Economic Impact of Utility Costs on Amine-Based and Cryogenic Carbon Capture Technologies

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INTERNATIONAL CCS KNOWLEDGE CENTRE

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The International CCS Knowledge Centre

The International CCS Knowledge Centre is a not-for-profit organization founded by SaskPower and BHP Canada Inc. in 2016.

Our mandate is to promote and enable the development, deployment and implementation of carbon capture and storage projects.

2016 → 2021 → 2022 → 2026

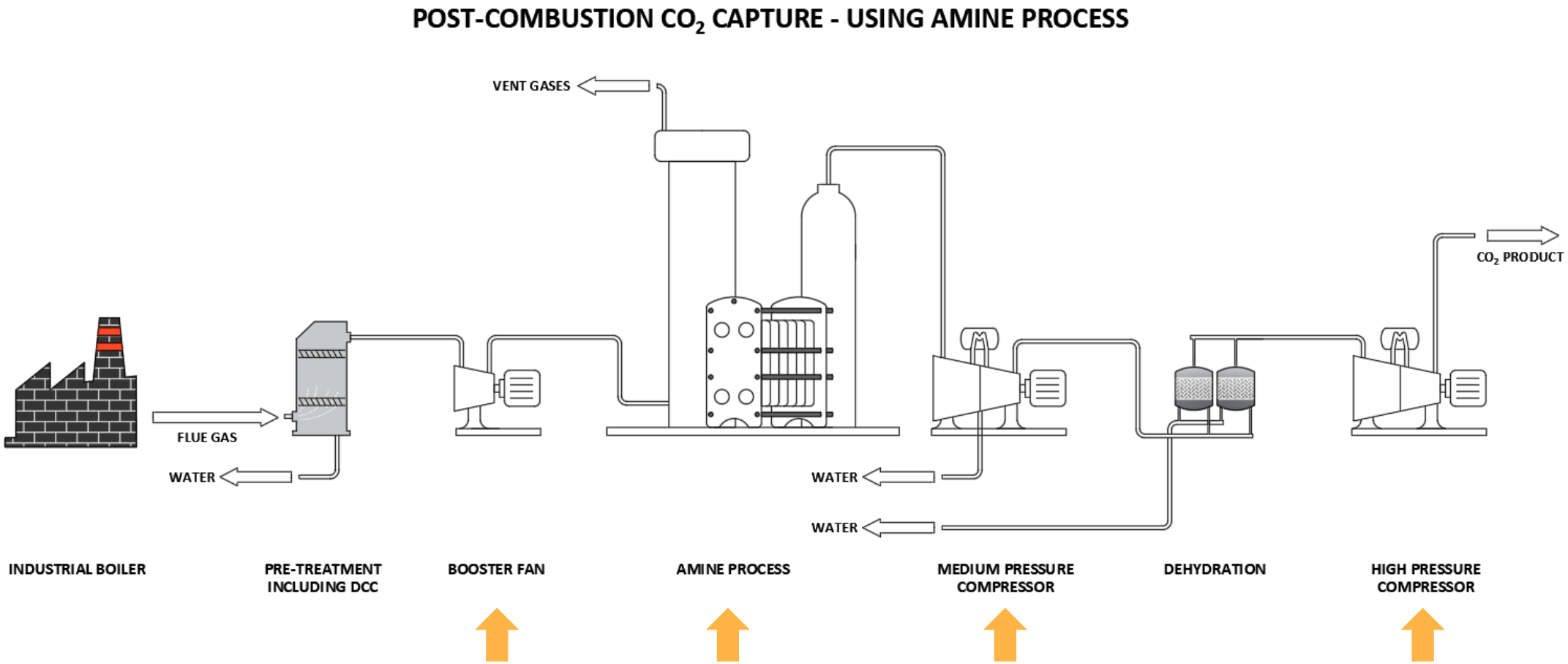
The first five years (2016-2021) the Knowledge Centre was largely a promotional and advocacy organization, spreading the knowledge and learnings about the implementation of SaskPower's Boundary Dam Carbon Capture Project.

The next 5 years (2022-2026) strategic efforts to move towards a self-sustaining organization. We provide independent strategic and technical services to clients to support their CCS projects.

