Oil and Gas Technical Work Group
Option Proposals – Executive Summaries

	Summary List of Option Proposals	Lead(s)
O&G 1	Best Conservation Practices	Jim Pfeiffer
O&G 2	Reductions in Fugitive Methane Emissions	Jane Williamson
O&G 3	Electrification of Oil and Gas Operations, with Centralized Power Production and Distribution	Sean Lowther
O&G 4	Improved Efficiency Upgrades for Oil and Gas Fuel Burning Equipment	Sean Lowther
O&G 5	Renewable Energy Sources in Oil and Gas Operations	Sean Lowther
O&G 6	Carbon Capture and Geologic Sequestration with Enhanced Oil Recovery from High CO_2 Fuel Gas at Prudhoe Bay	Diane Shellenbaum
O&G 7	Carbon Capture and Geologic Sequestration with Enhanced Oil Recovery in and near existing Oil or Gas Fields	Diane Shellenbaum
O&G 8	Carbon Capture and Geologic Sequestration away from Known Geologic Traps	Diane Shellenbaum

O&G 1 Best Conservation Practices

Executive Summary

The Best Conservation Practices Policy Option reduces direct carbon dioxide emissions through common-sense measures that minimize fuel consumption. Specific initiatives will be developed to suit the needs of specific conservation opportunities. Such initiatives/opportunities include (but are not limited to):

- Consumption of liquid fuel at/in support of North Slope Oil Fields; (described more below)
- Minimize fuel required for operation of flares;
- Optimize existing process to minimize energy consumption;
- Reduce miles driven in support of operations by employees and contractors;

- Increase fuel economy of vehicles used in support of operations;
- Cut electricity use in offices and camps.

Option Design

The option reduces carbon emissions by managing down the amount of fuel used to support production of Oil & Gas operations in Alaska. The option is largely behavior-based and is achieved by ongoing encouragement to individuals in making good conservation choices and, through repetition, for those choices to become habits. The option does not require large capital projects to accomplish.

Goals

> Enroll oil & gas workforce in energy conservation efforts;
> Reduce fuel/energy used in support of oil & gas operations.

Timing and Parties Involved

> North Slope Producers;
> ADEC public outreach function;
> GreenStar Program?;
> Option is intended to be implemented near term (0-2 years).

Option Implementation Mechanisms

The option would be implemented through a workforce outreach program to share best practices for reducing fuel consumption. Initial sharing from SOA/ADEC regarding successful implementation of public outreach programs such as the “Plug It In at 20 Degrees” program. Sharing best practices and individual/organizational recognition programs could be developed through the GreenStar program, the SOA website, and/or North Slope producer intranet sites.

Relationship to Other Efforts

> North Slope Producers have begun efforts;
> GreenStar program already established to coordinate similar efforts;
> ADEC and the Municipality of Anchorage have successfully performed similar outreach.

Key Uncertainties

There are other opportunities, not yet identified within our efforts. Our efforts need to be focused upon accomplishing these reductions in an efficient manner. A mechanism to ensure easy, cooperative, public transfer of applicable knowledge, expertise, and technical training to the Alaska oil and gas stakeholders needs to be developed. Expert oil and gas assistance will be needed to help develop a process to attain that goal. This assistance may come from within industry, government, and the University system.

The State and Federal governments and oil and gas industry should work cooperatively and ensure funding to develop programs and policies that result in greenhouse gas reduction through energy conservation. Alaska has an abundance of oil and gas technical expertise; Alaska citizens with many years of training. Their talents and technical input are required to ensure efficient, successful progress in this effort. The State of Alaska and industry should help ensure Alaskan expertise is retained and that adequate training is provided to future generations.

Feasibility Issues

There are no significant feasibility issues with implementation of this option. Conservation efforts will need to be tempered by operational integrity and life safety issues, particularly on the North Slope.

Benefits

This option will result in near-term reductions of carbon emissions, as well as emissions of conventional pollutants. There are more opportunities that the O&G TWG have not yet identified that could significantly decrease greenhouse gases and increase oil and gas reserves. With appropriate policies towards training and retaining technically qualified individuals within the industry, State government, and University programs, future generations will have greater opportunities within the State.

