



Fueling a Greener Future

Every Year **in the USA**



34.5 billion tons unrecycled municipal solid waste (MSW) are buried in landfills

10 million tons bio-hazardous waste are incinerated



30 billion tons organic & dairy waste are generated

1.5 million tons of plastics enter the oceans



while **1,300 superfund sites** need cleaning

RAVENSR is the solution.

Society is **Demanding Renewable Energy**

National governments and international organizations are increasing pressure,

And some companies have responded boldly.

The New York Times
**U.N. Adopts Ambitious Global Goals
After Years of Negotiations**



EU sees 'Green Deal' delays but keeps climate target plan: draft document

Caixin

New Draft Law Puts Clean Power at the Forefront of China's Energy Policy



Toward a low-emissions future
Repsol climate roadmap



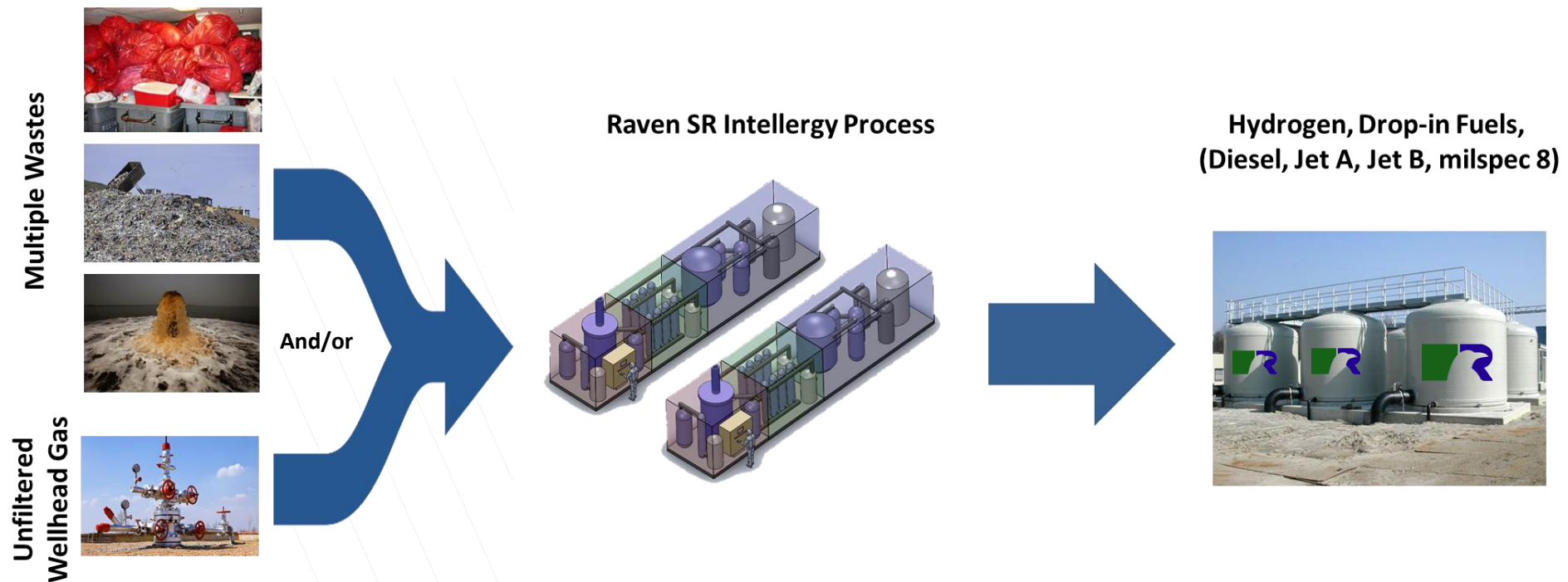
OIL AND GAS CLIMATE INITIATIVE



RAVENSR is the solution.

