



[www.kyclimatechange.us](http://www.kyclimatechange.us)

## Brief Descriptions of Catalog Items Energy Supply Technical Work Group

*This document provides brief descriptions of the policy options contained in the corresponding Technical Work Group (TWG) Catalog of State GHG Reduction Policy Actions. The catalog and these brief descriptions will be developed more fully during the climate planning process in Kentucky.*

### ES-1. EMISSION POLICIES AND OVERARCHING ITEMS

#### 1.0 Overarching Items

Overarching items include any current commitments and goals associated with greenhouse gas (GHG) emissions. Examples include any efforts to develop GHG emission reduction goals and targets and an associated action plan for achieving them. Overarching items also include current and potential future regional initiatives, such as those developed under the auspices of the Regional Greenhouse Gas Initiative or the Western Climate Initiative.

#### 1.1 GHG Cap and Trade

A cap-and-trade system is a market mechanism by which GHG emissions are limited or capped at a specified level, and those participating in the system are required to hold permits for each unit of emissions. Through trading, participants with lower costs of compliance can choose to overcomply and sell their additional reductions to participants for whom compliance costs are higher. In this fashion, overall costs of compliance are lower than they would otherwise be.

The initial allocation of the allowances is a crucial policy decision. They can be auctioned (with the proceeds used to benefit consumers who will pay higher costs), or allocated to existing sources, or some combination of the two. Participants can range from a small group within a single sector to the entire economy. As with carbon taxes, the compliance obligation can be imposed “upstream” at the fuel extraction or import level, or “downstream” at points of fuel consumption.

Among the important considerations with respect to a cap-and-trade program are the sources and sectors to which it would apply; the level and timing of the cap; how allowances would be distributed (whether load-based or generation-based, how new market entrants are accommodated, how leakage is addressed, etc.); and what, if any, offsets would be allowed. Other issues to consider include which GHGs are covered; whether there is linkage to other trading programs; banking and

---

borrowing; early reduction credit; what, if any, incentive opportunities may be included; use of any revenue accrued from permit auctions; and provisions for encouraging energy efficiency.

The principal example of a GHG cap-and-trade system in the U.S. today is the Northeast and Mid-Atlantic states' Regional Greenhouse Gas Initiative (<http://www.rggi.org/>).

## **1.2 Carbon/GHG Tax**

A GHG tax would be a tax on each ton of carbon dioxide equivalent (CO<sub>2</sub>e) emitted from certain sources. The tax could be imposed upstream, based for example on the carbon content of fuels (e.g., fossil fuel suppliers), or at the point of combustion and emission. Although taxed entities would pass some or all of the cost on to consumers, there would be competitive pressure to find cost-effective ways to lower (or offset) emissions. Consumers who see the implicit cost of GHG emissions in products and services could adjust their behavior to lower emissions and reduce costs. The program can be designed to be “revenue neutral” (not a net tax increase), for example, by offsetting costs with a corresponding tax reduction (income, payroll, business, etc.); can fund policies and programs to assist with reducing GHG emissions; or can be directed to helping the competitiveness of industries or assisting communities affected by the tax.

## **1.3 Generation Performance Standards and/or Mitigation Requirements for Electricity**

A generation performance standard (GPS) is a mandate that requires load-serving entities to acquire electricity, or power plant developers to build and operate new generation, with a per-unit emission rate below a specified mandatory standard. In some cases, GHG offsets or credits can be used to mitigate emissions and achieve compliance. A market-based variation of a GPS would allow generators with emission rates lower than the GPS to sell their extra “credits” to generators with emission rates higher than the standard.

## **1.4 GHG Targets or GHG Performance Standards**

The setting of GHG targets or performance standards, either mandated or aspirational, can be a mechanism to identify desired GHG emission reductions from a specific baseline year. The rate and amount of reductions from a business-as-usual emission curve are determined by year. In addition to or in lieu of targets, performance standards addressing emission levels and types can be set.

## **1.5 Technology Research and Development**

Research and development (R&D) funding can be targeted toward a particular technology or group of technologies as part of a state initiative to build an industry around that technology in the state, and/or to set the stage for adoption of the technology for use in the state. For example, an agency can be established with a mission to help develop and deploy energy storage technologies. R&D funding can also be made available to any renewable or other advanced technology through an open bidding procedure (i.e., driven by bids received rather than by a focused strategy to develop a particular technology). Funding can also be given for demonstration projects to help commercialize

technologies that have already been developed, but that are not yet in widespread use. Finally, funding could be targeted to increase collaboration among existing institutions in the state for R&D.

Technology R&D is necessary for the preservation of a reliable electricity supply under the carbon constraints that are being contemplated as a matter of public policy. A single technology will not accomplish the broad objectives; rather, technologies of various types and that now exist at various points along the technology development curve will require consideration.

