Carbon Capture Deployment Notes

Scaling Technology to Reduce Emissions; Protecting Employment in Carbon Levered Areas

The Current Scenario

- Signatories to the 2015 Paris Climate Agreement agreed to target holding global temperatures below 2ºC above pre-industrial levels by reducing global greenhouse gas emissions.
- According to the International Energy Agency (IEA), the energy sector (including fuel production and electricity generation) accounts for two-thirds of anthropogenic greenhouse-gas emissions and 90% of energy sector CO_2 emissions are attributable to fossil fuel combustion.
- IEA identified emission reductions in the power and industrial sectors as critical components of reducing energy sector CO_2 intensity.

Carbon Capture and Storage as part of the solution

- Fossil fuel extraction and conventional generation is expected to continue even as countries make investments to convert to an energy sector based on cleaner technologies and fuels. CCS provides one of the few ways to mitigate the impact of this continued consumption in the near term.
- **Both the United Nations and the IEA highlight the potential of carbon capture and storage (CCS) to reduce emissions in the power and industrial sectors. The IEA's base case (Bridge Scenario) is only consistent with a 2.8º** target. One third of the incremental emission reductions acquired to meet the 2º target are achieved via a ramp-up to 5.1 Gt/yr of carbon sequestration by 2040.
- To reach 5.1 Gt/year target, about half of global cement and steel production capacity and a portion of global chemicals production capacity will need to be equipped with CCS by 2040. The IEA has separately estimated that such deployment will cost well in excess of $200bn.

CCS Explained

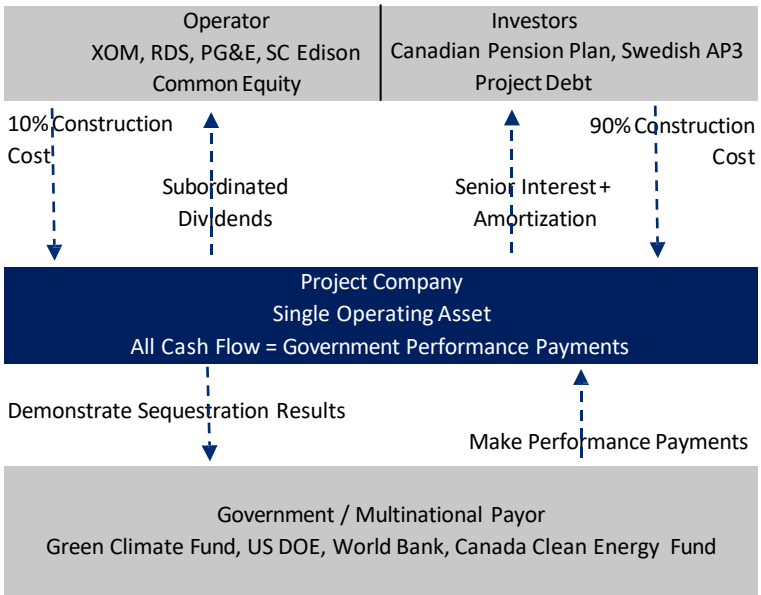
- CCS involves the isolation, processing, and compression of CO_2 produced during power generation and industrial processes, followed by the injection of the CO_2 into an underground formation.
- Storage formations are co-located with existing fossil fuel production activity, and may benefit from existing local expert labor and supporting infrastructure.
- The IPCC identified 12 operational CCS projects and 10 additional projects under construction.
- **The IPCC estimates between 200 and 2,000 Gt of global carbon storage capacity, or enough storage to support 39 – 390 years of storage at the IEA's 5.1 Gt/year target.**

A Lag in Deployment: The Financial Challenge

- Deployment of CCS has been quite slow. Despite the abundance of capacity for CCS projects and demonstrated technological feasibility, deployment of CCS as of the 2015 IEA report was just 27 Mt/year.
- Several characteristics of CCS make it difficult to obtain capital, both private and public.
  - Technology and operations risk associated with a large capital asset handling dangerous materials.
  - The size of the assets under construction requires large levels of upfront investment.
  - **Financial rates of return for CCS projects arise from one of two sources: regulatory savings (i.e., avoidance of carbon tax) or the sale of captured CO_2 for end use in enhanced oil recovery or other industrial applications.**
- CCS construction is currently funded through public-private capital:
  - Grants from a public capital provider, equity from the operator and potentially project finance debt from institutional investors.
  - Public capital is sized such that the regulatory savings or CO_2 sales revenue generate the required rate of return for the private investors.
- **This public-private funding structure discourages deployment because it does not properly allocate risks and rewards associated with the risks, upfront costs, and limited cash flows.**
  - *Public capital:* Bears technology risk and construction cost (e.g., about $1bn CAD for the Quest project). Large ticket sizes are challenging because of explicit or implicit mandates to distribute funding across the constituent base and technology risk can be politically infeasible.
  - *Private capital:* Financial rates of return from regulatory savings or EOR are too low.
- As more projects come online and prove the concept and attractiveness as an investment vehicle, we expect more institutional investors to commit capital.

