



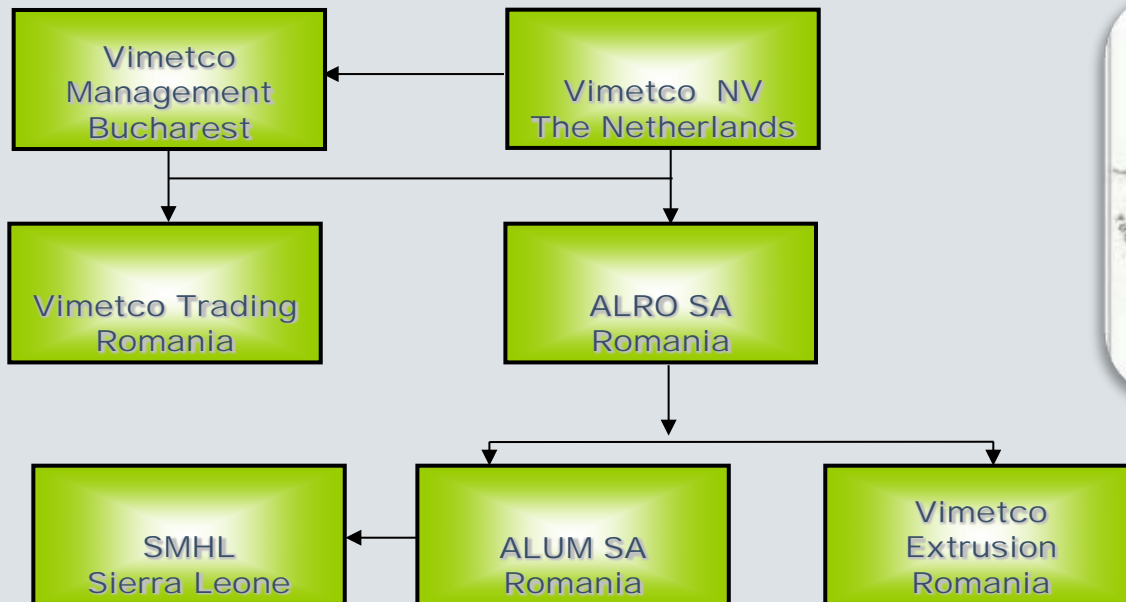
Alro – Company experience on industrial energy efficiency investments

SUMMARY

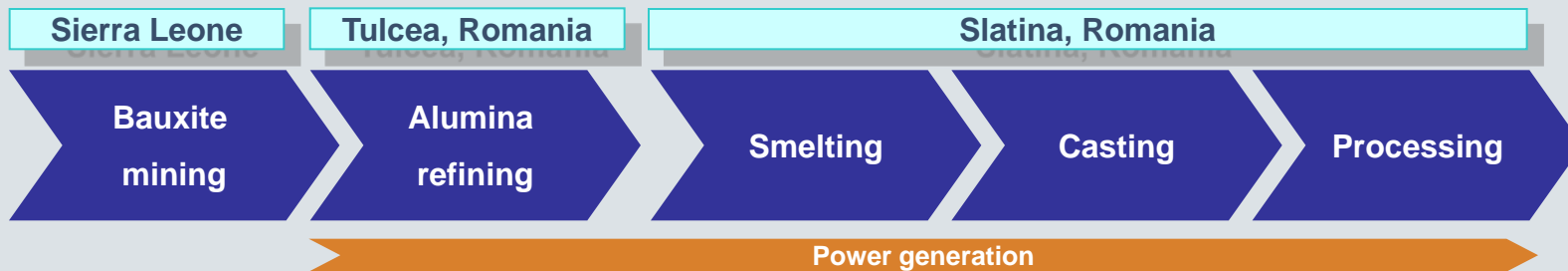
- **ALRO – Short overview**
- **Vertically integrated operation**
- **Last 15 years strategy**
- **Investment Structure**
- **Special Focus Environment and Energy Efficiency**
- **Examples**
- **Investment Management**
- **Results**
- **ALRO's vision for the future**

ALRO - General Information

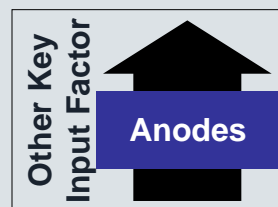
- ✓ ALRO is a private-owned company, the largest primary aluminum smelter in the Eastern Europe.
- ✓ Its products: billets, slabs, wire rod, plates, sheets and strips.
- ✓ ALRO's shareholders:
 - ✓ VIMETCO - 84.19%
 - ✓ PROPRIETATEA Fund - 10.03%
 - ✓ Others - 5.78%
- ✓ Since 1997 it has been listed in the Bucharest Stock Exchange
- ✓ ALRO is part of the VIMETCO Group
- ✓ ALRO is member of the European Aluminum Association and of the Aluminium REACH Consortium



ALRO -Vertically integrated operations



- Acquired Sierra Minerals bauxite mine, sole supplier of bauxite to Alum, with roughly 30 mil. t resource base
- Tulcea production facility with capacity of 600kt
- 100% of the ALRO needs

