TAX BARRIERS TO FOUR RENEWABLE ELECTRIC GENERATION TECHNOLOGIES

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ABSTRACT

The tax loads associated with constructing and owning current and advanced solar central receiver, biomass-electric, and flash and binary cycle geothermal projects are compared to the tax loads incurred by natural gas-fired generation matched in size, hours of operation, and technology status. All but one of the eight renewable projects carry higher tax burdens under current tax codes. These higher tax loads proportionately reduce the competitiveness of renewables. Three tax neutralizing policies are applied to the renewable projects, each restoring competitiveness for some of the projects. The results show that RD&D must be accompanied with such public initiatives as tax neutrality in order for the majority of renewable projects to compete with advanced gas turbines in the emerging electric services market.

INTRODUCTION

This paper builds on previous work reported at the 1995 ASME/JSME/JSES International Solar Energy Conference from an ongoing study by the California Energy Commission into the tax loads carried by renewable generation projects compared to those of competing natural gas-fired projects (Jenkins and Reilly, 1995).

There are a number of features which distinguish the work reported here from the earlier paper. Open-loop biomass and liquid geothermal projects have been added to the solar central receiver projects previously analyzed. Tax codes pertaining to the renewable generation technologies have been reviewed to identify any sunset provisions which would affect taxation throughout the 30 year lives of the plants. A wider range of tax neutralizing measures has been analyzed. Finally, we have evaluated a uniform set of tax neutralizing measures workable for all four renewable energy technologies.

Previous analyses of tax equity issues for electric generation projects were reported by Lotker (1991) and Hadley, et al. (1993).[1]

ISSUES CONCERNING TAX NEUTRALITY

The generation market is unique compared to most markets in the mix of capital-intensive and expense-intensive technologies which compete to provide very similar electric power services. For example, hydroelectric projects have cost as much as $5,000/kW but are low in cost to operate, while gas-fired combined cycle plants have cost as little as $500/kW but must buy fuel for operation. In contrast, most markets have competing goods, and manufacturing and supply infrastructures, with similar capital/expense ratios. To illustrate, all competing providers within the housing construction and natural gas supply markets face capital-intensive outlays, while competing providers within the accounting and legal services markets operate expense-intensive firms.

The problem for technologies of dissimilar capital and expense ratios competing to provide similar services in the same market is that capital and expense receive different tax treatments, and these differences are unlikely to result in equal tax loads between the projects built using those technologies. Under utility ownership of generation projects, the tax equity issues could be ignored, since it was the best economic mix of generation facilities which dictated choice, and capital investment earned a nearly guaranteed rate of return.

Under the emerging competitive electric services market, however, some technologies and their supporting industries will face greater difficulty, even survival questions, unless such equity issues as unequal taxation and unrecognized externality benefits and costs relative to the fossil competition are addressed. Until these equity issues are addressed, RD&D alone will not bring about competitiveness for the majority of renewable technologies analyzed in this study.

[1]The tax equity issue has also been studied by Greg Kolb, Sandia National Laboratories, Albuquerque, New Mexico; Brian Parsons and D. J. Packey at the National Renewable Energy Laboratory, Golden, Colorado, and by Dallas Burtraw and Pallavi R. Shah of the Resources for the Future under contract to the Office of Technology Assessment, United States Congress.

Most renewable generation technologies, such as solar, wind, geothermal, and closed loop biomass with dedicated farms, have to capitalize the means used to tap their energy resources. This prepayment is avoided by the competing fossil plants, but at the expense of fuel cost. The implications of this difference for taxation are at the root of the unequal tax burdens between the projects. Packey (1993) has shown that a major source of the excess tax load carried by capital-intensive technologies arises from property and sales taxes.

As in the previous paper, the generation facilities are assumed to be owned by independent power producers (IPPs). IPPs, including the unregulated subsidiaries of utilities, will no doubt build only those facilities which provide the greatest competitive edge, and the cost of building, fueling and operating the facilities will be the strongest driver. In the future, the options will include very clean and efficient advanced gas turbine, combined cycle plants which will meet foreseeable emissions regulations without requiring supplementary emissions control. This current and future gas-fired competition is considered in the study.

