PLASMA ARC TECHNOLOGY

You name it – We treat it

Council of Scientific & Industrial Research

SEED
the root of sustainability

The Consortium

Council of Scientific Industrial Research – Technology provider

Positronics India- Product Developer

Sustainable Energy & Environment Designs- EPC consultant

About CSIR - CMERI

CSIR-CMERI
CENTRAL MECHANICAL ENGINEERING RESEARCH INSTITUTE

- The Central Mechanical Engineering Research Institute (CMERI) is the apex R&D institute for mechanical engineering under the aegis of the **Council of Scientific and Industrial Research** (CSIR). Being the only national level research institute in this field, CMERI's mandate is to serve industry and develop mechanical engineering technology so that India's dependence on foreign collaboration is substantially reduced in strategic and economy sectors. Besides, the institute is facilitating innovations and inventions for establishing the claims of Indian talent in international fields where Indian products shall ultimately compete.

About Positronics

- Positronics India, sends a signal to us of mass less unit Positively charged particles. The name resembles to electron. Electronics but of opposite charge.
- The company was formed in 2005 its founder Mr Shyama Prasad Manna, a Btech Hons from IIT Kharagpur (1985) with the idea of developing innovative products in the field of New and Renewable Energy for domestic and Industries simultaneously running the show with the conventional projects. It also meets the demands of various industries in this competitive market as a profound service provider in services like Industrial Automation, Turnkey projects, Design and Engineering on instrumentation, developing PLC / SCADA based systems or even component level developments, etc.

About SEED

SEED
the root of sustainability

- SEED (Sustainable Energy & Environment Designs) is an energy and environment project management consulting company specializing in waste to energy, bio-fuels, Renewable energies, Water and wastewater treatment and bioremediation under the able leadership of Mr. P.Dev Anand who has 3 decades of sound experience.

- He is a mechanical engineer with masters in environmental management, masters in business administration. A panel consultant for world bank- waste to energy cell. An alumni of US Government –International Visitor Leadership Program of Clean Energy and Climate Change.

Industry Overview

- High Demand for Renewable and Clean Electric Energy
- Lack of Efficient & Safe Waste Disposal Systems
- Increasingly Stringent Environmental Regulations
- Increasing Interest in Fuel Cell and Hydrogen Gas

Plasma Gasification vs Incineration

Plasma Gasification	Incineration
Occurs in the absence or near absence of oxygen, prohibiting combustion.	Excess air is induced to ensure complete combustion.
Gases resulting from degradation of organics are collected and used for production of various forms of energy and/or industrial chemicals.	All potential energy converted to heat.
Products of degradation largely converted to inert (non-hazardous) glass-like slag of a volume 6% to 15% of the original solids volume.	Combustion results in ash (as much as 30% of original solids volume) that must often be treated as hazardous waste.
Emissions substantially lower than those resulting from incineration	Far greater emissions of GHG and other pollutants than with thermal gasification systems.

The Technology

What if there were a technology..

- That Could Transform Any Inorganic Waste Into Inert Glassy Stone?
- That Could Transform Organic Waste Into Clean Gas Used To Produce Energy?

Plasma Arc Can Do All Of That & More:

- It Works By Passing An Electric Arc Current Through Ionized Gas
- Any Kind Of Substance In The Arc Is Broken Down Into:
  - Clean Gases That Can Be Used To Generate Several Forms Of Energy
  - Inert Slag That Can Be Safely Reused

Plasma – A mature technology

Late 1800's: Plasma Arc Heater Developed For Metal Industry

Early 1900's: Plasma Heaters Used In The Chemical Industry

1950's: Plasma Arc Cutting & Welding

1990's: Used To Simulate Heat Of Spacecraft Re-entry

1960's: Plasma Arc Utilized In Steel Mill Operations

1991: Plasma Research Facility Founded at Georgia Tech

1998: Plasma Municipal Solid Waste Plant Operational In Japan

Today: Used in Industrial Plants Worldwide

- Chemical Industry
- Metallurgical Industry
- Waste/Environment Industry

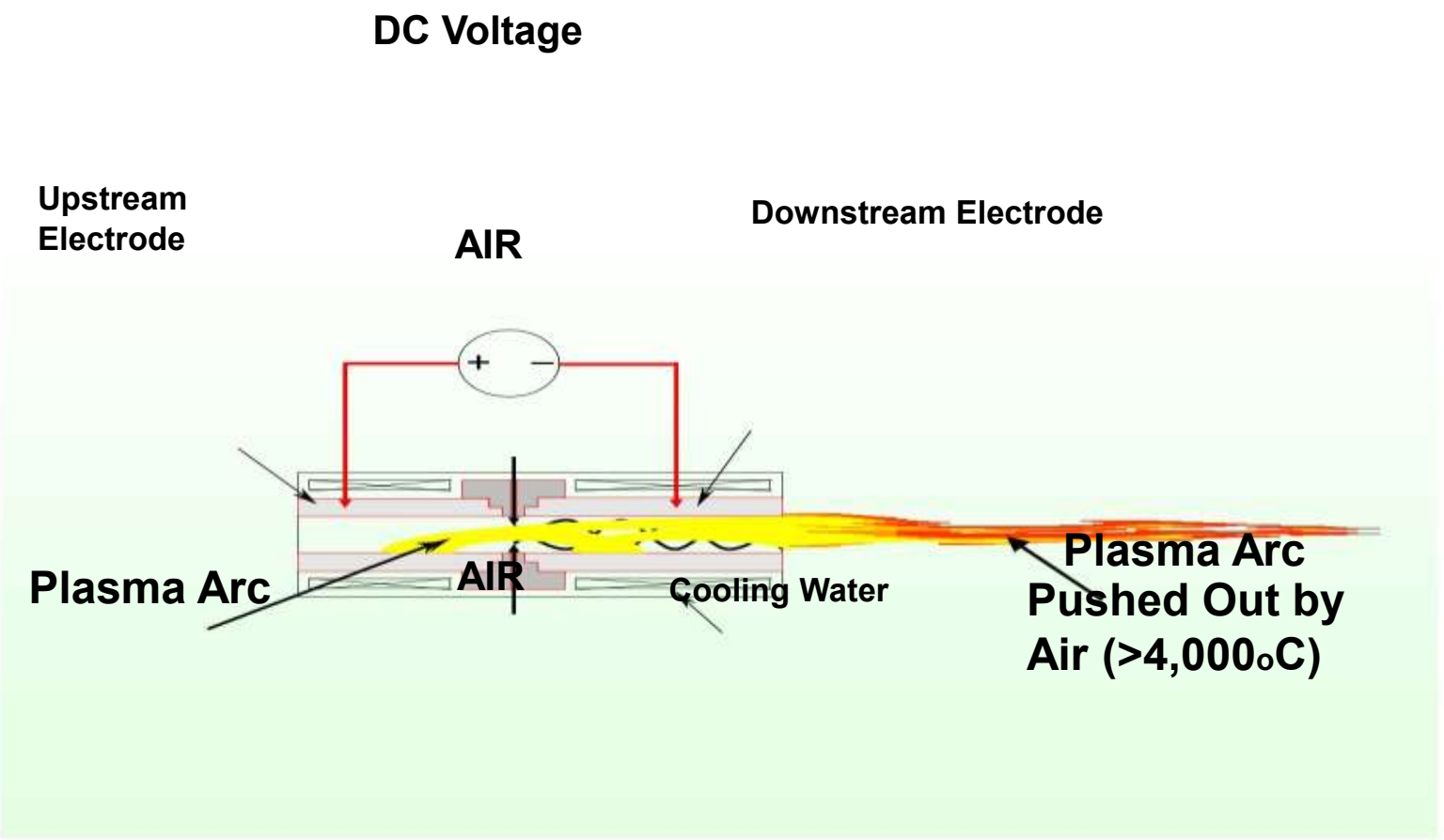
What is PLASMA?

