FEDERAL / PROVINCIAL / TERRITORIAL
ENERGY TECHNOLOGY WORKING GROUP
(ETWG)

MOBILISING COLLABORATION IN ENERGY TECHNOLOGY

TO ADDRESS

CANADA'S CURRENT AND FUTURE ENERGY CHALLENGES

REPORT TO
COUNCIL OF ENERGY MINISTERS

St. Andrews, New Brunswick
September 20, 2005

Energy Technology Working Group
August 2005

EXECUTIVE SUMMARY

Canada's economy has been built on the development and use of Canada's energy resources which, to date, have provided relatively economical and readily available energy supply to fuel Canada's economic growth and quality of life. Energy sustains manufacturing jobs in Ontario, provides employment from Newfoundland to British Columbia and is a source of significant revenues across the country that maintain important social lifestyles such as health care and education.

In recent years, however, issues related to energy supply and use have emerged which are of concern to Energy Ministers – tightening supply of natural gas, impacts on the environment arising from energy production and use, and rising energy costs which have become the single biggest threat to competitiveness and have created economic uncertainty in several industrial sectors. For example, natural gas prices in Canada are currently the highest in the world and are higher than major competitors in Europe, China, India and Japan.

To address growing concerns over primary energy supplies, the burgeoning growth in energy demand and increasing public commitment to environmental protection, Energy Ministers agreed that innovation and new technologies are key to addressing the economic and environmental challenges facing Canada in the 21st century. For this reason, the Council of Energy Ministers (CEM) established the Energy Technology Working Group (ETWG) in September 2003. It assigned the ETWG the broad goal of ensuring that Canada remains a global leader in energy innovation by fostering a collaborative approach amongst governments and industry towards addressing these issues through innovative technologies. Energy Ministers called for development of a strategic approach to technology collaboration amongst federal-provincial-territorial governments starting with a sound strategy to be implemented through an integrated approach to research, development and demonstration (RD&D) programs.

To put this request into action, the federal, provincial and territorial governments have developed a working partnership and have consulted with the energy industry and research organizations to broaden the engagement. A strategy was developed which seeks to identify, develop and move forward on new transformational energy technologies through partnerships between governments and industry.

A total of 29 priority areas of significance to Canada's jurisdictions have been identified in six broad groupings. The degree of interest by each jurisdiction in these areas was determined. "Technology gap" analyses were completed for six priority areas (biomass, bitumen and heavy oil upgrading, clean coal, distributed generation, hydrogen and wind). These initial gap analyses showed the current state of the technology, the future state where Canada needs to be in 10 or 20 years, and the key market and technology drivers to get there.

Comprehensive inventories of current federal, provincial and territorial energy RD&D initiatives were developed to support collaboration and ensure a thorough understanding of available programs.

Recognizing the importance of energy technology to the growth and sustainable practices of Canada's industry, Energy Ministers directed the ETWG to broaden the dialogue on priorities with industry representatives.

During the past year, a productive round of consultations with industry associations identified issues and drivers of interest. Considerable progress was also made in linking with major industry groups and research providers to identify technology barriers to industrial development and areas of research opportunity.

As one outcome of this dialogue, there is now a growing consensus across the country that the strategic goals for energy technology include:

- improving energy efficiency and adapting demand side management technologies;
- increasing energy production from conventional and non-conventional sources in a sustainable manner to meet Canadian needs and realize value-added export opportunities;
- promoting development of clean energy sources as part of the overall energy mix, including renewable and alternate energy; and
- creating dedicated research and innovation capacity that will foster and attract investment in new energy technologies and improvements in environmental performance.

Canada's role in moving the priority technologies ahead was identified, taking account of the opportunities opened up as a result of Canada's resource endowment and the state of development of each technology internationally. Clearly, it is necessary to be selective to make the best use of innovation capacity and scarce resources. Four positions were identified for Canada's actions on priority technologies:

i. **Leading in world** – Canada leads in the world in terms of technical know-how and possessing an advanced industrial cluster. Technologies in this area include oil sands and heavy oil, carbon dioxide geological storage, bioprocesses in industrial applications, hydrogen supply infrastructure, mobile fuel cell applications and nuclear fission.

ii. **Aspires to lead in adaptation** - Based on existing strengths, Canada adapts and further develops advanced energy technologies and aspires to become a world leader in selected areas. This position was taken on technologies within the categories of cleaner fossil fuels, biotechnology, hydrogen production, storage and conversion, advanced energy end-use, and renewable and alternative energy production.

iii. **Putting to use** – Canada adapts and deploys global energy technologies but does not aspire to become a leader in their development. This position was taken on technologies within the categories of cleaner fossil fuels, advanced energy end-use, and renewable and alternative energy production.

iv. **Monitoring development** – Canada monitors the development of global technologies so as to be in a position to adapt the technologies when they are sufficiently developed. The only technology identified by the ETWG here was nuclear fusion.

Looking ahead, the work to date on the strategy, the identification of priority technologies and a better understanding of existing mechanisms across the country will be put into action through a suite of technology projects built on partnerships with jurisdictions and industry. Early discussion on potential energy technology projects to consider yielded a number of projects of interest, such as clean coal, ocean energy, net-zero buildings and biomass substitution of fossil fuels.

To move ahead in each priority area, particularly where “Canada leads”, progress will be made by:

- integrating the recommendations and action plans from existing technology roadmaps (such as those completed for oilsands, CO_2 capture and storage, clean coal, hydrogen, fuel cell commercialisation and bio-based feedstocks, fuels and industrial products) with the ETWG’s approach to project priority setting;
- guiding and harmonizing the work of many governments across Canada in their pursuit of formulating energy technology innovation strategies. For the year ahead, such strategies would include the federal Sustainable Energy S&T Strategy, and the energy research and innovation strategies of many provinces;
- working to collaborate on and accelerate the development of priority technology projects currently being initiated elsewhere, such as clean coal, ocean energy, net-zero buildings and biomass substitution of fossil fuels in industrial energy use;
- broadening the dialogue with industry and research organizations to focus on industry priorities and strengthening collaboration and investment opportunities in energy technology with the ETWG;
- moving ahead with new projects involving the development and demonstration of innovative technologies by making use of existing funding mechanisms; and
- streamlining collaboration between governments and industry through further development of the proposal for a new Canadian Energy Technology Partnership Program (proposed by Saskatchewan).

The ETWG looks to the Energy Ministers to endorse and support its proposed program, which will result in collaborative project initiatives with greater strategic focus and strong potential for reducing environmental impacts and improving long-term Canadian energy security and competitiveness.

In this regard, Ministers’ dedicated effort is crucial to secure timely investments to support the development, demonstration and widespread use of transformative energy technologies that will be needed in Canada.

Figures and Tables

Appendices

1. Global and National Perspectives

Growing energy demand and threats to energy supplies, coupled with growing environmental and climate concerns, are driving the need for energy technology solutions. Tomorrow's energy systems will depend on a diverse range of supply sources and technologies to produce, transport and use energy in a world seeking more sustainable forms of energy.

