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## Energy Supply (ES) Technical Work Group

### Summary List of Pending Priority Policy Options for Analysis

Policy No.	Policy Option	GHG Reductions (MMtCO <sub>2</sub> e)			Net Present Value (Million \$)	Cost-Effectiveness (\$/tCO <sub>2</sub> e)	Level of Support
		2020	2030	Total 2010–2030			
ES-1	Biomass Development and Efficiency Improvements at Existing Power Plants	<i>Not Yet Quantified</i>					<i>Pending</i>
ES-2	Demand Side Energy Efficiency and Management Programs	<i>Not Yet Quantified</i>					<i>Pending</i>
ES-3	Advanced Fossil Fuel Technology (IGCC, CCSR, Advanced Pulverized Coal, CFB) Incentives, Support, or Requirements	<i>Not Yet Quantified</i>					<i>Pending</i>
ES-4	CCSR Enabling Policies, R&D, Infrastructure, and Incentives, Including Enhanced Oil Recovery Using CO <sub>2</sub>	<i>Not Yet Quantified</i>					<i>Pending</i>
ES-5	Pricing Strategies to Promote Efficiency and Renewables, Including Net Metering, Feed-In Tariff, Interconnection Rules, Inclined Rates, and Examination of the Standard Rate Structure	<i>Not Yet Quantified</i>					<i>Pending</i>
ES-6	New Nuclear Energy Capacity	<i>Not Yet Quantified</i>					<i>Pending</i>
ES-7	Renewable Energy Incentives and Barrier Removal, Including CHP	<i>Not Yet Quantified</i>					<i>Pending</i>
ES-8	Technology Research and Development (Not Including CCSR or Wind Potential Study)	<i>Not Yet Quantified</i>					<i>Pending</i>
ES-9	Policies to Support Wind Energy	<i>Not Yet Quantified</i>					<i>Pending</i>
ES-10	Shale Gas Development and Natural Gas Transportation Infrastructure and Gas-to-Liquids Technology	<i>Not Yet Quantified</i>					<i>Pending</i>
ES-11	Smart Grid, Including Transmission and Distribution Efficiency	<i>Not Yet Quantified</i>					<i>Pending</i>

Policy No.	Policy Option	GHG Reductions (MMtCO <sub>2</sub> e)			Net Present Value (Million \$)	Cost-Effectiveness (\$/tCO <sub>2</sub> e)	Level of Support
		2020	2030	Total 2010–2030			
ES-12	Coal-to-Liquids Production: GHG Emission Reduction Incentives, Support, or Requirements	<i>Not Yet Quantified</i>					<i>Pending</i>
	<b>Sector Total After Adjusting for Overlaps</b>						
	<b>Reductions From Recent Actions (EISA Title II requirements for new appliances and lighting)</b>						
	<b>Sector Total Plus Recent Actions</b>						

\$/tCO<sub>2</sub>e = dollars per metric ton of carbon dioxide equivalent; CCSR = carbon capture and sequestration or reuse; CFB = circulating fluidized-bed; CHP = combined heat and power; EERS = energy efficiency resource standard; EISA = Energy Independence and Security Act of 2007; GHG = greenhouse gas; IGCC = integrated gasification combined-cycle units; MMtCO<sub>2</sub>e = million metric tons of carbon dioxide equivalent; R&D = research and development.

Negative values in the Net Present Value and the Cost-Effectiveness columns represent net cost savings.

The numbering used to denote the above policy recommendations is for reference purposes only; it does not reflect prioritization among these important policy recommendations.

## ES-1. Biomass Development and Efficiency Improvements at Existing Power Plants

### Policy Description

As directed by Kentucky 2007 House Bill (HB) 1 and subsequent amendments to Kentucky Revised Statutes (KRS) 152.720, the Kentucky Department for Energy Development and Independence (DEDI) published *Intelligent Energy Choices for Kentucky's Future: Kentucky's 7-Point Strategy for Energy Independence* (“energy plan”).<sup>1</sup> This strategic action plan outlined seven strategies to restructure Kentucky’s energy portfolio to continue Kentucky’s role as an energy leader.

Although biomass development constitutes a significant role in the energy plan’s first three strategies, this recommended policy primarily focuses on Strategy 2: Increase Kentucky’s Use of Renewable Energy. This policy option is intended to include new and repowered existing stand-alone plants, co-firing biomass at fossil-fuel electric generating units, and energy efficiency improvements at fossil-fuel electric generating units.

The average coal-fired power plant in Kentucky is more than 35 years old. There have been significant advances in power generation technology during that period. Implementing efficiency improvements at existing power plants has the potential to decrease carbon dioxide (CO<sub>2</sub>) and other emissions on a pound per million British thermal unit (lb/MMBtu) basis, while at the same time reduce fuel costs. However, uncertainties in the Clean Air Act’s New Source Review (NSR) program pose a significant disincentive, not only to power plant efficiency improvements but also to biomass co-firing, because in some cases such a project may be deemed a “major modification,” triggering additional pollution control requirements that can cost hundreds of millions of dollars. Refinements in the regulatory program are needed to fully achieve the potential benefits of biomass co-firing and efficiency improvements at existing power plants.

### Policy Design

**Goals:** Implementing a policy for biomass development will support the Kentucky energy plan’s proposed Renewable and Efficiency Portfolio Standard (REPS). The REPS calls for a 25% reduction of Kentucky’s energy needs in 2025 through energy efficiency, conservation, and use of renewable sources. This policy allows Kentucky to reduce the use of its traditional energy source (i.e., coal), and leads to the timely and cost-effective reduction of CO<sub>2</sub> emissions.

In accordance with the Kentucky energy plan, by 2025:

- Kentucky’s biomass resources can contribute more than 50% of the state’s renewable energy potential.
- 12,000 new jobs can be created, resulting from an energy-producing sector utilizing biomass.
- Kentucky can use the estimated 3.5 million dry tons per year of underutilized biomass to generate electricity to meet energy demands.

<sup>1</sup> See: <http://www.energy.ky.gov/energyplan2008/>.

- Use of biomass resources can help achieve the 25% energy reduction goal.
- Use of biomass resources can provide and reach the annual target of 4,182,000 megawatt-hours (MWh).

The lack of a biomass supply chain is a major impediment to the use of biomass in Kentucky. Biomass development will require creation of the infrastructure necessary to support the procurement, transport, and utilization of biomass.

Promoting efficiency improvements at existing power plants has the potential to make a significant contribution toward reduction of Kentucky’s carbon footprint. Current technologies could achieve efficiency improvements in the range of 3%–5% for the current generating fleet. While power plant efficiency improvements of up to 5% on a statewide basis would require an aggressive effort, it would also offer significant benefits, including both cost savings to the electricity customer and a reduction of up to 5 million tons of CO<sub>2</sub> emissions annually. For such an effort to be feasible, regulatory actions at both the state and the federal levels are necessary. Efficiency improvements will be analyzed in two steps to determine potential cost and benefits; first, as applied to all 500-MW or greater generating units, and second as applied to all 250–500-MW units.

**Timing:** To meet the 2025 goals set forth in the Kentucky energy plan, electric generation from biomass will have to increase by 12 times the amount currently used for generation. Because power plant efficiency improvements offer some of the most cost-effective CO<sub>2</sub> reductions available, a priority should be placed on pursuing necessary regulatory actions to facilitate such an effort. The Division for Air Quality within Kentucky’s Department for Environmental Protection will review the NSR program and determine strategies to allow for the power plant efficiency improvement projects in the framework of the NSR program. In addition, the Division for Air Quality will consult and provide technical information to the U.S. Environmental Protection Agency (EPA) for consideration to determine whether power plant efficiency projects should be exempt from NSR permitting.

**Parties Involved:**

- Electric generators and biomass producers located in Kentucky may be affected by this policy.
- All regulatory agencies involved with permitting, determining compliance, and enforcing regulatory requirements will also be involved in implementing this policy. The agencies involved may include the following: Kentucky Public Service Commission (PSC), EPA, Federal Land Manager, U.S. Army Corp of Engineers, Division for Air Quality, Division of Water, Division of Waste Management, Division of Forestry, U.S. Forest Service.

