

Carbon Capture Deployment Notes

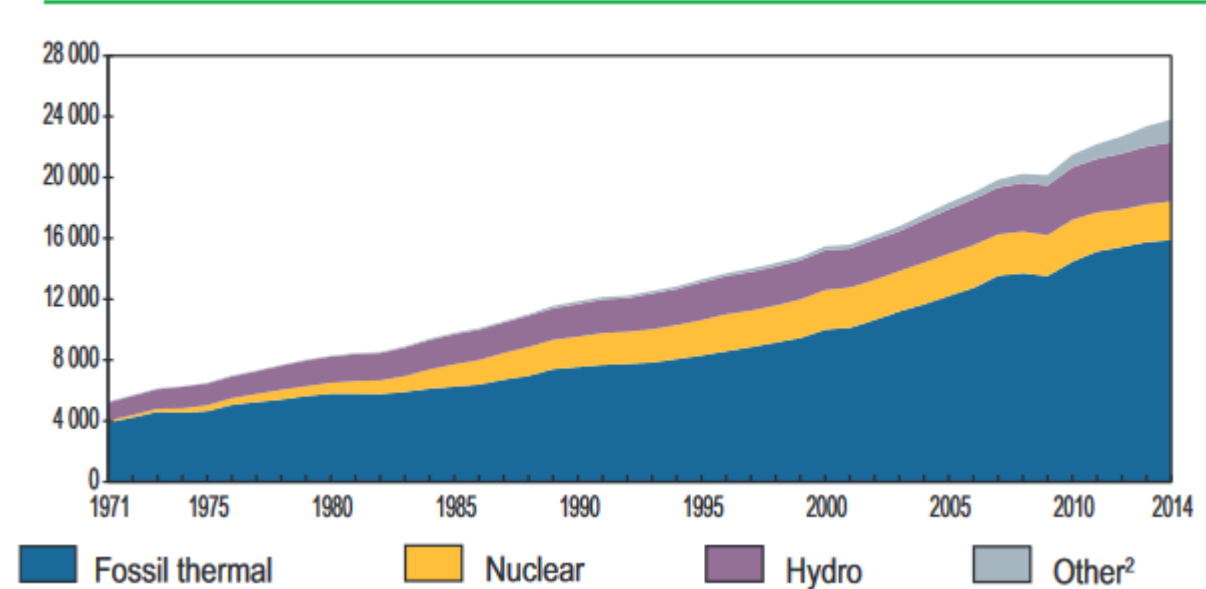
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Confession: I was a Carbon Capture
and Storage skeptic

But the Impact Is Real

- The International Energy Agency (IEA) expects that 5.1 Gtpa of carbon capture and storage (“CCS”) is needed to reach the Paris Climate Agreement’s goal of keeping global temperatures within 2°C of pre-industrial levels
- Our solution involves storage **without enhanced oil recovery**
- A number of prominent environmental groups in the U.S. support CCS: the ENGO Network on CCS was formed in 2011 for “the safe and effective deployment of CCS as a timely mitigation tool for combating climate change,” and counts the Natural Resources Defense Council, the Clean Air Task Force, and the Environmental Defense Fund as members
- CCS also benefits labor forces who could be negatively impacted by decarbonization

World electricity generation¹ from 1971 to 2014
by fuel (TWh)



Key World Energy Statistics, 2016. International Energy Agency.

If the impact is real,
why is there so little deployment?

Three Challenges Limit Deployment

Deployment Potential

- Potential storage locations globally could support over 650 Gt of carbon sequestration
- Only 27 mtpa of active carbon sequestration at the end of 2015

Three Central Challenges

1. Technology Risk: Several prominent CCS projects have run over time and budget



2. Ticket Size: CCS projects typically cost hundreds of millions of dollars to construct
3. Limited Revenue Opportunities: CCS projects rely on avoided regulatory costs or on the sale of carbon for enhanced oil recovery or industrial applications

Filling the Gap: Carbon Capture Deployment Notes

Three Challenges Addressed by Structure

1. Technology Risk

- All three participants share risk:



Payor

- Guarantees loan principal regardless of sequestration outcome
- No responsibility for construction cost overrun
- Interest and equity bonus tied to sequestration performance



Institutional Debt Investors

- Principal is guaranteed
- No responsibility for construction cost overrun
- Interest tied to sequestration performance



Equity Owner / Project Operator

- Cures any construction cost overrun with equity cure
- Equity bonus payment tied to sequestration performance

2. Ticket Size

- Payors spread ticket size over life of the loan
- Upfront payments met by the much deeper capital markets