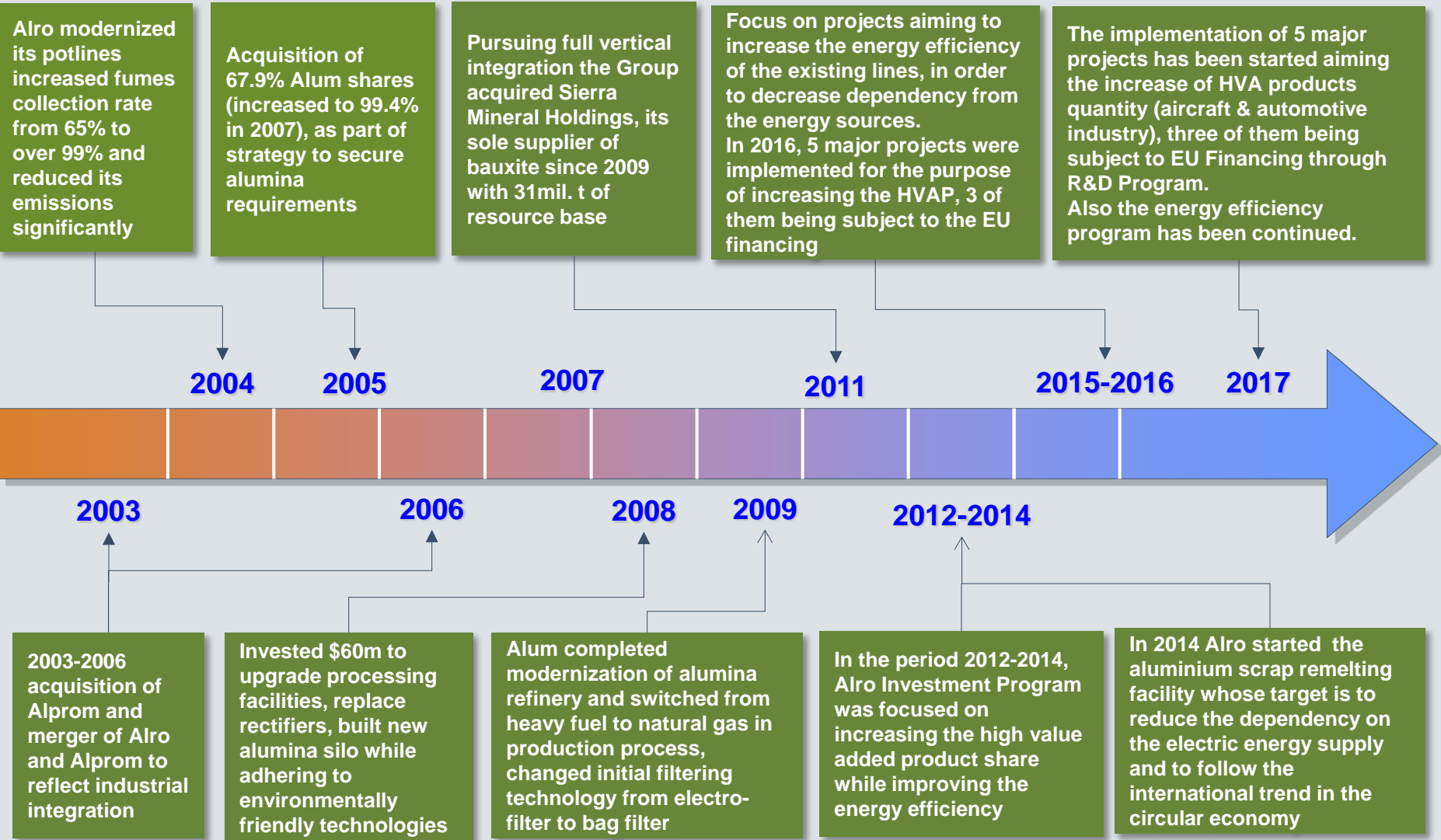


- Group activity
- External supply
- Location of facility

- All carbon anodes required for the electrolysis cells are produced internally
- Slatina production facility, which includes the smelter, anode plant and cast aluminium facility, has total capacity of 265kt of electrolytic aluminium and 340kt of cast aluminium
- Slatina processing facility capacity is 90kt of processed aluminium, depending on product mix; with capacity increase program is going up to 120,000 MT in 2020
- Vimetco extrusion with 25 kt capacity

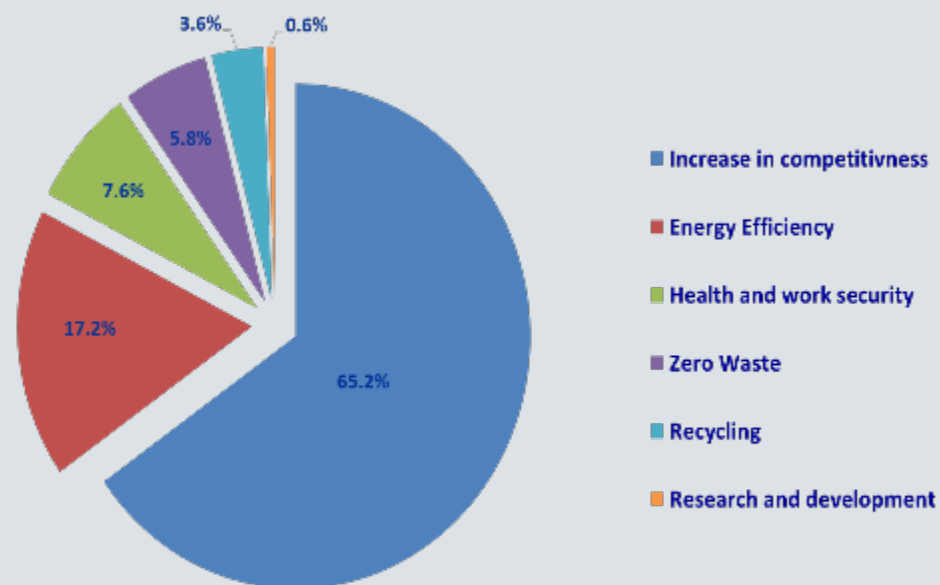
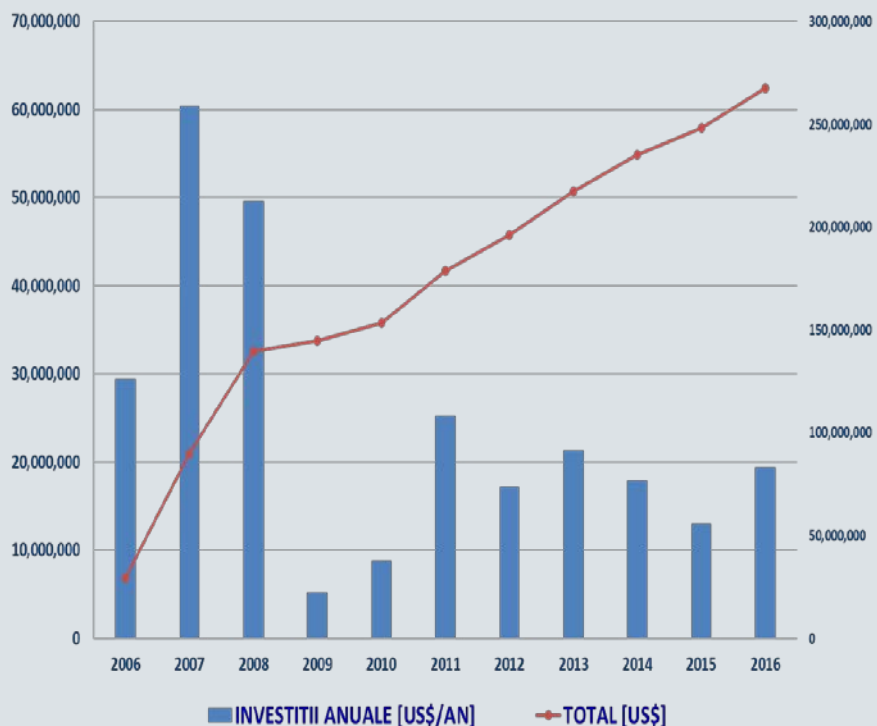
Last 15 Years Strategy