**Other:** It is necessary for a regulating authority or legislative body to establish standards for low-impact, sustainably harvested biomass, and to ensure that biomass used as fuel to achieve the goals of this policy meets these standards.

**Implementation Mechanisms**

**Related Policies/Programs in Place**

**Type(s) of GHG Reductions**

**Estimated GHG Reductions and Net Costs or Cost Savings**

**Data Sources:**

**Quantification Methods:**

**Key Assumptions:**

**Key Uncertainties**

**Additional Benefits and Costs**

**Feasibility Issues**

**Status of Group Approval**

**Level of Group Support**

**Barriers to Consensus**

## ES-2. Demand Side Energy Efficiency and Management Programs

### Policy Description

Demand side management (DSM), energy efficiency education, programs, pilots, or goals for reduced electricity consumption call for actions that influence the quantity and/or patterns of use of energy consumed by end users. This option focuses on increasing investment in electricity DSM and energy efficiency through innovative actions developed and implemented by utilities, community partners, and customers. The ultimate goal is to provide tools, information, assistance, and knowledge that will help customers manage their energy consumption more efficiently and reduce their energy consumption.

### Policy Design

Given the current cost of electricity in Kentucky, the lack of consensus in the U.S. House and Senate on increasing the costs of electricity through the establishment of a price on carbon, renewable portfolio standards, efficiency standards, or clean energy standards, the most cost-effective method of preparing the Commonwealth for increased energy efficiency and demand side management is to increase education, the number of efficiency and DSM programs, and pilot projects that provide customers with the tools and information needed to better manage their energy consumption.

The current rate structure for utilities in Kentucky creates a business environment where additional energy efficiency and conservation measures may have a negative financial impact for utilities. Historically, utility rate structures encourage the sale of power. To align energy efficiency and conservation incentives with the utilities' business model, Kentucky should examine alternative rate structures that equalize the incentive for utilities to invest in cost-effective energy efficiency with the incentive to invest in new supply resources.

### Goals:

1. On a collaborative basis, by June 2011, develop a consortium of investor-owned utilities (IOUs), electric cooperatives, and municipal utilities to work with the Kentucky Department for Energy Development and Independence (DEDI) and the PSC to develop rate mechanisms and remove regulatory barriers so that utilities are better able to invest in DSM and energy efficiency programs.
2. By January 2012, have in place a regulatory environment that provides a mechanism and procedure for investment in DSM and energy efficiency. Such investment may include, but is not limited to:
  - a. Consumer and member education
  - b. Consumer and member focus groups
  - c. Pilot programs to explore and test creative and innovative opportunities
    - i. SCADA (supervisory control and data acquisition) systems

- ii. Communication systems
  - iii. Advanced Volt/Var control
  - iv. Smart feeder switching systems (self-healing power grid)
  - v. Direct-load control systems
  - vi. Smart Home systems including, but not limited to:
    - 1. In home displays
    - 2. Smart meters
    - 3. Home energy networks and gateways
    - 4. Smart thermostats
    - 5. Smart appliances
    - 6. Load management systems
    - 7. Energy Web portals displaying energy usage data and comparisons
    - 8. Integrated utility home network, communication, and data transfer
  - vii. Distributed generation pilots where consumers work collaboratively to implement economic alternative power supply systems, such as:
    - 1. Solar water-heating systems
    - 2. Heat pump water-heating systems
    - 3. Geothermal heating, ventilating, and air conditioning (HVAC) and water-heating systems
    - 4. Wind power systems
    - 5. Biomass power supply systems
    - 6. Solar power supply systems
    - 7. Net-zero-energy homes
    - 8. Electric vehicle/utility interconnection systems
  - viii. Energy storage systems
  - ix. Weatherization, HVAC upgrades, and Energy Star appliance upgrade pilot programs in collaboration with finance and community networks to provide innovative funding mechanisms to assist customers to finance their energy efficiency efforts.
3. By June 2011, have DEDI in a collaborative effort with the Kentucky PSC and the state's utilities, based on empirical studies of nationwide energy efficiency and DSM programs, determine the costs of electricity where participation in energy efficiency and DSM has become commonplace. In addition, determine the impact of DSM on energy consumption in Kentucky as well as nationwide. Charts identifying the aggregated DSM energy savings from

filed programs from 1995 through 2015 would provide a good historical basis to assist in determine reasonable policy going forward.

4. By January 2012, have pilot programs and consumer education in place at all utilities in the Commonwealth.
5. By January 2014, the pilot programs will have advanced to make energy efficiency/DSM opportunities available to all consumers in the Commonwealth. Beginning in 2014, and running to 2030, targets for DSM GHG reductions will be considered, pending additional research on experience in other states with comparable demographics and energy price points.
6. As the costs of electricity increase to the level that causes significant energy efficiency/DSM results, have a strong, viable consumer education program and an energy efficiency/DSM plan in place at all utilities in the Commonwealth.

**Timing:** See above.

**Parties Involved:** IOUs, municipals, cooperatives, DEDI, Kentucky PSC, community action groups, financial concerns, environmental groups, DSM equipment manufacturers. It is the intent to work in a collaborative process so that the roles of these parties will be properly aligned.

**Other:** None.

## Implementation Mechanisms

## Related Policies/Programs in Place

## Type(s) of GHG Reductions

## Estimated GHG Reductions and Net Costs or Cost Savings

**Data Sources:**

**Quantification Methods:**

**Key Assumptions:**

## Key Uncertainties

## Additional Benefits and Costs

**Feasibility Issues**

**Status of Group Approval**

**Level of Group Support**

**Barriers to Consensus**

### ES-3. Advanced Fossil Fuel Technology (IGCC, CCSR, Advanced Pulverized Coal, CFB) Incentives, Support or Requirements

#### Policy Description

Advanced fossil technologies for electric generation include more efficient—and thus lower-emitting—generation technologies. Advanced fossil technologies combined with carbon capture and sequestration or reuse (CCSR) may have the potential to significantly lower CO<sub>2</sub> emissions associated with fossil fuel-based electricity generation. Advanced fossil technologies that could be considered include advanced pulverized coal (advanced supercritical or ultra-supercritical units), integrated gasification combined-cycle units (IGCC), advanced circulating fluidized-bed (CFB) technology, and advanced natural gas combined-cycle units (NGCC).

Policies to encourage the development of these technologies may include mandates or incentives to use advanced coal technologies for new coal plants, such as a mandate that requires new fossil fuel-fired power plant designs that must accommodate CCSR or must achieve a specific higher efficiency rating or lower net CO<sub>2</sub> emission rate. Alternatively, a mandate might require that all or a portion of new fossil fuel plants be of a certain stage of development (most proven, highest efficiency).

Incentives may take the form of full recovery of prudently incurred utility investments in advanced fossil fuel technologies, direct subsidies, or assistance in financing electric generating projects. A combination of mandates and incentives is also possible.

#### Policy Design

The Governor's *Intelligent Energy Choices for Kentucky's Future* recognized that as the third-largest producer of coal in the United States, Kentucky's challenge is to pragmatically adopt inherently cleaner, newer energy sources, as well as innovative uses of traditional energy sources. Among other comments, the Governor said: "Kentucky can be a national leader in energy technology and production."

This policy for advanced fossil fuel technology should support the development of clean, reliable, affordable and efficient energy sources that help improve Kentucky's energy security, reduce our CO<sub>2</sub> emissions, and provide economic prosperity. In consideration of the Governor's seven strategies, which establish 2025 as a target date, the proposed policy design elements should include:

- Appropriate legislative action to address barriers.
- Support for demonstration unit deployment.
- Cost recovery and/or other incentives.
- Adequate agency oversight.

It is important to note that all electric generation facilities must be approved by either the Kentucky PSC or Kentucky’s State Board on Electric Generation and Transmission Siting on a case-by-case basis.

**Goals:** This policy does not quantify specific reduction goals. However, in support of the Governor’s *Intelligent Energy Choices for Kentucky’s Future*, where the seven strategies establish 2025 as a target date, the following goals should be considered:

- The state should support the development of at least one advanced fossil fuel electric generating project utilizing coal and one utilizing natural gas by 2020. In an effort to illustrate and quantify potential cost and benefits of deploying advanced fossil fuel technology designs, calculations from this goal are based on the replacement of the equivalent amount of capacity of older, existing coal-fired (or natural gas) units within the state. It is important to note that transmission capability must be assessed for any new large generator interconnection, as well as the impact of removing any existing generation resource. Transmission upgrades may result in increased costs for the analyses.
- Newly required or replacement base-load electric generation utilizing fossil fuels should be advanced fossil fuel technology designs. These generating resources may originate from entities filing Integrated Resource Plans or merchant sources.

