



Net positive: The power of circular economy and sustainability in lead batteries

ILA AGENDA

1. Moura Group | Overview
2. PAM - Moura Environmental Program
3. Balance: Environmental x Competitiveness
4. Project: Moura Unit of Recycling & Metals



who we are

Largest Battery Manufacturer & Recycler in South America

Seven industrial plants in Brazil and Argentina

+ **6500 employees**

Sales Leader in South America

+ **90 distribution** centers in Brazil, Argentina and Uruguay

50% vehicles produced in South America are equipped with our batteries.

+ **55% of the start stop vehicles made in South America** are equipped with our batteries.

14 Sales Representatives (14 countries).



MOURA

MOST REMEMBERED
BEST-SELLING AND
PREFERRED

By our consumers in
Brazil, Argentina
and Uruguay



1st PLACE IN
BRAZIL



1st PLACE IN
URUGUAY

1st LUGAR
NA ARGENTINA





PROGRAM OF REVERSE LOGISTIC

EVERY NEW BATTERY SOLD, AN
OLD BATTERY IS COLLECTED

LEAD CONSUMPTION

AFTERMARKET

OEM

LEAD CONSUMPTION

AFTERMARKET

MOURA

ECOSYSTEM

CIRCULAR ECONOMY

PAM Moura Environmental Program



MOURA

ECOSYSTEM

CIRCULAR ECONOMY

INDUSTRY

+6 MILLION

Batteries manufactured and sold for the aftermarket



Industry



MOURA

ECOSYSTEM

CIRCULAR ECONOMY

DISTRIBUTION

+90

own units



Distribution



MOURA

ECOSYSTEM

CIRCULAR ECONOMY

RETAIL

+55K

sales points in BRA, ARG e URU



Retail

MOURA

ECOSYSTEM

CIRCULAR ECONOMY

CONSUMER

+40%

market share



Consumer

MOURA

ECOSYSTEM

CIRCULAR ECONOMY

COLLECTION
AND RECYCLING

~120k ton

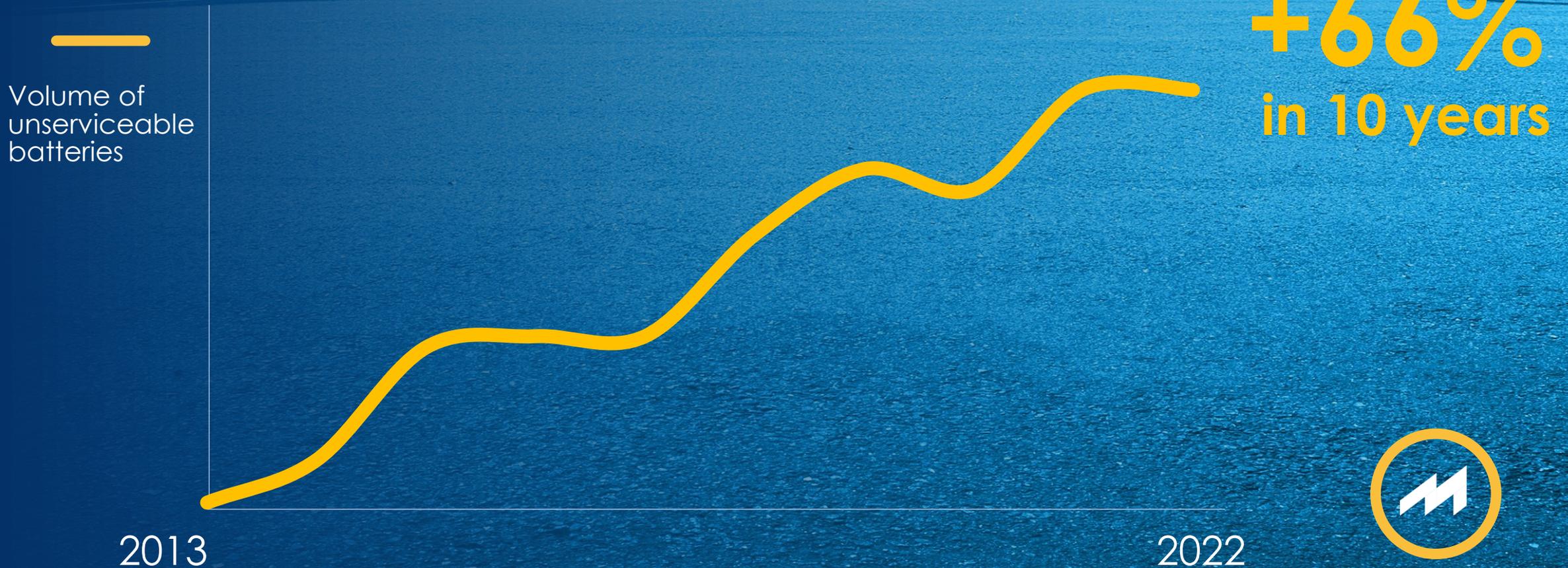


Recycling

BIN
collection

HISTORY

MOURA REVERSE LOGISTICS



MARKET STRATEGY



Strategies to balance
guidelines and ensure the
execution of reverse logistics.

