Renewable energy opportunities in the oil and gas sector

Executive Summary

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Introduction

At first glance, they would seem like natural enemies. Yet for many years, the global O&G sector has been investing in renewable energy (RE) technologies and projects. Between 2000 and 2010, U.S.-based O&G companies invested roughly $9 billion in renewables (wind, solar, biofuels) — roughly 20% of the total U.S. renewable investment of $47 billion over the same period.[1]

Drivers for the O&G sector to play an active role in RE include regulatory (biofuel content standards, renewable portfolio standards, feed-in tariffs, emerging GHG obligations), ideological (environmentally motivated customers, employees and project host communities), and simple public relations. There is also a case to be made for First Mover advantage, as the O&G companies who lead in this space will be able to position themselves more-credibly as Energy companies ahead of their peers. Significant challenges to the growth of RE investment are the low price of natural gas and the absence of meaningful carbon price in many jurisdictions.

From an economic perspective, RE effort by O&G companies is an opportunity to leverage the niche cost advantages these RE technologies offer, particularly in remote off-grid environments. It also plays to the strengths of these companies — low cost of capital, expertise in land acquisition, skilled at resource characterization, engineering, large-scale project management, and stakeholder engagement. It offers companies useful means to diversify energy inputs, products and services in the face of volatile energy input costs and peaking or declining oil demand in key markets. It can earn them important political capital with key public authorities that can be helpful in supporting their other lines of business. And it positions them for a potential transition in energy markets, signaled by the rapid pace of cost reduction for many RE technologies.

To support and systematize the efforts of the O&G sector in this space, a group of leading companies engaged with the Pembina Institute in 2012 to review the history of RE activity, share experiences, extract the opportunities, barriers and enablers, and draw some conclusions for how to move this area forward if and where appropriate.

RE dimensions & case studies

This study found six areas of RE action and engagement by O&G companies and four main applications, drawing on desk research and case study presentations provided by the participant companies and invited experts. Specific case studies and examples are detailed in the main report.

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[1] T2 and Associates, *Key Investments in Greenhouse Gas Mitigation Technologies from 2000 Through 2010 by Energy Firms, Other Industry and the Federal Government* (2011). www.iogawv.com/Resources/Docs/2011_api_ghg_investment.pdf

