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International Comparison of Depreciation Rules and Tax Rates for Selected Energy Investments

Prepared for the American Council for Capital Formation

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Executive Summary

The American Council for Capital Formation requested from the Quantitative Economics and Statistics group of Ernst & Young LLP an analysis comparing the tax depreciation rules for various energy investments between the United States and selected foreign countries.

The analysis examined eleven asset types used in the energy sector across twelve countries. The analysis examined the tax depreciation in several ways: 1) the percentage of the original investment recovered during the first five years, 2) the percentage of the original investment recovered during the first ten years, 3) the net present value of the depreciation deductions over the life of the asset, and 4) the effective tax rate of the investment taking into account depreciation, tax credits and the countries' marginal tax rate.

The results of the study are:

- The United States generally has less favorable tax depreciation rules for electric generation, electric transmission and distribution, and petroleum refining than many other countries, including a number of the U.S.'s major trading partners.

- The U.S. generally has slower cost recovery during the first five and ten years after the investment than the comparison countries. For example, investments in electric generation fueled by natural gas, nuclear and coal recovers less than 38% of the original investment during the first five years and 68% during the first ten years in the U.S., compared to 80% and 97%, respectively in Canada.

- When the time value of money is taken into account, the U.S. depreciation rates remain less favorable than most of the competitor countries. Again, an investment in electric generation fueled by natural gas, nuclear and coal has a net present value of depreciation over the entire recovery period of less than 66% of the original investment in the U.S. compared to 84% in Canada.

- Because the United States has the second highest statutory corporate marginal tax rate among OECD countries combined with generally less favorable tax depreciation rules, the differences in effective tax rates are even greater. Based on a number of assumptions including economic depreciation, we estimate the corporate effective tax rate on investments in electric generation fueled by natural gas, nuclear and coal at 27-31% in the U.S., compared to 14% in Canada.

- These findings are consistent across all of the energy assets studied, including different types of electric generation, electricity transmission and distribution, pollution control equipment, and petroleum refining.

- Cross-country comparisons require a number of assumptions and limitations to summarize the complex tax treatment of multiple investments across multiple countries. The analysis makes note of the assumptions and limitations.

International Comparison of Depreciation Rules and Tax Rates for Selected Energy Investments

Introduction

The American Council for Capital Formation requested from the Quantitative Economics and Statistics group of Ernst & Young LLP an analysis comparing the tax depreciation rules for various energy investments between the United States and selected foreign countries.

The analysis examined eleven asset types used in the energy sector across twelve countries. The analysis examined the tax depreciation in several ways: the percentage of the original investment recovered during the first five years and during the first ten years, the net present value of the depreciation deductions over the life of the asset, and the effective tax rate of the investment taking into account depreciation, tax credits and the countries' marginal tax rate. The net present value and effective tax rate analyses are presented with a constant inflation rate across countries. The analysis uses the tax rules in effect in 2006.

The eleven countries besides the United States the American Council for Capital Formation has selected include many important trading partners of the United States. According to OECD statistics, in 2005, the selected countries accounted for more than 65% of United States imports and more than 60% of United States exports.[1]

Energy Investments Analyzed

The eleven energy investments analyzed range from electric generation, transmission and distribution, to pollution control equipment and petroleum refinery equipment. The specific assets evaluated are:

Electric Generating Facilities: Gas – Includes assets used in the production of electricity for sale fueled by gas. In the United States, these assets are in Asset Class 49.15 (IRS Revenue Procedure 87-56) with a class life of 20 years, and a recovery period of 15 years.

Electric Generating Facilities: Coal – Includes assets used in the production of electricity for sale fueled by coal. In the U.S., these assets are in Asset Class 49.13 with a class life of 28 years and a recovery period of 20 years.

Electric Generating Facilities: Nuclear – Includes assets used in the nuclear power production of electricity for sale, but does not include nuclear fuel assemblies which have a five year recovery period. In the U.S., these assets are in Asset Class 49.12 with a class life of 20 years and a recovery period of 15 years.

[1] Organisation for Economic Co-operation and Development, SourceOECD 2005 Annual Statistics of International Trade

Combined Heat and Power Using Conventional Fuel – These assets include co-generation facilities that use a heat engine or power station to generate both electricity and useful heat. In the U.S., these assets are in Asset Class 49.13 with a class life of 28 years and a recovery period of 20 years.

Distribution of Electrical Heat and Steam Generated for Self Use – These assets are used in the production and/or distribution of electricity for use by the taxpayer in its industrial manufacturing process or plant activity and not ordinarily available for sale to others. In the U.S., these assets are in Asset Class 00.4 with a class life of 20 years and a recovery period of 15 years.

Electric Transmission Lines – Includes assets used in the transmission of electricity for sale. In the U.S., these assets are generally in Asset Class 49.14 with a class life of 30 years and a recovery period of 15 years.

Electric Distribution Lines – Includes assets used in the distribution of electricity for sale. In the U.S., these assets are in Asset Class 49.14 with a class life of 30 years and a recovery period of 20 years.

Electricity Smart Meters – Includes assets that are a general class of meter which not only measures the quantity of kilowatt hours but also the "quality of supply" functions and is capable of being read remotely. Smart meters communicate electricity consumption data automatically to and from a central computer, usually by radio frequency or power line communication. In the U.S., these assets are currently treated as part of the electric distribution system, and are included in Asset Class 49.14 with a class life of 30 years and a recovery period of 20 years.

Pollution Control Discharge Modification Equipment: These assets include pollution control equipment that modifies the outputs (e.g., thermal discharge control) rather than modifying inputs (e.g., scrubbers). In the U.S., these assets have a recovery period of seven years.

Petroleum Refining Crude Unit (Distillation): Includes assets used for the distillation of crude petroleum into gasoline and its other components. In the U.S., these assets are in Asset Class 13.3 with a class life of 16 years and a recovery period of 10 years.

