Adelca Carbon Footprint Report 2011

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Prepared by	Tom Gibbs	19.11.2012
Checked by	Aphra Morrison	19.11.2012
Approved by	Kevin Houston	19.11.2012

Title: Adelca Carbon Footprint Report 2011
Client: Adelca

Address: Carbon Masters, Edinburgh Technology Transfer Centre, The University of Edinburgh, King's Buildings, 4th Floor, Alrick Building, Edinburgh EH9 3JL.

Telephone: +44 (0) 131 472 4815

Authors: Tom Gibbs, Carbon Masters Consultant
Approved by: Kevin Houston, Company Director

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Executive Summary

Introduction

Adelca, Acería del Ecuador C.A. a steel manufacturing company based in Quito, Ecuador, has commissioned Carbon Masters to carry out its first organisational carbon footprint. This report is based on data provided by Adelca for the calendar years 2009, 2010 and 2011 and enables a comparison of Carbon emission performance against previous years. The results in this report also provide a baseline for Adelca to develop a carbon management strategy and a plan on how to reduce their carbon emissions in future years.

Carbon Masters consultants have been working closely with Adelca's personnel to ensure the best data is used at all times. The footprint assessment has been calculated using the Carbon Guru software platform and its associated methodology based on International standards (GHG Protocol and ISO 14064 part 1) and in addition has a strong focus on quality assurance.

This assessment followed the Greenhouse Gas Protocol and covers all Scope 1 (direct) and Scope 2 (indirect) emissions sources and several Scope 3 (indirect) emission sources. These cover e.g electricity consumed from the grid, oil/fuel used for both owned transport and in the furnaces in Laminados. In addition to direct emissions fuel used in third party hauliers for both inbound and outbound logistics, water use, waste sent to landfill. All the basket of six greenhouse gases as identified in the Kyoto Protocol have been included in the assessment and the results are represented in tonnes of carbon dioxide equivalent (tCO_2e).[1]

Carbon Footprint Results

In summary, Adelca's emissions for calendar year 2011 were 154,400 tCO_2e. They have increased from 133,600 tCO_2e in 2009 and 147,800 in 2010. An increase of 9.7% and 4% respectively. Scope 1 emissions (direct emissions) forms the largest part of Adelca's carbon footprint largely due to the process emissions involved in their steel manufacturing processes and the emissions from the fuel consumption arising from Adelca's company-owned vehicles. The three highest identified emission sources which together constitute c. 55% of Adelca's total carbon footprint are: electricity, fuel usage and inbound logistics via air freight.

Figure 1 Adelca's Direct and Indirect Carbon Emissions (Scopes)

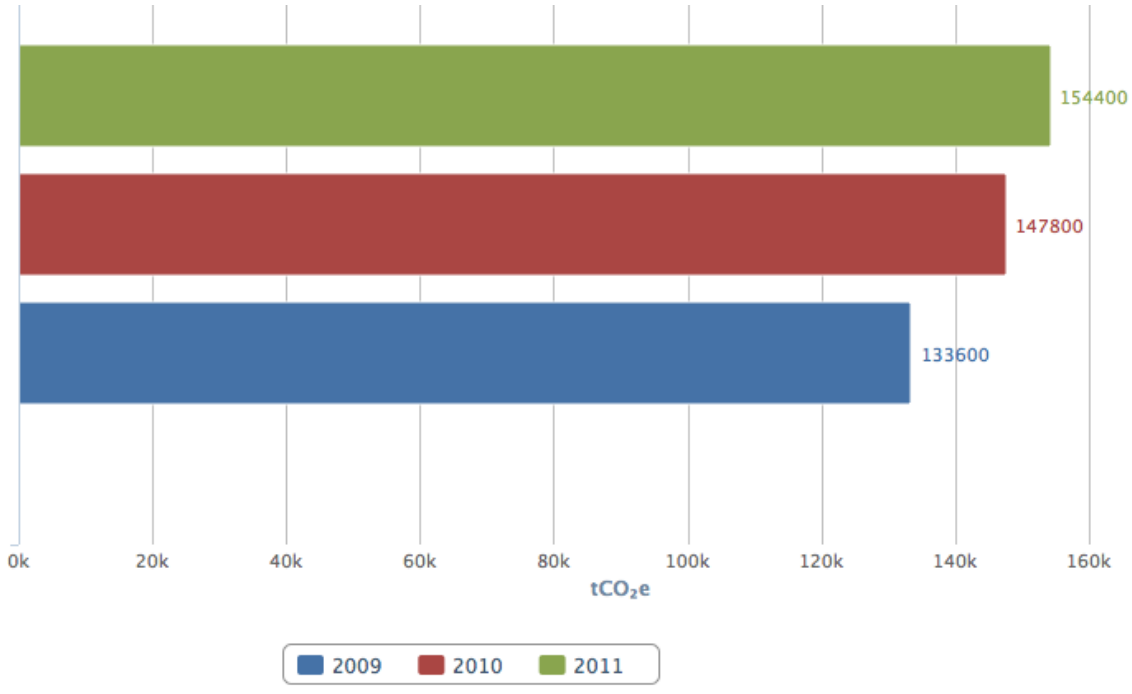
Scope		tCO_2e/year	%
Scope 1		60,790	39
Scope 2		46,842	30
Scope 3		46,818	30
	Total	154,449	100

[1] The six Kyoto gases are carbon dioxide (CO_2), methane (CH_4) nitrous oxide (N_2O), hydrofluorocarbons (HFCs), sulphur hexafluoride (SF_6) and perfluorocarbons (PFCs). The global warming potential (GWP) of each gas is shown in the Appendix A.

Table 1 Adelca's Top Ten Emission Sources 2011

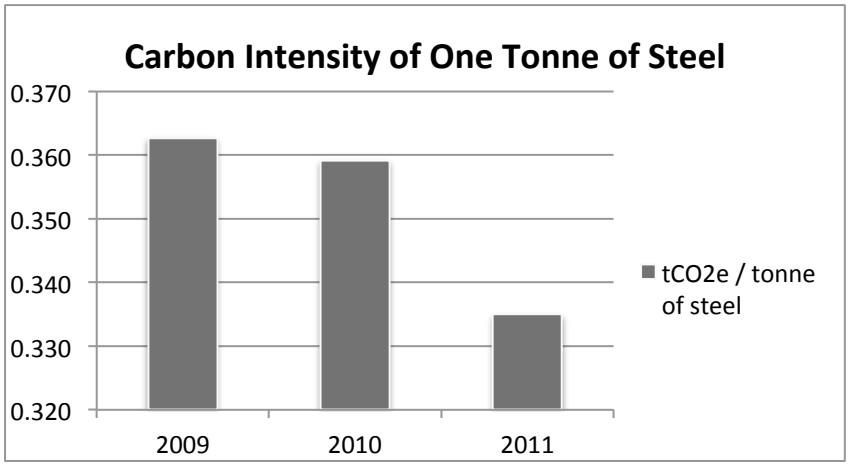
Business Unit	Scope	Activity	Question	Type	tCO_2e	% Of Total
Acería	2	Premises	Electricity	Electricity	38,547	24.96%
Otros	3	Inbound Third-Party Deliveries	Air freight	Average air freight	26,052	16.87%
Laminados	1	Premises	Other fuel(s)	Residual fuel oil, stationary	19,253	12.47%
Acería	1	Process Emissions	Coal	Anthracite	17,433	11.29%
Otros	3	Inbound Third-Party Deliveries	Road freight, shared vehicle	Truck deliveries	11,818	7.65%
Laminados	1	Premises	Other fuel(s)	Diesel	7,507	4.86%
Acería	1	Premises	Other fuel(s)	LPG	6,072	3.93%
Laminados	2	Premises	Electricity	Electricity	5,888	3.81%
Otros	3	Inbound Third-Party Deliveries	Sea freight	Sea freight, Bulk carrier, average	5,134	3.32%
Acería	1	Process Emissions	Carbonate Flux	Dolomitic lime	4,241	2.75%

Figure 2 Emissions Trends 2009, 2010, and 2011



However, the company's production output has risen at a higher rate than its carbon emissions which means each tonne of production in 2011 has a lower carbon intensity than in 2009.

Figure 3 Carbon Intensity of One Tonne of Steel



Key Performance Indicators

In addition to collecting data on emission sources, Adelca also provided to Carbon Masters a series of key performance indicator data covering their steel making operations. Carbon Masters have used this data in consultation with steel experts in the UK to carry out a comparison of Adelca's KPI's with other similar steel manufacturers. A full comparison of the data vs the benchmark is contained in *Recommendations* section of this report (part 7.2).

When compared to other steel plants with similar operations, we identified several areas where Adelca's performance in terms of energy efficiency could be improved. The largest variance between Adelca's performance and other typical plants were in:

i. The billet-reheating furnace in Laminados: 3.96 GJ is used to heat every tonne of billet compared with 1.8 – 2.5 GJ per tonne of billet in a typical plant.
ii. In Aceria's EAF, Adelca consumes greater amounts of electricity, electrodes and refractory per tonne of steel than in other typical plants.
iii. The casting shop in Acería also consumes over 25 kWh of electricity more per tonne of steel compared with other plants (40 kWh versus 10-20 kWh).

