Hydrogen/Ammonia Investment Opportunities in Alberta

Presentation for TIER Workshop

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Natural Gas Strategy and Engagement
Alberta Energy
November 2023

Natural Gas Vision and Strategy and Hydrogen Roadmap

GETTING ALBERTA BACK TO WORK

Natural Gas Vision and Strategy

Alberta

Vision: Alberta is the **preferred source** of clean, secure and responsibly sourced natural gas, **supplying domestic and global demand** for energy and a range of products across the natural gas value chain.

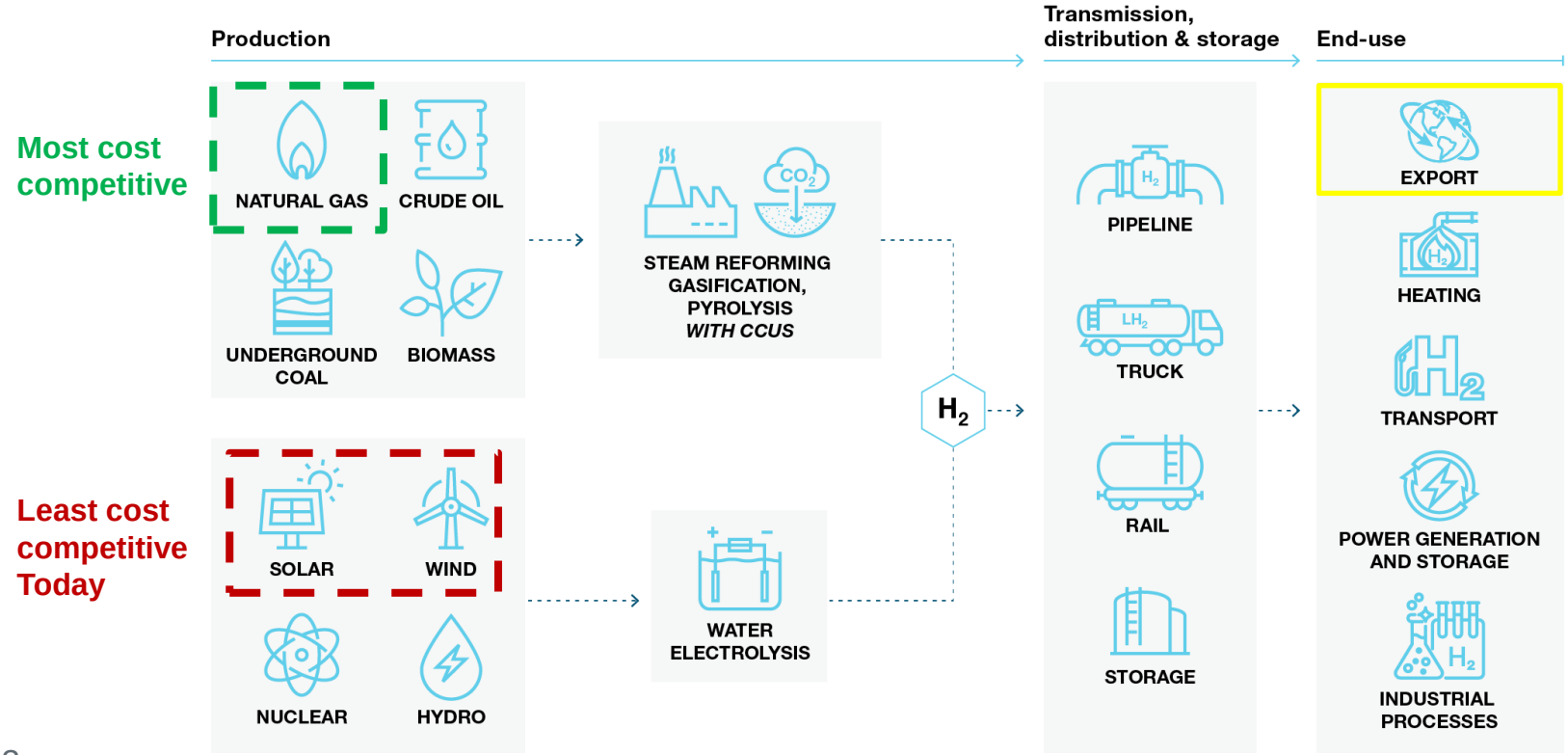
Natural Gas Advisory Panel	Natural Gas Vision and Strategy	Alberta Hydrogen Roadmap
May 2018	October 2020	November 2021

Alberta Hydrogen Roadmap

Alberta

Alberta

Alberta's Clean Hydrogen Economy



Alberta's Ambition and Advantages

Ambition for 2030

Clean hydrogen is integrated at scale into Alberta's domestic energy system for use in transportation, heat, power generation, and renewable energy storage, as well as industrial use. Alberta has established itself as the global supplier-of-choice in clean hydrogen exports.

Hydrogen Roadmap to 2030

Themes

- Build New Market Demand
- Enable Carbon Capture & Storage
- De-risk Investment
- Activate Technology and Innovation
- Ensure regulatory efficiency, codes, and standards to drive safety
- Lead the way and build alliances
- Pursue hydrogen exports

Markets and Opportunities

- Utility Heat
- Power Generation
- Industry
- Mobility/Transportation
- Exports

Actions

Deploy hydrogen to support stable demand and set up for long-term decarbonization

- Ensure public safety and enable hydrogen blending
- Evaluate pure hydrogen networks and communities in Alberta

Provide access to clean hydrogen as an integrated energy solution for decarbonisation and grid resiliency

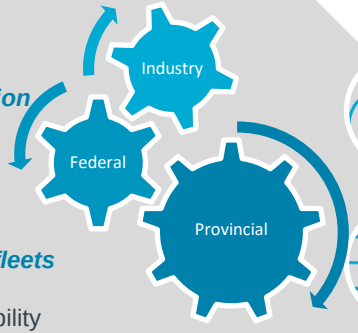
- Decarbonize existing hydrogen production
- Provide access to clean hydrogen and flexibility of use

Prove out and accelerate technology for heavy duty and captive fleets

- Establish and de-risk distribution and refueling infrastructure
- Explore opportunities for larger-scale deployment in promising mobility applications (buses, commercial trucks)

Unlock the supply chain to enable global market access

- Establish Alberta as a credible hydrogen supplier with importers
- Export feasibility studies and a comprehensive market access plan



Outcomes

- Decarbonize hard-to-abate sectors in Alberta's economy and international markets
- Increased employment and economic activity in Alberta
- Extend the natural gas value chain by growing new markets
- Maximize federal support for hydrogen in Alberta

Hydrogen Growth Market – Exports (Ammonia)

- Alberta aims to become a global supplier of clean, responsibly sourced hydrogen and its derivatives .
- Overseas exports in the form of liquefied hydrogen are uneconomic (today).
- Ammonia offers immediate opportunity.
- Asia is a critical early market – looking to use ammonia directly.