Petroleum Refining Fluid Catalytic Cracking Unit: Includes assets used for the catalytic cracking of crude petroleum and its other components. In the U.S., these assets are in Asset Class 13.3 with a class life of 16 years and a recovery period of 10 years.

Methodology

Ernst & Young used its foreign tax desk network to collect information from the non-U.S. countries. Tax specialists for each of the countries provided information about the tax depreciation rules, any special credits, and any other special tax rules applying to the

specific assets. For purposes of this analysis, a number of assumptions and limitations needed to be made to summarize the comparative tax treatment of multiple assets across many countries.

Tax depreciation rules require the classification of many assets into different recovery periods. The U.S. assignment of cost recovery allowances may depend on the particular asset or the particular industry activity in which the asset is used.[2] For example, the U.S. has a single recovery period for assets used in electric generating facilities, whether they are structures or machinery. Some countries, such as Germany, have different recovery periods depending on the specific assets used within the electric generating facility. In such cases, a single asset recovery period representing a significant asset was chosen rather than attempting to estimate an average recovery period or estimating multiple recovery periods for multiple assets for a single facility.

Many countries have special tax rules (accelerated depreciation, credits, or lower rates) for certain types of activities or fuels. For example, the U.S. and several of the comparison countries have favorable tax treatment for renewable fuels. A number of countries have more favorable tax treatment for economic activity occurring in special economic zones. For purposes of this study, the estimates are based on tax rules for general activity rather than targeted geographic or targeted input incentives.

The estimates assume the investments were put in place July 1, 2006. Many countries have half-year or monthly conventions for tax depreciation. The tax rules are those applicable in 2006. Some of the tax provisions are temporary and will change in future years.

Where there is an option of depreciation rules, the estimate calculates the most favorable tax rule. For example, if companies have the choice between straight-line depreciation and double-declining balance depreciation, the double-declining balance depreciation is used. Some companies may choice to use straight-line depreciation due to otherwise expiring net operating losses or some other reason.

Some countries have more favorable tax rules that are available under certain circumstances including approval by the tax administrator. If the tax provision is not automatic and generally available, then that special provision is not included in the estimate.

Net Present Value of Depreciation Deductions.

Depreciation deductions generally are taken over multiple years. Deductions taken in future years do not have the same financial value as deductions taken in the year of the investment, due to the time value of money. Net present values adjust a stream of future deductions into the current period equivalent. Calculating net present values requires an assumption about the discount rate used to value future income or expenses. Most

[2] U.S. Department of the Treasury, Report to The Congress on Depreciation Recovery Periods and Methods, July 2000, p. 31.

financial analysts use a weighted average of the returns to debt and equity. This can vary by a number of factors across firms and countries, by the debt/equity ratio, the statutory marginal tax rate, real rates of return, and inflation rates.

A recent Congressional Budget Office study[3] estimated the weighted average cost of funds was 6.63%. We have rounded up to 7% to calculate the net present value based on a U.S. weighted average cost of funds, which might be most applicable to a U.S. based multi-national corporation. In comparison, Michael Devereux in a recent analysis of international tax rules assumed a 10% interest rate and a fixed inflation rate of 3.5%.[4] A higher discount rate would lower the net present value more for longer-lived assets.

Effective Tax Rate on Energy Investments

An additional measure comparing the effect of tax systems on investments across time, assets, and/or countries is a measure of an effective tax rate. An effective tax rate takes into account not only tax depreciation but also statutory marginal tax rates and tax credits.

An effective tax rate measures the difference between the pre-tax rate of return and the after-tax rate of return as a percentage of the pre-tax rate of return. There are numerous potential effective tax rates.[5] For purposes of this analysis, we have calculated the effective corporate tax rate on investment, after-corporate income tax and before personal income taxes.[6] For purposes of this analysis, the estimates assume that multinational corporations provide an after-corporate tax, but pre-individual investor tax, rate of 7.0% real, which is the long-term historical U.S. average on corporate equities.

The Appendix I describes the calculation of the effective tax rate measures.

Results

The international comparison results are presented in four tables.

International Comparison of Nominal Capital Costs Recovered After Five Years for Selected Energy Investments

Table 1 shows the amount recovered during the initial five years of cost recovery deductions in the U.S. for the selected energy investments ranges from 30% for coal electric generation facilities, distribution lines and smart meters to 64% for pollution control equipment. Coal electric generation facilities are recovered over 20 years under

[3] Congressional Budget Office, Computing Effective Tax Rates on Capital Income, December 2006.
[4] Devereux, M.P., R. Griffith, and A. Klemm, "Corporate Income Tax Reforms and International Tax Competition", June 2002
[5] CBO, ibid.
[6] CBO, ibid, King, M.A. and Don Fullerton, The Taxation of Income from Capital, A Comparative Study of the United States, the United Kingdom, Sweden and West Germany (1984), Jorgenson, D.W., and Ralph Landau, Tax Reform and the Cost of Capital: An International Comparison (1993).

a double declining balance method with a half-year convention in the first year. Pollution control equipment is recovered straight-line over seven years.

Other countries' capital cost recovery in the first five years ranges from 21% for electric transmission and distribution lines in Brazil to immediate write-off of 100% for all of the selected assets in Malaysia plus a number of other assets in several other countries. Mexico allows over 100% of the historical nominal cost for pollution control equipment during the first five years, because it provides an inflation adjustment plus a short recovery period. Table 1 compares nominal capital costs recovered after five years as percent of total asset value for selected energy investments.