Costs

It is believed no additional SOA budget is necessary to implement. Policy option will require modest amount of ADEC focus related to sharing best practices and coordination of effort. Costs to O&G producers in Alaska will be modest and will vary by initiative.

Other Impacts

The option will enroll the Alaskan oil & gas workforce in conservation efforts, allowing those behaviors to be leveraged to find further reduction opportunities.

Initiative Description- Reduce Liquid Fuel Consumption on the North Slope

The focus of this initiative is reducing consumption of liquid fuel at/in support of North Slope Oil Fields.

Initiative Design

The initiative reduces carbon emissions by reducing the amount of liquid fuel consumed through trip reduction, idling management, fleet transformation, smarter use of support equipment (Tioga heaters, light plants, etc), and any other measures to reduce liquid fuel consumption.

Goals

> Enroll oil & gas workforce in liquid fuel conservation efforts;
> Minimize liquid fuel used to support North Slope oil & gas operations.

Timing and Parties Involved

> North Slope Producers and contractors;
> Option is intended to be implemented now.

Initiative Implementation Mechanisms

Initiative would use same implementation mechanisms as described in the conservation option.

Relationship to Other Efforts

> Would be coordinated with other conservation initiatives.

Key Uncertainties

The extent of reductions available through this initiative.

Feasibility Issues

There are no significant feasibility issues with implementation of this option. Conservation efforts will need to be tempered by life safety issues.

Benefits

This option will result in near-term reductions of carbon emissions, as well as emissions of conventional pollutants.

Costs

It is believed no additional SOA budget is necessary to implement. Policy option will require modest amount of ADEC focus related to sharing best practices and coordination of effort. North Slope producers have efforts underway to reduce liquid fuel consumption due to expense and logistics issues related to importation of ULSD, and the option would not increase costs.

Other Impacts

The option increases net production of petroleum in Alaska. The option reduces the risk of fuel spills from intrastate transportation. The option helps reduce market pressure on Alaska-produced Ultra-Low Sulfur Diesel (ULSD).

O&G 2: Reductions in fugitive methane emissions

Executive Summary

This option relates to reductions in fugitive methane emissions. In this option, the following would be explored:

a) Refinements to fugitive methane inventories;

b) Assessment of potential reductions of fugitive methane;

c) Development of model fugitive methane reduction programs appropriate to Alaska Oil & Gas Operations.

Very rough order of magnitude fugitive methane emissions are estimated by ICF International at +/- 0.162 million metric tonnes CO_2e per year[1], with nearly all occurring in the upstream oil and gas production and processing operations. As the volumes estimated are low, we believe a major study specific of economics and opportunities to reduce fugitive methane or to develop a model fugitive methane reduction program is not appropriate at this time due to the small volume involved. However, we endorse inclusion of this option within a category of smaller scale energy conservation and GHG reductions. This effort would explore Alaska relevant opportunities that can be implemented within the next five years and also identify funding and policy opportunities to help us get through the next phase.

Policy Implications/Recommendations

Operators are required to obtain approval and to report purposeful venting to the Alaska Oil and Gas Conservation Commission (AOGCC) as well as any flaring within the oil and gas fields. For 2007, the reported volume for methane venting was 45 million standard cubic feet or about .015 million metric tonnes CO_2e per year. The Commission will continue to ensure that operators consistently report such emissions, and work with ADEC to ensure reporting requirements can easily be imported into any final GHG inventory database.

Encouragement of efforts to reduce fugitive methane emissions on a case by case basis is appropriate. Work is proceeding on the federal level (EPA/DOE) and within API to develop estimation methods for fugitive methane. We recommend the State of Alaska follow that work, but not “re-invent the wheel” as these volumes appear to be low. If fugitive emission reporting is required under any federal legislation, we can follow the requirements laid out within those regulations at that time.

While the costs to reduce fugitive methane may be low on a case by case basis, development of model fugitive methane reduction programs could be very time consuming, and potentially take focus away from more important issues and from actual accomplishment of the emission reduction.

