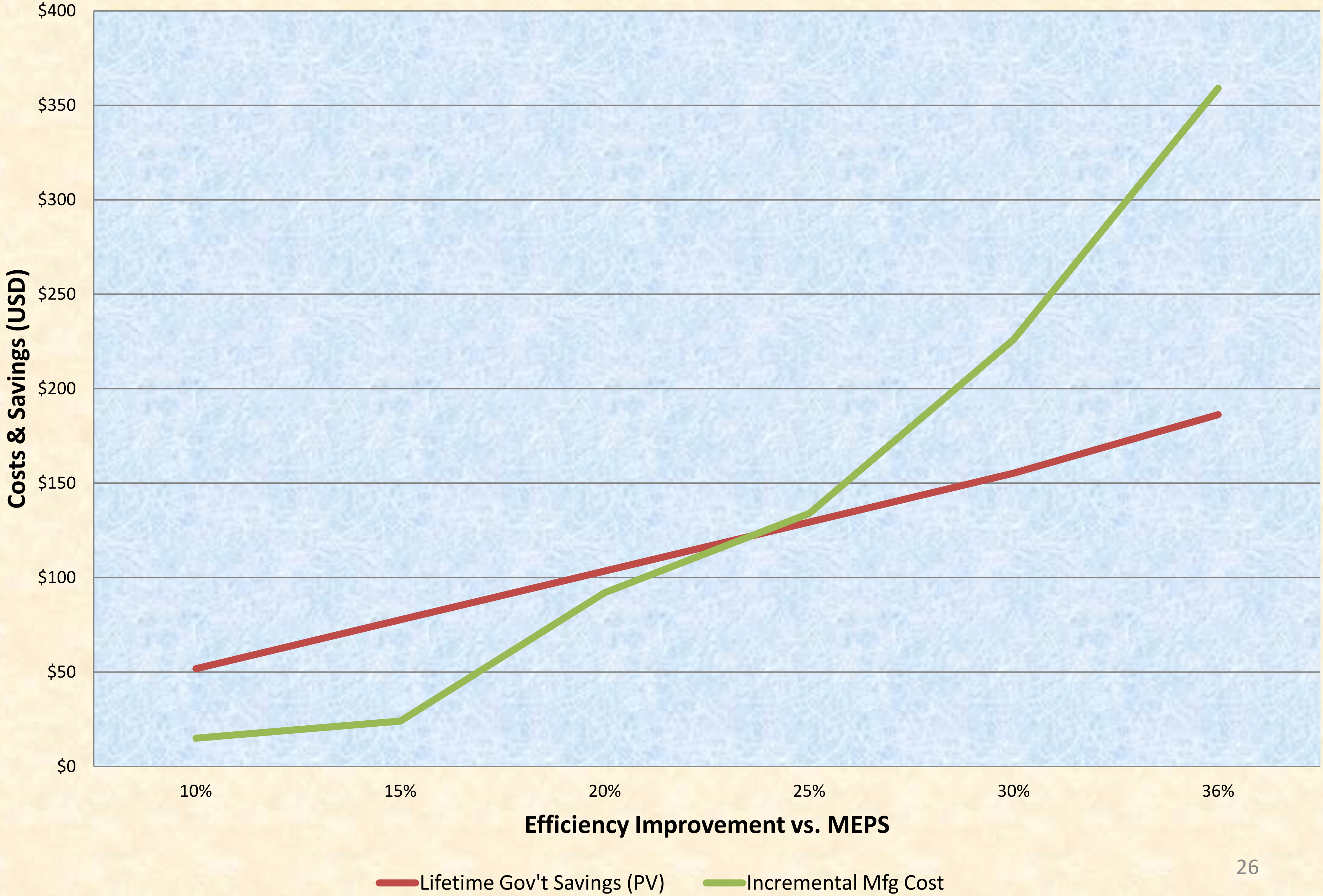
COST AND ENERGY SAVINGS FROM A HYPOTHETICAL FINANCIAL INCENTIVE FOR REFRIGERATORS IN MEXICO

Incremental Energy Efficiency: Government Subsidy Svgs & Incremental Mfg Costs for Refrigerators



Incremental Energy Efficiency: Government Subsidy Svgs & Incremental Mfg Costs for Refrigerators

CONCLUSION

At **Net Zero Cost** to the Mexican Government, we can get efficiency improvements of:

- **Window A/Cs ≅ 28% beyond MEPS**
- **Refrigerators ≅ 25% beyond MEPS**

Incentives for **LED TVs** result in **net positive revenue** for the Mexican Government

OUR POLICY POSITION

- In economies where governments subsidize electricity consumption, energy efficiency is highly undervalued, making it very difficult to raise appliance standards. Any efficiency improvements, however, can result in net cash flow benefits to the government through avoided subsidies.

- In this **second-best world**, financial incentives for efficiency can achieve deep energy savings at no net cost. Hence, policies to promote incentives should be a **first-choice option** in such regimes.

THANK YOU

We would like to thank the SEAD Initiative for supporting the research that went into this presentation.

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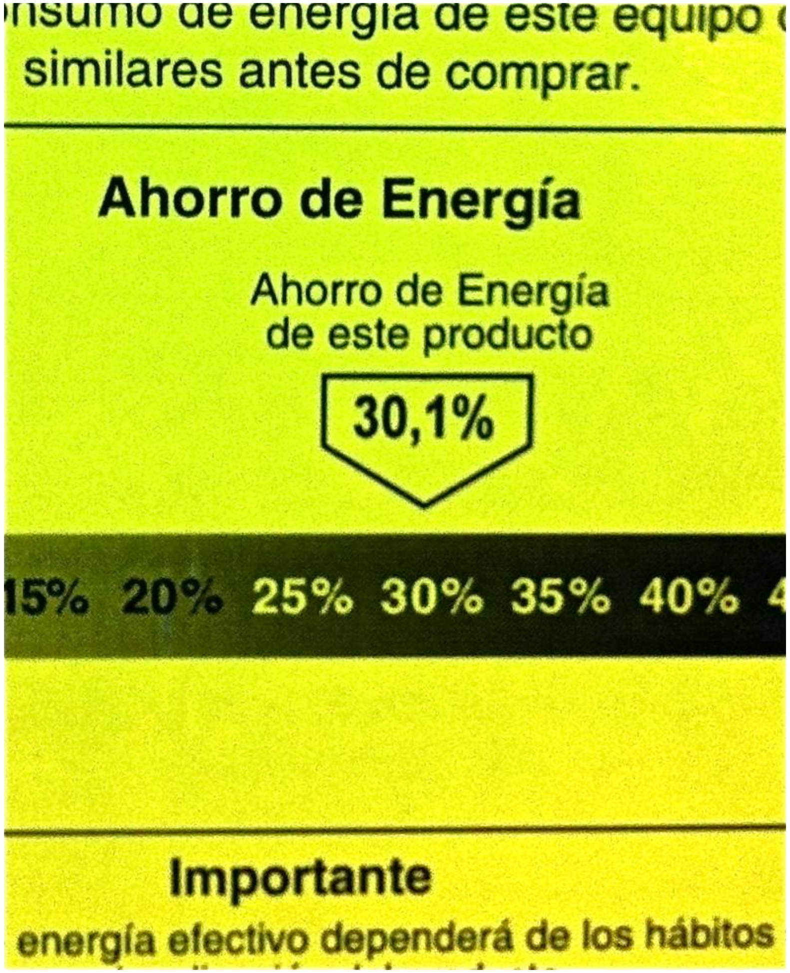
SUPPORTING SLIDES