Table 1: International Comparison of Nominal Capital Costs Recovered After Five Years for Selected Energy Investments, 2006

	Electric Generation					Electric Transmission & Distribution Lines			Pollution Control Equipment	Petroleum Refining	
	Gas	Coal	Nuclear	Combined Heat & Power Generation	Self-Generated Electricity	Transmission Lines	Distribution Lines	Smart Meters	Discharge Modification	Crude Unit (Distillation Unit)	Fluid Catalytic Cracking Unit
United States	37.7%	29.5%	37.7%	29.5%	37.7%	37.7%	29.5%	29.5%	64.3%	63.1%	63.1%
Brazil	37.7%	47.5%	N/A	37.7%	63.1%	20.6%	20.6%	31.2%	89.6%	63.1%	63.1%
Canada	79.6%	79.6%	79.6%	79.6%	79.6%	31.2%	31.2%	63.1%	79.6%	79.6%	79.6%
China	39.8%	39.8%	39.8%	39.8%	39.8%	39.8%	39.8%	39.8%	41.3%	39.8%	39.8%
Germany	30.0%	30.0%	37.5%	30.0%	30.0%	33.1%	33.1%	63.1%	79.6%	72.3%	79.6%
India	55.6%	55.6%	55.6%	55.6%	55.6%	55.6%	55.6%	100.0%	100.0%	66.1%	66.1%
Indonesia	45.0%	45.0%	45.0%	45.0%	45.0%	45.0%	45.0%	45.0%	45.0%	45.0%	45.0%
Japan	49.7%	49.7%	49.7%	49.7%	45.6%	37.4%	37.4%	49.7%	76.9%	72.3%	72.3%
Rep of Korea	57.7%	57.7%	57.7%	57.7%	57.7%	57.7%	57.7%	57.7%	89.0%	89.0%	89.0%
Malaysia	100.0%	100.0%	100.0%	100.0%	100.0%	90.0%	90.0%	90.0%	100.0%	90.0%	90.0%
Mexico	46.2%	46.2%	46.2%	46.2%	46.2%	23.1%	23.1%	23.1%	101.2%	32.3%	32.3%
Taiwan	49.7%	49.7%	49.7%	49.7%	49.7%	49.7%	49.7%	49.7%	96.6%	78.5%	78.5%

Table 2 compares the nominal capital costs recovered after five years to the proportion recovered under United States' tax depreciation rules. In addition to the number of countries with greater, similar and lower amounts recovered after five years, the table also shows the percent of United States international trade with countries in each of the three groups.[7]

Table 2: Countries where Nominal Capital Costs Recovered After Five Years are Greater, Similar, and Less than under United States' Tax Depreciation Rules, 2006

Asset Group	Asset	Number of Countries			Percent of International Trade		
		Greater	Similar	Less	Greater	Similar	Less
Electric Generation	Gas	9	1	1	58%	2%	5%
	Coal	10	1	0	59%	5%	0%
	Nuclear	9	1	0	58%	5%	0%
	Combined Heat & Power Generation	10	1	0	59%	5%	0%
	Self-Generated Electricity	10	0	1	59%	0%	5%
Electric Transmission & Distribution Lines	Transmission Lines	6	1	4	19%	8%	37%
	Distribution Lines	9	0	2	51%	0%	13%
	Smart Meters	10	0	1	53%	0%	11%
Pollution Control Equipment	Discharge Modification	9	0	2	52%	0%	12%
Petroleum Refining	Crude Distillation Unit	7	1	3	39%	2%	23%
	Fluid Catalytic Cracking Unit	7	1	3	39%	2%	23%

International Comparison of Nominal Capital Costs Recovered After Ten Years for Selected Energy Investments

Table 3 shows the amount recovered during the initial ten years of cost recovery deductions in the U.S. for the selected energy investments ranges from 53% for coal electric generation facilities, distribution lines and smart meters to 100% for pollution control equipment. Coal electric generation facilities are recovered over 20 years under a double declining balance method with a half-year convention in the first year. Pollution control equipment is recovered straight-line over seven years.

[7] Percent of international trade is calculated by dividing the sum of imports and exports with each country by total United States imports and exports. The countries under consideration account for 64% of total imports and exports combined, so the total for each row equals 64%. The figures for nuclear generation are slightly lower because Brazil is excluded since it does not have any nuclear generating facilities.

Table 3: International Comparison of Nominal Capital Costs Recovered After Ten Years for Selected Energy Investments, 2006

	Electric Generation					Electric Transmission & Distribution Lines			Pollution Control Equipment	Petroleum Refining	
	Gas	Coal	Nuclear	Combined Heat & Power Generation	Self-Generated Electricity	Transmission Lines	Distribution Lines	Smart Meters	Discharge Modification	Crude Unit (Distillation Unit)	Fluid Catalytic Cracking Unit
United States	67.5%	53.2%	67.5%	53.2%	67.5%	67.5%	53.2%	53.2%	100.0%	96.7%	96.7%
Brazil	63.2%	74.4%	N/A	63.2%	87.9%	38.6%	38.6%	54.7%	99.2%	87.9%	87.9%
Canada	96.6%	96.6%	96.6%	96.6%	96.6%	54.7%	54.7%	87.9%	96.6%	96.6%	96.6%
China	84.8%	84.8%	84.8%	84.8%	84.8%	84.8%	84.8%	84.8%	67.2%	84.8%	84.8%
Germany	63.3%	63.3%	79.2%	63.3%	63.3%	57.3%	57.3%	87.9%	96.6%	93.4%	96.6%
India	80.3%	80.3%	80.3%	80.3%	80.3%	80.3%	80.3%	100.0%	100.0%	84.9%	84.9%
Indonesia	71.8%	71.8%	71.8%	71.8%	71.8%	71.8%	71.8%	71.8%	71.8%	71.8%	71.8%
Japan	76.6%	76.6%	76.6%	76.6%	72.4%	62.8%	62.8%	76.6%	95.0%	93.4%	93.4%
Rep of Korea	83.8%	83.8%	83.8%	83.8%	83.8%	83.8%	83.8%	83.8%	100.0%	100.0%	100.0%
Malaysia	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Mexico	103.7%	103.7%	103.7%	103.7%	103.7%	51.8%	51.8%	51.8%	101.2%	72.5%	72.5%
Taiwan	76.6%	76.6%	76.6%	76.6%	76.6%	76.6%	76.6%	76.6%	100.0%	96.2%	96.2%

Other countries' capital cost recovery in the first ten years ranges from 39% for electric transmission and distribution lines in Brazil to immediate write-off of 100% for most of the selected assets in Malaysia. Table 3 compares nominal capital costs recovered after ten years as percent of total asset value for selected energy investments.