Government of Canada Incentives

Clean Technology Manufacturing ITC: of up to 30%, focused on net-zero technologies and extract, process or recycle of certain minerals essential to clean technology.

Clean Hydrogen ITC:15% - 40% of eligible project costs, depending on “cleanliness” of projects.

Carbon Capture, Utilization and Storage (CCUS) ITC: 50% credit for equipment associated with point-source CCUS projects, declining in 2030 and 2040 to incent early adoption.

Clean Electricity ITC: proposed 15% refundable tax credit for certain non-emitting or low emitting electricity generation systems

Government of Alberta Incentives

Alberta Petrochemicals Incentive Program (APIP)

- Grants of 12% of eligible capital expenses

Technology Innovation and Emissions Reduction (TIER) regulation

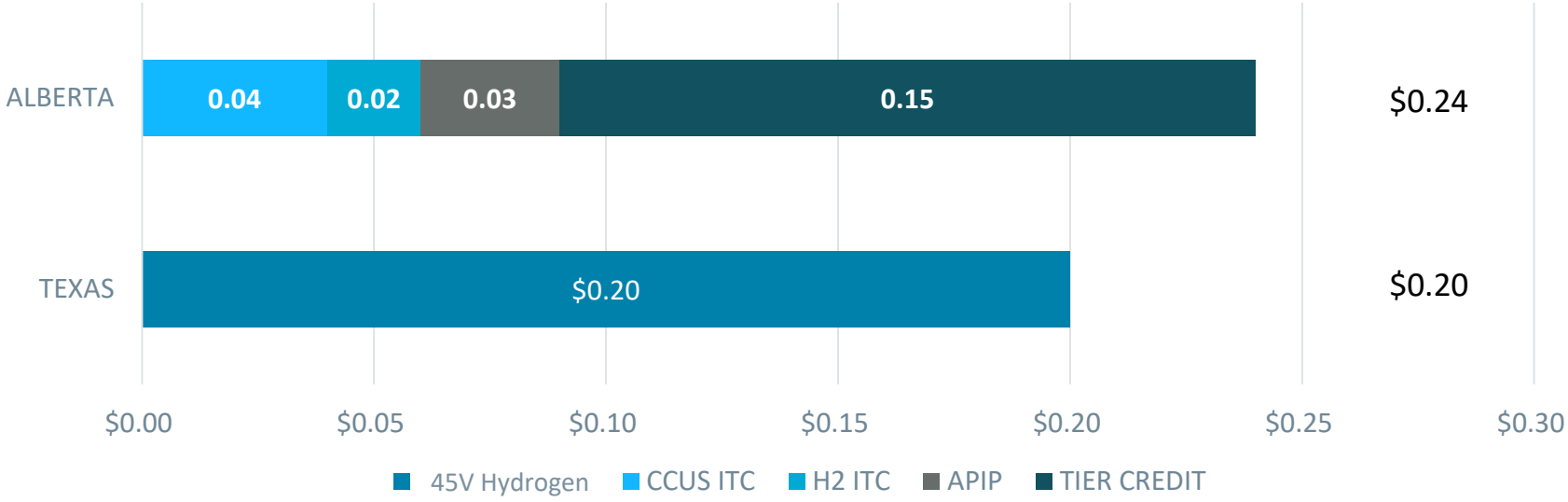
- Tradable carbon credits created from blue hydrogen/ammonia production

CCUS Incentive Program (in development)

- To be determined

Blue Ammonia is competitive

Average Annual Gross Revenue from policy sources for hypothetical 1 million tonne/year blue ammonia project, 2025-2034 ($ per kg of ammonia)



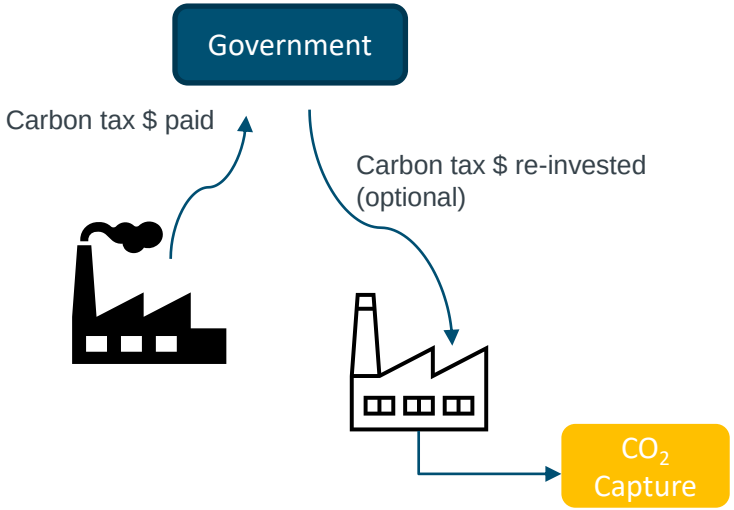
Source: The_Low-Carbon_Playbook_Oct_2023.pdf (cleanprosperity.ca)

Technology Innovation and Emissions Reduction Regulation (TIER)

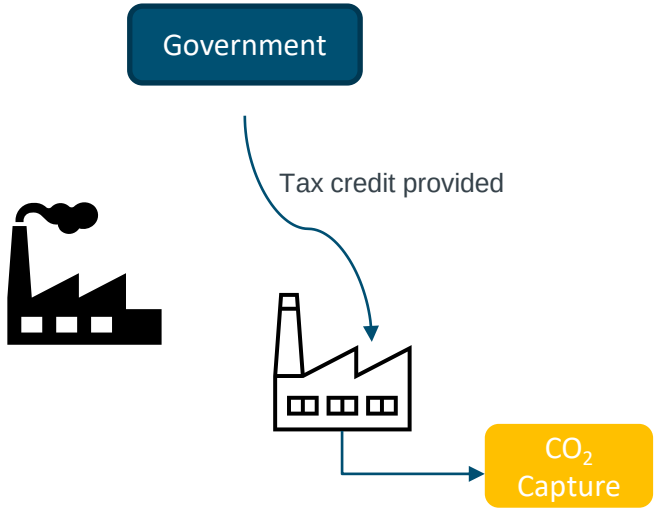
Presentation for TIER Workshop

John Storey-Bishoff, Executive Director
Climate regulation and carbon markets
Alberta Environment and protected areas
November 2023