- “Fourth State” of matter
- Ionized gas at high temperature capable of conducting electrical current
- Sun, Lightning is an example

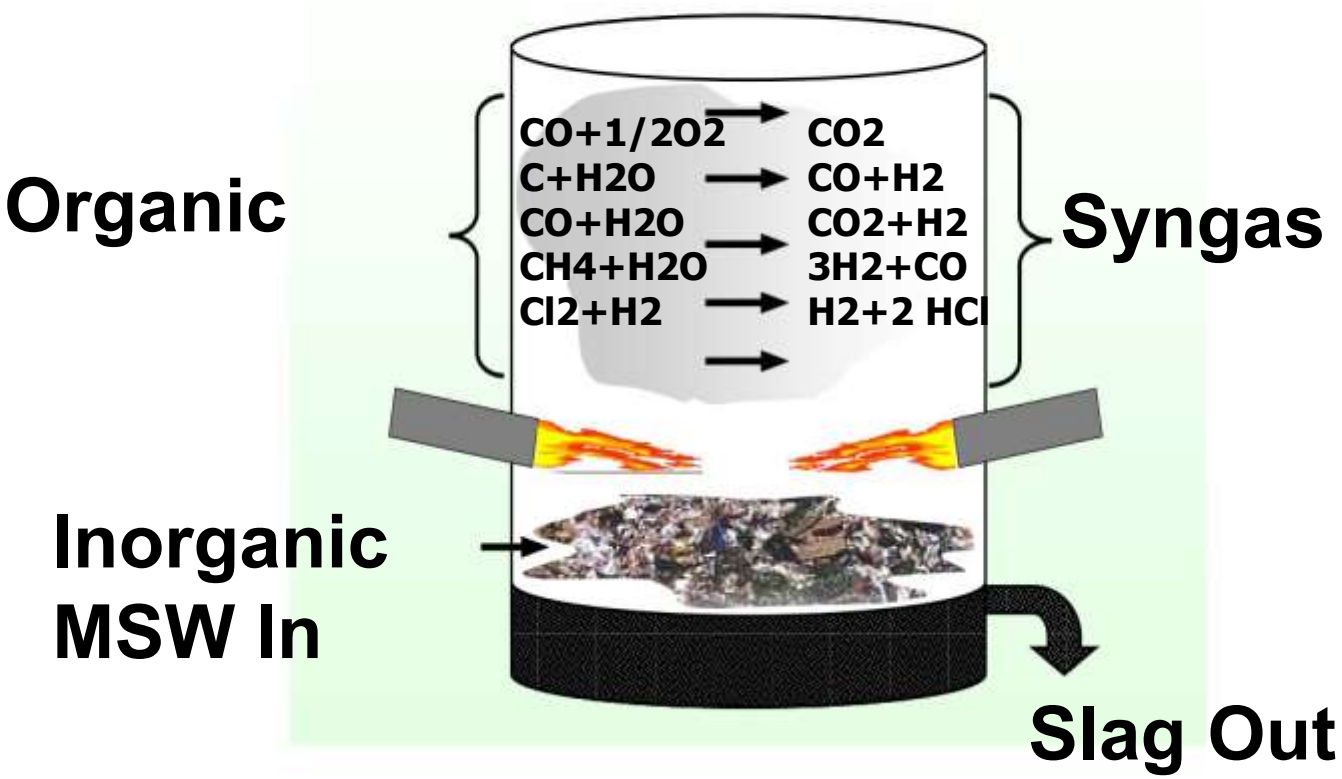
from nature

- **Man-made Plasma is created by passing electricity through a gas (air) causing a change in the state of the gas and a significant temperature increase often exceeding 10,000^{o}F.**

The Plasma Torch



Vitrification of MSW



Temperature Profile

- Exit Gas, 1700 C
- Coke Bed, 1800 – 4000 C
- Torch Plume, > 5000 C
- Slag Pool, 1700 – 1800 C

The Configurations

Plasma Torch Treatment

- Plasma Arc Generated In A Torch Body
- Arc Pushed Out Of Torch, Forming A Plume
- >3,000ºC Plume Applied To Feedstock
- Produces Syngas & Slag

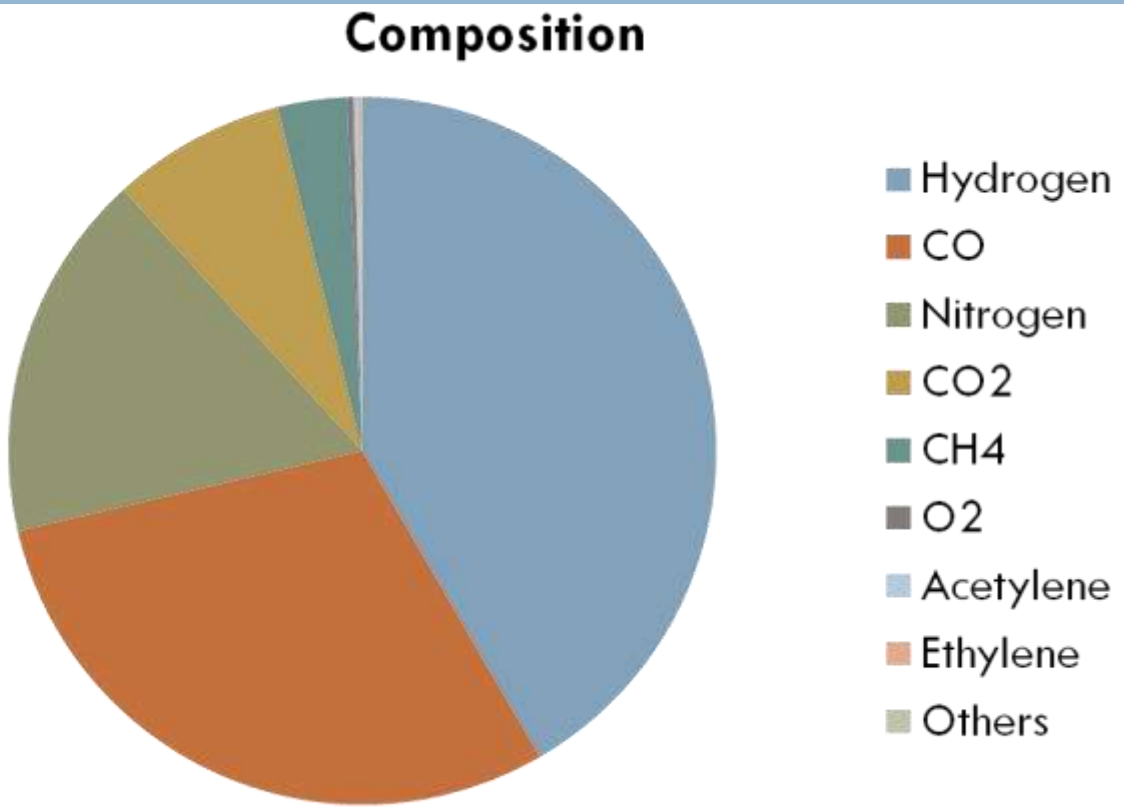
Plasma Arc Treatment

- Plasma Arc Formed Between Two Electrodes
- Solid Waste Passed Through Arc
- Produces Syngas & Slag

