Chile
Environmental Industry 2011
Case Study

October 2011

This publication was produced by Environmental Business International, Inc. and Nathan Associates Inc. for the United States Agency for International Development. Its contents are the sole responsibility of the author or authors and do not necessarily reflect the views of USAID or the United States government.

Acknowledgements

This case study was developed with financial support from the governments of Australia, New Zealand and the United States.

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1. Introduction

APEC has recognized that an open global trade and investment system is necessary for the dissemination and increased utilization of environmental goods and services (EGS). The EGS sector is devoted to solving, limiting or preventing environmental problems. EGS companies may be involved in manufacturing goods or providing services related to water or air pollution, waste management, renewable energy, monitoring, analysis and assessment, or a number of other areas. The development of an EGS industry in developing economies is instrumental to eliminating preventable diseases, enhancing quality of life, protecting natural resources and attracting in-bound investment.

This report is the third of an intended series of studies organized and sponsored by APEC Technical Assistance and Training Facility (TATF) on select APEC member economies to improve understanding of EGS in their economies and enhance capacity to promote sustainable growth through domestic EGS frameworks. Previous case studies covered Malaysia and Mexico and Vietnam will be also be released in 2011.

Methodology and Definition of EGS Used in the Study

The objective of this report is to characterize the EGS industry in Chile, not necessarily to define it. Research focused on companies operating in the market, so the segments discussed in this report reflect how these companies fall into groups of similar operations rather than national or international industry codes or certifications.

First, research and data on EGS sectors, EGS companies in Chile, environmental policy, the regulated community and the economy in Chile and South America were aggregated and assessed. Next, a database of EGS companies and contacts in Chile was compiled using government, trade association and private sector lists with company-by-company website searches. Primary research—face-to-face meetings, telephone interviews, and e-mail question-and-answer—with EGS companies, government officials and experts in the field was conducted. A detailed survey instrument was sent to more than 1,200 EGS companies or contacts in Chile by e-mail and resulted in 89 responses from a representative spread of EGS segments. (The results of which are cited below using the source designation Chile Environmental Industry Survey 2011; Environmental Business International, Inc.) Market quantification in each segment was conducted by identifying revenue generation in as many companies as possible in the segment, gathering market size or market share estimates from as many industry participants as possible and reconciling the estimates with other estimates or spending figures available. Employment, export and import estimates are derived from government statistics available in a limited number of product categories and mostly from surveys and interviews.

As with any emerging and largely undefined industry sector, official figures are essentially nonexistent. This study and its conclusions are conducted to help draw a more accurate and comprehensive picture of environmental markets and industries in the APEC region and throughout the world.

EGS in Chile—a $3.4 Billion Market

The value of the EGS market in Chile is estimated at $3.4 billion in 2010, according to research conducted for this report and for other studies by Environmental Business International, Inc., a California-based global business research firm that has focused on the environmental industry since 1988. Analysis of 10 service and equipment segments reveals an EGS industry generating revenue of $3.0 billion in 2010 with imports of goods and services valued near $500 million. The EGS industry in Chile employed an estimated 28,700 workers in about 2,010 private companies in 2010.

The $3.5 billion environmental market accounted for 1.7 percent of Chile's gross domestic product in 2010, and growth in the environmental industry was five to six percentage points higher than the 3.5–4.5 percent annual growth in Chile's GDP from 2006 to 2008. Growth in Chilean EGS segments before the global recession averaged 7-9 percent per annum from 2004 to 2008. The EGS market grew from $2.4 billion in 2005 to $3.4 billion in 2010, and from 1.4 percent of GDP in 2005 to 1.7 percent of GDP in 2010 and is expected to reach 1.8 percent of GDP in 2012 with annual growth in the 7-8 percent range.

By far the largest contributors to revenue and employment in the Chilean environmental industry are water utilities and wastewater treatment systems, which are operated mostly by the same entities throughout Chile and account for 60 percent of the EGS market in 2010. Water equipment and chemicals and solid waste management are the second- and third-largest segments in terms of revenue, although solid waste is estimated to be the second-largest employer, with about 7,000 jobs in Chile.

The EGS industry in Chile is relatively well developed compared to the industry in other nations, but different segments vary considerably in their stage of evolution:

- The water and wastewater infrastructure is well developed, and private companies manage the great majority of water and sewage systems.
- The consulting and engineering segment is well developed, with domestic capacity and international players, small companies and large companies, broad-based engineering firms with construction capability and specialist consulting firms all competing in a vibrant market.
- The solid waste infrastructure has evolved recently with ample landfill capacity, but collection systems remain fragmented because of institutional fragmentation in many municipalities; formal recycling programs are emerging but not implemented consistently.
- Air quality remains a problem in some cities in Chile, and although monitoring networks have evolved, controls on emissions and government enforcement in air pollution have not been matched in water. In terms of air quality management, progress can be verified in three levels: strengthening and updating regulations, developing and implementing prevention, and decontamination plans. Additionally, as part of the Clean Air Programme, a special plan has been developed to control industrial air emissions between 2010 and 2014. The first priority of the Plan is to reduce particulate matter, SO2, and NOx emissions in order to limit concentrations of PM2.5 in the atmosphere.
- Remediation projects in developed areas are rare, but signature projects will probably drive demand from citizens and government agencies to clean up contaminated sites.

- Environmental work for Chile's substantial and influential mining industry (making up 15–20 percent of GDP and about 50 percent of exports) tends to be development oriented, and strong growth will continue to provide work for consulting and engineering (C&E) firms, contractors and equipment providers in supplying water and energy needs to mining companies.
- Though potential is large for renewable energy in solar, wind and geothermal and the government has set an ambitious target of 20 percent by 2020, there are currently only a few market and government incentives, However, new rules and programs are being initiated such as Law 20365 in August 2009 which establishes a tax exemption for solar thermal systems in new home construction.

Open Market Leads to Equipment Imports and Domestic Capacity in Services

The evolution of the environmental industry in Chile provides an interesting case in free markets, domestic capacity and the distinction between goods and services. Simply put, open markets and free trade has sped the local adoption of high-level environmental technology, especially in water, but this has likely hampered the development of local manufacturing capacity and investment in water treatment technology. On the other hand, open markets have cultivated a much more competitive, and notably larger, set of service industries in Chile.

Relatively open markets and appealing business conditions for foreign firms and owners in Chile have provided opportunity for environmental companies to export to Chile, to set up service operations or to acquire firms in Chile. This has led to local conditions where, in markets such as water supply and wastewater treatment with sufficient market drivers and demand, systems are on par with those in the developed world. It has also meant that local water treatment equipment manufacturers have mostly not been competitive, nor have they had much market incentive to invest in, develop, sell, or possibly export advanced water treatment technology since imported equipment has mostly been meeting the local needs.

Conversely, exposure to the world's leading water equipment companies has made Chile's environmental C&E firms and water/wastewater management firms considerably more competitive and qualified to design, implement and manage projects and water and wastewater infrastructure in their own growing market and possibly in neighboring economies. Similarly, multinational C&E firms have frequently chosen Chile as a regional hub because of its more advanced market and engineering population that has cultivated a more competitive and sophisticated service business, in comparison with other Latin American countries. Many global C&E leaders have opened offices, acquired multiple firms, or established joint ventures in Chile expressly to pursue environmental opportunities across South America with Chile as a base.

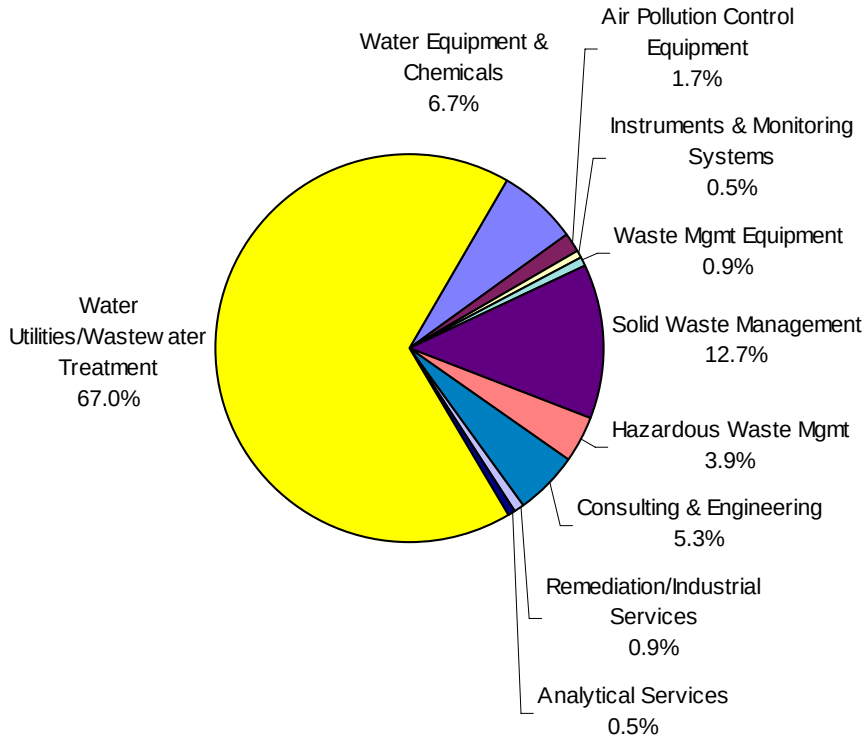
In environmental projects, the consulting engineer and the equipment or technology provider are almost always different commercial entities. The C&E firm is selling its expertise and objectivity to design the best solution (very few environmental problems, and hence their solutions, are the same) and often serves as a communication bridge to the regulatory enforcement entity, obtaining permits and maintaining license to operate.

Equipment accounted for 22 percent ($770 million) of the $3.4 billion EGS market in Chile in 2010, with an estimated 62 percent of that equipment provided by imports (see Figure 2-1). In

the largest segment, water equipment and chemicals, market participants affirmed that much of the specialty treatment, automation or analytical equipment was imported from European suppliers and that local manufacturers supplied most of the commodity equipment such as pipes, pumps and valves. In aggregate, imports of environmental equipment in Chile outnumber exports by a factor of about 20 to 1. Export and import statistics for selected Harmonized System (HS) codes indicate import/export ratios of 17 in water treatment equipment, more than 30 in air pollution equipment and more than 50 in instrumentation (see Tables 2-5 and 2-8 for data on water equipment and instruments). The data also indicate that this ratio did not change much in the time period analyzed (2005–2009) and that both imports and exports are growing faster than the market in each segment.

The figure below describes the different EGS categories as part of the Chilean EGS Industry and shares associated in each segment.

Figure 1-1
Segment Shares in the Chilean EGS Industry, $3 Billion in 2010



Source: Environmental Business International estimates derived from a variety of sources, including company surveys, company interviews, government documents and interviews, trade statistics, economic statistics, and company and government websites. Industry size indicates revenue generated by Chilean companies in total, including domestic markets and exports. Market size in subsequent tables includes imports but excludes exports by Chilean companies.