1998
Law of
Environmental
Crimes nº 9.605

2008
CONAMA
Resolution nº
401

2010
PNRS 12.305

2017
Federal Decree
9.177

2019
Sectoral
Agreement for
Lead-Acid
Batteries with
MMA

2020
Addendum
Agreement signed
with CETESB

2024
Bilateral
Agreement
with Uruguay

LEGISLATION

SUPPORTING REVERSE LOGISTICS IN BRAZIL

LEAD CONSUMPTION

AFTERMARKET

OEM

LEAD CONSUMPTION

OEM

PRESENCE IN AUTOMAKERS

9 OUT OF **10**
BEST-SELLING
CARS
IN BRAZIL IN
2022



FIAT | STRADA



GM | ONIX



GM | ONIX PLUS



FIAT | MOBI



VW | GOL



GM | TRACKER



VW | T-CROSS



FIAT | ARGO



JEEP | COMPASS



NET POSITIVE OEM

Where we want to get to?

SUSTAINABILITY

throughout the supplier chain

SUSTAINABILITY

throughout the supplier chain



Proper sustainability management (waste, energy consumption, greenhouse gas emissions, water usage).



Protection of ecosystems



Fair working conditions



Compliance

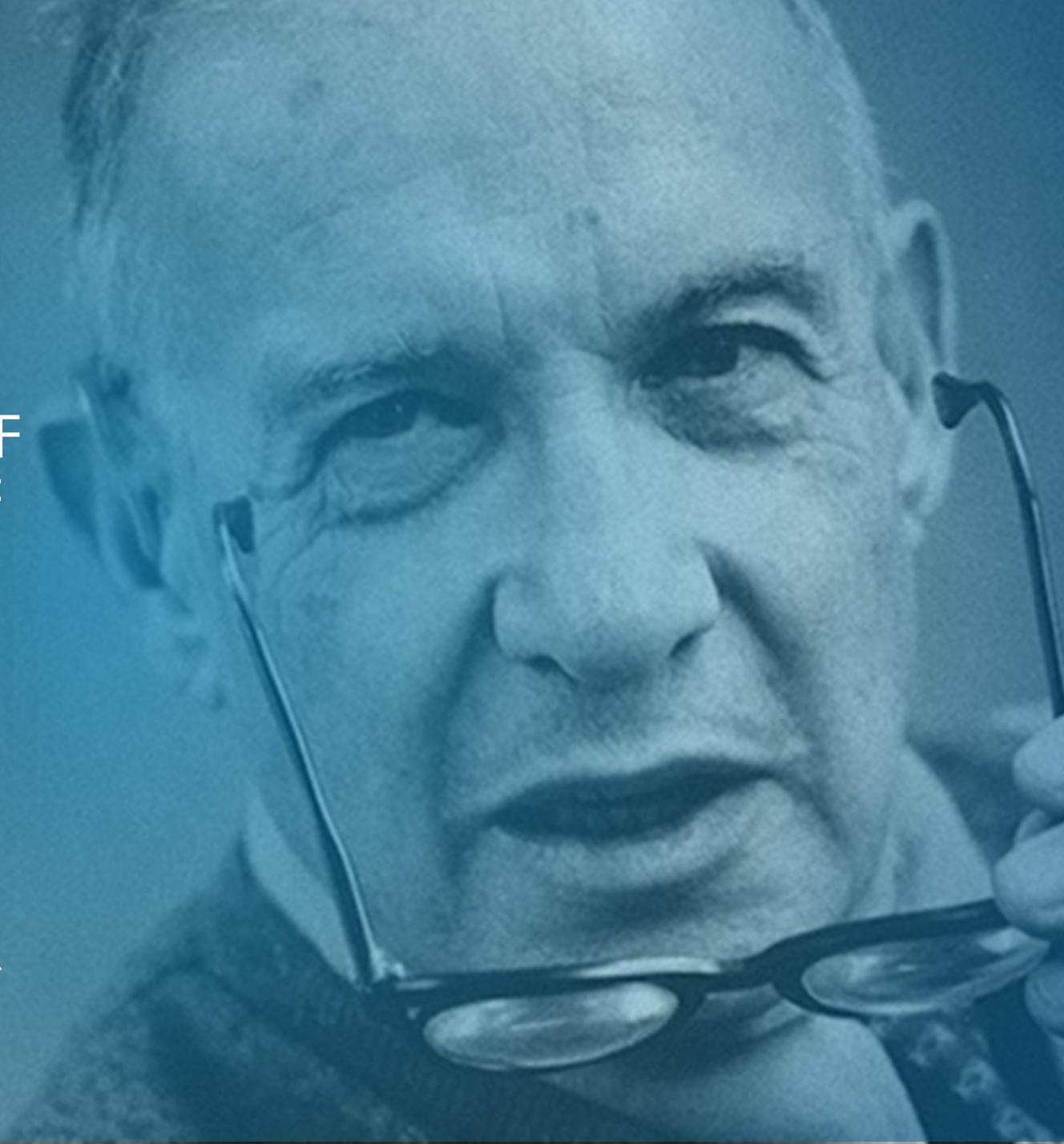


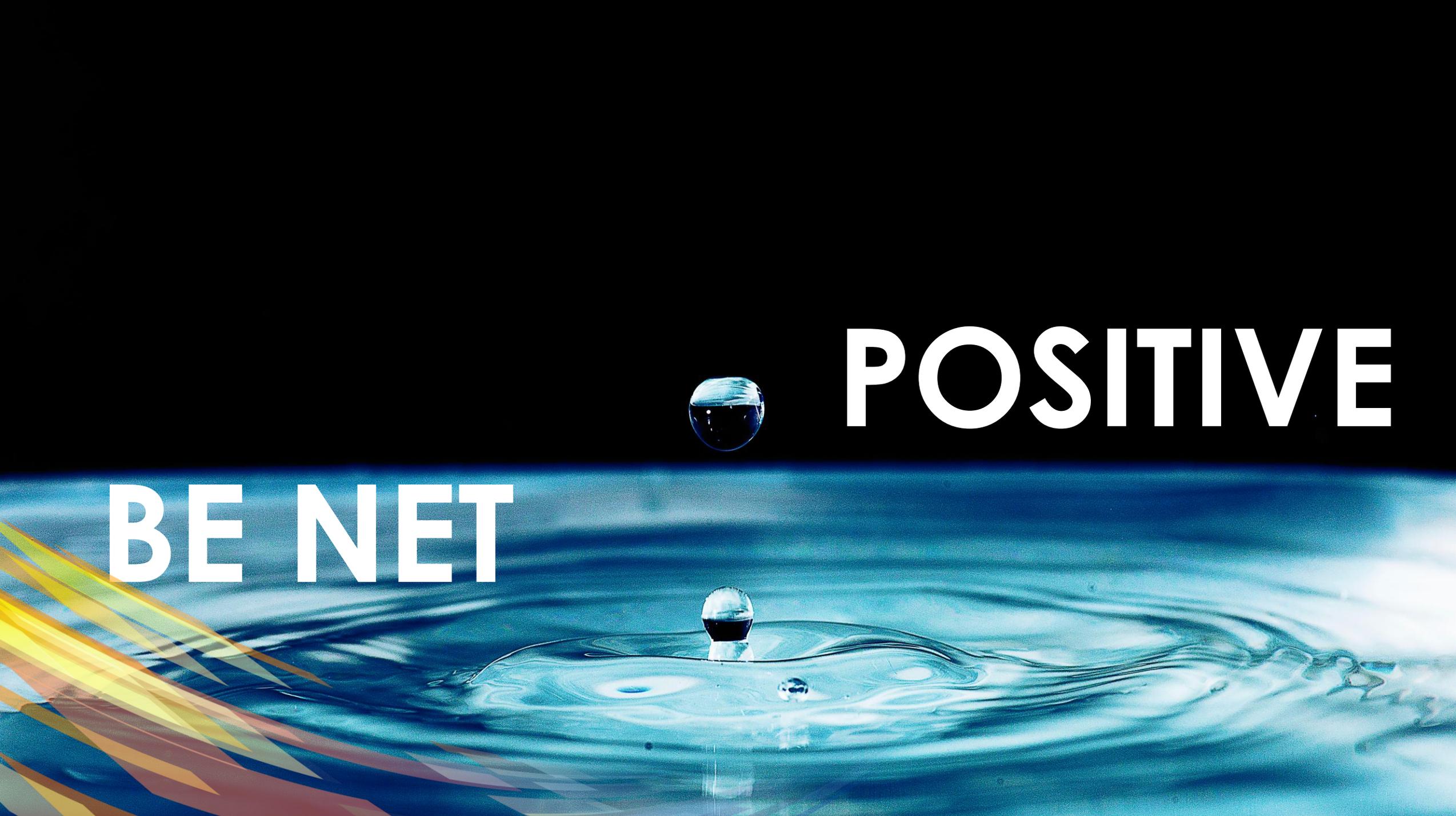
Standards and regulations

NET POSITIVE

“PROFIT FOR A COMPANY IS LIKE OXYGEN FOR A PERSON. IF YOU DON'T HAVE ENOUGH OF IT, YOU'RE OUT OF THE GAME. BUT IF YOU THINK YOUR LIFE IS ABOUT BREATHING, YOU'RE REALLY MISSING SOMETHING”

DRUCKER, PETER





BE NET



POSITIVE



FUTURE

BALANCE
SUSTAINABILITY X COMPETITIVENESS

KNOWLEDGE AND PARTNERS

TECHINICAL AGREEMENT

A SUSTAINABLE WORLD POWERED BY LEAD BATTERIES THAT MEET THE HIGHEST STANDARDS IN RAW MATERIALS AND BATTERIES SOURCING, MANUFACTURING AND RECYCLING GLOBALLY



