Clean & Renewable Energy (CRE) Subcommittee

Summary List of Policy Recommendations

Policy No.	Policy Option	CO_2 Reduction 2012	CO_2 Reduction 2020	Total 2009–2020	Net Present Value 2009–2020 (Million $)	Cost/ton ($/t$CO_2$e)	Change in Generation Cost in 2020 $/MWh **	Status of Option
CRE-1	Education	*Not Quantifiable*						Unanimous
CRE-2	Technology Initiatives, Including Renewables	4.7	33.4	192.6	$5,653	$29.4	$25.7	Supermajority (3 Objections)
CRE-3a	Federal Cap and Trade, Including Offsets To Promote Renewables	*Not Quantified*						Pending
CRE-3b	MGA Cap and Trade, Including Offsets To Promote Renewables	*Not Quantified*						Pending
CRE-4a	Decarbonization Fund	2.2	11.4	74.1	$316	$4.3	$3.1	Supermajority (2 Objections)
CRE-4b	Carbon Tax (~~Economy-wide~~All sectors except AFW)	*Quantified Separately--See Text*						Pending
CRE-5	Performance Standards (50% Reduction by 2050)	4.9	11.4	95.4	$2,650.6	$27.8	$7.3	Supermajority (3 Objections, 1 Abstention)
CRE-6	Voluntary GHG Commitments	*Not Quantified*						Pending
CRE-7	Policies Related to Nuclear Power	0.0	9.7	9.7	$268	$27.6	$4.5	Pending
CRE-8	Support for Grid-based Renewable Energy & Development (8a: 400K MWh/yr)	0.3	4.8	22.9	$557.6	$24.4	$3.0	Pending
CRE-9	Transmission System Upgrading	*Not Quantified*						Pending
CRE-10	R&D for Emerging Technologies and Corresponding Incentives	*Not Quantified*						Pending
CRE-11	Distributed Generation/Co-Generation	0.0	0.1	0.5	$14	$29.1	$0.1	Pending
CRE-12	Combined Heat and Power	0.3	2.1	13.6	–$564.3	–$41.4	$0.0	Unanimous
CRE-13	Pricing Strategies To Promote Renewable Energy and/or CHP	1.2	5.6	35	$1,128	$32.1	$4.7	Supermajority (3 Objections)
	Sector Total After Adjusting for Overlaps	6	48	233	$5,921	$25		
	Reductions From Recent Actions	0	0	0	0	0		
	Sector Total Plus Recent Actions	6	48	233	$5,921	$25		

CO_2 = carbon dioxide; Reduct. = Reduction; $/t$CO_2$e = dollars per metric ton of carbon dioxide equivalent; $/MWh = dollars per megawatt-hour; MGA = Midwestern Governors Association; GHG = greenhouse gas; 400k MWh/yr = 400,000 megawatt-hours per year; R&D = research and development; CHP = combined heat and power.

* Represents the change in the cost of generation in $/MWh in the Policy case from the No-Policy case to meet Iowa's electricity demand or for exports.

Draft Overlap Discussion

The amount of carbon dioxide equivalents (CO_2e) emissions reduced in the policy options within the Energy Supply (ES) sector overlaps with some of the quantified benefits and costs of other policy options within the ES sector and in other sectors. Those overlaps were identified and adjusted to eliminate double counting. If a policy's impact by type of energy supplied was less than the impact from an overlapping policy for the same type of energy supplied, then it was excluded from the cumulative analysis. The ES sector totals were reduced accordingly, as shown in the summary table above.

The following text overview identifies specifically where those overlaps occurred and how they were resolved under the Clean and Renewable Energy (CRE) proposed policies:

CRE-2 (Renewables Technologies Initiative)—This recommendation addresses actions that promote the use of renewable energy sources, while CRE-5 (Generation Performance Standard) and CRE-8 (Renewables Targets) are proposed as regulatory requirements for electric utilities and nonutilities. It is likely that the electricity generated by the new renewable energy sources that are developed pursuant to CRE-2 will be purchased by the large power producers that are required to comply with the clean energy targets of CRE-5. Therefore, the reductions of CRE-5 are subtracted from CRE-2.

CRE-5 (Generation Performance Standards)—A generation performance standard is a requirement that generators follow to reduce the CO_2 intensity of their generation portfolio, while providing regulatory flexibility in the compliance pathway. In the short term, a performance standard can reduce the incentives for new fossil fuel generation with high CO_2 intensity. In the long term, the generation portfolio can be considered similar to a renewable portfolio standard, but with a larger basket of compliance options. The renewable energy generated from this policy is assumed to overlap with CRE-2.

CRE-8 (Renewables Targets)—The renewables targets under this option are similar, but less aggressive than what is forecasted to occur under CRE-5. Similar generation mixes are expected under either approach. For that reason, CRE-8 is considered redundant to CRE-5, and electricity generation and associated CO_2 reductions from this option are eliminated through the overlap analysis.

CRE-13 (Pricing Strategies)—This recommendation promotes the use of net metering to deploy clean energy technologies at the point of customer use. For renewables, there is very little overlap with other CRE policy options because the other options promote the deployment of large-scale renewable energy projects, like wind farms and co-firing biomass in pulverized coal boilers, while this recommendation sites small-scale renewables. However, the combined heat and power (CHP) element of this option could overlap with CRE-12 (Combined Heat and Power) for industrial or commercial customers who might site microturbines or other CHP technologies at the point of use. For this reason, the electricity generation and associated CO_2 reductions from this option are reduced by 50%.

Overlaps With Other Sectors

The increased use of renewable energy from governments in Energy Efficiency and Conservation (EEC) policy option EEC-13 (Government Lead by Example) is not expected to overlap with CRE policies. EEC-13 has a goal of increasing renewable power generation among government end users. Voluntary green power purchasing typically does not count toward utility renewable portfolio standards, such as CRE-8b the Midwestern Governors Association (MGA) renewables target.

CRE-4a (Decarbonization Fund)—This policy recommendation is a mechanism to fund renewable energy and energy efficiency, along with low-income weatherization and clean energy research and development (R&D). The renewables that are assumed to be deployed under the quantification of this recommendation are expected to be redundant to CRE-8b (MGA renewable portfolio standard [RPS]), and CO_2 reductions from this recommendation are eliminated through the overlap analysis. The energy efficiency deployment that results from this option is expected to be completely redundant to energy efficiency under EEC-1.

CRE-2 also overlaps with Agriculture, Forestry, and Waste Management (AFW) policy options AFW-3 and AFW-9. The reductions from the AFW sector are assumed to completely overlap with CRE-2, and are subsumed under the CRE option.

The electricity energy efficiency investments from the suite of EEC policy recommendations reduce electricity demand and thus make it possible to meet renewable energy mandates more cost-effectively. For example, under EEC-12, electricity demand in 2020 is reduced by almost 5,000 gigawatt-hours (GWh) versus the reference case. CRE-8b assumes a 20% RPS by 2020, which is 4% more renewables (as a percentage of retail sales) than is forecasted under the reference case. Therefore, the implementation of EEC-12 would require 200 GWh fewer of renewable resources to meet the RPS target. Using the renewable energy cost assumptions for CRE-8b, the reduced spending on renewables that cost more than reference case generation in 2020 would result in savings of $.3 million in that year.

Finally, an additional feedback is that certain CRE policies will have the effect of reducing the GHG emissions associated with energy production, so that EEC policies that target electricity use will have a reduced impact on overall emissions. However, this impact is small and has not been reflected in the analysis beyond the avoided CO_2 methodology that assumes in the later years of the program that 21% new renewables are avoided by implementing the EEC options. (The CRE methodology does not include avoided renewables, because doing so would contradict the goals of the CRE options.) See the Annex to this document for a discussion of the avoided CO_2 methodology.

CRE-1. Education

Policy Description

This recommendation is directed at education and outreach for the purposes of nurturing public consciousness of climate change issues, as well as providing technical skills training for employment in positions that directly support greenhouse gas (GHG) emission reduction activities.

Broad awareness engages citizens of all ages to take direct action to reduce GHG emissions through personal and public means. It also builds grass-root support for government, industrial, and civil society actions with regard to GHG emission reduction programs, policies, or goals.

Technical instruction and training of citizens will provide the number of skilled employees needed to fill critical jobs in the new and growing industries that will provide emission reductions and clean energy.

Policy Design

Goals: The goals of this policy option are qualitative. They focus on developing, implementing, and executing a statewide climate change control awareness education and job-training program that:

- Provides a platform that, along with imparting knowledge, encourages a bias for action on the part of all Iowans.
- Provides a specified environmental education curriculum to primary, secondary, and post-secondary audiences within the state.
- Provides continuous public exposure through a variety of communications channels to educate and enhance the awareness of Iowans about environmental issues.
- Provides technical job training in support of the growing need by Iowa’s renewable energy industries for skilled workers.
- Develops statewide environmental literacy. The outcome of a successful environmental education program is one in which the learner progresses to deeper knowledge, can apply it to address complex environmental issues, and makes wiser decisions based on that knowledge.

Timing: Begins with the 2010 academic year.

Implementing Parties: Elementary and secondary school districts, municipal governments, the three regents state universities, Iowa community colleges, community partners/associations.

Other: None currently identified.

Implementation Mechanisms

TBD.

Related Policies/Programs in Place

Junior Solar Sprint —This program for middle school children in Iowa engages students in miniature car races in which the cars are powered by small photovoltaic (PV) cells. The students build cars from kits provided to each participating class. The statewide program has grown to include 3,000–4,000 students per year. It is administered by the Center for Energy & Environmental Education at the University of Northern Iowa.

The Iowa Alliance for Wind Innovation and Novel Development—This newly formed organization aims to create a partnership among the educational community, government, associations, and private sector for the purpose of meeting the education, training, skills development, research, and testing needs of the state's expanding renewable energy industry.

Iowa Energy Center—The Energy Center awards scholarships to Iowa high school students at the State Science and Technology Fair of Iowa for exceptional energy-related projects.

Iowa Renewable Energy Association's Energy Learning Lab—"Make electricity from the sun and the wind, measure how much electricity is used by appliances, make hydrogen and use it to power a fuel cell model car, and use the sun to heat water. Your students will love using the Iowa Renewable Energy Association's energy education tools, available free of charge to teachers and schools for one week. In return, you will be asked to provide your name and contact information, a short paragraph describing how the tools were used in the classroom, and one or two digital pictures of students using the Energy Learning Lab materials" (http://www.irenew.org/learninglab.html).

Maquoketa Valley Electric Cooperative's Renewable Energy Education in the Community (ReEC)—This new initiative showcases the residential application of two renewable energy technologies—wind and solar PV—recently installed at the cooperative's headquarters in Anamosa. These units are designed for installation in residential neighborhoods, and each will provide a portion of a home's electrical needs. ReEC will allow anyone to evaluate the real-time performance of these units and to use the data in a variety of education programs throughout Iowa.

Iowa Clean Cities Coalition (ICCC)—Based in Des Moines, Iowa's state capital and largest city, the ICCC coordinates educational activities, promotes renewable fuels and renewable fuel infrastructure, and collaborates with partners to promote emerging technologies in Iowa.

State Energy Council (SEC)—SEC brings together state agencies to communicate, collaborate, and coordinate efforts to meet the goal of advancing energy efficiency and renewable energy in Iowa. SEC seeks to capitalize on the skills, responsibilities, and resources of participating agencies through agency collaboration.

Iowa Electrathon—Sponsored by Alliant Energy, the Iowa Electrathon is an educational program that engages high school or college students in researching, designing, building, and racing Electrathon cars (small one-person electric vehicles with limited battery capacity).

www.bioediowa.org—This Web site informs Iowans about the public-sector education and training opportunities within the biorenewable energy industry.

Type(s) of GHG Reductions

Avoiding electricity generation from fossil fuel sources results in GHG reductions, primarily from carbon dioxide emissions (CO_2), but also trace amounts of methane (CH_4) and nitrous oxide (N_2O) emissions.

Estimated GHG Reductions and Costs or Cost Savings

Qualitative.

Data Sources: Not applicable.

Quantification Methods: Not applicable.

Key Assumptions: Not applicable.

Key Uncertainties

None currently identified.

Additional Benefits and Costs

None currently identified.

Feasibility Issues

None currently identified.

Status of Group Approval

Approved.

Level of Group Support

Unanimous.

Barriers to Consensus

None.

CRE-2. Technology Initiatives, Including Renewables

Policy Description

This policy recommendation deals with the implementation of clean and renewable energy technologies that are currently commercially available, and their potential for implementation in Iowa. States can undertake initiatives focused on developing, promoting, and/or implementing one or more specific technologies that show promise for reducing GHG emissions. Technologies could include (among others) wind, biomass (including refuse-derived fuels), landfill gas to energy, hydropower, solar, and geothermal. This policy would support providing state government and other private and public parties with resources and incentives for analysis, targeted research and development (R&D), market development, and adoption of GHG-reducing technologies that are not covered by other CRE policies.

Policy Design

In 2008, the Iowa Legislature passed and the Governor signed a law that required the Iowa Utility Association, in consultation with the Iowa Association of Electric Cooperatives and the Iowa Association of Municipal Utilities, to conduct a technical study of the potential for cost-effective renewable energy generation by 2025. The study will be transmitted to the Iowa Office of Energy Independence by December 1, 2008, and included in the Iowa Energy Independence Plan required to be submitted by the Office to the Governor and the General Assembly by December 14, 2008. If time allows, efforts should be taken to ensure that the goals studied under this policy recommendation are consistent with this plan, and should be considered placeholders until that study is completed.

