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FINAL DRAFT REPORT ON ENERGY EFFICIENCY AND RENEWABLE ENERGY

Prepared by the Air Pollution Prevention Forum
For the Western Regional Air Partnership

"*Recommendations of the Air Pollution Prevention Forum to Increase Energy Efficiency and Conservation in the GCVTC States,*"

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Table of Contents

Executive Summary 1

1. The Forum and its Mission 11

    1.1 Renewable Energy and Energy Efficiency: Barriers and Opportunities 13

2. The Work of the Forum 17

3. Recommendations for Policy Makers 21

    3.1 Recommendations to Increase Generation from Renewable Resources 22
    3.2 Energy Efficiency Recommendations 24

4. Impacts of the Forum's Recommendations 29

    4.1 Overview of the Impact Analysis 29
    4.2 Energy Efficiency Options, Costs, and Energy Savings 29
    4.3 Impacts of Efficiency and Renewable Energy on Electricity Supply Costs and Emissions 39
    4.4 Impacts of Efficiency and Renewable Energy on Selected Economic Indicators 44

Appendices 47

Executive Summary

This report summarizes the work that the Air Pollution Prevention Forum has carried out since its inception. The report describes how the Forum has accomplished its work, the energy efficiency and renewable energy options and recommendations developed by the Forum, and the Forum's analysis of the impacts of those options on energy costs and air emissions.

Main Conclusions of the Air Pollution Prevention Forum

The Forum has come to five key conclusions about the role of energy efficiency and renewable energy in helping the Grand Canyon visibility transport region to reduce haze and improve air quality:

- Renewable generation currently provides about 6 percent of regional electricity needs. With only a very small increase in the costs of electricity supply, the region can increase this level to 10 percent by the year 2005 and 20 percent by 2015.
- Small reductions in haze-causing air emissions will result from attaining these "10/20 goals" for renewable energy. These reductions can be a helpful part of the multi-sector, multi-measure strategies the region needs to reduce haze.
- The region can pursue additional demand-side energy efficiency policies and measures over the next fifteen years. The Forum evaluated new energy efficiency sufficient to reduce electric energy requirements by eight percent in 2018, finding that it would result in decreases in the total costs of electricity supply.
- There will be small reductions in haze-causing air emissions from pursuing energy efficiency to the level evaluated by the Forum. These reductions can be a helpful part of the multiple strategies the region needs to reduce haze.
- Pursuing both the 10/20 goals and new energy efficiency can produce modest reductions in haze-causing air emissions, with an overall reduction in electricity supply costs.

There are other benefits from pursuing energy efficiency and renewable energy, which states, communities, and Native American tribes may wish to consider in evaluating energy initiatives. Among benefits identified by the Forum are: reduced emissions of harmful air pollutants and greenhouse gases; increases to the diversity of fuel supply; reductions in environmental impacts such as land and water use; and modest improvements to economic indicators like the overall levels of income and employment.

The Forum and its Work

The Western Regional Air Partnership was formed in 1997 to succeed the Grand Canyon Visibility Transport Commission (GCVTC or the Commission). There are nine states and 211 tribes within the Grand Canyon visibility transport region as defined by the U.S. Environmental Protection Agency (EPA). The Western Regional Air Partnership concerns itself with implementing the Commission's recommendations for the Grand

Canyon transport region, as well with improving visibility more broadly throughout the West. The Partnership, encompassing a larger overall area than the Grand Canyon visibility transport region, is an organization of 13 western states, many tribal nations, and federal agencies.

One of the Commission's recommendations was to increase electric generation from renewable resources so that it provides 10 percent of electricity needs in the transport region by the year 2005, and 20 percent by 2015 (the "10/20 goals"). Another recommendation was that energy efficiency should be promoted through several means. These renewable energy and energy efficiency recommendations are a core focus of the Forum's work. The Western Regional Air Partnership has charged the Forum to describe and recommend policy actions and incentives through which state and local governments and Native American tribes can increase the use of renewable energy and energy efficiency and reduce haze-causing emissions.

A basic context for the Forum's work is the Regional Haze Regulation – Final Rule promulgated by EPA in 1999, which requires each state to submit a state implementation plan (SIP) that sets goals for progress in reducing regional haze in the 156 national park and wilderness areas in the country. SIPs must include strategies to reduce haze, including either enforceable limitations on stationary sources or a market trading program to reduce emissions from them, as well as other measures. Though tribal participation in implementing the Regional Haze Rule is optional, tribes are encouraged to submit tribal implementation plans (TIPs) that may include many of the same elements as SIPs.

Section 308 of the Regional Haze Rule provides a basic compliance path for individual states. Section 309 is an optional compliance path that encourages the states and tribes in the Grand Canyon visibility transport region to work together on a regional basis in preparing their implementation plans. One requirement of Section 309 is implementation of the Commission's renewable energy and energy efficiency recommendations. The Air Pollution Prevention Forum aims to assist state and local governments and tribes to take a *regional* approach to renewable energy and energy efficiency pursuant to Section 309.

The Air Pollution Prevention Forum has conducted meetings, discussions, policy analysis, and technical research. Communication is aided by a website containing meeting agendas and presentations, documents assembled and prepared by the Forum, and e-mail and website links.[1] The Forum has produced the following five main sets of written work product:

- ***Final Draft Recommendations of the AP2 Forum to Increase the Generation of Electricity from Renewable Resources*** (December 2000). This report assesses options states can pursue to meet the 10/20 goals. The following electric power resources are considered renewable by the Forum: wind energy, solar energy (photovoltaic cells as well as solar thermal systems), geothermal, biomass, landfill gas, and low impact hydropower. Large scale conventional hydropower facilities

[1] To reach the Forum site go to www.wrapair.org and select "Committees and Forums," then the "Air Pollution Prevention Forum."

and biomass from solid waste, black liquor, or treated wood are not included in this definition.

- ***Discussion Paper on Scoping the Energy Efficiency Work of the AP2 Forum*** (2001). This paper and follow-on work included: recommendations on energy efficiency; identification of technical characteristics, market applicability, and program approaches for major energy efficiency options; and refining energy efficiency options and analyzing their achievable market penetration, costs, and impacts on electric energy consumption and peak demands.
- ***The Tribal Renewables Report*** (Draft, April 2002). This report proposes several initiatives tribes can implement to promote progress toward the regional 10/20 goals. It provides background information to assist tribes to evaluate renewable energy development in the context of their individual cultural norms and economic economic development objectives.
- ***The Tribal Efficiency Report*** (Draft, June 2002). This report identifies ways for tribes to assess and pursue energy efficiency. It discusses potential positive contributions of efficiency to tribal economic and social objectives, and proposes actions for tribes to consider.
- ***Economic Assessment of Implementing the 10/20 Renewable Energy Goals and Energy Efficiency Recommendations*** (Draft, October 2002). This report on the Forum's economic modeling work quantifies the impacts of energy efficiency and renewable energy on generating capacity, electricity production, air emissions, electricity supply costs, and regional economic indicators.

Recommendations

The Air Pollution Prevention Forum's work identifies policies that state, tribal, and local governments can consider to increase the use of renewable energy and energy efficiency. The Forum believes that the exchange of ideas among the stakeholders from throughout the region who have been part of its work program, the analysis of policy options in Forum reports, and the technical analyses conducted by the Forum can help states and tribes to adopt the energy efficiency and renewable energy goals of the Grand Canyon Visibility Transport Commission, and to file implementation plans under Section 309 of the Regional Haze Rule. The Forum hopes the resources it has developed can also be useful to tribal, state, and local governments in considering energy efficiency and renewable energy in other contexts, such as pollution prevention, reduction of greenhouse gas emissions, and managing the economic impacts and risks of providing electricity and other energy services.

Renewable energy recommendations. The Forum found that direct or indirect financial incentives for renewable energy production or consumption are likely required to meet the 10/20 goals. Initiatives to attain the 10/20 goals must address the cost disadvantage of renewable energy resources compared to conventional generation based on fossil fuel. There are also non-price market barriers which affect the market penetration of renewable resources, such as the technical and financial terms for connecting and integrating renewable resources to the electric grid, and a cost of investment capital that is somewhat higher than is the case for conventional generating facilities.

The two most powerful incentive mechanisms to promote renewable energy are the renewable resource portfolio standard and the systems benefit charge (also called societal benefits change or public benefits charge). A resource portfolio standard approach defines the minimum portion of electricity sold into a given jurisdiction that must be provided by defined renewable resources. A systems benefit charge approach levies a charge on electricity consumers and uses the monies collected to support public benefits such as renewable energy. **The Forum recommends that states adopt a renewable portfolio standard, a systems benefit charge for renewable energy resources, or both.**

If the renewable portfolio standard is chosen as the core financial incentive approach, the Forum recommends that levels of 10 percent in 2005 and 20 percent in 2015 be chosen. If a systems benefit charge is chosen, it should be funded and designed to facilitate increases in renewable energy sufficient to attain the 10/20 goals

The Forum also identified other policy options to support development of markets for renewable energy. The Forum recommends that states consider the following supplemental initiatives:

- Facilitate programs allowing consumers to buy renewable or "green" power by establishing consumer protection guidelines, power disclosure rules, a regional generation tracking system, and consumer education programs.
- Establish state government renewable energy purchasing requirements.
- Adopt the regional SO_2 emissions/market trading program that has been developed by the Western Regional Air Partnership.
- Eliminate barriers to moving renewable generation through the transmission/distribution system.
- Improve the permitting process for renewable generating facilities.
- Adopt state tax incentives for renewable energy projects.

The Forum also recommends that states support complementary efforts by the federal government, including a national renewable resource portfolio standard with tradable permits; development of tax credits for renewable energy resources, including an extension of the federal production tax credit for wind and biomass through 2015;[2] and a mandatory federal agency renewable energy purchase requirement of 10 percent by 2005 and 20 percent by 2015.

The Forum recommends that tribes consider developing Tribal Implementation Plans under the Regional Haze Rule, committing to expanded use of renewable energy. The Report recommends that tribes consider additional initiatives, including:

- Develop a tribal energy policy that includes renewable energy measures.

[2] The production tax credit is periodically adjusted for inflation and stood at $0.018/kWh in 2002.

- Establish an energy authority to assume responsibility for tribal energy strategy.
- Create education programs to help consumers understand options relating to renewable energy.
- Expedite the permitting for renewable energy projects within tribal jurisdiction.
- Establish an economic development corporation to develop renewable resources.
- Require federal facilities located on reservation lands to purchase some electricity from renewable sources.
- Promote broad federal policies and appropriations that can assist and stimulate renewable energy development on tribal lands.
- Use inter-tribal collaboration where that will help develop the resources needed for effective action.

Energy efficiency recommendations. Section 309 implementation plans are to include programs to preserve and expand energy efficiency efforts. In its 1996 report, the Commission recommended appliance and building efficiency standards, as well as efficiency approaches and programs funded by distribution utility ratepayers.

The Forum identified a number of market barriers that limit the level of market adoption of efficiency measures or practices. Many households and businesses do not yet understand the effectiveness of energy efficiency measures in reducing energy use, apply rather quick payback requirements in evaluating potential investments in efficiency, or emphasize lowest first cost in purchasing equipment or constructing buildings. The persistence of these market barriers is one reason why several states, tribes, and communities in the transport region are already pursuing policies that promote energy efficiency in order to reduce total the costs of energy services. There is also increasing interest in the air quality community in considering energy efficiency as a pollution prevention measure.

In general, the most powerful policy mechanisms to promote additional efficiency are demand-side energy efficiency programs funded by electricity consumers (ratepayers), and mandated efficiency standards for equipment and buildings. **The Forum recommends that states and tribes consider maintaining ratepayer-funded energy efficiency where it is substantial, and establishing or increasing it elsewhere.** Consideration should be given to funding levels that it is estimated will facilitate substantial amounts of energy conservation that would not otherwise occur.

The Forum also urges states and tribes to consider supporting the development of national building efficiency standards. While there is a national program of efficiency standards for appliances and equipment, there is no national program of mandatory building standards. States, tribes, and communities should adopt or enhance energy efficiency building standards within their jurisdictions. States can also consider development of equipment efficiency standards.[3] Beyond the basic policies of efficiency

[3] States can apply to the Department of Energy for waivers permitting them to adopt higher standards for equipment that is federally regulated. They are also free to develop standards for any equipment not subject to federal efficiency standards.

standards and ratepayer-supported energy efficiency, the Forum offers supplemental recommendations. The Forum's additional recommendations to states are:

- Develop a public buildings efficiency plan, including efficiency standards for state and municipal new construction, a continued or enhanced public building retrofit program, life-cycle cost procurement standards for energy-using equipment, and training of building operation and maintenance staff.
- Enlist water and waste utilities to develop combined water/energy conservation programs.
- Consider tax incentive programs to promote investment in energy efficiency measures by consumers and businesses. Tax credits can complement or substitute for ratepayer-funded energy efficiency.
- Promote better energy price signals by considering greater use of real-time, time of use, inclined block, and other pricing approaches that may more effectively communicate the cost of electricity (and natural gas) supply to consumers.