Concept of Neutral Taxation

For an economist, the "first-best efficient" market for competing commodities is one that is (1) perfectly competitive, and (2) has no production or consumption externalities (inputs and outputs which lie outside of market pricing). A problem arises when a set of revenue-generating taxes is introduced into this ideal world. Taxes can cause distortions in the efficient allocation of resources. The set of taxes that generates the least distortion in the efficient allocation of goods in this ideal world is one that has no competitive effects.

An interpretation of this point of view, used in this paper, is that it is desirable to have the relative market shares of competing commodities determined not by differences in tax loads, but the other components that go into pricing (as well as by any differences in the features of the commodities). For an analytical statement see Packey (1993), who provides a mathematical definition of tax equity.[2] A more complete interpretation of taxation which least distorts the efficient allocation would include differences in externalities (societal costs and benefits not included in market prices). We omit externalities in this analysis.

We apply the principle of minimizing competitive effects by matching pairs of renewable and gas-fired generation projects in terms of output, operating time and technological advancement, and compare the tax loads. The plants and their characteristics are listed in Table 1. Note that the first solar central receiver project is unique among the matched comparisons, in that the plant is assumed to be the first of its kind in commercial operation, built without any guarantee of follow-on orders (and thus will have higher heliostat costs than will be typical for the Nth plants constructed).

Three Types Of Tax Neutrality Issues

As in our previous paper, we define three types of tax neutrality issues. The first two types relate to the possibility that differing total tax loads will affect relative competitiveness, while the third type refers to the distribution of tax revenues paid across governments.

Type I: The relative tax loads carried by two different plant technologies which compete to provide the same electric services.

Type II: The relative tax loads carried by the current and advanced versions of the same plant technology which compete to provide the same electric services.

Taxing authorities are, of course, interested in the consequences of tax policy for their tax revenues. In the past, incentives have been provided in an attempt to make more level the playing field between classes of technologies, but these have frequently distorted the customary distribution of tax revenues between levels of government. This consideration leads to a third type of tax neutrality issue.

Type III: The relative distribution and amounts of tax revenues received by local, state and federal governments produced by taxation of two different plant technologies which compete to provide the same electric services.

One of the challenges undertaken by this and the earlier study is to explore tax neutralizing measures which achieve for the renewable projects the size and distribution of tax revenues between levels of governments which these governments customarily receive from the competing gas-fired projects.

METHODOLOGY

Financial Model

The financial model employed in this study is an expansion of the cash flow model developed by Luz International, Limited in the course of raising over $2 billion in financing its 354 MW of solar-electric projects in California. The model calculates the revenues and tax payments for each major project participant, the developer, California and non-California equity investors, lender, constructor, operations and maintenance provider (O&M), other service provider (legal, environmental, etc.), and the supplier of natural gas. Revenues are presented in terms of labor, materials and profit. Taxes are identified by corporate and individual taxpayers, by federal, state and local government, and by income, federal social security, state disability insurance, sales, and property taxes. The tax data are tabulated annually over the 30 year life of a project, plus the period of project construction.

Assumptions

Cost and performance estimates, shown in Table 1, were provided by the staff of the California Energy Commission and participants in the generation market. The estimates for the central receiver projects were derived from Sandia-furnished material. Commission staff developed estimates for current biomass and geothermal generation projects based on industry surveys in past years, and for future technologies based on other data at hand. Perhaps the greatest uncertainty in the cost estimates lies in the geothermal area, due primarily to the difficulty in obtaining cost data which the industry regards as proprietary. Therefore, the precise competitiveness of the projects we have analyzed cannot be inferred from our results.

The cost and performance estimates for the competing gas-fired technologies were developed from Commission sources (California

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[2] There is an extensive economics literature on optimal taxation See, for example, Ramsey (1927), Baumol and Bradford (1970), and Boskin and Robinson (1985). However, the focus of the literature is on the taxation of commodities, not on the taxation of factors of production (generation plants), in different stages of market maturity, with dissimilar capital and expense structures, and producing a similar commodity (electricity).