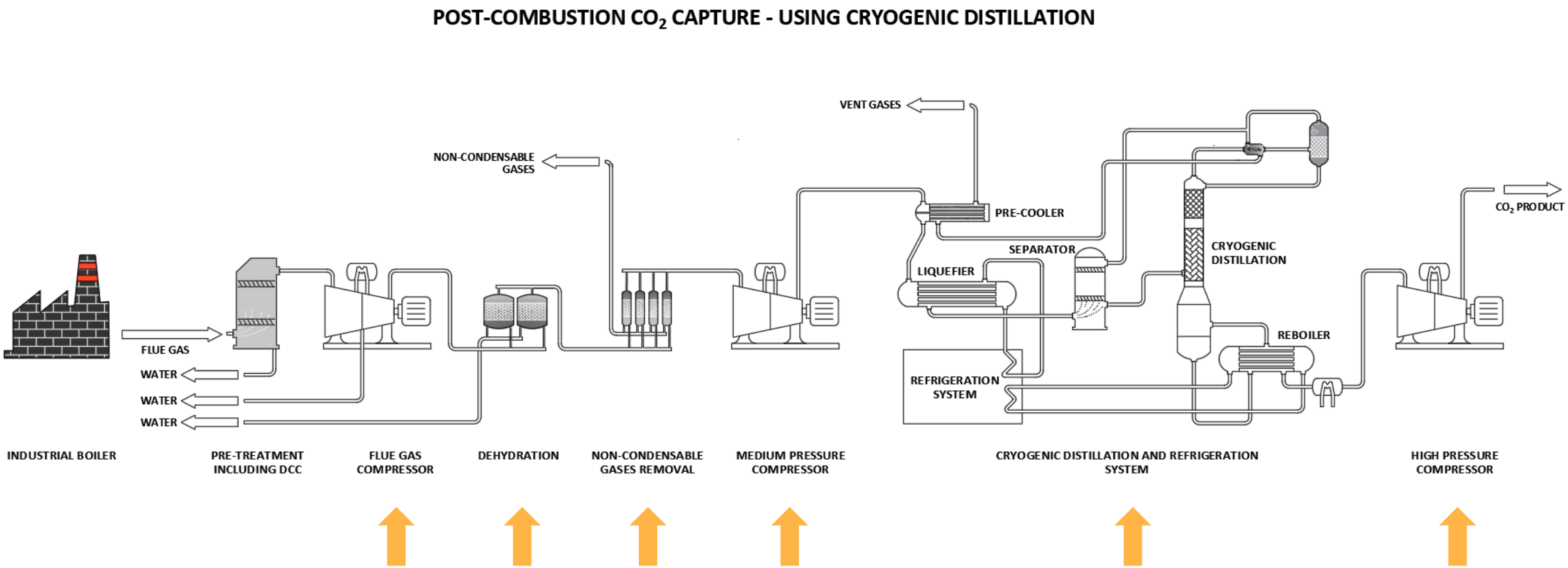
Comparison of Cryogenic and Amine-based Carbon Capture

	AMINE-BASED ABSORPTION	CRYOGENIC DISTILLATION
TRL	9	6-8
CO_2 Concentration in Feed Gas	2-30%	> 12-15%
Captured CO_2 (Scope 1)	Greater than host facility's emissions (due to heat for amine regeneration)	Emissions from the host facility only
Secondary Emissions	Potential	Typically none
Energy Requirements	Electric and thermal	Electric