**Timing:** Coincident with new or replacement base-load electric generation needs.

**Parties Involved:** Legislative bodies from Commonwealth of Kentucky, Kentucky PSC, Kentucky’s State Board on Electric Generation and Transmission Siting, Kentucky energy suppliers.

**Other:** None.

**Implementation Mechanisms**

**Related Policies/Programs in Place**

**Type(s) of GHG Reductions**

**Estimated GHG Reductions and Net Costs or Cost Savings**

**Data Sources:**

**Quantification Methods:**

**Key Assumptions:**

**Key Uncertainties**

**Additional Benefits and Costs**

**Feasibility Issues**

**Status of Group Approval**

**Level of Group Support**

**Barriers to Consensus**

## ES-4. CCSR Enabling Policies, R&D, Infrastructure, and Incentives, Including Enhanced Oil Recovery Using CO<sub>2</sub>

### Policy Description

Fossil fuels are the primary fuel for electricity generation in Kentucky and in the United States, and will remain so according to projections from the Energy Information Administration (EIA) in its latest *Annual Energy Outlook*.<sup>2</sup> For fossil fuels to operate in a GHG-constrained world, the capture of CO<sub>2</sub> from natural gas and coal-fueled power plants, and the successful storage or utilization (in a manner permanently preventing its entering the atmosphere or oceans) of that carbon is necessary.

Steps to encourage the development of carbon capture, storage and utilization require a multi-pronged approach. The Commonwealth has partnered with private utilities and federal agencies in investing in the study of carbon capture technology development at existing power plants. This is one piece of the puzzle. The further characterization of the capacity of the geology in Kentucky to successfully store carbon after capture is also a necessary investment.

Kentucky has funded several successful projects to date, but more is needed to be done to facilitate large-scale storage by private entities. The legal and regulatory issues involved around carbon capture and storage (CCS) also have to be addressed. For the purpose of this policy, “utilization” is assumed to mean enhanced oil and gas recovery, and algae fuel development. Utilization of CO<sub>2</sub> for these purposes and other uses has been funded in part, but more work needs to be done in this area as well. Generators of CO<sub>2</sub> may not be located near areas with adequate storage or utilization potential, so transportation issues involved with intrastate and interstate pipelines must also be addressed.

### Policy Design

- Develop policy recommendations that address the intrastate and interstate legal and regulatory issues concerning CO<sub>2</sub> storage and transportation.
- Develop funding mechanisms to scale up the carbon capture research presently being done in order to prove feasibility at a larger scale.
- Develop a proposal for a demonstration plant for the integration of a commercial-sized capture retrofit project for potential federal funding.
- Develop funding mechanisms that will facilitate the further evaluation of carbon storage and utilization potential in the Commonwealth. The policy should recognize the impacts on efficiency of CCSR technology implications if applied to existing units, as there will be an associated loss of capability from those units (parasitic load increases).

<sup>2</sup> U.S. Department of Energy, Energy Information Administration. *Annual Energy Outlook 2010*. DOE/EIA-0383(2010). May 11, 2010. Available at: <http://www.eia.doe.gov/oiaf/aeo/>.

**Goals:**

- By 2018, site a commercial-size demonstration project for CCS or utilization in the Commonwealth.
- By 2012, consider legislation addressing the intrastate and interstate legal and regulatory issues, including pore space ownership and long-term liability assignment.
- Conduct an ongoing study of potential for storage and utilization capacity.

**Timing:** See above.

**Parties Involved:** U.S. Department of Energy (DOE), Kentucky General Assembly, Kentucky PSC, Kentucky Energy and Environment Cabinet (EEC), universities, Kentucky Geological Survey, and regulated utilities.

**Other:** Promote education and outreach programs for carbon storage and transportation.

**Implementation Mechanisms**

**Related Policies/Programs in Place**

**Type(s) of GHG Reductions**

**Estimated GHG Reductions and Net Costs or Cost Savings**

**Data Sources:**

**Quantification Methods:**

**Key Assumptions:**

**Key Uncertainties**

**Additional Benefits and Costs**

**Feasibility Issues**

**Status of Group Approval**

**Level of Group Support**

**Barriers to Consensus**

## **ES-5. Pricing Strategies to Promote Efficiency and Renewables, Including Net Metering, Feed-In Tariff, Interconnection Rules, Inclined Rates, and Examination of the Standard Rate Structure**

### **Policy Description**

#### **PRICING STRATEGIES**

Pricing strategies should be developed to encourage both energy efficiency and conservation. Such strategies can take many forms and are best implemented by individual utilities working in concert with regulatory bodies to best address the needs of its particular customer group. Generally, whatever strategies are adopted, the rate structure should be based on the cost of providing service with the objective to send the proper price signal to the customer. Budget billing requirements that erase the price signals provided by all rate designs in responding to either seasonal or time-of-use consumption patterns should be reviewed to evaluate their ability to achieve the goal of consumption cost awareness. Similarly, since a tariff contains many rate structures, the overall design should eliminate subsidization of groups of customers within a class as well as subsidization of one rate class by another. The overall goal should be to isolate as much of the variable cost of providing service as possible. Opportunities exist for utilities to employ more sophisticated rate structures than have been available in the past due to advanced metering, but it must be recognized that such metering has a higher cost and necessitates aggressive customer education and acceptance, and the recovery of these costs through customer charges must be allowed by the regulatory agency.

#### **INTERCONNECTION RULES AND NET METERING**

The purpose of interconnection rules and net metering policies is to facilitate the cost-effective interconnection of renewable or distributed energy resources onto the power grid, supporting the expansion of the supply of renewable electricity.

The development of renewable energy sources is one of many avenues that should be considered toward the goal of reducing GHG emissions. The rules for interconnecting new renewable power generators onto the electricity grid can be a hindrance to or a support for, or can have a neutral effect on the development of these new generators.

Net metering is an important aspect of interconnection, which has played a critical role in the development of distributed renewable energy. Under net metering, the retail electricity supplier credits renewable power supplied to the grid by an eligible generator. This credit may be crucial to the financial viability of most renewable electricity projects. A net metering law may establish a standard procedure for interconnecting renewable energy systems, thereby removing significant administrative barriers.

It should be noted that net metering is distinctly different from the Qualifying Facilities rules that govern the interconnection of facilities intending to sell power to the grid. The distinction is important because net metering exists to serve facilities aiming to meet some or all of their annual electricity demand, rather than those built for the purpose of selling power.

Interconnection under net metering is more financially attractive to the customer-generator than the Qualifying Facilities tariffs. Under net metering, the customer's renewable generation is credited at the retail rate. Under Qualifying Facilities, the generator is paid the avoided cost rate, which is less than the retail rate, making net metering a more favorable policy for renewables.

It should also be noted that numerous organizations dedicated to advancing the deployment of renewables have identified net metering and supporting interconnection standards as key facilitating policies. These include (but are not limited to) the Interstate Renewable Energy Council, the Solar Energy Industries Association, and DOE.

### **FEED-IN TARIFF**

A Feed-in tariff (FIT) establishes rates for renewable power and mandates electric utilities to purchase that renewable power under long-term contracts at these above-market rates (which would be established by the PSC).

FITs are also known as “production-based incentives” because the payments are based on the amount of electricity generated by the facility and recorded on a meter. Many incentive programs, such as tax credits and rebates, pay people for purchasing and installing equipment, but there is no verification that the systems actually generate power. Under FITs, payments are only made for electricity generated onto the grid.

## **Policy Design**

### **PRICING STRATEGIES**

Specific pricing strategies have both positive and negative attributes.

