



**UNIVERSITY  
OF ALBERTA**

# ECON 366: Energy Economics

## Topic 2.4: Oil and Gas Project Valuation

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# Net Present Value and other project finance metrics

Recall the idea of a net present value of a stream of profits  $\Pi_t$  for  $n$  time periods indexed by  $t$ :

$$NPV = \sum_{t=1}^n \frac{1}{(1+r)^t} \Pi_t$$

This concept forms the basis of a number of important measures used to evaluate projects:

- $NPV_k$ , the net present value at a  $k\%$  rate of discount e.g.  $NPV_{10}$
- *payback* is the number of periods  $n$  it takes for  $NPV_0$  to be positive (i.e  $r = 0$ )
- *discounted payback* is the number of periods  $n$  it takes for  $NPV_k > 0$  for  $k > 0$ 
  - (i.e for some  $r > 0$ , usually 10%)
- *internal rate of return* (IRR) is the rate  $k$  such that  $NPV_k = 0$
- *supply cost* or *break even oil price* is the price at which  $NPV_k = 0$ , usually reported for  $NPV_{10} = 0$

# Net Present Value and other project finance metrics

Recall the idea of a net present value of a stream of profits  $\Pi_t$  for  $n$  time periods indexed by  $t$ :

$$NPV = \sum_{t=1}^n \frac{1}{(1+r)^t} \Pi_t$$

- Why might an oil company use *payback* or \*discounted payback as a metric?
- Does *break even* mean what you think it means?
- Which metric would you prefer?

# Net Present Value and other project finance metrics

Recall the idea of a net present value of a stream of profits  $\Pi_t$  for  $n$  time periods indexed by  $t$ :

$$NPV = \sum_{t=1}^n \frac{1}{(1+r)^t} \Pi_t$$

This deck looks at the last modification to that formula: the *supply cost* for an oil project.

- *supply cost* or *break even oil price* is the price at which  $NPV_k = 0$ , usually reported for  $NPV_{10} = 0$

# Supply Cost

Let  $p$  be the price of oil

- $p$  is usually a benchmark, WTI or Brent
- $p$  could also be implied plant-gate bitumen prices, for example

Now, allow the stream of profits to be a function of prices  $p$  for each time  $t$ , denoted by  $\Pi_t(p_t)$ , and let the supply cost be given by:

$$\text{Supply cost} = \{\bar{p}_t\}_{t=1}^n \ni \sum_{t=1}^n \frac{1}{(1+r)^t} \Pi_t(\bar{p}_t) = 0$$

i.e.  $\{\bar{p}_t\}_{t=1}^n$  is the set of constant *real* (or, increasing nominal) oil prices chosen such that the net present value of the project is zero, usually for  $r = 10$  or  $r = 12$

# Oil Sands Project Economics

What does an oil sands investment involve?

- Purchase a lease
- Seek regulatory approval
- Build an extraction facility
- Burn diesel and/or natural gas
- Use chemicals
- Produce bitumen
- Purchase diluent
- Ship and sell diluted bitumen
- Reclaim/remediate land and tailings

# Oil Sands Project Economics

What does an oil sands investment involve for our purposes today?

- Build an extraction facility
- Burn diesel and/or natural gas
- Use chemicals
- Produce bitumen
- Purchase diluent
- Ship and sell diluted bitumen

A simplified version of the problem

# The basic approach to a financial model

What do I need to know to assess the NPV (or other metrics) for this project?

- Construction costs and schedules
- Operating and maintenance costs
- Output
- Prices
- Fiscal regimes (taxes and royalties)
- Financing

Initially, let's worry about the big ones

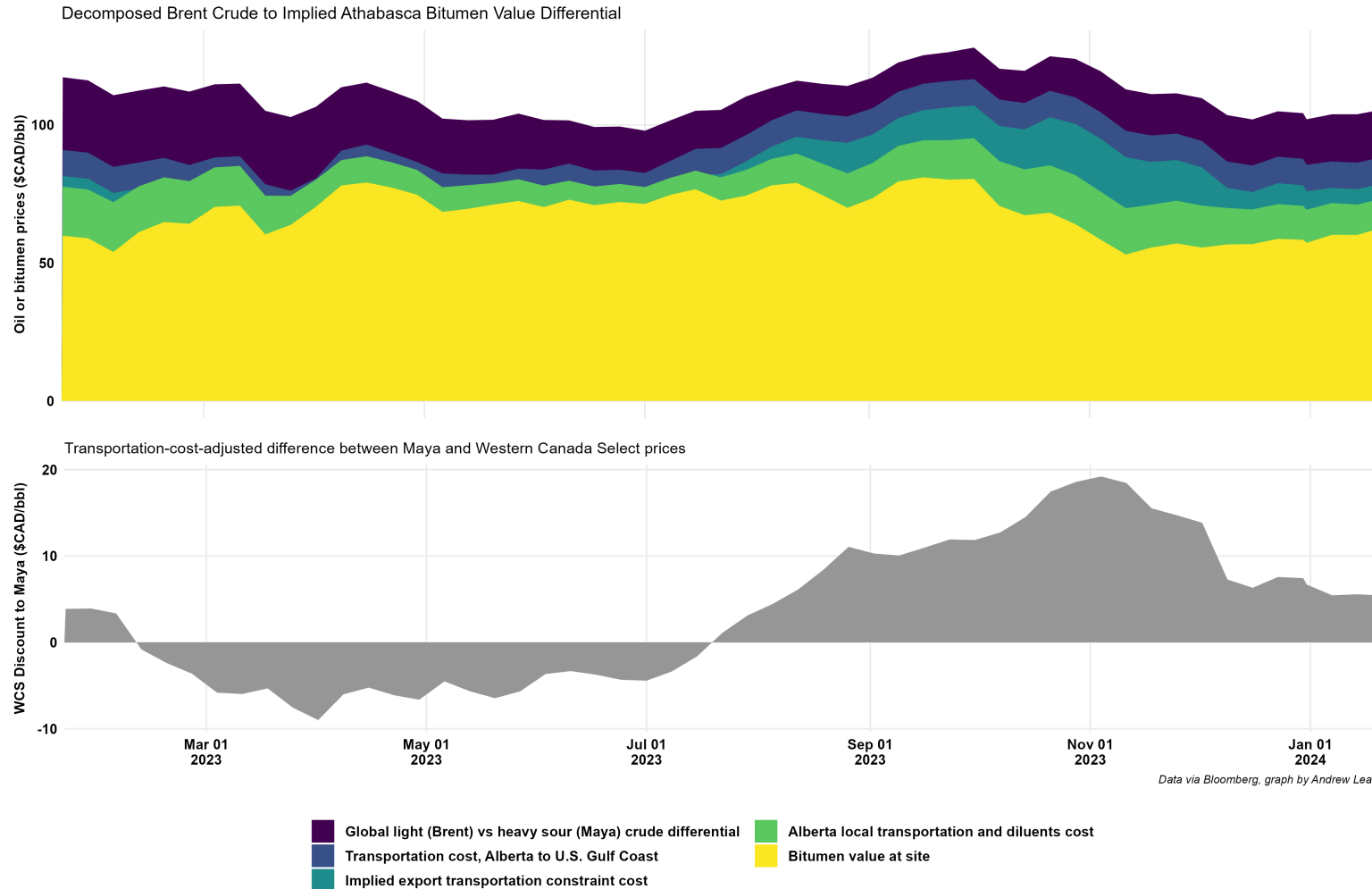
- Prices
- Output
- Capital, operating and maintenance



# What am I selling?

- Oilsands projects produce bitumen (not a homogeneous commodity, but we'll treat it as such for today)
- In order to be transported by pipeline, bitumen must be diluted
- Diluted bitumen trades roughly on par with heavy oil
- Heavy oil trades at a discount to light oil due to its lower value to refiners

# Recall this graph of oil sands pricing?



Now we need to solve for the top of the yellow: the implied value of bitumen at the plant gate

# Derived value of bitumen



How much is a barrel of bitumen worth?

- Start with the price of a barrel of WCS at Hardisty – \$US 56, or \$CA 75 per barrel
- Now, what do I need to do to get bitumen from my site to Hardisty in WCS-form?
- A barrel of WCS is (approximately) 30% diluent, 70% bitumen
  - I need to purchase .3 barrels of diluent at Hardisty, for a price of \$110/bbl, or \$33 diluent cost
  - I need to ship that to my site, at a cost of \$1/bbl, or \$0.30 total cost
  - I need to ship one barrel of WCS-equivalent to Hardisty, at a cost of \$1.50
- My net revenue from the sale of a barrel of WCS equivalent is  $(75-33-0.30-1.50)=40.20$  What's the implied value of a barrel of bitumen at site?

$$\frac{\$75 - \$33 - \$0.30 - \$1.50}{0.7 \text{ bbl bitumen}} = \frac{\$40.20}{0.7 \text{ bbl bitumen}} = \frac{\$57.43}{\text{bbl bitumen}}$$

# Pricing in the model template

Year		2020	2021	2022	2023	2024	2025
<b>Production Year</b>		0	0	0	1	2	3
<b>Years since construction</b>		0	1	2	3	4	5
<b>Operating</b>		1	1	1	1	1	1
<b>Energy Price inflation index (incl pipeline tolls)</b>	2.00%	1.000	1.020	1.040	1.061	1.082	1.104
<b>Overall inflation index</b>	2.00%	1.000	1.020	1.040	1.061	1.082	1.104
<b>Capital Escalation index</b>	2.00%	1.000	1.020	1.040	1.061	1.082	1.104
<b>Non-energy cost escalation index</b>	2.00%	1.000	1.020	1.040	1.061	1.082	1.104
<b>Discount rate</b>	10.00%	1.000	0.909	0.826	0.751	0.683	0.621
<b>Pricing (\$CDN/bbl unless indicated)</b>							
<b>WTI forecast, \$US</b>	Sproule Forecast						
<b>\$US/\$CDN</b>	Sproule Forecast						
<b>WTI forecast</b>	Calculated	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
<b>Edmonton Light Discount to WTI</b>		-	-	-	-	-	-
<b>Edmonton Light Price</b>	Calculated	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
<b>WCS Discount to Edmonton Light</b>		-	-	-	-	-	-
<b>WCS (\$CAD)</b>	Calculated	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
<b>Condensate Premium to Edmonton Light</b>		-	-	-	-	-	-
<b>Condensate</b>	Calculated	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
<b>Blending ratio</b>	30%	0.30	0.30	0.30	0.30	0.30	0.30
<b>Dilbit Quality discount to WCS</b>	\$0.00	-	-	-	-	-	-
<b>Athabasca dilbit price</b>	Calculated	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
<b>Bitumen (implied)</b>	Calculated	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
<b>Natural Gas (\$/GJ)</b>							
<b>AECO C</b>	Sproule Forecast						