Canada now faces the task of meeting growing demand for a competitive energy supply while permitting continued sustainable development of its domestic energy resources. In addition, accelerating the exploitation of new clean energy fuels, alternative energy sources and greatly improved end-use efficiency are major priorities. New transformative technologies will be a key cornerstone of Canada's overall energy strategy into the future.

Setting a course for the role of energy technology in Canada calls for the development of a multi-faceted innovation strategy designed to accelerate widespread deployment of today's and tomorrow's best technologies into the marketplace and ultimately achieve national energy sustainability. The development of new transformative technologies in partnership with stakeholders in governments across Canada and with industry will be an important component of the strategy. Elements will include identification of high priority technologies as well as the use of existing and new innovative funding mechanisms to bring projects currently in the pipeline as well as new priority projects into fruition. ***Technologies will be targeted that make the best use of Canada's resources and most effectively address vital issues including energy prices, affordability, competitiveness, economic development and environment and climate change.***

One often-overlooked aspect of our aim to achieve energy sustainability is the socio-economic dimension. Clearly, we need to understand not just technology, but also how people use and manage technology, and how energy markets manage the transitions and risks associated with achieving widespread use of new technologies and more efficient end-use practices.

There is a growing recognition of the need to ***adopt a holistic approach*** to energy management, which integrates human interaction with novel energy technologies and the functioning of energy markets. Work in this area requires an interdisciplinary approach, which integrates the behavioural, and natural sciences. The creation of a robust "community of practice" involving participants from the private sector, academia, interest groups and government should be investigated.

2. Developing a Strategic Approach to Fostering Technology Development and Collaboration

Energy Ministers recognised and strongly endorsed that innovation and new technology will be key to addressing the economic and environmental challenges Canada faces going into the 21st century.

To provide a vehicle to foster a collaborative approach amongst governments in Canada, Energy Ministers established the Energy Technology Working Group (ETWG) in 2003 with a four-part mandate:

- review existing energy research, development and demonstration programs across the country and identify Canadian strengths and weaknesses;

- identify technology priority areas for cooperative, concentrated efforts;
- develop options for enhanced collaboration amongst governments, industry, research institutions and other key partners; and
- prepare an inventory of Canada's energy research capacity.

The federal government (Natural Resources Canada) has joined with provinces and territories (British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec, New Brunswick, Nova Scotia, Newfoundland and Labrador, and Yukon) to put this mandate into action.

To deliver this original mandate, a strategic approach was developed by the ETWG which incorporates a vision for the role and advancement of technology, identifying priority technologies of significance to Canada, finding existing mechanisms managed by governments in Canada to move them ahead, and developing an implementation plan for a new phase of technology projects.

A first progress report was tabled at the CEM meeting in Iqaluit in July 2004. At that meeting, ***Ministers endorsed the recommendation to foster technology progress through a collaborative framework*** that would include:

- a broad statement to endorse and support federal, provincial and territorial collaboration in energy technology and innovation;
- a set of customized bilateral and multilateral agreements that results in implementation of collaborative programs or projects;
- development of suitable mechanisms for collaboration by building on existing mechanisms; and
- broadening the dialogue to include industry.

These objectives were achieved through ongoing work and a series of face-to-face meetings (Regina, November 25-26, 2004, Halifax, April 14-15, 2005 and Toronto, June 9-10, 2005). The overall strategy was further strengthened by the information, priorities and support voiced through a productive dialogue with industry. The ETWG has taken action to: define energy priorities, find funding mechanisms available today to support energy technology RD&D, and build the next phase of its work plan, which will support and further develop new technology projects across the country (see Figure 1).