We Turn **Trash** Into **Clean Fuels**

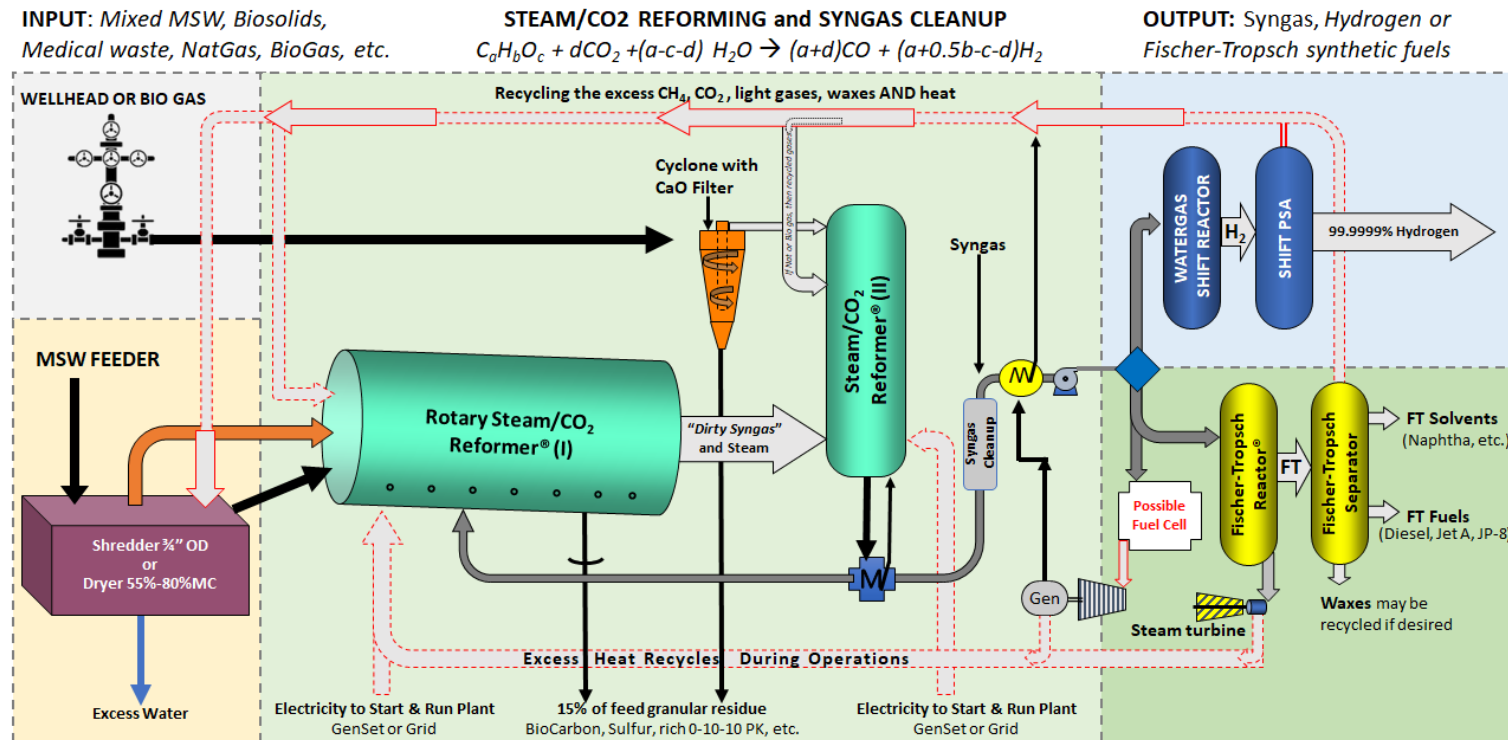
Our feedstock is waste - biomass, plastics, paper, medical waste, toxic waste – pretty much anything except metals and glass.



Our products are the cleanest fuel on the planet – hydrogen, or cleaner burning, synthetic Fischer-Tropsch fuels.

Using Our Patented Technology

Raven SR has 12 patents, including two basic chemistry patents, but the process is surprisingly simple.