<div>  <div> <b>Table 1 - North American Oil</b>  <b>Sproule - GTI</b>  <b>Summary of Price Forecasts, Inflation and Exchange Rates</b> </div> <div>   <small>Goobie Tulk Inc.</small> </div> </div>														
Prices in Canadian Dollars														
	1				Synthetic			Western			2		3	
	WTI	USA LLS	USA	Canadian	Crude Oil	Cromer	Hardisty	Select	Hardisty	Cold Lake	Energy	Operating	Capital	
	Cushing	Onshore	Central OK	Light Sweet	Edmonton	LSB	Heavy	(WCS)	Bow River	Blend	Cost	Cost	Cost	Exchange
	Oklahoma	40 API	Sweet	40 API	32 API	35 API	12 API	20.5 API	24.9 API	22.6 API	Inflation	Inflation	Inflation	Rate
Year	\$US/Bbl	\$US/Bbl	\$US/Bbl	\$/Bbl	\$/Bbl	\$/Bbl	\$/Bbl	\$/Bbl	\$/Bbl	\$/Bbl	%/Yr	%/Yr	%/Yr	CAD/USD
2009 Act	61.63	57.23	58.19	66.20	69.20	63.86	55.65	58.66	59.71	57.67	-38.1%	0.7%	-9.0%	0.88
2010 Act	79.43	74.83	75.88	77.80	80.89	76.57	62.30	67.21	68.27	65.96	28.9%	1.7%	4.0%	0.97
2011 Act	95.00	90.36	91.41	95.16	102.33	89.68	69.10	77.09	78.30	74.99	19.6%	1.4%	5.3%	1.01
2012 Act	94.19	89.58	90.63	86.57	92.50	84.42	65.00	73.08	74.36	71.42	-0.8%	1.0%	4.5%	1.00
2013 Act	97.98	97.55	93.26	93.27	100.12	91.59	64.98	74.93	76.16	72.91	4.0%	1.0%	0.7%	0.97
2014 Act	93.00	96.75	86.35	93.99	101.47	92.66	76.40	81.06	81.67	79.02	-5.1%	2.0%	-1.0%	0.91
2015 Act	48.80	52.38	41.71	57.45	62.25	55.57	40.42	44.83	45.35	43.60	-47.5%	1.8%	-18.7%	0.78
2016 Act	43.32	44.88	35.83	52.80	58.17	51.35	34.08	38.89	39.22	37.69	-11.2%	1.2%	-9.7%	0.76
2017 Act	50.95	54.13	44.96	61.85	67.74	62.06	45.76	50.24	50.85	49.33	17.6%	1.7%	2.4%	0.77
2018 Act	64.77	69.81	61.58	68.49	74.95	73.06	44.74	52.34	53.11	51.14	27.7%	2.4%	4.2%	0.77
2019 Act	57.02	62.71	53.34	68.87	75.32	69.68	55.11	58.77	59.10	57.57	-12.0%	-0.7%	0.4%	0.75
2020 Act	39.40	41.20	35.92	45.39	48.47	45.40	31.47	35.59	35.92	34.39	-30.9%	-5.2%	-5.2%	0.75
2021 Act	67.91	69.46	64.41	80.31	83.26	80.07	63.82	68.73	69.04	67.53	72.4%	4.1%	7.9%	0.80
2022 12 mo. Act	94.23	96.65	90.69	119.73	128.54	119.97	95.71	101.64	101.96	100.44	38.7%	8.6%	11.2%	0.77
2023 12 mo. Est	86.00	89.00	82.50	110.67	114.67	110.17	80.96	88.00	89.32	87.00	2.4%	0.0%	0.0%	0.75
2024	84.00	85.97	80.40	101.25	105.37	100.74	82.23	89.38	90.72	88.41	-2.3%	3.0%	3.0%	0.80
2025	80.00	80.95	76.32	96.18	100.38	95.65	77.34	84.06	85.32	83.08	-4.8%	2.0%	2.0%	0.80
2026	81.60	82.57	77.85	98.10	102.38	97.56	78.88	85.74	87.03	84.74	2.0%	2.0%	2.0%	0.80
2027	83.23	84.22	79.41	100.06	104.43	99.51	80.46	87.46	88.77	86.43	2.0%	2.0%	2.0%	0.80
2028	84.90	85.90	80.99	102.06	106.52	101.50	82.07	89.21	90.55	88.16	2.0%	2.0%	2.0%	0.80
2029	86.59	87.62	82.61	104.10	108.65	103.53	83.71	90.99	92.36	89.93	2.0%	2.0%	2.0%	0.80
2030	88.33	89.37	84.27	106.18	110.82	105.60	85.39	92.81	94.20	91.72	2.0%	2.0%	2.0%	0.80
2031	90.09	91.16	85.95	108.31	113.04	107.72	87.09	94.67	96.09	93.56	2.0%	2.0%	2.0%	0.80
2032	91.89	92.99	87.67	110.47	115.30	109.87	88.84	96.56	98.01	95.43	2.0%	2.0%	2.0%	0.80

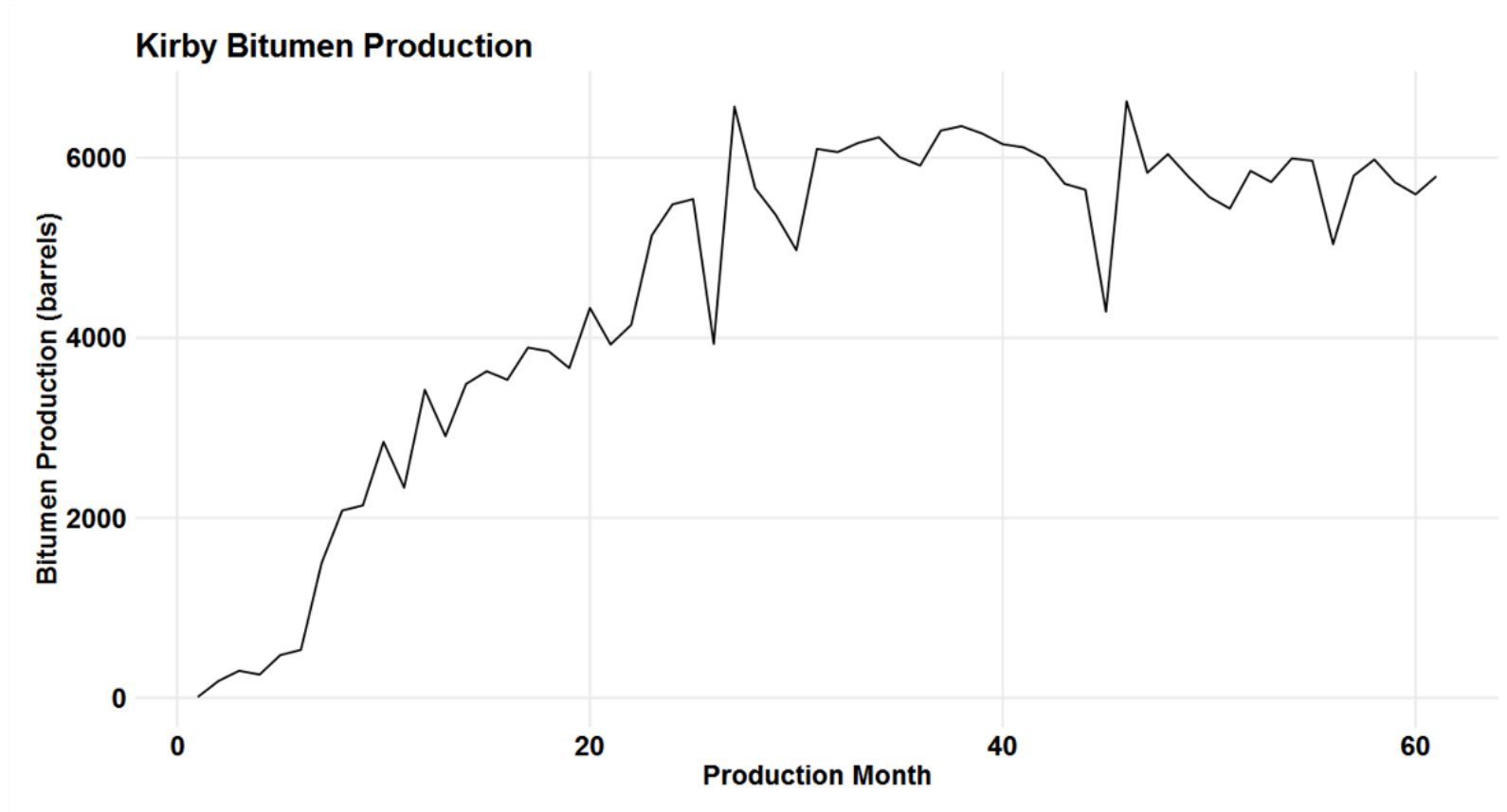
You can access the latest Sproule forecast [here](#).