- Inclining block rates as they refer to energy charges are mainly employed for smaller consumers, residential, and general service, where the customer group is fairly homogenous and only basic kilowatt-hour (kWh) metering is available. Inclining block rates are not effective in encouraging conservation, unless the higher-use blocks are much more expensive, and at that level they are not cost based. This has an adverse impact on low-income customers who often lack the resources to reduce consumption by replacing energy-consuming devices with high-efficiency units or by housing modifications. Based upon this information, this pricing structure is not recommended.
- Flat block rates as they refer to energy charges are mainly employed for smaller consumers, residential, and general service, where the customer group is fairly homogenous and only basic kWh metering is available. This rate design utilizes only a customer charge and energy charge with the fixed demand component bundled within the energy charge at an average load factor. Although flat block rates have a better alignment of costs with pricing, they offer no incentive for the customer to modify consumption patterns by either improving efficiency or conserving energy. This rate structure is not recommended, unless it is used as a transitional rate to a more effective time-of-use rate or when combined with a demand charge. This pricing scheme is not recommended for rates with only a customer charge and an energy charge, but is appropriate for rates that also include a demand component.
- Time-of-use rates are currently directed at larger customers because of the historically higher cost of the required metering. However, with the availability of advanced metering at lower

prices, this rate structure may be appropriate for use by a larger number of customers. With a customer charge, a flat energy charge, and a demand charge divided into sufficient tiers, the customers have the flexibility to modify consumption patterns, reducing both billing and contribution to system peaks. Such a rate structure fulfills all goals.

This pricing structure is the most advantageous for all types of customers in aligning price with cost, sending the appropriate signal to the customer, and modifying consumption patterns to maximize system efficiency and conservation. Time-of-use rates are recommended when combined with an aggressive and robust customer education plan, involving all stakeholder groups and innovative tools for customers to manage their energy usage.

To date, these tools are in the development stage. Consequently, the use of alternative transitional rate structures may be helpful while the utility is developing the educational information and tools to assist the customer in taking full advantage of time-of-use rate structures. Critical peak pricing may also be effectively combined with traditional time-of-use rates to possibly deliver an excellent cost-based price signal to encourage energy efficiency.

- Real-time rates require advanced metering and communication with the customer with real-time price signals on a real-time basis of minutes, hours, or next day. Directed at larger customers because of the sophistication needed to monitor the pricing and react operationally, real-time rates have not been readily accepted by customers. Typically electric energy billings account for a relatively small portion of commercial/industrial total expenses; hence, customers do not believe the proposed savings justify the effort. While the rate structure is appropriate, it is not recommended, since customer acceptance is low.
- Cost-of-service rates may take several forms and are dependent on the proper classification of fixed and variable costs into customer, energy, and demand components. Properly identifying fixed and variable costs and assigning them to the customer classes as customer, energy, or capacity is the starting point. Whatever rate design is chosen and approved by the Kentucky PSC, it should then follow cost of service as closely as possible. Customer charges must fully reflect customer cost. Energy charges must be limited as nearly as possible to only reflecting variable cost. Demand charges must be comprised of fixed costs in sufficient detail so as to incent consumption modification. Cost-of-service rates can be used very effectively to transition to time-of-use rates described above.
- Other rate considerations include seasonal differentials and power factor recognition. Seasonal differentials are useful in assigning cost, but have little impact on consumption patterns, unless used in conjunction with other techniques, such as time-of-use pricing. Power factor recognition, either through kilowatt (kW) correction or kilovolt-ampere (kVA) billing, is vital for providing larger customers an accurate price signal.

**Goals:** Time-of-use rates should be implemented by 2012. Modification of consumption patterns resulting in increased system efficiency may be measured through decreased system peaks, increased system load factors, and increased system power factors. Even without a reduction in kWh sales, these impacts may result in a reduction of GHGs, since losses are related to load exponentially.

**Timing:** See above.

**Parties Involved:** Utilities, PSC, Attorney General, Customers, community action groups, and other interested parties.

**Other:** None.

**INTERCONNECTION RULES AND NET METERING:**

**Goals:** The goal of this policy is to establish the most supportive net metering and interconnection rules to most effectively facilitate the connection of renewable or distributed energy resources to the grid.

*Net Metering*—Kentucky’s net metering law could be amended in the following ways:

- Consider changing the cap on the size of eligible systems, or at least increase the cap from 30 kW. This will enable large industrial and commercial customers to participate in net metering.
- Adjust the cap on the aggregate total of net metering generation.
- Allow third-party ownership of systems eligible for net metering. This will enable customers to lease renewable energy equipment or enter into Power Purchase Agreements for the purchase of renewable power and utilize net metering.
- Allow utility ownership of renewable distributed generation, storage solutions, and/or energy conservation devices “behind” the customer meter, with recovery equal to the cost of new generation capacity.

**Timing:** The measures to amend the net metering guidelines should be considered by the Kentucky legislature in 2011.

**Parties involved:**

- Kentucky retail electric suppliers and their customers.
- Renewable energy companies would have a direct stake in this and would financially benefit from the implementation of these policies.
- Environmental groups, to the extent they support renewable energy development.
- The Attorney General is typically involved in cases before the PSC.

**Other:** None.

**FEED-IN TARIFF:**

Kentucky’s FIT should apply to the following renewable energy technologies: solar, wind, low-impact biomass/biogas, and hydroelectric. FITs are only successful if well designed.

The rates paid to renewable energy producers would be established by the Kentucky PSC for each technology, and would be based on the total cost for generating the power, allowing a reasonable payback period. Utilities would be mandated to purchase power from any renewable

energy generator within the state who meets the technical requirements. Residential and small commercial systems would all be eligible to participate.

FITs would be established for each eligible technology, and different rates would be allowable within a class of technology based on size or other factors, where the PSC finds that these differences significantly affect the cost of generating power.

Every two years, the PSC would review the tariffs for each technology and adjust the rates and interconnection guidelines as appropriate. The amount paid for the renewable power would be recovered by the utilities through a surcharge on the customer's monthly bill.

The rates established by the PSC would be binding on municipal utilities, but not on Tennessee Valley Authority (TVA) distributors.

**Goals:** See above.

**Timing:** No timelines set at this time. The PSC will establish an administrative case to establish the guidelines for the FIT within 180 days of the enactment of FIT legislation.

**Parties involved:** Electric utilities, industrial customers, the Attorney General, renewable energy companies, environmental and public interest organizations.

## Implementation Mechanisms

## Related Policies/Programs in Place

## Type(s) of GHG Reductions

## Estimated GHG Reductions and Net Costs or Cost Savings

**Data Sources:**

**Quantification Methods:**

**Key Assumptions:**

## Key Uncertainties

## Additional Benefits and Costs

## Feasibility Issues

**Status of Group Approval**

**Level of Group Support**

**Barriers to Consensus**

## ES-6. New Nuclear Energy Capacity

### Policy Description

Nuclear power has historically been a low-GHG source of electricity. However, no new commercial reactor has come on line in the United States since 1996, due to high capital costs, the absence of a repository or technology for permanent disposal of nuclear waste, and public concerns for safety. The federal government has been supportive of nuclear expansion, emphasizing its importance in maintaining a diverse energy supply and its reputation for producing electricity with negligible pollutant emissions during operation. Congress has also offered significant financial subsidies for new nuclear plants in an effort to jump-start the industry.

Steps to encourage nuclear power options in the state could begin with the removal of the statutory ban against constructing a nuclear plant in Kentucky (Kentucky Revised Statute 278.600-610), could include the provision of a streamlined siting review and a streamlined appeals process, and could enact policies to reduce the risk to capital. The state could serve as a facilitator in developing a new nuclear facility, recognizing the cost and financing burdens such a facility could impose on existing state companies. Small-scale nuclear options could also be considered.

### Policy Design

#### Goals:

- Develop policy recommendations to encourage the licensing and construction of baseload nuclear power plants in Kentucky. State-level legislative and regulatory approaches are needed to overcome barriers and facilitate construction of new nuclear plants.
- Install 2,000 MW of nuclear generation in Kentucky.

**Timing:** Consider removal of barriers and improved regulatory approaches in 2011 and baseload operating units by 2025.

**Parties Involved:** Kentucky General Assembly, PSC, Nuclear Regulatory Commission, EEC, regulated utilities, municipal utilities, TVA, and energy company consortia.