Table 1-1
Value of Chilean EGS Industry by Subsector, 2010

Subsector	Revenue in $ mil	Share %
Water equipment and chemicals	221	7.3%
Air pollution control equipment	52	1.7%
Instruments and monitoring systems	15	0.5%
Waste management equipment	26	0.9%
Solid waste management	380	12.6%
Hazardous waste management	118	3.9%
Consulting and engineering	160	5.3%
Remediation/industrial services	27	0.9%
Analytical services	14	0.5%
Water utilities, wastewater treatment	2,012	66.5%
Total EGS Industry	**3,024**	**100**

Source: Environmental Business International estimates derived from company surveys and interviews, government documents and interviews, trade statistics, economic statistics, and company and government websites.
Note: Industry=Market+ exports-imports. Industry size indicates revenue generated by Chilean companies in total, including domestic markets and exports.

Finally, it is important to note that foreign firms who enter the market and invest in Chile bring jobs, technology and engage in partnerships with local firms, so their entry into the market isn't always at the expense of local firms. In general, open markets and Free Trade Agreements (FTAs) have influenced the EGS industry by accelerating both the entry of global technology and management systems into the market and the development of highly competitive environmental service sectors.

Market Drivers

According to companies operating in Chile, the main drivers of demand in the environmental market in Chile are federal environmental laws and regulations and their enforcement, followed by the state of the economy and international standards self-imposed by multinational corporations. (See survey responses in table in the more detailed Market Drivers section below).

Additional drivers of significance in Chile were "International pressure relating to environment and climate change," and "Partnership with foreign environmental firms," reflecting the impact of the openness of markets in Chile and their ties to the global business community. "Federal government budgets" and "Municipal and state budgets" appear farther down the list of market drivers than in countries where the government has taken a more interventionist role in the environmental market.

Although the National Commission for the Environment (CONAMA) in Chile has been in existence since 1994 and has had the authority to enforce a broad suite of regulations and standards covering all environmental media (see more detailed discussion in Timeline of environmental regulation in Chile below), many Chilean EGS companies cite a lack of clarity in the rules or inconsistent enforcement as key problems inhibiting development of demand

for their goods and services. Chilean EGS companies also would like to see standards and enforcement closer to the levels in North America and Europe, as well as more resources for the agencies to do their job. In 2010, Chile's environmental institutions were redesigned with the creation of the Ministry of the Environment, the Ministerial Council for Sustainability, the Environmental Assessment Service, and the Superintendence for the Environment. This redesign will be complemented by the creation of the Environmental Courts and the Biodiversity and Protected Areas Service, which are now being considered by the Congress. These new environmental institutions respond to two of the country's priorities: to increase the importance of environmental matters in the national government and to clearly define responsibilities in the various fields that involve sustainable development.

Environmental industry analysts have long stated that the best determinant of an economy's environmental industry competitiveness internationally is the consistency and development of its domestic market, driven mainly by enforcement of environmental laws and regulations. Whereas Chilean companies do indeed appear to have some justification in complaining about inconsistent enforcement, particularly in air pollution and certain industries (and this is almost a universal complaint in the developing world), the privatization of the water infrastructure and the holding of these firms to a high standard by a dedicated government institution has made the Chilean water industry more than competent to meet local water and wastewater needs to a high standard, and even consider export activities.

Likewise the consulting & engineering community in Chile has benefited from active and consistent market demand in water and wastewater projects, and also from the relatively open markets that Chile has maintained leading to investment and involvement of global industries and corporations that have brought their own international operating standards into Chile, thus educating the local project management community as well.

2. EGS Industry Statistics

Statistical Summary and Overview of the EGS Market

The following is an estimate of market size, number of companies and employment by segment in the Chilean EGS industry. Market and industry statistics are presented in core EGS segments or traditional environmental industry segments pertaining mostly to air, water and waste issues. In this case the market is defined by revenue generated in country by global firms, and the industry is revenue generated by firms based in Chile or subsidiaries of foreign firms based in Chile: **Industry = Market – imports + exports**.

Emerging segments such as renewable energy, energy efficiency and green product or service sectors are not analyzed to the same extent, although research and interviews affirm developing consumer interest and growth from a small base of business in these areas. Tables 2-1 and 2-2 summarize market size, exports, imports, industry size, number of companies, and estimated employment by segment.

Table 2-1
Environmental Market and Environmental Industry in Chile, 2010 ($ million)

	Market Size ($ mil)	Import %	Export %	Import ($ mil)	Export ($ mil)	Industry Size ($ mil)
EQUIPMENT						
Water equipment and chemicals	507	60	8	277	16.3	221
Air pollution control equipment	140	65	6	91	3.0	52
Instruments and monitoring systems	40	65	4	26	0.5	15
Waste management equipment	80	70	7	56	1.9	26
SERVICES						
Solid waste management	380	1	1	2	1.9	380
Hazardous waste management	120	2	0	2		118
Consulting and engineering	161	20	19	32	30.6	160
Remediation	30	25	18	8	4.9	27
Analytical services	15	10	5	2	0.8	14
Water utilities, wastewater treatment	2,010	0	0	4	6.0	2,012
Total	**3,484**	**15**	**2**	**499**	**66**	**3,024**

Source: Environmental Business International estimates derived from company surveys and interviews, government documents and interviews, trade statistics, economic statistics, and company and government websites.
Note: Industry=Market+ exports-imports. Market size in US $ millions indicates revenue generated by worldwide companies from Chilean customers, including imports Industry size in other tables indicates revenue generated by Chilean companies in total, including domestic markets and exports.

Table 2-2
Chilean Environmental Industry, 2010

	Industry Size ($ mil)	Number of Companies	Employees
EQUIPMENT			
Water equipment and chemicals	221	160	1,260
Air pollution control equipment	52	50	330
Instruments and monitoring systems	15	40	90
Waste management equipment	26	130	160
SERVICES			
Solid waste management	380	800	7,000
Hazardous waste mgmt	118	80	1,380
Consulting and engineering	160	250	1,860
Remediation	27	40	320
Analytical services	14	60	210
Water utilities, wastewater treatment	2,012	400	16,000
Total	**3,024**	**2,010**	**28,600**

Source: Environmental Business International estimates derived from a variety of sources, including company surveys, company interviews, government documents and interviews, trade statistics, economic statistics, and company and government websites. Industry size indicates revenue generated by Chilean companies in total, including domestic markets and exports.

The presence of Small and Medium Enterprises (SMEs) in the EGS Industry is substantial in Chile. SMEs represent an estimated 18% of all EGS revenue, with a total amount of $542 million in 2010 (see table below). For example in Water Equipment and Chemical Subsector, SME revenue is $50 million and that is around 20-30% of the total subsector. In general, service categories have a larger share of SMEs as the barriers to entry are lower.

Table 2-3
Small and Medium Enterprises in Environmental Industry, 2010 ($million)

	Industry Size ($ mil)	SME Revenue Share (%)	SME Revenue ($ mil)
EQUIPMENT			
Water equipment and chemicals	221	20–30	50
Air pollution control equipment	52	20–25	12
Instruments and monitoring systems	15	10–15	2
Waste management equipment	26	20–25	6
SERVICES			
Solid waste management	380	30–40	133
Hazardous waste management	118	10–20	18
Consulting and engineering	160	30–40	56
Remediation	27	30–40	10
Analytical services	14	30–40	5
Water utilities/wastewater treatment	2,012	10–15	252
Total	**3,024**	**18**	**542**

Source: Environmental Business International estimates derived from company surveys and interviews, government documents and interviews and company and government websites.

Table 2-4 uses available data to estimate annual growth of the Chilean Environmental Market. It is important to note that in Table 2-4 market size in US $ millions indicates revenue generated by worldwide companies from Chilean customers, including imports. This contrasts with industry size represented in other tables that indicate revenue generated by Chilean companies in total, including domestic markets and exports.

Table 2-4
Estimated Growth of Chilean Environmental Market 2006–2012 ($ mil in sales each year)

Segment and Annual Sales	2006	2007	2008	2009	2010	2011	2012
EQUIPMENT							
Water equipment and chemicals	394	429	460	478	507	563	625
Air pollution control equipment	115	129	141	139	140	147	154
Instruments and monitoring systems	36	37	38	38	40	44	48
Waste management equipment	72	75	78	78	80	83	87
SERVICES							
Solid waste management	265	294	320	346	380	411	444
Hazardous waste management	75	87	98	108	120	133	147
Consulting and engineering	112	126	140	148	161	187	217
Remediation	20	23	25	28	30	38	47
Analytical services	13	13	13	14	15	16	17
Water utilities/wastewater treatment	1,575	1,717	1,841	1,933	2,010	2,121	2,237
Core environmental goods and services	**2,676**	**2,931**	**3,155**	**3,308**	**3,484**	**3,741**	**4,021**
Annual growth	**9.5%**	**9.5%**	**7.7%**	**4.9%**	**5.3%**	**7.3%**	**7.4%**
GDP growth	4.6%	4.6%	3.7%	-1.7%	5.2%	5.9%	5.4%
EGS % of GDP	**1.46%**	**1.53%**	**1.59%**	**1.69%**	**1.69%**	**1.72%**	**1.75%**

Source: Environmental Business International estimates derived from company surveys and interviews, government documents and interviews, trade statistics, economic statistics, and company and government websites.

Export Statistics

Tables from 2-5 to 2-12 present statistics for selected HS codes that most closely match environmental equipment subsegments in water treatment and environmental instruments. Exact matches of HS codes to EGS segments do not exist, and tracking trade in environmental equipment using official statistics is challenging.

The numbers in the tables below are actual figures taken from trade databases and are not modified or estimated. They do represent only part of the segment in question and a portion of the figures likely are non-environmental applications. These data sets are presented to illustrate more the trends in gains or declines and the proportion of imports to exports in selected product categories, rather than attaching any importance to the absolute values of each product category.

Table 2-5
Chilean Imports and Exports of Selected Water Treatment Equipment, 2005–2009 ($US)

HS Code and Description	2005	2006	2007	2008	2009
IMPORTS					
842121—Filtering or purifying machinery and apparatus for water	31,297,683	31,815,794	38,614,389	46,201,336	79,080,659
842129—Filtering or purifying machinery and apparatus for other liquids	21,462,507	36,794,376	23,431,476	18,451,813	29,813,369
842199—Parts of filtering or purifying machinery and apparatus for liquid or gases	32,138,163	36,050,006	42,162,410	67,360,102	52,669,419
Total	**84,898,353**	**104,660,176**	**104,208,275**	**132,013,251**	**161,563,447**
Annual Change		23%	0%	27%	22%
EXPORTS					
842121—Filtering or purifying machinery and apparatus for water	2,971,291	3,201,730	3,198,798	3,302,075	4,563,087
842129—Filtering or purifying machinery and apparatus for other liquids	314,308	1,313,382	1,536,959	420,881	1,017,466
842199—Parts of filtering or purifying machinery and apparatus for liquid or gases	1,426,497	3,267,063	2,412,827	3,015,911	2,674,662
Total	**4,712,096**	**7,782,175**	**7,148,584**	**6,738,867**	**8,255,215**
Annual change		65%	-8%	-6%	23%
Ratio of imports to exports	**18.0**	**13.4**	**14.6**	**19.6**	**19.6**

Source: U.S. International Trade Commission

Table 2-6
Chilean Exports of Selected Water Treatment Equipment by Partner Economy, 2005–2009

Economy	Share (%)
Peru	34
Colombia	14
Argentina	12
Canada	11
Bolivia	8
Ecuador	6
Mexico	5
Uruguay	2
Brazil	1
Paraguay	1
Costa Rica	1
Venezuela	1
United States	1
All other	3