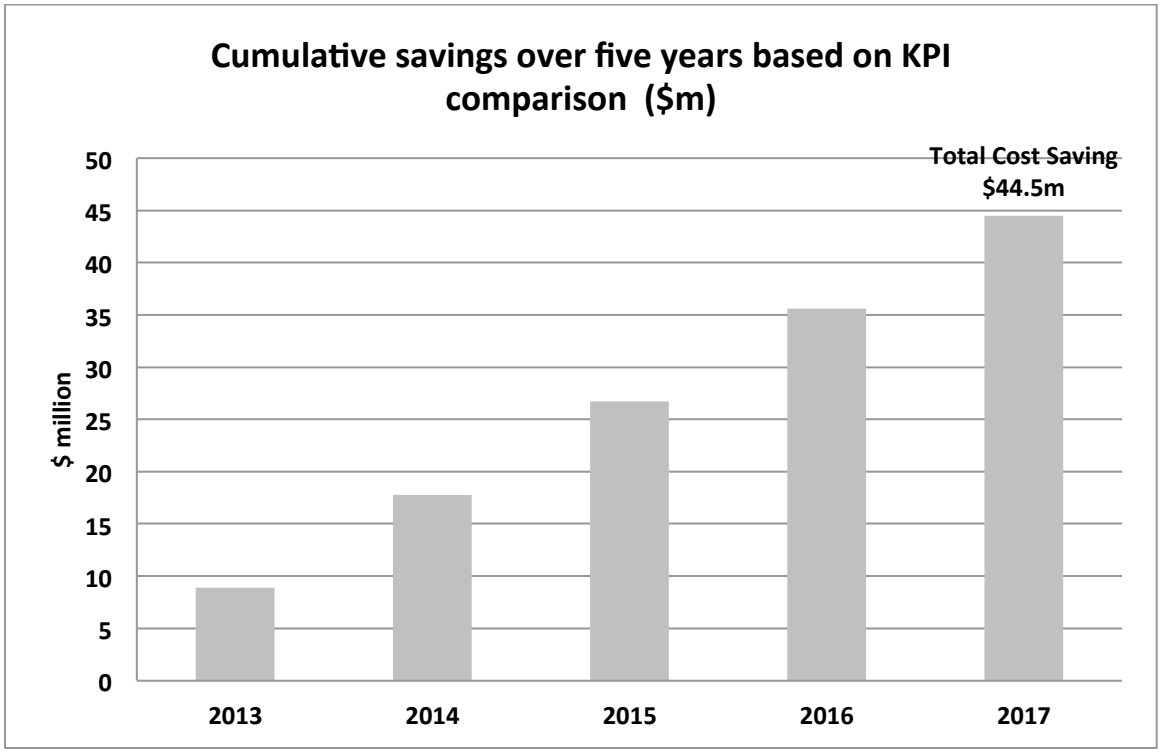
Potential Savings

Energy, business travel, waste, water and logistics/deliveries etc. all provide potential opportunities to reduce carbon emissions and cut costs right across Adelca's operations**. In particular, the KPI figures for Adelca's production processes indicate immediate cost savings potential from a number of identified improvements of close to $9million per annum [at current throughput rates].** The improvement in reheat furnace energy efficiency [valued at ~$4m per annum] is the largest item within this total. The combined annual savings over a five-year period reaches almost $45 million.

Table 2 Adelca's Potential for Cost Reductions

Parameter	Change	Impact $/t	Tonnage	Annual Cost saving $m
Electrode use	20% improvement	$5/tonne	225kt	$1.1m
Refractory use	50% improvement	$4/tonne	225kt	$0.9m
EAF electricity use	Reduce by 75 kWhr/t	$4.50/t	225kt	$1.0m
EAF yield	2% improvement	$8/tonne	225kt	$1.8m
Caster yield	2% improvement	$0.35/tonne	200kt	$0.1m
Reheat furnace energy	2 GJ/t improvement	$20/t	200kt	$4.0m
Total				$8.9m

Figure 4 Potential for Cost Savings over Five Years



Recommendations

Carbon Masters have provided a series of recommendations designed to reduce Adelca's carbon emissions and cut costs:

- **Develop and implement a Carbon Management Plan** for the entire organisation that has support from senior management, to ensure ongoing commitment to reducing emissions. This plan would cover the detailed projects that Adelca could carry out to reduce their emissions, reduce their energy consumption per tonne of steel produced, improve their energy efficiency, and recue the overall costs of their operations

- **The emission reduction activities**, should have a major emphasis on reducing emissions from the three highest identified emission sources which together constitute c.55% of Adelca's total footprint: **Electricity, fuel usage and inbound logistics.**
- **Reduce electricity consumption** per unit of steel produced in Acería by seeking specialist advice on improving the energy efficiency of the steel making process and options for reducing the carbon emissions associated with the EAF and process emissions.
- **Consider how current energy supplies are procured** and whether or not there may be an opportunity to re-negotiate contracts / change suppliers / agree a fixed price etc. to reduce costs.
- **Fuel usage:** carry out a renewable energy scoping study to investigate switching to renewable energy sources to replace the use of these fuels. For example, develop a renewable energy project that investigates wind turbines, biomass boilers, solar panels, heat pumps etc. as a way of displacing fossil fuel-based sources of energy including electricity from the grid.
- **Review transportation/logistics procedures** to identify any potential for savings. Specifically explore switching inbound airfreight logistics to road and sea freight to reduce costs and carbon.

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1 Introduction

1.0 Background

Adelca, Acería del Ecuador C.A., is the leading company in the production of long steel in Ecuador with more than 1,400 employees, and an installed capacity for the production of 25,000 tons of steel per month. The company is also the largest recycler in the country, transforming thousands of tons of scrap metal into steel every year using an electric arc furnace. At the steel works, scrap steel is turned into large billets which are passed onto to a separate production line to be loaded into a reheating furnace. The re-heated billets are then passed down the production line onto a roughing mill and drawn to produce steel rods of various dimensions to be sold for example to the construction industry. On a third production line, steel wire from the plant is combined with imported wire from abroad and transformed into various products for example nails, fencing, mesh etc.

Adelca takes its responsibilities in the areas of sustainability and corporate social responsibility very seriously. Its work in this area was recently recognised and praised by the Autonomous Government of Pichincha at the 2012 General Rumiñahui Awards. The objective of this recognition is to evaluate and celebrate the work of Ecuadorian organisations that comply fully with their work commitments, tax, environmental responsibilities, and through their actions act as an exemplar for other organisations. Besides the new project to measure and reduce the company's Carbon Footprint with Carbon Masters, Adelca has been part of the United Nations Global Compact since December 12th, 2011, and is continually working with stakeholders in different programs such as:

- Recyclers Club
- Training for the community
- Health for the community
- Continuing education
- Colleges and schools
- Junior achievement
- Senior/elderly
- Children from the parish
- Mothers support
- Autistic
- Down syndrome
- Reforestation
- Inclusive business

1.1 Aims & Objectives

This carbon footprint report quantifies Adelca's 2011 Greenhouse Gas (GHG) Emissions covering their steel production plant and their two manufacturing sites where they turn the finished steel (billets and wire) into a range of products such as nails, fencing and steel rods for construction. By accurately measuring the GHG emissions associated with their operations, Adelca can develop and improve their carbon management activities and identify opportunities for energy efficiency improvements and carbon emission reduction. By taking proactive steps to measure, manage, report and reduce their carbon emissions, Adelca are demonstrating leadership and showing commitment

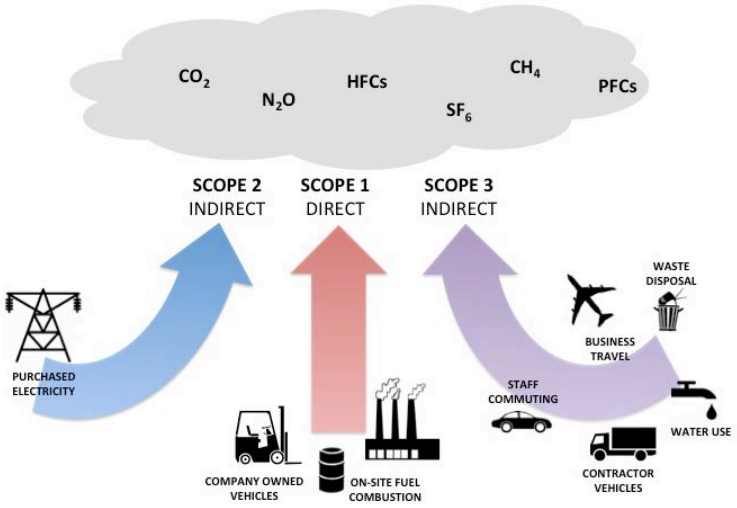
to addressing the risks associated with dangerous climate change. The methodology used to calculate the footprint is fully in line with the Greenhouse Gas Protocol. This report covers the emissions from Adelca's steel manufacturing facilities in Aloag, near Quito, Ecuador. It includes Scope 1, Scope 2 and some Scope 3 emissions sources using the most up-to-date conversion factors.

1.2 What is a Greenhouse Gas Assessment?

A greenhouse gas emissions assessment quantifies the total greenhouse gases (GHGs) produced directly and indirectly from an organisation's activities within a specified timeframe. It quantifies all six Kyoto greenhouse gases where applicable and is measured in units of carbon dioxide equivalent, or CO_2e. The six Kyoto gases are carbon dioxide (CO_2), methane (CH_4) nitrous oxide (N_2O), hydrofluorocarbons (HFCs), sulphur hexafluoride (SF_6) and perfluorocarbons (PFCs). The global warming potential (GWP) of each gas is shown in the Appendix A.

This assessment has been carried out in accordance with the World Business Council for Sustainable Development and World Resources Institute's (WBCSD/WRI) Greenhouse Gas Protocol; a Corporate Accounting and Reporting Standard. This protocol is considered current best practice for corporate or organisational greenhouse gas emissions reporting. GHG emissions have been reported by the three WBCSD/WRI Scopes:

Figure 5 WBSCD/WRI Greenhouse Gas Emissions Scopes



Scope 1 includes direct GHG emissions from sources that are owned or controlled by the company such as natural gas combustion and company owned vehicles.

Scope 2 indirect GHG emissions from the consumption of purchased electricity, heat or steam.

Scope 3 includes all other indirect emissions such as waste disposal, business travel and staff commuting. Reporting of these activities is optional under the WBCSD/WRI GHG Protocol, but as they can contribute a significant portion of overall emissions Carbon Masters recommends they are reported where applicable.

1.3 Boundary and Scope

The operational control approach has been used to determine the organisational boundary of this assessment and covers all operations over which the company has the full authority to introduce and implement its operating policies. The operational boundary of this assessment covers all of the Scope 1, Scope 2, and a wide range of Scope 3 emissions arising from Adelca's operations as demonstrated in the table below.

