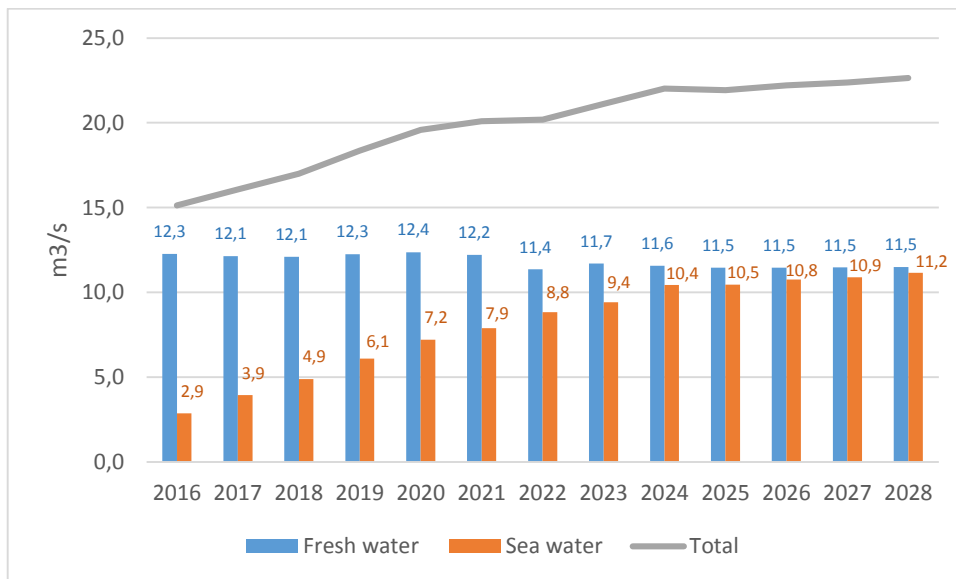


Forecast of water consumption in copper mining 2017-2028

Abstract

Every year, the Chilean Copper Commission (Cochilco) elaborates a 10-years forecast of water consumption in copper mining. To perform this forecast, Cochilco uses as a starting point its copper production forecast, coupled with the results of the annual water consumption survey. Overall, this report presents separated forecast for water consumption by origin (fresh or sea water), by geographical region (eight regions in Chile), by type of process (mine, concentration, hydrometallurgical process, smelter, refinery, and others), by project status (base, probable, potential, and possible), by state of development (operation, in action, feasibility, pre-feasibility), and by completeness of environmental permits (N/A meaning “does not apply”, approved EIA, presented EIA, and without EIA). This year, based on 2016 data, consumption is estimated from year 2017 to 2028.

Regarding water origin, on one hand, it is expected that seawater consumption would increase, reaching 11.2 m³/s in 2028. This rise represents a 289.9% increase compared to the original 2.9 m³/s consumed in 2016. On the other hand, fresh water consumption is expected to fall from 12.3 in 2016, to 11.5 m³/s in 2028. This represents a 6.3% decrease in fresh water consumption. Sea water could be desalinated water as well as salty water.

