
PYROGENESIS
State-of-the-art industrial technology solving some of the world's most pressing environmental, engineering, and energy problems.
Annual General Meeting
June 22, 2023
NASDAQ:PYR | TSX: PYR | FRA: 8PY

About this Presentation

This presentation is dated June 22, 2023, and is strictly intended to provide general information about PyroGenesis Canada Inc. ("PyroGenesis", the "Company", "we" or "our") and its business. This presentation does not constitute an offer to sell or the solicitation of an offer to buy any securities of PyroGenesis.

General

All amounts in this presentation are expressed in Canadian dollars unless otherwise indicated. Information appearing in this presentation is a select summary of PyroGenesis' business, operations and results. Our latest annual information form as well as our latest consolidated financial statements and management's discussion and analysis thereon are available on SEDAR at www.sedar.com, and on EDGAR at www.sec.gov, under our profile.

Forward-Looking Information

This presentation contains forward-looking statements and forward-looking information (collectively, "forward-looking statements") within the meaning of applicable securities legislation. All statements other than statements of historical fact contained in this presentation are forward-looking statements, including, without limitation, statements regarding: our products and services; the execution of our growth strategy; relations with suppliers and customers; future financial position; business strategy; potential acquisitions; potential business partnering; litigation; and plans, outlook, potential, and objectives. In certain cases, forward-looking statements can be identified by the use of words such as "outlook", "potential", "plans", "expects", "does not expect", "is expected", "budget", "scheduled", "estimates", "forecasts", "intends", "anticipates" or "does not anticipate", or "believes", or variations of such words and phrases or state that certain actions, events or results "may", "could", "would", "might" or "will be taken", "occur" or "be achieved" and similar words or the negative thereof. These forward-looking statements are based on PyroGenesis' management's current expectations and are subject to a number of risks, uncertainties, and assumptions, including market and economic conditions, business prospects or opportunities, future plans and strategies, projections and anticipated events and trends that affect the Company and its industry.

Although management of the Company believes that the expectations reflected in such forward-looking statements are reasonable and based on reasonable assumptions and estimates, there can be no assurance that these assumptions or estimates are accurate or that any of these expectations will prove accurate. The Company cannot assure investors that actual results, performance or achievements will be consistent with these forward-looking statements and additional risks and uncertainties discussed in the Company's materials filed with the Canadian and US securities regulatory authorities from time to time, available under the Company's profile on SEDAR at www.sedar.com and on EDGAR at www.sec.gov, under our profile. There can be no assurance that forward-looking statements will prove to be accurate, as actual results and future events could differ materially from those anticipated in such statements. Accordingly, readers should not place undue reliance on forward-looking statements. Forward-looking statements are provided as of the date of this presentation, and the Company assumes no obligation to update or revise such forward-looking statements to reflect new events or circumstances except as required under applicable securities laws. The forward-looking statements contained in this presentation are expressly qualified by this cautionary statement.

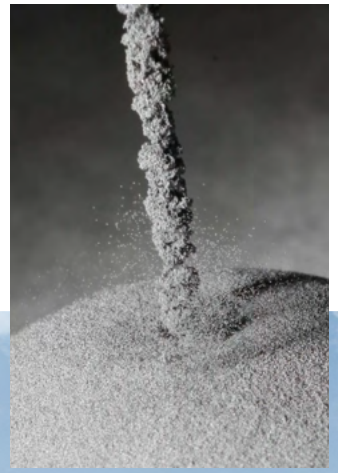
# Important Disclosures

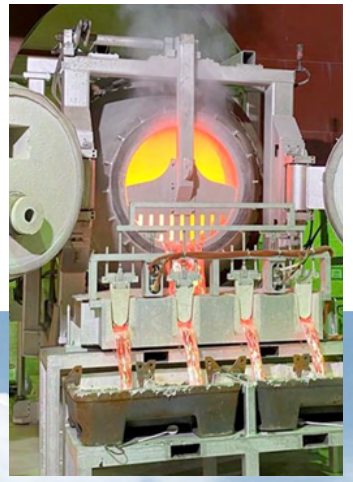
NASDAQ: PYR
TSX: PYR

# Company Overview

# 30 YEAR HISTORY

For 30 years, PyroGenesis has been advancing its expertise in ultra-high temperature processes to develop a technology ecosystem of services and solutions that helps heavy industry customers meet their fuel-switching, decarbonization, greenhouse-gas reduction, and process optimization goals.



PYROGENESIS

## ULTRA-HIGH TEMPERATURE INDUSTRIAL PROCESSES

To help solve key environmental, engineering, and energy challenges facing heavy industry.