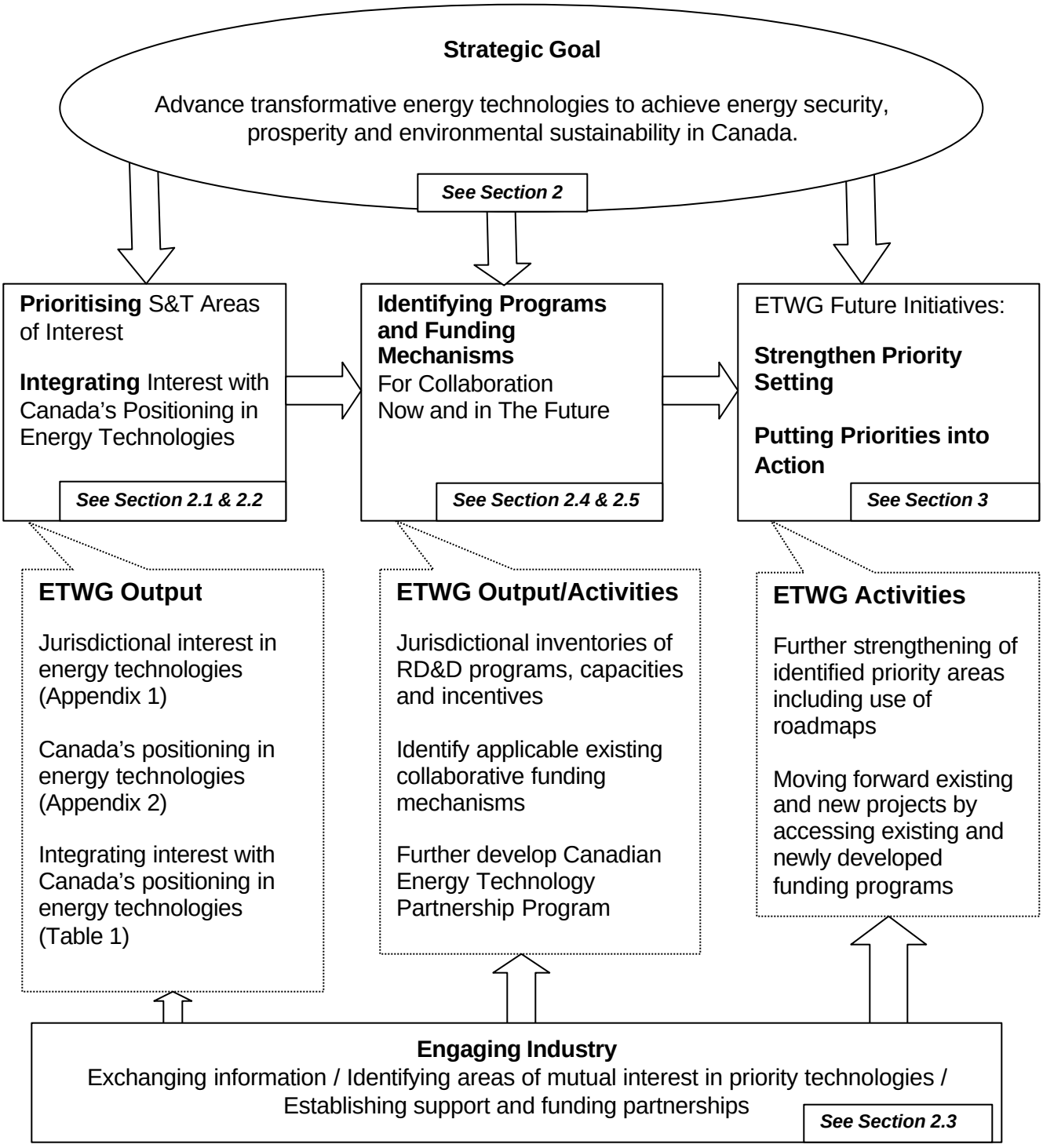

Figure 1: ETWG Strategy to Mobilise Energy Technology Collaboration

2.1 Prioritising Technologies of Interest to Canada's Jurisdictions

Selecting priority energy areas, which encompass promising technology solutions to current and future energy issues, was an important initial step. As expected, the technology areas of interest to each jurisdiction are determined by their resource endowments, the nature of their energy economy, and issues of local concern.

Although no technology ranking was attempted, jurisdictions considered aspects such as the ability of the technology to have a significant impact in their respective regions on energy supplies, demand characteristics of the local economy, their need or ability to perform technology RD&D, or the amount of investment dollars directed to the technology in question.

The suite of priority technologies demonstrates that there are many common interests in a limited number of priority technologies (as indicated in Appendix 1). One key message from this table is that there is a balanced interest across a wide range of energy technologies covering energy supply, conversion and end-use. While there are diverse needs across the various jurisdictions, there is a common view that technology is key to making all energy sources and all end-use applications available to us to the extent possible.

2.2 Defining Canada's Role in Advancing Priority Technologies

Among the suite of priority technologies, Canada must focus and prioritize its level of effort and investments to maximise economic prosperity, ensure energy security and minimize environmental impact. These objectives must be fulfilled making the best use of limited resources and research capacity. Some technologies will require world-leading effort, since the nature of the resource may be unique, or the importance of the technology to Canada warrants a heavy level of investment. For others, Canada can focus efforts on global intelligence to adapt technologies to Canadian circumstances.

A first pass has been completed to define Canada's positioning in addressing each priority technology area. The technologies have been grouped into four categories defined by the level of effort that Canada's science and technology should dedicate to their advancement. These four categories are: "Leading the world", "Aspires to lead in adaptation", "Putting to use" and "Monitoring development". Table 1 summarises the first three categories along with the respective jurisdictional levels of interest (taken from Appendix 1). The full document outlining Canada's position in advancing these priority technologies is attached in Appendix 2.

The ETWG will revisit the concepts embodied in Table 1 in the coming year as part of its approach to priority setting and evaluating the potential impact of energy technology projects.

Table 1: Canada's Positioning in Priority Energy Technologies: "Leading in World", "Aspires to Lead in Adaptation" and "Putting to Use"

Canada's Positioning in Advancing Priority Energy Technologies (Provincial-Territorial Abbreviations Indicate High / Medium Level of Initial Interest)			
Technology Area	**Leading in World** *(Technologies in which Canada is currently a leader)*	**Aspires to Lead in Adaptation** *(Technologies in which Canada strives to become a leader by adapting from others)*	**Putting to Use** *(Technologies, which Canada intends to adapt from others)*
Cleaner Fossil Fuels	**Oilsands** AB, SK	**Unconventional oil and gas (incl. frontier)** BC, AB, SK, NB, NS, NL	**Conventional oil and gas** BC, AB, SK, NL
	Heavy oil AB, SK	**Upgrading** AB, SK	**CNG/LNG** BC, AB, QC, NB, NS, NL, YT
		Low-rank clean coal technology BC, AB, SK	**Clean coal technologies (other than low-rank)** BC, AB, NS
	CO_2 geological storage BC, AB, SK, QC, NS, NL		**CO_2 capture** BC, AB, SK, QC, NS, NL
			Water in energy production BC, AB, ON, NL
Biomass Technologies	**Bio-processes in/for industrial applications** BC, AB, SK, MB, ON, QC, NB, NS	**Conversion of biomass into energy and higher value products** BC, AB, SK, MB, ON, QC, NB, NS	
		Production, storage, pre-processing and transportation BC, AB, SK, MB, ON, QC, NB, NS, YT	
		Integrated bio-systems (biorefining) BC, AB, SK, MB, ON	

Hydrogen Production, Storage and Conversion	**Mobile applications (PEM technology)** BC, AB, MB, ON, QC	**Stationary applications (SOFC)** BC, AB, MB, ON, QC	
	Hydrogen infrastructure BC, AB, SK, MB, ON, QC		
Advanced Energy End-Use		**Buildings and communities** BC, AB, SK, MB, ON, QC, NB, NS, NL, YT	**Industry** BC, AB, SK, MB, ON, QC, NB, NS, NL
		Integrated "Smart" technologies BC, AB, MB, ON, QC, NB, NS, NL	**Transportation** BC, AB, MB, ON, QC, NB, NS, NL
			Electricity transmission AB, ON, QC, NL
			Energy storage AB, ON
Renewables and Alternative Energy Production		**Hydro** BC, SK, MB, ON, QC, NB, NS, YT	**Wind** BC, AB, SK, MB, ON, QC, NB, NS, NL, YT
		Solar thermal (system components) BC, MB, ON, QC, NB, NS	**Solar photovoltaics** BC, MB, ON, NB, NS
		Ocean energy BC, NB, NS, NL	**Geothermal** BC, MB, QC, NB, NS, YT
		Small-to-intermediate fossil fuel conversion AB, MB, ON, NS	
		Grid integration BC, AB, MB, ON, QC, NB, NS, NL	
Nuclear	**Fission** ON, NB		

2.3 Industry's Perspectives on Needs and Priorities

Energy Ministers recognized that the ***engagement of industry is critically important to the ETWG strategy***, and endorsed the ETWG's recommendation that stronger engagement with industry to discuss the strategy, challenges and opportunities is essential to the success of investments in technology development.

As such, the ETWG met with a wide range of industry associations spanning the supply, conversion and end-use sectors to identify the business and market drivers, technology needs, and priorities and explore possibilities for collaboration (see Table 2 below).

Industry's presence at the ETWG table has been most constructive and will continue on an ongoing basis in the future. In regards to broadening the dialogue, the ETWG has most recently initiated discussion with the Cement Association of Canada and the Canadian Wind Energy Association to explore collaboration in identifying and initiating projects to move forward on.