Investment Vehicle

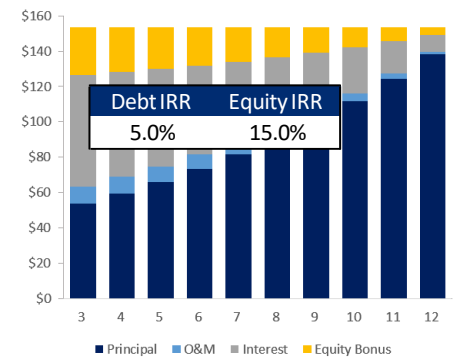
- Project company created by oil & gas operators and ring fenced to single asset.
- Project company obtains performance payment contract ("PFS Security") with Payor.
  - Face value equal to 90% of the construction cost of project.
  - The Payor makes a fixed payment in all periods except for a stump payment at the end of the loan life in certain cases.
- Project company raises 10% of construction cost from operator common equity and the remainder from project debt investors.
  - If the Base Sequestration Target is not reached, all of the payment is applied to amortizing the face value. If the Base Sequestration Target is reached, the payment is allocated to amortization and interest. If the Bonus Sequestration Target is reached, the payment is allocated to amortization, interest and an equity bonus payment.
  - **Amortization payments made in all cases, therefore debt holders are guaranteed return of principal (yield floor at 0%).**
  - Equity Base Rate sized to hurdle ROE at 15% at expected performance.



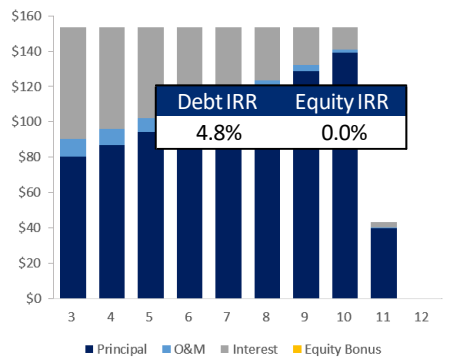
Sample Project Assumptions

- Construction Cost = $1.0bn
- Construction Time = two years
- Expected carbon sequestered per year = 1.0 mtpa
- Term sheet base sequestration rate = 0.85 mtpa
- Term sheet bonus sequestration rate = 0.95 mtpa
- Payor pays $153.5MM each year in all cases (except for a final stub payment to clear balance). Number of payments and allocation adjusts for performance

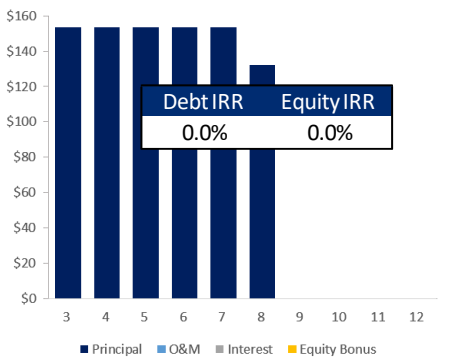
Expected Case



Lender Case



Sequestration Downside Case



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Target Investors

Project Operators:

- Operators of CCS projects are well capitalized integrated oil & gas, coal, and other industrial companies. These groups have a demonstrated track record with operating CCS facilities and committing balance sheet to the projects. Using XOM, RDS and CVX from the integrated oil space, all three have balance sheet exposure in CCS projects (Quest, Gorgon, etc.) and all spend around $20bn in annual capex even in the current low price environment.
- Investment criteria for large operators of CCS facilities is as follows:
  - Industry standard 10-15% return on capital invested
  - Technology complementary to core portfolio
  - For CCS assets, ability to generate cash flow through fossil commodity price cycles and offset regulatory pressures on the core business.
- **Our proposed structure meets all three of the above criteria:**
  - **Equity IRR sized to 15% in the expected case**
  - CCS removal, transport and injection already part of core assets (i.e. Gorgon) and closely related to processes such as natural gas removal and injection, water injection, etc.
  - **Asset class explicitly designed for emissions reduction**.

Indicative Terms	
Issuer	Project Company
Payor	US DOE
Face Value	$1.0bn
Payment	$153.5 million paid annually
Payment Allocation	
Below Base Sequestration	Amortization
Between Base and Bonus Sequestration	Amortization + Interest Rate
Above Bonus Sequestration	Amortization + Interest Rate + Bonus Rate
Treasury Rate	US Treasury + Credit Spread + Risk Premium
US Treasury Rate	2.50%
Credit Spread	0.00%
Risk Premium	3.00%
Bonus Rate	3.00%
Base Sequestration Target	0.85 mtpa
Bonus Sequestration Level	0.95 mtpa
Equity Cure	All other capital needs at the project company must be met with equity injection from the sponsor

Project Finance Investors: The global market for project finance debt is estimated at around ~$400bn. The investor base includes the most well capitalized institutional investor groups such as Sovereign Wealth Funds, Public Pension Reserve Funds (PPRFs), private investment funds, and insurance companies. **Globally, 1% (or ~$200bn) of pension funds is allocated toward project finance though some funds invest substantially more – 6% of the Canadian Pension Plan and 9% of the Swedish AP3 fund, for example**. The project finance market provides the depth needed to reach the deployment levels required by the emission scenarios, though we expect this market to open only after the PFS structure has been tested in the project operator segment.