Wastes handled by Plasma

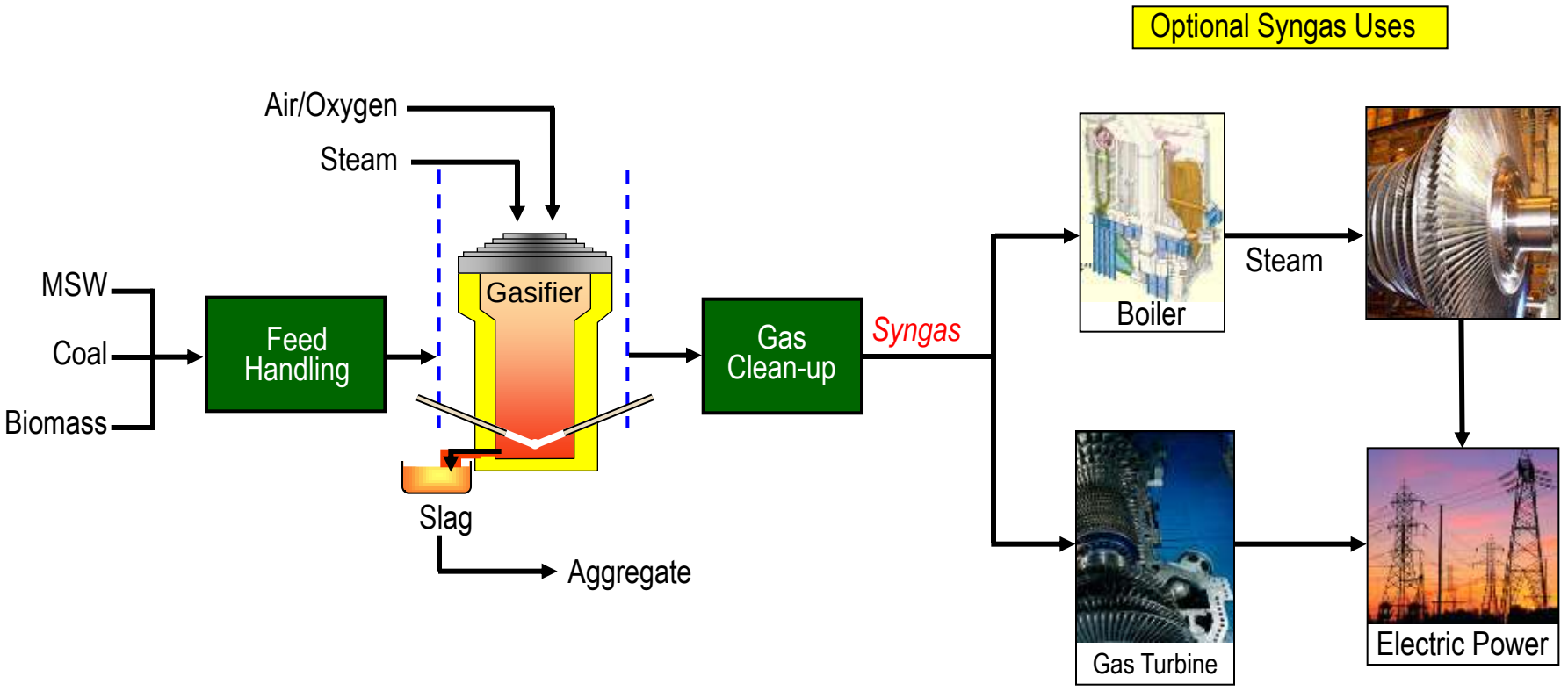
Typical Composition of Syngas

Hydrogen	42%
CO	30%
Nitrogen	17%
CO2	8%
CH4	3.20%
O2	0.30%
Acetylene	0.20%
Ethylene	0.10%
Others	0.10%