Recommendations to tribes are described in the Forum's *Tribal Efficiency Report.* The Report evaluates potential initiatives that tribes can consider to meet tribal objectives as well as support the Commission's recommendations on efficiency. The Report identifies ways for tribes to assess and pursue energy efficiency that fit in with their varying tribal goals and needs. The Report recommends possible initiatives for tribes to consider, including:

- Develop a tribal energy plan that includes energy efficiency goals.
- Establish an energy authority which can implement efficiency programs and be an advocate for tribal energy consumers.
- Hire an energy manager to direct energy programs, including energy efficiency.
- Adopt energy efficient building codes and integrate efficiency into housing projects.
- Create education programs to help consumers understand efficiency options.
- Support broad national, state, and utility policies and programs that can help promote energy efficiency on tribal lands.
- Consider intertribal collaboration to help develop the resources needed for action.

Impact Analysis

The Forum conducted a program of technical and quantitative analysis to identify the direct economic costs and benefits of energy efficiency and renewable energy initiatives, as well as the indirect effects of these initiatives on the economies of the states in the transport region. To characterize the main renewable energy recommendations, the impact analysis modeled achievement of the 10/20 goals for the transport region.

Unlike the area of renewable energy, the Commission did not propose quantitative goals for energy efficiency. The Forum therefore developed a method to quantify the impacts if

states and tribes in the region pursue its energy efficiency policy recommendations to a substantial, though not necessarily aggressive, degree.

Impacts of energy efficiency. The Forum developed an illustrative suite of options for additional energy efficiency in the region that is (a) reasonably achievable and (b) likely to be cost-effective. "Cost-effective" means that the reduction in the total costs of electricity due to energy efficiency is greater than the total resource costs of energy efficiency. These options consist of energy efficiency technologies and practices in buildings and facilities in the residential, commercial, institutional, and industrial sectors. To evaluate these options, the Forum assumed programs funded through systems benefit charges and, for a few options, enhanced appliance efficiency standards. Of course, the Forum's supplemental efficiency recommendations would provide additional policy levers to promote the efficiency options that were analyzed.

It is important to note that the Forum did not set out to identify the optimal amount of energy efficiency. The amount of energy efficiency being pursued in California and Oregon is already above the levels in the Forum's analysis, while the amount being pursued in the rest of the region is currently below those levels. States, local governments, or tribes may have very good reasons to pursue energy efficiency to a greater degree than modeled in the Forum's illustrative energy efficiency package. Energy efficiency options were analyzed for three sub-regions within the larger Grand Canyon air transport region:

- The interior West -- New Mexico, Arizona, Nevada (less the Las Vegas region), Colorado, Utah, eastern Idaho, and Wyoming.
- Oregon plus western Idaho.
- California plus the Las Vegas region of Nevada.

In the interior West and Oregon/western Idaho regions, the analysis was based on a bottom-up assessment of a wide range of efficiency measures. In the California/Las Vegas region, the analysis adapted a national study to that region. Most options were modeled as demand-side management type programs, so the analysis added the costs of administration and marketing to the incremental costs of the measures themselves. Some measures were modeled as equipment efficiency standards.

Implementation of the final package of energy efficiency options was modeled through the year 2018.[4] Together, the three regional energy efficiency packages save some 54,000 gigaWatt-hours (GWh) of electricity annually by 2018, a reduction of eight percent in average demand in that year. The electricity supply costs avoided through energy efficiency were found to substantially exceed the costs of energy efficiency that are depicted in the figure. By the final year of energy efficiency implementation, 2018, avoided cost savings are twice the costs of energy efficiency, and the resulting net benefit

[4] While energy efficiency programs were assumed implemented through 2018, the benefits from measures installed during that time period were calculated for several years beyond 2018.

to the region is $2.1 billion (2001$). Energy efficiency reduces levelized annual electricity production costs for the region by about $1,083 million through the year 2022.

By 2018, the energy efficiency package reduces NO_x emissions by about 10,000 short tons and CO_2 emissions by 44 million metric tonnes. These impacts represent about one percent of NO_x emissions and about 11 percent of CO_2 emissions from electricity generation without the energy efficiency. There are also very small reductions in the emission of particulate matter.

The package of options developed for the impact analysis does not exhaust the potential for demand-side efficiency initiatives. The Forum urges states and tribes to: consider building code enhancements, which save gas as well as electricity; encourage on-site combined heat and power systems, which increase overall energy efficiency where environmentally appropriate; and consider efficiency options that are higher in cost but may help to reduce electricity demand during high-cost peak usage periods.

Renewable Energy. The modeling of the impacts of the Forum's renewable energy recommendations found that if the 10/20 goals are implemented, the total amount of incremental new renewable energy capacity in the west by 2018 would be over 21 gigaWatts (GW), and the incremental generation from renewable energy relative to the reference case would be 92,000 GWh. According to the Forum's analysis, additional electricity production costs will be incurred for the transport region to meet the 10/20 goals: a $282 million increase in levelized annual electricity production costs through 2022, representing an increase of about two percent. This result assumes that wind power costs will be somewhat reduced due to improvements in technology and performance as a result of greater utilization.

By the year 2018, achievement of the 10/20 goals reduces NO_x emissions by about 8,000 tons and CO_2 emissions by 39 million metric tonnes. These impacts represent about one percent of NO_x emissions and about 10 percent of CO_2 emissions without the additional renewable energy generation due to the 10/20 goals. There are also very small reductions in the emission of particulate matter.

Energy efficiency and renewable energy. When both the 10/20 goals and the energy efficiency recommendations are implemented, air emissions are reduced more than with energy efficiency or renewable energy alone. With energy efficiency and renewable energy, NO_x emissions are reduced by about 14,000 tons in 2018, and CO_2 emissions by some 56 million metric tonnes. These impacts represent about two percent of NO_x emissions and about 14 percent of CO_2 emissions without energy efficiency and renewable energy. The reduction in the emission of particulate matter, though quite small, is also greater than with either energy efficiency or renewable energy alone. The table below summarizes key impacts of energy efficiency and renewable energy in 2018.

When energy efficiency and renewable energy are both implemented, there are direct economic benefits to the region in the form of reduced electric supply costs. There is a small net cost in 2005, but thereafter there are net savings. The net avoided cost savings

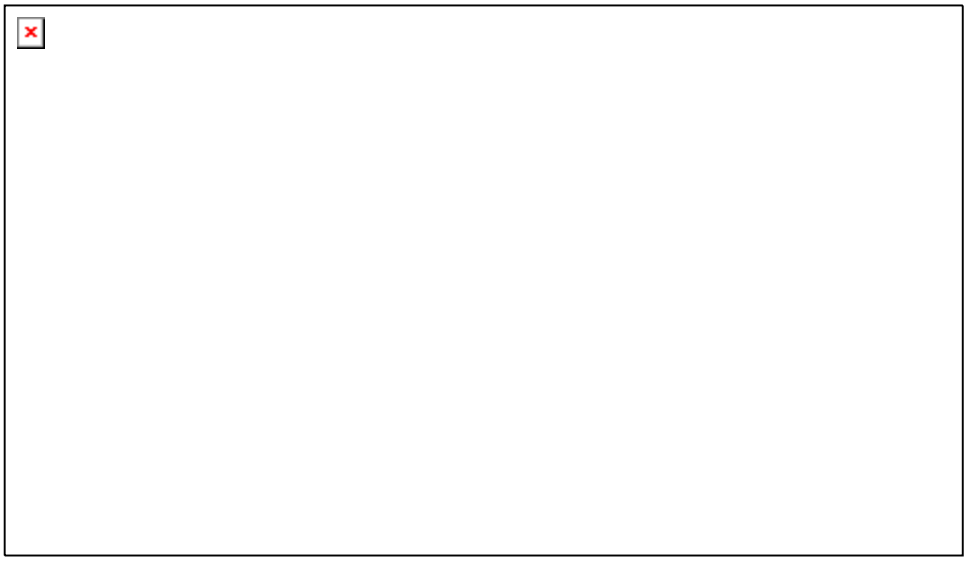
grows to some $1.8 billion in 2018, as shown in the figure below. Levelized annual electricity production costs through 2022 are reduced by about $751 million.

Though energy efficiency and renewable energy reduce conventional electric generation requirements they do not necessarily yield SO_2 reductions, since the regional SO_2 cap and trading program was assumed to be in effect in the reference case for the modeling analysis of energy efficiency and renewable energy. In this context, increasing the use of energy efficiency and renewable energy reduces the costs of complying with the SO_2 milestones in the Annex to the Regional Haze Rule developed by the Western Regional Air Partnership.

Physical Impacts of Energy Efficiency and Renewable Energy Recommendations Projected in Year 2018

Regional Impact	Amount of Impact	% Change	Comment
Total annual electricity consumption in the transport region	-56,000 GWH	-8	Reductions to seasonal peak demand are greater
Consumption of electricity from renewable resources	+82,000 GWH	+283	14% more of total electricity consumption is from renewables
Cost of electricity services	-$1.8 billion	-9	See note*
Emissions of NO_x	-14,000 tons	-2	Short tons
Emissions of CO_2	-56 million tonnes	-14	Metric tonnes

Cost* Impacts -- Energy Efficiency and Renewable Energy



Implications of Regional Impacts for States and Tribes

The Forum believes its modeling of the impacts of implementing its energy efficiency and renewable energy recommendations can help to inform deliberations in states and tribes about how to most effectively use energy efficiency and renewable energy in meeting the provisions of Section 309 of the Regional Haze Rule as well as broader energy and environmental policies. The modeling results are, of course, subject to uncertainties regarding future economic, technological, and policy variables.

Implications for Regional Economic Indicators

The Forum evaluated the impact of the 10/20 goals and its energy efficiency package on some indicators of overall economic activity in the transport region. This analysis was conducted using an input-output model developed by Regional Models, Inc. (REMI). At the levels modeled by the Forum, the impacts of energy efficiency and renewable energy on regional economic indicators were slight but positive. On average between 2005 and 2020, implementation of the 10/20 goals would add some 627,000 jobs per year and some $73 million per year to total personal disposable income. Implementation of the energy efficiency recommendations with the 10/20 goals would add 8.4 million jobs per year on average during this period, and increase personal disposable income by about $776 million per year. Given the large size of the region's economy these are small impacts, all under one-half of one percent, but they are positive effects.

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*Cost of electricity services comprised of: capital and operating cost of electricity production, transmission, and distribution; plus consumer investment in energy efficiency; plus industrial steam costs.

1. The Forum and its Mission

The 1990 amendments to the U.S. Clean Air Act authorized establishment of a Grand Canyon Visibility Transport Commission (GCVTC or the Commission). The commission's focus was on the multi-state region affecting visibility in the Grand Canyon National Park. Specifically, the Commission focused on preserving clear days and improving visibility in the sixteen national parks and wilderness areas ("Class I areas") on the Colorado Plateau. There are nine states and 211 tribes within the Grand Canyon transport region defined by the U.S. Environmental Protection Agency (EPA). The Commission was comprised of regional governors, tribal representatives, and federal agencies. During 1991-1996 the Commission conducted a wide-ranging program of environmental and economic data gathering and analysis. In its report to the EPA in 1996, the Commission presented findings and recommendations addressing the problem of regional haze. The Commission also recommended the creation of a western regional organization to carry on its business in future years.

The Western Regional Air Partnership was formed in 1997 as the successor to the Commission. The Western Regional Air Partnership is a voluntary organization of 13 western states, numerous tribal nations, and federal agencies.[5] The Western Regional Air Partnership focuses both on implementing GCVTC recommendations and, more broadly, on improving visibility in all Class I areas throughout the west. The Air Pollution Prevention Forum is one of the several forums and committees through which the Western Regional Air Partnership conducts its work.

A Regional Haze Rule promulgated by the EPA requires states to undertake several steps in order to reduce haze in 156 national parks and wilderness areas across the country. Haze results when pollutants emitted into the atmosphere reduce visibility. Increased energy efficiency and increased use of renewable energy resources are recognized means of reducing haze-causing pollutants.