Table 2-7
Chilean Imports of Selected Water Treatment Equipment by Partner Economy, 2005–2009

Economy	Share (%)
United States	18
South Korea	12
Italy	12
Netherlands	9
Germany	9
Spain	6
Israel	5
Finland	3
Brazil	3
Denmark	3
Argentina	2
China	2
Canada	1
United Kingdom	1
Peru	1
All other	11

Source: U.S. International Trade Commission; HS 842121. Chilean Imports/Exports of HS 842121 only: Filtering or purifying machinery and apparatus for water

Table 2-8
Chilean Imports and Exports of Selected Environmental Instruments, 2005–2009 ($US)

HS Code and Description	2005	2006	2007	2008	2009
IMPORTS					
902710, Gas or Smoke Analysis Apparatus	5,034,911	5,468,637	7,394,396	10,142,260	8,740,663
902720, Chromatographs And Electrophoresis Instruments	1,619,290	3,583,144	2,856,439	3,648,891	4,973,284
902730, Spectrometers, Spectrophotometers and Spectrographs	5,337,688	3,963,437	6,109,637	6,115,038	4,653,257
902750, Instruments Using Optical Radiations (UV, Visible, IR)	3,660,276	3,692,512	6,441,806	5,629,769	7,635,132
902610, Instruments for Measuring the Flow or Level of Liquids	12,700,769	14,463,986	16,735,479	20,191,123	20,564,646
Total	**28,352,934**	**31,171,716**	**39,537,757**	**45,727,081**	**46,566,982**
Annual Change		10%	27%	16%	2%
					EXPORTS
902710, Gas or Smoke Analysis Apparatus	139,583	91,576	113,603	147,085	108,795
902720, Chromatographs And Electrophoresis Instruments	78,550	32,362	9,200	72,567	89,035
902730, Spectrometers, Spectrophotometers and Spectrographs	21,739	19,389	270,626	53,240	113,999
902750, Instruments Using Optical Radiations (UV, Visible, IR)	93,139	34,704	110,617	103,614	143,172
902610, Instruments for Measuring the Flow or Level of Liquids	222,878	372,593	115,648	472,878	343,653
Total	**555,889**	**550,624**	**619,694**	**849,384**	**798,654**
Annual Change		-1%	13%	37%	-6%
Ratio of imports to exports	**51.0**	**56.6**	**63.8**	**53.8**	**58.3**

Source: U.S. International Trade Commission

Table 2-9
Chilean Exports of Selected Environmental Instruments by Partner Economy, 2005–2009

Economy	Share (%)
United States	30
Peru	17
Argentina	10
Bolivia	9
Canada	6
Germany	5
Ecuador	3
Sweden	3
Mexico	2
Kazakhstan	2
El Salvador	2
Colombia	1
Brazil	1
All other	10

Table 2-10
Chilean Imports of Selected Environmental Instruments by Partner Economy, 2005–2009

Economy	Share (%)
United States	37
Germany	13
France	7
Mexico	6
Denmark	6
Spain	4
Canada	4
Netherlands	3
United Kingdom	3
Brazil	3
Switzerland	2
Italy	2
China	2
Japan	2
Sweden	1
All other	6

Source: U.S. International Trade Commission; HS 902610; Chilean Imports/Exports of HS 902610 only: Instruments for Measuring the flow of Liquids/Filtering Equipment

Chilean Exports reported in a survey conducted for this report indicated that Chilean EGS exports are concentrated in the South America region; this is likely based in the proximity of the clients, the familiarity of language and the similar environmental problems neighboring nations face.

Table 2-11
Leading Regions for Chilean EGS Exports: All Segments, 2010 (%)

	Primary Export	Secondary Export
Other South America	55	14
Argentina	18	14
Brazil	14	14
USA	14	5
Europe	14	5
Canada	9	5
Australia/NZ	9	5
China	5	5
Central America	0	9
Mexico	0	9
Africa	5	0
Other Asia	5	0
India	0	5
Japan	0	0

Source: Chile Environmental Industry Survey 2011; Environmental Business International, Inc. Question was" If you are exporting or providing services outside Chile please select to which markets." Note: Of 83 companies that responded to this question, 22 indicated that they had some environmental business outside Chile.

The following table was derived from a survey which requested companies' opinion on which client sector they estimate growth in EGS demand between 2010 and 2020. The responses indicated that it is anticipated that mining will experience significant growth, followed by water/wastewater, power and oil and gas sector. The transportation sector is expected to have more modest growth, but it is expected that this growth will exceed demand by government agencies as clients of EGS firms.

Table 2-12
Top Growth Client Sectors for Environmental Companies in Chile, 2010–2020 (%)

	Major Growth	Significant Growth	Modest Growth	Slow Growth	No Growth	Decline
Mining	63	29	8	0	0	0
Water/wastewater	18	36	36	0	11	0
Power utilities	18	36	36	6	0	3
Manufacturing/ industry	14	31	41	14	0	0
Oil and gas	19	33	26	15	4	4
Agriculture	10	14	34	28	10	3
Transportation	3	17	38	31	7	3
Regional government	8	20	16	24	28	4
City government	4	17	17	26	30	4
Federal government	4	14	32	21	21	7

Source: Chile Environmental Industry Survey 2011; Environmental Business International, Inc. Client sectors are ranked by the weighted product of the first three and the last column. Question was: What do you see as the key client or market sectors for growth in the environmental industry in Chile in 2010-2020?

3. Segment Review: Environmental Consulting and Engineering

Central to any economy's environmental industry is the environmental consulting and engineering (C&E) sector. C&E firms provide analysis, assessment, audit, impact statement, and other services and also provide project design, equipment specification, construction management, operations and maintenance. C&E firms work in virtually every environmental medium—water, air, solid waste, recycling, remediation and renewable energy. C&E firms are involved in the public and private sectors at all levels and in every industrial sector. Firms may be consultants providing advisory services or engineers providing design services and project management, or both.

Firms focused on consulting provide most of the front-end analysis such as environmental auditing, environmental impact assessments, planning, permitting and other services such as carbon footprint, energy efficiency and CDM projects. Almost all specialist consulting firms are local businesses and almost all are SMEs.

Environmental consulting firms typically start as small businesses, and the sector has relatively low barriers to entry, usually requiring just credentialed personnel or certification to perform a specific service such as an environmental audit or impact assessment. Some consulting firms do more engineering work such as design and project management that may be specific to a technical niche like water or natural resources or specific to an industry like mining or energy. Most larger firms work in all technical and market sectors.

Of the leading 20 or so environmental C&E firms in Chile, there is roughly an equal mix of independent Chilean enterprises and foreign-owned firms manned principally by Chilean nationals. Of the independent Chilean enterprises, most have a total of 50-500 employees, some specializing in environmental work with 80-100% of their employees and some with environmental C&E as just one practice area with 20-40% of their employees. Of the foreign-owned firms, some acquired Chilean firms to establish a presence in the country or the region and others established an office in Chile, usually when following a multinational client into the country and often then choosing Chile as a hub for South American operations (see examples below.)

Table 3-1
Environmental Consulting and Engineering Firms in Chile

Environmental Consulting Firms	No. of Firms	No. of Employees	Revenue ($)
Firms with 20–100 environmental employees	20	1,080	97,200,000
Firms with 2–20 environmental employees	230	800	64,000,000
Total	**250**	**1,880**	**161,200,000**

The environmental consulting and engineering market in Chile grew from less than $100 million in revenue in 2005 to more than $160 million in 2010, according to research conducted for this report by EBI. Annual growth averaged 10–12 percent during 2005–2008,

with a number of smaller firms growing 30 percent or more. The global recession of 2008–2009 affected growth only moderately—C&E growth averaged 8–9 percent in 2008 and 2009, and only 7 percent of C&E survey respondents reporting a decline in revenue in 2009. The forecast for growth is high—an average of 16 percent a year in 2011 and 2012. Two-thirds of survey respondents expect environmental C&E growth of 12 percent or more.

Leaders in Environmental Consulting

- **International:** Hatch Ingenieros Y Consultores Ltda., SNC Lavalin Chile S.A., SKM Chile Ltda., GHD S.A., Golder Associates S.A., AMEC-Cade, Arcadis Geotecnica, Fluor Chile S.A., ARA WorleyParsons, Halcrow, Black and Veatch Chile Ltda, MWH Chile Ltda.
- **Local:** Poch y Asociados, Gestión Ambiental Consultores (GAC), Cica S.A. Ingenieros Consultores, SIGA Consultores S.A., Jaime Illanes y Asociados, G&K, Hidrosan, SGA S.A.

Examples of Foreign Entries into Chile in Environmental Consulting

Australian firm GHD gained local presence in Chile in January 2001 by integrating the Chilean engineering services company Promina S.A.

In September 2007, U.S.-based multibillion-dollar firm AMEC acquired CADE-IDEPE, the largest independent Chilean engineering services company at the time. CADE-IDEPE, which employed 540 people, had been a close partner of AMEC since 1994. AMEC CEO Samir Brikho said the acquisition would "provide AMEC with both a high quality engineering base in the fast growing South American market and a high-value engineering centre to support our rapidly growing Natural Resources and Power and Process businesses in North America."

When looking to expand its presence in Latin America, Australian engineering company WorleyParsons identified Chile, with its politically stable environment and growing economy, as a suitable base for expansion. The increased levels of trade and commercial interaction between Chile and Australia also made it an attractive destination, as did a marked growth in the capacity to exchange and export technology. Given Chile's developed levels of technical capacity and the fact that two of the world's largest copper producers have headquarters in Santiago, Worley-Parsons saw the opportunity to develop a centre for the base metals sector that could be used as a regional hub of operations and provide support to WorleyParsons minerals and metals operations elsewhere. In November 2006 WorleyParsons announced a 50:50 joint venture with the Chilean engineering company Arze, Recine y Asociados, Ingenieros Consultores (ARA). The company is now operating as ARA WorleyParsons, with 550 staff, located primarily in Santiago.

In April 2009, Canada's SNC-Lavalin announced the acquisition of VST Ingenieros Ltda, a leading Chilean consulting engineering firm specializing in mining geotechnical work with expertise and technology in thickened tailings disposal. The Santiago-based company has approximately 50 employees.

In August 2011, global projects firm Sinclair Knight Merz (SKM) acquired leading Chilean water engineering consultancy IRH to create SKM-IRH, which offers water and environmental services to organizations across South America. IRH the acquired company

specialized in water supply and networks, hydraulics, urbanization, storm water systems, water and sewage treatment, and environmental management. SKM chief executive Paul Dougas said that the acquisition was a direct response to the needs of clients in South America, especially in the mining sector. In staff numbers, IRH was one-tenth the size of SKM's 600 people in Chile at the time of acquisition, working mainly in mining, materials handling and power. The merger with IRH is SKM's most significant move in Chile since its 2005 merger with Minmetal, then one of Chile's largest engineering and construction management firms.