Table 2: Industry Participation in the ETWG Process

Energy Supply Sector	Energy Conversion Sector	Energy End-Use Sector
Canadian Association of Petroleum Producers (CAPP) Canadian Energy Pipeline Association (CEPA) Propane Gas Association of Canada (PGAC) Canadian Wind Energy Association (CanWEA) Canadian Nuclear Association (CNA)	Canadian Electricity Association (CEA) Canadian Clean Power Coalition (CCPC) Manitoba Hydro (Biotechnology) Hydrogenics / Fuel Cells Canada	Coalition of Industrial Energy Consumers: • Canadian Steel Producers Association (CSPA), • Cement Association of Canada (CAC), • Forest Products Association of Canada (FPAC), • Canadian Chemical Producers' Association (CCPA) Association québécoise de la maîtrise de l'énergie (AQME) Canadian Gas Association (CGA) Canadian Mortgage and Housing Corporation (CMHC)
Energy Dialogue Group (EDG)		

2.4 Identifying Programs and Funding Mechanisms for Collaboration

Access to the appropriate funding mechanism will be fundamental to the success of this federal-provincial-territorial collaboration. As a first step, this means tapping into appropriate existing funding programs. To identify and facilitate awareness of existing energy technology programs, the ETWG has prepared and maintains an up-to-date set of comprehensive inventories of RD&D programs, capacities and incentives resulting from federal, provincial and territorial scans across the innovation spectrum.

In the short term, the ETWG will make the best use of existing funding mechanisms to support priority project investments. There are currently both federal and provincial funding sources, and opportunities for co-funding. The challenge will be to make the right project-to-funding connections. This will be a key task of the ETWG for the coming year.

2.5 Proposing A New Program and Funding Structure

While accessing existing funding sources would be an acceptable ad-hoc solution to fund projects in the short term, a dedicated program to support government collaboration is the preferred long-term solution. This program would address the need for a one-stop-shop source for funding federal-provincial-territorial-industry collaborative ETWG projects.

In response to directions from Ministers to develop suitable mechanism(s) for technology collaboration, the ETWG proposes establishing a federal-provincial-territorial-industry energy technology program – the ***Canadian Energy Technology Partnership Program***.

This program, first proposed by Saskatchewan and summarised in Appendix 3, would have the following key conceptual features:

- dedicated program framework rather than an ad-hoc structure;
- established criteria for project screening and evaluation;
- ongoing program governance;
- requires the participation of at least one province and industry, together with the federal government; and
- establishes a cost-sharing arrangement of ? federal - ? provincial - ? industry funding.

The Energy Dialogue Group (EDG) submitted a report to CEM 2005, which includes a section on technology that summarises the EDG's recommendation on the objectives and deliverables that the ETWG should adopt. The above proposed Canadian Energy Technology Partnership Program in combination with priority setting will address all of the recommendations, including:

- creating a strategic framework for collaboration between governments and industry;
- establishing project selection criteria and funding requirements;
- ensuring identifiable economic gains for Canada by focusing on projects of high commercial potential;
- providing effective governance; and
- spanning supply to end-use energy technologies.

3. Future Initiatives – Work Plan for the Coming Year

The ETWG has built upon the mandate set by Energy Ministers to create a unique partnership between governments and industry. This has enabled the identification of a limited number of priority energy technology areas. Additionally, the ETWG identified existing funding mechanisms and initiated the development of a dedicated funding program. While good progress has been made to date to foster the engagement of governments and industry, much remains to be done.

The work plan for the coming year aims to achieve the following:

I. Strengthening priority setting of energy technology projects

In the coming year, the ETWG will further strengthen the approach to priority setting energy technology projects and incorporate the recommendations and action plans of the federal technology roadmaps (oilsands, CO_2 capture and storage, clean coal, hydrogen, fuel cell commercialisation and bio-based feedstocks, fuels and industrial products), such that ultimately a guide for project screening will be formulated.

II. Collaborating on energy technology innovation strategies across Canada

Contribute to the work on energy technology strategies and innovation initiatives underway in many governments across Canada. For the year ahead, these would include the federal Sustainable Energy S&T Strategy, and the energy research and innovation strategies of many provinces.

III. Moving forward on high-priority projects of mutual interest

i. The ETWG will endeavour to accelerate a number of existing project initiatives which are currently under development, such as those related to clean coal, ocean energy, net-zero buildings and biomass substitution of fossil fuels in industrial energy use.

ii. The ETWG will pursue various new projects proposed during recent roundtable discussions at the ETWG meetings.

iii. The ETWG will facilitate access to funding by linking projects with existing funding programs.

IV. Developing collaborative arrangements

The ETWG intends to further develop a collaborative federal-provincial-territorial-industry program and funding framework. This will include exploring the concepts proposed by Saskatchewan as well as the use of networks such as EnergyINet to facilitate an integrated approach to project delivery and crosscutting initiatives.

V. Broadening the dialogue with industry

The ETWG plans to continue and expand upon its engagement of industry by facilitating the participation of additional industry associations in ETWG project selection criteria and promising opportunities. In addition, the ETWG will seek industry funding and support in identifying and initiating projects to move forward on.

4. Recommendations

The ETWG recommends that Ministers endorse the following key action items of the ETWG's work plan for the coming year (outlined above) to:

I. **Provide a sounding board and guidance for governments across Canada to harmonize strategies in energy technology innovation.**

II. **Initiate further development and collaboration on energy technology project initiatives currently being discussed outside the ETWG.**

III. **Continue to engage and work with industry to ensure a common strategic purpose on energy technology and joint mechanisms for project funding.**

IV. **Identify and pursue new energy technology projects based on the ETWG's established priorities.**

V. **Facilitate access to currently available funding mechanisms for the above-mentioned projects.**

VI. **Further develop a dedicated energy technology partnership program, which will serve to formalise a framework for federal-provincial-territorial-industry collaboration.**