STANDARDS AND LABELING, EXAMPLES

Sello FIDE Endorsement Label

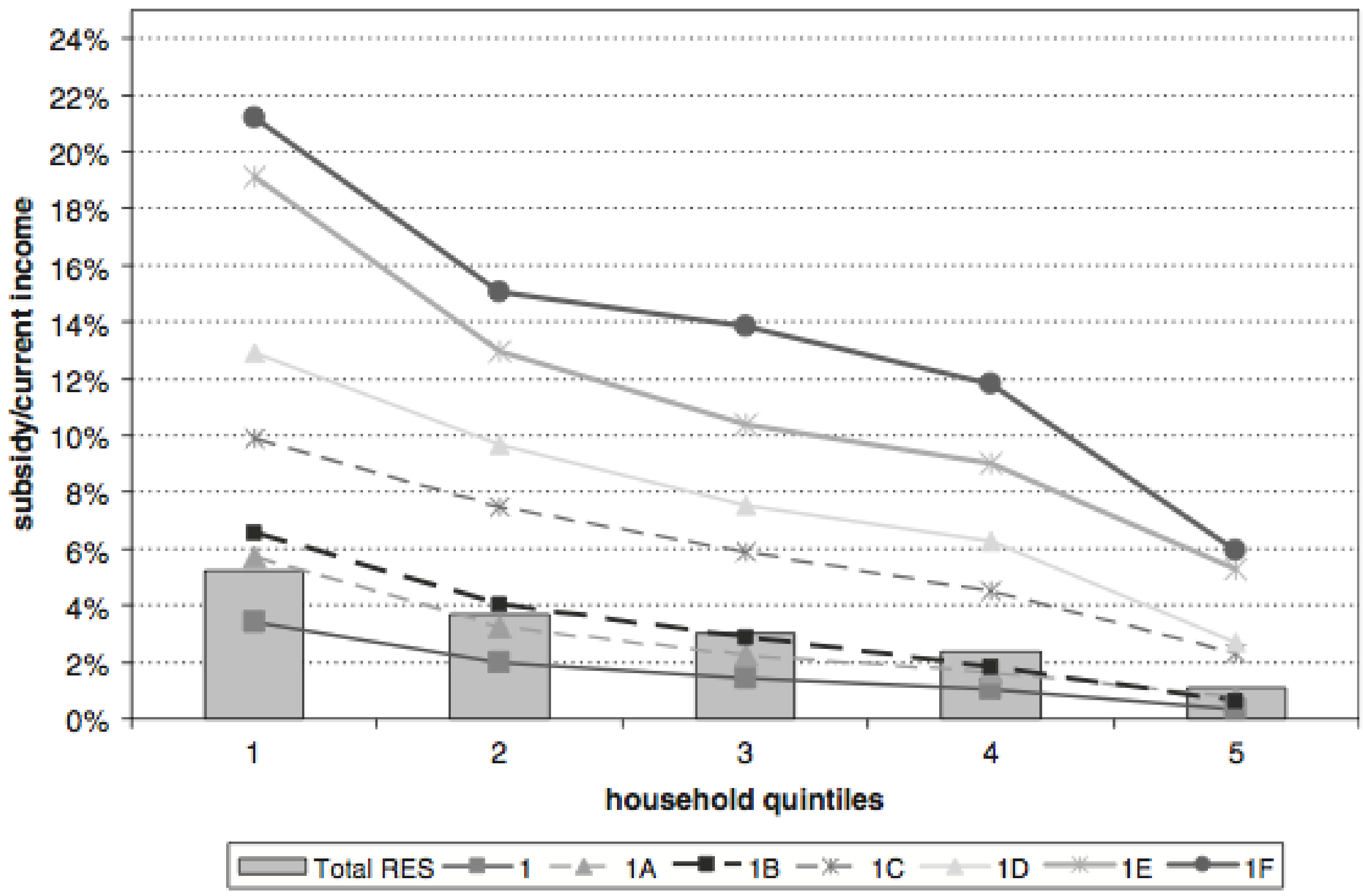


Refrigerator Comparison Label

RESIDENTIAL ELECTRICITY SUBSIDIES

- Subsidies for residential electricity in Mexico is a social program of the federal government
- Although originally meant to help low income households, “Residential electricity subsidies in Mexico disproportionately benefit large-volume consumers and those living in warm areas” (World Bank 2009), as seen in the following graph