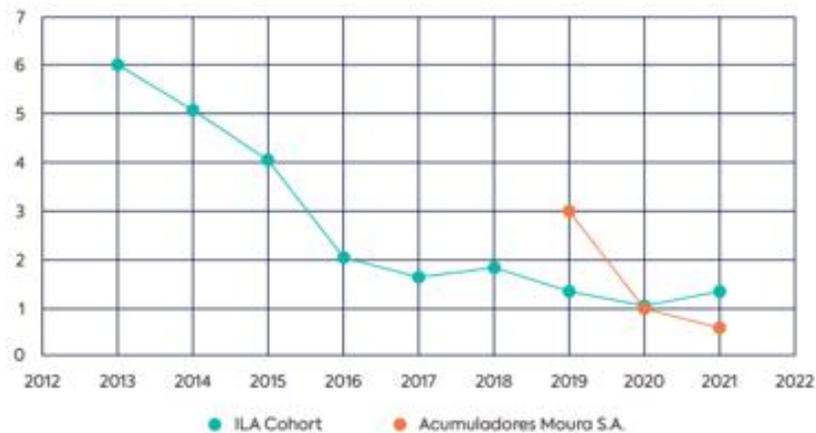
ENVIRONMENTAL INTERNAL KPIs

Lead in the Blood ($\mu\text{g}/\text{dl}$)

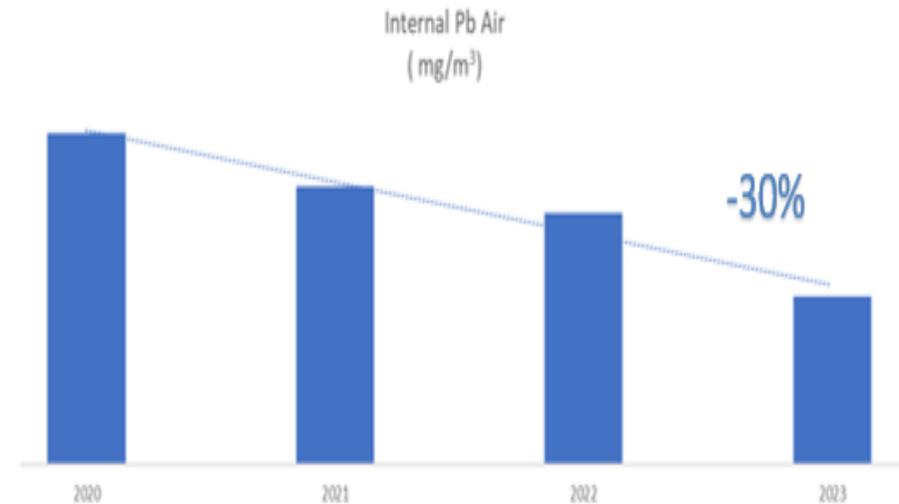
Indor – Lead in Air (mg/m^3)

Figure 5

Percentage of employees $\geq 30 \mu\text{g}/\text{dL}$ 2013-2021 (original ILA Cohort)



Note: Companies joining programme after 2018 are not included in this graph.



BALANCE

ENVIRONMENTAL X COMPETITIVENESS

LME Sn | 2010 - 2023

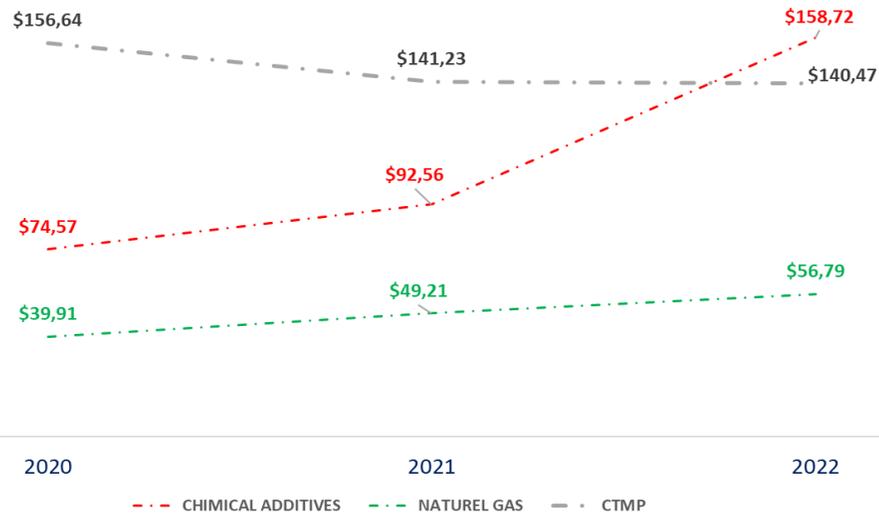
LME Sn
2010 - 2023



BALANCE

ENVIRONMENTAL X COMPETITIVENESS

CHEMICAL ADDITIVES (\$/Ton)