The Air Pollution Prevention Forum (The Forum) was established to help states and tribes to develop initiatives in the areas of renewable energy and energy efficiency. The Forum is comprised of representatives of environmental, federal, industrial, public, small business, state and local governmental, and tribal interests.[6] The Forum intends its work to be helpful to states as they prepare implementation plans to submit to the EPA pursuant to the Regional Haze Rule. Tribes may prepare implementation plans pursuant to the Regional Haze Rule, but are not required to do so. The Forum intends its work to be helpful to tribes which elect to prepare implementation plans and/or implement programs to reduce haze.

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[5] The Western Regional Air Partnership is jointly administered by the Western Governors' Association and the National Tribal Environmental Council.

[6] Administration of Forum operations is provided by the Western Interstate Energy Board, an organization of western U.S. states and three Canadian provinces that is hosted by the Western Governors' Association.

In 1980 the EPA had established its first haze regulations under the Clean Air Act, which included requirements for preparation of state implementation plans (SIPs). In 1999, the EPA promulgated its Regional Haze Regulation – Final Rule, which amends those SIP requirements (40 CFR Part 51). Pursuant to the new Section 51.308, each state must prepare and submit a SIP that sets goals for progress in reducing regional haze in 156 Class I areas in the country. Since all states generate emissions that may degrade visibility in one or more of these areas, all are required to submit SIPs. The SIPs must include long-term strategies to reduce haze, including either enforceable emissions limitations on, or an emissions trading program to reduce emissions from, stationary sources, as well as other measures.

The new Section 309 of the Regional Haze Rule specifically encourages the states and tribes in the Grand Canyon transport region to work together on a regional basis in preparing their implementation plans. This section is available to states in the region that elect to implement the recommendations of the Commission. Section 309 SIPs are due by December 31, 2003.[7] Tribes have the option of submitting Tribal Implementation Plans (TIPs). A TIP can address Section 309 measures which a tribe wishes to implement, and is not subject to the time deadline for SIPs.

Section 309 implementation plans must address emissions from mobile sources, fire, dust, and stationary sources. Reduction of sulfur dioxide (SO_2) emissions from stationary sources is addressed in an Annex to the Commission report that was prepared by the Western Regional Air Partnership. The Annex establishes SO_2 emissions reduction milestones for the nine-state region, a voluntary emissions reduction program, and a regional SO_2 market trading (cap and trade) program to be implemented if progress toward the regional milestones falls short. The cap and trade program was developed by the Western Regional Air Partnership's Market Trading Forum and its Initiatives Oversight Committee.

In addition to SO_2, other air emissions contribute to regional haze: nitrogen oxides (NO_x), suspended particulate matter, volatile organic compounds, ammonia, and soot. Renewable energy and energy efficiency can help reduce several of these emissions.

One of the Commission's recommendations regarding air pollution was to promote renewable energy resources. Specifically, the commission recommended that states and tribes in the transport region should aim to increase power generation from renewable resources so that renewable generation provides 10 percent of regional power needs by the year 2005, and 20 percent by 2015 (the 10/20 goals). This report uses the term "renewable energy" as shorthand for electricity generation from renewable resources.

[7] Any state in the Grand Canyon transport region that does not avail itself of Section 309 must submit SIPs pursuant to Section 308. Section 308 SIPS will likely not be due to EPA until 2004-2008 (i.e., one to three years after the EPA establishes a state's air quality attainment status relative to emissions of particulate matter less than 2.5 microns in diameter).

Another Commission recommendation on air pollution was that energy conservation should be promoted through a variety of means. The commission did not provide any quantitative target for energy conservation levels in the transport region.

It is these renewable energy and energy conservation recommendations made by the GCVTC that are a core focus of the work of the Air Pollution Prevention Forum. The *Western Regional Partnership Work Plan Update* of October 31, 2001, states that "the WRAP has charged the AP2 Forum to identify and recommend legislative actions, economic incentives and regulatory policies that states and tribes can adopt to increase use of renewable energy and energy efficiency[8] and reduce haze causing emissions in the region."

Initiatives to increase energy efficiency and renewable energy levels have both benefits and costs. Section 309 of the Regional Haze Rule recognizes that the incremental costs of implementing the 10/20 goals and increasing energy conservation need to be identified. It also recognizes the need to identify the range of benefits from increased use of energy efficiency and renewable energy. In addition to the reduction of haze-causing emissions, energy efficiency and renewable energy reduce other air emissions from fossil-fueled power generation, such as carbon dioxide (CO_2), the main "greenhouse gas" contributing to global warming. In the case of energy efficiency, there is the further benefit of reducing the amount of energy required by buildings, facilities, and industry, thereby reducing their energy costs. The Forum has undertaken to identify both the direct economic costs and benefits of energy efficiency and renewable energy, and the indirect impacts of energy efficiency and renewable energy initiatives on the economies of the states in the region.

1.1 Renewable Energy and Energy Efficiency: Barriers and Opportunities

Renewable energy. In 1998, renewable resources provided six percent of all electric generation in the nine-state Grand Canyon transport region. There was 6200 MW of renewable energy generating capacity in the region, 88 percent of it in California.[9] Though the real price of power from most renewable energy technologies is falling, none has yet become the least-cost technology versus the cheapest conventional non-renewable resources for which renewable energy might substitute.[10]

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[8] This final report on the work of the Forum uses the term energy efficiency in the same sense as the GCVTC's "energy conservation.".

[9] See data in the *Final Draft Recommendations of the AP2 Forum to Increase the Generation of Electricity from Renewable Resources*. Renewable energy figures do not include generation from conventional hydro-electric facilities.

[10] For example, in the impact analysis carried out for the Forum (and described in section 4 below), the levelized production cost for wind was assumed to start at about $40/MWh (2001 $), while the levelized production from new conventional generation (approximated by an oil/gas steam unit repowered to combined cycle) was assumed to be $35/MWh. These figures include the fuel savings from wind; the up-front capital cost of wind power is much higher than that of conventional generation assets.

In addition to the price premium that is still required by renewable energy resources, there is evidence of non-price market barriers which have added to the difficulty of building and operating renewable energy on a market basis without special policy support. For instance, investors have vast amounts of cumulative experience with conventional fossil generating plants, and by comparison renewable energy technologies are relatively new. Investors will attach greater risk to the new, and the experience in the renewable industry to date has often been that the availability of capital is less and its cost more.

There are also a number of issues concerning the availability of transmission and the terms of its availability that affect the market penetration of grid-connected renewable energy. Transmission pricing is only partially evolving toward approaches that are more accommodating of intermittent resources like wind power. The non-discriminatory interconnection of renewable energy resources to the electric grid has been perceived as a problem by the renewable industry and by experts on renewable energy.

Thus most additions of renewable energy capacity to date have benefited from policy support or one or another sort, as detailed in *Final Draft Recommendations of the AP2 Forum to Increase the Generation of Electricity from Renewable Resources*. The Forum set out to evaluate and develop recommendations to address the price and non-price barriers to renewable energy. By supporting the substantially increased market penetration level of the 10/20 goals, implementation of such recommendations may lead to market transformation and a sustainable reduction in market barriers to renewable energy.

Energy efficiency. Energy efficiency refers to productivity in the use of energy. Since energy efficiency resources can substitute for energy supply at the point of end-use consumption by increasing the productivity of energy use, they encompass a wide range of technologies -- many kinds of efficient appliances and equipment, building shell and systems measures, and energy management controls and practices. Energy efficiency can increase due to market trends or technological change. However a number of non-price market barriers hold down the level of market adoption of efficiency measures or practices. It has often been found that both households and businesses use shorter payback requirements in evaluating energy efficiency investments than they do in evaluating other financial or business investments. Most energy users require that energy efficiency investments be paid back through efficiency savings within one to three years. Such payback requirements equate to annual rate of return requirements (discount rate) of 30 percent and up. Factors contributing to the observed payback gaps may include:

- Consumers lack information about technology characteristics, the impacts of their behavior on energy bills, and the non-energy benefits of energy efficiency.
- Consumers emphasize low first-cost, especially, but not only, where incentives are "split" (builders and designers vs. buyers or tenants in new construction, landlords vs. tenants in existing buildings).

- Low-income consumers may have extremely high discount rates and not have the educations to calculate the benefits of efficiency improvements.
- Businesses ration capital, giving projects that reduce operating costs lower priority than projects which meet production/sales requirements directly. Indeed, many firms don't employ formal rules of investing.

Some states and localities in the region have been addressing the market barriers to energy efficiency through policy intervention for decades. These jurisdictions have continued to evolve their energy efficiency initiatives as technologies and markets change and as consumer awareness evolves. Other jurisdictions have undertaken energy efficiency initiatives more sparingly or sporadically. Based on its work, the Forum found that the rate of market penetration and the ultimate market saturation of energy efficiency technologies continue to be affected by market barriers to consumer investment in the lowest life-cycle options. The Forum evaluated and developed energy efficiency recommendations to assist states, tribes, and localities to craft initiatives to address market barriers and produce new and additional demand-side savings, after taking into account the effects of past electric demand side management as well as existing market trends and policies.

2. The Work of the Forum

During 2000 – 2002 the Air Pollution Prevention Forum has conducted meetings and discussions, assembled data and documents bearing on energy efficiency and renewable energy in the region, and conducted original policy analysis and technical research. Some of the meetings have served as workshops where national energy experts have worked with Forum members to develop information, analysis, and policy directions on energy efficiency and renewable energy. Communication among Forum members and friends is aided by a website (part of the Western Regional Air Partnership site, www.wrapair.org) which contains e-mail and website links, meeting agendas and presentations, and documents assembled and prepared by the Forum.[11] The work of the Forum is supported by substantial amounts of time contributed by its members, contributions of time from outside experts, and external grants.

Subgroups were organized as needed to assist the Forum in various aspects of its work. The Tribal Interests Working Group assisted in the assessment of drafts of tribal reports on renewable energy and energy efficiency. The Quantitative Working Group reviewed the research design and the execution of quantitative analyses prepared for the Forum. Energy Efficiency and Renewable Resources subgroups worked on developing information and policy analysis in the energy efficiency and renewable energy areas, respectively.

Major original documents prepared by the Forum are:

- *Final Draft Recommendations of the Air Pollution Prevention Forum to Increase the Generation of Electricity from Renewable Resources.*
- *Discussion Paper on Scoping the Energy Efficiency Work of the Air Pollution Prevention Forum* and follow-on documents.
- *Recommendations of the Air Pollution Prevention Forum to Increase the Generation of Electricity from Renewable Resources on Native American Lands* (the "Tribal Renewables Report").
- *Recommendations of the Air Pollution Prevention Forum to Increase the Use of Energy Efficiency on Native American Lands* (the "Tribal Efficiency Report").
- *Economic Assessment of Implementing the 10/20 Renewable Energy Goals and Energy Efficiency Recommendations.*

Each of these documents serves as an appendix to the present report. These documents and the Forum's other work products and records can be found at the Forum website. In this section of the present report we summarize the scope and contents of the documents and the work process behind them. While two of the reports specifically address recommendations to tribes, it is hoped that tribes may find information in the

[11] To reach the Forum site go to www.wrapair.org and select "Committees and Forums," then the Air Pollution Prevention Forum.

other reports to be useful. States and localities may also find ideas in the tribal reports to be of value to them.

Final Draft Recommendations of the AP2 Forum to Increase the Generation of Electricity from Renewable Resources, December, 2000. The Forum assessed options that states can pursue in order to meet the 10/20 goals for renewable generation in the GCVTC region. The report was drafted by the staff of the Western Interstate Energy Board, with extensive contributions from Forum members. The report compared the recent level of renewable generation in the region --some 5.6 percent in 1999-- with the goal that renewable generation provide 10 percent of regional power needs in 2005, and 20 percent by 2015. The report identified and evaluated a range of policy options and described the experience with them in and out of the transport region. Recommendations that state policy makers and can pursue were identified and linked to the provisions of Regional Haze Rule Section 51.309. While most recommendations involve direct action by states or communities, some address the role of federal government. Forum members intensively discussed and refined the draft recommendations and solicited comments from outside experts before finalizing the recommendations. The final draft recommendations on renewable generation are described below in Section 3 of this report.

Discussion Paper on Scoping the Energy Efficiency Work of the AP2 Forum. Completed early in 2001 by Western Interstate Energy Board staff with input from Forum members, the discussion paper addressed the barriers to market penetration of energy efficiency, and options that can address those barriers. The scoping paper encompassed both the Grand Canyon transport region and the broader Western Regional Air Partnership region. The paper described regional demographic and economic trends and their relation to energy consumption, profiled existing state and federal/state programs relating to energy efficiency, and offered a preliminary and general range of options to promote efficiency. The scoping paper and the Forum's discussion of it constituted beginning steps in the process of developing efficiency options and recommendations. Follow-on work to develop final draft recommendations on energy efficiency included the following major elements.