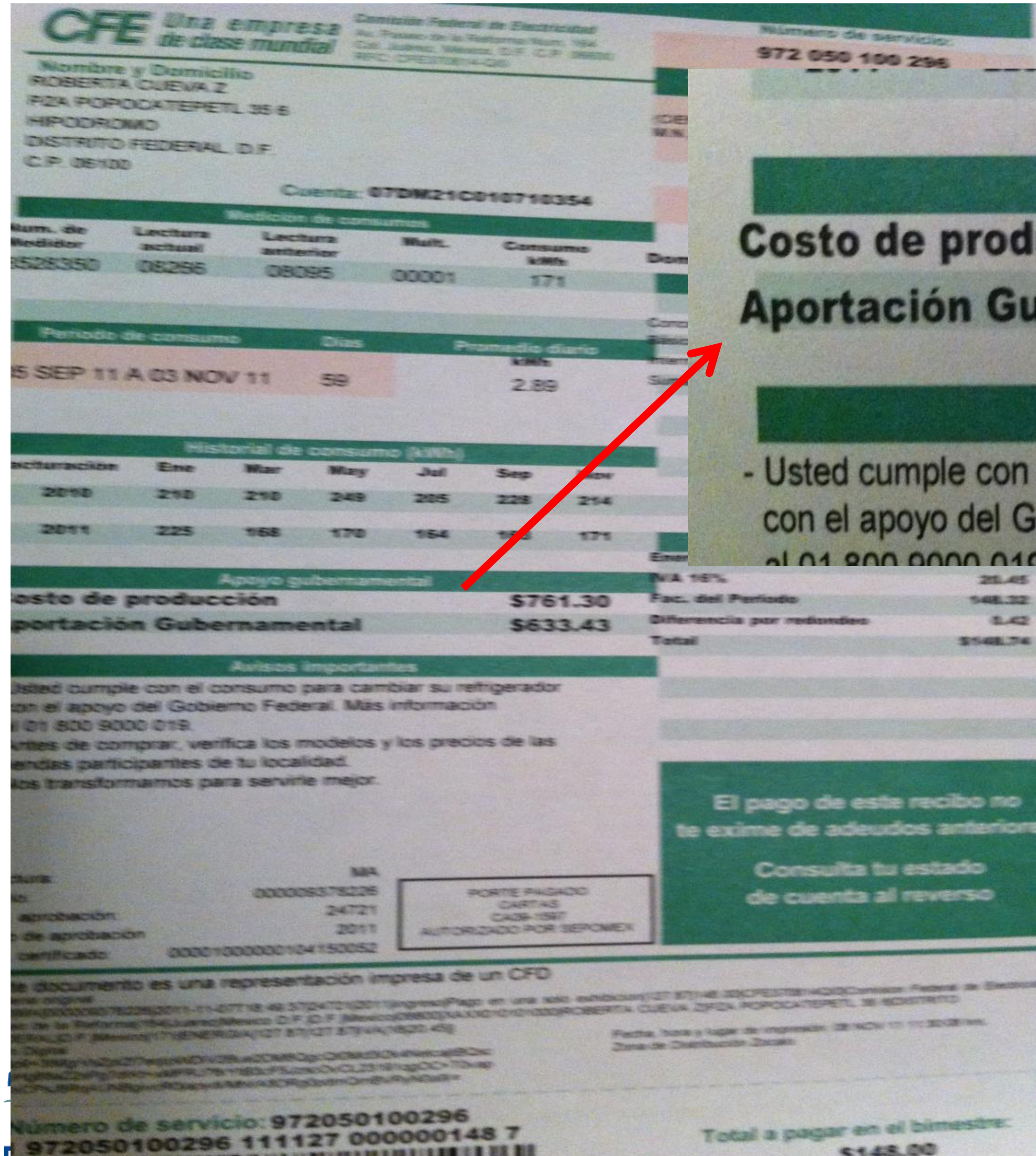
Figure 3.4. Electricity Subsidies as a Percentage of Household Income, by Income Quintiles

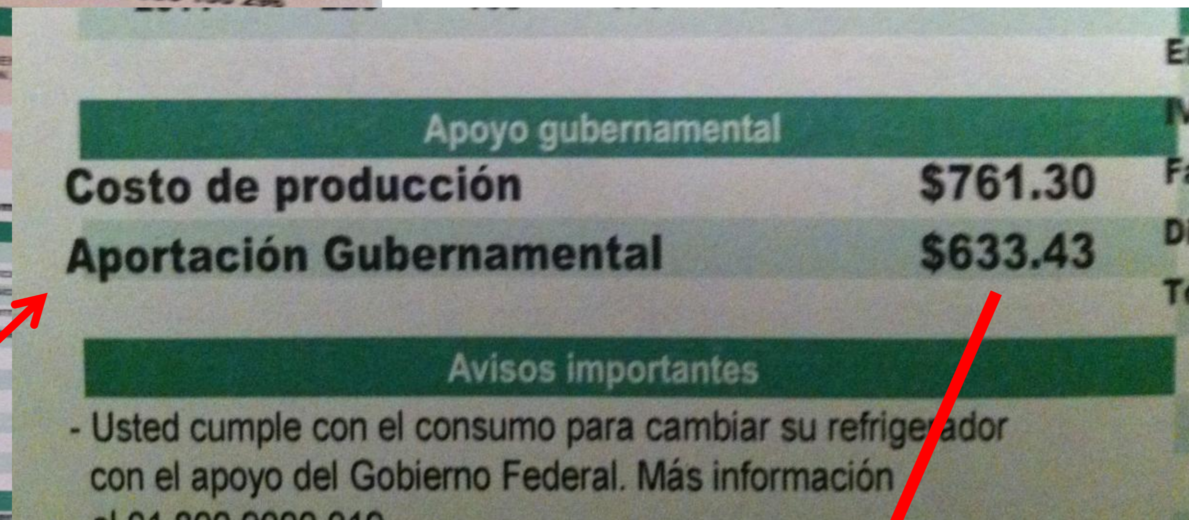


RES = Residential electricity subsidies.

Source: Scott 2007 using ENIGH (2006) and CFE tariff data.

EXAMPLE OF GREG'S BILL





$633.43 / $761.30
Gov't portion Cost of Production
= 83.2% Subsidy

FACTORS THAT FURTHER INCREASE BENEFITS TO GOVERNMENT

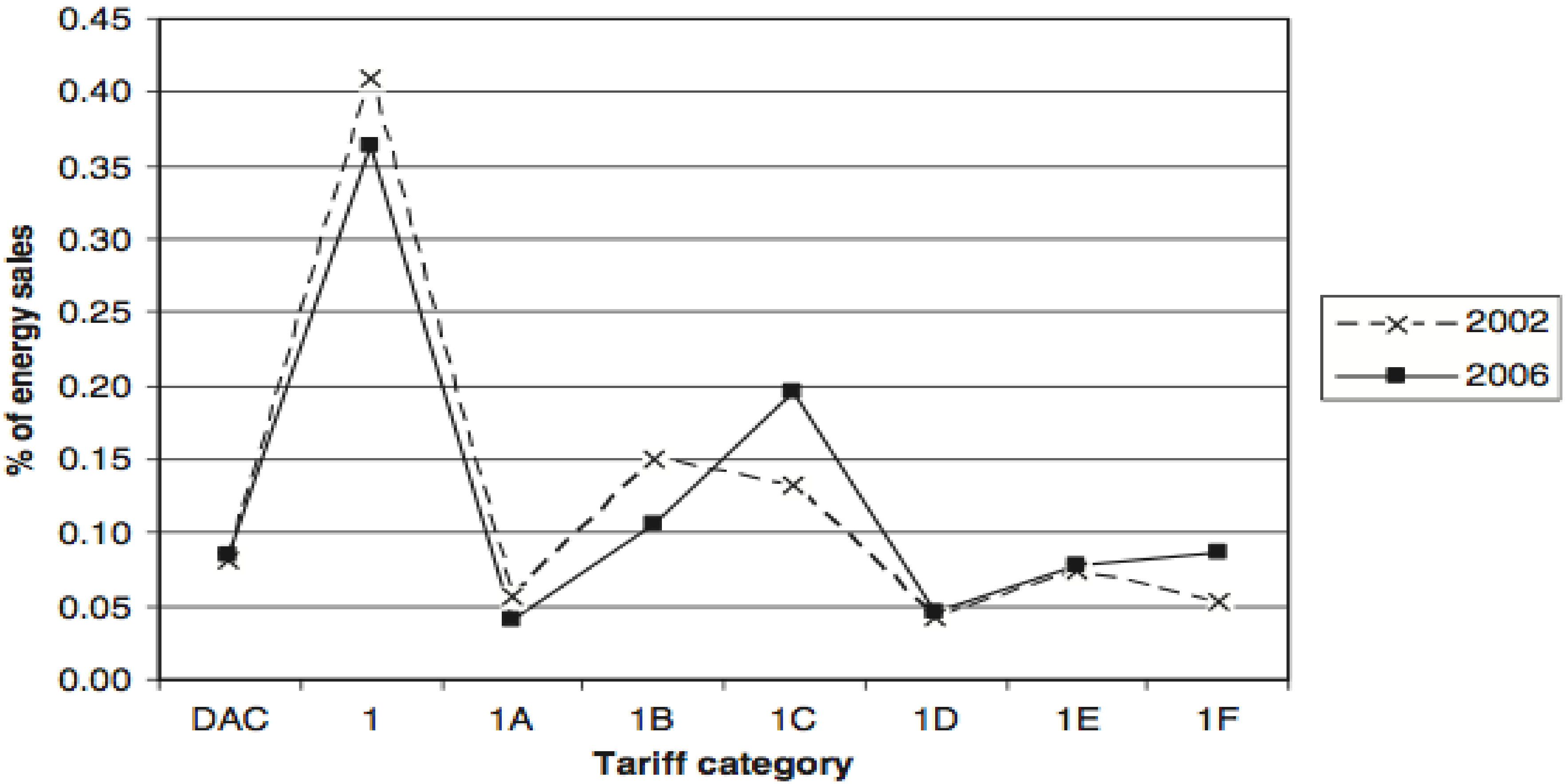
- We assume the incentive covers the full up-front cost differential. Assumes complete consumer myopicity
- Improvement in efficiency lowers long-term marginal cost of generation -> lowering subsidy burden
- The resulting market transformation will make it easier to strengthen standards