... while optimising capacity to increase production of value added products



Investment Structures

The previous mentioned strategy was implemented by following structure of investment :



Special Focus – EU rules compliance

The Efficiency Program leading to 99% degree of compliance with EU rules determined by EU –JRC Report 2015

Main directions developed by Alro

Energy efficiency increase

- Reduction of specific power consumption;
- Audit performed by best in class technology provider and benchmarking;
- Replace the classic light bulbs with LED lamps;
- Install variable speed drives to the electrical motors;
- Introduce slotted anodes;
- Invest constantly in best available equipment.

Increase recycling rates for waste/scrap

- Increase the capacity of the eco-recycling shop;
- Cooperate with universities and other companies for waste recycling;
- Active participation in the European Aluminium waste task force.

Progressive reduction of CO2 emissions

- Reduction of natural gas specific consumption;
- Reduction of anode consumption;
- Reduction of consumption for materials that have direct link with CO2.

Air emissions reduction

- Installation of dry scrubbing units;
- Installation of fume treatment centers;
- Installation of volatile treatment center;
- Full compliance with NFM BREF;
- Cooperation with highly ranked providers.

Reduction of industrial water consumption

- Installation and commissioning of forced cooling towers and water treatment equipment;
- Active participation in the European Aluminium water task force.

BENCHMARKING JRC STUDY 2015

Company	City	Technology	Max brownfield efficiency (MWh/t)	Distance-to-target (%)
Aluminium Dunkerque S.A.	Graveline-sur-Loon-Plage	AP30	12.8	93 %
Trimet Aluminium AG	St.-Jean-de-Maurienne	AP18 AP30	13.2	99 %
Hydro Aluminium Deutschland GmbH	Neuss	VAW CA-163	13.2	93 %
Trimet Aluminium AG	Essen	Alusuisse EPT-14	13.5	92 %
Trimet Aluminium AG	Hamburg	Reynolds P19	13.8	98 %
Voerdal GmbH	Voerde	Kaiser P69	13.6	91 %
Aluminium de Grece S.A. (ADG)	St. Nicolas (Distomon)	AP07 AP09	13.2	100 %
Atlantic Aluminium Co.	Keitines	-	13.2	100 %
Alcoa Fjardal	Reydarfjordur	AP30	12.8	97 %
Nordic Aluminium Company	Grundartangi	VAW CA-180	13.2	96 %
Nordural Helguvik	Helguvik	AP36	12.8	100 %
Rio Tinto Alcan Iceland Co. Ltd.	Straumsvik	Alusuisse EPT-10	13.2	88 %
Vimetco Arlo SA	Slatina	AP09	13.2	99 %
SLOVALCO	Ziar nad Hronom	Hydro HAL-230	13.2	98 %
Talum, d.d. Kidricevo	Kidricevo	AP18	13.2	94 %
Alcoa Inespal SA Aviles	Aviles	PF-VSS	13.8	98 %
Alcoa Inespal SA La Coruna	La Coruna	PF-VSS	13.8	91 %
Alcoa Inespal San Ciprian	San Ciprian	AP-14	13.2	95 %
Rusal Kubikenborg Aluminium AB	Sundsvall	Kaiser P86	13.5	100 %
Alcan Smelting & Power UK	Fort William	AP18	13.2	99 %

Financing Energy Efficiency Projects - Examples

- In 2010 following the collaboration with EBRD, an energy audit was performed in which a number of 16 projects impacting Alro and Alum energy efficiency and a number of 3 projects impacting the quality of product were identified.

Based on the performed audit, a funding contract amounting to 180 million US\$ was signed, of which an important part were allotted to the implementation of the 19 identified projects for energy efficiency;

More specifically for ALRO-Slatina the proposed interventions incurred 11% of savings in electricity consumption for internal services and 10.5 % savings in thermal energy utilization;

For ALUM, the proposed interventions provided 10.5% of savings in electricity consumption and almost 5% savings in thermal energy.

- In 2013 a scrap recycling facility was commissioned with overall capacity of 35 000 t. Recycling means 95% less energy and 80% less CO₂ emission compared with aluminium produced by electrolysis. The investment value was approx. 10 mil US\$;
- From 2015 According to EU-Energy Efficiency Directive and Romanian Legislation for Energy Efficiency ALRO S.A. is audited periodically by an independent auditor certified by Romanian Energy Regulatory Authority (ANRE).

Seven project were identified by the specialist which means 2.9 million US\$ investment with savings of power 1% /t of electrolytic Al , water 4.7% and natural gas 7.41%.