Amine-based Carbon Capture: Utility Consumption



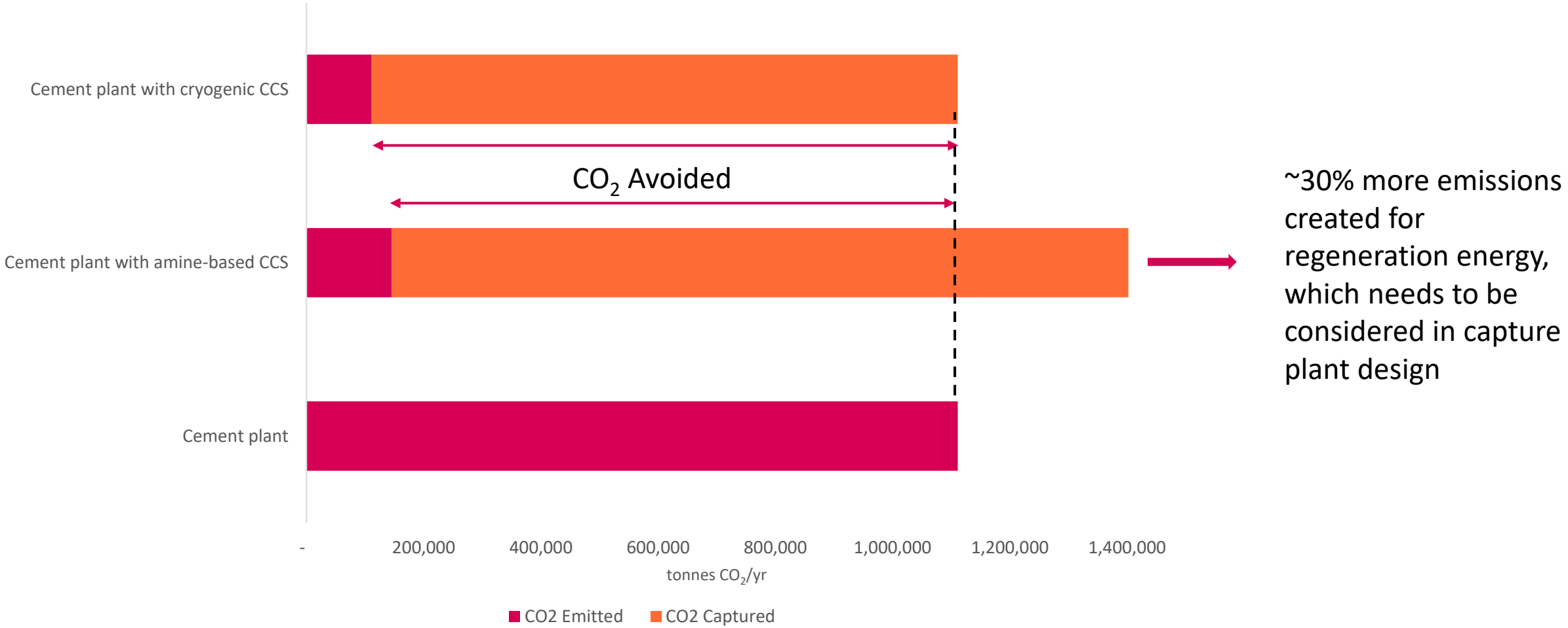
Cryogenic Carbon Capture with PSA: Utility Consumption



Case Study

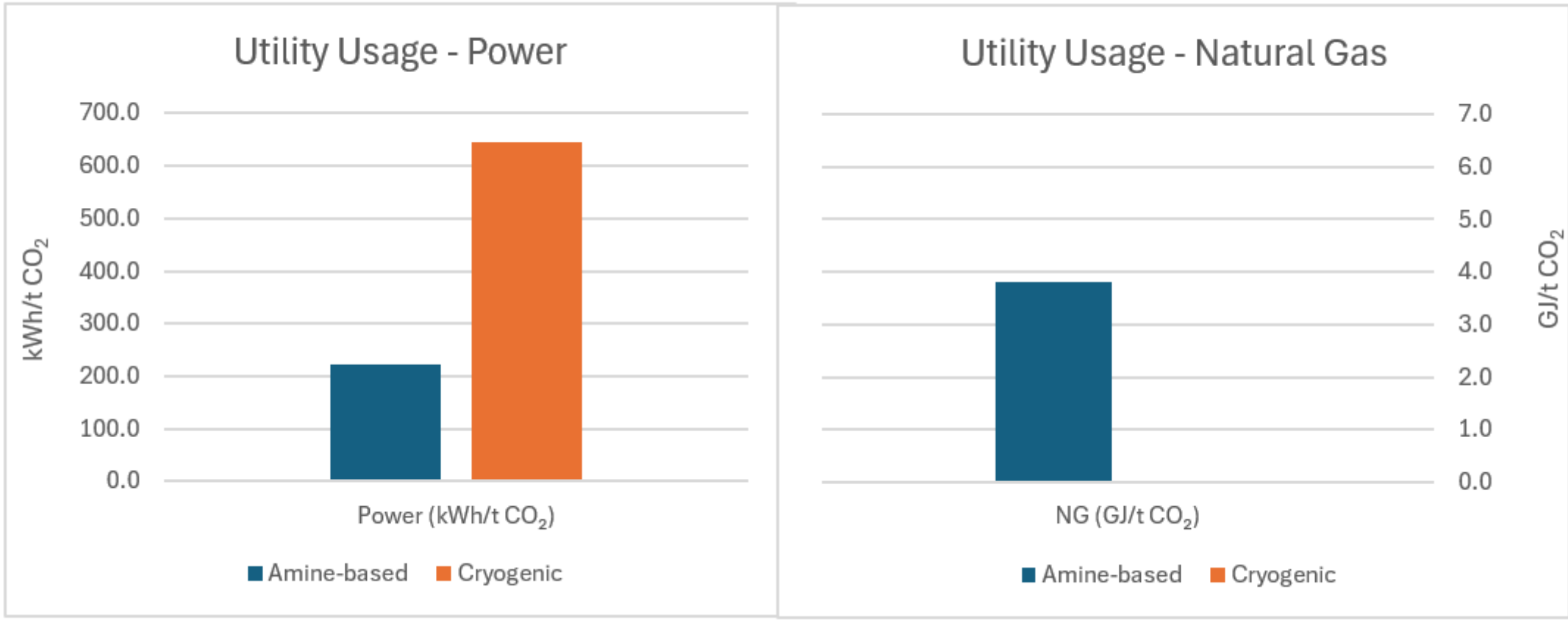
Category	Details
Facility Type	Gas-fired kiln for clinker production
CO_2 Emissions	Cement Plant: 1.1 MTPA Auxiliary Boiler: 0.3 MTPA
CO_2 Concentration	Cement Plant: 12.4 mol% Combined with Aux Boiler: 9.8 mol%
CO_2 Capture Rate	90%
CO_2 Product Conditions	Pressure: 17,926 kPag Temperature: 40 °C
Cooling Method	Air cooling
Waste Heat Recovery	Not utilized