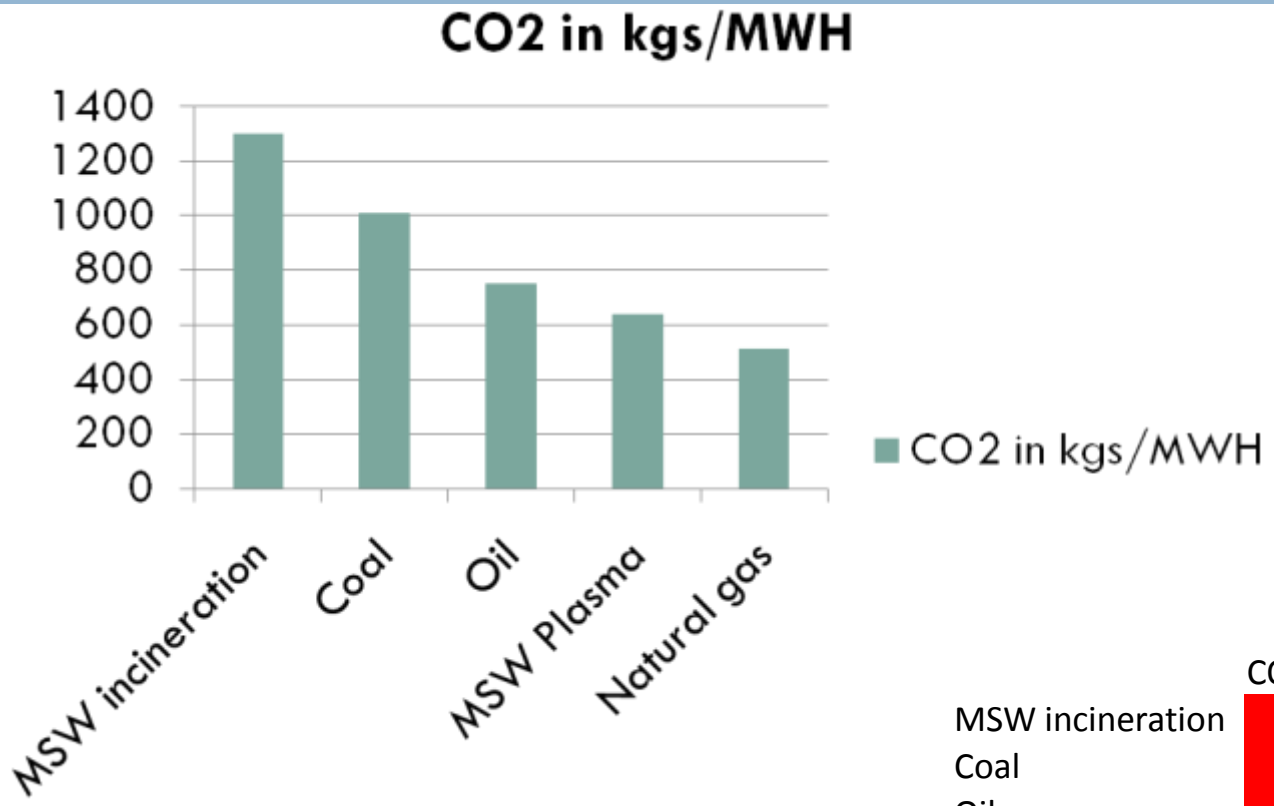
Application: Power Generation

Variety of Feedstocks → Flexible Process → Variety of Energy Products



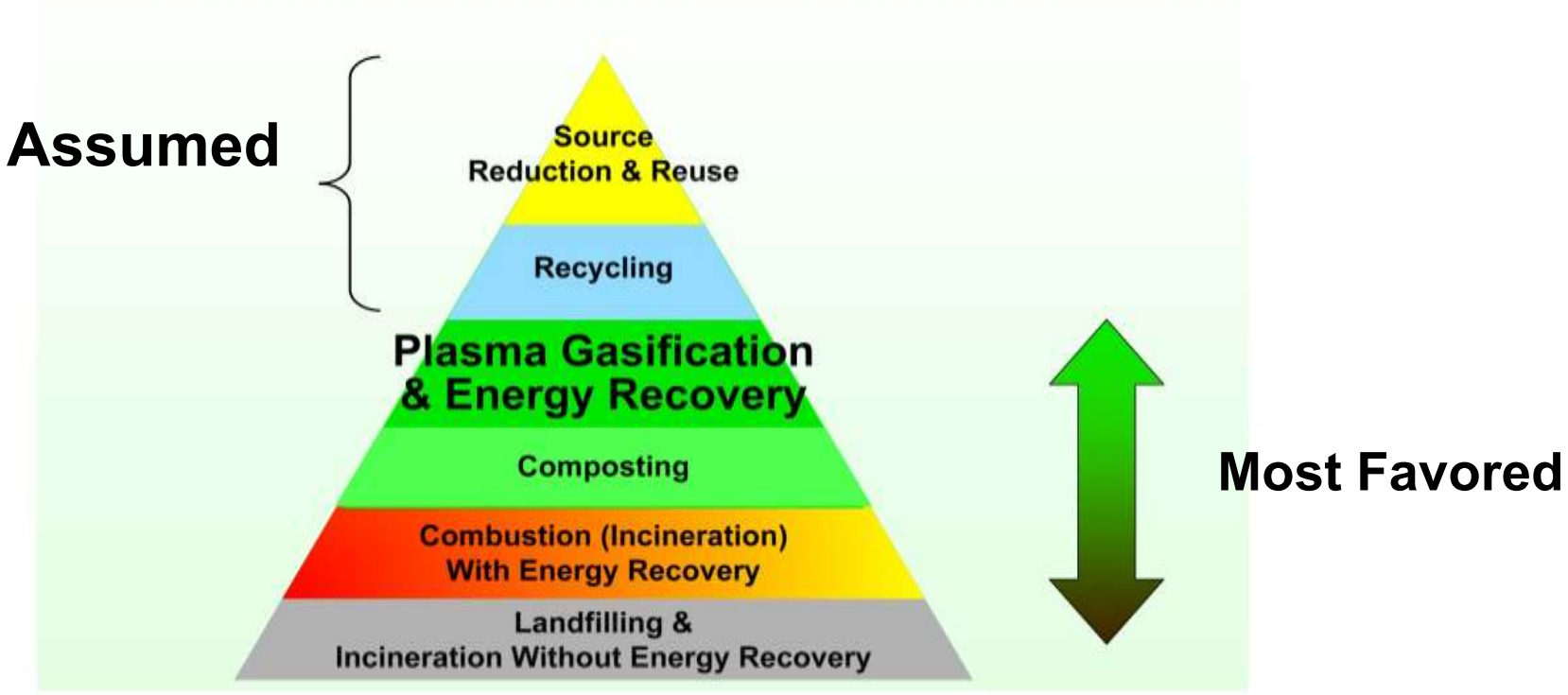
Low Cost → Gasifier → High Value

CO2 Emissions



	CO2 in kgs/MWH
MSW incineration	1300
Coal	1012
Oil	752
MSW Plasma	639
Natural gas	511

Waste Handling Hierarchy



Traditional Incinerators compalred to Gasification, Plamsa Arc & Pyrolysis

Differences:

Traditional mass burn incinerators directly burn the waste material and have ash residual

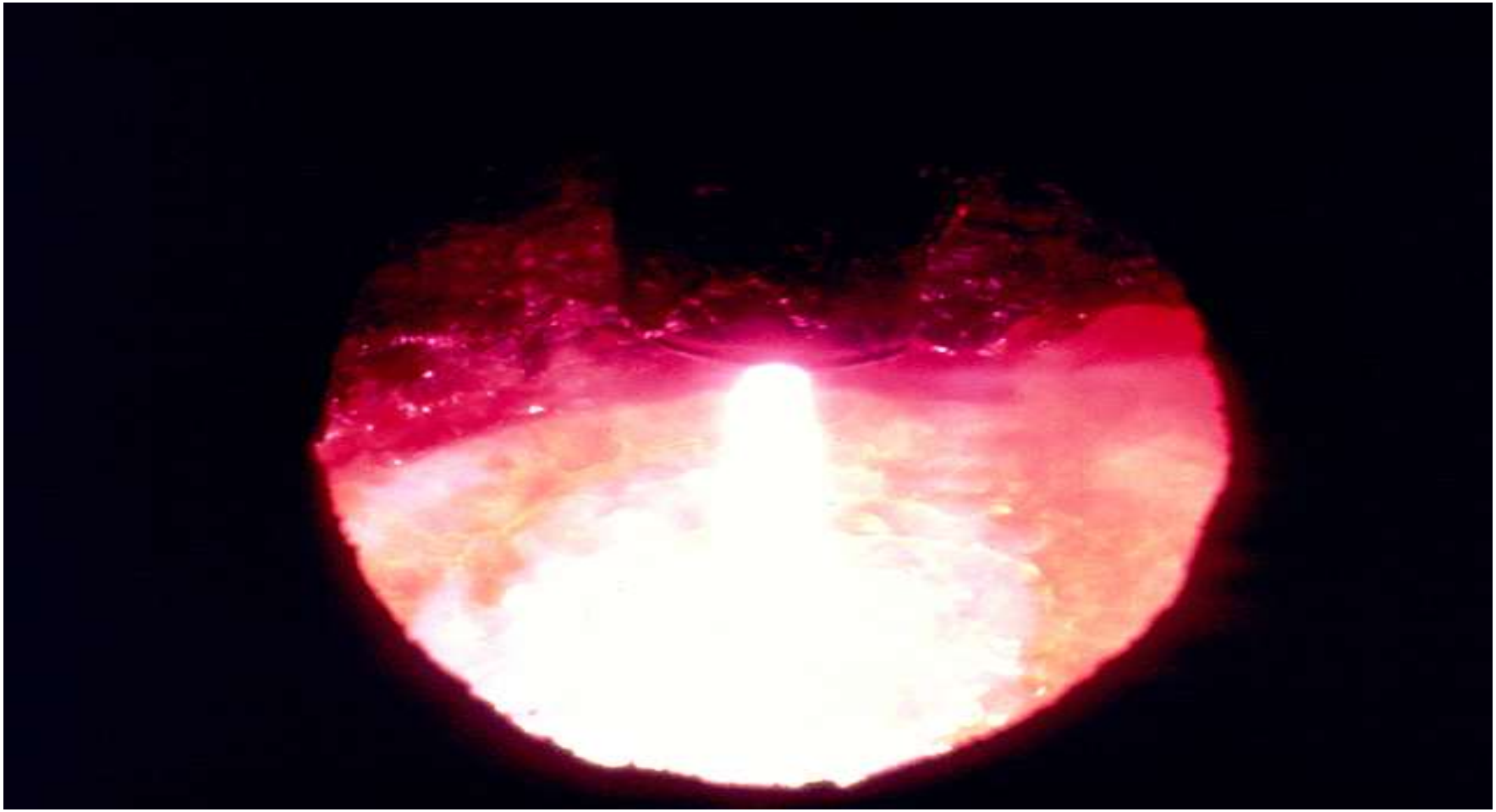
Most gasification technologies heat the waste first, then in a second stage of the process syngas is combusted/incinerated.