### **1.6 Integrated Resource Planning**

Integrated resource planning (IRP) is a planning process that strives to meet needs for electricity services in a manner that meets multiple objectives, such as least cost, meeting emission standards, fuel diversity, renewable portfolio standard (RPS) requirements, etc. An IRP process should include evaluation of all options, from both the supply and the demand sides, in a fair and consistent manner, building in flexibility to account for future uncertainties. While originally targeted primarily toward cost minimization, IRP processes have increasingly considered the environmental risks and the potential costs associated with future regulation of GHGs.

Kentucky could add the cost of future carbon constraints to utility IRP requirements. Utilities in Kentucky have had to prepare IRPs since the 1990s, and more recently they have considered the impacts of carbon constraints as sensitivity runs within their IRP analyses. Kentucky does not yet require IRPs to quantify environmental risks and costs associated with GHGs or stipulate how this information will affect regulatory decisions. The required addition of the cost of future carbon constraints could have an impact on what resources are pursued in these plans.

### **1.7 Carbon Markets**

Numerous U.S. companies and organizations, including many utilities, have taken on voluntary GHG reduction commitments. Some of these are organized through the U.S. Environmental Protection Agency's (EPA's) [Climate Leaders](#) program. These commitments can be based on total GHG emissions in a given year, or can be defined on an intensity basis (tons of CO<sub>2</sub>e per megawatt-hour [MWh] generated or delivered). Some entities with voluntary commitments also transact through the [Chicago Climate Exchange](#), a self-regulating pilot program for reducing and trading GHG emissions in North America.

### **1.8 Midwest Renewable Energy Planning Group**

This policy option would develop a Midwest Renewable Energy Planning Group to coordinate renewable energy development between Kentucky and neighboring states. Issues to be addressed would include identifying and bringing down barriers to large-scale development of renewable energy in the region; identifying and resolving transmission grid issues that restrict transmission of renewable power across the region and into Kentucky; identifying administrative or legal barriers to large-scale development of renewable energy; sharing best practices; and developing a strategy for large-scale transition to renewable power in the region over the next one to two decades.

**[NOTE: This proposed policy might better be developed in the Cross-Cutting Issues TWG.]**

## **ES-2. RENEWABLE ENERGY AND ENERGY EFFICIENCY**

### **2.1 Renewable and/or Environmental Portfolio Standard**

A renewable portfolio standard (RPS) requires utilities to supply a certain, generally fixed percentage of electricity from an eligible renewable energy source(s). About 20 states currently have an RPS in place. In some cases, utilities can also meet their portfolio requirements by purchasing renewable energy certificates (RECs) from eligible renewable energy projects. With REC “trading,” it may be beneficial to consider a variety of renewable resources.

Similar to an RPS, an environmental portfolio standard (EPS) requires utilities to supply a certain, generally fixed percentage of electricity from both eligible renewable energy source(s) and energy efficiency or other GHG emission-reducing technologies. About 20 states currently have an RPS in place, while only a handful has implemented an EPS.

### **2.2 Grid-Based Renewable Energy Incentives and/or Barrier Removal**

This policy option reflects financial incentives to encourage investment in renewable energy resources, such as wind and solar resources. Examples include (1) direct subsidies for purchasing/selling renewable technologies; (2) tax credits or exemptions for purchasing renewable technologies; (3) renewable energy payments (REPs, sometimes called feed-in tariffs), which provide direct payments to renewable generators for each kilowatt-hour (kWh) of electricity generated from a qualifying renewable facility; (4) tax credits for each kWh generated from a qualifying renewable facility; and (5) regulatory policies that provide incentives and/or assurance of cost recovery for utilities that invest in central station renewable energy systems. In addition, this policy option would make it a priority for the relevant state agencies to identify and rectify barriers to the development of renewable resources in the state.

Considerations for this option could also include interconnection standards and production/performance-based incentives (e.g., statewide program or rebate—such as in the form of dollars per kWh—designed to encourage the use of renewable energy by offering production payments for grid-tied electricity generated by wind, solar, and biomass resources).

### **2.3 Distributed Renewable Energy Incentives and/or Barrier Removal**

This option is analogous to Energy Supply ES-2.2, but focuses on providing incentives for and removing barriers to distributed renewable energy resources throughout the state. Considerations for this option could include corporate tax incentives, sustainable building tax credits, wind and solar energy tax deductions, renewable energy bond programs, personal tax incentives, sales tax incentives, lease purchase programs, grant programs, and loan programs.

One purpose of the incentives could be to achieve a balance between utilities (investor-owned utilities, cooperatives, and municipals) that desire to venture into distributive generation and renewable energy and consumers who desire to invest in distributed generation and renewable energy. Incentives would be crafted to ensure that neither party is disadvantaged.

