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# Iowa Climate Change Advisory Council **Final Report**

12/23/08





December 23, 2008

The Honorable Chester J. Culver and  
The State of Iowa General Assembly  
State Capitol Building  
1007 East Grand Ave  
Des Moines, Iowa 50319

Dear Governor Culver and Legislators,

In the 2007 legislative session, you signed into law SF 485, which established the Iowa Climate Change Advisory Council (ICCAC). This Council was charged with identifying policies and strategies for Iowa to respond to the challenge of global climate change by reducing its greenhouse gas (GHG) emissions and spurring economic growth through technological innovation. ICCAC formed subcommittees and considered policy options in five areas: Energy Efficiency and Conservation (EEC); Clean and Renewable Energy (CRE); Transportation and Land Use (TLU); Agriculture, Forestry, and Waste Management (AFW); and Cross-Cutting Issues (CC). Enclosed is the Final Report of the Council.

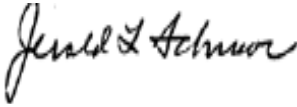
In the Final Report, the Council presents two scenarios designed to reduce statewide greenhouse gas emissions by 50% and 90% from a 2005 baseline by the year 2050. For the 50% reduction by 2050, the Council recommends approximately a 1% reduction by 2012 and an 11% reduction by 2020. For the 90% reduction scenario, the Council recommends a 3% reduction by 2012 and a 22% reduction 2020. These interim targets were based on a simple extrapolation assuming a linear rate of reduction between now and 2050.

In providing these scenarios for your consideration, ICCAC approved 56 policy options from a large number of possibilities. There are more than enough options to reach the interim and final emission targets in both the 50% and 90% reduction scenarios. Direct costs and cost savings of these policy options were also evaluated with the help of The Center for Climate Strategies, who facilitated the process and provided technical assistance throughout the entire process, and who developed the Iowa Greenhouse Gas Emissions Inventory and Forecast in close consultation with the Iowa Department of Natural Resources (IDNR) and many Council and Sub-Committee members. About half of the policy options presented in this report will not only reduce GHG emissions but are highly cost-effective and will save Iowans money. Still other options may require

significant investment but will create jobs, stimulate energy independence, and advance future regional or federal GHG programs.

Please feel free to call upon us if you have questions about the report. We stand ready and willing to help in any future charge to the Council to prosper our economy and improve our environment, while reducing Iowa's greenhouse gas emissions.

Sincerely yours,



Jerald L. Schnoor  
Chair, ICCAC

On behalf of ICCAC Members:

Franklin Cownie, Vice Chair  
Marian Gelb, Secretary  
Roxanne Carisch  
Richard Cruse  
Jennifer Easler  
Thomas Fey  
Teresa Galluzzo  
Shelley Hackett  
Thomas Hadden III  
Nile Lanning  
Robert Loyd

David Miller  
Richard Ney  
Norman Olson  
Julie Smith  
Dawn Snyder  
Roya Stanley  
William Stigliani  
Krista Tanner  
Stephanie Weisenbach  
Cathy Woollums

c: State of Iowa General Assembly  
Richard Leopold, Director, DNR

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Special thanks to ICCAC Chairman Jerry Schnoor, for his stellar leadership throughout the process, and to Vice Chair Franklin Cownie and Secretary Marian Gelb. ICCAC also recognizes the many individuals who participated in the sector-based Subcommittees, all of whom are listed in Appendix C. Although this report is intended to represent the results of the ICCAC's work, the ICCAC would be remiss if it did not recognize and express appreciation for the time and effort each Subcommittee member spent in discussion, study, deliberation and in formulating recommendations during this process.

Our great appreciation also goes to Richard Leopold, Director of Iowa Department of Natural Resources, and his dedicated staff of Jason Marcel and Marnie Stein who supervised and coordinated all state activities associated with the ICCAC process, served as liaisons to the Subcommittees, arranged meetings and assisted with meeting summaries. Many thanks also to Barbara Stock, Karrie Darnell, Nick Page, and Amanda Hostetler of the Iowa DNR, who assisted in arranging meeting facilities, recording meetings, and other meeting support logistics throughout the process.

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Rachel Anderson  
Andy Bollman  
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# Iowa Climate Change Advisory Council Members

Note: Each member was appointed to represent a specific stakeholder organization or interest group. These are noted in italics after each member's name.

## Executive Committee

**Jerald Schnoor**, *Center for Global and Regional Environmental Research, University of Iowa*, Professor

**Franklin Cownie**, *Local Government*, Mayor, City of Des Moines

**Marian Gelb**, *Environmental Organization*, Executive Director, Iowa Environmental Council

## Additional Current Voting Members

**Roxanne Carisch**, *Rural Electric Cooperatives*, CEO, Electric Distribution Co-op, Calhoun County Electric Cooperative Association

**Richard Cruse**, *Department of Agronomy, Iowa State University*, Professor

**Jennifer Easler**, *Iowa Office of Consumer Advocate*, Attorney

**Thomas Fey**, *Public Member*, Lobbyist/Consultant, Fey & Gomez, Inc.

**Shelley Hackett**, *Iowa Association of Business and Industry*, Environmental Engineer, John Deere Waterloo Works

**Teresa Galluzzo**, *Public Member*, Research Associate, Iowa Policy Project

**Thomas Hadden III**, *Public Member*, Executive Director, Metro Waste Authority

**Nile Lanning**, *International Brotherhood of Electrical Workers*, Retired Line Foreman, Alliant Energy

**Robert Loyd**, *Alternative Energy Equipment Manufacturing*, Plant Manager, Clipper Turbine Works and Clipper Windpower

**David Miller**, *Iowa Farm Bureau*, Economist, Director of Research and Commodity Services,

**Richard Ney**, *Iowa Renewable Fuels Association*, Environmental Engineer/Consultant, Sebesta Blomberg & Associates, Inc.

**Norman Olson**, *Iowa Energy Center*, Iowa State University, Biobased Chemical and Fuels Research

**Julie Smith**, *Iowa Association of Municipal Utilities*, Attorney

**Dawn Snyder**, *Conservation Group*, Education Programs Director, Woodbury County Conservation Board

**Roya Stanley**, *Iowa Office of Energy Independence*, Director

**William Stigliani**, *Center for Energy and Environmental Education, University of Northern Iowa*, Professor and Director

**Krista Tanner**, *Iowa Utilities Board*, Board Member

**Stephanie Weisenbach**, *Public Member*, Program Coordinator, 1000 Friends of Iowa

**Cathy Woollums**, *Investor-Owned Utilities*, Senior Vice President, Environmental Services, MidAmerican Energy Holding Company

## **Non-Voting Members**

**Robert Hogg**, State Senator, Iowa Legislature

**Steve Kettering**, State Senator, Iowa Legislature

**Donovan Olson**, State Representative, Iowa Legislature

**Ralph Watts**, State Representative, Iowa Legislature

## **Past Members**

**James Burns**, *Iowa Public Transit Association*, Public Transit Director, Region 12 Council of Governments – resigned June 2008

**Ed Fallon**, *Public Member* – resigned January 2008

**Joanne Howard**, *Iowa Association of Business and Industry*, Environmental Engineer, Deere & Company – resigned February 2008

## **Iowa Department of Natural Resources (DNR) Staff**

**Marnie Stein**, Senior Environmental Specialist, DNR Air Quality Bureau

**Jason Marcel**, Supervisor, DNR Air Quality Bureau

# Acronyms and Abbreviations

\$/kWh	dollars per kilowatt-hour
\$/MM	millions of dollars
\$/MWh	dollars per megawatt-hour
\$/t	dollars per metric ton
\$/tCO <sub>2</sub> e	dollars per metric ton of carbon dioxide equivalent
AAR	American Association of Railroads
AASHTO	<a href="#"><u>American Association of State Highway &amp; Transportation Officials</u></a>
ac	Acre
AEO2007	<i>Annual Energy Outlook 2007</i>
AEO2008	<i>Annual Energy Outlook 2008</i>
AFW	Agriculture, Forestry, and Waste Management [Subcommittee]
AFUE	annual fuel utilization efficiency
AFW	Agriculture, Forestry, and Waste Management
AIA	American Institute of Architects
ANL	Argonne National Laboratory
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
B20	fuel blend of 20% biodiesel and 80% gasoline
B100	fuel consisting of 100% biodiesel
BAU	business as usual
BBtu	billion British thermal units
BMP	best management practice
BBtu	billions of British thermal unit
BELC	Business Environmental Leadership Council
BOC	Building Operator Certification
BRT	bus rapid transit
Btu	British thermal unit
C	Carbon
CAA	Clean Air Act
CAFE	corporate average fuel economy
CAFO	concentrated animal feeding operation
CARB	California Air Resources Board
CC	Cross-Cutting Issues [Subcommittee]
CCS	carbon capture and storage
CCSR	carbon capture and storage or reuse
CCX	Chicago Climate Exchange
CDD	cooling degree-days
CEBCS	Commercial Buildings Energy Consumption Survey
CEEE	Center for Energy and Environmental Education



cf	cubic feet
CFL	compact fluorescent light
CH <sub>4</sub>	Methane
CHP	combined heat and power
CMAQ	Congestion Mitigation and Air Quality
CO	carbon monoxide
CO <sub>2</sub>	carbon dioxide
CO <sub>2</sub> e	carbon dioxide equivalent
CPP	critical peak pricing
CRE	Clean and Renewable Energy [Subcommittee]
CRP	Conservation Reserve Program [USDA]
CSA	community-supported agriculture
CTRE	Center for Transportation Research and Education
CUTR	Center for Urban Transportation Research
DART	Des Moines Area Rapid Transit
DG	distributed generation
DNR	[Iowa] Department of Natural Resources
DOE	[United States] Department of Energy
DOT	[Iowa] Department of Transportation
DSM	demand-side management
E10	fuel blend of 10% ethanol and 90% gasoline
E85	fuel blend of 85% ethanol and 15% gasoline
EE	energy efficiency
EEC	Energy Efficiency and Conservation [Subcommittee]
EEP	energy efficiency plan
eGRID	Emissions & Generation Resource Integrated Database
EIA	Energy Information Administration [US DOE]
EISA	Energy Independence and Security Act of 2007
EOR	enhanced oil recovery
EPA	[United States] Environmental Protection Agency
EPAct	Energy Policy Act of 2005
EPRI	Electric Power Research Institute
EPS	environmental portfolio standard
ES	Energy Supply
FAA	Federal Aviation Administration
FERC	Federal Energy Regulatory Commission
FHWA	Federal Highway Administration
FIA	Forest Inventory and Analysis [USFS]
ft	Foot
FTE	full-time-equivalent
FY	fiscal year
gal	Gallon
GAP	Gap Analysis Program
GHG	greenhouse gas
GJ	Gigajoule

GM	genetically modified
GPS	global positioning system
GREET	Greenhouse gases, Regulated Emissions and Energy use in Transportation [model]
GWh	gigawatt-hour [one million kilowatt-hours]
GWP	global warming potential
HB	House Bill
HDD	heating degree-day
HDPE	high-density polyethylene
HDV	heavy-duty vehicle
HFC	Hydrofluorocarbon
HOV	high-occupancy vehicle
HR	House Resolution
HUD	[United States] Department of Housing and Urban Development
HVAC	heating, ventilation, and air conditioning
HWP	harvested wood product
I&F	Inventory and Forecast
IAC	Industrial Assessment Center
IAMU	Iowa Association of Municipal Utilities
ICCAC	Iowa Climate Change Advisory Council
ICCC	Iowa Clean Cities Coalition
ICCT	International Council on Clean Transportation
ICLEI	Local Governments for Sustainability [formerly International Council for Local Environmental Initiatives]
IDALS	Iowa Department of Agriculture and Land Stewardship
IDED	Iowa Department of Economic Development
IDNR	Iowa Department of Natural Resources
IDED	Iowa Department of Economic Development
IEC	Iowa Energy Center
IECC	International Energy Conservation Code
IESNA	Illuminating Engineering Society of North America
IGCC	integrated gasification combined cycle
IOU	investor-owned utility
IPCC	Intergovernmental Panel on Climate Change
ISU	Iowa State University
IUB	Iowa Utilities Board
K-12	kindergarten through 12th grade
kg	Kilogram
kW	Kilowatt
kWh	kilowatt-hour
lb	Pound

LCFS	low-carbon fuel standard
LDPE	low-density polyethylene
LDV	light-duty vehicle
LED	light-emitting diode
LEED	Leadership in Energy and Environmental Design [Green Building Rating System™]
LEED-ND	Leadership in Energy and Environmental Design for Neighborhood Development
LFG	landfill gas
LFGcost	landfill gas cost model
LFGTE	landfill gas-to-energy
LIHEAP	Low-Income Home Energy Assistance Program
LMOP	Landfill Methane Outreach Program [US EPA]
LNG	liquefied natural gas
LRR	low-rolling resistance
LULC	land use land cover
MAC	mitigation abatement cost
MAPP	Mid-Continent Area Power Pool
MEC	Manufacturers Energy Consumption Survey
metric ton	1,000 kilograms or 22,051 pounds
MGA	Midwestern Governors Association
MJ	Megajoule
MM	Million
MMBtu	millions of British thermal units
MMtCO <sub>2</sub> e	million metric tons of carbon dioxide equivalent
mpg	miles per gallon
mph	miles per hour
MRF	material recovery facility
MSA	metropolitan statistical areas
MSW	municipal solid waste
MW	megawatt [one thousand kilowatts]
MWh	megawatt-hour [one thousand kilowatt-hours]
N	Nitrogen
N <sub>2</sub> O	nitrous oxide
N/A	not applicable
NAHB	National Association of Home Builders
NAS	National Academies of Science
NEED	National Energy Education Development
NEI	National Emissions Inventory
NEMA	National Electrical Manufacturing Association
NESCAUM	Northeast States for Coordinated Air Use Management
NG	natural gas

NGCC	natural gas combined cycle
NGO	nongovernmental organization
NGTT	natural gas combustion turbine
NHTS	National Household Travel Survey
NIH	National Institutes of Health
NO <sub>3</sub>	Nitrate
NO <sub>x</sub>	oxides of nitrogen
NOAA	National Oceanic and Atmospheric Administration
NPV	net present value
NRC	Nuclear Regulatory Commission
NRCS	[USDA] Natural Resources Conservation Service
NREL	National Renewable Energy Laboratory [US DOE]
NRI	National Resources Inventory [USDA]
NSF	National Science Foundation
O&M	operation and maintenance
OCA	[Iowa] Office of Consumer Advocate
ODS	ozone-depleting substance
OEI	[Iowa] Office of Energy Independence
ORNL	Oak Ridge National Laboratory
P	phosphorus
PET	polyethylene terephthalate
PFC	perfluorocarbon
PHEV	plug-in hybrid electric vehicle
PIRG	Public Interest Research Group
PRI	Program-Related Investment
PURPA	Public Utilities Regulatory Policies Act
PV	photovoltaic
R&D	research and development
RCI	Residential, Commercial, and Industrial
REC	rural electric cooperative
REC	renewable energy certificate
RECS	Residential Energy Consumption Survey
ReEC	Renewable Energy Education in the Community
REFIT	renewable energy feed-in tariff
RISE	Revitalize Iowa's Sound Economy
RFIB	Renewable Fuels Infrastructure Board
RFS	renewable fuel standard
RPS	renewable portfolio standard
RTA	Regional Transit Authority
SB	Senate Bill
SC	Subcommittee

SEC	State Energy Council
SEER	seasonal energy efficiency ratio
SF <sub>6</sub>	sulfur hexafluoride
SIT	State [GHG] Inventory Tool [US EPA]
SO <sub>2</sub>	sulfur dioxide
SO <sub>x</sub>	oxides of sulfur
STASGO	State Soil Geographic Databases
STB	Surface Transportation Board
T&D	transmission and distribution
t	metric ton
tC	metric tons of carbon
tCO <sub>2</sub>	metric tons of carbon dioxide
tCO <sub>2</sub> e	metric tons of carbon dioxide equivalent
tCO <sub>2</sub> e/MWh	metric tons of carbon dioxide equivalent per megawatt-hour
TDR	transfer of development rights
TLU	Transportation and Land Use [Subcommittee]
TOD	time-of-day
TOD	transit-oriented development
ULI	Urban Land Institute
UNFCCC	United Nations Framework Convention on Climate Change
UNI	University of Northern Iowa
USDA	United States Department of Agriculture
US DOE	United States Department of Energy
US EPA	United States Environmental Protection Agency
USFS	United States Forest Service [USDA]
USGS	United States Geological Survey [U.S. Department of the Interior]
VEGA	Vehicle Energy and Greenhouse Gas Assessment
VMT	vehicle miles traveled
VOC	volatile organic compound
WARM	Waste Reduction Model [US EPA]
WTE	waste to energy
WWTP	wastewater treatment plant
yr	year

# Executive Summary

## Background

The Iowa General Assembly enacted Senate File 485 in 2007 and House File 2571 in 2008. This legislation creates the Iowa Climate Change Advisory Council (ICCAC) which consists of twenty-three (23) voting members appointed by the Governor that serve three-year staggered terms. The Council is also comprised of four (4) non-voting, ex-officio members from the General Assembly.

As specified in Iowa Code section 455B.851, “The council shall submit the greenhouse gas emission reduction proposals to the governor and the general assembly by January 1, 2009.” The proposals include the following:

- After consideration of a full range of policies and strategies, including the cost-effectiveness of the strategies, the council shall develop multiple scenarios designed to reduce statewide greenhouse gas emissions by fifty percent and ninety percent by 2050.”
- The Council shall also develop short-term, medium-term, and long-term scenarios designed to reduce statewide greenhouse gas emissions and shall consider the cost-effectiveness of the scenarios.
- The Council shall establish 2005 as the baseline year for purposes of calculating reductions in statewide greenhouse gas emissions.

The ICCAC began its deliberative process at its second meeting on December 17, 2007 following an organizational meeting via teleconference on October 15, 2007. ICCAC met a total of eight times, with the final in-person meeting held on November 10, 2008, followed by a conference call on December 10, 2008 for review of this report. About 75 additional teleconference meetings of ICCAC’s five supporting Subcommittees (SCs) were also held to identify and analyze various potential policy actions in advance of the ICCAC’s November 10, 2008, final decisional meeting.

The five SCs considered information and potential policy options in the following sectors:

- Energy Efficiency and Conservation (EEC)
- Clean and Renewable Energy (CRE)
- Transportation and Land Use (TLU);
- Agriculture, Forestry, and Waste Management (AFW); and
- Cross-Cutting Issues (CC) (i.e., issues that cut across the above sectors).

The Center for Climate Strategies (CCS) provided facilitation and technical assistance to the ICCAC and each of the SCs. The SCs consisted of ICCAC members and selected additional members. Members of the public were invited to observe and provide input at all meetings of the

ICCAC and SCs. The SCs served as advisers to the ICCAC and helped generate initial options on Iowa-specific policy options to be added to the catalog of existing state actions; priority policy options for analysis; draft proposals on the design characteristics and quantification of the proposed policy options; specifications and assistance for analysis of draft policy options (including best available data sources, methods and assumptions); and other key elements of policy option proposals, including related policies and programs, key uncertainties, co-benefits and costs, feasibility issues, and potential barriers to consensus.

## Key Outcomes

In fulfillment of the requirements of this legislation the Council has prepared this Report which includes the following key outcomes:

- The Iowa Greenhouse Gas (GHG) Emissions Inventory and Forecast has been prepared which outlines baseline conditions as of 2005<sup>1</sup> and projected emissions through 2025 if no changes to the business as usual reference case are made. These projections were prepared in close consultation with the Iowa Department of Natural Resources (IDNR) and many Council and Sub-Committee members offered specific recommended improvements during its development. ICCAC recommends that the GHG Emissions Inventory and Forecast be updated annually.
- Approval of a comprehensive package of multi-sector policy options to reduce GHG emissions and address related energy and commerce issues in Iowa. ICCAC approved 56 policy options for inclusion in this Final Report. The ICCAC Members present and voting approved 32 of these policy options unanimously, approved 11 more with a super-majority vote (support of 80% or more of the members present and voting ), and 13 additional options with a simple majority supporting it. One option failed to gain ICCAC approval. Explanations of objections are included in Appendices F through J of this Report, which contain detailed accounts of the ICCAC's options along with descriptions of key uncertainties in the analysis.
- Evaluation of the direct costs and direct cost savings of the policy options in Iowa. The ICCAC analyzed quantitatively the direct costs or cost savings of 37 of its 56 policy options. Although the total net cost associated with the 37 policies analyzed is estimated at about \$ 4.8 billion between 2009 and 2020, the weighted-average cost-effectiveness of the 37 policies is estimated to be approximately \$8.80/tCO<sub>2</sub>e reduced. Many of the policies are estimated to yield significant cost-saving opportunities for Iowans. Other policies will incur net costs.
- The Council developed two GHG Reduction Scenarios. One scenario was specified by the enabling legislation to achieve a 50% reduction from the baseline year [2005] by 2050. The Council developed a second GHG reduction scenario to achieve a 90% GHG reduction below the 2005 baseline year by 2050. The Council chose 2012 and 2020 as its short-term and mid-term intervals, respectively.

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<sup>1</sup> Year 2005 was selected as the base year for the GHG reduction scenarios and cost-effectiveness analysis because emissions inventory data are more complete for year 2005 than for previous years.

- For a 50% reduction by 2050 scenario the Council recommends approximately a 1% reduction by 2012 and an 11% reduction by 2020. For the 90% reduction scenario the Council recommends approximately a 3% reduction by 2012 and a 22 % reduction by 2020. For both scenarios, a simple linear extrapolation was used from Iowa’s estimated 2009 emissions to the targets of 50% and 90% reductions in 2050, which allowed delineation of interim targets for each scenario in 2012 and 2020. The assumption of linearity was made because there were plenty of reductions in the approved policy options to achieve the interim targets, and a more extensive analysis was beyond the scope of this report. The ICCAC based its options on its review of the potential overall emission reduction estimates (as compared to the GHG emissions inventory and forecast) for 38 of 56 policy options for which emission reductions were quantified, and its review of goals and targets adopted by several other states. Of the 56 policy options, 38 were analyzed quantitatively to have a cumulative effect of reducing emissions by about 20 million metric tons of carbon dioxide equivalent (MMtCO<sub>2</sub>e) in 2012 and 105 (MMtCO<sub>2</sub>e) in 2020. Together, if the 38 quantified policy options and the recent federal and state actions (or their functional equivalent) are successfully implemented, the 2020 emission reduction scenario is achievable based on results of analysis of ICCAC proposals conducted through the ICCAC and Subcommittee process.
- In addition, the ICCAC recommends that the state report biennially to the Governor and the state legislature on the state’s progress in reducing GHG emissions under these scenarios.

## Iowa GHG Emissions Inventory and Reference Case Projections

In April 2008, CCS completed a draft GHG emissions inventory and reference case projection to assist the ICCAC and SCs in understanding past, current, and possible future GHG emissions in Iowa, and thereby inform the policy development process.<sup>2</sup> The ICCAC and SCs reviewed, discussed, and evaluated the draft inventory and projections methodologies, as well as alternative data and approaches for improving the draft inventory and projections. The final report<sup>3</sup> incorporating comments provided by the Subcommittees that were approved by the ICCAC at their September 2008 meeting and incorporated into the final report during October, is available at: [http://www.iaclimatechange.us/Inventory\\_Forecast\\_Report.cfm](http://www.iaclimatechange.us/Inventory_Forecast_Report.cfm) . At the 7th ICCAC meeting in November 2008 the Council received the final I-F Report and agreed to file and forward it to the Governor and Legislature.

The inventory and reference case projections included detailed coverage of all economic sectors and GHGs in Iowa, including future emission trends and assessment issues related to energy, the

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<sup>2</sup> Center for Climate Strategies. *Draft Iowa Greenhouse Gas Inventory and Reference Case Projections, 1990–2025*. Prepared for the Iowa Climate Change Advisory Council. April, 2008. Available at: [http://www.iaclimatechange.us/Inventory\\_Forecast\\_Report.cfm](http://www.iaclimatechange.us/Inventory_Forecast_Report.cfm).

<sup>3</sup> Center for Climate Strategies. *Final Iowa Greenhouse Gas Inventory and Reference Case Projections, 1990–2025*. Prepared for the Iowa Climate Change Advisory Council. October, 2008. Available at: [http://www.iaclimatechange.us/Inventory\\_Forecast\\_Report.cfm](http://www.iaclimatechange.us/Inventory_Forecast_Report.cfm). See pages 13 and 14 of this report for a list of the the revisions that the ICCAC made to the inventory and reference case projections; these revisions are also identified at the end of Chapter 2 of the ICCAC final report.



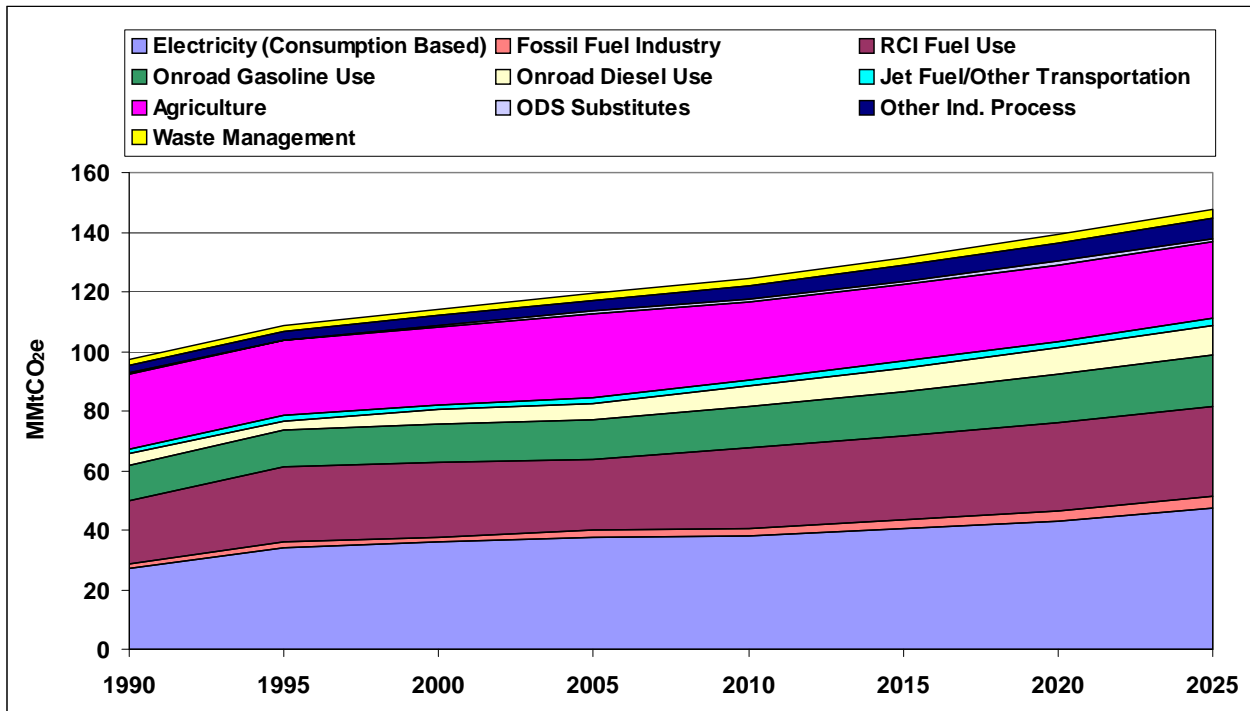
economy, and population growth. It is important to note that the emission estimates reflect the GHG emissions associated with the electricity sources used to meet Iowa's demands, corresponding to a consumption-based approach to emissions accounting. Another way to look at electricity emissions is to consider the GHG emissions produced by electricity generation facilities in the state—a production-based method. The study covers both methods of accounting for emissions, but for consistency, all total results are reported as consumption-based.

As illustrated in Figure ES-1, under the reference case projections, Iowa's gross GHG emissions continue to grow steadily, climbing to about 148 MMtCO<sub>2</sub>e by 2025, 52% above 1990 levels. This equates to a 1.1% annual rate of growth from 2005 to 2025. Relative to 2005, the share of emissions associated with electricity consumption and the transportation sector both increase slightly to 32% and 20%, respectively, in 2025. The share of emissions from the industrial processes and fossil fuel industry sectors is projected to increase to 6% and 3%, respectively, by 2025. The share of emissions from the RCI fuel use sector and the waste management sector is projected to remain the same at about 20% and 2%, respectively, of Iowa's gross GHG emissions in 2025. The agriculture sector is the only sector in Iowa whose emission share in 2025 is projected to decrease from its emission share in 2005 (from 23% in 2005 to 17% in 2025).

Emissions associated with electricity consumption are projected to be the largest contributor to future GHG emissions growth, followed by emissions associated with the transportation sector, as shown in Figure 2-4. Other sources of emissions growth include the RCI fuel use sector and the increasing use of HFCs and PFCs as substitutes for ozone-depleting substances in refrigeration, air conditioning, and other applications. The agriculture sector is the only sector in which emissions are projected to decrease from 2005 to 2025. Table 2-2 summarizes the growth rates that drive the growth in the Iowa reference case projections, as well as the sources of these data. Figure ES-2 depicts the 2005 distribution of sources in Iowa compared to the United States (U.S.) .

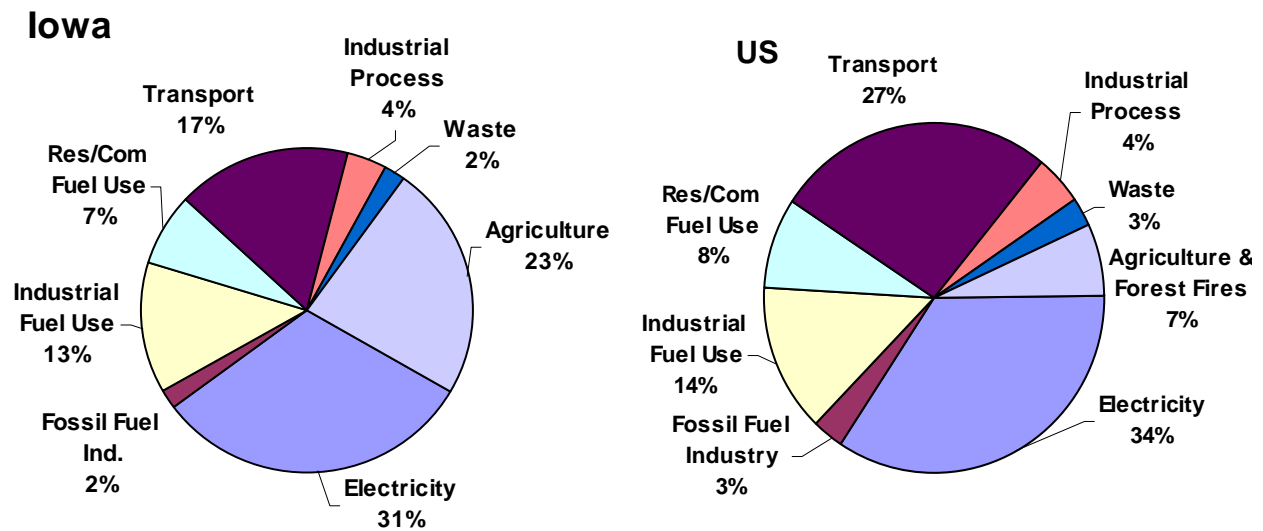
Estimates of carbon sinks within Iowa's forests, including urban forests and land use changes as well as agricultural soils, have also been included in this report. The current estimates indicate that about 27 MMtCO<sub>2</sub>e were stored in Iowa soils, forests and agricultural biomass in 2005. When all statewide emission sources and sinks are considered, this leads to *net* emissions of 92 MMtCO<sub>2</sub>e in Iowa in 2005, an amount equal to 1.4% of total US net GHG emissions.

**Figure ES-1. Gross GHG emissions by sector, 1990–2025: historical and projected (consumption-based approach) business-as-usual/base case**



ODS – ozone depleting substances

**Figure ES-2. Gross GHG emissions by sector, 2005: Iowa and U.S.**



## Recent Actions

The federal Energy Independence and Security Act of 2007 (EISA) was signed into law in December 2007. This law contains several requirements that will reduce GHG emissions as they are implemented over the next few years. During the ICCAC process, sufficient information was identified (e.g., implementation schedules) to estimate GHG emission reductions associated with implementing the Corporate Average Fuel Economy requirements and energy efficiency requirements for new appliances and lighting associated with the EISA's Title IV (Energy Savings in Buildings and Industry) and Title V (Energy Savings in Government and Public Institutions) requirements in Iowa.

Iowa has recently embarked on statewide public sector energy efficiency initiatives in response to concerns about energy costs. The state is implementing two energy efficiency initiatives under Executive Orders 6 and 41. Executive Order 06<sup>4</sup> by Governor Culver establishes a Green Government Initiative in Iowa that is targeted at three areas (buildings, materials and biofuels). Several Task Forces have been established to address the specific areas. Executive Order 41<sup>5</sup> by Governor Vilsack requires that all state agencies reduce energy consumption in state buildings.

Together, these federal and state requirements are estimated to reduce gross GHG emissions for all sectors combined in Iowa by about 3.4 MMtCO<sub>2</sub>e (a 2.4% reduction) from the business-as-usual emissions in 2020.

In addition, Iowa utilities have been pursuing energy efficiency programs for some time. These investments are not quantified in the analysis because EEC subcommittee members indicated that the energy impacts from these efficiency programs are already incorporated into the utility load growth forecasts which were used for the reference case inventory and forecast (eg they are already in the baseline).

## ICCAC Policy Options (Beyond Recent Actions)

The ICCAC developed 56 policy options. The ICCAC Members present and voting approved 32 of these policy options unanimously, approved 11 more with a super-majority vote (support of 80% or more of the members present and voting ), and 13 additional options with a simple majority supporting it. One option failed to gain ICCAC approval and is not included in this report. At this time these policy options have not been prioritized nor ranked in any order of preference. Explanations of objections are included in Appendices F through J of this Report, which contain detailed accounts of the ICCAC's options.

Of the 56 policy options, 38 were analyzed quantitatively to have a cumulative effect of reducing emissions by about 20 million metric tons of carbon dioxide equivalent (MMtCO<sub>2</sub>e) in 2012 and 105 (MMtCO<sub>2</sub>e) in 2020.

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<sup>4</sup> State of Iowa, Executive Department. Executive Order Number Six, February 21, 2008. Available at <http://publications.iowa.gov>

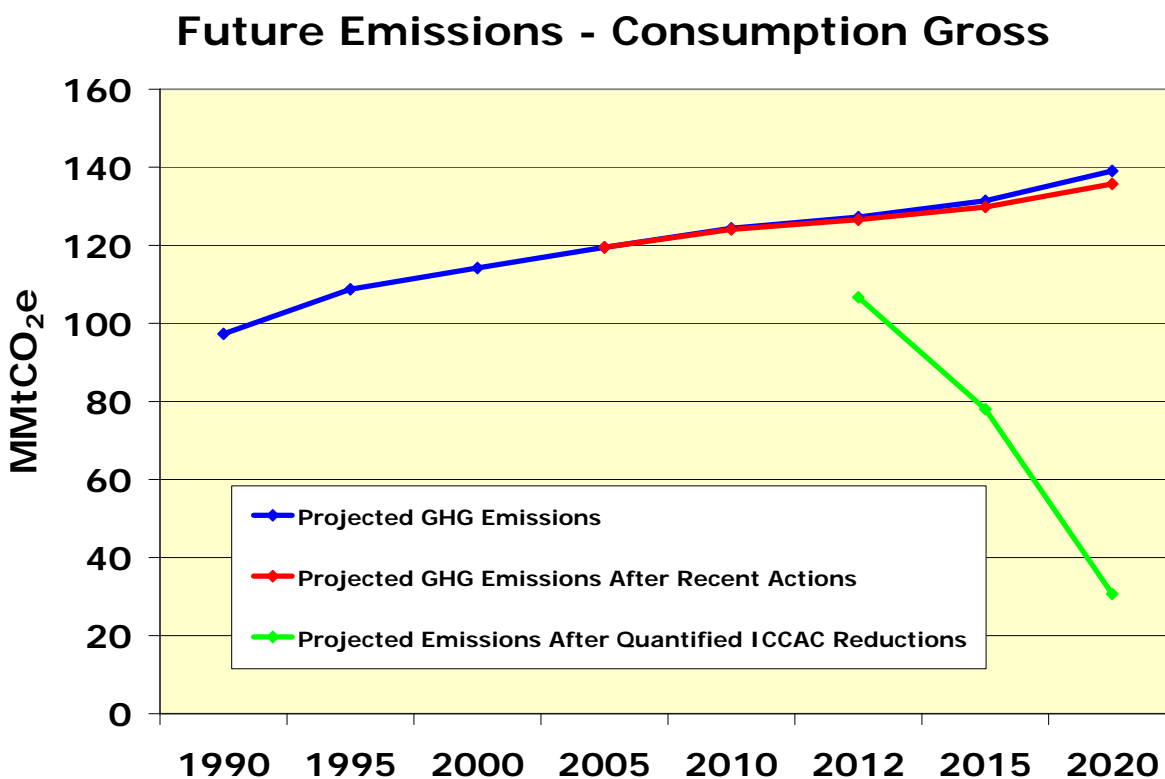
<sup>5</sup> State of Iowa, Executive Department. Executive Order Number Forty-one. April 22, 2005. Available at [http://publications.iowa.gov/2619/1/EO\\_41.pdf](http://publications.iowa.gov/2619/1/EO_41.pdf)

Figure ES-3 presents a graphical summary of the potential cumulative emission reductions associated with the recent federal and state actions and the 38 policy options relative to the business-as-usual reference case projections. Table ES-1a provides the numeric estimates underlying Figure ES-3 for the 50% reduction by 2050 scenario and Table ES-1b provides the same estimate for the 90% reduction scenario by 2050. In Figure ES-3:

- The blue line shows actual (for 1990, 1995, 2000, and 2005) and projected (for 2010, 2012, 2015 and 2020) levels of Iowa' gross GHG emissions on a consumption basis. (The consumption-based approach accounts for emissions associated with the generation of electricity in Iowa to meet the state's demand for electricity)
- The red line shows projected emissions associated with recent federal and state actions that were analyzed quantitatively.
- The green line shows projected emissions if all of the ICCAC's 38 options that were analyzed quantitatively with respect to their GHG reduction potential are implemented successfully and the estimated reductions are fully achieved. (Note that other ICCAC options would have the effect of reducing emissions, but those reductions were not analyzed quantitatively, so are not reflected in the green line.)

