Sustainable Energy from Fossil Carbon and Beyond[†]

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The world's dependence on energy from fossil carbon sources (coal, petroleum and natural gas) will continue to increase unless counteracted by rising sustainability concerns. Two measures to address the concerns are presented: 'carbon capture and storage' (CCS) and 'biochar', for coping with fossil carbon dioxide from large industrial point sources and from distributed sources (such as automobiles, planes and domestic furnaces), respectively.

The limitations of these counter-measures as well as the challenges associated with renewable energy sources (including hydroelectric power, wind, solar and biomass), when viewed from a global perspective, are spurring the quest for fundamentally different sources of energy. One promising source is 'nuclear fusion', the process which powers the sun and other stars. Nuclear fusion requires primarily isotopes of hydrogen, which are abundant, and does not create long-term radioactive waste, unlike nuclear fission.

Different approaches have been taken to create the extremely high temperatures and pressures necessary for nuclear fusion. The most promising approach, which is now nearing experimental verification, is based on 'inertial confinement' wherein high-power laser beams are targeted on small fuel pellets consisting of hydrogen isotopes. Inertial confinement will be described in lay language and opportunities for laser development identified, thereby conforming with the theme of the symposium.

Canada is presently the only advanced country that is not a member of an international fusion initiative. Given its potential for carbon-free, sustainable energy, the importance of laser systems and, more generally, the role of photonics in nuclear fusion, Canada's position should be reconsidered.

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Green photonics: trends and directions

Michael Lebby, GM and CTO Translucent

The state of photonics technologies and products has been growing quickly over the past few years, and with the recent interest in cleaner, more efficient solutions we have seen the rise of a new field in photonics: Green photonics. This talk will review the status of green photonics as it relates to the photonics field, and will explore how the technologies will develop over the next decade. Green photonics technology and market philosophy has been evolving for years as a large portfolio of engineers and scientists strive for energy efficiency, cleaner solutions and improved health in their designs. Included within green photonics are the traditional photonics segments such as photonic lighting, solar, optical networking, photonics integration, to name a few. Data presented will show that many classic photonic fields will become more 'green' through better, more efficient product design over the decade.

For the past five years, green photonics has become topical, political, and to some extent even cultural. There has been a strong need in the industry to forecast and predict the optoelectronics expectations for both green photonics and photonics lighting technologies for the next ten years to 2021. The cultural impact for green, clean, and energy efficient lifestyle that includes photonic lighting, solar and improved photonics components such as laser diodes, photodetectors, image sensors for example, is just beginning. Over the next decade, many innovative new products will emerge in many industries that will better define and demonstrate these technologies. The area that is now becoming clear to many both inside and outside the photonics industry is that a broad range of products and services that the economy will utilize over the next decade will contain optoelectronics (a term that is used interchangeably with photonics), either as key components, or as components that enable better and more efficient systems both in the workplace as well as home.

The talk aims to motivate designers of photonics technologies to continue their focus on better, more efficient, cleaner solutions as it is clear from the data presented that green photonics is here to stay.

Smart Grids

Muriel McGrath
Partner (Energy & Communications)
IBM Global Business Services

Smart grid technologies transform the way electricity is generated, transmitted, distributed and managed, adding intelligence throughout the grid to improve system reliability and efficiency, improving management of supply and demand, optimize operations and streamline costs. By using digital sensors, advanced communication networks and analytics, utilities can understand demand in near real-time.

These smart grids use information to automate, monitor and control the two-way flow of energy — from the source to the plug. Smart grids can also incorporate new sustainable energies such as wind and solar generation, and integrate electric vehicles.
Utility companies around the globe, faced with an ever intensifying and interconnected set of challenges, are looking for even smarter ways of doing business. More and more, utilities are viewed as being a critical link to solving the challenges we all face related to climate change and the care of our planet’s energy resources.

Renewable energy: a Hydro-Québec perspective

Gaétan Lantagne
Scientific Director
Institut de recherche d'Hydro-Québec

Hydro-Québec is a large electric utility generating over 36 GW of renewable hydro-electric power. Hydro-Québec is also a major North-American player in wind power with a contracted supply of 657 MW and planning for 4000 MW of integrated wind power by 2015. Energy efficiency is also a major strategic direction of the corporation with a cumulated energy savings target of 11 TWh by 2015. New technologies are being explored as potential new supplies of electric power for the future demand and markets: hydrokinetic turbines; high temperature geothermal energy (enhanced ground source); osmotic power and solar. The presentation will describe the various renewable energy options on the table- from an R&D standpoint- and the already existing links between the energy and photonic businesses. It will also discuss some issues of renewable energy within the context of the incoming domains of interactive (smart) grid and electric transportation.