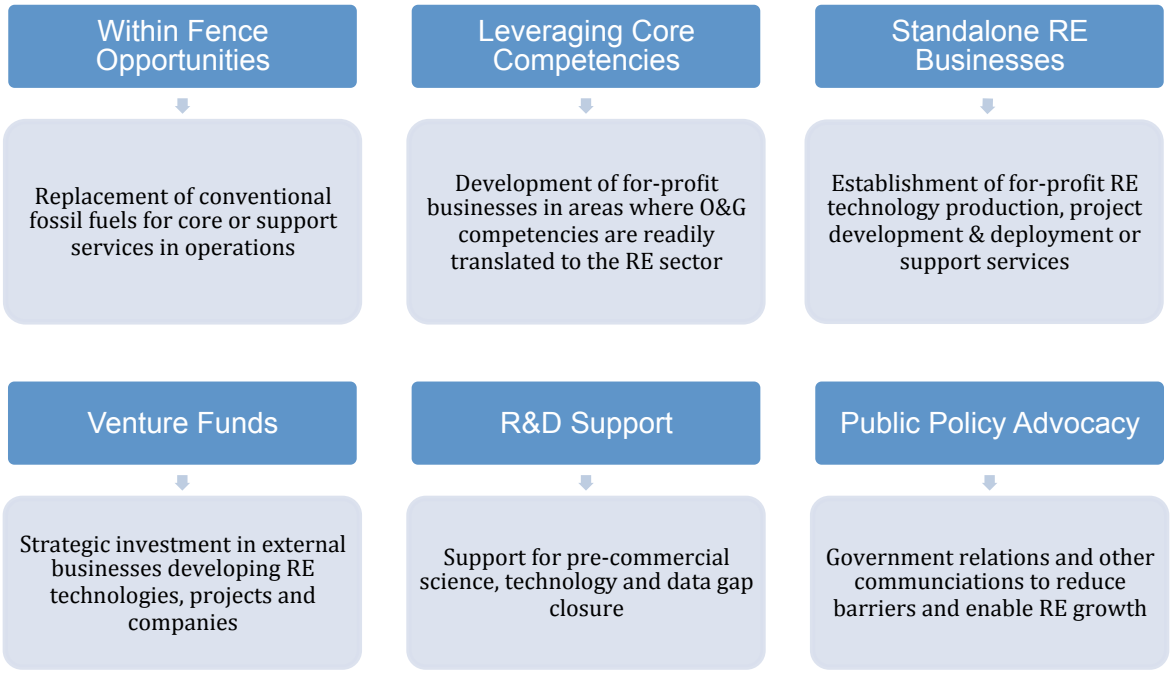

Figure 1. Dimensions of RE activity by O&G companies

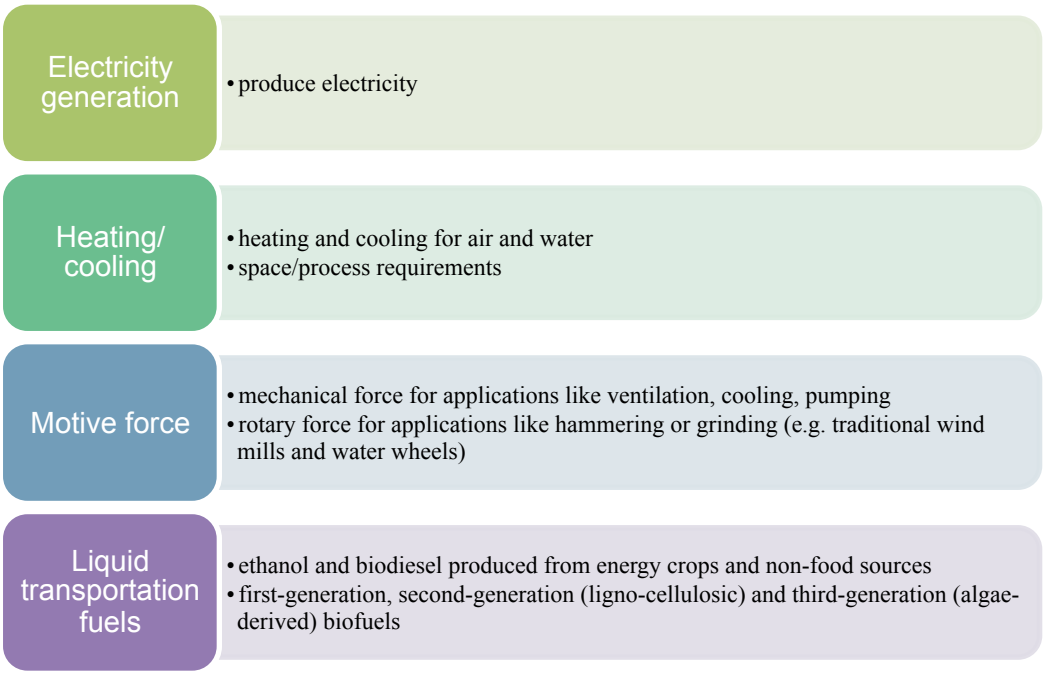

Figure 2. RE applications used by O&G companies

Discussion highlights

There is a high level of interest in RE amongst O&G leaders, coupled with skepticism about the scale of the opportunity.

Participating companies are genuinely interested in better understanding *what* RE technology are available, the state of technology and *how* these technologies can work for them. Some O&G companies also view RE as a threat to their hydrocarbon fuels business. Nonetheless, there is evidence that energy return on energy input (EROI) in fossil fuel production is declining, and that fossil-based transportation fuel demand in North America has peaked.