Goals: Increase Iowa renewable electric production:

- From landfill gas-to-energy projects by 9,000 megawatt-hours (MWh) annually until the maximum feasible generation of approximately 90,000 MWh per year is developed.
- From waste-to-energy projects by 65,500 MWh annually until the maximum feasible generation of approximately 655,000 MWh per year is developed.
- From wind projects by up to 2.6 million MWh annually or until the feasible amount of wind generation that can be integrated into the grid is reached.
- From co-firing biomass agricultural residues in existing pulverized coal boilers at a rate of 10% of coal generation, or approximately 3,600 MWh annually.
- From biomass generation from dedicated energy crops up to 760,000 MWh annually until the maximum feasible generation is developed.
- From repowering hydroelectric facilities by up to 112,000 MWh annually until the maximum feasible generation is developed.

Initial specific targets for additional technologies listed in the policy description (such as wind) are to be determined upon review of best available data to characterize the maximum cost-effective potential of each of the major technology options until the study mentioned above is completed.

Timing: Beginning in 2011, continuing through 2020.

Implementing Parties: State government, private and public partners on a voluntary basis.

~~**Other:** None currently identified.~~

Implementation Mechanisms

Biomass co-firing can be a low-cost, near-term means of converting biomass to electricity and displacing coal use by adding up to 15% biomass in high-efficiency coal boilers. Biomass energy conversion factors and crop yield estimates will be used to determine the number of farm acres needed to reach specific percentage and MWh goals.

A standard interconnection rule will ensure that distributed power products meet minimum requirements for performance, safety, and maintenance and will significantly advance the commercialization of these new technologies. Standardized interconnection rules, which are generally developed and administered by a state's public utility commission, establish clear and uniform processes and technical requirements for connecting distributed generation (DG) systems to the electric utility grid. Interconnection standards will reduce barriers to connection of DG systems to the grid identified by other policy options. 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 Energy Policy Act of 2005 (EPAct 2005) directs states to consider upgrading their standards for interconnecting small generators within 1 year of enactment (http://www.epa.gov/chp/pdf/interconnection_factsheet.pdf).

Related Policies/Programs in Place

None currently identified.

Type(s) of GHG Reductions

Avoiding electricity generation from fossil fuel sources results in GHG reductions primarily from CO_2 emissions, but also trace amounts of CH_4 and N_2O emissions.

~~None currently identified.~~

Estimated GHG Reductions and Costs or Cost Savings

Table 1. Estimated GHG reductions and costs of or cost savings from CRE-2

Quantification Factors	2012	2020	Units
GHG emission savings	4.7	33.4	$MMtCO_2e$
Net present value (2008–2020)	$336	$5,653	$ Million
Cumulative reductions	7	193	$MMtCO_2e$

Cost-effectiveness	\$45.6	\$29.4	\$/tCO$_2$e
Change in generation cost	\$4.1	\$25.7	\$/MWh

GHG = greenhouse gas; MMtCO$_2$e = million metric tons of carbon dioxide equivalent; \$/tCO$_2$e = dollars per metric ton of carbon dioxide equivalent; \$/MWh = dollars per megawatt-hour.

Data Sources:

- Spreadsheet Iowa Biomass to Displace Coal, sent by Jeff Myrom June 23, 2008, shows biomass co-firing corn stover would utilize 5.5% of Iowa harvested cropland.
- Harding, N.S., and D.A. Tillman. (ND). "U.S. Biomass Cofiring Experience." Available at: http://www.iea.org/textbase/work/2004/zets/apec/presentations/harding.pdf
- Connor, A.M., J.E. Francfort, and B.N. Rinehart. 1998. *U.S. Hydropower Resource Assessment Final Report*. DOE/ID-10430.2, p. 19. Idaho National Engineering and Environmental Laboratory. Available at: http://hydropower.inl.gov/resourceassessment/pdfs/doeid-10430.pdf
- Iowa Department of Natural Resources. (ND). Hydropower. Footnote #7. (Not available online.)
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- Iowa Department of Natural Resources. (ND). Switchgrass and Other Energy Crops. (Not available online.)
- Demeter, C.P., D.F. Knowles, J. Olmstead, M. Jerla, P. Shah. September 9, 2003. *Assessment of Power Production at Rural Utilities Using Forest Thinnings and Commercially Available Biomass Power Technologies*. Antares Group, Inc: Landover, MD. Available at: http://www.antaresgroupinc.com/DOERUSreport.htm
- U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy. 2008. *20% Wind Energy by 2030*. Available at: http://www1.eere.energy.gov/windandhydro/pdfs/41869.pdf

Energy Consumption by Sector (Billions of British Thermal Units [BBtu])

- Historical energy consumption in the state, by sector, is from the U.S. Department of Energy (DOE) Energy Information Administration (EIA) State Energy Data, available at http://www.eia.doe.gov/emeu/states/_seds.html. To calculate future projected energy consumption, growth factors were applied to the historical 2005 data to calculate projections through 2030. The growth factors are based on a combination of two parameters. One accounts for growth within the residential, commercial, and industrial (RCI) sectors, with growth factors for the residential sector based on projected population growth (from http://data.iowadatacenter.org/datatables/State/stpopest19002007.xls and http://data.iowadatacenter.org/browse/projections.html), growth in the commercial sector based on nonmanufacturing employment growth projections, and industrial growth based on manufacturing employment. Employment projections were taken from Labor Market and Economic Research Bureau, Iowa Workforce Development, Iowa Industry Projections, 2006–2016 (http://iwin.iwd.state.ia.us/pubs/statewide/indprojstatewide.pdf). The other factor is growth in electricity sales, which was calculated based on historical retail sales from 1990 to 2005, obtained from the EIA Iowa Electricity Profile, in GWh. Available from Table 8 at: http://www.eia.doe.gov/cneaf/electricity/st_profiles/iowa.html.

Power Station Electricity Generation (GWh) and Fuel Use (BBtu)

- Gross generation for 2005 was obtained from the EIA-906 and EIA-920 databases on fuel stocks at all electric power sector generating facilities, broken down by fuel type (http://www.eia.doe.gov/cneaf/electricity/page/eia906_920.html). Data for later years were projected from the 2005 figure based on projections of growth in generation for the Mid-Continent Area Power Pool (MAPP) region. The projected regional consumption and generation data are from the EIA *Annual Energy Outlook 2008* (AEO2008) and can be accessed by downloading the "Electricity Generation & Renewable Resource" file at http://www.eia.doe.gov/oiaf/aeo/supplement/index.html. On-site usage was subtracted from all generation figures.

Costs Associated With Electricity Generation

- The costs in the United States to produce electricity using different types of technologies are from the *Assumptions to the Annual Energy Outlook 2007, With Projections Through 2030*, and are based on an analysis of U.S. energy supply, demand, and prices using the EIA National Energy Modeling System. See Table 39 in the "Electricity Market Module," available at: http://www.eia.doe.gov/oiaf/archive/aeo07/assumption/index.html.

Energy Price Projections Through 2030

- Energy prices by region are from the EIA Supplemental Tables to the AEO2008. Download "Consumption & Prices by Sector & Census Division" at: http://www.eia.doe.gov/oiaf/aeo/supplement/. Energy prices by region begin with Table 11.

Quantification Methods:

Heat Rates (Btu/kWh)

- Heat rates indicate how much fuel is used (British thermal units [Btu]) to generate a given amount of electricity (kilowatt-hour [kWh]), and they vary greatly depending on the type of power stations and the fuel used. Heat rates are used to convert figures for electricity into figures for fuel use so the fuel use can be converted into GHG emissions using GHG emission factors. Heat rates for 2005 for each type of generation and fuel were calculated from 2005 fuel use (in BBtu) divided by 2005 generation (GWh). Projections for 2006 and beyond are based on annual combustion efficiency growth rates for the MAPP region. Combustion efficiency for a given year is calculated for each fuel type as the fuel use (in quadrillion Btu) divided by the electricity generated (in billion kWh), and the combustion efficiency growth rate applied to this value is based on the change in combustion efficiency from the previous year.

GHG Emissions Associated With End-Use Consumption (by Sector)

- Historical CO_2 data by sector (and further broken down by fuel type) were calculated by two U.S. Environmental Protection Agency (EPA) State Greenhouse Gas Inventory Tool (SIT) software modules: the Fossil Fuel Combustion Module and—for emissions from industrial sources—the SIT module for industry. CH_4 and N_2O emissions were calculated by the Stationary Combustion Module and—for emissions from industrial sources—the SIT module for industry.

- Projected emissions through 2030 were based on the 2005 data, with growth factors compounded from year to year, as discussed above under Energy Consumption by Sector.

GHG Emissions Associated With Electricity Generation From Different Technologies and Fuels

- The projected data for each GHG were calculated for each fuel and generation type (e.g., nonlignite coal in a steam plant) as a direct product of the projected generation data (in GWh), described above under Power Station Electricity Generation and Fuel Use. Metric tons (t) of CO_2 are calculated from generation as:

  $$tCO_2 = GWh \times (Btu/kWh) \times (tCO_2/MMBtu) \times (\%\text{ of that fuel in the fuel mix})$$

  where (Btu/kWh) is the heat rate and (tCO_2/MMBtu) is the CO_2 emission factor. Calculations for CH_4 and N_2O are similar, =, which are then converted to CO_2 equivalents (CO_2e) using global warming potentials of 21 for CH_4 and 310 for N_2O. The emission factors used for each GHG were the same as those used in the EPA SIT software modules.

Key Assumptions:

- Renewables include landfill gas, waste-to-energy, wind, hydro repowering, 10% biomass co-firing, and biomass energy crops.
- The capacity factor for wind is 36%, which is the DOE 2015 class 3 capacity factor.
  - Iowa Energy Center's Wind Maps show nearly all of the state at or above an annual Class 3 wind resource (http://www.energy.iastate.edu/Renewable/wind/maps/annual.htm).
- The rate at which costs are discounted annually is 5%.
- Net present value (NPV) is calculated in 2008 dollars.
- NPV is calculated beginning in 2009.
- All electricity from coal-fired generation is coming from sources within Iowa (no imports).
- Renewables displace marginal sources of generation (50% coal, 50% natural gas) through 2012. From 2013 on, renewables displace the thermal new-build mix of 99% coal, 1% natural gas.

Key Uncertainties

DRAFT:

There is a risk that GHG reductions are overstated and the costs per ton of CO_2e reductions are understated if high-CO_2-intensity resources are assumed to be redispatched or not built due to increased renewables (the avoided CO_2 methodology).[1]

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[1] Annex A of this document defines the rationale behind the assumption used for the avoided CO_2 methodology in these analyses.

Additional Benefits and Costs

None currently identified.

Feasibility Issues

None currently identified.

Status of Group Approval

Approved.

Level of Group Support

Super Majority (3 objections).

Barriers to Consensus

Unspecified.

CRE-3a. Federal Cap and Trade, Including Offsets To Promote Renewable Energy

Policy Description

A cap-and-trade system is a constructed market-based compliance mechanism in which GHG emissions are limited to a specified amount (i.e., the cap), and entities subject to the cap can buy and sell (i.e., trade) emission allowances. In theory, a properly designed cap-and-trade system of sufficient market size can lower the cost of compliance of meeting the emissions cap to all entities involved. This is possible because participants with a lower cost of compliance can reduce emissions below their allocation and sell their additional allowances to a participant with a cost of compliance that is otherwise higher than the market allowance price.

Many variables can be incorporated into a cap-and-trade system, including the GHGs and sectors covered, upstream or downstream coverage, banking, safety valve prices, tie-ins with regional or international trading systems, offsets, early action credits, technology incentives, auctioning, triggers for on and off ramps, and the "glide path" of the cap. Each factor can have a significant influence on the market price of allowances, and thus the cost of compliance to and impacts on ratepayers.

Policy Design

Goals: Compliance with a federal cap-and-trade program is assumed to take the following steps:

- Realistically, the cap-and-trade program will need to follow a slow-stop-reverse glide path. An immediate or abrupt reversal of the current emissions growth path is unrealistic, given current technology options, and is more likely to cause undue economic hardship.
- Given the timeline outlined in CRE-2, the cap-and-trade program would begin to slow emissions growth between 2015 and 2020. To encourage technology development, bonus allowances would be granted for baseload renewable energy and carbon capture and storage (CCS) projects. To minimize the chance of significant rate impacts on consumers, the majority of allowances would be distributed for free during this time window. However, some allowances would be auctioned to assist low-income consumers, and to generate funds for emissions reduction and development of emission avoidance technology.
- Between 2020 and 2025, emissions growth would stop and slowly begin to reverse. To encourage technology development, bonus allowances would be granted for baseload renewable energy and CCS projects at the same reward rate used between 2015 and 2025. The majority of allowances would be distributed for free during this time window. However, a greater number of allowances would be auctioned to assist low-income consumers, and to generate funds for emissions reduction and development of emission avoidance technology.
- Between 2025 and 2030, emission allowances would begin to accelerate downward. To encourage technology development, bonus allowances would continue to be granted for baseload renewable energy and CCS projects, but at a lower reward rate than that used between 2015 and 2025. The majority of allowances would be distributed for free during this time window. However, an increasingly greater number of allowances would be auctioned to

assist low-income consumers, and to generate funds for emissions reduction and development of emission avoidance technology.