# BY THE NUMBERS

**30+ Years**
founded in 1991

**156 Patents**
granted or pending

**3 Facilities**
2 factories, 1 engineering HQ

**3 Major verticals**
each with multiple solutions

**120 Employees**
largely engineers & scientists

**$30M Backlog**
signed & awarded as of May 15

**2.5 Years on TSX**
publicly listed November 2020

**2+ Years on Nasdaq**
publicly listed March 2021

PYROGENESIS

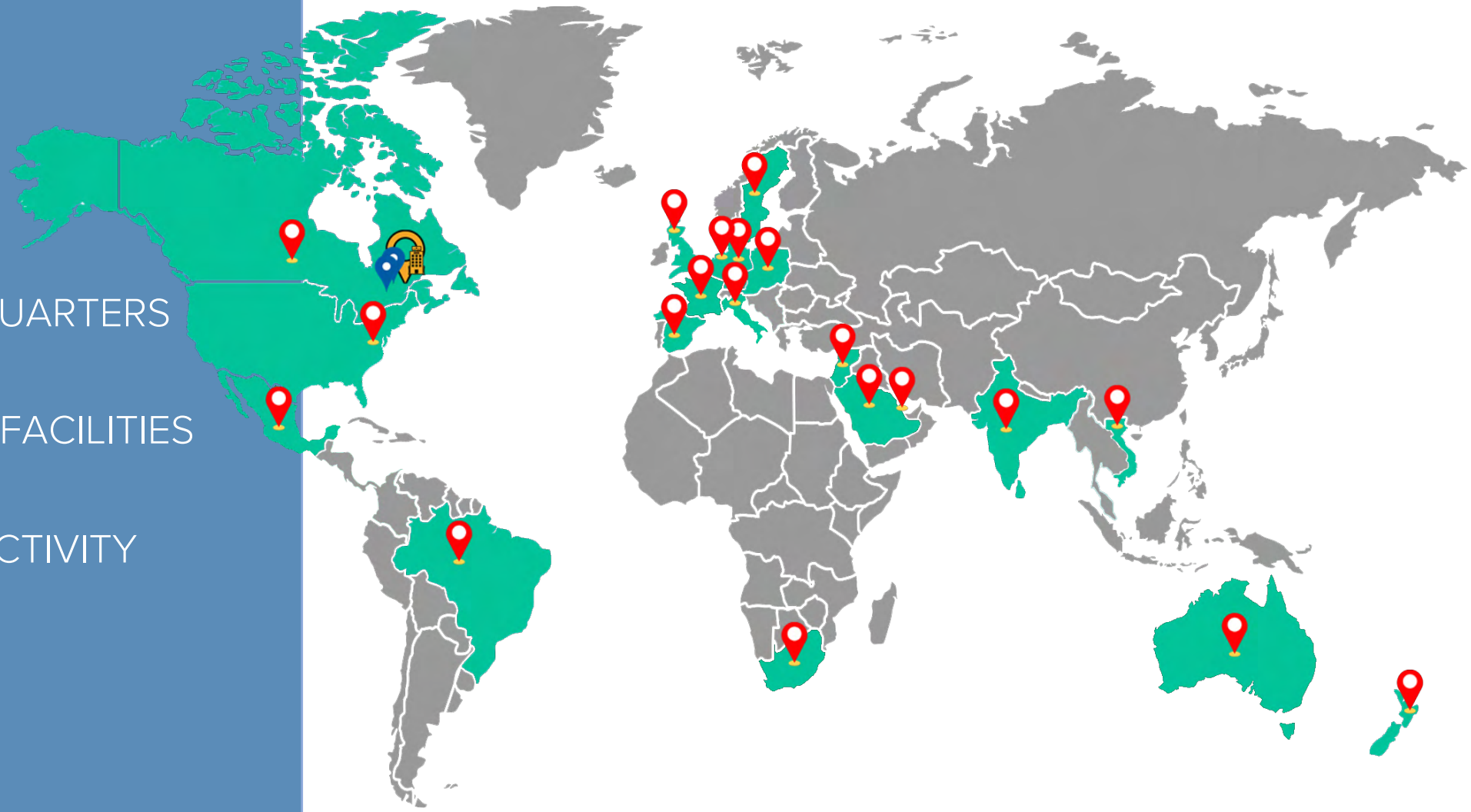
# GLOBAL SALES

## 6 CONTINENTS
## 20 COUNTRIES

COMPANY HEADQUARTERS

MANUFACTURING FACILITIES

OVERALL SALES ACTIVITY

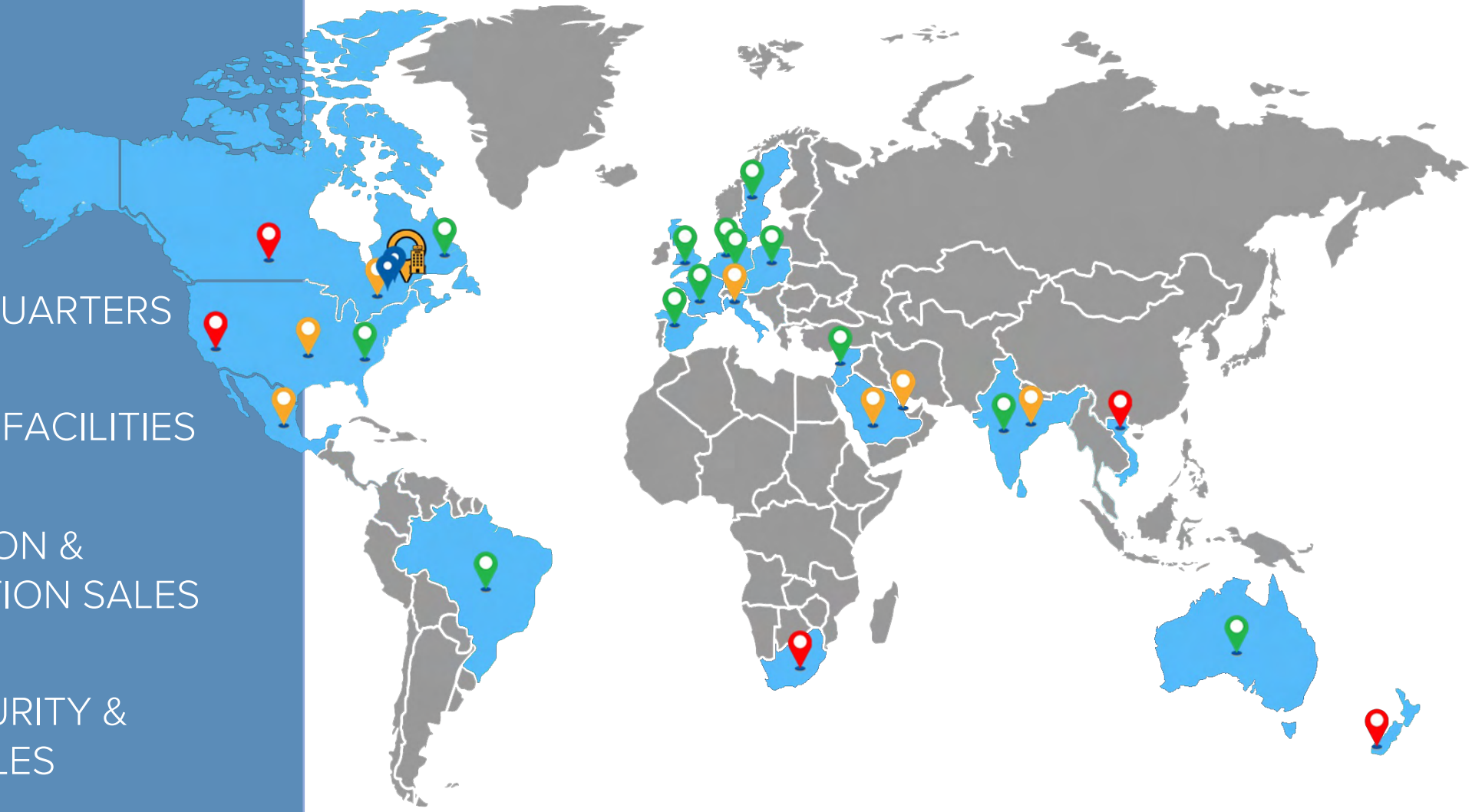


PYROGENESIS

# GLOBAL SALES

## SALES BY PROJECT TYPE

- COMPANY HEADQUARTERS
- MANUFACTURING FACILITIES
- ENERGY TRANSITION & EMISSION REDUCTION SALES
- COMMODITY SECURITY & OPTIMIZATION SALES
- WASTE REMEDIATION SALES



PYROGENESIS

# INVESTMENT THESIS

**1** | Serving the largest sectors of the global industrial decarbonization effort

- PyroGenesis' all-electric plasma-based industrial furnace burners and waste destruction systems, along with biogas upgrading and desulphurization technologies, serve the rapidly growing mandate to lower industrial fossil fuel usage and greenhouse gas emissions

**2** | Major regulatory and policy drivers

- Favourable regulatory dynamics as numerous international governments introduce both escalating emissions taxes and substantial decarbonization incentives, such as the renewable energy-heavy US Inflation Reduction Act of August 2022
- Strong policy tailwinds for high-emitting industries such as aluminum and steel, who face self-mandated carbon reduction deadlines after embracing Paris Accord targets

**3** | Category maker

- With a strong IP profile of 150+ patents granted/pending, PyroGenesis offers differentiated solutions unique to several markets

**4** | Contributing to the circular economy

- PyroGenesis' solutions, such as metal dross recovery systems and coke-oven gas purification systems, enable reuse of elements within the industrial production process to provide a sustainability advantage