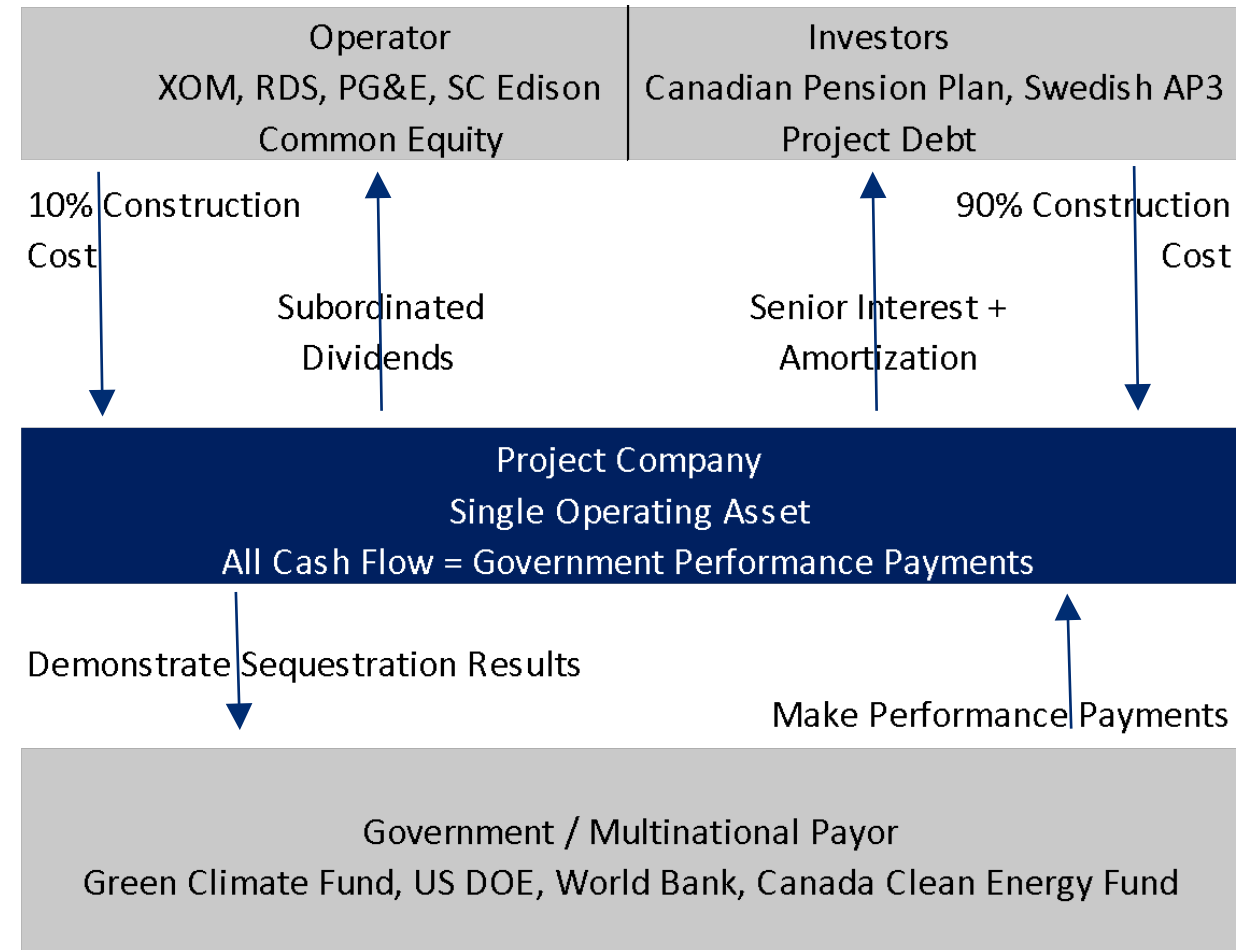
3. Source of Revenue

- Payor provides project revenue through the pay-for-performance contract
- Proposed structure does not require any enhanced oil recovery, thereby expanding the suite of feasible CCS projects and eliminating any impact ambiguity

Development Company Capital Structure

Investment Vehicle

- Project company created by oil & gas, utility or industrial operators and ring fenced to single asset
- **Performance Payment Contract:** project company obtains performance payment contract (“PFP Security”) with Payor
 - Face value equal to 90% of the construction cost of project
 - Payor makes a fixed payment in all periods, except for a stump payment at the end of the loan life in certain cases
- **Construction Cost Financing:** Project company raises 10% of construction cost from operator common equity and 90% from project debt investors (FV of PFP Security = FV of debt)
- **Allocation of PFP Cash Flow:**
 - Base Sequestration Target not met: Entire payment applied to principal reduction
 - Base Sequestration Target met: Payment applied to principal reduction and interest
 - Bonus Sequestration Target met: Payment applied to principal reduction, interest, and an equity bonus payment
- **Principal reductions made in all cases, therefore debt holders are guaranteed return of principal (yield floor at 0%)**
- Equity Base Rate set to hurdle 15% ROE at expected performance



Modeling the Structure

Assumptions

- Construction Cost = \$1.0 bn
- 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 \$154MM annually in all cases (plus a final stub payment to clear balance)

Case	Debt IRR	Debt Payback
Expected	5.0%	10
Lender	4.8%	9
Sequestration Downside	0.0%	8
Construction Overrun	5.0%	10
Construction Delay	3.7%	9
Construction Overrun + Delay	3.7%	9

Case	Equity IRR	Equity Payback
Expected	15.0%	7
Lender	0.0%	0
Sequestration Downside	0.0%	0
Construction Overrun	-21.7%	0
Construction Delay	1.4%	2
Construction Overrun + Delay	-33.7%	0

Payment Waterfall

Case	# of Payments	Allocation	Overrun Costs
Expected	10	Principal, interest, and equity bonus	N/A
Lender	9	Principal, interest	N/A
Sequestration Downside	8	Principal	N/A
Construction Cost Overrun	10	Principal, interest, and equity bonus	Equity owner funds cost overrun
Construction Delay	9	Principal until facility completion; Principal, interest, and equity bonus thereafter	N/A
Construction Overrun and Delay	9	Principal until facility completion; Principal, interest, and equity bonus thereafter	Equity funds cost overrun