Carbon Pricing/Incentive Systems



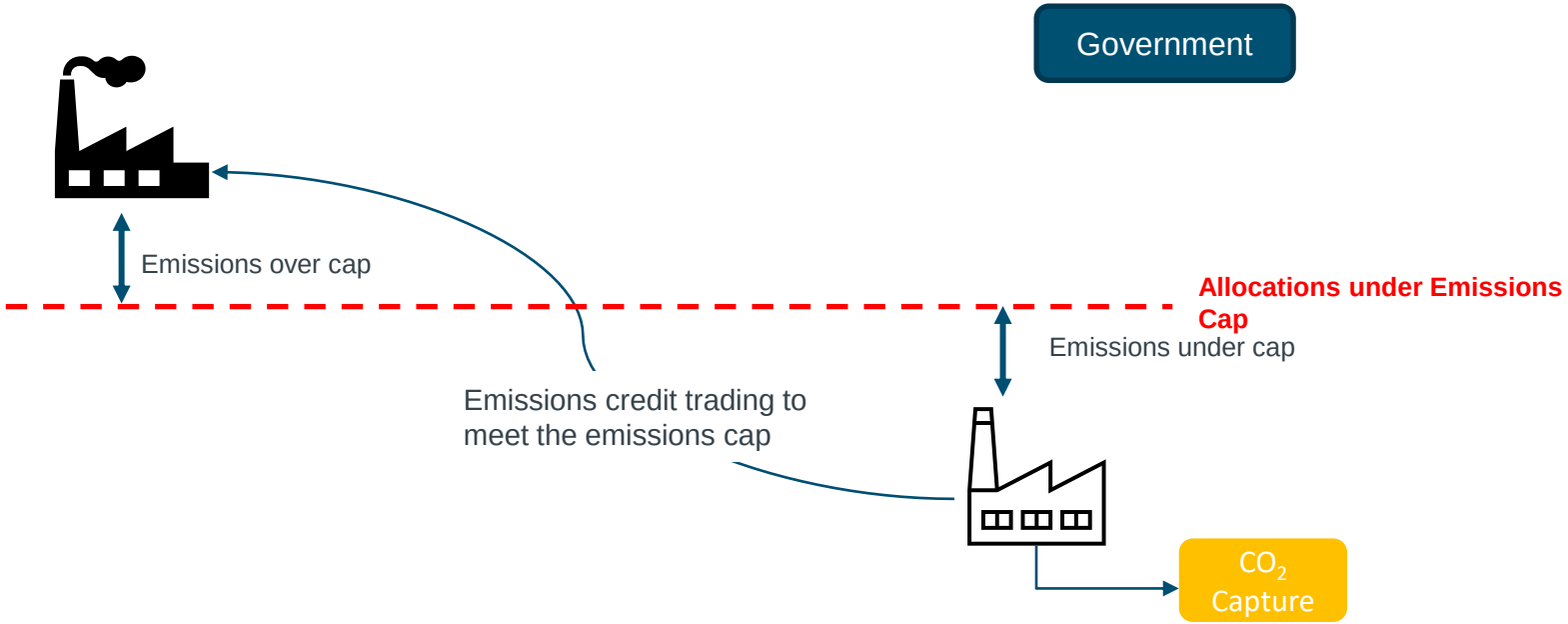
Carbon Tax System



45Q Tax Credit
(US IRA)