# Sproule Prices

Year		2023	2024	2025	2026	2027	2028	2029	2030
Production Year		0	0	0	1	2	3	4	5
Years since construction		0	1	2	3	4	5	6	7
Operating		1	1	1	1	1	1	1	1
Energy Price inflation index (incl pipeline tolls)	2.00%	1.000	1.020	1.040	1.061	1.082	1.104	1.126	1.149
Overall inflation index	2.00%	1.000	1.020	1.040	1.061	1.082	1.104	1.126	1.149
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Discount rate	10.00%	1.000	0.909	0.826	0.751	0.683	0.621	0.564	0.513
<b>Pricing (\$CDN/bbl unless indicated)</b>									
WTI forecast, \$US	Sproule Forecast	86.00	84.00	80.00	81.60	83.23	84.90	86.59	88.33
\$US/\$CDN	Sproule Forecast	0.75	0.80	0.80	0.80	0.80	0.80	0.80	0.80
WTI forecast	Calculated	114.67	105.00	100.00	102.00	104.04	106.12	108.24	110.41
Edmonton Light Discount to WTI	\$0	-	-	-	-	-	-	-	-
Edmonton Light Price	Calculated	114.67	105.00	100.00	102.00	104.04	106.12	108.24	110.41
WCS Discount to Edmonton Light	15%	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
WCS (\$CAD)	Calculated	97.47	89.25	85.00	86.70	88.43	90.20	92.01	93.85
Condensate Premium to Edmonton Light	2%	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Condensate	Calculated	116.96	105.02	100.02	102.02	104.06	106.14	108.26	110.43
Blending ratio	30%	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Dilbit Quality discount to WCS	\$0.00	-	-	-	-	-	-	-	-
Athabasca dilbit price	Calculated	97.47	89.25	85.00	86.70	88.43	90.20	92.01	93.85
Bitumen (implied)	Calculated	89.11	82.49	78.56	80.13	81.74	83.37	85.04	86.74

- Production timelines will vary by facility, resource type, production technology, etc.
- Production drives the revenue side of your cash flow model
- Oil sands facilities tend to have a long ramp-up (3-4 years for mines, 1-2 years for in-situ) followed by stable production at or close to nameplate capacity for 25-50 years depending on the facility

# Production





# Production and revenue in the model template

Year		2020	2021	2022	2023	2024	2025	2026
<b>Production Year</b>		0	0	0	1	2	3	4
<b>Production</b>								
Nameplate Capacity (bbl/d)	35000	35,000	35,000	35,000	35,000	35,000	35,000	35,000
Ramp-up (%)	Assumed	-	-	-	0.30	0.60	0.84	1.00
Percentage design capacity achieved	100.00%	-	-	-	0.30	0.60	0.84	1.00
Operational Capacity (bbl/d)	Calculated	-	-	-	10,500.00	21,000.00	29,400.00	35,000.00
Total Annual Production (mmbbl)	Calculated	-	-	-	3.83	7.67	10.73	12.78
Cumulative Production (mmbbl)	Calculated	-	-	-	3.83	11.50	22.23	35.00
Average daily bitumen production (bbl/d)	Calculated	-	-	-	10,500.00	21,000.00	29,400.00	35,000.00
Condensate req (bbl/d)	Calculated	-	-	-	4,500.00	9,000.00	12,600.00	15,000.00
Annual condensate use (mmbbl)	Calculated	-	-	-	1.64	3.29	4.60	5.48
Dilbit production (bbl/d)	Calculated	-	-	-	15,000.00	30,000.00	42,000.00	50,000.00
Annual dilbit production (mmbbl)	Calculated	-	-	-	5.48	10.95	15.33	18.25
Cumulative Bitumen Production (mmbbl)	Calculated	391.43						
Cumulative Dilbit Production (mmbbl)	Calculated	559.18						
<b>Revenue</b>		2,020.00	2,021.00	2,022.00	2,023.00	2,024.00	2,025.00	2,026.00
Bitumen at site (\$/bbl)	From above	51.20	51.93	50.57	51.58	52.61	53.66	54.73
Production (mmbbl)	From above	-	-	-	3.83	7.67	10.73	12.78
<b>Gross Bitumen revenue (\$mm)</b>	Calculated	-	-	-	197.67	403.25	575.83	699.23

# Initial capital and construction costs (including land)

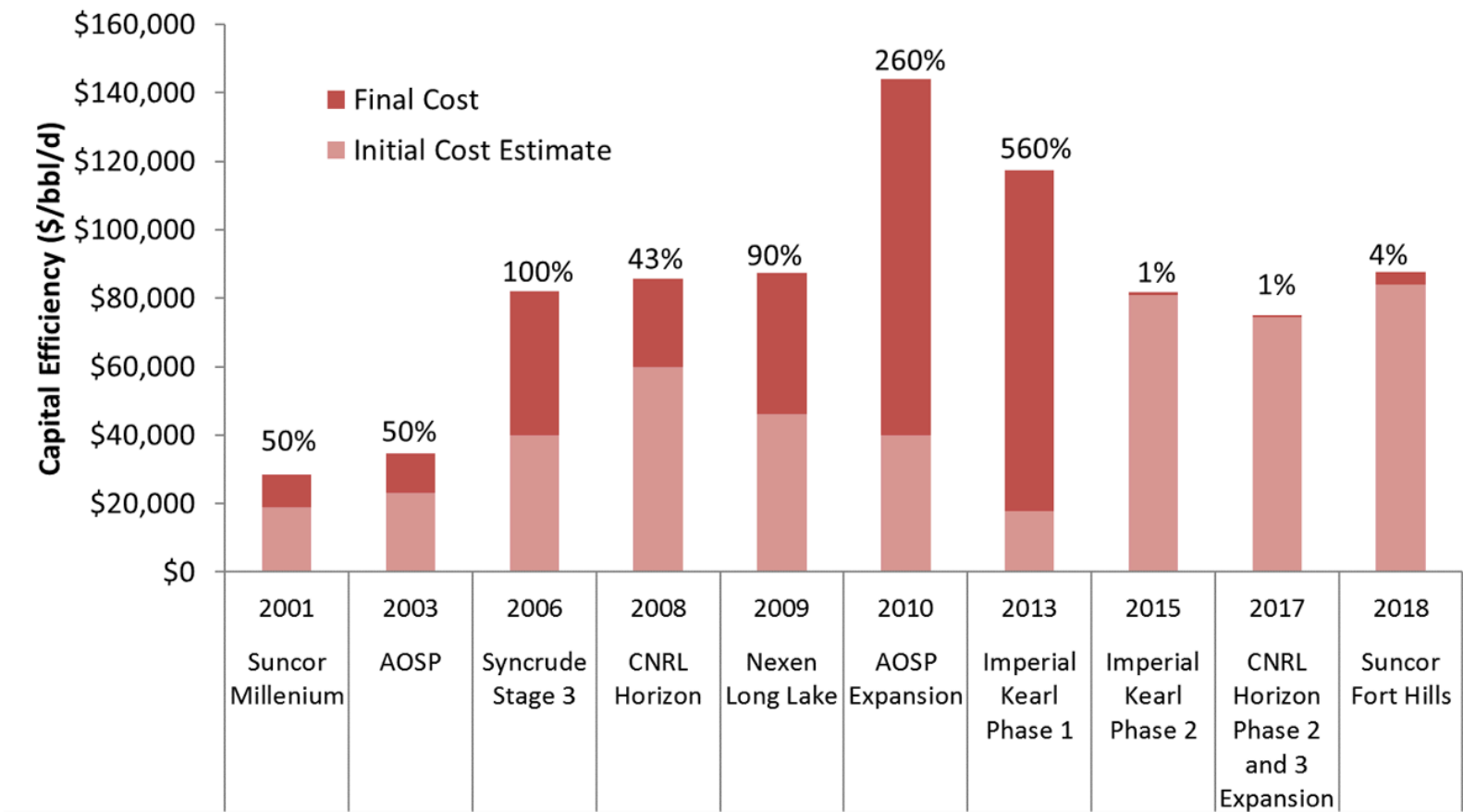
Expressed in cost *per flowing barrel*:

$$\frac{\text{Project capital up-front capital cost (dollars)}}{\text{Project daily production capacity (barrels per day)}}$$

For example: Firebag 4 total cost was \$1.7 billion for 42,500 b/d of capacity = \$40,000 *per flowing barrel*

Think of the oil production from a facility as an annuity, and the cost *per flowing barrel* as the up-front payment to access that annuity for a term equal to the project life.

# Capital cost inflation was once a major risk



# Project operating costs and fiscal policies

OPEN DATA

## Alberta Oil Sands Royalty Data

Summary

Detailed Information

Related (1)

### DESCRIPTION

Publishing this royalty data as it was a recommendation of the 2015 Royalty Review Advisory Panel that also gave direction on the Modernized Royalty Framework that came into force on January 1, 2017.

### UPDATED

August 4, 2022


### TAGS

### RESOURCES

 [2021 Oil sands project data as of May 9, 2022 \(published in August 2022\)](#)

2021 Oil sands project data as of 12:00:00 AM May 9, 2022, industry is...

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 [2020 Oil sands project data as of May 9, 2022 \(published in August 2022\)](#)

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 [2019 Oil sands project data as of May 9, 2022 \(published in August 2022\)](#)