Participants

Project Operators

Operator Characteristics

- For-profit corporations in industrial, power and oil & gas businesses
- Typically large, mature companies with stability and cash distribution mandate from investors
- Significant emissions footprint

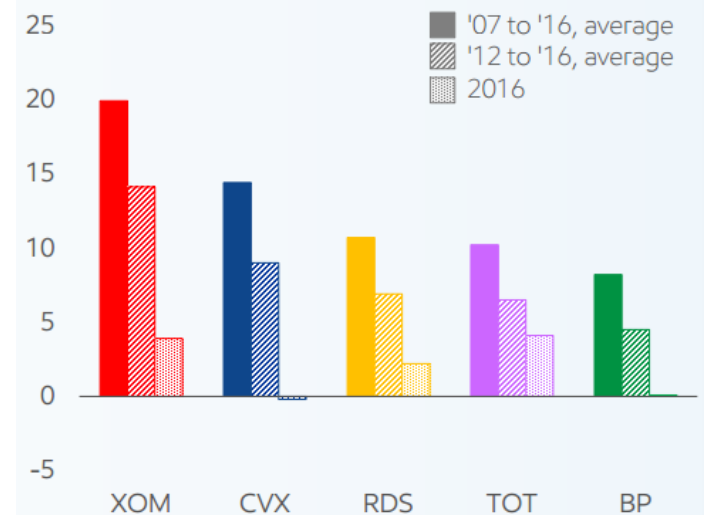
CCS Benefits to Operator

- CCS technology utilizes existing asset base
- Improves execution
 - Avoids investment in technology or marketing of unfamiliar feedstocks
 - Extends life of existing facilities

- Rate of return consistent with ROIC for a typical oil & gas operator
- No carbon price risk
- High quality credit risk

Return on average capital employed

Percent



Private Capital Providers

We expect private capital to provide 90% of the upfront capital (principal guaranteed) and receive senior interest and amortization over life of the asset

Private Capital Characteristics

- Typically large institutional investors with allocation for infrastructure and a long-term investing strategy
- Fund managers prefer direct investing as a more cost effective means of accessing private market investments

CCS Benefits to Private Capital

- Provides opportunity to deploy dry powder (recent estimates of >\$100bn dry powder available for infrastructure)
- Principal guarantee de-risks investment, with potential for 5% IRR / 10x capital payback in expected case

Example transactions and Target Investors

- Canadian Pension Plan's investment in Quest CCS project
- Abu Dhabi Investment Authority and Qatar Investment Authority investment in Indian infrastructure projects
- Sweden's AP3 Pension Fund investment in Ellevio

Substantial Capital Available for Deployment

Institutional Investors	AUM (USD tn)	Current avg. investment in infrastructure
OECD Institutional Investors	80	1% / 800 bn
Emerging Market Institutional Investors	5	<1% / 25bn
Sovereign Wealth Funds	4	2% / 80 bn
Other global institutional capital (asset / wealth management)	20	1% / 200 bn

Who are our payors?

- Multinational organizations and government entities
- Several of these bodies are already involved in CCS projects using the current financing models
- Examples: Canadian and Alberta governments (Quest), US Department of Energy (Petra Nova)

Serving Climate Change Mitigation Commitments





- Paris Agreement: 141 parties have ratified the agreement, which asks signatories to set climate goals (Nationally Determined Contributions) and formulate long-term decarbonization strategies
- Many multinationals and governments have made climate commitments and already offer grants or loans with highly favorable terms
- Eligibility for funds often relies on proof of impact; non-EOR CCS offers calculable reductions in CO₂ emissions
- CCS is particularly appealing where there are limitations around installing additional renewables (resource deficiency, grid stability) or there is reliance on an entrenched conventional generation asset base

Protecting Employment

- CCS projects provide employment for fossil fuel locations, easing distributional impacts of decarbonization
- Example: Petra Nova expected to generate over 1,000 jobs during construction and 20 new permanent jobs during operation. More importantly, the retrofit protects existing employees at the power plant and indirect jobs associated with the operation of the power plant