Classification: Public

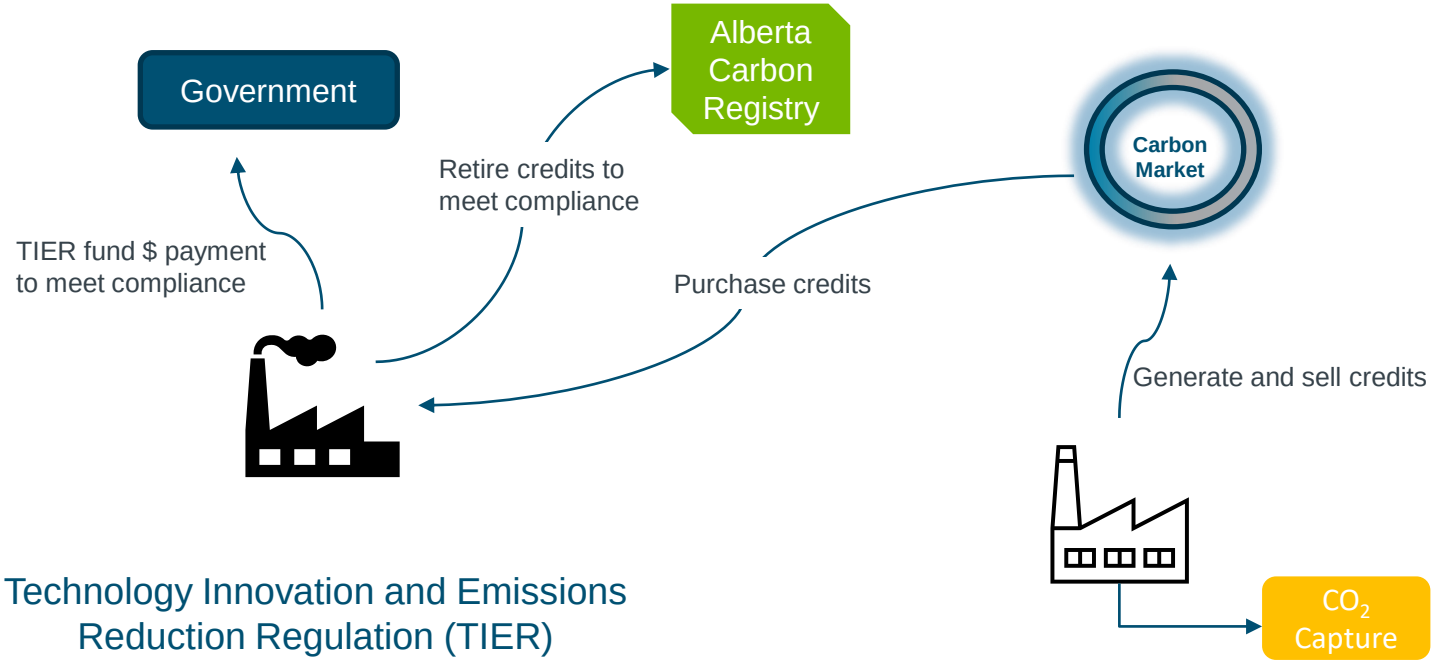
Carbon Pricing/Incentive Systems



Cap and Trade System

Classification: Public

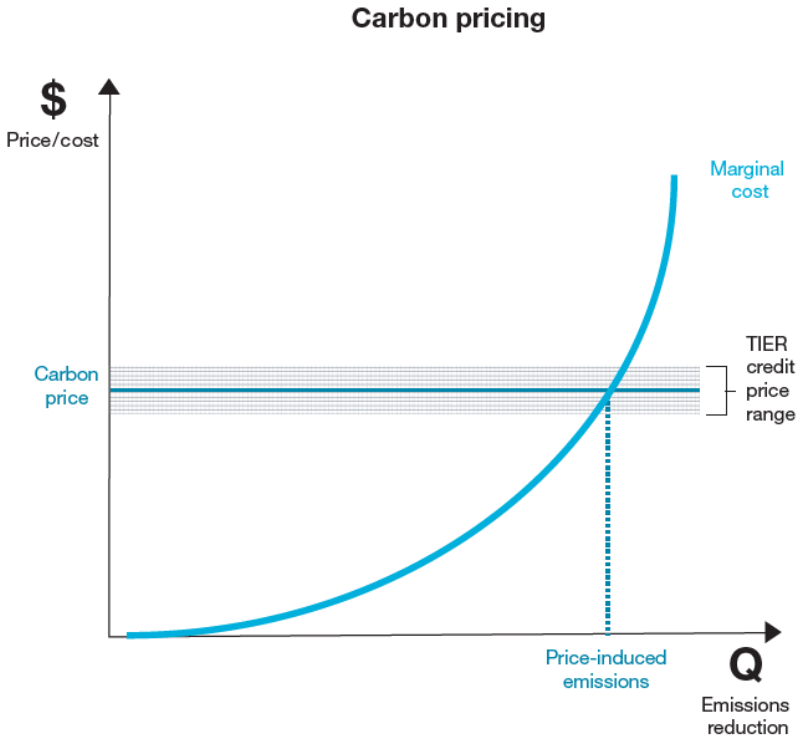
Carbon Pricing/Incentive Systems

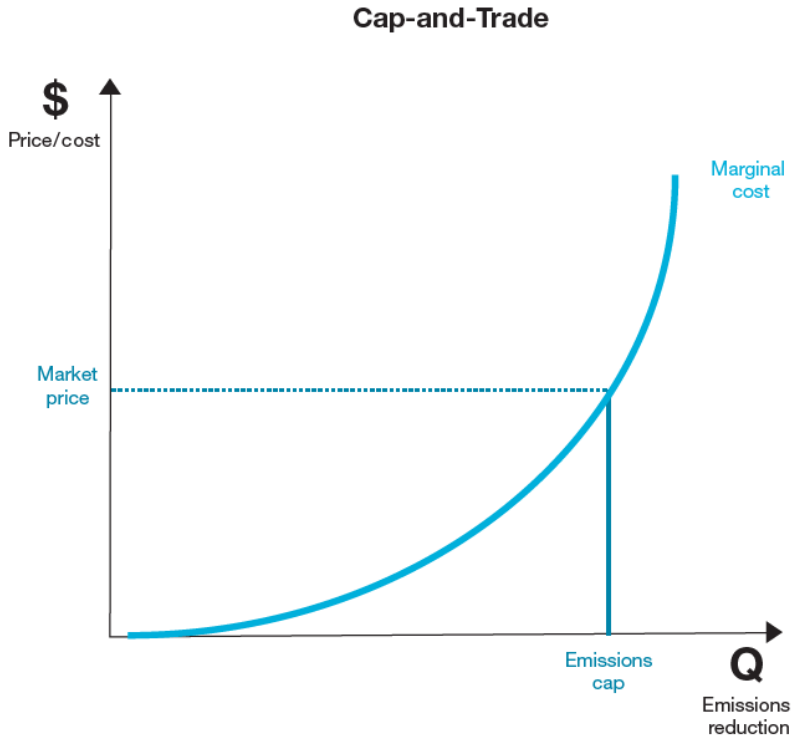


Technology Innovation and Emissions Reduction Regulation (TIER)

Classification: Public

Carbon Pricing Systems





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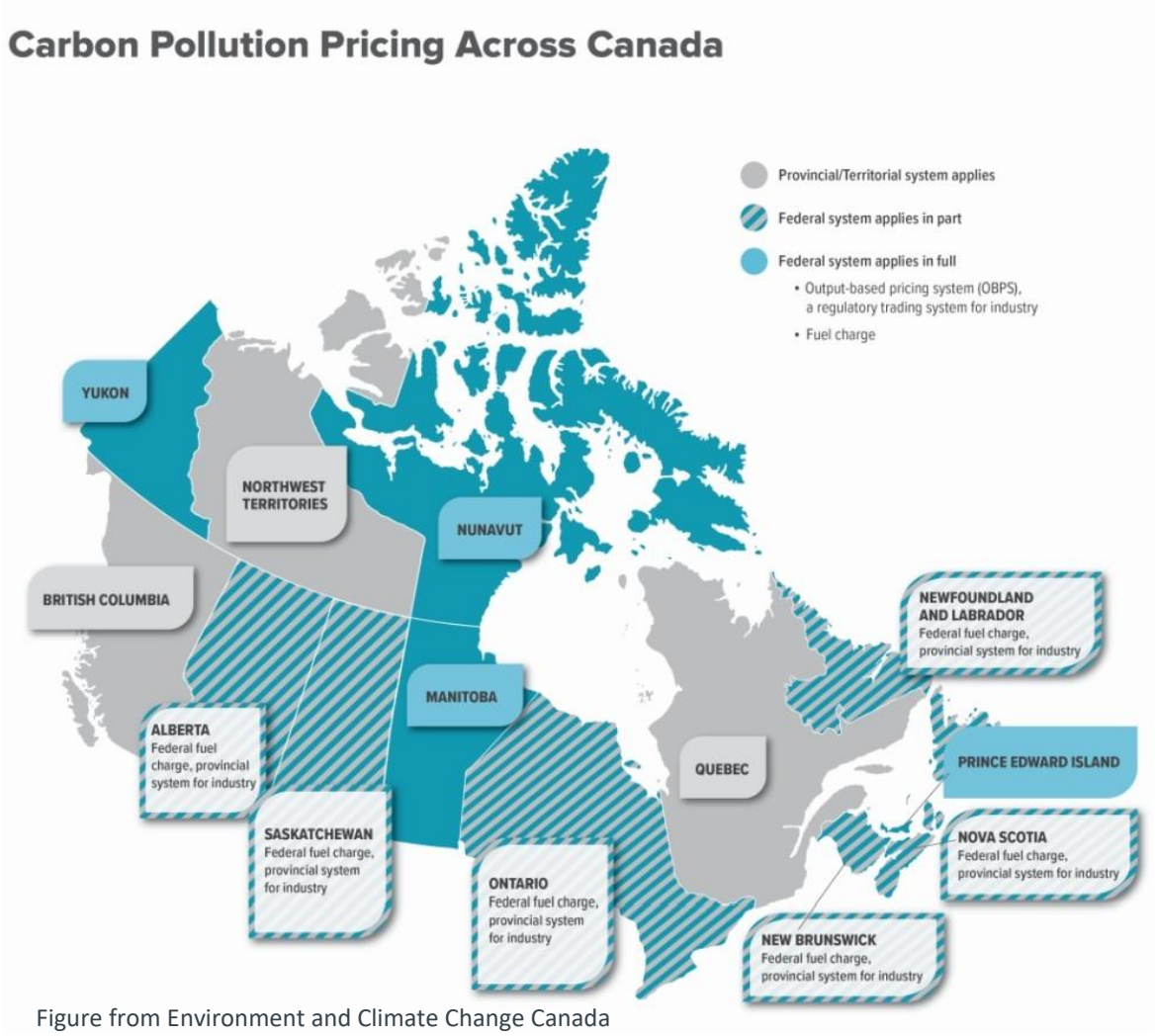