TABLE 1
CHARACTERISTICS OF RENEWABLE AND COMPETING GAS-FIRED TECHNOLOGIES

Technology	Size (MW)	Capacity Factor	Heat Rate HHV Basis Btu/kWh	Plant Cost $1994 $/kW	Other Cost $1994 $/kW	Total Cost $1994 $/kW	First Full Year (1996) Operating Costs in $1994			
							Fuel Cost C/kWh	Labor & Material C/kWh	Other O&M C/kWh	Total O&M C/kWh
Current Technology										
1st Solar Central Receiver	100	36%		3,672	403	4,074		1.60	1.45	3.05
Steam Recuperated Gas Turbine	100	36%	9,281	681	148	829	2.70	0.62	0.93	4.25
Biomass Combustion (1)	25	90%	13,860	1,931	616	2,547	2.57	1.88	0.70	5.15
LM2500 Combined Cycle (1)	30	90%	8,076	1,262	405	1,667	2.10	0.64	0.83	3.58
Flash Geothermal	110	87%		2,095	370	2,465		1.52	1.08	2.60
Combined Cycle	100	90%	7,910	693	149	842	2.30	0.36	0.38	3.04
Binary Cycle Geothermal	53	75%		3,208	610	3,818		3.36	1.18	4.54
LM6000 Combined Cycle	52	75%	7,666	881	247	1,128	2.23	0.52	0.67	3.42
Future Technology										
Advanced Central Receiver	200	63%		2,745	278	3,024		0.55	0.57	1.13
Combined Cycle	200	63%	6,638	533	90	623	1.93	0.45	0.37	2.74
Biomass Gas. Combined Cy. (1)	75	85%	8,789	1,374	307	1,680	1.63	0.87	0.32	2.82
Combined Cycle (1)(2)	51	85%	6,828	899	252	1,150	1.77	0.46	0.59	2.82
Combined Cycle (1)(2)	100	85%	6,828	693	149	842	1.77	0.39	0.39	2.55
Flash Geothermal	110	90%		1,990	355	2,345		1.23	0.84	2.07
Combined Cycle	100	90%	6,828	693	149	842	1.99	0.36	0.38	2.73
Binary Cycle Geothermal	24	80%		2,805	750	3,555		1.47	1.67	3.14
Combined Cycle	30	80%	7,409	1,262	405	1,668	2.16	0.73	0.92	3.81

Note: (1) Plant is in the PG&E service territory and has a different gas cost forecast than the plants in the SCE service territory.
(2) The tax loads and capacity payments as determined by the project cash flows are averaged in order to simulate a gas-fired plant matched to the future biomass gasification, combined cycle plant.

Energy Commission, 1992), the Sacramento Municipal Utility District, the Technical Assessment Guide (Electric Power Research Institute, 1993), and a comparative analysis of steam-injected gas turbines and combined cycle plants (Electric Power Research Institute, 1989).

Other major assumptions include:

- Construction begins on January 1, 1994 for the solar and gas-fired plants, and on January 1, 1993 for the geothermal and biomass combustion plants.
- Financing closes July 3, 1994; plant startup is October 1, 1994.
- An allowance of two weeks planned maintenance per year, with a four-week planned overhaul period every five years.
- 15 year debt with mortgage-style amortization at 9.2 percent.
- Minimum debt coverage ratio is 1.5:1.
- 1993 values for California utility incremental energy rates were used to determine the energy sales revenues.
- California investors participate in the project to the extent that all California tax benefits are used. Non-California investors use all of the federal tax benefits.[3]

Tax revenues are summarized both in totals and as the 30-year net present value (NPV) using the 6.5 percent discount rate recommended by the federal government (Office of Management and Budget, 1992). The 6.5 percent rate also represents the cost of money to the

[3]The effect of the federal alternative minimum tax (AMT) was not modeled in the study. AMT limits the ability of investors to shelter income from federal taxes. The effect of AMT is to force a developer to choose between a restricted population of investors able to make use of the tax benefits of the investment, and reducing the tax benefits of the investment, including tax neutralizing benefits, so that prospective investors are not affected by AMT. The National Energy Policy Act of 1992 provided independent domestic oil developers with relief from AMT, but did not do so for the renewable generation technologies.

government as listed in February 1994 for U.S. Government Treasury Notes with a maturity of 15 years.