In light of this, companies that wish to be in business for the long term need to be (and in some cases already are) 'crossing the energy bridge' by developing a portfolio of transition investments in RE, in the areas described above (Figure 3). Nonetheless, innovation has historically been limited in the Canadian O&G sector, except with public support (e.g. AOSTRA[2]). Looking at Canadian R&D investments in 2010[3], only seven O&G companies make the top 100 list, with R&D investments at 0.2% to 0.6% of revenue, which is at the bottom end of the scale. The oilsand industry is starting to shift this, with emerging initiatives such as the Canadian Oil Sands Innovation Alliance beginning to change corporate culture.

The case studies from the publically available information and research (see Figure 3) and workshop presentations revealed that O&G companies that have integrated renewable technologies into their operations and business lines have done so on an ad-hoc basis, and the results have been hit-and-miss. Favourable project economics (i.e. a good return on investment) is the top decision criterion with the biggest economic challenge being low prices for natural gas and carbon emissions. Remote off-grid applications show the most promise, generally.

Challenges to RE investment in the O&G sector include ensuring grid access, integrating renewables in standard O&G engineering templates, competing for capital against higher-return O&G projects, and overcoming lack of RE technology literacy.

A series of technology presentations from industry experts indicated that core RE technologies (wind, shallow geothermal, and in some regions solar) are reliable and mature, and others are advancing rapidly (see Figure 4). Participants noted the importance of perfecting energy storage to make RE economics work, of standardizing technologies to reduce design and installation costs, and of harnessing the complementarities between natural gas-based power and intermittent renewables.

[2] http://www.eclac.org/publicaciones/xml/9/38969/Public_private_alliance_innovation_Canadian_W292.pdf

[3] http://www.researchinfosource.com/media/2011Top100Listsup.pdf

			Dimension					
Company	Application	Technology	Within-fence operations	Leveraging synergies with core competencies	Stand-alone RE business	Venture funds to support RE business	R&D	Public policy
Shell	Fully renewable-powered off-shore O&G platform equipped with small wind turbines and solar panels. The system reduces CO_2 emissions, and removes the need for electrical connection (typically using a power cable along the seabed floor) thus reducing environmental impacts, ongoing operational risk and infrastructure costs.	Electricity generation from wind and solar	■				■	
Suncor	Major ethanol business. Uses 40 million bushels of corn annually. In 2011, the plant doubled its production capacity to 400 million litres / year.	First-generation ethanol from corn		■	■			
Cosan	Major ethanol business. $12 billion joint venture between Shell and Cosan. Produces 2 billion litres / year with a plan for 4 billion litres / year.	First-generation ethanol from sugar cane	■	■	■		■	
Chevron	Global electricity production business. World's largest producer of geothermal energy with capacity of 1,273 MW.	High-temperature geothermal		■	■			
Chevron and Brightsource	Steam production for EOR. A demonstration project to test the viability of using solar energy for EOR. The project heats up recycled water to produce steam that is injected into oil reserves.	Concentrating solar thermal	■			■		
Devon	Electricity production for gas plant. A wind turbine was planned for the gas plant that would have expected to provide 40% of plant's energy needs. Project did not proceed as it was decided to close the Coleman gas plant.	Wind turbine	■					
Aera LLC	Steam production for EOR. Co-owned by ExxonMobil and Shell, the plant was to utilize waste biomass to produce steam for EOR. The project failed to meet air emission regulations and the full system was not built.	Waste biomass combustion	■	■			■	
Statoil and Statkraft	Statoil's first full-scale commercial offshore wind investment. Project consists of 88 x 3.6 MW wind turbines located between 17 to 23 kilometres off the coast of Norfolk, UK. Site	Electricity generation from wind		■	■		■	

O&G companies are making the most progress on RE in the biofuels space, driven principally by government mandate. Wind is commercial now, but generally has lower ROI than traditional O&G investments. Applications using biomass for steam or power are challenged by the need for long-term fixed-price contracts for the biomass, and by transportation distance/diesel fuel price volatility.

Stand-alone RE business lines (wind farms, ethanol) have had more success and traction than RE projects generating energy within O&G operations, with the exception of solar in remote applications. Western Canada's largest buyer of solar technologies, for example, is the O&G sector.