CO_2 captured and avoided



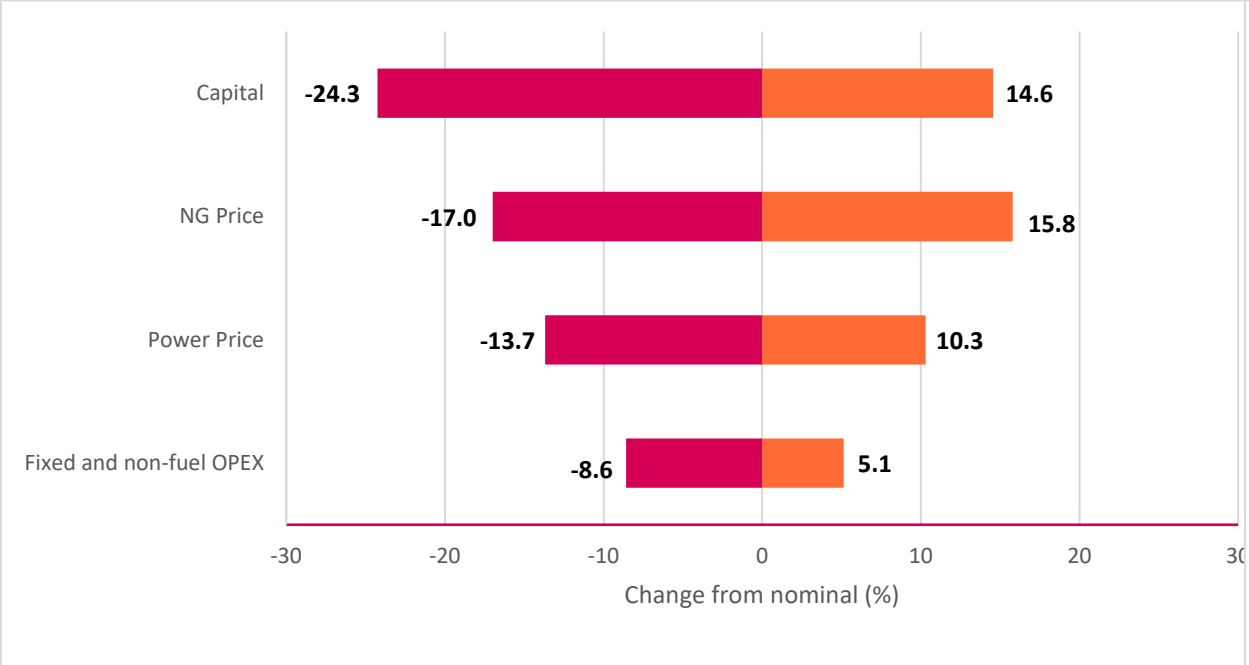
~30% more emissions created for regeneration energy, which needs to be considered in capture plant design