- Beyond 2030, emission allowances would continue to accelerate downward to 50% or 90% below 2005 levels by 2050. In 2031, approximately half of all allowances would be distributed for free, but by 2050 all allowances would be auctioned. Auctioned allowances would still be utilized to assist low-income consumers, and to generate funds for emissions reduction and development of emission avoidance technology.
- In general, the larger the scope of a cap-and-trade program, the more likely the odds of lowering the cost of compliance for all participants. Thus, a federal cap-and-trade program is recommended as the first choice. A regional cap-and-trade program, such as the MGA Accord, is the second-best choice and is also the minimum size recommended for a cap-and-trade program. A state-level program is not likely to be a cost-effective option; therefore, it is not recommended.

Timing: Assuming that cap-and-trade legislation is passed within the first year of a new presidential administration (2009), it will most likely take EPA 3 years to complete the rulemaking (2012). However, nearly all federal rulemakings are litigated, which could take another 2–3 years for a final rule to emerge (2015). For these reasons, a federal cap-and-trade program is unlikely to begin prior to 2015.

Parties Involved: All sectors of the economy must be covered to ensure actual emission reductions. The electric generating sector is likely to cover all units emitting 10,000 tons of CO_2 or more pear year. This policy would require adoption of a federal or regional cap-and-trade system by the Iowa Legislature, and implementation by appropriate federal and state government agencies.

Other: Governor Culver has announced his policy intention of incorporating Iowa into a regional cap-and-trade system proposed by the MGA.

Implementation Mechanisms

Many variables can be incorporated into a cap-and-trade system, including the GHGs and sectors covered, upstream or downstream coverage, banking, safety valve prices, tie-ins with regional or international trading systems, offsets, early action credits, technology incentives, auctioning, triggers for on and off ramps, and the glide path of the cap. Each factor can have a significant influence on the market price of allowances, and thus the cost of compliance to and impacts on ratepayers.

All allowances for a cap-and-trade program (2015–2050) would be given unique serial numbers and created, but not distributed, within the first year of the program. To help minimize costs to ratepayers, unlimited banking of distributed allowances and limited borrowing of allowances from future years would be allowed.

To encourage the development of biomass-based renewable energy, CO_2 emissions from the combustion of biomass (e.g., switchgrass, corn stover) or methane from the decomposition of organic matter (e.g., landfill gas, manure biogas) would not count against the cap.

Related Policies/Programs in Place

MWG Accord.

Type(s) of GHG Reductions

CO_2, CH_4, N_2O: All sectors of the economy must be covered to ensure actual emission reductions. The electric generating sector is likely to cover all units emitting 10,000 tons of CO_2 or more per year. Covering smaller sources would greatly increase administrative complexity for the federal agency implementing the program.

Avoiding electricity generation from fossil fuel sources results in GHG reductions primarily from CO_2 emissions, but also trace amounts of CH_4 and N_2O emissions.

Estimated GHG Reductions and Costs or Cost Savings

TBD

Data Sources: TBD

Quantification Methods: TBD

Key Assumptions: TBD

Key Uncertainties

TBD

Additional Benefits and Costs

TBD

Feasibility Issues

TBD

Status of Group Approval

TBD

Level of Group Support

TBD

Barriers to Consensus

TBD

CRE-3b. MGA Cap-and-Trade, Including Offsets To Promote Renewable Energy

Policy Description

A cap-and-trade system is a constructed market-based compliance mechanism in which GHG emissions are limited to a specified amount (i.e., the cap), and entities subject to the cap can buy and sell (i.e., trade) emission allowances. In theory, a properly designed cap-and-trade system of sufficient market size can lower the cost of compliance of meeting the emissions cap to all entities involved. This is possible because participants with a lower cost of compliance can reduce emissions below their allocation and sell their additional allowances to a participant with a cost of compliance that is otherwise higher than the market allowance price.

Many variables can be incorporated into a cap-and-trade system, including the GHGs and sectors covered, upstream or downstream coverage, banking, safety valve prices, tie-ins with regional or international trading systems, offsets, early action credits, technology incentives, auctioning, triggers for on and off ramps, and the glide path of the cap. Each factor can have a significant influence on the market price of allowances, and thus the cost of compliance and impacts on ratepayers.

Policy Design

Goals: The goals of this policy are assumed to be those adopted by the MGA cap-and-trade program. The Iowa Climate Change Advisory Council (ICCAC) should revisit what action to take on this option once the MGA cap levels and model rule have been developed. ~~The preliminary short- and long-term goals for modeling and analytic purposes recommended to the Midwestern Greenhouse Gas Reduction Accord Advisory Group by the Target-Setting, Data and Reporting Subgroup are:~~

~~□15%, 20%, and 25% below 2005 levels by 2020; and~~

~~□60–80% below 2005 levels by 2050.~~

Timing: The policy would start in concert with other MGA actions.

Parties Involved: All sectors of the economy must be covered to ensure actual emission reductions. The electric generating sector is likely to cover all units emitting 10,000 tons of CO_2 or more pear year. This policy would require adoption of a regional cap-and-trade system by the Iowa Legislature, and implementation by appropriate federal and state government agencies.

~~**Other:** None currently identified.~~

Implementation Mechanisms

Many variables can be incorporated into a cap-and-trade system, including the GHGs and sectors covered, upstream or downstream coverage, banking, safety valve prices, tie-ins with regional or international trading systems, offsets, early action credits, technology incentives, auctioning, triggers for on and off ramps, and the glide path of the cap. Each factor can have a significant influence on the market price of allowances, and thus the cost of compliance to and impacts on ratepayers.

Related Policies/Programs in Place

MWG Accord.

Type(s) of GHG Reductions

The cap-and-trade program includes emissions from all six GHGs—CO_2, CH_4, N_2O, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride—from the covered sectors.

Avoiding electricity generation from fossil fuel sources results in GHG reductions primarily from CO_2 emissions, but also trace amounts of CH_4 and N_2O emissions.

Estimated GHG Reductions and Costs or Cost Savings

Not quantified: The GHG reductions and costs associated with this option have not been quantified because of current uncertainties about the stringency of the MGA cap, which sectors will be covered under the cap, as well as the degree of inclusion of flexibility mechanisms, such as offsets.

Key Uncertainties

A number of design variables and the quality of data for cost curves and emission projections can affect cap-and-trade simulation results, including permit prices, volume of permits traded, and cost distribution among trading participants.

Additional Benefits and Costs

In addition to direct cost savings of compliance and GHG emission reductions, other potential impacts are possible on labor, value added, income, market share of industries, energy independence, energy prices, air quality, and other environmental or economic outcomes.

Feasibility Issues

TBD

Status of Group Approval

TBD

Level of Group Support

TBD

Barriers to Consensus

TBD

CRE-4a. Decarbonization Fund

Policy Description

A decarbonization fund is a fee on GHG emissions intended to transition society to a new, non-GHG-emitting state in the future. If multiple GHGs are covered, the global warming potentials of the covered gases are normalized into CO_2 equivalents prior to assessment of the fee. Thus, carbon fee proposals usually provide an annual fee levied on each ton of CO_2 or CO_2e.

A small portion of a decarbonization fee is to provide some market signal to consumers to reduce emissions. However, many GHG emissions result from necessities of life, such as heating and cooling and the preparation of food. Thus, given the current state of technology, there are practical and ethical limits to the assessment of a decarbonization fee for the purposes of a price signal. Therefore, the fee for this option is applied only to the electric utility sector.

The most important policy aspect of a decarbonization fee is that the revenue generation potential of even a small fee, feeding into a targeted decarbonization fund, can be significant. Given this, the monies derived from a decarbonization fee can provide a strong incentive toward GHG emission reductions. Thus, the most effective decarbonization fee design would include both the front-end variables (i.e., the covered GHGs, the amount levied per ton of emissions) and the back-end variables (i.e., where revenue is housed, how revenue is utilized).

Policy Design

Goals: The goals of this policy are:

- To help mitigate the potential impacts on the economy, the decarbonization fee should be phased in and capped at a reasonable rate, allowing for long-term planning by consumers. Therefore, as a starting point for the analysis, it is recommended that the decarbonization fee for electric generation begin at \$1/tCO_2 in 2010 and increase by \$1/year until a cap of \$10/tCO_2 is obtained in 2019. The funding in 2019 is estimated at \$320 million.
- To help mitigate potential impacts on low-income consumers, it is recommended that 10% of the funds derived from a decarbonization fee be directed toward targeted assistance (e.g., the Low-Income Home Energy Assistance Program [LIHEAP]) and energy efficiency programs. LIHEAP funding would be approximately \$32 million in 2019.
- To ensure the proper accounting and availability of decarbonization funds, the fees would be included in an adjustment clause, with costs passed directly to customers on a dollar-for-dollar basis and the resulting revenue placed into a dedicated fund. The decarbonization funds could only be utilized for programs and initiatives that transition the electric generating sector to a low-carbon future (e.g., new non-emitting or low-emission generation, energy efficiency, R&D of baseload renewables, and CCS). The Iowa Utilities Board (IUB) would have the authority to audit and review the use of the decarbonization funds.
- The decarbonization fee would be phased out, or reduced to a level that allows continued future system emissions performance, once a 50% or 90% reduction in emissions from 2005 is achieved by 2050.

Timing: The program begins in 2010 at $1/ton CO_2, and the fee reaches $10/ton in 2019.

Parties Involved: Potentially any entity, public or private, with a significant quantity of GHG emissions or emission offsets.

Implementation Mechanisms

This policy would require adoption of a decarbonization fee by the Iowa Legislature and implementation by appropriate state government agencies. It should be applied statewide, requiring a rate mechanism approved through the IUB for rate-regulated utilities, with legislative support, particularly for non-rate-regulated utilities.

Related Policies/Programs in Place

Nothing similar is in place in Iowa.

Type(s) of GHG Reductions

Avoiding electricity generation from fossil fuel sources results in GHG reductions primarily from CO_2emissions, but also trace amounts of CH_4 and N_2O emissions.

~~None currently identified.~~

Estimated GHG Reductions and Costs or Cost Savings

Table 2. Estimated GHG reductions and costs of or cost savings from CRE-4a

Quantification Factors	2012	2020	Units
GHG emission savings	2.2	11.4	$MMtCO_2e$
Net present value (2008–2020)	$144.7	$315.6	$ Million
Cumulative reductions	3.9	74.1	$MMtCO_2e$
Cost-effectiveness	$36.8	$4.3	$/$tCO_2e$
Change in generation cost	$0.1	$3.1	$/MWh

GHG = greenhouse gas; $MMtCO_2e$ = million metric tons of carbon dioxide equivalent; $/$tCO_2e$ = dollars per metric ton of carbon dioxide equivalent; $/MWh = dollars per megawatt-hour.

The decarbonization fee could result in about 3,400 GWh of new renewable energy resources by 2020, which when combined with existing renewable resources results in a renewable energy equivalent of 22% of energy generation. The cost-effectiveness per tCO_2 is lower than the fee in 2020 for two reasons: (1) cost-effectiveness is measured as an average over the period, and (2) the benefits from energy efficiency reduce the impacts of renewable generation that cost more than existing thermal generation.

Data Sources: See CRE-2.

Quantification Methods: See CRE-2.

Key Assumptions:

- The decarbonization fee for electric generation begins at \$1/tCO_2 in 2010 and increases by \$1/year until a cap of \$10/tCO_2 is obtained in 2019, and is then kept constant through 2030.
- The new renewable generation that results from the decarbonization fee comes 95.8% from wind, 2% each from biomass and solar PV, and 0.2% from liquefied petroleum gas.
- Efficiency is capped as a percentage of generation at 20%.
- The funding goes 30% to efficiency, 40% to renewables, 10% to LIHEAP, and 20% to other.
- The levelized costs of energy efficiency measure is \$37.13/MWh in 2009. The source for capital costs is Quantec, Summit Blue Consulting, Nexant, Inc., A-TEC Energy Corporation, and Britt/Makela Group (February 2008), *Assessment of Energy and Capacity Savings Potential in Iowa: Final Report,* vol. I. This figure includes all utility and participant costs. Utility fixed costs are assumed to be 24% of the capital cost, based on MidAmerican Energy Company EE [energy efficiency] Action Plan filing Docket # EEP-08-02, vol. II, p. A1-8.
- The avoided cost of electricity in 2009 is \$72/MWh. The figure is from 2009–2013 Energy Efficiency Plan Interstate Power and Light Company Docket No. EEP-08-123-Apr-08, p. 33. The values base case is without an externality factor.
- The real rate at which costs are discounted annually is 5%,
- NPV is calculated in 2008 dollars.
- NPV is calculated beginning in 2009.
- All electricity from coal-fired generation is coming from sources within Iowa (no imports).
- Renewables displace marginal sources of generation (50% coal, 50% natural gas) through 2012. From 2013 on, renewables displace the thermal new-build mix of 99% coal, 1% natural gas.
- Energy efficiency measures are assumed to displace marginal sources of generation (50% coal, 50% natural gas) through 2012. From 2013 on, energy efficiency displaces the new-build mix of 78% coal, 21% renewables, and 1% natural gas.

Key Uncertainties

None currently identified.

Additional Benefits and Costs

- The quantification does not include the 10% of funds that go to low-income assistance and 20% that goes to “other.” Thus, the emission reduction estimates are likely to be higher than estimated in the quantification process.
- A decarbonization fee has the potential for negative externalities, such as impacts on the economy, particularly low-income consumers, and the potential that the funds would be used for unrelated programs that do not directly assist the transition to a low-carbon future. Therefore, these issues must be addressed explicitly at the creation of the decarbonization fee policy.