Alro's Energy Efficiency Projects Examples

Project: Industrial water recirculation station for the billets and wire rod plants

Code: 172.10.THE.1 (AR 5)

Initial Budget: 2,375,000 US\$

NPV: 200,361 US\$

IRR: 17.8%

Purpose: The project concerns the modernization of the industrial water recirculation system at the Cast House.



Project: Improvement of combustion at anode baking furnaces

Code: 082.07.ANZ.1 (AR 6)

Initial Budget: 2,200,000 US\$

NPV: 313,377 US\$

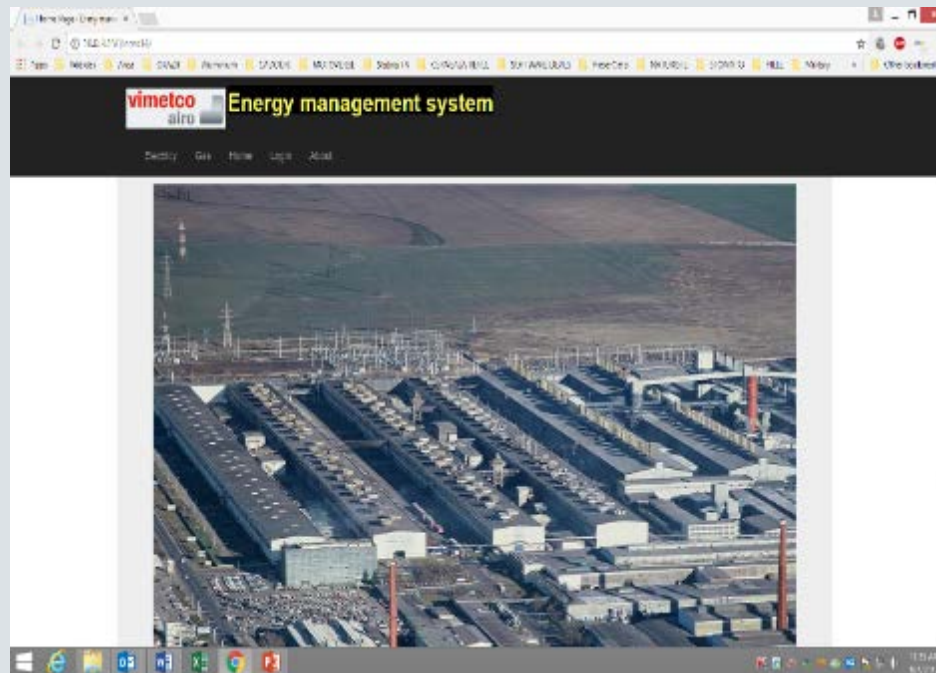
IRR: 19%

Purpose: The project concerns the combustion optimization at three baking furnaces for anodes, consisting of combustion control and automation.



Alro's Energy Efficiency Projects –cont'

Project: Improvement of EMS
Code: 225.10.ALR.1/ 226.10.ALP.1 (AR 9)
Initial Budget: 400,000 US\$
NPV: 472,124 US\$
IRR: 38.8%
Purpose: To extend the Energy Management System by adding supplementary metering devices. This measure allows a better monitoring and implementation of ISO 50 001 .



ECO RECYCLING SHOP

At the end of 2013 we started the aluminum scrap melting facility of an overall capacity of 35,000 tonnes/year, with the following advantages:

- recycles scraps;
- reduces the fabrication cycle of aluminum products;
- reduces ALRO's dependency on high electricity price, considering that the energy for recycling is only 5-7% from the energy necessary to produce electrolytic aluminium.

We plan to increase the capacity of this eco recycling shop to 100,000 tpa until 2020.



Overview photo of eco recycling shop

We are using state-of-the-art equipment:

- Double chamber furnace with high efficiency oxygen burners (these burners use less natural gas compared with standard burners);
- Induction furnace;
- Fume treatment center.