Figure from Environment and Climate Change Canada

Classification: Public

Alberta's Carbon Pricing System

- First industrial carbon pricing system in North America
  - Specified Gas Emitters Regulation (2007 – 2017)
  - Carbon Competitiveness Incentive Regulation (2018 – 2019)
  - Technology Innovation and Emissions Reduction Regulation (2020 – present, amended for 2023 and onwards)

Federal Carbon Price and Alberta Fund Credit Price

Year	2023	2024	2025	2026	2027	2028	2029	2030
Price ($) per tonne CO_2e	$65	$80	$95	$110	$125	$140	$155	$170

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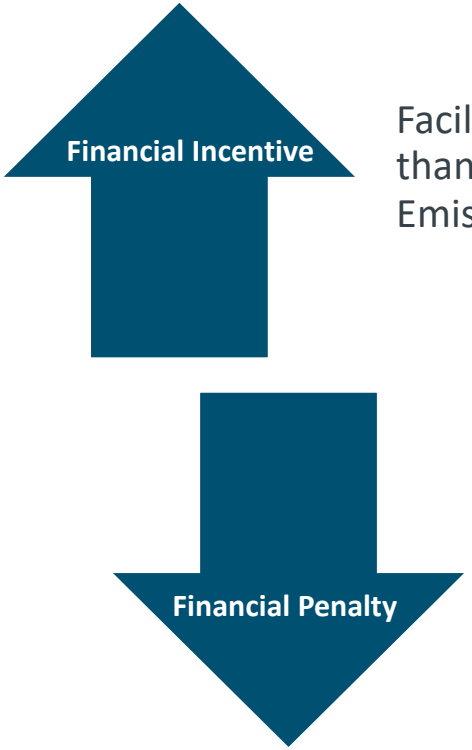
Alberta's Carbon Pricing System

- Incent emissions reductions through carbon pricing NOT emissions cap
- Encourage technology innovation
- Prevents carbon leakage
- Compliance outcome does not impact a facility's actual carbon intensity



Facilities that perform better than their benchmark generate Emission Performance Credits

Facilities that perform worse than their benchmark are subject to a compliance obligation

Classification: Public

Key Features of Alberta System

- Regulation applies to individual facilities in Alberta.
- Mandatory Entry into TIER (Large Emitters)
  - 100,000 tonnes of carbon dioxide equivalent in 2016 or later
  - Imports more than 10,000 tonnes of hydrogen
- Volunteer Entry into TIER (Opted-In and Aggregate Facilities)
  - Facilities that are competitively impacted or “emissions-intensive-trade exposed”
    - Aggregate Facility – conventional oil and gas facility
    - Opted-in Facility – other facilities
- Interaction with Canadian Federal Fuel Charge
  - TIER demonstrated equivalency to federal output-based system for 2020 - 2030
  - Regulated facilities are exempted from the federal fuel charge

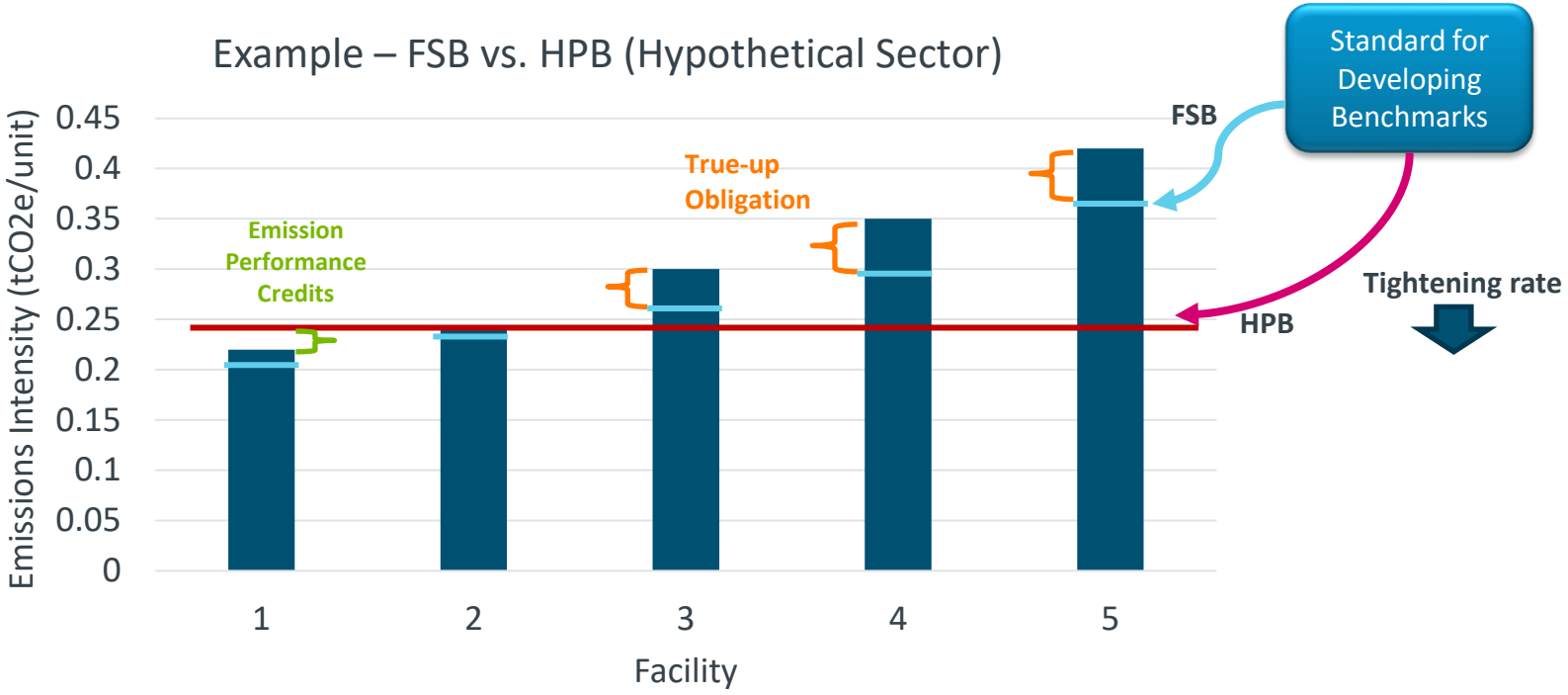
Classification: Public

Key Features of Alberta System

- Facilities must comply with:
  - High Performance Benchmark (HPB) – “best in class” performance
  - Facility-Specific Benchmark (FSB) – facility historical performance
- Reduction targets
  - Increase 2% per year starting in 2023
  - Oil Sands facilities - increase 4% in 2029 – 2030
  - Appy to FSBs and HPBs starting in 2023
  - Industrial process emissions not subject to reduction target at this time