- Development of recommendations on a variety of energy efficiency initiatives for consideration by states and tribes, as described in Section 3 below.

- Identification of best practices for energy efficiency. With the help of several enlisted outside experts, Forum members developed a series of short write-ups of best practices. The write-ups summarized the technical characteristics, market applicability, and possible programmatic initiatives for each energy efficiency practice. The write-ups helped to inform the Forum's prioritizing of energy efficiency options.

- Prioritizing energy efficiency options. At its meeting in March 2001 the Forum considered a wide set of potential efficiency options. Options that could address objectives other than the Commission's energy conservation goals were discussed – for example, options that could help states deal with short-term capacity shortages in the West. Options were prioritized according to several criteria, including their potential for assisting states in meeting the Commission's energy conservation goals. The results of this initial ranking exercise are available at the Forum website. The initial prioritization was passed to Tellus Institute, which served as consultant to the Forum on energy efficiency. Tellus reconfigured the options that address mid to long term energy efficiency objectives relating to the Commission goals. The focus was on options that reduce to reduce electricity requirements from the power grid.

- Refining energy efficiency options. In the Fall of 2001 Tellus' reconfigured efficiency options were circulated among Forum members, and accepted by them for purposes of modeling the economic impacts of energy efficiency. Tellus analyzed the achievable market penetration, costs, and impacts of the options upon electric energy consumption and peak demands in the Grand Canyon visibility transport region, using its ECO^{TM} model. ICF Consulting, as consultants to the Western Regional Air Partnership for electric system modeling, incorporated the load impacts and cost vectors from the Tellus analysis into the IPM^{TM} model, and calculated the resource benefits from energy efficiency under a variety of scenarios. In January 2002, the Forum reviewed the initial results of the Tellus and ICF work, and refined the set of options so that it would consist of energy efficiency measures likely to prove cost-effective compared to electricity supply costs. The direct and indirect economic impacts of the refined set of energy efficiency options were then estimated, as described further in Section 4 of this report.

Tribal Renewables Report, Draft, April, 2002. The Forum evaluated initiatives that tribes could implement in order to promote progress toward the regional 10/20 goals. This project was conducted by researchers at Northern Arizona University with input from Forum members. The report describes the policy and regulatory context relating to tribal action on renewable energy. Tribes may prepare implementation plans pursuant to Section 309 (or, alternatively, Section 308), but are not required to do so. The report reviews the potential for and current status of renewable energy development on tribal lands. Designed to serve as a reference for tribal energy planners, the report provides substantial background information on renewable energy systems and resources. It recommends that tribes develop energy policies, explore ways to promote additional renewable resources, and develop energy education programs for energy consumers and for schools. The report has numerous additional recommendations for action by tribes within their lands, as well as recommendations for tribal energy initiatives involving other parties and governments.

Tribal Efficiency Report, Draft, June 2002. The tribal efficiency project evaluates potential energy efficiency initiatives that tribes can consider as ways of meeting tribal objectives as well as supporting the Commission's energy conservation recommendations. This project was conducted by Northern Arizona University researchers with input from Forum members. The report describes selected tribal energy conservation activities including the results of energy efficiency site visits. It also evaluates the applicability of efficiency options modeled by the Forum (see the next document description). Like the *Tribal Renewables Report*, the *Tribal Efficiency Report* also describes the regulatory context whereby tribes may, but need not, apply to participate in implementation of the Regional Haze Rule. The report recommends ways for tribes to assess and pursue energy efficiency. The economic benefits of efficiency can further tribal energy, economic, and social goals. Like the *Tribal Renewables Report*, this document was written with recommendations intended for tribal leaders, and includes substantial background information as a resource for tribal energy managers.

Economic Assessment of Implementing the 10/20 Renewable Energy Goals and Energy Efficiency Recommendations, Draft, October 2002. The Forum modeled the energy, economic, and emissions impacts of achieving the GCVTC 10/20 goals, as well as the impacts of a suite of energy efficiency options developed by the Forum. This analytical work was conducted by ICF Consulting, with support in the area of energy efficiency provided by Tellus Institute as subconsultant to ICF. Tellus used its ECO model to develop the impacts on electricity requirements of the suite of energy efficiency options. Using the IPM capacity expansion and production costing model, ICF evaluated the direct impacts of the energy efficiency and renewable energy options, both separately and together, under a variety of scenarios. A REMI model was used to develop the indirect economic impacts of the energy efficiency and renewable energy recommendations on states in the region (impacts on state income and employment levels, for example). The results of this analysis are detailed in Section 4 of this report.

3. Recommendations for Policy Makers

The Air Pollution Prevention Forum's work has aimed to identify policies that states, communities, and Native American tribes can adopt to increase the use of renewable energy and energy efficiency. The evaluation of policies recommended by the Forum is a matter for each jurisdiction to consider. The Forum hopes that the exchange of ideas among the variety of stakeholders from throughout the region who have been part of its work program, the identification and analysis of policy options in Forum reports, and the technical analyses of the energy, economic, and environmental impacts of policy options that has been conducted by consultants to the Forum, can help make it feasible for states and tribes to adopt the renewable energy and energy conservation goals of the Grand Canyon Visibility Transport Commission, and thus to file Implementation Plans under Section 51.309 of the Regional Haze Rule. If the Forum has succeeded, the body of information it has developed can help states and tribes to decide what mix of specific actions to include as part of their plans. The Forum hopes that this information is also useful to states, tribes, and local communities in considering energy efficiency and renewable energy resources in other contexts.[12]

While the Forum has focused on energy efficiency and renewable energy options, its recommendations in those areas are best understood in the context of the Western Regional Air Partnership's development of an SO_2 emissions reduction program, including a backstop market trading program. The Western Regional Air Partnership's Market Trading Forum drafted an emissions reduction program for the Grand Canyon transport region. SO_2 emissions are important contributors to haze formation. States and tribes that wish to pursue haze reduction strategies by participating in Section 309 of the Regional Haze Rule must develop milestones for SO_2 emissions. They also must develop a regional market trading ("cap and trade") program and agree to implement it if the milestones cannot be attained otherwise. The Market Trading Forum developed the Annex to the GCVTC Report that the Western Regional Air Partnership submitted to the EPA in September, 2000. In May 2002, the EPA proposed to approve the Annex and issued proposed modifications to 40 CFR 51.309 to incorporate its SO_2 milestones, which decline from 720,000 tons in 2003 to 510,000 tons in 2018. The Annex includes the structure for a regional SO_2 market trading program to be implemented if progress toward these regional milestones falls short.

Increased use of renewable generation resources are one means of achieving SO_2 emissions reductions, so an SO_2 emissions program is likely to result in increased use of renewable energy. The Air Pollution Prevention Forum recommended to the EPA that the market trading program in the final Annex should include emission allowances for

[12] To give one example, States which adopt new renewable energy or energy efficiency programs may find that these measures are helpful not only in complying with the Regional Haze Rule, but also with basic National Ambient Air Quality Standards. States should explore the role of measures which may also be used to help meet necessary reductions in air quality limited areas, and thus be included in their generals SIPs.

renewable energy generation issued at the rate of 2.5 tons per MW of capacity. Renewable energy recommendations developed by the Forum do not otherwise detail an SO_2 emissions program since participation in such a program is already required of states and tribes electing to participation in Section 309 of the Regional Haze Rule. The degree to which the Forum's renewable energy recommendations can help the region attain its SO_2 emissions milestones was explored in the economic modeling described in Section 4 of this report. Similarly, an SO_2 emissions program may also result in increased use of energy efficiency resources and again, the Forum's energy efficiency recommendations focus on other policies, which synergize with an SO_2 emissions program.

3.1 Recommendations to Increase Generation from Renewable Resources

A substantial increase in power generation from renewable resources is required for the Grand Canyon visibility transport region to attain the 10/20 goals. Renewable resources are more costly than conventional generation based on fossil fuel. Wind power is the most abundant renewable resource in and near the transport region. The cost gap between wind power and the most commonly chosen conventional generation --natural gas fired power plants-- is declining, but it persists in the future under scenarios examined in the Forum's economic analysis and modeling work. Initiatives to attain the 10/20 goals must therefore address the cost disadvantage of renewable energy. There is also evidence of market barriers to development of renewable energy, above and beyond the cost gap.

The Forum found that direct or indirect financial incentives for renewable energy production or consumption are likely required to meet the 10/20 goals. The two most powerful incentive mechanisms are the renewable resource portfolio standard, and the systems benefit charge.

A renewable portfolio standard approach defines the minimum portion of electricity sold into a given jurisdiction that must be provided by defined renewable resources. The electricity retailer may invest in renewable energy directly (where permitted to own generation) in order to meet renewable portfolio standard requirements, or may trade with power suppliers to do so. Resources located outside a jurisdiction may, through trading, be the source of renewable energy to meet its renewable portfolio standard requirement. The Forum recommends that any state renewable portfolio standard should allow renewable energy from outside the state to count toward its requirement, so that energy producers can locate their renewable energy facilities in the best and lowest cost locations. Tracking systems are required to allocate renewable generation to the service areas or states in which it is said to be consumed.

A systems benefit charge approach levies a charge on ratepayers and uses to monies collected to subsidize renewable energy. A systems benefit charge approach may also be used for other purposes, such as funding energy efficiency programs. A systems benefit charge levied on ratepayers in one jurisdiction may normally be used only to support development of renewable resources within that jurisdiction. Systems benefit

charge based programs do not support development of renewable resources in other jurisdictions in the region, as a renewable resource portfolio standard with trading may. Programs used by states that have adopted systems benefit charges for renewables vary in design. The Forum urges that any stand-alone systems benefit charge program should be structured to maximize the amount of additional renewable production and consumption that results from the incentives put into the market.

A few states in the East have opted for a combination of the renewable portfolio standard and systems benefit charge approaches. These approaches can be complementary, rather than overlapping, if the systems benefit charge programs are used to support technologies that are unlikely to be selected due to the renewable portfolio standard – technologies that are more costly or not as market-ready, for example. Projects that receive systems benefit charge support might also be precluded from selling to renewable portfolio standard markets.

Recommendations for consideration by states. The Forum recommends that states adopt a renewable portfolio standard, a systems benefit charge for renewable energy resources, or both. If the renewable portfolio standard is chosen as the core financial incentive approach, the Forum recommends that levels of 10 percent in 2005 and 20 percent in 2015 be chosen, to help the region meet its 10/20 goals. If a systems benefit charge is chosen, it should be at a level that is estimated to facilitate substantial increases in renewable energy.

The Forum recommends consideration of a number of other policies which can help support the emergence of robust markets for renewable resources. The Forum recommends that states facilitate development of programs that allow consumers to buy renewable or "green" power by adopting the consumer protection guidelines of the National Association of Attorneys General, and by establishing power labeling and disclosure rules, a regional generation tracking system, and consumer education programs. The Forum also recommends that state governments establish renewable energy state purchasing requirements; adopt the SO_2 emissions/market trading program, as described above; eliminate barriers to moving renewable generation through the transmission/distribution system; improve the permitting process for renewable generating facilities; and adopt state tax incentives for renewable energy projects.

Finally, the Forum also recommends that states should support complementary efforts by the federal government, including a national renewable portfolio standard with tradable permits; development of tax credits for renewable energy resources, extension of the federal production tax credit of $.018/kWh for wind and biomass through 2015, and a mandatory federal agency renewable energy purchase requirement of 10 percent by 2005 and 20 percent by 2015.

Recommendations for consideration by tribes. The Forum recommends that tribes develop a Tribal Implementation Plan under the provisions of the Regional Haze

Rule and the Tribal Authority Rule[13]. The Tribal Implementation Plan should commit the tribe to expand the use of renewable energy. The Forum also recommends that tribes create education programs to help consumers understand their options relating to renewable power, and that they take steps to expedite the permitting process for renewable energy projects within their jurisdiction. The *Tribal Renewables Report* offers the following additional recommendations for the consideration of tribes:

- Develop a tribal energy policy that includes renewable energy measures.
- Establish an energy authority to assume overall responsibility for tribal energy strategy.
- Establish an economic development corporation to foster development of tribal renewable resources.
- Develop renewable energy resources within the framework of an overall tribal energy plan.
- Purchase electricity from renewable resources where practical.
- Require federal facilities located on reservation lands to use some energy supplied from renewable resources.
- Seek adequate appropriations for existing federal statutes that will assist tribes in implementing renewable projects, and for equitable financial support for renewable projects comparable to tax credits.
- Consider multi-party collaborations to develop renewable energy resources, with other tribes or independent power producers
- Promote a federal RPS, federal tax credits for renewable energy generation, expansion of the government's procurement of green energy, and expansion of the federal "Buy Indian" policy to include the purchase of renewable energy generated on tribal lands.