#### **2.4 Combined Heat and Power Incentives and/or Barrier Removal**

Combined heat and power (CHP) can reduce GHG emissions by increasing the overall efficiency of fuel use. However, there are numerous barriers to CHP, including inadequate information; institutional barriers; high transaction costs because of small projects; high financing costs because of lender unfamiliarity and perceived risk; "split incentives" between building owners and tenants; and utility-related policies, like interconnection requirements, high standby rates, exit fees, etc. The lack of standard-offer or long-term contracts, lack of payment at avoided-cost levels, and lack of recognition for emission reduction value provided also create obstacles. Policies to remove these barriers can include improved interconnection policies, improved rates and fees policies, streamlined permitting, recognition of the emission reduction value provided by CHP and clean distributed generation (DG), financing packages and bonding programs, power procurement policies, education and outreach, etc.

Financial incentives for CHP could include (1) direct subsidies for purchasing/selling CHP systems given to the buyer/seller; (2) tax credits or exemptions for purchasing/selling CHP systems given to the buyer/seller; (3) tax credits or exemptions for operating CHP systems; (4) an REP, which is a direct payment to CHP owners for each kWh of electricity or British thermal unit (Btu) of heat generated from a qualifying CHP system; and (5) tax credits for each kWh or Btu generated from a qualifying CHP system.

**[NOTE: This option is analogous to ES-2.2, Grid-Based Renewable Energy Incentives and/or Barrier Removal.]**

#### **2.5 Green Power Purchases and Marketing**

Green power refers to electricity produced by environmentally benign sources, such as wind, solar, biomass, and hydroelectric generating resources. These programs allow consumers to purchase "green tags" along with their electricity, ensuring that a quantity of electricity equal to their purchase contributed to the development and support of renewable resources. Generally voluntary, these programs can be implemented on a statewide or regional basis.

#### **2.6 Pricing Strategies to Promote Renewable Energy (e.g., Net Metering)**

Kentucky has net metering but it is currently limited to 30 kW. Current statutes do not call for the purchase of surplus production by the utility. In the neighboring state of Ohio, net metering has no size limit, and utilities purchase excess production at net metering rates.

This policy option would remove Kentucky’s 30-kW limit and add provisions for purchase of surplus production. Pricing and metering strategies can provide price signals and revenue streams to support investment in and optimal operations of renewable energy systems. Net metering allows owners of grid-connected DG (generating units on the customer side of the meter, often limited to some maximum kW level) that generate excess electricity to sell it back to the grid, effectively “turning the meter backward.”

Net metering provides several incentives for renewable DG by reducing transaction costs (e.g., no need to negotiate contracts for the sale of electricity back to the utility) and increasing revenue by setting compensation at retail electricity rates, rather than at utility avoided costs. The state could adopt rules for net metering and interconnection for renewable energy systems (e.g., up to 2 megawatts [MW] in capacity). Qualified renewable generators could be categorized into tiers.

In addition to net metering, pricing strategies of relevance to distributed renewable energy systems can include REPs (sometimes called feed-in tariffs), and “time-of-use” rates, which are fixed rates for different times of the day and/or for different seasons that reflect the time-varying value of electricity.

**[NOTE: See new policy ES-2.17, Feed-in Tariff.]**

## **2.7 Renewable Energy Development Issues (Zoning, Siting, etc.)**

Policies can be developed to help overcome barriers to renewable energy development. Institutional and market barriers include price distortions, failure of the market to value the public benefits of renewable energy and the social cost of fossil fuel technologies, inadequate information, institutional barriers to grid interconnection, high transaction costs because of small projects, high financing costs because of lender unfamiliarity, and perceived risk. These barriers can be overcome through a suite of financial and regulatory redresses, as well as through information and public education campaigns.

Financial obstacles can be addressed through property tax exemptions, exclusions, and credits; personal income tax credits or deductions to cover the expense of purchasing and installing renewable energy equipment; loan programs to aid in financing the purchase of renewable energy equipment; and grant programs designed for R&D or to help a project achieve commercialization.

Regulatory policies can include solar or wind easements of access rights; development guidelines at the local level to enhance renewable energy generation (e.g., requiring proper street orientation); and requirements that utilities provide information and utility leasing programs for renewable energy production to customers in remote regions.

## **2.8 Demand-Side Energy Efficiency (RCI Focus)**

Demand-side energy efficiency incentivizes energy efficiency in the consumer sector. Smart metering to allow consumers to interact and manage energy use is part of this policy. (See the Residential, Commercial, and Industrial [RCI] TWG Brief Catalog Descriptions.)

## **2.9 Hydro Efficiency Improvements, Capacity Increase, and Barrier Removal**

This policy option would improve the efficiency in operations and outputs from hydropower and remove barriers to incorporating efficiency measures.