Classification: Public

Allowable Emissions Under TIER



 Classification: Public

Classification: Public

High-Performance Benchmarks

Product	Benchmark Unit
Ammonia	tonne
Ammonium Nitrate	tonne
Bitumen - Oil Sands In Situ	m^3 of bitumen
Bitumen - Oil Sands Mining	m^3 of bitumen
Canola Oil – Crude	tonne
Cement	tonne
Coal – Bituminous	tonne
Coal - Sub-bituminous	tonne
Electricity	MWh
Ethyl Alcohol	litres absolute alcohol
Ethylene Glycol	tonne
High-value Chemicals	tonne
Hydrogen	tonne
Industrial Heat	GJ
Natural Gas Processing	Alberta gas processing index
Urea - Granular	tonne

Classification: Public

High-Performance Benchmarks

High-performance Benchmark (CO_2e tonnes per benchmark unit)									
Product	Benchmark Unit	2023	2024	2025	2026	2027	2028	2029	2030
Ammonia*	tonne	1.758	1.746	1.735	1.723	1.711	1.699	1.688	1.676
Electricity	MWh	0.3626	0.3626	0.3552	0.3478	0.3404	0.3330	0.3256	0.3182
Hydrogen	tonne	8.993	8.919	8.844	8.769	8.694	8.620	8.545	8.470

* In process of publication

Classification: Public

Regulated Products with Facility-Specific Benchmarks

Agroindustry
- Biodiesel
- Canola oil – Crude
- Canola Oil – Refined
- Flour
- Gluten
- Malt
- Vegetable Oil – Refined

Chemicals
- Carbon Black
- Ethylene Glycol
- High Value Chemicals
- Hydrogen Peroxide
- Industrial Heat
- Iso-octane
- Linear Alpha Olefins
- Methanol
- Natural Gas Liquids
- Pentane
- Polyethylene
- Styrene

Coal Mines
- Coal - Bituminous
- Coal - Sub-bituminous

Conventional Oil and Gas
- Crude Oil – Conventional

Distilling
- Ethyl Alcohol

Fertilizer
- Ammonia
- Ammonium Nitrate
- Ammonium Sulphate
- Urea

Food Processing
- Potato Products
- Fresh and Frozen Beef and Veal
- Sugar – Liquid
- Sugar – Refined

Forest Products
- Lumber
- Lumber – Laminated Veneer
- Lumber – Panels
- Oriented Strand Board
- Paper Newsprint
- Plywood
- Pulp – Bleached Kraft

Landfill
- Landfill Methane

Manufacturing
- Fibreglass
- Wallboard
- Roofing Shingles
- Forged Steel

Metals
- Cobalt
- Nickel

Mineral
- Cement
- Lime Magnesium Oxide
- Sand – Frac or Finished
- Sand - Mined

Natural Gas Processing
- Sulphur
- Cavern Storage
- Natural Gas
- Natural Gas Processing

Oil Sands
- Bitumen – Oil Sands In Situ
- Bitumen – Oil Sands Mining

Pipeline
- Natural Gas Throughput

Refining
- Asphalt
- Calcined Coke
- Refined Petroleum Products

Upgrading
- Crude Oil - Synthetic

Classification: Public

Key Features of Alberta System

- Regulated Emissions
  - Large emitter and opted in facilities:
    - Scope 1 emissions
    - Some scope 2 emissions through allocation adjustment– imported electricity, heat and hydrogen
    - Can subtract capture recognition tonnes for facilities with capture.
  - Aggregate facilities
    - Stationary fuel combustion emissions
    - Flaring emissions (starting in 2023)
    - No scope 2 emissions
  - Excludes biomass CO_2 and fuels where federal fuel charge applied

Classification: Public

Key Features of Alberta System

- True-up Obligation

  = Total Regulated Emissions (TRE) – Allowable Emissions (AE)

- Treatment of Indirect (Scope 2) Emissions
  - Large emitter and opted in facilities - scope adjustment to Allowable Emissions:
    - Imported heat (I_{he}) = 0.06173 tonnes CO_2e / GJ
    - Imported hydrogen (I_{hy}) = 8.993 tonnes CO_2e / tonne
    - Imported electricity (I_E) = 0.3626 tonnes CO_2e / MWh
  - Ex. AE = Product(s) x Benchmark(s) – [I_{He} x 0.06173 + I_{Hy} x 8.993 + I_E x 0.3626]
  - Aggregate facilities – no scope adjustments to Allowable Emissions