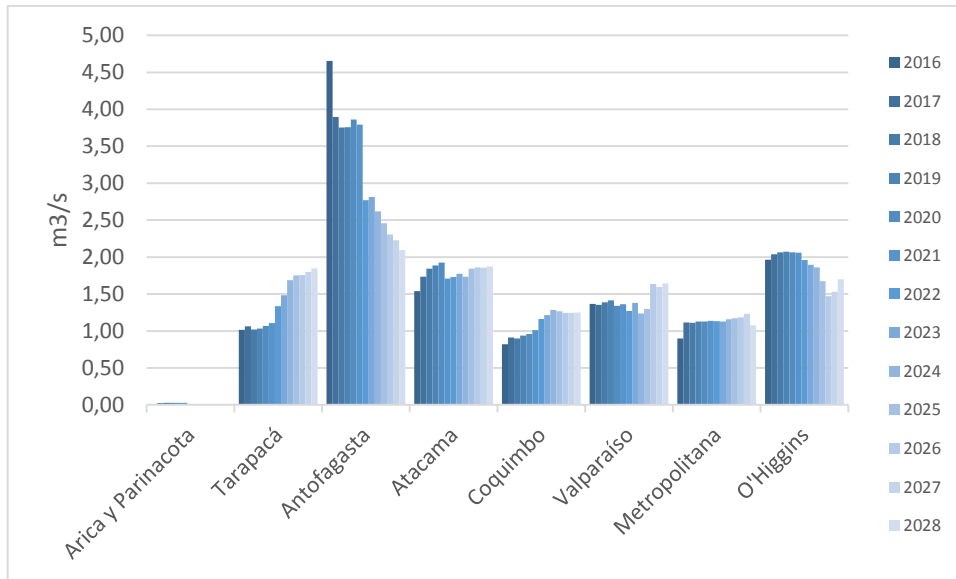


Water consumption forecast by origin

Source: Cochilco, 2017

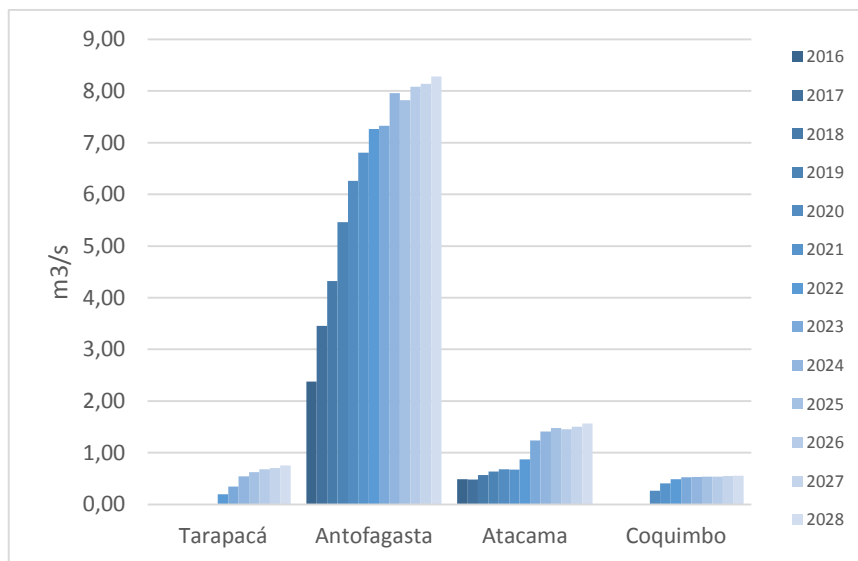
Regarding regional water consumption, eight Chilean regions are covered in this study. From north to south these are: Arica y Parinacota, Tarapacá, Antofagasta, Atacama, Coquimbo, Valparaíso, Metropolitana, and O’Higgins. Among those, Antofagasta is the one that is expected to vary the most its consumption of both, fresh and sea water. Regarding fresh water, by 2028 Antofagasta would reduce its consumption by 55%, while O’Higgins would reduce it by 13.4%. Arica y Parinacota has such a low consumption level, that its expected variations are not conclusive. The five other regions are expected to increase their fresh water consumption. Tarapacá would do it by 82%, Atacama by 21.7%, Coquimbo by 52.3%, Valparaiso by 20.1%, and Metropolitana by 19.3%.