3.2 Energy Efficiency Recommendations

Section 309 implementation plans are to include programs to preserve and expand energy efficiency efforts. In its 1996 report, the Commission stated:

> The Commission supports the continued development and implementation of national energy efficiency standards for motors, appliances and lighting and recommends the national adoption of the California energy efficiency standards[14]. The Commission also supports the construction of energy efficient buildings, both residential and commercial, and proposes the reinstatement of incentives for building energy efficient structures.…The Commission also suggests the continuation of demand-side management programs, despite current funding restrictions. The Commission recommends that continuing attention be paid to maintaining the role of

[13] In 1998, EPA regulations established a framework through which tribes may implement Clean Air Act programs. The regulations are known as the Tribal Authority Rule (40 CFR part 49).
[14] "California standards" is evidently a reference to that state's Title 24 building efficiency standards program.

> energy conservation within the changing electric power industry markets. Energy conservation programs should be preserved and expanded through such mechanisms as "system benefit charges" paid at the distribution level....(*Report of the Grand Canyon Visibility Transport Commission to the United States Environmental Protection Agency*, June 1996, pages 31-32.)

The Forum acted directly to support the recommendation on national energy efficiency standards by communicating to legislators and the U.S. Department of Energy its support for increasing central air conditioner efficiency standards to the level of "seasonal energy efficiency ratio" 13. The Forum also urges states and tribes to consider actively supporting the development of national equipment and building efficiency standards. Because national standards are uniform among all states, they reduce the burden on states of developing state-specific standards, and they mitigate inter-state competitive concerns that can arise when states pursue efficiency standards on their own.[15]

The construction of new buildings and the renovation of existing buildings present ideal opportunities to install efficient equipment or measures. When not taken advantage of, an opportunity is "lost." To the extent efficiency is not maximized in the construction process, it becomes more difficult to "retrofit" a building for efficiency later on, if it can be done at all. While there is an extensive national program of efficiency standards for appliances and equipment, there is no national program of mandatory building standards. In addition to prodding the federal government to take action in this area, the states and tribes should adopt or enhance energy efficiency building standards within their jurisdictions.

As reported in Section 4 below, implementation of the primary renewable energy recommendations of the Forum will tend to increase the costs of electricity under most scenarios examined by the Forum. To help offset these cost impacts, states and tribes may wish to promote energy efficiency actions which assist households, businesses, and other facilities to reduce their electricity use and thus their energy costs. A set of cost-effective energy efficiency options developed by the Forum is described in Section 4. The Forum hopes that states and tribes can use this information to help them decide what specific targets of opportunity are most suitable for their energy efficiency initiatives.

Recommendations for consideration by states. The Forum recommends that states maintain ratepayer-funded energy efficiency where it is substantial, as in Oregon and California, and establish or increase it elsewhere. Ratepayer-funded efficiency takes two basic forms.

1. Utility demand side management plans approved and funded on a case by case basis are employed in states such as Colorado and Utah which retain full cost of

[15] While states are free to develop building construction standards as they see fit, they are pre-empted by federal law from developing efficiency standards for equipment covered by the federal appliance standards program, unless they apply for and receive a waiver from the Department of Energy.

service regulation. Utilities that are publicly or cooperatively owned develop demand side management based on their varying governance procedures.

2. The funding of energy efficiency through system benefit charges, with programs delivered by utility or non-utility entities, is employed in states that have restructured their electric industry.

Ratepayer funded energy efficiency programs often include combinations of information, marketing, technical assistance, and financial incentives and/or financing arrangements. Substantial experience with demand-side energy efficiency programs (also known as "energy conservation" and "demand side management" has accumulated in the over 20 years since they were pioneered by some western states. This experience can be drawn on to so design programs that they are likely to have strong market impacts. A common design approach is to target technologies or efficiency practices which, while commercially available, are only penetrating a given market to a low degree due to market barriers. The informational and financial resources of a program are then targeted to customers, retailers, wholesalers, manufacturers, building managers, energy service contractors, and/or other market actors based on where the greatest leverage to influence behavior lies given the structure of each relevant market.

Techniques to monitor and evaluate the short and long-term performance of energy efficiency programs have evolved over the years, and are now highly developed. Combinations of inspection and verification, end-use metering, statistical analysis of the billed consumption of consumers, and tracking of the market shares of measures promoted through energy efficiency are used to isolate the effect on energy consumption and demand that results from efficiency. With the enhanced reliability of these impact evaluation methods, as states and tribes can launch energy efficiency programs they can, and should, simultaneously specify the techniques to monitor them and evaluate their impact.

Beyond efficiency standards and ratepayer-supported energy efficiency programs, other kinds of initiatives can help to promote energy conservation. The Forum offers additional recommendations to states. Tribes and communities may also find it useful to consider these recommendations. The Forum's additional recommendations to states are:

- Develop a comprehensive public buildings efficiency plan, including mandatory efficiency standards for state and municipal new construction, a continued or enhanced public building retrofit program employing performance contracting as appropriate, developing life-cycle cost procurement standards for energy-using equipment and systems, and training building operation and maintenance staff and certifying them.
- Enlist water and waste utilities in the development of combined water/energy conservation programs.
- Consider developing tax incentive programs to promote investment in energy efficiency measures by consumers and businesses. Tax credit programs can complement or substitute for ratepayer-funded energy efficiency programs.

- Promote better energy price signals to consumers. Rate design is a normal and recurring part of the utility regulatory process as well as of the operation of publicly owned utilities. Progress toward implementing real-time, time of use, inclined block, and other pricing approaches that may more effectively communicate the cost of electricity (and gas) supply to consumers has been only modest throughout the Western Regional Air Partnership region.

Recommendations for consideration by tribes. The Forum's research recognizes the diversity of tribal lands and the need for tribal governments to selectively pursue energy efficiency opportunities. Forum recommendations offer options in three broad categories:

1. Initiatives that individual tribes can implement on their own.
2. On-reservation strategies that can be best pursued in collaboration with others, including tribes, states, federal agencies and energy providers.
3. Tribal support for state and national programs to improve energy efficiency.

Individual tribal energy efficiency initiatives. The Forum recommends that tribes consider developing several initiatives (or sustaining them if they are already begun). These include:

- Develop a tribal energy plan to establish goals, including goals for energy efficiency.
- Appoint a tribal energy manager to develop, implement, and maintain a program focusing on tribal energy use, including energy efficiency strategies.
- Tribal energy authority -- tribes without an energy (utility) authority should consider establishing such an entity (individually or in collaboration with other tribes). When the electricity provider is someone other than a tribal entity, the energy authority can advocate for tribal electricity customers, possibly negotiating lower electricity rates and improving the reliability of service. The energy authority will make decisions and implement plans based on the tribal vision within the indigenous culture.
- New construction and building renovations -- the Forum recommends that tribes consider adopting energy efficient building codes such as the International Energy Conservation Code, and integrate energy efficiency into housing plans.
- Electrification expansions -- the Forum recommends that energy efficiency be integrated with plans for new electrification.
- Education -- the Forum recommends that tribes consider training programs to educate electricity users within tribal lands about energy efficiency.
  Evaluate the cost of building energy systems and energy-consuming equipment using life-cycle costing methods.
- Tribal Implementation Plan: tribes may consider developing a Tribal Implementation Plan under the provisions of the Regional Haze Rule and the Tribal Authority Rule. The Tribal Implementation Plan would commit the tribe to develop an energy plan and employ energy efficiency to reduce electricity consumption.

Collaborative program improvements in energy efficiency. Where tribes may lack the resources to establish their own energy authority or even to hire their own energy manager it may be beneficial to initiate partnerships with other tribes to establish an energy authority or to hire an energy manager. Among the functions collaboration can serve, the Forum recommends that tribes consider intertribal collaborations to pursue energy efficiency.

There are several federally sponsored programs in which tribes may participate, including the Weatherization Assistance Programs and the U.S. Department of Energy's Rebuild America Program. The Forum recommends that tribes participate in such federal efficiency programs. Tribes may also consider requesting the federal government to implement the energy conservation and renewable energy development provisions of existing laws, including funding for training programs for tribal energy professionals related to energy efficiency and renewable energy.

Support for external energy efficiency programs. The Forum recommends that tribes support utility demand-side management programs that encourage electricity users to be efficient. Tribe can also show leadership by supporting system benefit charges that will be used to support demand-side management programs. In addition, the Forum recommends that tribes support national energy efficiency policies and standards.

4. Impacts of the Forum's Recommendations

4.1 Overview of the Impact Analysis

The Forum conducted a program of technical and quantitative analysis to identify the direct economic costs and benefits of energy efficiency and renewable energy initiatives, as well as the indirect effects of these initiatives on the economic indicators in the transport region. The analysis was done in three stages:

1. Estimating the costs of energy efficiency measures and programs, and their impact on electric energy consumption and peak demand.
2. Modeling the effect of the energy efficiency measures as well as achievement of the 10/20 renewable energy goals upon the electric generation mix, the emission of some air pollutants, and the total costs of producing and delivering electricity services in the region.
3. Estimating the effect of implementing the energy efficiency measures and the10/20 goals on some regional economic indicators, mainly total state income and total state employment.

Subsections 4.2, 4.3, and 4.4 describe how each of these stages of the analysis was carried out, and the chief results at each stage.

4.2 Analysis of Energy Efficiency Options, Costs, and Energy Savings

Unlike the area of renewable energy, where it set quantitative goals, the Commission did not propose quantitative goals for energy efficiency. The Forum needed to develop a method for illustrating the possible quantitative results if states and tribes in the region pursue its recommendations to a substantial, though not necessarily aggressive, degree. To accomplish this quantification, the Forum developed a suite of options corresponding to the potential for additional energy efficiency in the region that is (a) reasonably achievable and (b) likely to be cost-effective. By "cost-effective" the Forum means that the reduction in the total costs of electricity services due to energy efficiency is greater than the total resource costs of energy efficiency.

The total cost of electricity services is measured by the revenues required from consumers to pay for the level of electricity provided. The reduction to these costs is based on the decremental effects of energy efficiency options. The savings impacts represent the *difference* between expected electricity use without the measures in place (i.e., using standard-efficiency devices and practices) and electricity use with the efficiency measures implemented to the degree we estimate is achievable. Load impacts are calculated measure by measure, increased to account for avoided transmission and distribution losses, and summed up for the region. The load impacts from efficiency were determined at this stage of the analysis. However, the value of those electricity savings

and their emissions reduction benefits, were determined in the electric system modeling stage of the analysis, described in Section 4.3 below.

The total resource costs of energy efficiency reflect the additional costs of installing and maintaining the recommended measures, compared to not doing so (i.e., relative to using standard equipment and practices to supply the same energy services), plus any additional program costs incurred to implement the recommendations (e.g., administrative and marketing costs incurred by a sponsoring agency delivering an energy efficiency program). The costs of energy efficiency measures and programs was determined in this stage of the analysis

The set of energy efficiency options developed by the Forum were not meant to comprise all cost-effective options, nor all technically feasible options that would have environmental benefits. Rather, a set of reasonably achievable programs was developed to represent the energy, cost, and emissions impacts if a moderately ambitious level of energy efficiency is pursued throughout the region. For purposes of analysis the transport region was broken into three sub-regions, as follows:

- The interior West — New Mexico, Arizona, Nevada (less the Las Vegas region), Colorado, Utah, eastern Idaho, and Wyoming.
- Oregon plus western Idaho.
- California plus the Las Vegas region of Nevada.

Tellus Institute developed an analysis of energy efficiency options for each of the three sub-regions. In the interior West and Oregon/western Idaho sub-regions, the analysis was based on a bottom-up assessment of a wide range of efficiency measures. In the California/Las Vegas sub-region, the analysis was based on adapting a national study to that region.[16] The final package of energy efficiency options that was used to characterize the impact of energy efficiency is listed in the following table. The "measures" are specific technologies and practices whose cost and performance characteristics were calculated to develop energy efficiency impacts. The "major options" are the program or policy categories into which the measures were grouped in the each study.

Most options were modeled as demand-side management type programs, so we added the costs of administration and marketing to the incremental costs of the measures themselves in our analysis. To promote acceptance of program measures, we assumed financial incentives in the development of the option. We based the level of participation or market penetration projected to be achieved by each option on documented experience with comparable well-designed demand-side management programs.