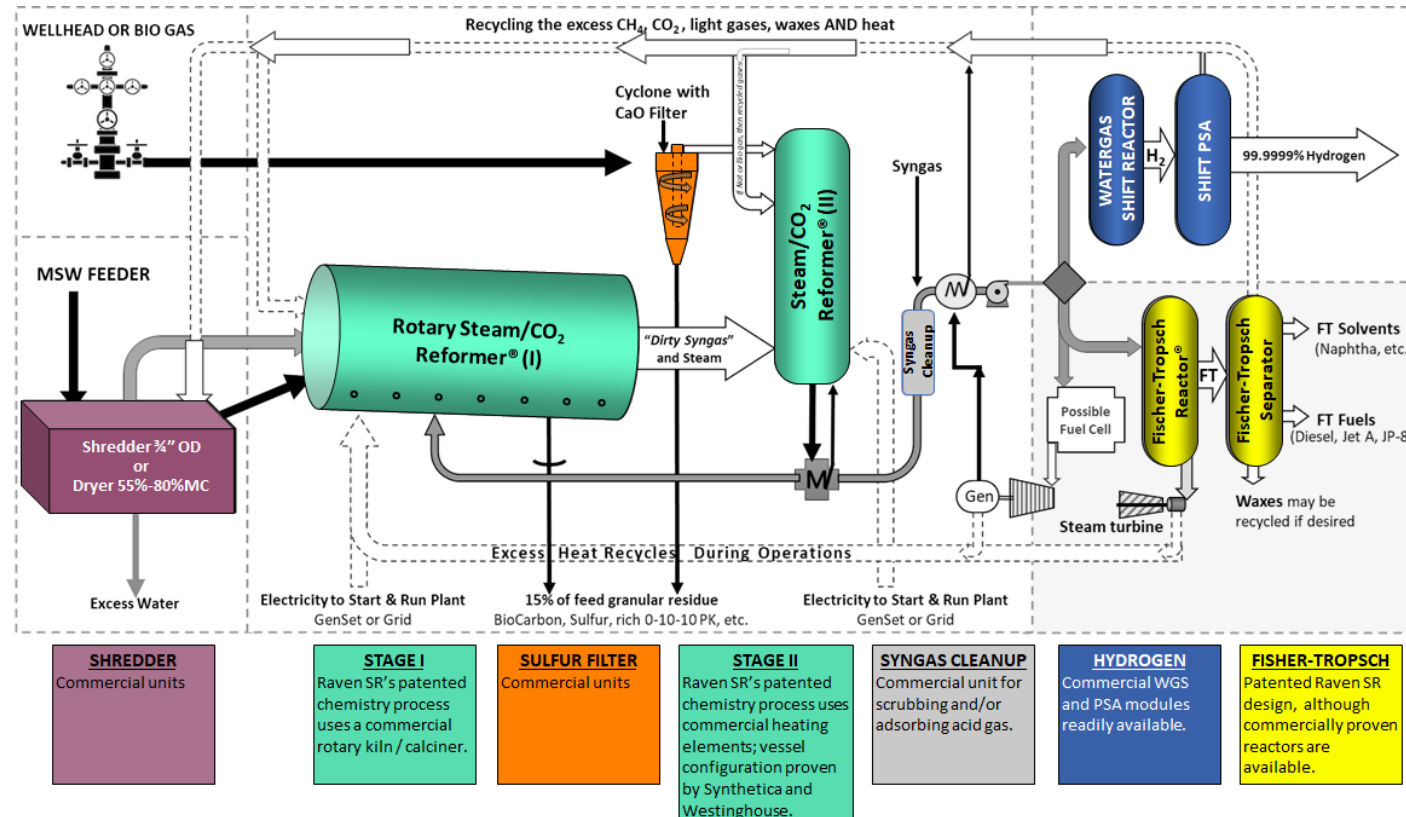


Patent Nos.: U.S. 8,858,900, U.S. 14/847,798, U.S. 14/995,713, U.S. 15/514,041, U.S. 62/776,203, U.S. 16/40,349, International Patent No. WO 2005/001977, European Patent No. 1,913,683, European Patent No. 04755504.0, Canadian Patent No. 2,530,496, Chinese Patent No. 99813930.0, U.S. Patent No. 7,556,736, U.S. Patent No. 6,187,465.

We heat the waste until it turns to syngas, then separate the hydrogen from the carbon, and either reform it into synthetic fuels, or extract the hydrogen and sequester the carbon.