**Other:** Promote programs to develop job opportunities in the construction and operation of nuclear units.

### Implementation Mechanisms

### Related Policies/Programs in Place

**Type(s) of GHG Reductions**

**Estimated GHG Reductions and Net Costs or Cost Savings**

**Data Sources:**

**Quantification Methods:**

**Key Assumptions:**

**Key Uncertainties**

**Additional Benefits and Costs**

**Feasibility Issues**

**Status of Group Approval**

**Level of Group Support**

**Barriers to Consensus**

## ES-7. Renewable Energy Incentives and Barrier Removal, Including CHP

### Policy Description

#### RENEWABLE PORTFOLIO STANDARD

Renewable portfolio standards (RPS) require utilities to meet a portion of their electricity demand with electricity generated with renewable resources. Twenty-nine states and the District of Columbia have enacted some form of portfolio standard. The Governor's energy plan, *Intelligent Energy Choices for Kentucky's Future*, sets a target of 16% efficiency and 1000 MW of renewable electricity by 2025.

An RPS with an energy efficiency component will mandate the use of renewable sources of electricity and may stimulate energy efficiency programs. It is extremely difficult to increase the use of renewable electricity in the state without a legislative mandate. The cost of generating electricity from renewable resources is typically higher than from conventional resources, such as coal. The levelized energy cost (LEC) of a coal-fired power plant may be as low as \$.03/kWh whereas the LEC for solar electricity could be as high as \$.30/kWh. This is important because the PSC must approve the procurement of renewable electricity and cost recovery for utilities within its jurisdiction. If a utility can generate or purchase the electricity at a lower cost, the PSC must approve the acquisition of electricity above this cost.

RPS policies vary across the states that have adopted them, and Kentucky should review its own renewable opportunities and craft an RPS that best suits the state. The energy plan cited that residential electricity use was 24% above the national average in 2006. The opportunity exists to use electricity more efficiently. A Kentucky portfolio standard could incorporate efficiency mandates.

Kentucky has an opportunity to develop energy crops and a supply chain that will facilitate their development and use.

Distributed generators of renewable electricity can provide benefits. Distributing solar throughout a region that has adequate sun could reduce the demand for electricity at the source. Distributed renewable systems can sometimes make use of existing transmission and distribution (T&D) lines. A Kentucky portfolio standard should allow for deployment of distributed sources of renewable electricity.

In addition to establishing demand for renewable electricity through a portfolio standard, Kentucky should consider support for locally or at least regionally supplied renewable resources. Building local supply chains for biomass has the capacity to increase the amount of dollars available to qualify in localities. Since Kentucky has significant potential to grow biomass for energy, policies could be derived that ensure supply is available to meet the standard set by the legislature. A portfolio standard is just one part of the equation; supply must also develop.

## **HYDROELECTRIC DEVELOPMENT**

There are three primary barriers associated with the development of hydroelectric power plants. Federal Energy Regulatory Commission (FERC) licensing can take 2–5 years. Siting is specific to the resource and the availability of dams, since constructing new dams is controversial. Kentucky currently has 783 MW of installed hydroelectric capacity in the state. The potential according to the 1998 *U.S. Hydropower Resource for Assessment for Kentucky* is just under 900 MW.<sup>3</sup> Within this potential is 105 MW of power associated with the Meldahl hydroelectric plant, which is already under construction. Construction of Smithland and Cannelton plants are also underway.

It is possible to address the economic barrier that exists. Currently the Incentives for Energy Independence Act already includes hydroelectric facilities as eligible projects for tax incentives, provided they generate 1 MW of power or more and incur a \$1 million investment.

New hydro capacity and improvements to existing hydro plants that result in added capacity should qualify as a renewable energy resource under a state portfolio standard.

## **COMBINED HEAT AND POWER**

Combined heat and power (CHP) and waste heat recovery are systems that enable a consumer to make better use of waste heat or thermal energy associated with industrial processes or power production. Several barriers exist to increasing these systems. One of the biggest barriers is the spark spread, which is the difference between the cost of fuel for the CHP system to produce power and heat on site and the offset cost of purchased grid power. A second barrier is the use of standby charges, which are set to reflect the costs associated with generating the electricity if a CHP system fails to generate its agreed-upon amount of electricity.

## **BARRIER REMOVAL**

The large-scale development (1 MW and greater) of grid-based and distributed renewable energy resources could offer benefits and opportunities for Kentucky.

Effective policies are needed to remove the financial, educational, and regulatory barriers to the large-scale development of renewable energy resources in Kentucky and to provide adequate incentives.

## **Financial Barriers**

Renewable technologies entail high capital costs, but for some (wind, solar, hydro) no recurring fuel costs. Financial incentives are needed to offset the low cost of the current conventional energy system and to provide the investor the financial return to invest in the higher capital costs of renewable technologies.

Renewable resources are competing against prices based on electricity generated from coal. Power from Kentucky's existing coal plants is relatively inexpensive. If national carbon

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<sup>3</sup> A.M. Conner and J.E. Francfort. *U.S. Hydropower Resource Assessment for Kentucky*. DOE/ID-10430(KY). Idaho Falls, ID: Idaho National Engineering and Environmental Laboratory and Lockheed Martin Idaho Technologies Company, July 1998. Available at: [hydropower.inel.gov/resourceassessment/pdfs/states/ky.pdf](http://hydropower.inel.gov/resourceassessment/pdfs/states/ky.pdf).

regulation comes to pass, the cost of power from those plants will increase. It will take a very substantial carbon price to make some forms of distributed renewable electricity cost-effective. Taking action in anticipation of the federal government setting a price on carbon should proceed carefully. Premature action would increase the cost of electricity for Kentucky consumers.

Another financial barrier that exists is the upfront cost of large-scale, distributed renewable electricity systems and the cost to finance those systems. Specifically related to solar, a financing model—third-party partnership model—should be developed to address this barrier and to make efficient use of federal tax credits available for solar power. An entity, such as a school, hosts a 1 MW or above solar system and purchases the electricity from that system. A solar developer serves as the middle man and receives the solar Renewable Electricity Credits. The third party receives income from the electricity sales, as well as reduced tax liability associated with the tax credits in exchange for upfront capital.

A problem arises in Kentucky whenever a utility under the jurisdiction of the PSC serves the area. The host is required to purchase electricity from that utility and not from the solar project. This barrier could be removed by allowing a consumer to purchase the electricity from a 1-MW renewable system that is attached to the consumer. This financing model is especially important when financing distributed solar projects for entities without tax liability, such as schools.

### **Educational Barriers**

There is a great lack of education among the public and decision makers about renewable energy and its availability in Kentucky. The large-scale development of distributed renewable energy must engage a much larger segment of the population in the generation of power than is presently the case. A broad, intensive, and long-term educational campaign is needed to educate the citizenry about energy fundamentals and renewable energy.

### **REGIONAL RENEWABLE ENERGY PLANNING GROUP**

Kentucky currently generates very little renewable energy, and the question of the state’s true potential for generating renewable power remains a subject of debate. Each state has its own unique, local resources (natural, human, infrastructural, economic) and its own particular needs. A Regional Renewable Energy Planning Group would invite each of Kentucky’s neighboring states (and perhaps others from the region) to work together to find opportunities to solve common problems, to share resources and knowledge, and to cooperate in meeting the common goals of cutting GHG emissions and developing a thriving renewable energy economy.

## **Policy Design**

### **RENEWABLE PORTFOLIO STANDARD (RPS)**

**The group could not reach consensus on specific percentages and timetables for an RPS, but agreed to study the following for investigative purposes and suggested energy efficiency analysis using the two major federal initiatives as scenarios for assessing cost and benefits.**

#### **Goals:**

- Enact an RPS that incorporates efficiency and renewable electricity resources. To assess a range of RPS targets, the following are to be quantified as follows:

- *Upper target*—Starting at the end of 2014, require a renewable contribution of 2%. Every 4 years thereafter, increase the contribution by 4%, so that in 2018 the standard would be 6%; 2022, 10%; 2026, 14%; and 2030, 18%.
- *Lower target*—Exactly half of the upper target standards in each year.
- For modeling of efficiency targets, use the national targets proposed by the Waxman and Bingaman as sensitivity targets.