Appendix 1
Energy Technology Areas of Interest to Canadian Jurisdictions

Interest Level: H = High; M = Medium; L = Low; Blank = No Interest

Technology Category / Sub-Category	BC	AB	SK	MB	ON	QC	NB	NS	NL	YT
1. Cleaner Fossil Fuels										
1.1 Enhanced/more efficient recovery of bitumen, heavy oil, conventional oil	M	**H**	**H**					L	H	
1.2 Bitumen and heavy oil upgrading	L	**H**	M					L	**H**	
1.3 Clean coal	M	**H**	**H**		L	L		M		
1.4 CO_2 capture, transportation and storage, incl. enhanced coalbed methane recovery and acid gas injection	**H**	**H**	**H**		L	M		M	M	
1.5 Natural gas production, compression, storage and distribution, incl. CNG and LNG	M	M			L	M	**H**	**H**	**H**	**H**
1.6 Water in energy production	M	**H**		L	M	L		L	**H**	
Advanced Energy End-Use										
2.1 Buildings and communities	**H**	M	M	M	**H**	**H**	M	**H**	M	M
2.2 Industry	**H**	M	M	M	**H**	**H**	**H**	M	M	
2.3 Transportation	**H**	M		M	**H**	**H**	M	M	M	
2.4 Integrated "smart" technologies	**H**	M		M	**H**	M	M	M	M	L
2.5 Electricity transmission		M			M	M			M	
2.6 Energy storage		M							M	
3. Renewables and Alternate Energy Production										
3.1 Wind	M	M	M	**H**	**H**	**H**	**H**	**H**	**H**	M
3.2 Solar	M	L		**H**	**H**	L	M	M	L	
3.3 Geothermal	**H**	**H**		**H**		M	M	M		M
3.4 Ocean energy	**H**	L					**H**	**H**	M	
3.5 Hydro	M	L	M	M	M	M	M	M	**H**	M
3.6 Small to intermediate-scale fossil fuel conversion	L	**H**		M	M	L		M	L	L
3.7 Integration to the grid	**H**	**H**		**H**	**H**	**H**	**H**	M	**H**	
4. Biotechnology										
4.1 Biomass production, storage and transportation	**H**	M	M	**H**	**H**	**H**	**H**	M	L	M
4.2 Biomass and waste recovery and conversion for stationary heat and/or power applications (e.g. biogas)	**H**	M	**H**	**H**	M	**H**	**H**	**H**	L	L
4.3 Conversion processes for industrial bioproducts	**H**	M	M	M	M	M	M	M	L	
4.4 Biofuels (e.g., ethanol, biodiesel) for transportation applications	**H**	M	**H**	**H**	**H**	**H**	M	M	L	
4.5 Biorefining processing systems, incl. Biocatalysts	M	M	M	M	**H**	L	L	L	L	
5. Hydrogen Production, Storage and Conversion										
5.1 Mobile applications, incl. fuel cells	**H**	M		**H**	**H**	**H**	L	L	L	
5.2 Stationary applications, incl. fuel cells	**H**	**H**		**H**	**H**	**H**	L	L	L	
5.3 Hydrogen infrastructure, incl. production, storage, conversion and distribution	**H**	**H**	M	**H**	**H**	**H**	L	L	L	
6. Nuclear										
6.1 Fission		L			**H**		**H**	L		
6.2 Fusion		L				L	L	L		

Appendix 2

Canada's Positioning in Priority Energy Technologies*

Technology Area	Drivers	Vision for the Future	Current / Planned Initiatives
1. Leading in World			
Cleaner Fossil Fuels Oilsands	• High oil prices and increasing violence in the Middle East • Global recognition of our enormous size of the oilsands and heavy oil reserves • Significant capital investment in new technologies • Favourable generic royalty regime • Climate change concerns	• Develop key technologies that will contribute significantly to the growth of production levels to three million barrels per day of bitumen and heavy oil by 2020. • Reduce CO2 emissions to same level per bbl as conventional oil	• Low-pressure variants to Steam-Assisted Gravity Drainable (SAGD) • In Situ solvent-based and combustion-based recovery techniques • "At-face" mining extraction variants • Improved understanding of slurry formation and solvent selection • Breakthroughs in tailings management • Refinery process improvements
Cleaner Fossil Fuels Heavy oil	• Declining production, premature well abandonment and under utilized infrastructure • Reserve increases of over a billion barrels and the doubling of recovery rates from 5 to 10%, • High oil prices • Environmental: the elimination of flaring and venting	• Develop key technologies that will contribute significantly to the growth of production levels to three million barrels per day of bitumen and heavy oil by 2020.	• Develop post primary and post - cold recovery techniques • Reduce water and water handling costs • Reduction of flaring and venting practices • Development of gathering systems to mitigate trucking requirements

Technology Area	Drivers	Vision for the Future	Current / Planned Initiatives
Cleaner Fossil Fuels CO_2 geological storage	• The climate change challenge could be addressed through CO_2 capture and storage • Canada has one of the world's best regions for geological storage • Federal, Alberta and Saskatchewan CO_2 Royalty Credit programs	• Reduce greenhouse gas emissions by developing technologies to store carbon dioxide.	• A monitoring, measurement and verification (MMV) program has been initiated at the Penn West iCO_2 EOR field pilot in Alberta, jointly by AERI and Western Economic Diversification • Petroleum Technology Research Centre's Weyburn CO_2 MMV project in Saskatchewan • Development of CO_2 EOGR, and enhanced coal bed methane projects at Alberta Research Council and elsewhere • Acid gas disposal (injection monitoring program) R&D at ARC. • International coordination of CO_2 capture and storage technology development and implementation activities • Assessment of Sequestration Resources
Renewables and Alternative Energy Production Hydro	• Sustainable Development - local, renewable, green energy source. • Environmental - climate change (no direct GHGs); increasing fish friendliness. • Economic - increasing costs of conventional sources; adds to energy diversification, supply and security; facilitates independent power producers, competitive markets & regional development; need for demonstrations of emerging technologies. • Trend towards distributed generation (for small and medium-scale hydro). • Social - positive public perception of RETS.	• Hydraulic energy will continue to make a significant contribution to Canada's energy supply, with emerging technologies, such as small-scale and low-head hydro providing an increasing share • Canadian S&T investments in these emerging technologies will create economic opportunities for Canadians in Canada and Internationally	• Low-head and very low-head turbines • Water current turbines • Fish-friendly turbines • Refurbishment technologies for older sites • Automation and control systems • Hydro-wind integration

Technology Area	Drivers	Vision for the Future	Current / Planned Initiatives
Biotechnology Biomass Conversion & Utilization Technologies (Bio-processes)	• High energy intensity of industrial sector • High energy / production costs • International climate change commitments (GHG reduction obligations)	• New more energy-efficient bio processes replace traditional unit operations in a variety of applications • Reduced energy intensity of several industrial sectors	New technologies or more efficient current technologies, including work on: • cellulase coenzymes • petroleum bio-upgrading • pectinase enzyme for natural fibre processing
Hydrogen Production, Storage and Conversion Mobile fuel cell applications (Lead in PEM technology)	• Environmental / sust. devel. - climate change and air quality, clean energy supply source. • Economic - maintain SME enterprises. Remain competitive with the US. • Energy supply - reduce use of natural gas & exploit Canada's abundant potential production capacity. • Energy security (reduce dependence on other countries for energy)	• Clean hydrogen produced from variety of feed stocks (fossil fuels, biomass, nuclear, hydro). • Significant part of Canada's transportation & power generation mix (10% by 2030). • Canada becomes world leader in clean hydrogen-based economy.	• Hydrogen Highway in BC • Hydrogen Village in Ontario • BC Hydrogen Strategy • Building a knowledge-based technology cluster in BC, and across Canada • Demonstration Centre at NRC-IFCI (includes fuelling station, vehicles, photovoltaic panels, HTEC, etc.) • NRC National Hydrogen and Fuel Cell Strategy • Vancouver Fuel Cell Vehicle Project • NRC-IFCI PEM Technology R&D Program • NRC Fuel Cell R&D Program