Based on **Known and Proven Processes**

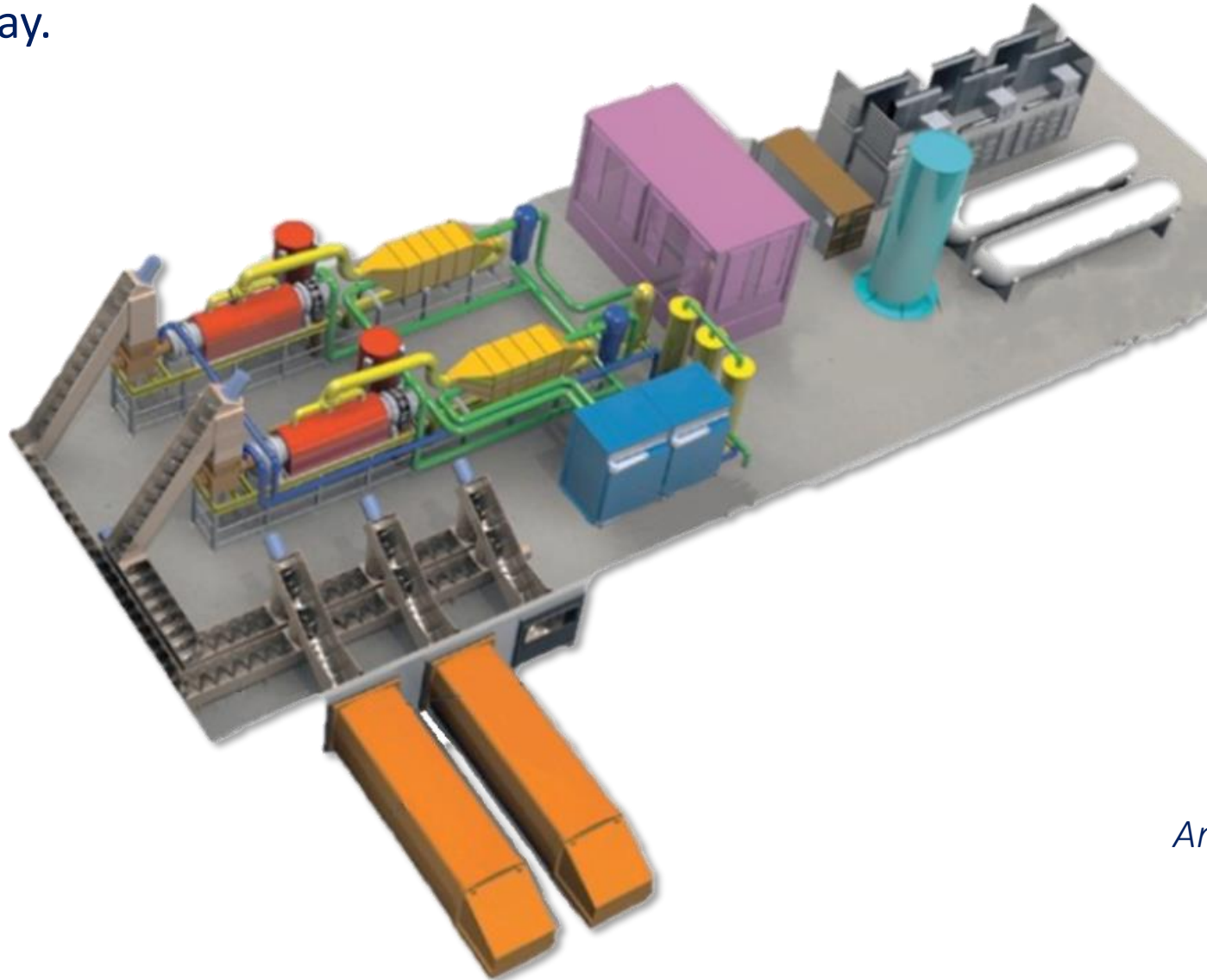
Much of the process is known and proven, or based on known and proven processes.



With the Raven SR “secret sauce” in the Rotary Steam/CO₂ reformers (green processes). We also have patented Fischer Tropsch technology (yellow) though we can use any FT system.

What It **Will Look Like**

Future 150 wet-ton/day Steam/CO₂ Reforming MSW to Hydrogen projected to produce 15,000 kgs/day.