Kentucky has untapped hydro potential at existing dams, including large dams, such as the Kentucky-owned navigational dams on the Ohio River. Most hydroelectric power comes from the potential energy of dammed water driving a water turbine and generator. Hydroelectric power generation can occur at different scales, from small to large. Small hydro plants produce up to 10 MW, although projects up to 30 MW in North America are considered small hydro and typically have the same regulations. Since hydroelectric dams do not burn fossil fuels, they do not directly produce carbon dioxide (CO<sub>2</sub>) or other GHGs. While some CO<sub>2</sub> is produced during the manufacture and construction of the project, this is typically a tiny fraction of the operating emissions of equivalent fossil-fuel electricity generation. However, siting hydroelectric plants can be difficult and controversial, due to such factors as technical feasibility, other environmental and habitat concerns, property value impacts, and safety considerations, among others.

Incentives, government investment, “right-sizing” regulatory standards, and other approaches can be used to encourage efforts to identify and develop hydropower opportunities.

## **2.10 Utility Energy Efficiency Incentives and Barrier Removal**

This policy option reflects financial incentives and barrier removal for utilities to encourage investment in energy efficiency and conservation technologies. This option could include tax incentives, direct subsidies, or policies that reduce the regulatory burden for implementing energy efficiency measures.

Considerations for this option could include corporate tax incentives, sustainable building tax credits, green building incentives, green building standards for state facilities, energy efficiency bond programs, personal tax incentives, sales tax incentives, lease purchase programs, grant programs, and loan programs.

## **2.11 Consumer Energy Efficiency Incentives and Barrier Removal**

This policy option reflects financial incentives and barrier removal for consumers to encourage investment in energy efficiency and conservation technologies. Considerations for this option could include corporate tax incentives, sustainable building tax credits, green building incentives, green building standards for state facilities, energy efficiency bond programs, personal tax incentives, sales tax incentives, lease purchase programs, grant programs, and loan programs.

## **2.12 Research and Development for Renewable Technologies**

This option is similar to ES-2.7, above, but focuses on specific R&D efforts related to renewable energy technologies.

### 2.13 Co-Location or Integration of Energy-Producing Facilities

This policy option would encourage the co-location of integrated energy-producing facilities to enable the more efficient utilization of heat and energy. Examples of this co-location include co-firing of biomass or the integration of ethanol and biodiesel facilities.

### 2.14 Wind Energy Potential Evaluation

This policy option would install 10 metrological towers at prime locations identified in the new National Renewable Energy Laboratory (NREL) study. The NREL study shows that Kentucky has about 700 MW of potential wind capacity at 100 meters with a capacity factor of over 30%, and 40,000 MW of wind potential at 100 meters with a capacity factor of over 25%. These best sites need to be identified. With over 40,000 MW of potential at a 25% capacity factor, this suggests that the Commonwealth may have tremendous potential with higher capacity factors at 120 meters, which could be determined by collecting 120-meter data (120-meter wind turbine towers are now designed and are starting to be built). The higher metrological towers proposed here should cost about \$20,000 each. The development of good wind data at higher hub heights could help to convince utilities and independent producers to locate wind farms in Kentucky.

### 2.15 Photovoltaic Demonstration Projects

This policy option would provide subsidies to facilitate the installation of five grid-connected photovoltaic (PV) plants, each plant a minimum of 1 MW and at least one plant a minimum of 5 MW. Large-grid-connected PV plants are being installed around the country, primarily where state subsidies help with the cost. The cost of this new technology continues to drop. Kentucky needs to interconnect some of these plants to utilities in the state, so they might gain experience and collect data to determine the impact of these plants on their systems, particularly the ability to produce power during summer peak periods. **[NOTE: This could be incorporated into ES-2.2, Grid-Based Renewable Energy Incentives and/or Barrier Removal.]**

### 2.16 Inclined Block Rates

Inclined block rates send pricing signals to customers to encourage conservation of energy and reductions in GHG emissions. Some states have historically approved declining block rates, which reduce the per-unit cost of energy as consumption increases. Inclined block rates do the reverse—they increase the per-unit cost as consumption increases. This would serve to discourage consumption and encourage efficiency and conservation.

**[NOTE: This is also proposed as RCI-1.14 and RCI-5.4.]**

### 2.17 Feed-in-Tariff

Under a feed-in tariff, utilities would be required to purchase renewable energy from producers under long-term contracts. Rates would be established by the Public Service Commission, so

producers could make a reasonable return. Any extra costs could be recovered by the utilities from their ratepayers.

