



**Centro  
Mario  
Molina**

Investigación & desarrollo

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# Decarbonization of vehicles and non road machinery in mining industry

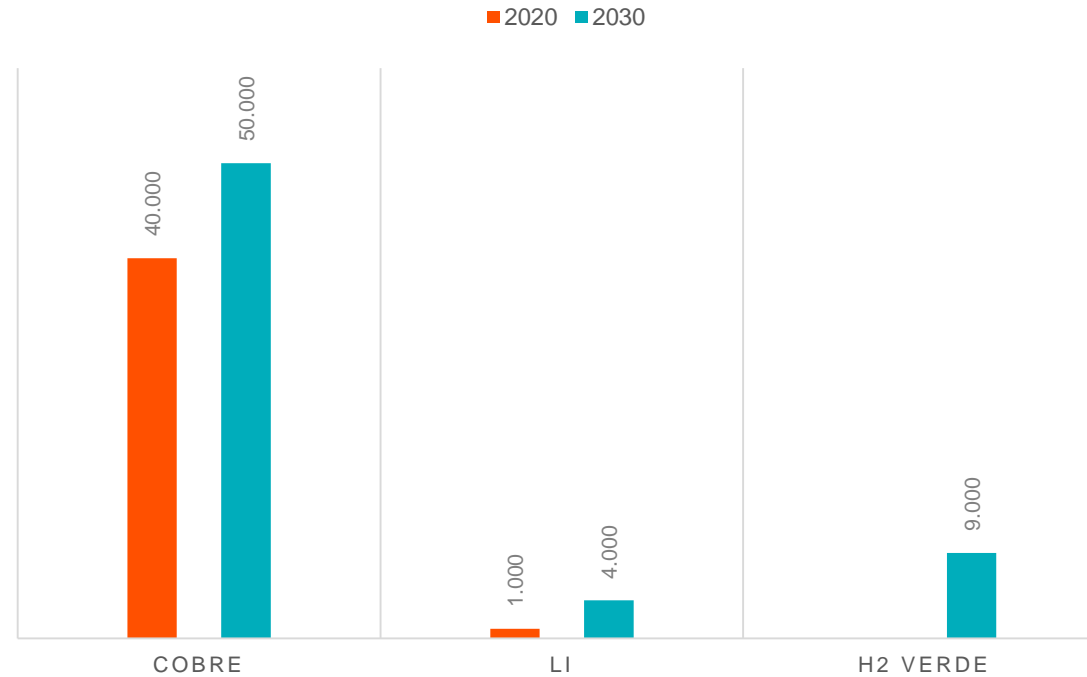
Transporte y Logística para una Minería más  
Sustentable