FACTORS THAT DECREASE BENEFITS TO GOVERNMENT

- We ignore costs of program administration, transactions, etc.
- We assume that appliance performance does not deteriorate over its life
- We ignore free-riders

Largest Tariff Classes by Sales

Figure 2.2. Electricity Sales by Tariff Category, in 2002 and 2006



Source: Based on Aburto 2007, with CFE statistics.

Table 3.1. Distribution of Residential Electricity Subsidies by Consumption Decile

Decile	Average Consumption kWh/ HH-month	Total Subsidy Mpesos/ yr	Average Subsidy Pesos/ kWh	Average Subsidy Pesos/ HH-year	Subsidy Distribution %	Cumulative Subsidy %
1	5	1,402	9.03	550	2.6	2.6
2	38	2,980	2.56	1,169	5.6	8.2
3	64	4,003	2.05	1,571	7.5	15.8
4	85	4,801	1.85	1,884	9.0	24.8
5	111	5,737	1.70	2,251	10.8	35.6
6	131	6,463	1.62	2,536	12.2	47.7
7	148	6,981	1.55	2,739	13.1	60.9
8	181	7,961	1.44	3,124	15.0	75.8
9	224	7,529	1.10	2,954	14.2	90.0
10	404	5,314	0.43	2,085	10.0	100

Source: Aburto 2007 using 2005 CFE data.

Table 3.3. Distribution of Electricity Subsidies by Income Decile in each Tariff Category (ENIGH 2006)										
				Subsidies in Tariff Structures						
Deciles	*Oportunidades Energéticas*	Total	Cumulative Total	1	1A	1B	1C	1D	1E	1F
1	35.0	5.7%	5.7%	9.5%	8.1%	13.7%	2.3%	2.9%	4.6%	0.5%
2	21.1	7.6	13.3	10.1	10.6	12.9	4.8	6.8	6.5	4.4
3	17.6	8.0	21.3	10.0	10.2	9.8	6.5	7.2	8.0	5.8
4	10.1	8.9	30.2	10.4	12.3	10.7	6.8	13.5	6.8	6.9
5	6.6	10.3	40.5	10.8	9.5	9.6	9.8	9.3	12.3	10.7
6	3.8	10.5	51.0	10.9	10.7	9.6	12.3	6.2	10.4	8.7
7	2.9	12.0	62.9	11.6	9.5	9.2	12.2	13.9	12.9	13.4
8	1.7	11.5	74.5	10.2	10.3	9.8	15.2	10.9	12.3	8.3
9	0.7	13.3	87.8	8.9	11.9	10.2	17.0	15.5	15.0	15.8
10	0.6	12.2%	100.0%	7.8%	6.9%	4.6%	13.1%	13.8%	11.1%	25.6%
Subsidy to deciles 1–4/40	2.10	0.61		0.76	0.83	0.84	0.45	0.69	0.53	0.43

Source: Scott 2007.

Table 3.2. Estimated Electricity Consumption (kWh per Month), by Income Decile and Tariff Zone

Income Decile	Average	Tariff Zone 1	1A	1B	1C	1D	1E	1F
1	**146**	115	124	165	222	297	538	345
2	**189**	129	176	196	309	415	500	804
3	**210**	146	190	187	360	419	508	640
4	**212**	143	212	200	329	426	516	545
5	**244**	159	229	204	372	416	551	791
6	**248**	167	209	214	380	506	553	806
7	**273**	167	269	245	411	516	627	1023
8	**277**	168	245	237	429	606	704	807
9	**336**	189	262	246	489	581	765	1209
10	**391**	229	284	349	613	641	901	1405
Average	**230**	163	221	223	423	506	629	951

Source: Scott 2007 using ENIGH data to estimate consumption based on reported expenditure. Consumption among households reporting non-zero electricity expenditure.

Source: World Bank 2009

Table E.2. Residential Electricity Subsidies, Consumption, and Spending by Tariff Type: Administrative and Household Survey Data