Potential Benefit to State

While a more comprehensive estimation method and audit would be required to better estimate fugitive methane emission volumes in a “bottoms-up”, field by field approach, ICF rough order of magnitude estimated volumes are about .16 million metric tonnes CO_2e. If full elimination of the fugitive methane is accomplished, roughly 450 million standard cubic feet per year could be recovered for sale or in field use as fuel. The potential reduction would be on a case by case basis.

Qualitative Summary of the Potential Cost and GHG Savings

[1] Appendix E, Table E-2 of the Alaska GHG Inventory estimated roughly 3 million metric tonnes CO_2e for the oil and gas operations in 2005. While ICF did not have access to the full model used in the inventory, they believe the tool may have used emission factors not intended for “fugitive” methane and are much higher than that of IPPC guidelines. The ICF summary is provided as an Appendix to this document.

While dependent upon the particular situation, we would anticipate costs of some reduction efforts may be low, and could be accomplished relatively quickly. However, some fixes could be more complex and costly, and potentially require some production shut-in to achieve.

For fugitive methane reduction, we are concerned that significant costs could result if high accuracy is expected for measurement of volumes. Care should be taken that options to measure/report/ decrease methane fugitive emission are not overkill and delay progress in actual reduction in greenhouse gases. Further work by the O&G TWG, with help of technical expertise within their own organizations is needed to help identify and quantify costs and GHG savings from energy conservation options.

Implementation Path

Determine actual Alaska fugitive emissions sizes and locations. Make recommendation on appropriate types of monitoring/estimating methods appropriate to identify and prioritize fugitive methane sources. After identification of sizes and sources, encourage appropriate mitigations.

Until the inventory is better understood, the State should emphasize the need for extra diligence at all oil and gas operations, especially as part of an overall emphasis on conservation and anti-waste practices. This may fit well with one of the Cross Cutting TWG options of encouraging overall conservation practices.

Research Needs

If a high amount of accuracy is needed to measure fugitive methane, new tools, R&D for finding leaks and measuring volumes may be required.

O&G 3: Electrification of Oil and Gas Operations, with Centralized Power Production and Distribution

Executive Summary

This option recommends the State of Alaska and the Oil and Gas stake holders study the economics and technical feasibility of developing a centralized power sharing and distribution system to serve Alaska's major oil and gas operations, and possibly expected expansion areas.

To maximize benefits and efficiencies, this option should be implemented in conjunction with O&G 4 and 5 to provide a comprehensive thermal efficiency upgrade package for hydrocarbon recovery activities. (See Appendix A for additional details)

Policy Implications/recommendations

The State of Alaska should encourage Oil and Gas stake holders to invest in centralized electrical power generation on the North Slope through a facilitated coordinated regulatory environment, as well as incentivizing the massive capital investments that will be required.

The State of Alaska should ensure that it has on staff a trained and experienced workforce to implement the large permitting and regulatory changes for the North Slope Operations within its agencies to help for the facilitate the implementation of the GHG reduction options.

Potential Benefit to State

This has a direct financial benefit for the state as well as a greenhouse gas emissions benefit.

The state would benefit from a centralized power grid at major oil and gas operations (especially the North Slope), in that the major efficiencies gained mean less fuel burned, and more fuel ultimately available for sale. In addition, the citizens of the state would benefit as the less fuel burned, the smaller the amount of GHG emissions.

Qualitative Summary of the Potential Cost and GHG Savings

There is a very large potential cost of this option, with a very rough estimated in the 100's of Millions of dollars to Billions of dollars depending on the scope and complexity. Maximum benefits would be gained through implementing this option in conjunction with Option 2, improving the efficiency of oil and gas equipment. These options together have the potential to cut GHG output from North Slope hydrocarbon recovery activities by greater than two-thirds of the current GHG emissions.

In the Oil and Gas production, transport, and refining sector on the North Slope there are 11 Million Metric Tons of CO_2e produced each year[2]. Assuming that we can improve the overall thermal efficiency of oil and gas operations by two and two thirds of the current efficiency, this would translate into a GHG reduction of greater than 7 Million Metric Tons of CO_2e.