Vitrified slag residue instead of ash.

Ideally suited for waste treatment

- Hazardous & toxic compounds broken down to elemental constituents by high temperatures
- Organic materials
  - Pyrolyzed or volatilized
  - May be converted to fuel gases
  - Amenable to conventional off-gas treatment
- Residual materials (radionuclides, heavy metals, etc.) immobilized in a rock-like vitrified mass which is highly resistant to leaching

All inorganic waste are vitrified in the plasma molten slag pool



Byproducts from Municipal Solid Waste and Coal Ash

Molten Stream Processing (Product)		Salable Product Uses
Air Cooling (Gravel)		Coarse Aggregate (roads, concrete, asphalt)
Water Cooling (Sand)		Fine Aggregate (construction products)
Water Cooling (Metal Nodules)		Recyclable Metals
Spinning Machines (“Plasma Wool”)		Insulation, Agriculture, Oil Spill Cleanup

"*Black Gold*" Tile Proved Superior to Recycle Glass Tile Product

Vitrified Sediment Is Re-Usable for a Variety of Applications

- Architectural Tile Manufacture
- Glass Fiber (Rock Wool Insulation)
- Sandblasting Grit (Black Beauty®)
- Roadbed Aggregate (“Glasphalt”)
- Roofing Granules (Shingle Manufacture)
- Recycle Glass Cullet
- Environmentally Innocuous Fill Material

Advantages

- Gasification Technology Performing at Atmospheric Pressure, Elevated Temperature and High Plant Availability
- Capable of Utilizing Integrated Mixed Waste and/or Coal Fines/Waste as Feed
- Compact and Modular
- Non-Polluting and Environmentally Safe
- High Recovery of Clean Renewable Energy as Electricity and/or H2
- Economically Competitive
- Proven Technology

Emissions

Parameters	Units	USEPA standards	EPA standards	Plasma emissions
Nox	ppmvd	150	250	35-40
PM	mg/dscm	20-24	34	<5
SO2	ppmvd	30	55	<2
HCl	ppmvd	25	15	<10
CO	ppmvd	100	40	<20
Hg	Micro g/dscm	50-80	55	<2
PCDD/PCDF	Nano g/dscm	13-30	25	0

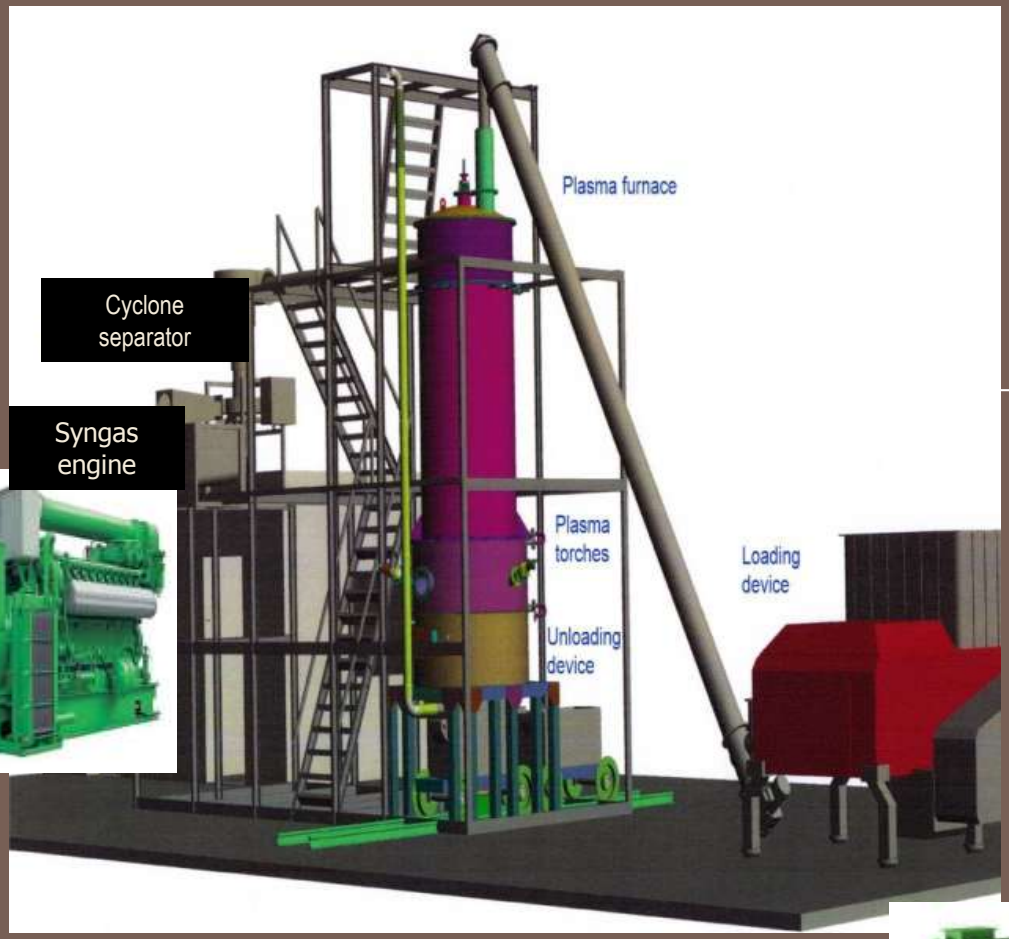
Plasma Gasification: State-of-the-Art

- **> 22**: Commercial plasma plants in operation (4 are WTE plants)
- **> 6**: Demonstration plasma plants completed or under construction
- **> 15**: Companies whose primary business is plasma technology
- **> 30**: Countries involved in plasma gasification projects

Pilot facility (500 kgs/day)

Pilot facility (2000 kgs/day)

Schematic Process Flow Diagram (MSW)