Table 3-2
Foreign Leaders in Chilean Environmental C&E

Chilean Entity	Base of Global Business
Hatch Ingenieros Y Consultores Ltda.	UK-USA
SNC Lavalin Chile S.A.	Canada
SKM Chile Ltda.	Australia-Global
GHD S.A.*	Australia
Golder Associates S.A.	Canada
AMEC-Cade*	USA
Arcadis Geotecnica*	Holland
Fluor Chile S.A.	USA
ARA WorleyParsons	Australia-Global
Halcrow	UK
Black and Veatch Chile Ltda	USA
MWH Chile Ltda.	USA

Source: Environmental Business International; derived from surveys, interviews and company information

C&E Profile: Poch y Asociados

Poch is a good example of a multidisciplinary engineering firm in Chile. Poch employs about 500 people, about 100 of whom work in environmental consulting. The company generates about $90,000 in revenue for each environmental staff member, and the company totaled about $30 million in revenue in 2010. Of the 100 environmental staff, about 30 work in natural resources, about 30 in sustainable development or environmental compliance issues (10 of this group work in climate change–related projects, where Poch is a leader), and the rest are in environmental management and social development and relations with the community. Poch covers sectors like energy, mining, food and beverage, buildings and infrastructure.

Growth of the engineering and environment consulting business has averaged 15–20 percent a year, and CEO Andres Poch said the recession has had an important impact on the business, except for mining, which remains very active and demanding. Poch said the business has become competitive, but the C&E sector is characterized by many firms of many sizes from many countries, but manned mostly by Chilean engineering talent that has benefited from exposure to and competition with global expertise. Poch said 15–20 percent of its business comes from outside Chile, with Peru its largest foreign market.

Poch also noted that 14,000 engineers of all types work in Chile and agreed that an estimate of about 1,500 on environmental projects was reasonable. He noted, however, that 12,000 engineers are needed just for mining projects in Chile, and that Brazil has only about a third of the engineers it needs to meet the demand for projects of all types. The shortage is leading to accelerated programs for training and education, but the shortage will be hard to overcome and will affect the business in terms of pricing and compensation.

C&E Profile: ARCADIS

ARCADIS is a global engineering business based in the Netherlands. It has expanded its business in many parts of the world through acquisition and growth. ARCADIS has made two acquisitions in Chile: in 1997, Geotecnica Consultores; and in 2007, Idesol. ARCADIS has about 500 employees in Chile with about 100 in the environmental practice. Almost 80 percent of the business is mining related, but energy and infrastructure (e.g., airports and power lines) are also significant clients for environmental projects. The environmental practice has seen steady growth—from about 25 people in 2005 to 100 in 2011. Most of the work is conventional environmental work in permits and compliance, but ARCADIS has a significant practice in site investigation and remediation. Ximena Espoz, who heads the environmental practice, says that remediation work is driven mostly by looking at sites that are worth cleaning up and selling, rather than any regulatory program so far, although she said some oil companies have funded major remediation projects. Work in solid waste is also lacking, she observed, because municipalities need integrated waste plans with significant waste per capita growth in the cities and little in the way of course control. She echoed the consensus of others that solid waste was not yet a priority. ARCADIS' air quality work is mostly in energy generation and copper smelting, and much of the water work is for the mining industry, as the water infrastructure is well managed by the private utilities. For mining companies, "the main concern is water," she said.

The dominance of the mining industry in Chile is a challenge for ARCADIS and other C&E firms because qualified engineers are hired away at higher salaries often enough that Espoz refers to consulting firms as a "training ground" for the mining industry. She also sees a scarcity of engineering talent on the horizon, considering the industry's growth and the moderate pace of new graduates coming out.

ARCADIS works in renewable energy development around the world but has yet to see much demand in Chile.

Areas of new demand in environmental consulting include the move to sustainability by industry, institutions, retail and consumer-facing businesses and managing their "social license to operate," said Espoz. She observed that in Chile, the history of a well-developed business in agricultural exports has resulted in "excellent systems for tracking and sanitary standards" that could apply to other industries.

C&E Profile: SK Ecologia

SK Ecologia S.A. is representative of a small specialist firm that has grown very well in the environmental industry. The firm offers a wide range of services, including environmental studies, water treatment, air quality monitoring, oil spill cleanup, noise control, and renewable energy. SK Ecologia S.A. has 35 employees and revenue of $4–5 million, growing its

environmental practice steadily at about 5 percent per year the last few years. Clients include the food industry, pulp and paper, rubber and oil companies. The company is a relatively independent part of Sigdo Koppers, one of Chile's largest diversified conglomerates.

SK Ecologia S.A. designs solutions and has relationships with equipment firms in air pollution control and solar photovoltaic's in order to complete projects with clients. Recent upgrading of particulate matter (PM) standards in air pollution from PM 10 to PM 2.5 (or 2.5 micrometers of particle size in smoke) has provided work in air pollution control and renewable energy is just beginning to become a market in Chile, according to the company, which has taken the lead on three projects totaling almost 40 MW of solar PV. SK's 40 people are virtually all educated in Chile and the firm does not work outside the country.

SK manager Cesar Vargas Infante echoes the sentiment of other industry participants when listing his three top priorities for the government: a clear energy policy, including requirements for more renewable energy; higher standards for food quality, agriculture and food processing; and more comprehensive rules and enforcement for air pollution, including transport exhaust and mining dust.

4. Segment Review: Waste Management

Background

The solid waste management system in Chile is undergoing gradual change, providing opportunities for private companies to collect and dispose of municipal waste and to build and manage the infrastructure of a modern, sanitary solid waste industry. Whereas Santiago has upgraded its landfill situation in recent years, it still lacks organized recycling and composting programs, source control and centralized collection contracts, according to solid waste companies interviewed and surveyed for this report. Outside Santiago, modern sanitary landfills are required in many areas, as are the programs of an integrated solid waste management system now common in the developed world.

It is estimated that the Santiago Metropolitan Region (RM) generates about 7 million tons of waste per year, about half of which is residential waste or municipal solid waste (MSW), and the other half industrial, commercial and construction and demolition waste. In 2005, 6 million tons of MSW were disposed in all of Chile, and volumes are estimated to have grown 6–10 percent per year, faster than economic growth.

Santiago RM has an area of 16,000 km^2 (2 percent of the total area of Chile) and about 7 million inhabitants, or approximately 40 percent of the total population in Chile. In Santiago the amount of MSW produced increased from about 0.8 kg per capita per day in 1995 to about 1.2 kg per capita per day in 2008, or about 3 million tons in total. Organic waste has decreased from 68 percent in 1990 to 50 percent in 2007, while paper and cardboards increased from 15 percent to 18 percent and plastics from 6 percent to 10 percent. These changes are correlated with rising income levels in Chile.

Treatment of MSW in Santiago is limited mostly to final disposal, with very little formal recovery or recycling, biological or thermal treatment, or recovery of biomass. In Santiago, private companies operate four relatively new landfills, where approximately 87 percent of the municipal solid waste is disposed of. Usually, MSW is left in bags or containers on the street, curbside or hanging on fences, where it is collected by collection companies. The frequency of collection varies from two to three times a week to daily, depending on the region. Most waste firms truck the waste to a transfer station where it is compressed and shipped by rail to a sanitary landfill as far as 65 km outside the city.

The rest of the waste is recycled, mainly as an informal activity. About 400,000 tons of waste, mainly paper, cardboard and metals are collected, separated and recycled by the informal sector. A recycling rate of 10–15 percent in Chile is achieved only because of the contribution of the informal sector. In many low- and middle-income countries, collecting, sorting, trading and recycling disposed materials provide income to thousands of people, according to a study by Karlsruhe Institute of Technology (KIT) on municipal solid waste management in Santiago. In general, informal recyclers work in parallel with the formal waste management system. The recyclers work in an independent manner, inasmuch as municipalities and companies do not contract them to carry out the recycling, but only purchase the collected materials. According to nonofficial estimates cited by KIT, between 5,000 and 15,000 people work as primary collectors in Santiago, many using tricycles as a transport and working tool,

separating the materials and selling them to middlemen, who deliver them as secondary raw materials to production companies. KIT estimates publicly organized materials recycling is less than 1 percent (about 25,000 tons per year) and collection of biowaste amounts to about 10,000 tons per year, from which about 3,300 tons of compost is produced.

Of the 245 final disposal sites for solid waste registered with Chilean sanitary authorities in 2005, fewer than half had a sanitary authorization and one in six had an environmental authorization. Sites lacking authorization have coverage and compacting problems and inadequate controls for gas and liquid emissions (or leaching into the ground). They do not have closed perimeters, are pest infested, are located in residential areas or areas restricted for environmental or cultural preservation purposes, or lack land use authorization. Many are slated for closure.

Santiago's modern sanitary landfills are equipped with a bottom liner and a collection system for leachate, and part of the landfill gas produced is captured and flared or used to produce electricity on site. Capturing and flaring can be financed by U.N Clean Development Mechanisms projects, which provide extra income for the landfill operating companies. In November 2009 a plant to generate electricity from landfill gas started operation in Loma los Colorados landfill with two generators of 1 MW power capacity each; generation capacity is planned to be extended to 14 MW by the end of 2011, and total capacity is expected to generate 28 MW by 2024.

Business Profile

Chile's solid waste industry is estimated at $380 million in 2010, up from $240 million in 2005. Three companies—KDM, Hidrosan and Proactiva—own and manage the landfills in Santiago and operate their own collection divisions. A number of smaller companies compete for municipal collection contracts in the almost 300 municipalities in Metropolitan Region.

Outside the capital, the business is considerably more fragmented, with local contractors and older landfill owners still operating. It is expected, however, that many will be unable to compete as stricter rules for landfills are enforced or dumps are forced to close in coming years. Ownership and management of modern, sanitary landfill is becoming more of a competitive advantage for collection companies that offer integrated collection, processing and disposal services and are in control of their own captive landfill tipping fees. Furthermore, the ability to add recycling and organic waste separation and processing services to municipal collection contracts will also give an advantage to larger firms.

Table 4-1
Solid Waste Industry in Chile ($mil)

	Solid Waste Revenue
Top companies: KDM, Hidrosan, Proactiva, Ecoser	220
Smaller regional companies (700–800)	160
Total	380

Source: Environmental Business International estimates; derived from surveys, interviews and company information

Waste management equipment is an $80 million market in Chile, consisting mostly of collection vehicles, specialty containers and landfill equipment. Most of the vehicles and heavy equipment is imported.

KDM: KDM estimates it has about a 30 percent share of the collection market, 900 collection employees, and 300 trucks in Santiago. In all of Chile, KDM generates about $100 million in solid waste revenue and has 1,600 employees. KDM has four divisions in Chile: landfill operation, hauling, KDM Energy and KDM Services. KDM Energy develops and manages landfill gas projects. KDM Services manages mostly waste for mining companies, including Codelco, Chile's national mining company. KDM is owned by Urbaser-Danner Group, a 50/50 joint venture of Spanish conglomerate ACS (formerly Dragados) and U.S. firm Kenbourne Environmental Engineering. KDM reports its landfill business has been growing 3–4 percent annually and its mining services business 10–15 percent. The company expects to be well positioned as the solid waste industry consolidates nationally.

Hidrosan: Hidrosan Group owns and operates one of Santiago's four landfills under the Santa Marta Consortium. It provides an interesting case in the evolution of a diversified environmental services provider, with consulting, equipment, chemicals, water and waste. Hidrosan was founded to do engineering projects, but in time, the company started offering more integral services such as design, civil and electrical works construction, equipment supply and assembly, and turnkey project delivery, especially in drinking water and industrial and municipal wastewater treatment.