Tax Load Boundaries Used In The Analysis

Tax loads are tabulated at two levels. Case 1, the topmost level, accounts for all sources of tax liability for every party having direct transaction with the project.[4] Case 1 is important because it reflects the secondary tax revenue impacts of a project, including (1) taxes paid due to the construction and operation of the project, and (2) taxes paid due to the delivery and sale of natural gas.[5] Case 2 is a subset of Case 1, and is significant because it (1) covers the tax liabilities of the parties closest to the project, and (2) requires the fewest assumptions about the income tax liabilities of the parties. We do not have a preference for one tax case over the other. The cases and coverage are listed below:

Case 1 Tax Load: All participants having direct transactions with the project.

- State and federal income taxes on California and non-California investors
- State and local sales tax on materials
- Annual property tax on the plant
- State and federal income taxes, including FICA and CASDI (California State Disability Insurance), on:

  Developer
  Lender
  Constructor
  O&M provider
  Other service provider
  Natural gas supplier

Case 2 Tax Load: Owner income, property and sales taxes

- State and federal income taxes on California and non-California investors
- State and local sales tax on materials
- Annual property tax on the plant

Study Approach

The cash flow model was used to develop financially viable gas-fired and renewable project matched pairs. The energy revenue for each cash flow was set equal to the avoided cost profile of the California utility service territory in which the project pairs were assumed to be located, and the capacity payment was then adjusted until a 16 percent, 30 year after-tax return on equity was achieved. Using this approach, the project tax load (and the distribution of tax revenues between levels of government) become the study variables to be manipulated through various assumed tax policies. The capacity payment required for a market rate of return becomes a means for measuring the impact on plant competitiveness of the tax load associated with that policy.

Since the project cash flows under current codes revealed that most renewable generation projects carry greater tax burdens than the gas-fired competition, we developed a series of tax neutralizing measures for renewable generation so that the tax loads would become more equal.

Tax Policies Analyzed

Four distinct types of tax policies were analyzed for each renewable technology project, as follows:

- **Pre-Preferential Code**. Project taxed as a gas-fired plant, as it would have been before any preferential tax treatments were accorded renewable energy generation. The purpose of including this tax policy is to determine the true difference in the tax load between the renewable and gas-fired projects under a common tax treatment.
- **1994 Tax Code**. Project taxed to 1994 federal, state and local tax codes. An exception was taken to the 1994 California tax code, which in 1994 provided an exemption from property taxes for the solar portion of a solar-electric project. This exemption expired at the end of 1994, and so is not included in the analysis. Since no other tax code provisions for any of the renewable technologies are scheduled for expiration, we consider the 1994 code as "current" tax law.
- **Absolute Neutrality**. Project taxed so as to be absolutely neutral in total tax load (Type I neutrality) and in the distribution of tax revenues (Type III neutrality) with the matching gas-fired plant. Neutral tax policies are developed for Case 1, drawing on a range of tax strategies, and for Case 2 relying primarily on energy production tax credits. Separate absolute neutrality tax policies are developed for the current and future versions of the renewable technologies. The purpose of this portion of the analysis is to explore effective alternative tax treatments and establish the change in competitiveness brought about by tax neutrality.
- **Uniform Code**. Project taxed under a postulated uniform code for renewable generation which is designed to achieve approximate Types I and III tax neutrality against the matched gas-fired projects, regardless of the type of technology and whether it is current or future in nature. The purpose of this analysis is to address the need for a common approach to tax neutrality for renewable generation. A uniform code was devised for Case 1, only, due to study resource constraints.

Further details for each of the above policies are provided in Table 2.

RESULTS AND DISCUSSION

Figures 1 through 4 (provided in the Appendix) show the results for the four tax policies and two tax load cases for the renewable generation technologies in their current and future versions. The capacity payment required for a market rate of return is plotted against the total levelized tax load. The results for the Case 1 and Case 2 tax loads are plotted for the pre-preference tax treatment, 1994

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[4] The boundary of the analysis could be extended beyond Case 1, even to the source of such raw materials as metals, petroleum and natural gas, but at the cost of numerous, likely compromising assumptions.

[5] The lender's tax payments are an important component of the Case 1 tax loads. The federal income tax paid by the lender on profits from fees and interest amounts to 37 percent of the NPV of all federal tax revenues collected from the 200 MW central receiver project. The largest revenue item, income taxes paid by the project owners, amounts to 48 percent of the federal total.