**Timing:**

- Congress is debating a national RPS. Kentucky must be prepared to enact policies that ensure development of renewable resources within the state if a national standard is enacted. Developing renewable energy projects within the state to meet the mandate may yield a more positive economic impact, since importing renewable electricity from out of state will result in loss of wealth from the state.
- This policy, along with policies that ensure local supply of renewable resources, must be timed to coincide in such a way that the local resource is available to meet the standard at each benchmark year. If local resources are not available, renewable electricity will likely be purchased from other states.

**Parties Involved:** The PSC will oversee compliance with the mandate; customers will be affected by the cost of the mandate; energy developers will be impacted by the demand for renewable and low-carbon resources; and energy auditors and contractors will be affected by the growth in efficiency programs.

**HYDROELECTRIC GENERATION**

**Goals:** Properly define hydroelectric resources within the state portfolio standard to ensure efficiency improvements that increase capacity are included, despite the fact that changes are being made to an existing plant.

**Timing:** See RPS above.

**Parties Involved:** Existing permit holders, potential hydroelectric developers, utilities, PSC, and Kentucky Cabinet for Economic Development, provided changes are made to the existing incentives.

**Other:** It is important to note that FERC gives preference to municipally owned utilities when awarding hydro licenses. An IOU that is required to comply with a portfolio standard may not have access to potential hydroelectric capacity.

**COMBINED HEAT AND POWER**

**Goals:** Properly define CHP and waste heat recovery within the state portfolio standard, to ensure that the systems could contribute to a utility’s compliance with any part of the standard (efficiency, renewable—if powered by a renewable resource).

**Timing:** See RPS above.

**Parties Involved:** Utilities, PSC, consumers with CHP or waste heat recovery systems.

**Other:** None.

### **BARRIER REMOVAL**

Three strategies are called for to address the barriers described above.

1. *Feed-In Tariffs*—Use FITs to promote the development of renewable energy.
2. *Third-Party Partnership Model*—Enable the benefits of this model for distributed solar systems 1 MW and above by allowing the host entity to purchase the generation from onsite systems.
3. *Renewable Energy Education Program*—Develop a well-funded, long-term statewide program to educate the general population and decision makers about energy fundamentals and renewable energy. This program would also address conservation and energy efficiency and enable customers to better understand where their energy comes from, what their options are for using less energy and lowering energy costs, and how to become renewable energy generators. This program could be funded by a Systems Benefit Charge on the utility bills of all residential, commercial, and industrial electric customers (\$0.0001/kWh (or 0.1 mil)) would generate approximately \$10 million per year for the program.

**Goals:** See above.

**Timing:** See RPS above.

**Parties Involved:** These policies would be implemented through an act of the legislature. Other parties involved include electric utilities, PSC, Center for Renewable Energy Research and Environmental Stewardship (CRERES), the Conn Center at the University of Louisville (which manages CRERES), Attorney General, Kentucky’s industrial and manufacturers’ associations (they would have positions on any changes to the PSC and creation of the Systems Benefit Charge and the FIT), renewable energy businesses, environmental and public interest organizations. All energy consumers, including residential, low-income, seniors, commercial, and industrial.

**Other:** None.

### **REGIONAL RENEWABLE ENERGY PLANNING GROUP**

1. Identify opportunities for interstate collaboration to meet needs for renewable energy and GHG emission reduction.
2. Identify barriers to transmission of renewable power across the region (and into and out of Kentucky) (FERC Issue).
3. Identify opportunities for sharing economic benefits and costs of renewable energy development.
4. Develop solutions to common problems related to renewable energy development and GHG emission reduction.

**Goals:** This sub policy does not have specific quantifiable goals at this point.

**Timing:** The Planning Group would be initiated in 2011 and would continue meeting so long as its activities were fruitful.

**Parties Involved:** Kentucky, Ohio, Indiana, Illinois, Missouri, Tennessee, North Carolina, Virginia, West Virginia State Energy Office personnel (Renewable Energy staff), representatives from electric utilities, local and regional renewable energy businesses, local and regional environmental and public interest organizations, energy consumer organizations, Attorney General, Kentucky industrial utility customers, etc.

**Other:** None.

### Implementation Mechanisms

### Related Policies/Programs in Place

### Type(s) of GHG Reductions

### Estimated GHG Reductions and Net Costs or Cost Savings

**Data Sources:**

**Quantification Methods:**

**Key Assumptions:**

### Key Uncertainties

### Additional Benefits and Costs

### Feasibility Issues

### Status of Group Approval

### Level of Group Support

## Barriers to Consensus

## ES-8. Technology Research and Development (Not Including CCSR or Wind Potential Study)

### Policy Description

Kentucky has benefited from low-cost energy supplies due to its bountiful supply of fossil fuel resources. However, with increasing environmental pressures on the utilization of these resources, it is imperative that the state develop a broader portfolio of environmentally feasible technologies for energy production. Technology research, development, and demonstration (RD&D) must play a critical role in the development of economically feasible solutions for Kentucky's future.

Kentucky has invested heavily in research and development (R&D) for fossil fuels. This policy will develop a roadmap for expanding the research into renewable energy sources, energy efficiency technologies, distributed/grid-scale storage, carbon-free fuel generation, and pyrolysis of municipal solid waste, and will provide for large-scale demonstrations, as well as smaller deployments in residential or commercial applications. The policy should enable development of Kentucky-specific roadmaps for implementation of renewable energy generation and conservation technologies.

One area of particular interest is the demonstration of solar electric generation. While photovoltaics (PVs) have been around for many years, it is only recently that their prices have begun to come down to the point that PVs are being installed as part of utilities' generation mix. In other parts of the country, PVs are now being installed on a utility scale. While PV prices are not yet competitive with cheaper generation currently in use in Kentucky, it is important that utilities gain some experience now with this technology, so adoption will be easier as PV prices come down and fossil fuel costs rise. Utilities need to gain experience in how to interconnect and integrate utility-scale PVs into their systems. This will help to quantify the benefits of this technology that will help utilities provide valuable power during expensive summer peak periods. Another area of related interest is with utility-scale/substation-scale energy storage to enable adaptation of solar electricity and peak demand management.

### Policy Design

The Governor's seven-point energy plan, *Intelligent Energy Sources for Kentucky's Future*, proposed a multifaceted solution for Kentucky's energy future, while focusing on technologies that will reduce the environmental impacts of energy use. Of particular note in the plan is the expanded use of renewable energy, including solar and wind. Innovative renewable technologies are also an option.

The energy plan outlined several goals for attainment of a viable renewable energy industry within the Commonwealth. The Governor stated that "by 2025, Kentucky will derive at least 25 percent of its projected energy demand from energy efficiency, renewable energy and biofuels...." This policy should enable the identification of the technological and economic

barriers of implementing this goal and should provide research and demonstration opportunities and funding mechanisms to close the gaps in attaining this goal.

**Goals:**

- In collaboration with a panel of industry experts, DEDI will develop a comprehensive roadmap for the ultimate deployment of solar electricity, renewable energy storage, solar fuels, wind, biofuels, and other renewable energy forms within the Commonwealth. The roadmap should identify areas of basic and/or applied research required for ultimate deployment of the technologies. In addition, demonstration projects should be identified.
- DEDI will construct a directed research effort for each technology gap identified in the roadmap. Research opportunity notices will periodically be issued, and DEDI will manage the portfolio of research projects.
- Where technologies are sufficiently mature, DEDI will develop demonstration and/or pilot projects to bring the technologies to commercial readiness.
- DEDI will develop funding mechanisms for RD&D projects.
- DEDI will develop communication plans regarding these technologies.
- Install five utility-scale PV power plants of at least 1 MW each, with one of the plants being at least 5 MW. Each of the major utilities in Kentucky should be targeted as partners in installing these plants. Subsidies need to be supplied to bring the cost of these pilot plants down to the point that they are cost competitive for the participating utilities. These pilot plants may be installed directly by the utility, or by an independent power producer (IPP) working with a utility, in the utilities service territory.

**Timing:**

- *December 2010:* Publish a comprehensive renewable energy roadmap.
- *January 2011:* Issue R&D notices.
- *February 2011:* Issue demonstration project notices.
- *March 2011:* Announce first-round funding for demonstration projects.
- *April 2011:* Announce first-round funding for R&D projects.
- *2011:* Parties, including utilities and others, should form a working group to identify potential projects and project locations. This group should also quantify the level and source of subsidies needed for each demonstration project, and work on securing these funds.
- *2012:* The first of these 5 demonstration projects should be installed.
- *2013:* The remaining 4 demonstration projects should be installed.
- *2014 and beyond:* Data should be taken from these projects that will aid in the installation of future utility-scale PV plants.