Feasibility Issues

DRAFT:

There is a risk that GHG reductions are overstated and the costs per ton of CO_2e reductions are understated if high-CO_2-intensity resources are assumed to be redispatched or not built due to increased renewables (the avoided CO_2 methodology).[2]

Status of Group Approval

Approved.

Level of Group Support

Super Majority (2 objections).

Barriers to Consensus

Unspecified.

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[2] Annex A of this document defines the rationale behind the assumption used for the avoided CO_2 methodology in these analyses.

CRE-4b. Carbon Tax

Policy Description

A carbon tax is a tax on each ton of CO_2 emitted from an emissions source covered by the tax. The tax would be imposed at the point of combustion and emission. If any of those sources sequesters CO_2, the CO_2 that was sequestered would not be taxed. If GHGs besides CO_2 are being taxed, those emissions are converted to a CO_2 equivalent.

Alternatively, the tax could be imposed based on the tons of coal, gallons of oil, volume of natural gas, and even gallons of petroleum purchased. Again, if any of those sources sequesters CO_2, that equivalent to the CO_2 that was sequestered would not be taxed.

In general, a Btu from coal produces 30% more CO_2 than a Btu from oil and 80% more CO_2 than a Btu from natural gas. Per Btu, the carbon tax would be greatest on sources burning coal, less on than those that burn oil, and least on those burning natural gas.

By implementing measures to reduce GHGs, an entity can reduce the amount of tax paid.

The tax is constant and predictable. It can be implemented quickly and simply, being collected by the Iowa Department of Revenue. It does not require a new energy trading market. The tax would be paid upstream, at the point the carbon is emitted.

The tax could be passed along to consumers, it could be taken off the bottom line of the utility, or a combination of both.

The taxes collected could be used to offset the increased cost of the power to low-income consumers and could be used to fund other programs in the state that would reduce GHG emissions.

If a cap-and-trade system takes a number of years to implement, the carbon tax might be a good interim policy.

If the carbon tax must be paid primarily by the emission sources and not simply passed in total to the consumer, it would encourage emitters to pursue renewable energy sources or carbon sequestration. If some of the carbon tax is passed to the consumer, it would encourage immediate reductions of GHGs by consumers who pursue conservation and energy efficiency measures. If the tax is high enough, it would shift consumers into purchasing green power from the utilities, which today is priced higher than non-green power. That shift would provide money for the utilities to increase investment in renewable energy.

Policy Design

Goals: The goals of this policy are:

- To achieve reductions in GHGs through implementation of an appropriate $/ton carbon tax in Iowa, particularly working in concert with energy efficiency programs, conservation programs, and programs to encourage customers to purchase green power.
- To identify the specific legislative and regulatory actions that would be needed to support the carbon tax in Iowa, including dealing with entities that sequester carbon and assisting low-income consumers affected by the carbon tax.
- To determine what programs and initiatives the collected tax revenue should be allocated to support, including low-income consumer assistance, education, and others.

Timing: This policy would become effective with action by the Iowa Legislature and implementation by the Iowa Department of Revenue, beginning in 2010.

Parties Involved: State legislators, Iowa Department of Revenue. It would affect every consumer of electrical power, transportation fuels, or any other fossil fuel with a carbon content in the state. It might require the IUB to determine how much of the tax can be passed on to the consumer.

Other: None currently identified.

Implementation Mechanisms

The IUB would have to determine how much of the tax would be passed on to consumers.

Related Policies/Programs in Place

None in Iowa.

Type(s) of GHG Reductions

Avoiding electricity generation from fossil fuel sources results in GHG reductions primarily from CO_2 emissions, but also trace amounts of CH_4 and N_2O emissions.

~~TBD~~

Estimated GHG Reductions and Costs or Cost Savings

THESE RESULTS HAVE NOT BEEN APPROVED BY THE CRE SUBCOMMITTEE

According to the subcommittee's request, the carbon tax would cover all economic sectors except AFW sector. In the analysis, we simulate five carbon tax scenarios for Iowa in 2020. In the first three scenarios, we simulate the tax rate necessary for the tax covered sectors in Iowa to achieve the three MGA goals (15%, 20%, and 25% below their 2005 sectoral emissions level in 2020). In Scenarios 4 and 5, we simulate two given tax rates at $30/tCO$_2$e and $40/tCO$_2$e, and evaluate the amount of emission reductions achieved by these sectors through the implementation of the carbon tax.

In Table 3, the second column presents the tax rate in $/tCO$_2$e. Columns 3 and 4 show the emission reductions corresponding to the tax rate in both percentage and quantity terms. Column 5 presents the mitigation cost. The 2020 total emissions from the tax covered sectors in Iowa are

98.99 $MMtCO_2e$ if we assume the RPS is implemented in the baseline. The difference between the total emissions and the emissions reduced by those sectors will be the amount for which a tax payment will be needed (see Column 6). Column 7 indicates the carbon tax payments by the emitters (or the tax revenue collected by the government), which is the product of the numbers in Columns 2 and 6. The last column shows the total net cost, which is the sum of the mitigation cost and the tax payment.

In Scenarios 1–3, the three MGA goals are translated into 23.40%, 27.91%, and 32.41% below the 2020 baseline emissions of the tax covered sectors. To achieve the three emission reduction goals, the corresponding tax rate would be \$2.86/tCO_2e, \$11.78/tCO_2e, and \$21.28/tCO_2e, respectively. In Scenarios 4 and 5, when the respective tax rates are given at the level of \$30/tCO_2e and \$40/tCO_2e, the emission reductions that can be achieved in Iowa are 36.30% and 40.49%, respectively, below the 2020 baseline level of these sectors, or 35.94 $MMtCO_2e$ and 40.08 $MMtCO_2e$, respectively.

Please note in this study, we did not analyze the economic impacts associated with tax revenue recycling.

Table 3. Simulation results of Iowa carbon tax

Scenario	Tax Rate (\$/tCO_2e)	Emission Reduction* (Percentage from 2020 BAU)[†]	Emission Reduction* ($MMtCO_2e$)	Mitigation Cost (\$MM)	Emissions That Require Payment of a Carbon Tax ($MMtCO_2e$)	Carbon Tax Payments (\$MM)	Net Cost (\$MM)[‡]
1	\$2.86	23.40	23.17	-\$408.53	75.82	\$216.62	-\$191.91
2	\$11.78	27.91	27.63	-\$376.09	71.36	\$840.63	\$464.53
3	\$21.28	32.41	32.09	-\$302.60	66.90	\$1,423.58	\$1,120.98
4	\$30.00	36.30	35.94	-\$204.08	63.05	\$1,891.58	\$1,687.50
5	\$40.00	40.49	40.08	-\$59.35	58.91	\$2,356.44	\$2,297.09

* In equilibrium, the emitter will choose to mitigate to the level where its marginal abatement cost equals the tax rate.

[†] The Iowa 2020 BAU emissions level of the tax covered sectors is 98.99 $MMtCO_2e$ with RPS implemented in the baseline.

[‡] Sum of Mitigation Cost and Tax Payment.

\$/tCO_2e = dollars per metric ton of carbon dioxide equivalent; $MMtCO_2e$ = million dollars per metric ton of carbon dioxide equivalent; BAU = business as usual; \$MM = millions of dollars.

Data Sources:

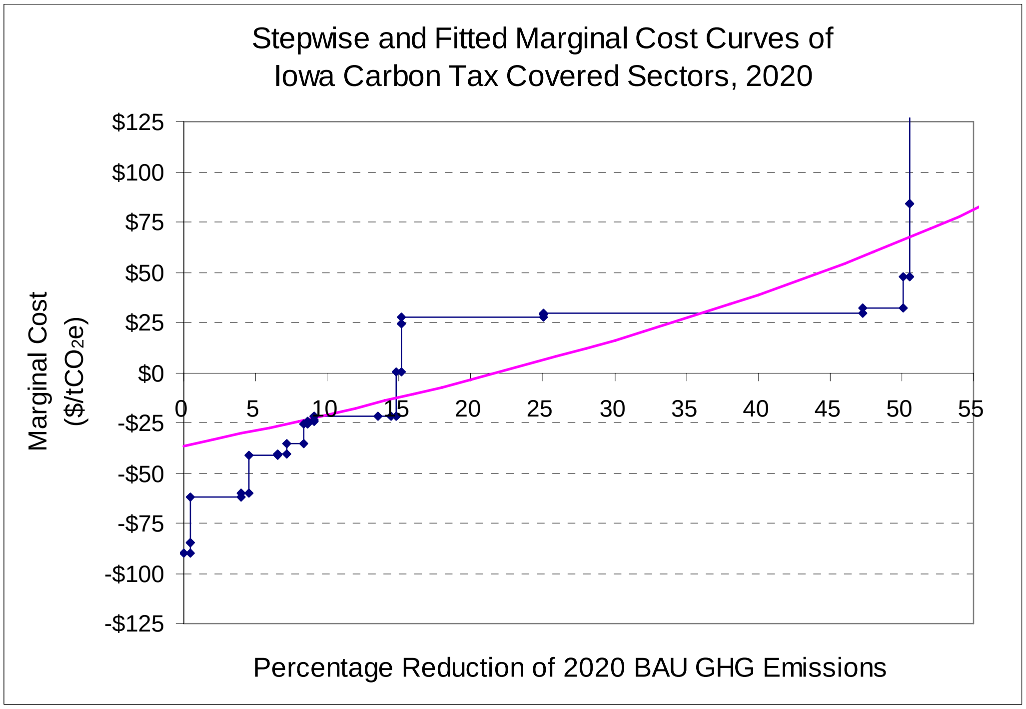
- Iowa Climate Change Advisory Council. 2008. Quantification Analysis of Mitigation Options from the EEC, CRE, and TLU Subcommittees.
- Draft Inventory and Forecast Analysis of Iowa by CCS.

Quantification Methods:

In this analysis, a carbon tax is assumed to be imposed on all the emission sources in Iowa except for the AFW sector. Facing a given carbon tax, the emitter would choose to implement measures to reduce GHGs up to the point where its marginal mitigation cost is equal to the tax rate, and would choose to pay the tax for the remaining emissions.

For any given tax rate, we can estimate reductions by the emission sources, as well as how much tax is paid for the emissions generated, by looking at the marginal cost curve of the tax covered sectors alone (Figure 1).

Figure 1. Stepwise and fitted marginal cost curves of Iowa carbon tax covered sectors: 2020



$/tCO$_2$e = dollars per metric ton of carbon dioxide equivalent; GHG = greenhouse gas dioxide; BAU = business as usual.

Notes:

1. The marginal cost curve in Figure 2 is developed based on the quantification analysis results for individual mitigation options provided by the EEC, CRE, and TLU Subcommittees. Those options that are not quantified for emission reduction potentials or cost-effectiveness are not included in the cost curve development.

2. Since the Renewable Portfolio Standard is assumed to be implemented separately from the Carbon Tax program, CRE-5 “Performance Standards”, which pertains to the RPS in Iowa, is excluded from the list of options used in the cost curve development.

Key Assumptions:

In this analysis, we assume the RPS policy will be implemented separately from the carbon tax program in Iowa. Therefore, the emission reductions that are expected to be achieved from the RPS policy are subtracted from the Iowa 2020 baseline emissions before we perform the carbon tax analysis. Accordingly, the marginal cost curve shown above also excludes the RPS policy option.

The modeling assumes that the policy options represented by the cost curve are fully realized without barriers to implementation.

Key Uncertainties

The quality of data for cost curve and emission projections of Iowa can affect the carbon tax simulation results, including tax rate levels to achieve the MGA 2020 goals, emission reductions associated with different tax rates, amount of emissions that requires payment of the carbon tax, and tax revenue collected.

DRAFT:

There is a risk that GHG reductions are overstated and the costs per ton of CO_2e reductions are understated if high-CO_2-intensity resources are assumed to be redispatched or not built due to increased renewables (the avoided CO_2 methodology).[3]

Additional Benefits and Costs

The tax revenue collected could provide Iowa with a range of additional benefits as a direct result of this policy. The revenue can be redistributed to low-income consumers or directed to other GHG mitigation programs in the state, including R&D in new or improved fuels and technologies.

Feasibility Issues

~~TBD~~Market barriers and market failures might prevent market mechanisms from achieving the GHG reductions that are being modeled.

Status of Group Approval

TBD

Level of Group Support

TBD

Barriers to Consensus

TBD

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[3] Annex A of this document defines the rationale behind the assumption used for the avoided CO_2 methodology in these analyses.

CRE-5. Performance Standards

Policy Description

A generation performance standard (GPS) is an emissions rate hurdle that must be met for compliance by sources supplying electricity to consumers in Iowa. Typically, a GPS is expressed in pounds (lb) of CO_2/MWh. An RPS is a type of performance standard, identifying a target percentage of a generator's supply mix that must be from sources that meet the RPS's definition of renewable. A GPS can be applied to new generation or can include the system-wide emissions rate of an entity's generating fleet.

In either scenario, the theory of a GPS is to lower the emissions rate over time to obtain a desired end point. Given this, a GPS can have many variables, including coverage of generating units or load-serving entities, offsets, the inclusion of energy efficiency programs, technology incentives, trading of renewable energy credits, penalty rates for noncompliance, emissions from purchased power, triggers for on and off ramps, and the rate of change to the emissions standard. Each factor can have a significant influence on the cost of compliance and thus on ratepayers.