If this option is done in concert with Options 4, 5, 7, and 8 the overall GHG savings could end up being greater than 70%, of the baseline values.[3]

Implementation Path

To minimize time required for implementation, regulatory and capital investment hurdles should be addressed immediately by both the State and the stake holders. The critical path is for State to design incentives to facilitate a significant level of capital investments, operators to begin design of facilities needed to maximize the GHG reductions within an acceptable economic framework. A large factor in the economics of this option are values for carbon and for natural gas.

Research Needs

The technical and economic feasibility and any and all incentives should be fully investigated and a recommendation for each and every project individually and reviewed as a collective of projects to ensure both short term and long term vision is maintained.

Economic Research Areas-

- Determine what the period of performance is for the projects and the study
- Model and recommend the most effective incentives to encourage the capital investment in thermal efficiency improvements for hydrocarbon recovery activities. The study should take into account any effects on the economy and jobs within the sector and its supporting businesses.
- Research the value of carbon near and long term to determine the value of avoided emissions.
- Research the value of natural gas over the required performance period for the study

Technical Research Areas-

- Engage with Federal, State or Private Entities that may be doing research efficiency upgrades.
- Producing power on the North Slope where both the Methane and potential geological sequestration space are abundant, performing CO_2 capture and sequestration as EOR and transporting the power via very long power lines to markets in and outside of Alaska. Research focus should be on the ability to transport power over long distances.

[2] Based on data compiled by the state for 2002
[3] See footnote 1

O&G 4: Improved Efficiency Upgrades for Oil and Gas Fuel Burning Equipment

Executive Summary

This option recommends the State of Alaska and the Oil and Gas stake holders study the economics and technical feasibility of replacing older technology equipment with newer high efficiency equipment to improve overall thermal efficiency, thus reducing GHG emissions per unit of generated power.
To maximize benefits and efficiencies, this option should be implemented in conjunction with O&G 3 and 5 to provide a comprehensive thermal efficiency upgrade package for hydrocarbon recovery activities. (See Appendix A for additional details.)

Policy Implications/recommendations

The State of Alaska should encourage the Oil and Gas stake holders to invest in capital projects to improve the overall efficiency of oil and gas fuel burning equipment.
The State of Alaska should ensure that it has on staff a trained and experienced workforce to implement the large permitting and regulatory changes for the North Slope Operations within its agencies to help for the facilitate the implementation of the GHG reduction options.

Potential Benefit to State

This has a direct financial benefit for the state as well as a greenhouse gas emissions benefit.
The state would benefit from upgrades in efficiencies of fuel burning equipment in that there will be greater overall saleable hydrocarbons recovered from the oil and gas production areas, as fewer hydrocarbons will need to be used for fueling operations. In addition, the citizens of the state would benefit as the less fuels burned, the smaller the amounts of GHG emissions.

Qualitative Summary of the Potential Cost and GHG Savings

There is a very large potential cost of this option, with a very rough estimated in the 100's of Millions to Billions of dollars. This option has the potential to cut GHG output from North Slope hydrocarbon recovery activities by possibly 5.5 Million Metric tons.
In the Oil and Gas production, transport, and refining sector on the North Slope there are 11 Million Metric Tons of CO_2e produced each year[4]. Assuming that we can improve the overall thermal efficiency of oil and gas operations equipment by double what it is today, this would translate into a GHG reduction of greater than 5.5 Million Metric Tons of CO_2e.
If this option is done in concert with Options 3, 5, 7 and 8 the overall GHG savings could end up being greater than 70%, of the baseline values.[5]

Implementation Path

To minimize time required for implementation, regulatory and capital investment hurdles should be addressed immediately by both the State and the stake holders. The critical path is for State to design incentives to facilitate a significant level of capital investments in more efficient fuel burning equipment compared to the current equipment employed in hydrocarbon recovery activities. The various operators should begin review of all of the in service fuel burning equipment and how they could be replaced with newer higher thermal efficiency equipment. A review of the design of the facilities is needed to ensure that we are maximizing the GHG reductions within an acceptable economic

[4] Based on data compiled by the state for 2002
[5] See footnote 1

framework. This options feasibility has some bearing on both the North Slope Fuel Gas being assigned a value as well as a value for carbon.