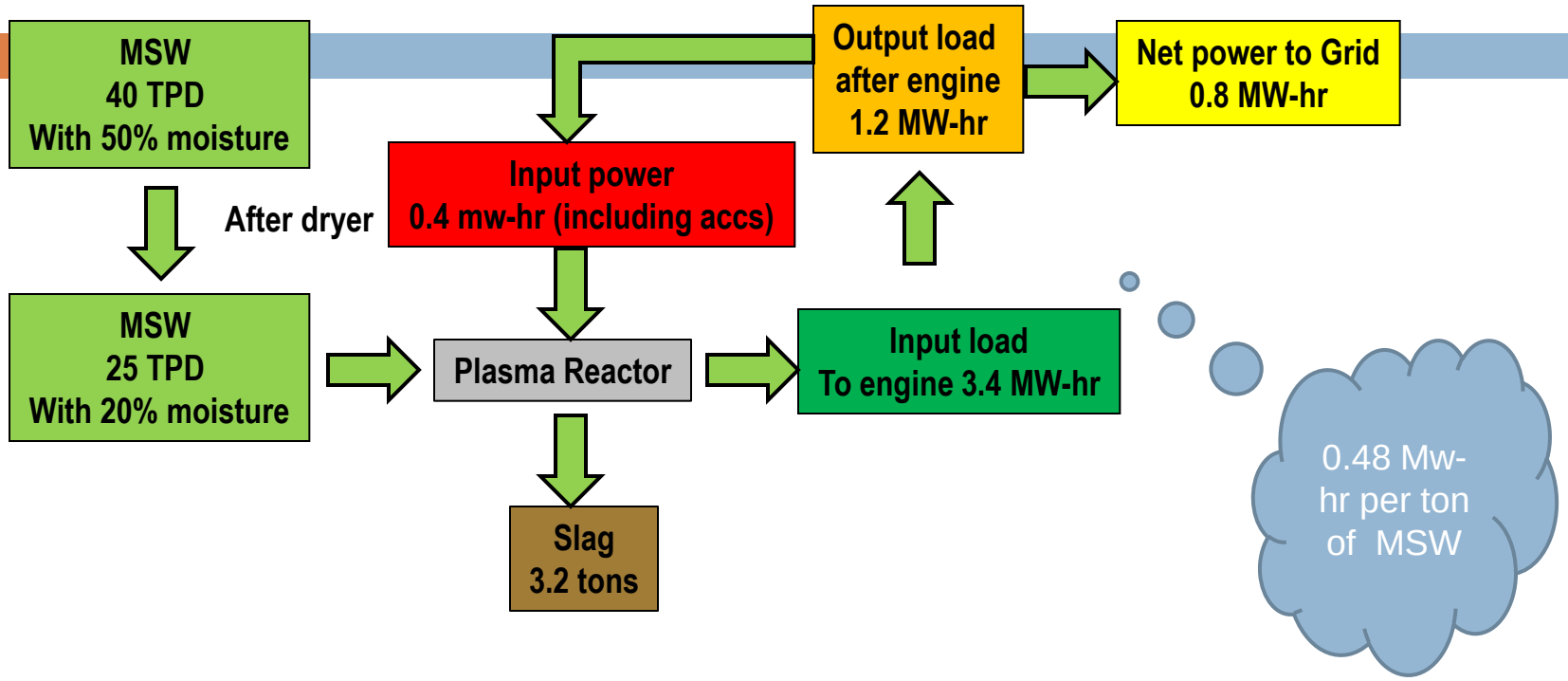
MSW material in

Shredder

Magnetic seperator

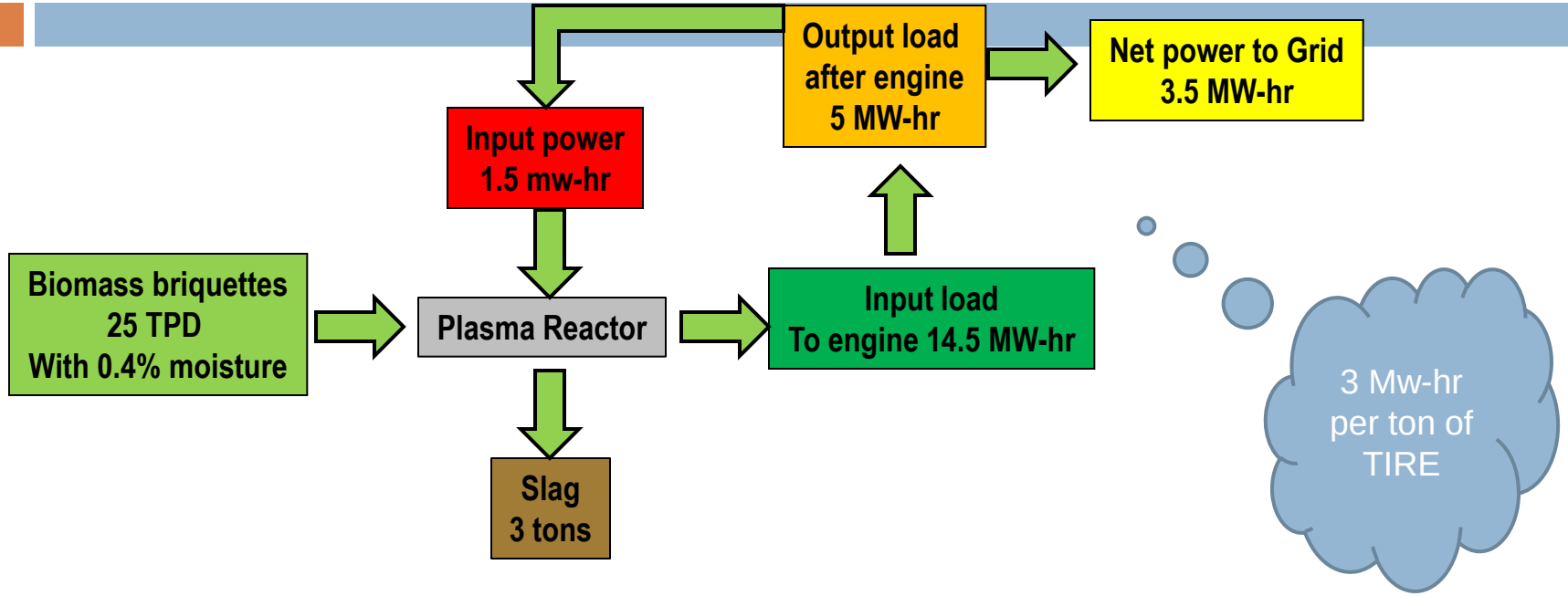
Dryer

Mass balance for MSW



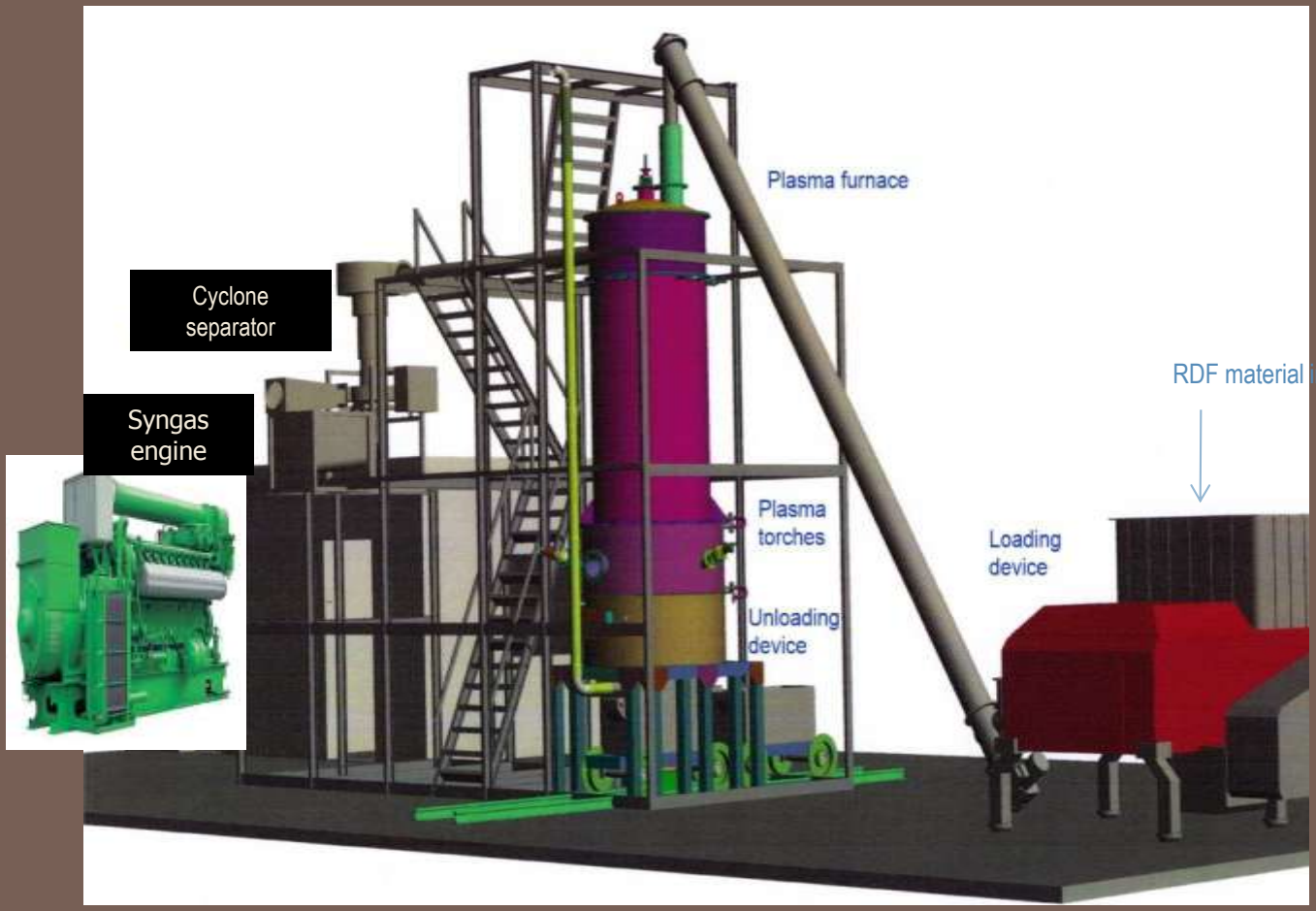
MSW PROXIMATE ANALYSIS		
CARBON%	9.5	%
VM%	46.6	%
MOISTURE%	28.1	%
ASH% (OPTIONAL)	15.6	%