[16] The national study that was drawn on for the California (plus Las Vegas) region analysis is *Smart Energy Policies: Saving Money and Reducing Pollutant Emissions through Greater Energy Efficiency*, by Steven Nadel and Howard Geller with the Tellus Institute. Washington: American Council for an Energy-Efficient Economy, September 2001, Report No. E012.

Asterisks in the following table (**) indicate measures or options that were not modeled as demand-side management type programs. For these options, no administration and marketing costs were added to the incremental costs of the measures themselves. The "standards" options assume that over a period of several years, expanded or upgraded efficiency standards are implemented.[17] The market penetration of the affected appliances and equipment is then virtually 100 percent. In some cases, a period of demand-side management is assumed for a few years, before the enhanced standards come into force.

[17] States and tribes can work together regionally to urge federal action on appliance standards. A state can develop appliance standards directly if the products involved are not covered by federal standards, or if the state receives a waiver from the U.S. Department of Energy.

Table 1 -- Energy Efficiency Options

Demand-Side Management Type Programs Except where Indicated **

Interior West -- Residential Sector

Major Option	Types of Measures
Efficient cooling systems	Evaporative cooling – installation, retention and renewal of systems
Appliance recycling	Removal of older refrigerators and freezers
Efficient lighting	Mix of compact fluorescent lamp based measures
Appliance standards **	Clothes washers – mix of Energy Star vertical axis machines and horizontal axis machines
	Appliance standby loss – reduce loss to one watt per electronic device
Building thermal performance	Weatherization – existing buildings

Interior West -- Commercial Sector

Major Option	Types of Measures
Efficient lighting	Mix of better technologies
Efficient refrigeration	Mix of better technologies
Efficient cooling systems	Cooling efficiency – mix of better systems
	Indirect/direct evaporative cooling
Efficient space heating system	Ground source heat pump
	Fuel switching from electric to gas
Multi-measure strategies for existing building stock	Miscellaneous devices (LED traffic lights and signs, clothes washers, computers, monitors and other office electronics)
Retro-commissioning	Operations and maintenance of existing building stock
Water heating	Mix of efficiency and fuel switching from electric
Transformers	Efficiency improvements

Interior West -- Industrial Sector

Major Option	Types of Measures
Transformers	Efficiency improvements
Motors	Premium motors (including replace rather than rewind) and motor downsizing
Motor drive systems	System upgrades of fans, air compressors, pumps

Oregon / w. Idaho -- Residential Sector

Major Option	Types of Measures
Efficient cooling systems	Evaporative cooling – installation, retention and renewal of systems
Appliance recycling	Removal of older refrigerators or freezers

Efficient lighting	Mix of compact fluorescent lamp–based systems
Appliance standards**	Clothes washers – mix of energy star vertical axis machines and horizontal axis machines
	Appliance standby loss – reduce loss to 1 watt per electronic device

Oregon / w. Idaho -- Commercial Sector

Major Option	**Types of Measures**
Efficient lighting	Mix of better technologies
Efficient refrigeration	Mix of better technologies
Efficient cooling systems	Cooling efficiency – 20 ton package units
Efficient space heating system	Ground source heat pump
	Fuel switching from electric to gas
Multi-measure strategies for existing building stock	Miscellaneous devices (LED traffic lights and signs, clothes washers, computers, monitors and other office electronics)
Retro-commissioning	Operations and maintenance of existing building stock
Water heating	Mix of efficiency and fuel switching from electric
Transformers	Efficiency improvements

Oregon / w. Idaho -- Industrial Sector

Major Option	**Types of measures**
Transformers	Efficiency improvements
Motors	Premium motors (including replace rather than rewind) and motor downsizing
Motor drive systems	System upgrades of fans, air compressors, pumps
Aluminum process improvements	Retrofit options to improve efficiency of cells (reduce anode-cathode spacing) and reduce heat loss

California/Las Vegas -- All Sectors

Major Option	**Types of measures**
System benefit fund	Demand-side management for lighting, appliances, air conditioning, motor systems, other
Equipment efficiency standards**	Distribution transformers, commercial refrigeration, exit signs and traffic lights, torchieres, commercial unit heaters, air conditioners, ice makers, residential refrigerators, dishwashers, standby loss reduction
Tax incentives for efficiency**	Clothes washers, refrigerators, air conditioning, gas heat pumps, heat pump water heating, furnaces, efficient new construction (residential and commercial)

The boxes on the next two pages show how energy efficiency options were evaluated for the interior West and Oregon/western Idaho regions. The example option is efficient customer-side transformers in commercial and industrial facilities. The example employs three steps. The first two steps -- compiling measure costs and performance data and measure benefit/cost analysis, and estimating program markets and participation -- are carried out and documented in Excel™ workbooks. The third step, calculating energy efficiency program costs and savings, uses the ECO™ software tool.

HIGH EFFICIENCY COMMERCIAL/INDUSTRIAL TRANSFORMERS: OPTION DEVELOPMENT

Step 1: Compile Measure Cost and Performance Data; Analyze Measure Benefit/Cost.

On average, efficient "TP-1" transformers save 23.3 kWh per kVA of transformer capacity (commercial applications) and 7.4 kWh per kVA of capacity (industrial applications) relative to standard new transformers.[18] "KVA" is thousand volt-amps, a measure of transformer capacity. To estimate energy savings a transformer lifetime of 30 years was used. Peak savings were estimated using a peak factor of 0.156 kW per MWh of energy savings[19]. Incremental costs for commercial-sized units were taken to be $4.42 per kVA, and for industrial-sized transformers, $1.81 per kVA.

The benefits of the measures consist of estimated energy and capacity costs for electricity generation that would be avoided due to the saved electricity. When the benefits from the savings were compared to the costs for the measures, both measures proved very cost-effective, with benefit/cost ratios of 3.3:1 for commercial transformers and 2.6:1 for industrial transformers.

Step 2: Estimate Program Market and Participation, and Administration Costs.

The size of the transformer market in the interior West region was derived from national sales of "dry-type" transformers, estimated to total 22 million kVA in 2000[20]. Average commercial and industrial load factors of 20 and 40 percent were applied to allocate these sales[21], resulting in estimated national transformer sales of 14.7 million kVA in the commercial sector and 7.3 million kVA in industry. Based on interior West commercial and industrial electricity sales in 2000 (61,615 and 54,858 GWh, respectively) and analogous figures for the U.S., transformers sales in the interior West were calculated as 870,654 kVA in the commercial sector and 375,684 kVA in industry[22]. These year 2000 sales were projected through 2018 using commercial and industrial electricity sales growth rates from National Energy Modeling System (NEMS) projections for the Mountain Census Region, yielding estimates of the markets for transformer sales during the 2002 to 2018 program period.

Program participation was based on experience with what well-advertised, aggressive demand-side management programs can accomplish. A participation rate of 15 percent of transformer sales in the first program year and 30 percent in subsequent years was assumed, based on a program start up budget of $500,000 (for several staff plus developing program marketing materials), as well as a substantial sponsor incentive equal to 50 percent of the incremental cost of the transformers. Administrative costs equal to 15 percent of incentive costs were assumed, based on the considerable effort likely to be required for ongoing program marketing, processing incentive applications, and tracking program activity, costs, and impacts. The "free- rider" fraction was taken to be 15 percent[23].

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[18] Data on incremental costs and savings for efficient transformers were derived from Tables 5.4, 5.7, and 5.8 of Supplement to the "Determination Analysis" (ORNL-6847) and Analysis of the NEMA Efficiency Standard for Distribution Transformers, by P. Barnes et al. This Oak Ridge National Laboratory Report (ORNL-6925, September 1997) was received from Jan Berry of ORNL. "TP-1" is an EPA Energy Star standard for transformers. ORNL expert Lance McCord provided additional information needed to estimate average transformer costs and savings.

[19] The peak factor (kW/MWh saved) is from the "National" worksheet of Northeast Energy Efficiency Partnerships workbook "neep1017.xls", which summarizes national energy savings potential for several energy efficiency measures. Average transformer lifetime is also from this source.

[20] From the 1997 ORNL report cited earlier.

[21] See The Cadmus Group, Inc (1999), Metered Load Factors for Low-Voltage, Dry-Type Transformers in Commercial, Industrial, and Public Buildings, from www.neep.org.

[22] National and state electricity sales data from the U.S. Energy Information Administration.

[23] "Free-riders" are program participants that would have adopted the measure even in the absence of the sponsor's incentive program. In practice, "free-ridership" is sometimes measured

Step 3: Program Costs and Savings Estimates.
Measure cost, savings, and lifetime estimates prepared in Step 1, above, together with estimates of annual program participation for each measure, administrative cost factors, sponsor cost fractions, and free-ridership estimates from Step 2, were entered into the ECO tool, together with estimates of discount rates (4.88 percent annually, on a real basis) capital recovery factors (based on device lifetimes and the assumed discount rate), and the future inflation rate (2.8 percent annually)[24]. ECO was then used to calculate streams of annual costs (on both "expensed" and annualized bases) and savings (electrical energy and peak power) for each measure (commercial and industrial transformers) in the program, as well as for the program as a whole. Cost data from ECO (presented as customer and sponsor measure costs, and sponsor administrative costs) and savings data were aggregated with costs from other programs, and savings data were likewise aggregated, and the "package" of annual costs and savings results was summarized for consideration by the Forum and for use in air pollution and economic impact modeling.

Also evaluated were many demand-side management options that are not included in the final set of recommendations summarized in the table above. These options are identified in *Economic Assessment of the 10/20 Renewable Energy Goals and Energy Efficiency*.

One basis for excluding several of the options studied from the final package of energy efficiency recommendations was their relative cost. The "cost of saved energy" is a measure often used in evaluating demand-side management options. This is the overall lifetime cost of a demand-side management measure per unit of energy saved. The cost of saved energy is calculated by dividing the additional cost of the efficiency measure (relative to standard technologies) by the electric savings such a measure produces. To identify a package of energy efficiency options that would be clearly cost-effective, we excluded options with a cost of saved energy above $.054/kWh[25] from the final package of energy efficiency recommendations. However, individual states *are* encouraged to consider additional options, for three reasons.

1. Higher cost energy efficiency options that save on-peak electricity may be cost-effective based on a state's costs for meeting peak demand.
2. Building standards programs did not meet the cost of saved energy threshold for the final set of energy efficiency options largely because the Forum did not evaluate their ability to save gas, the predominant heating fuel in the West. However, states should evaluate such programs on the basis of their joint electric/gas benefits. California and Oregon have advanced building standards

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by post-program evaluation surveys or by market studies, but in many instances, for planning of demand-side management programs, values in the range of 10 to 20 percent are assumed.

[24] The discount rate used here is similar to real discount rates used by large utilities operating in the West.

[25] Real levelized cost of saved energy in 2001 dollars. The "real levelized" cost is a uniform annual cost of saved electricity, in constant dollars, the present value of which equals the present value of the actual costs of the demand-side management option over its lifetime.

programs, and other states in the region should certainly consider a process of regular upgrade of building codes to promote energy efficiency.

3. States may wish to consider promoting options that are not currently cost-effective, in order to realize their environmental benefits, or to support development of emerging technologies.

Combined heat and power. Based on the results of national studies, the Tellus team identified a considerable achievable potential for the application of combined heat and power (also known as cogeneration) in all three of the modeled regions. Implementation of combined heat & power could result in significant cost savings, displacement of capacity (about 7.5 GW at the end-use level), and overall fuel (gas) savings relative to separate production of power and heat, and would also help, in many instances, to ease transmission constraints by providing distributed generation. Gas-fired combined heat & power systems do, however, produce emissions of nitrogen oxides (NO_x), as well as reducing emissions of NO_x by displacing generation from conventional power plants. Depending on the type of combined heat & power used and the type and extent of emissions control equipment with which it is fitted, combined heat & power might result in a net increase of NO_x emissions relative to separate heat production and power generation. This result is far from certain, as it depends on the average emission factors for combined heat & power systems meeting current standards in major airsheds in the West.

Though any increase in NO_x emissions from the implementation of modern, regulations-compliant combined heat and power system is likely to be modest relative to overall NO_x emissions from power generation in the West, Forum members were sufficiently concerned about the potential impact of combined heat & power systems on local and regional air quality that a consensus decision was made to leave savings (and costs) of programs to promote on-site combined heat & power out of the total energy-efficiency savings figure passed on to the IPM modeling effort. However, the Tellus analysis confirmed the substantial potential for combined heat & power to cost-effectively displace conventional electric generation at a net increase in overall efficiency for the joint production of electricity and thermal energy. For this reason, state, local, and tribal policymakers are urged to evaluate the potential role of promoting on-site combined heat & power in their individual jurisdictions.