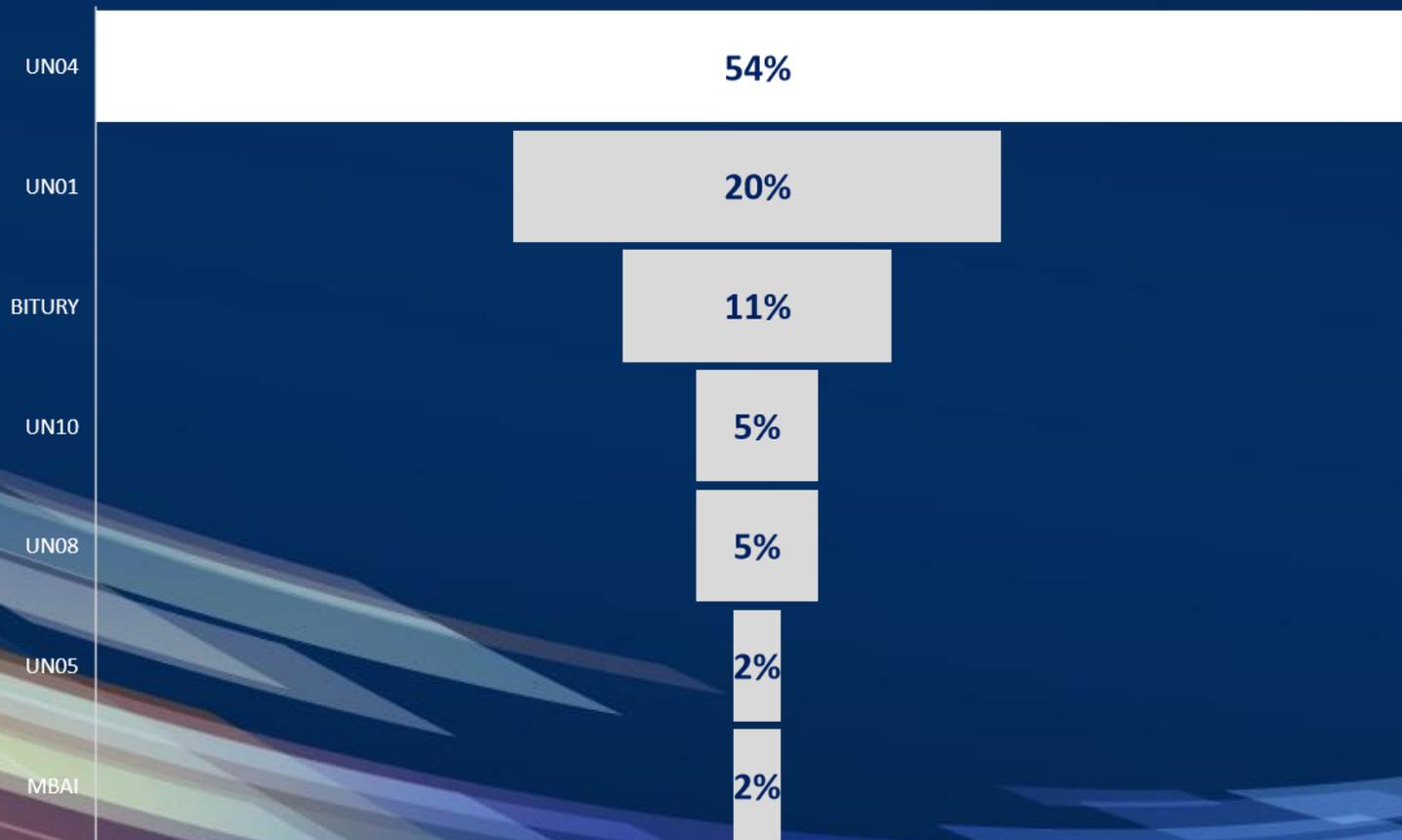
SODA ASH PRICE (\$/Ton)