Feed-in tariffs have been adopted in other states as a way to promote the installation of new renewable resources. They could apply to the following renewable energy technologies: solar, wind, biogas (including landfill gas), low-impact biomass, geothermal, and new-capacity hydroelectric. Feed-in tariffs work by establishing a market in which investors can make a reasonable profit and provide long-term stability for those investments. The Public Service Commission could establish different purchase rates for each technology, depending on the costs associated with those plants. Residential-, commercial-, and utility-scale systems would all be eligible to participate. Feed-in tariffs have been considered by the State Legislature.

### 2.18 Pyrolysis Demonstration/Evaluation Projects

Pyrolysis is a noncombustion heat treatment that chemically decomposes waste by applying heat to the waste in an oxygen-free environment. The byproducts of the process include heat, char, oil, and combustible gases. The combustible gases are being used in some instances as a fuel source to heat the decomposition process and as the energy source for internal-combustion generators. Unsorted municipal waste as well as various bio-wastes can be used as feedstock. Commercial-scale demonstration projects could be sponsored by or promoted using state-funded incentives. **[NOTE: This could be included under ES-2.12, Research and Development for Renewable Technologies, or ES-1.5 Technology Research and Development, especially if one of these is to be restated as “Research, Development, and Demonstration.”]**

## ES-3. FOSSIL FUEL AND NUCLEAR ELECTRICITY

### 3.1 Advanced Fossil Fuel Technology (e.g., IGCC, CCSR, Advanced Pulverized Coal, CFB) Incentives, Support, or Requirements

Advanced fossil technologies 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 integrated gasification combined-cycle (IGCC), advanced pulverized coal, and advanced circulating fluidized-bed (CFB) technology.

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 plants to achieve a specific low net CO<sub>2</sub> emission rate. Alternatively, a mandate might require that all or a portion of new coal plants be of a certain type, such as IGCC. Incentives may take the form of direct subsidies or assistance in securing financing, and/or off-take agreements. A combination of mandates and incentives is also possible.

Policies to encourage CCSR could include a state agency or department within an existing agency tasked with promoting CCSR, evaluation studies to identify geologically sound reservoirs, R&D funding to improve CCSR technologies, and/or financial incentives or mandates to capture and store or capture and reuse carbon.

### **3.2 Efficiency Improvements and Repowering Existing Plants**

Efficiency improvements refer to increasing generation efficiency at power stations through incremental improvements at existing plants (e.g., more efficient boilers and turbines, improved control systems, or combined-cycle technology). Repowering existing power plants refers to switching to lower- or zero-emitting fuels at existing plants, or for new-capacity additions, including use of biomass or natural gas in place of coal or oil. Policies to encourage efficiency improvements and repowering of existing plants could include incentives or regulations as described in other options, with adjustments for financing opportunities and emission rates of existing plants.

### **3.3 Biomass Co-firing at New Fossil Fuel Power Stations**

This policy option would promote the co-firing of biomass at new fossil fuel power stations to reduce GHG emissions and the use of fossil fuels in general.

### **3.4 Nuclear Power Review, Support, and Incentives**

This policy option would conduct an inventory of existing capacity, and develop supporting measures and a range of incentives to encourage and promote existing nuclear power. **[NOTE: Not applicable in Kentucky.]**

### **3.5 Relicensing/Up-rating Existing Nuclear Power**

Nuclear plant relicensing allows a nuclear power plant to extend the life of the facility for 20 years past its original 40-year license term. This is considered a low-cost and low-emission source of energy because there are limited additional capital costs or additional embodied emissions associated with extending the life of fully depreciated and operating nuclear plants. The Nuclear Regulatory Commission (NRC), the nation's regulatory authority for nuclear power, considers the relicensing program one of its major cornerstones of current regulatory activity. A nuclear power plant up-rating is a process whereby a licensee receives approval from the NRC to operate a plant at a higher power level than the level authorized in the original license. **[NOTE: Not applicable in Kentucky.]**

### **3.6 New Nuclear Energy Capacity**

Nuclear power has historically been a low-GHG source of electricity. However, no new commercial reactor has come on line in the U.S. 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, including limitations on liability for nuclear accidents.

Steps to encourage nuclear power options in the state would have to begin with the removal of the statutory ban against constructing a nuclear plant in Kentucky (KRS 278.600-610), and could include the provision of streamlined siting review and a streamlined appeals process. The state could develop finance authority to assume the developer role (and potentially an equity ownership role) for new nuclear resources. Under such a scenario, the state would not need to be an operator of nuclear facilities. Instead, it 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 power options could also be considered.