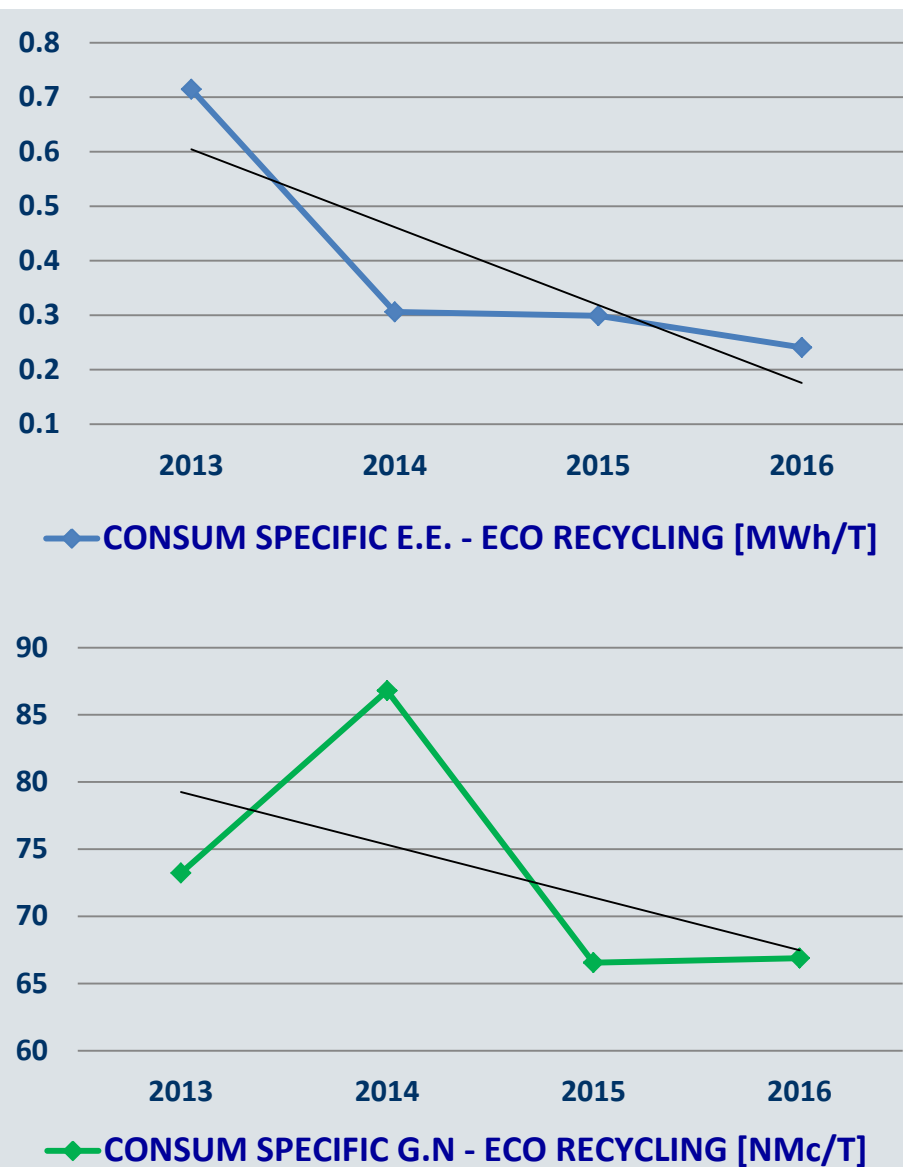
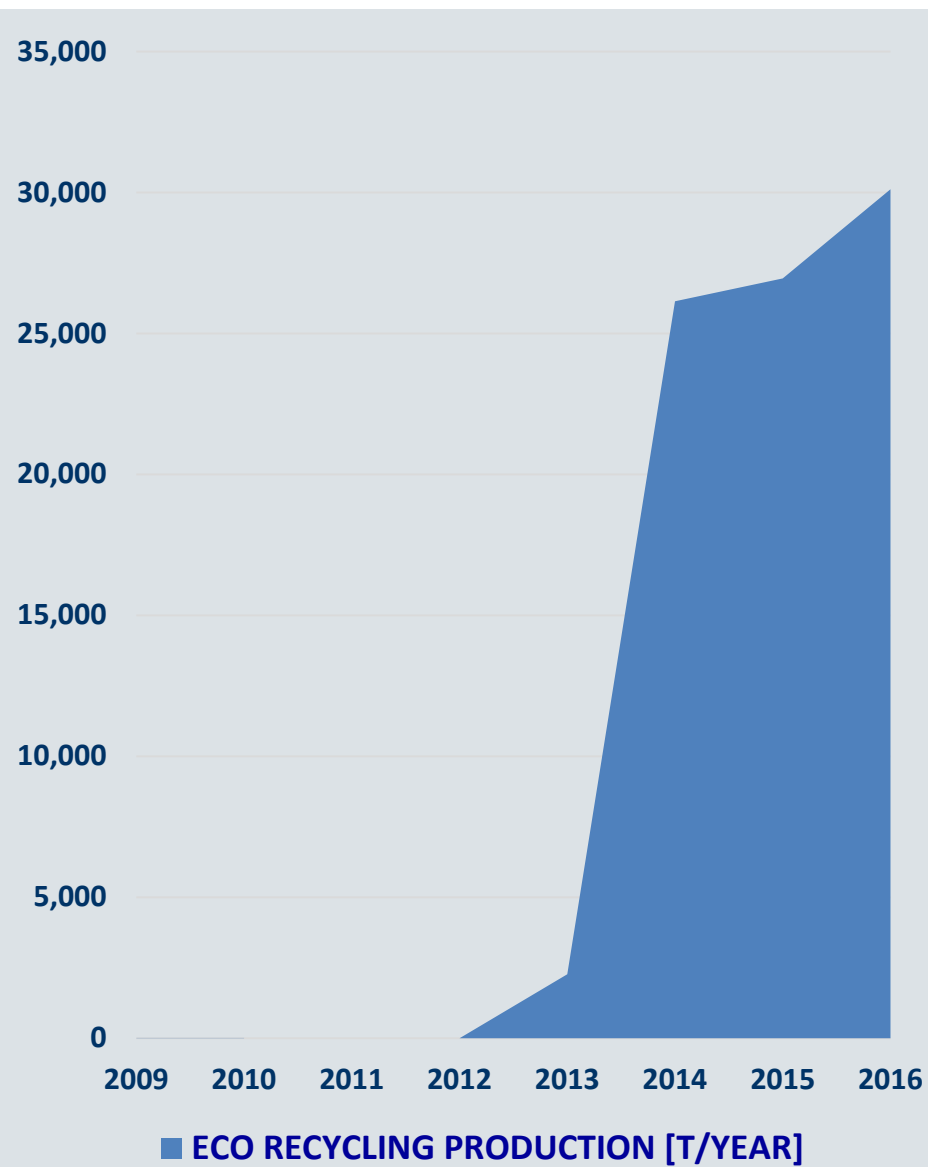