For the policy options offered by the ICCAC to yield the levels of estimated emission reductions shown in Table ES-2, they must be implemented in a timely and thorough manner. Table ES-3 depicts the final policy options of the Council and their associated GHG reductions and costs/savings for each sector.

**Figure ES-3. Annual GHG emissions: reference case projections and ICCAC options (consumption-basis, gross emissions)**



MMtCO<sub>2</sub>e = million metric tons of carbon dioxide equivalent; GHG = greenhouse gas; ICCAC = Iowa Climate Change Advisory Council.

**Table ES-1a. Annual emissions: reference case projections and impact of ICCAC options (consumption-basis, gross emissions) - 50 % Reduction Scenario by 2050**

Consumption Basis - Gross Emissions							
	1990	2000	2005	2010	2012	2015	2020
Projected GHG Emissions	97.3	114.2	119.5	124.4	127.3	131.4	139.1
Reductions from Recent Actions			0.0	0.3	0.7	1.6	3.3
Projected GHG Emissions After Recent Actions*			119.5	124.1	126.6	129.8	135.7
Remaining GHGs After Reduction Scenarios Recommended by ICCAC					118.8	NA	106.3
Total GHG Reductions from ICCAC Policies					19.9	51.8	105.1
Difference Between ICCAC Scenarios and Reductions**					12.1	NA	75.7
Projected Emissions After Quantified ICCAC Reductions					106.7	78.0	30.6

\* Reductions from recent actions include the Energy Independence and Security Act of 2007, Title III. GHG reductions from Titles IV and V of this Act have not been quantified because of the uncertainties in how they will be implemented. It is expected that Titles IV and V measures will overlap with EEC policies. Projected annual emissions also include reductions from recent actions. Existing utility energy efficiency programs are not included in the existing action analysis because they are impounded in the utility load growth forecasts used in the Iowa Inventory and Forecast. \*\* (Difference = Row 4- row 7)

**Table ES-1b. Annual emissions: reference case projections and impact of ICCAC options (consumption-basis, gross emissions)- 90 % Reduction Scenario by 2050**

<b>Consumption Basis - Gross Emissions</b>							
	<b>1990</b>	<b>2000</b>	<b>2005</b>	<b>2010</b>	<b>2012</b>	<b>2015</b>	<b>2020</b>
Projected GHG Emissions	97.3	114.2	119.5	124.4	127.3	131.4	139.1
Reductions from Recent Actions			0.0	0.3	0.7	1.6	3.3
Projected GHG Emissions After Recent Actions*			119.5	124.1	126.6	129.8	135.7
Remaining GHGs after Reduction Scenarios Recommended by ICCAC					115.3	NA	93.5
Total GHG Reductions from ICCAC Policies					19.9	51.8	105.1
Difference Between ICCAC Scenarios and Reductions					8.6	NA	62.9
Projected Emissions After Quantified ICCAC Reductions					106.7	78.0	30.6

\* Reductions from recent actions include the Energy Independence and Security Act of 2007, Title III. GHG reductions from Titles IV and V of this Act have not been quantified because of the uncertainties in how they will be implemented. It is expected that Titles IV and V measures will overlap with EEC policies' Projected annual emissions also include reductions from recent actions.. Existing utility energy efficiency programs are not included in the existing action analysis because they are impounded in the utility load growth forecasts used in the Iowa Inventory and Forecast. \*\* (Difference = Row 4- row 7)

**Table ES-2. Summary by sector of estimated impacts of implementing all of the ICCAC options (cumulative reductions and costs/savings)**

<b>Sector</b>	<b>GHG Reductions (MMtCO<sub>2</sub>e)</b>			<b>Net Present Value 2009–2020 (Million \$)</b>	<b>Cost-Effectiveness (\$/tCO<sub>2</sub>e)</b>
	<b>2012</b>	<b>2020</b>	<b>Total 2009–2020</b>		
Energy Efficiency and Conservation	1.1	8.5	42.8	-\$1,057	-\$25
Clean and Renewable Energy	5.8	48.0	233.5	\$5,921	\$25
Transportation and Land Use	1.6	11.1	55.0*	-\$2,219	-\$59
Agriculture, Forestry, and Waste Management	11.3	37.4	233.0	\$2,139	\$9.2
Cross-Cutting Issues	Non-quantified, enabling options				
<b>TOTAL (includes all adjustments for overlaps)</b>	<b>19.9</b>	<b>105.1</b>	<b>564.3</b>	<b>\$4,785</b>	<b>\$8.8</b>

GHG = greenhouse gas; MMtCO<sub>2</sub>e = million metric tons of carbon dioxide equivalent; \$/tCO<sub>2</sub>e = dollars per metric ton of carbon dioxide equivalent.

The values in this table do not include the effects of recent actions. Negative values in the Net Present Value and the Cost-Effectiveness columns represent net cost savings associated with the policy options.

Within each sector, values have been adjusted to eliminate double counting for policies or elements of policies that overlap. In addition, values associated with policies or elements of policies within a sector that overlap with policies or elements of policies in another sector have been adjusted to eliminate double counting. Appendix F (for the EEC sectors), Appendix G (for the CRE sectors), Appendix H (for the TLU sectors) and Appendix I (for the AFW sectors) of this report provide documentation of how sector-level emission reductions and costs (or cost savings) were adjusted to eliminate double counting associated with overlaps between policies.

\* Deduct total TLU-6 2009-2020 reductions [17.7MMt] from 55.03 total = 37.3, before calculating cost/ton for TLU Options. Total Reductions for calculation of cost-effectiveness: 564.3- 17.7 = 546.6. [ $\$4.785 / 546.6 = \$8.8/t$ ]

**Table ES-3. Energy Efficiency and Conservation Policy Options**

No.	Policy Option	CO <sub>2</sub> Reduction 2012	CO <sub>2</sub> Reduction 2020	Total 2009–2020	Net Present Value 2009–2020 (Million \$)	Cost/Ton (\$/tCO <sub>2</sub> e)	Level of Support
EEC-1	Consumer Education Programs	<i>Not quantified</i>					Unanimous
EEC-2	Demand-Side Management (DSM)/Energy Efficiency Programs for Natural Gas	0.08	1.24	5.43	–\$191.77	–\$35.29	Super Majority (4 objections)
EEC-3	Financial Mechanisms for Energy Efficiency	1.62	6.11	36.81	–\$805.05	–\$21.87	Super Majority (1 objection)
EEC-4	Improved Building Codes for Energy Efficiency	0.05	0.40	1.89	–\$46.27	–\$24.44	Super Majority (5 objections)
EEC-5	Incentive Mechanisms for Achieving Energy Efficiency	0.35	3.29	16.33	–\$350.79	–\$21.48	Unanimous
EEC-6	Promotion and Incentives for Improved Design and Construction in the Private Sector	0.00	0.12	0.46	–\$11.36	–\$24.57	Super Majority (1 objection)
EEC-7	Training and Education for Builders and Contractors	<i>Not quantified</i>					Unanimous
EEC-8	Focus on Specific Residential Market Segments	0.09	0.98	4.83	–\$122.53	–\$25.37	Unanimous
EEC-9	Midwestern Governors Association Energy Security and Climate Stewardship Platform	0.13	4.13	17.14	–\$375.69	–\$21.92	Majority (9 objections)
EEC-10	Energy Management Training/Training of Building Operators	0.10	1.29	5.48	–\$129.49	–\$23.63	Super Majority (1 objection)
EEC-11	Rate Structures and Technologies To Promote Reductions	0.04	0.21	1.20	–\$25.73	–\$21.45	Unanimous
EEC-12	Demand-Side Management (DSM)/Energy Efficiency Programs for Electricity	0.39	4.38	20.33	–\$444.81	–\$21.88	Super Majority (4 objections)
EEC-13	Government Lead by Example: Improved Design, Construction, and Energy Operations in New and Existing State and Local Government Buildings	0.08	0.36	1.97	1.04	0.53	Majority (6 objections)
EEC-14	More Stringent Appliance Efficiency Standards	0.94	2.20	17.33	–\$708.15	–\$40.85	Super Majority (2 objections)
	<b>Sector Total After Adjusting for Overlaps</b>	<b>1.1</b>	<b>8.6</b>	<b>43.2</b>	<b>–\$1,064.5</b>	<b>–\$24.7</b>	
	<b>Reductions From Recent Actions: EISA (2007) and Executive Orders #6 and 41</b>	<b>0.44</b>	<b>1.42</b>	<b>9.19</b>			
	<b>Sector Total Plus Recent Actions</b>	<b>1.6</b>	<b>10.0</b>	<b>52.3</b>			

DSM = demand-side management; EISA = Energy Independence and Security Act of 2007; GHG = greenhouse gas; MMtCO<sub>2</sub>e = million metric tons of carbon dioxide equivalent; \$/tCO<sub>2</sub>e = dollars per metric ton of carbon dioxide equivalent. Existing utility energy efficiency programs are not included in the recent action analysis because they are impounded in the utility load growth forecasts used in the Iowa Inventory and Forecast.

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

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

**Table ES-3. (continued) Clean and Renewable Energy Policy Options**

No.	Policy Option	CO <sub>2</sub> Reduction 2012	CO <sub>2</sub> Reduction 2020	Total 2009–2020	Net Present Value 2009–2020 (Million \$)	Cost/ton (\$/tCO <sub>2</sub> e)	Change in Generation Cost in 2020 \$/MWh*	Level of Support	
CRE-1	Education	<i>Not Quantified</i>							Unanimous
CRE-2	Technology Initiatives, Including Renewables	4.7	33.4	192.6	\$5,653	\$29.4	\$25.7	Super Majority (3 Objections)	
CRE-3	MGA Cap and Trade, Including Offsets To Promote Renewables	<i>Not Quantified</i>							Majority (5 Objections)
CRE-4	Decarbonization Fund	2.2	11.4	74.1	\$316	\$4.3	\$3.1	Super Majority (2 Objections)	
CRE-5	Performance Standards (50% Reduction by 2050)	4.9	11.4	95.4	\$2,650.6	\$27.8	\$7.3	Super Majority (3 Objections, 1 Abstention)	
CRE-6	Voluntary GHG Commitments	<i>Not Quantified</i>							Unanimous
CRE-7	Policies Related to Nuclear Power	0.0	9.7	9.7	\$268	\$27.6	\$4.5	Majority (5 Objections)	
CRE-8	Support for Grid-Based Renewable Energy & Development (MGA Target of 20% of retail sales by 2020)	0.0	2.3	4.3	\$93.4	\$21.8	\$1.5	Unanimous	
CRE-9	Transmission System Upgrading	<i>Not Quantified</i>							Unanimous
CRE-10	R&D for Emerging Technologies and Corresponding Incentives	<i>Not Quantified</i>							Unanimous
CRE-11	Distributed Generation/Co-Generation	0.0	0.1	0.5	\$14	\$29.1	\$0.1	Super Majority (1 Objection)	
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	Super Majority (3 Objections)	
	<b>Sector Total After Adjusting for Overlaps</b>	<b>6</b>	<b>48</b>	<b>233</b>	<b>\$5,921</b>	<b>\$25</b>			
	<b>Reductions From Recent Actions</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>			
	<b>Sector Total Plus Recent Actions</b>	<b>6</b>	<b>48</b>	<b>233</b>	<b>\$5,921</b>	<b>\$25</b>			

GHG = greenhouse gas; MMtCO<sub>2</sub>e = million metric tons of carbon dioxide equivalent; \$/tCO<sub>2</sub>e = dollars per metric ton of carbon dioxide equivalent.

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

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



**Table ES-3. (continued) Transportation and Land Use Policy Options**

No.	Policy Option	GHG Reductions (MMtCO <sub>2</sub> e)			Net Present Value 2009–2020 (Million \$)	Cost-Effectiveness (\$/tCO <sub>2</sub> e)	Level of Support
		2012	2020	Total 2009–2020			
TLU-1	Smart Growth Bundle with Transit	0.076	0.242	1.53	–\$377	–\$245	Unanimous
TLU-1a	Expand and Improve Transit Infrastructure	0.004	0.026	0.127	\$7.2	+\$57	Majority (5 objections)
TLU-2	GHG Impacts for State and Local Capital Funding	<i>Quantified as part of TLU-1 and TLU-1a</i>					Unanimous
TLU-4	Support Passenger Rail Service in Iowa	N/A	0.008	0.026	\$15	+\$597	Majority (7 objections)
TLU-5a	Adopt Best Workplaces for Commuters in Iowa	0.02	0.02	0.21	\$18	\$84	Majority (6 objections)
TLU-5b	Distributed Workplace Models	<i>Non-quantified, qualitative option</i>					Unanimous
TLU-6	Light Duty Vehicles Fuel Efficiency Incentives	0.44	3.65	17.70*	NQ	NQ	Supermajority (3 objections)
TLU-7	Fuel Efficient Operations for Light Duty Vehicles	0.11	0.65	3.41	–\$306.9	–\$90	Unanimous
TLU-8	New Vehicle Standards (Tailpipe GHG and Fuel Economy)	N/A	0.8	4.1	–\$246	–\$60	Unanimous
TLU-9	Freight Strategies (Truck and Rail)	0.39	0.63	5.9	\$30	+\$5	Supermajority (1 objection)
TLU-10	Fuel Strategies (20% Low Carbon Fuel Standard)	0.60	5.11	22.03	–\$1,359	–\$62	Unanimous
	<b>Sector Total After Adjusting for Overlaps and Synergies</b>	<b>1.64</b>	<b>11.14</b>	<b>55.03*</b>	<b>–\$2,218.50</b>	<b>–\$59</b>	
	<b>Reductions From Recent Actions (Federal CAFE Requirements)</b>	<b>0.26</b>	<b>1.93</b>	<b>9.39</b>	<b>Not Quantified</b>		
	<b>Sector Total Plus Recent Actions</b>	<b>1.9 (8.3)</b>	<b>13.07 (48)</b>	<b>64.42</b>	<b>N/A</b>	<b>N/A</b>	

CAFE = corporate average fuel economy; GHG = greenhouse gas; MMtCO<sub>2</sub>e = million metric tons of carbon dioxide equivalent; \$/tCO<sub>2</sub>e = dollars per metric ton of carbon dioxide equivalent; N/A = not applicable.

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

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

\*Deduct total TLU-6 2009–2020 reductions [17.7MMt] from 55.03 total = 37.3, before calculating cost/ton for TLU Options.

**Table ES-3. (continued) Agriculture, Forestry, and Waste Management Policy Options**

No.	Policy Option	GHG Reductions (MMtCO <sub>2</sub> e)			Net Present Value 2009–2020 (Million \$)	Cost-Effectiveness (\$/tCO <sub>2</sub> e)	Level of Support
		2012	2020	Total 2009–2020			
AFW-1	Nutrient Management						Majority (7 Objections)
	Increase Efficiency of Fertilizer	0.11	0.53	3.0	–\$103	–\$34	
	Seasonally Flooded Areas	0.002	0.009	0.05	\$10	\$194	
	Improved Nutrient Distribution	0.02	0.1	0.55	\$373	\$693	
AFW-2	Wetlands and Drainage	0.01	0.16	0.57	\$120	\$218	Majority (5 Objections)
AFW-3	Expanded Use of Agriculture and Forestry Biomass Feedstocks for Electricity, Heat, or Steam Production	4.4	20	113	\$4,281	\$38	Unanimous
AFW-4	Encourage Large-Scale Manure/Methane Management Capture Utilization						Unanimous
	Methane Management Capture Utilization	0.8	3	17	\$63	\$4	
	Manure Management	0.2	0.7	4.6	–\$38	–\$8	
AFW-5	Land Management to Promote Sequestration Benefits						Unanimous
	Conservation Tillage	2.9	9	56	–\$6	–\$0.1	
	Agriculture Land Conversion	0.1	0.4	2.6	\$199	\$76	
	Conservation Grazing	0.1	0.3	1.7	–\$116	–\$67	
	Afforestation	0.2	0.6	4.1	\$216	\$53	
	Unmanaged Grazed Forested Land	0.3	0.8	5.5	\$93.7	\$17	
Urban Forestry	0.1	0.4	2.4	–\$99	–\$41		
AFW-6	Cellulosic Biofuel*	2.0	9.8	49	–\$1,410	–\$29	Unanimous
AFW-7	Improved On-Farm (or First Point of Purchase) Energy Use and Efficiency						Unanimous
	Renewable Energy	0.02	0.08	0.5	\$23	\$51	
	Energy Efficiency	0.2	0.9	5.9	–\$610	–\$104	
AFW-8	Waste Management Strategies	1.5	4.1	26.5	–\$220	–\$8	Unanimous
AFW-9	Landfill Methane Energy Programs	0.2	0.8	4.8	\$4	\$0.8	Unanimous
	<b>Sector Total After Adjusting for Overlaps</b>	<b>11</b>	<b>37</b>	<b>233</b>	<b>\$2,139</b>	<b>\$9</b>	
	<b>Reductions From Recent Actions</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>\$0.0</b>	<b>\$0.0</b>	
	<b>Sector Total Plus Recent Actions</b>	<b>11</b>	<b>37</b>	<b>233</b>	<b>\$2,139</b>	<b>\$9</b>	

GHG = greenhouse gas; MMtCO<sub>2</sub>e = million metric tons of carbon dioxide equivalent; \$/tCO<sub>2</sub>e = dollars per metric ton of carbon dioxide equivalent.

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

\* Note that the costs/savings of this option include a \$1.01/gallon federal subsidy for cellulosic ethanol.

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

**Table ES-3. (continued) Cross-Cutting Issues Policy Options**

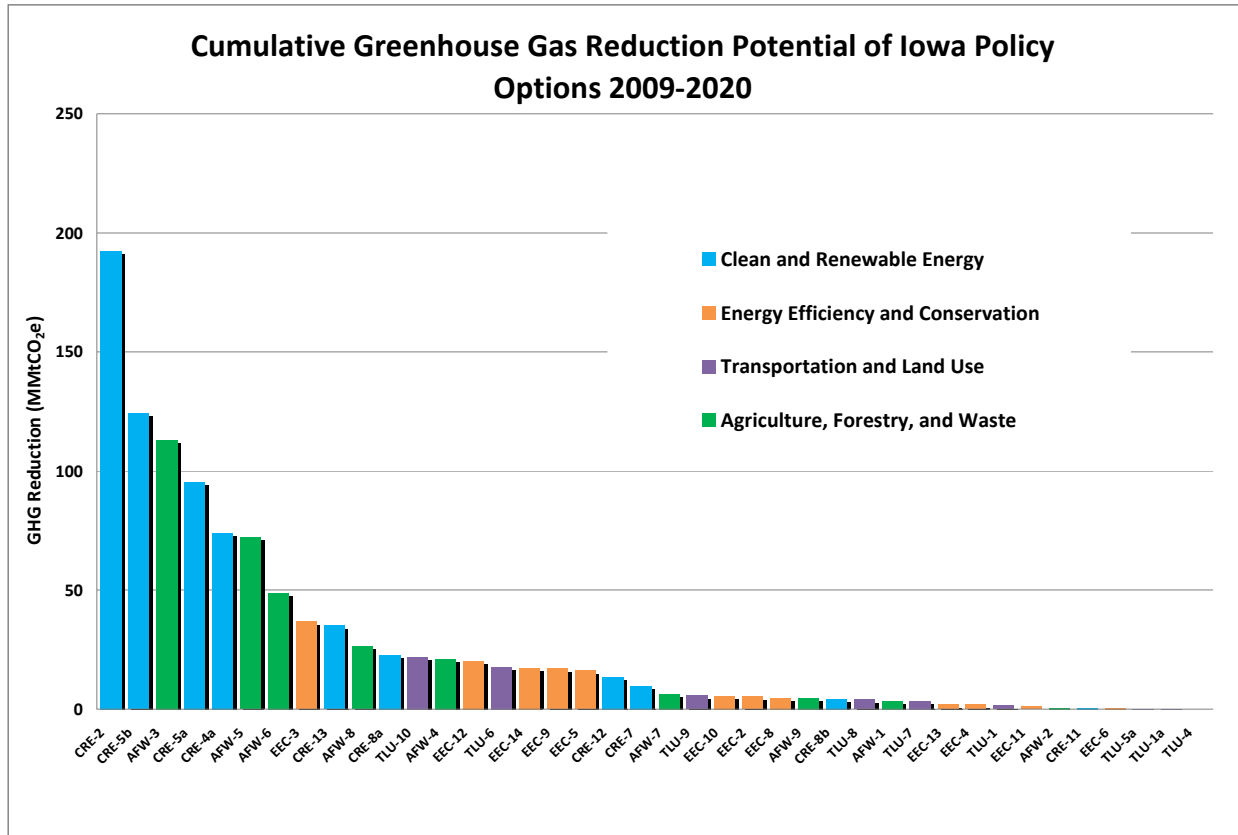
Policy No.	Policy Option	GHG Reductions (MMtCO <sub>2</sub> e)			Net Present Value 2009–2020 (Million \$)	Cost-Effectiveness (\$/tCO <sub>2</sub> e)	Status of Option
		2012	2020	Total 2009–2020			
CC-1	GHG Inventories, Forecasting, Reporting, and Registry	<i>Not Quantified</i>					Unanimous
CC-2	Statewide GHG Reduction Scenarios	<i>Not Quantified</i>					Majority (4 Objections)
CC-3	State and Local Government GHG Emissions (Lead by Example)	<i>Not Quantified</i>					Unanimous
CC-4	Public Education and Outreach	<i>Not Quantified</i>					Unanimous
CC-5	Tax and Cap Policies—Lead Transferred to the CRE SC	<i>Not Quantified</i>					Transferred
CC-6	Seek Funding for Implementation of ICCAC Options	<i>Not Quantified</i>					Unanimous
CC-7	Adaptation and Vulnerability	<i>Not Quantified</i>					Unanimous
CC-8	Participate in Regional and Multistate GHG Reduction Efforts	<i>Not Quantified</i>					Unanimous
CC-9	Encourage the Creation of a Business-Oriented Organization To Facilitate Investment in Climate-Related Business Opportunities and To Share Information and Strategies, Recognize Successes, and Support Aggressive GHG Reduction Goals	<i>Not Quantified</i>					Unanimous

GHG = greenhouse gas; MMtCO<sub>2</sub>e = million metric tons of carbon dioxide equivalent; \$/tCO<sub>2</sub>e = dollars per metric ton of carbon dioxide equivalent.

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

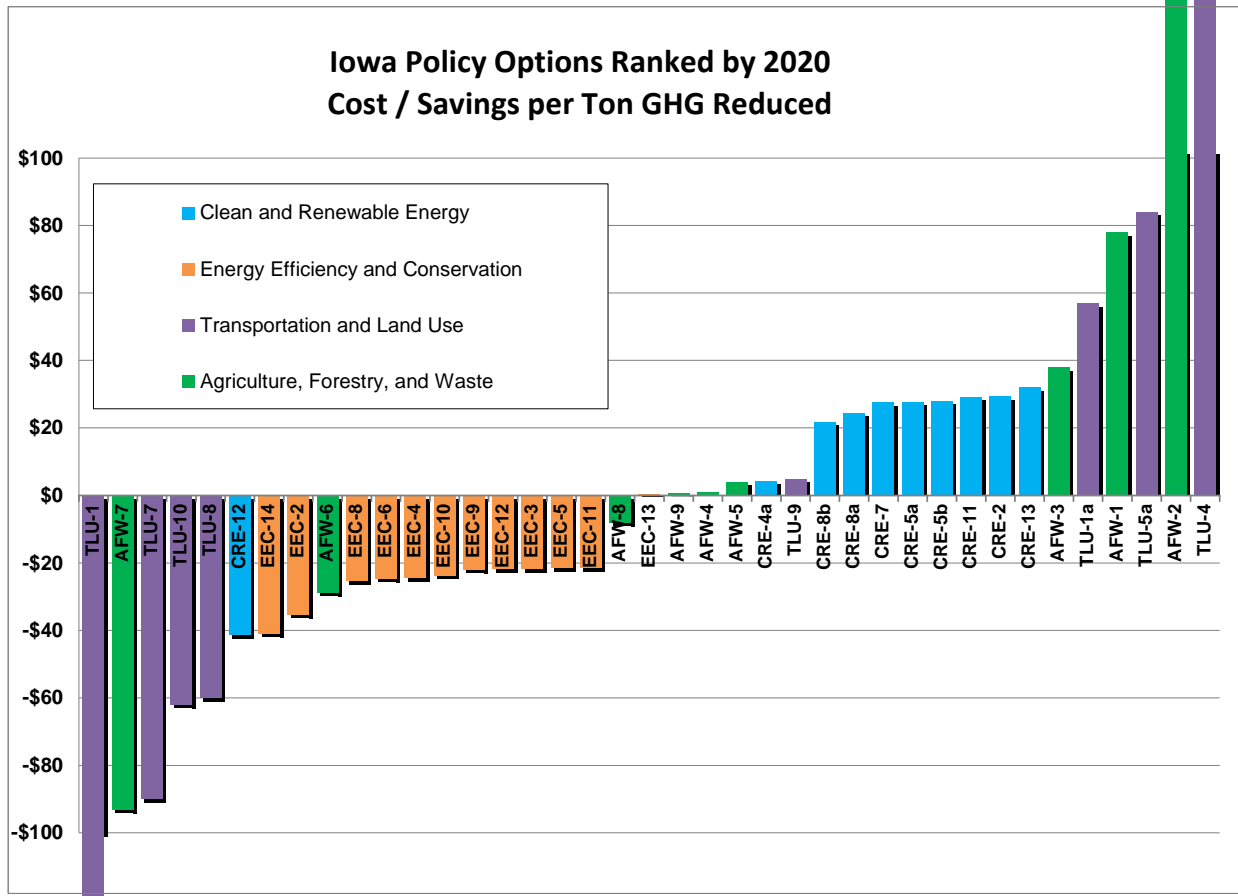
As explained above, the ICCAC considered the estimates of the GHG reductions that could be achieved by 38 of its options derived from 2005 baseline data, and the costs (or cost savings) of 37 of the options. Figure ES-4 presents the estimated tons of GHG emission reductions for each policy option for which estimates were quantified, expressed as a cumulative figure for the period 2009–2020. In addition to the imprecision in GHG reductions achieved by each policy option, there are uncertainties about the exact cost (or cost savings) per ton of reduction achieved. Figure ES-5 presents the estimated dollars-per-ton cost (or cost savings, depicted as a negative number) for each policy option for which cost estimates were quantified, expressed as a cumulative figure for the period 2009–2020. This measure is calculated by dividing the net present value of the cost of the policy option by the cumulative GHG reductions, all for the period 2009–2020.

**Figure ES-4. ICCAC policy options ranked by cumulative (2009–2020) GHG reduction potential**



GHG = greenhouse gas; MMtCO<sub>2</sub>e = million metric tons of carbon dioxide equivalent; AFW = Agriculture, Forestry, and Waste Management; EEC = Energy Efficiency and Conservation; TLU = Transportation and Land Use; CRE = Clean and Renewable Energy

Figure ES-5. ICCAC policy options ranked by cumulative (2009–2025) net cost/cost savings per ton of GHG removed

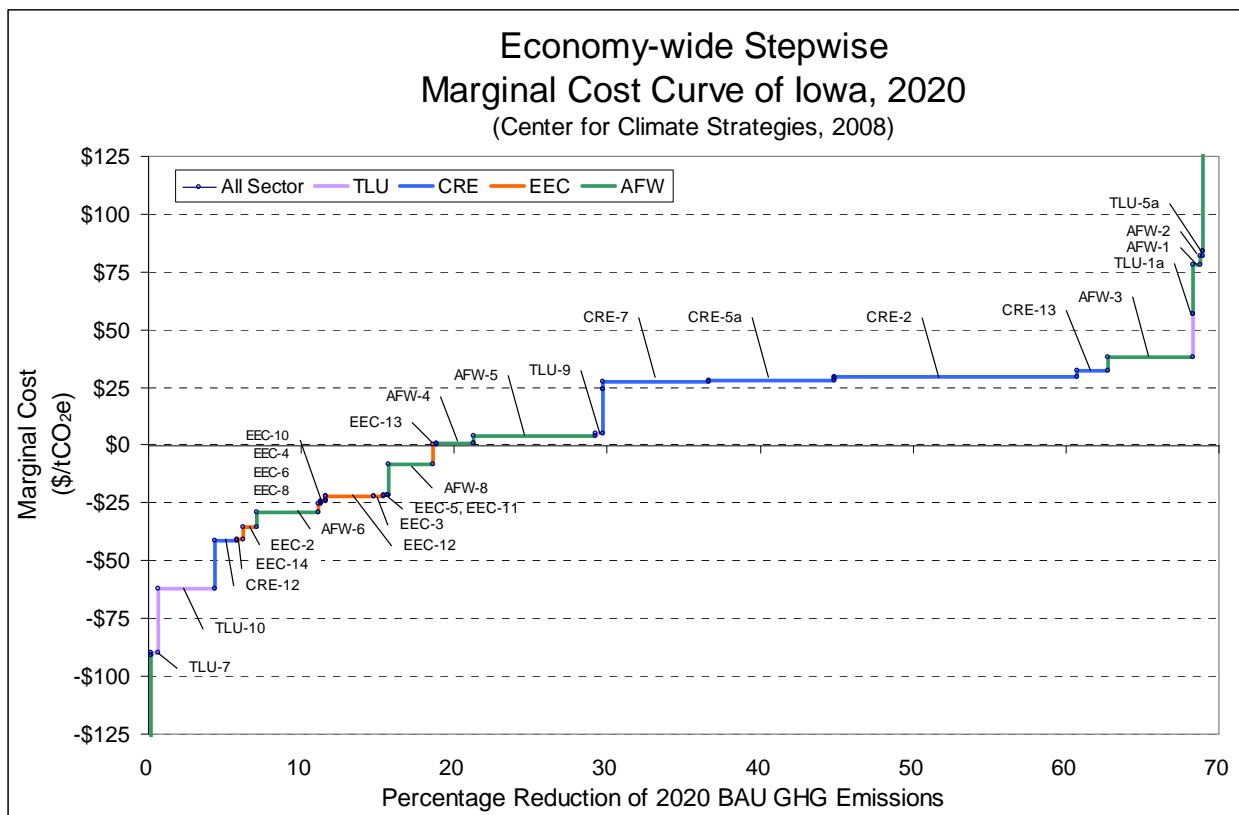


GHG = greenhouse gas; EEC = Energy Efficiency and Conservation; TLU = Transportation and Land Use; CRE = Clean and Renewable Energy; AFW = Agriculture, Forestry, and Waste Management.

Negative values represent net cost savings and positive values represent net costs associated with the policy option.

Figure ES-6 presents a stepwise marginal cost curve for Iowa. The horizontal axis represents the percentage of GHG emissions reduction in 2020 for each option relative to the business as usual (BAU) forecast. The vertical axis represents the marginal cost of mitigation (expressed as the cost-effectiveness of each policy option on a cumulative basis, 2009-2020). In the figure, each horizontal segment represents an individual policy. The width of the segment indicates the GHG emission reduction potential of the option in percentage terms. The height of the segment relative to the x-axis shows the average cost (saving) of reducing one MMTCO<sub>2</sub>e of GHG emissions with the application of the option.

**Figure ES-6. Stepwise marginal cost curve for Iowa, 2025**



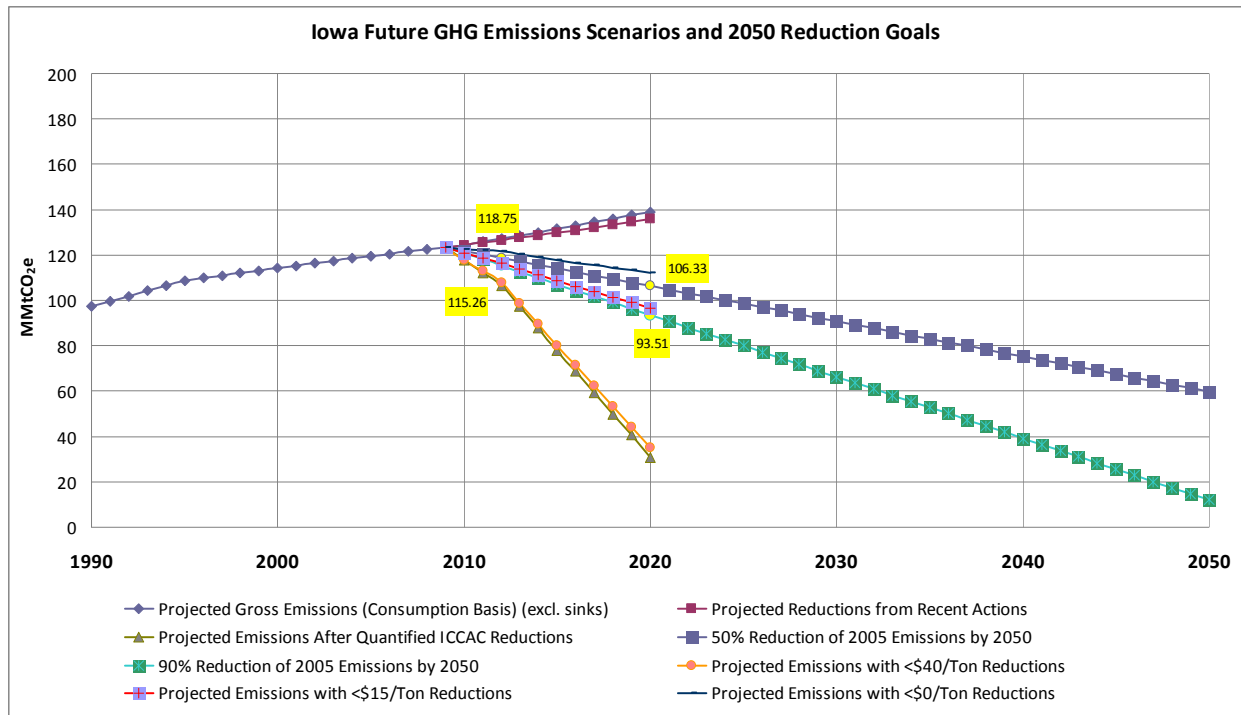
BAU = business as usual; GHG = greenhouse gas; tCO<sub>2</sub>e = metric tons of carbon dioxide equivalent; AFW = Agriculture, Forestry, and Waste Management; EEC = Energy Efficiency and Conservation; TLU = Transportation and Land Use; CRE = Clean and Renewable Energy.

Negative values represent net cost savings and positive values represent net costs associated with the policy option.

Note: Results have been adjusted to remove overlaps between policies.

Finally, Figure ES-7 presents a graph with a linear extrapolation out to 2050 for the two ICCAC scenarios; a 50% GHG Reduction scenario [blue line] and a 90% GHG Reduction scenario [green line]. The 2012 and 2020 intersection points on each of these scenario lines were chosen for the short and mid-term scenario proposals. For both scenarios, a simple linear extrapolation was used from Iowa's estimated 2009 emissions to the targets of 50% and 90% reductions in 2050, which allowed delineation of interim targets for each scenario in 2012 and 2020. The assumption of linearity was made because there were plenty of reductions in the approved policy options to achieve the interim targets, and a more extensive analysis was beyond the scope of this report. For comparative purposes the figure also includes three lines indicating the projected emissions with three cost-effectiveness projections: for less than \$40/T, \$15/T and \$0/T with orange, red and blue shades, respectively.

**Figure ES-7. Iowa Future GHG Emissions Scenarios and 2050 Reduction Goals**



# Chapter 1

## Background and Overview

### Creation of the Iowa Climate Change Advisory Council

#### Iowa Senate File 485

The Iowa General Assembly enacted Senate File 485 in 2007 and House File 2571 in 2008. This legislation created the Iowa Climate Change Advisory Council (ICCAC) which consists of twenty-three (23) voting members appointed by the Governor, and serve three-year staggered terms. The Council is also comprised of four (4) non-voting, ex-officio members from the General Assembly.

As specified in Iowa Code section 455B.851, “The council shall submit the greenhouse gas emission reduction proposals to the governor and the general assembly by January 1, 2009.” The proposals include the following:

- After consideration of a full range of policies and strategies, including the cost-effectiveness of the strategies, the Council shall develop multiple scenarios designed to reduce statewide greenhouse gas emissions, including one scenario that would reduce such emissions by fifty percent and ninety percent by 2050.
- The Council shall also develop short-term, medium-term, and long-term scenarios designed to reduce statewide greenhouse gas emissions and shall consider the cost-effectiveness of the scenarios.
- The Council shall establish 2005 as the baseline year for purposes of calculating reductions in statewide greenhouse gas emissions

#### ICCAC’s Response

In fulfillment of the requirements of this legislation ICCAC held eight meetings over the last fifteen months. Additionally, the Council formed five technical Subcommittees (SCs) to assist the Council in formulating options. These SCs met numerous times between the ICCAC meetings. As a result the Council has prepared this Report which includes the following key outcomes and options:

- The Iowa Greenhouse Gas (GHG) Emissions Inventory and Forecast has been prepared which outlines baseline conditions as of 2005<sup>1</sup> and projected emissions through 2025 if no changes to the business as usual reference case are made. These projections were prepared in close consultation with the Iowa Department of Natural Resources (IDNR) and many Council and Sub-Committee members offered specific recommended improvements during its development. ICCAC recommends that the GHG Emissions Inventory and Forecast be updated annually.