Gaining ground in other areas of renewables will require hydrocarbon companies to go beyond thinking of themselves as in the liquid fuels business alone. The precedent is there: Suncor is for example the fifth largest power producer in Alberta (through its onsite cogeneration facilities and offsite wind power developments), and many O&G companies are investigating the power business more seriously because of the fall in price for natural gas, obliging them to move up the value chain by producing power or supporting NG vehicle infrastructure.

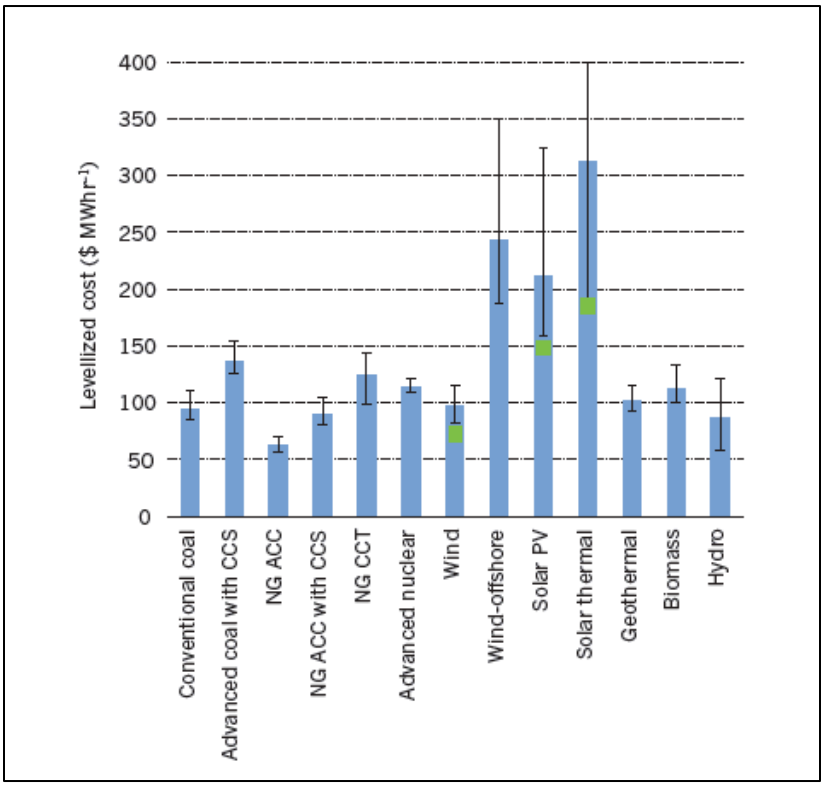

Figure 4. Projections of the 2016 average cost of electricity from various sources in the U.S.

The green squares on the diagram show that, in 2012 wind, utility-scale solar photovoltaics and solar thermal energy are already at or below the lower end of the 2016 estimates. [ACC – advanced combined cycle; CCS – carbon capture and storage; CCT – conventional combustion turbine; NG – natural gas; PV – photovoltaics]

Source: U.S. Energy Information Administration[4]

It was pointed out that O&G corporate financial structure may limit renewables investment**.** O&G companies generally have a debt target of ~30% debt to ~70% equity, whereas this is usually reversed in utilities. With this high equity financial structure, it is harder to justify taking on RE projects that typically have lower returns. On the other hand, given the comparatively-small scale of renewables projects to

[4] Cited in Chu, Steven, and Majumdarm A. Opportunities and challenges for a sustainable energy future. Nature, Vol 488, 16 August 2012: doi:10.1038/nature11475

O&G projects, petroleum companies can fund these out of general revenues rather than requiring investment from capital markets.

Impeding this sort of action by the O&G sector is the comparatively high capital cost and relatively-lower risk/reward of RE options. RE design alternatives are often NPV-positive but are regularly edited out of final design during value engineering, where capital cost minimization is the primary objective. This fails to recognize that many RE projects are modular and scalable, making them more manageable and less vulnerable to schedule, resource uncertainty and cost overruns than O&G activities.