Artist's conception

That Can Use A **Wide Range of Wastes**

The Raven SR system has been tested using the following waste streams:

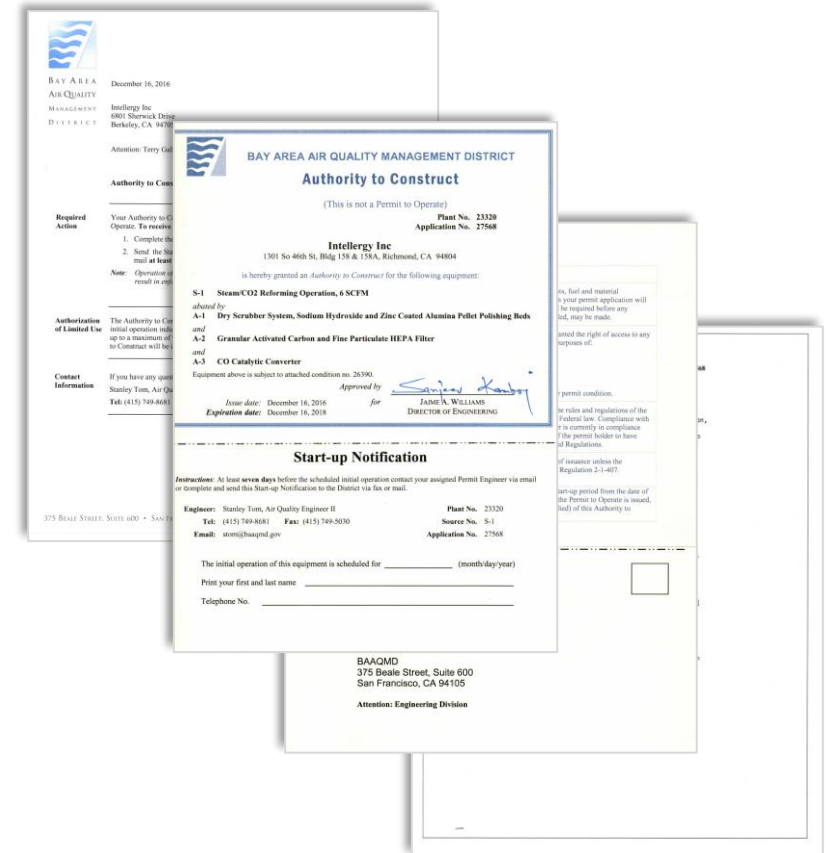
1. Paint cans, partially full of paint of all types
2. Printed circuit boards
- 3. Industrial solvents** of all types
4. Red shop rags
5. Kevlar cloth and parts
6. Aromatic chlorinated solvents with benzene
7. Epoxy waste
- 8. Plastics**, including non-recyclables
9. NASA Astronaut waste, including feces
- 10. Medical waste** of all types
11. Slurry Chelating Steam generator cleaning compounds with Cr⁺⁶
12. Pleated Cartridge filters containing **highly radioactive waste**
13. Silicon wafer Fab solvents and chemicals
14. Creosote contaminated wood & soils
- 15. Biosolids**
16. Animal carcasses and bedding waste
- 17. Laboratory waste**
18. Australian Sheep Dip waste

Rocks and metals are dropped out of the system.

And Have Received Environmental **Approval**

Raven SR's patented Steam/CO₂ technology is significantly cleaner than any competing system, principally because it is a non-combustion process.

- BAAQMD approved. The process has been approved by the rigorous Bay Area Air Quality Management District in Northern California.
- GHG reduction. A single 25 ton per day unit will reduce GHGs by 8,200 tons per year.
- Mixed input. Units can eliminate toxic waste, infected medical waste, and mixed waste from the environment.
- High credits. Because of its low carbon footprint, Raven SR can qualify for higher credits than competing systems.