Table 3 Summary of Data Included in thei GHG Assessment

Scope	Activity
Scope 1	Premises (LPG, diesel, residual fuel oil) Fugitive emissions (SF_6 from circuit breakers) Company-owned vehicles Process emissions (materials added during steel-making process e.g. coal, limestone)
Scope 2	Premises (electricity consumption)
Scope 3	Emissions from contractor-owned vehicles Waste (incinerated, landfill, recycled) Water supply Business travel (includes taxi, airplane, car, hotel) Inbound third-party deliveries (by road, sea, air) Outbound third-party deliveries (by road)

1.3.1 Exclusions

The following sources have been excluded from the assessment:

Table 4 Exclusions

Emission Source	Reason for exclusion
Heat and power at regional sales / scrap collection points	Lack of data / immaterial
Employee commuting	Lack of data
Refrigeration units / air con	Immaterial
Heat and power at Cumbaya office	Lack of data / immaterial

1.3.2 Business Units

Adelca's GHG assessment has been organised into four 'control points' to cover each of the company's business units as shown in the table below:

Table 5 Adelca's Business Units

Area	Description
Acería (Steel Works)	This is where scrap metal is melted down using an electric arc furnace (EAF) and recycled into steel 'billets' (a semi-finished casting product).
Laminados (Rolled Steel)	The billets then enter the reheating furnace and are heated to approximately 1200 degrees to enable the lamination process. This involves sending the hot billets through a roughing mill to decrease their diameter and increase their length to create rods of various dimensions used mainly in the construction industry.
Trefilados (Wire Drawings)	Some of the output from Laminados goes into a block which forms loops and produces wire rod. After going through a stripping process (removing the superficial oxide), the wire

	rod undergoes a cold mechanical transformation, reducing its diameter according to needs. The output in the shape of a coil can be the final product or raw material for other products such as nails, fencing etc.
Otros (Others)	This includes all other emission sources not directly attributable to one of the three areas above. For example, the administrative side of the business (emissions arising from offices), inbound and outbound third-party deliveries, business travel etc.

2 Results 2011 Carbon Footprint by Scope

Scope 1 emissions form the largest portion of Adelca's carbon footprint which is due to the highly energy intensive processes involved in manufacturing steel. However, the use of electricity to make steel in the electric arc furnace and the presence of a global supply chain means that scope 2 and 3 emissions are also significant.

Figure 6 Adelca's 2011 Emissions by Scope

Scope	tCO_2e/year	%
Scope 1	60,790	39
Scope 2	46,842	30
Scope 3	46,818	30
Total	154,449	100

2.1 Scope 1

At 39%, Adelca's Scope 1 emissions make up the largest share of their total GHG emissions. Measuring Scope 1 and Scope 2 emissions is a requirement under the GHG Protocol as these are considered to be the emissions a company has the most ability to control.

Table 6 Adelca's 2011 Scope 1 Emissions

Source of Emissions	Carbon Dioxide Emissions (tCO_2/yr)	Methane Emissions (tCH_4/yr)	Nitrous Oxide Emissions (tN_2O/yr)	Total Emissions (tCO_2e/yr)	Percentage
Scope 1	**60,540**	**3.2**	**0.52**	**60,790**	**39%**
Company-Owned Vehicles	137	0.0063	0.0013	138	0%
Cars	137	0.0063	0.0013	138	0%
Premises	33,538	1.2	0.22	33,649	22%
Other fuel(s)	33,538	1.2	0.22	33,634	22%
Dielectric medium loss	0	0	0	15	0%
Process Emissions	26,865	2	0.3	27,002	17%
Coal	19,330	2	0.3	19,468	13%
Carbonate Flux	5,892	0	0	5,892	4%
EAF Carbon Electrodes	1,643	0	0	1,643	1%

*Other fuels(s) is comprised of diesel, propane and bunker oil.
** Dielectric medium loss represents SF_6 in circuit breakers.

2.2 Scope 2

Adelca's Scope 2 emissions consist entirely of electricity emissions from electricity purchased from the grid. In fact, electricity is the single largest source of carbon emissions in all of Adelca's operations.

Table 7 Adelca's 2011 Scope 2 Emissions

Source of Emissions	Carbon Dioxide Emissions (tCO_2/yr)	Methane Emissions (tCH_4/yr)	Nitrous Oxide Emissions (tN_2O/yr)	Total Emissions (tCO_2e/yr)	Percentage
Scope 2	**46,715**	**1.5**	**0.29**	**46,842**	**30%**
Premises	46,715	1.5	0.29	46,842	30%
Electricity	46,715	1.5	0.29	46,842	30%

2.3 Scope 3

Reporting Scope 3 emissions is optional under the Greenhouse Gas Protocol, but is recommended as best practice as:

a) They can contribute a significant amount to an overall footprint

b) Whilst they are indirect emission sources, Adelca may be able to influence them and bring about reductions in future years.

Table 8 shows the breakdown of Adelca's Scope 3 emissions – as you can see from the chart the majority of emissions in this category come from inbound third-party deliveries by air, road and sea. Emissions from inbound deliveries are significantly higher than for outbound because raw materials and goods and sourced from around the world whereas Adelca's finished products are nearly all sold within Ecuador.

Table 8 Adelca's 2011 Scope 3 Emissions

Source of Emissions	Carbon Dioxide Emissions (tCO_2/yr)	Methane Emissions (tCH_4/yr)	Nitrous Oxide Emissions (tN_2O/yr)	Total Emissions (tCO_2e/yr)	Percentage
Scope 3	**46,341**	**4.8**	**1.1**	**46,818**	**30%**
Business Travel	299	0.0086	0.0052	301	0%
Air travel	120	0.0018	0.0038	121	0%
Hotel night stays	35	0.00072	0.00011	35	0%
Taxi	144	0.0061	0.0013	145	0%
Inbound Third-Party Deliveries	42,673	0.54	1.1	43,005	28%
Air freight	25,798	0.4	0.82	26,052	17%
Road freight, shared vehicle (tonne.km factors)	11,783	0.14	0.11	11,818	8%
Sea freight (basic options list)	5,092	0	0.14	5,134	3%
Outbound Third-Party Deliveries	3,274	0.01	0.0099	3,277	2%
Road freight, whole vehicle (km factors)	3,274	0.01	0.0099	3,277	2%
Premises	20	4.2	0	159	0%
Incinerated waste	20	0	0	20	0%
Landfilled waste	0	4.2	0	105	0%
Water supply	0	0	0	34	0%
Sub-Contractors' Vehicles	76	0.0035	0.00072	76	0%
Cars	76	0.0035	0.00072	76	0%

3 2011 Carbon Footprint by Business Unit

In addition to measuring emissions by scope as recommended by the GHG Protocol, Carbon Guru an industry leading GHG accounting software platform, facilitates the measurement of emissions by business unit as well as emissions sources, which is arguably more useful to an organisation seeking to understand which parts of its operations emit the most greenhouse gases.

Figure 7 GHG Emissions by Business Unit (tCO2e)

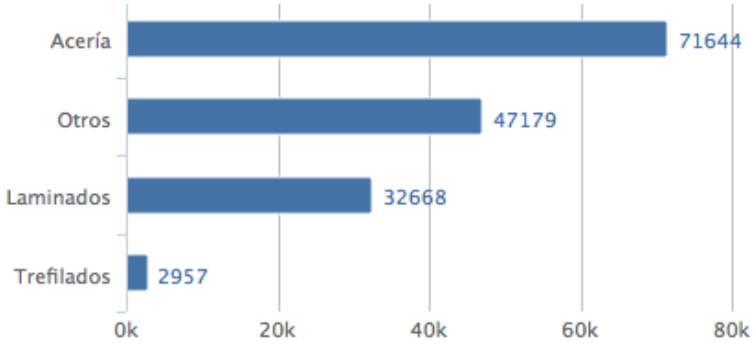


Table 9 Adelca's Top Ten Emissions Sources 2011

Business Unit	Scope	Activity	Question	Type	tCO_2e	% Of Total
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Otros	3	Inbound Third-Party Deliveries	Air freight	Average air freight	26,052	16.87%
Laminados	1	Premises	Other fuel(s)	Residual fuel oil, stationary	19,253	12.47%
Acería	1	Process Emissions	Coal	Anthracite	17,433	11.29%
Otros	3	Inbound Third-Party Deliveries	Road freight, shared vehicle	Truck deliveries	11,818	7.65%
Laminados	1	Premises	Other fuel(s)	Diesel	7,507	4.86%
Acería	1	Premises	Other fuel(s)	LPG	6,072	3.93%
Laminados	2	Premises	Electricity	Electricity	5,888	3.81%
Otros	3	Inbound Third-Party Deliveries	Sea freight	Sea freight, Bulk carrier, average	5,134	3.32%
Acería	1	Process Emissions	Carbonate Flux	Dolomitic lime	4,241	2.75%

3.1 Acería

Acería accounts for over 46% of Adelca's 2011 GHG emissions, with total emissions of 71,644 tCO_2e. As you can see from Figure 8, almost one quarter of Adelca's entire organizational footprint stems from electricity consumption in Acería (steel works). Another major source of emissions are process emissions from the addition of carbonate fluxes, deterioration of carbon electrodes, and consumption of coal. Altogether, these process emissions account for 17.5% of Adelca's overall carbon footprint.