Induction furnace



Double chamber furnace

ECO RECYCLING Evolution



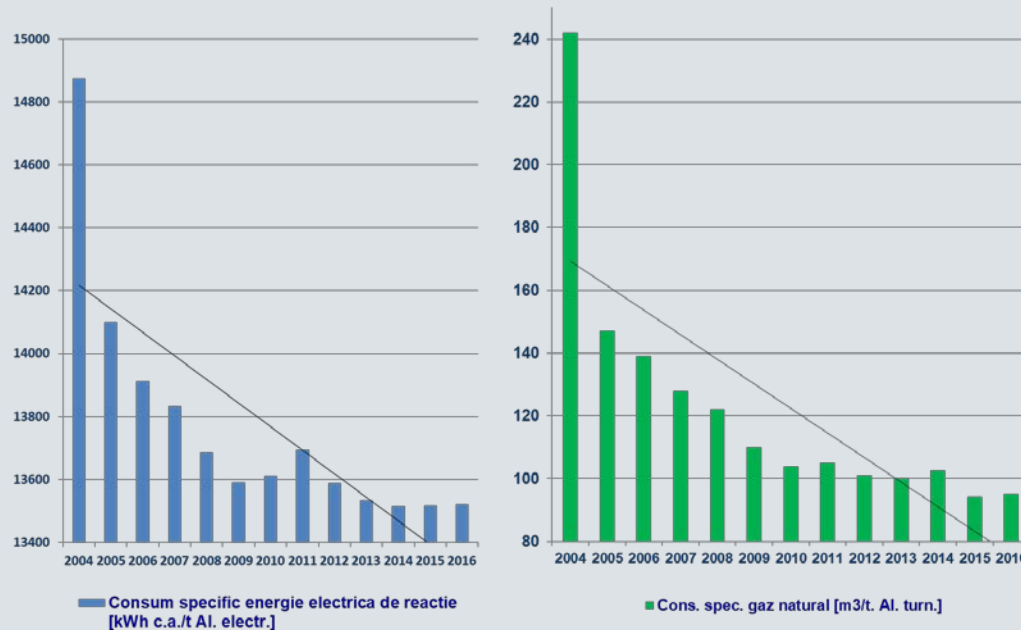
Investment projects management

Prior to the Investment Program compilation and approval, each project is analyzed in detail and a comprehensive file for each project is prepared, including: the project objectives and benefits, necessary capital expenditures broken down by cost elements and time, execution schedule, KPI for each investment etc.

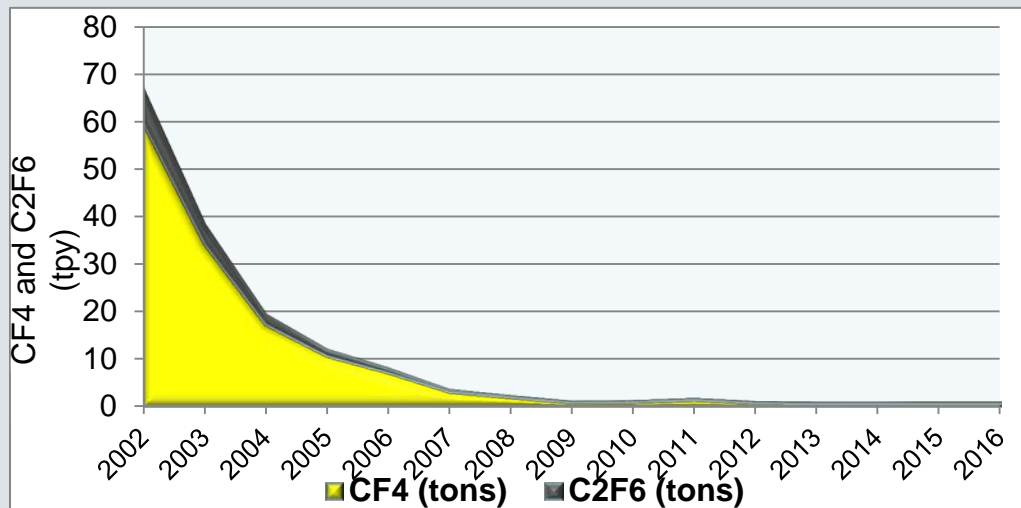
The entire investment program is managed by Integrated Project Team and followed up by dedicated software tools, such as: Primavera / MS Project Manager, SAP

The screenshot displays a project management software interface. On the left, a table lists investment items with columns for 'ACTIVITATE', 'Original Duration', 'Start', 'Finish', 'Budgeted Cost', 'Actual Cost', and 'Remaining Resources'. The main area shows a Gantt chart with tasks represented by horizontal bars across a timeline from 2014 to 2017. On the right, a list of investment items is shown with columns for 'Criteriu Investitie', 'Descrierea activitatii de raportare', 'Stare', 'Scad', 'C/Cole', 'Unita', and 'Tip'. The interface includes various toolbars and navigation options.

Results -POWER CONSUMPTION / GHG EMISSIONS



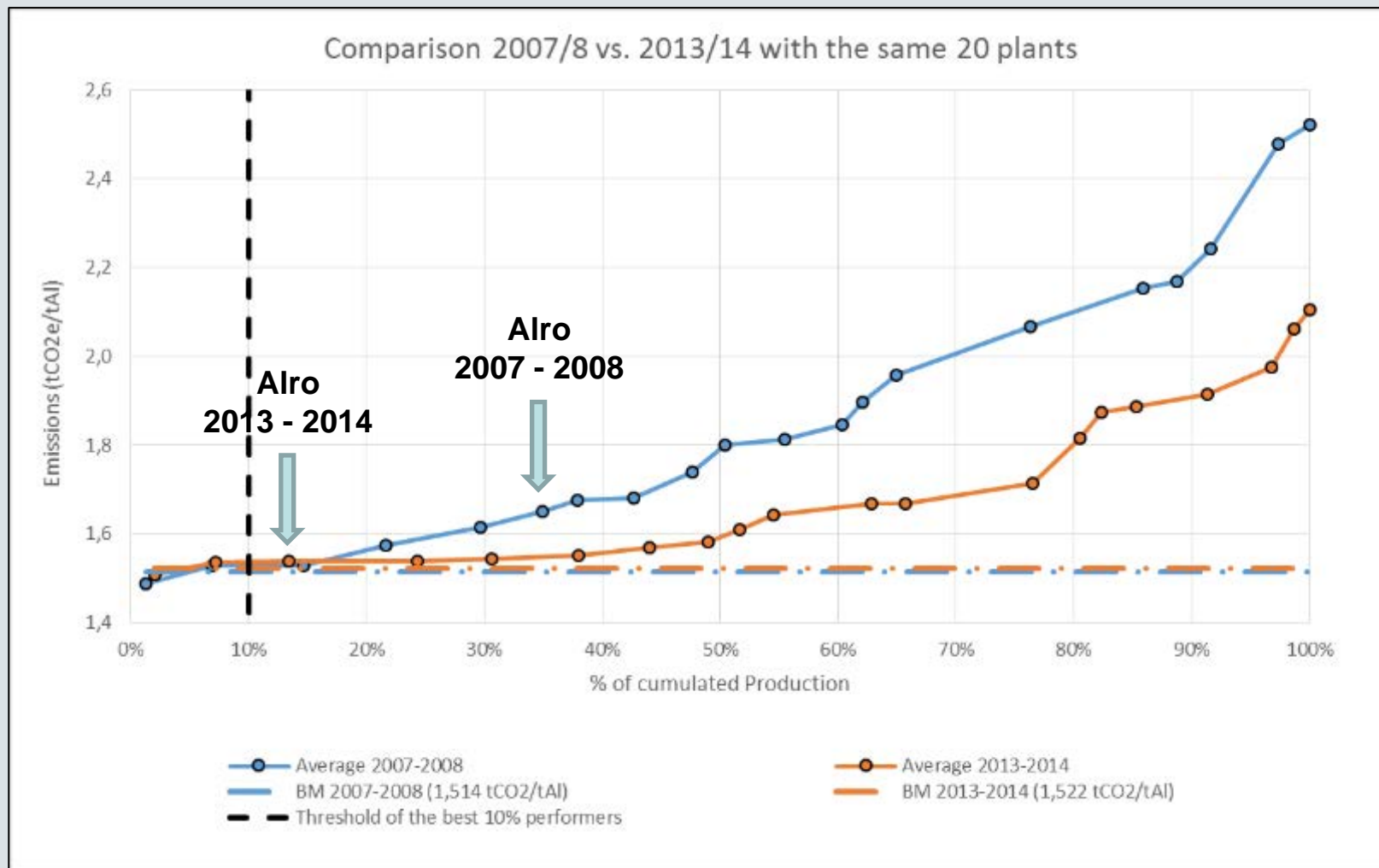
From 2004 until now the AC power in the smelting plant decreased by 9% and Natural Gas consumption about 2.5 times the lowest energy consumption per electrolytic metal ton ever recorded in its 50 years of history.