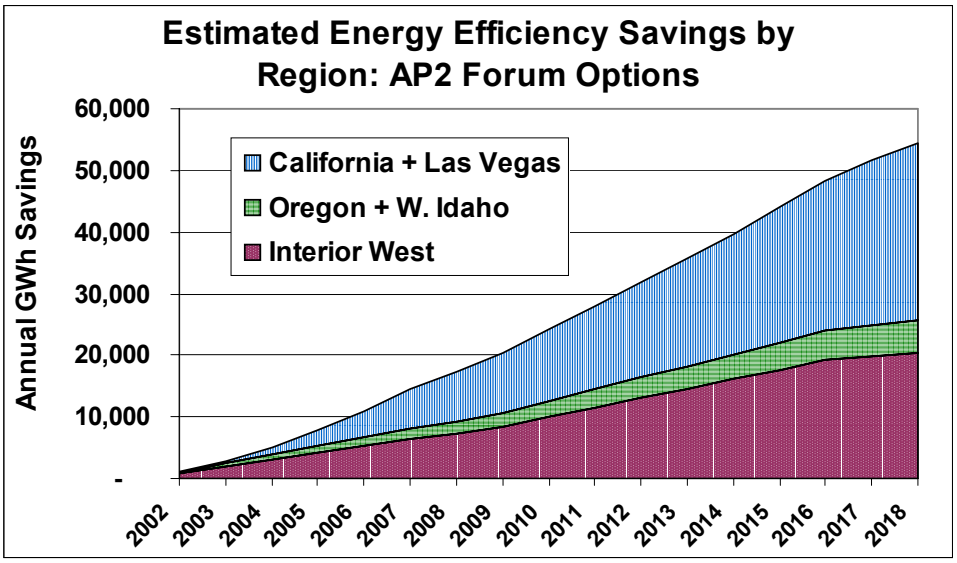
Summary results: energy efficiency. The package of energy efficiency options that was used to characterize the impact of energy efficiency, as described above, was modeled using Tellus' ECO™ model. Implementation of the package of energy efficiency options was modeled through the year 2018.[26] Together, the three regional energy efficiency packages save approximately 54,000 GWh of electricity annually by 2018, a reduction of eight percent in average demand in that year. Energy efficiency also reduces peak demand in 2018 by 11.2 percent (OR/w. ID), 11.6 percent (CA/Las Vegas),

[26] While energy efficiency programs were assumed implemented through 2018, the benefits from measures installed during that time period were calculated for several years beyond 2018.

and 13.3 percent (interior West).[27] The peak demand reduction is greater than the average demand reduction because a number of the options evaluated would save more energy during periods of high electricity use. The annualized cost of this energy efficiency package in 2018 is $1.6 billion (2001 dollars).

Figures 1 through 4 show, respectively, the energy savings, summer peak savings, and annualized costs of the sum of all three regional energy efficiency packages modeled for the Forum. Figure 1 shows the energy savings by region, while Figure 2 shows the same energy savings within the three major market segments: residential, commercial/institutional, and industrial customers.

Figure 1



[27] These peak demand reductions are related to the winter season in Oregon/w. Idaho and the summer season in the other two regions (interior West, California/Las Vegas).

Figure 2

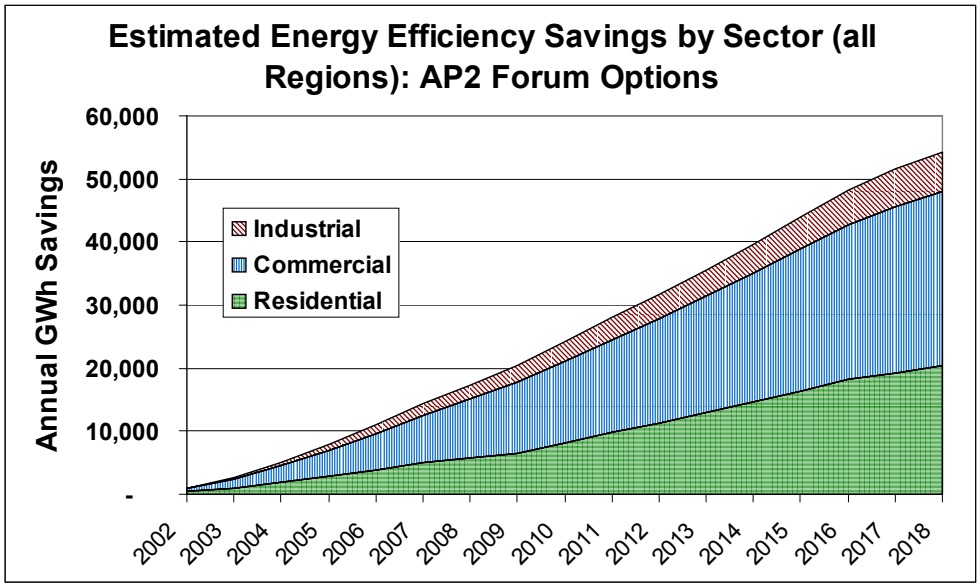


Figure 3

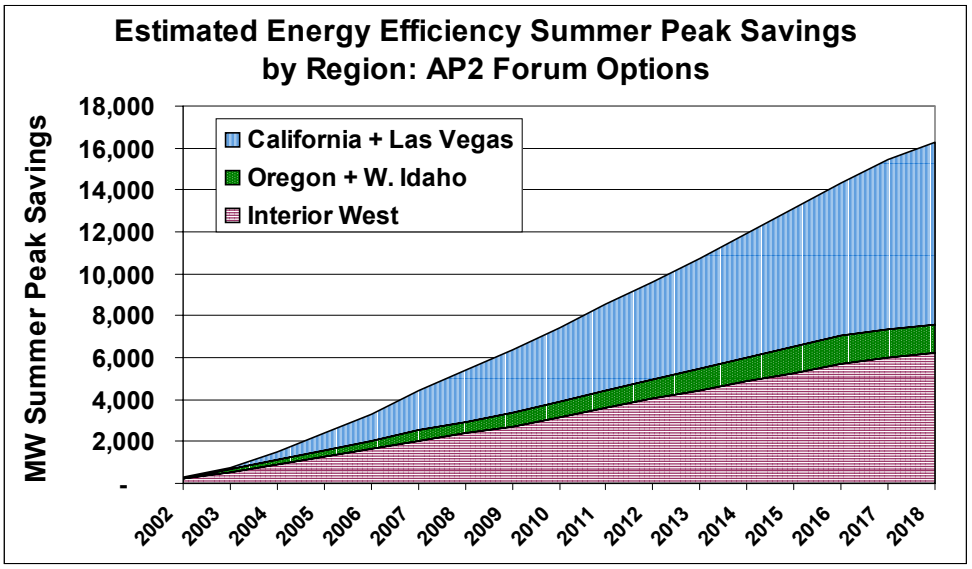
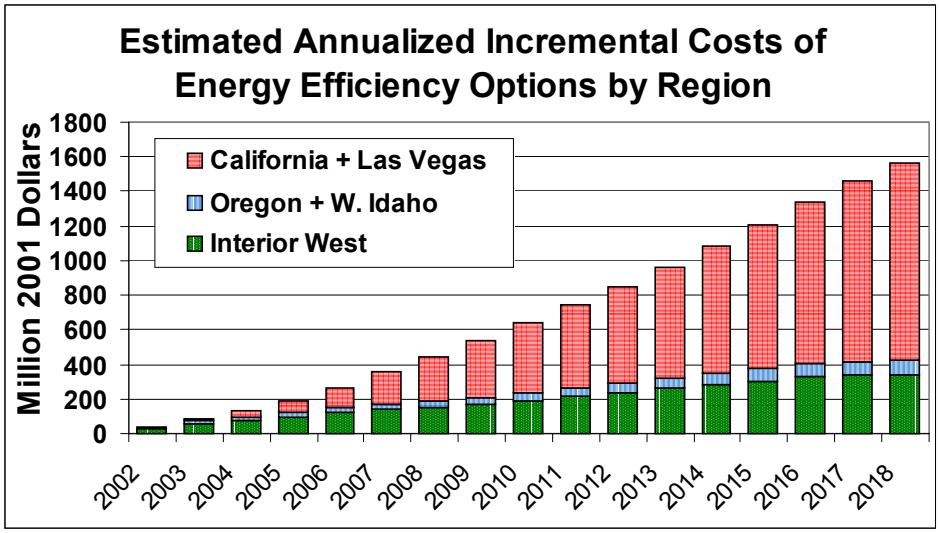


Figure 4



4.3 The Impacts of Efficiency and Renewable Energy on Electricity Supply Costs and Emissions

The modeling of the direct impacts of the energy efficiency and renewable energy recommendations on the electric generation sector employed ICF Consulting's Integrated Planning Model™ (IPM). IPM represents many regional electric power markets within the continental U.S. In order to fit within the IPM regional structure, The nine GCVTC states and 211 tribes were analyzed as three sub-regions, as noted in Section 4.2: the interior West, Oregon/western Idaho, and California plus the Las Vegas area.

To estimate the value of the electricity saved through that energy efficiency, the IPM model was employed. IPM was also used to estimate the impacts of the renewable energy 10/20 goals. IPM is a capacity expansion and production costing model for analyzing the electric power and industrial steam markets. It is a dynamic optimization model that finds the least total cost of the system over any given study time frame. ICF had used IPM to analyze the economic impacts of implementing the initial SO_2 emissions program for the transport region that was developed by the Market Trading Forum.

To model the direct impacts of the Forum's recommendations a number of scenarios were constructed. A basic reference scenario was established to simulate the operation of the western electric supply system through and beyond the year 2018. The reference scenario was taken from a prior analysis of the SO_2 emissions program developed by the Market Trading Forum. The reference scenario thus assumes that the SO_2 emissions program is in place, with a market trading system in use to attain the program's emissions milestones for the region. Because the SO_2 emissions program and milestones included in the final Annex to the Commission Report differ somewhat from those drafted by the Market Trading Forum, this scenario does not exactly represent the final SO_2 emissions program. The reference scenario assumed that the costs of energy efficiency resources did not change in real terms over the analysis period, since market

barriers to investment in energy efficiency would retard its market penetration and delay further price decreases from economies of scale. Variants of the basic reference scenario were used to explore the sensitivity of its results to changes in some input variables (such as natural gas prices, costs of wind power, and the extension of the federal tax credit for power production from renewable resources through 2009).

The Forum's policy recommendations were then modeled to determine their net impact compared to the reference scenario and its sensitivity cases. The following policy cases were constructed and run:

- Renewable energy, set at the level of the 10/20 goals, that could be satisfied by renewable resources in the nine-state/ 211-tribe region or elsewhere in the West.
- Energy efficiency, based on the achievable energy efficiency package developed by Tellus and described above, represented in IPM as reductions to loads served, with the incremental costs of efficiency added to the costs of the electric supply system.
- A combination of the energy efficiency and renewable energy recommendations.

Key energy, economic, and emissions impacts are described below. Impacts related to electricity generation were estimated through electric system modeling analyses employing the IPM model. The capacity additions and electric generation that occur in the different scenarios are described in *Economic Assessment of the 10/20 Renewable Energy Goals and Energy Efficiency*. The transmission and distribution related cost savings resulting from energy efficiency were estimated on the basis of historical data on these costs contained in the U.S. Department of Energy's National Energy Modeling System.

Impacts of energy efficiency. The electricity supply costs avoided through energy efficiency were calculated by modeling the regional electricity supply system with and without the efficiency option package described above. Electric avoided cost savings were found to substantially exceed the costs of energy efficiency that were depicted in Figure 4. Energy efficiency reduces levelized annual electricity production costs for the region by about $1.1 billion (through 2022, 2001$).

Table 1 shows the annualized costs and benefits implementing energy efficiency relative to the reference case. Note that values in parentheses in () Table 1 are negative costs. Efficiency provides benefits in reduced electricity production and electricity transmission and distribution costs that offset the costs of efficiency measures and programs by more than two to one (a benefit/cost ratio of 2.3).

Table 2

Net Costs and Benefits of Forum Energy Efficiency Options	Cost or Value (Million $2001)
Levelized Annual Incremental Electricity Production Cost	$ (1,136)
Levelized Annual Energy Efficiency Cost	$ 835
Levelized Annual Transmission & Distribution Avoided Costs from Energy Efficiency	$ (782)
Levelized Annual Value of Incremental Net Production Cost	$ (1,083)
Benefit/Cost Ratio for Energy Efficiency Options	2.30

By the year 2018, the energy efficiency package reduces NO_x emissions by about 10,000 tons and CO_2 emissions by 44 million metric tonnes. These impacts represent about one percent of NO_x emissions and about 11 percent of CO_2 emissions without energy efficiency. There are also very small reductions in the emission of particulate matter.