Policy Design

Goals: The goals of this policy are to

- Identify the likely reasonable cost regulatory structures for a GPS to comply with the scenarios modeled.
- Analyze the costs and benefits of GPS scenarios to reach the
    - 5(a): 50% reduction goal from 2005 emissions levels by 2050, and
    - 5(b): 90% reduction goal from 2005 emissions levels by 2050.

Timing: This policy would require adoption of a GPS by the Iowa Legislature and implementation by the IUB.

Parties Involved: The Iowa Legislature, IUB, and entities covered by the GPS.

Other: Various forms of GPS have been utilized by many states and countries to encourage zero- and low-emitting generation while providing regulatory flexibility in the compliance pathway.

Implementation Mechanisms

To accomplish this policy recommendation's goals, an initial draft policy outline for a GPS is as follows:

- The simplest approach to model the 50% and 90% reduction scenarios, from a 2005 emissions baseline, is a system-wide emissions rate from an entity's generating fleet.
- In 2005, the average emissions rate for electrical generating fleets in Iowa was approximately 1,800 lb CO_2/MWh. By 2050, demand for electricity is expected to approximately double.

Therefore, the draft GPS path begins at 1,800 lb CO_2/MWh in the year 2010. The end points for the performance standards in 2050 are 450 lb CO_2/MWh for the 50% reduction scenario, and 90 lb CO_2/MWh for the 90% reduction scenario. Nonetheless, it is important to note that these end points are theoretical and will need to be amended according to real-world growth in the demand for electricity.

- The success of an emissions performance standard depends upon the reasonable cost technologies available. Consistent with CRE-10, baseload renewable energy and CCS technologies are not expected to be commercialized until the 2020–2025 time frame. Therefore, the GPS must provide incentives for developing these technologies in Iowa.
- The emissions performance standard for both goals begins in 2010 at 1,800 lb CO_2/MWh for an entity's generating fleet. For the 50% scenario, the standard will be reduced by approximately 33.75 lb CO_2/MWh per year through 2050. For the 90% scenario, the standard will be reduced by approximately 42.75 lb CO_2/MWh per year through 2050.
- Electric generating entities employing baseload renewable energy and CCS technology prior to 2025 would receive a bonus multiplication factor for such MWh to stimulate technology development. Between 2025 and 2030, the bonus multiplication factor would continue to be granted for baseload renewable energy and CCS projects, but at a lower reward rate than used between 2015 and 2025.
- To encourage the development of biomass-based renewable energy, CO_2 emissions from the combustion of biomass (e.g., switchgrass, corn stover) or methane from the decomposition of organic matter (e.g., landfill gas, manure biogas) would not count against the emissions performance standard.

Related Policies/Programs in Place

None currently identified.

Type(s) of GHG Reductions

Avoiding electricity generation from fossil fuel sources results in GHG reductions primarily from CO_2 emissions, but also trace amounts of CH_4 and N_2O emissions.

~~None currently identified.~~

Estimated GHG Reductions and Costs or Cost Savings

The target in 5a (Table 4) results in 16,000 GWh of renewables by 2020, or 30% of net generation; 2008 renewables generation (including hydropower and municipal solid waste) is estimated at 9.8%.

Table 4. 5a—For the 50% reduction by 2050 option (14.3% by 2020)

Quantification Factors	2012	2020	Units
GHG emission savings	4.9	11.4	$MMtCO_2e$
Net present value (2008–2020)	$722.5	$2,650.6	$ Million
Cumulative reductions	18.1	95.4	$MMtCO_2e$
Cost-effectiveness	$40.0	$27.8	$/tCO_2e$

Change in generation cost	$3.3	$7.3	$/MWh

GHG = greenhouse gas; MMtCO$_2$e = million metric tons of carbon dioxide equivalent; $/tCO$_2$e = dollars per metric ton of carbon dioxide equivalent; $/MWh = dollars per megawatt-hour.

The target in 5b (Table 5) results in 21,300 GWh of renewables by 2020, or 40% of net generation; 2008 renewables generation (including hydropower and municipal solid waste) is estimated at 9.8%.

Table 5. 5b—For the 90% reduction by 2050 option (25.7% by 2020)

Quantification Factors	2012	2020	Units
GHG emission savings	5.7	16.1	MMtCO$_2$e
Net present value (2008–2020)	$892.9	$3,480.1	$ Million
Cumulative reductions	20.1	124.3	MMtCO$_2$e
Cost-effectiveness	$44.5	$28.0	$/tCO$_2$e
Change in generation cost	$4.2	$10.3	$/MWh

GHG = greenhouse gas; MMtCO$_2$e = million metric tons of carbon dioxide equivalent; $/tCO$_2$e = dollars per metric ton of carbon dioxide equivalent; $/MWh = dollars per megawatt-hour.

Data Sources: See CRE-2.

Quantification Methods: See CRE-2.

Key Assumptions:

- The program begins in 2009 and runs through 2020.
- The generation performance standard deploys new resources equal to 90% from wind, 10% from biomass.
- The real interest rate used to discount cash flows is 5%.
- NPV is calculated in 2008 dollars.
- NPV is calculated beginning in 2009.
- All electricity from coal-fired generation is from sources within Iowa (no imports).
- Renewables displace marginal sources of generation (50% coal, 50% natural gas) through 2012. From 2013 on, renewables displace the thermal new-build mix of 99% coal, 1% natural gas.

Key Uncertainties

Compliance penalties for nonperformance need to be addressed in future iterations of this policy recommendation.

DRAFT:

There is a risk that GHG reductions are overstated and the costs per ton of CO_2e reductions are understated if high-CO_2-intensity resources are assumed to be redispatched or not built due to increased renewables (the avoided CO_2 methodology).[4]

Additional Benefits and Costs

None currently identified.

Feasibility Issues

Regulated actors ability to reduce emissions by 26% by 2020 is an issue for concern.

Status of Group Approval

Approved.

Level of Group Support

Super Majority (3 objections, 1 abstention).

Barriers to Consensus

Unspecified.

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[4] Annex A of this document defines the rationale behind the assumption used for the avoided CO_2 methodology in these analyses.

CRE-6. Voluntary GHG Commitments

Policy Description

Numerous U.S. companies and organizations, including many utilities, have taken on voluntary GHG reduction commitments. Some of these are organized through EPA's Climate Leaders program. Others include participation in Power Partners and the EIA 1605(b) Voluntary GHG Emission Reduction Program. Forty two companies, including some of the world's largest—e.g., GE, Dupont, IBM, and Duke Energy—have joined together as the Business Environmental Leadership Council (BELC) of the Pew Center on Global Climate Change. These companies are voluntarily addressing global climate change through proactive and innovative measures, including setting targets for GHG emission reductions, implementing innovative energy supply and demand solutions, improving waste management practices, participating in emissions trading, and investing in carbon sequestration opportunities and research. Thirty-seven of these BELC companies have established GHG reduction targets. Some of these companies have achieved their targets and are currently evaluating new goals, while others are considering first-time targets.

These commitments can be based on total GHG emissions in a given year or specific voluntary projects, or can be defined on an intensity basis (tCO_2e/MWh generated or delivered.) Some entities with voluntary commitments also transact through the Chicago Climate Exchange (CCX), a pilot program for reducing and trading GHG emissions in North America. Currently more than 350 entities are participating in the CCX, including the University of Iowa and Iowa Farm Bureau.

Policy Design

Goals: The goals for an Iowa Voluntary GHG program include:

- Encourage Iowa businesses and citizens to voluntarily begin reducing GHG emissions immediately, without waiting for mandatory Iowa or national GHG reduction program measures. A goal of this program is to obtain voluntary commitments from each of Iowa's investor-owned utilities (IOUs) to reduce GHG emissions by at least 6% below the baseline year 2005 emissions by 2010, and to obtain similar commitments from 25% of Iowa's GHG-emitting private businesses.
- Provide a means for Iowa voluntary GHG emission reductions to be quantified and recognized by applying Iowa-approved GHG quantification methods.
- Allow rate-regulated utilities assurance of cost recovery for voluntary GHG reduction measures that are previewed and approved by the IUB. The rates charged by some utilities in Iowa are regulated and must be approved by the IUB. The rate-regulated utilities in Iowa are MidAmerican Energy Company, Interstate Power and Light Company, Aquila, Inc., Atmos Energy Corporation, and Linn County REC. The rates of the rural electric cooperatives and the municipal utilities are not regulated or approved by the IUB, except that Linn County REC has voluntarily asked that its rates be regulated. Rate-regulated utilities would have to propose actions they would take to reduce their GHG emissions for approval by the IUB. If

the IUB approved those measures, cost recovery means that the IUB would allow the rate-regulated utility to recover the cost of the approved GHG reduction measures in rates the utility charges its customers.

- Provide documentation that supports voluntary measures receiving full credit under a future Iowa or national mandatory or voluntary GHG reduction program (e.g., credit for early action).
- Enable Iowa voluntary GHG emission reduction measures to receive credit as certifiable CO_2 offsets for use inside and outside of the United States.

Timing: Upon promulgation of CRE-6.

Parties Involved: All sectors and sources that wish to provide for voluntary GHG reductions or offsets, including government, utilities, industry, business, commercial building owners, and homeowners.

Implementation Mechanisms

Legislation will provide for voluntary GHG emission reductions to be registered and for costs-recovery mechanisms. The Iowa Department of Natural Resources (IDNR) will be authorized to provide voluntary measure recordkeeping and provide for review for public interest. The IUB will be authorized to review and approve any costs for rate-regulated utilities.

Related Policies/Programs in Place

None currently identified.

Type(s) of GHG Reductions

Avoiding electricity generation from fossil fuel sources results in GHG reductions primarily from CO_2 emissions, but also trace amounts of CH_4 and N_2O emissions.

~~Reductions in emissions of CO_2, as well as other GHGs, depending on participation in the program.~~

Estimated GHG Reductions and Costs or Cost Savings

Not quantifiable.

Data Sources: Not applicable.

Quantification Methods: Not applicable.

Key Assumptions: Not applicable.

Key Uncertainties

TBD

Additional Benefits and Costs

TBD

Feasibility Issues

TBD

Status of Group Approval

TBD

Level of Group Support

TBD

Barriers to Consensus

TBD

CRE-7. Policies Related to Nuclear Power

Policy Description

Nuclear power has potential as an alternative source of electricity for meeting GHG reduction goals. During operation, nuclear plants generate no GHGs, although, as with any new structure, GHG emissions are associated with the construction of the facility. Nuclear power generation is classified as baseload generation and is designed to operate at high-capacity factors. It is also the largest single source of non-carbon-emitting electric generation. As a result, it is a potential energy supply alternative, in large scale, to meet Iowa's growing electric needs and for possible long-term replacement of baseload coal-fired generation.

As of the end of the 2007, 104 commercial nuclear generating units were licensed by the U.S. Nuclear Regulatory Commission (NRC), with an electric capability of 97,400 MW. The most recent reactor came on line in 2007. The current administration has been supportive of nuclear expansion, emphasizing its importance in maintaining a diverse energy supply and its potential for producing electricity with negligible GHG emissions during operation.

Other means of incorporating nuclear generation include license renewal and uprating for existing plants. Nuclear license renewal allows a nuclear power plant to extend the life of the facility for 20 years past its original 40-year license term. The NRC considers the license renewal program one of its major cornerstones of current regulatory activity. A nuclear power plant uprating is a technical review process whereby a licensee may receive approval from the NRC to operate a plant at a higher power level than the level authorized in the original license. License renewal and power uprates typically require some capital investment for upgrades and rebuilding of plant subsystems.

Iowa's only nuclear plant is the Duane Arnold Energy Center, which is owned by the FPL Group, through its subsidiary FPL Energy (70% ownership), Central Iowa Power Cooperative (20% ownership), and Corn Belt Power Cooperative (10% ownership). Duane Arnold received approval for a power uprate in 2001, and currently has a license from the NRC to operate until 2014. In acquiring its ownership share in 2005, FPL committed to seek license renewal for an additional 20 years, until 2034. MidAmerican Energy Company is a 25% owner of the Quad Cities Nuclear Power Station near Cordova, Illinois, which also completed a power uprate, and has received license renewal from the NRC to operate until 2032.

It is currently estimated that it would take approximately 10–12 years to design, permit, and construct a new nuclear power plant. Therefore, steps should be taken today if Iowa chooses to employ nuclear power as part of a balanced and diversified energy portfolio[5] that achieves Iowa's long-term carbon emission reduction goals.

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[5] Including, among others, renewable energy, conservation, and energy efficiency measures.

The focus of this particular policy is to determine the economic feasibility of nuclear power in a carbon-constrained environment and to define specific state legislative and regulatory actions to facilitate licensing, financing, and construction of new nuclear power plants in Iowa.

Policy Design

Goal: Build one new 1200-MW nuclear power plant in Iowa.

Timing: To have the plant operational by January 1, 2020.

Parties Involved: This policy would become effective with action by the Iowa Legislature and implementation by the IUB, IDNR, and other state agencies. IOUs, generation and transmission electric cooperatives, municipalities, Iowa Department of Public Health, environmental advocacy groups, state legislators, county government and economic development leaders, business advocacy groups, the Office of Energy Independence, and the Office of Consumer Advocate.

Other: None currently identified.

Implementation Mechanisms

TBD

Related Policies/Programs in Place

As a starting point, the analysis should assume that the NRC approves the license renewal application for the Duane Arnold Energy Center.

Type(s) of GHG Reductions

Avoiding electricity generation from fossil fuel sources results in GHG reductions primarily from CO_2 emissions, but also trace amounts of CH_4, and N_2O emissions.