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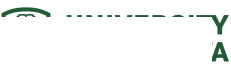
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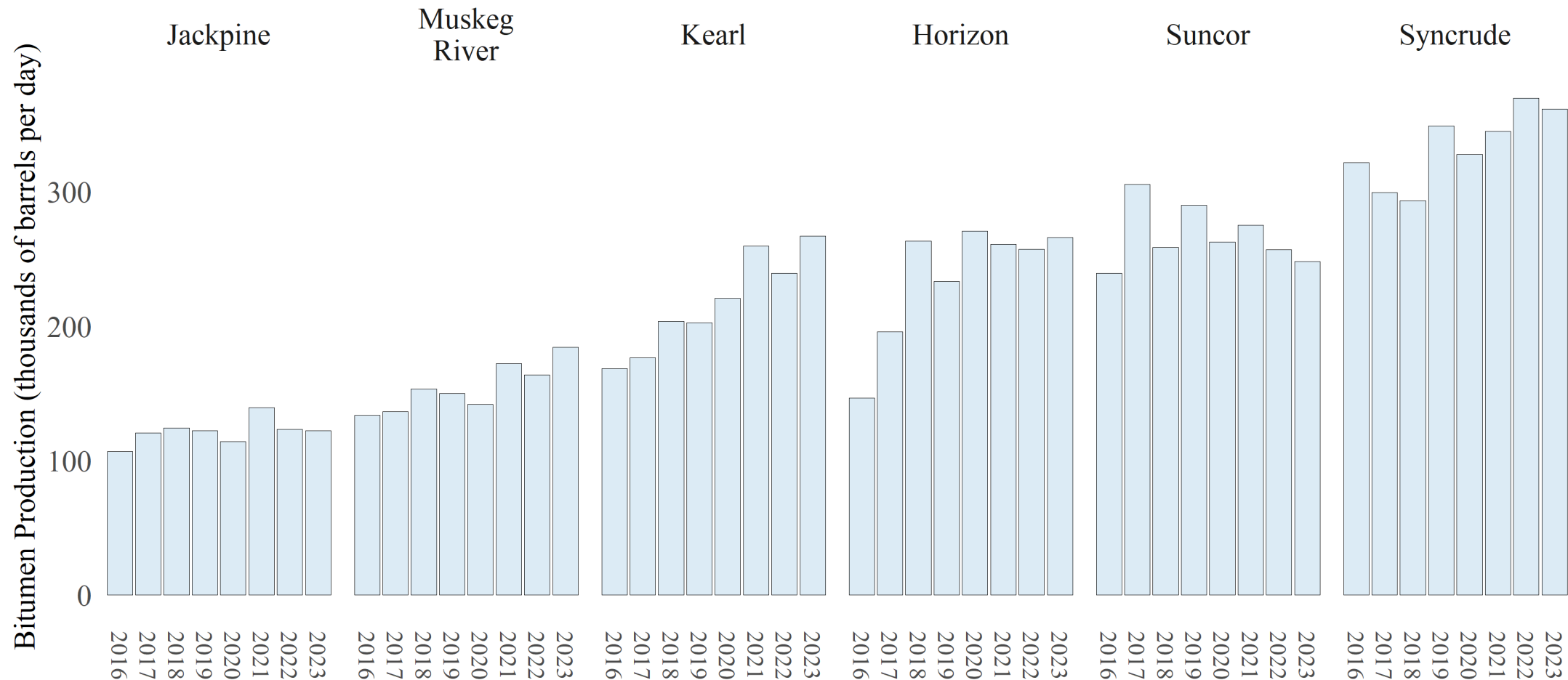
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You can access the data [here](#) and some background on oil sands royalties [here](#). The [historical data](#) and the [Alberta Revenue Workbook](#) are going to be used in upcoming data exercises.

# Mining Production



Annual Bitumen Production, Oil Sands Mining Projects

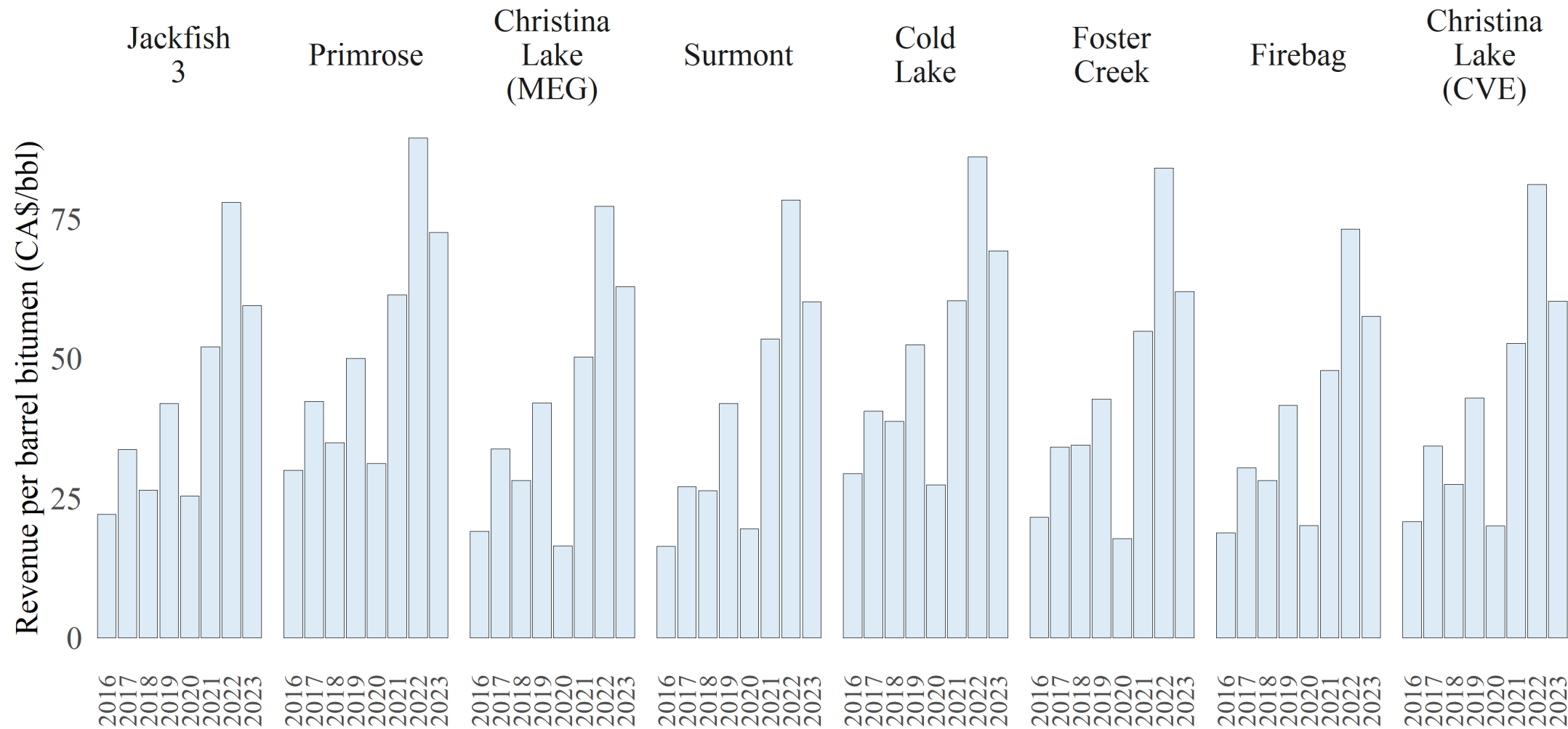


Data via Government of Alberta, graph by @andrew\_leach

# In Situ Revenue Per Barrel



Gross Revenue per Barrel Bitumen, Larger In Situ Oil Sands Projects



Data via Government of Alberta, graph by @andrew\_leach

# Sustaining capital costs

- Ongoing investment for maintenance of large facilities, including pipelines, well-pads, etc.
- Sustaining capital cost captures large expenditures, so does not include all maintenance
- Typical values are between \$10-12/bbl produced for SAGD facilities, and \$6-8 per barrel produced for mining operations

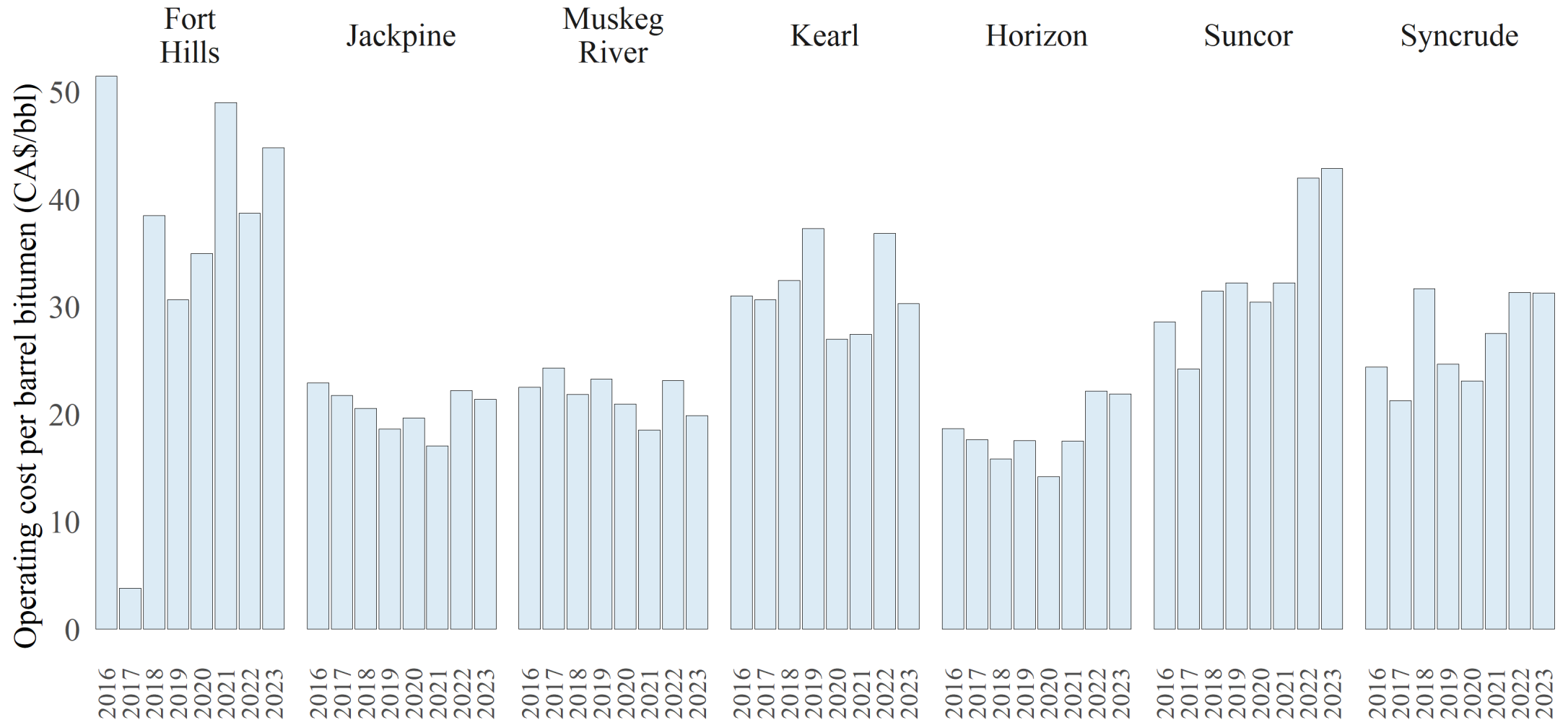
# Operating costs

- Traditionally separated into gas and non-gas operating costs
- Natural gas is the single largest component for SAGD facilities.
- Some cost figures will also report labour costs as separate components of operating and sustaining capital expenditures
- Highly variable at the facility level
  - SAGD facilities tend to be in the \$5-15/bbl range
  - Mining facilities have increased significantly, to \$25-30/bbl (bitumen) ranges, with \$40-50/bbl SCO costs in some years
  - Kearl, the only mine to not upgrade bitumen, had reported operating costs at \$36-40/bbl, those decreased by about \$10/bbl when the next phase came online
  - Fort Hills is...well not good