Hidrosan operates the following business units in Chile:

- Hidrosan: Engineering consulting firm specialized in sanitary infrastructure solutions
- Hidrolab: Water quality laboratory in monitoring, analysis and advisory services
- Surquímica: Chemical supply company in fluoride for drinking water and special products
- San Isidro: Water and wastewater utility concession company for small cities
- Aguas Patagonia: Water and wastewater utility concession company in Chile's Region XI
- Aguas Chañar: Water and wastewater utility concession company in Chile's Region III
- Santa Marta Consortium: Municipal and industrial solid waste disposal company for southern greater Santiago, including a transfer station and a landfill
- Celle Consortium: BOT contract for a drinking water treatment plant in Chile's Region II
- Tratacal: Municipal wastewater treatment concession company in Chile's Region II
- Consorcio Chillan: Management of a hotel, ski area, springs, and spa in Chile's Region VIII
- Resco: Municipal solid waste disposal company for Coyhaique in Chile's Region XI.

Hazardous Waste Leaders

Commercial hazardous waste management and medical waste management generated about $120 million in revenue in Chile in 2010, with a roughly equal mix of foreign and local ownership of service operations.

Table 4-2
Hazardous Waste Management Industry in Chile, 2010

Firm	Revenue ($mil)
Hidronor (Group Machiels: Belgium)	20–30
Bravo Energy Chile (USA)	10–20
Coactiva (Gp Polpaico: Holcim, Swiss cement)	10–20
Resiter (Chile)	10–20
Disal (Chile)	10–20
HERA Ecobio (Grupo HERA, Spain)	5–10
Abengoa Chile (Spain)	5–10
Ecoclean (Chile)	5–10
Proactiva (Spain)	5–10
Ecoser (Chile)	5–10
Procesan: Stericycle (USA: medical waste)	5–10
Demarco (KDM)	5–10
Other 50-70 Companies	20–40
Total	**120**

Source: Environmental Business International; derived from surveys, interviews and company information

Hazardous waste can be solid, liquid or mixed waste and is generally trucked to a permitted facility. In Chile, this waster is mainly landfilled. A certain amount of waste is blended and used as alternative fuel or raw material in cement kilns or other controlled industrial furnaces in what is called coprocessing. Coactiva, a unit of Cemento Polpaico (controlled by Swiss cement conglomerate Holcim), has become a local leader in coprocessing technology and has committed to using Chile as a model for international guidelines for coprocessing industrial waste.

Coactiva has seen the coprocessing of mixed waste increase from 10,000 tons in 2003 to 30,000 tons in 2010. About half of this volume consisted of waste oil, during initial years of operation, evolving to almost 100% of solid and pasty industrial waste at present.

Typical hazardous waste disposal fees in Chile (for all available technologies) are in the range of $80-300/ton. Very specific cases consisting in limited volumes of persistent organic pollutants (as PCBs for example) are exporting mainly to Europe to be incinerated, with a cost around $6,000/ton.

In addition to Coactiva, there are some other cement facilities in Chile co-processing industrial waste , including used tires. Including Coactiva and other Chilean players, there are five cement plants co-processing industrial waste in Chile that derive, in average, about 16 percent of their thermal energy from waste.

Remediation

The clean-up of contaminated industrial sites and former waste storage areas are still an early-stage business in Chile—estimated to be in the $20–30 million range. A few relatively well-

publicized major projects are underway, but a consistent regulatory program to assess sites and require their remediation is not in place. Chilean government agencies have developed some processes for risk assessment in order to justify the remediation process. Most projects are either properties with multinational companies involved, in the redevelopment process, or with high-profile contamination. ENAP, Chile's national oil company, has probably been the biggest client in the market and has reportedly assessed some 2,000 sites, only a small portion of which have required some form of remediation to date.

The decontamination of mining properties is a significant business, but is viewed mostly as a part of the mining business rather than a standalone environmental industry segment. CODELCO's estimates of expenditures on decontamination dwarf EBI's $20-30 million estimate of the recognized commercial remediation market for cleaning up unused or abandoned sites.

5. Segment Review: Water and Wastewater

The water and wastewater services sector in Chile stands as a distinct example of how a growing economy can establish a modern water infrastructure with the application of appropriate policy and investment over time. Factors that led to this success were reform of the water sector in the 1990s (regional concessions, additional regulations, increasing water rates, subsidies for low-income households) before full privatization, which started in 1998. Also a dedicated national authority—Superintendencia de Servicios Sanitarios (SISS)[1]—was formed to oversee water and wastewater quality and systems throughout the country.

Chile's full, although staged, privatization, along with the country's general policy of open markets and openness to foreign investment allowed a fairly rapid privatization of the water infrastructure and accelerated investment in wastewater facilities, often with the involvement of international companies. Chile's water statistics are the envy of Latin America: 99.8 percent of the urban population has access to potable water supply, and 95.2 percent to sanitation.

Besides regulating water quality and wastewater treatment, SISS compiles and publishes consistent annual statistics on water and wastewater service utilities. Data for 2010 indicate that the top water companies generated $1.6 billion in revenue. SISS also provides a history of the development of the water and wastewater infrastructure in Chile and the recent history of business conditions.

From 1998 to 2008, the Chilean water sector privatized rapidly. In 1997 private companies served less than 10 percent of the market, and by late 2008, over 95 percent of potable water and wastewater treatment services were provided by private companies. The 23 largest private water companies operating in Chile, listed in Table 5-1, accounted for $1.6 billion in 2010 revenue tracked by SISS, and the top three—Aguas Andinas, Essbio and Esval—accounted for almost 60 percent of that total.

In addition to the private utilities tracked, a number of small water companies and municipal authorities operate in small remote areas and rural communities. Accounting for more revenue are private companies that manage industrial water and wastewater systems that treat wastewater before it is discharged into the sewer system or given permitted discharge into bodies of water. Industrial water purification systems are also used for the food and high-tech industries.

SISS has increasingly worked to raise quality standards. In 1998,Decree 609 was enacted, to regulate the industrial wastewater that is discharged in sewage systems (around 84 percent of the industry). In 2000, another Decree,90, entered in force, and it is applied to the industrial wastewater that is discharged in lakes, rivers and ocean (around the 13 percent of the industry). Finally, in 2002, Decree 46 was enacted, which set strict environmental regulations on the discharge of industrial wastewater on ground water (it is 1.6 percent of the industry). Since 2010, SISS monitors around 4.000 industries directly in order to maintain control of

[1] www.siss.gob.cl

wastewater. Compliance with Decree standards for 2010 was: Decree 609, 71 percent; Decree 90, 91 percent; and Decree 46, 76 percent. Regarding the domestic wastewater, the total coverage in 2010 was 86.9 percent; the stated goals for 2016 is 98.6 percent.

Table 5-1
Chilean Water/Wastewater Treatment Industry, 2010

	$ mil	No. of Employees
Aguas Andinas	530	2,879
Essbio	200	2,006
Esval	180	1,684
Aguas De Antofagasta	110	619
Aguas Cordillera	80	336
Nuevo Sur	70	568
Essal	70	809
Aguas Araucania	60	732
Aguas Del Valle	60	594
Aguas Del Altiplano	60	630
Smapa	50	406
Other Urban Private Utilities	100	1,207
Subtotal	**1,570**	**12,470**
Municipal/Rural Systems*	100	1,328
Industrial**	340	2,184
Total	**2,010**	**15,982**

*Source: Environmental Business International; derived from Superintendencia de Servicios Sanitarios (SISS) annual report and surveys, interviews and company information. The top 11 utilities were published income for these firms by SISS and here converted to $US. * Municipal/Rural systems are small communities or rural private entities that provide water or manage wastewater and revenues and employment are estimated by EBI from interviews with consultants in water business. ** Industrial water/wastewater services are mainly the operation of wastewater facilities for manufacturing industries that either discharge into bodies of water under permit or must ore-treat before discharging into the sewage system. Aguasin, Ecoriles, Aguasin, Soluciones Industriales, Manantial, Ecopreneur, Cotaco, Aguas y Riles, Ecosystems, Sidecar and Reichol are leading Chilean companies in industrial water and wastewater treatment. Degremont, Veolia and Siemens are foreign leaders.*

The water industry is expected to continue growing, and the supply of water and wastewater equipment and chemicals has a higher growth rate than most other segments. Companies and commercial officers expect the following water segments to continue growing rapidly:

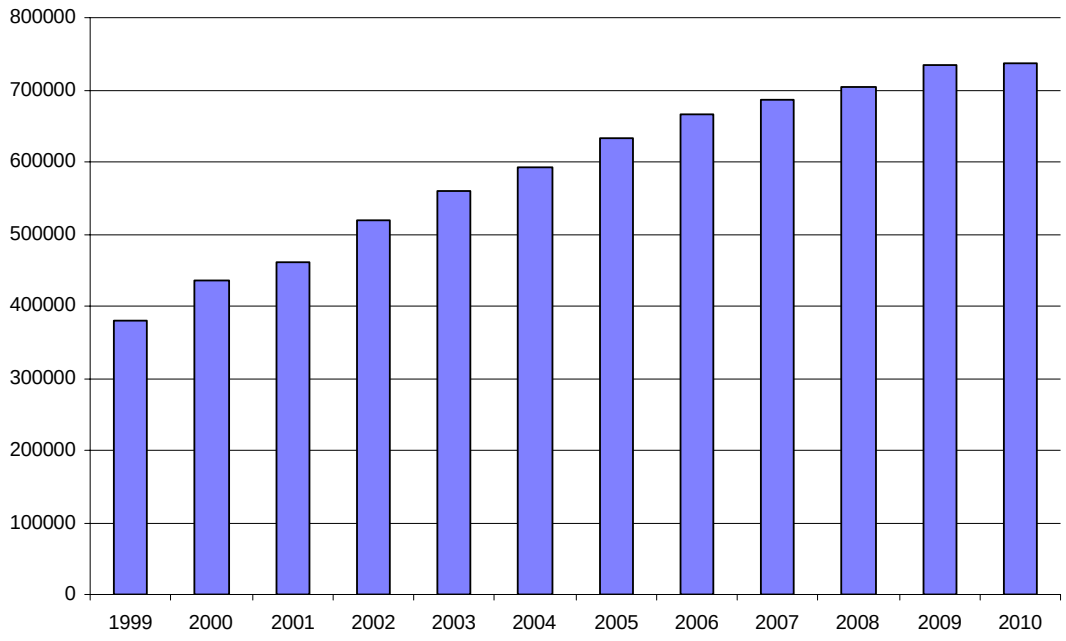
- Potable water treatment systems for municipalities, industry and tourism developments
- Water reuse systems for industrial and agricultural use
- Pretreatment technology for wastewater and sludge-processing equipment
- Water collection, storage, and irrigation systems, including piping systems, irrigation channels, and water reservoirs
- Innovative water reuse and recirculation systems for municipal and industrial applications

- Water reuse systems for mining and aquaculture
- Consulting, design and engineering services for the construction of wastewater treatment plants, which include primary and secondary treatment, biosolids processing and advanced treatment
- Sewage networks in the rural sector.

Table 5-2
Growth of Operating Income in Chile's Regulated Water Utilties: 2000-2010 (Million CLP)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Operating income	434,984	460,904	518,922	560,710	591,466	633,232	664,912	686,393	705,037	734,426	736,938
Income growth	14.3%	6.0%	12.6%	8.1%	5.5%	7.1%	5.0%	3.2%	2.7%	4.2%	0.3%

Figure 5-1
Growth of Operating Income in Chile's Regulated Water Utilties: 2000-2010 (Million CLP)



Source: Superintendencia de Servicios Sanitarios (SISS). Note Chilean pesos are used as the units in this chart to avoid currency fluctuations impacting the annual growth rate in domestic operations.