**5** | Decades of technology leadership

- 25+ years of commercialization and R&D prior to senior capital market entry
- Large, globally-recognized team of leading in-house plasma expertise

**6** | Diverse customer and solution base

- Revenue opportunities across multiple industries

PYROGENESIS

# PLASMA: NATURE'S CARBON-FREE ENERGY SOURCE AND OUR AREA OF EXPERTISE

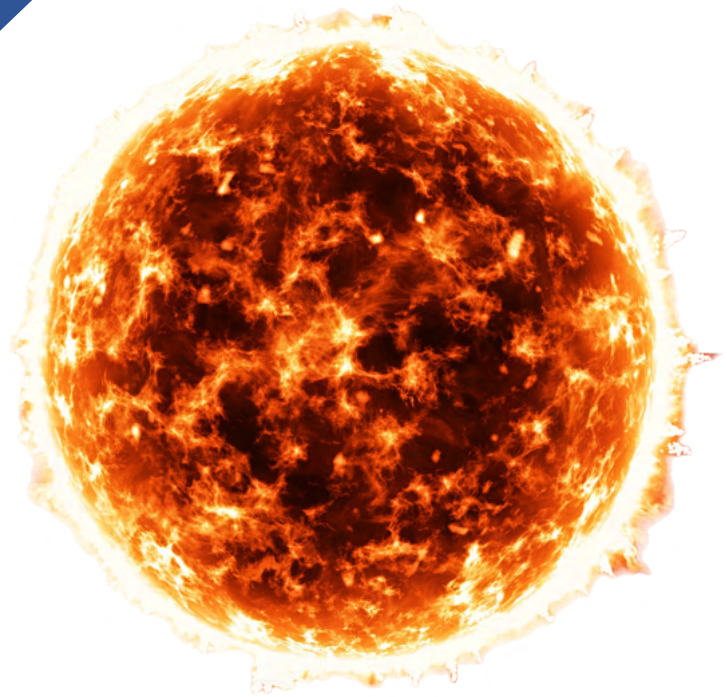
# CORE INNOVATION

- **We are experts in ultra-high temperature industrial processes**
- **Many of our technology solutions utilize plasma**
- We have one of the largest teams of plasma experts in the world
- Our scientists and engineers have decades of experience in creating plasma technologies, as well as conducting plasma R&D for governments, academia, military, and industry

## What is Plasma?

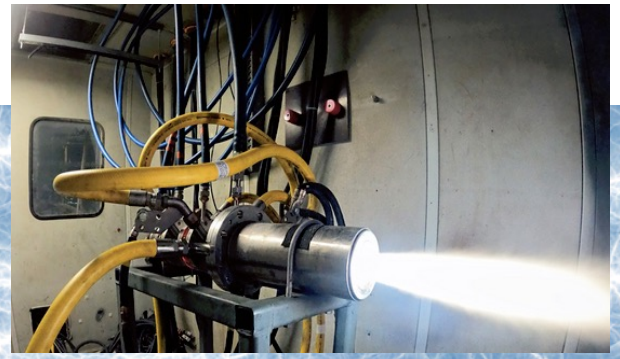
- Plasma is the 4th state of matter, created when gas is super-heated and energized with electricity
- The Sun is plasma, at 10,000°F
- Man-made plasma is electric, uses no fossil fuels, and emits no GHG, making it a carbon-free fuel source

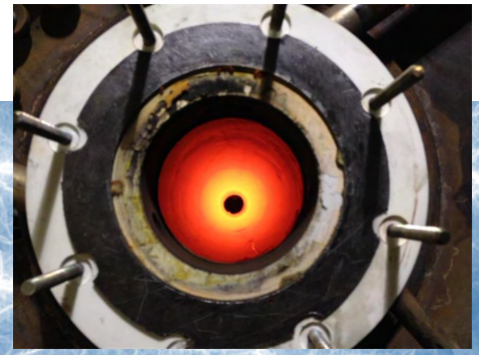
PYROGENESIS



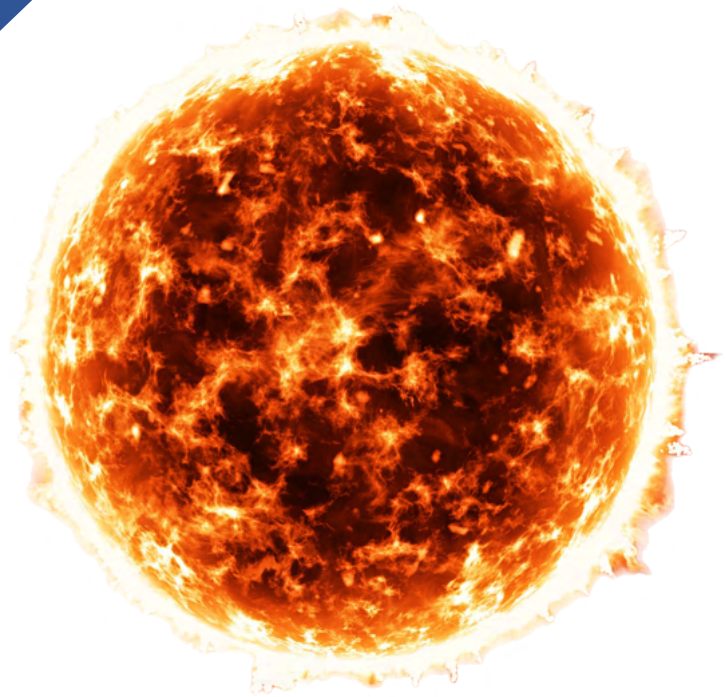
# CORE INNOVATION

- Our **plasma-based solutions** operate at up to 10,000°F
- The ultra-high heat enables the use of plasma across multiple solutions and heavy industries, including defense, aluminum, mining, steel, waste destruction, 3D printing
- Plasma torches are available from 50kW to 2mW+ output per torch; 3mW+ torches are currently in development
- Plasma systems provide numerous environmental and technical benefits, including integration with computerized process controls





# CORE INNOVATION



## HOW WE DEPLOY PLASMA'S UNIQUE CAPABILITIES

**Heat** →

Furnace Fuel Switching / Electrification

**Purify** →

Toxic Refrigerant Removal

**Return Composite Materials Back to Their Original Form** →

Recovery and Valorization of Materials from Dross

**Alter the State of a Material** →

Metal Powders for 3D Printing

**Destroy** →

Ship-board Waste Destruction

# Strategy

# BUSINESS STRATEGY

We've bundled our technologies into a solution ecosystem, under three verticals aligned to heavy industry economic drivers:

## Energy Transition & Emission Reduction

- fuel switching, utilizing our electric-powered plasma torches and biogas upgrading technology to help heavy industry reduce their fossil fuel use and greenhouse gas emissions