Cámara Alemana, AHK Chile

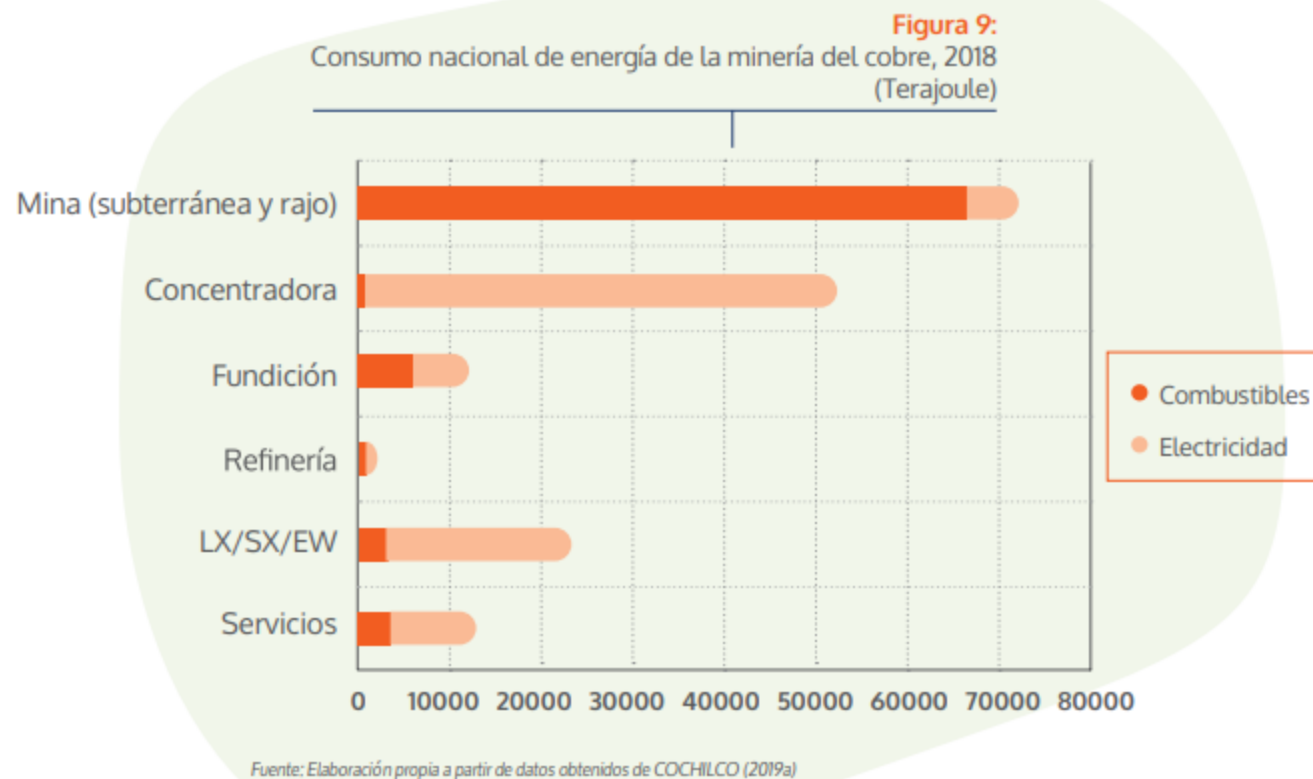
Martes 8 junio 2021

**Global decarbonization will have a positive impact on national economic growth due to our role as a key raw material supplier**

### EXPORTATIONS [MILL USD]



## Diesel consumption is the main source of direct emission from national copper mining



Estudio minería y cambio climático

## Extraction trucks (CAEX) are the main sources of GHG and local pollutants (PM, BC and NOx)

Emisiones de CO<sub>2</sub> eq de la industria minera del cobre en Chile, 2015

	Millones de toneladas de CO <sub>2</sub> eq	Participación en las emisiones totales de Chile
Emisiones directas minería del cobre	5,7	5,3%
Emisiones indirectas minería del cobre	13,9	12,8%
<b>Emisiones totales sector minero (emisiones directas + emisiones indirectas)</b>	<b>19,6</b>	<b>18,1%</b>
Emisiones totales de Chile	108,2	100%