Impacts of renewable energy. The modeling of the impacts of the Forum's renewable energy recommendations found that if the 10/20 goals are implemented, the total amount of incremental new renewable energy capacity in the west by 2018 would be over 21 GW, and the incremental generation from renewable energy relative to the reference case would be 92,000 GWh.[28] According to the Forum's analysis, additional electricity production costs will be incurred for the transport region to meet the 10/20 goals. The $282 million increase in levelized annual electricity production costs, 2005-2022, represents an increase of about two percent. This result assumes that wind power costs will be somewhat reduced from the reference scenario due to improvements in technology and performance as a result of greater utilization. Figure 5 shows the change in annual production costs incurred by meeting 10/20 goals, while Figure 6 shows the net

[28] To characterize the renewable energy recommendations for its impact analysis, the Forum assumed that the recommendation of the GCVTC — renewable generation providing 10 percent of Grand Canyon transport regional electric power needs by the year 2005, and 20 percent by 2015 — was achieved. The policy approach that would most closely approximate the modeling assumptions used is a regional renewable portfolio standard with trading. System benefit charge policies to achieve the same goals could be as costly or somewhat more costly than a renewable portfolio standard. Beyond the renewable portfolio standard and/or systems benefit charge, the Forum's other recommendations on renewable energy would tend to make achievement of the 10/20 goals more likely than would relying solely on the renewable portfolio standard and/or systems benefit charge approach. The electricity cost and emissions impacts of attaining the 10/20 goals would not change materially as a result of implementation of the Forum's additional recommendations on renewable energy, which emphasize steps to help markets for renewable power function, but some of those recommendations could require modest outlays in government spending.

renewable generation capacity added if the 10/20 goals are implemented, relative to the reference case.

Figure 5

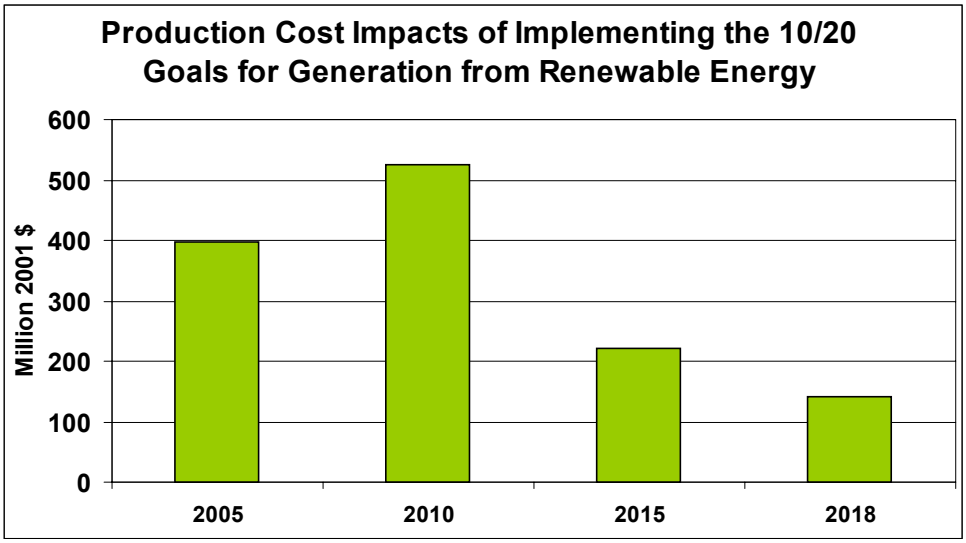
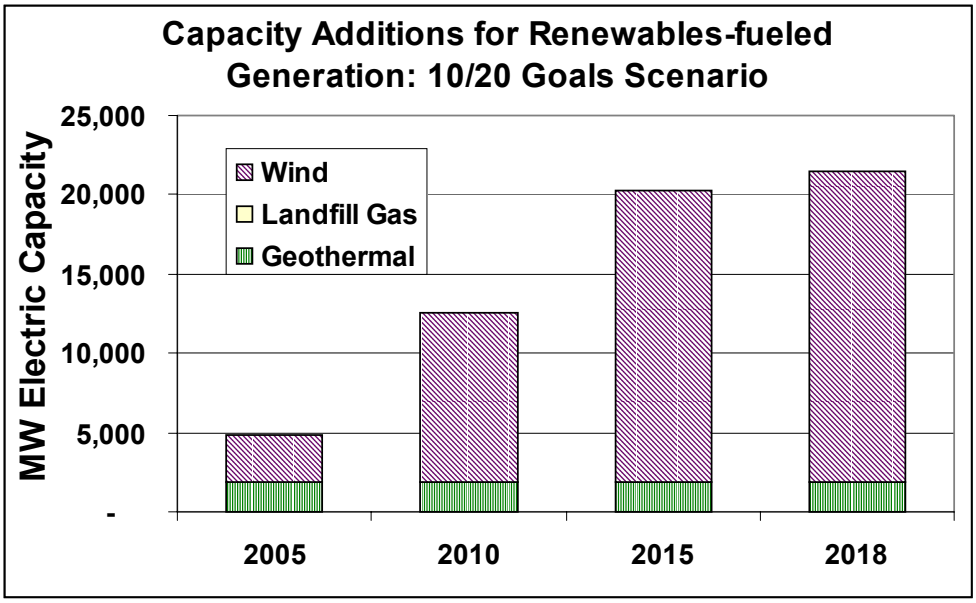


Figure 6

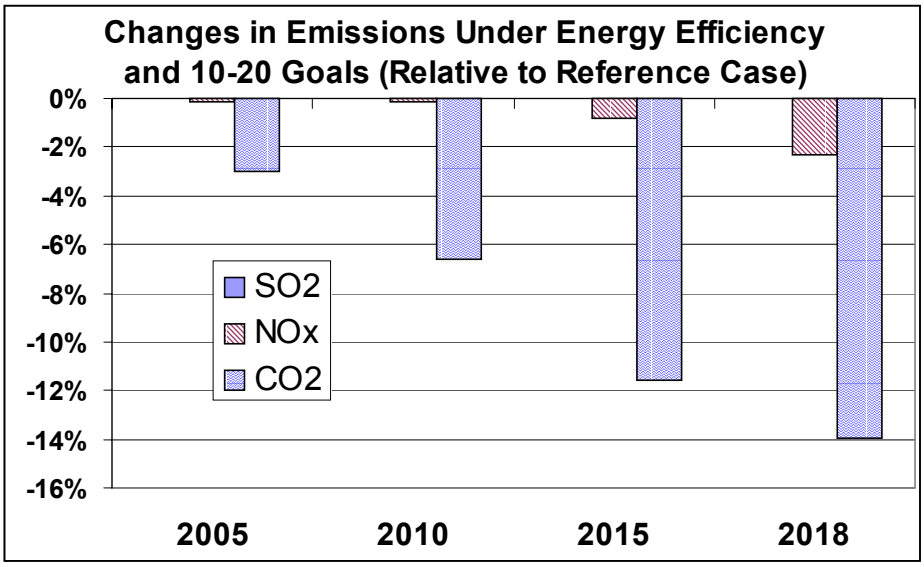


By the year 2018, achievement of the 10/20 goals reduces NO_x emissions by about 8,000 tons and CO_2 emissions by 39 million metric tonnes. These impacts represent about one percent of NO_x emissions and about 10 percent of CO_2 emissions without renewable energy. There are also very small reductions in the emission of particulate matter.

Impacts of energy efficiency and renewable energy. When the 10/20 goals and the energy efficiency recommendations are both implemented, air emissions are reduced more than with either efficiency or renewables alone. Due to interactions among these two resources and other existing and new generation resources, the emissions reductions do not equal the sum of impacts from energy efficiency and renewable energy separately. However, with both efficiency and renewables, NO_x emissions are reduced by about 14,000 tons in 2018, and CO_2 emissions by some 56 million metric tonnes. These impacts represent about 2 percent of NO_x emissions and about 14 percent of CO_2 emissions without energy efficiency and renewable energy, as shown in Figure 7. The reduction in the emission of particulate matter, though still quite small, is also greater than with either energy efficiency or renewable energy alone.

Though energy efficiency and renewable energy reduce electric generation requirements they do not necessarily yield SO_2 reductions, since the regional SO_2 trading program was assumed to be in effect in the modeling analysis of the effects of energy efficiency and renewable energy. In this context, what energy efficiency and renewable energy do is reduce the costs of complying with the SO_2 milestones in the GCVTC Annex developed by the Western Regional Air Partnership.

Figure 7



When energy efficiency and renewable energy are both implemented, there are direct economic benefits to the region in the form of reduced electric supply costs. There is a small net cost in 2005, but thereafter there are net savings. The net avoided cost savings to the region grows to some $1.8 billion in 2018, as shown in Figure 8. Levelized annual electricity production costs for the period 2005-2022, net of the costs of implementing energy efficiency measures and programs, are reduced by about $751 million.

Figure 8

Implications of regional impacts for states and tribes. The modeling of the impacts of implementing the Forum's energy efficiency and renewable energy recommendations provides analysis that the Forum hopes can help to inform deliberations in states and tribes about how to support energy efficiency and renewable energy in the contexts of both Section 309 of the Regional Haze Rule and their broader energy and environmental policies. The results project regional impacts if the states and tribes generally implement the same policies — a renewable portfolio standard or its equivalent, ratepayer funded energy efficiency or its equivalent, and the supporting policies suggested in Section 3. Even under these assumptions, the results are subject to uncertainties regarding future economic, technological, and policy variables. The results are, at best, indicative of what the impacts of implementing GCVTC recommendations on energy efficiency and renewable energy might be. As individual states and tribes wrestle with the Regional Haze Rule and other energy and environmental issues, they may consult the Forum's body of work for insights on available technologies and policies and the impacts which they may have.

4.4 The Impact of Efficiency and Renewable Energy on Economic Indicators (Indirect Impacts)

An economic analysis was conducted to assess the indirect or secondary impacts of the 10/20 goals and energy efficiency recommendations on the regional economy of the Transport Region. For this analysis, the results from the IPM modeling served as inputs to the REMI input/output economic model. This assessment of regional economic

impacts focused on changes in employment, gross regional product, and personal disposable income.

Implementation of the 10/20 goals and energy efficiency recommendations has a slight impact on the regional economy. The regional impacts are less than one half of one percent. Table 3 summarizes the annual average regional impacts under the policy scenarios.

Table 3 -- Annual Average Changes In Key Economic Indicators for the Transport Region Under the Policy Scenarios (2005 – 2020)

	Employment		Gross Regional Product		Personal Disposable Income	
	(Persons)	(% Change)	(Million 2001$)	(% Change)	(Million 2001$)	(% Change)
10/20 Goals	627	0.00%	-312	-0.01%	73	0.00%
Energy Efficiency (EE)	8,415	0.02%	450	0.02%	776	0.04%
10/20 Goals + EE	4,097	0.01%	-58	0.00%	547	0.03%

The results of the regional economic analysis indicate that the 10/20 goals and energy efficiency may, on average, lead to an increase in economic activity. Over time, the policies lead to small increases in economic activity in the early years and a small decline in later years. On average, the 10/20 goals will lead to small increases in employment and personal income along with a small decline in gross regional product. Implementation of the energy efficiency recommendations results in small increases in employment, personal disposable income and gross regional product. The impacts on gross regional product under the 10/20 goals and energy efficiency are largely the result of increased capital investments in new renewable energy generating capacity. An increase in construction sparked by the investments appears to be the key driver for growth.

Though the modeling and analytical results provide detailed estimates of potential impacts, it is important to recognize the very small magnitude of the results summarized in Table 3. With such slight perturbations at the level of the regional economy, it may be more meaningful to focus on the policies' direct impacts in the energy sector (Table 2).

Appendices

All appendices are available at the Forum website. To reach the site, go to www.wrapair.org and select "Committees and Forums," then the Air Pollution Prevention Forum.

Final Draft Recommendations of the AP2 Forum to Increase the Generation of Electricity from Renewable Resources. December 2000.

Discussion Paper on Scoping the Energy Efficiency Work of the AP2 Forum . 2001. Follow-on EE documents are also available at the Forum website.

Recommendations of the Air Pollution Prevention Forum to Increase the Generation of Electricity from Renewable Resources on Native American Lands (the "Tribal Renewables Report"). Draft, April 2002.

Recommendations of the Air Pollution Prevention Forum to Increase the Use of Energy Efficiency on Native American Lands (the "Tribal Efficiency Report"). Draft, June 2002.

Economic Assessment of Implementing the 10/20 Renewable Energy Goals and Energy Efficiency Recommendations. Draft, October 2002.