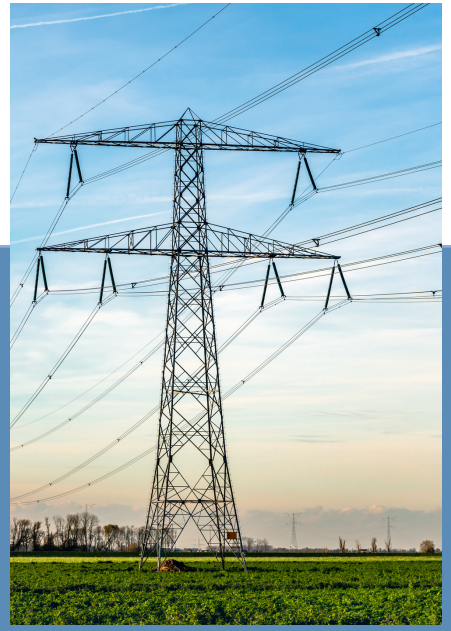
## Commodity Security & Optimization

- recovery of viable metals, and the optimization of production to increase output, maximize raw materials, and improve availability of critical minerals

## Waste Remediation

- safe destruction of hazardous materials, and the recovery and valorization of underlying substances such as chemicals and minerals

Solution Ecosystem



**Energy Transition & Emission Reduction**

**Commodity Security & Optimization**

**Waste Remediation**

PYROGENESIS

# GROWTH STRATEGY

GROWTH THROUGH CROSS-SELL, RELATIONSHIPS, MARKET EXPANSION, AND CONTINUED TECHNOLOGY ACCEPTANCE

LEVERAGING INDUSTRIAL DECARBONIZATION TREND

## Organic Growth

- Outbound Sales
  - Focused on 3-verticals:
    1. Energy Transition & Emission Reduction
    2. Commodity Security & Optimization
    3. Waste Remediation
- Insider Advantage
  - Uncover on-site opportunities
- New Tech Development
- Government & Academia Relationships
- Engineering Study Requests

## M&A / JVs

- Acquisition
  - Targeting small private firms
  - AirScience Technologies acquired 08/12/21 (now Pyro Green-Gas)
- Joint Ventures
  - Partnering with key customers on potential commercial endeavors
  - Leveraging relationships and engineering reputation

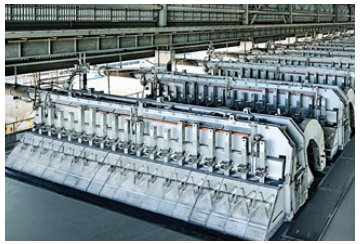
# GROWTH STRATEGY

GROWTH THROUGH CROSS-SELL, RELATIONSHIPS, MARKET EXPANSION, AND CONTINUED TECHNOLOGY ACCEPTANCE

LEVERAGING INDUSTRIAL DECARBONIZATION TREND

## Organic Growth

ALUMINERIE ALOUETTE PARTNERSHIP



**Aluminerie Alouette** is an aluminum producer in Quebec, home to the largest primary aluminum smelter in the Americas.

Alouette is co-owned by Rio Tinto (40%), AMAG Austria Metall (20%), Hydro Aluminium Norway (20%), Marubeni Metals Japan (13.33%) and Investissement Quebec (6.67%).

PyroGenesis has partnered with Alouette on various technologies to help decrease Alouette's environmental footprint by recovering, and re-using, valuable materials waste stemming from primary aluminum production processes, including from spent pot linings (SPL) and electrolytic bath.

PYROGENESIS

# Solution Ecosystem

# SOLUTION ECO-SYSTEM

## Energy Transition & Emission Reduction

- Iron ore furnace plasma burners
- Biogas upgrading, desulphurization, and pollution control

- Plasma aluminum remelting furnace
- Plasma burners for aluminum holding tanks
- Plasma burners for carbon anode baking furnaces

## Commodity Security & Optimization

- Aluminum dross recovery
- Titanium metal powders for additive manufacturing (industrial 3D printing)
- Coke oven gas purification

- Nano-silicon battery powders

- Fumed silica manufacturing

## Waste Remediation

- Ship-board waste destruction
- Land-based solid/hazardous waste destruction

- Aluminum dross residue valorization

- Aluminum spent pot linings recovery and valorization

Each vertical has several technology solutions at different stages towards commercialization. Our R&D is focussed on developing additional solutions within these three verticals.

# SOLUTION ECO-SYSTEM

## Energy Transition & Emission Reduction

**Commercialized**
- Iron ore furnace plasma burners
- Biogas upgrading, desulphurization, and pollution control systems

**Commercial-Ready**
- Plasma aluminum remelting furnace
- Plasma burners for aluminum holding tanks
- Plasma burners for carbon anode baking furnaces

## Commodity Security & Optimization

**Commercialized**
- Aluminum dross recovery
- Titanium metal powders for additive manufacturing (industrial 3D printing)
- Coke oven gas purification

**Pre-Commercial/Pilot**
- Nano-silicon battery powders

**In Development**
- Fumed silica manufacturing

## Waste Remediation

**Commercialized Technology**
- Ship-board waste destruction
- Land-based solid/hazardous waste destruction

**Commercial-Ready**
- Aluminum dross residue valorization

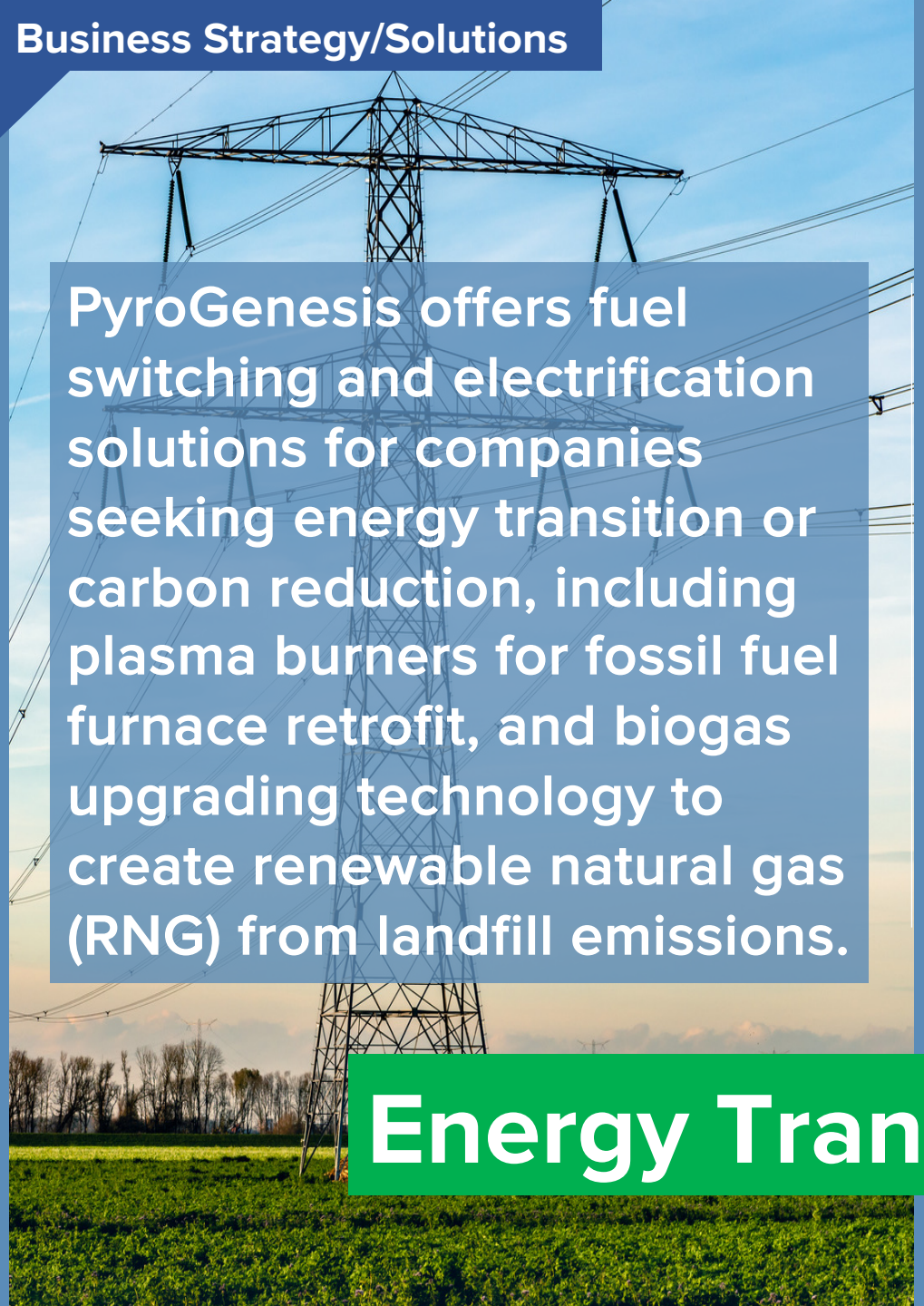
**In Development**
- Aluminum spent pot linings recovery and valorization