#### **ES-4. FOSSIL FUEL PRODUCTION, PROCESSING, AND DELIVERY**

##### **4.1 Oil and Gas Production: GHG Emission Reduction Incentives, Support, or Requirements**

Emissions of both methane (CH<sub>4</sub>) and CO<sub>2</sub> can be reduced in oil and gas production. Natural gas consists primarily of CH<sub>4</sub>, a potent GHG. Any reduction in leaks during production, processing, and transportation/distribution avoids GHG emissions. Stopping these leaks may also be economically beneficial because it can prevent the waste of valuable product. The EPA Natural Gas STAR program offers numerous methods of preventing leaks, including preventive maintenance (improving the overall efficiency of the gas production and distribution system); reducing flashing losses (releases when pressure drops at storage tanks, wells, compressor stations, or gas plants); and changing and replacing parts and devices to reduce leaks and improve efficiency. States could take steps to encourage all oil and gas production companies operating in-state to participate in the EPA Gas STAR program.

##### **4.2 Natural Gas Transmission and Distribution**

As with leaks of CH<sub>4</sub> in oil and gas operations, any reduction of leaks during production, processing, and transportation/distribution reduces GHG emissions to the atmosphere and prevents the waste of valuable product.

##### **4.3 Oil Refining: GHG Emission Reduction Incentives, Support, or Requirements**

Options for reducing CH<sub>4</sub> and CO<sub>2</sub> emissions during the production of liquid fuels at oil refineries include various efficiency measures, such as enhanced CHP, along with carbon capture and storage (CCS). Regulations, incentives, and/or support programs can be applied to achieve these reductions.

#### **4.4 Coal Production: GHG Emission Reduction Incentives, Support, or Requirements**

CH<sub>4</sub> and CO<sub>2</sub> emissions can be reduced in a number of ways, and CH<sub>4</sub> can be recovered in the production of coal. These options include various efficiency measures, use of CHP for operations, CCS, and capture and use (or at least flaring) of CH<sub>4</sub> that would otherwise be vented to the atmosphere. Regulations, incentives, and/or support programs can be applied to achieve these goals.

#### **4.5 Coal-to-Liquids and Gas-to-Liquids Production: GHG Emission Reduction Incentives, Support, or Requirements**

Coal can also be converted into liquid fuels like gasoline or diesel by several different processes. Coal-to-liquids plants are typically energy intensive, producing about 10 times more CO<sub>2</sub> emissions than conventional oil refineries in order to produce liquid fuels. However, with CCS (and co-production of electricity and liquid fuels), such emissions can be substantially reduced.<sup>1</sup> Regulations, incentives, and/or support programs can be applied to achieve these goals.

Gas-to-liquids (GTL) technology could also be assessed for its GHG reduction potential when coupled with CCS options. GTL is a refinery process to convert natural gas or other gaseous hydrocarbons into longer-chain hydrocarbons in liquid form.

#### **4.6 Low-GHG Hydrogen Production Incentives and Support**

Hydrogen is not an energy source, but rather an energy carrier. It must be produced from other energy resources, such as fossil fuels (coal, oil, gas), renewable electricity (wind, solar), renewable fuels (biofuels, landfill gas), or nuclear power. However, it may facilitate the avoidance of GHG emissions by storing energy produced when and where available to be used when needed. The net GHG implications of producing hydrogen depend on the energy resource from which it is produced. To produce hydrogen from fossil fuels with low-GHG emissions, it would be necessary to do it in conjunction with CCS. Policies in support of this option would provide incentives to projects that help develop or deploy low-GHG hydrogen production technologies, as well as advance the technology of efficiently storing electric energy as hydrogen and converting it back to electricity.

#### **4.7 Shale Gas Development**

In the last few years with the advent of natural gas shale discoveries within the continental United States, the marketable supply of natural gas reserves has increased significantly. As a result, price volatility has moderated and natural gas has re-emerged as a strong viable candidate to reduce carbon emissions. Kentucky has potential opportunities in the Illinois Basin fields located in western Kentucky and the Marcellus fields located in eastern Kentucky. Both options need to be

---

<sup>1</sup> International Energy Agency, *Energy Technology Perspectives—Scenarios and Strategies to 2050*, 2006. Available at: [http://www.iea.org/textbase/publications/free\\_new\\_Desc.asp?PUBS\\_ID=1693](http://www.iea.org/textbase/publications/free_new_Desc.asp?PUBS_ID=1693). Well-to-wheel GHG emissions from coal liquids are approximately twice those of conventional oil products. Co-generation and carbon capture and storage can reduce those emissions to levels similar to, or slightly below, those of conventional oil products.

investigated regarding the market potential of developing both areas and the possible carbon impact of shifting to greater utilization of Kentucky shale gas reserves as an energy source.

#### **4.8 Infrastructure to Facilitate Transition to Natural Gas in Transportation**

This policy option would offer incentives to private providers of compressed natural gas (CNG) infrastructure for vehicular use. The development of an alternative-fuel infrastructure can aid in the promotion of CNG or alternative-fuel use and offset the expense of equipment and installation costs. The convenient locations of stations offering CNG or other alternative fuels at competitive prices can increase the use of the fuels.

