

Table of content

| | | |
|-------|--|----|
| 1 | Introduction | 1 |
| 1.1 | Motivation and Basic Backgrounds:..... | 1 |
| 1.2 | Objectives | 2 |
| 1.3 | Scope..... | 2 |
| 2 | Background | 4 |
| 2.1 | Chilean Energy Balance and GHG Emissions of Main Sectors | 4 |
| 2.2 | Transport Sector..... | 4 |
| 2.3 | Mining Industry | 6 |
| 2.4 | Road Trucks | 8 |
| 2.4.1 | Road Trucks Classification..... | 8 |
| 2.4.2 | Transport Trucks for Mining | 8 |
| 2.4.3 | Gas Emissions by Diesel Consumption..... | 10 |
| 2.4.4 | Mining routes of transport | 10 |
| 2.5 | Hydrogen and Fuel Cell Trucks..... | 13 |
| 2.5.1 | Hydrogen | 13 |
| 2.5.2 | Types of Hydrogen | 14 |
| 2.5.3 | Use of Green Hydrogen..... | 14 |
| 2.5.4 | Levelized Cost of Green Hydrogen | 15 |
| 2.5.5 | Fuel Cell Technology | 17 |
| 2.5.6 | Fuel Cell Trucks and Diesel comparison..... | 17 |
| 2.6 | Total Cost of Ownership (TCO) | 19 |
| 3 | Methodology | 21 |
| 4 | Truck Selection | 22 |
| 4.1 | Diesel Vehicle..... | 22 |
| 4.2 | Hydrogen Vehicles for Comparison | 23 |
| 5 | Route for Study and Transport Parameters | 25 |
| 6 | Technical Analysis | 27 |
| 6.1 | Estimation for Speed Profiles | 27 |
| 6.2 | Calculation of Power, and Energy Consumption..... | 31 |
| 6.2.1 | Diesel power and Energy Consumption | 31 |
| 6.2.2 | H ₂ Power and Energy Consumption | 33 |
| 6.3 | Truck Operating Cycles | 35 |
| 6.3.1 | Individual Truck Cycle | 35 |
| 6.3.2 | Total Year Operation | 36 |

| | | |
|-------|--|----|
| 7 | Economic Analysis..... | 39 |
| 7.1 | Economic Parameters | 39 |
| 7.1.1 | Capital Expenditures | 40 |
| 7.1.2 | Operational Expenditures | 41 |
| 8 | Results Analysis | 43 |
| 8.1 | Truck Cycle Results | 43 |
| 8.2 | TCO Results..... | 45 |
| 8.2.1 | TCO Weight Breakdown | 45 |
| 8.2.2 | Results for TCO Breakdown, Base KPI [USD] | 46 |
| 8.2.3 | Results for TCO Breakdown, [USD/km] KPI..... | 47 |
| 8.3 | Implementation Year of H2 Technologies..... | 50 |
| 8.3.1 | H2 Truck Cost Variation | 50 |
| 8.3.2 | Green Tax Variation on CO ₂ Emissions..... | 53 |
| 8.4 | Energy consumption, Annual Transport Parameters and CO ₂ Reduction Potential..... | 56 |
| 8.5 | Necessary Infrastructure | 57 |
| 9 | Conclusions | 61 |
| | Glossary | 63 |
| | Bibliography | 65 |
| | Annexes | 69 |
| A- | Route 1 TCO Results: Altonorte – Iquique | 69 |
| B- | Route 2 TCO Results: Collahuasi – Pozo Almonte | 70 |
| C- | Route 3 TCO Results: Chuquicamata – Antofagasta..... | 71 |
| D- | H2 Cost Projection..... | 72 |
| E- | Diesel Cost Projection | 73 |
| F- | H2 Truck Cost Projection..... | 74 |
| G- | Speed Profiles Route 1 Altonorte – Iquique | 75 |
| H- | Speed Profiles Route 2 Collahuasi – Pozo Almonte..... | 78 |
| I- | Speed Profiles Route 3 Chuquicamata – Antofagasta..... | 81 |