Each vertical has several technology solutions at different stages towards commercialization. Our R&D is focussed on developing additional solutions within these three verticals.

PYROGENESIS

# Energy Transition & Emission Reduction

# OVERVIEW



**PyroGenesis offers fuel switching and electrification solutions for companies seeking energy transition or carbon reduction, including plasma burners for fossil fuel furnace retrofit, and biogas upgrading technology to create renewable natural gas (RNG) from landfill emissions.**

## Target Sectors

- Iron ore
- Aluminum
- Solid Waste/ Landfill
- Steelmaking
- Automaking/ Manufacturing
- Chemical
- Government

## Commercialized Technology

- ✓ Iron ore furnace plasma burners
- ✓ Biogas upgrading, desulphurization, and pollution control

## Commercial-Ready Solutions

- Aluminum remelting plasma furnace
- Plasma burners for holding tanks
- Plasma burners for carbon anode baking furnaces

**Energy Transition & Emission Reduction**

PYROGENESIS

# TAILWINDS

## REGULATORY, POLICY, GEOPOLITICAL, AND SOCIAL DRIVERS

**Paris Accord**, to limit the increase in climate temperature to below 2C, via 50% emission reduction by 2030, and net zero by 2050.

**US Inflation Reduction Act**, which provides significant federal funding for climate efforts, directing nearly $400 billion funding to clean energy, with the goal of substantially lowering US carbon emissions by the end of this decade, with clean electricity and transmission commanding the biggest portion.

**Aluminum industry** commitment of net zero by 2050.

**Individual large emitters** instituting their own fast-tracked climate plans.

**G7 nations** committing to net zero by 2050, with Canada committing to reduce 40-45% GHG emissions by 2030, UK committing to 78% reduction by 2035.

Carbon Tax Escalations

(Canada: https://www.canada.ca/en/environment-climate-change/services/climate-change/pricing-pollution-how-it-will-work/carbon-pollution-pricing-federal-benchmark-information/federal-benchmark-2023-2030.html#toc3 )

**Energy Transition & Emission Reduction**

PYROGENESIS

SOLUTION

# PLASMA BURNERS FOR IRON ORE BAKING

- Upstream iron ore producers turn lower quality ore into marble sized pellets (pelletization) for transportation and later use in blast furnaces
- Pelletization furnaces burn heavy fuels, bunker fuel, diesel, or natural gas

## Technology Solution

Fuel-switching to PyroGenesis' electric plasma torches eliminates fossil fuel use and CO2 emissions from gas furnaces burners.

**Energy Transition & Emission Reduction**

PYROGENESIS

SOLUTION

# PLASMA BURNERS FOR IRON ORE BAKING

## STATUS: commercialized in 2022

- Completed initial systems sales to two largest global ore firms
- Torches to undergo in-furnace trials at both client factories in 2023
- Successful completion of ongoing trials may result in multi-unit orders in near/medium term

## OUTLOOK/POTENTIAL

- ~$1.8MM sale price per torch, $7MM NPV per torch (over 20 years)
- PyroGenesis owns the global patent on the technology

**Energy Transition & Emission Reduction**

SOLUTION

# BIOGAS UPGRADING AND DESULPHURIZATION

- US landfill off-gas is an enormous emissions problem, equivalent to 20 million cars
- According to the EPA, it's the third largest source of human-related methane emissions in the US, at ~15%

## Technology Solution

Pyro Green-Gas' landfill biogas upgrading, purification, desulphurization, and pollution control systems convert landfill methane into RNG

**Energy Transition & Emission Reduction**

PYROGENESIS

SOLUTION

# BIOGAS UPGRADING AND DESULPHURIZATION

## STATUS: mature and growing business

- Pyro Green-Gas, a Montreal company (formerly AirScience Technologies), was acquired by PyroGenesis in August 2021
- An experienced provider of systems for RNG, pyrolysis-gas purification, biogas & landfill-gas flares and thermal oxidizers, purification of coke-oven gas (COG), and landfill gas flares

## OUTLOOK/POTENTIAL

- Operating since 1993, with array of clients including in Italy and India
- The acquisition effectively provides PyroGenesis with a 15+ year advantage compared to building similar operations from scratch

**Energy Transition & Emission Reduction**

PYROGENESIS

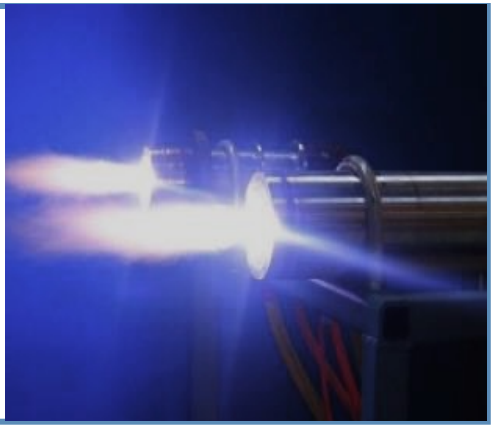
SOLUTION

# ALUMINUM REMELTING PLASMA FURNACE

- Aluminum demand is surging amid rising material costs
- Industry faces 77% carbon reduction target by 2050
- Holding tanks, remelting furnaces, and anode baking furnaces all burn gas

## Technology Solutions

- Plasma-heated remelting furnace for secondary aluminum producers and recyclers
- Plasma torch burner replacements for holding tanks and anode baking furnaces