Table 4 compares the nominal capital costs recovered after ten years to the proportion recovered under United States' tax depreciation rules. The table shows both the number of countries with greater, similar and lower amounts recovered and the percent of United States international trade with countries in each of the three groups.

Table 4: Countries where Nominal Capital Costs Recovered After Ten Years are Greater, Similar, and Less than under United States' Tax Depreciation Rules, 2006

Asset Group	Asset	Number of Countries			Percent of International Trade		
		Greater	Similar	Less	Greater	Similar	Less
Electric Generation	Gas	9	0	2	58%	0%	6%
	Coal	11	0	0	64%	0%	0%
	Nuclear	10	0	0	62%	0%	0%
	Combined Heat & Power Generation	11	0	0	64%	0%	0%
	Self-Generated Electricity	10	0	1	59%	0%	5%
Electric Transmission & Distribution Lines	Transmission Lines	6	0	5	19%	0%	44%
	Distribution Lines	9	0	2	51%	0%	13%
	Smart Meters	10	0	1	53%	0%	11%
Pollution Control Equipment	Discharge Modification	1	5	5	11%	9%	43%
Petroleum Refining	Crude Distillation Unit	2	2	7	4%	22%	38%
	Fluid Catalytic Cracking Unit	2	3	6	4%	26%	33%

International Comparison of the Discounted Present Value of Capital Costs Recovered Over the Entire Asset Life for Selected Energy Investments

Table 5 shows the discounted present value of cost recovery deductions over the entire asset life in the U.S. for the selected energy investments range from 58% for coal electric generation facilities, distribution lines and smart meters to 79% for pollution control equipment. Other countries' discounted present value of depreciation deductions ranges from 43% for electric transmission and distribution lines in Brazil to 100% for pollution control equipment in India. Table 5 compares the net present value of capital costs recovered as percent of total asset value for selected energy investments.

Table 5: International Comparison of the Discounted Present Value of Capital Costs Recovered for Selected Energy Investments over the Entire Asset Life, 2006

	Electric Generation					Electric Transmission & Distribution Lines			Pollution Control Equipment	Petroleum Refining	
	Gas	Coal	Nuclear	Combined Heat & Power Generation	Self-Generated Electricity	Transmission Lines	Distribution Lines	Smart Meters	Discharge Modification	Crude Unit (Distillation Unit)	Fluid Catalytic Cracking Unit
United States	65.9%	58.2%	65.9%	58.2%	65.9%	65.9%	58.2%	58.2%	78.6%	79.7%	79.7%
Brazil	60.9%	68.0%	N/A	60.9%	76.7%	43.0%	43.0%	55.2%	88.1%	76.7%	76.7%
Canada	83.9%	83.9%	83.9%	83.9%	83.9%	55.2%	55.2%	76.7%	83.9%	83.9%	83.9%
China	73.5%	73.5%	73.5%	73.5%	73.5%	73.5%	73.5%	73.5%	73.5%	81.5%	73.5%
Germany	62.8%	62.8%	68.5%	62.8%	62.8%	56.9%	56.9%	76.7%	83.9%	80.9%	83.9%
India	73.0%	73.0%	73.0%	73.0%	73.0%	73.0%	73.0%	98.4%	100.0%	79.3%	79.3%
Indonesia	71.3%	71.3%	71.3%	71.3%	71.3%	71.3%	71.3%	71.3%	71.3%	71.3%	71.3%
Japan	69.6%	69.6%	69.6%	69.6%	67.0%	60.9%	60.9%	69.6%	95.0%	93.4%	93.4%
Rep of Korea	74.1%	74.1%	74.1%	74.1%	74.1%	74.1%	74.1%	74.1%	87.9%	87.9%	87.9%
Malaysia	93.5%	93.5%	93.5%	93.5%	93.5%	94.7%	94.7%	94.7%	98.3%	94.7%	94.7%
Mexico	79.2%	79.2%	79.2%	79.2%	79.2%	64.1%	64.1%	64.1%	97.3%	72.2%	72.2%
Taiwan	69.3%	69.3%	69.3%	69.3%	69.3%	69.3%	69.3%	69.3%	91.5%	83.5%	83.5%

Table 6 compares the net present value of capital costs recovered during the first fifty years of the asset life to the proportion recovered under United States' tax depreciation rules. The table shows both the number of countries with greater, similar and lower amounts recovered and the percent of United States international trade with countries in each of the three groups.

Table 6: Countries where the Net Present Value of Capital Costs Recovered is Greater, Similar, and Less than under United States' Tax Depreciation Rules, 2006

Asset Group	Asset	Number of Countries			Percent of International Trade		
		Greater	Similar	Less	Greater	Similar	Less
Electric Generation	Gas	9	0	2	58%	0%	6%
	Coal	11	0	0	64%	0%	0%
	Nuclear	10	0	0	62%	0%	0%
	Combined Heat & Power Generation	11	0	0	64%	0%	0%
	Self-Generated Electricity	10	0	1	59%	0%	5%
Electric Transmission & Distribution Lines	Transmission Lines	6	0	5	19%	0%	44%
	Distribution Lines	8	0	3	38%	0%	26%
	Smart Meters	10	0	1	62%	0%	2%
Pollution Control Equipment	Discharge Modification	9	0	2	52%	0%	12%
Petroleum Refining	Crude Distillation Unit	7	1	3	49%	1%	13%
	Fluid Catalytic Cracking Unit	6	1	4	38%	1%	25%

International Comparison of the Corporate Effective Tax Rate for Selected Energy Investments

Table 7 shows the corporate effective tax rates in the U.S. for the selected energy investments range from 22% for petroleum refining assets to 51% for electric distribution smart meters. Corporate effective tax rates incorporate not only depreciation deductions, but also marginal tax rates and tax credits.