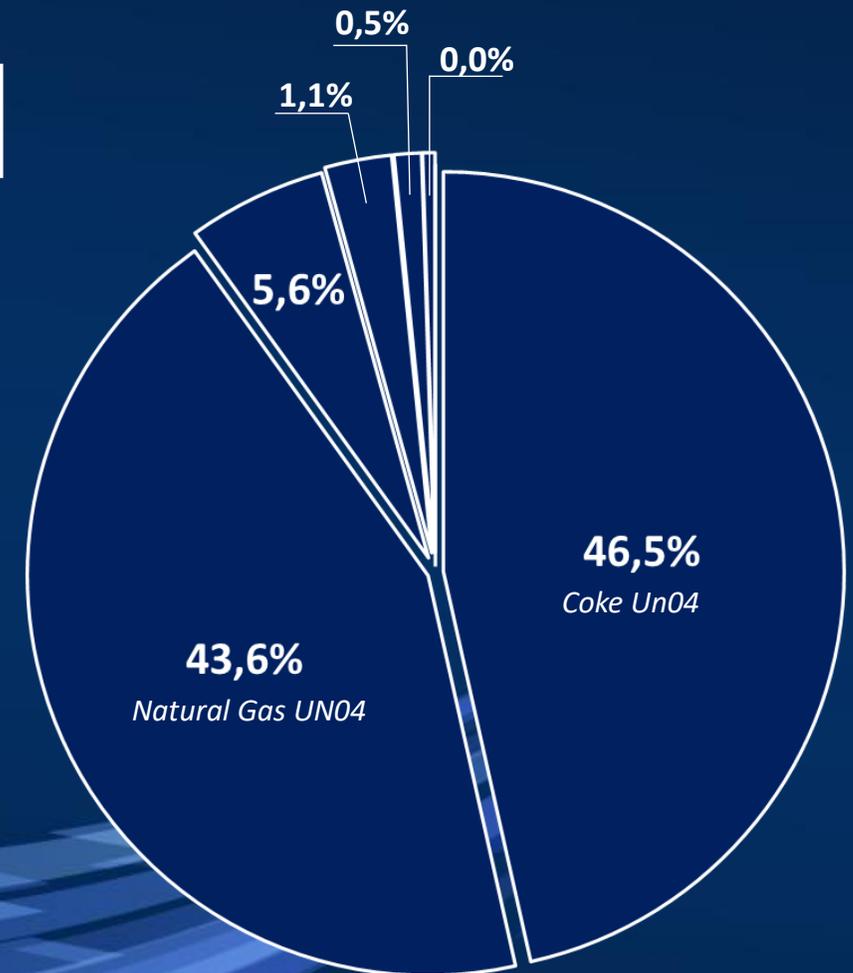
BALANCE

ENVIRONMENTAL X COMPETITIVENESS

% CO2 EMISSION X BUSINESS UNIT



EMISSIONS UN04



BALANCE

ENVIRONMENTAL X COMPETITIVENESS

Metso:Outotec

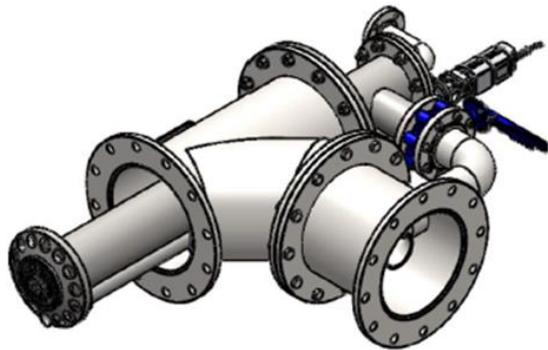


Figura 1 – Exemplo de Queimador KFS Metso Outotec

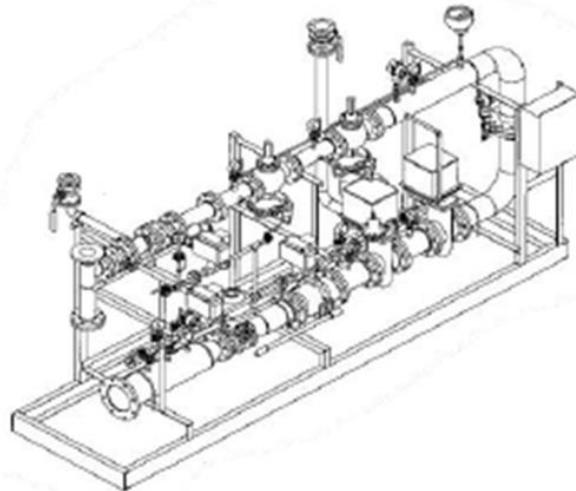


Figura 2. Croqui do Skid da Válvula

Technological Partnership
in the development of the
furnace burner :

- USE OF OXYGEN IN THE PROCESS
- REDUCTION OF EMISSION OF CO₂
- INCREASE OF FURNACE PRODUCTIVITY

CBI ROUTEMAP

HOW WILL PB CONTRIBUTE TO THESE GOALS?

Tests	MOURA Results GEN 4	MOURA Results GEN 5	MOURA Results 2020	MOURA Results 2021	Target for 2021	Target for 2022	Target for 2025	Target for 2028
DCA (A/Ah)	0,16	0,69	0,70	1,09	1,0	1,25	2,0	2,0
17,5% cycle test Continuous (25°C)	1020	1510	1696	1896	1800	2000	3000	---
Water Loss (g/Ah)	2,66 g/Ah	2,11	2,91	2,87	<3	<3	<3	<3
Cycles J2801 (Units)	14	15	16	16	16	16	17	19
Wh/kg @25°C	45	45	45	45	48	50	50	---
W/kg CCA @ -18°C	398	395	395	395	400	450	500	---

12V AUTOMOTIVE BATTERIES

Lead batteries are the **safest, cost competitive and more reliable** technology for cranking a vehicle!