Classification: Public

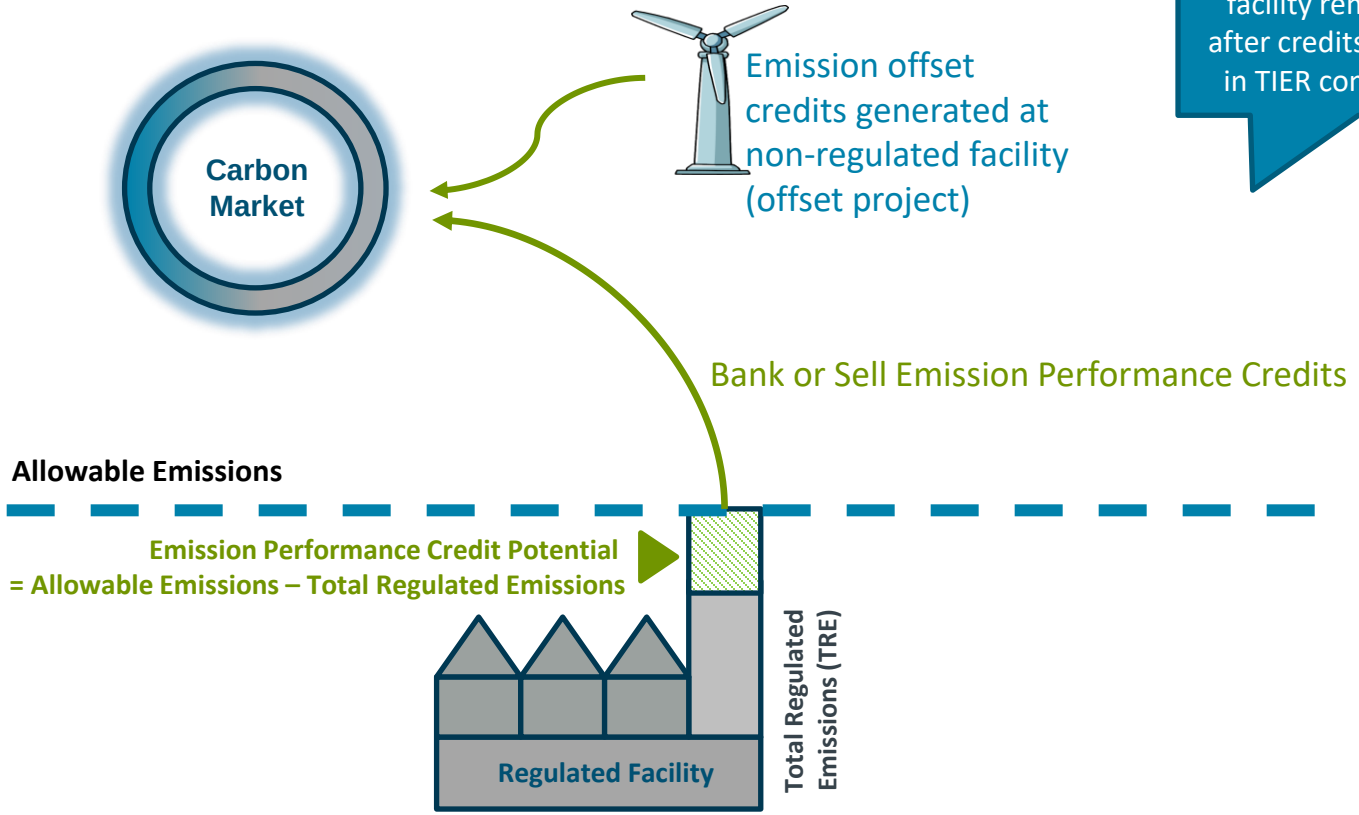
Key Features of Alberta System

- Emission Offset Quantification Protocols
  - 18 approved protocols
  - CO_2 Capture and Permanent Storage in Deep Saline Aquifers
- Four standards under TIER
  - Standard for Completing Greenhouse Gas Compliance and Forecasting Reports
  - Standard for Validation, Verification and Audit
  - Standard for Greenhouse Gas Emission Offset Project Developers
- Alberta Greenhouse Gas Quantification Methodologies (AQM)

Classification: Public

Generating Credits

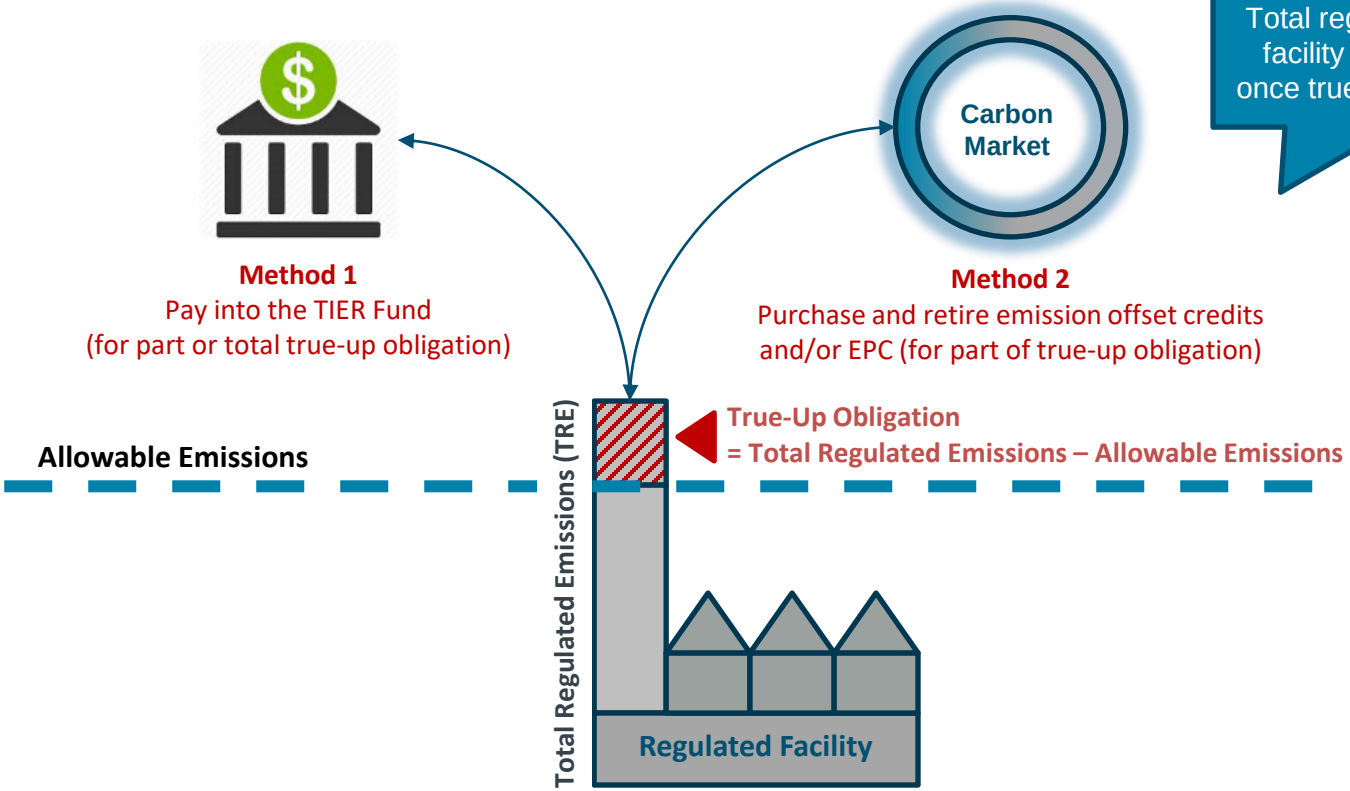
Note
Total regulated emissions at facility remain unchanged after credits are sold or used in TIER compliance system



Classification: Public

Meeting True-Up Obligation

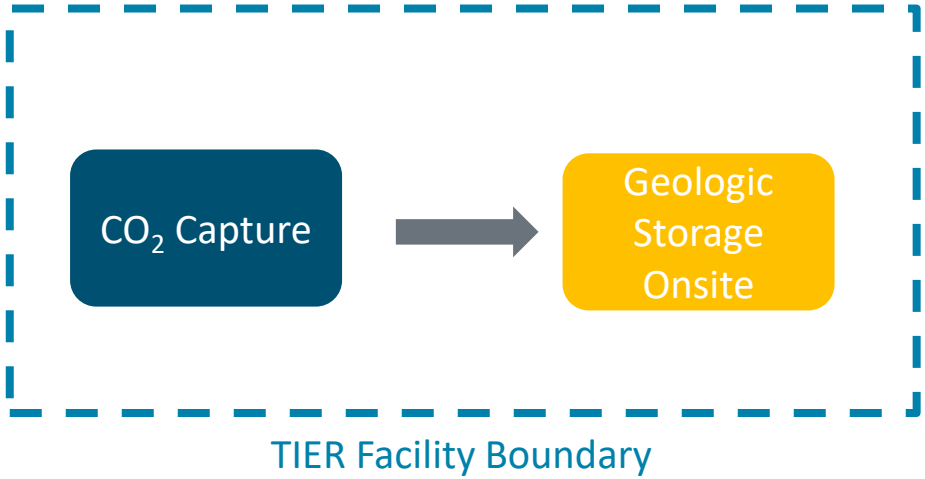
Note
Total regulated emissions at facility remain unchanged once true-up obligation is met