Tariff/ Subsidy	Subsidy			Electricity Consumption			Electricity Spending			Users		Average Price
	Million MP	Distribution	MP/HH (monthly)	MWh	Distribution	kWh/HH (monthly)	Million MP	Distribution	MP/HH (monthly)	Million Households	Distribution	MP per KWh
Administrative Data (CFE 2006)												
Total RES	**63,971**	**100.0%**	**202**	**44,452,408**	**100.0%**	**141**	**43,719**	**100.0%**	**138**	26.348	100.0%	**0.984**
1	24,893	38.9%	143	16,146,697	36.3%	93	14,224	32.5%	82	14.493	55.0%	0.881
1A	2,896	4.5%	160	1,811,376	4.1%	100	1,493	3.4%	82	1.508	5.7%	0.824
1B	7,404	11.6%	195	4,709,015	10.6%	124	4,004	9.2%	106	3.158	12.0%	0.850
1C	13,332	20.8%	277	8,709,386	19.6%	181	7,767	17.8%	161	4.018	15.3%	0.892
1D	3,227	5.0%	331	2,038,791	4.6%	209	1,713	3.9%	176	0.813	3.1%	0.840
1E	5,659	8.8%	470	3,430,456	7.7%	285	2,651	6.1%	220	1.004	3.8%	0.773
1F	6,423	10.0%	680	3,862,778	8.7%	409	2,935	6.7%	311	0.787	3.0%	0.760
DAC	137	0.2%	20	3,743,909	8.4%	550	8,933	20.4%	1312	0.568	2.2%	2.386
OEC (2007)	**2,919**	**4.4%***	**50**							**4.864**		
Survey Data (ENIGH 2006)												
Total RES	**62,007**	**100.0%**	**319**	**48,393,315**	**100.0%**	**249**	**55,230**	**100.0%**	**285**	**16.173**	**100.0%**	**1.141**
1	20,046	32.3%	176	17,005,975	35.1%	149	21,153	38.3%	186	9.494	58.7%	1.244
1A	1,972	3.2%	273	1,468,338	3.0%	203	1,585	2.9%	219	0.603	3.7%	1.080
1B	6,779	10.9%	279	4,981,331	10.3%	205	5,289	9.6%	217	2.027	12.5%	1.062
1C	17,287	27.9%	644	11,082,745	22.9%	413	9,562	17.3%	356	2.238	13.8%	0.863
1D	4,153	6.7%	786	2,593,447	5.4%	491	2,130	3.9%	403	0.440	2.7%	0.821
1E	4,021	6.5%	1098	2,268,973	4.7%	620	1,475	2.7%	403	0.305	1.9%	0.650
1F	8,669	14.0%	1618	5,094,962	10.5%	951	3,674	6.7%	686	0.446	2.8%	0.721
DAC	–919	–1.4%	–124	3,897,543	8.1%	524	10,361	18.8%	1393	0.620	3.8%	2.658
OEC (2007)	**2,348**	**3.6%***	**50**							**3.914**		

*Of total domestic electricity subsidies.

Source: CFE, ENIGH (2006).

Tariff Type	Season: Summer/ Non-summer		Tariff Blocks	Range kWh	Tariff per kWh
1		<140	Básico	1–75	0.610
			Intermedio	76–140	0.724
		>140	Básico	1–75	0.610
			Intermedio	76–125	1.006
			Excedente	126–	2.126
1A	S	<150	Básico	1–100	0.530
			Intermedio	101–150	0.631
		>150	Básico	1–100	0.530
			Intermedio	101–150	0.796
			Excedente	151–	2.126
	NS	<150	Básico	1–75	0.610
			Intermedio	76–150	0.724
		>150	Básico	1–75	0.610
			Intermedio	76–125	1.006
			Excedente	126–	2.126
B	S	<225	Básico	1–125	0.530
			Intermedio	126–225	0.631
		>225	Básico	1–125	0.530
			Intermedio	126–200	0.796
			Excedente	201–	2.126
	NS	<175	Básico	1–75	0.610
			Intermedio	76–175	0.724
		>175	Básico	1–75	0.610
			Intermedio	76–150	1.006
			Excedente	151–	2.126
C	S	<300	Básico	1–150	0.530
			Intermedio	151–300	0.631
		>300	Básico	1–150	0.530
			Intermedio	151–450	0.796
			Excedente	451–	2.126
	NS	<175	Básico	1–75	0.610
			Intermedio	76–175	0.724
		>175	Básico	1–75	0.610
			Intermedio	76–150	1.006
			Excedente	151–	2.126

Domestic Electricity Tariffs (Average May–October 2006)

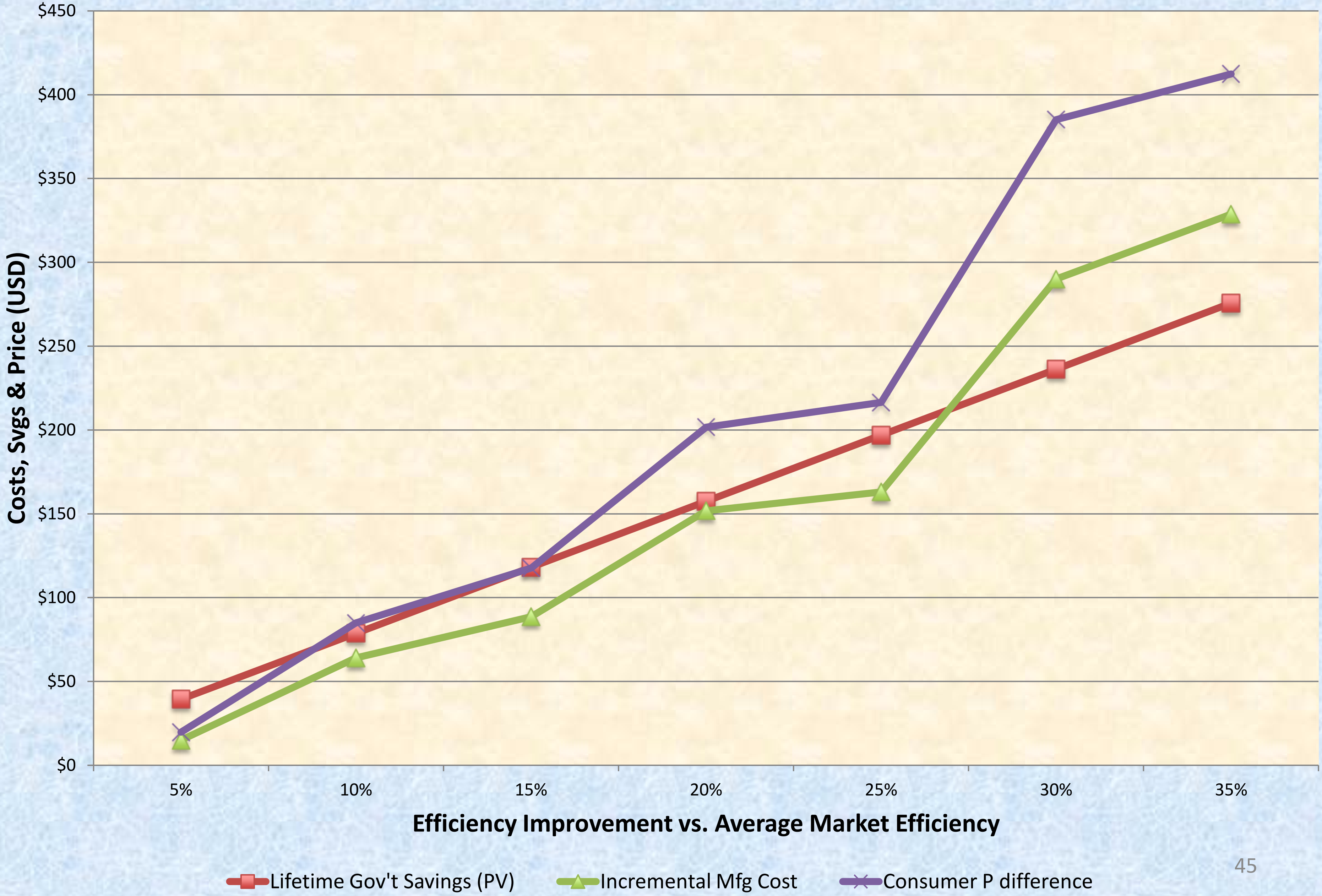
ent

Domestic Electricity Tariffs (Average May–October 2006) (*Continued*)