+97%
of new
vehicles by
2030*

ICE
MHEV
HEV
PHEV
BEV

Adopted by
all powertrain
technologies

MOURA BESS

INTELLIGENT BATTERY ENERGY STORAGE SYSTEM



+ 10 years
of Development



BESS

(Battery Energy Storage System)



R&D



National
Engineering



Made in
Brazil



Installation
Operation
Maintenance



MOURA
Warranty



Reverse
Logistics

THE CHALLENGE THAT MOVES US IS **ENERGY**



PbC BESS to allow
EV's fast charging

PV + BESS + EV CHARGING

TECHNOLOGY



- **Flooded** - Maintenance-free batteries with excess electrolyte.



- **EFB** - Enhanced flooded battery, responsible for application in vehicles with start stop technology and more electrification level



- **AGM** - Battery with electrolyte retained in an AGM separator



- **Gel** - Battery with molecularly retained electrolyte in gel form, responsible for the recombination of gases, thus avoiding long-term water loss, giving greater longevity to the battery

The presence of minor impurities in lead can result in displacement of the reaction potentials of evolution of hydrogen and oxygen at the negative and positive electrodes respectively (water consumption). In the grids and connections, the formation of unwanted phases that have a greater susceptibility to corrosion may occur, in both cases premature battery failure will occur.



PROJECT NEW UNIT
Reciclyng & Metals

HIGHLIGHTS

1. Competitivity

Optimized Layout
Quality of Materials



2. Sustainability

Exhaust System
Negative
Pressure System



3. Innovation

Automations
Acid Recycling

TECHNOLOGY

GENERAL INDICATORS

➤ Un14 Process

1. BREAKER MACHINE



Material quality
New Breaker

Paste
Humidity
<10%

Amount of
paste in
polypropylene
: 800 ppm

Amount of
paste in
coarse metal:
1,5%
Humidity: 8%

Amount of
paste in fine
metal : 5%
Humidity: 8%



➤ **Current process**

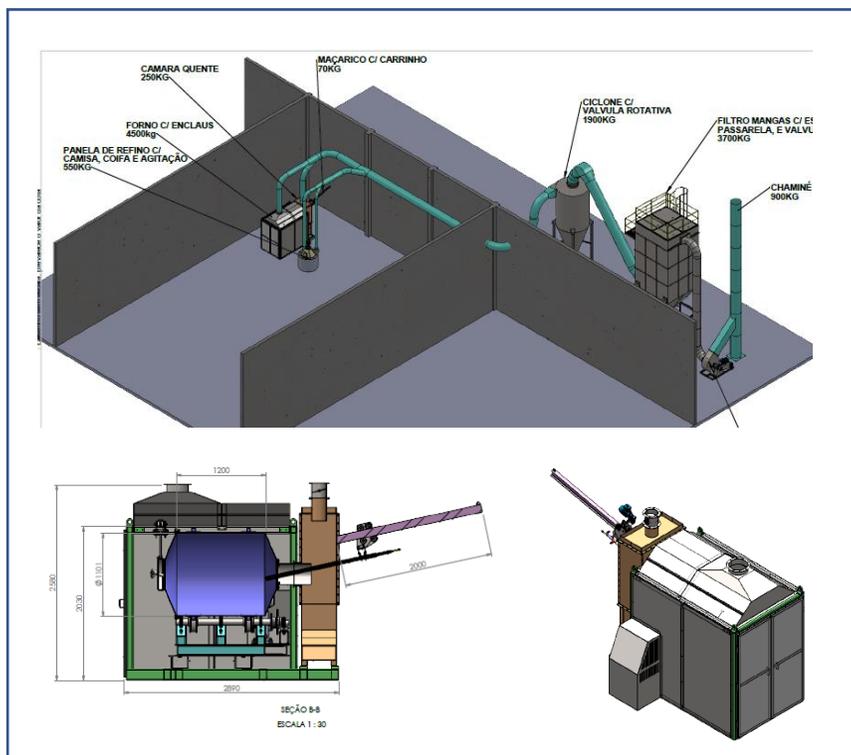
- Paste + Metal + Separator
Pb/Sb + Pb/Ca + PbO + PbSO4+ PE
- humidity 18%