Research Needs

The technical and economic feasibility and any and all incentives should be fully investigated and a recommendation for each and every project individually and reviewed as a collective of projects to ensure both short term and long term vision is maintained.

Economic Research Areas-

- Determine what the period of performance is for the projects and the study
- Model and recommend the most effective incentives to encourage the capital investment in thermal efficiency improvements for hydrocarbon recovery activities. The study should take into account any effects on the economy and jobs within the sector and its supporting businesses.
- Research the value of carbon near and long term to determine the value of avoided emissions.
- Research the value of natural gas over the required performance period for the study

Technical Research Areas-

- Engage with Federal, State or Private entities that may be doing research in energy efficiency improvements in equipment
- Study alternative low CO_2 producing fuels that have upfront CO_2 capture, such as Hydrogen produced from field gas Methane.
- Review changes in current technologies for simple changes that could improve thermal efficiency such as firing temperature changes or thermal efficiency improvement packages from the manufacturers[6]

[6] Could have a negative impact in NOx production forcing NSR review

O&G 5: Renewable Energy Sources in Oil and Gas Operations

Executive Summary

This recommends the State of Alaska and the Oil and Gas stake holders study the economics and technical feasibility of developing renewable energy sources to improve overall thermal efficiency, thus reducing GHG emissions per unit of generated power.

To maximize benefits and efficiencies, this option should be implemented in conjunction with O&G 3 and 4 to provide a comprehensive thermal efficiency upgrade package for hydrocarbon recovery activities. (See Appendix A for additional details.)

Policy Implications/recommendations

The State of Alaska should encourage the Oil and Gas stake holders to invest in capital projects to install renewable energy wherever possible in oil and gas operations. These are only possible where an renewable energy source is located near the Oil and Gas operation.

The State of Alaska should ensure that it has on staff a trained and experienced workforce to implement and changes in permitting and regulatory environment needed to add additional power facilities.

Potential Benefit to State

This has a direct financial benefit for the state as well as a greenhouse gas emissions benefit.

The state would benefit from adding renewable energy options to oil and gas operations as fewer hydrocarbons would have to be burned as fuel, which leaves greater overall hydrocarbons volumes available for sale. In addition, the citizens of the state would benefit as the less fuels burned, the smaller the amounts of GHG emissions.

Qualitative Summary of the Potential Cost and GHG Savings

There is a large potential cost of this option, which depends on the type and size of potential renewable energy source that could be co-located with any particular oil and gas operation. The potential savings in terms of GHG emissions would depend on the amount and type of power replaced.

The potential amount of GHG emissions saved by replacing natural gas generation and industrial heating with renewable energy source is 0-50% of the current output, depending on the availability of a renewable energy resource. This estimate is based on the idea that a vast majority of fuel burning equipment could either be replaced with alternative power sources and the portions that are not replaced require lower overall fuel demands, due to the renewable energy supplementing the fuel burning equipment. Actual savings are unknown until full evaluation of O&G operations is conducted.

Implementation Path

To minimize time required for implementation, regulatory and capital investment hurdles should be addressed immediately by both the State and the stake holders. The critical path is for State to design incentives to facilitate a research and design of arctic based renewable energy sources. This will require a significant level of capital investments, and the operators should begin to research designs and re-design of facilities needed to maximize the GHG reductions within an acceptable economic framework. This options feasibility has some bearing on both the North Slope Fuel Gas being assigned a value as well as a value for carbon.

Research Needs

The technical and economic feasibility and any and all incentives should be fully investigated and a recommendation for each and every project individually and reviewed as a collective of projects to ensure both short term and long term vision is maintained.