Tariff Type	Season: Summer/ Non-summer		Tariff Blocks	Range kWh	Tariff per kWh
D	S	<400	Básico	1–175	0.530
			Intermedio	176–400	0.631
		>400	Básico	1–175	0.530
			Intermedio	176–600	0.796
			Excedente	601–	2.126
	NS	<200	Básico 1–75	1–75	0.610
			Intermedio	76–175	0.724
		>200	Básico 1–75	1–75	0.610
			Intermedio 76–175	76–175	1.006
			Excedente	176–	2.126
E	S	<750	Básico	1–300	0.436
			Intermedio	301–750	0.561
		>750	Básico	1–300	0.436
			Intermedio	301–900	0.718
			Excedente	901–	2.126
	NS	<250	Básico	1–75	0.610
			Intermedio 76–200	76–200	0.724
			Excedente	201–250	2.126
		>250	Básico 1–75	1–75	0.610
			Intermedio 76–200	76–200	1.006
			Excedente	201–	2.126
F	S	<1200	Básico 1–300	1–300	0.436
			Excedente	301–1200	0.561
		>1200	Básico 1–300	1–300	0.436
			Intermedio Bajo 301–1,200	301–1200	0.718
			Intermedio Alto	1201–2500	1.338
			Excedente	2500–	2.126
	NS	<250	Básico 1–75	1–75	0.610
			Intermedio 76–200	76–200	0.724
			Excedente	201–250	2.126
		>250	Básico 1–75	1–75	0.610
			Intermedio 76–200	76–200	1.006
			Excedente	201–	2.126

Source: CFE.

Incremental Energy Efficiency: Gov't Subsidy Svgs, Incremental Mfg Costs & P Increase for Room Air Conditioners



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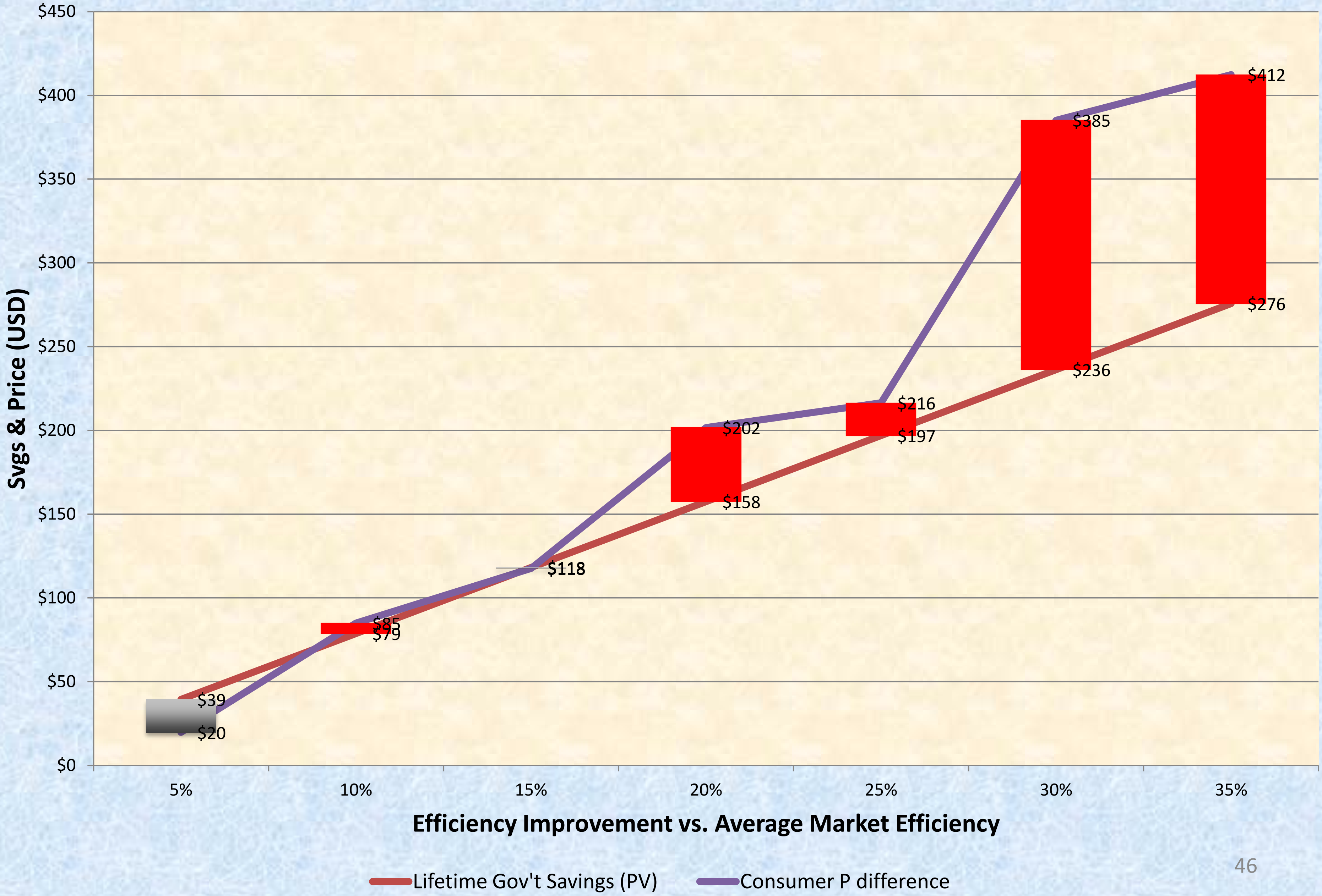