**Energy Transition & Emission Reduction**

PYROGENESIS

SOLUTION

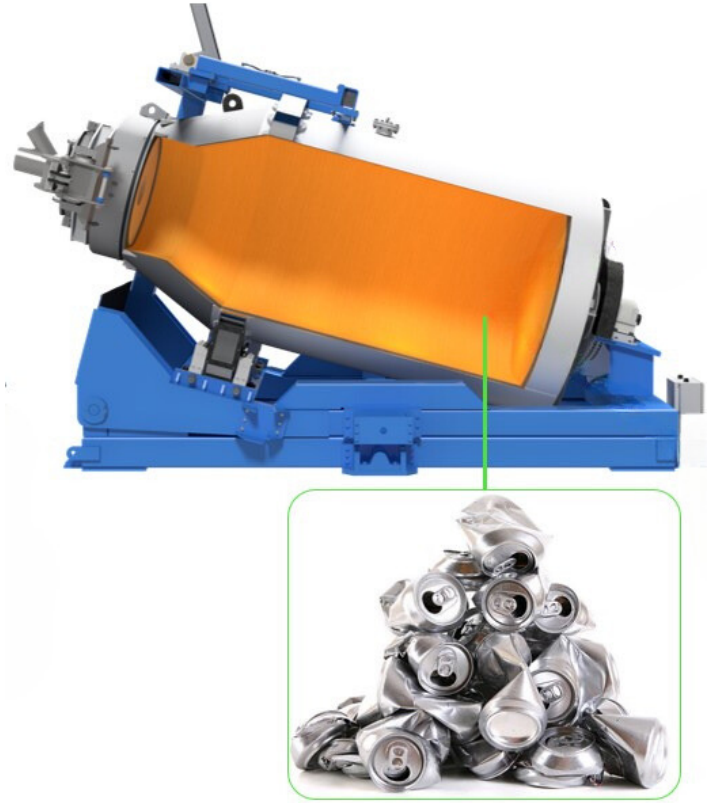
# ALUMINUM REMELTING PLASMA FURNACE

## STATUS: commercial-ready

- The development of a remelting furnace using plasma is based off our existing Drosrite metal recovery furnace design, which has been in use commercially for several years
- Plasma burner replacement for client holding tanks or furnaces is nascent

## OUTLOOK/POTENTIAL

- With aluminum demand growing, recyclers and secondary producers are increasing capacity while investigating carbon-free solutions
- Anode baking furnaces use between 4 and 100 burners per furnace; our suitable plasma torch model is ~$250K-$500K per torch



**Energy Transition & Emission Reduction**

PYROGENESIS

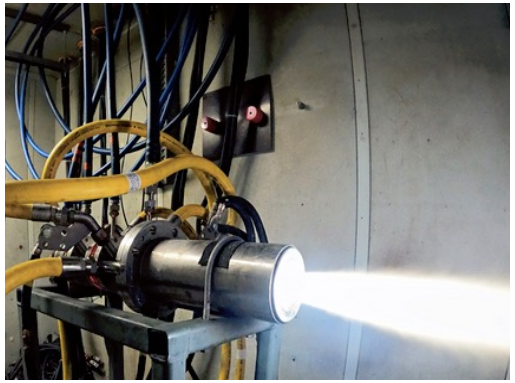
SOLUTION

# PLASMA TORCH, COKE-OVEN GAS CONVERSION FOR STEELMAKING

- **Steelmaking** relies heavily on coal, coke, and diesel
- Causes 7-12% of global GHG emissions
- Releases more than 3 billion metric tons of carbon dioxide each year, making steel the industrial material with the biggest climate impact

## Technology Solutions

- Plasma torches can replace gas burners in various steps of the iron and steel process
- Pyro Green-Gas technology converts coke-oven gas to high value, reusable hydrogen



**Energy Transition & Emission Reduction**

PYROGENESIS

SOLUTION

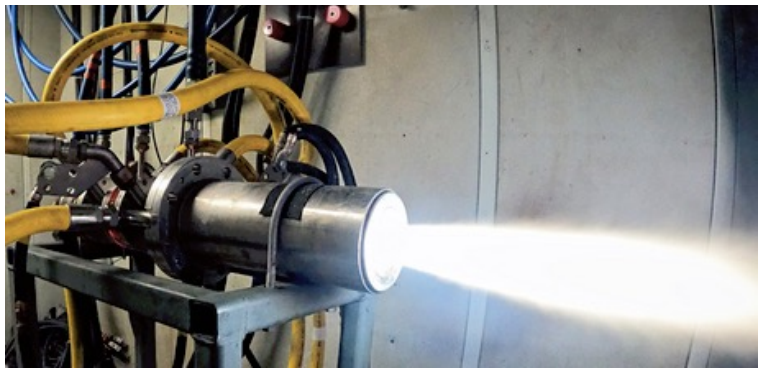
# PLASMA TORCH, COKE-OVEN GAS CONVERSION FOR STEELMAKING

## STATUS: commercial-ready / commercial

- Plasma torches are being trialed in iron ore baking, an upstream step of the steelmaking process; outreach to steelmakers is occurring
- Pyro Green-Gas has coke oven gas conversion technology in use

## OUTLOOK/POTENTIAL

- With similar infrastructure and emission reduction targets as pelletization plants, steelmaking presents a range of opportunities
- We are quoting ~$250K to $1.8MM sale price per torch during initial sales outreach to steelmakers, of which there are dozens globally



**Energy Transition & Emission Reduction**

PYROGENESIS

PYROGENESIS

# Commodity Security & Optimization

# OVERVIEW

**As the growing popularity of vital materials collides with demands for higher quality, lower environmental impact, and the disruption of supply chains by geopolitical issues, we can recover viable material from waste, improve output, and develop new means of producing critical metals.**

## Target Sectors

- Aluminum
- Aerospace
- Automotive
- Manufacturing
- Military
- Government
- Steelmaking

## Commercialized Solutions

- ✓ Aluminum dross recovery (Drosrite)
- ✓ Titanium metal powders for additive manufacturing (industrial 3D printing)
- ✓ Coke oven gas purification

## Pre-Commercial

- Nano-silicon battery powders

## In Development

- Fumed silica manufacturing

**Commodity Security & Optimization**

PYROGENESIS

# TAILWINDS

## REGULATORY, POLICY, GEOPOLITICAL, AND SOCIAL DRIVERS

- Rising demand for key metals, such as aluminum and iron
  - Demand for aluminium forecast to grow by 80% by 2050
- Critical minerals designations by many countries:
  - Canada - https://www.canada.ca/en/campaign/critical-minerals-in-canada/canadian-critical-minerals-strategy.html
- Instability around energy availability and energy price
- Supply chain disruptions made worse by political, geopolitical unrest
- Re-shoring / on-shoring trend for metals and minerals
- Rising raw materials prices

**Commodity Security & Optimization**

PYROGENESIS

SOLUTION

# DROSRITE™ ALUMINUM DROSS PROCESSING

- Dross is a residual byproduct of smelting; when air comes into contact with molten aluminum, the drying top layer absorbs impurities rising to the surface
- The result is a mix of contaminants and metal, traditionally skimmed and discarded
- Cold dross metal recovery methods are inefficient, creating a toxic salt residue

## Technology Solutions

- Our patented hot dross Drosrite™ systems recover 98% of the aluminum in dross – a 20% higher rate, a 50% lower opex, a lower carbon footprint, and without the aluminum-contaminating salt required by the traditional method allowing for on-site in-line processing without leaving the factory.