TABLE 2
SUMMARY OF TAX NEUTRALIZING POLICIES

Tax Policies Analyzed	Tax Neutrality Policies for Renewable Generation Plants		
	Federal	State	Local
For Case 1 Tax Loads			
Absolute Neutrality Policies (tailored to each technology)	Current tax incentives remain in effect Energy tax credit if not already available Shorten depreciation period Tax lender's profit at 50% normal rate; assume lender reduces project debt rate from 9.2 to 6.9%	Allow deferral of sales tax on construction materials Energy tax credit if not already available Depreciate to federal schedule	Allow deferral of sales tax on construction materials Defer property tax; base tax on plant income
Uniform Code of Neutrality	10% energy tax credit 2 year depreciation period Tax lender's profit at 50% normal rate; assume lender reduces project debt rate from 9.2 to 6.9%	4% energy tax credit 2 year depreciation period 5 year deferral of sales tax	5 year deferral of sales tax 4 year deferral of property tax
For Case 2 Tax Loads			
Absolute Neutrality Policies (tailored to each technology)	Energy production tax credit Energy tax credit	Energy production tax credit 2 year deferral of sales tax	Base property tax on production 2 year deferral of sales tax

tax code, absolute tax neutrality treatment, and uniform tax treatment policies.

A review of Figures 1 through 4 shows that, unless taxed preferentially, the eight renewable generation projects always carry a higher tax burden than the matching gas-fired plants. The renewable projects will carry a higher tax load even under the preferential tax treatments of the current codes, although the results in Figures 4C and 4D for the binary cycle projects show near-equity. In spite of the fact that (1) the geothermal and biomass technologies are more fuel-like than their solar cousin, and (2) the two geothermal technologies can be highly competitive under certain situations, no renewable technology can be competitive if not taxed preferentially.

These results support the main assertion of the study, that renewable generation technologies bring a fundamentally significant tax issue to the policy table which has not been addressed at a unified level.

Pre-Preferential Tax Treatment

Table 3 lists the ratios of the levelized tax loads for the renewable generation projects relative to the levelized loads carried by the competing gas-fired projects, assuming that the renewable projects are taxed non-preferentially to the same codes as the gas-fired projects.

The central receiver and geothermal projects, which have the highest capital cost among all projects analyzed, show the most extreme response to being taxed as gas-fired projects. The energy-collecting fields of these technologies must pay sales and property taxes; there is no sales tax on natural gas, only occasional local use taxes. Also note that the advanced central receiver has a lower capital cost than the current and future binary cycle geothermal plants (see Table 1), yet has a higher tax load ratio than either of these geothermal projects. The reason is that the geothermal (as do the biomass) projects have more in common with fossil technologies since they are more fuel-like in cost structure and tax treatment, including for geothermal the use of the depletion allowance tax provision generally available to technologies which deplete the energy resources being tapped.

TABLE 3
RATIOS OF TAX LOADS UNDER PRE-PREFERENTIAL TAX TREATMENT

Technology	Ratios of Levelized Tax Loads for Matched Renewable and Gas-Fired Projects (Renewable C/kWh)/(Gas-Fired C/kWh)	
	Case 1	Case 2
Current		
1st Central Receiver	4.0	6.2
Biomass Combustion	1.5	1.4
Flash Geothermal	2.2	2.8
Binary Geothermal	2.5	2.6
Future		
Central Receiver	3.0	3.9
Biomass Gasification	1.6	2.0
Flash Geothermal	2.0	2.3
Binary Geothermal	1.8	2.1

1994 Tax Code

Table 4 shows the ratios of the tax loads for the renewable projects to those of the gas-fired projects under the 1994 tax codes. While the 1994 codes provide a degree of preference toward the renewables, almost without exception, the renewable projects carry higher tax loads than their gas-fired counterparts.[6]

Review of each of the plots in Figures 1 through 3 will show that the 1994 tax codes are not sufficiently preferential to the current and future solar, biomass and flash geothermal technologies to bring these

[6]The ratios shown in Table 4 for the first central receivers are somewhat higher than those shown in Table 2 of our previous paper. The reason is that the California solar property tax exemption was utilized in the earlier study.