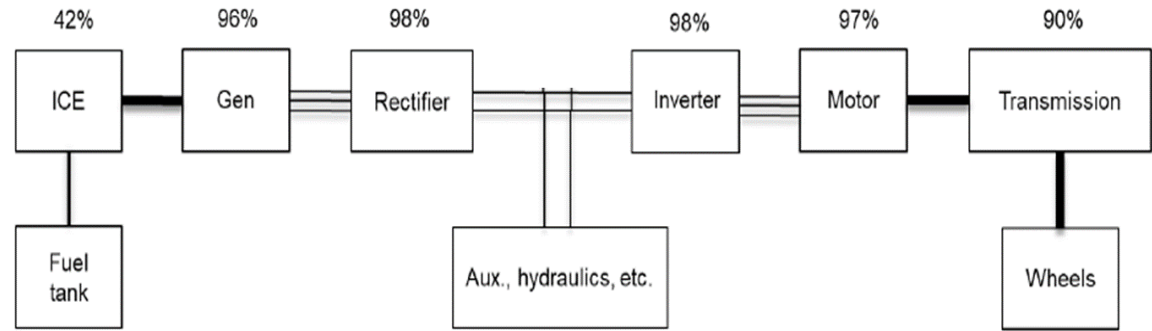
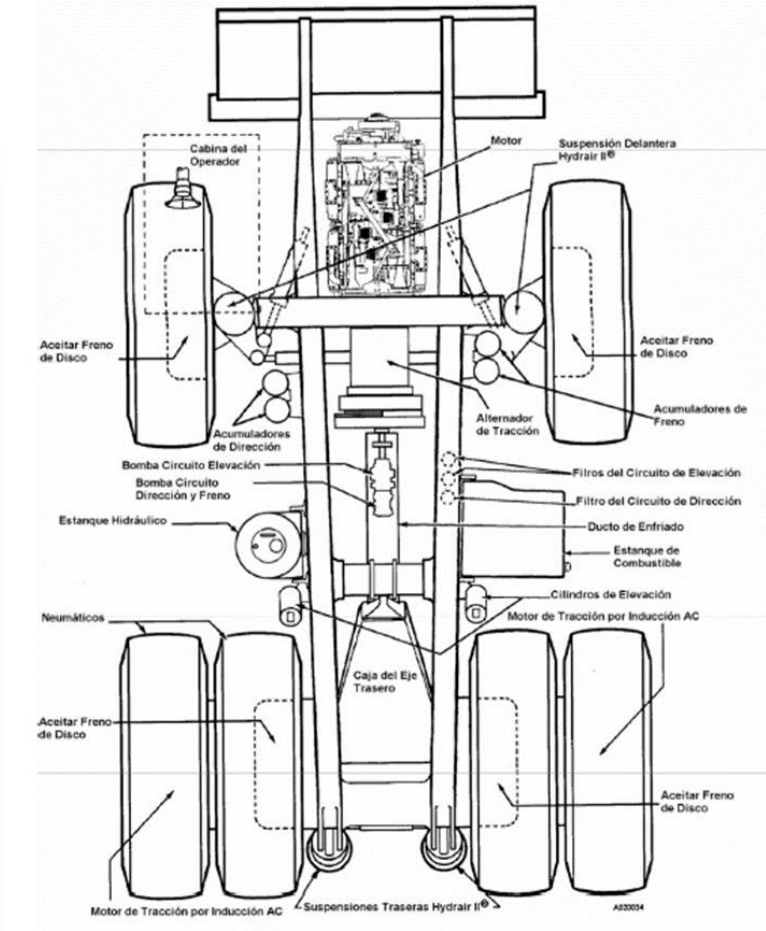
Fuente: Elaboración propia con datos obtenidos de COCHILCO (2016a, 2016b) y Ministerio del Medio Ambiente, (2018).

Estudio minería y cambio climático



## The national mining industry must reduce its dependency on diesel to offer green copper for global decarbonization

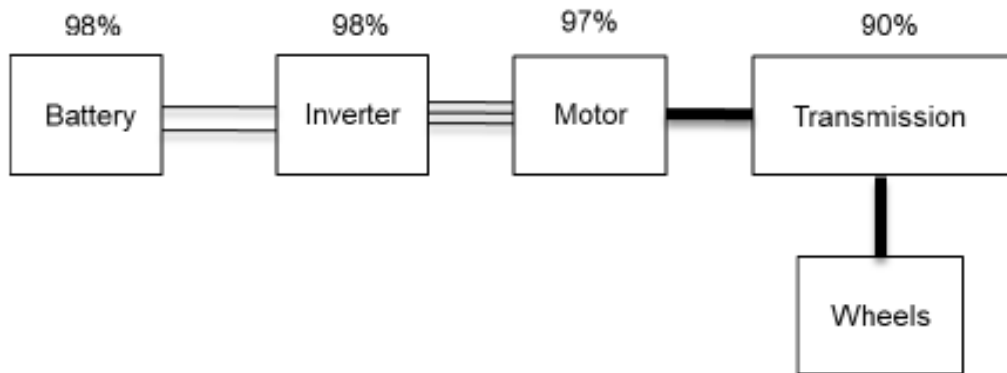
- There are 2,200 CAEXs operating in several mines under different work cycles.
- A program for the adoption of zero-emission technologies for CAEXs should be started as soon as possible.
- Technology disruptions allow customized solutions according to the specific work cycles, creating opportunities for early business cases for zero emission technologies.
- The decarbonization of the CAEX fleet of national mining is a 10 billion USD process that creates opportunities for new technology providers and also could create chances for local industry to be involved in the future of CAEX's value chain.