Deployment Roadmap

Institutional Investors Require Proof of Concept

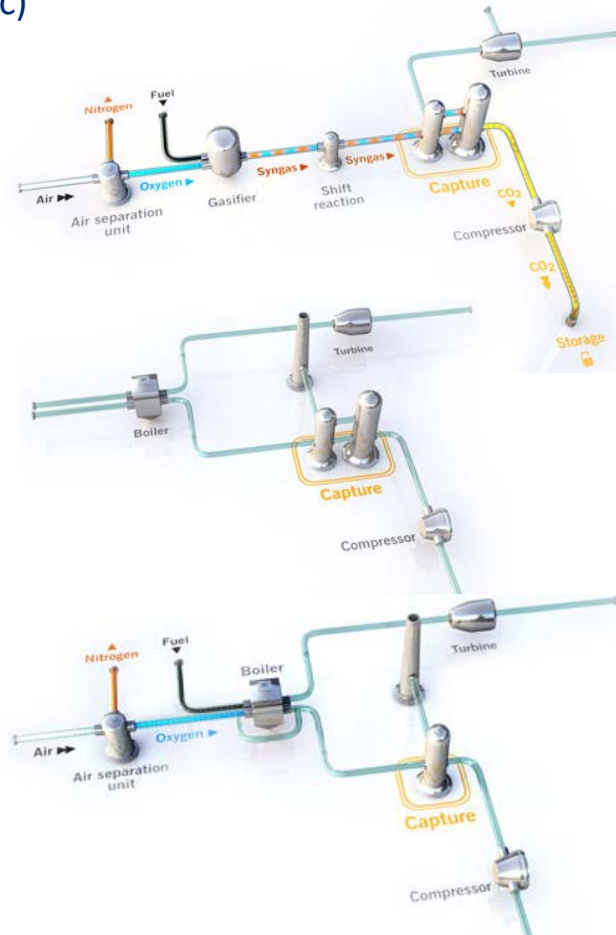
	Initial Stage	Scale Stage
Project Operators	 Existing experience with CCS investment and with investing alongside government bodies facilitates participation	 By scale stage, operators should have enough experience with the technology and the proposed financial structure to maintain participation
Private Capital Providers	 Lack of experience with CCS and a new financial structure inhibits participation from private capital markets	 Multiple projects with operators taking the entire capital structure act as proof of concept for the proposed financial structure. Debt rates of return from high quality payor incentivizes participation

Appendix

The Technology

Compression

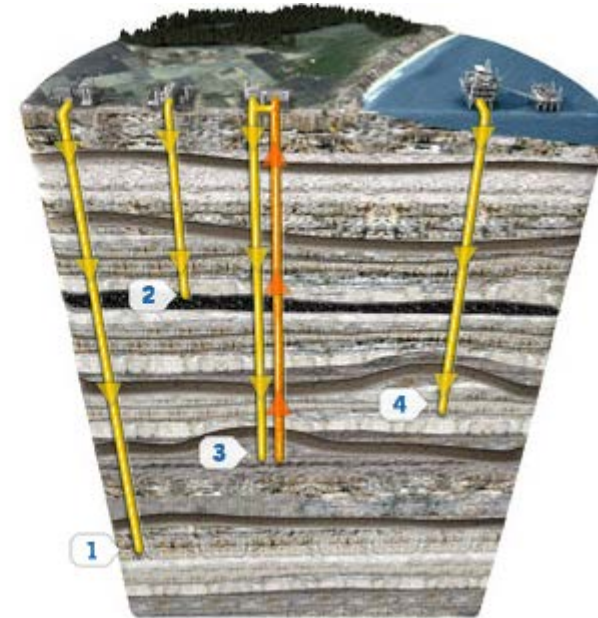
- Carbon capture refers to removing the carbon dioxide produced during the combustion of fossil fuels. A capture process can be applied to coal and natural gas fired generation plants, natural gas processing facilities, fertilizer production and industrial materials manufacturing (cement, pulp, etc)
- Pre-Combustion: Converts fuel used by facility (i.e. coal) to a mixture of hydrogen and CO₂ from which the CO₂ can be separated
- Post-Combustion: In the most basic application, CO₂ is absorbed from the facility's exhaust gas using a liquid solvent. The solvent-CO₂ mix is then heated to separate the CO₂
- Oxyfuel: Hybrid technique using oxygen (instead of air) for fuel combustion. Resulting exhaust gas primarily consists of water vapor and CO₂ from which the CO₂ can easily be separated



Storage

- Storage involves compressing CO₂ into a liquid and pumping it into a geologic formation sealed by cap rock
- Typically use one of four types of locations

- 1 Saline formations
- 2 Injection into deep unmineable coal seams or ECBM
- 3 Use of CO₂ in enhanced oil recovery
- 4 Depleted oil and gas reservoirs



- Feasible locations not a constraint – “many centuries” worth of sites already available per the Carbon Capture and Storage Institute

Natalie Bodington



- Former third-party evaluator and consultant for utility energy efficiency programs
- Pursuing a joint MBA and MS in Environment and Resources with a focus in cleantech and renewables

Ryan Calvert



- Former project development officer covering energy efficiency and renewable energy finance
- Pursuing an MBA with a focus on impact investing

Tom Loftus



- Former analyst for energy group at multinational bank
- Pursuing an MBA with a focus on corporate finance and energy markets

Jen McPhillips



- Former consultant with experience covering social impact projects and climate change risk mitigation
- Pursuing an MBA with a focus on impact investing

Indicative Term Sheet

Indicative Terms	
Issuer	Project Company
Payor	US DOE
Face Value	\$900MM
Payment	\$154MM 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