TABLE 4
RATIOS OF TAX LOADS UNDER 1994 CODES

Technology	Ratios of Levelized Tax Loads for Matched Renewable and Gas-Fired Projects (Renewable C/kWh)/(Gas-Fired C/kWh)	
	Case 1	Case 2
Current		
1st Central Receiver	2.2	2.1
Biomass Combustion	1.4	1.3
Flash Geothermal	1.8	1.9
Binary Geothermal	1.8	1.0
Future		
Central Receiver	1.8	1.9
Biomass Gasification	1.4	1.6
Flash Geothermal	1.6	1.6
Binary Geothermal	1.3	1.1

projects into tax neutrality with the matching gas-fired generation. Furthermore, the excess tax burden carried by these renewable generation projects contributes to their inability to compete in the market.

In Fig. 4 we begin to see a shift for binary cycle projects from the previous results. The future technology project does not achieve equal taxation in Fig. 4B, but it does become competitive with its gas-fired competition. It would become even more competitive with tax neutrality. In Fig. 4C, the current binary cycle project achieves tax neutrality under the 1994 code, but not competitiveness, while in Fig. 4D, the future technology project is essentially equally taxed and competitive.

Unlike any of the other renewable technologies, the binary cycle geothermal project can achieve competitiveness through RD&D within the treatment accorded by the 1994 tax code. This is the only such case among the four renewable energy technologies analyzed. Hence, these results show that RD&D must be coupled with other public policies, such as tax neutrality, in order for solar, biomass and geothermal technologies to become competitive in the face of advanced gas turbine developments.

The first commercial central receiver, shown in Figures 1A and 1C, raises an issue distinct from the other renewable plants. The higher initial capital cost of a first commercial plant brings with it higher tax loads, making these projects even more difficult to finance and operate profitably. This was less a barrier to the introduction of new technologies for utility owners of such projects than it will be for the emerging competitive market. In the new market, there is no incentive to be the first with a new technology, unless the first plant is at least as cost-effective as the competition. If a first commercial renewable plant is likely to be built only when tax loads are neutral, then unequal taxation has become a barrier to innovation, a barrier we can ill afford to continue.

Recall that the third criterion for tax neutrality is that each level of government should receive the same revenue for renewable generation as it would receive from the matching gas-fired generation. Figures 5 and 6 show for the Case 1 and Case 2 tax load conditions, respectively, the tax revenues collected by each level of government under the 1994

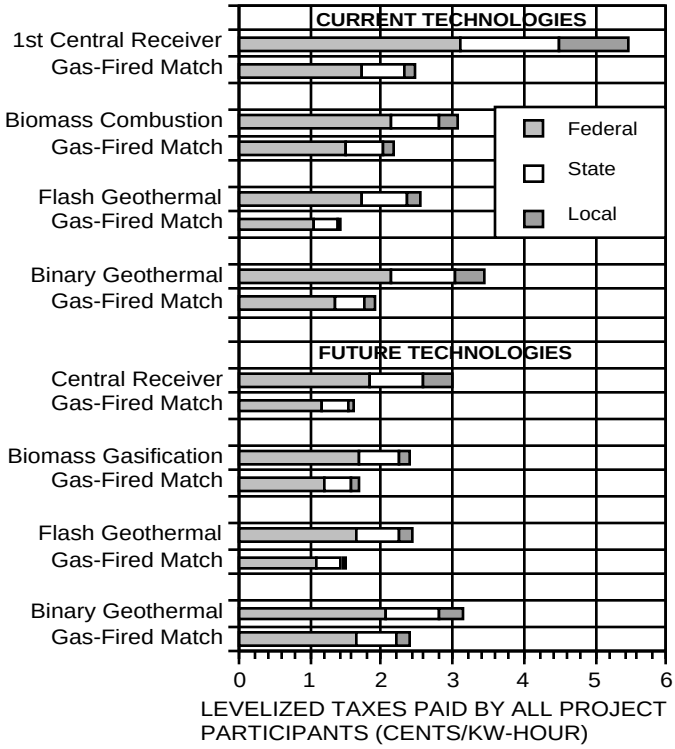

Figure 5

Government Tax Revenues Under 1994 Codes (Case 1)