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<sup>1</sup> Year 2005 was selected as the base year for the GHG reduction scenarios and cost-effectiveness analysis because emissions inventory data are more complete for year 2005 than for previous years.



- Approval of a comprehensive package of multi-sector policy options to reduce GHG emissions and address related energy and commerce issues in Iowa. ICCAC approved 56 policy options for inclusion in this Final Report. The ICCAC Members present and voting approved 32 of these policy options unanimously, approved 11 more with a super-majority vote (support of 80% or more of the members present and voting ), and 13 additional options with a simple majority supporting it. One option failed to gain ICCAC approval. Explanations of objections are included in Appendices F through J of this Report, which contain detailed accounts of the ICCAC's options.
- Evaluation of the direct costs and direct cost savings of the policy options in Iowa. The ICCAC analyzed quantitatively the direct costs or cost savings of 37 of its 56 policy options. Although the total net cost associated with the 37 policies analyzed is estimated at about \$ 4.8 billion between 2009 and 2020, the weighted-average cost-effectiveness of the 37 policies is estimated to be approximately \$8.80/tCO<sub>2</sub>e reduced. Many of the policies are estimated to yield significant cost-saving opportunities for Iowans. Other policies will incur net costs.
- The Council developed two GHG Reduction Scenarios. One scenario was specified by the enabling legislation to achieve a 50% reduction from the baseline year [2005] by 2050. The Council developed a second GHG reduction scenario to achieve a 90% GHG reduction below the 2005 baseline year by 2050. The Council chose 2012 and 2020 as its short-term and mid-term intervals, respectively. For a 50% reduction by 2050 scenario the Council recommends a 1% reduction by 2012 and an 11% reduction by 2020. For the 90% reduction scenario the Council recommends a 3% reduction by 2012 and a 22 % reduction by 2020. The ICCAC based its options on its review of the potential overall emission reduction estimates (as compared to the GHG emissions inventory and forecast) for 38 of 56 policy Options for which emission reductions were quantified, and its review of goals and targets adopted by several other states. Of the 56 policy Options, 38 were analyzed quantitatively to have a cumulative effect of reducing emissions by about 20 million metric tons of carbon dioxide equivalent (MMtCO<sub>2</sub>e) in 2012 and 105 (MMtCO<sub>2</sub>e) in 2020. Together, if the 38 quantified policy options and the recent federal and state actions (or their functional equivalent) are successfully implemented, the 2020 emission reduction scenario based on results of analysis of ICCAC proposals conducted through the ICCAC and Subcommittee process is achievable.
- In addition, the ICCAC recommends that the state report biennially to the Governor and the state legislature on the state's progress in reducing GHG emissions under these scenarios.

## **Recent Actions**

### **GHG Reductions Associated With Recent Federal Actions**

The federal Energy Independence and Security Act of 2007 (EISA) was signed into law in December 2007. This law contains several requirements that will reduce GHG emissions as they are implemented over the next few years. During the ICCAC process, sufficient information was identified (e.g., implementation schedules) to estimate GHG emission reductions associated with implementing the Corporate Average Fuel Economy requirements and energy efficiency requirements for new appliances and lighting associated with the EISA's Title IV (Energy Savings in Buildings and Industry) and Title V (Energy Savings in Government and Public

Institutions) requirements in Iowa. The GHG emission reductions projected to be achieved by these actions are shown in Figure 1-1. Table 1-1 provides the numeric estimates underlying Figure 1-1.

### **Recent State Actions**

Iowa has recently embarked on statewide energy efficiency programs in response to concerns about energy costs. The state is implementing two energy efficiency initiatives under Executive Orders 6 and 41. Executive Order 6<sup>2</sup> by Governor Culver establishes a Green Government Initiative in Iowa that is targeted at three areas (buildings, materials and biofuels). Several Task Forces have been established to address the specific areas. Executive Order 41<sup>3</sup> by Governor Vilsack requires that all state agencies reduce energy consumption in state buildings. The estimated reductions associated with each of these efforts is also incorporated into Figure 1-1 and Table 1-1.

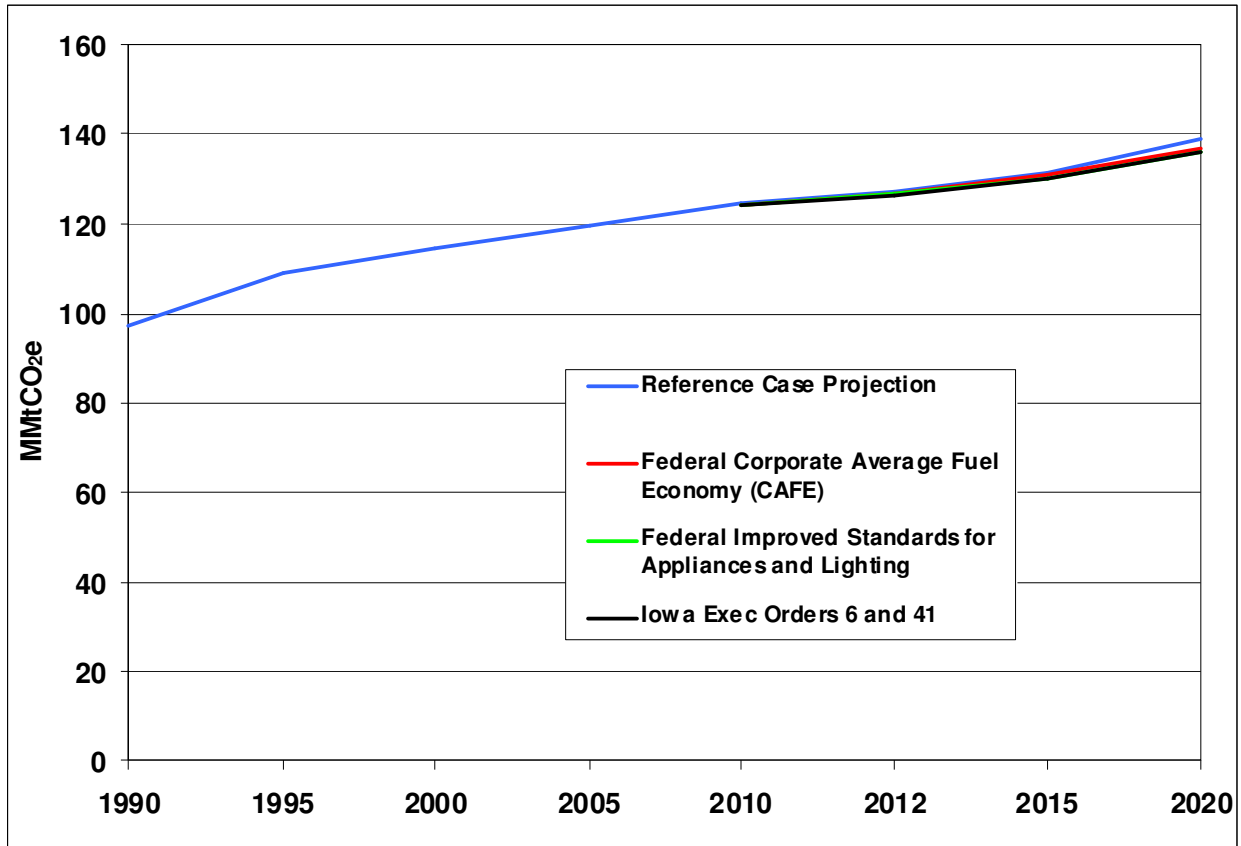
Together, these federal and state requirements are estimated to reduce gross GHG emissions for all sectors combined in Iowa by about 3.4 MMtCO<sub>2</sub>e (a 2.4% reduction) from the business-as-usual emissions in 2020.

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<sup>2</sup> State of Iowa, Executive Department. Executive Order Number Six, February 21, 2008 Available at <http://publications.iowa.gov>

<sup>3</sup> State of Iowa, Executive Department. Executive Order Number Forty-one. April 22, 2005. Available at [http://publications.iowa.gov/2619/1/EO\\_41.pdf](http://publications.iowa.gov/2619/1/EO_41.pdf)

**Figure 1-1. Estimated emission reductions associated with the effect of recent federal and state actions in Iowa (consumption-basis, gross emissions)**



MMtCO<sub>2</sub>e = million metric tons of carbon dioxide equivalent.

**Table 1-1. Estimated emission reductions associated with the effect of recent federal and state actions in Iowa (consumption-basis, gross emissions)**

Sector / Recent Action	GHG Reductions (MMtCO <sub>2</sub> e)		GHG Emissions (MMtCO <sub>2</sub> e)	
			Business as Usual	With Recent Actions
	2012	2020	2020	2020
<b>Energy Efficiency and Conservation (EEC)*</b>				
Federal Improved Standards for Appliances and Lighting Requirements	0.23	1.13	29.7	28.6
Iowa Executive Orders 6 and 41	0.21	0.29		28.3
<b>Transportation and Land Use (TLU)</b>				
Federal Corporate Average Fuel Economy (CAFE) Requirements	0.26	1.93	27.2	25.2
<b>Total (EEC + TLU Sectors)</b>	0.70	3.35	56.9	53.5
<b>Total (All Sectors)</b>			139.1	135.7

GHG = greenhouse gas; MMtCO<sub>2</sub>e = million metric tons of carbon dioxide equivalent.

\*EEC in this report specifically addresses residential, commercial and industrial (RCI) fuel use.

## The ICCAC Process

The ICCAC began its deliberative process at its second meeting on December 17, 2007 following an organizational meeting via teleconference on October 18, 2007. ICCAC met a total of seven times, with the final decisional meeting held on November 10, 2008, followed by a conference call on December 10, 2008 for review of this report. About 75 additional teleconference meetings of ICCAC's five supporting Subcommittees were also held to identify and analyze various potential policy actions in advance of the ICCAC's November 10, 2008 final decisional meeting.

The five SCs considered information and potential options in the following sectors:

- Energy Efficiency and Conservation (EEC);
- Clean and Renewable Energy (CRE);
- Transportation and Land Use (TLU);
- Agriculture, Forestry, and Waste Management (AFW); and
- Cross-Cutting Issues (CC) (i.e., issues that cut across the above sectors).

The Center for Climate Strategies (CCS) provided facilitation and technical assistance to the ICCAC and each of the SCs, based on a detailed proposal approved by the ICCAC. The SCs consisted of ICCAC members and selected additional members. Members of the public were invited to observe and provide input at all meetings of the ICCAC and SCs. The SCs served as advisers to the ICCAC and helped generate initial options on Iowa-specific policy options to be added to the catalog of existing states actions; priority policy options for analysis; draft proposals on the design characteristics and quantification of the proposed policy options; specifications and assistance for analysis of draft policy options (including best available data sources, methods and assumptions); and other key elements of policy option proposals, including related policies and programs, key uncertainties, co-benefits and costs, feasibility issues, and potential barriers to consensus. Where members of a SC did not fully agree on options to the ICCAC, the summary of their efforts was reported to the ICCAC as a part of its consideration and actions. The ICCAC then made its decisions after reviewing the SCs' proposals, including modifications as deemed appropriate in their judgment.

The ICCAC process employed a model of informed self-determination through a facilitated, stepwise, fact-based, and consensus-building approach. The process was facilitated by CCS, an independent, expert facilitation and technical analysis team. It was based on procedures that CCS has used in a number of other state climate change planning initiatives since 2000, but was adapted specifically for Iowa. The ICCAC process sought but did not mandate consensus, and it explicitly documented the level of ICCAC support for policies and key findings through a voting process established in advance, including barriers to full consensus where they existed on final consideration of proposed actions.

The 56 policy options (out of more than 300 potential options considered) adopted by the ICCAC and presented in this report were developed through a stepwise approach that included: (1) expanding a list existing states actions to include additional Iowa-specific actions; (2) developing a set of "priority for analysis" options for further development; (3) fleshing these

proposals out for full analysis by development of “straw proposals” for level of effort, timing and parties involved in implementation; (4) developing and applying a common framework of analysis for options, including sector specific guidance and detailed specifications for options that include data sources, methods and key assumptions; (5) reviewing results of analysis and modifying proposals as needed to address potential barriers to consensus; (6) finalizing design and analysis of options to remove barriers to final agreement; and (7) developing other key elements of policy proposals such as implementation mechanisms, co-benefits, and feasibility considerations. At the final three meetings of the process, policy options with at least majority support (defined as less than half of those present objecting) from ICCAC members present were adopted by the ICCAC and included in this report. The SCs’ options to the ICCAC were documented and presented to the ICCAC at each ICCAC meeting. All of the ICCAC and SC meetings were open to the public and all materials for and summaries of the ICCAC and SC meetings were posted on the ICCAC Web site ([www.iaclimatechange.us](http://www.iaclimatechange.us)). A detailed description of the deliberative process is included in Appendix B.

## Analysis of Policy Options

With CCS providing facilitation and technical analysis, the five SCs submitted options for policies for ICCAC consideration using a “policy option template” conveying the following key information:

- Policy Description
- Policy Design (Goals, Timing, Parties Involved)
- Implementation Mechanisms
- Related Policies/Programs in Place
- Type(s) of GHG Reductions
- Estimated GHG Reductions and Net Costs or Cost Savings
- Key Uncertainties
- Additional Benefits and Costs
- Feasibility Issues
- Status of Group Approval
- Level of Group Support
- Barriers to Consensus

In its deliberations, the ICCAC reviewed, modified, and reached group agreement on various policy options. The final versions for each sector, conforming to the policy option templates, appear in Appendices F through J and constitute the most detailed record of decisions of the ICCAC. Appendix E describes the methods used for quantification of the 38 policy options that were analyzed quantitatively. The quantitative analysis produced estimates of the GHG emission reductions and direct net costs (or cost savings) of implementation of various policies, in terms of both a net present value from 2009 to 2020 and a dollars-per-ton cost (i.e., cost-effectiveness). The key methods are summarized below.

**Estimates of GHG Reductions:** Using the projection of future GHG emissions (see below) as a starting point, 38 policy options were analyzed by CCS to estimate GHG reductions attributable to each policy in the individual years of 2012 and 2020 and cumulative reductions over the

period 2009–2020. The estimates were prepared in accordance with guidance by the appropriate SC and the ICCAC, which later reviewed the estimates and, in some cases, directed that they be revised with respect to such elements as goals, data sources, assumptions, sensitivity analysis, and methodology. Many policies were estimated to affect the quantity or type of fossil fuel combusted; others affected methane or CO<sub>2</sub> sequestered. Among the many assumptions involved in this task was identification of the appropriate GHG accounting framework—namely, the choice between taking a “production-based” approach versus a “consumption-based” approach to various sectors of the economy.<sup>4</sup>

**Estimates of Costs/Cost Savings:** The analyses of 37 policy options included estimates of the direct cost of those policies, in terms of both net costs or cost savings during 2009–2020 and a dollars-per-ton cost (i.e., cost-effectiveness). Following is a brief summary of the approach used to estimate the costs or cost savings associated with the policy options:

- *Discounted and annualized costs or cost savings*—Standard approaches were taken here. The net present value of costs or cost savings was calculated by applying a real discount rate of 5%. Dollars-per-ton estimates were derived as an annualized cost per ton, dividing the present value cost or savings by the cumulative GHG reduction measured in tons. As was the case with GHG reductions, the period 2009–2025 was analyzed.
- *Cost savings*— Total net costs or savings were estimated through comparison of monetized costs and savings of policy implementation over time, using discounting. These net costs could be positive or negative; negative costs indicated that the policy saved money or produced “cost savings.” Many policies were estimated to create net financial cost savings (typically through fuel savings and electricity savings associated with new policy actions).
- *Direct vs. indirect effects*—Estimates of costs and cost savings were based on “direct effects” (i.e., those borne by the entities implementing the policy).<sup>5</sup> Implementing entities could be individuals, companies, and/or government agencies. In contrast, conventional cost-benefit analysis takes the “societal perspective” and tallies every conceivable impact on every entity in society (and quantifies these wherever possible).

**Additional Costs and Benefits:** The ICCAC options were guided by four decision criteria that included GHG reductions and monetized costs and cost savings of various policies, as well as other potential co-benefits and costs (e.g., social, economic, and environmental) and feasibility considerations. The SCs were asked to examine the latter two in qualitative terms where deemed important and quantify them on a case-by-case basis, as needed, depending on need and where data were readily available.

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<sup>4</sup> A production-based approach estimates GHG emissions associated with goods and services produced within the state, and a consumption-based approach estimates GHG emissions associated with goods and services consumed within the state. In some sectors of the economy, these two approaches may not result in significantly different numbers. However, the power sector is notable, in that it is responsible for large quantities of GHG emissions, and states often produce more or less electricity than they consume (with the remainder attributable to power exports or imports).

<sup>5</sup> “Additional benefits and costs” were defined as those borne by entities other than those implementing the policy option. These indirect effects were quantified on a case-by-case basis, depending on magnitude, importance, need, and availability of data.

**Implementation Mechanisms:** The analysis for each option (see Appendices F through J) of the ICCAC includes guidance on the policy instruments or “mechanisms” that were prescribed or assumed for the policy action. This includes a range of potential mechanisms including, for instance, funding incentives, codes and standards, voluntary and negotiated agreements, market based instruments, information and education, reporting and disclosure, and other instruments. In some cases, the recommended instruments are precise. In other cases, they are more general and envision further work to develop concrete programs and steps to achieve the goals recommended by the ICCAC.

## Iowa GHG Emissions Inventory and Reference Case Projections

In April 2008, CCS completed a draft GHG emissions inventory and reference case projection to assist the ICCAC and SCs in understanding past, current, and possible future GHG emissions in Iowa, and thereby inform the policy development process.<sup>6</sup> The ICCAC and SCs reviewed, discussed, and evaluated the draft inventory and projections methodologies, as well as alternative data and approaches for improving the draft inventory and projections. The final report incorporating comments provided by the Subcommittees that were approved by the ICCAC at their September 2008 meeting and incorporated into the final report during October, is available at: [http://www.iaclimatechange.us/Inventory\\_Forecast\\_Report.cfm](http://www.iaclimatechange.us/Inventory_Forecast_Report.cfm). At the 7th ICCAC meeting in November 2008 the Council received the final I-F Report<sup>7</sup> and agreed to file and forward it to the Governor and Legislature.

The inventory and reference case projections included detailed coverage of all economic sectors and GHGs in Iowa, including future emission trends and assessment issues related to energy, the economy, and population growth. It is important to note that the emission estimates reflect the GHG emissions associated with the electricity sources used to meet Iowa’s demands, corresponding to a consumption-based approach to emissions accounting. Another way to look at electricity emissions is to consider the GHG emissions produced by electricity generation facilities in the state—a production-based method. The study covers both methods of accounting for emissions, but for consistency, all total results are reported as consumption-based.

As illustrated in Figure 1-2, under the reference case projections, Iowa’s gross GHG emissions continue to grow steadily, climbing to about 148 MMtCO<sub>2</sub>e by 2025, 52% above 1990 levels. This equates to a 1.1% annual rate of growth from 2005 to 2025. Relative to 2005, the share of emissions associated with electricity consumption and the transportation sector both increase slightly to 32% and 20%, respectively, in 2025. The share of emissions from the industrial processes and fossil fuel industry sectors is projected to increase to 6% and 3%, respectively, by

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<sup>6</sup> Center for Climate Strategies. *Draft Iowa Greenhouse Gas Inventory and Reference Case Projections, 1990–2025*. Prepared for the Iowa Climate Change Advisory Council. April, 2008. Available at: [http://www.iaclimatechange.us/Inventory\\_Forecast\\_Report.cfm](http://www.iaclimatechange.us/Inventory_Forecast_Report.cfm)

<sup>7</sup> Center for Climate Strategies. *Final Iowa Greenhouse Gas Inventory and Reference Case Projections, 1990–2025*. Prepared for the Iowa Climate Change Advisory Council. October, 2008. Available at: [http://www.iaclimatechange.us/Inventory\\_Forecast\\_Report.cfm](http://www.iaclimatechange.us/Inventory_Forecast_Report.cfm). See pages 13 and 14 of this report for a list of the the revisions that the ICCAC made to the inventory and reference case projections; these revisions are also identified at the end of Chapter 2 of the ICCAC final report.

2025. The share of emissions from the residential commercial and industrial and commercial (RCI) fuel use sector and the waste management sector is projected to remain the same at about 20% and 2%, respectively, of Iowa's gross GHG emissions in 2025. The agriculture sector is the only sector in Iowa whose emission share in 2025 is projected to decrease from its emission share in 2005 (from 23% in 2005 to 17% in 2025).

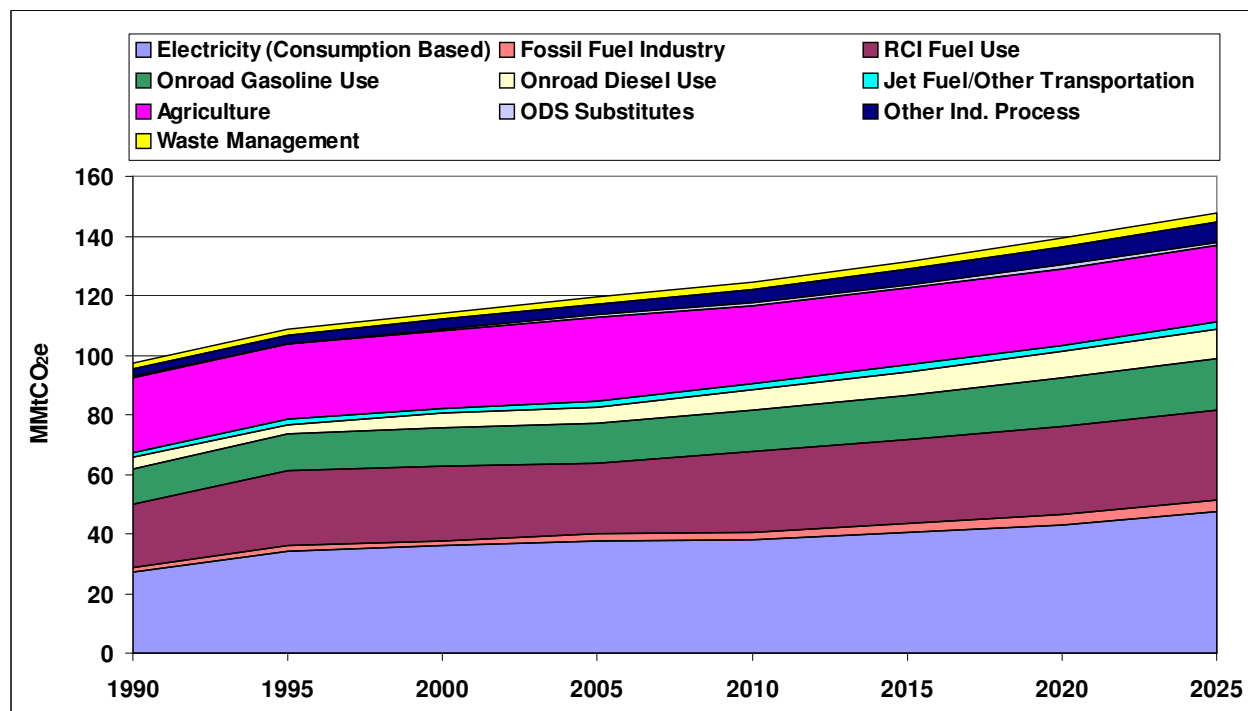
Emissions associated with electricity consumption are projected to be the largest contributor to future GHG emissions growth, followed by emissions associated with the transportation sector. Other sources of emissions growth include the RCI fuel use sector and the increasing use of HFCs and PFCs as substitutes for ozone-depleting substances in refrigeration, air conditioning, and other applications. The agriculture sector is the only sector in which emissions are projected to decrease from 2005 to 2025. Figure 1-3 depicts the 2005 distribution of sources in Iowa compared to the United States (U.S.) .

Estimates of carbon sinks within Iowa's forests, including urban forests and land use changes as well as agricultural soils, have also been included in this report. The current estimates indicate that about 27 MMtCO<sub>2</sub>e were stored in Iowa soils, forests and agricultural biomass in 2005. This leads to *net* emissions of 92 MMtCO<sub>2</sub>e in Iowa in 2005, an amount equal to 1.4% of total US net GHG emissions.

While Iowa's estimated emissions growth rate presents challenges, it also provides major opportunities. Key choices regarding technologies and infrastructure can have a significant impact on emissions growth in Iowa. The ICCAC's options document the opportunities for the state to reduce its GHG emissions, while continuing its strong economic growth by being more energy efficient, using more renewable energy sources, and increasing the use of cleaner transportation modes, technologies, and fuels.

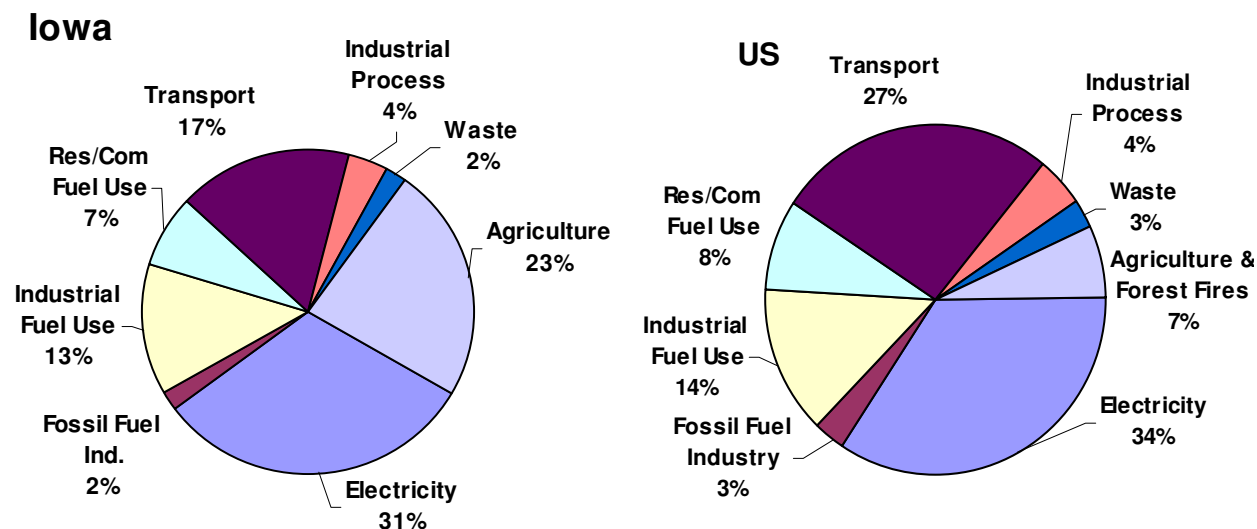


**Figure 1-2. Gross GHG emissions by sector, 1990–2025: historical and projected (consumption-based approach) business as usual / base case**



MMTCo<sub>2e</sub> = million metric tons of carbon dioxide equivalent; RCI = direct fuel use in residential, commercial, and industrial sectors; ODS = ozone-depleting substance; Ind. = industrial.

**Figure 1-3. Gross GHG emissions by sector, 2005: Iowa and U.S.**



### ICCAC Policy Options (Beyond Recent Actions)

The ICCAC recommended 56 policy options. The ICCAC Members present and voting approved 32 of these recommended policy options unanimously, approved 11 more with a super-majority vote (support of 80% or more of the members present and voting), and 13 additional options

with a simple majority supporting it. One option failed to gain ICCAC approval. Explanations of objections are included in Appendices F through J of this Report, which contain detailed accounts of the ICCAC's options.

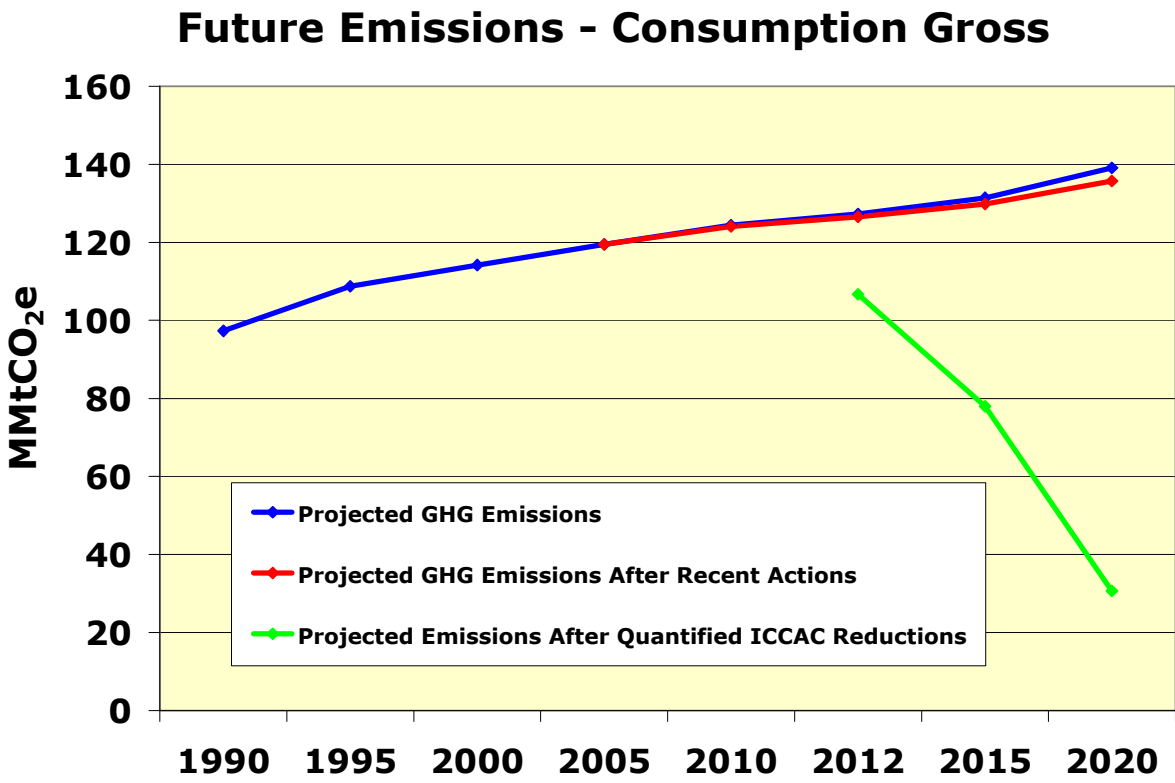
Of the 56 policy options, 38 were analyzed quantitatively to have a cumulative effect of reducing emissions by about 20 million metric tons of carbon dioxide equivalent (MMtCO<sub>2</sub>e) in 2012 and 105 (MMtCO<sub>2</sub>e) in 2020.

Figure 1-4 presents a graphical summary of the potential cumulative emission reductions associated with the recent federal actions and the 38 policy options relative to the business-as-usual reference case projections. Table 1-2a provides the numeric estimates underlying Figure 1-4 for the 50% reduction by 2050 scenario and Table 1-2b provides the same estimate for the 90% reduction scenario by 2050. In Figure 1-4:

- The blue line shows actual (for 1990, 1995, 2000, and 2005) and projected (for 2010, 2012, 2015 and 2020) levels of Iowa's gross GHG emissions on a consumption basis. (The consumption-based approach accounts for emissions associated with the generation of electricity in Iowa to meet the state's demand for electricity)
- The red line shows projected emissions associated with recent federal and state actions that were analyzed quantitatively.
- The green line shows projected emissions if all of the ICCAC's 38 options that were analyzed quantitatively with respect to their GHG reduction potential are implemented successfully and the estimated reductions are fully achieved. (Note that other ICCAC options would have the effect of reducing emissions, but those reductions were not analyzed quantitatively, so are not reflected in the green line.)

For the policy options offered by the ICCAC to yield the levels of estimated emission reductions shown in Table 1-3, they must be implemented in a timely, aggressive, and thorough manner. Table 1-4 depicts the final policy options of the Council and their associated GHG reductions and costs/ savings for each sector.

Figure 1-4. Annual GHG emissions: reference case projections and ICCAC options (consumption basis, gross emissions)



MMtCO<sub>2</sub>e = million metric tons of carbon dioxide equivalent; GHG = greenhouse gas; ICCAC = Iowa Climate Change Advisory Council.

Table 1-2a. Annual emissions: reference case projections and impact of ICCAC options (consumption basis, gross emissions) 50% GHG reduction Scenario by 2050

	Consumption Basis – Gross Emissions						
	1990	2000	2005	2010	2012	2015	2020
Projected GHG emissions	97.3	114.2	119.5	124.4	127.3	131.4	139.1
Reductions from recent actions			0.0	0.3	0.7	1.6	3.3
Projected GHG emissions after recent actions*			119.5	124.1	126.6	129.8	135.7
GHG reduction scenarios recommended by ICCAC					118.8	N/A	106.3
Total GHG reductions from ICCAC policies					19.9	51.8	105.1
Difference between ICCAC scenarios and reductions *					12.1	N/A	75.7
Projected emissions after quantified ICCAC reductions					106.7	78.0	30.6

GHG = greenhouse gas; ICCAC = Iowa Climate Change Advisory Council; N/A = not applicable.

Reductions from recent actions include the Energy Independence and Security Act of 2007, Title III. GHG reductions from Titles IV and V of this Act have not been quantified because of the uncertainties in how they will be implemented. It is expected that Titles IV and V measures will overlap with EEC policies. Projected annual emissions also include reductions from recent actions. Existing utility energy efficiency programs are not included in the existing action analysis because they are impounded in the utility load growth forecasts used in the Iowa Inventory and Forecast. \* Difference = Row 4- row 7)

**Table 1-2b. Annual emissions: reference case projections and impact of ICCAC Options (consumption basis, gross emissions) 90% GHG reduction Scenario by 2050**

	Consumption Basis – Gross Emissions						
	1990	2000	2005	2010	2012	2015	2020
Projected GHG emissions	97.3	114.2	119.5	124.4	127.3	131.4	139.1
Reductions from recent actions			0.0	0.3	0.7	1.6	3.3
Projected GHG emissions after recent actions*			119.5	124.1	126.6	129.8	135.7
GHG reduction scenarios recommended by ICCAC					115.3	N/A	93.5
Total GHG reductions from ICCAC policies					19.9	51.8	105.1
Difference between ICCAC scenarios and reductions *					8.6	N/A	62.9
Projected emissions after quantified ICCAC reductions					106.7	78.0	30.6

GHG = greenhouse gas; ICCAC = Iowa Climate Change Advisory Council; N/A = not applicable.

Reductions from recent actions include the Energy Independence and Security Act of 2007, Title III. GHG reductions from Titles IV and V of this Act have not been quantified because of the uncertainties in how they will be implemented. It is expected that Titles IV and V measures will overlap with EEC policies. Projected annual emissions also include reductions from recent actions. Existing utility energy efficiency programs are not included in the existing action analysis because they are impounded in the utility load growth forecasts used in the Iowa Inventory and Forecast. \* Difference = Row 4- row 7)

**Table 1-3. Summary by sector of estimated impacts of implementing all of the ICCAC options (cumulative reductions and costs/savings)**

Sector	GHG Reductions (MMtCO <sub>2</sub> e)			Net Present Value 2009–2020 (Million \$)	Cost-Effectiveness (\$/tCO <sub>2</sub> e)
	2012	2020	Total 2009–2020		
Energy Efficiency and Conservation	1.1	8.5	42.8	–\$1,057	–\$25
Clean and Renewable Energy	5.8	48.0	233.5	\$5,921	\$25
Transportation and Land Use	1.6	11.1	55.0*	–\$2,219	–\$59
Agriculture, Forestry, and Waste Management	11.3	37.4	233.0	\$2,139	\$9.2
Cross-Cutting Issues	Non-quantified, enabling options				
<b>TOTAL (includes all adjustments for overlaps)</b>	<b>19.9</b>	<b>105.1</b>	<b>564.3*</b>	<b>\$4,785</b>	<b>\$8.8</b>

GHG = greenhouse gas; MMtCO<sub>2</sub>e = million metric tons of carbon dioxide equivalent; \$/tCO<sub>2</sub>e = dollars per metric ton of carbon dioxide equivalent.

The values in this table do not include the effects of recent actions. Negative values in the Net Present Value and the Cost-Effectiveness columns represent net cost savings associated with the policy options.

\* Deduct total TLU-6 2009-2020 reductions [17.7MMt] from 55.03 total = 37.3, before calculating cost/ton for TLU Options. Total Reductions for calculation of cost-effectiveness: 564.3- 17.7 = 546.6. [ $\$4.785 / 546.6 = \$8.8/t$ ]

Within each sector, values have been adjusted to eliminate double counting for policies or elements of policies that overlap. In addition, values associated with policies or elements of policies within a sector that overlap with policies or elements of policies in another sector have been adjusted to eliminate double counting. Appendix F (for the EEC sectors), Appendix G (for the CRE sectors), Appendix H (for the TLU sectors), and Appendix I (for the AFW sectors) of this report provide documentation of how sector-level emission reductions and costs (or cost savings) were adjusted to eliminate double counting associated with overlaps between policies.