**Commodity Security & Optimization**

PYROGENESIS

SOLUTION

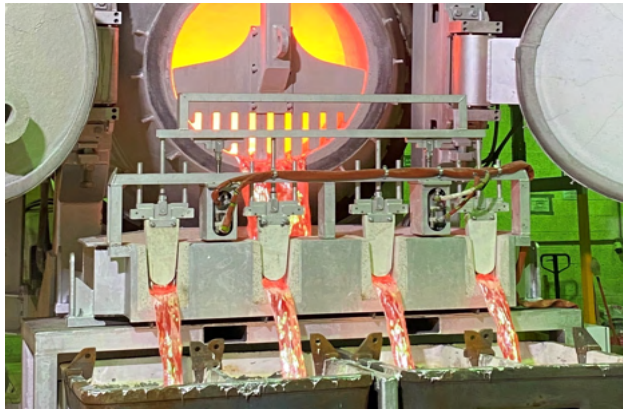
# DROSRITE™ ALUMINUM DROSS PROCESSING

## STATUS: commercialized

- Drosrite systems are processing dross at Ma'aden in Ras Al Khair Saudi Arabia, the largest greenfield aluminum smelter in the world
- 14 Drosrite™ orders placed since debut in 2016
- We continue to raise the price while advancing the technology

## OUTLOOK/POTENTIAL

- With aluminum demand growing, raw material prices rising, and ongoing supply chain instability, primary aluminum producers seek technology like Drosrite to maximize their output.
- New opportunities are with recyclers and downstream manufacturers



**Commodity Security & Optimization**

PYROGENESIS

SOLUTION

# NEXGEN™ TITANIUM METAL POWDERS

- Titanium metal powder is in high demand by additive manufacturers due to a high strength/light weight combination, putting it on the critical mineral list of many countries
- Used by aerospace, medical industries for 3D printed parts and tools

## Technology Solution

- As inventor of the gold standard plasma atomization process, our newly-launched patented NexGen™ metal powder production system increases output, lowers cost, and improves yield – while delivering what we believe is the market's highest quality titanium powder.

**Commodity Security & Optimization**

PYROGENESIS

SOLUTION

# NEXGEN™ TITANIUM METAL POWDERS

## STATUS: commercialized

- We have taken a series of steps – starting with a ground-up rethink and improvement of the technology for NexGen™ – to position us as an eventual leader in the high-quality powder space.

## OUTLOOK/POTENTIAL

- Additive manufacturing is growing at 19% CAGR, to $45Bn by 2028
- Q2 saw our first by-the-tonne order, for 5 tonnes of titanium powder
- The company is in the final stage of a 2-year long qualification process with a major global aerospace firm for official supplier status

**Commodity Security & Optimization**

PYROGENESIS

# Waste Remediation

# OVERVIEW

**PyroGenesis technology facilitates the safe destruction of hazardous materials, and the recovery and valorisation of underlying substances such as chemicals and minerals.**

## Target Sectors

- Military
- Aluminum
- Government
- Solid Waste/ Landfill
- Chemical
- Medical

## Commercialized Solutions

- ✓ Ship-board waste destruction
- ✓ Land-based solid/hazardous waste

## Commercial-Ready Solutions

- Aluminum dross residue valorization

## In Development

- Aluminum spent pot linings recovery and valorization

**Waste Remediation**

PYROGENESIS

# TAILWINDS

## REGULATORY, POLICY, GEOPOLITICAL, AND SOCIAL DRIVERS

- Tightening landfill regulations
- Restrictions around:
  - refrigerant disposal
  - Incineration
  - medical waste disposal
- Rising awareness around “forever chemicals” such as PFAS
- Legal mitigation for heavy industry dealing with decades of potential claims for unsafe disposal
- Recognition of the value inherent within some waste streams and the benefit of seeking technology that can safely reconstitute and potentially reuse waste material

**Waste Remediation**

SOLUTION

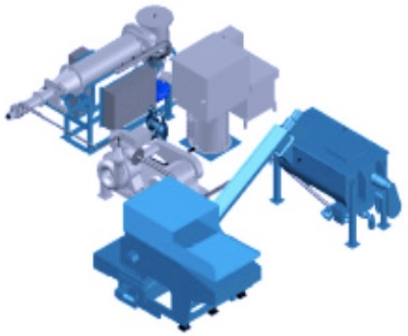
# SHIP-BOARD WASTE DESTRUCTION (PAWDS)

- Sea-borne ships cannot dump non-biodegradable waste into the ocean
- Compacted onboard trash quickly uses up storage space, forcing premature return to port

## Technology Solution

PyroGenesis PAWDS system safely destroys paper, plastic, food, oily rags, wood, and waste-oil on-board ships, with zero emissions.

USS Gerald R. Ford



**Waste Remediation**

PYROGENESIS

SOLUTION

# SHIP-BOARD WASTE DESTRUCTION (PAWDS)

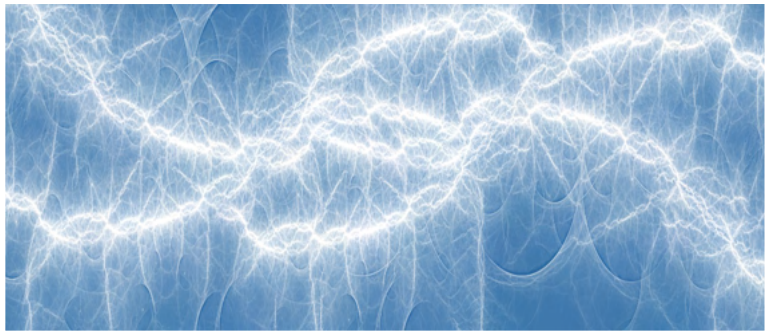
## STATUS: commercialized

- US Navy purchased multiple PAWDS systems for use on the newest class of aircraft carriers
- The Ford-class carriers are the world's largest warships, and the most technologically advanced ships ever built

USS Gerald R. Ford

## OUTLOOK/POTENTIAL

- Systems for 2 ships have been built and delivered (one now at sea)
- 2 more systems in production, for later delivery
- PAWDS formally specified into the design of future Ford class builds



**Waste Remediation**

PYROGENESIS

SOLUTION

# SOLID AND HAZARDOUS WASTE DESTRUCTION

- Legislation is tightening restrictions on allowable landfill waste in jurisdictions worldwide
- Industrial, medical, and synthetic refrigerant waste - including CFCs, HFCs, and HCFCs – are under scrutiny

## Technology Solution

- Our waste destruction options include waste-to-energy, solid waste, chemicals, and refrigerants
- SPARC destroys refrigerants and chemicals cleanly with no incineration, to 6N efficiency (99.9999%)

**Waste Remediation**

PYROGENESIS

SOLUTION

# SOLID AND HAZARDOUS WASTE DESTRUCTION

## STATUS: commercialized

- New $6M SPARC sale Q1 2023 to New Zealand product stewardship organization, due to NZ government's refrigerant destruction mandate