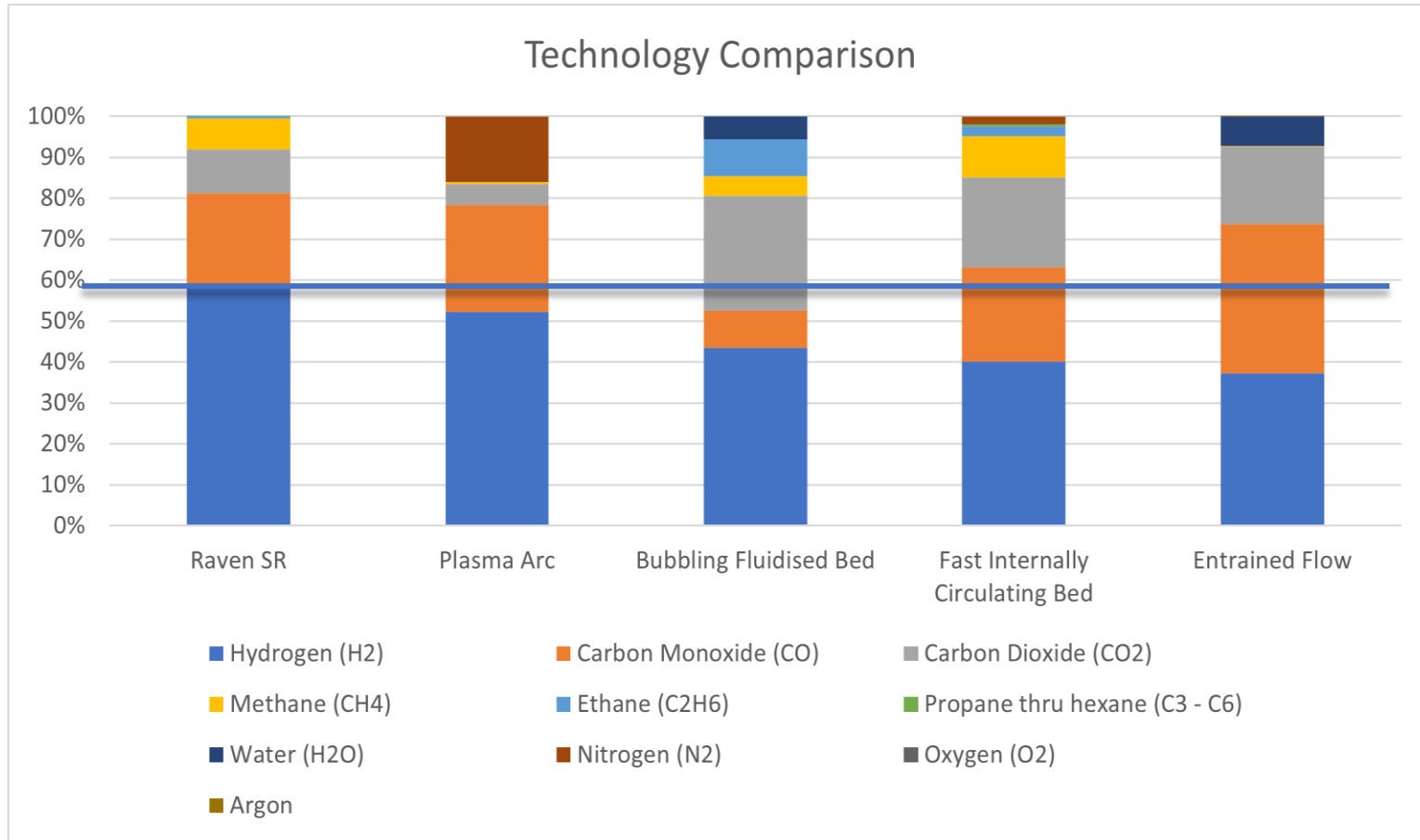
We Are **Not Typical Gasification**

The critical difference is that Raven SR allows no free oxygen into our system – chemically there is no combustion nor are catalysts used in the front end. We are instead thermal decomposition, which means:

- Higher efficiency – we don't burn our feedstock for heat, we convert it to fuel
- Better operations – we don't have tar build up or hotspot issues, reducing downtime
- Lower cost – we don't need any expensive catalysts in our front end
- A cleaner process – lower emissions are better for GHG reductions as well as possible site locations
- Greater feedstock options – multiple feedstocks at once with a moisture content 30-55% reducing need of screening and drying

It's All In the Syngas

Raven SR's syngas has more hydrogen, and less GHG than other processes.



This process delivers more high-purity hydrogen and gives us close to the ideal (2.1:1) hydrogen to carbon monoxide ratio for synthetic fuel production.

Comparable Project: **Plasma Gasification**

Project: California, Projected operational by Q1 2023.