Figure 8 Aceria Emissions (tCO2e)

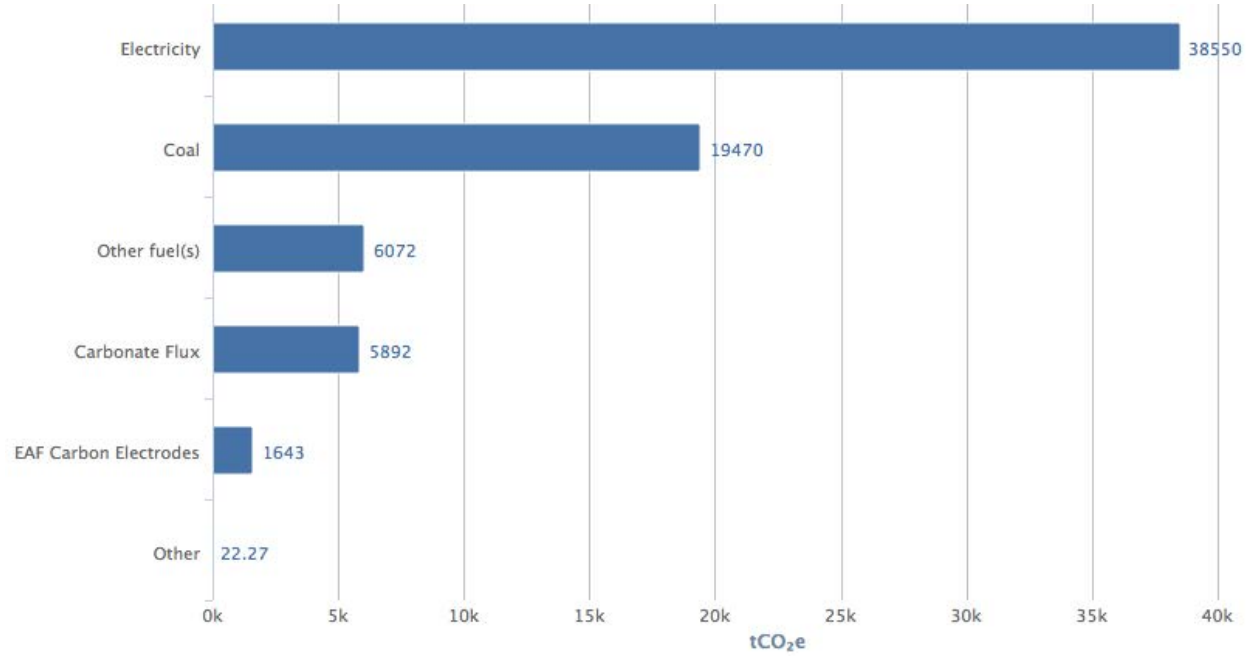


Table 10 Aceria Emission Sources

Business Unit	Scope	Activity	Question	Type	tCO_2e	% of Total
Acería	2	Premises	Electricity	Electricity	38,547	24.96%
Acería	1	Process Emissions	Coal	Anthracite	17,433	11.29%
Acería	1	Premises	Other fuel(s)	LPG	6,072	3.93%
Acería	1	Process Emissions	Carbonate Flux	Dolomitic lime	4,241	2.75%
Acería	1	Process Emissions	Coal	Coking coal	2,034	1.32%
Acería	1	Process Emissions	Carbonate Flux	Limestone	1,651	1.07%
Acería	1	Process Emissions	EAF Carbon Electrodes	EAF carbon electrode	1,643	1.06%
Acería	3	Premises	Water supply	Water supply	12	0.01%
Acería	1	Premises	Dielectric medium loss	SF6 (sulphur hexafluoride)	10	0.01%
Acería				**TOTAL**	**71,644**	**46.39%**

3.2 Trefilados

Trefilados emitted an estimated 2,957 tCO_2e in 2011 which makes up less than 2% of Adelca's 2011 emissions. Electricity is the main source of emissions in Trefilados. A breakdown of emissions from Trefilados is shown in Figure 9.

Figure 9 Trefilados Emissions (tCO2e)

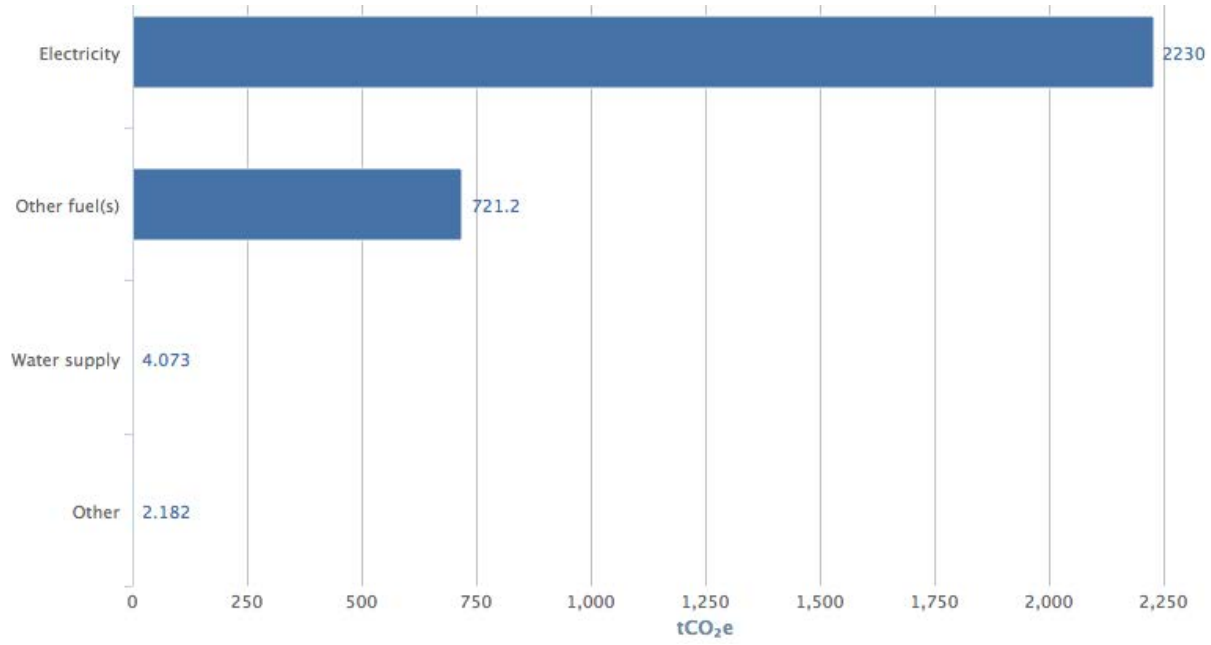


Table 11 Trefilados Emission Sources

Business Unit	Scope	Activity	Question	Type	tCO_2e	% of Total
Trefilados	2	Premises	Electricity	Electricity	2,230	1.44%
Trefilados	1	Premises	Other fuel(s)	Residual fuel oil, stationary	519	0.34%
Trefilados	1	Premises	Other fuel(s)	Diesel	202	0.13%
Trefilados	3	Premises	Water supply	Water supply	4	0.00%
Trefilados	1	Premises	Dielectric medium loss	SF6 (sulphur hexafluoride)	2	0.00%
Trefilados				**TOTAL**	**2,957**	**1.91%**

3.3 Laminados

Laminados contributes 21.15% towards Adelca's total carbon emissions. The largest source of emissions comes from the stationary combustion of residual fuel oil.

Figure 10 Laminados Emissions (tCO2e)

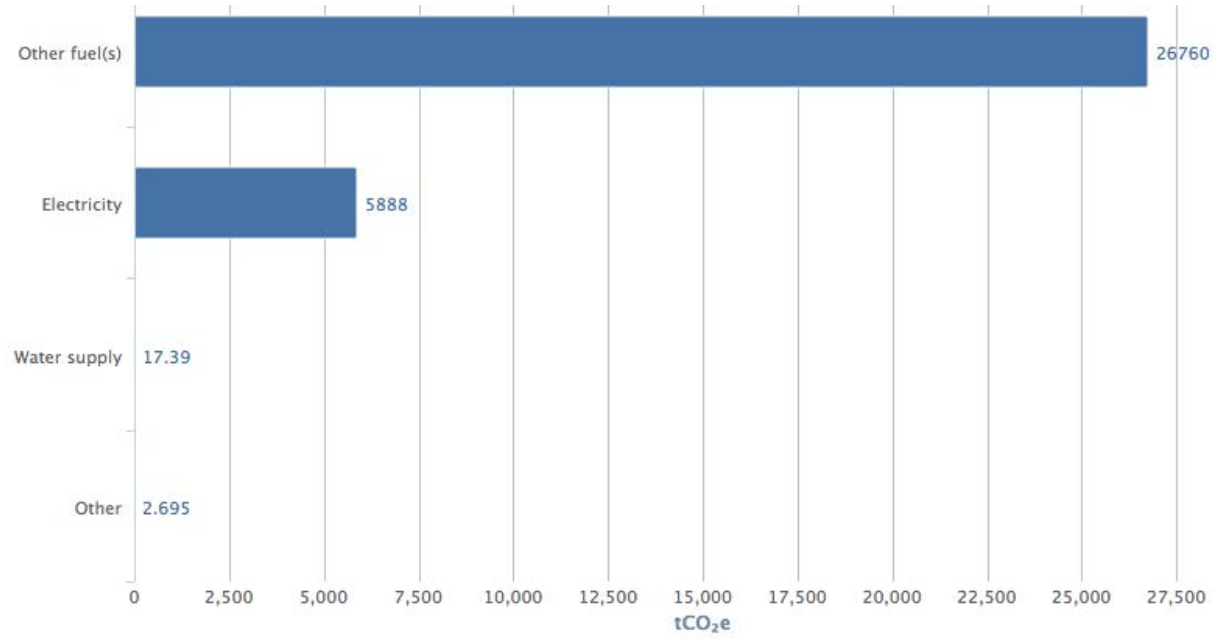


Table 12 Laminados Emission Sources

Business Unit	Scope	Activity	Question	Type	tCO_2e	% of Total
Laminados	1	Premises	Other fuel(s)	Residual fuel oil, stationary	19,253	12.47%
Laminados	1	Premises	Other fuel(s)	Diesel	7,507	4.86%
Laminados	2	Premises	Electricity	Electricity	5,888	3.81%
Laminados	3	Premises	Water supply	Water supply	17	0.01%
Laminados	1	Premises	Dielectric medium loss	SF6 (sulphur hexafluoride)	3	0.00%
Laminados				**TOTAL**	**32,668**	**21.15%**

3.4 Otros

Emissions from Otros make up 30.55% of Adelca's total carbon footprint. Inbound and outbound deliveries by third-parties are included in this Business Unit. These include deliveries by road, sea and air. However, as they are not controlled by Adelca (scope 3), the company can only influence these emissions indirectly by working with the relevant partners i.e. delivery firms.