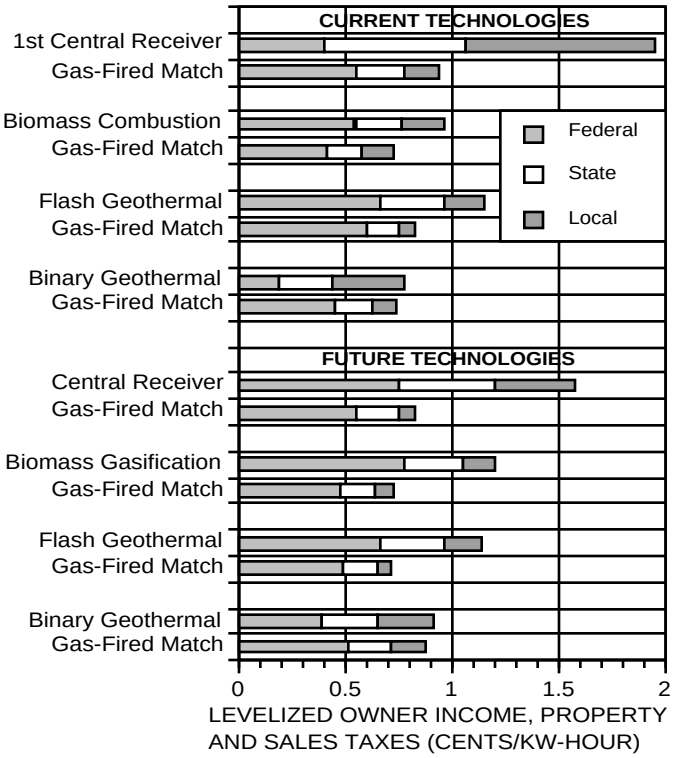

Figure 6

Government Tax Revenues Under 1994 Codes (Case 2)

tax code. The challenge in the design of tax-neutral policies is to equalize both the total tax load between matched pairs of renewable and gas-fired projects, and to achieve a distribution of revenues between levels of government which is free from technology bias.

In Figures 5 and 6, the first central receiver carries double the total levelized tax load compared to the matching gas-fired project, but five times more in local taxes. Similar ratios apply to the future technology central receiver. The remaining, more fuel-like renewable technologies show less of a disparity in total tax payments and in the distribution of tax payments between levels of government, even though one of these technologies, the future binary cycle project, has a higher capital cost than the future central receiver. From this observation, we surmise that the more severe problems with unequal tax loads will be found among the pure solar, wind and ocean thermal projects, because these technologies have no fuel-like or depletable resource.

We next illustrate the competitive effects of policies which would provide tax neutrality for renewable generation.

Absolute Tax Neutrality

A tax policy of absolute neutrality brings the tax payments from renewable projects to the different levels of government into near equality with the payments made by the matched competing gas-fired projects. The first implication to be noted in Figures 1 through 4 is the nearly straight line relationship between the three points established by pre-preference tax treatment, the 1994 tax code, and absolute neutrality tax policies. Thus, reducing tax loads toward neutrality with the gas-fired competition improves proportionately the competitiveness of renewable generation.

Figure 3 shows that under tax neutrality, the current and future flash geothermal projects reach competitiveness with their gas-fired competition for both Case 1 and 2 tax loads. Figures 1B and 2B show nearly the same result for the future central receiver and the future biomass combustion plant under Case 1 tax loads. Hence, tax neutrality is a strategy which can assure pay back from RD&D and commercialization for some renewable technologies, even if it is not coupled with the recognition of such externality benefits as emissions reduction.[7]

Uniform Code Of Neutrality

The construction of the uniform code has to be a compromise between the specific treatments required to achieve absolute neutrality for each renewable technology, and the goal of identifying one uniform treatment for the four renewable technologies in their current and future forms. The performance of the uniform code devised in this study therefore varies across Figures 1 through 4.

In principle, it is possible for a renewable technology project with a tax load under 1994 codes in the neighborhood of the tax load of the matched gas-fired plant to experience an even lower tax load under the uniform code, thus overcompensating the playing field away from a fairly competitive and efficient market.

Considering the Case 1 tax loads for which it was designed, the uniform code under-compensates for neutrality in central receiver and flash geothermal projects, for future technology biomass gasification combined cycle, and for current technology binary cycle geothermal projects. It slightly over-compensates in the future technology binary cycle project, but is equal to the effectiveness of absolute neutrality in the current biomass technology project.