Target Payors

- Governments: The majority of the operating CCS projects online today demonstrate government commitment to the technology.
  - Quest Project in Canada financed with ~$120MM in grants from Canadian federal government and ~$800MM in grants from the Alberta provincial government.
  - US DOE involved in a cost sharing funding program on all demonstration projects in the US. This includes $190MM on the Petra Nova Project and $270MM to the soon to be in-service Kemper Project.
- Multilateral Development Banks / Other Financing Entities: Development banks have an established history lending to climate infrastructure projects – the World Bank's portfolio is 20% allocated to climate projects and the Asian Development Bank funds $3bn of climate projects a year with an announced plan to target $6bn per year by 2020. Furthermore, the Paris Climate Agreement's Financial Mechanism has spawned custom entities such as the Green Climate Fund (pledged over $10bn to date) for climate finance.
- Investment criteria for these organizations focuses on impact outcomes. The Green Climate Fund, for example, lists the following investment criteria:
  - Impact potential
  - Financial viability
  - "Paradigm shift" potential (sustainability of change, scalability/replicability of project)
  - Needs of the country where project is located & absence of other funding sources
  - Country commitment and ability to implement
  - Economic efficiency
- Our proposed structure meets the criteria of Target Payors:
  - **Technology impact and paradigm shift potential by making non-EOR CCS projects feasible, substantially increasing scope of CCS for emissions reductions.**
  - Importantly, CCS facilities are capital intensive and located onsite with existing carbon assets, implying that financing such projects serves dual purpose of emissions reduction and protecting / growing employment in carbon levered areas (dual mandate of programs like the DOE's Clean Coal Initiative and the World Bank).
  - Structure is financially viable in that it spreads payment over many years and establishes a mechanism for compensating capital providers.
  - Private markets allocated all construction cost overrun risk; amortization allocation increases if sequestration performance not met.

Risks and Mitigation

- Performance payment contracts have yet to be implemented on this scale and there is no subordinate investor (typically philanthropic capital) in this proposal to absorb initial losses. Securing buy-in from the investors will require stakeholder education.
  - Pay-for-Performance exists at smaller scale and has achieved success in a number of applications in the United States and the UK.
  - Operators and project finance investors have experience lending side-by-side with governments or to securities with guarantees provided by government agencies.
  - Equity commitment of operator and sequestration targets align capital structure incentives with traditional funder objectives.
- Construction Cost Overrun / Sequestration Operations:
  - Target investor group (operators and project finance investors) have experience assuming or mitigating construction and technology risk. We assume EPC contracts will be lump sum turnkey arrangements and that the Target Investors will require independent consultants to monitor sequestration performance (consistent with existing CCS projects).
  - Government explicitly protected from these risks by the PFS structure.
- Change in Government / Policy Priority:
  - While priorities may shift away from the CCS technology or even from emissions reductions in general, our target traditional funders consist of high credit quality governments and agencies with strong incentives to perform on their debt obligations. We therefore view repayment risk on a government debt security as less risky than the policy risk assumed by investors in projects where regulatory cost savings are the primary source of rate of return.

Metrics for Social Impact

- The metric used by the PFS security will be net CO_2 sequestered (metric tonnes per annum). This will be calculated as gross CO_2 sequestered less CO_2 emitted in capture, compression, transportation and injection.
- While not a condition for payment, we expect carbon capture projects to generate new job opportunities – case study examples show 1,000 new jobs during construction and 300 during operation.
- The development team will measure the CO_2 sequestered and report on a quarterly basis to all project participants to ensure 1.0 / 1.5 mtpa targets are met.

- **Sources:** 1. "Adoption of the Paris Agreement," United Nations, Conference of the Parties 21st Session, 12/11/2015 2. "Energy and Climate Change," The International Energy Agency, World Energy Outlook Special Report, 2015 3. "Addendum: Technical examination process to unlock mitigation potential for raising pre-2020 ambition through carbon dioxide capture, use and storage," United Nations Framework Convention on Climate Change, Nov 2014 4. "Technology Roadmap: Carbon Capture and Storage" International Energy Agency, 2013. 5. Della Croce, R., Yermo, J., (2013), "Institutional investors and infrastructure financing", OECD Working Papers on Finance, Insurance and Private Pensions, No.36, OECD Publishing. 6. "Record of Decision, Texas Clean Energy Project," Department of Energy, Sept 29, 2011. 7. "Carbon Capture and Storage in Developing Countries," The World Bank, 2012. 8. "Investment Framework," Green Climate Fund, 2014.