Figure 11 Otros Emissions (tCO2e)

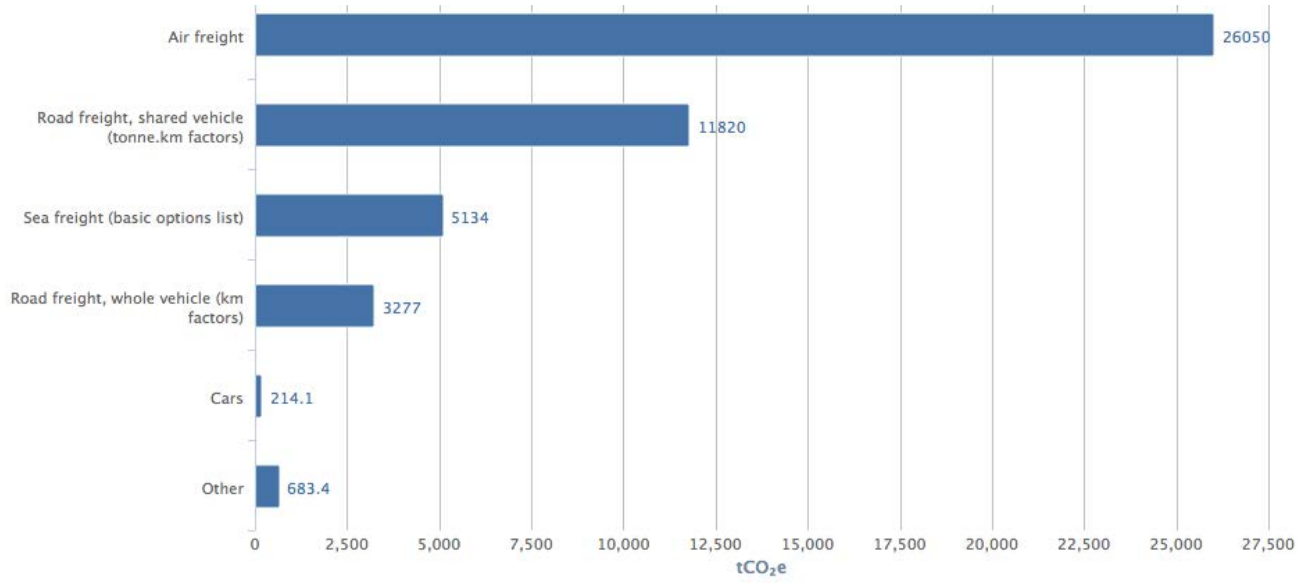


Table 13 Otros Emission Sources

Business Unit	Scope	Activity	Question	Type	tCO_2e	% of Total
Otros	3	Inbound Third-Party Deliveries	Air freight	Average air freight	26,052	16.87%
Otros	3	Inbound Third-Party Deliveries	Road freight, shared vehicle	Truck deliveries	11,818	7.65%
Otros	3	Inbound Third-Party Deliveries	Sea freight	Sea freight, Bulk carrier, average	5,134	3.32%
Otros	3	Outbound Third-Party Deliveries	Road freight, whole vehicle	Diesel medium and heavy duty truck	3,277	2.12%
Otros	2	Premises	Electricity	Electricity	177	0.11%
Otros	3	Business Travel	Taxi	Average taxi	145	0.09%
Otros	1	Company-Owned Vehicles	Cars	Average gasoline cars	138	0.09%
Otros	3	Premises	Landfilled waste	Waste, landfilled, MSW	105	0.07%
Otros	1	Premises	Other fuel(s)	LPG	81	0.05%
Otros	3	Sub-Contractors' Vehicles	Cars	Average gasoline cars	76	0.05%
Otros	3	Business Travel	Air travel	Short-haul	53	0.03%
Otros	3	Business Travel	Air travel	Medium-haul, average class	39	0.03%
Otros	3	Business Travel	Hotel night stays	Hotel night stays	35	0.02%
Otros	3	Business Travel	Air travel	Long-haul, average class	29	0.02%
Otros	3	Premises	Incinerated waste	Waste, incinerated (no heat recovery), MSW	20	0.01%
Otros	3	Premises	Water supply	Water supply	0	0.00%
Otros	3	Premises	Incinerated waste	Waste, incinerated (heat recovery), MSW	0	0.00%
Otros	3	Premises	Recycled waste	Waste, recycled	0	0.00%
Otros				**TOTAL**	**47,179**	**30.55%**

4 Emissions Against Key Performance Indicators

4.1 Emissions Relative to Key Performance Indicators

Measuring emissions against a KPI allows an organization to measure the carbon intensity of their activities and helps to account for increases or decreases in production or service provision over time. Adelca has chosen to measure emissions against the number of full time equivalent employees and output (in tonnes of steel produced).

Table 14 GHG Emissions Relative to KPI

Business Unit	Indicator	Unit	Response	tCO_2e/ Indicator
ADELCA	Full Time Equivalent Employees	No.	1,244	**124.16**
Acería	Steel output	Metric tonnes	233,432	**0.31**
Laminados	Steel output	Metric tonnes	183,625	**0.18**
Trefilados	Steel output	Metric tonnes	43,682	**0.07**

4.2 KPI Comparison with other Steel Manufacturing Facilities

When compared to other steel plants with similar operations, there are several areas where Adelca's performance in terms of energy efficiency could be improved. The largest variance between Adelca's performance and other typical plants is the billet reheating furnace: 3.96 GJ / tonne billet compared with 1.8 – 2.5 GJ / tonne billet in a typical plant. In the EAF, Adelca consumes more electricity, electrodes and refractory per tonne of steel than typical plants. The casting shop also consumes 45 kWh of electricity per tonne of steel compared to 10-20 kWh in other plants. Some of this difference is due to a mismatch between the overall productivity between the Acería plant and the Laminados plant in comparison to other steel plants which indicate potential for increased capacity utilisation, and reduced energy consumption.

Table 15 Comparison with Other Steel Manufacturing Facilities (KPIs)

Facility	Parameter	Typical Value	Adelca
EAF	Tap-to-tap time	55 minutes	42-45 minutes
	Electricity consumption	375 kWh / tonne	450 kWh / tonne
	Electrode consumption	1.8 kg / tonne	2.45 kg / tonne
	Refractory consumption	4.5 kg / tonne	9.5 kg / tonne
	Lime	~50 kg lime / tonne	n/a
	Oxygen use	35-40 Nm^3/t	40 Nm^3/t
	Operating hours / year	7000-8000 net hours	6000 net hours
	Yield	92.5%	90%
	Typical nominal transformer power	~0.6 - 0.9 MVA / tonne	1.66 MVA / tonne
	Nominal capacity	~670 kt crude steel / year	~250 kt crude steel / year
Billet continuous casting	Typical min billet size	100mm x 100mm	100mm x 100mm
	Typical max billet size	160mm x 160mm	130mm x 130mm
	Max casting speed	~4 metres / min	~2 metres / min
	Yield	95% - 96%	n/a
	Electricity	10-20 kWh / tonne billet	45 kWh / tonne billet
	Fuel	0.2-0.4 GJ / tonne billet	n/a
	Nominal capacity	~825 kt billet / year	~250 kt billet / year
Billet reheat furnace	Furnace speed	30 - 80 tonnes per hour	73 tonnes per hour
	Fuel oil / gas	1.8 - 2.5 GJ / tonne billet	3.96 GJ / tonne billet
Light sections and bar	Typical # of stands	17	30
	Max billet length	~11-12 metres	12 metres
	Typical rolled bar diameter - min	12 mm	8 mm
	Typical rolled bar diameter - max	50 mm	32 mm
	Typical rolling speed max	16 metres / second	17 metres / second
	Yield	95% - 97%	95.5%
	Electricity	110 kWh / tonne bar	110 kWh / tonne bar
	Operating hours / year	6000 - 6200 hours	4000 hours
	Nominal capacity	~300 kt bar / year	~450 kt bar / year

5 Methodology

5.1 Carbon Guru and the Greenhouse Gas Protocol

This greenhouse gas assessment has been carried out using **Carbon Guru**, Carbon Masters industry-leading greenhouse gas assessment software solution. Carbon Guru combines an easy-to-use client interface with a robust and up-to-date knowledge base maintained by industry experts.

Carbon Guru is built upon the Greenhouse Gas Protocol Corporate Standard, which is the most widely used international carbon accounting standard, and is considered to be current best practice in carbon accounting. Carbon Guru measures all six greenhouse gases for each activity type, and reports these emissions in tonnes of CO_2e to account for the different global warming potentials of each gas. Emissions factors used in the tool to convert activity data to CO_2e are up-to-date and based on the most robust data available for each country. The software platform itself has been developed by Ecometrica, who are recognised as experts in the field of GHG accounting and have built the tool around their combined experience of over 1,000 greenhouse gas assessments.

This GHG assessment has been carried out in four stages (more detail on each is in the sections that follow):

Figure 12 GHG Assessment Process

5.2 Site Visit and Data Collection

The data used in this report has been collected by Adelca, with guidance given on data requirements by Carbon Masters during an initial site visit and subsequent emails, phone calls and webinars. The majority of the data has been provided in raw format, which has then been entered onto the Carbon Guru software platform along with supporting evidence (such as spreadsheets and fuel bills). Carbon Masters have provided assistance in collating and analysing the raw data as well as guidance on the quality of data required for this GHG Assessment. The table below shows the complete list of datasets used for this Greenhouse Gas Assessment:

Table 16 Summary of Data Sources

Business Unit	Question	Source
Acería	Electricity	Cost data / BAAN ERP
Acería	Full Time Equivalent Employees	RRHH
Acería	LPG	Laminados
Acería	SF6 (sulphur hexafluoride) emissions	Ing. Pedro Álvarez / ABB
Acería	Steel produced (metric tonnes)	Ing. Javier Villalva
Acería	Total CO2 emissions (metric tonnes)	Acería Management
Acería	Water supply	General Management
ADELCA	Full Time Equivalent Employees	RRHH
ADELCA	Steel produced (metric tonnes)	Ing. Javier Villalva
Laminados	Diesel	Ing. Aguilera
Laminados	Electricity	Cost data / BAAN ERP
Laminados	Full Time Equivalent Employees	RRHH
Laminados	Residual fuel oil, stationary combustion	Ing. Aguilera
Laminados	SF6 (sulphur hexafluoride) emissions	Ing. Pedro Álvarez / ABB
Laminados	Steel produced (metric tonnes)	Ing. Javier Villalva
Laminados	Water supply	General Management
Other	Air freight	Logistics
Other	Air travel	Logistics
Other	Cars (company owned)	Cost data
Other	Cars (sub-contractors)	Accountancy
Other	Full Time Equivalent Employees	RRHH
Other	Hotel night stays	Cost data
Other	Incinerated waste	Environmental control
Other	Landfilled waste	Environmental control
Other	LPG	Warehouse Laminados
Other	Recycled waste	Environmental control
Other	Road freight, shared vehicle (tonne.km factors)	Logistics
Other	Road freight, whole vehicle (km factors)	Logistics
Other	Sea freight (basic options list)	Logistics
Other	Taxi	Cost data
Other	Water supply	General Management
Otros	Electricity	Cost data / BAAN ERP
Trefilados	Diesel	Warehouse Laminados
Trefilados	Electricity	Cost data / BAAN ERP
Trefilados	Full Time Equivalent Employees	RRHH
Trefilados	Residual fuel oil, stationary combustion	Bodega Laminados
Trefilados	SF6 (sulphur hexafluoride) emissions	Ing. Pedro Álvarez / ABB
Trefilados	Steel produced (metric tonnes)	Ing. Javier Villalva
Trefilados	Water supply	General Management