**Table 1-4. Energy Efficiency and Conservation Policy Options**

Policy No.	Policy Option	CO <sub>2</sub> Reduction 2012	CO <sub>2</sub> Reduction 2020	Total 2009–2020	Net Present Value 2009–2020 (Million \$)	Cost/Ton (\$/tCO <sub>2</sub> e)	Level of Support
EEC-1	Consumer Education Programs	<i>Not quantified</i>					Unanimous
EEC-2	Demand-Side Management (DSM) / Energy Efficiency Programs for Natural Gas	0.08	1.24	5.43	–\$191.77	–\$35.29	Super-majority (4 Obj.)
EEC-3	Financial Mechanisms for Energy Efficiency	1.62	6.11	36.81	–\$805.05	–\$21.87	Super-majority (1 Obj.)
EEC-4	Improved Building Codes for Energy Efficiency	0.05	0.40	1.89	–\$46.27	–\$24.44	Super-majority (5 Obj.)
EEC-5	Incentive Mechanisms for Achieving Energy Efficiency	0.35	3.29	16.33	–\$350.79	–\$21.48	Unanimous
EEC-6	Promotion and Incentives for Improved Design and Construction in the Private Sector	0.00	0.12	0.46	–\$11.36	–\$24.57	Super-majority (1 Obj.)
EEC-7	Training and Education for Builders and Contractors	<i>Not quantified</i>					Unanimous
EEC-8	Focus on Specific Residential Market Segments	0.09	0.98	4.83	–\$122.53	–\$25.37	Unanimous
EEC-9	Midwestern Governors Association Energy Security and Climate Stewardship Platform	0.13	4.13	17.14	–\$375.69	–\$21.92	Majority (9 Obj.)
EEC-10	Energy Management Training/Training of Building Operators	0.10	1.29	5.48	–\$129.49	–\$23.63	Super-majority (1 Obj.)
EEC-11	Rate Structures and Technologies To Promote Reductions	0.04	0.21	1.20	–\$25.73	–\$21.45	Unanimous
EEC-12	Demand-Side Management (DSM) / Energy Efficiency Programs for Electricity	0.39	4.38	20.33	–\$444.81	–\$21.88	Super-majority (4 Obj.)
EEC-13	Government Lead by Example: Improved Design, Construction, and Energy Operations in New and Existing State and Local Government Buildings	0.08	0.36	1.97	1.04	0.53	Majority (6 Obj.)
EEC-14	More Stringent Appliance Efficiency Standards	0.94	2.20	17.33	–\$708.15	–\$40.85	Super-majority (2 Obj.)
	<b>Sector Total After Adjusting for Overlaps</b>	<b>1.1</b>	<b>8.6</b>	<b>43.2</b>	<b>–\$1,064.5</b>	<b>–\$24.7</b>	
	<b>Reductions From Recent Actions: EISA (2007) and Executive Orders #6 and 41</b>	<b>0.44</b>	<b>1.42</b>	<b>9.19</b>			
	<b>Sector Total Plus Recent Actions</b>	<b>1.6</b>	<b>10.0</b>	<b>52.3</b>			

CO<sub>2</sub> = carbon dioxide; \$/tCO<sub>2</sub>e = dollars per metric ton of carbon dioxide equivalent; Obj. = objection(s); EISA = Energy Independence and Security Act of 2007.

Negative values in the Net Present Value and the Cost/Ton (cost-effectiveness) columns represent net cost savings.

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

**Table 1-4 (continued). Clean and Renewable Energy Policy Options**

Policy No.	Policy Option	CO <sub>2</sub> Reduction 2012	CO <sub>2</sub> Reduction 2020	Total 2009–2020	Net Present Value 2009–2020 (Million \$)	Cost/ton (\$/tCO <sub>2</sub> e)	Change in Generation Cost in 2020 \$/MWh*	Level of Support
CRE-1	Education	<i>Not quantified</i>						Unanimous
CRE-2	Technology Initiatives, Including Renewables	4.7	33.4	192.6	\$5,653	\$29.4	\$25.7	Super-majority (3 Obj.)
CRE-3	MGA Cap-and-Trade, Including Offsets To Promote Renewables	<i>Not quantified</i>						Majority (5 Obj.)
CRE-4	Decarbonization Fund	2.2	11.4	74.1	\$316	\$4.3	\$3.1	Super-majority (2 Obj.)
CRE-5	Performance Standards (50% Reduction by 2050)	4.9	11.4	95.4	\$2,650.6	\$27.8	\$7.3	Super-majority (3 Obj., 1 Abst.)
CRE-6	Voluntary GHG Commitments	<i>Not quantified</i>						Unanimous
CRE-7	Policies Related to Nuclear Power	0.0	9.7	9.7	\$268	\$27.6	\$4.5	Majority (5 Obj.)
CRE-8	Support for Grid-Based Renewable Energy & Development (MGA Target of 20% of retail sales by 2020)	0.0	2.3	4.3	\$93.4	\$21.8	\$1.5	Unanimous
CRE-9	Transmission System Upgrading	<i>Not quantified</i>						Unanimous
CRE-10	R&D for Emerging Technologies and Corresponding Incentives	<i>Not quantified</i>						Unanimous
CRE-11	Distributed Generation / Co-Generation	0.0	0.1	0.5	\$14	\$29.1	\$0.1	Super-majority (1 Obj.)
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	Super-majority (3 Obj.)
	<b>Sector Total After Adjusting for Overlaps</b>	<b>6</b>	<b>48</b>	<b>233</b>	<b>\$5,921</b>	<b>\$25</b>		
	<b>Reductions From Recent Actions</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>\$0</b>	<b>\$0</b>		
	<b>Sector Total Plus Recent Actions</b>	<b>6</b>	<b>48</b>	<b>233</b>	<b>\$5,921</b>	<b>\$25</b>		

CO<sub>2</sub> = carbon dioxide; \$/tCO<sub>2</sub>e = dollars per metric ton of carbon dioxide equivalent; \$/MWh = dollars per megawatt-hour; Obj. = objection(s); MGA = Midwestern Governors Association; Abst. = abstention; GHG = greenhouse gas; R&D = research and development; CHP = combined heat and power.

Negative values in the Net Present Value and the Cost/Ton (cost-effectiveness) columns represent net cost savings.

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

**Table 1-4 (continued). Transportation and Land Use Policy Options**

Policy No.	Policy Option	GHG Reductions (MMtCO <sub>2</sub> e)			Net Present Value 2009–2020 (Million \$)	Cost-Effectiveness (\$/tCO <sub>2</sub> e)	Level of Support
		2012	2020	Total 2009–2020			
TLU-1	Smart Growth Bundle with Transit	0.076	0.242	1.53	–\$377	–\$245	Unanimous
TLU-1a	Expand and Improve Transit Infrastructure	0.004	0.026	0.127	\$7.2	\$57	Majority (5 objections)
TLU-2	GHG Impacts for State and Local Capital Funding	<i>Quantified as part of TLU-1 and TLU-1a</i>					Unanimous
TLU-4	Support Passenger Rail Service in Iowa	N/A	0.008	0.026	\$15	\$597	Majority (7 objections)
TLU-5a	Adopt Best Workplaces for Commuters in Iowa	0.02	0.02	0.21	\$18	\$84	Majority (6 objections)
TLU-5b	Distributed Workplace Models	<i>Non-quantified, qualitative Option</i>					Unanimous
TLU-6	Light-Duty Vehicles Fuel Efficiency Incentives	0.44	3.65	17.70	N/Q	N/Q	Super-majority (objections)
TLU-7	Fuel Efficient Operations for Light-Duty Vehicles	0.11	0.65	3.41	–\$306.9	–\$90	Unanimous
TLU-8	New Vehicle Standards (Tailpipe GHG and Fuel Economy)	N/A	0.8	4.1	–\$246	–\$60	Unanimous
TLU-9	Freight Strategies (Truck and Rail)	0.39	0.63	5.9	\$30	\$5	Super-majority (1 obj.)
TLU-10	Fuel Strategies (20% Low Carbon Fuel Standard)	0.60	5.11	22.03	–\$1,359	–\$62	Unanimous
	<b>Sector Total After Adjusting for Overlaps and Synergies</b>	<b>1.64</b>	<b>11.14</b>	<b>55.03*</b>	<b>–\$2,218.50</b>	<b>–\$59*</b>	
	<b>Reductions From Recent Actions (Federal CAFE Requirements)</b>	<b>0.26</b>	<b>1.93</b>	<b>9.39</b>	<b>Not Quantified</b>		
	<b>Sector Total Plus Recent Actions</b>	<b>1.9 (8.3)</b>	<b>13.07 (48)</b>	<b>64.42</b>	<b>N/A</b>	<b>N/A</b>	

GHG = greenhouse gas; MMtCO<sub>2</sub>e = million metric tons of carbon dioxide equivalent; \$/tCO<sub>2</sub>e = dollars per metric ton of carbon dioxide equivalent; N/A = not applicable; N/Q = not quantified; LRR = low rolling resistance; BAU = business as usual.

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

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

\* Deduct total TLU-6 2009-2020 reductions [17.7MMt] from 55.03 total = 37.3, before calculating cost/ton for TLU Options.



# Chapter 2

## Inventory and Projections of GHG Emissions

### Introduction

This chapter summarizes Iowa's greenhouse gas (GHG) emissions and sinks (carbon storage) from 1990 to 2025. The Center for Climate Strategies (CCS) prepared a draft of Iowa's GHG emissions inventory and reference case projections for the Iowa Department of Natural Resources (Iowa DNR) as part of the Iowa Climate Change Advisory Council (ICCAC) process. The draft inventory and reference case projections, completed in April 2008, provided the ICCAC with an initial, comprehensive understanding of current and possible future GHG emissions. The draft report was provided to the ICCAC and its Subcommittees (SCs) to assist them in understanding past, current, and possible future GHG emissions in Iowa, and thereby inform the policy option development process. The ICCAC and SCs have reviewed, discussed, and evaluated the draft inventory and methodologies, as well as alternative data and approaches for improving the draft GHG inventory and forecast. The inventory and forecast have since been revised to address the comments provided by the ICCAC.

The information in this chapter reflects the information presented in the final *Iowa Greenhouse Gas Inventory and Reference Case Projections* report (hereafter referred to as the Inventory and Projections report).<sup>1</sup> The final report, incorporating comments provided by the Subcommittees that were approved by the ICCAC at their September 2008 meeting and incorporated into the final report during October, is available at: [http://www.iaclimatechange.us/Inventory\\_Forecast\\_Report.cfm](http://www.iaclimatechange.us/Inventory_Forecast_Report.cfm). At the 7th ICCAC meeting in November 2008 the Council received the final I-F Report and agreed to file and forward it to the Governor and Legislature.

Historical GHG emission estimates (1990 through 2005)<sup>2</sup> were developed using a set of generally accepted principles and guidelines for state GHG emission inventories, relying to the extent possible on Iowa-specific data and inputs. The reference case projections (2006–2025) are based on a compilation of various existing projections of electricity generation, fuel use, and other GHG-emitting activities, along with a set of simple, transparent assumptions described in the final Inventory and Projections report.

The Inventory and Projections report covers the six types of gases included in the U.S. GHG inventory: carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF<sub>6</sub>). Emissions of these GHGs are presented using a common metric, CO<sub>2</sub> equivalence (CO<sub>2</sub>e), which indicates the relative

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<sup>1</sup> Center for Climate Strategies. *Final Iowa Greenhouse Gas Inventory and Reference Case Projections: 1990–2025*. Prepared for the Iowa Climate Change Advisory Council. October 2008.

<sup>2</sup> The last year of available historical data for each sector varies between 2000 and 2005.

contribution of each gas, per unit mass, to global average radiative forcing on a global warming potential-weighted basis.<sup>3</sup>

It is important to note that the emission estimates reflect the GHG emissions associated with the electricity sources used to meet Iowa's demands, corresponding to a consumption-based approach to emissions accounting. Another way to look at electricity emissions is to consider the GHG emissions produced by electricity generation facilities in the state—a production-based method. The study covers both methods of accounting for emissions, but for consistency, all total results are reported as consumption-based.

## Iowa GHG Emissions: Sources and Trends

Table 2-1 provides a summary of GHG emissions estimated for Iowa by sector for 1990, 2000, 2005, 2010, 2020, and 2025. As shown in this table, Iowa is estimated to be a net source of GHG emissions (positive, or gross, emissions). Iowa's forests serve as sinks of GHG emissions (removal of emissions, or negative emissions). Iowa's net emissions are derived by subtracting the CO<sub>2</sub> equivalent emissions in sinks from the gross GHG emission totals. The following sections discuss GHG emission sources and sinks, trends, projections, and uncertainties.

## Historical Emissions

### Overview

In 2005, on a gross emissions consumption basis (i.e., excluding carbon sinks), activities in Iowa accounted for approximately 120 million metric tons (MMt) of CO<sub>2</sub>e emissions, an amount equal to 1.7% of total U.S. gross GHG emissions. On a net emissions basis (i.e., including carbon sinks), activities in Iowa accounted for approximately 92 MMtCO<sub>2</sub>e of emissions in 2005, an amount equal to 1.4% of total U.S. net GHG emissions.<sup>4</sup> Iowa's GHG emissions are rising faster than those of the nation as a whole. From 1990 to 2005, Iowa's gross GHG emissions increased by 23%, while national gross emissions rose by 16%.<sup>5</sup> Table 2-1, below, presents Iowa's historical and reference case GHG emissions by sector for

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<sup>3</sup> Changes in the atmospheric concentrations of GHGs can alter the balance of energy transfers between the atmosphere, space, land, and the oceans. A gauge of these changes is called radiative forcing, which is a simple measure of changes in the energy available to the Earth-atmosphere system. Holding everything else constant, increases in GHG concentrations in the atmosphere will produce positive radiative forcing (i.e., a net increase in the absorption of energy by the Earth). See: Boucher, O., et al. "Radiative Forcing of Climate Change." Chapter 6 in *Climate Change 2001: The Scientific Basis*. Contribution of Working Group 1 of the Intergovernmental Panel on Climate Change Cambridge University Press. Cambridge, United Kingdom. Available at: [http://www.grida.no/climate/ipcc\\_tar/wg1/212.htm](http://www.grida.no/climate/ipcc_tar/wg1/212.htm).

<sup>4</sup> The national emissions used for these comparisons are based on 2005 emissions from U.S. Environmental Protection Agency, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2006*, April 15, 2008, EPA430-R-08-005. Available at: <http://www.epa.gov/climatechange/emissions/usinventoryreport.html>.

<sup>5</sup> During this period, population grew by 6% in Iowa and by 19% nationally. However, Iowa's economy grew at a faster rate on a per capita basis (up 51% vs. 33% nationally).

**Table 2-1. Iowa historical and reference case GHG emissions, by sector\***

<b>Million Metric Tons CO<sub>2</sub>e</b>	<b>1990</b>	<b>2000</b>	<b>2005</b>	<b>2010</b>	<b>2020</b>	<b>2025</b>
<b>Energy (Consumption Based)</b>	<b>67.0</b>	<b>82.1</b>	<b>84.6</b>	<b>90.5</b>	<b>103.3</b>	<b>111.0</b>
<b>Electricity Use (Consumption)</b>	<b>27.4</b>	<b>35.8</b>	<b>37.6</b>	<b>38.0</b>	<b>43.1</b>	<b>47.5</b>
Electricity Production (in-state)	26.7	36.7	36.3	41.8	41.8	41.8
<i>Coal</i>	<i>26.5</i>	<i>36.3</i>	<i>34.9</i>	<i>40.4</i>	<i>40.4</i>	<i>40.4</i>
<i>Natural Gas</i>	<i>0.17</i>	<i>0.24</i>	<i>1.15</i>	<i>1.15</i>	<i>1.15</i>	<i>1.15</i>
<i>Oil</i>	<i>0.05</i>	<i>0.10</i>	<i>0.15</i>	<i>0.15</i>	<i>0.15</i>	<i>0.15</i>
<i>MSW/Landfill Gas</i>	<i>0.01</i>	<i>0.02</i>	<i>0.06</i>	<i>0.06</i>	<i>0.06</i>	<i>0.06</i>
Imported (Exported) Electricity	0.68	-0.87	1.33	-3.74	1.38	5.78
<b>Residential/Commercial/Industrial (RCI) Fuel Use</b>	<b>21.3</b>	<b>25.3</b>	<b>24.1</b>	<b>27.0</b>	<b>29.7</b>	<b>30.2</b>
Coal	5.53	6.42	6.22	6.45	6.82	6.83
Natural Gas	10.9	11.6	11.0	13.9	15.8	16.3
Petroleum	4.70	7.25	6.78	6.51	6.93	6.86
Wood (CH <sub>4</sub> and N <sub>2</sub> O)	0.13	0.08	0.08	0.17	0.19	0.20
<b>Transportation</b>	<b>16.9</b>	<b>19.1</b>	<b>20.7</b>	<b>22.8</b>	<b>27.2</b>	<b>29.4</b>
On-road Gasoline	11.4	12.8	13.0	13.9	16.2	17.2
On-road Diesel	3.96	4.66	5.69	6.76	8.80	9.94
Rail	0.31	0.26	0.56	0.56	0.56	0.56
Marine Vessels, Natural Gas, LPG, Other	0.81	1.07	1.04	1.07	1.22	1.29
Jet Fuel and Aviation Gasoline	0.39	0.34	0.45	0.48	0.45	0.42
<b>Fossil Fuel Industry</b>	<b>1.49</b>	<b>1.81</b>	<b>2.25</b>	<b>2.61</b>	<b>3.32</b>	<b>3.78</b>
Natural Gas Industry	1.48	1.81	2.25	2.61	3.32	3.78
Coal Mining	0.01	0.00	0.00	0.00	0.00	0.00
<b>Industrial Processes</b>	<b>2.74</b>	<b>3.82</b>	<b>4.59</b>	<b>5.35</b>	<b>7.04</b>	<b>8.14</b>
Cement Manufacture (CO <sub>2</sub> )	1.18	1.28	1.28	1.35	1.48	1.56
Lime Manufacture (CO <sub>2</sub> )	0.06	0.06	0.09	0.11	0.14	0.17
Limestone and Dolomite Use (CO <sub>2</sub> )	0.20	0.21	0.18	0.17	0.15	0.15
Soda Ash (CO <sub>2</sub> )	0.03	0.03	0.03	0.02	0.02	0.02
Iron & Steel (CO <sub>2</sub> )	0.03	0.10	0.12	0.16	0.27	0.36
Ammonia and Urea (CO <sub>2</sub> )	0.64	0.56	0.49	0.47	0.44	0.43
Nitric Acid Production (N <sub>2</sub> O)	0.30	0.57	1.01	1.05	1.14	1.19
ODS Substitutes (HFC, PFC)	0.00	0.83	1.23	1.87	3.25	4.15
Electric Power T&D (SF <sub>6</sub> )	0.29	0.17	0.15	0.14	0.13	0.13
<b>Waste Management</b>	<b>2.18</b>	<b>2.27</b>	<b>2.40</b>	<b>2.57</b>	<b>2.95</b>	<b>3.16</b>
Waste Combustion	0.07	0.07	0.06	0.06	0.05	0.05
Landfills	1.65	1.68	1.82	1.97	2.30	2.48
Wastewater Management	0.46	0.53	0.52	0.54	0.60	0.62
<b>Agriculture</b>	<b>25.4</b>	<b>26.0</b>	<b>27.9</b>	<b>26.0</b>	<b>25.8</b>	<b>25.6</b>
Enteric Fermentation	5.04	4.39	4.26	3.81	3.27	2.98
Manure Management	4.49	6.02	6.64	6.55	6.86	7.01
Agricultural Soils	15.7	15.5	16.8	15.5	15.4	15.3
Agricultural Burning	0.13	0.16	0.19	0.2	0.24	0.26
<b>Gross Emissions (Consumption Basis)</b>	<b>97.3</b>	<b>114.2</b>	<b>119.5</b>	<b>124.4</b>	<b>139.1</b>	<b>147.9</b>

Million Metric Tons CO <sub>2</sub> e		1990	2000	2005	2010	2020	2025
	<i>Increase relative to 1990</i>		17%	23%	28%	43%	52%
<b>Emissions Sinks</b>		<b>-21.8</b>	<b>-19.9</b>	<b>-27.3</b>	<b>-27.3</b>	<b>-27.3</b>	<b>-27.3</b>
<b>Forestry and Land Use</b>		<b>-10.5</b>	<b>-8.53</b>	<b>-15.9</b>	<b>-15.9</b>	<b>-15.9</b>	<b>-15.9</b>
	Forested Landscape	-7.88	-7.88	-15.3	-15.3	-15.3	-15.3
	Urban Forestry and Land Use	-2.59	-0.65	-0.63	-0.63	-0.63	-0.63
<b>Agricultural Soils (Cultivation Practices)</b>		<b>-11.4</b>	<b>-11.4</b>	<b>-11.4</b>	<b>-11.4</b>	<b>-11.4</b>	<b>-11.4</b>
<b>Net Emissions (Consumption Basis) (including forestry and land use sinks)</b>		<b>75.4</b>	<b>94.3</b>	<b>92.2</b>	<b>97.1</b>	<b>111.8</b>	<b>120.6</b>

MMtCO<sub>2</sub>e = million metric tons of carbon dioxide equivalent; CH<sub>4</sub> = methane; N<sub>2</sub>O = nitrous oxide; MSW = municipal solid waste; LPG = liquefied petroleum gas; ODS = ozone-depleting substance; HFC = hydrofluorocarbon; PFC = perfluorocarbon; SF<sub>6</sub> = sulfur hexafluoride; T&D = transmission and distribution.

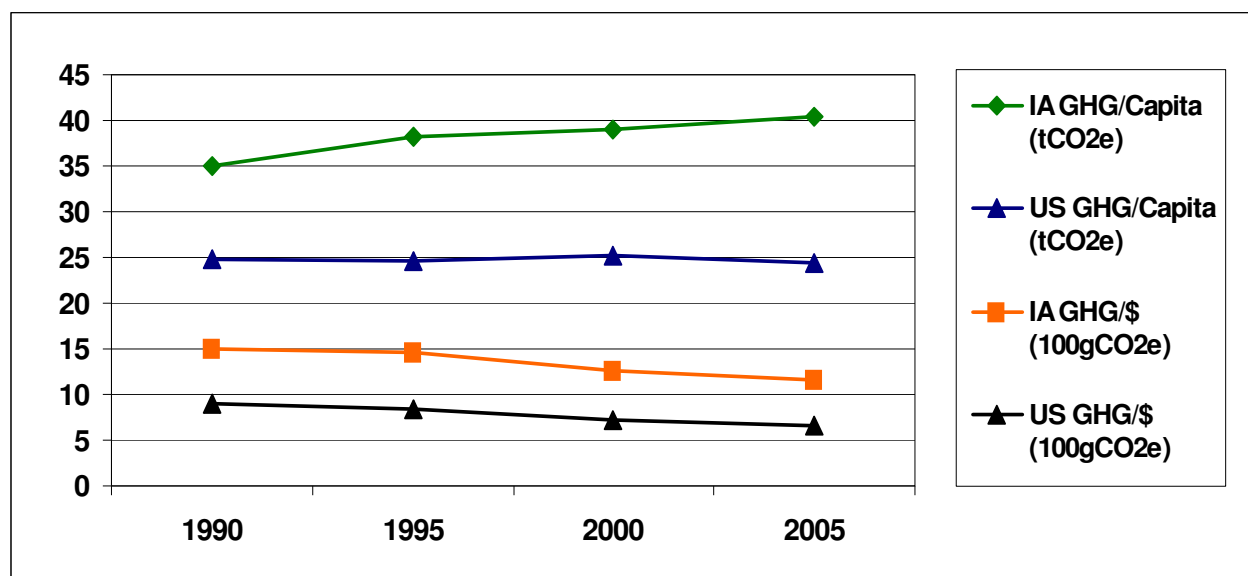
\* Totals may not equal exact sum of subtotals shown in this table due to independent rounding.

In Iowa, gross CO<sub>2</sub>e emissions on a per capita basis were about 40 metric tons (t) of gross CO<sub>2</sub>e in 2005, higher than the national per capita emissions of about 24 tCO<sub>2</sub>e in 2005. Figure 2-1 illustrates the state's emissions per capita and per unit of economic output. It also shows that while per-capita emissions have increased from 1990 to 2005 in Iowa, per capita emissions for the nation as a whole remained fairly flat from 1990 to 2005. The higher per capita emission rates in Iowa are due in part to emissions in the agricultural industry (agricultural industry emissions are much higher than the national average) and a lower population density (due to a larger rural area) in Iowa relative to the US as a whole.<sup>6</sup> In both Iowa and the nation as a whole, economic growth exceeded emissions growth throughout the 1990–2005 period. From 1990 to 2005, emissions per unit of gross product dropped by 26% nationally, and by 24% in Iowa.<sup>7</sup>

<sup>6</sup> Based on information from the US Census Bureau (<http://quickfacts.census.gov/qfd/states/19000.html>), Iowa has 55,869 square miles, which is 1.6% of the nation's 3,537,438 square miles. In 2005, Iowa had a population density of 53.3 persons per square mile, as compared with 84.7 persons per square mile for the US.

<sup>7</sup> Based on real gross domestic product (millions of chained 2000 dollars) that excludes the effects of inflation. U.S. Department of Commerce, Bureau of Economic Analysis. "Gross Domestic Product by State." Available at: <http://www.bea.gov/regional/gsp/>.

**Figure 2-1. Iowa and U.S. gross GHG emissions, per-capita and per-unit gross product**

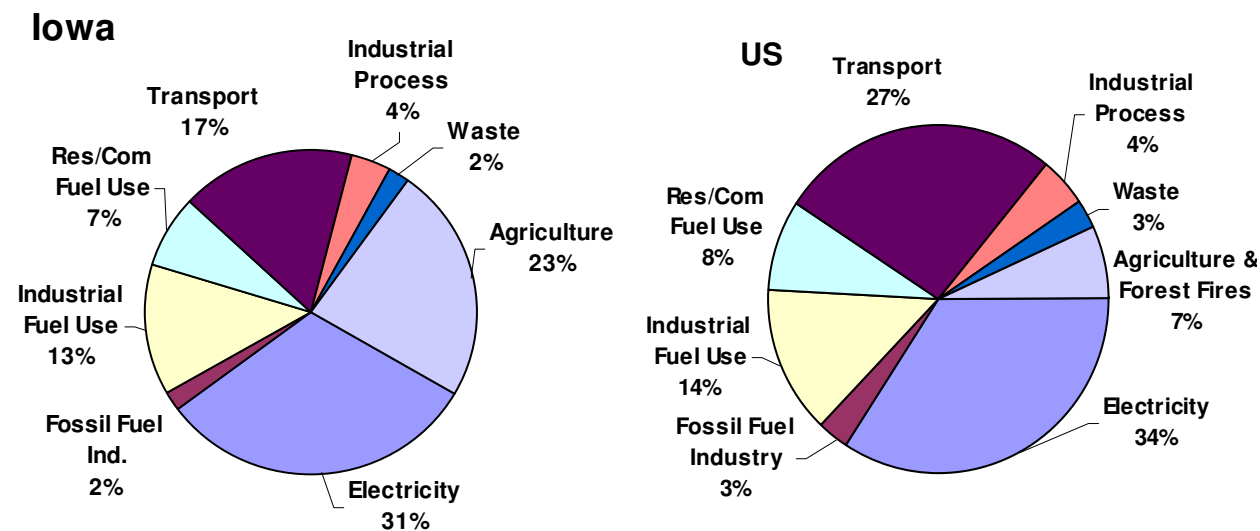


GHG = greenhouse gas; tCO<sub>2</sub>e = metric tons of carbon dioxide equivalent.; g = grams.

Figure 2-2 compares gross GHG emissions estimated for Iowa to emissions for the U.S. for 2005. The principal sources of Iowa's GHG emissions in 2005 are electricity consumption (31% of Iowa's gross GHG emissions); agriculture (23% of Iowa's gross GHG emissions); residential, commercial, and industrial (RCI) fuel use (20% of Iowa's gross GHG emissions); and transportation (17% of Iowa's gross GHG emissions). Figure 2-2 also shows that the industrial processes sector in Iowa accounted for 4% of gross GHG emissions in 2005. These emissions are rising due to the increasing use of HFCs and PFCs as substitutes for ozone-depleting chlorofluorocarbons.<sup>8</sup> Other industrial process emissions include CO<sub>2</sub> released by cement and lime manufacturing; CO<sub>2</sub> released during soda ash, limestone, and dolomite use; CO<sub>2</sub> released during ammonia, urea, and iron and steel production; N<sub>2</sub>O released during nitric acid production; and SF<sub>6</sub> released from transformers used in electricity transmission and distribution systems. Also, landfills and wastewater management facilities produce CH<sub>4</sub> and N<sub>2</sub>O emissions that accounted for 2% of total gross GHG emissions in Iowa in 2005. Similarly, emissions associated with the production, processing, transmission, and distribution of fossil fuels accounted for 2% of the gross GHG emissions in 2005.

<sup>8</sup> Chlorofluorocarbons are also potent GHGs; however, they are not included in GHG estimates because of concerns related to implementation of the Montreal Protocol on Substances That Affect the Ozone Layer. See Appendix I in the Final Inventory and Projections report for Iowa ([http://www.iaclimatechange.us/Inventory\\_Forecast\\_Report.cfm](http://www.iaclimatechange.us/Inventory_Forecast_Report.cfm)).

Figure 2-2. Gross GHG emissions by sector, 2005: Iowa and U.S.



Notes: Res/Com = Residential and commercial fuel use sectors. Emissions for the residential, commercial, and industrial fuel use sectors are associated with the direct use of fuels (natural gas, petroleum, coal, and wood) to provide space heating, water heating, process heating, cooking, and other energy end-uses. The commercial sector accounts for emissions associated with the direct use of fuels by, for example, hospitals, schools, government buildings (local, county, and state) and other commercial establishments. The industrial processes sector accounts for emissions associated with manufacturing and excludes emissions included in the industrial fuel use sector. The transportation sector accounts for emissions associated with fuel consumption by all on-road and non-highway vehicles. Non-highway vehicles include jet aircraft, gasoline-fueled piston aircraft, railway locomotives, boats, and ships. Emissions from non-highway agricultural and construction equipment are included in the industrial sector. Emissions associated with forest wildfires and rangeland burning were not calculated for Iowa due to a lack of data on acreage burned.

Electricity = Electricity generation sector emissions on a consumption basis, including emissions associated with electricity imported from outside of Iowa and excluding emissions associated with electricity exported from Iowa to other states.

Forestry emissions refer to the net CO<sub>2</sub> flux<sup>9</sup> from forested lands in Iowa, which account for about 8% of the state's land area.<sup>10</sup> Iowa's forests are estimated to be net sinks of CO<sub>2</sub> emissions in the state, reducing net GHG emissions by 16 MMtCO<sub>2</sub>e in 2005. In addition, estimates of net carbon fluxes from agricultural soil cultivation practices are estimated to be net sinks of CO<sub>2</sub> emissions in Iowa, reducing net GHG emissions by 11 MMtCO<sub>2</sub>e in 2005. However, the

<sup>9</sup> "Flux" refers to both emissions of CO<sub>2</sub> to the atmosphere and removal (sinks) of CO<sub>2</sub> from the atmosphere.

<sup>10</sup> Total forested acreage in Iowa is 2.8 million acres. Total forested area and forest type percentages provided by P. Tauke, DNR to M. Stein, DNR on March 21, 2008. The total land area in Iowa is 35.8 million acres (<http://www.50states.com/iowa.htm>).

Inventory and Projections report does not consider above-ground carbon sequestration in agriculture because it is not considered to be sequestered.<sup>11</sup>

## Reference Case Projections

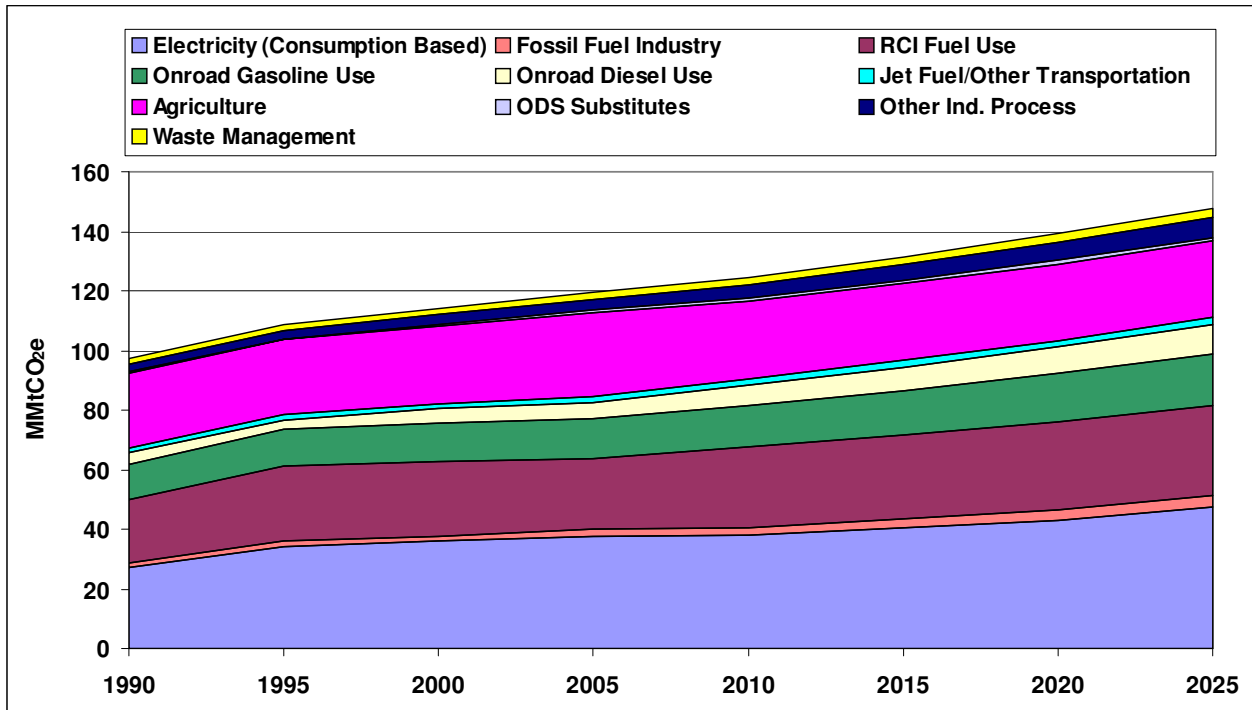
Relying on a variety of sources for projections, as noted in the Inventory and Projections report, a simple reference case projection of GHG emissions through 2025 was developed. As illustrated in Figure 2-3 and shown numerically in Table 2-1, under the reference case projections, Iowa's gross GHG emissions continue to grow steadily, climbing to about 148 MMtCO<sub>2</sub>e by 2025, 52% above 1990 levels. This equates to a 1.1% annual rate of growth from 2005 to 2025. Relative to 2005, the share of emissions associated with electricity consumption and the transportation sector both increase slightly to 32% and 20%, respectively, in 2025. The share of emissions from the industrial processes and fossil fuel industry sectors is projected to increase to 6% and 3%, respectively, by 2025. The share of emissions from the RCI fuel use sector and the waste management sector is projected to remain the same at about 20% and 2%, respectively, of Iowa's gross GHG emissions in 2025. The agriculture sector is the only sector in Iowa whose emission share in 2025 is projected to decrease from its emission share in 2005 (from 23% in 2005 to 17% in 2025).

Emissions associated with electricity consumption are projected to be the largest contributor to future GHG emissions growth, followed by emissions associated with the transportation sector, as shown in Figure 2-4. Other sources of emissions growth include the RCI fuel use sector and the increasing use of HFCs and PFCs as substitutes for ozone-depleting substances in refrigeration, air conditioning, and other applications. The agriculture sector is the only sector in which emissions are projected to decrease from 2005 to 2025. Table 2-2 summarizes the growth rates that drive the growth in the Iowa reference case projections, as well as the sources of these data.

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<sup>11</sup> Above-ground carbon re-enters the natural carbon cycle and is lost to the atmosphere through respiration or decomposition either directly or indirectly (e.g., used as energy as animal feed or by humans) over relatively short periods of time (months to years). Carbon sequestration in agriculture is below ground in the form of soil carbon (i.e., the result of the photosynthesis process), where carbon can be stored over long periods of time (potentially indefinitely). The U.S. Environmental Protection Agency (EPA) Web sites <http://www.epa.gov/sequestration/ccycle.html> and [http://www.epa.gov/sequestration/local\\_scale.html](http://www.epa.gov/sequestration/local_scale.html) have some useful information. For additional information on the potential for sequestration in agriculture, see EPA's *Greenhouse Gas Mitigation Potential in U.S. Forestry and Agriculture* (<http://www.epa.gov/sequestration/pdf/greenhousegas2005.pdf>).