Key technical features include:

- Plasma Gasification with Temperature > 5,000 °F
- 42,000 tons of sorted paper waste p.a.
- 3.8 MM kg hydrogen p.a.

Raven SR produces 10% more from the same input and Raven can process a far wider variety of feedstock.

Key Financing Points:

- \$55MM project cost

Raven SR can produce 50% more hydrogen using the same CapEx.

Comparable Project: **Bubbling Fluidized Bed**

Project: Nevada, expected operational by 2021.

Key technical features include:

- 175,000 tons p.a. waste input
- 10,000,000 gallons Jet A output

Raven SR can produce 4.1x the fuel from the same input

Key Financing Points:

- \$100M spent over 10 years to develop technology
- \$280M project cost (originally \$200M)

Raven SR can produce the same output for 30% of the CapEx

Comparable Project: **Microwave Plasma (MWP)**

Project: Multiple companies are creating projects converting Biogas or RNG to Syngas.

Key technical features include:

- Microwave excited plasma converts biogas (various combinations of CH₄, CO₂ and H₂O) into syngas.

Raven SR's technology is more dynamic and can produce hydrogen from biogas as well as MSW from landfills.

Key Financial Points:

- Process requires ~35 kWh/kg H₂

Raven SR Uses only 16 kWh/kg H₂

Comparable Project: **Electrolysis**

Electrolysis (using solar generated electricity to break up water) is the favored method to make hydrogen,

But Raven SR is superior in many ways:

Metric	Electrolysis	Raven SR
Water Used/kg H2	9 liters	0 liters
Energy Used/kg H2	60 kWh	16 kWh
Carbon Sequestered/kg H2	0 kgs	0.7 kgs
Waste Eliminated/kg H2	0 kgs	4.7 kgs
Subsidies	Typically Yes	No
Cost/kg H2	\$8-11	\$2-3
CO2 Emitted/kg H2	0 kgs	2 kgs



Fukushima Hydrogen Energy Research Field Production Facility (18 ha, 2,500 kgs/day, US \$189M)

The **Greener Green Hydrogen**

Raven SR's patented Steam/CO₂ technology not only produces green hydrogen but has the added green benefits of...

- **Processing wet-waste** without drying (*biogenic and non-biogenic at same time*)
- **Diverting waste** from landfills (*reducing the demand of landfill expansion*)
- Using **less electricity** per kilogram of H₂
- Consuming **less clean water** (*an increasingly limited resource*)
- **Fewer process emissions**
- And **avoiding CO₂e emissions** by diverting waste from landfills and composting

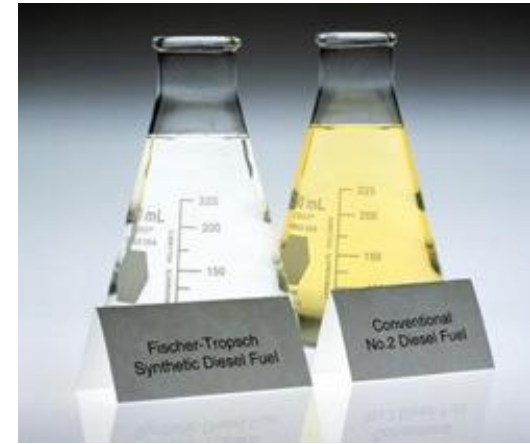
Our Syngas can produce **FT Fuels or Hydrogen**

Daily output from a 25 dry-ton system can be:

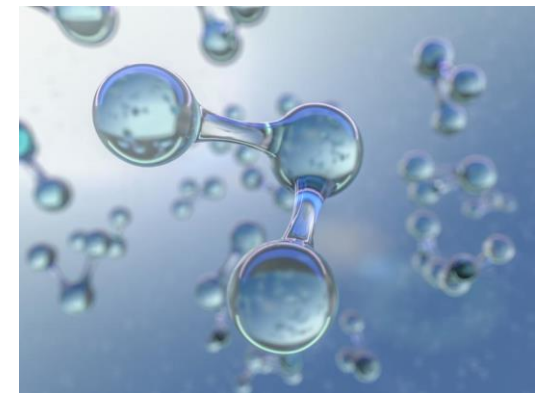
Up to 5,000 gallons of synthetic fuels – diesel, Jet A or naphtha.