Summary of findings – Utility Usage

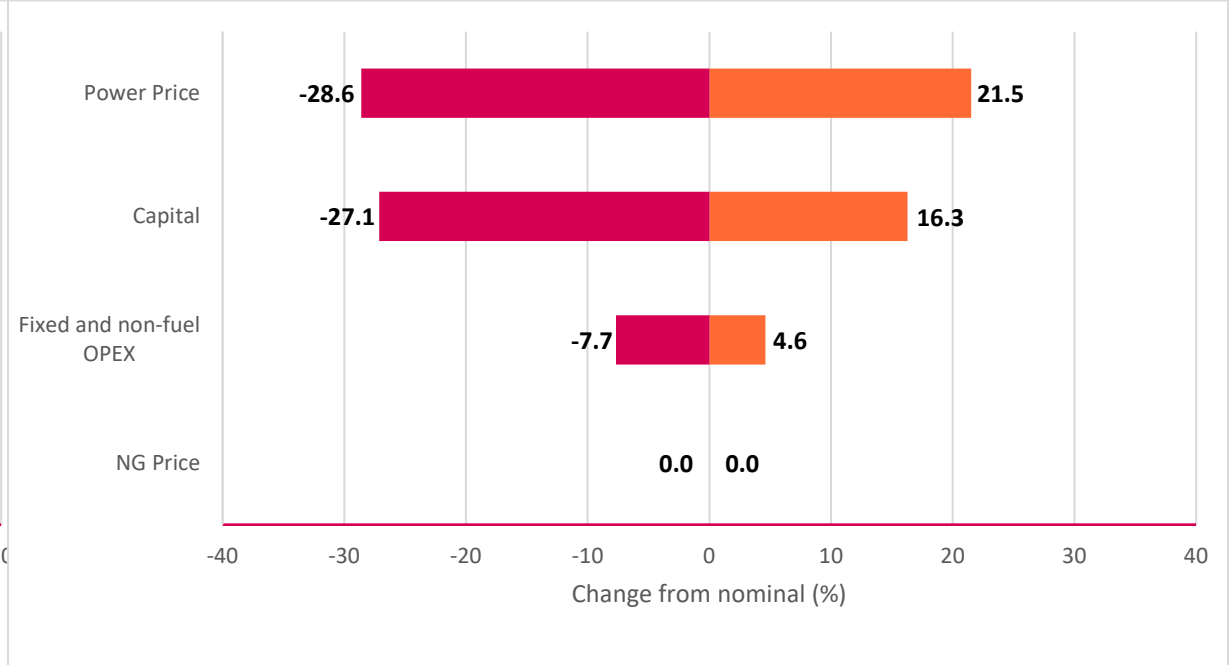


Summary of findings – Economic Sensitivity

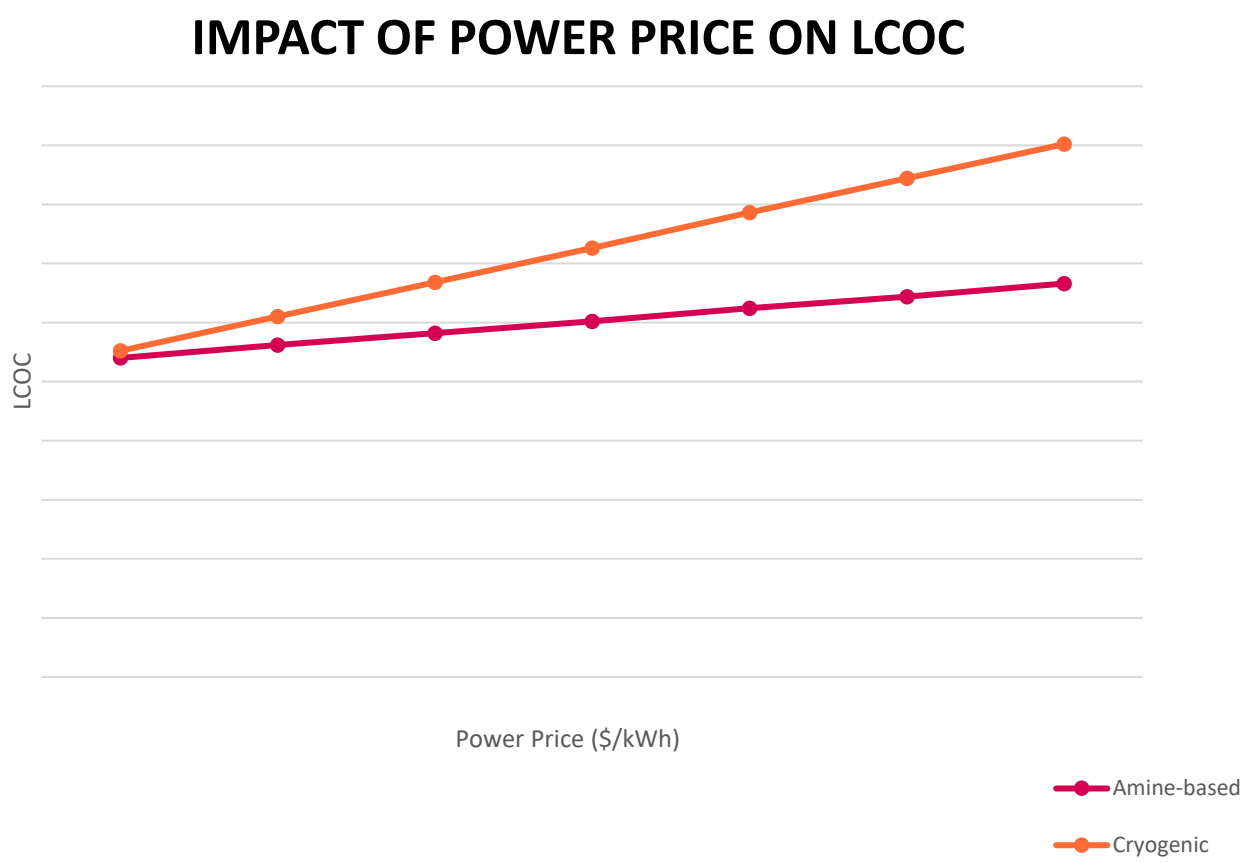
AMINE-BASED



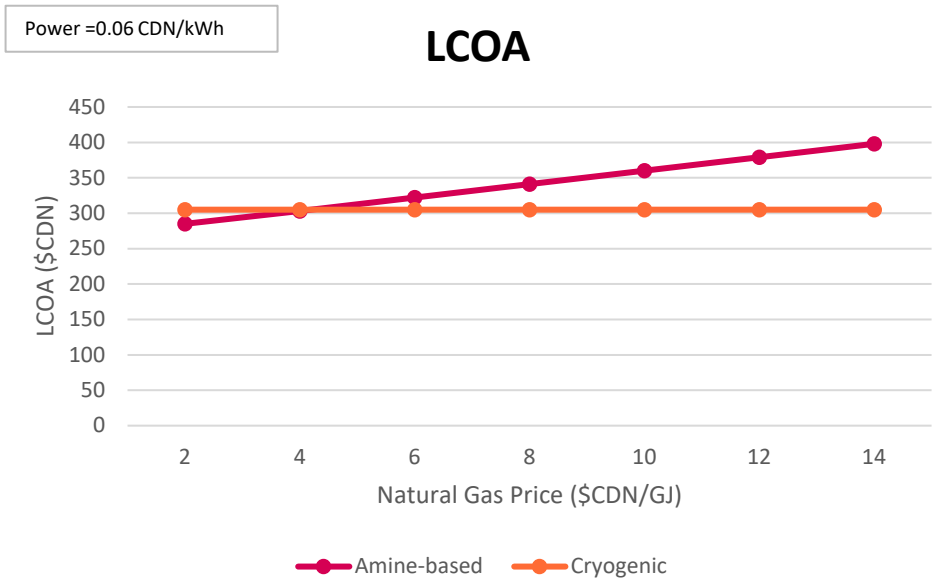
CRYOGENIC

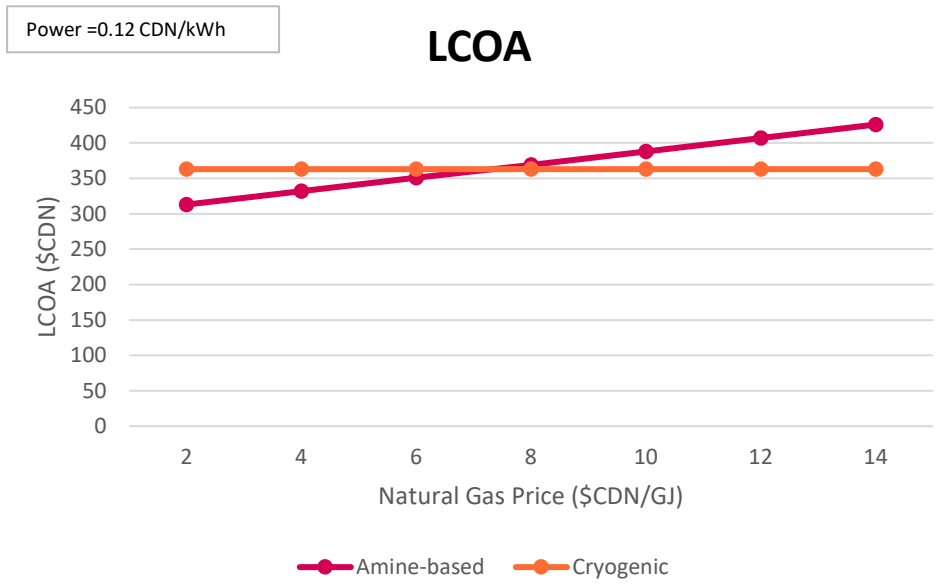


Summary of findings – Sensitivity to power price



Impact of Utility Cost on LCOA





Summary of findings