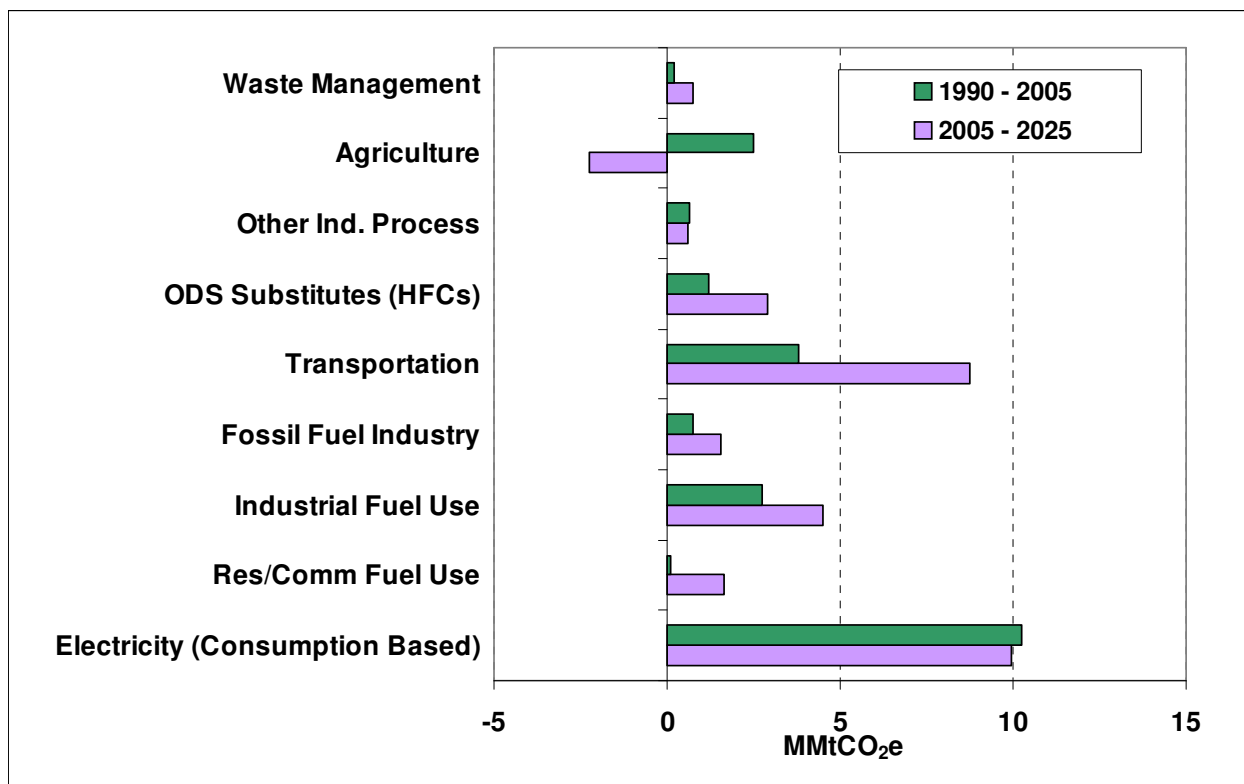
**Figure 2-3. Iowa gross GHG emissions by sector, 1990–2025: historical and projected**



MMtCO<sub>2</sub>e = million metric tons of carbon dioxide equivalent; RCI = direct fuel use in residential, commercial, and industrial sectors; ODS = ozone-depleting substance; Ind. = industrial.



**Figure 2-4. Sector contributions to gross emissions growth in Iowa, 1990–2025: reference case projections**



MMtCO<sub>2</sub>e = million metric tons of carbon dioxide equivalent; ODS = ozone-depleting substance; HFCs = hydrofluorocarbons; Res/Comm = direct fuel use in the residential and commercial sectors (see Fig. 2-2 note for full definition.)

**Table 2-2. Key annual growth rates for Iowa, historical and projected**

	1990–2005	2005–2025	Sources
Population	0.42%	0.06%	Decennial Population and Population Estimates for Iowa: 1900 – 2007 - <a href="http://data.iowadatacenter.org/datatables/State/stpopest19002007.xls">http://data.iowadatacenter.org/datatables/State/stpopest19002007.xls</a> "Iowa Census Data Tables: Projections," State Data Center of Iowa, <a href="http://data.iowadatacenter.org/browse/projections.html">http://data.iowadatacenter.org/browse/projections.html</a>
Electricity Sales -Total Sales <sup>a</sup> -IA Sales <sup>b</sup>	2.50% 2.40%	1.90% 1.50%	For 1990-2005, annual growth rate in total electricity sales for all sectors combined in Iowa calculated from EIA State Electricity Profiles (Table 8) <a href="http://www.eia.doe.gov/cneaf/electricity/st_profiles/iowa.html">http://www.eia.doe.gov/cneaf/electricity/st_profiles/iowa.html</a> and sales by Iowa generators calculated by subtracting T&D losses from net generations collected from EIA Annual Electric Utility Data - 906/920 database. For 2005-2025, annual growth rates are based on data that Iowa utilities provided for Iowa load growth forecast for 2007 through 2025.
Vehicle Miles Traveled	2.10%	1.80%	Iowa historical VMT data (1994-2006) provided by, Iowa Department of Transportation. Future data were estimated based on historical trends.

<sup>a</sup> Represents annual growth in total sales of electricity by generators inside or outside of Iowa to RCI sectors located within Iowa.

<sup>b</sup> Represents annual growth in total sales of electricity by generators in Iowa to RCI sectors located within Iowa.

## **A Closer Look at the Four Major Sources: Electricity Consumption; Agriculture; Residential, Commercial, Industrial (RCI) Fuel Consumption; and Transportation**

### *Electricity Consumption Sector*

As shown in Figure 2-2, electricity use in 2005 accounted for 31% of Iowa's gross GHG emissions (about 38 MMtCO<sub>2</sub>e), which was slightly lower than the national share of emissions from electricity generation (34%). On a per-capita basis, Iowa's GHG emissions from electricity consumption are higher than the national average (in 2005, 12.7 tCO<sub>2</sub>e per capita in Iowa, versus 8.1 tCO<sub>2</sub>e per capita nationally). Electricity generated by plants located in Iowa comes primarily from coal (71% in 2005), while virtually all of the rest comes from nuclear (17% in 2005), wind and hydroelectric (6% in 2005), and natural gas (5% in 2005).

In 2005, emissions associated with Iowa's electricity consumption (38 MMtCO<sub>2</sub>e) were about 1.3 MMtCO<sub>2</sub>e higher than those associated with electricity production (36.3 MMtCO<sub>2</sub>e). The higher level for consumption-based emissions reflects GHG emissions associated with net imports of electricity from other states to meet Iowa's electricity demand.<sup>12</sup> In some historical and forecast years, Iowa is an electricity importing state. In other years, Iowa is an electricity exporting state—when its total gross generation by the in-state power plants exceeds the annual demand for electricity in the state. The reference case projection assumes that production-based emissions (associated with electricity generated in-state) will increase by about 5 MMtCO<sub>2</sub>e between 2005 and 2025, and consumption-based emissions (associated with electricity consumed in-state) will increase by about 10 MMtCO<sub>2</sub>e.

While estimates are provided for emissions from both electricity production and consumption, unless otherwise indicated, tables, figures, and totals in this report reflect electricity consumption emissions. The consumption-based approach can better reflect the emissions (and emission reductions) associated with activities occurring in the state, particularly with respect to electricity use (and efficiency improvements), and is particularly useful for decision making. Under this approach, emissions associated with electricity exported to other states would need to be covered in those states' inventories in order to avoid double counting or exclusions. The reference case forecast for Iowa assumes significant wind generation resources are added and also excludes to base-load coal plants that are currently at various stages of the permitting and approval process. The CCS methodology allows new fossil-based generation to be included in the reference case only when the plants have received all necessary permits which has not occurred for the two coal plants proposed in Iowa.

### *Agricultural Sector*

The agricultural sector accounts for 23% of the gross GHG emissions in Iowa in 2005. This is significantly higher than the national average for agricultural emissions in that year (7%). However, this is not at all surprising considering the importance of the agricultural sector to the economy in Iowa.

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<sup>12</sup> Estimating the emissions associated with electricity use requires an understanding of the electricity sources (both in-state and out-of-state) used by utilities to meet consumer demand. The current estimate reflects some very simple assumptions, as described in Appendix A of the Inventory and Projections report.

These emissions primarily come from agricultural soils, manure management, and enteric fermentation. Agricultural soils can produce GHG emissions from nitrogen fertilizers and manure as well as from decomposition of crop residues. Manure management can result in CH<sub>4</sub> emissions as a result of manure breaking down. Enteric fermentation is the result of normal digestive processes of livestock; it creates CH<sub>4</sub> emissions. All of these processes can result in emissions of N<sub>2</sub>O. Emissions from the agricultural sector are projected to decrease by 8% between 2005 and 2025. This decrease is expected to come primarily from the agricultural soils-livestock and enteric fermentation categories.

### *Residential, Commercial, and Industrial Fuel Use Sectors*

In 2005, combustion of oil, natural gas, coal, and wood in the RCI sectors contributed about 20% (about 24 MMtCO<sub>2</sub>e) of Iowa's gross GHG emissions, slightly lower than the RCI sector contribution for the nation (22%). Activities in the RCI<sup>13</sup> sectors produce GHG emissions when fuels are combusted to provide space heating, process heating, and energy for other applications.

The residential sector's share of total RCI emissions from direct fuel use was 20% (4.8 MMtCO<sub>2</sub>e) in 2005, the commercial sector accounted for 15% (3.6 MMtCO<sub>2</sub>e), and the industrial sector's share of total RCI emissions from direct fuel use was 65% (15.7 MMtCO<sub>2</sub>e). Overall, emissions for the RCI sectors (excluding those associated with electricity consumption) are expected to increase by 25% between 2005 and 2025. Emissions from the commercial sector are projected to increase by 48% from 2005 to 2025. The industrial sector is predicted to have a 29% increase. In contrast, emissions from the residential sector are expected to decrease slightly (1%) between 2005 and 2025.

### *Transportation Sector*

As shown in Figure 2-2, the transportation sector accounted for about 17% of Iowa's gross GHG emissions in 2005 (about 21 MMtCO<sub>2</sub>e), which was significantly lower than the national average share of emissions from transportation fuel consumption (27%). The GHG emissions associated with Iowa's transportation sector increased by 3.8 MMtCO<sub>2</sub>e between 1990 and 2005.

From 1990 through 2005, Iowa's GHG emissions from transportation fuel use have risen steadily at an average rate of about 1.4% annually. In 2005, onroad gasoline vehicles accounted for about 63% of transportation GHG emissions. Onroad diesel vehicles accounted for another 28% of emissions. Air and marine travel, rail, and other sources (natural gas- and liquefied petroleum gas- (LPG-) fueled-vehicles used in transport applications) accounted for the remaining 9% of transportation emissions. GHG emissions from onroad gasoline use increased 14% between 1990 and 2005. Meanwhile, GHG emissions from onroad diesel use rose 44% during that period, suggesting rapid growth in freight movement within or across the State.

Emissions from on-road gasoline vehicles are projected to increase by 1.4% annually from 2005 to 2025, and emissions from on-road diesel vehicles are projected to increase by 2.8% annually from 2005 to 2025. Total transportation emissions are expected to reach 29 MMtCO<sub>2</sub>e by 2025, at a 1.6% annual rate of growth from 2005.

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<sup>13</sup> The industrial sector also includes emissions associated with agricultural energy use.

## ICCAC Revisions

The ICCAC made the following revisions to the inventory and reference case projections, which explain the differences between the final Inventory and Projections report and the draft initial assessment completed during April 2008:<sup>14</sup>

### *Energy Supply:*

- The inventory now includes MidAmerican Energy Company's 25% ownership of the 1,700 megawatt (MW) Quad Cities Station nuclear plant in Illinois. This equates to about 3,350 gigawatt-hours (GWh) at 90% capacity. In both the inventory and reference case projections, this generation has been treated as an in-state resource because of its ownership status.
- A revised load growth forecast for Iowa provided by the Iowa utilities has been used.
- The AEO 2007 growth forecast data for MAPP region generation in the draft I&F was updated with data from AEO 2008.
- In the initial analysis, Energy Information Administration (EIA) forecast data of the Mid-Continent Area Power Pool (MAPP) region was used to project the electricity generation growth by fuel type in Iowa. In this report, added/retired electricity generation capacities provided by the Iowa utilities was used to project the electricity generation by fuel type in Iowa for the forecast years.
- Added the 790 MW Walter Scott, Jr. supercritical coal plant that came online in 2007;
- Added the 1284.3 MW new wind capacities of MidAmerican between 2005-2009;
- Included the minority, Iowa share of the uprate for the Duane Arnold Energy Center that is scheduled to be completed in 2009, resulting in approximately a 10 MW capacity increase;
- Added the 200 MW Alliant Franklin County (Whispering Willow) wind farm (will be on the line by 2010);
- Added the 2010 Corn Belt 71 MW wind capacity; and
- Included 100 MW of new wind capacity each year from 2014 to 2020, in response to the Clean and Renewable Energy (CRE) SC's request to extrapolate the 2008-2013 wind installation (average of 100 MW per year) to the future.

In addition to the reference case, two sensitivity cases were analyzed for electricity supply. Sensitivity Analysis Case 1 added the following new capacities, in addition to those new capacities added in the reference case:

- The 649 MW Marshalltown coal plant;
- The 10% biomass co-firing requirement;
- The retirement of the Lansing units;
- Fuel switching in the Dubuque Generating Station Units from coal to natural gas; and
- Alliant 200 MW new wind capacity by 2013.

Sensitivity Analysis Case 2 added the following new capacity, in addition to those new capacities added in the reference case and those added in Sensitivity Analysis Case 1:

- The 750 MW Elk Run plant.

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<sup>14</sup> In addition, a minor change was made to the transportation sector reference case projection emissions. This was done to correct the growth rate for marine gasoline fuel consumption to reflect the historical marine gas consumption trend, leading to a decrease of 0.03 MMtCO<sub>2</sub>e in the marine emissions.

### *Agriculture:*

- The estimation of soil carbon flux due to cultivation practices has been revised using a year 2000 estimate of the soil carbon sequestration in Iowa. This comes from a publication by William Stigliani, which references a 2001 study of soil carbon in Iowa. This replaced the United States Department of Agriculture (USDA) 1997 soil carbon estimates used for the initial analysis.

### **Key Uncertainties**

Some data gaps exist in this inventory, and particularly in the reference case projections. Key tasks for future refinement of this inventory and forecast include review and revision of key drivers, such as the electricity demand, agricultural activities, RCI fuel use, and transportation growth rates that will be major determinants of Iowa's future GHG emissions (see Table 2-2 and Figure 2-4). These growth rates are driven by uncertain economic, demographic and land use trends (including growth patterns and transportation system impacts), all of which deserve closer review and discussion.

# Chapter 3

## Energy Efficiency and Conservation

### Overview of Greenhouse Gas Emissions

Activities in the residential, commercial, and industrial (RCI) sectors produce greenhouse gas (GHG) emissions when fuels are combusted to provide space heating, process heating, and other applications. In 2005, combustion of oil, natural gas, coal, and wood in the RCI sectors contributed about 26% (about 24 million metric tons of carbon dioxide equivalent [MMtCO<sub>2</sub>e]) of Iowa's gross GHG emissions. In 2005, this sector was the second largest source of GHG emissions in the state, following the electricity supply sector (37 MMTCO<sub>2</sub>e).<sup>1</sup> In addition, industrial process (nonfuel use) emissions are forecasted to nearly double by 2020, primarily due to the increasing use of hydrofluorocarbons as substitutes for ozone-depleting chlorofluorocarbons. Together, industrial process emissions, including cement production and chemical manufacturing, will account for an additional 5.6% of Iowa's gross GHG emissions (8.14 MMtCO<sub>2</sub>e).

Considering only the direct emissions that occur within buildings and industries, however, ignores the fact that nearly all electricity sold in the state is consumed as the result of RCI activities. If the emissions from all three subsectors of RCI are included (i.e., direct fuel use, emissions associated electricity consumption, and industrial processes), they total about 70% of the state's gross GHG emissions in 2005. Therefore, the state's future GHG emissions will depend heavily on future trends in the consumption of electricity and other fuels in these sectors.

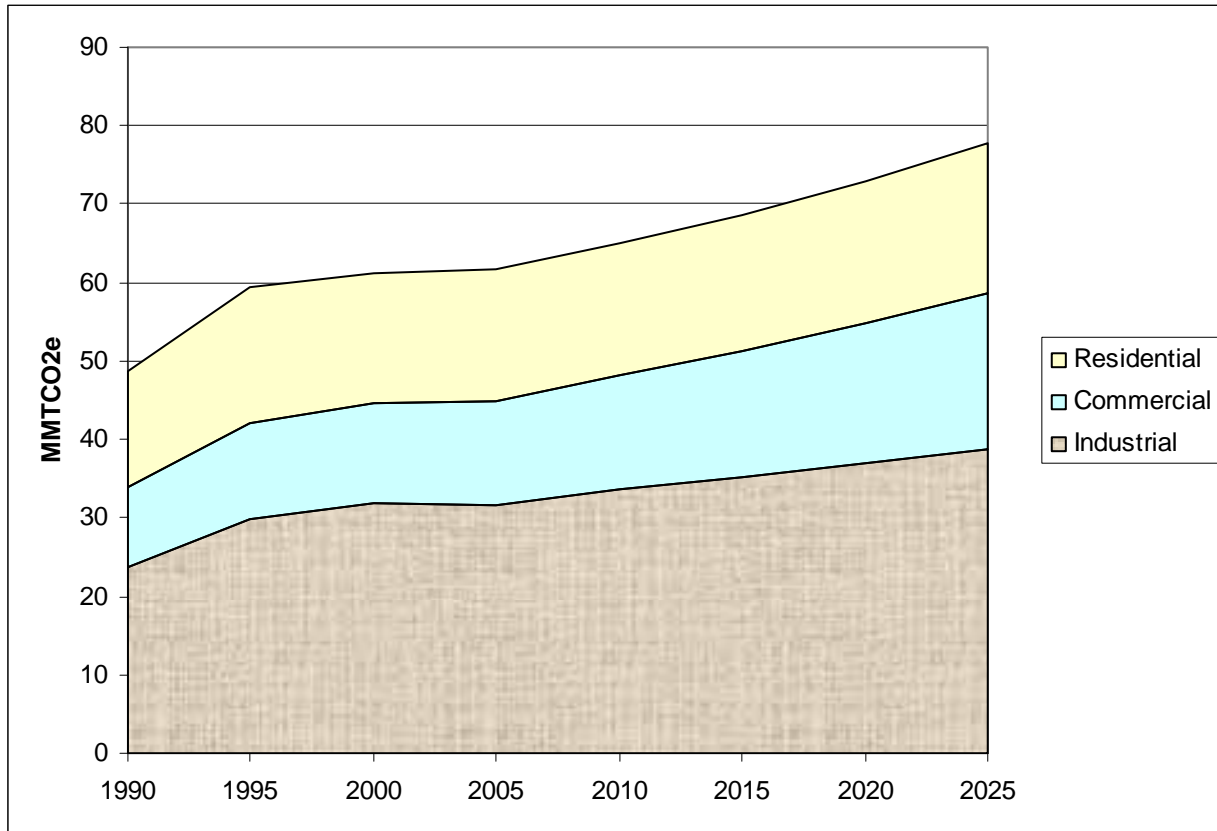
Figure 3-1 shows the growth in GHG emissions by sector through 2025, including electricity use. For the 15-year period from 2005 to 2020, GHG emissions are expected to grow the fastest in the electricity sector, which is forecasted to grow at a 1.0% annual rate. GHG emissions in the residential sector are expected to grow at 0.6%, the commercial sector at 2.2%, and the industrial sector at slightly more than 1% a year.

Much of the growth in GHG emissions over the period can be attributed an average 1.9% annual growth in electricity demand over the 2005–2020 period for the RCI sectors. However, electricity-related GHG emissions are projected to grow by only 1.0% per year, due to the addition of significant wind generation resources in the reference case.

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<sup>1</sup> Emissions associated with the electricity supply sector (discussed in Chapter 4) have been allocated to each of the RCI sectors for comparison of those emissions to the emissions associated with direct fuel consumption. Note that this comparison is provided for information purposes, and that emissions estimated for the electricity supply sector are not double counted in the total emissions for the state.

**Figure 3-1. Historical and projected residential, commercial, and industrial greenhouse gas emissions by sector in Iowa: 1990–2025\***

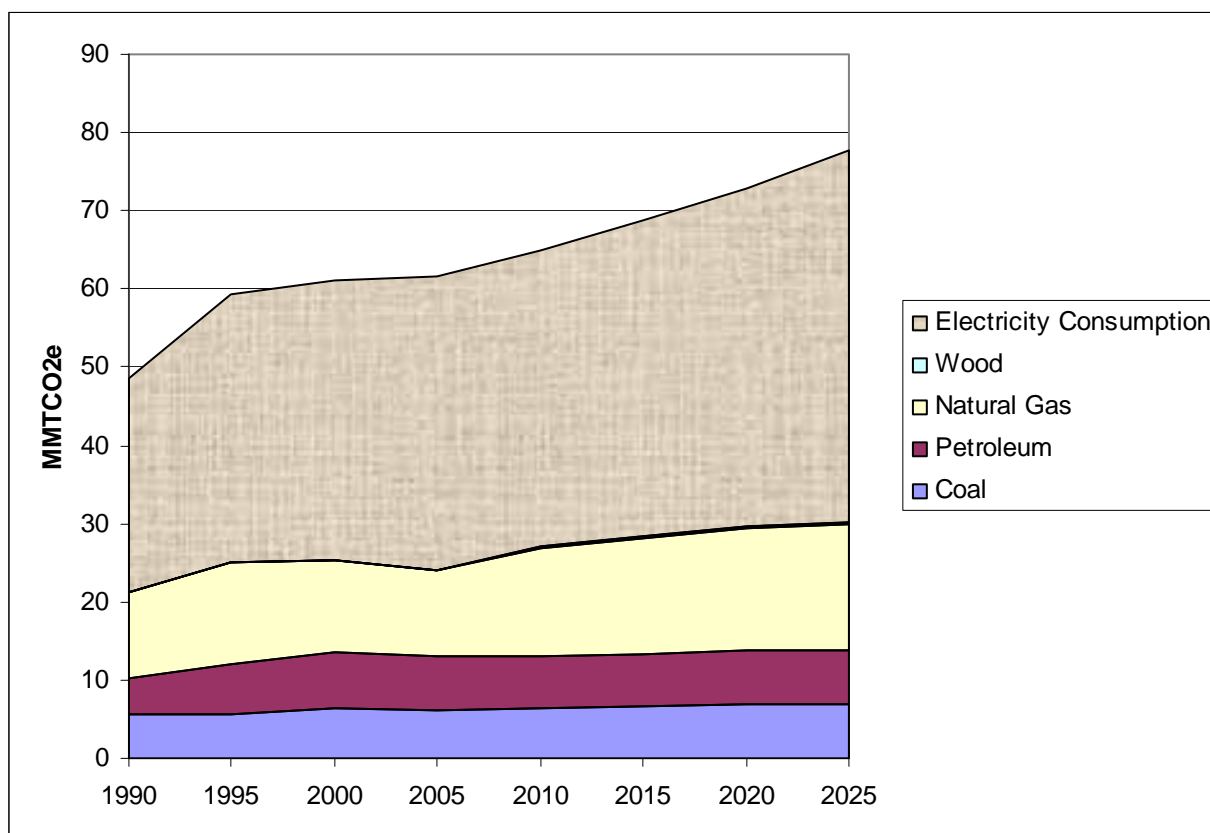


MMtCO<sub>2</sub>e = million metric tons of carbon dioxide equivalent

\* Emissions associated with the direct use of natural gas, petroleum, coal, and wood and the consumption of electricity. Sources: Tables 3a, 4a, and 5a of Final Iowa Greenhouse Gas Inventory and Reference Case Projections 1990–2025. Available at: <http://www.iacimatechange.us/ewebeditpro/items/O90F20404.pdf>.

Figure 3-2 shows the growth in GHG emissions by fuel type through 2025. For the 15-year period 2005–2020, emissions in the sector are dominated by electricity supply, which rise by 15% from 37 MMtCO<sub>2</sub>e in 2005 to 43 MMtCO<sub>2</sub>e in 2020. Direct emissions from coal are forecasted to increase slightly at a rate of 0.6% per year (not including coal use for electricity generation). Emissions from natural gas explode, rising 2.9% per year. The emissions data from natural gas mask large differences in the growth of the use of this fuel. Residential natural gas consumption is expected to stay nearly constant from 2005 to 2020, while commercial and industrial gas use is expected to increase by 3.3% and 4.6% per year, respectively.

**Figure 3-2. Historical and projected residential, commercial, and industrial GHG emissions by type of fuel in Iowa, 1990–2025\***



MMtCO<sub>2</sub>e - million metric tons of carbon dioxide equivalent

\* Emissions associated with the direct use of natural gas, petroleum, coal, and wood and the consumption of electricity. Wood-related GHG emissions are too small to be distinguished. Source: Tables 3a, 4a, and 5a of Final Iowa Greenhouse Gas Inventory and Reference Case Projections 1990-2025. Available at: <http://www.iaclimatechange.us/ewebeditpro/items/O90F20404.pdf>.

## Key Challenges and Opportunities

The principal means to reduce RCI emissions include improving energy efficiency, substituting electricity and natural gas with lower-emission energy resources (such as biomass and wind), and implementing various strategies to decrease the emissions associated with electricity production (see Chapter 4, Clean and Renewable Energy [CRE]). The state’s aggressive pursuit of energy efficiency in recent years gives stakeholders valuable experience with programmatic efforts to reduce emissions through programs and initiatives to improve the efficiency of buildings, appliances, and industrial practices. While the gas and electricity sectors in Iowa have been securing energy efficiency supplies that are the cheapest source of new resources, recent reports indicate that there is still untapped “low-hanging fruit” remaining in the form of low-cost energy efficiency opportunities in the RCI sectors. Programmatic efforts to harvest these resources are likely to create significant green collar jobs scoping, implementing, and evaluating energy efficiency projects.



Electric utilities in Iowa are required by law to offer cost-effective energy efficiency programs (Iowa Code §§ 476.6(14)). Also, Iowa investor owned utilities (IOUs) have a long history of conducting demand-side management (DSM) programs, under statutes adopted in 1990 and modified in 1996. Municipal and rural electric cooperatives have a more mixed history offering energy efficiency programs. The Iowa Utilities Board is reviewing IOU plans on the effects of goals equivalent to saving an additional 1.5% of retail electric sales in Iowa annually. Currently, IOUs achieve new (incremental) savings equivalent to 0.8% of electricity and natural gas sales.

The Iowa Climate Change Advisory Council (ICCAC) —through the work of its Energy Efficiency and Conservation (EEC) Subcommittee—has identified significant opportunities for reducing GHG emissions growth attributable to the RCI sectors in Iowa. These include expanding or launching energy efficiency programs for electricity, natural gas, and other direct-use fuels; regularly updating building codes; expanding the use of combined heat and power applications; and requiring state and local governments to implement beyond-code building practices. The ICCAC has also identified significant opportunities to reduce GHG emissions through policies addressing electricity production, such as tapping into the state’s large biomass and wind potential (detailed in Chapter 4).

## Overview of Policy s and Estimated Impacts

The ICCAC presents, with varying levels of support, a set of 14 policies for the RCI sectors that offer significant, cost-effective GHG emissions reductions within the state. These options and results are summarized in Table 3.1. The GHG emission reductions and costs per ton of GHG reductions for 14 of these policies were quantified. The quantified policy options could lead to emission savings from reference case projections of:

- 8.5 MMtCO<sub>2</sub>e per year by 2020, and a cumulative savings of 43 MMtCO<sub>2</sub>e from 2009 to 2020, and
- Net cost savings of over \$1.0 billion through 2020 on a net present value basis.<sup>2</sup> The weighted-average costs of these policies are a net savings of nearly \$25/MMtCO<sub>2</sub>e.

Because most energy use occurs in buildings, the recommended policies center on improving energy efficiency in buildings. There is overlap among the policies as to the types of activities and equipment they cover, but the text following Table 3-1 provides general guidance on how the policies complement each other.

Energy Efficiency and Conservation (EEC) policy option EEC-1 increases the human capital component of energy efficiency by providing education and training for energy users across the state. Similarly, EEC-7 trains builders and developers in the use of energy efficiency technologies and building practices. EEC-2 and EEC-12 are the most general recommended policies that deploy DSM natural gas measures and energy efficiency across all types of energy use: space conditioning, windows, appliances, and water heating and other end uses and technologies. Efficiency improvements occur through improvements in building shells (EEC-4,

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<sup>2</sup> The net cost savings, shown in constant 2005 dollars, are based on fuel expenditures; operations, maintenance, and administrative costs; and amortized, incremental equipment costs. All net present value analyses here use a 5% real discount rate.

EEC-6, EEC-13) or enhancing the efficiency of energy-consuming equipment within the buildings (EEC-14, EEC-12).

**Table 3-1. Summary List of ICCAC Options**

No.	Policy Option	CO <sub>2</sub> Reduction 2012	CO <sub>2</sub> Reduction 2020	Total 2009–2020	Net Present Value 2009–2020 (Million \$)	Cost/Ton (\$/tCO <sub>2</sub> e)	Level of Support
EEC-1	Consumer Education Programs	<i>Not quantified</i>					Unanimous
EEC-2	Demand-Side Management (DSM)/Energy Efficiency Programs for Natural Gas	0.08	1.24	5.43	-\$191.77	-\$35.29	Super Majority (4 objections)
EEC-3	Financial Mechanisms for Energy Efficiency	1.62	6.11	36.81	-\$805.05	-\$21.87	Super Majority (1 objection)
EEC-4	Improved Building Codes for Energy Efficiency	0.05	0.40	1.89	-\$46.27	-\$24.44	Super Majority (5 objections)
EEC-5	Incentive Mechanisms for Achieving Energy Efficiency	0.35	3.29	16.33	-\$350.79	-\$21.48	Unanimous
EEC-6	Promotion of and Incentives for Improved Design and Construction in the Private Sector	0.00	0.12	0.46	-\$11.36	-\$24.57	Super Majority (1 objection)
EEC-7	Training and Education for Builders and Contractors	<i>Not quantified</i>					Unanimous
EEC-8	Focus on Specific Residential Market Segments	0.09	0.98	4.83	-\$122.53	-\$25.37	Unanimous
EEC-9	Midwestern Governors Association Energy Security and Climate Stewardship Platform	0.13	4.13	17.14	-\$375.69	-\$21.92	Majority (9 objections)
EEC-10	Energy Management Training/Training of Building Operators	0.10	1.29	5.48	-\$129.49	-\$23.63	Super Majority (1 objection)
EEC-11	Rate Structures and Technologies To Promote Reductions	0.04	0.21	1.20	-\$25.73	-\$21.45	Unanimous
EEC-12	Demand-Side Management (DSM)/Energy Efficiency Programs for Electricity	0.39	4.38	20.33	-\$444.81	-\$21.88	Super Majority (4 objections)
EEC-13	Government Lead by Example: Improved Design, Construction, and Energy Operations in New and Existing State and Local Government Buildings	0.08	0.36	1.97	1.04	0.53	Majority (6 objections)
EEC-14	More Stringent Appliance Efficiency Standards	0.94	2.20	17.33	-\$708.15	-\$40.85	Super Majority (2 objections)
	<b>Sector Total After Adjusting for Overlaps</b>	<b>1.1</b>	<b>8.6</b>	<b>43.2</b>	<b>-\$1,064.5</b>	<b>-\$24.7</b>	
	<b>Reductions From Recent Actions: EISA (2007) and Executive Orders #6 and 41</b>	<b>0.44</b>	<b>1.42</b>	<b>9.19</b>			
	<b>Sector Total Plus Recent Actions</b>	<b>1.6</b>	<b>10.0</b>	<b>52.3</b>			

CO<sub>2</sub> = carbon dioxide; DSM = demand-side management; NPV = net present value; \$/tCO<sub>2</sub>e = dollars per metric ton of carbon dioxide equivalent; EISA = Energy Independence and Security Act (2007).

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

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

The policy options also differ among the customer classes they target. EEC-13 requires government to lead the rest of the state by example by requiring that new construction and retrofits of existing building stock meet high-performance building requirements. EEC-8 targets low-income residential customers and tenants who typically have less efficient capital equipment and appliances, but are typically hard to reach for utility energy efficiency programs.<sup>3</sup>

There are varying degrees of overlap between policy options which are discussed in more detail in Appendix F. Government high-performance building standards (EEC-13) typically have little overlap with utility efficiency programs because government efficiency improvements are usually implemented via executive orders and procurement standards that might not capture utility incentives. Peak-demand reductions through smart metering (EEC-11) does not overlap with other programs that might reduce peak demand through efficient air conditioners under EEC-12. However, there is overlap in the expected emission reductions and costs among some of the policies within the RCI sectors, as well as between policies in the RCI and energy supply (ES) sectors.

For example, EEC-9, the Midwestern Governors Association energy efficiency target, mirrors the reductions targeted under EEC-2 and EEC-12, so its reductions are eliminated from the adjusted totals. Also, EEC-8 provides energy efficiency investments for low-income residential customers. Well-designed utility and nonutility energy efficiency/DSM programs will target these populations, but not at the level identified under this policy option; therefore, EEC-8 is assumed to overlap with EEC-2 and EEC-12. Also, incentives to purchase ENERGY STAR appliances under EEC-14 are expected to overlap with utility and nonutility incentive programs under EEC-2 and EEC-12.

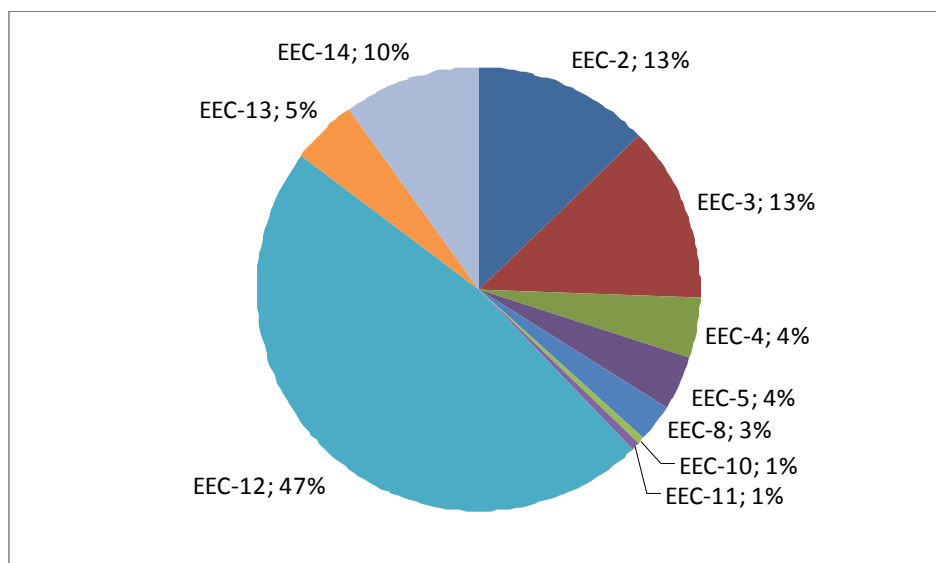
There is also a potential interaction between the RCI and ES sector policies concerning the clean energy portfolio components in policy option CRE-8 (Midwestern Governors Association renewable portfolio standard [RPS]). Under EEC-12, electricity demand in 2020 is reduced by almost 5,000 gigawatt-hours (GWh) versus the reference case. CRE-8b assumes a 20% RPS by 2020, which is 4% more renewable energy sources (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 \$0.3 million in that year.

Figure 3-3 shows the cumulative emission reductions from the policy options that have been quantified and produce reductions net of overlaps for the entire planning period for 2009–2020.

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<sup>3</sup> See WGA. (2005). Figure III-1. Comparison of the Market Penetration of Energy Efficiency Measures in Owner-Occupied and Rental Housing in California. P. 19.

**Figure 3-3. Aggregate (Cumulative) GHG emission reductions, 2009-2020\***



\*These are the reductions from the Energy Efficiency and Conservation (EEC) policy options, *net of overlaps between options*. Each option number is followed by a semicolon and the percent of total reductions that it represents.

The policy options for the EEC sectors are affected by both state and federal policies that incentivize or mandate more efficient use of energy. The federal Energy Independence and Security Act (EISA) of 2007 was signed into law in December 2007. This law contains several requirements that will reduce GHG emissions as they are implemented over the next few years. During the ICCAC process, sufficient information was identified (e.g., implementation schedules) to estimate GHG emission reductions associated with implementing energy efficiency requirements for new appliances and lighting in Iowa under Title III of the EISA.

The net effect of these reductions was estimated at 1,300 GWh of electricity and 1,300 billion British thermal units of natural gas savings in Iowa by 2020. The associated GHG reductions for these savings are projected to be 1.1 MMtCO<sub>2</sub>e for 2020 using the EEC carbon dioxide (CO<sub>2</sub>) methodology. Note, however, that GHG emission reductions associated with the EISA Title IV (Energy Savings in Buildings and Industry) and Title V (Energy Savings in Government and Public Institutions) requirements have not been quantified because of the uncertainties about how they will be implemented. It is expected that these requirements will overlap with some of the RCI policy options, especially EEC-4 and EEC-13.

As mentioned in the text below, Iowa utilities have been pursuing energy efficiency programs for some time. These investments are not quantified in the analysis because EEC subcommittee members indicated that the energy impacts from these efficiency programs are already incorporated into the utility load growth forecasts which were used for the reference case inventory and forecast (eg they are already in the baseline). The assumed incremental (new) statewide energy efficiency investments are equal to 0.82% of retail natural gas sales, and 0.69% of electricity sales over the planning period. These investments are deducted from each of the relevant energy efficiency targets in the individual policy options. For example, energy

efficiency target in EEC-12 (culminating at 2% of retail sales) is reduced by 0.69% to an incremental 1.31% of new investments by 2020. This approach avoids double counting reductions from existing programs in the policy options. Assuming incremental energy efficiency investments from existing actions in Iowa remained unchanged from 2006 levels, Iowa's cumulative electric energy efficiency deployment would be approximately 15% of sales in 2020. For natural gas, Iowa's cumulative natural gas energy efficiency deployment would be approximately 19% of sales in 2020. When using the levelized cost estimate assumptions developed for the EEC sector, total utility and participant spending on energy efficiency/DSM from existing actions in the reference case is estimated at \$270 million in 2020.

The Iowa Utilities Board is reviewing investor-owned utility plans to increase incremental electricity and natural gas investments to 1.5% of natural gas and electricity sales. These plans have not been approved and are therefore not included in the quantitative analyses. However, these targets are similar to those of options EEC-2 and EEC-12 for natural gas and electricity with the primary difference that the two ICCAC options escalate to investments equal to 2% of sales later in the planning period.