~~TBD~~

Estimated GHG Reductions and Costs or Cost Savings

Table 6. GHG reductions and costs of or cost savings from CRE-7

Quantification Factors	2012	2020	Units
GHG emission savings	0.0	9.7	MMtCO$_2$e
Net present value (2008–2020)	N/A	$267.7	$ Million
Cumulative reductions	N/A	9.7	MMtCO$_2$e
Cost-effectiveness	N/A	$27.6	$/tCO$_2$e
Change in generation cost	N/A	$4.5	$/MWh

GHG = greenhouse gas; MMtCO$_2$e = million metric tons of carbon dioxide equivalent; $/tCO$_2$e = dollars per metric ton of carbon dioxide equivalent; $/MWh = dollars per megawatt-hour; N/A = not applicable.

Data Sources: See CRE-2.

- Moody's Investors Service. October 2007. "New Nuclear Generation in the United States: Keeping Options Open vs. Addressing An Inevitable Necessity." Available at: http://www.moodys.com.

Quantification Methods: See CRE-2.

Key Assumptions:

- That one new nuclear plant with a capacity of 1200 MW is operating in Iowa by 2025.
- The existing Duane Arnold Energy Center is operating with a new license until 2034.
- A 90% capacity factor for new nuclear units.
- The real interest rate used to discount cash flows is 5%.
- NPV is calculated in 2008 dollars.
- NPV is calculated beginning in 2009.
- All electricity from coal-fired generation is coming from sources within Iowa (no imports).

Key Uncertainties

There are considerable uncertainties about the cost characteristics of new nuclear power. EIA's cost estimates for new nuclear are employed in this analysis, but are much lower than other recent reports, such as Moody's, that estimate installed costs of $5,700/kW.

DRAFT:

There is a risk that GHG reductions are overstated and the costs per ton of CO_2e reductions are understated if high-CO_2-intensity resources are assumed to be redispatched or not built due to increased renewables (the avoided CO_2 methodology).[6]

Additional Benefits and Costs

None currently identified.

Feasibility Issues

None currently identified.

Status of Group Approval

TBD

Level of Group Support

TBD

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[6] Annex A of this document defines the rationale behind the assumption used for the avoided CO_2 methodology in these analyses.

Barriers to Consensus

TBD

CRE-8. Support for Grid-Based Renewable Energy and Development

Policy Description

This policy option reflects financial incentives to encourage investment in renewable energy resources by businesses and individuals that sell power commercially. Grid-based renewable energy facilities are assumed to be those that interconnect directly with the transmission system.

Policies can be developed to help overcome financial barriers and increase incentives for renewable energy development. Institutional barriers, such as low market prices, the inability of the market to assign values to the public benefits of renewables and the social costs of fossil fuel technologies, high transaction costs relative to smaller project sizes, and high financing costs because of lender unfamiliarity and perceived risk, can be overcome through a suite of financial and regulatory incentives for renewable energy development. These policies and incentives can include:

- Direct subsidies for buying or selling renewable generation equipment.
- Tax credits or exemptions for buying or selling renewable generation equipment.
- Government-sponsored or -facilitated loan programs for buying renewable generation equipment.
- Tax credits or direct subsidies for each kWh generated or sold from renewable generation facilities.
- Government-sponsored or -facilitated loan programs supporting the manufacture of renewable generation equipment.
- Direct subsidies supporting the manufacture of renewable generation equipment.
- Tax credits or exemptions supporting the manufacture of renewable generation equipment.
- Regulatory policies that provide incentives and/or assurance of cost recovery for utilities that invest in renewable energy systems.
- Regulatory policies that streamline certification requirements for renewable generation plants.
- Iowa regulatory support for federal transmission cost-allocation policies that are equitable and promote the cost-efficient siting of renewable generation resources.

The reference case scenario predicts that renewables generation will rise from approximately 6% of retail sales in 2005 to 11% in 2009, and will rise to 16% of retail sales by 2020.

Policy Design

Goals:

- 8a: Increase grid-based renewable electric production in Iowa by 400,000 MWh (400 GWh) of generation in the first year and growing by 1% of retail MWh sales each year thereafter. This policy adds an average of 521 GWh of new renewable resources per year over 2012–

2020 and results in incremental renewables generation equal to 3.7% of retail sales by 2015, and 8.2% of retail sales by 2020. Including assumed reference case renewables deployment, CRE-8a results in approximately 24.2% of renewables as a percentage of retail sales by 2020, and 32.2% by 2030.

- 8b: The MGA renewable energy goal: An RPS for the Midwest region equivalent to 10% of retail MWh sales by 2015, 20% by 2020, and 30% by 2030. Iowa's reference case renewable generation exceeds the linear MGA target until approximately 2018, and then adds an average of 767 GWh of new renewable resources per year over 2018–2020. CRE-8b results in new renewables generation equal to 4% of retail sales by 2020, and additional increments equal to 1% of retail sales each year thereafter. Including assumed reference case renewables deployment, CRE-8b results in the MGA target of 20% of renewables as a percentage of retail sales by 2020, and 30% by 2030.

Timing:

- Beginning in 2012, continuing through 2020.
- As specified in the MGA renewable energy goal.

Parties Involved: Grid-based renewable generation developers.

Implementation Mechanisms

- Identify barriers to grid-based renewable generation development.
- Quantify barriers in dollar terms.
- Determine specific incentive levels and durations needed to overcome barriers.
- Set incentive levels and program limits to achieve grid-based renewable generation development goals.
- Provide federal production tax credit.

Related Policies/Programs in Place

Current policies and programs include:

- Tax exemptions for buying or selling renewable generation equipment:
  - The property tax exemption for methane gas conversion available under Iowa Code § 427.1(29);
  - The property tax exemption for renewable energy facilities available under Iowa Code § 441.21;
  - The local option special assessment for wind generation facilities available under Iowa Code § 427B.26;
  - The replacement generation tax exemption for renewable energy facilities available under Iowa Code § 437A.6; and
  - The sales tax exemption for wind and solar generation equipment available under Iowa Code §§ 423.3(54) and 423.3(90).

- Government-sponsored or -facilitated loan programs for buying renewable generation equipment:
    - The alternate energy revolving loan program under Iowa Code § 476.46; and
    - The Iowa Energy Bank loan program under Iowa Code § 473.19.
- Tax credits for each kWh generated or sold from renewable generation facilities:
    - The wind and renewable energy tax credits available for kWh sold under Iowa Code chapters 476B and 476C; and
    - The wind energy tax credits available for kWh generated and consumed on site under Iowa Code chapter 476B.
- Regulatory policies that provide incentives and/or assurance of cost recovery for utilities that invest in renewable energy systems:
    - Advance ratemaking principles available for utility-owned renewable generation facilities under Iowa Code § 476.53, which are determined in advance of plant construction and before the utility's next rate case.
- Regulatory policies that streamline certification requirements for renewable generation plants:
    - The IUB chapter 24 rules for "Location and Construction of Electric Power Generating Facilities" (199 IAC 24), and the "25 MW per gathering line" exemption for wind-generating facilities described in IUB Docket No. DRU-03-2.

~~The DOE report *20% Wind Energy by 2030: Increasing Wind Energy's Contribution to U.S. Electricity Supply* (http://www.20percentwind.org/20p.aspx?page=Report) describes an expansion of U.S. wind-generation capacity from 11.6 GW in 2006 to 305 GW by 2030, with more than 10 GW located in Iowa by 2030. The 10 GW of wind capacity in Iowa would be equivalent to an Iowa RPS of 60%–80%, based on 2006 Iowa retail sales of 43,000 GWh (i.e., 60% RPS if the wind capacity generates at a 30% capacity factor; 80% RPS if it generates at a 40% capacity factor).~~

The DOE report *20% Wind Energy by 2030: Increasing Wind Energy's Contribution to U.S. Electricity Supply* (http://www.20percentwind.org/20p.aspx?page=Report) describes an expansion of U.S. wind-generation capacity from 11.6 GW in 2006 to 305 GW by 2030, with more than 10 GW located in Iowa by 2030. This 10 GW of Iowa wind capacity in Iowa would be equivalent to an Iowa RPS of 40%–50%, based on estimated 2006 Iowa retail sales of 67,651 GWh in 2030 (i.e., 40% RPS if the combined wind capacity generates at a 31% capacity factor, and 50% RPS if it generates at a 39% capacity factor).

Type(s) of GHG Reductions

Avoiding electricity generation from fossil fuel sources results in GHG reductions primarily from CO_2 emissions, but also trace amounts of CH_4 and N_2O emissions.

~~None currently identified.~~

Estimated GHG Reductions and Costs or Cost Savings

Table 7. Estimated GHG reductions and costs of or cost savings from CRE-8a

Quantification Factors	2012	2020	Units
GHG emission savings	0.3	4.8	$MMtCO_2e$
Net present value (2008–2020)	$16.2	$557.6	$ Million
Cumulative reductions	0.3	22.9	$MMtCO_2e$
Cost-effectiveness	$54.4	$24.4	$\$/tCO_2e$
Change in generation cost	$0.2	$3.0	$/MWh

GHG = greenhouse gas; $MMtCO_2e$ = million metric tons of carbon dioxide equivalent; $\$/tCO_2e$ = dollars per metric ton of carbon dioxide equivalent; $/MWh = dollars per megawatt-hour.

Table 8. Estimated GHG reductions and costs of or cost savings from CRE-8b

Quantification Factors	2012	2020	Units
GHG emission savings	0.0	2.3	$MMtCO_2e$
Net present value (2008-2020)	$0.0	$93.4	$ Million
Cumulative reductions	0.0	4.3	$MMtCO_2e$
Cost-effectiveness	$0.0	$21.8	$\$/tCO_2e$
Change in generation cost	$0.0	$1.5	$/MWh

GHG = greenhouse gas; $MMtCO_2e$ = million metric tons of carbon dioxide equivalent; $\$/tCO_2e$ = dollars per metric ton of carbon dioxide equivalent; $/MWh = dollars per megawatt-hour.

Data Sources:

MGA. 2007. *Energy Security and Climate Stewardship Platform for the Midwest.* http://www.midwesterngovernors.org/Publications/MGA_Platform2WebVersion.pdf

Quantification Methods: See CRE-2.

Key Assumptions:

- The program runs from 2012 through 2020. For CRE-8b, the gap between the MGA target and the policy goal in 2015 and 2020 is met in a linear deployment of new renewables.
- Coal is the fossil fuel displaced, and it is replaced by grid-based renewable electric production: wind (95%), solar PV (2%), and biomass (3%).
- The real interest rate used to discount cash flows is 5%.
- NPV is calculated in 2008 dollars.
- NPV is calculated beginning in 2009.
- All electricity from coal-fired generation is coming from sources within Iowa (no imports).

- Renewables displace marginal sources of generation (50% coal, 50% natural gas) through 2012. From 2013 on, renewables displace the thermal new-build mix of 99% coal, 1% natural gas.

Key Uncertainties

DRAFT:

There is a risk that GHG reductions are overstated and the costs per ton of CO_2e reductions are understated if high-CO_2-intensity resources are assumed to be redispatched or not built due to increased renewables (the avoided CO_2 methodology).[7]

As a sensitivity analysis, the assumption of avoiding 50% coal, 50% gas generation for the entire planning period (2009–2020) instead of 2013–2020 in CRE-8a results in the year 2020 CO_2 reductions decreasing from 4.8 to 3.5 million MMtCO_2, cumulative 2009–2020 reductions decrease from 22.9 to 16.7 MMtCO_2, and the 2020 price increases from $24.40 to $43.20/t$CO_2$.

~~None currently identified.~~

Additional Benefits and Costs

None currently identified.

Feasibility Issues

None currently identified.

Status of Group Approval

TBD

Level of Group Support

TBD

Barriers to Consensus

TBD

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[7] Annex A of this document defines the rationale behind the assumption used for the avoided CO_2 methodology in these analyses.

CRE-9. Transmission System Upgrading

Policy Description

Developing policies to address the long-term demand for electricity requires not only consideration for enhancing the generating portfolio mix and demand-side and energy efficiency programs, but also measures to improve both the regional and the local distribution systems in order to diminish bottlenecks, enhance throughput, and reduce transmission line losses.

Opportunity exists to significantly increase transmission line carrying through the implementation of new construction methods and retrofit activities on the transmission grid, including incorporating advanced composite conductor technologies, reactive compensation technologies, and grid management software. Siting new transmission lines can be a difficult process, given their cost and perceived impacts on health, the environment, and the use, enjoyment, and value of property. Future development of renewable energy facilities will require the addition of new or the upgrade of currently existing transmission lines, which must be integrated into the regional transmission grid. Policy measures in support of this option could provide incentives to utilities and transmission owners to upgrade transmission systems and reduce barriers to siting new transmission lines. This policy option could also include reductions in the use and leakage of sulfur hexafluoride from electrical equipment, plus use of efficient transformers and other advanced materials and equipment. Given the long lead time (between 4 and 7 years) for large transmission line planning, permitting, and construction, current distribution line capacity should be evaluated immediately as a “quick start” measure to get carbon-free distributed generation on the grid.

Several energy efficiency measures can be implemented to reduce the transmission and distribution (T&D) line losses of electricity. Utilities use a variety of components throughout the T&D system to reduce losses. Increasing the efficiency of these components can further reduce losses. Vermont, for example, offers a rebate to encourage users to install energy-efficient transformers. Regulations, incentives, and/or support programs can be applied to achieve greater efficiency of T&D system components.