Economic Research Areas-

- Determine what the period of performance is for the projects and the study
- Model and recommend the most effective incentives to encourage the capital investment in renewable energy projects at oil and gas operations. The study should take into account any effects on the economy and jobs within the sector and its supporting businesses.
- Research the value of carbon near and long term to determine the value of avoided emissions.
- Research the value of natural gas over the required performance period for the study

Technical Research Areas-

- Engage with Federal, State or Private Entities that may be doing research in renewable energy sources such as wind, hydro and geothermal, especially as they related to conditions found in Alaska.
- Study location and types of renewable options to enhance the thermal efficiency of hydrocarbon recovery activities.

O&G 6: Carbon Capture and Geologic Sequestration with Enhanced Oil Recovery from High CO_2 Fuel Gas at Prudhoe Bay

Executive Summary

This option relates to the technical feasibility and economics of the capture, transport and geologic sequestration of CO_2 (CCS) specifically from produced gas used for fuel in and around Prudhoe Bay. The goal is to remove and sequester the 10-12% CO_2 from the natural gas produced at Prudhoe before that gas is burned in power generators. The geologic sequestration should utilize a reservoir where economics can be improved from enhanced oil recovery (EOR.) This differs in nature from O&G 7, in that it refers to removing CO_2 from entrained gas before combustion, rather than from the combustion exhaust, and the technology of this kind of capture is more advanced, though has never been implemented on the North Slope. (See Appendix A for additional details.)

Potential Benefit to State

In 2005, about 1.25 MMT (million metric tonnes) of CO_2 emissions on the North Slope were due to naturally occurring CO_2 entrained within the gas. In addition to the immediate benefit of capturing CO_2 prior to combustion, studying and potentially implementing a pilot for the capture and sequestration of CO_2 from fuel gas has long term benefit to eventual gas sales. Sale gas specifications will require removal of most of the CO_2 from much larger gas volumes than are currently handled. (At projected gas sales production rates of 2 to 4 Bscfd, 5 to 10 MMT CO2/yr will ultimately need to be captured and sequestered.)

In addition to the benefit of reduced CO_2 emissions, sequestering the CO_2 in a reservoir where it can be used to enhance the oil recovered has great potential value.

Qualitative Summary of the Potential Cost and GHG Savings

Huge (100's of millions of dollars) of capital expenditures will be required by facility owners as significant retrofitting of existing power generating facilities will be needed. In addition, significant amounts of fuel will be to be burned to power the capture, compression and injection process. Dependant on the type of capture technology chosen, additional water resources may also be required. Additional expenditures could also be required for CO_2 transport pipelines and injection wells, and will be required to fund a long term monitoring program. Potential GHG savings is 1 million metric tonnes.
Significant commitment from regulators will be needed to overcome existing hurdles in permitting/royalty/and regulatory environment

Policy Implications/recommendations

While this option could be implemented immediately, the smaller the amount of fuel to be treated, the less CO_2 that has to be removed and sequestered, and the less fuel burned to do so. Ideally, energy efficiencies options (3,4, and 5) should be put into place asap to reduce overall fuel consumption as much as possible. (The additional energy usage for capture, transport, and storage of CO_2 also means the actual reduction in CO_2 emissions achieved by a CCS project is less than the volume captured.)
Key hurdles are investment/ capital cost and regulatory environment. Policies should focus on:

1) Encouraging investment through incentives (see details in Appendix A.)

2) Simplifying/streamlining the regulatory environment:

    a. Avoid overlapping regulations, ie State and Federal both regulating GHG emissions and underground injections. Recommend coordinating/participating with development of Federal regulations to both insure the regulations fit Alaska, to allow early implementation.

    b. Study State permitting/regulatory personnel requirements. Establish policies to pay and retain sufficient qualified employees to do the job.

Implementation Path

To minimize time required for implementation, regulatory and capital investment hurdles should be addressed immediately. Critical path is for State to design incentives appropriate for capital investments, operators to begin design of facilities needed to strip the CO_2 from the fuel stream, transport it to a reservoir, and inject it for EOR, and finally that State and operators start working the complicated regulatory/permitting issues. Final economics will depend on the value for carbon. Financing CCS projects will be sensitive to that value, and will be dependent on future cap and trade or carbon tax legislation.
Longer term, this technology will need to be implemented for eventual Gas Sales, and at that point the economics will dramatically improve for treating fuel gas.