Water and Wastewater Business and Ownership Profiles

Many of the largest water companies in Chile have significant foreign partners or ownership.

Aguas Andinas is owned by a 50/50 joint venture of the Agbar Group (former Aguas Barcelona, Spain) and the Suez Group (former Lyonnaise des Eaux, France). Aguas Andinas is Chile's leading water and wastewater utility, with about 1,6 million clients, serving an urban population of 5.6 million and generating about $700 million in total revenue in 2010 (the revenue listed in the table above is only for its water utility business). Like established private sector water utilities in the developed world, Aguas Andinas has diversified into other

segments that are faster growing and often more profitable, if not as stable as the utility business.

Aguas Andinas has four divisions: the regulated water/wastewater utility that is large but growing at only 3-4 percent in recent years; Anam, a laboratory and environmental testing business doing about $15 million in revenue and with 30–35 percent growth; an equipment supply business with about $20 million in sales growing about 10 percent; and Ecoriles, an industrial wastewater treatment business that did about $25 million in revenue in 2010 and is growing about 30 percent per year. Ecoriles' largest client is the mining industry, but middle market manufacturers such as food, chemicals, dairy, poultry and fish contribute, as do pulp and paper, other sewage treatment companies, and institutional and commercial facilities.

Other leading water utilities have attracted foreign investment:

- Canada's Ontario Teachers' Pension Plan (OTPP), an investment fund with more than $100 billion in assets, has ownership stakes in Essbio, Aguas Nuevo Sur Maule and Esval. In July 2011, OTPP increased its stakes in two Chilean water utilities after making successful bids in an auction managed by CORFO, a Chilean economic development agency. OTPP increased its ownership in Essbio S.A. to 89.6 percent from 51.1 percent and of Esval S.A. to 94.2 percent from 69.8 percent. The successful bid for the additional shares was more than $500 million. CORFO retains a 5 percent stake in Essbio and Esval, enabling it to veto issues such as water rights transfers and utilities concessions.
- In January 2009, the Aguas Nuevas group, Chile's third-largest water utility, which includes Aguas Araucania, Aguas del Antiplano and Aguas Magallanes, was sold to Spanish private equity fund Santander Infrastructure Fund by the Solari Group. The Solari family, whose main business is department stores, earlier reportedly nearly sold to a Japanese conglomerate and an Australian private equity fund, among other suitors. Santander Group paid between $300 and $350 million. Santander was a lead investor in the deal, which bought British utility Thames Water from RWE in 2006. Aguas Nuevas was created in 2004 when the Solari Group acquired 30-year concessions for Essat, Essar and Esmag for $179 million.

Water Equipment

In the water equipment segment, Chilean water companies work mainly with suppliers from Germany, Italy, France, Belgium and England. Leading water equipment brands include Degremont from France, Siemens from Germany, KSB from Germany and US-based multinational GE.

Water equipment and chemical sales are estimated at $460 million in 2010 and have been growing 4–6 percent in the past two years; growth of an average of 10–12 percent a year is expected as industrial wastewater systems are built. Although most specialty treatment equipment and chemicals continue to be imported, much of the commodity equipment such as pipes, pumps, and valves is manufactured domestically.

Managers estimate that chemicals are 15–20 percent and equipment is 10–15 percent of the operating costs of water and wastewater plants, so the supply of ongoing materials is not an insignificant market. However, the largest demand for water equipment, treatment and delivery is expected for the mining industry, specifically from two multibillion-dollar projects

in Region II; in one $3-4 billion project, seawater will be treated and pumped up to 200 kilometers and 2,000 meters in elevation for copper mining.

Water scarcity is a serious constraint to the Chilean mining sector, and water supply is vital to the economy as a whole, given that mining accounts for about a fifth of Chile's GDP and almost half of exports. A November 2010 report by Cochilco, the Chilean copper commission, concludes that, after peaking in 2017, copper production will reach 7.3 million tonnes in 2020, and water usage will increase by 45 percent. Currently, the mining industry in Chile consumes 1.03 million cubic meters per day, with copper production accounting for 976,300 cubic meters per day of that in 2008. The needs of the sector will reach 1.47 million cubic meters per day in 2020, even with expected efficiency savings from improved water use practices.

Trade Issues in Water Equipment

The U.S. commercial service reports improved business in Chile for U.S. water equipment firms since the U.S.–Chile Free Trade Agreement (FTA) was signed in 2004. The FTA eliminated tariffs on 97 percent of U.S. products imported into Chile and more than 95 percent of Chilean exports to the U.S. and set tariffs on all products to be eliminated within 12 years. The elimination of Chile's 6 percent general tariff has made U.S. products significantly more competitive, as U.S. imports were previously losing ground to other countries with which Chile already had preferential trade agreements (such as Europe).

6. Segment Review: Air Pollution

Air pollution has long been one of Chile's most apparent environmental problems. The recovery of the air quality in urban areas is one of the main challenges to be addressed by Chile's new Ministry of Environment, which was formed in late 2010.

New strategies are being designed to control emissions from transport, industry, fuel and a plan for improved monitoring of air quality, using regulations and incorporating economic instruments as a tool to reduce emissions. Chile gained valuable experience with an emission trading program to reduce and cap emissions of particulate matter smaller than 10 microns (PM10) from stationary sources in the 1990s that met its goal of a 50 percent reduction in 1998.

The Air Pollution Prevention Plan in the Metropolitan Region, is a structural program launched in 1998 and the Plan has had several updates. The last update, in 2009, sought to strengthen the control of PM10 direct emissions, particulate matter and ozone precursors. The air quality data indicates that the region is no longer in condition of NO_2 and CO saturation, although this situation persists for PM10 and ozone. The greatest reduction in particulate matter has been achieved in PM 2.5. Another important achievement is the number of days on the daily standard for PM10; 2010 had the lowest number of days reported above the standard. The last update of the plan seeks to reduce diesel vehicle emissions through technological improvements and higher standards for light vehicles and motorcycles, and incentives for vehicles with low and zero emission.

Most of the market for air pollution control equipment in Chile is for stationary-source air pollution control. While transport emissions are a considerable problem, the last automotive production and assembly plant in Chile closed in mid-2008 and specialty mobile emissions control systems are already part of the vehicle business, almost 75 percent of which are imported from Asia.

In stationary sources, electric power generation and copper smelting are the two largest markets for APC equipment providers. There is an emission standard for power plants which sets limits based on European standards for three air pollutants: particulate matter, sulfur dioxide and nitrogen oxide. The APC equipment market is estimated at $140 million, supplied mostly by imported equipment from Europe, the United States, and more recently China. Following growth in the 10–12 percent range up to 2008, air pollution control equipment vendors reported a slight contraction in the market in 2009 and a flat market in 2010. Although power plant emissions requirements exist for particulate matter, sulfur dioxide and nitrous oxides, growth is not expected to be as high in APC equipment as it is in other EGS segments.

7. Segment Review: Renewable Energy

Chile has a number of challenges in its energy sector. While the privatization in electricity that preceded the privatization of the water sector is also seen as a model of reform in Latin America, dependence on imports and the lack of a national grid limit its options.

- Total installed electricity capacity in July 2010 was 15.94 GW: 64.9 percent is thermal (mostly gas, coal and oil), 34 percent hydroelectric, and nearly 1 percent wind power. (The Ministry of Energy reports more detailed sources: Gas 34.3%, Coal 14.3%, Oil 13.6%, Hydro 34.6%, Wind 1.1%, Biomass 1.1% and Mini hydro (less 9 MW) 1.0%.

Total electric generation in 2008 was 56.3 TWh—42 percent by hydropower and the remaining 58 percent produced by thermal sources, again mostly gas, coal and oil. Generation figures vary significantly by year depending on the amount of rainfall each year.

Chile faces issues that pertain to renewable and traditional sources of energy.

- Energy security: Chile imports 72 percent of the sources for its total energy (including transportation fuels, heating fuels and electricity): 98 percent of its oil, 92 percent of its coal and 74 percent of its natural gas.
- Increasing environmental and social problems resulting from large hydro and coal power generation with increasing public opposition.
- Massive increase in CO^2 emissions due to entry of coal-based power generation, the transport sector, and mining are forecasted.
- Chile's November 2010 entry to the OECD "rich countries club" is exerting some pressure on Chilean government and industry to be more aware of the climate change impacts of its actions. In addition, consumer awareness in Europe and North America is forcing Chilean manufacturers to be more concerned about the carbon footprint of their exported products.

Chile's government has a stated goal of 20 percent renewable energy by 2020, but the energy industry thinks there is little chance of reaching this. Some policies have been put in place, including the following two laws that are presently in force:

- Law 20,257/2008, establishes an obligation for electric companies. The law establishes that a percentage of the energy they provide must come from Renewable Energy Sources (5% from 2010 to 2014, increasing to 10% by 2024)
- Law 20,365/2009, provides a tax exemption that covers the costs incurred in the purchase and installation of solar thermal systems for the heating of sanitary water in new homes.
- Law N°19,940/2004, establishes the conditions that the small-scale generators must fulfill to use the transmission systems and distribution networks. The law mentions that producers can receive income equivalent to other energy sources and exempts non-conventional energy from paying the cost of using the transmission facilities, with a limit of 5% of Renewable Energy on the total installed capacity.

The current situation in Chile ERNC shows significant improvements in the regulatory framework in the past four years. However, there are still some barriers that avoid a stronger development of renewable energy production, especially regarding to the price of power sales contracts. Renewable energies are very close to being economically competitive with

traditional sources, but work in some key areas must be intensified to achieve the ambitious goal in renewable energy as the 20% proposed for 2020.

Chile's general free market approach means energy companies don't expect much in the way of incentives, requirements, feed-in-tariffs or tax credits to stimulate renewable development. Power requirements for the mining industry cannot be intermittent either, putting solar and wind at a disadvantage to coal and gas for powering the mines.

During August 2009, the Renewable Energy Center was created, the main objective of which is to promote and facilitate the development of Renewable Energy Industry, coordinating public and private initiatives to optimize the potential use of renewable energy resources that exist in Chile.

SN Power is a Norwegian renewable energy producer that mostly focuses on hydropower. It currently operates two run of the river hydropower plants, La Higuera and La Conflencia of 155 and 158 MW installed capacity respectively, both located 250 km south of Santiago. It also operates a 46 MW wind farm, called Totoral, located 300 kms north of Santiago. SN Power's mission is to become a leading hydropower company in emerging markets, contributing to economic growth and sustainable development.

According to Global Wind Energy Council (GWEC), Chile's installed wind capacity at the end of 2009 was 168 MW, up from 20 MW at the end of 2008. SN Power is using global wind turbine leader Vestas to supply turbines and says other developers are also using mostly the Danish firm's equipment. On another wind farm, SN Power did the permitting, Swedish firm Skanska did the construction and Vestas supplied the turbines and the operations and maintenance contract.

Although wind energy has shown some growth, solar energy has not seen much activity in Chile. Geothermal is another area with good potential but little development or investment.

In 2000, Law 19,657 established a regulatory framework for exploration and exploitation of geothermal energy. Companies says that the government is responding, but focusing on generation, but not transmission, which is key to renewables that are frequently located in remote areas.