# Mining Operating Costs

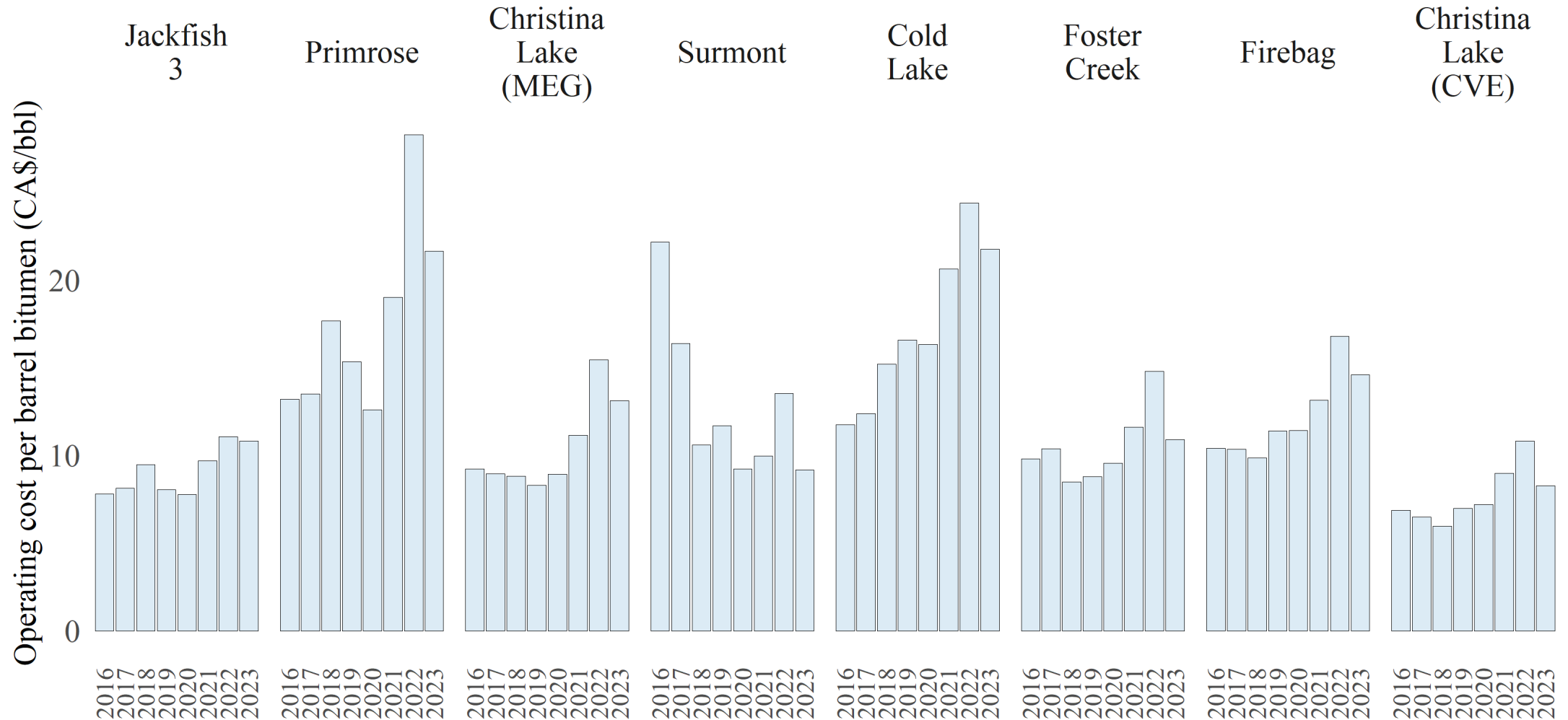
## Operating Costs, Oil Sands Mining Projects



Data via Government of Alberta, graph by @andrew\_leach

# In Situ Operating Costs

## Operating Costs, Larger In Situ Oil Sands Projects



Data via Government of Alberta, graph by @andrew\_leach

- Oil sands were, for a long time, the most interesting royalty issue in the province
- Historically, oil sands operations were marginal projects
- Significant dependence on the price of oil
- Role for government to encourage investment to create jobs, stimulate the economy
- *Generic oil sands royalty regime* imposed royalty rates at a fixed 1% of gross revenues until the project costs had been recovered, 25% of net revenues afterwards
- 2008 regime introduced a sliding scale for both the base rate and the post-payout rate based on prices
  - Environmental *costs* were recognized as project costs after 2008
- 2015 Royalty Review largely left oil sands royalties unchanged
- Long run oil price outlook may make new projects challenging regardless of royalty structure

| What makes a *good* royalty regime?

- Base royalty rate of 1% for \$55/bbl and below, increasing linearly to 9% for \$120/bbl
- Post-payout royalty rate of 25% up to \$55/bbl, and increasing linearly to 40% for \$120/bbl and above

Royalties depend on oil prices, but *what* oil price, *when* and *where*?

- the WTI (Cushing) price for a given month, expressed in Canadian currency, calculated as the product of:
  - a. the simple average of the WTI prices for the trading days of the preceding month expressed in American currency, and
  - b. the simple average of the daily actual USD/CAD (noon) exchange rates for that month.

# Net Revenue Calculation

What's the net revenue for the purposes of royalty calculations?

The amount by which the project's revenue exceeds allowed costs, minus other net proceeds. Net revenue can never be below zero.

Calculated as Gross Revenue – Operating Costs – Capital Costs – Return Allowance – Other Costs + Other Net Proceeds.

Financing costs are exempt from net revenue calculations

# Payout Calculation

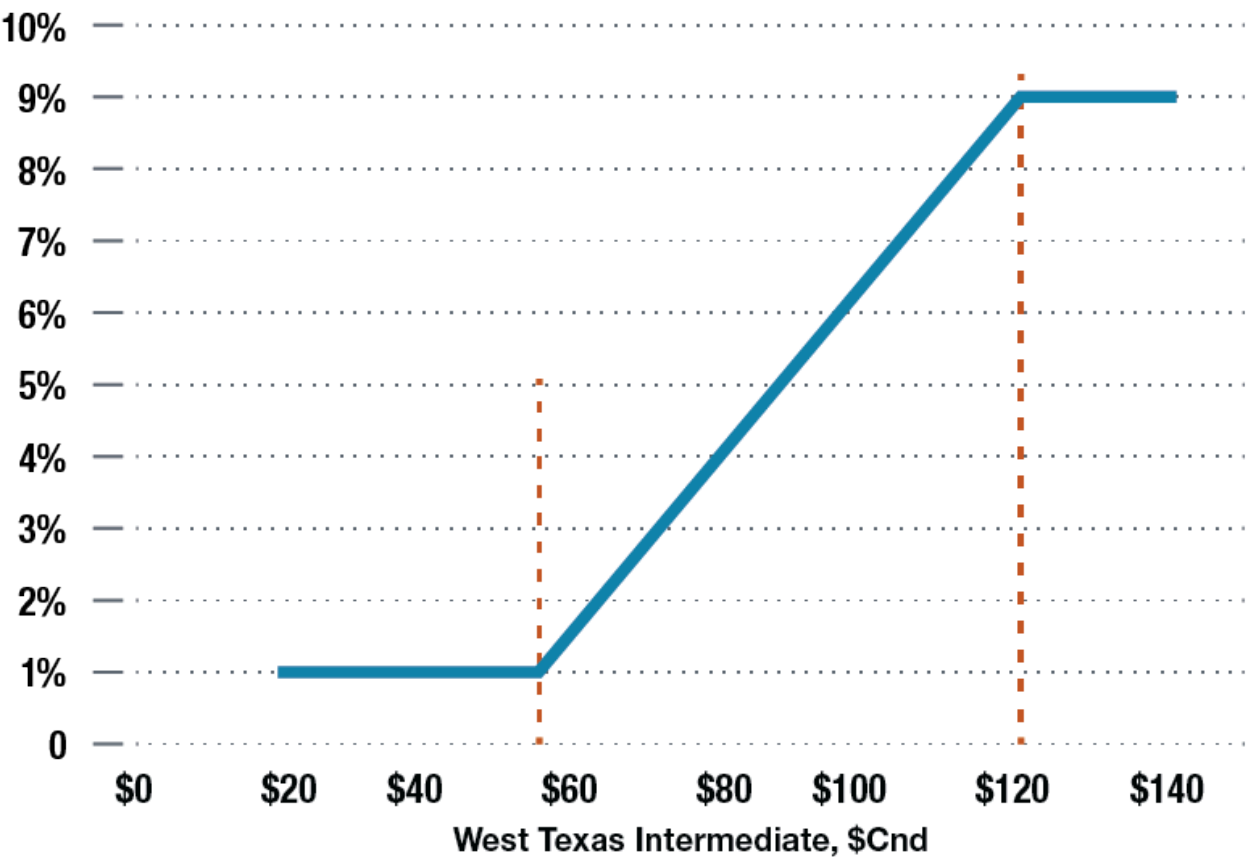
How do you know if a project has paid back its initial investment and you're paying a net or a gross revenue royalty?