## OUTLOOK/POTENTIAL

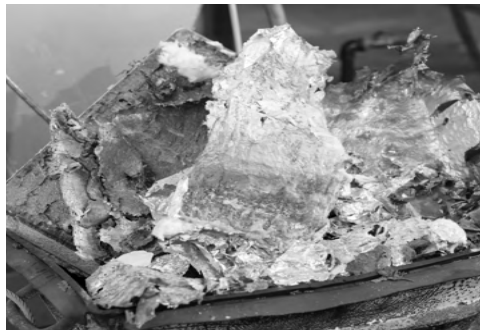
- Previously a latent division, we are seeing renewed interest due to tightening landfill restrictions worldwide
- SPARC sale to New Zealand includes option for second $6M system, as demand is expected to exceed capacity due to NZ government changing refrigerant destruction rules from voluntary to mandatory

**Waste Remediation**

SOLUTION

# ALUMINUM DROSS RESIDUE VALORIZATION

- While systems like our Drosrite can reclaim valuable metals from aluminum dross, a chemical residue remains
- The residues are packed full of toxic chemicals and usually landfilled



## Technology Solution

Working with a partner, PyroGenesis determined that the chemical residues, if treated correctly, can safely uncover raw chemicals that can be sold back into the market, or valorized.

**Waste Remediation**

SOLUTION

# ALUMINUM DROSS RESIDUE VALORIZATION

## STATUS: commercial-ready

- We are establishing a joint venture with an international partner
- The ultimate goal is to build small factories to process the dross residue from nearby aluminum producers

## OUTLOOK/POTENTIAL

- The joint venture is currently undergoing a due diligence phase
- Residue samples from dross processed by us was lab tested
- An economic analysis is helping to determine 1st factory location
- Initial timelines target 2023/24 for first factory design

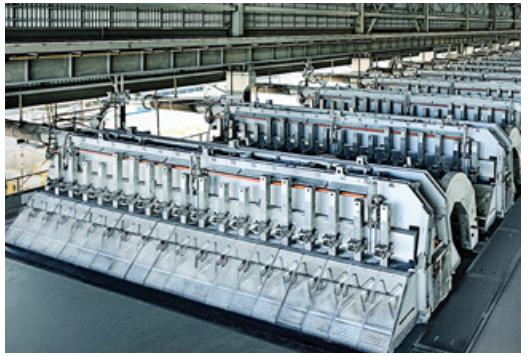
**Waste Remediation**

PYROGENESIS

SOLUTION

# ALUMINUM SPENT POT LINING VALORISATION

- Aluminum is produced inside a steel shell (or “pot”) lined with carbon cathode material that conducts electricity
- The lining loses conductivity in 2-6 years and is replaced
- Contaminated by chemicals, the toxic “spent pot lining” is stored or landfilled, a major environmental problem



## Technology Solution

Partnering with Aluminerie Alouette, the largest smelter in the Americas and co-owned by Rio Tinto, our solution transforms the spent lining into synthesis gas and aluminum fluoride: reusable raw materials.

**Waste Remediation**

PYROGENESIS

SOLUTION

# ALUMINUM SPENT POT LINING VALORISATION

## STATUS: in development

- Alouette and PyroGenesis have recently expanded the partnership
- Compared to chemical treatments currently used, our method is projected to generate major savings resulting from the decrease or elimination of costs of treatment, transportation, and land-filling

## OUTLOOK/POTENTIAL

- Every aluminum smelter globally produces spent pot lining (SPL)
- Average of 15-35 kg of SPL are generated per ton of aluminum produced; ~ 1.5 million tons of SPL are produced annually worldwide
- Potential total addressable global market of ~$3 billion

**Waste Remediation**

PYROGENESIS

PYROGENESIS

# Operational Highlights

# REVENUE DIVERSIFICATION

## CONTRACTS FROM MULTIPLE BUSINESS LINES

| | |
|---|---|
| Aluminum Waste Remediation | $2.7M to recover and valorize waste residue from primary aluminum production |
| 3D Printing / Additive Manufacturing | 5 tonne order for titanium metal powder; option for 6 tonnes more |
| Ship-Board Waste Destruction | 3 plasma waste destruction torches, to US Navy (in addition to 4 full system sales) |
| Hazardous Refrigerant Destruction | $6M land-based system to destroy refrigerants from across New Zealand |
| Air Purification | System to decontaminate dust generated during lithium battery recycling |
| Energy Transition Study | Computational fluid dynamics (“CFD”) study to evaluate the use of plasma in the European conglomerate’s chemical production boilers |
| Fuel Switching Study | Study to investigate the feasibility of using plasma torches as a heating source in aluminum cast house furnaces, for international primary aluminum producer |
| Dross Processing / Air Purification | Test plasma torches for recovering magnesium metal from dross and recycled minerals; develop a method to clean and decontaminate particulate matter produced during primary magnesium production |
| Government Contract | $1.15M Phase 2 contract award from Innovative Solutions Canada |

# PARTNERSHIPS

## PYROGENESIS DEVELOPS PARTNERSHIPS TO HELP DRIVE INNOVATION AND GROWTH

HPQ SILICON

ALUMINERIE ALOUETTE

AUBERT & DUVAL

- **HPQ Silicon** is an advanced materials engineering provider that offers sustainable silica (Si02) and silicon (Si) solutions. Based in Quebec, HPQ is developing a portfolio of value-added silicon products sought after by electric vehicle and battery manufacturers. PyroGenesis is building the technology and pilot plants for HPQ while also holding royalty rights on some eventual product sales. PyroGenesis also owns shares in HPQ.
- **Aluminerie Alouette** is an aluminum producer in Quebec, home to the largest primary aluminum smelter in the Americas. The company is majority owned by Rio Tinto. PyroGenesis has partnered with Alouette on various technologies to help decrease Alouette's environmental footprint by mitigating, and re-using, waste stemming from aluminum production, including from spent pot linings (SPL) and electrolytic bath.
- **Aubert & Duval** – co-owned by Airbus, Safran, and Tikehau Capital, is a century-old supplier of critical parts and materials, and specialty steels, superalloys and titanium, to high-precision customers, notably the aerospace, defence, nuclear and medical industries. The company generates annual revenues of ~€550 million and employs 3,700 people, mostly in France. PyroGenesis partners with A&D through A&D's metal powders for additive manufacturing division, where A&D will act as the exclusive supplier of PyroGenesis titanium metal powders in the EU.

PYROGENESIS

# SUMMARY

- ✓ Tailwinds from industrial carbon reduction trend and major policy and regulatory drivers
- ✓ 30 years developing technologies supported, vetted, and adopted by major global corporations, governments, and military
- ✓ IP strength from 150+ patents granted or pending in US, Canada, and globally
- ✓ Long tail of potential additional large-market applications
- ✓ Diversified revenue sources
- ✓ Significant potential upcoming catalysts

PYROGENESIS

# PYROGENESIS

## Using Plasma-Based Solutions to Reduce the World's Carbon Footprint


**Contact:**
Rodayna Kafal, Vice President
Investors Relations and Strategic Business Development
Phone: (514) 937-0002
E-mail: ir@pyrogenesis.com


www.pyrogenesis.com