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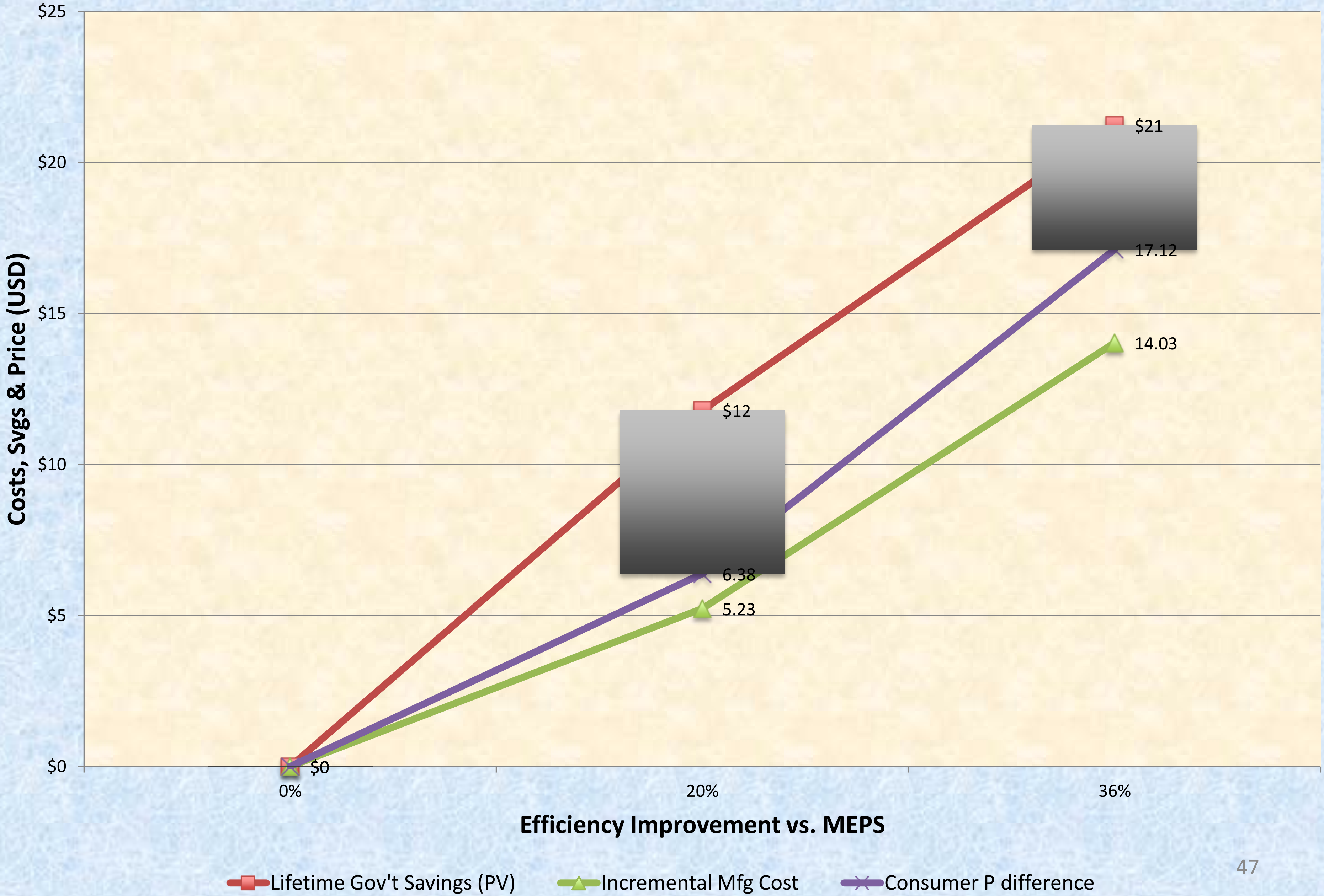

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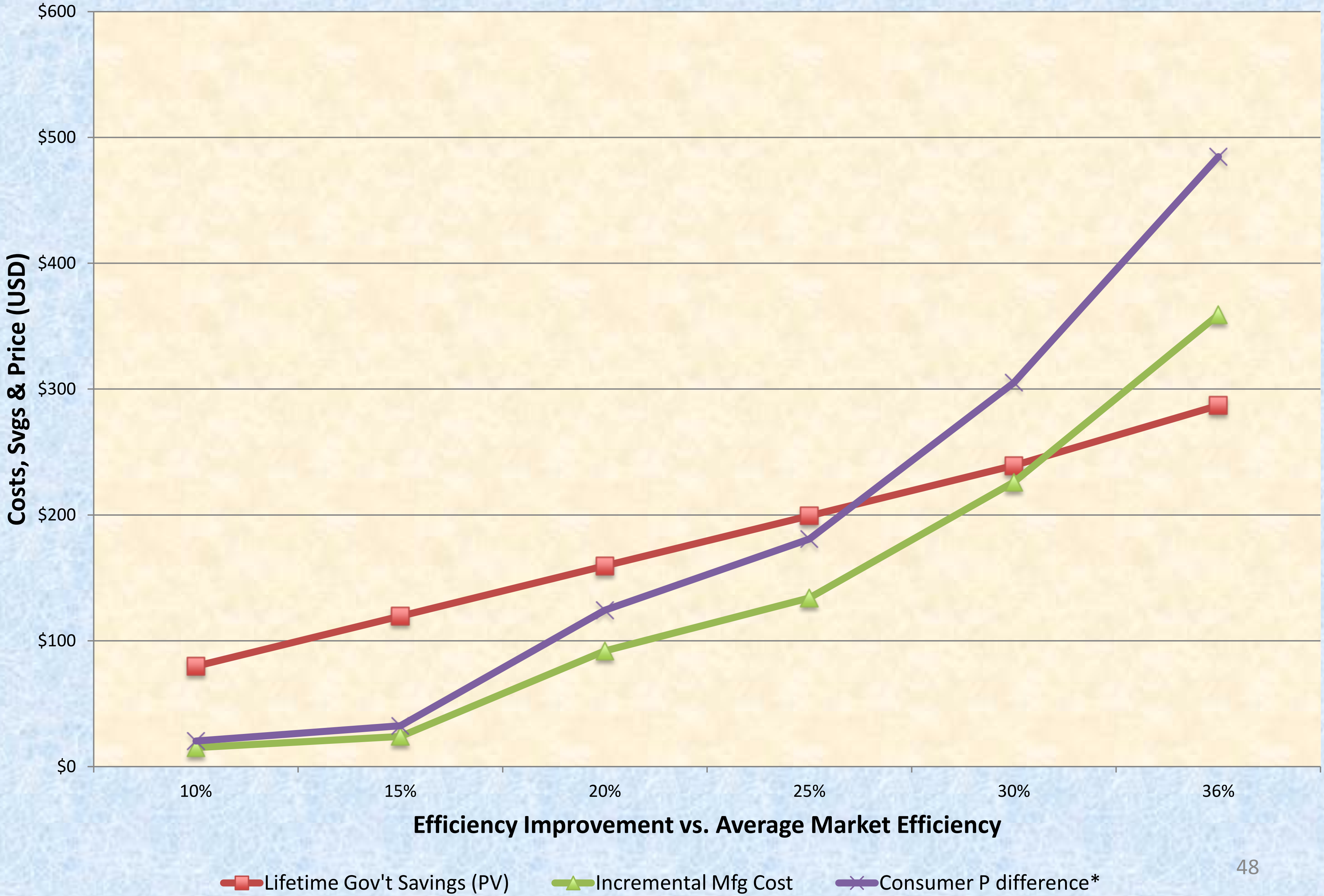