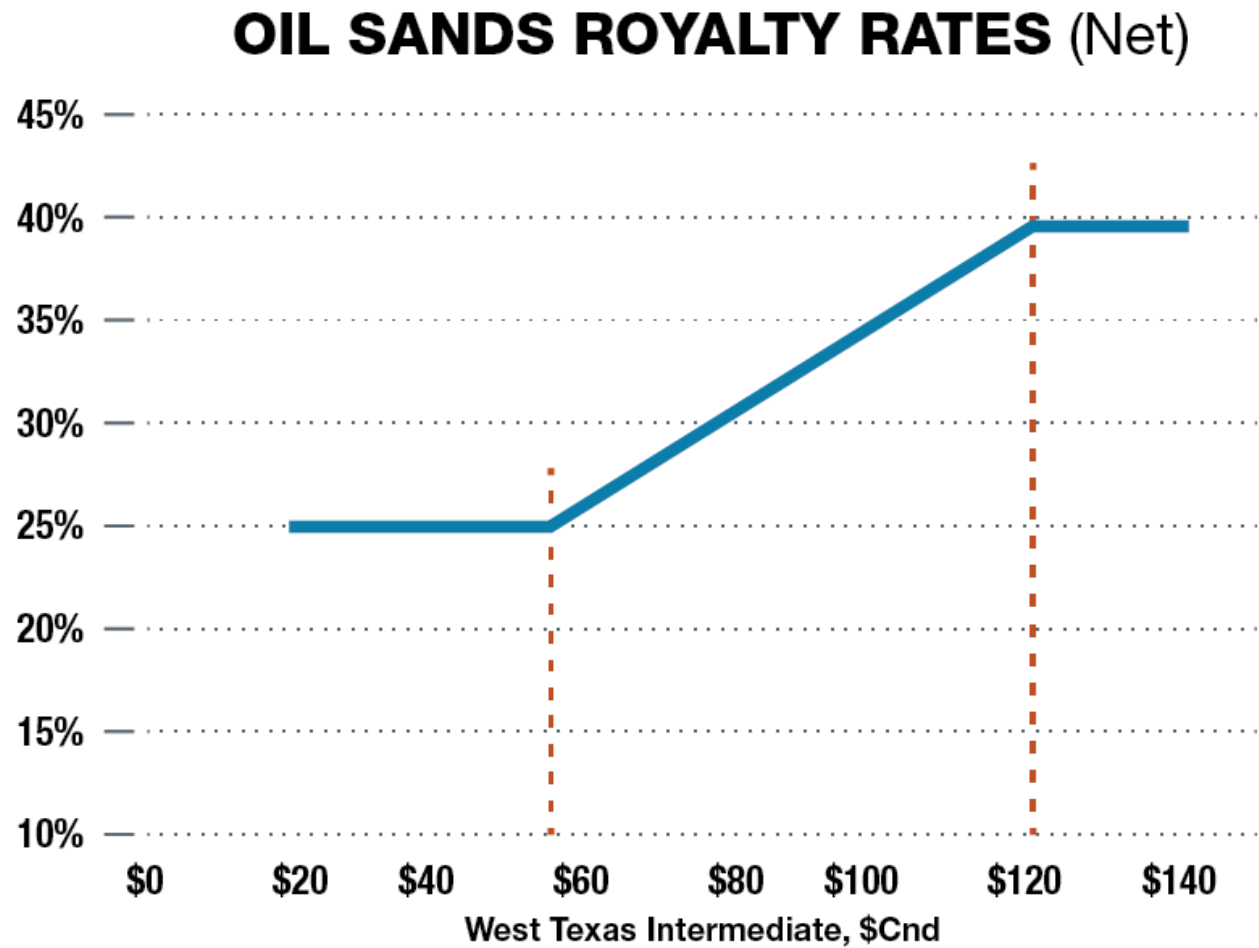
Project payout occurs when a project's cumulative revenues first equal or exceed its cumulative costs. Royalties are typically higher in the post-payout phase. **Once a project achieves payout it remains in the post-payout phase.**

Payout calculation assumes unrecovered capital costs are carried at the Government Long Term Bond Rate. Think of a virtual line of credit where all expenses are spent via the line, and all revenues deposits to pay back the line. When the line is *paid off*, the project has reached *payout*.

Projects always pay the greater of the calculated net or gross revenue royalty

## OIL SANDS ROYALTY RATES (Gross)







# Payment of Royalties

- Always has been “in-kind” for conventional, “in cash” for oil sands
- Government had not wanted to be in the upgrading/refining business, and so did not accept bitumen in lieu of cash

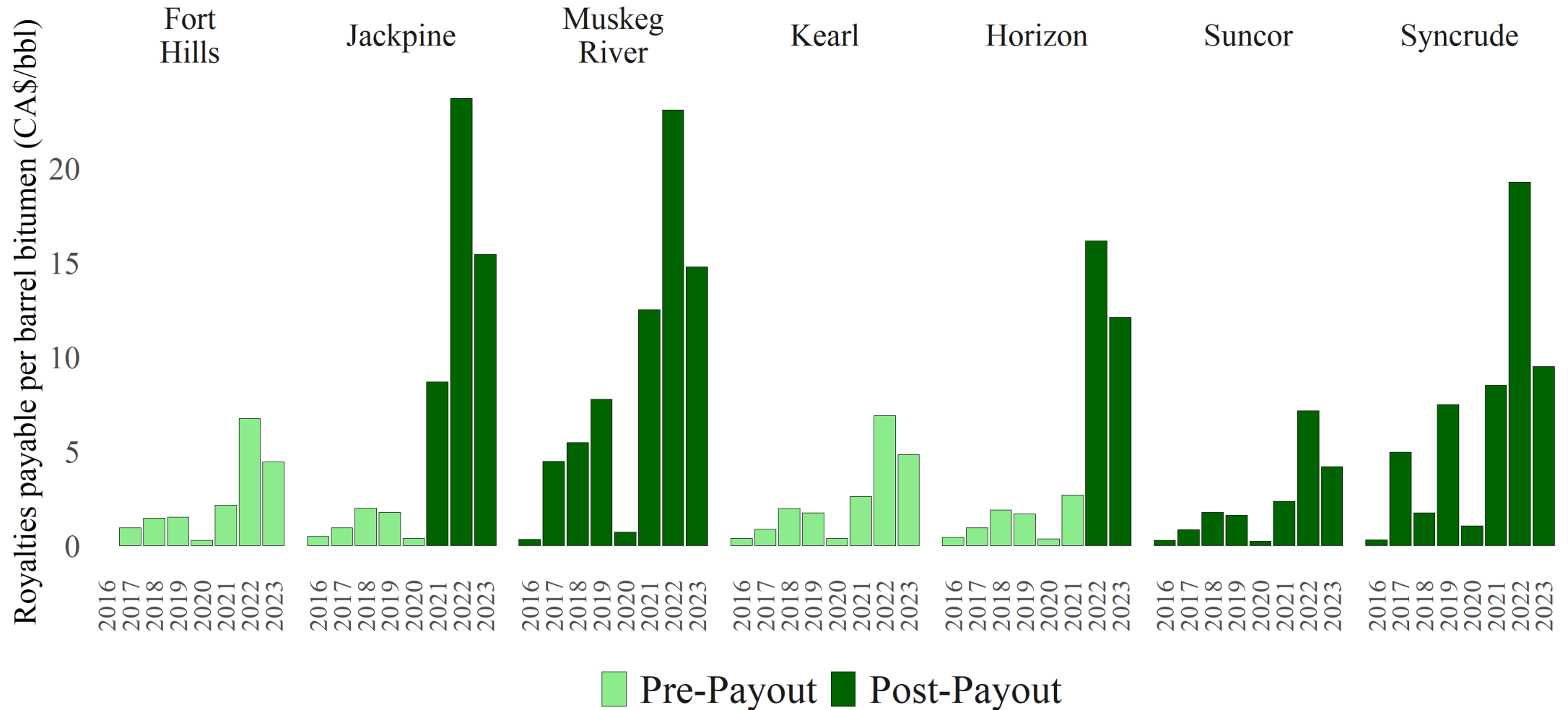
Under the 2008 royalty regime:

“The government intends to have a portion of its royalty share of bitumen in-kind commercially upgraded to higher value products in the province. The government wants to hear from companies interested in buying bitumen from the province for upgrading and other value-added activities in Alberta.”

For our purposes, that's not really important, but it does matter for producers.