5.3 Quality Assurance Process

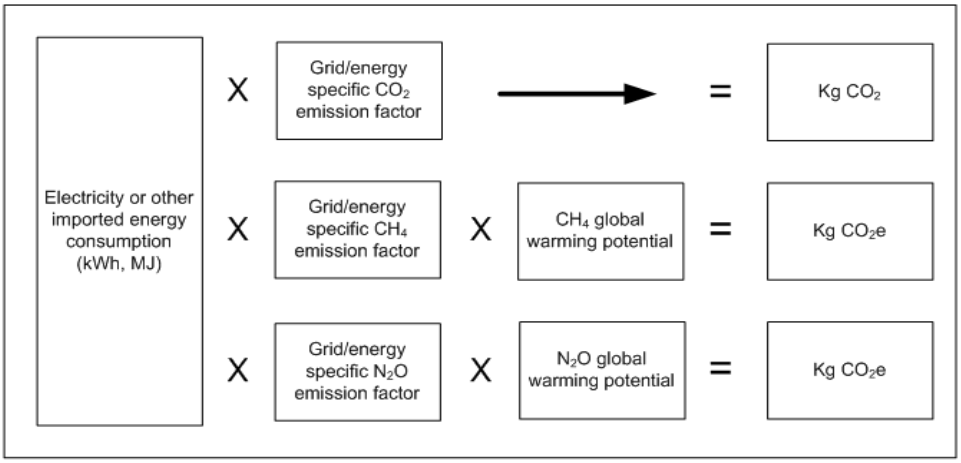
All the data used for this GHG assessment has been fully quality assured by a Carbon Masters analyst. This process involves going through each dataset individually and checking that appropriate methods have been used to sort the data and estimate any missing values.

As part of this quality assurance process, Carbon Masters identified a few minor weaknesses in the data collection methods and in the data itself – which has been improved upon wherever possible.

For example, 2009 water consumption for *Acería, Laminados* and *Trefilados* has been estimated using the average of 2010 and 2011, as have taxi distances and number of hotel nights for calculating emissions from business travel. Recommendations have been made in the final section of this report on how data could be improved for future GHG assessments.

5.4 Calculation Methods for this Assessment

Figure 13 Emission Calculation Methodology



Following the quality assurance process, the Carbon Guru software platform has been used to calculate the greenhouse gas emissions for each activity type. ***Figure 17*** gives an example of the kind of calculation made using Carbon Guru – in this case converting activity data (electricity use) into the a total value for kg CO_2e. The Carbon Guru platform uses robust and up to date emissions factors, specific to each country / region.

5.4.1 Process Emissions

The method for calculating GHG emissions from EAF steel facilities includes calculating emissions from carbonate flux, use of carbon electrodes and CO_2 emissions from any coke or coal used in the process. Table 17 shows the various steps undertaken. Process emissions have been calculated following guidance from:
US Environmental Protection Agency's "Climate Leader Greenhouse Gas Inventory Protocol Core Module Guidance: Direct Emissions from Iron & Steel Production"
IPCC (2006) Guidelines, Volume 2, Table 2.1. (taken from GHG Protocol Guidance document)

Table 17 Steps for Calculating Process Emissions

Step 1	Ensure all possible sources of emissions have been identified i.e. quantities of all carbonate flux and carbon electrodes
Step 2	Determine the amount of carbonate flux used. This should be in terms of pure $CaCO_3$ and $MgCO_3$. Therefore, the total amount of flux used needs to be adjusted for purity.
Step 3	Calculate the flux carbon factor. This is based on the stoichiometric ratio of C to $CaCO_3$ and $MgCO_3$. Or using published default values.
Step 4	Determine the amount of electrodes used. This could be based on the actual amounts used or

	could be estimated based on the amount of steel produced.
Step 5	Determine the electrode carbon factor. This is based on the carbon content of the electrode or using published default values.
Step 6	Calculate CO_2 emissions. Multiply the values from Steps 2 – 5.
Step 7	Calculate emissions from any coke or coal used in the process and include in final figure.

5.4.2 Fugitive Emissions (SF_6)

The global warming potential of one tonne of Sulphur Hexafluoride (SF_6) was confirmed as being 22,800 times greater than one tonne of Carbon Dioxide (CO_2), in the 2007 IPCC Fourth Assessment Report. It was suspected that Adelca operates multiple circuit breakers and / or substations which emit SF_6 therefore the steps in Table 18 were taken to determine their significance.

Table 18 Steps for Calculating Fugitive Emissions

Step 1	Collect background site information
Step 2	Create inventory of all SF_6–containing units
Step 3	Assign annual leakage rates to units: - If pre-1980, leakage rate is 3% - If 1980-1990 leakage rate is 2% - If 1990-2000 leakage rate is 1% - If post-2000 leakage rate is 0.5% NB. If no year is identified, a conservative leakage rate of 3% is applied
Step 4	Calculate global warming potential in terms of CO_2e

Once Adelca's engineers had compiled an inventory of all SF_6-containing units, Carbon Masters worked with electrical contractor ABB to determine volumes of SF_6 in each unit. From there Carbon Masters were able to establish leakage rates and calculate the overall emissions of SF_6.

The methodology used has been derived from a review of available literature including the Inter Governmental Panel on Climate Change (IPCC), International Electrotechnical Commission (IEC) and the Unites States Environmental Protection Agency (US EPA).

6 Emissions Trends 2009-2011

In absolute terms, Adelca's total emissions have increased over the last three years from 133,643 tCO_2e in 2009 to 154,449 tCO_2e in 2011. Each business unit has also witnessed an overall increase as shown in the figure below.

Figure 14 Emissions Trends by Business Unit (1/2)