Fresh water consumption forecast by region
Source: Cochilco, 2017

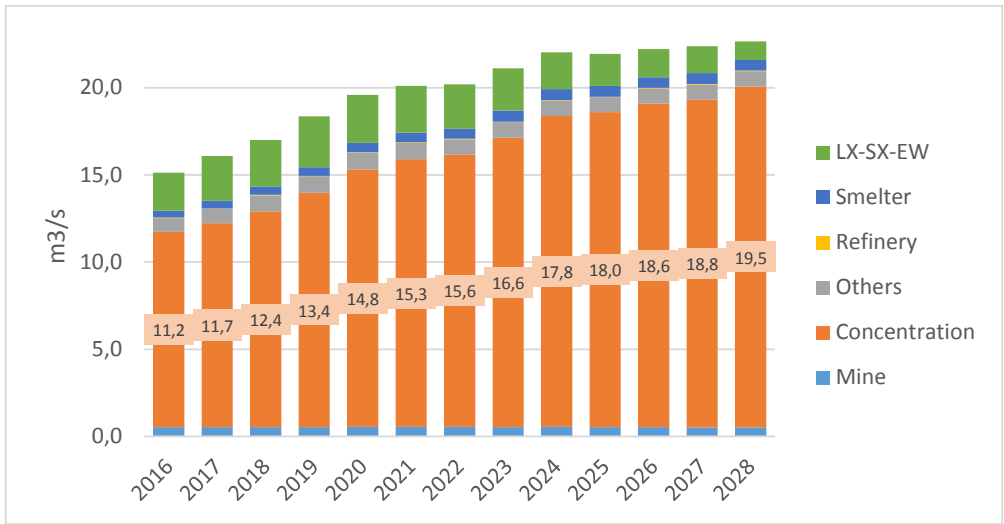
Regarding sea water, in 2028, Antofagasta would be consuming 8.28 m³/s, this is, a 248.5% increase with respect to 2016. Atacama would also increase its consumption by 222% with respect to 2016, reaching 1.57 m³/s by 2028.



Sea water consumption forecast by region
Source: Cochilco, 2017

Regarding type of process, the one that currently uses more water is concentration, and by 2028 it is expected to remain in first place. By 2028, concentration process would increase its total water consumption by 75%, of which fresh water would be by 7.1%, and sea water by 329%. On the other hand, hydrometallurgical process would decrease its consumption by 51.7%. In the hydrometallurgical process there are three different stages that are considered: Lixiviation, solvent extraction, and electro winning (LX-SX-EW).

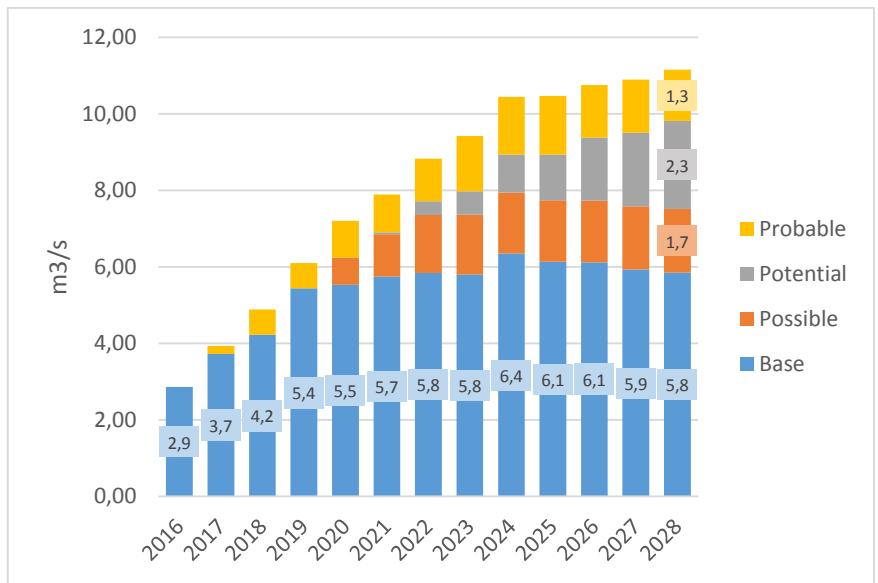




Total water consumption forecast by type of process

Source: Cochilco, 2017

Regarding project status, by 2028, projects that would explain almost half of sea water consumption, are the ones under the category of probable, potential, or possible. This is, projects with a degree of uncertainty in their materialization.