total composition	99.8	%

Mass balance for Tires

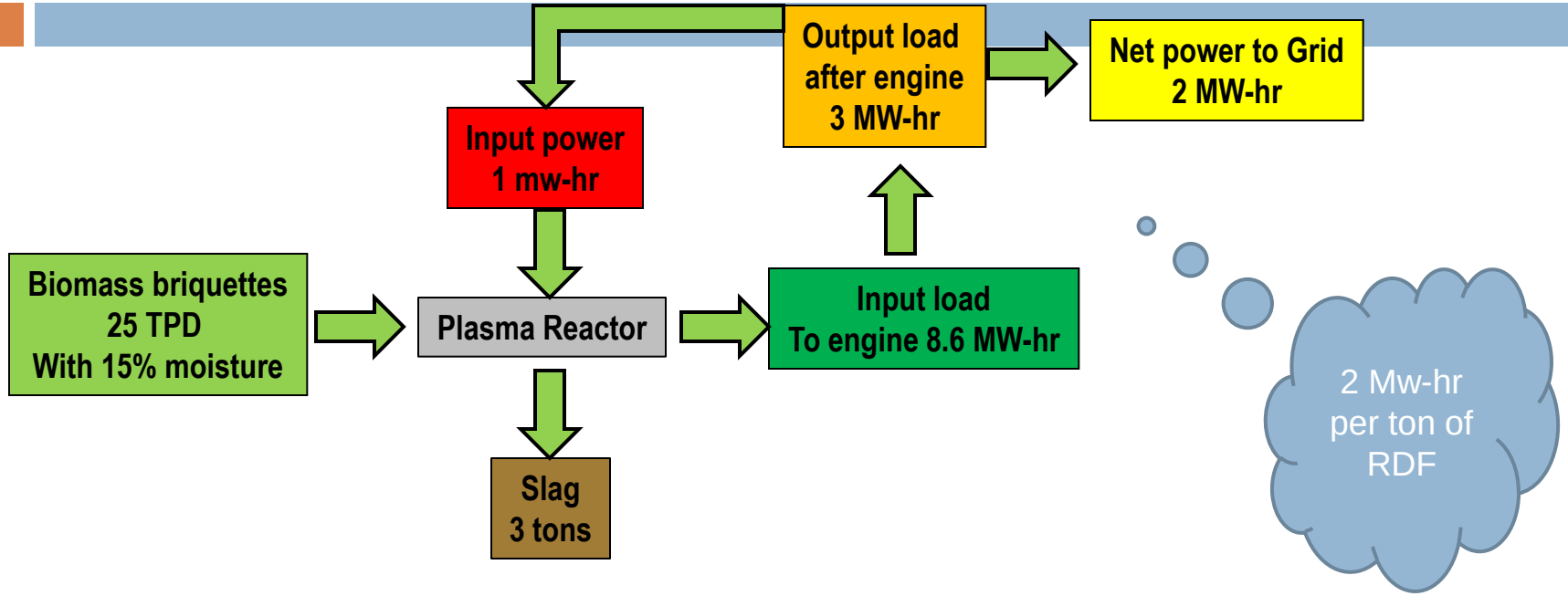


PROXIMATE ANALYSIS		
CARBON%	22	%
VM%	63.6	%
MOISTURE%	0.4	%
ASH% (OPTIONAL)	14	%
total composition	NA	%
ULTIMATE ANALYSIS		
C	88.10	%
H	7.90	%
O	1.40	%
N	0.5	

Schematic Process Flow Diagram (Briquettes)