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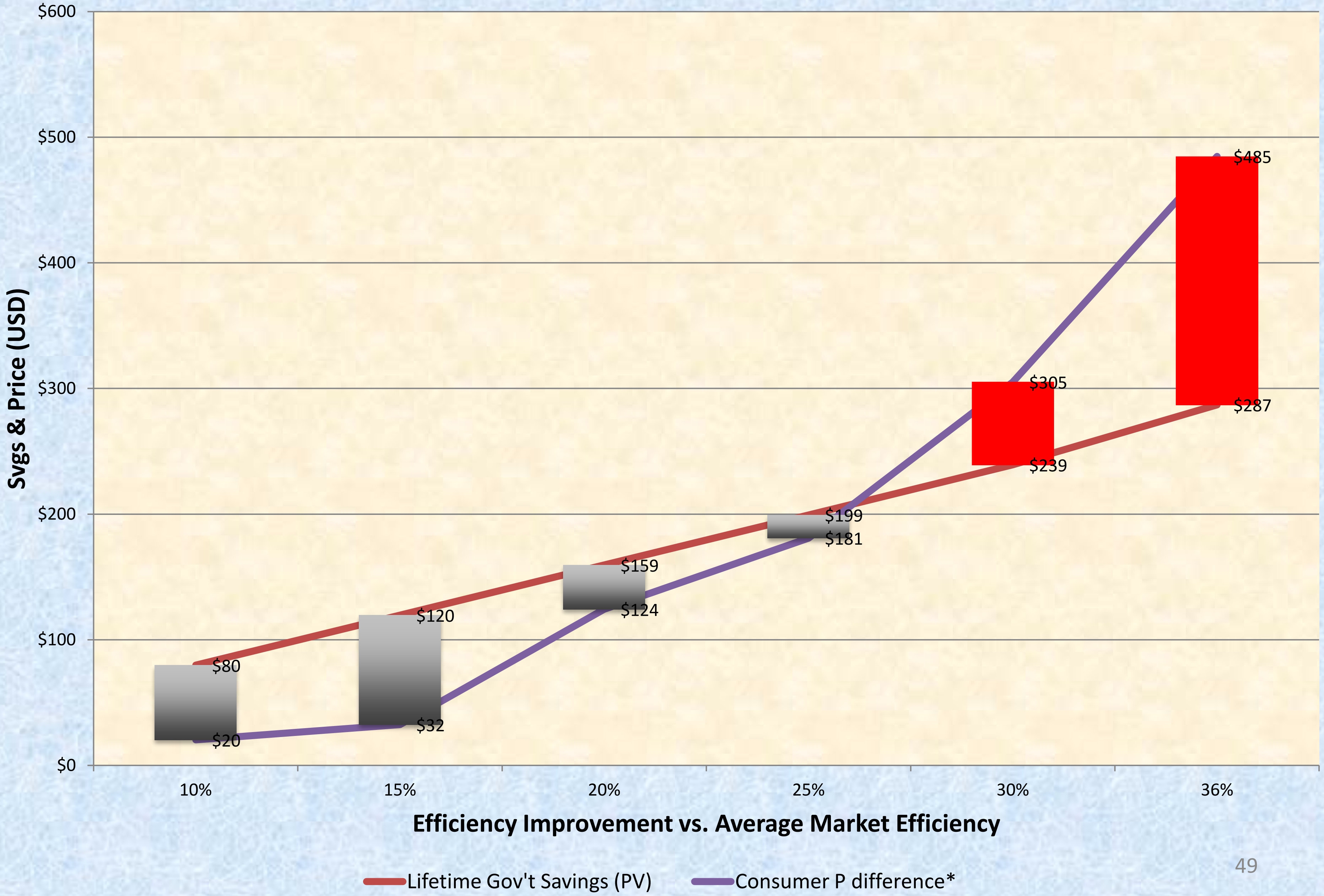

EXAMPLES OF OTHER SEAD COUNTRIES WITH SUBSIDIZED TARIFFS

- Brazil: 50% subsidy for residential electricity customers
- India: Agricultural Sector
- South Africa: 2008 consumer pricing 1/2 of replacement value of power plant
- Russia: ‘Gap’, from electricity subsidies, between average Russian price & int’l price, equal to US$15B in 2009

Brazil


India


South Africa


Russia

RESULTS

- Gov’ts that subsidize electricity rates can offer financial incentives that produce a net positive cash flow (not considering environmental costs or externalities)
- The more an appliance consumes, the more savings efficiencies will generate and thus the higher the incentive levels that can be offered and still provide a positive cash flow to the government
- Positive cash flow from financial incentives is driven by the rate of subsidy, the baseline consumption, the change in efficiency and incremental manufacturing costs
- These drivers cause certain levels of incentives to provide larger cash flows (to the gov’t) depending on individual household conditions
- The LBL Revenue Tool can determine which levels of efficiency improvement incentives can produce these positive cash flows
- The tool could be used to derive an individual HH’s optimal incentives

CONSIDERATIONS

- The net returns from these incentives are actual revenues that can be used to spend on other social goods such as education, housing, increased investment in electricity infrastructure, etc.
- The positive returns discussed in this presentation do not consider the social benefits accrued from reduced negative externalities associated with each kWh saved – these benefits would be additional
- The tool could be used to target households in which subsidies are substantially higher than those assumed in these examples allowing for even larger incentives while maintaining a positive cash flow – possibly covering even more efficient technologies
- Because the subsidy calculation does not take into account long run investment in infrastructure, the subsidy amounts are probably underestimates

SUBSIDIZED ELECTRICITY

- Because of externalities, electricity is underpriced thus efficiency is undervalued. Electricity subsidies exacerbate this effect
- For governments that provide these subsidies, every kWh saved is a cost savings, too
- Standards and labeling can provide much in the way of savings for free but it can be politically difficult to improve standards in a context in which efficiency is so undervalued
- They also do not push the market forward
- In such contexts, aggressive financial incentives for efficient end uses can simultaneously provide energy savings and fiscal savings (can serve as compliment and alternative to strengthening standards)

Policy Implications

① Subsidies on electricity can drive down the perceived value of efficiency thus making it politically difficult, with both consumers and industry, to strengthen standards and improve end-use energy efficiency. In these cases, aggressive financial incentives can be used to move fleet efficiency of appliances forward

② In subsidized electricity contexts, policy could and should be driven by determining what incentives could be offered to both save energy and provide a positive revenue stream for the government, not by consumer cost effectiveness

③ Because the revenue tool shows that the financial case for an incentive and efficiency level is dependent on the individual household contexts, the tool could be used to maximize energy savings and government savings

④ This is just the case for incentives based on a positive cash flow for the government, there is still a strong case to be made for financial incentives based on environmental externalities and imperfect information in purchasing decisions

⑤ Investigation of the implications of decreasing revenue for government-owned utilities (loss of government subsidies and ratepayer revenue for each saved kWh). No decoupling mechanism is necessarily available and, even if it were, it would be counterproductive with regards to financial incentives