Iowa's Executive Orders #41 (Governor Vilsack)<sup>4</sup> and #6 (Governor Culver)<sup>5</sup> to reduce energy use in state buildings will also have an impact on future GHG emissions. The avoided electricity and natural gas GHG emissions are estimated at about 0.30 MMtCO<sub>2e</sub> in 2020. The policy options described briefly below, and in more detail in Appendix F, not only result in significant emission reductions and costs savings, but also offer a host of additional benefits as well. These benefits include savings to consumers and businesses on energy bills, which can have macroeconomic benefits; reduction in spending on energy by low-income households; reduced peak demand, electricity system capital and operating costs, risk of power shortages, energy price increases, and price volatility; improved public health as a result of reduced pollutant and particulate emissions by power plants; reduced dependence on imported fuel sources; and green collar employment expansion and economic development.

For these policies recommended by the ICCAC to yield the levels of savings described here, they must be implemented in a timely and thorough manner. This means, for example, not only putting the policies themselves in place, but also attending to the development of "supporting policies" that are needed to help make the recommended policies effective. While the adoption of the recommended policies can result in considerable benefits to Iowa's environment and consumers, careful, comprehensive, and detailed planning and implementation, as well as consistent support, of these policies will be required if these benefits are to be achieved.

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<sup>4</sup> State of Iowa, Executive Department. *Executive Order Number Forty-One*. Available at: [http://publications.iowa.gov/2619/1/EO\\_41.pdf](http://publications.iowa.gov/2619/1/EO_41.pdf).

<sup>5</sup> State of Iowa, Executive Department. *Executive Order Number Six*. February 2008. Available at: <http://publications.iowa.gov/6275/1/06-080221%5B1%5D.pdf>.

## Energy Efficiency and Conservation Policy Descriptions

### EEC-1 Consumer Education Programs

With a unanimous vote, the ICCAC presents a broad climate change and GHG reduction education program. The ultimate effectiveness of emission reduction activities in many cases depends on providing information and education to consumers regarding the energy and GHG emission implications of their choices. Public education and outreach, through such implementing organizations such as the Iowa Energy Center, is vital to fostering a broad awareness of climate change issues and effects (including co-benefits, such as clean air and public health) among the state's citizens. Such awareness is necessary to engage citizens in actions to reduce GHG emissions in their personal and professional lives. This option focuses on public education and outreach to stimulate decisions that yield energy efficiency savings. Consumer education is an integral component of most existing DSM programs offered by investor-owned and consumer-owned utilities. The goal of the program is to achieve a 5% reduction in residential energy consumption by 2020 implemented by the Iowa Office of Energy Independence, community colleges, secondary schools, building professional trade groups, and utilities.

### EEC-2 Demand-Side Management (DSM)/Energy Efficiency Programs for Natural Gas

By a super majority vote, the ICCAC presents the option that Iowa increase the efficiency of natural gas use in the state through a goal of deploying new energy efficiency and DSM natural gas measures equal to 1.5% of retail sales by 2015 and 2.0% by 2017. This policy involves implementing new or expanding existing energy efficiency programs for all sectors, including the RCI sectors. Iowa's IOUs are currently conserving 0.8% of sales with new energy efficiency and DSM measures and have plans to double this to 1.5% by 2015. This measure then expands those plans to 2.0% in 2017.

### EEC-3 Financial Mechanisms for Energy Efficiency

By a super majority vote, the ICCAC presents an option for modernizing the financial mechanisms that could increase energy efficiency provided by relevant utilities and nonutilities. Incentives for a variety of energy consumers can improve energy performance of buildings, equipment, and residences. Some of the utilities active in Iowa have offered such financing mechanisms in other states and for specific market segments in Iowa. At least one Iowa utility has a pilot program for a no-interest revolving loan fund. The goal of the option is to reduce consumption of electricity, natural gas, and heating fuels across all end-user categories by 2% of retail sales annually. End users include public-sector, industrial, commercial, multifamily residential, and residential users. Note that the GHG reductions and costs of or benefits from natural gas and heating fuels are not quantified in the summary table for this option.

#### **EEC-4. Improved Building Codes for Energy Efficiency**

By a super majority vote, the ICCAC presents the option of setting a goal for reducing building energy consumption, to be achieved by increasing standards for the minimum performance of new and substantially renovated commercial and residential buildings through the adoption and enforcement of building codes. Building codes would be made more stringent via incorporation of aspects of advanced/next generation building designs and construction standards, such as sustainable design and green building standards. Building codes should promote further reduction of GHG emissions through adoption of sustainable design or green building standards. Buildings are significant consumers of energy and other resources. Adoption and enforcement of building energy and related codes can be an effective way to eliminate the least efficient energy approaches in new or renovated buildings. The goal of this option is to reduce energy consumption per square foot of floor space at newly constructed and renovated buildings by 15% by 2012 and 50% by 2025. The new codes become effective initially in 2010, and the final goal is achieved by 2025.

This policy also included undertaking a comprehensive review of existing state and local building codes in Iowa to determine where increased energy efficiency can be achieved. This review will be undertaken by the new Commission on Energy Efficiency Standards and Practices, established by legislation enacted this year. Second, the policy aims for increasing the stringency of the Iowa Energy Code and developing a training and certification program for code officials, builders, and contractors on energy efficiency and related sustainable design standards, and in code enforcement.

#### **EEC-5. Incentives for Energy Efficiency**

By a unanimous vote, the ICCAC presents the option of changing the incentive structures in Iowa to deploy energy efficiency. The goal of this policy is to reduce consumption by 15% of retail sales by 2020. Energy efficiency plans in Iowa address both electric and natural gas use through a variety of programs. New incentive approaches are of three types:

##### *Potential Type 1 Incentives to IOUs*

- Decouple IOU revenues from sales of electricity or natural gas.
- Allow IOUs to rate-base their energy efficiency expenditures and earn returns on these investments.
- Allow IOUs to recover revenues that decrease due to DSM, net of utility system cost savings.
- Allow IOUs to implement a revenue normalization mechanism to recognize the impacts of declining per-customer sales due to DSM and other causes, while also recognizing additional sales due to customer growth.
- Allow IOUs to offer all DSM programs as shared-savings or Pay-As-You-Go loan programs, with the interest or earnings on these loans retained as earnings by the IOUs.
- Offer the IOUs some form of monetary reward based on amounts of capacity and energy saved, recoverable from customers as part of DSM costs.

- Evaluate alternative rate regulation structures to better align utility interests with energy efficiency goals. For example, MidAmerican’s revenue sharing mechanism incorporates an element of reward for energy efficiency because energy efficiency contributes to the utility’s ability to sell electricity in the wholesale market and generate additional revenues that are, pursuant to the revenue sharing arrangement, allocated between the utility and its customers. Thus, the utility and its customers are rewarded for energy efficiency.
- Allow IOUs to “own” all or part of the “carbon credit” impact of capacity and energy saved by DSM programs, and to retain as earnings any funds received from sale of credits based on these savings, above a certain level.
- Require IOUs to document performance, and penalize IOUs that do not meet specific goals by certain dates, to the extent that there is inadequacy in the current Iowa statutes and rules requiring program documentation, and allow the IUB to conduct prudence reviews and impose penalties.

#### *Potential Type 2 Incentives to Utility Customers*

- Rate discounts or payments to participants in load management programs, for savings of peak load electric kilowatt (kW).
- Time-of-use rates to electric customers, which offer lower rates off peak and much higher rates during peak electric use periods.
- Free energy audits and simple on-site energy efficiency measures installed during audits.
- Advanced energy efficiency evaluation and design services, typically for nonresidential customers.
- Assistance to residential homebuilders in the form of training, inspection of homes, cash payments for meeting standards, and certification/recognition of highly efficiency homes.
- Rebates and loans to customers for purchasing energy-efficient appliances and equipment.
- Customer education and training on energy-efficient appliances and measures (insulation, infiltration, building weatherization measures, HVAC sizing and maintenance, etc.).

#### *Type 3 Incentives, to Other Energy Efficiency Stakeholders*

Another solution to the assumption that Iowa IOUs will not improve their DSM performance very much beyond current levels of energy and capacity savings is to transfer the administration of energy efficiency programs to an independent, third-party administrator. The administrator would be subject to a performance-based compensation structure, including incentives for superior performance.

Another means of overcoming the utilities’ disincentive to aggressively promote DSM programs and achieve energy efficiency results is to replace the current system of utility-administered incentives with a system that provides incentives directly to retailers of energy-efficient products and services, energy-efficient product lenders, and building contractors/designers. Some utilities currently offer these stakeholders incentives to promote energy-efficient products, including training, free publicity, and per-item restocking payments to dealers and sales people for promotion of energy-efficient appliances and equipment. Similarly, incentives could be paid



directly to marketing firms to advertise and educate consumers about energy-efficient products and energy efficiency services.

#### **EEC-6. Promotion of and Incentives for Improved Design and Construction in the Private Sector**

By a super majority vote, the ICCAC presents this option, which provides incentives and targets to induce the owners and developers of new and reused (major retrofitted) residential and commercial buildings to improve the buildings' efficiency for using energy and other resources, along with provisions for raising targets periodically and providing resources to building industry professionals to help achieve the desired building performance. This policy can include elements to encourage the improvement and review of energy use goals over time, and to encourage flexibility in contracting arrangements to encourage integrated energy- and resource-efficient design and construction. The goal of the policy is to reduce energy consumption by the equivalent of 10% of retail electric sales and natural gas in residential and commercial buildings beginning January 1, 2010.

#### **EEC-7. Training and Education for Builders and Contractors**

By a unanimous vote, the ICCAC presents the option of an education and outreach policy for building professionals and code enforcement officials to encourage incorporation of energy efficiency and GHG emission reduction measures into construction. These programs can train designers, architects, builders, contractors, and code officials on a variety of relevant energy efficiency issues, such as building shell design, insulation, and proper heating and air conditioning sizing and installation, and can be supported by licensing requirements for design and building trade professionals that address knowledge of techniques for reducing energy use and sustainable design. The policy is to be in place by 2010.

#### **EEC-8. Technology Improvements in Targeted Markets**

By a unanimous vote, the ICCAC presents an option incorporating energy efficiency programs, funds, or goals (such as improved weatherization and appliances/HVAC) that focus on specific market segments at rental properties and low-income residential units. Low-income customers typically have less energy-efficient equipment due to informational barriers and a lack of access to capital. Also, there is a split incentive in rental markets where the tenant pays the energy bills, so the owner has no incentive to install energy-efficient technologies. Specific approaches that the policy could take include:

- Expand Iowa's Weatherization Assistance Program to make the homes of low-income Iowans more energy efficient.
- Develop minimum efficiency goals for rental properties, such as use of compact fluorescent light bulbs and energy-efficient appliances. Evaluate each unit with the departure of current tenants via a pre-rental inspection program before a new tenant takes possession.

- Provide financial mechanisms to assist with the retrofitting of rental properties with energy-efficient appliances, insulation, and high-efficiency furnaces.
- Establish a shared savings or zero-interest loan program to make energy-efficient appliances affordable for everyone.
- Design policies that allow paying for energy-efficient appliances over time on residential utility bills.

Targeting specific market segments can also be an effective component of a regional market transformation alliance.

#### **EEC-9.      Midwestern Governors Association Energy Security and Climate Stewardship Platform**

By a majority vote, the ICCAC presents the option that Iowa participate in the development and implementation of the Midwestern Governors Association Energy Security and Climate Stewardship Platform, signed in November 2007 by Governor Culver.<sup>6</sup> This policy is designed to address the energy efficiency goal of meeting at least 2% of the region’s annual retail sales of natural gas and electricity through energy efficiency programs by 2015 and annually thereafter. This policy option will require all of Iowa’s utilities—investor owned, municipal, and cooperatives—to save at least 2% of their annual retail sales of natural gas and electricity through energy efficiency programs by 2015.

#### **EEC-10.     Energy Management Training/Building Operators**

By a super majority vote, the ICCAC presents as an option the training of building energy managers and operators. In many facilities, utility bills can be significantly decreased through more efficient equipment and building operation. Administrative and technical training can inform and encourage energy managers, school officials, building operators, and others responsible for facility energy efficiency to utilize methods for minimizing unnecessary energy waste. This policy would increase education and demonstrate the benefits of energy-efficient building operation through government “leading by example” of energy service contracting. The goal of the policy is to require energy managers and facility operators in all sectors to obtain certification for successful completion of the training program starting in 2010.

#### **EEC-11.     Rate Structures and Technologies To Promote Reductions**

Passed by a unanimous vote, this policy option affects various elements of utility rate design that are geared toward reducing GHG emissions, often with other benefits as well, such as reducing peak power demand. The overall goal is to present rate structures so as to better reflect the actual economic and environmental costs of producing and delivering electricity, as those costs vary by time of day, by day of the week, by season of the year, and from year to year. In this way, rates

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<sup>6</sup> Midwestern Governors Association. 2007. *Energy Security and Climate Stewardship Platform for the Midwest*. Midwestern Energy Security & Climate Stewardship Summit. Available at: <http://www.wisgov.state.wi.us/docview.asp?docid=12495>.

provide consumers with information reflecting the impacts of their consumption choices. The goal of the policy is to reduce electricity consumption through pricing by 2% of retail sales, with compliance beginning on January 1, 2010. Options for implementation include seasonal rates, time-of-day rates, critical peak pricing, and real-time pricing of electricity.

#### **EEC-12. Demand-Side Management (DSM)/ Energy Efficiency Programs for Electricity**

By a super majority vote, the ICCAC presents as an option a DSM/energy efficiency policy to invest in energy efficiency equal to 1.0% of retail electricity sales per year by 2013, 1.5% per year by 2015, and 2.0% per year by 2017. DSM/energy efficiency is a policy approach that requires actions that influence both the quantity and the patterns of energy consumed by end users. This policy option focuses on DSM/energy efficiency programs run by electric utilities, and may be designed to work in tandem with other recommended strategies that can also encourage efficiency gains. The DSM obligations and goals apply to all electric utilities in Iowa. IOUs are starting at 0.8% of retail sales; municipal utilities and rural electric cooperatives start at varying levels.

#### **EEC-13. Government Lead by Example: Improved Design, Construction, and Energy Operations in New and Existing State and Local Government Buildings**

By a majority vote, the ICCAC presents an option that the state of Iowa and municipal and county governments and school districts provide leadership in energy efficiency by adopting policies that improve the energy efficiency of new and renovated public buildings, and the equipment and appliances used therein. This policy option provides targets to improve the efficiency of energy use in new and existing state and local government buildings that are much higher than code standards. The goals for the policy are as follows:

- Require that all new construction and major renovations of government-owned buildings, including schools and publicly owned hospitals, meet sustainable design standards.
- Starting in 2008, all new state buildings and major renovations will be designed to meet a fossil fuel, GHG-emitting, energy consumption performance standard of 50% of the regional average for that building type.
- All state and local governments will require the procurement of energy-efficient equipment, including lighting, office equipment, and other appliances, such as ENERGY STAR. (This goal element is quantified under EEC-14.)
- The fossil fuel reduction standard for all new buildings will be increased to:
  - 60% in 2010
  - 70% in 2015
  - 80% in 2020
  - 90% in 2025
  - All state buildings will be carbon neutral in 2030 (zero net energy, using no fossil fuel GHG-emitting energy to operate).

Implementing parties include state and local governments, the Capitol Planning organization, all three Regents institutions, Iowa Association of Counties, League of Cities, Iowa Association of School Boards, Iowa State Education Association, School Administrators of Iowa, private contractors, and the Iowa State Building & Construction Trades Council.

#### **EEC-14. More Stringent Appliance Efficiency Standards**

By a supermajority vote, the ICCAC presents an option increasing the efficiency of appliances in the state. Appliance standards reduce the market cost of energy efficiency improvements by incorporating technological advances into base appliance models, thereby creating economies of scale. Appliance efficiency standards can be implemented at the state level for appliances not covered by federal standards, or standards can be jointly developed by multiple states. The goal of the policy is to achieve 5% reduction in energy consumption from residential, commercial, and industrial consumers via:

- 80% minimum efficiency standards by 2010 for appliances not covered by federal standards;
- 100% market penetration of ENERGY STAR appliances in purchase transactions in which state funds are involved (state purchasing contracts, state grants or loans, etc.) by 2012; and
- A doubling of market penetration of ENERGY STAR appliances in purchases made in the residential, commercial, and industrial sectors, where applicable, up to 100% by 2017.

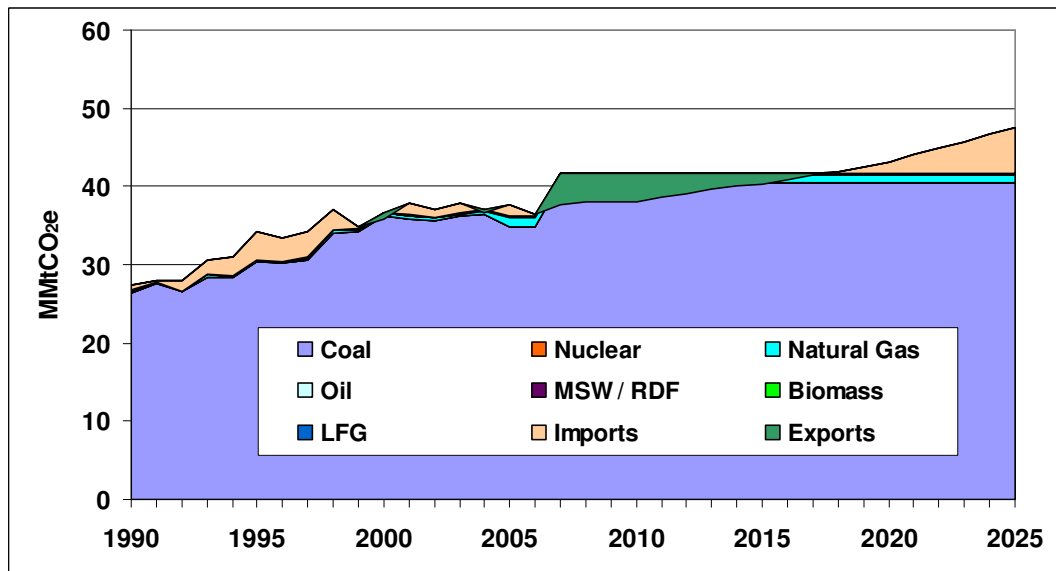
# Chapter 4 Clean and Renewable Energy

## Overview of Greenhouse Gas Emissions

The energy supply (ES) sector is by far the largest contributor to Iowa’s greenhouse gas (GHG) emissions. The 2005 emissions associated with Iowa electricity consumption are estimated at 37.6 million metric tons of carbon dioxide equivalent (MMtCO<sub>2</sub>e), which is nearly double the next-largest sector of residential, commercial, and industrial (RCI) fuel use. Iowa’s GHG emissions from the ES sector are due to the state’s reliance on coal as a source of electricity generation. Emissions from the sector are expected to grow by approximately 10 MMtCO<sub>2</sub>e through 2025 as demand for electricity increases. This represents approximately 35% of the projected increase in statewide GHG emissions over the period. Iowa Climate Change Advisory Council (ICCAC) stakeholders in the Clean and Renewable Energy (CRE) Subcommittee submitted electricity load growth forecasts that average 1.9% over the 2005–2025 period. However, GHG emissions grow by only 1% per year due to increases in electricity generation from wind resources.

Iowa is expected to be a large importer of electricity in the later years of planning period under the reference case. Figure 4-1 shows the breakdown of GHG emissions on a consumption basis through 2025 by fuel type. Sectoral emissions on a production accounting basis are lower in 2025 than in the reference case (41.8 MMtCO<sub>2</sub>e), due to the imported power that is excluded from this inventory method. However, under the two sensitivity cases forecasted, energy production 2025 emissions are estimated at 45.44 MMtCO<sub>2</sub>e for the Sutherland scenario, and 50.09 MMtCO<sub>2</sub>e for the Elk Run scenario (not shown).

**Figure 4-1. Historical and projected GHG emissions from Iowa power plants: 1990–2025**



Source: Figure A5. Final Iowa Greenhouse Gas Inventory and Reference Case Projections 1990\_2025. [http://www.iaclimatechange.us/Inventory\\_Forecast\\_Report.cfm](http://www.iaclimatechange.us/Inventory_Forecast_Report.cfm).

MMtCO<sub>2</sub>e = million metric tons of carbon dioxide equivalent; LFG = landfill gas; MSW = municipal solid waste; RDF = refuse-derived fuel.

## Key Challenges and Opportunities

There are significant opportunities to reduce GHG emissions growth associated with energy production and supply in Iowa, such as promoting distributed renewable generation, combined heat and power applications, investing in technology research and development (R&D) in the state, and diminishing the carbon intensity of electrical generation through greater use of renewable energy and nuclear power. There are also significant opportunities to reduce GHG emissions through policies addressing electricity consumption, and these can often provide cost savings as well as GHG mitigation benefits. In Chapter 3, Energy Efficiency and Conservation (EEC), interested readers can find the 14 policy options that the ICCAC has presented for the residential, commercial, and industrial sectors to improve the efficiency of electricity consumption.

The ICCAC is presenting several policies to increase the efficiency of electricity generation within the ES sector. These include expanding combined heat and power (CHP) production for commercial, industrial, and biofuels processors (CRE-12) and distributed generation (CRE-11), which includes some small CHP applications.

Iowa has some of the largest renewable energy resource supplies in the country in the form of wind and biomass energy. The ICCAC presents options for promoting the development of these resources through a number of policies designed to address the various barriers to realizing the potential for renewable resources. Implementation of renewable resources can be encouraged through feed-in tariffs; direct financial support for biomass and other resources; renewable electricity targets; and performance standards that reduce the CO<sub>2</sub> intensity of generation resources over time. Smaller, distributed resources can be specifically targeted through actions to reduce financial, permitting, and interconnection barriers. Technology R&D can encourage market acceptance of a variety of technologies by lowering the cost or improving the performance of renewable generation, and by encouraging collaboration between R&D, government, academic, and commercial sectors. R&D activities also produce employment and economic development benefits in the state.

## Overview of Policy Options and Estimated Impacts

The ICCAC presents a set of 13 policies for the ES sector that offer the potential for significant GHG emission reductions in Iowa. Eight of these have been quantified to estimate the potential for avoided GHG emissions. Figure 4-2 shows the percentage of potential GHG reductions from five CRE policy options with reductions that don't overlap with other options. If implemented together, the quantified policy options could lead to:

- Emission reductions of 48 million metric tons of carbon dioxide equivalent (MMtCO<sub>2</sub>e) per year by 2020, and 233 MMtCO<sub>2</sub>e cumulative savings from 2008 through 2020.
- Net costs of almost \$6.0 billion through 2020 on a net present value basis.<sup>1</sup> The weighted-average cost of these policies is approximately \$25/MMtCO<sub>2</sub>e.

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<sup>1</sup> The net cost savings, shown in constant 2005 dollars, are based on fuel expenditures; operations, maintenance, and administrative costs; and amortized, incremental equipment costs. All net present value analyses here use a 5% real discount rate.

- The rate impacts of the policy options vary depending on the scale of the policy. A few of the options have negligible or modest potential impacts on ratepayers. Others, like CRE-2, which incentivizes the development of the majority of the estimated renewable electricity supplies in the state, could raise generation costs by up to \$26 per megawatt hour (MWh). However, given that 50% of retail electricity sales could come from renewables sources under this policy, it is likely that the electricity generated by this type of policy would be sold to parties outside the state which could instead be a source of revenue to Iowa.

Six of these policies were approved unanimously by the ICCAC, five with a super majority, and two with majority support. Table 4-1 shows the GHG reductions, costs, and levels of support for the 13 policy options.

One of the options increases the human capital component of energy production and consumption by enhancing education about the effects of climate change and giving workers the skills necessary for a green-collar economy. Many of the options focus on economic incentives to make clean sources of electricity competitive with more carbon intensive sources (CRE-2, CRE-8, CRE-11, CRE-12, CRE-13). Other options require producers to deploy more climate-friendly generation resources (CRE-5). One option levies a fee based on the carbon content of generation in order to fund energy efficiency and renewable sources of energy (CRE-4). The most complex option (CRE-3) links Iowa's GHG reductions efforts with the cap and trade program being developed by the Midwestern Governors Association (MGA). Getting clean electricity to the end user is a challenge, given the status of existing transmission and distribution (T&D) assets and that renewable resources are often sited far from demand centers. This is an issue even for the wind resources that are assumed to be built in the reference case for the Iowa Inventory and Forecast. CRE-9 incentivizes upgrading of the T&D system in order to get clean energy to the market. Two of the options incentivize the production of electricity at the point of the end user (CRE-11, CRE-12).

The totals reported at the bottom of Table 4-1 take into account overlaps in the expected emissions reductions and costs among some of the policies within the ES sector, as well as between policies in the ES, RCI, and agricultural, forestry, and waste management (AFW) sectors. Care was taken in the determination of benefits from each of the sectors to ensure that the combined calculated impact of the policies would not double count benefits that overlap.

CRE-2 (Renewable Technologies Initiative)—This option encompasses the estimated supply curve for renewable electricity through 2020. 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-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. The reductions from this option are eliminated through the overlap analysis.

CRE-13 (Pricing Strategies)—This option promotes the use of net metering and feed-in tariffs 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 option sites small-scale renewables. However, the 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 carbon dioxide (CO<sub>2</sub>) reductions from this option are reduced by 50%.

CRE policy options also overlap with other sectors. CRE-4 (Decarbonization Fund) levies a fee based on the greenhouse gas emissions from electric generation to transition to a new, non-emitting and low emitting sources of electricity by funding specified activities such as low income weatherization, energy efficiency, research and development and renewable sources of energy . The renewables and energy efficiency deployment from this option are assumed to overlap with other CRE and EEC options.

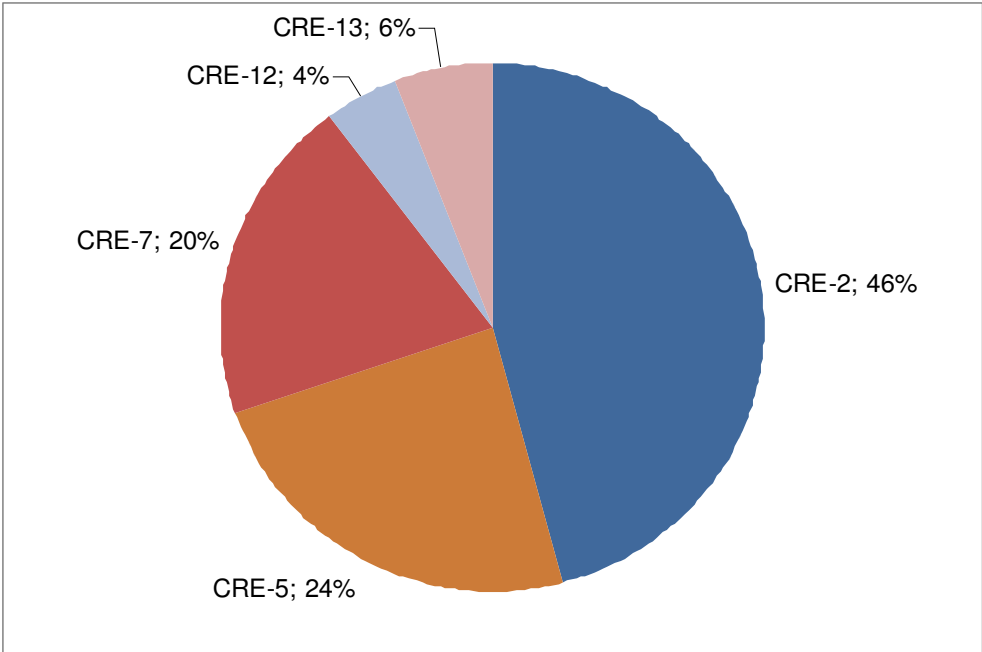
CRE-2 also overlaps with policy options AFW-3 and AFW-9. The reductions from the AFW sectors are assumed to completely overlap with CRE-2, and are subsumed under the CRE option.

The electricity energy efficiency investments from the suite of EEC policy options 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% renewables target by 2020, which is 4% more renewable energy sources (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 renewables 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 \$0.3 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<sub>2</sub> 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 Annex A in the CRE Appendix for a discussion of the avoided CO<sub>2</sub> methodology.



**Figure 4-2. Percentage of avoided greenhouse gas emissions by CRE policy: 2008–2020**



\* These are the reductions from the policy options, *net of overlaps between options*.

**Table 4-1. Summary list of policy options**

No.	Policy Options	GHG Reductions (MMtCO <sub>2</sub> e)			Net Present Value 2009–2020 (Million \$)	Cost-Effectiveness (\$/tCO <sub>2</sub> e)	Change in Generation Cost in 2020 \$/MWh*	Level of Support
		2012	2020	Total 2009–2020				
CRE-1	Education	<i>Not quantified</i>						Unanimous
CRE-2	Technology Initiatives, Including Renewables	4.7	33.4	192.6	\$5,653	\$29.4	\$25.7	Super Majority (3 objections)
CRE-3	MGA Cap and Trade, Including Offsets To Promote Renewables	<i>Not quantified</i>						Majority (5 objections)
CRE-4	Decarbonization Fund	2.2	11.4	74.1	\$316	\$4.3	\$3.1	Super Majority (2 objections)
CRE-5	Performance Standards (50% Reduction by 2050)	4.9	11.4	95.4	\$2,650.6	\$27.8	\$7.3	Super Majority (3 objections, 1 abstention)
CRE-6	Voluntary GHG Commitments	<i>Not Quantified</i>						Unanimous
CRE-7	Policies Related to Nuclear Power	0.0	9.7	9.7	\$268	\$27.6	\$4.5	Majority (5 objections)
CRE-8	Support for Grid-Based Renewable Energy & Development (MGA Target of 20% of retail sales by 2020)	0.0	2.3	4.3	\$93.4	\$21.8	\$1.5	Unanimous
CRE-9	Transmission System Upgrading	<i>Not quantified</i>						Unanimous
CRE-10	R&D for Emerging Technologies and Corresponding Incentives	<i>Not quantified</i>						Unanimous
CRE-11	Distributed Generation/Co-Generation	0.0	0.1	0.5	\$14	\$29.1	\$0.1	Super Majority (1 objection)
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	Super Majority (3 objections)
	<b>Sector Total After Adjusting for Overlaps</b>	<b>6</b>	<b>48</b>	<b>233</b>	<b>\$5,921</b>	<b>\$25</b>		
	<b>Reductions From Recent Actions</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>\$0.0</b>	<b>\$0.0</b>		
	<b>Sector Total Plus Recent Actions</b>	<b>6</b>	<b>48</b>	<b>233</b>	<b>\$5,921</b>	<b>\$25</b>		

CO<sub>2</sub> = carbon dioxide; MMtCO<sub>2</sub>e = million metric tons of carbon dioxide equivalent; \$/tCO<sub>2</sub>e = dollars per metric ton of carbon dioxide equivalent; \$/MWh = dollars per megawatt-hour; MGA = Midwestern Governors Association; GHG = greenhouse gas; 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. This is one measure of the possible rate impacts to customers from the policies.

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

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

The options offered here present a balanced portfolio of policies to significantly reduce GHG emissions associated with electricity supply in Iowa. Iowa's considerable natural endowments of wind and biomass resources, coupled with its low population density, positions Iowa as a leader in the region and the nation to deploy clean energy. The state can benefit from developing and selling these resources to trading partners who don't have Iowa's resources or have moved more slowly. For Iowa to capture these economic advantages, the suite of policy options offered here needs to be authorized and implemented in a timely, consistent, and thorough manner.

## Clean and Renewable Energy Policy Descriptions

### CRE-1. Education

By unanimous approval, the ICCAC presents a policy option 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 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.

Beginning in the 2010 academic year, the goals of this policy option 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; and develops statewide environmental literacy. The policy is implemented by elementary and secondary school districts, municipal governments, the three Regents state universities, Iowa community colleges, and community partners/associations.

### CRE-2. Technology Initiatives, Including Renewables

By a majority approval, the ICCAC presents a policy option that deals with the implementation of CRE technologies that are currently commercially available. Iowa can undertake initiatives focused on developing, promoting, and/or implementing one or more specific technologies that show promise for reducing GHG emissions. This policy would support providing state government and other private and public parties with resources and incentives for analysis, targeted R&D, market development, and adoption of GHG-reducing technologies that are not covered by other CRE policies.

CRE-2 has specific goals for annual increases of renewable electric production in Iowa subject to maximum feasible supply constraints: landfill gas-to-energy projects—9,000 megawatt-hours (MWh), municipal waste—65,500 MWh, wind energy—2.6 million MWh, biomass cofiring of agricultural residues—3,600 MWh, biomass from energy crops—760,000 MWh, and repowering hydropower facilities—112,000 MWh.

### **CRE-3. Midwest Governors Cap and Trade, Including Offsets To Promote Renewables**

By a majority vote, the ICCAC presents a policy option for Iowa's participation in the Midwest Governors Cap and Trade program. 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. The goals of this policy are assumed to be those adopted by the MGA cap-and-trade program. The ICCAC should revisit what action to take on this option once the MGA cap levels and model rule have been developed. The policy would start in concert with other MGA actions. 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.

### **CRE-4. Decarbonization Fund**

By a super majority vote, the ICCAC presents a policy option for the adoption of a fee on each ton of CO<sub>2</sub> emissions produced by the electricity supply sector to transition to a new, non-emitting and low-emitting sources of electricity. 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). 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/metric ton (t) of CO<sub>2</sub> in 2010, and increase by \$1/year until a cap of \$10/tCO<sub>2</sub> is obtained in 2019. The funding in 2019 is estimated at \$320 million. This funding could only be used for energy efficiency, renewable energy development, R&D, and low-income weatherization assistance programs and initiatives.

### **CRE-5. Performance Standards**

By a supermajority vote, the ICCAC presents a policy option for generation performance standard (GPS) to be applied to the electricity supply sector. A GPS is an emissions rate hurdle that must be met for compliance by sources supplying electricity to consumers in Iowa. A GPS can be applied to new generation or can include the system-wide emissions rate of an entity's

generating fleet. The ICCAC presents two GPS targets for policymakers to choose from: either 5(a) which is the less aggressive option targeting a 50% reduction in CO<sub>2</sub> intensity per MWh from 2005 emission levels by 2050, or the more aggressive 5(b) option targeting a 90% reduction goal from 2005 emissions levels by 2050.

#### **CRE-6. Voluntary GHG Standards**

By a unanimous vote, the ICCAC presents a policy option for adopting standards to recognize voluntary GHG reductions by entities in the state. The standard provides an incentive for companies that 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. The goals for an Iowa voluntary GHG program include: encouraging Iowa businesses and citizens to voluntarily begin reducing GHG emissions immediately, without waiting for mandatory Iowa or national GHG reduction program measures; obtaining voluntary commitments from each of Iowa's investor-owned utilities to reduce GHG emissions by at least 6% below the baseline year 2005 emissions by 2010; and obtaining similar commitments from 25% of Iowa's GHG-emitting private businesses. Also, the voluntary standards should provide rate-regulated utilities assurance of cost recovery for voluntary GHG reduction measures that are previewed and approved as prudent and reasonable by the Iowa Utilities Board.

#### **CRE-7. Policies Related to Nuclear Power**

By a majority vote, the ICCAC presents a policy option that, if deemed necessary, would build one new 1200-megawatt nuclear power plant in Iowa by January 1, 2020. 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 that achieves Iowa's long-term carbon emission reduction goals. The focus of this particular option 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 a new nuclear power plant in Iowa. There are considerable uncertainties about the cost characteristics of new nuclear power. The latest numbers for nuclear power, based on an average of data prepared by Progress Energy Florida and Florida Power and Light, estimate the total levelized unit cost of nuclear power is \$100/MWh (\$2006 dollars) generated.<sup>2</sup> This is nearly double the \$52/MWh used in the quantification for CRE-7 in Iowa.

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<sup>2</sup> Assumes a useful life (and life for calculation of annualized capital costs) of 40 years, a capacity factor of 91%, an average installed capital cost of \$7,091/kW, \$79/kW-yr fixed O&M costs, \$3.1/MWh variable O&M costs, \$15/MWh fuel costs, and a 8.5%/yr weighted-average cost of capital. See: <http://www.flclimatechange.us/ewebeditpro/items/O12F19875.pdf>.

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

By a unanimous vote, the ICCAC presents a policy option for financial incentives to encourage investment in renewable energy resources by businesses and individuals who sell power commercially. The policies 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 kilowatt-hour (kWh) generated or sold from renewable generation facilities.

This option includes two different pathways for promoting renewable energy development. CRE-8a (More aggressive case) increases 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. CRE-8b (Less aggressive case) reflects the MGA renewable energy goal, which is a goal for the Midwest region equivalent to 10% of retail MWh sales by 2015, 20% by 2020, and 30% by 2030. 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.

## **CRE-9. Transmission System Upgrading**

By a unanimous vote, the ICCAC presents a policy option to upgrade Iowa's transmission system. The policy's goals 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; and 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.

## **CRE-10. Research and Development (R&D) for Emerging Technologies and Corresponding Incentives**

By a unanimous vote, the ICCAC presents a policy option for supporting R&D of emerging technologies to develop demonstration projects and eventual commercialization of reasonable-cost generation technologies with low or zero GHG emissions. Technology areas often cited as

requiring such reasonable-cost developments are CO<sub>2</sub> capture and storage (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). A small fee per kWh of electricity could generate significant funding for R&D and commercialization. By 2010, the policy would begin to implement the R&D funding mechanisms.

#### **CRE-11. Distributed Generation/Co-Generation**

By a super majority vote, the ICCAC presents a policy option focusing on encouraging investment in small-scale distributed generation (DG) through incentives or subsidies and the prevention of barriers for both utility and consumer investment, with a goal of deploying 7500 MWh per year of new distributed renewable generation by 2010 and continuing each year thereafter. 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 photovoltaic 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.