8. Market Drivers

According to companies operating in Chile, the main drivers of demand in the environmental market in Chile are federal environmental laws and regulations and their enforcement, followed by the state of the economy, and international standards of multinational corporations in the absence of any international standards or regulations. Laws and regulations was the most commonly selected answer among survey respondents, 55 percent of which cited this as the most important driver for their business (many respondents selected more than one "most important driver").

Table 8-1
Factors Cited as Top Environmental Market Drivers in Chile in 2011 (% of Respondents)

Factor	Most Important	Very Significant	Significant	Not Significant	No Impact
Enforcement of federal environmental laws and regulations	55	29	14	2	0
State of the economy	26	55	19	0	0
International standards of multinational corporations	20	32	29	17	2
International pressure relating to environment and climate change	15	29	39	15	2
Partnership with foreign environmental firms	11	21	42	18	8
Municipal and state budgets	6	33	31	28	3
New programs to develop green technology in Chile	6	24	45	21	3
Media coverage of environmental issues	5	28	41	26	0
Federal government budgets	9	21	24	32	15
Domestic public pressure and environmental NGO activity	8	17	33	36	6
Clean Development Mechanism projects or generation of certified emission reductions	5	16	46	30	3
International development funds or bank funding (IADB or World Bank)	5	14	32	43	5
Regional agreements through APEC or free trade agreements	0	20	37	40	3

Source: Chile Environmental Industry Survey 2011; Environmental Business International, Inc. Question was "Please rate the impact of the following market drivers in 2011 on your company's ability to generate revenue in the environmental business in Chile."

It is important to note that one of the top market drivers in the EGS Market is the enforcement of laws and regulations. In the following section, the institutional framework is described in order to give a general view of the timeline of environmental policy and regulation in Chile

Legal Background to Chilean Environmental Policy

The Chilean Constitution of 1980 grants all Chileans the right to live in a pollution-free environment, and notes that it is the State's responsibility to ensure that this right is not threatened and to guarantee the preservation of nature. It also identifies the conservation of the environmental heritage as one of its social functions.

Law 19,300 on the General Environmental Framework was approved in 1994. This normative body established a structured environmental management system. The law regulates a series of conflicting interests, beginning with the premise that no activity, however legitimate it may be, can be carried out at the expense of the environment. Specifically, the law establishes a set of legal regulations and definitions, environmental management instruments, areas of responsibility, enforcement mechanisms, the environmental protection fund, and government institutions in charge of addressing issues that are related to the environment. The Principal Environmental Management Instruments are: Instruments for Establishing Environmental Quality Standards, Prevention Instruments, Corrective Instruments, Compliance Instruments, Economic Instruments, Education and Research Instruments, Citizen Participation Instruments, and Instruments for Generating Information

Also of note, Chile's accession to become a member of the OECD required reviewing its environmental legal and institutional framework. This review was a contributing factor to some of the new legislation being proposed and is explained below.

Institutional Framework

In 1993 the "Presidential Instruction Guideline for Environmental Impact Assessment of Investment Projects" was developed, establishing the Environmental Impact Assessment System.

In 1994, Law 19,300 officially created the National Commission for the Environment - CONAMA- a public service, functionally decentralized with legal status and own patrimony.

The General Environmental Framework Law did not significantly alter the institutional framework neither within the central government nor in decentralized government levels. However, the law imposes certain tasks and responsibilities on municipalities and confers on them some new authority mainly related to environmental impact assessment.

In 1997, Decree N° 30 was enacted, establishing the Environmental Impact Assessment System (SEIA).

In 1998, CONAMA approved the Environmental Policy for Sustainable Development and Atmospheric Decontamination and Prevention Plan of Metropolitan Region.

Since CONAMA's creation, environmental legislation has strengthened through a number of regulations regarding air and water quality standard, water emission, air pollutants and wastewater regulations, solid waste treatment and hazardous waste management.

Nowadays, Chile also has laws and regulations related to different environmental issues such as the protection of the ozone layer, biodiversity and natural areas, or those aimed to reduce noise and light pollution, water and soil pollution, chemicals waste management, and citizen participation instruments.

The Environmental Impact Assessment System catalyzes the installation of specialized companies that provide different types of service related to environment. Additionally, the market begins to demand technologies that enable companies to fulfill the environmental requirements. Chile today has, in some productive sectors as in the mining case, advanced technologies that seek to increase productivity and efficiency. They often involve risk management that reduces impacts on the environment. The progress is also due to the different international agreements signed, which has helped in the adoption of such technologies.

During the last two decades, Chile has also joined multilateral environmental initiatives, signing a number of agreements, such as the Basel Convention, Rotterdam Convention, Stockholm Convention and Kyoto Protocol, among others.

In 2006, the National Strategy on Climate Change was approved by the Council Members of CONAMA. In 2008, the Action Plan on Climate Change 2008-2012 was published.

After more than a decade of application of Law 19.300 and considering the need to strengthen environmental institutions in Chile, Law 20.173 was issued in 2007, creating the post of Minister President of CONAMA .

In January 2010, Law N° 20,417 introduced amendments to the Chilean environmental Institutional framework, creating:

- **The Ministry of Environment,** responsible for the design and implementation of policies, plans and programs for environmental protection, biological diversity and renewable natural resources conservation, promoting sustainable development and the integrity of environmental policies and legislation regulating.

- **The Ministers for Sustainability Board**, which acts as a deliberative body of public policy by integrating different ministers. One of the main responsibilities is to ensure regulatory integrity. Its decisions are binding and mandatory.

- **The Environmental Assessment Service,** the technical body responsible for administering the Environmental Assessment System. Its central function is to manage the information system on environmental permits and licenses and the base line information system of the projects.

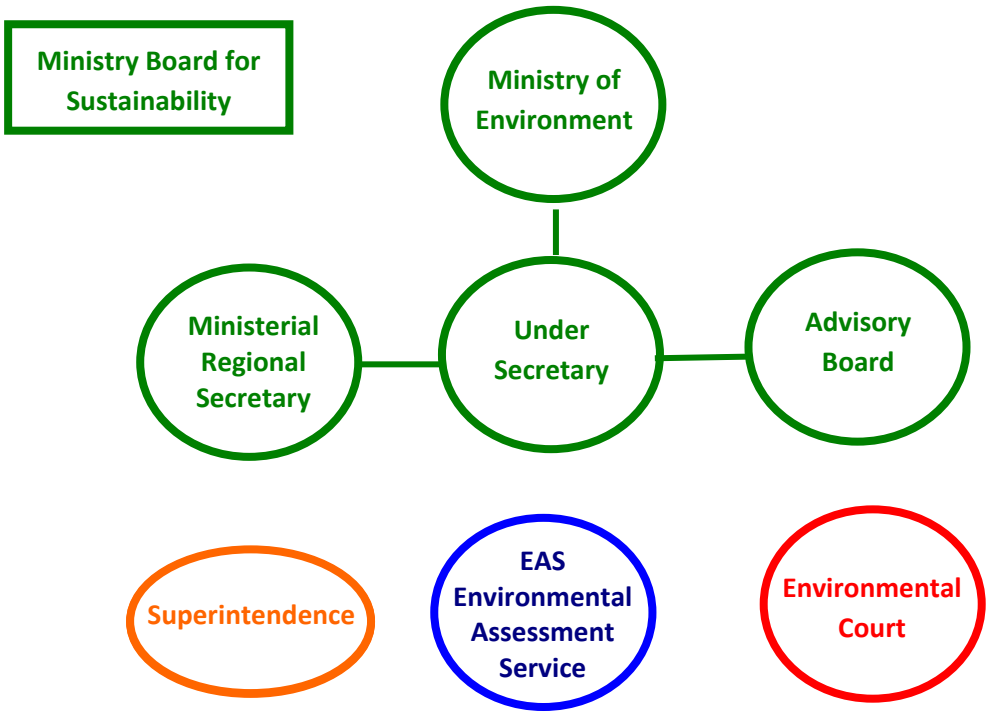
- **The Superintendence of Environment,** an autonomous body whose purpose is to manage an integrated environmental control intended to implement, organize and coordinate the monitoring and control of environmental qualification decisions.

The institutional framework redesign will be complemented by the creation of the Environmental Courts and the Service of Biodiversity and Protected Areas. These bills are currently with Congress. This includes a proposal for establishment of Environmental Law Courts, which would be an independent special court, subject to the directive of the Supreme Court.

The objectives of the Service for Biodiversity and Protected Areas is to ensure the preservation of nature and environmental heritage conservation, in order to protect

biodiversity, and proposes to the Ministry of Environment to create protected areas to be promoted to the Ministerial Council for Sustainability.

The new structure of the Ministry of Environment, since August 2011, is shown in the diagram below:



Chile and Climate Change

Chile signed the Kyoto Protocol in 1997 and ratified it in August 2002. Regarding this Agreement, the country has been very active in the promotion and implementation of projects under the Clean Development Mechanism (CDM). Chile has become a major player in Latin America and at a worldwide level in terms of registered projects and approved methodologies.

Concerning the interest in using the CDM swiftly, Chile established its Designated National Authority (DNA) in 2003, a Protocol's requirement to develop projects aimed at reducing emissions through the CDM in order to participate in the carbon market. Chile has 73 projects in the UN Pipeline.

At the end of 2010, the CDM Executive Board had registered 42 of these projects, anticipating an overall reduction of 4.9 million tons of CO2 equivalent (UNFCCC, 2010). In terms of evolution in the number of national projects requested approval to participate in the CDM, it is important to note that since 2007, there was a downward trend in the number of projects with only 4 projects approved in 2009. This trend was reversed in 2010 when 20 projects were approved.

The Export Promotion Bureau, PROCHILE under the Ministry of Foreign Affairs, is primarily responsible for the promotion of the Chilean project portfolio abroad.

In August 2010, Chile submitted its voluntary commitment to mitigate Greenhouse Gases to the Secretariat of the United Nations Framework Convention on Climate Change. The target

is that by 2020, 20% of the installed capacity of national electricity generation comes from non-conventional renewable energies, which are environmentally sustainable in local and global terms. Similarly, Chile adopted the green growth concept in the OECD, whose central axis is to move towards a low carbon economy.

9. Technology and R&D Summary

In the Chilean Environmental Industry Survey 2011 conducted for this report, environmental companies were asked: "How do you view the state of domestic research and development in environmental technology or any specific segments of the environmental industry in Chile? Who is leading this effort (government, universities, companies, etc.) and is the level of priority, effort and investment increasing notably?"

The open-ended question allowed respondents to comment on the state of environmental R&D. Few companies painted a positive domestic picture, but most indicated that there was access to high-level technology from global sources adapted for local use. Obstacles of inadequate links between business and universities were cited. These are some of the comments:

- In Chile, the basic knowledge about the development of environmental technologies is high.
- I would say R&D is at a good level in Chile and it is lead by the technology sector and private companies.
- I fear that in Chile the most we do is to bring technologies from Europe and / or USA
- Currently there is little investment in research and development of environmental technology in Chile. In general environmental technologies are purchased abroad.
- Research and development is very slow in Chile and there is very little in the way of business-university relationships that could further development of environmental technology.
- In Chile most companies simply copy and improve what is already known, or adapt technology or processes to domestic needs.
- The share of expenditure on R&D in Chile is 0.4% of GDP, which is quite low. Universities are the principal source of environmental R&D. Others are hoping for regulatory changes that would encourage growth in the sector, especially the private companies in the field.
- Chile does not make you want to develop new prototypes or models because there is [little] intellectual property protection.
- Research at the regional level is low. What is mostly done in Chile is the application of proven technologies from other countries.
- R&D in Chile is very low. The standards in the market are set by leading international companies and I do not see growth in investment in environmental R&D as a priority in Chile.
- Research is advancing much more slowly than required by industry and not always focused on applications to real problems
- Slow, because government support is needed to discern and define the environmental business in the longer term.