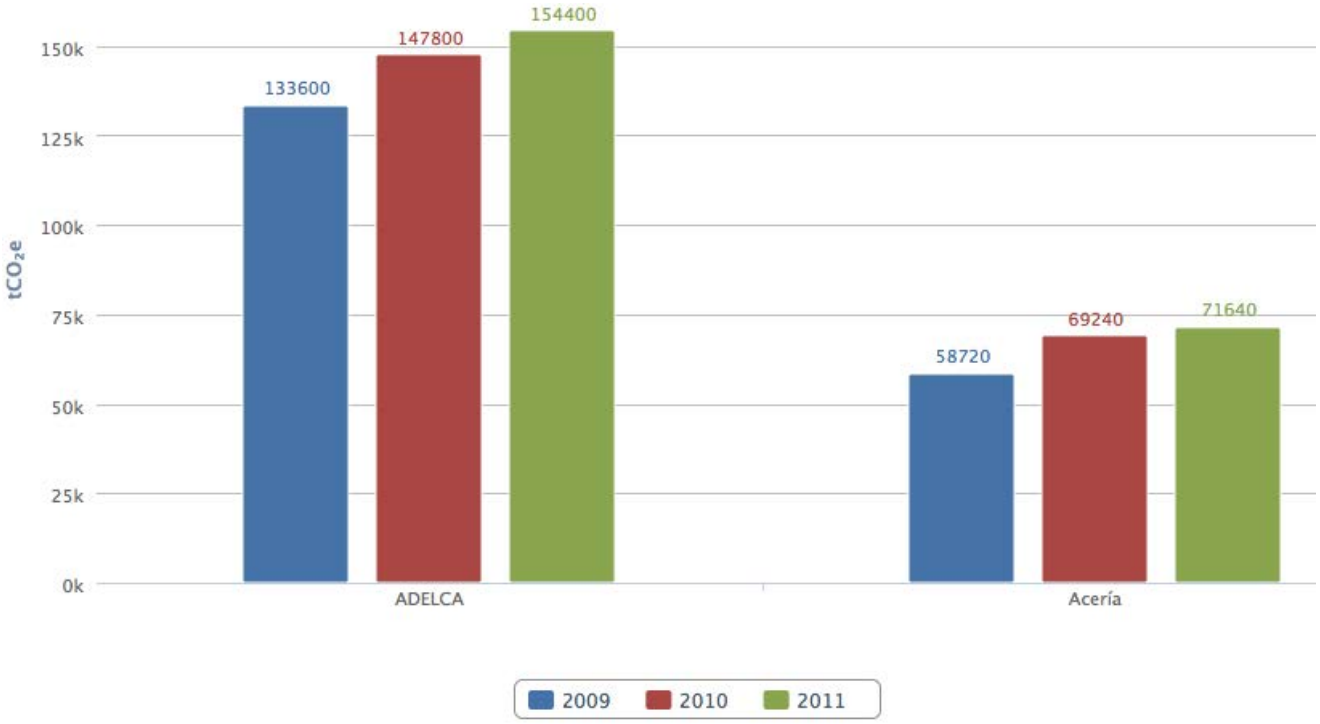
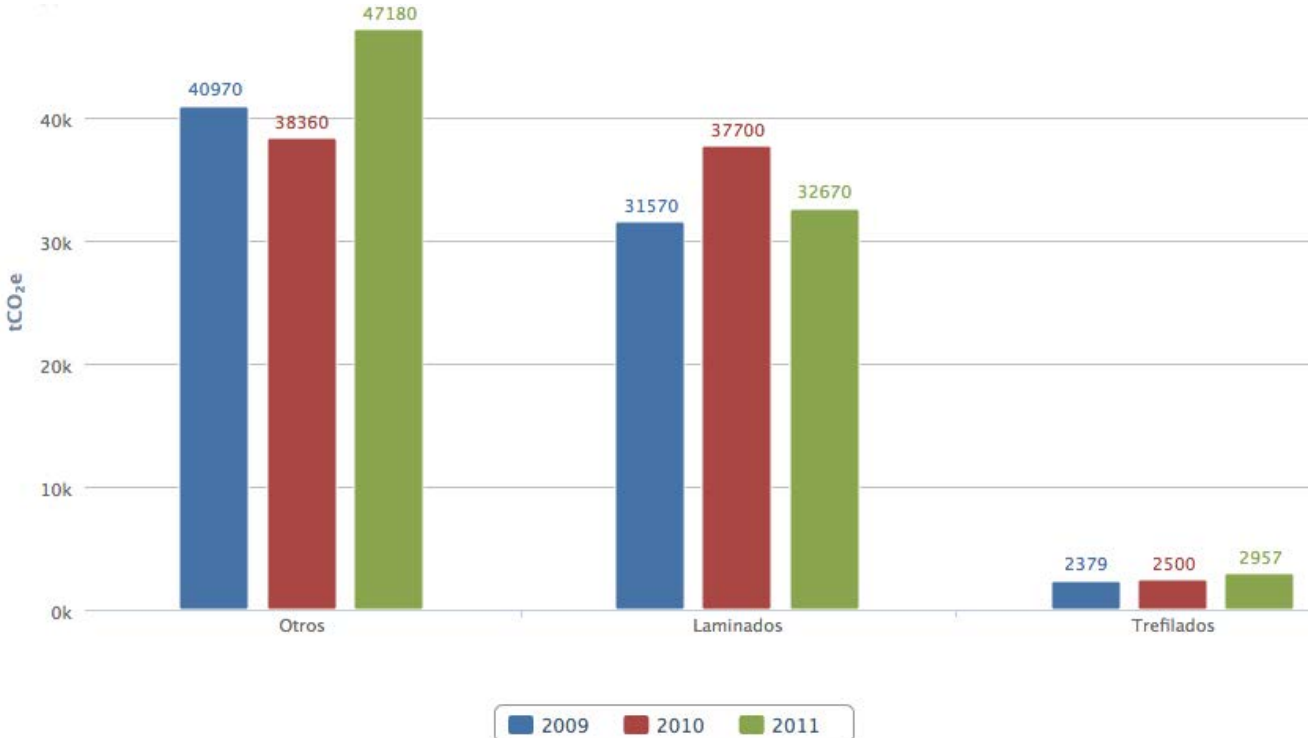
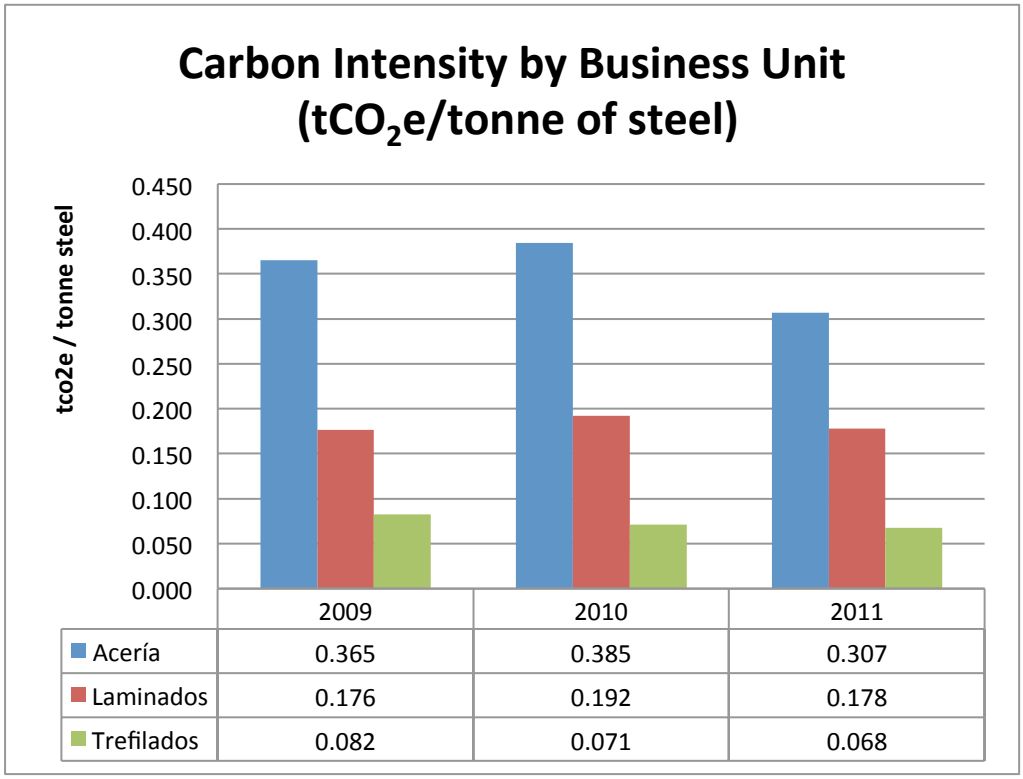


Figure 15 Emissions Trends by Business Unit (2/2)



However, the volume of steel produced by the company has also risen so it is to be expected that emissions have increased, especially considering there is currently no carbon / energy management plan in place. The figure below analyses the level of emissions against production levels for each business unit. A closer look at business unit Acería shows the carbon intensity of production has actually decreased from 0.365 (tCO_2e/tSteel) in 2009, to 0.307 (tCO_2e/tSteel) in 2011. A similar reduction is also found in Laminados and Trefilados. However, Adelca's next step must be to reduce absolute emissions in order to reduce operational costs.

Figure 16 Carbon Intensity by Business Unit



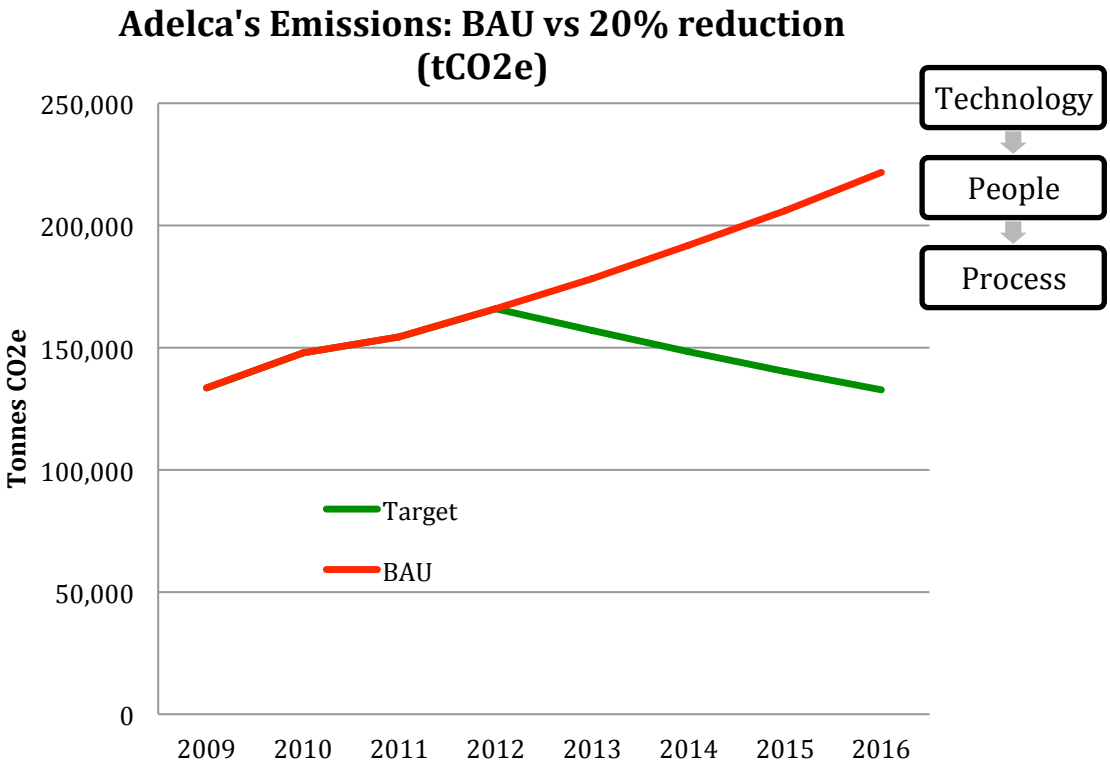
	2009	2010	2011
Acería	0.365	0.385	0.307
Laminados	0.176	0.192	0.178
Trefilados	0.082	0.071	0.068

7 Recommendations

7.1 Choosing a Low Carbon Path

With the right carbon management plan, Adelca could set itself on a low carbon path to reduce carbon emissions and costs. The red line in the chart shows Adelca's emissions for 2009, 2010 and 2011 with a projection based on historical growth in emissions. The green line is for illustrative purposes only and shows what a 20% reduction in emissions looks like (20% by 2016 based on estimated 2012 emissions). In order to achieve such a reduction, it's essential to have a plan based on technologies, people and processes as explained below.

Figure 17 Adelca's Emissions Path



7.2 Magnitude of Cost Savings Potential / The Size of the Prize

This section provides an indication of some of the financial savings that may be available to Adelca by improving efficiencies in the steel making process. The figures are based on KPIs supplied by Adelca personnel, which were compared against data from similar steel plants from around the world.