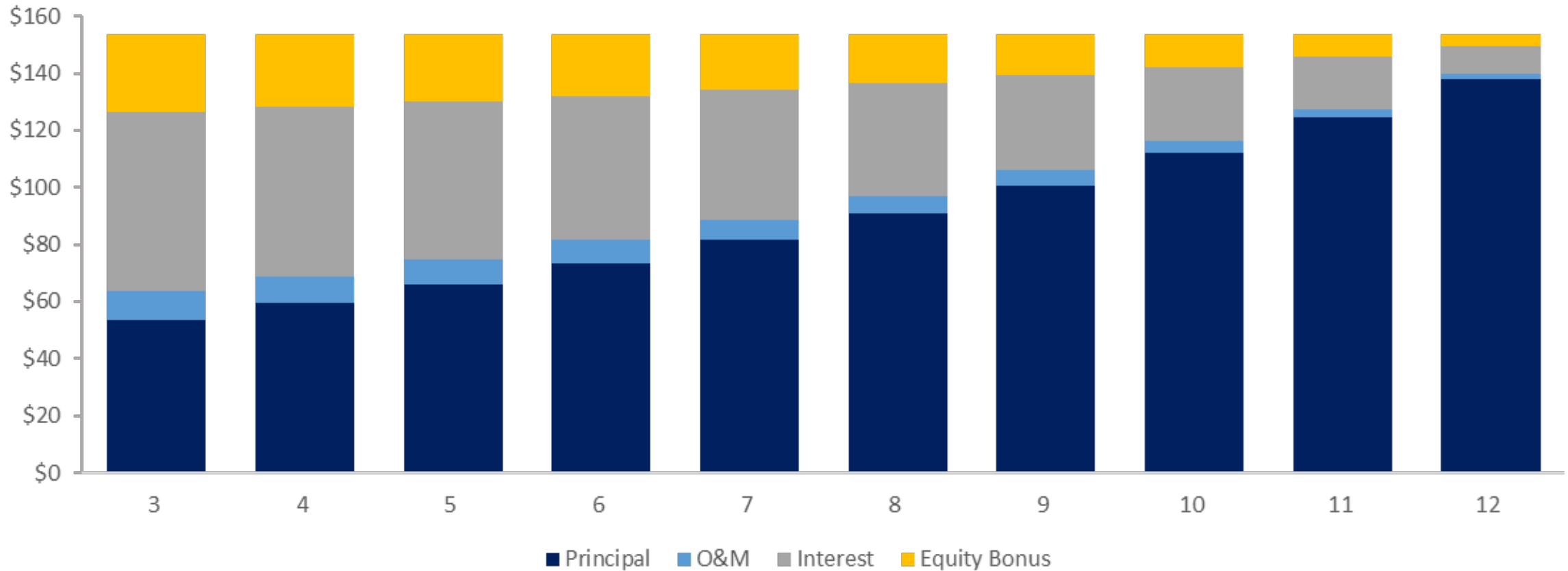
Expected Case

Assumptions

- Term sheet as shown previously
- Facility constructed on time and on budget
- Annual sequestration of 1.0 mtpa beginning in year three

Returns

	Debt	Equity
IRR	5.0%	15.0%
Payback	10	7



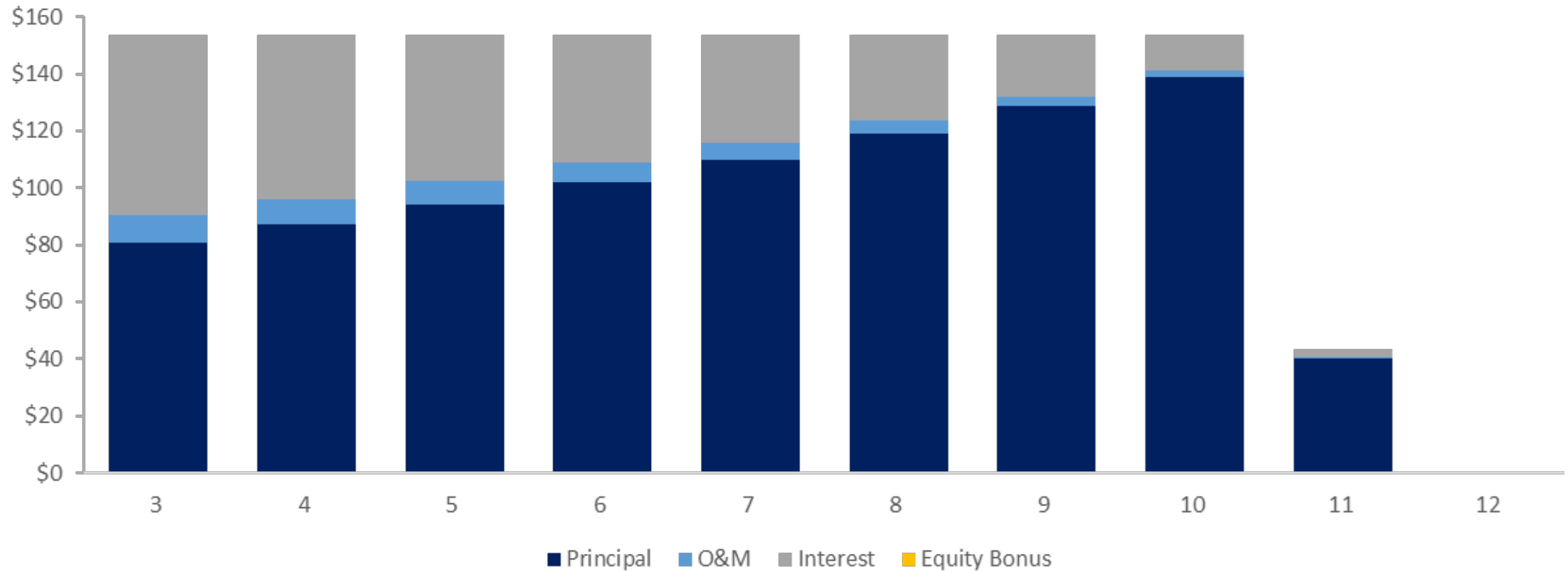
Lender Case

Assumptions

- Term sheet as shown previously
- Facility constructed on time and on budget
- Annual sequestration of 0.9 mtpa beginning in year three