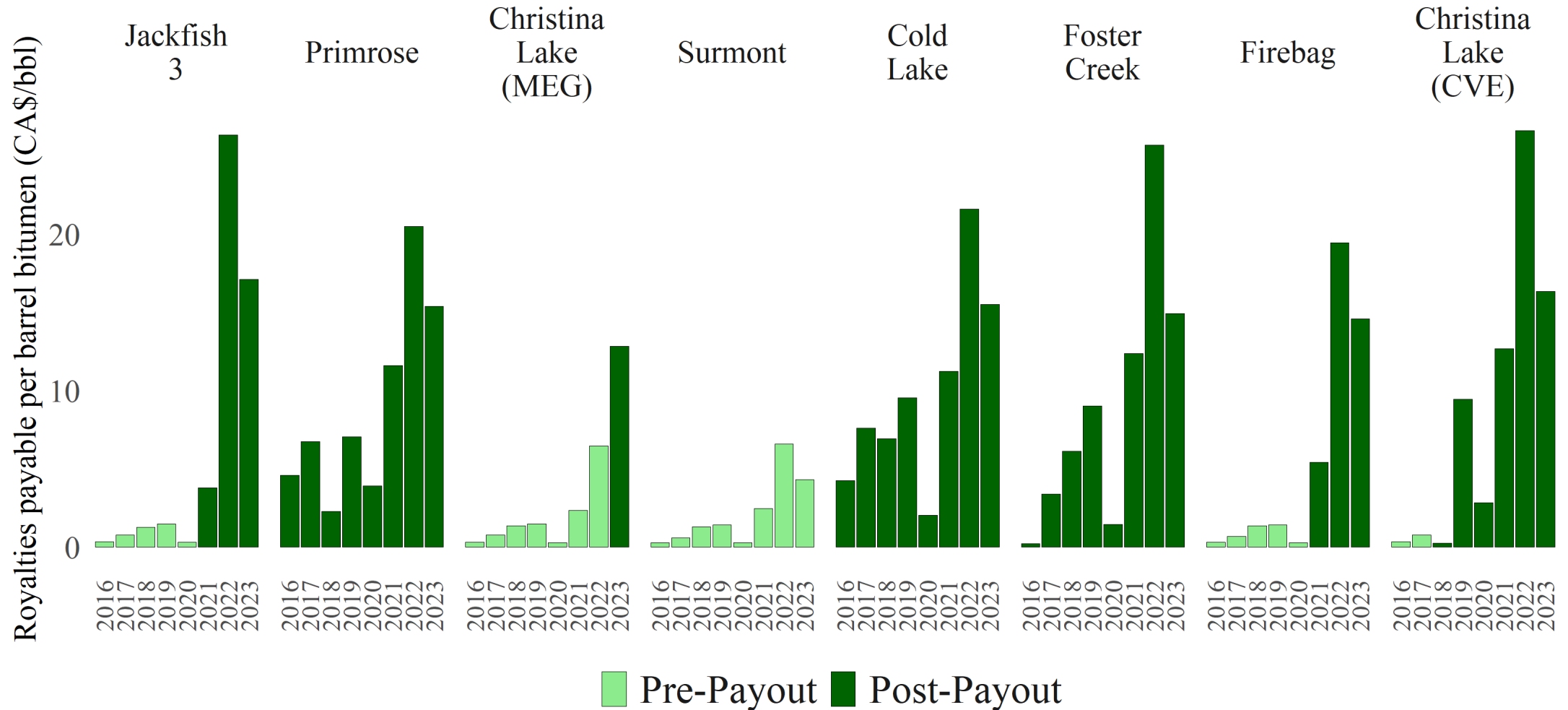
# Mining Royalties

**Royalties Payable per Barrel Bitumen, Oil Sands Mining Projects**



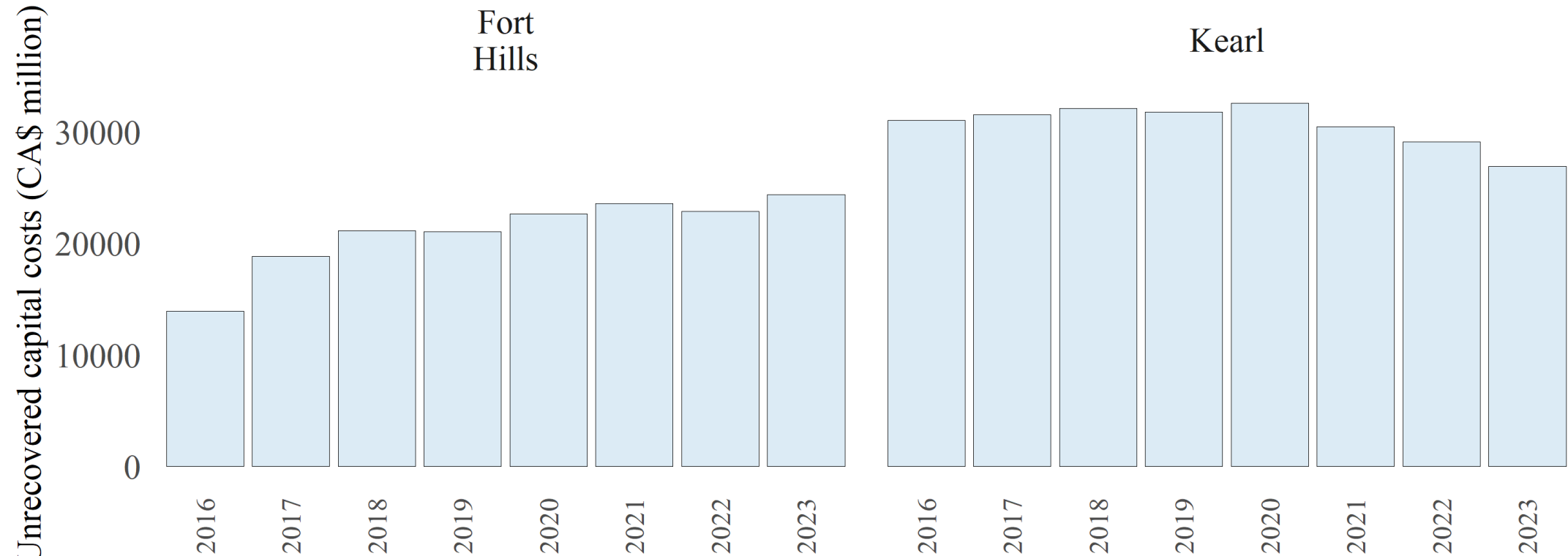
# In Situ Royalties

## Royalties Payable per Barrel Bitumen, Larger In Situ Oil Sands Projects



# Mining unrecovered capital costs

Unrecovered capital costs per royalty formula, oil sands mining projects

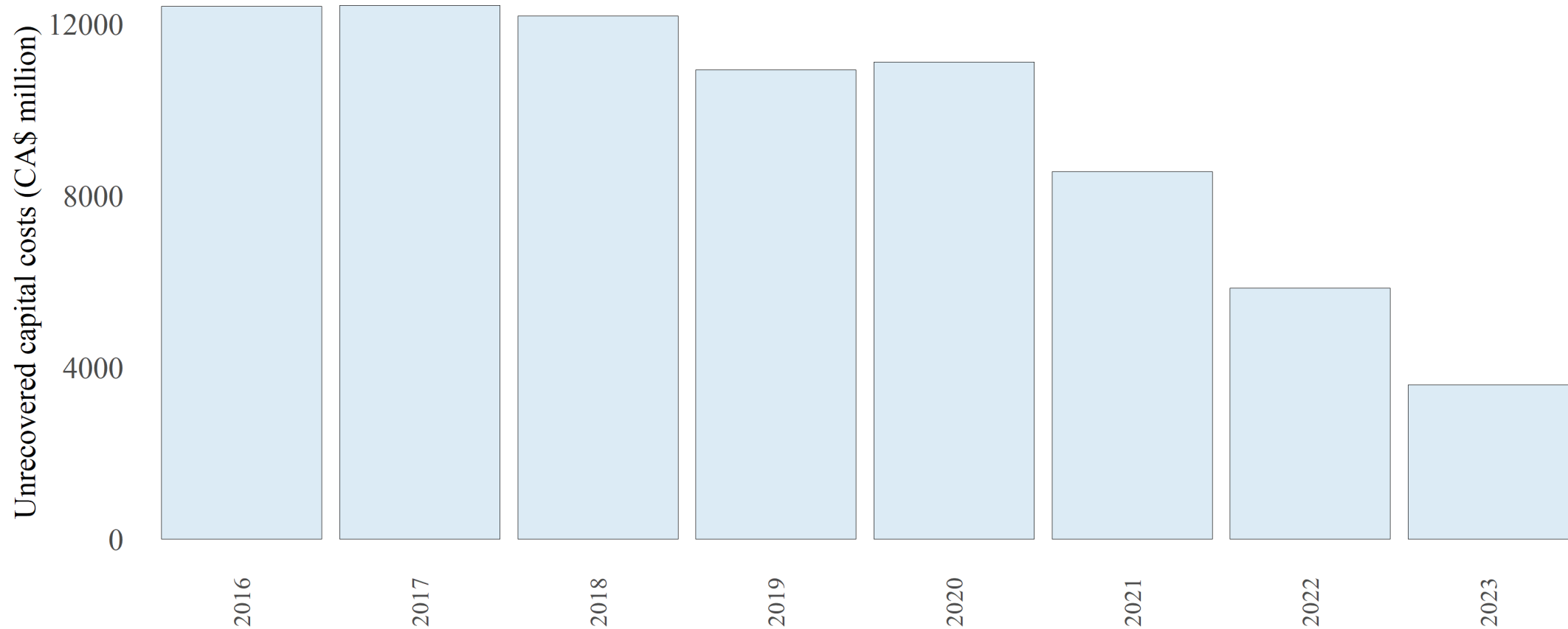


Data via Government of Alberta, graph by @andrew\_leach

# In Situ Unrecovered Capital Costs

Unrecovered capital costs per royalty formula, larger in situ oil sands projects

Surmont

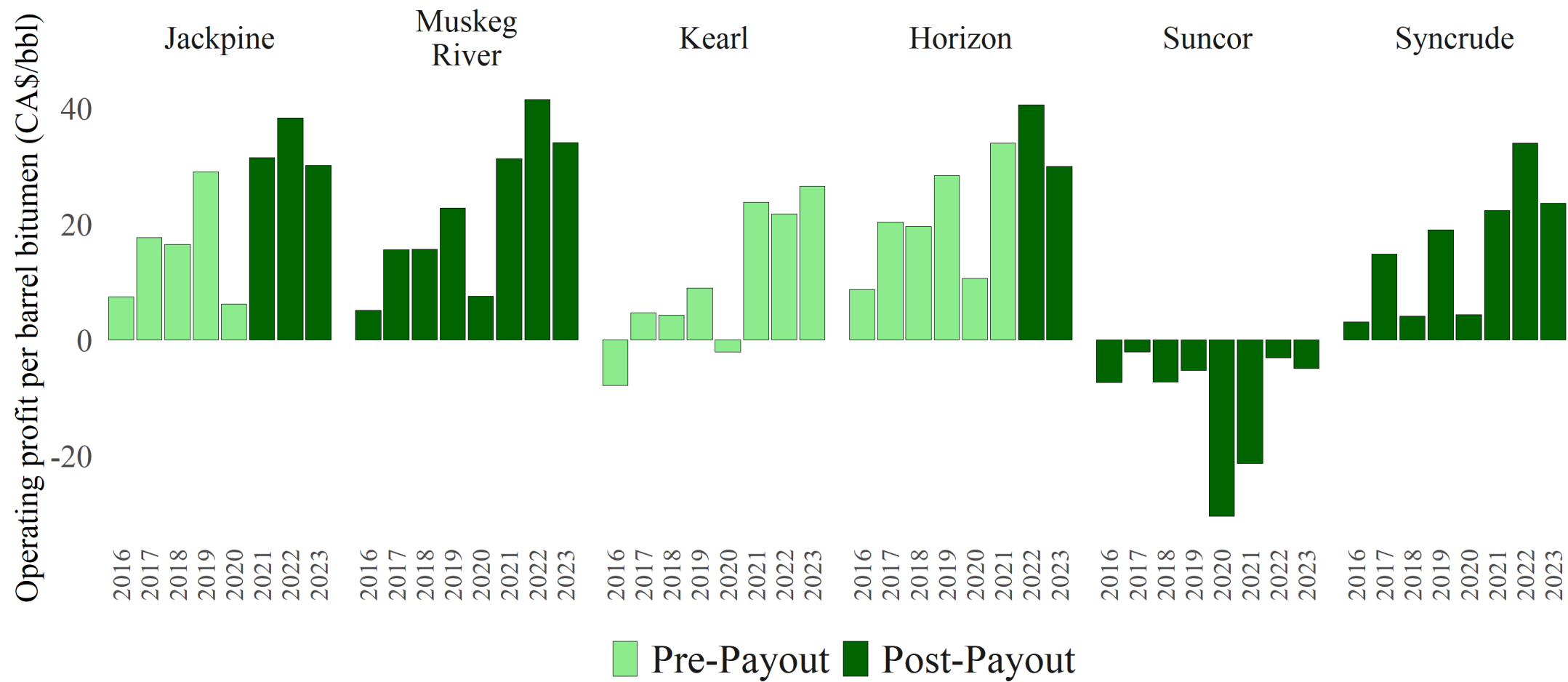


Data via Government of Alberta, graph by @andrew\_leach

# Mining Operating Profits (Post-Royalty)

## Operating Profit per Barrel Bitumen, Oil Sands Mining Projects

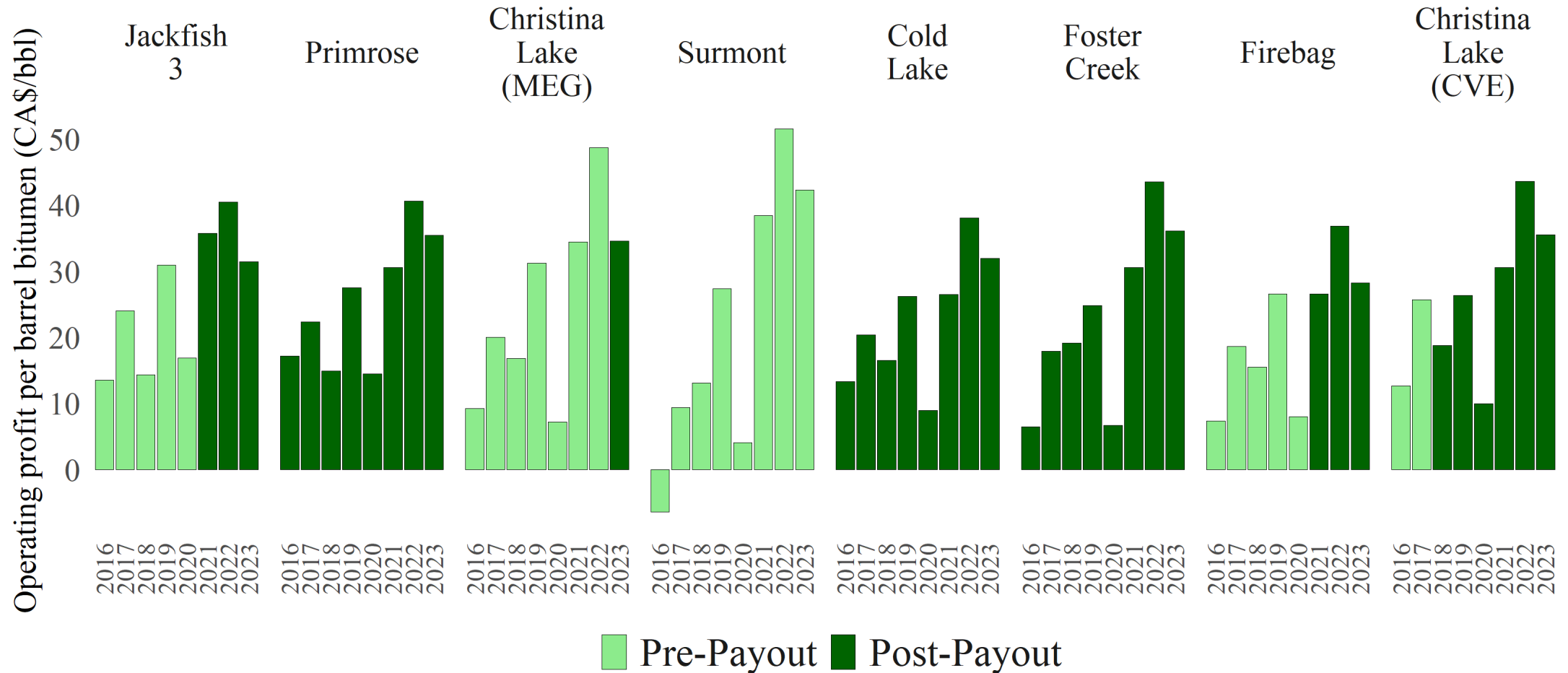
Gross revenue net operating and capital costs and royalties, excluding Fort Hills



# In Situ Operating Profits

## Operating Profit per Barrel Bitumen, Oil Sands In-Situ Projects

Gross revenue net operating and capital costs and royalties



Main tax policies include

- Federal and provincial corporate taxes
  - Capital cost allowance
  - CDE and CEE
- Other issues affect junior oil and gas companies a lot more than oil sands firms
  - e.g. flow-through shares and tax losses

We won't go into details on corporate taxes, but they are calculated in your model



# The intuition in the model: commodity prices

## Project NPV<sub>10</sub> sensitivity to commodity prices

		WTI price (US\$ 2023)						
		30	40	50	60	70	80	90
NIT Gas Price (CA\$ 2023)	3.00	-517	216	863	1447	1971	2463	2942
	4.00	-639	113	766	1355	1883	2377	2859
	5.00	-770	9	669	1262	1794	2292	2776
	6.00	-902	-95	572	1169	1705	2206	2693
	7.00	-1034	-201	474	1076	1616	2120	2610
	8.00	-1167	-309	376	983	1527	2035	2526

# The intuition in the model: differentials

**Project NPV<sub>10</sub> sensitivity to heavy:light differentials**

		WTI price (US\$ 2023)						
		30	40	50	60	70	80	90
Differential (% discount for WCS vs Edm Light)	10%	-368	392	1070	1684	2235	2754	3260
	12%	-442	304	967	1565	2103	2608	3101
	14%	-517	216	863	1447	1971	2463	2942
	16%	-593	128	759	1328	1839	2317	2783
	18%	-678	39	655	1209	1706	2171	2624
	20%	-762	-50	551	1090	1573	2025	2465

# Supply cost basics

- the particular project in the model I've given you has a supply cost of about \$40/bbl WTI
- supply costs will vary (all else equal) with:
  - heavy oil differential (+, higher diff means higher WTI price needed)
  - CAD (+, stronger CAD (fewer CAD per USD) means higher WTI price needed)