Investigation into the validity of these survey comments leads the following remarks.

According to the 6th Survey of Research and Development (R&D) conducted by the National Institute of Statistics, and the Third Survey about Expenditure and Staff on Research and Development conducted by the Chilean Ministry of Economy, spending on R&D is 0.4%, one of lower scoring nations, according to the OECD Science, Technology and Industry Scoreboard 2011. Business sector involvement in terms of funding is only at 43.7%, which is quite low compared to the OECD average of 63.7%. The state's participation in Chile is 33.8%, which is higher than the average share of OECD States, with an average value of 27.9%. In terms of implementation, the 40.4% is held by the private sector, compared with 69.6% OECD average.

In terms of intellectual property (IP), adequate protection of IP is a high priority for Chile. Recently, Chile has acceded to several WIPO multilateral treaties (Trademarks Law Treaty, Patent Cooperation Treaty, Budapest Treaty and the Brussels Convention) and is in the constant process of domestic implementation of its international commitments, which have contributed to substantially improving the standards of the Chilean IP system. Chile is also developing an ongoing process with the aim of strengthening several public institutions, such as the creation of an Intellectual Property Crimes Brigade (BRIDEPI) exclusively devoted to investigate both intellectual and industrial property rights violations. Due in part to these achievements, the European Commission’s annual report regarding IP enforcement recognized the efforts undertaken by Chile in this area.

Additionally, the enactment of the most important reform to the Chilean copyright law in the past 40 years is a clear example of these improves. The copyright reform seeks to substantially improve the protection of intellectual property incorporating new civil and criminal procedures and guarantees the legitimate access for its citizens to cultural goods, through the incorporation of internationally recognized exceptions and limitations.

10. Education and Training

For the Chilean Environmental Industry Survey 2011 conducted for this report, environmental companies were asked, "What percentage of your technical staff were educated abroad and do you believe domestic educational institutions are producing an adequate supply of engineers, scientists and trained officials to [do] environmental jobs in government and the private sector today?"

The mean response was that about 10% of technical staff in EGS companies operating in Chile were educated out of the country, indicative of an education and training system more than adequate to supply personnel to the EGS industry. 38% of survey respondents said 5% or fewer were educated abroad and only 12% said 40% or more of technical staff were educated out of the country.

Table 10-1
Percentage of Technical Staff Educated Abroad

Range	No. of Firms	Share of Total
0%	8	19%
1-5%	8	19%
7-15%	14	33%
20-25%	7	17%
40-50%	3	7%
60-100%	2	5%
	42	

Responses to the open-ended question "Do you believe domestic educational institutions are producing an adequate supply of engineers, scientists and trained officials to [do] environmental jobs in government and the private sector today?" varied considerably. While more said yes than no to the basic question, many that said yes qualified their responses with improvements required or elements lacking in the stock of technical personnel produced by the Chilean education system.

- Yes, but only at the level of environmental management. Many graduates in Chile do not have the technical capabilities to carry out a proper evaluation of a project and even less, a subsequent audit or official report that is required.
- Yes, in general there are many courses and institutions that train professionals in environmental matters.
- Increasingly.
- Yes, but at a low level only
- There are enough people yes, but those who are really qualified, no.
- Absolutely not, there is a disconnect between the level of professionals that are produced and the technology and products that are used in the international market

- Not yet. I think that they need more training in this area.
- There is a lack of expertise in the academic institutions in the subject matters applied in real environmental projects in the market
- Many are produced but they are low-skilled
- There is no educational policy in this area like there is in European countries, the USA, Australia or Japan. Programs in Chile are limited to industrial development and marketing aspects but do not provide enough emphasis on research,. development and regulatory aspects of chemicals and sustainable development
- No, I believe the most ambitious students specializing in environmental studies should be studying overseas

11. Chilean Companies' Suggestions of Initiatives for EGS Industry Support

For the Chilean Environmental Industry Survey 2011 conducted for this report, environmental companies were also asked, "What could the Chilean government, domestic trade organizations or any international organizations do to make business better for you or make the Chilean environmental industry more competitive?"

These comments were collected from private companies. Because responses were given to a question about what could be done better, they are unlikely to emphasize the positive.

Survey Responses

- Clarity and consistency in environmental regulation
- The Chilean government should train more government employees who work in [environmental compliance], improve their working tools (computers and software), so the corporate sector is motivated to meet environmental requirements. In the case of international organizations, seek to standardize environmental regulations, or at least be clear about the similarities and differences in order to have a clear idea of what and how to export
- The government invests in development of international research organizations with loans to encourage the investment in environmental quality
- Make sure environmental studies are done by companies that are in Chile. For many industries (Codelco for example), it is easier to hire a foreign company than a Chilean one
- Establish funding lines for the implementation of new technologies and research and development.
- The generation of quality standards and training of specialists in the enforcement of environmental regulations and legal codes (DS 90/2001, 46/2001 DS, etc.).
- Require compliance with environmental regulations and provide long-term soft loans to enforce the rules
- Improve oversight and greater control of enforcement
- Fostering technology research, greater international integration in environmental issues
- Regulations at the level of Europe and the USA. Promote enterprise responsibility, promote Chilean product registration, support local research and development
- Work on improving environmental standards, including a department on climate change.

Chilean Government Programs

While no Chilean government agency has specifically targeted programs to support the development of EGS market or the industry in Chile, a number of departments have started initiatives as reported in a July 2011 inter-department meeting concerning the EGS industry.

Ministry of Environment: While responsible for environmental quality and indirectly the principal driver of EGS markets, the new Ministry of Environment realizes that Chile has a challenge to develop national environmental technologies and goods. Ministry of Environment recognizes Spain, which previously imported turbines for wind power, and currently exports these products through national companies. Some specific examples that offer potential already are: a robotic technology that collects waste from the bottom of rivers in aquaculture; advanced work in vineyards and biodynamic compounds in wine; and the potential of exporting environmental consulting services.

Ministry of Mining: Mining is one of Chile's largest sectors and the Ministry of Mining recognizes it is very important for Chile to have environmental goods and services that offer solutions to the mining sector, as well as support the design of policies in the development of the EGS sector. The new installation of an Australian Research Centre for biotechnology research and innovation in mining and research entities the Institute of Mining and Metallurgy and Biosigma are also seen as sources of industry competitiveness.

Ministry of Economy: The Ministry recognizes that many EGS companies are SMEs and has conducted a survey recently to obtain information of SMEs and their current status.

National Council for Cleaner Production: Chile recognizes a desire to determine or classify the supply of EGS in two different types: for treatment or for prevention (the last one is an objective pursued by the Council) and is hopeful that further studies could calculate the participation or percentage of the EGS market is in prevention. The Council also believes it would be important to establish the Best Available Technologies in environmental goods and services.

Ministry of Energy: Ministry of Energy notes that the State enacted Laws N°19940 (2004), N°20018 (2005) and N° 20.257 (2007) to promote the development of renewable energy and diversify the energy mix. There is also a tax exemption of 100% for new houses, to foster the construction and use of solar collectors up to 4,500 UF as well as other incentives. Chile recognizes that the development of renewable energy needs an auxiliary industry and is interested to know renewable energy industries have developed in other APEC economies.

Renewable Energy Center (CER) has provided an initial study of renewable energy companies and will continue research on the sector.

Invest Chile notes the existence of an instrument in Invest Chile that aims to increase high-tech investments in Chile. One of the requirements is that the ownership of the company should be over 50% foreign. Invest Chile co-finances up to a total amount of US$2 million

InnovaChile aims to promote the values of entrepreneurship and innovation, support business development that generates high economic and social impact, and facilitate tools to know and adopt good practices and innovation within companies. In addition, the Chilean Economic Development Agency – CORFO, after several changes in its approach, now aims to increase the competitiveness of the country through its productive structure. CORFO has a wide range of support lines, having several targeted specifically related to environmental issues, based on improved management processes:

• Pre- investment in Non-Conventional Renewable Energies Program
• Promotion of Quality
• FAT Technical Assistance Funds
• Pre-investment Energy Efficiency Program.
• Pre-investment Environment Program in
• Irrigation Pre-investment Program
• Pre-investment Artisan Fisheries Management Program

CORFO also makes available resources to promote innovation and entrepreneurship, through competitive grants that target those small businesses that provide environmental services.

Ministry of Health: Although the Ministry of Health does not make policies or tools to promote environmental goods and services, this Ministry is responsible for protecting the population's health. It therefore controls factors, elements or environmental agents that may affect population health, some examples of which are regulating and monitoring the quality of drinking water or sanitary conditions and establishing minimum security in waste management. This Ministry works directly with environmental services suppliers through the formalization and control processes of the respective activities.

Superintendence of Sanitary Services: This entity regulates the quality and coverage of drinking water and wastewater treatment and water treatment. They oversee companies using the discharge regulations as a tool of assessment. SISS provides a comprehensive annual report of the sector.

12. Appendix

Environmental Industry Segments

Segment	Description	Examples of Clients
Environmental Services		
Environmental Testing & Analytical Services	Provide testing of "environmental samples" (soil, water, air and some biological tissues)	Regulated industries, Gov't, C&E, Hazardous waste and remediation contractors
Wastewater Treatment Works	Collection and treatment of residential, commercial and industrial wastewaters. Facilities are commonly know as POTWs or publicly owned treatment works.	Municipalities, Commercial Establishments & All industries
Water Utilities	Selling water to end users: Municipal entities and private companies	Consumers, Commercial, All industries, Institutions
Solid Waste Management	Collection, processing and disposal of solid waste & commercial collection of recyclables	Municipalities & All industries
Hazardous Waste Management	Collection, processing and disposal of hazardous, medical waste, nuclear waste	Chemical, Petroleum, Mfgrs Government agencies
Remediation and Industrial Services	Cleanup of contaminated sites, buildings and environmental cleaning of operating facilities	Government agencies Property owners, Developers Industry
Environmental Consulting & Engineering (C&E)	Engineering, consulting, design, assessment, permitting, project management, O&M, monitoring, etc.	Industry, Government Municipalities, Waste Mgmt. companies, POTWs
Environmental Equipment		
Water Equipment & Chemicals	Provide equipment, supplies and maintenance in the delivery and treatment of water and wastewater.	Municipalities & All industries
Instruments & Information Systems	Produce instrumentation for the analysis of environmental samples. Includes info systems and software.	Analytical services, Gov't Regulated companies
Air Pollution Control Equipment	Produce equipment and tech. to control air pollution. Includes vehicle controls.	Utilities, Waste-to-energy Industries, Auto industry
Waste Management Equipment	Equipment for handling, storing or transporting solid, liquid or haz waste. Includes recycling/remediation equipment.	Municipalities Generating industries Solid waste companies

Source: Environmental Business International Inc. (San Diego, Calif.)