Returns

	Debt	Equity
IRR	4.8%	0.0%
Payback	9	0



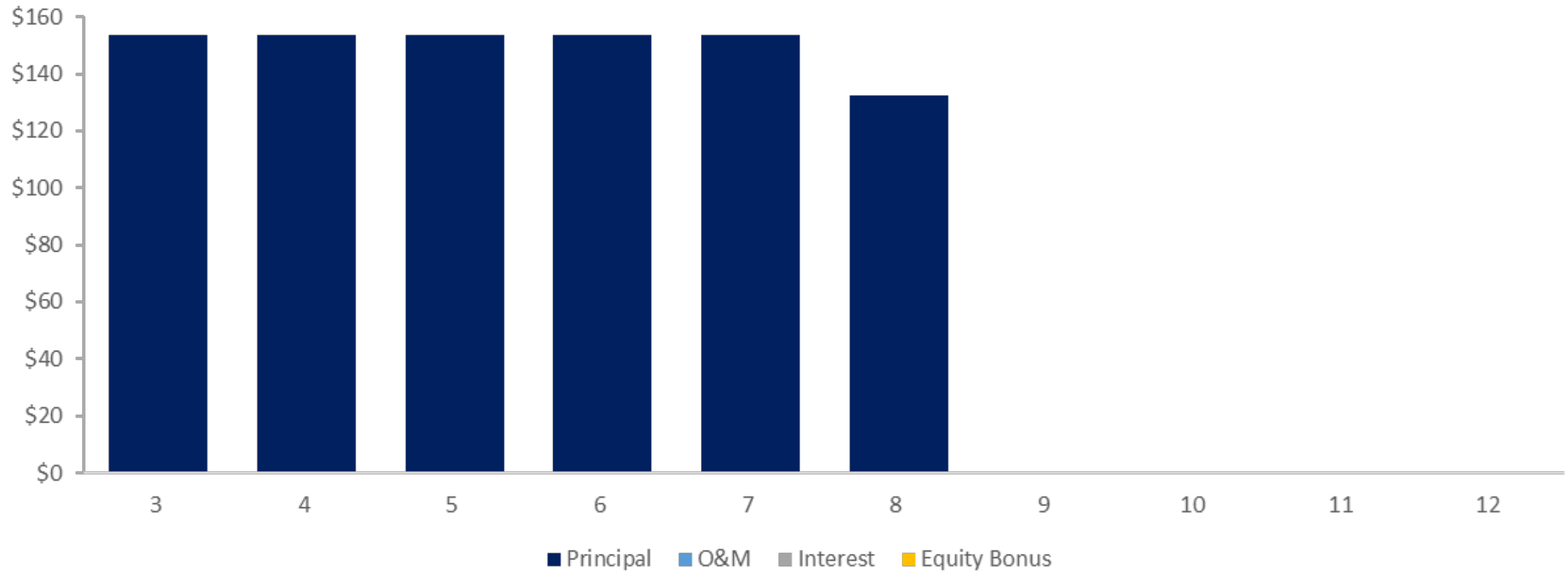
Sequestration Downside Case

Assumptions

- Term sheet as shown previously
- Facility constructed on time and on budget
- Annual sequestration of 0.8 mtpa beginning in year three