  - gas prices (+, higher gas price means higher WTI price needed)
  - capital costs (+, higher Capital cost means higher WTI price needed)
  - operating costs (+, higher op costs means higher WTI price needed)
  - taxes and royalties (+, higher taxes mean higher WTI price needed)

# Supply Costs in Practice

Table S3.4 Alberta crude bitumen supply costs, 2022

Project type	Production		Capital cost range	Capacity utilization	Estimated supply cost
	(10 <sup>3</sup> m <sup>3</sup> /d)	(bbl/d) <sup>a</sup>	(millions of dollars)		(\$US WTI equivalent per barrel)
In situ SAGD	6.4	40,000	630 – 1,390	90%	46 – 54
Standalone mine	15.9	100,000	9,000 – 11,000	90%	76 – 84

<sup>a</sup> bbl/d = barrels per day.

# Supply Costs in Practice

**Table S4.3 Alberta crude oil supply costs by PSAC area, 2022**

Area	Formation	Type of well	Type of oil	Total measured depth	Initial productivity	Total capital cost	Fixed operating cost	Variable operating cost	Crude oil supply cost- single well	Crude oil supply cost- multiwell pad with 4 wells
				(m)	(m <sup>3</sup> /d)	(Cdn\$000)	(Cdn\$000/year)	(Cdn\$/m <sup>3</sup> )	(Cdn\$/bbl)	(Cdn\$/bbl)
PSAC 2	Cardium	Horizontal	Sweet light	3 900	15.5	3 618	81.36	50.36	34.03	27.71
PSAC 2	Cardium	Horizontal	Sweet medium	3 600	9.1	3 860	66.97	57.77	67.01	55.11
PSAC 2	Spirit River	Horizontal	Sweet light	4 230	17.8	6 533	71.26	50.36	47.71	37.94
PSAC 3	Sunburst	Vertical	Sweet medium	1 540	4.6	1 088	42.37	90.73	42.64	n/a
PSAC 3	Banff	Horizontal	Sour medium	3 800	12.9	5 851	34.31	95.17	71.21	58.49
PSAC 3	Viking	Horizontal	Sweet medium	2 000	7.1	1 484	22.55	29.99	21.38	18.55
PSAC 4	Lloyd SS	Vertical	Sweet heavy	1 100	6.0	1 509	74.03	70.36	46.15	n/a
PSAC 4	Sparky SS	Horizontal	Sweet heavy	1 600	6.0	1 809	74.03	70.36	53.49	43.11
PSAC 5	Rock Creek	Horizontal	Sweet medium	2 300	5.3	2 580	67.29	47.03	76.42	64.77
PSAC 5	Cardium	Horizontal	Sweet light	3 800	12.4	3 223	81.36	50.36	40.14	32.40
PSAC 7	Gilwood	Vertical	Sweet light	1 770	5.8	1 820	75.68	86.65	58.73	n/a
PSAC 7	Keg River	Horizontal	Sweet light	2 050	8.9	3 622	203.05	25.92	72.53	62.54
PSAC 7	Beaverhill Lake	Directional	Sweet light	2 500	6.1	2 678	75.68	86.65	75.48	n/a
PSAC 7	Montney	Horizontal	Sweet light	4 000	29.6	6 180	83.19	98.50	32.57	26.76

Note: Cost data from petroCUBE and the PSAC Well Cost Study Winter 2022 have been used to estimate the supply costs.

(m<sup>3</sup>/d) = cubic metre per day.

(bbl) = barrel.

# Key concept review

- Netback bitumen pricing
- Royalty regimes for oil sands and non-oil sands extraction in Alberta