	AMINE-BASED CAPTURE	CRYOGENIC CAPTURE
CO_2 Captured	1.3 Mtpa	1 Mtpa
Capital	100%	114%
OpEx	Varies, depends on utility prices	
Energy Usage	100%	67-85%

Conclusions

Amine-based capture typically results in ~30% more emissions to be captured onsite due to the energy required for solvent regeneration.

Capital costs are generally lower for amine systems, but operating costs vary significantly depending on utility prices and energy sources.

The economic viability of each technology depends on the balance between CAPEX and OPEX, which varies by site, scale, and energy pricing.

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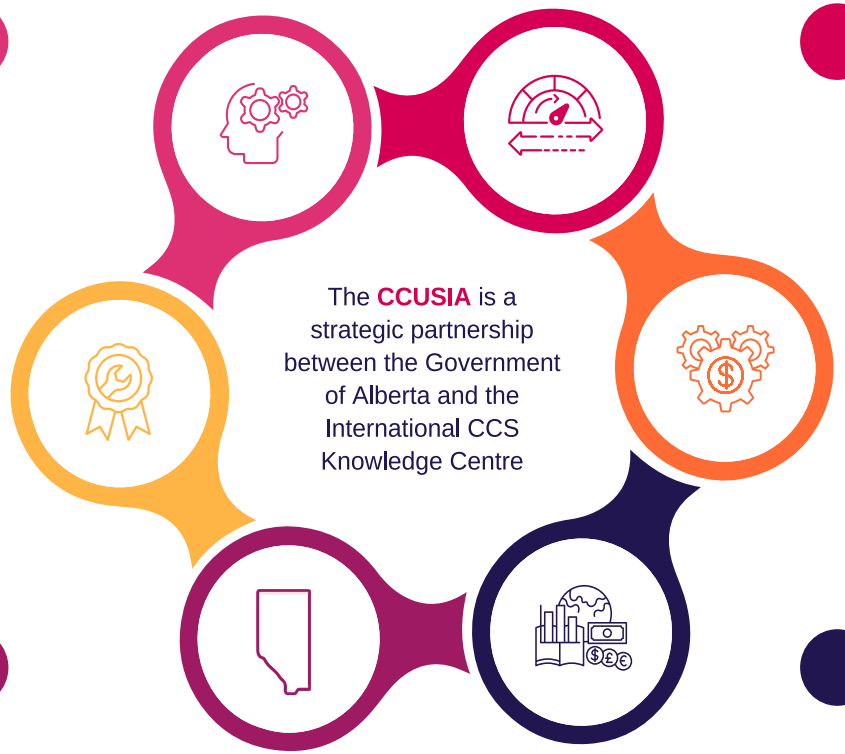

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Economic Sensitivity – Canadian Utility Pricing and Incentives Included