Returns

	Debt	Equity
IRR	0.0%	0.0%
Payback	8	0



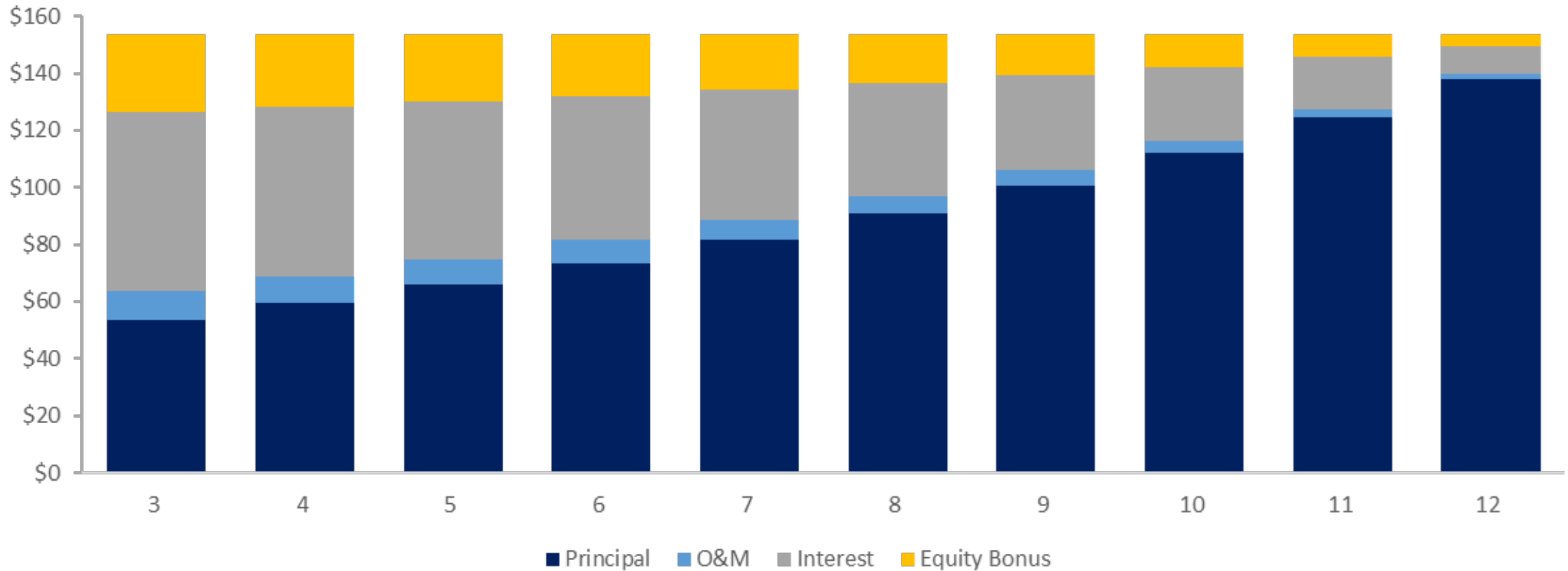
Construction Cost Overrun Case

Assumptions

- Term sheet as shown previously
- Facility constructed on time and but at a cost of \$1.5 billion
- Annual sequestration of 1.0 mtpa beginning in year three

Returns

	Debt	Equity
IRR	5.0%	-21.7%
Payback	10	0



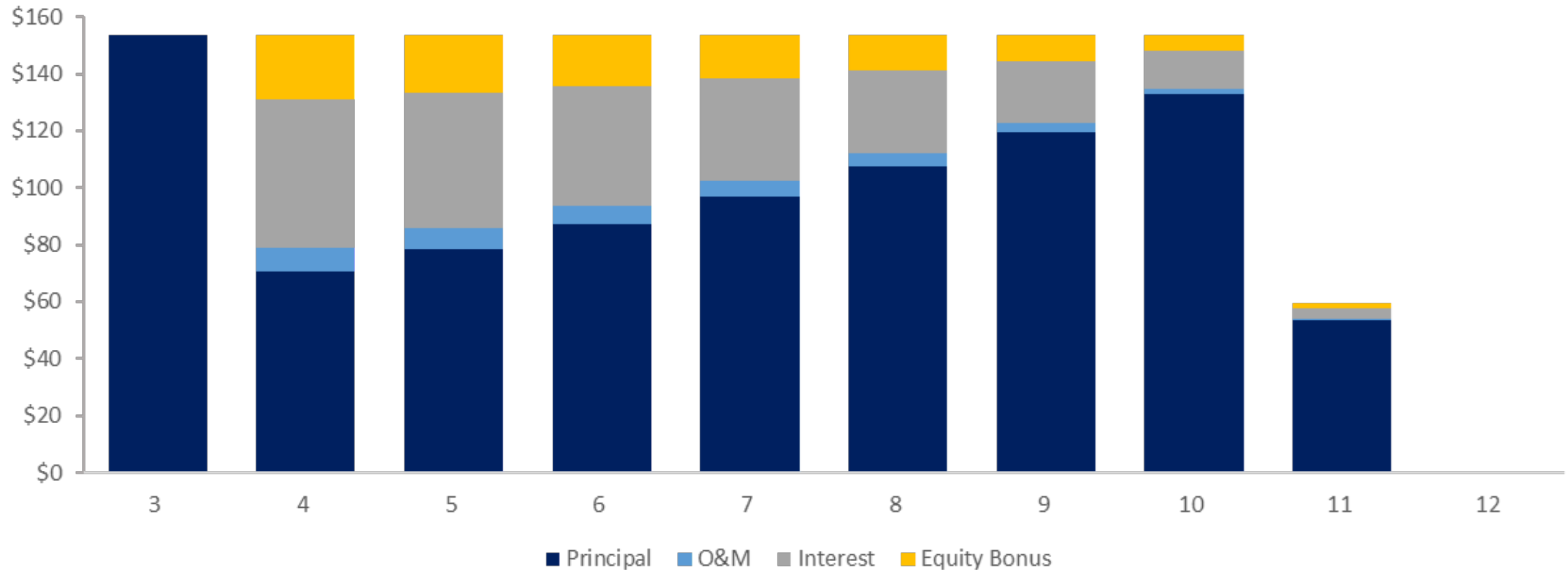
Construction Delay Case

Assumptions

- Term sheet as shown previously
- Facility constructed over three years at a cost of \$1.0bn
- Annual sequestration of 1.0 mtpa beginning in year four