Technology Area	Drivers	Vision for the Future	Current / Planned Initiatives
Hydrogen Production, Storage and Conversion Hydrogen Infrastructure	• Economic development • Sustainable development • Environmental performance	• Viable hydrogen infrastructure and niche market.	Hydrogen infrastructure development is critical to fuel cell commercialization, particularly in transportation applications. The Hydrogen Highway will demonstrate the technical and operational capabilities of a fully functioning hydrogen fueling infrastructure. The infrastructure will offer fuel from multiple hydrogen sources, showcasing production, storage and distribution technologies and a wide range of end-use applications, including heavy duty, light duty and captive fuel cell vehicles; as well as stationary, portable and micro fuel cell applications. • NRC-IFCI Demonstration Centre • Hydrogen Village • Vancouver Fuel Cell Vehicle Program • Demonstration of HySTAT 50 kW hydrogen energy station at PEI
Nuclear Fission	• Environmental (Climate Change) • Infrastructure Renewal (ON, QC, NB) • Economic (Canada's nuclear industry)	• Technology development to replace or renew electrical generating capacity in ON, QC and NB. • Technology development to adapt Candu nuclear technology to energy requirements of mining and refining AB tar sands. • Technology improvements for upgrading performance of Canadian fission reactors in world markets. • Technology development for long-term storage of radioactive waste. • Technology development for hydrogen production for fuel cell use.	• Development of the ACR-1000 advanced reactor, with a variety of fuel options • Examination of the opportunity for Candu nuclear energy for the Alberta oilsands • Opportunities for upgrade of Candu reactors in ON, NB.

Technology Area	Drivers	Vision for the Future	Current / Planned Initiatives
2. Aspires to Lead in Adaptation			
Cleaner Fossil Fuels Unconventional oil and gas	• Significant tight gas and coal bed methane resources • High natural gas prices and high demand • Lower greenhouse gas emissions - make natural gas the preferred fuel	• Develop a number of key technologies that will result in 15% of natural gas production coming from non-conventional sources.	• Unconventional gas technology roadmap to increase reserves and production • Novel drilling techniques and fracture technology • Enhanced coal bed methane field pilot
Cleaner Fossil Fuels Upgrading	• Economic - need to capture greater value. • Energy Supply - need for petrochemical feedstock, and to replace dwindling diluent supply. • Environmental - need to reduce emissions. • Sustainable Development - need to reduce energy intensity and water usage.	• Meet quality specifications of North American refineries • Reduce capital costs by 30% & overall costs by 20% by 2020. • 20% reduction in energy intensity by 2020. • Near zero emissions. • Develop an integrated upgrading/refining/petrochemical complex by 2020.	• Hydrocarbon Upgrading Task Force identifying non-technology advancements needed to achieve vision • New catalyst development for converting heavy oil into petrochemical feedstocks and other added-value products • New technology for the selective separation of asphaltenes • Production of activated carbon from oil sands coke for mercury capture in coal-fired power plants • Other conversions of waste by-products into value-added products • Refinery process improvements
Advanced Energy End-Use Buildings / Communities	• Energy Supply – increasing energy costs make housing less affordable and less secure. • Sustainable Development- urban sprawl increases land and resource use, decreases quality of life and productivity.	• By 2030, all new homes will be built to net-zero energy standards and all communities built to be more liveable for less cost, consuming less energy and resources.	• A national community scale net-zero energy housing initiative launched. • Best practices being promoted for residential intensification, transit oriented communities. • Continuing work with R-2000, LEED, Codes and Standards.

Technology Area	Drivers	Vision for the Future	Current / Planned Initiatives
Advanced Energy End-Use Integrated "Smart" technologies	• Environmental • Energy Supply • Sustainable Infrastructure • Security	• Implementation of "smart" technologies to efficiently manage energy supply and use, e.g. "smart" kWh consumption meters.	• Development and implementation of hardware, software, information management and human interface for "smart" kWh meters.
Renewables and Alternative Energy Production Solar Thermal* *Leading in World in some system components	• Economic - Higher energy costs are driving increased interest in alternatives. Declining fossil fuel production will drive demand for alternatives to fossil fuels for heating/cooling applications. Financial incentives are starting to have a positive impact on the market. • Heating Demand - Space heating and hot water account for 80% of energy demand in Canadian homes. • Sustainable Development - local, renewable, green energy source. • Social - Positive public perception and will use if cost-competitive. • Climate Change Challenge - The one tonne challenge can be met by installing a single solar water heater on a home.	• Increase Canadian solar heating equipment sales by ten-fold to $40-$50 M/y within 10 years. • Significant contribution to the net-zero energy home concept. • By 2020, installation of 100,000 residential solar water heaters displacing 50% of fossil fuel use • Installation of several projects integrating underground thermal energy storage, solar heating and energy efficient housing to demonstrate the displacement of 90% of fossil fuel use for space heating from solar on a community scale.	• Development and commercialization of low-flow solar water heaters having 30% reduced capital costs. • Development of standards and certification/rating program for residential solar water heaters. • Pilot projects with utilities, builders, and developers for large-scale implementation of residential solar water heating. • Installation and monitoring of 52 home community using solar seasonal storage concept to displace 90% of space heating load with solar energy.
Renewables and Alternative Energy Production Ocean energy	• Environmental sustainability • Economic development • Energy security • Energy supply	• Electricity generation in the tens of MW from tidal power and ocean currents.	• Pilot projects in wave, tidal and other ocean energy technologies and supporting industries development. • R&D toward integration with other renewable energy (e.g., offshore wind) and conventional energy (e.g., offshore oil and gas) projects. • Establishment of national ocean energy test centres on all Canadian coasts - west, east and north.

Technology Area	Drivers	Vision for the Future	Current / Planned Initiatives
Renewables and Alternative Energy Production Small-to-intermediate fossil fuel conversion	• Trend towards decentralized power and heat generation • Higher energy efficiencies than in central generation • Smaller units required for hydrogen production	• Combined heat and power (CHP) projects, helping rural communities to generate jobs, revenues and meet their own energy needs in the most efficient and flexible manner possible.	• CHP inventory and feasibility study • Feasibility study for a bioenergy demonstration centre
Renewables and Alternative Energy Production Grid integration	• Address safety and reliability issues of intermittent renewable energy supply and distributed generation on the electricity network • Increasing reliability of electricity supply network through a more decentralized energy supply	• Enhance Canada's electricity distribution and transmission infrastructure by making it better able to integrate significant contributions from renewable and decentralised energy supply.	• Microgrid and electricity network automation • Canadian industrial capacity in innovative interconnection technology • Harmonization of standards, codes and regulations
Biotechnology Existing and New Biomass Supply (biomass production / storage / pre-processing / transport)	• Growing demand for evergreen, local biomass inventory info (e.g. ethanol and biodiesel plant siting) • Need for forest residue disposal and reduced environmental impacts • Greater value from resources • High delivered cost per tonne biomass • Need feedstock infrastructure for bio-based economy • Rural and aboriginal community development • New renewable feedstocks for chemicals, materials	• Infrastructure in place to sustainably support biomass demand. • Better utilize residues (no target). • New biomass feedstocks (high productivity, desired traits). Targeted hectares of bio industrial oil production: - 5.2 million in 2025 - 12 million in 2050 • New, waste biomass feedstocks, to replace valuable agricultural crops in biofuel production.	• Detailed GIS-based inventory of agriculture and forest residues; • Residue collection, preprocessing and characterization R&D; • Agroforestry and short rotation woody biomass plantation R&D; • Development of plants with specific traits (as new feedstocks for chemicals, etc.)