#### **CRE-12. Combined Heat and Power (CHP)**

By a unanimous vote, the ICCAC presents a policy option to promote CHP technology, which recovers waste heat from energy production for productive use. 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. Studies indicate substantial opportunities for electricity generation at commercial and industrial facilities in the state. In addition, Iowa's leadership as a biofuels producer is a significant source of CHP electricity, where the waste heat from electricity generation can be used to refine biofuel feedstocks.

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

By a super majority vote, the ICCAC offers this policy option focusing 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 Federal Energy Regulatory Commission's avoided cost standard. The goal of this option is to achieve a 10% shift to renewable energy sources, as a percentage of retail sales, through implementation of various pricing strategies. The policy begins with a 1% shift achieved in 2010, and continues with linear growth through 2019.

# Chapter 5

## Transportation and Land Use Sectors

### Overview of Greenhouse Gas Emissions

The transportation sector, which includes light- and heavy-duty (on-road) vehicles, aircraft, rail engines, and marine engines, is one of the largest contributors of gross greenhouse gas (GHG) emissions in Iowa. This sector accounted for 17% of Iowa's gross GHG emissions in 2005, which was slightly under the national average of 27%. However, by 2025, the share of emissions associated with the transportation sector is anticipated to increase slightly to 20%.

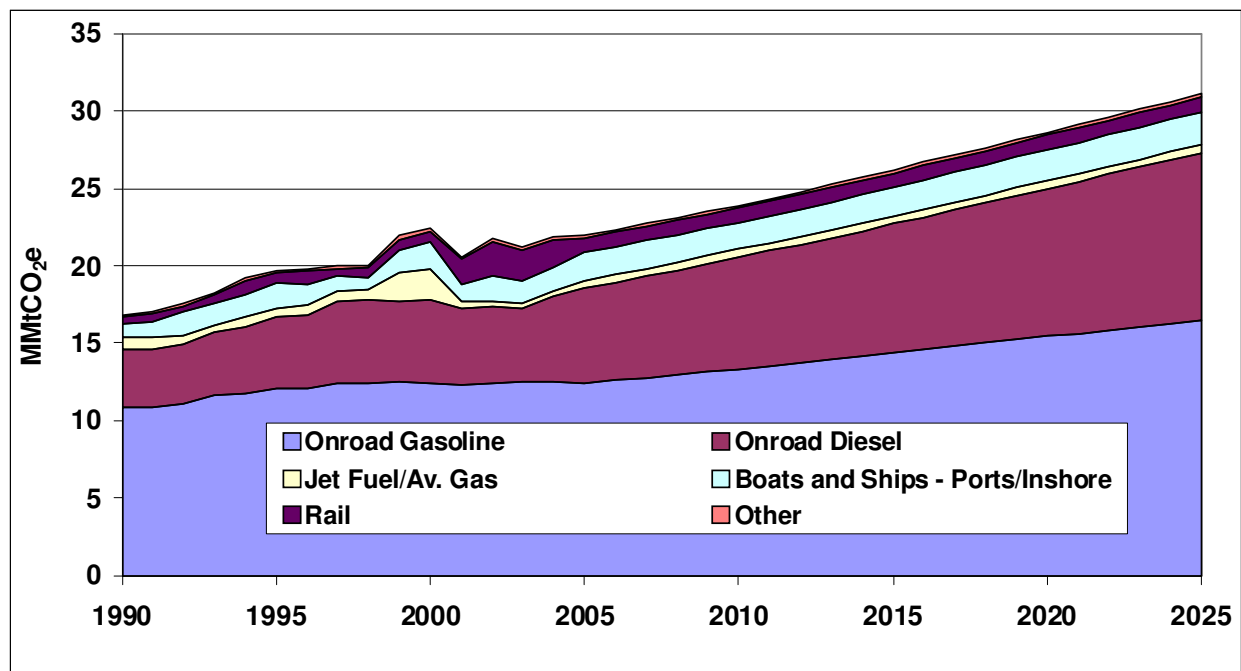
From 1990 to 2005, Iowa's GHG emissions from transportation fuel use have risen steadily at an average rate of about 1.4% annually. The GHG emissions associated with Iowa's transportation sector also rose accordingly, increasing by 3.8 million metric tons of carbon dioxide equivalent (MMtCO<sub>2</sub>e) emissions during the same time period from about 17 MMtCO<sub>2</sub>e to nearly 21 MMtCO<sub>2</sub>e. If left unabated, this number is expected to increase by nearly 30%, to 29.4 MMtCO<sub>2</sub>e by 2025.

Carbon dioxide (CO<sub>2</sub>) accounts for about 98% of transportation GHG emissions, with most of the remaining GHG emissions coming from nitrous oxide (N<sub>2</sub>O) emissions from gasoline engines. Emissions released from on-road gasoline consumption account for approximately 57% of the transportation sector's GHG emissions. This has historically been the largest share of transportation GHG emissions, and this trend is forecast to continue.

Figure 5-1 shows historic and projected transportation GHG emissions by fuel and source. As a result of Iowa's population and economic growth and an increase in total vehicle miles traveled (VMT), GHG emissions from on-road gasoline consumption increased by about 14% between 1990 and 2005 and accounted for 63% of the total transportation emissions in 2005. Meanwhile, GHG emissions from on-road diesel fuel consumption rose by 44% during that period, accounting for 28% of GHG emissions from the transportation sector in 2005, suggesting an even more rapid growth in freight movement within or across the state.

In the absence of significant increases in vehicle fuel economy, a significant reduction in VMT, or technological breakthroughs in low-carbon fuels, on-road gasoline and diesel emissions are expected to continue to grow. GHG emissions from on-road gasoline consumption are projected to increase by about 33%, and GHG emissions from on-road diesel consumption are expected to increase by 75% between 2005 and 2025. The consumption of these fuels will significantly contribute to the projected 42% increase in overall GHG emission levels for the entire state of Iowa over 2005 levels by 2025.

**Figure 5-1. Transportation GHG emissions by fuel source, 1990–2020**



MMtCO<sub>2</sub>e - million metric tons of carbon dioxide equivalent; av. gas = aviation gas.

## Key Challenges and Opportunities

Iowa has substantial opportunities to reduce transportation emissions. The principal means to reduce emissions from transportation and land use (TLU) are:

- Improving vehicle fuel efficiency,
- Substituting gasoline and diesel with lower-emission fuels, and
- Reducing total VMT.

In Iowa and in the nation as a whole, vehicle fuel efficiency has improved little since the late 1980s, yet many studies have documented the potential for substantial increases in efficiency, while maintaining vehicle size and performance. Automobile manufacturers typically oppose dramatic increases in fuel economy. Key points of contention include the cost to manufacturers and cost to consumers. Even with the adoption of the new federal corporate average fuel economy (CAFE) requirements, there may still be opportunities for further increases in fuel efficiency while maintaining vehicle size and performance.

The use of fuels with lower per-mile GHG emissions is growing in Iowa, and larger market penetration is possible. Conventional gasoline- and diesel-fueled vehicles can use low-level blends of biofuels. Alternative-technology vehicles can also use higher-level blends of biofuels, as well as other types of alternative fuels, such as natural gas and hydrogen. The type of fuel used is a crucial determinant of impact on emissions, as some alternative fuels have relatively little GHG benefit. Currently, the most prevalent biofuel in Iowa is corn-based ethanol, which

has a GHG benefit of 15.9% from a life-cycle perspective.<sup>1</sup> Key determinants of impact will be the development and deployment of fuel types. At present, fuel distribution infrastructure is a constraining factor.

Reducing VMT is crucial to mitigating GHG emissions from transportation. Developing smarter land-use and transportation development patterns that reduce trip length and support transit, ride sharing, biking, and walking can contribute substantially to this goal. A variety of pricing policies and incentive packages can also help to reduce VMT. Developing better planning methods and regulations, and increasing funding of multiple modes of transportation will be key components in achieving these goals.

## Overview of Policy Options and Estimated Impacts

The Iowa Climate Change Advisory Council (ICCAC) selected a set of 11 policies for the TLU sector that offer the potential for major economic benefits and emission savings. Implementing these policy options could lead to emission reductions of:

- 11.14 MMtCO<sub>2</sub>e per year by 2020, and
- 55.03 MMtCO<sub>2</sub>e cumulative from 2009 through 2020.

The weighted-average cost effectiveness of the selected policies is about -\$59/tCO<sub>2</sub>e. This average value includes policies that have both much lower and much higher likely costs per ton. One option, the cost of which particularly skews the numbers, is TLU-4, “Support Passenger Rail Service in Iowa.” This policy option has an identified cost per ton of \$597/tCO<sub>2</sub>e which is largely driven by high up-front capital costs associated with the development of new rail lines. It should be noted that by 2024 the cumulative ridership benefits are anticipated to outstrip these costs and this policy option will have a negative cost per ton beyond 2024.

The estimated impacts of the individual policy options are shown in Table 5-1. The ICCAC policy options are described briefly here and in more detail in Appendix H of this report. The options not only result in significant emission reductions, but offer a host of additional benefits as well. These benefits include reduced local air pollution; more livable, healthier communities; and economic development and job growth from the development of transit and rail, smart growth developments, and in-state biofuel production. To yield the levels of savings described here, these policies need to be implemented in a timely, aggressive, and thorough manner.

Some policy options focus on reducing VMT by further developing other modes of transportation, such as transit (TLU-1a) and passenger rail (TLU-4). Other VMT reduction strategies include implementing programs to eliminate or make commuting more efficient by improving pedestrian, bicycling, and carpooling options or placing work centers within established communities (TLU-5a, TLU-5b). Further rail development and implementing new freight strategies can also significantly reduce VMT associated with freight transportation (TLU-9). Another way to reduce VMT is to develop denser, mixed-use communities where the need

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<sup>1</sup> Biofuels analysis was based on information from the Argonne National Laboratory’s GREET model, version 1.8, which indicates a life-cycle emission reduction of 15.9% for E85 corn ethanol. See Appendix H for more details on assumed reduction factors for various types of biofuels.

for long commutes becomes significantly reduced and transit can be easily implemented (TLU-1). All of the above mentioned policy options help to reduce GHG emissions by moving people and freight more efficiently and providing other options for people and freight to reach their destinations.

Qualitative policies (policy options that are nonquantifiable) are an important component of the combined policies, but because they are not quantified, these options are not reflected in the GHG emission reductions or costs. These options focus on establishing a reliable source of capital funding for transportation related GHG reduction policies (TLU-2) and developing a distributed workplace model where smaller work centers are located in communities, thereby reducing VMT (TLU-5b). While the implementation of these options may contribute to significant GHG emission reductions, the immediate impact of these policies individually is not quantifiable.

Further developing the efficiency of vehicles can also have a major impact on reducing GHG emissions. TLU-6 focuses on providing incentives such as feebates, tax credits for low GHG vehicles, and operating incentives for low GHG vehicles to promote the purchase and operation of more efficient vehicles. Increased utilization of these low GHG emission vehicles can significantly impact overall GHG emissions associated with light-duty vehicle VMT. Working in concert with TLU-6, TLU-8 promotes the development of fuel efficient vehicles by promoting increased fuel economy standards through the adoption of a State Clear Car Program. TLU-7 aims at increasing vehicle efficiency by impacting consumer choice through educating consumers about vehicle maintenance and operation techniques and encouraging the use of fuel efficient tires.

Iowa can achieve greater alternative fuel use while simultaneously reducing GHG emissions by putting in place a low-carbon fuel standard (TLU-10). Such a policy option ensures that fuel sold in Iowa would meet, on average, a declining standard for GHG emissions measured in CO<sub>2</sub> equivalent per unit of fuel energy.

**Table 5-1. Summary list of TLU policy options**

No.	Policy Options	GHG Reductions (MMtCO <sub>2</sub> e)			Net Present Value 2009–2020 (Million \$)	Cost-Effectiveness (\$/tCO <sub>2</sub> e)	Level of Support
		2012	2020	Total 2009–2020			
TLU-1	Smart Growth Bundle with Transit	0.076	0.242	1.53	-\$377	-\$245	Unanimous
TLU-1a	Expand and Improve Transit Infrastructure	0.004	0.026	0.127	\$7.2	+\$57	Supermajority
TLU-2	GHG Impacts for State and Local Capital Funding	<i>Quantified as part of TLU-1 and TLU-1a</i>					Unanimous
TLU-4	Support Passenger Rail Service in Iowa	N/A	0.008	0.026	\$15	+\$597	Majority
TLU-5a	Adopt Best Workplaces for Commuters in Iowa	0.02	0.02	0.21	\$18	\$84	Supermajority
TLU-5b	Distributed Workplace Models	<i>Non-quantified, qualitative option</i>					Unanimous
TLU-6	Light Duty Vehicles Fuel Efficiency Incentives	0.44	3.65	17.70	NQ	NQ	Supermajority
TLU-7	Fuel Efficient Operations for	0.11	0.65	3.41	-\$306.9	-\$90	Unanimous

No.	Policy Options	GHG Reductions (MMtCO <sub>2</sub> e)			Net Present Value 2009–2020 (Million \$)	Cost-Effectiveness (\$/tCO <sub>2</sub> e)	Level of Support
		2012	2020	Total 2009–2020			
	Light Duty Vehicles						
TLU-8	New Vehicle Standards (Tailpipe GHG and Fuel Economy)	N/A	0.8	4.1	-\$246	-\$60	Unanimous
TLU-9	Freight Strategies (Truck and Rail)	0.39	0.63	5.9	\$30	+\$5	Supermajority
TLU-10	Fuel Strategies (20% Low Carbon Fuel Standard)	0.60	5.11	22.03	-\$1,359	-\$62	Unanimous
	<b>Sector Total After Adjusting for Overlaps and Synergies</b>	<b>1.64</b>	<b>11.14</b>	<b>55.03*</b>	<b>-\$2,218.50</b>	<b>-\$59</b>	
	<b>Reductions From Recent Actions (Federal CAFE Requirements)</b>	<b>0.26</b>	<b>1.93</b>	<b>9.39</b>	<b>Not Quantified</b>		
	<b>Sector Total Plus Recent Actions</b>	<b>1.9 (8.3)</b>	<b>13.07 (48)</b>	<b>64.42</b>	<b>N/A</b>	<b>N/A</b>	

CAFE = corporate average fuel economy; GHG = greenhouse gas; MMtCO<sub>2</sub>e = million metric tons of carbon dioxide equivalent; \$/tCO<sub>2</sub>e = dollars per metric ton of carbon dioxide equivalent; N/A = not applicable

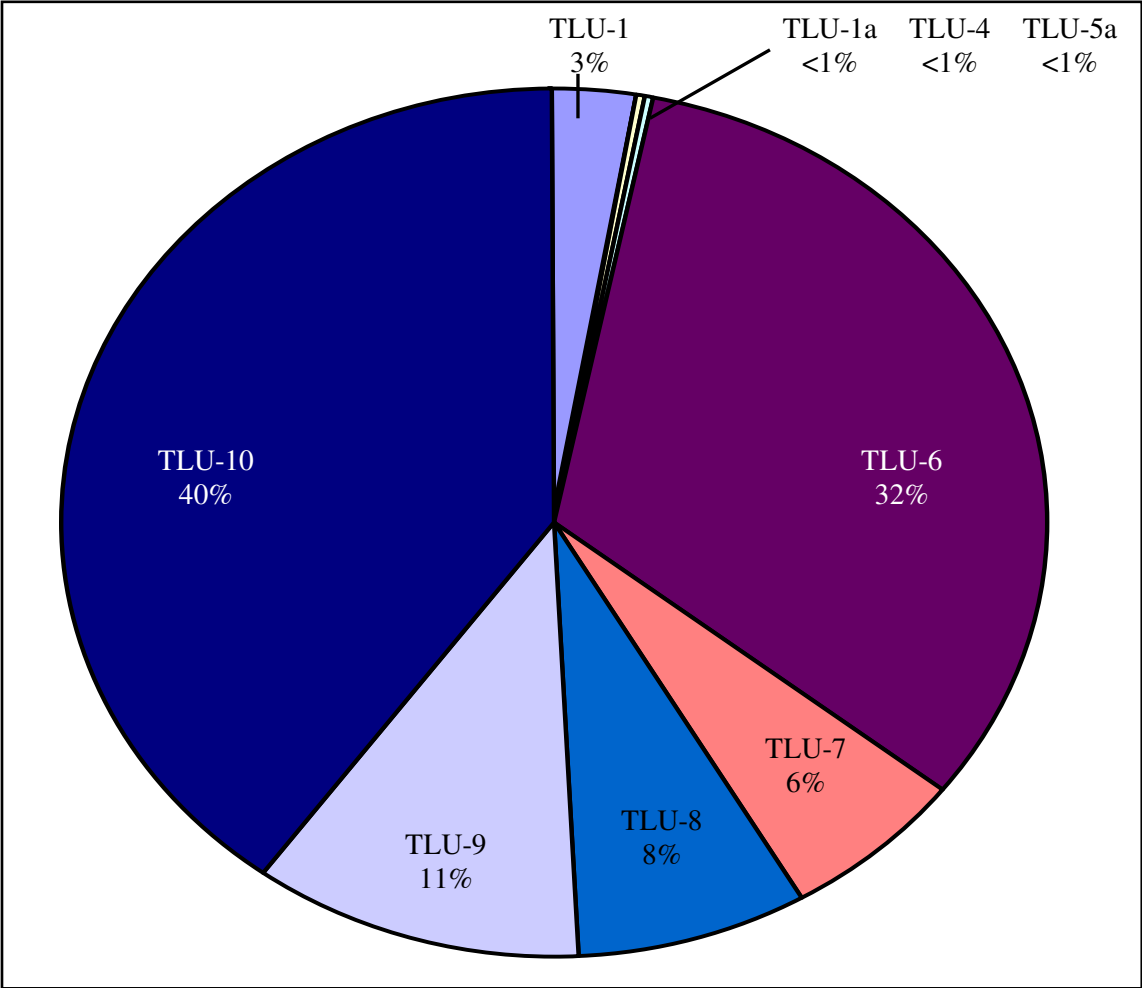
Negative values in the Net Present Value and the Cost-Effectiveness columns represent net cost savings.

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

Deduct total TLU-6 2009-2020 reductions [17.7MMt] from 55.03 total = 37.3, before calculating cost/ton for TLU Options.

Figure 5-2 shows the breakdown of the projected impacts of the TLU policies selected for further development, taken together, in terms of avoided GHG emissions. For the TLU policies developed by the ICCAC to yield the levels of savings described here, the policies must be implemented in a timely, aggressive, and thorough manner. This means, for example, not only putting the policies themselves in place, but also attending to the development of supporting policies that are needed to help make these TLU policies effective. While their adoption can result in considerable benefits to Iowa's environment and consumers, careful, comprehensive, and detailed planning and implementation, as well as consistent support of these policies will be required if these benefits are to be achieved.

Figure 5-2. Aggregate GHG Emission Reductions, 2009–2020



## Transportation and Land Use Sectors Policy Descriptions

The policy options described briefly here not only result in significant emission reductions but also offer a host of additional benefits, such as reduced local air pollution; more livable, healthier communities; and increased transportation choices. A more thorough description of these policy options along with their goals, implementation strategies, and other details is available in Appendix H.

### **TLU-1. Smart Growth Bundle with Transit**

This policy option calls for incentives and programs to encourage smart growth, including downtown revitalization, transit-oriented development, and enhancing the pedestrian and bicycle infrastructure, thereby reducing VMT. Current land-use development practices increase vehicle travel by dispersing destinations, which separates activities and favors automobile travel over alternative modes. "Smart growth" planning by local, regional, and state governments refers to development that reduces sprawl and maximizes environmental, fiscal, and economic resources. Under this policy option, Iowa would encourage, facilitate, and undertake a set of smart growth activities related to the following initiatives: downtown revitalization including infill and brownfield redevelopment, transit-oriented development, smart growth planning, the development of pedestrian and bicycle infrastructure, growth management planning, and the reformation of local zoning, tax, and building codes. Additionally, this policy option would provide both technical and financial support to local and regional agencies.

### **TLU-1a. Expand & Improve Transit Infrastructure**

The goal of this policy option is to achieve an annual ridership increase of 100% by the year 2020, to be measured on a per capita basis. This will be achieved by making improvements to existing transit service, such as increasing service frequency, offering more forms of transit, improving the quality of service, promoting ridesharing activities, and reducing travel times on selected transit routes. Additionally fare reductions, employer subsidies, and state incentives may all be offered to assist in increasing ridership. This policy option will shift passenger transportation from single-occupant vehicles to public transit, thereby reducing GHG emissions.

Additional funding will be provided by increasing state financing to at least 25% for transit systems across the state with increasing ridership or the ability to document VMT-reducing strategies. State legislation will also be proposed to enable new transportation-related fees, generated solely by users in a regional area, to be allocated directly to RTAs for VMT-reducing services.



**TLU-2. GHG Impacts for State and Local Capital Funding (to be a model for climate-friendly development patterns)**

The focus of this policy option is to ensure that state and local capital funding programs for the development, siting, and expansion of state facilities as well as funding used for community development, is utilized to promote policies and facilities that support GHG emission reductions. This includes making state and local government buildings location-efficient with compact development design, and ensuring that capital funding for infrastructure and funding for community development goes towards policies and development that promotes GHG reductions. Programs such as “complete streets”, smart growth development, and the development or enhancement of transit are all identified as projects that support GHG emission reductions and for which funding associated with this policy option could be dedicated.

**TLU-4. Support Passenger Rail Service In Iowa**

This policy option will focus on reducing single occupant vehicle travel by establishing and promoting a statewide passenger rail system in Iowa to supplement existing long-distance service. This rail system will include regional rail service from Dubuque to Chicago and between Omaha and Chicago with stops in Des Moines, Iowa City / Cedar Rapids, and the Quad Cities. A key to the success of this statewide passenger rail system will be in providing connections to other modes of transportation.

**TLU-5a. Adopt Best Workplaces for Commuters in Iowa**

This policy option focuses on reducing the VMT associated with commuters traveling to and from work. By making the daily commute more efficient or possibly eliminating the need for commuting to work, this policy reduces GHG emissions by reducing VMT. Promoting strategies such as telecommuting, carpooling, and vanpooling, and the use of alternative modes of transportation such as transit, bicycling, and walking to work this policy can be very effective at reducing VMT and roadway congestion during the peak commuting hours. The success of this policy option would depend upon buy-in from employers.

**TLU-5b. Distributed Workplace Model**

This policy option focuses on the commuting patterns of Iowa’s knowledge-based workforce. The Distributed Workplace Model is a community work model that moves beyond the “work from home” methodology of telecommuting and remotely supporting employees, and instead provides community-based multi-location work centers that will enhance access for both employers and employees. These work centers will accommodate a cluster of employees working for multiple employers, thereby reducing VMT associated with the commute to work.

#### **TLU-6. Light-Duty Vehicle Fuel Efficiency Incentives**

This policy option focuses on reducing GHG emissions within Iowa by improving the fuel economy of the light duty vehicle fleet by providing incentives such as feebates, tax credits for low-GHG vehicles, operating incentives for low-GHG vehicles, and vehicle registration fees which are reduced for low-emission vehicles and increased for high-emission vehicles. The goal of this policy would be to increase the fuel economy of the light duty vehicle fleet in Iowa by 20% by 2012, 100% by 2020, and 250% or more by 2050. This policy option would need to pass through the legislative process and implemented by state and local government agencies in partnership with the affected parties.

This policy option assumes no direct correlation between fuel economy and GHG emission efficiency. Although it is likely that an increase in fuel economy will result in reduced GHG emissions, the amount of this decrease or potential increase is dependent upon the carbon content and energy content of the fuel.

#### **TLU-7a. Fuel Efficient Operations for Light-Duty Vehicles**

This policy option focuses on improving the efficiency of light-duty vehicles by increasing the utilization of simple add on devices such as fuel efficient tires, and providing education on how to efficiently operate and maintain light duty vehicles. Maintenance tips would include items such as keeping tires properly inflated and regularly changing oil and air filters.

#### **TLU-8. New Vehicle Standards for Increased Fuel Economy and Reduced Greenhouse Gas Emissions**

This policy option promotes the development of a state clean car program. This program would go beyond the current federal CAFÉ emissions standards for cars and light trucks and would come from the “Tier 2” state clean car standards expected to be proposed in the near future under the federal Clean Air Act. The goals of this program would be to improve fuel economy by 20% by 2012, 100% by 2020, and 250% or more by 2050.

#### **TLU-9. Freight Strategies (Truck and Rail)**

This policy option proposes reducing Iowa’s overall GHG emissions generated by freight movement through a combination of identifying actions to support efficient freight movement, removing both physical and operational bottlenecks, encouraging railroad capital investment, and providing incentives for trucking companies to invest in hybrid technology.

#### **TLU-10. Fuel Strategies: Low-Carbon Fuel Standard (20% Reduction)**

This policy option seeks to reduce GHG emissions by decreasing the carbon intensity of vehicles fuels sold in Iowa. By setting a Low Carbon Fuel Standard (LCFS), all fuel providers in Iowa would be required to ensure the mix of fuel they sell into the Iowa market meets, on average, a

declining standard for GHG emissions measured in CO<sub>2</sub> equivalent per unit of fuel energy. This policy option does not specify any particular fuel or vehicle technology, leaving the door open to both current technology and future advances in the development of low-carbon fuels. The creation in Iowa of a LCFS will compliment the Federal Renewable Fuel Standard (RFS) creating additional demand of Iowa's renewable fuels across the country and increasing exports of Iowa's renewable fuels across the country as other states begin formalizing their own state standards for renewable fuels and GHG controls.

# Chapter 6

## Agriculture, Forestry, and Waste Management

### Overview of GHG Emissions

While the agriculture, forestry, and waste management (AFW) sectors are responsible for significant greenhouse gas emissions, the sector is also a significant sink for greenhouse gases in soils and in forest stocks. The gross AFW contribution to carbon dioxide equivalent (CO<sub>2</sub>e) emissions in 2005 was 30 million metric tons (MMt), or about 25% of the state's total. However, the AFW contribution to net emissions in 2005 was only 3 MMtCO<sub>2</sub>e due to the net sequestration of carbon in the forestry and agriculture sectors. As described in the Iowa Inventory and Forecast (I&F) report, it is important to recognize that emissions from fossil fuel consumption within the AFW sectors are included within the residential, commercial, and industrial (RCI) sectors (particularly the industrial sector).

Agricultural emissions include methane (CH<sub>4</sub>) and nitrous oxide (N<sub>2</sub>O) emissions from enteric fermentation, manure management, agricultural soils management, and agriculture residue burning. These emissions were estimated to be about 28 MMtCO<sub>2</sub>e in 2005. As shown in Figure 6-1, emissions from soil carbon losses from agricultural soils, manure management, fertilizer application, and crop residues all make significant contributions to the sector totals. Emissions include CO<sub>2</sub> emissions from oxidized soil carbon, application of urea, and application of lime. Sector emissions also include N<sub>2</sub>O emissions resulting from activities that increase nitrogen in the soil, including fertilizer (synthetic, organic, and livestock) application and production of nitrogen-fixing crops (legumes).

The largest source of emissions in the agricultural sector is the agricultural soils category, whose emissions are projected to hold steady from 1990 to 2025, accounting for 62% (15.7 MMtCO<sub>2</sub>e) of total gross agricultural emissions in 1990 and 60% (15.3 MMtCO<sub>2</sub>e) in 2025. In 1990, enteric fermentation accounted for about 20% (5.04 MMtCO<sub>2</sub>e) of total gross agricultural emissions. Enteric fermentation emissions decreased slightly to 4.26 MMtCO<sub>2</sub>e between 1990 and 2005 due to the decline in livestock populations during this period. Both the dairy cattle and beef cattle populations are projected to decrease in the future, and enteric fermentation emissions are estimated to decrease to 2.98 MMtCO<sub>2</sub>e in 2025, or about 12% of agricultural emissions.

The manure management category accounted for 18% (4.49 MMtCO<sub>2</sub>e) of total agricultural emissions in 1990 and increased to 24% (6.64 MMtCO<sub>2</sub>e) by 2005. Manure management is projected to increase slightly by 2025, to account for 27% (7.01 MMtCO<sub>2</sub>e) of total agricultural emissions at that time. This is largely due to the projection that the swine population will increase between 2005 and 2025.

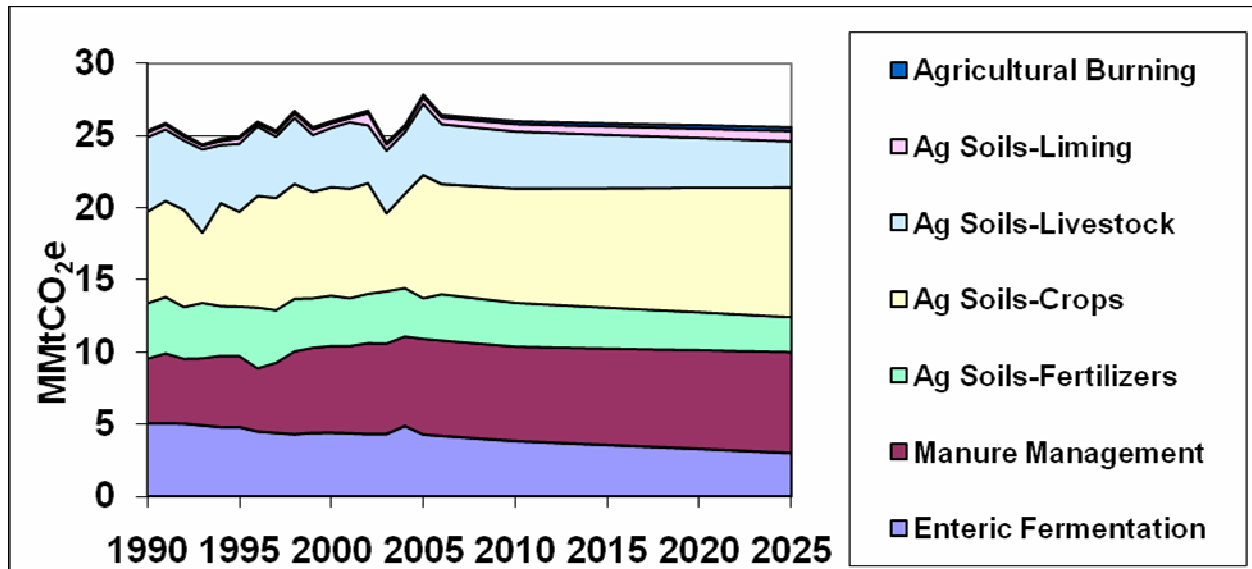
Forestland emissions refer to the net CO<sub>2</sub> flux<sup>1</sup> from forested lands in Iowa, which account for about 8% of the state's land area.<sup>2</sup> As shown in Table 6-1, U.S. Forest Service (USFS) data

<sup>1</sup> "Flux" refers to both emissions of CO<sub>2</sub> to the atmosphere and removal (sinks) of CO<sub>2</sub> from the atmosphere.

<sup>2</sup> Total forested area and forest type percentages provided by P. Tauke, Iowa Department of Natural Resources [DNR] to M. Stein (DNR) on March 21, 2008. The total land area in Iowa is 35.8 million acres (<http://www.50states.com/iowa.htm>).

suggest the total flux estimate including all forest pools is  $-12.2$  MMtCO<sub>2</sub>e/yr between 1990 and 2003, and is  $-24.4$  MMtCO<sub>2</sub>e/yr between 2003 and 2005.<sup>3</sup> These totals include large sink estimates for soil carbon ( $-4.3$  and  $-9.2$  MMtCO<sub>2</sub>/yr). The negative trend in carbon flux (sequestration) is likely due to the increase in timberland between 1990 and 2005.

**Figure 6-1. Historical and projected gross GHG emissions from the agriculture sector, Iowa, 1990–2025**



MMtCO<sub>2</sub>e = million metric tons of carbon dioxide equivalent

Notes: Ag Soils – Crops category includes: incorporation of crop residues and nitrogen-fixing crops (no cultivation of histosols estimated); emissions for agricultural residue burning are too small to be seen in this chart.

**Table 6-1. Annual forest carbon fluxes for Iowa**

Forest Pool	1990-2003 Flux (MMtCO <sub>2</sub> )	2003-2005 Flux (MMtCO <sub>2</sub> )
Forest Carbon Pools (non-soil)	-7.76	-15.1
Soil Organic Carbon	-4.28	-9.17
Harvested Wood Products	-0.12	-0.12
<b>Totals</b>	<b>-12.2</b>	<b>-24.4</b>
<b>Totals (excluding soil carbon)</b>	<b>-7.88</b>	<b>-15.3</b>

MMtCO<sub>2</sub>e = million metric tons of carbon dioxide equivalent

Note: Positive number indicates net emission. Based on U.S. Forest Service input, emissions from soil organic carbon are excluded from the forestry sector summary due to a high level of uncertainty.

Table 6-2, below, summarizes the estimated flux for the entire forestry and land use sector.

<sup>3</sup> Jim Smith, USFS, *US. Forest Carbon Calculation Tool: Forest-Land Carbon Stocks and Net Annual Stock Change* (<http://www.nrs.fs.fed.us/pubs/2394>), December 2007.

**Table 6-2. Forestry and land use flux and reference case projections (MMtCO<sub>2</sub>e)**

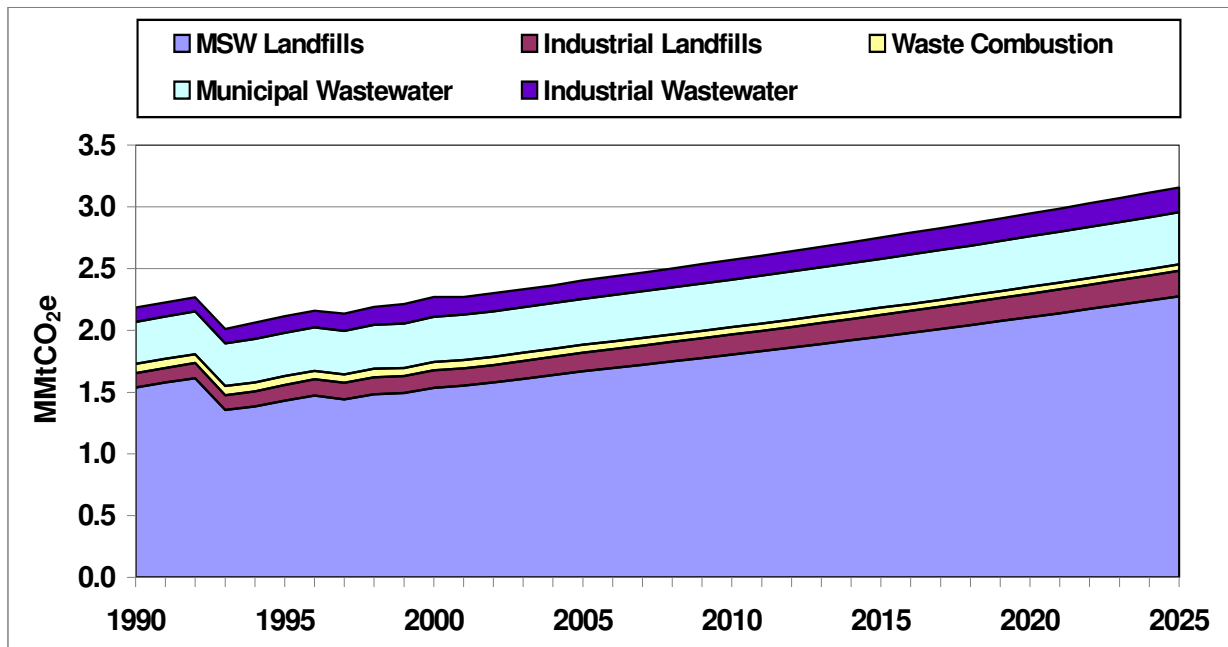
Subsector	1990	1995	2000	2005	2010	2020
Forested Landscape (excluding soil carbon)	-7.88	-7.88	-7.88	-15.3	-15.3	-15.3
Urban Forestry and Land Use	-2.59	-1.31	-0.65	-0.63	-0.63	-0.63
Forest Wildfires	N/A	N/A	N/A	N/A	N/A	N/A
<b>Sector Total</b>	<b>-10.5</b>	<b>-9.19</b>	<b>-8.53</b>	<b>-15.9</b>	<b>-15.9</b>	<b>-15.9</b>

MMtCO<sub>2</sub>e = million metric tons of carbon dioxide equivalent.

Note: Positive numbers indicate net emission. N/A = not available.

Figure 6-2 shows estimated historical and projected emissions from the management and treatment of solid waste and wastewater. Emissions from waste management consist largely of CH<sub>4</sub> emitted from landfills, while emissions from wastewater treatment include both CH<sub>4</sub> and N<sub>2</sub>O. Emissions are also included for municipal solid waste (MSW) combustion. Figure 6-2 illustrates that emissions from MSW landfills are projected to increase significantly through 2025. Overall, the waste management sector accounts for about 2% of Iowa’s total gross emissions per year from 1990 through 2025.

**Figure 6-2. Estimated historical and projected emissions from waste and wastewater management in Iowa**



MMtCO<sub>2</sub>e = million metric tons carbon dioxide equivalent; MSW = municipal solid waste.

Opportunities for GHG mitigation in the AFW sector involve measures that can reduce emissions within the sector or in other sectors. Examples of reductions that can occur within the sector include changes in crop management practices that reduce GHG emissions by building soil carbon (indirectly sequestering carbon from the atmosphere); more efficient nutrient application (reducing N<sub>2</sub>O emissions—note that emissions outside of the AFW sectors are also

reduced here due to the embedded energy in nutrients and the potential for lower energy consumption during their application); reforestation projects that achieve GHG reductions by increasing the carbon sequestration capacity of the state's forests; and landfill gas collection and control, which reduces methane emissions from landfills.