A related challenge is the lack of literacy in the O&G sector regarding RE technologies and their current relative cost competitiveness. Bringing triple-bottom-line considerations into design decision-making (e.g. through tools such as Life Cycle Value Assessment) and enhancing RE technology literacy in the O&G sector are critical enabling conditions that need to be strengthened to grow RE investment. One path forward for O&G companies is through venture funds such as those at Cenovus, Shell and Chevron, enabling 'behind the curtain' insight into a technology or business line without demanding a diversification of operating focus.

The level of effort O&G companies are putting into renewables in Canada is likely correlated with national political effort, which is lacking. Moreover, regulatory barriers impede efforts to bring renewables within the fence-line, since deviation from business-as-usual design brings with it risk to project approvals. Further complicating matters, grid access can be a challenge for power projects. Some RE opportunities, including wind and deep geothermal, have become controversial from a local stakeholder perspective, in some jurisdictions.

An important discussion focused on the fact that both the O&G sector and the RE sector are subsidized areas of the economy. It was asserted that a comparison of the relative level of subsidies to both sectors would help to reverse the conventional wisdom about the lack of commercial viability of renewables held by senior decision-makers and front-end engineers.[5]

Where national interest exists for development of either type of resource, regulatory and financial incentives can drive progress. Because RE is still proving itself, government needs to be part of the effort to lower barriers and support proof-of-concept efforts. Opportunities for developing RE in O&G in Alberta include through Alberta Innovates – Energy and Environment Solutions, and through the Climate Change and Emissions Management Corporation.

[5] The IISD's Global Subsidies Initiative offers a useful framework for this work: http://www.iisd.org/gsi/

Recommendations for O&G companies[6]

Leadership matters – In the absence of a strong carbon price or direction to shift to RE solutions, the drive for RE still has to come from inside the O&G companies, through internal champions, senior management support, and a corporate culture of innovation. Having this corporate vision enables research, support and investment into alternative forms of energy, including renewables; as well as strategic plays in business relationships, joint ventures and business lines.

Enhance RE literacy

- Benchmark successful RE projects/developers (within and external to O&G) to ascertain key success factors, including resource quality, market access and demand, technology maturity, reliability and interoperability, corporate structure, financing, implementation and operational practices.
- Bring designers and RE technology experts together regularly, in order to improve mutual understanding of needs and options, and to spur innovation. Consider establishing regular benchmarking and an RE in O&G leadership prize.
- Develop and adopt guidelines for assessing RE options in O&G project design, making use of best available technology and commercial practice. Reliability concerns can be resolved through basic project engineering activities such as RAM (reliability, availability, maintainability) analysis, to validate and compare RE utility systems to conventional systems. Standard Risk Analysis including "What If" and "HazOp" can further reduce uncertainty and highlight benefits of RE relative to conventional options. The resulting material could become the basis for a university or Society of Petroleum Engineers course.
- An ENGO like Pembina or other third party could establish a subscription-based annual State of RE in O&G review[7]

Develop RE targets and metrics – In keeping with the adage that what gets measured gets managed, participants heard that one company has a 'major project per 18 month' stretch target, which has helped overcome internal resistance. RE in O&G metrics could include:

- # of projects / year
- % of on-site energy needs met by RE
- % of capital deployed to RE
- % of GJ produced as RE as proportion of overall energy production
- % improvement in Energy Return On energy Invested (EROI)

Systematically investigate the options where the economics are likely most positive –. RE projects have been launched and failed because critical enabling factors were not present. For this reason, limit RE opportunities assessment to situations where the pre-conditions for success are already in place (e.g**.** resource availability, technology maturity, market demand and access, favorable royalty and tax treatment, capital availability, high cost of alternatives) rather than simply focusing efforts where corporate operations are, but resources are poor.

Factors that are often left out of consideration but that can enhance the RE business case include improvements to safety, on-stream days/reliability, EROI, reduced input price volatility and CO_2 abatement cost, and improvement in time from final investment decision to commissioning. Consider

[6] Breakout groups focused on answering the question "Name a few achievable actions that would advance RE within your company." The recommendations section is a summary of the responses heard, along with notes from the preceding discussions and background research.