Research Needs

Economic research:

a) Answer question of appropriate incentives, ie carrot or stick most effective. Model effects on economy and jobs with various scenarios.

b) Research long term value of carbon – huge impact on economics of these projects

c) Research long term value of natural gas

Technical research:

a) Engage with/observe DOE Phase III pilot project testing of various capture and sequestration technologies.

b) Technical Feasibility study of the different entrained CO_2 capture technologies,

O&G 7: Carbon Capture and Geologic Sequestration with Enhanced Oil Recovery in and near existing Oil or Gas Fields

Executive Summary

This option relates to the technical feasibility and economics of CO_2 capture, transport and geologic sequestration in or near existing Alaska oil and gas fields, including the upside of initial enhanced oil recovery (EOR.) Initial focus is intended to be on combustion sources (flue, or exhaust gases) generated on the North Slope, specifically Prudhoe Bay field, as Prudhoe facilities are the largest of Alaska's CO_2 stationary source emissions.

A significant portion of the stationary CO_2 emissions in Alaska are from the North Slope, and are a result of combustion for power generation in the oil fields. Fortuitously, the co-located or nearby oil and gas reservoirs provide likely storage space, with many of the oil reservoirs being likely candidates for CO_2 enhanced oil recovery. (See Appendix A for additional details.)

Potential Benefit to State

The 2002 estimate of CO_2 emissions related to oil and gas production at Prudhoe Bay is 9 MMT, almost ½ of all stationary GHG emissions in Alaska. Technically, a significant portion could be captured and injected into a nearby reservoir.

In addition to the benefit of reducing CO_2 emissions, sequestering the CO_2 in a reservoir where it can be used to enhance the oil recovered has significant impact on the economics.

Qualitative Summary of the Potential Cost and GHG Savings

100's of millions to billions in capital expenditures will be required by facility owners as significant additional retrofitting of existing power generating facilities will be needed. In addition, significant amounts of extra fuel (10-40%) will be needed to power the capture, compression and injection process. Dependant on the type of capture technology chosen, additional water resources may also be required. Expenditures could also be needed for CO_2 pipelines and injection wells, and will be required to fund a long term monitoring program.

Significant commitment from regulators will be needed to overcome existing hurdles in permitting/royalty/and regulatory environment

Potential GHG savings could be quite significant, up to 90% of emissions can avoided through a CCS process.

Policy Implications/recommendations

Because of the additional use of fuel required for capture, transport, and injection of CO_2, and the resultant GHG emissions related to its combustion, this option should be implemented only after or possibly concurrently with any and all energy efficiencies that can be put into place to first reduce emissions (see Options 3,4,and 5). The less fuel burned overall, the less GHG to deal with.

Key hurdles are investment/ capital cost and regulatory environment. Policies should focus on:

3) Encouraging investment through incentives (see details in Appendix A.)

4) Simplifying/streamlining the regulatory environment:

   a. Avoid overlapping regulations, ie State and Federal both regulating GHG emissions and underground injections. Recommend coordinating/participating with development of Federal regulations to both insure the regulations fit Alaska, to allow early implementation.

   b. Study State permitting/regulatory personnel requirements. Establish policies to pay and retain sufficient qualified employees to do the job.

Implementation Path

To minimize time required for implementation, regulatory and capital investment hurdles should be addressed immediately. Critical path is for State to design incentives appropriate for capital investments, operators to begin design of facilities needed to strip the CO_2 from the individual fuel exhaust streams, transport it to appropriate reservoirs, and inject it for EOR. Studies should include space, power requirements, and water requirements for each facility. Finally, the State and operators should immediately start working the complicated regulatory/permitting issues. Final economics will depend on the value for carbon. Financing CCS projects will be sensitive to that value, and will be dependent on future cap and trade or carbon tax legislation.

Research Needs

Economic research:

d) Answer question of appropriate incentives, ie carrot or stick most effective. Model effects on economy and jobs with various scenarios.

e) Research long term value of carbon – huge impact on economics of these projects

f) Research long term value of natural gas

Technical research:

Engage with/observe DOE Phase III pilot project testing of various capture and sequestration technologies.