Policy Design

Goals: The goals of this policy are to:

- Research how implementing modern grid technologies would enable a more efficient and intelligent transmission system.
- Identify specific legislative and regulatory actions that would be needed to support long-term, cost-effective alternatives that increase transmission system capabilities.
- Commission a study that would identify areas in Iowa’s transmission system where upgrading and/or expanding transmission would enable the state’s wind resources to be developed for Iowa users and for potential exports to other states. The study would focus on identifying both areas where large expansions are necessary to catapult Iowa’s wind production, as well as areas where smaller upgrades would enable wind installations for local

area purposes. The study would seek to quantify the incremental costs and identify the benefits and implementation time frames for alternatives that yield additional increases to T&D system capabilities, beyond normal planned expansion. The analysis should take into account reductions in GHG emissions that would result from energy saved due to lower line losses.

Timing: This policy would become effective with action by the Iowa Legislature and implementation by the IUB and other state agencies.

Parties Involved: IUB, IOUs, generation and transmission electric cooperatives, municipalities, representatives of environmental and economic development organizations, and the Office of Consumer Advocate, the Federal Energy Regulatory Commission (FERC), Midwest ISO, and transmission owners (such as ITC Midwest).

Implementation Mechanisms

Fully utilize the existing grid by balancing the congestion points in the grid by identifying and maximizing "sweet spots" that can match modest transmission capacity with good renewable resources.

~~**Other:** None currently identified.~~

Related Policies/Programs in Place

TBD

Type(s) of GHG Reductions

Avoiding electricity generation from fossil fuel sources results in GHG reductions primarily from CO_2 emissions, but also trace amounts of CH_4 and N_2O emissions.

~~TBD~~

Estimated GHG Reductions and Costs or Cost Savings

Not quantifiable.

Data Sources: ~~Not applicable.~~Midwest Ag Energy Network. 2006. *Where Agriculture Meets Energy: Policy Recommendations From the Midwest Ag Energy Summit.* (No Web link available.)

Quantification Methods: Not applicable.

Key Assumptions: Not applicable.

Key Uncertainties

TBD

Additional Benefits and Costs

TBD

Feasibility Issues

TBD

Status of Group Approval

TBD

Level of Group Support

TBD

Barriers to Consensus

TBD

CRE-10. R&D for Emerging Technologies and Corresponding Incentives

Policy Description

R&D of emerging technologies to develop demonstration projects and eventual commercialization of reasonable-cost generation technologies with low or zero GHG emissions is critical to solving the global climate change challenge. Technology areas often cited as requiring such reasonable-cost developments are CCS (e.g., in deep saline aquifers or coal seams) for fossil fuel facilities, and large-scale baseload renewable energy or technologies that can transform intermittent renewables into baseload generation (e.g., batteries, compressed air storage).

Given the magnitude of the task, an Apollo-like research program to create and field test such technologies that are commercially viable is needed. At present, such funding is not a significant portion of a rate-regulated utility's budget or the budgets of federal and state government agencies. Nonetheless, even a small fee per kWh of electricity could generate significant funding. However, funding is only half of the equation; strategies to use such funds to implement a focused program to commercialize generation technologies with low or zero GHG emissions must also be developed.

Policy Design

Goals: The goals of this policy, though unquantifiable in terms of emissions, are:

- By 2009, identify the likely funding mechanisms and policy tools that would provide further stimulus for the development of new, reasonable-cost, low- and zero-GHG-emitting electricity generation in Iowa.
- By 2009, analyze the costs and benefits of R&D program scenarios to help reach the 50% and 90% reductions targets from 2005 emission levels by 2050.
- By 2010, begin to implement the R&D funding mechanisms.
- By 2015, identify and begin characterizing areas within and near Iowa that are likely candidates for CCS, and begin larger-scale field studies of baseload renewable energy and technologies that can transform intermittent renewables into baseload generation.
- By 2020, complete larger-scale field studies and demonstrations of baseload renewable energy and technologies that can transform intermittent renewables into baseload generation. Prior to 2020, verify small-scale CCS test projects within suitable formations, and initiate larger-scale projects.
- By 2025, fully commercialize baseload renewable energy and technologies that can transform intermittent renewables into baseload generation, and fully integrate CCS into new coal-fueled power plants.
- By 2030, commercialize reasonable-cost CCS technology for coal-fueled power plants that were not originally designed for sequestration. Baseload renewable energy and

technologies that can transform intermittent renewables into baseload generation will be cost competitive without subsidies or incentives.

Timing: See above. ~~This policy may require the adoption of incentives by the Iowa Legislature, IUB, and potentially other appropriate state government entities.~~

Parties Involved: Iowa Legislature, IUB, electric utilities, and potentially other appropriate state government entities, such as the Office of Energy Independence, Iowa Power Fund, Iowa Department of Economic Development, and State Regents Institutions.

Other: The Iowa Power Fund is an example of a new state government board designed to help stimulate the research, development, and commercialization of new clean energy sources in Iowa.

Implementation Mechanisms

~~TBD~~This policy may require the adoption of incentives by the Iowa Legislature, IUB, and potentially other appropriate state government entities.

Related Policies/Programs in Place

CRE-4a/4b could provide a source of funding for this option.

Type(s) of GHG Reductions

Avoiding electricity generation from fossil fuel sources results in GHG reductions primarily from CO_2 emissions, but also trace amounts of CH_4 and N_2O emissions.

~~TBD~~

Estimated GHG Reductions and Costs or Cost Savings

Not quantifiable.

Data Sources: Not applicable.

Quantification Methods: Not applicable.

Key Assumptions: Not applicable.

Key Uncertainties

TBD

Additional Benefits and Costs

TBD

Feasibility Issues

TBD

Status of Group Approval

TBD

Level of Group Support

TBD

Barriers to Consensus

TBD

CRE-11. Distributed Generation/Co-Generation

Policy Description

This policy option focuses on encouraging investment in small-scale distributed generation (DG) through incentives or subsidies and the prevention of barriers for both utility and consumer investment.

Policy Design

Goal: 7500 MWh per year of new distributed renewable generation.

Timing: New distributed renewable generation beginning at in 2010 and continuing each year thereafter.

Parties Involved: All utilities serving customers in Iowa, state agencies with jurisdiction, other interested stakeholders.

Other: A funding source to cover any financial incentives would need to be determined. The level of credit or funding should be consistent for all utilities (IOUs, municipals, and cooperatives). The cost of the incentive should be shared among all end users so that no one is overly burdened.

Implementation Mechanisms

DG can be encouraged by ensuring access to the grid under uniform technical and contractual terms and charges for interconnection, including mandatory insurance coverage and amounts, that are based on economic costs, so that owners know in advance the requirements for parallel interconnection, and manufacturers can design standard packages to meet technical requirements. Changes that generally facilitate the integration of customer-owned DG with the grid could encourage the adoption of specific renewable energy and high-efficiency technologies, including small wind farms, solar PV systems, fuel cells, and microturbines. In addition, prices should be established that owners of distributed generators both pay and receive for electricity at levels consistent with utilities' costs. Uniform requirements for emissions, land use, and building codes should be established that are based on the technology of electricity generation, so that manufacturers can design suitable units and owners of distributed generators are not restricted in their siting and operating decisions relative to other new sources of generation.

Incentives for distributed renewables should include (1) direct subsidies for purchasing/selling renewable technologies; (2) tax credits or exemptions for purchasing/selling renewable technologies; (3) tax credits for each kWh generated from a qualifying renewable facility; (4) rebates to the customer from utilities for the installation of a residential renewable energy system similar to rebates for energy-efficient appliances; (5) state assistance for Iowa's utilities to implement a Smart Grid, which would more easily enable utility customers to be both users and producers; and (6) hiring a DG point person who would work within the Office of Energy Independence to assist utilities and customers to implement this policy, its incentives, and regulatory requirements in order to fully utilize the benefits from DG and reach the ICCAC's goal of 90% reduction of GHG emissions by 2050.

DG can be encouraged by ensuring access to the grid under uniform technical and contractual terms for interconnection that are based on best practices, so that owners know in advance the requirements for parallel interconnection and manufacturers can design standard packages to meet technical requirements. Changes that generally facilitate the integration of customer-owned DG with the grid could encourage the adoption of specific renewable energy and high-efficiency technologies, including solar PV systems, fuel cells, and microturbines. Uniform requirements for emissions, land use, and building codes should be established that are based on the technology of electricity generation, so that manufacturers can design suitable units and owners of distributed generators are not restricted in their siting and operating decisions relative to other new sources of generation.

Other implementation mechanisms include funding mechanisms and incentives, ~~[You mention incentives two paragraphs earlier. Is this redundant?]~~ and regulatory policies that support utility investments in small-scale distributed renewable energy. CRE-13 addresses feed-in tariffs and net metering to help facilitate investments in DG.

Related Policies/Programs in Place

Wind production tax credits, and tax exemptions on residential wind, solar (PV) panels, and solar hot water systems.

Type(s) of GHG Reductions

Avoiding electricity generation from fossil fuel sources results in GHG reductions primarily from CO_2 emissions, but also trace amounts of CH_4 and N_2O emissions.

~~None currently identified.~~

Estimated GHG Reductions and Costs (or Cost Savings)

Table 9. Estimated GHG reductions and costs of or cost savings from CRE-11

Quantification Factors	2012	2020	Units
GHG emission savings	0.0	0.1	$MMtCO_2e$
Net present value (2008-2020)	$2.0	$14.3	$ Million
Cumulative reductions	0.0	0.5	$MMtCO_2e$
Cost-effectiveness	$59.1	$29.1	$/tCO_2e$
Change in generation cost	$0.0	$0.1	$/MWh

GHG = greenhouse gas; $MMtCO_2e$ = million metric tons of carbon dioxide equivalent; $\$/tCO_2e$ = dollars per metric ton of carbon dioxide equivalent; $/MWh = dollars per megawatt-hour.

Data Sources:

- Energy Consumption by Sector (BBtu). See CRE-1.
- Power Station Electricity Generation (GWh) and Fuel Use (BBtu). See CRE-1.

Quantification Methods:

- Heat Rates (Btu/kWh). See CRE-1.
- GHG Emissions Associated With End-Use Consumption (by Sector). See CRE-1.
- GHG Emissions Associated With Electricity Generation From Different Technologies and Fuels See CRE-1.

Key Assumptions:

- The program begins in 2010 and continues annually.
- The new renewable DG will come from wind (95%) and solar PV (5%).
- The real interest rate used to discount cash flows is 5%.
- NPV is calculated in 2008 dollars.
- NPV is calculated beginning in 2009.
- Renewables displace marginal sources of generation (50% coal, 50% gas) through 2012. From 2013 on, renewables displace the thermal new-build mix of 99% coal, 1% natural gas.

Key Uncertainties

None currently identified.

Additional Benefits and Costs

None currently identified.

Feasibility Issues

DRAFT:

There is a risk that GHG reductions are overstated and the costs per ton of CO_2e reductions are understated if high-CO_2-intensity resources are assumed to be redispatched or not built due to increased renewables (the avoided CO_2 methodology).[8]

~~None currently identified.~~

Status of Group Approval

TBD

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[8] Annex A of this document defines the rationale behind the assumption used for the avoided CO_2 methodology in these analyses.

Level of Group Support

TBD

Barriers to Consensus

TBD

CRE 12. Combined Heat & Power

Policy Description

Combined heat and power (CHP) is a term used to describe scenarios in which waste heat from energy production is recovered for productive use. CHP scenarios most commonly occur at baseload generating stations, so that a reliable source of thermal energy can be provided to the users of the reclaimed thermal energy. The reclaimed thermal energy, while sometimes not of significant energy value for the baseload generating station, can be used by other nearby entities (e.g., within an industrial park or district steam loop) for productive purposes.

The theory of CHP is to maximize the energy use from fuel consumed and to avoid additional GHG emissions from entities near a baseload generating station via additional fossil fuel combustion. Generating stations in more rural areas will most likely require the co-location of new industry, thereby avoiding new emissions from development. However, generating stations in urban areas may have existing opportunities or may require the co-location of new industry. Thus, this goal may be more effective at slowing and stopping emission increases by targeting industrial development near baseload generating stations, rather than reversing current emissions from existing industry.

The key to implementing CHP systems is to provide adequate incentives for the development of infrastructure to capture and utilize the waste heat. Such incentives could come in many forms, such as recruiting suitable end users to the area, tax credits, grants, zoning, and offset credits for avoided emissions.

Policy Design

Goals: The goals of this policy are:

- Biomass, ethanol, and wind sectors will grow and develop facilities that might use CHP.
- To identify the likely policy tools that would provide significant stimulus for CHP developments in Iowa by 2009.
- To implement significant incentives for CHP development by 2010.
- To quantify the maximum cost-effective contribution of CHP scenarios to help reach the 50% and 90% reduction targets from 2005 emission levels by 2050.
- To provide sufficient stimulus to implement 50% of cost-effective CHP opportunities by 2025.
- To provide sufficient stimulus to implement 90% of cost-effective CHP opportunities by 2035.

Timing: This policy may require the adoption of incentives by the Iowa Legislature and appropriate state and local government agencies.

Parties Involved: Iowa Legislature, Iowa Department of Economic Development, electric generating stations, city and county governments, and other agencies as appropriate.

Implementation Mechanisms

This policy may assist the transportation group and any renewable fuels goal that would require an expansion of biofuel plants in Iowa. Such new plants could be given incentives to locate where CHP opportunities exist.