In addition, Kentucky should investigate the capability of the existing NG transmission and distribution (T&D) networks to meet potential transportation demands in the future.

**[NOTE: This is analogous to TLU-3.6, Alternative-Fuel Infrastructure Development.]**

### **ES-5. CARBON CAPTURE AND STORAGE OR REUSE (CCSR)**

#### **5.1 CCSR Enabling Policies (Administration, Regulation, Liability)**

Carbon capture and storage or reuse (CCSR) is a process that includes separation of CO<sub>2</sub> from industrial and energy-related sources, transport to a storage location, and permanent or long-term storage in isolation from the atmosphere. Ideally, the CO<sub>2</sub> from large point sources, such as power plants, can be compressed and transported for storage in geological formations, in the ocean, in mineral carbonates, or for use in industrial processes. Captured carbon can also be used for enhanced recovery of oil and gas (see ES-6.4, Environmental/GHG Emissions Disclosure). The net reduction of emissions to the atmosphere through CCSR depends on the fraction of CO<sub>2</sub> captured, the relative increase in CO<sub>2</sub> production resulting from loss in the overall efficiency of power plants that capture carbon, energy used for transport and storage, any leakage from transport, and the fraction of CO<sub>2</sub> retained in storage over the long term.

#### **5.2 CCSR Incentives and Infrastructure**

Policies to encourage development of CCSR technology could include a state agency or department within an existing agency tasked with promoting CCSR, financial incentives to capture and store or capture and reuse carbon, and/or mandates—coupled with technical feasibility and cost- and investment-recovery mechanisms, if appropriate—to capture and store or reuse CO<sub>2</sub> from power plants. Creating incentives to build and operate the rather complex infrastructure for CCSR is also part of the incentive system.

#### **5.3 CCSR Research and Development**

There are technological as well as financial barriers to implementation of CCSR. While separation, capture, and transport of CO<sub>2</sub> are themselves mature technologies, only three industrial-scale

storage projects are currently in operation: the Sleipner project in an offshore saline formation in Norway, the Weyburn enhanced oil recovery project in Canada, and the In Salah project in a gas field in Algeria. Further R&D funding to improve CCSR technologies and evaluation studies to identify geologically sound reservoirs will be needed for this technology to play a significant role in reducing GHG emissions.

#### **5.4 Enhanced Oil Recovery Using CO<sub>2</sub>**

This policy option would use CO<sub>2</sub> as a way to increase the amount of oil recovered from an oil field. This technology injects CO<sub>2</sub> into an oil reservoir, which displaces oil not recovered by other methods. In addition, the CO<sub>2</sub> increases the viscosity of the oil, allowing it to flow more quickly. Enhanced oil recovery provides an opportunity for sequestration of CO<sub>2</sub> with economic incentives.

### **ES-6. OTHER ENERGY SUPPLY OPTIONS (INCLUDING ENABLING POLICIES)**

#### **6.1 Transmission System Upgrading**

Measures to improve transmission systems to reduce bottlenecks and enhance throughput may be required to satisfy long-term electricity demands and improve the efficiency of operations system-wide. Opportunities may exist to substantially increase transmission line carrying capacity through the implementation of new construction and retrofit activities on the transmission grid, including incorporating advanced composite conductor technologies, capacitance technologies, and grid management software. Siting new transmission lines can be a difficult process, given their cost and their local impacts on the environment and on the use, enjoyment, and value of property. Policy measures in support of this policy option could provide incentives to utilities to upgrade transmission systems and reduce barriers to siting new transmission lines.

#### **6.2 General Distributed Generation Support (Interconnection Rules, Net Metering, etc.)**

Well-designed interconnection rules will ensure that distributed power products meet minimum requirements for performance, safety, and maintenance, at the same time significantly advancing the commercialization of these technologies. Such rules, generally developed and administered by a state's public utility commission, establish clear and uniform processes and technical requirements for connecting DG systems to the electric utility grid. Interconnection standards will reduce barriers to connection of DG systems to the grid. Connecting to the grid enables the facility to (1) purchase power from the grid to supply supplemental power as needed, for example, during periods of planned system maintenance; (2) sell excess power to the utility; and (3) maintain grid frequency and voltage stability, as well as utility worker safety. This topic is of particular interest, as the federal Energy Policy Act of 2005 directed states to consider upgrading their standards for interconnecting small generators within one year of enactment. (See <http://www.epa.gov/chp/index.html> for more information on the effects of federal legislation on DG systems and CHP.)

### **6.3 Reduce Transmission and Distribution Line Losses**

Several energy efficiency measures can be implemented to reduce T&D line losses of electricity. Utilities use a variety of components throughout the T&D system to manage losses. Increasing the efficiency of these components can further reduce losses and associated GHG emissions. For example, Vermont offers a rebate to encourage the installation of energy-efficient transformers. Regulations, incentives, and/or support programs can be applied to achieve greater efficiency of T&D system components.