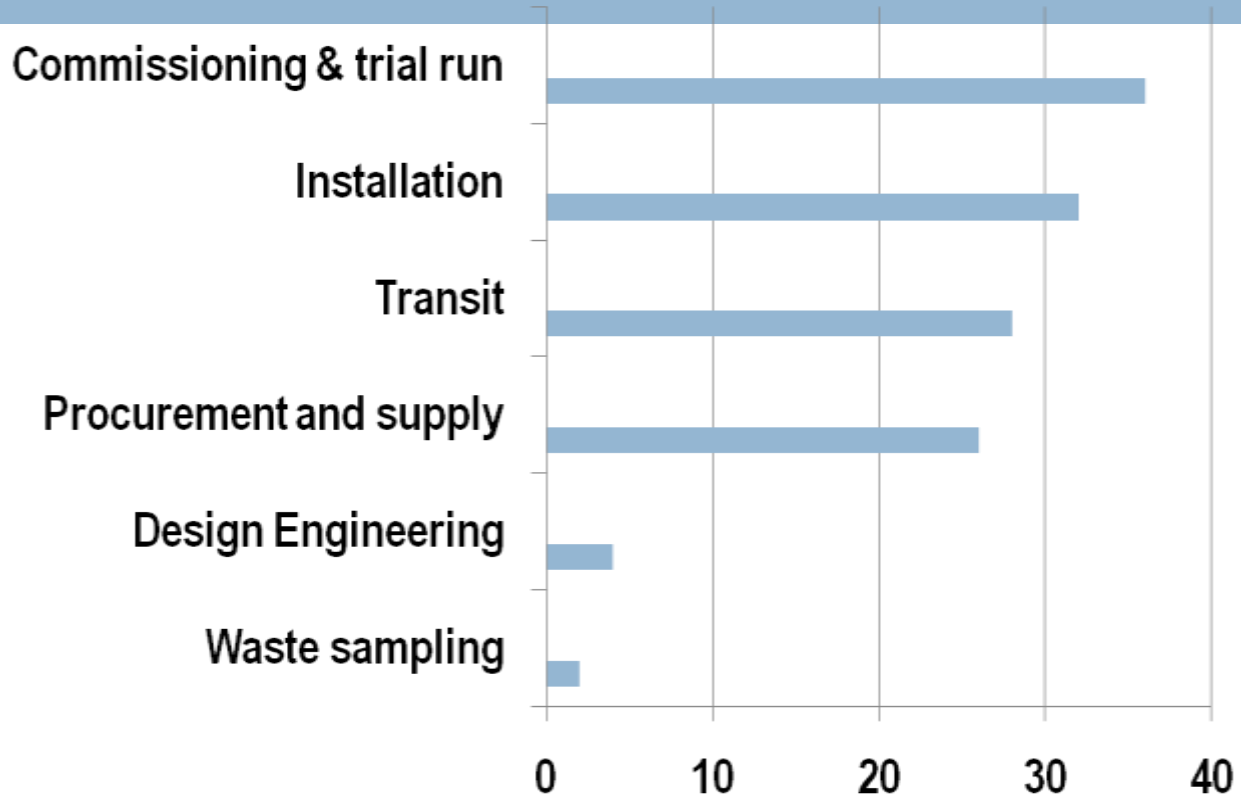


Mass balance for Briquettes

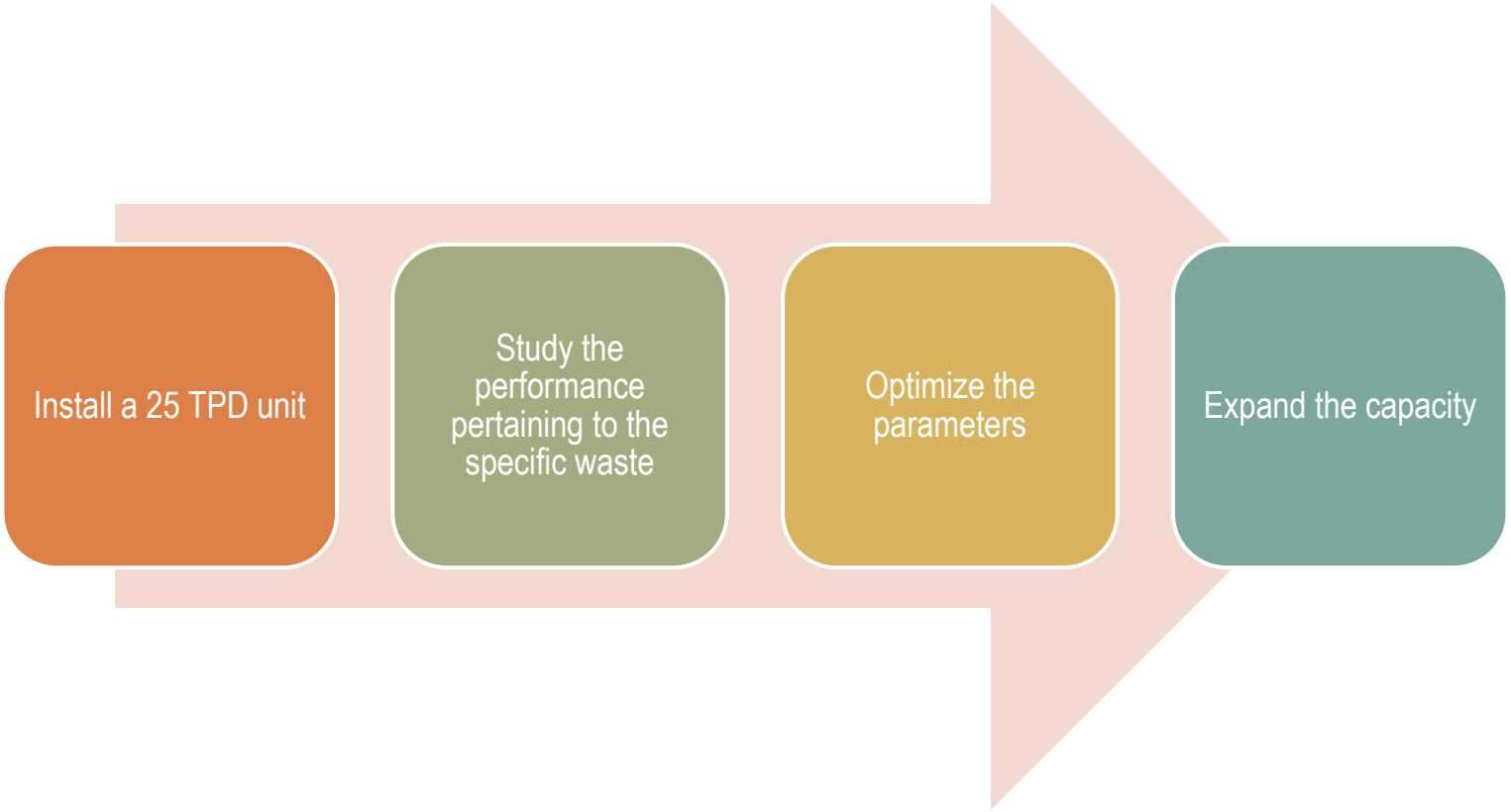


Briquette composition		
CARBON%	21	%
VM%	40	%
MOISTURE%	14	%
ASH% (OPTIONAL)	25	%
total composition	100	%

Project Milestones



Business Model



Plasma Arc- Ideal for Waste Treatment

Can Handle All Waste

Organic Material Becomes Clean Energy-Rich Gas

Inorganic Material Becomes Inert Slag/Glass

Environmentally Safe

Supports Energy Recovery

Provides Economic Opportunity

Thank You

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