Other countries' corporate effective tax rates range from -19% for pollution control equipment in Taiwan to 47% for electric distribution smart meters in Brazil. Table 7 compares effective tax rates for selected energy investments.

Table 7: International Comparison of the Effective Tax Rate on Selected Energy Investments, 2006

	Electric Generation					Electric Transmission & Distribution Lines			Pollution Control Equipment	Petroleum Refining	
	Gas	Coal	Nuclear	Combined Heat & Power Generation	Self-Generated Electricity	Transmission Lines	Distribution Lines	Smart Meters	Discharge Modification	Crude Unit (Distillation Unit)	Fluid Catalytic Cracking Unit
United States	26.7%	30.8%	26.7%	30.8%	26.7%	27.5%	31.7%	51.1%	23.4%	21.6%	21.6%
Brazil	25.7%	22.0%	N/A	25.7%	17.1%	33.5%	33.5%	47.1%	13.0%	19.9%	19.9%
Canada	13.5%	13.5%	13.5%	13.5%	13.5%	30.3%	30.3%	33.7%	18.1%	15.8%	15.8%
China	19.0%	19.0%	19.0%	19.0%	19.0%	19.0%	19.0%	34.6%	25.0%	22.1%	22.1%
Germany	28.3%	28.3%	25.1%	28.3%	28.3%	31.4%	31.4%	35.8%	19.5%	19.8%	17.1%
India	16.6%	16.6%	16.6%	16.6%	16.6%	16.6%	16.6%	2.6%	0.0%	15.5%	15.5%
Indonesia	18.4%	19.0%	19.0%	19.0%	19.0%	19.0%	19.0%	34.6%	25.0%	22.1%	22.1%
Japan	25.5%	25.5%	25.5%	25.5%	27.1%	30.6%	30.6%	43.6%	21.3%	20.4%	20.4%
Rep of Korea	5.2%	5.2%	5.2%	5.2%	5.2%	5.2%	5.2%	11.0%	-9.7%	-9.7%	-9.7%
Malaysia	4.8%	4.8%	4.8%	4.8%	4.8%	3.9%	3.9%	8.3%	1.8%	7.1%	7.1%
Mexico	12.7%	12.7%	12.7%	12.7%	12.7%	20.1%	20.1%	36.1%	2.6%	19.0%	19.0%
Taiwan	14.9%	14.9%	14.9%	14.9%	14.9%	14.9%	14.9%	23.3%	-18.8%	10.2%	10.2%

Table 8 compares the effective tax rates on capital investments to the proportion recovered under United States' tax rules. The table shows both the number of countries with lower, similar and higher effective tax rates and the percent of United States international trade with countries in each of the three groups.

Table 8: Countries where the Effective Tax Rate on Capital Investments is Lower, Similar, and Higher than under United States' Tax Rules, 2006

Asset Group	Asset	Number of Countries			Percent of International Trade		
		Lower	Similar	Higher	Lower	Similar	Higher
Electric Generation	Gas	9	1	1	58%	2%	5%
	Coal	11	0	0	64%	0%	0%
	Nuclear	10	0	0	62%	0%	0%
	Combined Heat & Power Generation	11	0	0	64%	0%	0%
	Self-Generated Electricity	9	1	1	52%	8%	5%
Electric Transmission & Distribution Lines	Transmission Lines	7	0	4	31%	0%	33%
	Distribution Lines	9	1	1	58%	5%	2%
	Smart Meters	11	0	0	64%	0%	0%
Pollution Control Equipment	Discharge Modification	9	0	2	52%	0%	12%
Petroleum Refining	Crude Distillation Unit	9	2	0	52%	12%	0%
	Fluid Catalytic Cracking Unit	9	2	0	52%	12%	0%

Appendix Tables 3-14 show the same results presented separately for each country individually.

Appendix I: Calculation Methodology

Calculation of Effective Tax Rates

Effective tax rates are computed by dividing the difference between the before tax rate of return on an investment and the after tax rate of return on an investment by the before tax rate of return on an investment. At the margin, a firm will make an investment if the after tax rate of return is at least equal to the interest payments required for such an investment plus inflation. This rate is the real interest rate, *r*. The real interest rate is composed of the nominal interest rate and inflation in the following form:

$$r = i + \pi$$

Where i is the nominal interest rate and π is the rate of inflation. Our estimates assume a nominal interest rate of 5% and an inflation rate of 2% for a total real interest rate of 7%.

The before tax rate of return necessary to reach a sufficient after tax return may be expressed with the following expression:

$$p = \frac{(r+q)}{1-u}(1-uz-k)-q$$

Where p represents the before tax rate of return equal to the real interest rate, q represents the economic depreciation of the asset, u represents the corporate income tax rate, z represents the net present value of tax depreciation allowances, and k equals the present value of any tax credits or incentives available for the investment.

The net present value of depreciation allowances, *z,* is the discounted sum of depreciation allowances. We calculate the net present value of depreciation allowances using the following formula. We examine depreciation allowances during the first fifty years after an investment:

$$z = \sum_{j=1}^{50} \frac{z_j}{(1+r)^{j-1}}$$

Where j is the year starting with year 1, the first year of the investment, and z_j is the depreciation allowance credited in year *j.*

The marginal effective tax rate, *ETR*, may thus be expressed in the following manner:

$$ETR = \frac{p-r}{p}$$

Rates of Economic Depreciation

For this study, we assume electric generation and transmission equipment other than smart meters depreciate at a rate of 5% per year, petroleum refining equipment depreciates at a rate of 7.5% per year, pollution control equipment depreciates at a rate of 10% per year, and smart meters depreciate at a rate of 20% per year.