**Parties Involved:** Legislative bodies of the Commonwealth of Kentucky, PSC, state government offices, utilities and other energy suppliers, universities and other research entities, CRERES.

**Implementation Mechanisms**

**Related Policies/Programs in Place**

**Type(s) of GHG Reductions**

**Estimated GHG Reductions and Net Costs or Cost Savings**

**Data Sources:**

**Quantification Methods:**

**Key Assumptions:**

**Key Uncertainties**

**Additional Benefits and Costs**

**Feasibility Issues**

**Status of Group Approval**

**Level of Group Support**

**Barriers to Consensus**

## ES-9. Policies to Support Wind Energy

### Policy Description

It has long been thought that there was little wind potential in Kentucky. This opinion was based on an old wind map from the 1980s that showed only very limited potential, and only in extreme eastern Kentucky. This map was at a 50-meter hub height, and was based on airport data taken at ground level. Since Kentucky is mostly covered by trees, we must get significantly above the tree canopy before we see significant wind.

In 2010, new wind maps published by the National Renewable Energy Laboratory (NREL) at 80 meters were released.<sup>4</sup> These maps show much more wind potential for Kentucky than previously thought. The 2010 wind map is at 80 meters. NREL also published projections of total wind potential for Kentucky at 100 meters, which estimates Kentucky to have between 40,000–50,000 MW of wind potential with a 25% capacity factor or greater. It should be noted that some wind turbines are being installed now in the United States at 100 meters.

While other states may have higher wind speeds, they are finding that sparsely populated areas with good wind sites are far away from any electric transmission. Kentucky is quite the opposite, with good transmission system lines (69 kV and up) lacing the state that that might serve a distributed network of wind farms. Larger wind farms and high penetration of wind in a particular area would require specific studies and would likely require transmission upgrades, like any larger new power plant. Kentucky's transmission access, coupled with taller towers and higher hub height wind turbines, may allow wind power to be generated cheaper in Kentucky than it can be imported from more windy states.

If Kentucky is to develop wind capacity, it first needs to better understand the resource. While the 2010 NREL study offers some new estimates, it is based on modeling and not actual data (although the model is validated with actual data collected at varying heights). Kentucky should collect wind data to further validate or identify bias within the wind map. The actual data can then be disseminated to utilities, independent developers, and elected officials and may influence policies.

### Policy Design

#### Goals:

- *Spring 2011:* Convene a Statewide Wind Working Group. Participants would include experts from government, utilities, IPPs, and universities. This group would identify funding sources, tower locations, and an entity to manage the data and would ensure the data are widely disseminated.
- *Summer–Fall 2011:* Identify 10 potential wind sites around Kentucky, for placement of meteorological towers. Locations should have good wind potential, as per the NREL studies, have potential for large development of multiple units with good potential construction

<sup>4</sup> See <http://www.nrel.gov/gis/wind.html>.

access, and be located within a reasonable distance of a transmission line. Whenever possible, equipment should be installed on existing structures to reduce cost. Areas deemed to have less certain wind speed by NREL, such as along ridge lines, should also be targeted for wind data collection sites.

- *Fall-Winter 2011*: Quantify the cost of monitoring and acquire the funds necessary to install the monitoring equipment and towers. Arrange for NREL to accommodate the data and make revisions to Kentucky’s wind potential if possible and if needed.
- *Spring 2012–Summer 2013*: Install equipment and collect and process data. Towers would collect wind speed data at an elevation appropriate to extrapolate information about wind speeds at 100 meters and 120 meters.
- *Spring 2012–Summer 2013*: Identify turbine designs that are best suited for Kentucky’s resource and landscape.
- *Fall 2013*: Disseminate monitoring results to utilities, IPPs, and the general public who might be interested in smaller installations in the general areas.
- *Spring 2012–Fall 2013*: Identify and work on state policy and legislative changes necessary for large-scale wind implementation. Complete an economic impact analysis based on the data to include levelized energy cost, impact on tax revenue, jobs, and electricity rates. Based on the findings of the analysis, the working group will recommend next steps, which may include specific goals for installed capacity.

**Timing:** See above.

**Parties Involved:** Participants in the Statewide Wind Working Group would include experts from government, utilities, IPPs, independent transmission organizations, and universities.

**Other:** None.

### Implementation Mechanisms

### Related Policies/Programs in Place

### Type(s) of GHG Reductions

### Estimated GHG Reductions and Net Costs or Cost Savings

**Data Sources:**

**Quantification Methods:**

**Key Assumptions:**

**Key Uncertainties**

**Additional Benefits and Costs**

**Feasibility Issues**

**Status of Group Approval**

**Level of Group Support**

**Barriers to Consensus**

## **ES-10. Shale Gas Development and Natural Gas Transportation Infrastructure and Gas-to-Liquids Technology**

### **Policy Description**

The shale gas policy will help stimulate increased shale gas production and development in Kentucky. Increased Kentucky production will provide more natural gas supply as an alternative fuel to help reduce overall GHG emissions. Additional production could provide additional severance tax revenues to the state. Additional production could also have some impact on the national supply/demand balance, and thus could have some, although probably limited, impact on natural gas prices.

The Natural Gas Transportation Infrastructure policy will help provide for the development of a natural gas filling station infrastructure across Kentucky. This will help to replace oil-based fuels and will thus reduce GHG emissions from vehicles. A program to provide such infrastructure has been undertaken in Utah.

The gas-to-liquids (GTL) policy will provide for the development of liquid fuels from natural gas. This will help to replace oil-based fuels and will reduce GHG emissions. There are three possible options for GTL fuels. The first is cryogenically liquefied natural gas (LNG), the second is liquids removed from natural gas, and the third is liquids (typically substitute diesel and/or gasoline) made by chemically converting natural gas to long-chain hydrocarbon molecules.

Diesel-fueled heavy vehicles converted to run on LNG offer four advantages: lower GHG emissions, lower emissions of air pollutants, significantly reduced cost compared to diesel, and reduced dependence on foreign oil. Liquids removed from natural gas prior to introducing it into a pipeline are higher-value products and can also help reduce consumption of oil-based fuels. Both of these alternatives should be pursued as part of Kentucky's energy strategy.

However, the third option (chemically changing natural gas into substitute gasoline or diesel fuel) is a higher cost process, and will emit GHGs generated during the conversion process. Also, since the same liquid fuel molecules (either gasoline or diesel) would be made during the conversion, there would be no reduction of GHG emissions during the burning of the fuel. Also, the automotive demand for liquid fuels is so huge that any appreciable penetration of that market, coupled with the other initiatives for LNG and natural gas liquids, would inevitably result in considerable upward pressure on natural gas prices, thereby threatening developing demand for natural gas in higher-value applications. Therefore, chemical conversion of natural gas into substitute gasoline or diesel fuel is not recommended.

All three of these topics are related to natural gas, a domestic fuel that can help to lessen our country's dependence on imported fuels. They can all help to stimulate Kentucky's economy and create jobs in Kentucky, while continuing to develop Kentucky's natural gas reserves. They can provide energy alternatives that help to reduce Kentucky's GHG emissions and also reduce the state's and the country's carbon footprint.

## Policy Design

It is not possible at this time to quantify costs or savings relating to these policies.

### Goals:

- *Shale Gas*—Provide for increased development of natural gas from shale formations, with an annual production increase of 50% by 2020, through increased drilling as well as enhanced drilling methods.
- *Natural Gas Transportation Infrastructure*—Provide for the development of a statewide network of compressed natural gas filling stations in order to have natural gas filling stations in all cities with populations greater than 10,000 by 2020 and to facilitate the increased use of natural gas as a vehicle fuel.
- *Gas to Liquids*—Provide for the development of liquid fuel from natural gas so that such fuel could be used in 2,000 heavy vehicles by 2016, instead of oil-based fuels currently used, such as gasoline or diesel fuel. Also, a secondary goal related to natural gas liquids is the removal of more liquids, sufficient to remove liquids from the planned 50% increase in shale production by 2020. By removing more liquids from the natural gas produced in Kentucky, this will alleviate liquids issues in pipelines and thus allow Kentucky production to be more easily marketable into interstate pipelines. The marketability of such liquids could provide additional revenue to producers, gas processors, and the state.