[7] Based on the SFA Pacific review of upgrader technologies. http://www.sfapacific.com/index.shtml

pairing RE technologies with each other (e.g. solar thermal with geothermal), making use of waste byproducts of oil and gas operations, and leveraging community investment and project closure/abandonment planning to enhance economics relative to pure play renewables.

Within-fence RE opportunities that should be investigated further by the O&G sector include:

- fuel switching to renewable resources where it is most likely to be economic. Application of biomass and CSP[8,9] to EOR, for example, shows promise in the context of high local resource availability.
- recovering injected heat from SAGD wells during blowdown / reclamation
- recovering heat or power from hot produced fluids/gases with geothermal technologies
- developing RE pumped energy storage in high head tailings ponds
- producing power from high water cut conventional wells with downhole turbines
- using Solarwall™ for heating remote camp operations or large warehouse buildings
- heat tracing frac lines with co-produced fluids
- utilizing (camp) waste water sludge for biogas production
- bridging opportunities between O&G and forestry. Options include developing a biomass for steam 'proof of concept', looking for synergy between the OS industry and forestry companies; and investigating biodiesel options through collaboration between the Canadian Fuels Association and the Ontario or Quebec forest sector.

Leverage core competencies – Participants heard an example in which an O&G company leveraged its supplier relationships to significantly improve RE project economics relative to competing pure play RE companies. In another example, an O&G parent extended a lower-cost line of credit to its standalone RE business. In a third example, the company chose to leverage its offshore platform expertise to enable development of leading offshore wind farm capabilities. Companies should investigate RE opportunities from the perspective of their relative strengths.

Aim for "base hits" rather than "home runs" – RE projects do not have to completely replace or offset core utilities for mega-projects, but rather can augment or complement conventional systems. Participants heard that shallow geothermal opportunities are already economic for use for heating camps and buildings, providing cooling in lieu of cooling towers, extracting useful energy from hot co-produced fluids and abandoned wells, providing low-grade heat for community projects (greenhouses, fish farms), and de-icing roads, and could be deployed to recover heat for power in SAGD wind-down. Companies should start with more modest ambitions, with the objective of learning and building momentum.

Treat RE like a real business – O&G companies should examine within and outside-fence RE business structures so that economics for RE projects are evaluated differently than O&G investments, and so that the RE business can take full advantage of any tax shields, debt-to-equity ratio differences, RE incentives, flow-thru equity options, favorable royalty structures and other capital advantages. Financial structure options including internal business unit vs. external standalone company should be explored, along with debt-to-equity options, to ensure the most advantageous tax treatment and other incentives are captured. Consider establishing a dedicated project fund to avoid capital competition.

[8] http://www.gdpcapital.co.uk/docs/thermal_EOR_CSP.pdf

[9] www.glasspoint.com/downloads/Raymond-James-Solar-EOR.pdf

Set a strong internal carbon price to drive investment in RE and efficiency – Develop a realistic, science-based internal price on carbon that is needed to make meaningful reductions in CO_2 emissions and include this carbon price in project economics. For example, Shell uses US$40/tonne; Suncor uses a range (USD$15-$45/tonne). Canada's National Roundtable on the Environment and the Economy released a report in 2012[10] stating that a carbon price of $150/tonne is needed to meet Canada's 2020 GHG emission reduction targets.

Consider advancing RE in OG through an industry consortium – OSLI or COSIA could facilitate taking this work forward with intellectual support from RE industry associations and ENGOs and financial support from government, building on the AOSTRA model. At one point, the oilsands were not economical — but companies got together with government and made it economical. The same thing can happen here if there is leadership and vision; there is power in cooperation and collaboration.

[10] NRTEE, *Reality Check: The State of Climate Progress In Canada* (2012). http://nrtee-trnee.ca/wp-content/uploads/2012/06/reality-check-report-eng.pdf