The rates applied for each investment are derived from the following asset classes from the U.S. Bureau of Economic Analysis: [8]

Appendix Table 1: Rates of Economic Depreciation

Investment	BEA Asset Class	BEA Rate of Depreciation	Assumed Rate
Electric Generation	Steam engines and turbines	5.16%	5%
Electric Transmission (other than smart meters)	Electrical transmission, distribution, and industrial apparatus	5.00%	5%
Electric Transmission (smart meters)	Other electrical equipment	18.34%	20%
Pollution Control Equipment	Special industrial machinery, n.e.c.; General industrial and materials handling equipment	10.31%-10.72%	10%
Petroleum Refining	Petroleum and natural gas exploration, shafts and wells	7.51%	7.5%

[8] Bureau of Economic Analysis, "BEA Rates of Depreciation, Service Lives, Declining-Balance Rates, and Hulten-Wykoff Categories" (1997) available at http://www.bea.gov/bea/an/0797fr/table3.htm, this table is found in Fraumeni, Barbara, "The Measurement of Depreciation in the U.S. National Income and Product Accounts," (1997) available at http://www.bea.gov/bea/an/0797fr/maintext.htm

Corporate Income Tax Rates

Below are the corporate income tax rates applied in the effective tax rate calculations:

Appendix Table 2: Corporate Income Tax Rates, 2006

Country	Tax Rate
United States	39.3%[9]
Brazil	34.0%
Canada	36.1%
China	33.0%
Germany	38.3%
India	30.0%
Indonesia	30.0%
Japan	39.7%
Rep of Korea	35.0%
Malaysia	28.0%[10]
Mexico	29.0%
Taiwan	25.0%

Source: OECD and Ernst & Young Corporate Tax Guide

[9] Section 199 ("production deduction") reduces the combined federal and state marginal corporate income tax rate from 39.3% to 38.3% in 2006 for electric generation, pollution control and petroleum refining assets.

[10] The Malaysian corporate income tax for firms in the petroleum industry is 38%, for other firms the corporate income tax is 28%.

Appendix II: Individual Country Results

Appendix Table 3: Value of Depreciation Deductions and Effective Tax Rates on Selected Energy Investments, 2006
United States

		Percent of Cost Recovered		Net Present Value of Depreciation Deductions	Effective Tax Rate
		Five Years	Ten Years		
Electric Generation	Gas	37.7%	67.5%	65.9%	26.7%
	Coal	29.5%	53.2%	58.2%	30.8%
	Nuclear	37.7%	67.5%	65.9%	26.7%
	Combined Heat & Power Generation Facilities Using Conventional Fuel (assumes power for sale)	29.5%	53.2%	58.2%	30.8%
	Distribution of Industrial Steam & Electricity Generated for Self-Use	37.7%	67.5%	65.9%	26.7%
Electric Transmission & Distribution Lines	Transmission Lines	37.7%	67.5%	65.9%	27.5%
	Distribution Lines	29.5%	53.2%	58.2%	31.7%
	Smart Meters	29.5%	53.2%	58.2%	51.1%
Pollution Control Equipment	Discharge Modification (e.g. thermal discharge control)	64.3%	100.0%	78.6%	23.4%
Petroleum Refining	Crude Unit (Distillation Unit)	63.1%	96.7%	79.7%	21.6%
	Fluid Catalytic Cracking Unit	63.1%	96.7%	79.7%	21.6%

Appendix Table 4: Value of Depreciation Deductions and Effective Tax Rates on Selected Energy Investments, 2006
Brazil

		Percent of Cost Recovered		Net Present Value of Depreciation Deductions	Effective Tax Rate
		Five Years	Ten Years		
Electric Generation	Gas	37.7%	63.2%	60.9%	25.7%
	Coal	47.5%	74.4%	68.0%	22.0%
	Nuclear	N/A	N/A	N/A	N/A
	Combined Heat & Power Generation Facilities Using Conventional Fuel (assumes power for sale)	37.7%	63.2%	60.9%	25.7%
	Distribution of Industrial Steam & Electricity Generated for Self-Use	63.1%	87.9%	76.7%	17.1%
Electric Transmission & Distribution Lines	Transmission Lines	20.6%	38.6%	43.0%	33.5%
	Distribution Lines	20.6%	38.6%	43.0%	33.5%
	Smart Meters	31.2%	54.7%	55.2%	47.1%
Pollution Control Equipment	Discharge Modification (e.g. thermal discharge control)	89.6%	99.2%	88.1%	13.0%
Petroleum Refining	Crude Unit (Distillation Unit)	63.1%	87.9%	76.7%	19.9%
	Fluid Catalytic Cracking Unit	63.1%	87.9%	76.7%	19.9%

Appendix Table 5: Value of Depreciation Deductions and Effective Tax Rates on Selected Energy Investments, 2006
Canada

		Percent of Cost Recovered		Net Present Value of Depreciation Deductions	Effective Tax Rate
		Five Years	Ten Years		
Electric Generation	Gas	79.6%	96.6%	83.9%	13.5%
	Coal	79.6%	96.6%	83.9%	13.5%
	Nuclear	79.6%	96.6%	83.9%	13.5%
	Combined Heat & Power Generation Facilities Using Conventional Fuel (assumes power for sale)	79.6%	96.6%	83.9%	13.5%
	Distribution of Industrial Steam & Electricity Generated for Self-Use	79.6%	96.6%	83.9%	13.5%
Electric Transmission & Distribution Lines	Transmission Lines	31.2%	54.7%	55.2%	30.3%
	Distribution Lines	31.2%	54.7%	55.2%	30.3%
	Smart Meters	63.1%	87.9%	76.7%	33.7%
Pollution Control Equipment	Discharge Modification (e.g. thermal discharge control)	79.6%	96.6%	83.9%	18.1%
Petroleum Refining	Crude Unit (Distillation Unit)	79.6%	96.6%	83.9%	15.8%
	Fluid Catalytic Cracking Unit	79.6%	96.6%	83.9%	15.8%