Returns

	Debt	Equity
IRR	3.7%	1.4%
Payback	9	2



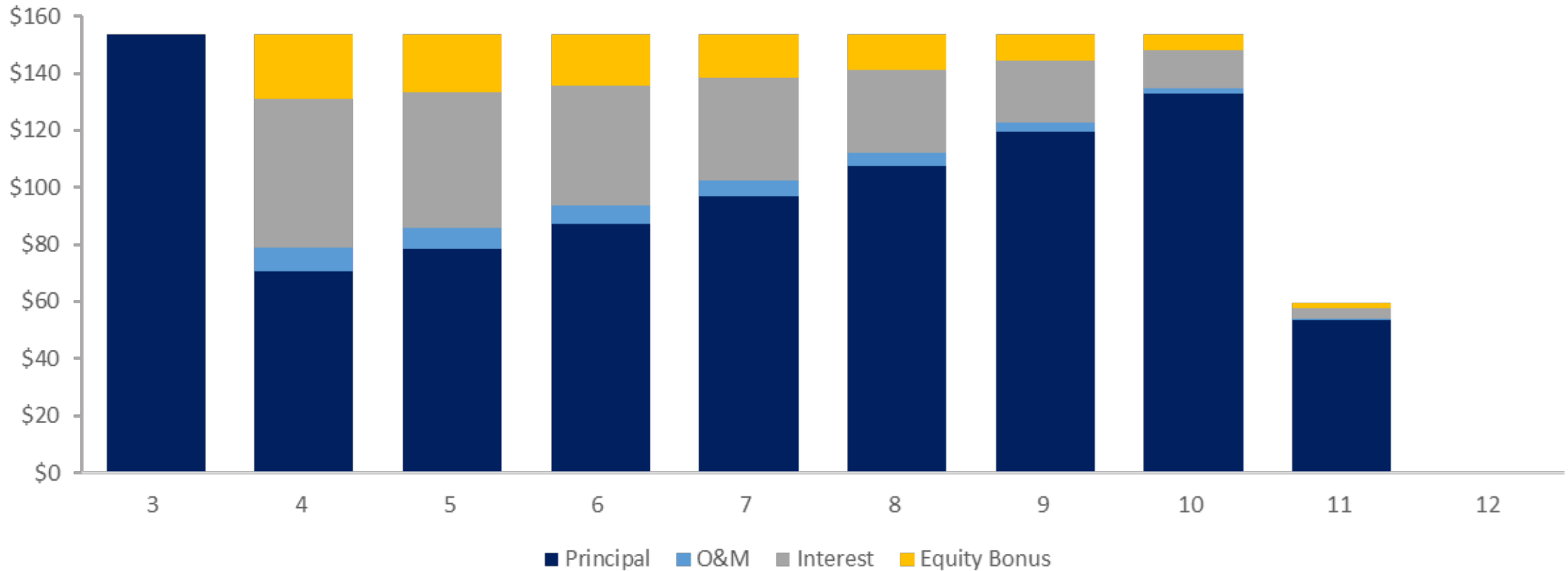
Construction Overrun and Delay Case

Assumptions

- Term sheet as shown previously
- Facility constructed over three years at a cost of \$1.5bn
- Annual sequestration of 1.0 mtpa beginning in year four

Returns

	Debt	Equity
IRR	3.7%	-33.7%
Payback	9	0



Model Cash Flow Examples

Expected Case Model

Project Cash Requirements (\$MM)	0	1	2	3	4	5	6	7	8	9	10	11	12
Construction Capex	0	(500)	(500)	0	0	0	0	0	0	0	0	0	0
Opex & Maintenance	0	0	0	(10)	(9)	(9)	(8)	(7)	(6)	(5)	(4)	(3)	(2)
Cash Requirement	0	(500)	(500)	(10)	(9)	(9)	(8)	(7)	(6)	(5)	(4)	(3)	(2)
Cash Received (\$MM)	0	1	2	3	4	5	6	7	8	9	10	11	12
Debt Capital Contribution	900	0	0	0	0	0	0	0	0	0	0	0	0
Equity Capital Contribution	0	0	100	0	0	0	0	0	0	0	0	0	0
Allocated to O&M	0	0	0	10	9	9	8	7	6	5	4	3	2
Allocated to Interest	0	0	0	63	59	55	50	45	40	33	26	18	10
Allocated to Equity	0	0	0	27	25	24	22	19	17	14	11	8	4
Allocated to Principal	0	0	0	54	59	66	73	82	91	101	112	124	138
Total Cash Received From Gov Payor	0	0	0	154	154	154	154	154	154	154	154	154	154

Construction Delay Case Model

Project Cash Requirements (\$MM)	0	1	2	3	4	5	6	7	8	9	10	11	12
Construction Capex	0	(333)	(333)	(333)	0	0	0	0	0	0	0	0	0
Opex & Maintenance	0	0	0	0	(8)	(8)	(7)	(6)	(5)	(3)	(2)	(1)	0
Cash Requirement	0	(333)	(333)	(333)	(8)	(8)	(7)	(6)	(5)	(3)	(2)	(1)	0
Cash Received (\$MM)	0	1	2	3	4	5	6	7	8	9	10	11	12
Debt Capital Contribution	900	0	0	0	0	0	0	0	0	0	0	0	0
Equity Capital Contribution	0	0	0	100	0	0	0	0	0	0	0	0	0
Allocated to O&M	0	0	0	0	8	8	7	6	5	3	2	1	0
Allocated to Interest	0	0	0	0	52	47	42	36	29	21	13	4	0
Allocated to Equity	0	0	0	0	22	20	18	15	12	9	6	2	0
Allocated to Principal	0	0	0	154	71	78	87	97	108	120	133	53	0
Total Cash Received From Gov Payor	0	0	0	154	154	154	154	154	154	154	154	59	0