Technology Area	Drivers	Vision for the Future	Current / Planned Initiatives
Biotechnology Biomass Conversion & Utilization Technologies (Technologies that convert biomass into energy, energy carriers, and higher value products)	• High cost of bioenergy and bioenergy carriers • Renewable, clean, CO_2 neutral energy supply (heat and power) • Renewable, clean, CO_2 neutral transportation fuels (e.g. ethanol, biodiesel) • Renewable power production incentive (RPPI) • Local environmental damage (air, groundwater, etc.) • Development of sustainable technologies, industries, communities • International climate change commitments (GHG reduction obligations) • Rural and aboriginal community development	• Bio-based energy and energy carriers are competitive with fossil fuel counterparts (on a full cost accounting basis). • Sustainably produced energy from a variety of biomass sources (forestry, agriculture, urban, marine materials) provide 8-9% of Canada's energy demand in 2025 (NEB forecast is 6-7%). • In 2020, the forest products industry will use bioenergy to provide 665 PJ and double its electricity output. • A variety of chemicals and materials are sustainably produced from biomass feedstocks and assume a growing market share.	New conversion technologies or more efficient current technologies, including: • combustion; • gasification; • pyrolysis; • anaerobic digestion; • pre-treatment , hydrolysis & fermentation tech. (cellulosic ethanol); • esterification • demonstration of ethanol from cellulose • demonstration of bio-diesel Supporting technologies, including: • separation, purification and extraction (higher value co-products); • secondary energy conversion that transforms the outputs of gasification, pyrolysis, etc.; • utilization (boiler testing, integration into existing heat & power systems)
Biotechnology Integrated BioSystems (biorefining, industrial clusters)	• Systems developed that capture greater value (i.e. bio-based energy and higher value products) • Need to provide renewable, sustainable alternatives to petroleum feedstocks and refining/processing • Development of sustainable industries, communities • Rural and aboriginal community development	• Development of several sustainable biorefinery systems, using various biomass feedstocks and producing a suite of energy and products. • Robust bio-refining sector in 2020. • Numerous communities will establish eco-industrial clusters that exchange bio energy or materials with one another to maximize resource efficiency.	• Improve process knowledge and understanding of several feedstock to end-product threads, involving different feedstocks and generating different product mixes. • Understanding and communication of factors needed to establish and assess bio-based eco-industrial clusters.

Technology Area	Drivers	Vision for the Future	Current / Planned Initiatives
Hydrogen Production, Storage and Conversion Stationary fuel cell applications	• Environmental / Sustainable Development - climate change and air quality, clean energy supply source. • Economic - maintain SME enterprises. Remain competitive with the US. • Energy Supply - reduce use of natural gas & exploit Canada's abundant potential production capacity.	• Development of Solid Oxide Fuel Cells (SOFC) for stationary applications in order to ensure that fuel cells become a significant part of Canada's transportation & power generation mix (10% by 2030). • Canada becomes a world leader in fuel cell technologies.	• 200 kW demonstration at the Northern Alberta Institute of Technology • A national strategic plan for the coordination and funding of a SOFC R&D program • Western Canadian Fuel Cell initiative has been jointly initiated by AERI and Western Economic Diversification • Clean hydrogen produced from variety of "impure hydrogen" sources (fossil fuels, biomass, nuclear, hydro) • NRC-IFCI Low Temperature SOFC Program • NRC-IFCI Demonstration of 5KW SOFC system used for combined heat and power • NRC-IFCI working on development of a multi-fuel SOFC system
3. Putting to Use			
Cleaner Fossil Fuels Conventional Oil and Gas	• Declining WCSB production • High oil and gas prices • Royalty credit programs to recover 73% oil and 41% gas that remain in the reservoir	• Develop a number of key technologies that will lead to a 20% increase in oil recovery through enhanced recovery processes by 2020.	• Innovative enhanced oil and gas recovery (EOGR) projects • Development of more sophisticated EOGR reservoir models • Reserves-addition business case study

Technology Area	Drivers	Vision for the Future	Current / Planned Initiatives
Cleaner Fossil Fuels Clean Coal* * Aspires to Lead in Adaptation of Low-Rank Clean Coal technology	• Social - public perception that coal is a "dirty" fuel. • Energy Supply Scarcity - strategic and competitive advantage as an energy source. • Environmental • Economic - need for demonstration plants operating with Canadian coals. Rising health costs due to emissions.	• Public acceptance of coal as a strategic and competitive source of clean energy. • Coal becomes a bridge to a clean, carbon free, near zero emissions energy economy. • Commercially competitive "Polygeneration" plants producing clean power, hydrogen, ultra-clean fuels and chemicals.	• Common national vision and business model developed by government-industry consortia, such as the Canadian Clean Power Coalition and Energy Innovation Network by 2005 • Evaluation and selection of feedstocks and technologies for different regional polygeneration plants by mid 2006. • Demonstration sites selected by 2006 and financing put in place by 2007. • Create an Ultra Clean Coal production and transportation centre (2008). • Demonstration of IGCC with CO_2 capture (2010). • Demonstration plant(s) with best commercial potential built by 2010. • Demonstration of oxy-fuel combustion with CO_2 capture (2010). • Demonstrate an integrated coal fired power plant with district heating (2014). • Fully operational commercial plant by 2015. • Demonstrate a coal based polygeneration facility producing electricity, steam, and hydrogen in association with oil-sands operations (2015). • Demonstrate integration of CO_2 capture from coal-fired facility with ECBM (2016). • Demonstrate commercial use of fuel cells in a coal-based electricity generation facility (2017).