Appendix Table 6: Value of Depreciation Deductions and Effective Tax Rates on Selected Energy Investments, 2006
China

		Percent of Cost Recovered		Net Present Value of Depreciation Deductions	Effective Tax Rate
		Five Years	Ten Years		
Electric Generation	Gas	39.8%	84.8%	73.5%	19.0%
	Coal	39.8%	84.8%	73.5%	19.0%
	Nuclear	39.8%	84.8%	73.5%	19.0%
	Combined Heat & Power Generation Facilities Using Conventional Fuel (assumes power for sale)	39.8%	84.8%	73.5%	19.0%
	Distribution of Industrial Steam & Electricity Generated for Self-Use	39.8%	84.8%	73.5%	19.0%
Electric Transmission & Distribution Lines	Transmission Lines	39.8%	84.8%	73.5%	19.0%
	Distribution Lines	39.8%	84.8%	73.5%	19.0%
	Smart Meters	39.8%	84.8%	73.5%	34.6%
Pollution Control Equipment	Discharge Modification (e.g. thermal discharge control)	41.3%	67.2%	73.5%	25.0%
Petroleum Refining	Crude Unit (Distillation Unit)	39.8%	84.8%	81.5%	22.1%
	Fluid Catalytic Cracking Unit	39.8%	84.8%	73.5%	22.1%

Appendix Table 7: Value of Depreciation Deductions and Effective Tax Rates on Selected Energy Investments, 2006
Germany

		Percent of Cost Recovered		Net Present Value of Depreciation Deductions	Effective Tax Rate
		Five Years	Ten Years		
Electric Generation	Gas	30.0%	63.3%	62.8%	28.3%
	Coal	30.0%	63.3%	62.8%	28.3%
	Nuclear	37.5%	79.2%	68.5%	25.1%
	Combined Heat & Power Generation Facilities Using Conventional Fuel (assumes power for sale)	30.0%	63.3%	62.8%	28.3%
	Distribution of Industrial Steam & Electricity Generated for Self-Use	30.0%	63.3%	62.8%	28.3%
Electric Transmission & Distribution Lines	Transmission Lines	33.1%	57.3%	56.9%	31.4%
	Distribution Lines	33.1%	57.3%	56.9%	31.4%
	Smart Meters	63.1%	87.9%	76.7%	35.8%
Pollution Control Equipment	Discharge Modification (e.g. thermal discharge control)	79.6%	96.6%	83.9%	19.5%
Petroleum Refining	Crude Unit (Distillation Unit)	72.3%	93.4%	80.9%	19.8%
	Fluid Catalytic Cracking Unit	79.6%	96.6%	83.9%	17.1%

Appendix Table 8: Value of Depreciation Deductions and Effective Tax Rates on Selected Energy Investments, 2006
India

		Percent of Cost Recovered		Net Present Value of Depreciation Deductions	Effective Tax Rate
		Five Years	Ten Years		
Electric Generation	Gas	55.6%	80.3%	73.0%	16.6%
	Coal	55.6%	80.3%	73.0%	16.6%
	Nuclear	55.6%	80.3%	73.0%	16.6%
	Combined Heat & Power Generation Facilities Using Conventional Fuel (assumes power for sale)	55.6%	80.3%	73.0%	16.6%
	Distribution of Industrial Steam & Electricity Generated for Self-Use	55.6%	80.3%	73.0%	16.6%
Electric Transmission & Distribution Lines	Transmission Lines	55.6%	80.3%	73.0%	16.6%
	Distribution Lines	55.6%	80.3%	73.0%	16.6%
	Smart Meters	100.0%	100.0%	98.4%	2.6%
Pollution Control Equipment	Discharge Modification (e.g. thermal discharge control)	100.0%	100.0%	100.0%	0.0%
Petroleum Refining	Crude Unit (Distillation Unit)	66.1%	84.9%	79.3%	15.5%
	Fluid Catalytic Cracking Unit	66.1%	84.9%	79.3%	15.5%

Appendix Table 9: Value of Depreciation Deductions and Effective Tax Rates on Selected Energy Investments, 2006
Indonesia

		Percent of Cost Recovered		Net Present Value of Depreciation Deductions	Effective Tax Rate
		Five Years	Ten Years		
Electric Generation	Gas	45.0%	71.8%	71.3%	18.4%
	Coal	45.0%	71.8%	71.3%	19.0%
	Nuclear	45.0%	71.8%	71.3%	19.0%
	Combined Heat & Power Generation Facilities Using Conventional Fuel (assumes power for sale)	45.0%	71.8%	71.3%	19.0%
	Distribution of Industrial Steam & Electricity Generated for Self-Use	45.0%	71.8%	71.3%	19.0%
Electric Transmission & Distribution Lines	Transmission Lines	45.0%	71.8%	71.3%	19.0%
	Distribution Lines	45.0%	71.8%	71.3%	19.0%
	Smart Meters	45.0%	71.8%	71.3%	34.6%
Pollution Control Equipment	Discharge Modification (e.g. thermal discharge control)	45.0%	71.8%	71.3%	25.0%
Petroleum Refining	Crude Unit (Distillation Unit)	45.0%	71.8%	71.3%	22.1%
	Fluid Catalytic Cracking Unit	45.0%	71.8%	71.3%	22.1%

Appendix Table 10: Value of Depreciation Deductions and Effective Tax Rates on Selected Energy Investments, 2006
Japan