As a result of constant concern for environmental protection, the 2016 perfluorocarbons (CF4 and C2F6 are gases which very high warming potential) emissions were 85 times lower than in 2002. The anode effect /day are near to „0”.

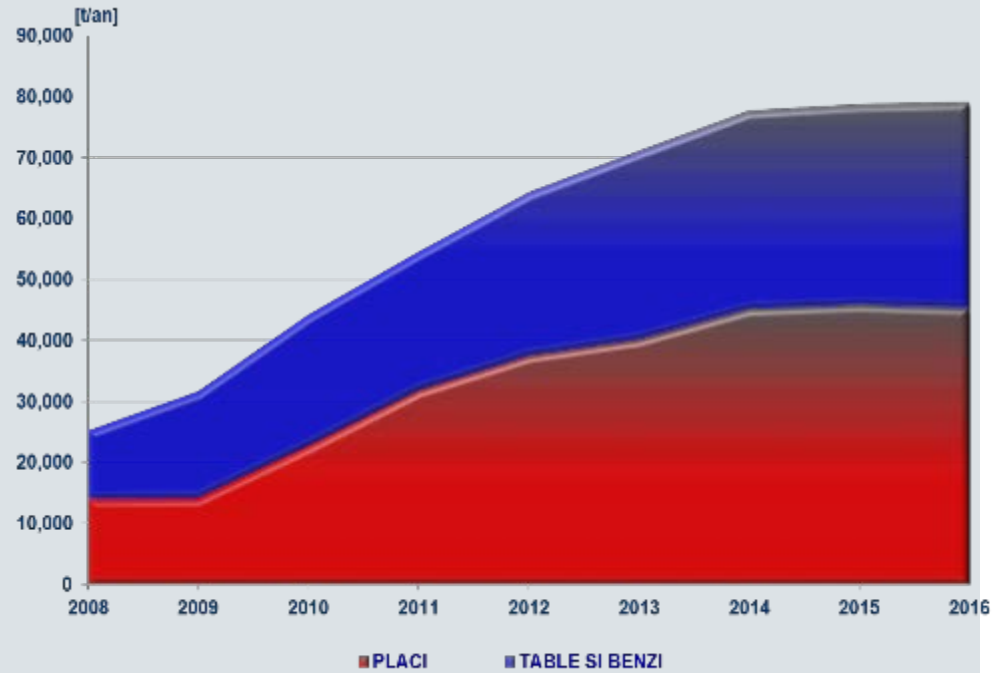
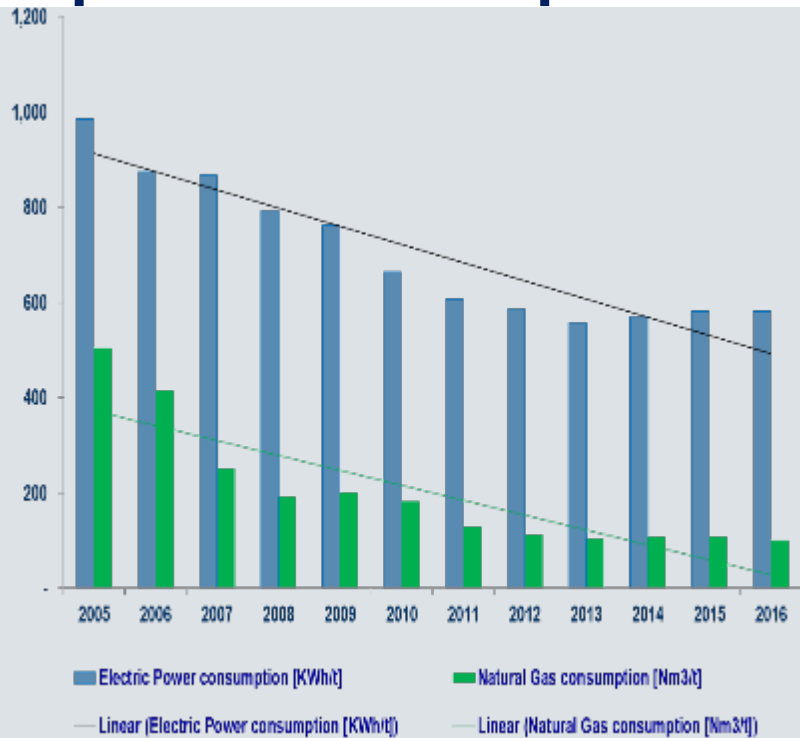
Results -European benchmarking

source: European Aluminium



Alro improved its position for CO2 emissions in the primary Al smelter from 6th place to 3rd place from 2007-2008 to 2013-2014.