Related Policies/Programs in Place

Renewable Fuels Standards (U.S. and Iowa)

Iowa's RFS is the most progressive standard in the country. The standard will be implemented beginning in calendar year 2009, with incentives eligible in 2010. The Iowa standard, in cooperation with the federal RFS, guides production and sets the following goals for renewable fuel use over a span of 14 years:

- 25% biofuel sales in Iowa by 2019.
- 36 billion gallons produced in the United States by 2022.
- 50% reduction in GHG emissions from biomass-based diesel and advanced biofuels.
- 20% reduction in GHG emissions from renewable fuels.
- 60% reduction in GHG emissions from cellulosic biofuels.

(Goals defined in Iowa RFS and the 2007 Energy Independence and Security Act).

Timing: Achieve by 2022 under the federal RFS and by 2019 under the Iowa RFS.

Parties Involved: Federal government, state government, producers, marketers, blenders, consumers, and refiners.

Type(s) of GHG Reductions

Avoiding electricity generation from fossil fuel sources results in GHG reductions primarily from CO_2 emissions, but also trace amounts of CH_4 and N_2O emissions.

~~None currently identified.~~

Estimated GHG Reductions and Costs or Cost Savings

Table 10. Estimated GHG reductions and costs of or cost savings from CRE-12

Quantification Factors	2012	2020	Units
GHG emission savings	0.3	2.1	$MMtCO_2e$
Net present value (2008–2020)	–$61.6	–$564.3	$ Million
Cumulative reductions	0.6	13.6	$MMtCO_2e$
Cost-effectiveness	–$104.5	–$41.4	$/tCO_2e$
Change in generation cost	5.4	0.0	$/MWh

GHG = greenhouse gas; MMtCO$_2$e = million metric tons of carbon dioxide equivalent; \$/tCO$_2$e = dollars per metric ton of carbon dioxide equivalent; \$/MWh = dollars per megawatt-hour.

Note: The costs are relative to the avoided cost of electricity, which does not include avoided T&D costs or capacity charges to end users.

Data Sources:

- NREL/FEMP. 2004. "Biomass Cofiring in Coal-Fired Boilers." Federal Energy Management Program (FEMP) Federal Technology Alert. DOE/EE-0288. June. Available at: http://www1.eere.energy.gov/femp/pdfs/fta_biomass_cofiring.pdf.
- Onsite Sycom Energy. 2000. *The Market and Technical Potential for Combined Heat and Power in the Commercial/Institutional Sector*. January. Available at: http://www.chpcentermw.org/pdfs/eiacom.pdf.
- DOE/Office of Renewable Energy and Energy Efficiency. (ND). *Net Energy Balance for Bioethanol Production and Use*. Available at: http://klprocess.com/Facts_Legends/USDOE_Energy_Bal.pdf.
- Estimates for Iowa biofuels consumption are derived from Iowa_transportation_CO2.xls file.

Quantification Methods:

Includes avoided T&D charges and thermal costs for commercial, industrial, and biomass CHP.

Key Assumptions:

- The program begins in 2010 and runs through 2019.
- The real interest rate used to discount cash flows is 5%.
- NPV is calculated in 2008 dollars.
- NPV is calculated beginning in 2009.
- All electricity from coal-fired generation is coming from sources within Iowa (no imports).
- T&D losses are 7%.
- Avoided electricity emissions are Iowa average emissions over the period at 7%.
- The fuel for new commercial CHP is 100% natural gas; for new industrial and biomass refineries, it is 50% coal and 50% natural gas.
- The program deploys only 30% of estimated achievable CHP potential in the state over the life of the program.
- Avoided cost of electricity in 2009–2018 from: 2009–2013 Energy Efficiency Plan Interstate Power and Light Company Docket No. EEP-08-1, April 23, 2008, p. 33. Values base case without externality factor. The 2009 avoided cost is \$.72/MWh.
- Avoided capacity charges for commercial CHP are: Ancillary Service Charge of \$0.28/kW/month, Facility Capacity—Distribution \$1.65/kW/month, On-Peak Demand Charge \$1.90/kW/month, System Usage Charge \$0.35/kWh. Avoided capacity charges for industrial and biomass are 50% of commercial. Fixed and variable operation and maintenance for displaced thermal are assumed to be \$0.07 MMBtu each.

- Displaced boiler efficiency is 80%.
- Renewables displace marginal sources of generation (50% coal, 50% natural gas) through 2012. From 2013 on, renewables displace the thermal new-build mix of 99% coal, 1% natural gas.

Key Uncertainties

DRAFT:

There is a risk that GHG reductions are overstated and the costs per ton of CO_2e reductions are understated if high-CO_2-intensity resources are assumed to be redispatched or not built due to increased renewables (the avoided CO_2 methodology).[9]

Additional Benefits and Costs

None currently identified.

Feasibility Issues

None currently identified.

Status of Group Approval

Approved.

Level of Group Support

Unanimous.

Barriers to Consensus

None.

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[9] Annex A of this document defines the rationale behind the assumption used for the avoided CO_2 methodology in these analyses.

CRE 13. Pricing Strategies To Promote Renewable Energy and/or CHP

Policy Description

This policy recommendation focuses on creating pricing and metering strategies that can encourage consumers to implement CHP, renewable energy, and overall reductions in GHG emissions. Pricing strategies, such as feed-in tariffs, provide minimum utility purchase rates for DG. Net metering is a policy that allows owners of DG (generating units on the customer side of the meter, often limited to some maximum kW level) to generate excess electricity and effectively sell it back to the utility by "turning the meter backward." Implementation of pricing strategies, such as feed-in tariffs, must be considered in light of existing rules, such as the FERC's avoided cost standard.

Policy Design

Goal: Achieve a 10% shift to renewable energy sources, as a percentage of retail sales, through implementation of various pricing strategies.

Timing: 1% shift achieved in 2010, with linear growth through 2019.

Parties Involved: All industrial, commercial, and residential electricity customers in Iowa; utilities; representatives of environmental and economic development organizations; IUB, Office of Consumer Advocate, Office of Energy Independence.

Implementation Mechanisms

Encourage net metering of renewable energy systems by:

- Creating a centralized net metering program that is a one-stop shop for net metering. Staff would work with customers and utilities to assist the process of net metering.
- Providing incentives to utilities to net meter with their customers.
- Providing incentives to customers to net meter with their utilities.
- Establishing uniform standards and requirements for utilities and customers.
- Requiring all Iowa's utilities to net meter with interested customers who meet the minimum requirements.
- Rewarding utilities that show leadership in net metering measured by the number of customers who are net metering and the amount of energy net metered.

Related Policies/Programs in Place

- IUB net metering rule for rate-regulated utilities (199 IAC 15.11(5)).
- Rate-regulated utility net metering tariffs.

- According to current FERC rules, states may not require utilities to pay more than the utility's avoided cost of electricity. This potentially limits state application of feed-in tariffs. Passage of a federal feed-in tariff law would supersede the FERC avoided cost standard.

Type(s) of GHG Reductions

Avoiding electricity generation from fossil fuel sources results in GHG reductions primarily from carbon dioxide emissions (CO_2), but also trace amounts of methane (CH_4), and nitrous oxide (N_2O) emissions.

~~None currently identified.~~

Estimated GHG Reductions and Costs or Cost Savings

Table 11. Estimated GHG reductions and costs of or cost savings from CRE-13

Quantification Factors	2012	2020	Units
GHG emission savings	1.2	5.6	$MMtCO_2e$
Net present value (2008–2020)	$90.4	$1,128.0	$ Million
Cumulative reductions	2.4	35.2	$MMtCO_2e$
Cost-effectiveness	$38.0	$32.1	$\$/tCO_2e$
Change in generation cost	$0.97	$4.67	$/MWh

GHG = greenhouse gas; $MMtCO_2e$ = million metric tons of carbon dioxide equivalent; $\$/tCO_2e$ = dollars per metric ton of carbon dioxide equivalent; $/MWh = dollars per megawatt-hour.

Data Sources:

- Energy Consumption by Sector (BBtu). See CRE-1.
- Power Station Electricity Generation (GWh) and Fuel Use (BBtu). See CRE-1.

Quantification Methods:

- Heat Rates (Btu/kWh). See CRE-1.
- GHG Emissions Associated With End-Use Consumption (by Sector). See CRE-1.
- GHG Emissions Associated With Electricity Generation From Different Technologies and Fuels. See CRE-1.

Key Assumptions:

- The program begins in 2010 and runs through 2019.
- The reduced GHG emissions come from reduced use of thermal resources, replaced by 80% wind, 15% biomass energy crops, 3% solar PV, and 2% fuel cells.
- The real discount rate is 5% per year.
- NPV is calculated in 2008 dollars.
- NPV is calculated beginning in 2009.
- All electricity from coal-fired generation is coming from sources within Iowa (no imports).

- Renewables displace marginal sources of generation (50% coal, 50% natural gas) through 2012. From 2013 on, renewables displace the thermal new-build mix of 99% coal, 1% natural gas.

Key Uncertainties

None currently identified.

Additional Benefits and Costs

None currently identified.

Feasibility Issues

DRAFT:

There is a risk that GHG reductions are overstated and the costs per ton of CO_2e reductions are understated if high-CO_2-intensity resources are assumed to be redispatched or not built due to increased renewables (the avoided CO_2 methodology).[10]

Status of Group Approval

Approved.

Level of Group Support

Super Majority (3 objections).

Barriers to Consensus

Unspecified.

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[10] Annex A of this document defines the rationale behind the assumption used for the avoided CO_2 methodology in these analyses.

ANNEX A

Avoided Electricity Emissions for the Energy Supply Sector

To estimate emission reductions from policy options that are expected to displace conventional grid-supplied electricity (i.e., renewable energy and CHP), a simple, straightforward approach is used. Through 2012, we assume that these policy options would displace generation from the a "marginal" mix of fuel-based electricity sources of 50% coal and 50% gas. (We assume that sources without significant fuel costs would not be displaced—e.g., hydro or other renewable generation.) After 2012, we assume that the policy options are likely to avoid a mix of new fossil fuel-based capacity additions. The thermal new-build mix is estimated to be 99% coal and 1% gas.

There is a risk that GHG reductions are overstated and the costs per ton of CO_2e reductions are understated if high-CO_2-intensity resources are assumed to be redispatched or not built due to increased renewables (the avoided CO_2 methodology).

As a sensitivity analysis, the assumption of avoiding 50% coal, 50% gas generation for the entire planning period (2009-2020) instead of 2013–2020 in CRE-8a results in the year 2020 CO_2 reductions decreasing from 4.8 to 3.5 MMtCO_2, cumulative 2009–2020 reductions decrease from 22.9 to 16.7 MMtCO_2, and the 2020 price increases from \$24.40 to \$43.20/tCO_2.

The reference approach described in the beginning of this annex ~~This approach~~ provides a transparent way to estimate emission reductions and to avoid double counting (by ensuring that the same MWh from a fossil fuel source is not "avoided" more than once). It can be considered a "first-order" approach; it does not attempt to capture a number of factors, such as the distinction between peak, intermediate, and baseload generation; issues in system dispatch and control; impacts of nondispatchable and intermittent sources, such as wind and solar; or the dynamics of regional electricity markets. These relationships are complex and could mean that policy options affect generation and emissions (as well as costs) in a manner somewhat different from that estimated here. Nonetheless, this approach provides reasonable first-order approximations of emission impacts and offers the advantages of simplicity and transparency that are important for stakeholder processes.

ANNEX B

Generation Modeling Assumptions

	2020						
Generation Modeling Assumptions	**Fuel Cost $/MMBtu**	**Capital Cost $/kW**	**Capacity Factor**	**Renewables Tax Credits**	**Integration Cost**	**Generation Cost MWh**	**Assumed CO_2 Emissions Intensity (t/MWh)**
Coal (existing pulverized)	$ 1.32	$ 479	75%	$ -	$ -	$ 23.84	1.03
Nuclear	$ 0.50	$ 2,631	90%	$ -	$ -	$ 52.40	0.00
Natural Gas	$ 5.50	$ 751	75%	$ -	$ -	$ 49.23	0.46
Oil	$ 10.30	$ 751	35%	$ -	$ -	$ 58.09	1.05
MSW	$ 0.50	$ 2,016	90%	$ -	$ -	$ 50.33	0.48
Biomass--Energy Crops	$ 7.47	$ 2,363	75%	$ (10.00)	$ -	$ 120.12	0.00
Biomass--Ag Residues	$ 7.47	$ 459	75%	$ (10.00)	$ -	$ 67.85	0.00
Landfill Gas	$ 0.50	$ 2,016	90%	$ -	$ -	$ 50.33	0.67
Wind	$ -	$ 1,703	36%	$ (20.00)	$ 4.00	$ 56.51	0.00
Hydro	$ -	$ 1,896	75%	$ (10.00)	$ -	$ 32.88	0.00
Solar	$ -	$ 6,006	30%	$ (10.00)	$ -	$ 254.60	0.00

$/MMBtu = dollars per million British thermal units; MSW = municipal solid waste; MWh = megawatt hour; t/MWh = metric tons per megawatt hour.

Capital costs and capacity factors come from the Assumptions to the Annual Energy Outlook 2007. Capital costs from that report have been adjusted for real inflation in the sector. Fuel costs come from the *Assumptions to the Annual Energy Outlook 2008*, with the exception of the two biomass fuel sources and landfill gas, which were developed by the AFW and CRE subcommittees.