		Percent of Cost Recovered		Net Present Value of Depreciation Deductions	Effective Tax Rate
		Five Years	Ten Years		
Electric Generation	Gas	49.7%	76.6%	69.6%	25.5%
	Coal	49.7%	76.6%	69.6%	25.5%
	Nuclear	49.7%	76.6%	69.6%	25.5%
	Combined Heat & Power Generation Facilities Using Conventional Fuel (assumes power for sale)	49.7%	76.6%	69.6%	25.5%
	Distribution of Industrial Steam & Electricity Generated for Self-Use	45.6%	72.4%	67.0%	27.1%
Electric Transmission & Distribution Lines	Transmission Lines	37.4%	62.8%	60.9%	30.6%
	Distribution Lines	37.4%	62.8%	60.9%	30.6%
	Smart Meters	49.7%	76.6%	69.6%	43.6%
Pollution Control Equipment	Discharge Modification (e.g. thermal discharge control)	76.9%	95.0%	95.0%	21.3%
Petroleum Refining	Crude Unit (Distillation Unit)	72.3%	93.4%	93.4%	20.4%
	Fluid Catalytic Cracking Unit	72.3%	93.4%	93.4%	20.4%

Appendix Table 11: Value of Depreciation Deductions and Effective Tax Rates on Selected Energy Investments, 2006
Rep of Korea

		Percent of Cost Recovered		Net Present Value of Depreciation Deductions	Effective Tax Rate
		Five Years	Ten Years		
Electric Generation	Gas	57.7%	83.8%	74.1%	5.2%
	Coal	57.7%	83.8%	74.1%	5.2%
	Nuclear	57.7%	83.8%	74.1%	5.2%
	Combined Heat & Power Generation Facilities Using Conventional Fuel (assumes power for sale)	57.7%	83.8%	74.1%	5.2%
	Distribution of Industrial Steam & Electricity Generated for Self-Use	57.7%	83.8%	74.1%	5.2%
Electric Transmission & Distribution Lines	Transmission Lines	57.7%	83.8%	74.1%	5.2%
	Distribution Lines	57.7%	83.8%	74.1%	5.2%
	Smart Meters	57.7%	83.8%	74.1%	11.0%
Pollution Control Equipment	Discharge Modification (e.g. thermal discharge control)	89.0%	100.0%	87.9%	-9.7%
Petroleum Refining	Crude Unit (Distillation Unit)	89.0%	100.0%	87.9%	-9.7%
	Fluid Catalytic Cracking Unit	89.0%	100.0%	87.9%	-9.7%

Appendix Table 12: Value of Depreciation Deductions and Effective Tax Rates on Selected Energy Investments, 2006
Malaysia

		Percent of Cost Recovered		Net Present Value of Depreciation Deductions	Effective Tax Rate
		Five Years	Ten Years		
Electric Generation	Gas	100.0%	100.0%	93.5%	4.8%
	Coal	100.0%	100.0%	93.5%	4.8%
	Nuclear	100.0%	100.0%	93.5%	4.8%
	Combined Heat & Power Generation Facilities Using Conventional Fuel (assumes power for sale)	100.0%	100.0%	93.5%	4.8%
	Distribution of Industrial Steam & Electricity Generated for Self-Use	100.0%	100.0%	93.5%	4.8%
Electric Transmission & Distribution Lines	Transmission Lines	90.0%	100.0%	94.7%	3.9%
	Distribution Lines	90.0%	100.0%	94.7%	3.9%
	Smart Meters	90.0%	100.0%	94.7%	8.3%
Pollution Control Equipment	Discharge Modification (e.g. thermal discharge control)	100.0%	100.0%	98.3%	1.8%
Petroleum Refining	Crude Unit (Distillation Unit)	90.0%	100.0%	94.7%	7.1%
	Fluid Catalytic Cracking Unit	90.0%	100.0%	94.7%	7.1%

Appendix Table 13: Value of Depreciation Deductions and Effective Tax Rates on Selected Energy Investments, 2006
Mexico

		Percent of Cost Recovered		Net Present Value of Depreciation Deductions	Effective Tax Rate
		Five Years	Ten Years		
Electric Generation	Gas	46.2%	103.7%	79.2%	12.7%
	Coal	46.2%	103.7%	79.2%	12.7%
	Nuclear	46.2%	103.7%	79.2%	12.7%
	Combined Heat & Power Generation Facilities Using Conventional Fuel (assumes power for sale)	46.2%	103.7%	79.2%	12.7%
	Distribution of Industrial Steam & Electricity Generated for Self-Use	46.2%	103.7%	79.2%	12.7%
Electric Transmission & Distribution Lines	Transmission Lines	23.1%	51.8%	64.1%	20.1%
	Distribution Lines	23.1%	51.8%	64.1%	20.1%
	Smart Meters	23.1%	51.8%	64.1%	36.1%
Pollution Control Equipment	Discharge Modification (e.g. thermal discharge control)	101.2%	101.2%	97.3%	2.6%
Petroleum Refining	Crude Unit (Distillation Unit)	32.3%	72.5%	72.2%	19.0%
	Fluid Catalytic Cracking Unit	32.3%	72.5%	72.2%	19.0%

Appendix Table 14: Value of Depreciation Deductions and Effective Tax Rates on Selected Energy Investments, 2006
Taiwan

		Percent of Cost Recovered		Net Present Value of Depreciation Deductions	Effective Tax Rate
		Five Years	Ten Years		
Electric Generation	Gas	49.7%	76.6%	69.3%	14.9%
	Coal	49.7%	76.6%	69.3%	14.9%
	Nuclear	49.7%	76.6%	69.3%	14.9%
	Combined Heat & Power Generation Facilities Using Conventional Fuel (assumes power for sale)	49.7%	76.6%	69.3%	14.9%
	Distribution of Industrial Steam & Electricity Generated for Self-Use	49.7%	76.6%	69.3%	14.9%
Electric Transmission & Distribution Lines	Transmission Lines	49.7%	76.6%	69.3%	14.9%
	Distribution Lines	49.7%	76.6%	69.3%	14.9%
	Smart Meters	49.7%	76.6%	69.3%	23.3%
Pollution Control Equipment	Discharge Modification (e.g. thermal discharge control)	96.6%	100.0%	91.5%	-18.8%
Petroleum Refining	Crude Unit (Distillation Unit)	78.5%	96.2%	83.5%	10.2%
	Fluid Catalytic Cracking Unit	78.5%	96.2%	83.5%	10.2%