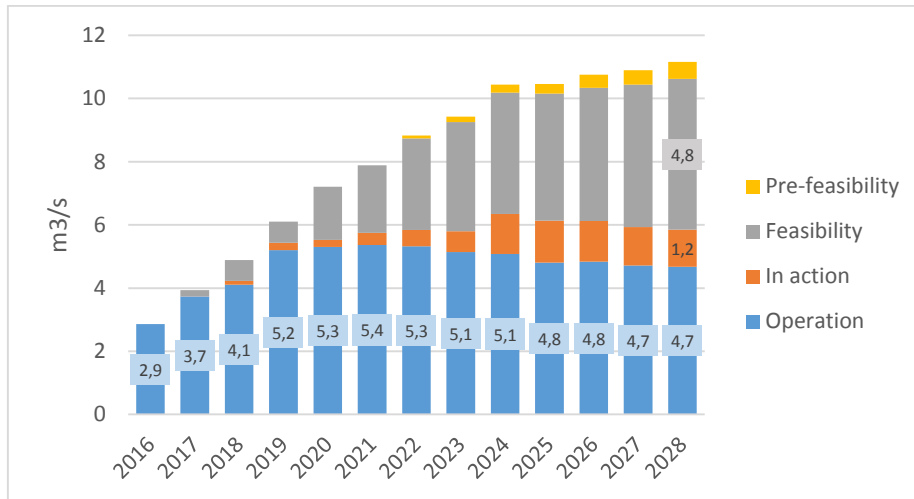


Sea water consumption forecast by project's status

Source: Cochilco, 2017

Something similar to project status, is expected to occur with state of development and sea water consumption. Only 42.8% of sea water consumption by 2028 would be explained by projects that are in operation.

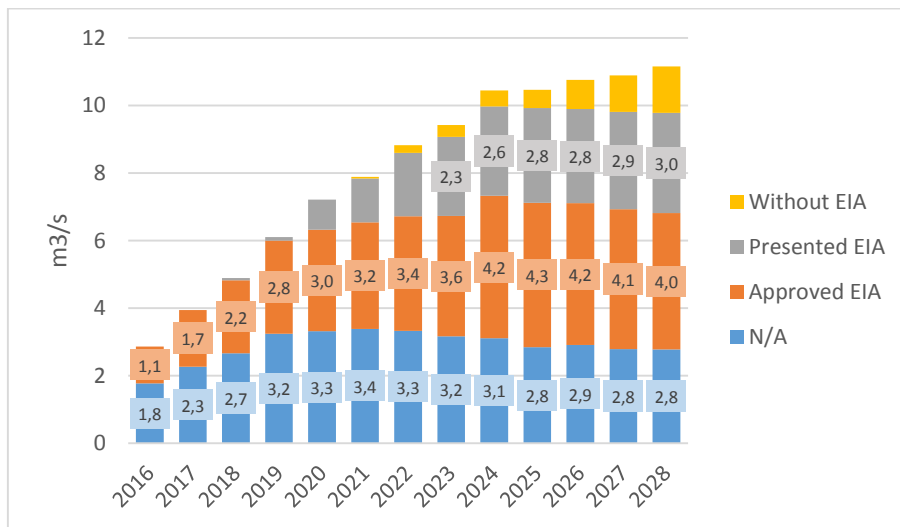




Sea water consumption forecast by state of development

Source: Cochilco, 2017

Last, regarding completeness of environmental permits, by 2028, 61% of sea water consumption will come from projects that are already up to date with environmental processing. Since 1994, according to the environmental law, developing an Environmental Impact Assessment (EIA) report is mandatory for every mining project that could cause an impact to the environment or to the people. Most of the projects under the category of “N/A” (does not apply) were made prior that year, or, are projects that do not fall under any of the circumstances that are defined in the environmental law.



Sea water consumption forecast by completeness of environmental permits

Source: Cochilco, 2017

There are differences with last year’s water consumption forecast (2.58% average error for fresh water, and 14.57% for sea water, for the 2016-2027 period). These differences are mainly due to three reasons. First, because of unexpected strikes, second, the entry of new projects that were not considered, and third, closure of some hydrometallurgical facilities.

It is important to note that desalination of sea water could solve the water scarcity issue in the north area of Chile, but not the one of water pollution due to mine waste. Therefore, a correct water management, and efficiency in its use is needed, regardless of its origin.