### **6.4 Environmental/GHG Emissions Disclosure**

Emission disclosure requires GHG emitters to publish their estimated GHG emissions on a regular (e.g., annual) basis. In addition to emissions, disclosure can include an accounting of business risks due to climate change, such as assets in danger of weather-related damage, threats to market share, and risks of future regulation. Environmental disclosure allows investors and consumers to obtain information regarding a firm's GHG emissions and climate risks, so as to make more informed purchasing and investment decisions, and provide an incentive for firms to reduce risk in these areas by, among other actions, reducing their CO<sub>2</sub> footprints. In the case of energy supply, environmental disclosure would take the form of providing consumers and stockholders with information on carbon emissions per kWh in a manner that would help them make informed decisions about electricity purchases and consumption, as well as evaluate investment risks. Environmental disclosure is effective particularly in areas where consumers have an opportunity select their electricity provider.

### **6.5 Public Benefits Charge Funds**

A public benefits charge (sometimes call systems benefits charge) is a fee assessed to utility customers based on their use of energy that is to be spent on public goods, such as energy efficiency. In many deregulated states, the public utility commissions have lost the ability to require efficiency programs of the electric utilities, so the public benefits charge has been introduced as a non-bypassable charge on electric bills. The funds collected are then provided to a third party to provide energy efficiency programming. The funds could be used to fund rebates for buyers of new, low-GHG-emitting technologies through a very small surcharge on electricity consumption.

### **6.6 Regulatory Reform for Electric Co-ops**

This policy option would create more flexibility and incentives for electric co-ops to optimize energy efficiency, with an emphasis on energy saved versus energy used.

### **6.7 N<sub>2</sub>O Reduction Co-Benefit**

Nitrous oxide (N<sub>2</sub>O), a minor component of total oxides of nitrogen (NO<sub>x</sub>) emissions from fossil fuel combustion, is one the most powerful GHGs. Each ton of N<sub>2</sub>O represents greater than 300 tons of CO<sub>2</sub>e. Emission policies further reducing NO<sub>x</sub> emissions from power plants would have the additional benefit of reducing releases of N<sub>2</sub>O into the atmosphere.

## 6.8 Smart Grid Policies

Smart Grid™ systems promote efficiency through improvements in system stability and better control technology and systems integration. Capabilities include enhanced utility and consumer feedback and control of electricity usage and enhanced integration of DG and intermittent renewable generation.

## 6.9 Landfill Gas Demonstration/Evaluation Projects

According to the EPA list of landfill gas (LFG) supply candidates,<sup>2</sup> Kentucky has 17 candidates for LFG recovery. The list is by no means all-inclusive. According to some studies, a landfill in a county with a feed-in population of approximately 40,000 can be expected to produce approximately 10,000 cubic feet (CF) per hour of methane. If a given state with a population of approximately 4 million landfills the waste it generates, it might recover an estimated 1,000,000 CF of gas per hour. Assuming methane has the same Btu value as natural gas, this is equivalent to 1,000 Btu/CF, or 1 billion Btu per hour of recoverable energy. Also according to EPA, the oxidation (burning) of LFG reduces the GHG effect by a factor of 21 to 1. Technology currently exists and is improving for LFG recovery and conversion.

Policies to use the renewable energy created at landfills by anaerobic digesters (methane) to make electric power, space heat, or liquefied natural gas are already under development in the state. However, regulatory and legal barriers have limited the penetration of this option.

**[NOTE: This is analogous to AFW-9.3, Landfill Methane Energy Programs.]**

## 6.10 Sustainable Energy Utility

The Sustainable Energy Utility (SEU) is a nonprofit corporation managed by a contract administrator that develops end-user markets for energy efficiency and conservation, customer-sited renewable energy, and affordable energy services for low- and moderate-income families. All energy end uses, including transportation, can be addressed by SEU programs. The SEU works statewide with a mandate to increase energy efficiency, conservation, and renewable energy.

The SEU received initial funding through bonding authority and then pays off the bonds through sharing energy savings with its customers, earning renewable energy credits, and other means.

Vermont was the first state to establish an energy efficiency utility, and Delaware recently established an SEU.<sup>3</sup>

---

<sup>2</sup> See <http://www.epa.gov/lmop/documents/xls/candlflsmopdata.xls>.

<sup>3</sup> For more information, see: <http://www.energizedelaware.org/> and <http://www.encyvermont.com/pages/>.

## **6.11 Cost-of-Service Utility Rate Structure**

This policy option would investigate moving utility rates to an accurate cost-of-service rate structure, thereby allowing energy utilities to shift from a business model that is financially dependent on increasing energy sales to a business model that is “energy sales neutral.”