**Timing:** All policies are needed and implementation should proceed on an expedited basis.

### Parties Involved:

- *Shale Gas*—All future drilling in Kentucky and natural gas producers, as well as financial institutions (in support of funds for the investments) and state agencies overseeing permits, etc.
- *Natural Gas Transportation Infrastructure*—Natural gas distribution companies, PSC, Kentucky Transportation Cabinet, and EEC.
- *Gas to Liquids*—Natural gas producers, natural gas distribution companies, natural gas transportation pipelines, and midstream processing entities. The policy would support new activity in cryogenically liquefying and distributing LNG.

**Other:** The Natural Gas Transportation Infrastructure policy should evaluate the natural gas T&D infrastructure in Kentucky to determine suitable available capacity for this program.

## Implementation Mechanisms

## Related Policies/Programs in Place

## Type(s) of GHG Reductions

**Estimated GHG Reductions and Net Costs or Cost Savings**

**Data Sources:**

**Quantification Methods:**

**Key Assumptions:**

**Key Uncertainties**

**Additional Benefits and Costs**

**Feasibility Issues**

**Status of Group Approval**

**Level of Group Support**

**Barriers to Consensus**

## ES-11. Smart Grid, Including Transmission and Distribution Efficiency

### Policy Description

The term “smart grid” has taken on wide range of meanings. Smart grid can be divided into two functional areas: customer load and use management, and T&D monitoring and control. Application of each can result in increased electrical efficiency, utilization, operational efficiency, reliability, or electricity load management. Each of the functional areas relies on advanced monitoring, controls, data analysis, and communications.

Kentucky’s electric utilities are in various stages of deploying Advanced Meter Infrastructure (AMI) or electric meters that are able to record consumption and other data hourly or more frequently, and are capable of two-way communication with a central location. The meters are also capable of communicating with equipment within the customer’s premises. In addition to allowing the customers to control their own usage more effectively, AMI enables various pricing strategies designed to reduce GHG emissions.

T&D monitoring and control are other areas where energy losses and service improvements can be gained. Enhanced voltage monitoring and control, real-time ambient condition monitoring, and automated switching are examples of “smart technologies.” Also, installation of higher-efficiency transformers and conductors can reduce energy losses in the delivery systems. T&D equipment are long-life assets, but replacements, when needed, should be with higher-efficiency designs over time. Distribution equipment is already subject to revised, higher-efficiency DOE standards and higher-efficiency distribution transformers may not be cost-effective at this time.<sup>5</sup>

Installation of smart grid technologies will enable other technologies, such as integration of intermittent or distributed generation.

This policy should be designed to accelerate the deployment of smart grid technologies and electricity delivery efficiency improvements. Current legislation and/or regulations require utilities to provide service in a least-cost manner. Those requirements for least cost would have to be modified to accomplish the objectives of this policy.

### Policy Design

#### Goals:

- 25% coverage for AMI by 2015, 50% by 2020, and 100% by 2025.
- Complete transmission infrastructure replacements (transformers and conductors) with higher-efficiency equipment as projects are implemented. Reduce transmission losses by 10% by 2030.
- Complete distribution infrastructure replacements (transformers and conductors) with higher-efficiency equipment as projects are implemented. Reduce distribution losses by 10% by 2030.

<sup>5</sup> Report from Howard Industries, October 14, 2009, <http://www.neppa.org/presentations/DOEFinalRule.pdf>.

T&D losses are typically around 5%, so a 10% reduction in the losses would be a 0.5% reduction of the net generation.

**Timing:** See above.

**Parties Involved:** These policies would apply to all electric utilities and will require enabling legislation, in the form of funding mechanisms and/or PSC authority for special rate treatment. Affected parties include electric utilities (PSC regulated, TVA distributors, and municipally owned) and customers.

**Other:** Pricing signals will be necessary for end-use reduction. A renewable and efficiency standard would encourage smart grid and transmission enhancements as a means to meet the efficiency standard.

### Implementation Mechanisms

### Related Policies/Programs in Place

### Type(s) of GHG Reductions

### Estimated GHG Reductions and Net Costs or Cost Savings

**Data Sources:**

**Quantification Methods:**

**Key Assumptions:**

### Key Uncertainties

### Additional Benefits and Costs

### Feasibility Issues

### Status of Group Approval

### Level of Group Support

## Barriers to Consensus

## ES-12. Coal-to-Liquids Production: GHG Emission Reduction Incentives, Support, or Requirements

### Policy Description

Coal is the only domestically obtainable asset available in sufficient quantity to meet America's demand for chemicals and liquid transportation fuels that are currently manufactured using foreign oil supplies. In fact, 94% of this nation's Btus are found in U.S. coal reserves. Natural gas and crude oil represent 4% and 2%, respectively, of the Btu total. A robust coal-to-liquids (CTL) industry would have a large positive impact on energy independence and national security. Unfortunately, traditional manufacture of liquids from coal (as exemplified by SASOL in South Africa) emits considerably more (some say as much or more than double) GHGs than manufacturing the same liquids from oil. Consequently, any move toward developing a CTL industry that has GHG reduction as a primary goal must include a method of reducing GHG emissions in the CTL manufacturing process. Currently, the only options on the horizon for accomplishing that reduction are using CO<sub>2</sub> captured during the CTL manufacturing process for enhanced oil recovery and/or coal bed methane recovery (EOR and/or CBMR), or capturing the CO<sub>2</sub> and sequestering it underground (CCS). Fortunately, both of these options appear feasible under the right circumstances (see the Implementation Mechanisms section).

The coal-to-gas (CTG) policy is based on using coal to enhance domestic natural gas supplies and to prevent the United States from becoming dependent on foreign supplies of natural gas. It shares many of the same characteristics, drivers, and constraints as CTL. The primary difference between the two is that the supply-side characteristics (domestic supply and pricing) for oil support development of a CTL industry. On the other hand, domestic natural gas supplies have increased enormously in the last few years, and it appears that they will continue to increase for the foreseeable future. Demand for natural gas is also increasing, and with the advantage in GHG emissions per unit of power produced that natural gas has over coal, that demand increase is expected to continue. Consequently, the future for natural gas prices and the answer to whether a CTG industry would be economically viable are much less certain.

Therefore, it is recommended that the CTG industry should not be pursued at this time. However, it should be noted that the enablers for CTL (EOR, CCS) in a carbon-constrained world are also necessary to enable CTG. So if in the future CTG becomes more attractive economically, then the same actions discussed in the Implementation Mechanisms section will be as necessary for CTG as they are for CTL.

CTL, especially in a carbon-constrained environment, will be necessary to maintain (and potentially increase) demand for Kentucky coal. This will directly improve the nation's energy independence and security, and will help to stimulate Kentucky's economy and create jobs while continuing to develop Kentucky's coal reserves. It can also help to reduce Kentucky's GHG emissions and the state's and the country's carbon footprint.

### Policy Design

**Goals:** Provide as many gallons of CTL fuels as Kentucky uses for transportation by 2025.

**Timing:** Work on the Implementation Mechanisms (see below) should proceed on an expedited basis. For CTL to be viable in a carbon-constrained world, contracts and pipeline construction for EOR and ECBM projects must be developed as soon as possible, and CCS development must progress rapidly.

**Parties Involved:** The CTL policy will involve coal producers, pipeline builders, and oil producers (for EOR), carbon sequestration firms and the Kentucky Geological Survey (for CCS development), financial institutions, and state agencies overseeing permits, etc.

**Other:** If a robust CTL industry results in additional demand for coal, educational institutions (both universities and technical colleges) must be ready to meet the demand for skilled workers for both the CTL industry itself and the coal mining industry.

### Implementation Mechanisms

### Related Policies/Programs in Place

### Type(s) of GHG Reductions

### Estimated GHG Reductions and Net Costs or Cost Savings

**Data Sources:**

**Quantification Methods:**

**Key Assumptions:**

### Key Uncertainties

### Additional Benefits and Costs

### Feasibility Issues

### Status of Group Approval

### Level of Group Support

## Barriers to Consensus