Clean Energy- a NRC Perspective

Marie D'Iorio
Director-General
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The National Research Council is Canada's national laboratory that builds Canada's innovation and technology capacity by supporting the growth of Canadian industry and by working on solutions to national challenges, in particular, clean energy. NRC leverages its facilities and expertise to advance the clean energy agenda in areas such as energy efficiency, renewable and alternative energy sources and cleaner fossil fuels, and uses its Industrial Research Assistance Program (NRC-IRAP) to assist small and medium-sized enterprises (SMEs) in the commercialization of their technologies. I will discuss a few photonics enabled clean energy solutions (efficient plastic solar cells and healthy building systems) and the benefits of an integrated systems approach.

Solar energy and Architecture

Miljana Horvat, M.Arch, Ph.D (Bldg.Eng.)
Associate Professor
Department of Architectural Science
RYERSON UNIVERISTY

Synopsis

This presentation will provide an overview of the enormous potential that solar energy harvesting has in buildings: from small scale in residential sector, to a greater scale in commercial buildings and, even, public spaces. Then, it will present the progress of the current research project by International Energy Agency, called IEA Task 41: Solar Energy and Architecture that involves researchers and practitioners (architects and engineers) from 14 countries. The main objective of this 3-year long project is to identify the obstacles to wider implementation of active solar systems in buildings and to help instigate high-quality solar architecture.

The Status of Photovoltaics in Canada

Rafael Kleiman
Scientific Director, Canadian Photovoltaic Innovation Network

Despite its northern latitudes, Canada has significant amounts of solar energy resources, at least equivalent to Germany, which now meets 1.1% of its electricity needs by solar PV, which is projected to rise to 10-15% over the coming decade. Ontario has recently enacted a significant Feed-in Tariff (FIT) program, which has the potential to rapidly increase PV deployment and to bootstrap a local industry to serve domestic demand and take a share of the rapidly increasing global demand – i.e. along the lines of the 'German model'. While provincial electricity needs and resources differ widely, there is an important role in inter-provincial cooperation with significant benefits to Canada as a whole. Research activity in Canadian universities has increased dramatically in the last few years, primarily due to an improved funding situation, resulting from the increased awareness of PV as part of the solution to meeting our energy needs in a sustainable way. Canadian researchers are currently engaged in investigating a wide range of technologies, with both short and long term impact. There is a significant research capacity in both expertise and infrastructure that has been translated from the photonics and optical communications sector to the PV sector to address the current technical challenges. An important recent development is the formation of a new network, the Photovoltaic Innovation Network, funded by NSERC, which brings together all relevant stakeholders with an interest in accelerating PV deployment in Canada. This network has a focus on the challenges associated with reduced costs and higher efficiencies of PV cells, in cooperation with and support of Canadian industry.

Legislation: an asset or an issue

Denis Leclerc

President and CEO

Écotech Québec

Plusieurs pensent que des politiques et réglementations contraignantes constituent le facteur déterminant du développement des technologies propres. Certains acteurs font ainsi des pressions pour que les gouvernements adoptent des normes plus sévères en matière d'environnement. L'objectif ne devrait pas seulement être de réduire l'impact sur l'environnement mais également d'accroitre la compétitivité des entreprises grâce à l'innovation technologique. Dans ce contexte, comment trouver le bon dosage entre l'amélioration de la compétitivité des entreprises et la réduction de leur empreinte écologique, sans créer d'effet pervers en cette période de relance économique. Écotech Québec, la nouvelle grappe des technologies propres du Québec, entend contribuer concrètement à l'atteinte de cet équilibre.

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Many believe that binding policies and regulations are the key driver in the development of clean technologies, know as cleantech. Some stakeholders are thus lobbying governments to adopt more stringent environmental standards. The objective should not only be to reduce the environmental impact but also to increase the competitiveness of enterprises through technological innovation. In this context, how to find the right balance between enhancing the business competitiveness and reducing the environmental footprint, without creating perverse effect in this period of economic recovery. Ecotech Quebec, the new cleantech cluster of Quebec, will contribute concretely to achieving this balance.