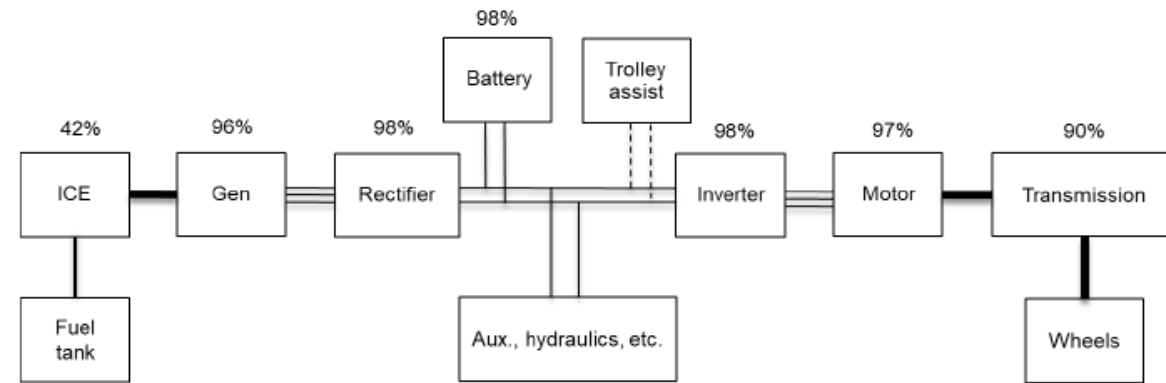
**Actual technology of CAEX: diesel-electric**



# Technology alternatives for CAEX (I)

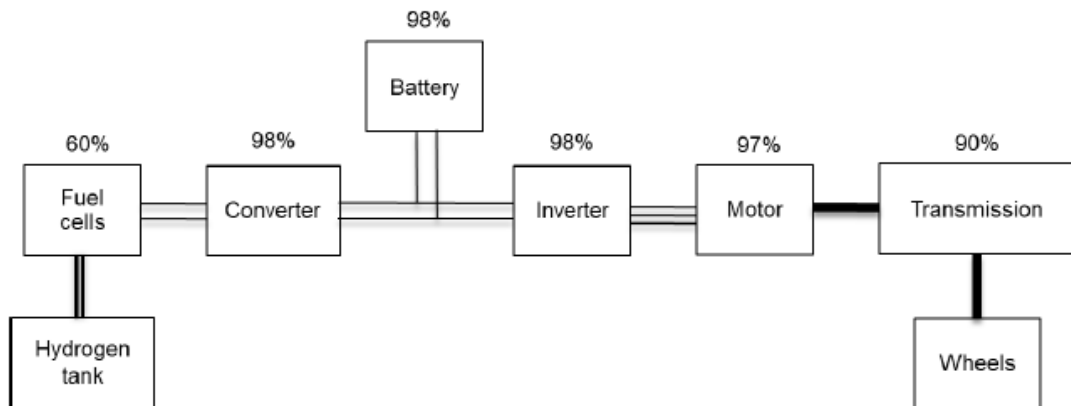


: Fully electric powertrain architecture.

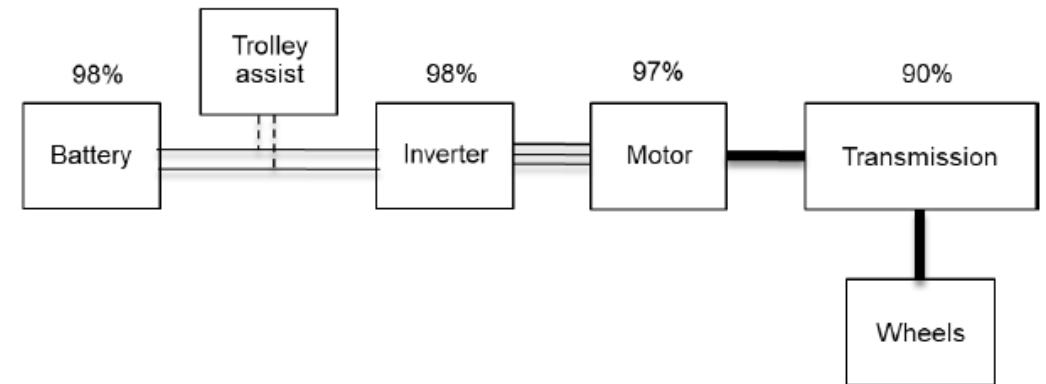


Hybrid electric trolley powertrain architecture.

