Testimony of Stuart M. Dalton
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Mr. Chairman and Members of the Board:

I am Stuart M. Dalton and I represent EPRI, a non-profit, collaborative organization conducting electricity-related R&D in the public interest. Our members, public and private, account for more than 90 percent of the kilowatt-hours sold in the U.S., and we serve more than 1,000 energy and governmental organizations in more than 40 countries.

My testimony focuses on the role we expect renewable energy resources to play in meeting future electricity demand and in reducing CO_2 emissions in the United States and in the Tennessee Valley Authority service area. For the future, we see uncertainty in fuel costs, in the levels of required reductions in CO_2 emissions, and in how climate change issues might affect power plant cooling and performance.

In any likely scenario, electricity's role in our nation's future will grow substantially. By 2050 we expect electricity will grow from under 15 percent to about 30 percent of the total primary energy in the U.S. Why? Because our ever more digital-electronic society requires flexibility and efficiency in electro-technologies, and because electricity will support a shift from oil-based to electric transportation.

Changes in the way we generate, deliver and consume electricity have the greatest technical potential to reduce CO_2 emissions. EPRI's "PRISM" analysis has shown

electric efficiency improvements, generation from nuclear power and new low-CO_2-emitting coal generation, plug-in hybrid vehicles and deployment of renewable energy generation can significantly reduce CO_2 in 25 to 30 years.

Bringing CO_2-reducing technologies into the mix likely will increase the cost of electricity by 150 percent. Without investment in those technologies, future costs for electricity and emissions reduction could be four times higher. And we know these technologies vary in the time needed for development and the risks involved in successful deployment. The recommended strategy is to continue to search for new low- and non-emitting options while keeping all the known options available.

There are significant wind, solar, geothermal, biomass, and waterpower resources in this country. However, these are not uniformly distributed. The wind resources in the TVA area generally are not economical to capture because of low average wind speeds. Geothermal resources also are limited. Solar resources are better distributed, although Phoenix or Albuquerque measure about 1.5 times more solar radiation than Nashville, and the potential for large-scale solar deployment is 10 to 20 years away. Hydropower modernizations have led to the largest recent increase in renewable energy production in the TVA, and O&M improvements are ongoing, but large-scale hydropower is not easily expanded.

Consequently, the bulk of my remarks will be directed to biomass. This does not mean TVA should abandon evaluation of other renewable options. It simply reflects our analysis which shows biomass as the strongest near-term regional option.

The biomass picture is large, complicated, and not very clearly defined due to a variety of factors:

- A large number of users of biomass resources with possible conflicting environmental profiles for use.
- Competition for available biomass among food, liquid fuels, electric energy, soil amendments, building supply and other producers.
- Vastly different types of biomass, ranging from manure to crop waste to industrial byproducts and sustainably managed energy plantations.
- The wide variety of technologies available for converting biomass to useful energy.
- Waste management and land and water use policies.

There are multiple pathways open to TVA for converting biomass to electric power. Chemical or biological production of fuels takes two forms -- gases or liquids. Gaseous fuels result from the actions of microorganisms, which produce methane. The methane is burned in an internal-combustion engine or a combustion turbine coupled to an electric generator. The gas typically is from landfills or anaerobic digesters. This reduces greenhouse gas impact significantly. However, the size of the generators is typically a few megawatts at most, so their role in electric generation is small.

Liquid biomass fuels such as biodiesel and ethanol have been demonstrated in limited electric power production, displacing oil in boiler service and combustion turbines. Liquid fuels tend to cost significantly more than solid biomass fuels, so their direct role in electricity production -- which will compete with transportation fuel needs -- also is likely to be small.

Gasification of biomass with high temperature steam, air, or oxygen (and sometimes pressures) to produce gaseous products, including methane, carbon monoxide, carbon dioxide, and steam, and pyrolysis (partial gasification) may produce liquids. There are hundreds of gasifiers installed around the world, though most of them are very small, and larger "utility-scale versions" are still developmental. EPRI, TVA, Southern Company, and other organizations are currently involved in research into biomass gasification to reduce cost and improve performance.

Direct combustion of biomass involves burning prepared (sized) biomass in conventional boilers. When biomass is burned with another fuel, it is called co-firing. Direct combustion can be accomplished either with new, dedicated combustion systems, or by retrofitting older coal units. Direct firing can occur in either a fluid-bed boiler or a stoker boiler or, more rarely, in a pulverized fuel boiler. Worldwide, biomass power stations of these types range from a few 10s of megawatts to more than two hundred megawatts. Their size, combined with a substantial experience base, makes direct combustion a reasonable choice for utilities such as TVA seeking a larger role for renewable energy.

Among the commonly consumed biomass fuels are wood and wood waste, straw and grasses, poultry litter and municipal solid waste.

TVA has played a significant role in the domestic development of co-firing, working with EPRI, DOE, and others to test concepts at the Allen, Colbert, and Kingston Fossil Plants. Biomass co-firing often has been called the "low-hanging fruit" of the renewable energy world because only a small investment is necessary. Co-firing can introduce up to 15% of the heat content in a boiler, though 5-10% is typically the upper limit. While most co-firing technology is near-commercial, there are unresolved technical issues, including impacts on deNOx catalyst life, boiler fireside corrosion, and fly ash sales and utilization.

The carbon footprint and sustainability of all of these generation technologies is largely determined by the characteristics of the biomass resources used. The TVA region is rich in biomass resources, but the vast majority of those resources are already in use. A 2003 EPRI/TVA study found that only 2 percent of the wood byproducts were given away or landfilled. The balance — some 400,000 tons — were being sold. As another example, the poultry industry in northern Alabama and Mississippi produces a byproduct called poultry litter, which consists of bedding material, detritus, and poultry manure. The largest current use is as field amendments or supplements. However, there is growing pressure to find another outlet for the material due to runoff issues and the buildup of phosphorus in the soils and it may be an alternate energy source. And so in the not-to-distant future, burning poultry litter may solve an environmental issue and provide renewable energy to the TVA.

EPRI has looked at the overall economics of future generation options under different scenarios based on technologies, fuels, and emissions as well as related incentives and policies. As one example, if there were a national goal to meet 15 percent of electrical demand with renewable generation in 2020, some regions would provide more and others less. Trading is assumed to be allowed and the cost of electricity increases in a non-uniform way. For this case in the Southeast (SERC/TVV region, excludes Florida), with the largest electrical demand in the US, less than 9% of generation is expected from renewable resources, and this is mostly biomass (wholesale cost may increase ~ 18% by in EPRI's estimate). The same case for Texas (ERCOT region) results in 24% from renewable resources, mostly wind energy with a ~ 12% cost of electricity increase.

In 10 minutes it is not possible to cover all the details of biomass or renewable options in TVA's area. For further information we suggest NREL documents and EPRI's recent Journal article on Renewables in summer 2007.