Technical feasibility study of the North Slope, specifically Prudhoe requirements to retrofit existing equipment to add capture technology, add pipelines, additional compressors and dehydrators, and wells needed to inject CO_2.

O&G 8: Carbon Capture and Geologic Sequestration away from Known Geologic Traps

Executive Summary

This option relates to the technical and economic feasibility of CO_2 capture, transport and geologic sequestration far from oil and gas infrastructure, and where a nearby storage reservoir is not proven. The capture and storage aspects, while similar in many aspects to those described in O&G 7 for sources near existing Alaska oil or gas fields, differ in two important aspects, 1) the type of capture mechanisms

that are applicable for coal are different than those used for natural gas, and 2) the fact that there are no known reservoirs nearby means that either a long pipeline needs to be built, or an exploration program to prove up an appropriate storage reservoir needs to be executed.
The stationary sources of CO_2 emissions in Interior Alaska are related to power generation from coal or diesel combustion, and the closest proven reservoirs likely to be capable of sequestering CO_2 are in the Cook Inlet basin (250-350 miles away.) (See Appendix A for additional details.)

Potential Benefit to State

The 2002 estimate of CO_2 emissions related to power generation in the Fairbanks area is 2 MMT CO2e, about 1/10th of all the stationary GHG emissions in Alaska. Technically, a significant portion could be captured and injected if the appropriate capture technology could be built, and a suitable storage site found.

Qualitative Summary of the Potential Cost and GHG Savings

Huge (100's of millions???) of capital expenditures will be required by facility owners as significant retrofitting of existing power generating facilities will be needed. In addition, significant amounts of fuel are needed to power the capture and injection process. Dependant on the type of capture technology chosen, additional water resources may also be required. More very large expenditures (10's to 100's of millions) will be needed for either an exploration program (wells, seismic, reservoir simulations) or a long (350 mile?) CO_2 pipeline. Additional funding will be required for injection wells and a long term monitoring program.
Significant commitment from State regulatory departments will be needed to overcome existing hurdles in the permitting and regulatory environment.

Policy Implications/recommendations

Because of the additional use of fuel required for capture, transport, and injection of CO_2, and the resultant GHG emissions related to its combustion, this option should be implemented only after or possibly concurrently with any and all energy efficiencies that can be put into place to first reduce emissions. The less fuel burned overall, the less GHG to deal with.
Key hurdles are investment/ capital cost and regulatory environment. Policies should focus on:

a) Encouraging investment through incentives (see details in full Appendix A.)

b) Simplifying/streamlining the regulatory environment:

c) Avoid overlapping regulations, ie State and Federal both regulating GHG emissions and underground injections. Recommend coordinating/participating with development of Federal regulations to both insure the regulations fit Alaska, to allow early implementation.

d) Study State permitting/regulatory personnel requirements. Establish policies to pay and retain sufficient qualified employees to do the job.

Implementation Path

To minimize time required for implementation, regulatory and capital investment hurdles should be addressed immediately. Critical path is for State to design incentives appropriate for capital investments, operators to begin design of facilities and permitting needed to strip the CO_2 from the individual fuel exhaust streams, and start either an exploration program to find a reservoir suitable for sequestration nearby, or the planning for a long pipeline. Capture technology studies should include space, power requirements, and water requirements for each facility. Finally, the State and operators should immediately start working the complicated regulatory/permitting issues. Final economics will depend on the value for carbon. Financing CCS projects will be sensitive to that value, and will be dependent on future cap and trade or carbon tax legislation.

<u>Research Needs</u>
Economic research:

g) Model and recommend most effective incentives. Model effects on economy and jobs with various scenarios.

h) Research long term value of carbon – huge impact on economics of these projects.

Technical research:
Study the technical feasibility of capturing CO_2 from coal and diesel power generation facilities in and around Fairbanks. Study economics of long pipeline as compared to the cost of an exploration program.

Note: This option deals with emissions outside the oil and gas sector. The O&G TWG was responsible for all CCS options as the geologic expertise was located in this TWG.