# Technology alternatives for CAEX (II)



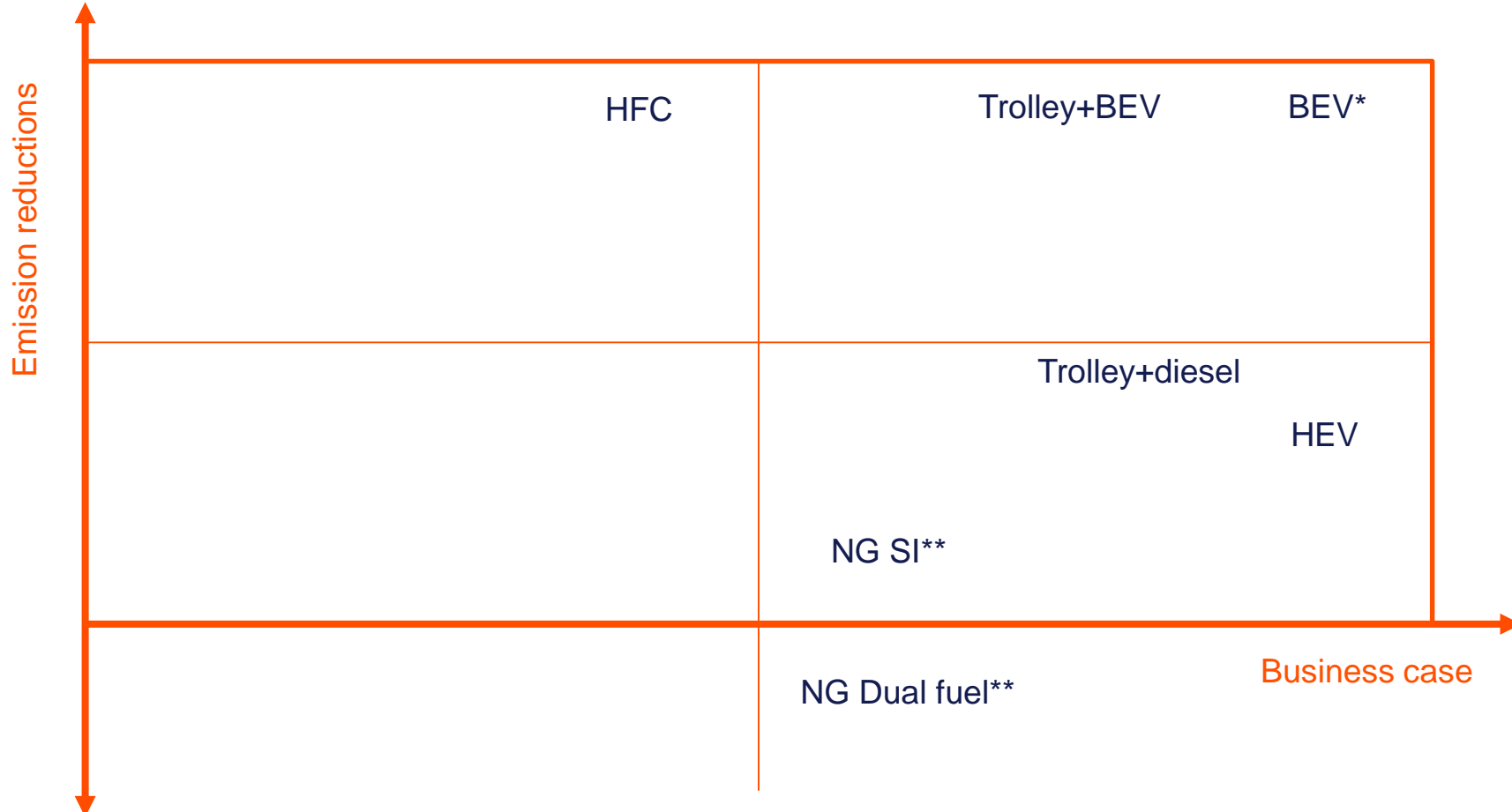
*Hydrogen fuel cell powertrain architecture.*



*Fully electric trolley powertrain architecture.*



# Competitiveness of technology options at 2021



HEV: Hybrid electric  
 BEV: Battery electric  
 HFC: Hydrogen Fuel Cell  
 NG SI: Natural gas spark ignition  
 NG Dual fuel: NG in compress ignition

BEV\*= for mining site where work cycles are not too long and opportunity charging is feasible.

NG SI and NG Dual Fuel\*\*= based on IEA Advanced Motor Fuels TCP project Enhanced Emission Performance and Fuel Efficiency for Heavy Duty Methane Fuelled Engines / 2014