Table 19 Adelca's KPIs versus Typical Values from Other Plants

Facility	Parameter	Typical Value	Adelca
EAF	Tap-to-tap time	55 minutes	42-45 minutes
	Electricity consumption	375 kWh / tonne	450 kWh / tonne
	Electrode consumption	1.8 kg / tonne	2.45 kg / tonne
	Refractory consumption	4.5 kg / tonne	9.5 kg / tonne
	Lime	~50 kg lime / tonne	n/a
	Oxygen use	35-40 Nm^3/t	40 Nm^3/t
	Operating hours / year	7000-8000 net hours	6000 net hours
	Yield	92.5%	90%
	Typical nominal transformer power	~0.6 - 0.9 MVA / tonne	1.66 MVA / tonne
	Nominal capacity	~670 kt crude steel / year	~250 kt crude steel / year
Billet continuous casting	Typical min billet size	100mm x 100mm	100mm x 100mm
	Typical max billet size	160mm x 160mm	130mm x 130mm
	Max casting speed	~4 metres / min	~2 metres / min
	Yield	95% - 96%	n/a
	Electricity	10-20 kWh / tonne billet	45 kWh / tonne billet
	Fuel	0.2-0.4 GJ / tonne billet	n/a
	Nominal capacity	~825 kt billet / year	~250 kt billet / year
Billet reheat furnace	Furnace speed	30 - 80 tonnes per hour	73 tonnes per hour
	Fuel oil / gas	1.8 - 2.5 GJ / tonne billet	3.96 GJ / tonne billet
Light sections and bar	Typical # of stands	17	30
	Max billet length	~11-12 metres	12 metres
	Typical rolled bar diameter - min	12 mm	8 mm
	Typical rolled bar diameter - max	50 mm	32 mm
	Typical rolling speed max	16 metres / second	17 metres / second
	Yield	95% - 97%	95.5%
	Electricity	110 kWh / tonne bar	110 kWh / tonne bar
	Operating hours / year	6000 - 6200 hours	4000 hours
	Nominal capacity	~300 kt bar / year	~450 kt bar / year

Assuming annual throughput of ~225kt in the EAF melt shop, 225 kt on the caster and 200kt in the bar mill, the cost savings potential was calculated for improvements in EAF electrode, refractory and electricity use, EAF yield, caster yield, and reheat furnace energy use. The calculations are as shown in Figure 18.

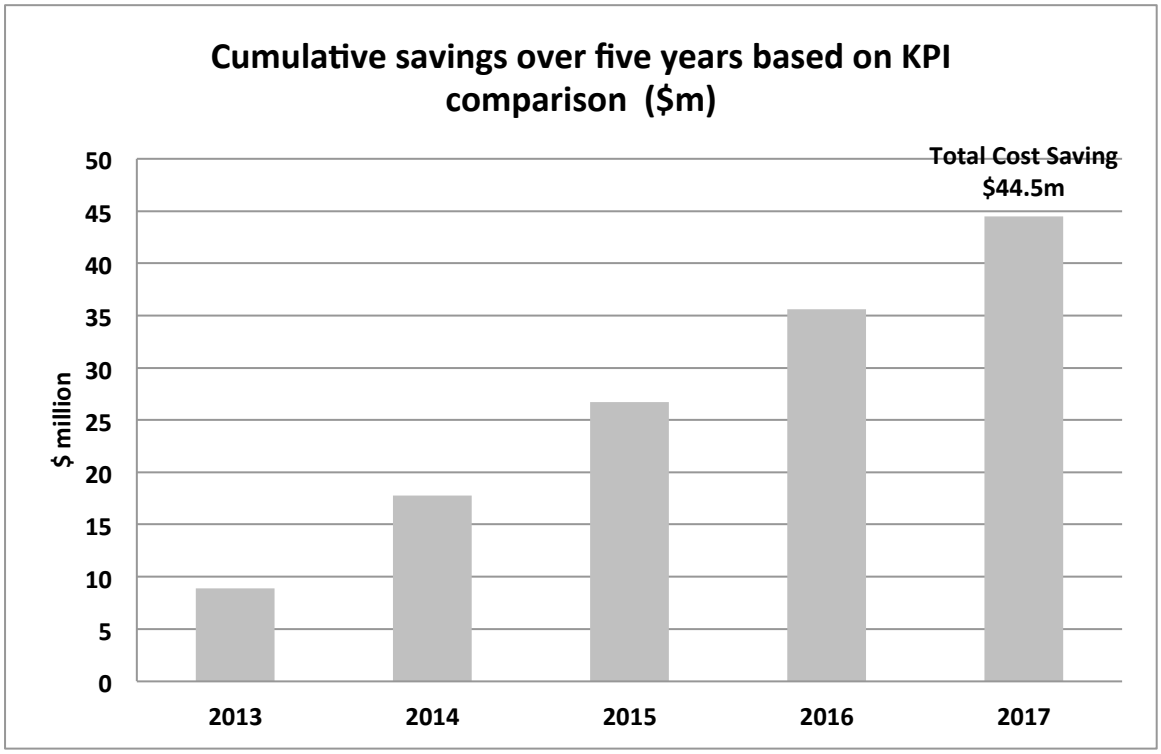
Figure 18 Indicative calculations of cost saving potential*

Parameter	Change	Impact $/t	Tonnage	Annual Cost saving $m
Electrode use	20% improvement	$5/tonne	225kt	$1.1m
Refractory use	50% improvement	$4/tonne	225kt	$0.9m
EAF electricity use	Reduce by 75 kWhr/t	$4.50/t	225kt	$1.0m
EAF yield	2% improvement	$8/tonne	225kt	$1.8m
Caster yield	2% improvement	$0.35/tonne	200kt	$0.1m
Reheat furnace energy	2 GJ/t improvement	$20/t	200kt	$4.0m
Total				$8.9m

*Calculations assume scrap price of ~$400/tonne, electricity cost of $0.06 per kWhr and other energy costs at $10/GJ and show the cost saving if more typical KPI figures prevailed.

The figures indicate an immediate cost savings potential from the various improvements of close to $9m per annum [at current throughput rates]. The improvement in reheat furnace energy efficiency [valued at ~$4m per annum] is the largest item within this total.

Figure 19 Potential Cost Savings Over Five Years



7.2 Recommended Actions

This section contains a series of recommendations that explain what Adelca needs to do to achieve reductions.

7.2.1 Develop and implement a Carbon Management Plan

Adelca needs to develop a plan to design, implement and review carbon reduction projects across the organisation. The plan should include:

- The business case for change
- Targeting setting
- Governance structure
- The plan should be agreed and ratified by senior management to ensure ongoing commitment to reducing carbon emissions and savings energy costs.
- Emission reduction activities, with a major emphasis on reducing emissions from the three highest identified emission sources which together constitute c.55% of Adelca's total footprint: Electricity, fuel usage and inbound logistics.

7.2.2 Focus on reducing Adelca's three highest sources of emissions

1. Reduce electricity consumption per unit of steel produced

Explore and implement opportunities to reduce electricity consumption particularly in Acería and Laminados.

- Implement an energy metering and monitoring system to manage energy consumption in kWh throughout the plant. Especially in Acería and Laminados. These systems usually result in **savings of between 5-10%** in total energy consumption. Based on Adelca's 2011 energy consumption, a 5% reduction would mean **annual cost savings of over $750,000.**
- Consider how current energy supplies are procured and whether or not there may be an opportunity to re-negotiate contracts / change suppliers / agree a fixed price etc. to reduce costs.
- Seek specialist advice on improving the energy efficiency of the steel making process and options for reducing the carbon emissions associated with the EAF and process emissions.

2. Reduce fuel consumption in Laminados by:

- Measuring and reporting consumption of fuel usage by business unit on an ongoing basis
- Investigate switching to renewable energy sources to replace the use of these fuels. For example, develop a renewable energy project that investigates wind turbines, biomass boilers, solar panels, heat pumps etc. as a way of displacing fossil fuel-based sources of energy including electricity from the grid. Based on actual 2011 data, supplying 10% of Adelca's total electricity consumption with an onsite wind turbine would reduce Adelca's electricity bill by c. $950,000 per year.

3. Review transportation/logistics procedures

Inbound and outbound third-party deliveries by road, air and sea make up 30% of all emissions and therefore should be reviewed to identify any potential for savings. Specifically explore switching inbound airfreight logistics to road and sea freight to reduce costs and carbon.

7.3.3 Key considerations for implementing the Carbon Management Plan at Adelca

- At the outset of developing a Carbon Management Plan, responsibility for carbon/energy should be assigned to an individual/team fully supported by senior management.
- Team should report to a steering committee made up of senior management and monitor progress in terms cost/energy/carbon savings.
- Employee Awareness
    - Ensure employee involvement is at the core of the Carbon Management Plan. To do this establish local work teams, to assist in tackling the various I identified projects complemented by external expertise where needed.
    - For example, one way to raise energy awareness and cooperation from personnel is to organise a training programme for all employees.
- Ensure all the learnings from the above are incorporated in the plans for Manta

7.3 Improving Data Collection

Data collection techniques are generally good with accurate data available for most sources of emissions. This report uses tonnes of carbon dioxide equivalent (tCO_2e) as the main unit of measurement. It is recommended that future reports continue to measure in tCO_2e to make annual comparisons simple.

Table 20 Recommendations for Data Improvements

Emission Source	Recommendations
Electricity	Better electricity metering systems required to measure consumption in kWh across the plant
Diesel	In *Trefilados* and *Laminados,* it is assumed that diesel accounts for 30% of overall fuel consumption. This is only an estimate therefore actual consumption by individual business unit should be recorded for future assessments.
Residual fuel oil	In *Trefilados* and *Laminados,* it is assumed that residual fuel oil accounts for 70% of overall fuel consumption. This is only an estimate therefore actual consumption should be recorded for future assessments.
Water	Continue to monitor supply and begin to monitor waste water for future assessments.
SF_6 from circuit breakers / refrigerant gases etc. (F Gas)	Create inventories / record of all units containing F Gases and SF_6 including types of gas, installation date, quantity of charge, and record all maintenance activity e.g. topping up of gases, any special events.

Appendices

Appendix A Global Warming Potential of Each Greenhouse Gas

The six Kyoto gases measured in this GHG Assessment are carbon dioxide (CO_2), methane (CH_4) nitrous oxide (N_2O), hydrofluorocarbons (HFCs), sulphur hexafluoride (SF_6) and perfluorocarbons (PFCs). The global warming potential (GWP) of each gas is shown in the table below:

Table 21 GWP of Kyoto Gases (IPCC 2007)

Greenhouse Gas	Global Warming Potential
Carbon dioxide (CO_2)	1
Methane (CH_4)	25
Nitrous oxide (N_2O)	298
Hydrofluorocarbons (HFCs)	124 - 14,800
Sulphur hexafluoride (SF_6)	22,800
Perfluorocarbons (PFCs)	7,390 - 12,200

The global warming potential (GWP) is a relative measure of how much heat a GHG traps in the atmosphere. It compares the amount of heat trapped by a certain mass of the gas in question to the amount of heat trapped by a similar mass of carbon dioxide. GWP is expressed as a factor of carbon dioxide (whose GWP is standardized to 1).

Measuring GHG emissions in tonnes of CO_2 equivalent (CO_2e), effectively means that each quantity of GHG emitted is multiplied by its GWP to give a standardized measure of its warming impact.