Technology Area	Drivers	Vision for the Future	Current / Planned Initiatives
Cleaner Fossil Fuels CO_2 capture	• The climate change challenge could be addressed through CO_2 capture and storage. • Very high CO_2 capture costs are a major barrier to the commercialization of these technologies.	• Reduce greenhouse gas emissions by developing technologies to capture and transport carbon dioxide.	• Post-combustion R&D at the International CO_2 Test Centre in Regina, Saskatchewan (a testing of amines for the capture of CO_2 from relatively dilute, but large volume sources of CO_2 such as coal-fired electrical generators, natural gas turbines and commercial boilers). • CANMET CO_2 Consortium initiatives (CETC Ottawa): - Development of Improved Capture Technologies - Integration and Optimisation of Capture Technologies - CO_2 Capture and Storage Systems Integration • Capture & Transportation: Two reports outline a program for CO_2 capture and storage in Canada by constructing a CO_2 backbone pipeline connecting CO_2 emission hubs to potential sinks for geological storage and enhanced oil and gas recovery
Cleaner Fossil Fuels CNG/LNG	Awaiting Input		

Technology Area	Drivers	Vision for the Future	Current / Planned Initiatives
Cleaner Fossil Fuels Water in energy production	• Water resources under increasing strain • Competition from the agricultural industry and other users • Southern basins are prone to drought; northern basins are prone to flooding • Lack of cost-effective water purification technologies	• Support the development of a number of key technologies that will result in a 50% reduction in fresh water usage by the energy industry by 2020.	Water management is a cross-cutting initiative; programs include: • Water needs survey of the energy industry • 'Step out' technologies dealing with the recycle or reuse of freshwater used and/or alternative disposition methods for formation waters produced with oil and gas • The geologic assessment of shallow water zones in areas where shallow gas and/or coal bed methane is being produced • Investigate the current status of oilsands mining water and tailings treatment methods to determine effectiveness and costs
Advanced Energy End-Use Industry	• Energy costs have increased significantly and are hampering industry competitiveness. • Climate Change compliance will have an impact on competitiveness unless mitigation measures are taken.	• The increased adoption of existing leading edge technology coupled with enhanced training, awareness and emphasis on organizational change can double industrial energy efficiency.	• Provide tools and services to Canadian industry to help them better understand potential to become more efficient. These tools include: - Improved diagnostic approaches: audits, benchmarking, process integration, computation fluid dynamics and, - Improved method of financing - Ways and means to take advantage of low-grade heat.
Advanced Energy End-Use Transportation	• Sustainable Development • Energy Supply • Social • Environmental	• Adapting the emerging R&D capacity of Canada's transportation and motor vehicle industry to new, community-integrated, low-energy modes of transportation.	• Current research in hydrogen fuel cell vehicles, biodiesel and ethanol fuel production. • Support for R&D for natural gas vehicles and fuelling infrastructure.

Technology Area	Drivers	Vision for the Future	Current / Planned Initiatives
Advanced Energy End-Use Electricity Transmission	• Security • Sustainable Infrastructure • Social • Environmental	• New technologies to increase the efficiency, capacity, and cost-effectiveness of electricity transmission lines and the stability of transmission systems.	
Advanced Energy End-Use Energy Storage	Awaiting Input		
Renewables and Alternative Energy Production Wind	• Sustainable Development - local, renewable, green energy source. • Environmental - climate change (no direct GHGs). • Economic - Wind Power Production Incentive (WPPI); increasing costs of conventional sources; adds to energy diversification, supply and security; facilitates independent power producers, competitive markets & regional development; need for development of components and wind turbine production in Canada. • Trend towards distributed generation. • Social - positive public perception.	• Wind energy will make a growing contribution to Canada's energy supply, providing 10% of Canada's energy by 2020. • Canadian S&T investments in wind energy technologies will create economic opportunities for Canadians in Canada and internationally. • Canadians will export expertise to evaluate sites, build and operate wind projects. • Successful integration of wind energy with electrical grid.	• Development of a Universal Wind Turbine • Development of Canadian Wind Turbine Standards • A National Wind Atlas (includes mapping and forecasting) • Establishment of a Very Small Wind Turbine testing program at the Atlantic Wind Test Site • Icing and adaptation to Nordic climates • Offshore wind energy
Renewables and Alternative Energy Production Solar Photovoltaic	• Sustainable Development -renewable green energy source. • Environmental - climate change (no direct GHGs).	• Incentives lead to economies of scale to reduce capital costs of solar photovoltaic (PV) energy supply. • Solar PV becomes competitive with conventional technologies.	• Harmonization of Standards and electrical code requirements • Testing and demonstrating integration concepts for residences and building • Optimizing design strategies to reduce overall system costs

Technology Area	Drivers	Vision for the Future	Current / Planned Initiatives
Renewables and Alternative Energy Production Geothermal	• Economic - need for alternatives to natural gas for oil sands recovery • Sustainable Development -renewable green energy source. • Environmental - climate change (no direct GHGs).	• Harness geothermal energy from deep rock sources to provide process heat for oilsands operations.	• Feasibility study for geothermal options in Canada. • Demonstration of the viability of geothermal sources for oil recovery from oil sands.
4. Monitoring Development			
Nuclear Fusion	• Future energy requirements • Environmental constraints		• Maintain a watching brief on world developments.

* Please make reference to or contact the ETWG when adapting information contained in this table.
Contact Frank Mourits (frank.mourits@nrcan.gc.ca) or Jeremy Sager (jsager@nrcan.gc.ca).

Appendix 3

The Canadian Energy Technology Partnership Program

Key features of the Canadian Energy Technology Partnership Program proposed by Saskatchewan can be summarised as follows:

- Program duration would be five (5) years.

- The program would fund energy technology R, D&D projects anywhere in Canada, including at the private sector, the federal government or provincial/territorial government departments and their agencies or crown corporations. Projects would only be eligible if there was some significant, novel aspect to the technology or to the application of the technology.

- Projects would be cost-shared by the federal government (1/3) from a dedicated pool of funds, by provinces/territories (1/3) and by industry (1/3). Each project would have to be funded by one or more provinces or territories, the federal government and industry. Projects without industry funding would not qualify.

- Project proposals, developed in collaboration with the above three partners, would be submitted to the ETWG to ensure that at least one province and industry were funding the project and that all provinces/territories would be aware of the applications. Such sharing of energy technology information across Canada would be an essential aspect of the program.

- Following the initial screening step by the ETWG, the federal government would be responsible for reviewing submitted proposals and making funding decisions. These decisions would be independent of any funding decisions by provinces/territories or industry and would be based on federal funding criteria.

- Federal officials on the ETWG would be the single point of contact for provinces/ territories to access federal funding.

- In order to ensure the transfer of technology information to all jurisdictions, regardless of whether they choose to participate or not, all project information, including proposals, technology evaluations and final reports would be made available to all jurisdictions through the ETWG.

There would be multiple advantages for the provinces/territories and industry of such a program. Some key advantages would be:

- Certainty of a dedicated federal pool of funds;

- Central point of access rather than close to 100 individual funds;

- Provinces/territories would have a strong incentive to work with industry and the federal government in identifying and developing potential projects;

- It would be easier for provinces to obtain provincial funding on the basis of leveraging funding with the federal government and industry;

- Technology transfer to the provinces/territories would be improved and multi-jurisdictional cooperation on major energy technology initiatives would be facilitated;

- Canadian investment in energy technology would increase, which would improve the potential for new energy technology to increase energy supplies, improve energy conversion and end-use efficiency, and reduce GHG emissions.