R&D

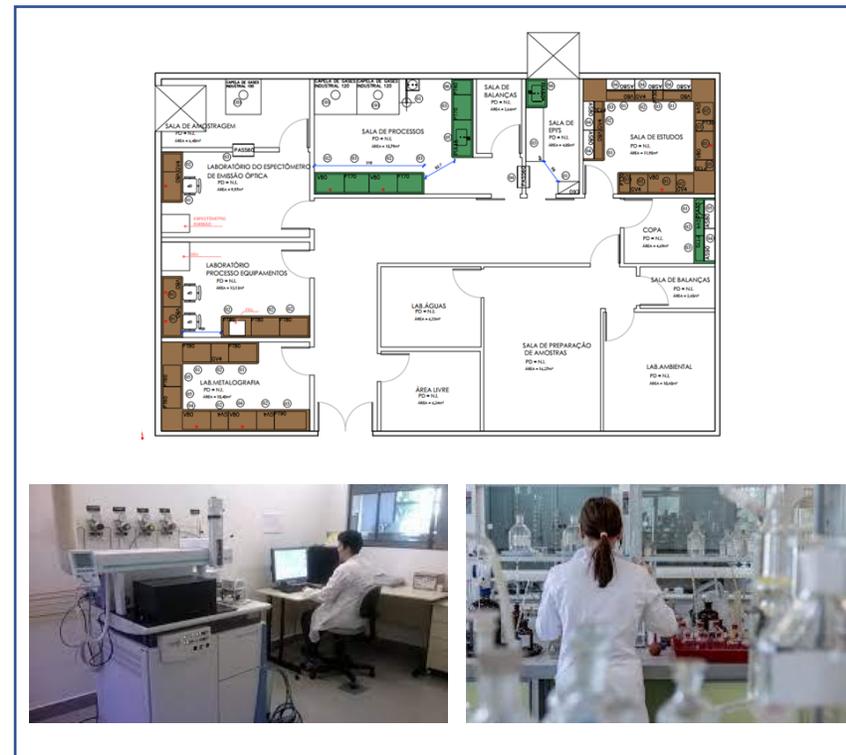
DEVELOPMENT

People
Process Knowledge
Partnership

PILOT PLANT



LABORATORY



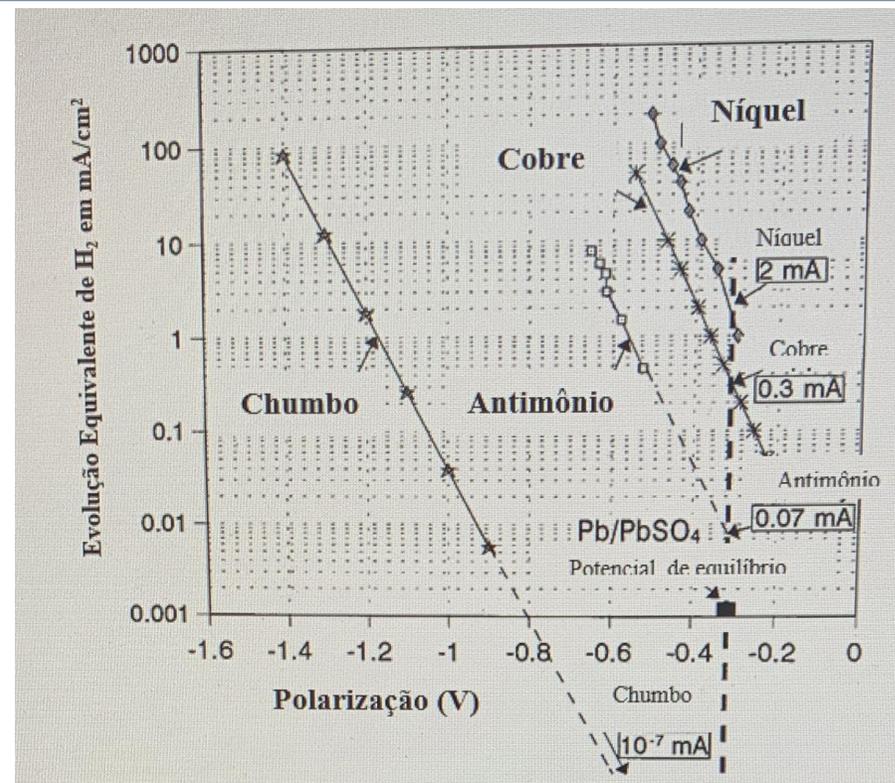
NEW BATTERY TECHNOLOGIES

- Requires a very **high degree of purity** of the Lead;
- **Lead impurities** can cause an imbalance in the electrochemical reactions of the battery generated in a failure in the first cycles of use.

TABLE II. TOTAL 4 h GAS GENERATION VOLUMES AT THE 5000 ppm OR SATURATION LEVEL

Contaminant	Gas Generated (cc)	Contaminant	Gas Generated (cc)
Aluminum	306.4	Iron	309.7
Antimony	2557.3	Lithium	258.4
Arsenic	626.2	Manganese	936.2
Barium	193.0	Mercury	194.2
Bismuth	916.0	Molybdenum	941.6
Cadmium	243.7	Nickel	1076.4
Calcium	172.5	Phosphorous	171.4
Cerium	286.4	Silver	285.8
Chlorine	266.4	Tellurium	1498.4
Chromium	571.8	Tin	179.2
Cobalt	5500.8	Vanadium	635.6
Copper	530.4	Zinc	218.4

NOTE: The standard cells averaged a value of 230.5 cc of gas generated during the 4 h period.



For the **Battery** of the Future, **Lead** of the Future

SOFT LEAD



Ca/Sn ALLOY



Sb ALLOY



PROGRESS OF PROJECT





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