Current and future flash geothermal projects, and the future binary cycle become competitive in Case 1 and 2 under the uniform neutrality treatment.

CONCLUSIONS

Findings

1. In our earlier paper, we surmised that tax loads may be higher for all capital-intensive technologies competing with expense-intensive technologies in the generation market. This study confirms that hypothesis for eight renewable generation projects as evidenced by the results for the pre-preference tax code. Even the preferential tax treatment of the 1994 codes does not equalize taxes for the renewable projects, with the exception of the binary cycle plant under the Case 2 tax load.

2. The higher tax load carried by renewable projects relative to the matching gas-fired projects proportionately reduces the competitiveness of the renewable generation.

3. The largest disparity in tax loading between the renewable technologies and the gas-fired competition is carried by the solar central receiver. The other renewable technologies are more fuel-like, and some use depletable resources. We advance the supposition that similar disparities may also obtain for other pure solar-electric technologies, as well as for wind and ocean thermal projects.

4. The results demonstrate that it is possible to provide tax-neutral policies for each renewable project analyzed.

5. A uniform code of tax neutrality can be developed. One such code and its performance has been demonstrated in this study. The field of candidate uniform policies for tax neutrality is probably large, although variations in cost, performance and financing between projects of differing technologies will work against a fully equitable uniform code of neutrality.

6. RD&D in renewable generation, which is needed to help these technologies compete with advances in gas-fired generation, must have a reasonable expectation of pay-off. The results show that RD&D alone cannot erase the adverse competitive effect of current tax policies and that tax neutrality would be an effective renewable business development policy.

7. The results show that renewable generation technologies bring a fundamentally significant tax issue to the policy table which has not been addressed at a unified, strategic level.

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[7] Some features of the Figures 1 through 4 require an explanation at this point. First, the flash geothermal projects achieve negative capacity payments under neutral taxation. This means that the projects are more profitable to investors than the 16 percent target rate of return. Second, flash geothermal projects are more profitable than the other three technologies. This result is partially due to the economy of scale of these 110 MW matched pairs, a phenomenon also observed between the current and future binary cycle projects, Fig. 4.

We also surmise that similar tax neutrality issues may prevail in other markets where capital-intensive and expense-intensive technologies are competing to provide similar services. We expect to investigate this issue in the environmental technologies area.

Achieving Tax Neutrality

What are the elements of a process for moving toward tax neutrality in the electric generation market? First, it is important to recognize that local, state and federal governments are the primary stakeholders in tax revenue collection. These governments expect to receive at least the same tax revenues from renewable generation as they do from the competing fossil-fueled generation.

Second, we must look beyond the pattern of tax preferences we as a society have employed in the past to level the playing field. For example, an analysis performed for Sandia National Laboratory showed that a Luz solar plant taxed to 1990 California codes (property tax exemption for solar equipment and a 10 percent state tax credit) would produce less in discounted local and state revenue than would the matching gas-fired plant. (Nathan and Chapman, 1994)

Third, we must remember that our ultimate aim is to create an efficient energy market. In our way of thinking, that means that market share among competing generation technologies should be determined not by differences in tax loads, but by the other components that go into price and service, as well as by differences in externalities (the societal benefits and costs not reflected in market pricing).

Fourth, government has a self-interest in maximizing tax revenue from investment capital, just as it does from before-tax revenue. Government would like to see the same sales and property tax revenues from a $2000/kW, 100 megawatt biomass plant as it would receive from a $500/kW, 400 megawatt gas-fired plant, because the capital outlay in either case is $200 million.

Neither the biomass plant nor any other renewable generation plant, however, would be built in the competitive market if taxed based on capital investment. Government, in its desire to maintain maximum revenues in the short term, could easily hamstring renewable generation. In the long term, that situation would lead to externality costs which informed society seems unwilling to bear. Hence, we currently have a compromise -- some tax equalizing preferences for renewables and some development of renewable electric generation.

It is our expectation that, as the renewable energy industry and policy-makers become more informed about the role of taxation in the competitive electric generation market, they can move tax treatment at the project level toward neutrality. That would lead, not surprisingly, to a more competitive and efficient electric generation market.

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