Classification: Public

CCUS Treatment under TIER

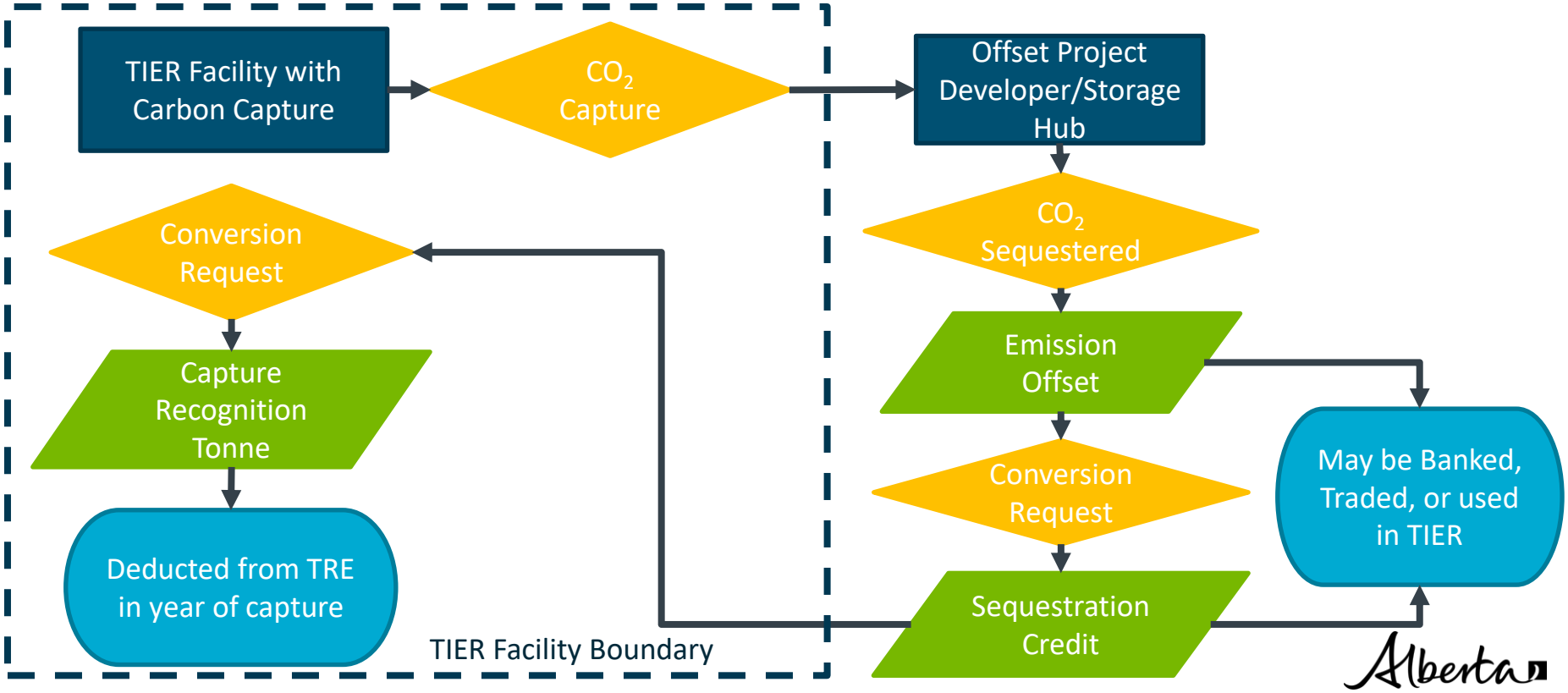
Scenario 1 – Sequestration on-site, CO_2 not included in TRE



CCUS Treatment under TIER

Scenario 2 – Exporting CO_2 to CCS Project (exported CO2 and credit generation)

CCUS Treatment under TIER



Capture Recognition Tonnes

- Different than EPCs, offset credits and sequestration credits
- Quantities are removed directly from the Total Regulated Emissions calculation
  - EPCs could be generated if TRE is less than AE
- Sequestration credits converted to capture recognition tonnes are applied directly to the facility that generated and captured the CO_2
  - Credits must be used for the year that the sequestration occurred

Classification: Public

Credit Usage Limit

- Credit use limit to increase 10% per year, starting in 2024.
- Designed to increase credit demand in TIER, and to allow increased compliance flexibility for TIER regulated facilities.

Compliance Year	2022	2023	2024	2025	2026 or later
Maximum % credit usage	60%	60%	70%	80%	90%

- Usage limit does not apply to capture recognition tonnes.

Classification: Public

Credit Expiration

EPCs Year that credit was issued in respect of	Compliance Years	Emission Offsets Year emission reduction occurred	Compliance Years	Sequestration Credits Year sequestration occurred	Compliance Years
2014 or earlier	2020	2014 or earlier	2020	-	-
2015 and 2016	2021	2015 and 2016	2021	-	-
8-year period		**9-year period**		**NA**	
2017	2018 – 2025	2017	2017 – 2025	-	-
2018	2019 – 2026	2018	2018 – 2026	-	-
2019	2020 – 2027	2019	2019 – 2027	-	-
2020	2021 – 2028	2020	2020 – 2028	-	-
2021	2022 – 2029	2021	2021 – 2029	-	-
2022	2023 – 2030	2022	2022 – 2030	-	-
5-year period		**6-year period**		**6-year period**	
2023	2024 - 2028	2023	2023 – 2028	2023	2023 – 2028
2024	2025 – 2029	2024	2024 – 2029	2024	2024 – 2029
2025	2026 – 2030	2025	2025 – 2030	2025	2025 – 2030

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Key Messages

- TIER is a Price-and-Trade system, not a Cap-and-Trade system
- Emissions reductions are financially incentivized through carbon pricing NOT emissions cap
- Credits traded and used for compliance under TIER does not:
  - change a facility's physical emissions on a provincial or national level
  - affect Canada's national GHG inventory or its Nationally Determined Contribution under the Paris Agreement
  - change the emissions intensity of the facility that sells credits or the facility that uses credits for compliance
  - change the carbon intensities of products produced by the facility

Classification: Public

Questions?

Follow up

Hydrogen questions? ENERGY.Hydrogen@gov.ab.ca

TIER questions? Epa.ghg@gov.ab.ca

Recorded Webinar

Technology Innovation and Emissions Reduction Regulation | Alberta.ca