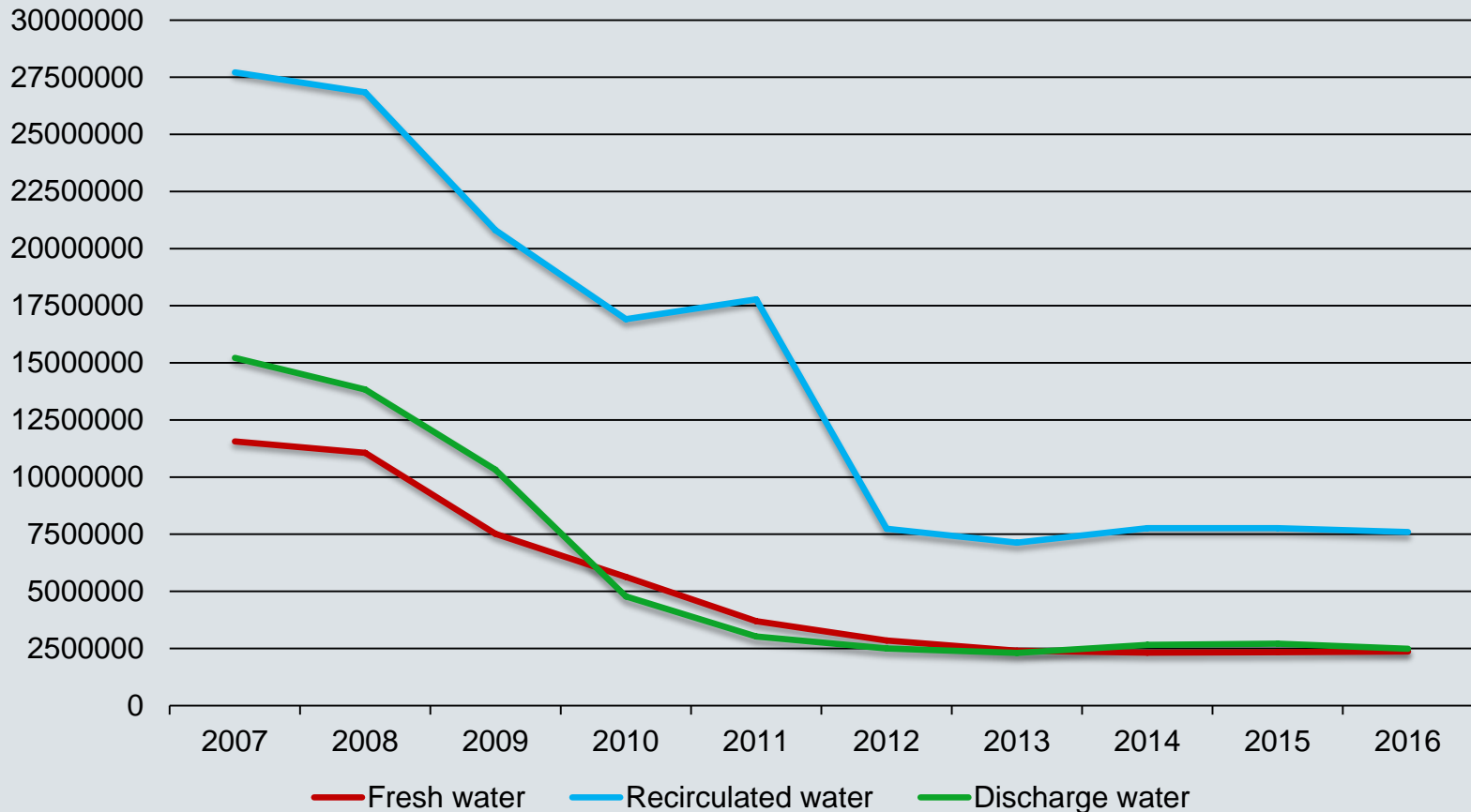
Results -Processed division power and natural gas specific consumption evolution 2003 - 2016



Specific consumptions of natural gas decreased 5 times since 2003 and the energy consumption decreased more than 2 times in the same period. Production from FRP increase 3 times especially high value products quantity.

ALRO is very active in assimilate new product dedicated for airspace, automotive and pressure vessels application - e.g. recently registered a new product call „ALRO Multibraze” for automotive industry.

Water consumption (m3)



Massive investment in water treatment and recycling equipment resulted in a reduction of fresh water use by 5 times and in the discharged water by 6 times in the last 10 years. Today water recycling rate is more than 80%.

ALRO's vision for the future

SHORT TERM

- ❑ Expand the market share by focusing on increasing the quantity of Very High Profitability Products (VHPP) in the product mix by diversifying the range of products (brazing, cast plates, automotive industry, aeronautical industries);
- ❑ Cost optimization and continuous improvement
- ❑ Increase Eco Recycling capacity to 100,000 t.

MEDIUM TERM

- ❑ FRP production increases to 120,000 t/year;
- ❑ New products development;
- ❑ Consolidate R&D at ALRO Group level
- ❑ Secure the competitive advantages taking into consideration the influence of knowhow and investment done so far

2018 - 2020

2021 - 2030

2031

LONG TERM

ALRO Factory of the Future (FoF)

- ❑ Fully implementation of the sustainability principles:
 - Full life cycle design for a circular economy;
 - Make aluminium a key enabler for the transition to a sustainability future;
 - Continue to develop innovative applications of aluminium in transport, packaging, buildings and in every day life.