For GHG reductions outside of the AFW sectors, actions taken within the sectors, such as production of liquid biofuels, can offset emissions in the transportation sector, while biomass energy can reduce emissions in the energy supply, residential, commercial, and industrial sectors. Similarly, actions that promote solid waste reduction or recycling can reduce emissions within the AFW sectors (future landfill CH<sub>4</sub>), as well as emissions associated with the production of recycled products (recycled products often require less energy to produce than similar products from raw materials). Finally, urban forestry projects can reduce energy consumption within buildings through shading and wind protection.

Following are primary opportunities for GHG mitigation identified by the Iowa Climate Change Advisory Council (ICCAC).

- **Nutrient management:** Increasing the efficiency and improving the distribution of nutrient application can reduce on-field application of nitrogen and reduce formation of N<sub>2</sub>O. Reductions may also occur when nitrogen runoff and leaching are reduced.
- **Wetlands and drainage:** Redesigning Iowa drainage systems with the consideration of GHG benefits can result in significant GHG benefits over the longer term through reduced nitrogen transport to water resources, which reduces N<sub>2</sub>O emissions by reducing denitrification from wet and seasonally flooded croplands.
- **Expanded use of forest and agricultural biomass:** Expanding the use of biomass energy from residue removed from forested areas during treatments to reduce fire risk, from crop residues and purpose-grown crops, and from livestock manure/poultry litter can achieve GHG benefits by offsetting fossil fuel consumption (to produce either electricity or heat/steam). Programs to expand sustainably procured biomass fuel production will most likely be needed to supply a portion of the fuel mix for the renewable energy goals under the Energy Efficiency and Conservation (EEC) and Clean and Renewable Energy (CRE) Subcommittees.
- **Manure management and methane utilization:** The capture and utilization of methane from livestock manure can reduce GHG emissions through reduced methane emissions and through offsetting fossil fuel-based energy production and the associated GHG emissions. Additionally, implementing improved manure handling and storage programs, practices, and technologies can reduce methane emissions from animal operations.
- **Land management to promote sequestration benefits:** Significant opportunities exist through the adoption of a number of different land management practices that either reduce emissions or increase sequestration. These include increasing the use of conservation tillage practices, converting marginal agricultural land to higher-sequestration permanent cover, implementing conservation grazing practices, establishing afforestation programs, and increasing urban tree coverage.

- **Cellulosic biofuels:** Producing renewable fuels, such as ethanol from energy crops, crop residue, forestry residue, or municipal solid waste can produce significant reductions when they are used to offset consumption of fossil fuels (e.g., gasoline and diesel in the transportation sector). This is particularly true when these fuels are produced using processes and/or feedstocks that emit much lower GHG emissions than those from conventional sources (e.g., corn-based ethanol).
- **Improved on-farm (or first point of purchase) energy use and efficiency:** On-farm energy efficiency and renewable energy offer emission savings and reduced costs to land owners.
- **Changes in municipal solid waste management practices:** Concentrating on enhancing the source reduction, recycling, and organics management (e.g., composting practices) in the state can result in significant GHG emission reductions. Also, for waste remaining after full implementation of these “front-end” practices, appropriate GHG-beneficial “end-of-life” practices should be implemented, including enhanced landfill gas collection and utilization.

## Key Challenges and Opportunities

Within the agriculture sector, the ICCAC recommends programs to promote farming practices that achieve GHG benefits, such as conservation tillage where soil management programs increase soil carbon levels, thereby indirectly sequestering carbon from the atmosphere. These programs were estimated to achieve reductions of approximately 9 MMtCO<sub>2</sub>e per year by 2020 through the implantation of conservation tillage practices on 75% of annual cropland by 2020.

Additionally, initiatives to reduce methane emissions from livestock manure through improved manure handling and storage practices and the capture and utilization of methane offer significant potential at low or negative costs. However, the feasibility of utilizing methane and displacing natural gas or electricity may be limited by the lack of sufficiently large dairy farms, seasonal variability, and the limited demand by nearby industries.

ICCAC policy option AFW-3 promotes the expanded use of biomass as an energy source for producing electricity, heat, or steam. Use of biomass to replace fossil fuels was estimated to reduce approximately 20 MMtCO<sub>2</sub>e by 2020. The ICCAC conducted a limited assessment of the available biomass resources in the state, which indicated that sufficient resources are available through 2020 to achieve the goals for both the cellulosic biofuels policy option (discussed below) and this biomass for energy option. A key challenge to the implementation of this policy is the proximity of the feedstock to the end user.

The ICCAC found significant opportunity in promoting biofuels production using feedstocks and production methods with superior GHG benefits (i.e., superior to conventional starch-based ethanol), almost 10 MMtCO<sub>2</sub>e by 2020. The ICCAC noted that there may be an overlap between the cellulosic biofuels option with agricultural options that seek to increase and maintain crop acreage in no-till production or in conservation management programs (i.e., in relation to using crop residue as an energy feedstock).

Within the forestry sector, afforestation, unmanaged grazed forested land, and urban forestry (all components of AFW-5) have the potential to deliver over 1 MMtCO<sub>2</sub>e/year of GHG reductions in 2020. By 2020, these programs call for establishing 250,000 acres of new forestlands,



improving management practices on 500,000 acres of unmanaged grazed forested land, and increasing the canopy cover of urban forest in Iowa communities by 25%.

AFW-8 and AFW-9 provide an integrated set of policy options for future management of municipal solid waste in Iowa. AFW-8 focuses on “front-end” waste management technologies—source reduction, recycling, and composting—while AFW-9 focuses on “end-of-use” waste management approaches. Source reduction and recycling will result in avoided landfill GHG emissions, as well as avoided product/packaging life-cycle GHG emissions. The combined front-end waste management elements produce substantial GHG savings—almost 5 MMtCO<sub>2</sub>e in 2020.

## **Overview of Policy Options and Estimated Impacts**

As noted above, the nine policy options for the AFW sectors address a diverse array of activities. Taken as a whole, they offer significant cost-effective emission reductions, as shown in Table 6-3.

Figure 6-3 shows the breakdown of the cumulative emission reductions (2009–2020) anticipated from the recommended actions in the AFW sectors. The greatest emission reductions achieved (31%) come from implementation of land management to promote sequestration benefits (AFW-5). The majority of these reductions are associated with increasing the use of conservation tillage practices.

The expanded use of agriculture and forestry biomass feedstocks for electricity, heat, or steam production (AFW-3) also offers significant GHG reductions, even after accounting for overlap with the CRE Subcommittee policies. Significant reductions are also achieved through AFW-6 cellulosic fuel incentives (16%), AFW-8 waste management strategies (11%), and AFW-4 large-scale manure/methane management, capture, and utilization (9%). Emission reductions from waste management strategies are life-cycle GHG reductions that occur both within and outside of Iowa (resulting from lower energy use and GHG emissions to create, transport, and dispose of new products and packaging that are avoided through source reduction and recycling). It is important to note that AFW-3 and AFW-6 overlap with policy options under the Transportation and Land Use (TLU) and CRE Subcommittees, respectively. After accounting for overlap, these policies contribute a significantly smaller proportion to the AFW sector total.

Table 6-3, the summary list of policy options, and Figure 6-3, a pie chart showing the percentage of avoided greenhouse gas emissions by policy, are on the following two pages.

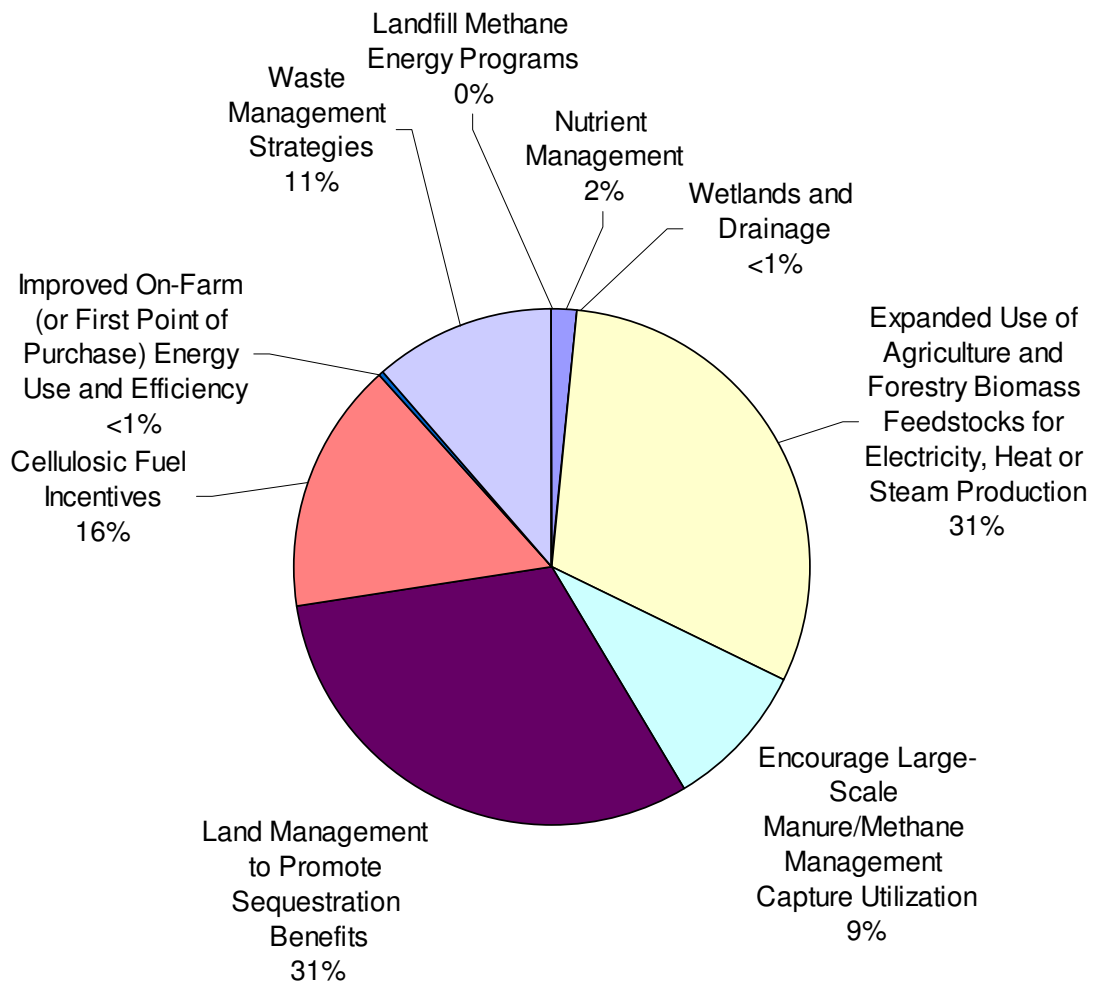
**Table 6-3. Summary List of Policy Options**

No.	Policy Option	GHG Reductions (MMtCO <sub>2e</sub> )			Net Present Value 2009–2020 (Million \$)	Cost-Effectiveness (\$/tCO <sub>2e</sub> )	Level of Support
		2012	2020	Total 2009–2020			
AFW-1	Nutrient Management						Majority (7 Objections)
	Increase Efficiency of Fertilizer	0.11	0.53	3.0	–\$103	–\$34	
	Seasonally Flooded Areas	0.002	0.009	0.05	\$10	\$194	
	Improved Nutrient Distribution	0.02	0.1	0.55	\$373	\$693	
AFW-2	Wetlands and Drainage	0.01	0.16	0.57	\$120	\$218	Super Majority (5 Objections)
AFW-3	Expanded Use of Agriculture and Forestry Biomass Feedstocks for Electricity, Heat, or Steam Production	4.4	20	113	\$4,281	\$38	Unanimous
AFW-4	Encourage Large-Scale Manure/Methane Management Capture Utilization						Unanimous
	Methane Management Capture Utilization	0.8	3	17	\$63	\$4	
	Manure Management	0.2	0.7	4.6	–\$38	–\$8	
AFW-5	Land Management to Promote Sequestration Benefits						Unanimous
	Conservation Tillage	2.9	9	56	–\$6	–\$0.1	
	Agriculture Land Conversion	0.1	0.4	2.6	\$199	\$76	
	Conservation Grazing	0.1	0.3	1.7	–\$116	–\$67	
	Afforestation	0.2	0.6	4.1	\$216	\$53	
	Unmanaged Grazed Forested Land	0.3	0.8	5.5	\$93.7	\$17	
	Urban Forestry	0.1	0.4	2.4	–\$99	–\$41	
AFW-6	Cellulosic Biofuel*	2.0	9.8	49	–\$1,410	–\$29	Unanimous
AFW-7	Improved On-Farm (or First Point of Purchase) Energy Use and Efficiency						Unanimous
	Renewable Energy	0.02	0.08	0.5	\$23	\$51	
	Energy Efficiency	0.2	0.9	5.9	–\$610	–\$104	
AFW-8	Waste Management Strategies	1.5	4.1	26.5	–\$220	–\$8	Unanimous
AFW-9	Landfill Methane Energy Programs	0.2	0.8	4.8	\$4	\$0.8	Unanimous
	<b>Sector Total After Adjusting for Overlaps</b>	<b>11</b>	<b>37</b>	<b>233</b>	<b>\$2,139</b>	<b>\$9</b>	
	<b>Reductions From Recent Actions</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>\$0.0</b>	<b>\$0.0</b>	
	<b>Sector Total Plus Recent Actions</b>	<b>11</b>	<b>37</b>	<b>233</b>	<b>\$2,139</b>	<b>\$9</b>	

GHG = greenhouse gas; MMtCO<sub>2e</sub> = million metric tons carbon dioxide equivalent; \$/tCO<sub>2e</sub> = dollars per ton of carbon dioxide equivalent.

\* Note that the costs/savings of this option include a \$1.01/gallon federal subsidy for cellulosic ethanol.

**Figure 6-3. Percentage of avoided greenhouse gas emissions by policy**



## **Agriculture, Forestry, and Waste Management Sectors Policy Descriptions**

The AFW sectors include emission mitigation opportunities related to the use of biomass energy, protection and enhancement of forest and agricultural carbon sinks, control of agricultural CH<sub>4</sub> and N<sub>2</sub>O emissions, production of renewable liquid fuels, production of additional biomass energy, forestation on nonforested lands, and an increase in municipal solid waste source reduction, recycling, composting, and landfill gas collection.

### **AFW-1 Nutrient Management**

This policy option promotes the use of improved manure management practices that reduce GHG emissions associated with manure handling and storage, including manure composting to reduce CH<sub>4</sub> emissions, movement of manure from nutrient-rich to nutrient-deficient areas, and improved methods for application to fields (for reduced N<sub>2</sub>O emissions). Application improvements include incorporating manure into soil instead of surface spraying or spreading.

### **AFW-2 Wetlands and Drainage**

This policy promotes the redesigning of drainage infrastructure over the next fifty years. Designing to reduce nitrogen transport to water resources also reduces N<sub>2</sub>O emissions in Iowa and downstream, with significant global GHG benefits over the longer term. This is due to the function of strategically targeted and designed denitrification wetland systems and the long life of both the wetlands and the drainage systems.

### **AFW-3 Expanded Use of Agriculture and Forestry Biomass Feedstocks for Electricity, Heat, or Steam Production**

This policy dedicates a sustainable quantity of biomass from agricultural industry residues, agricultural lands, wood industry process residues, unused forestry residues, agroforestry resources, and dedicated energy crops to efficient conversion to heat, steam, or electricity. This biomass should be collected and used in an environmentally acceptable manner, considering proper facility siting and feedstock use (e.g., proximity of users to biomass, impacts on water supply and quality, control of air emissions, cropping management, nutrient management, soil and nonsoil carbon management, and impacts on biodiversity and wildlife habitat). The objective is to create concurrent reduction of GHG emissions due to displacement of fossil fuel, considering life-cycle emissions associated with viable collection, hauling, and energy conversion and distribution systems. Local electricity or steam production yields the greatest net energy payoff.

*Note: This option is linked with some Clean and Renewable Energy (CRE) options (e.g., CRE-2<sup>4</sup> and CRE-13). AFW-3 focuses on the supply elements of the implementation of a biomass-to-energy program (e.g., availability, collection, and distribution), while the CRE options focus on the demand side (e.g., generation infrastructure and purchasing for consumers).*

#### **AFW-4 Encourage Large-Scale Manure/Methane Management Capture Utilization**

This policy is aimed at improving manure handling and storage practices; reducing methane emissions from livestock manure by installing large-scale anaerobic digester systems at concentrated animal feeding operations (CAFOs); and utilizing methane captured from the digesters to create heat or power, which offsets fossil fuel-based energy production and the associated GHG emissions. This option is focused on implementing these projects on a large scale (e.g., community-based systems or large CAFOs).

#### **AFW-5 Land Management to Promote Sequestration Benefits**

This policy option addresses a range of land management practices. On cultivated lands, the amount of carbon stored in the soil can be increased by the adoption of such practices as continuous conservation and no-till cultivation. By minimizing mechanical soil disturbance, these practices reduce the oxidation of soil carbon compounds and allow more stable aggregates to form. Converting marginal agricultural land used for annual crops to permanent cover (e.g., grassland/rangeland) increases the soil carbon or carbon in biomass. Rotational grazing, where animals are regularly moved from field to field, can reduce soil disturbance, improve plant vigor, and enhance soil carbon levels. Establishing forests on land that has not historically been forested (e.g., afforestation of agricultural land) and maintaining and improving the health and longevity of urban trees enhance the carbon stored in tree biomass. Indirect emission reductions from urban forestry may also occur by reducing heating and cooling needs as a result of planting shade trees.

#### **AFW-6 Cellulosic Biofuels**

This policy promotes sustainable in-state production of cellulosic biofuels from agriculture, forestry, and MSW feedstocks (raw materials) to displace the use of conventional petroleum-based fuels. It also promotes advanced biofuel production systems that improve the embedded energy content and carbon profile of biofuels. It focuses on feedstocks that favor energy production and are carbon neutral or carbon negative and that have multiple positive environmental benefits, such as maintaining carbon sequestration potential and soil productivity, and decreasing water and fossil fuel inputs during their production. This could help provide a strong economic market within the state and reduce GHG emissions through avoided fossil fuel consumption. This option also promotes the in-state development of cellulosic material and perennials that are able to be utilized.

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<sup>4</sup> CRE-2 incorporates or adjusts for biomass used by CRE-5 and CRE-8.

*Note: This option is linked with option TLU-10. AFW-6 focuses on the supply elements of the implementation of a biofuels program, while TLU-10 focuses on the demand side (e.g., vehicle technology requirements, E10, E85).*

#### **AFW-7 Improved On-Farm (or First Point of Purchase) Energy Use and Efficiency**

On-farm energy efficiency and renewable energy offer emission savings and reduced costs to landowners. Renewable energy can be produced and used on site at agriculture operations (e.g., installing solar or wind power, using hydropowered generators for irrigation, and converting diesel farm equipment to more efficient or renewable energy technology). The use of energy-efficient products, such as improved grain dryers, heat exchangers (dairy), electric motors, and energy-efficient building design, also offers significant potential for GHG reduction.

#### **AFW-8 Waste Management Strategies**

This policy option focuses on reducing the volume of waste from residential, commercial, and government sectors through programs that reduce the generation of waste. Reducing generation at the source reduces landfill emissions and upstream production emissions. Increasing recycling or reusing waste limits GHG emissions associated with landfill methane generation and with the production and transport of products and packaging from virgin materials (noting that different recycled materials will exhibit different costs and benefits on a life-cycle basis). Increasing recycling programs, creating new recycling programs, providing incentives for recycling construction materials, developing markets for recycled materials, and increasing average participation and recovery rates for all existing recycling programs can reduce overall emissions. Increasing organics management programs, such as composting, reduces GHG emissions associated with landfilled organic waste.

#### **AFW-9 Landfill Methane Energy Programs**

This policy promotes activities that further reduce GHG production by encouraging the use of energy recovery technologies. The focus is on the utilization of methane at landfills through the enabling of anaerobic digesters to capture and utilize that energy through electric power, heating, or liquefied natural gas. These technologies will help reduce GHG emissions from waste management, while producing cleaner energy. They make a twofold contribution to climate protection, by reducing emissions of methane and other GHGs into the atmosphere (via collection and control), and offsetting energy that would have otherwise come from fossil fuels. Methane gas generation by landfills is a GHG reduction strategy that may benefit from a cap-and-trade system, encouraging landfills to install flares at a minimum and possibly achieve electric generation if the economic incentives are sufficient.

# Chapter 7

## Cross-Cutting Issues

### Overview of Cross-Cutting Issues

Some issues relating to climate policy cut across multiple sectors. The Iowa Climate Change Advisory Council (ICCAC) addressed such issues explicitly in a separate Cross-Cutting Issues (CC) Subcommittee (SC). Cross-cutting options typically encourage, enable, or otherwise support emission mitigation activities and/or other climate actions. The types of policies considered for this sector are not readily quantifiable in terms of greenhouse gas (GHG) reductions and costs or cost savings. Nonetheless, if successfully implemented, they help build a foundation for other options and will contribute to GHG emission reductions and implementation of the ICCAC's policy options described in Chapters 3–6 of this report.

The CC SC developed options for eight policies (see Table 7-1) that were then reviewed, revised, and ultimately adopted by the ICCAC members present and voting. Seven of the options are focused on enabling GHG emission reductions and mitigation activities, while one (CC-7-Adaptation and Vulnerability) addresses adaptation to the changes expected from the effects of GHGs that will remain in the atmosphere for decades.

### Key Challenges and Opportunities

The ICCAC was charged with identifying a baseline case and GHG reduction scenarios with at least one of those scenarios aimed at achieving a 50% reduction of GHGs below a baseline year by 2050. In addition, the ICCAC chose to look at a second scenario aimed at achieving a 90% reduction of GHGs below the baseline by 2050. ICCAC established 2005 as the baseline year and identified a short-term target of reducing the 2005 GHG baseline by 1% by 2012 and a mid-term target of 11% by 2020 on the way to a 50% reduction by 2050. In the second scenario ICCAC identified a short-term target of reducing the 2005 GHG baseline by 3% by 2012 and a mid-term target of 22% by 2020 on the way to a 90% reduction by 2050.

The ICCAC based its options on its review of the potential overall emission reduction estimates (as compared to the GHG emissions inventory and forecast for business as usual) for 37 of 54 policy options for which emission reductions were quantified. It also considered the goals and scenarios adopted by several other states in its deliberations. While 17 other ICCAC policy options were not readily quantifiable, some of them would most likely achieve additional reductions, including several of the Cross-Cutting policy options.

The ICCAC just completed its first year of operation and has at least two more years to function under the original legislation. One of the first challenges it has is to develop its ongoing role and the priority areas it should focus on first following completion of this report. It will need to develop more detailed implementation plans and strategies to carry out many of the initiatives

proposed herein. A key challenge will be to identify resources that can be used to facilitate development of such implementation plans and strategies. A closely related challenge for the state will be to identify available resources needed to implement many of the initiatives outlined in this report. ICCAC will need to work closely with the Iowa Department of Natural Resources (DNR), the Iowa Power Fund and the Iowa Energy Center to examine these opportunities.

**Table 7-1. Cross- Cutting Issues Policy Options**

Policy No.	Policy Option	GHG Reductions (MMtCO <sub>2</sub> e)			Net Present Value 2009–2020 (Million \$)	Cost-Effectiveness (\$/tCO <sub>2</sub> e)	Status of Option
		2012	2020	Total 2009–2020			
CC-1	GHG Inventories, Forecasting, Reporting, and Registry	<i>Not Quantified</i>					Unanimous
CC-2	Statewide GHG Reduction Scenarios	<i>Not Quantified</i>					Majority (4 Objections)
CC-3	State and Local Government GHG Emissions (Lead by Example)	<i>Not Quantified</i>					Unanimous
CC-4	Public Education and Outreach	<i>Not Quantified</i>					Unanimous
CC-5	Tax and Cap Policies—Lead Transferred to the CRE SC	<i>Not Quantified</i>					Transferred
CC-6	Seek Funding for Implementation of ICCAC options	<i>Not Quantified</i>					Unanimous
CC-7	Adaptation and Vulnerability	<i>Not Quantified</i>					Unanimous
CC-8	Participate in Regional and Multi-state GHG Reduction Efforts	<i>Not Quantified</i>					Unanimous
CC-9	Encourage the Creation of a Business-Oriented Organization To Facilitate Investment in Climate-Related Business Opportunities and To Share Information and Strategies, Recognize Successes, and Support Aggressive GHG Reduction Goals	<i>Not Quantified</i>					Unanimous

GHG = greenhouse gas; MMtCO<sub>2</sub>e = million metric tons of carbon dioxide equivalent; \$/tCO<sub>2</sub>e = dollars per metric ton of carbon dioxide equivalent; ICCAC = Iowa Climate Change Advisory Council; CRE = Clean and Renewable Energy; SC = ICCAC.

## Overview of Policy Options and Estimated Impacts

Cross-cutting issues include policies that apply across the board to all sectors and activities. Cross-cutting options typically encourage, enable, or otherwise support emission mitigation activities and/or other climate actions. The ICCAC developed eight such policy options for implementation in Iowa. All are enabling policy options that are not quantified in terms of tons of GHG reduction or costs.



Detailed descriptions of the individual Cross-Cutting policy options as presented to and approved by the ICCAC can be found in Appendix J of this report. Following are highlights of some of the options approved by ICCAC:

The state needs to enhance its capacity to conduct inventory, forecasting, reporting and registry functions. It should have the capacity to inventory and forecast all statewide anthropogenic sources and sinks annually with projections out twenty years. It needs to develop a mandatory GHG emission reporting system for sources over de minimis levels and will need to formulate consistent protocols to use in doing so.

ICCAC is presenting two GHG reduction scenarios to the Governor and Legislature to meet a 50% and a 90% reduction level, respectively, below 2005 levels by 2050. It is anticipated that the Legislature will take up the issue of goals and scenarios in the 2009 session and may provide more specific direction regarding selection of short, mid and long-term reduction goals and scenarios. If so the ICCAC may be called on to assist in prioritizing and designing more detailed implementation strategies. The state should also develop a tracking system to measure progress over time in achieving GHG reductions against the above goals and scenarios.

The state has already embarked on numerous initiatives to reduce GHG emissions and will need to continue to do so. ICCAC suggests that the Governor should consider establishing a Governors Challenge to the state agencies and people of Iowa to find more reductions. The state should also assist local governments in their efforts to join the state in “leading by example” to find more reductions. The state and local governments should find additional energy efficiencies and GHG reductions in their procurements for buildings, vehicle fleets and office equipment.

A key to building a broad base of awareness and support for the policy options included in this report will require a public education and outreach effort. The ICCAC has identified numerous strategies over the next three years to do so in conjunction with academic, business, local government and other partners in this process.

Given Iowa’s vulnerability to impacts of climate change the state should develop a Climate Change Adaptation Plan to identify plan for and manage these impacts.

The state is a participant in the Midwestern Governors Climate Accord and Energy Security and Climate Stewardship Platform. The state should continue this proactive engagement with other states in the region in developing cost-effective multi-state reduction strategies.

Finally, it has been demonstrated that there are numerous economic and employment opportunities associated with implementation of many of the GHG reduction policy options being recommended by ICCAC. The Council encourages the creation of a business oriented entity to capitalize on these opportunities to create green jobs in Iowa and to promote new business ventures in this arena.

## Cross-Cutting Issues Policy Descriptions

### CC-1. Inventories, Forecasting, Reporting and Registry

#### Policy Description

Greenhouse gas (GHG) emission inventories and forecasts are essential for understanding the magnitude of all emission sources and sinks (both man made [anthropogenic] and natural), the relative contribution of various types of emission sources and sinks to total emissions, and the factors that affect trends over time. Inventories and forecasts help to inform state leaders and the public on statewide trends and mitigation opportunities and in verifying GHG reductions associated with implementation of action plan initiatives.

GHG reporting supports tracking and management of emissions. It can help sources identify emission reduction opportunities, reduce risks associated with possible future GHG mandates through early participation, and construct periodic state GHG inventories. GHG reporting is a precursor for sources to participate in GHG reduction programs, and/or a GHG emission registry, as well as to secure “baseline protection” (i.e., credit for early reductions).

A GHG registry enables recording of GHG emissions in a central repository with “transaction ledger” capacity to support tracking, reductions management, and “ownership” of documented *emission* reductions; it offers recognition opportunities; and/or provides a mechanism for regional, multi-state, and cross-border cooperation. Properly designed registry structures also provide a foundation for possible future trading programs.

### CC-2. Statewide GHG Reduction Scenarios

#### Policy Description

To date, Iowa has not adopted any mandatory statewide GHG reduction goals. Iowa Code Reference 455B.152(3)(a) and (b) and 455B.152(4), which the Iowa legislature passed in 2007, requires the IDNR to establish a GHG inventory and a voluntary GHG gas registry for tracking, managing, and crediting entities in the state that reduce their generation of GHGs. Under the same legislation, the ICCAC is required to recommend a baseline year from which to calculate future GHG reductions, and to develop multiple scenarios to reduce GHG emissions in Iowa by 2050, including interim years with targeted goals. A 50% reduction scenario by 2050 was specified in the legislation, and the ICCAC in its January 1, 2008, interim report recommended an additional scenario of 90% reduction by 2050, with subsequent scenarios to be determined for interim years of 2012 and 2020. The baseline year for Iowa is recommended in the Interim Report to be 2005.

Governor Culver issued the Green Government Executive Order (Executive Order 6) on February 21, 2008, which sets the goal of reducing “the use of electricity, natural gas, fuel oil and water in all state office buildings by at least 15% overall in the next 5 years, taking into

account growth in the state workforce and/or changes in building operations.” This follows Governor Vilsack’s Executive Order 41 to reduce electricity and natural gas by 15% by 2010 from the year 2000 baseline. These executive orders are establishing policy goals of greater than 1.5% per year reductions in the use of fossil fuels for state building operations in the near term, and presumably they will result in similar GHG reductions for state buildings if fully implemented.

Legislation in 2007 also produced the Iowa Office of Energy Independence (OEI) and the Iowa Plan for Energy Independence. The plan “shall provide cost effective options and strategies for reducing the state’s consumption of energy, dependence on foreign sources of energy, use of fossil fuels, and GHG emissions. The options and strategies developed in the plan shall provide for achieving energy independence from foreign sources of energy by the year 2025.” In addition, the Midwestern Governors Association adopted the Energy Security and Climate Stewardship Platform for the Midwest, which specifies an energy efficiency goal of at least 2% per year reduction in natural gas and electricity use to be achieved by 2015.

Transitioning from the fossil fuel age to a new mix of energy sources like energy conservation, efficiency, cellulosic biofuels, and wind power is already creating “green collar” jobs and invigorating the economy in Iowa. Early action alternatives have much greater effect in mitigating future climate change and its impacts compared to later reductions. Reductions for developed countries in the range of 25%–40% by 2020 and 80%–95% by 2050 were discussed in the initial Bali round of the Framework Convention on Climate Change in December 2007. It is recognized that “substantial deviation from baseline” will also be necessary for developing economies in Latin America, the Middle East, East Asia, and centrally planned Asia.

### **CC-3. State and Local Government GHG Emissions (Lead by Example)**

#### **Policy Description**

State of Iowa property belongs to all Iowans, and its expansion and upkeep is funded by Iowans’ tax dollars. The same is true for each Iowan’s public school and city or county government. The majority of Iowans believe strong action is required to reduce GHG emissions. Government buildings, office equipment, and vehicles are present in every Iowa community and are among the biggest energy consumers in the state. As such, they represent a very significant opportunity for changing the course of Iowa’s energy use.

State and local governments should be at the forefront of energy efficiency and renewable energy. By installing the most efficient technology and tapping local power sources, governments can reduce their own GHG emissions, create a significant opportunity for businesses to create and install efficient and/or renewable technologies, create a tested pool of Iowa-specific best practices, build communities’ sense of pride in their governments (perhaps boosted by tax decreases and economic benefit), and spur residents and businesses to pursue energy efficiency and renewable energy.

### Policy Description

The goal of climate change education extends well beyond the goal of conventional education, because it seeks not only to impart cognitive knowledge, but also to translate knowledge into positive action. Failure to appreciate this distinction has led to stagnation and lack of successful approaches in creating a public that is literate about issues relevant to climate change. According to the seminal work of Hungerford and Volk (1990),<sup>1</sup> there are three levels of environmental awareness:

- *Simple Awareness*—Knowing about the existence and importance of an environmental issue, but being unfamiliar with its complexities and having little relationship to personal change or action.
- *Personal Conduct Knowledge*—Understanding an environmental issue that lends itself to changes in personal conduct, but does not require detailed comprehension.
- *Environmental Literacy*—The outcome of a sound program of environmental education in which the learner progresses to deeper knowledge, and can apply it to address complex environmental issues and make wiser decisions.

Public education and outreach programs should address the public’s responsibility to maintain clean air, pure water, and fertile soil for their children and future generations. Adding to the challenge is that environmental information absorbed by the public stems from a diverse and unconnected smattering of sources that includes television, radio, print media, environmental groups, government publications, the Internet, the classroom, personal readings, chatting with friends, and other experiences. In general there is no quality control for the information. In the end, those seeking to learn about environmental issues are often left with little more than a collection of factoids, numerous and often conflicting opinions, and very little understanding—not enough to get beyond the “simple awareness” level cited above. Undoubtedly, excellent resources are available for public environmental education, but they may be lost in the background noise emanating from the cacophony of messages from disparate other sources.

There is not much detailed information about the level of climate change awareness in Iowa. The available evidence, however, suggests that it may not extend much past “simple awareness,” because there doesn’t appear to be significant change in personal conduct with respect to steps that would mitigate climate change. For example, optimizing energy efficiency is a major strategy for reducing GHG emissions, but a recent comprehensive study commissioned by the Iowa Utility Association shows enormous untapped potential in realizing that goal for Iowa.

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<sup>1</sup> Hungerford, H.R. and T.L. Volk (1990). Changing learner behavior through environmental education. *Journal of Environmental Education* Spring; 21(3):8–21. Available at: [http://eric.ed.gov:80/ERICWebPortal/custom/portlets/recordDetails/detailmini.jsp?\\_nfpb=true&\\_ERICExtSearch\\_SearchValue\\_0=EJ413973&ERICExtSearch\\_SearchType\\_0=no&accno=EJ413973](http://eric.ed.gov:80/ERICWebPortal/custom/portlets/recordDetails/detailmini.jsp?_nfpb=true&_ERICExtSearch_SearchValue_0=EJ413973&ERICExtSearch_SearchType_0=no&accno=EJ413973).

There is an urgent need for a comprehensive, objective, and authoritative climate change education campaign for Iowa that will improve the knowledge base and motivate individuals, communities, and organizations to take action to will reduce their GHG emissions.

#### **CC-5. Tax and Cap Policies**

##### **Policy Description**

The lead for developing this policy option was transferred by the ICCAC to the Clean and Renewable Energy Subcommittee. (See Chapter 4.)

#### **CC-6. Seek Funding and Financing for Implementation of ICCAC Options**

##### **Policy Description**

Funding must be obtained to implement some ICCAC options. In Iowa there are two organizations that fund projects related to the ICCAC goals: the Iowa Power Fund and the Iowa Energy Center. (See Appendix J for a description of these organizations.) Out-of-state and federal funding sources should also be considered. For all sources of funding, success would be enhanced through partnerships with other organizations and agencies.

#### **CC-7. Adaptation and Vulnerability**

##### **Policy Description**

Because of the existing buildup of GHGs in the atmosphere from past and current emissions, Iowa will experience effects of climate change for years to come, even if immediate action is taken to reduce its future GHG emissions. While Iowa may be less dramatically affected than coastal or arid regions of the country, the state will need to adapt to different sets of vulnerabilities, which may include impacts such as increased public health risks, urban infrastructure demands, and refugee movement. Thus, it is essential that the state develop a plan to manage the projected impacts of global climate change affecting Iowa, while broader mitigation efforts to lower atmospheric concentrations worldwide are being developed and implemented. Part of our adaptation must include strategies for mitigating and addressing human suffering, so that no one segment of the population or any of Iowa's natural resources or natural heritage sites suffers catastrophically.

#### **CC-8. Participate in Regional and Multi-State GHG Reduction Efforts**

##### **Policy Description**

Regional approaches undertaken in collaboration with partner states or other organizations can offer broader and more economically efficient opportunities to reduce GHG emissions across Iowa's economy. Iowa has already joined several organizations, including the Midwestern Greenhouse Gas Accord, the Midwestern Governors Energy Security and Climate Stewardship Platform, and multistate Climate Registry initiatives. These developments should be continued and should form the basis for Iowa's own programs. To the extent that Iowa's needs may not be

fully met by these initiatives, Iowa should consider developing supplemental or ancillary registry capacity or opportunity. (See CC-1.)

**CC-9. Encourage the Creation of a Business-Oriented Organization to Facilitate Investment in Climate-Related Business Opportunities and to Share Information and Strategies, Recognize Successes, and Support Aggressive GHG Reduction Goals**

**Policy Description**

Numerous economic and business opportunities can arise from implementing a comprehensive GHG reduction strategy for Iowa. A variety of job creation possibilities are implicit in new approaches to transportation, land use, green construction, recycling and reuse, and energy-efficient products and services. The state should work with public and private entities to identify, promote, and finance these opportunities for economic development and job creation. Iowa should also work to keep existing green jobs in Iowa and prevent them from moving out of state.

The growth of the “green industry” has the potential to benefit low- to mid-skill workers who can no longer depend on traditional manufacturing jobs. Since green jobs require applied technical skills, they generally pay decent wages. Unlike blue-collar jobs, many green-collar jobs require local employees and cannot be outsourced.

Another component of economic development is the promotion of buying locally-produced foods, goods, and products. Consumer support for the local economy helps sustain Iowa businesses, jobs, and tax base, while reducing the consumption of fuel (and CO<sub>2</sub> emissions) in the transportation of foods and products over great distances.