Raven SR systems can switch flexibly between FT fuels.

Up to 5,000 kgs of 99.9999% pure renewable gaseous H_2 (using MSW as a feedstock).



Cleaner FT fuels (left) vs traditional petroleum fuels



Raven SR is Developing **Two Projects**

Raven One (and Raven One^x) will be a 25 dry-ton per day system converting MSW and green waste into 5,000 kgs per day of renewable hydrogen.

Raven Two will be either:

- a 75-dry ton per day system to convert biomass to synthetic fuels
- A 75 dry ton per day system to convert sugarcane bagasse to synthetic fuels

Raven SR seeks out projects with have win-win cooperation with the feedstock and/or off-takers.



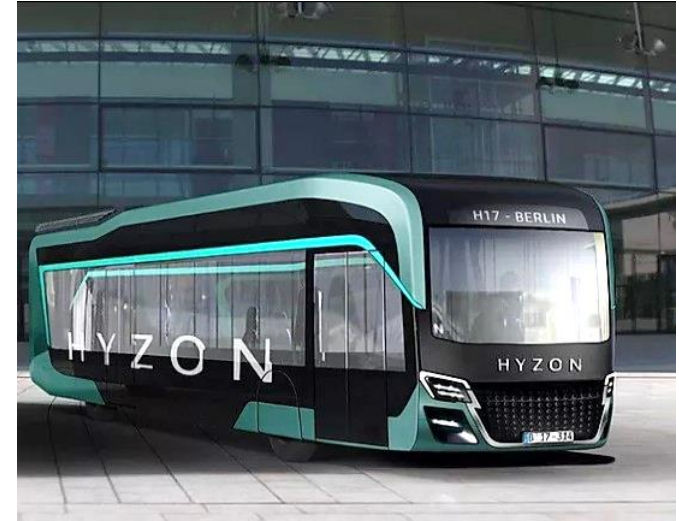
Raven & **HYZON** Motors

Raven SR and HYZON Motors have signed an MOU for a strategic alliance to develop a “local waste to local fuel for local mobility” projects.

Raven SR will provide renewable hydrogen to serve truck fleets under a single lease concept, including HYZON vehicles, maintenance and hydrogen fuel.

The ultimate goal will be to develop small, efficient hydrogen production and refueling units that can be installed anywhere there is waste, creating fuel on the spot, eliminating fuel transportation costs, and building a network of fuel for HYZON vehicles.

Initial collaboration will center around Raven One, to be based in San Jose, California.



Raven Management

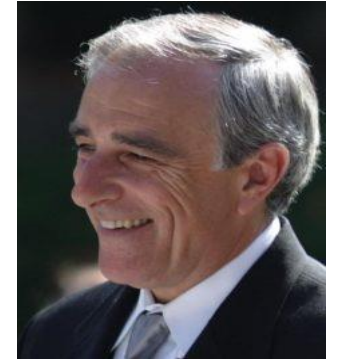


Matt Murdock, CEO. Serial entrepreneur, both in the U.S. and internationally, skilled in project delivery, negotiations, managing complex teams, problem solving and strategy. Quick grasp of complex issues and a focus on solutions.



Matt Scanlon, CFO. Wharton MBA, spent 10 years in the Middle East with a private venture firm, developing projects in energy, telecoms, agribusiness and advised project company management teams and worked with startups and entrepreneurs.

Rick Noling, Strategic Business. MBA, MS in aerospace and mechanical engineering, 30+ years success in turnaround, management and IPO of software, hardware, and new technologies companies.



Joseph Waidl, Engineer. 30 years experience in the renewable energy, chemical, nuclear power and semiconductor industries. Knowledge of process equipment design, process simulations, pilot-plant operations, nuclear reactor systems design and service support.



Raven SR **Outside the Box**

Raven SR's technology has far reaching implications. The company has patents for a one ton per day unit, suitable for neighborhoods, as well as for a sea-bound version.



Raven SR has a patented “Eco-Whale” marine unit that could scoop waste from the sea and convert them ship-board to hydrogen or FT fuels.



Raven SR 1 ton systems could be installed at neighborhood levels, converting household waste into fuel.



Raven SR can help resolve flared gas issues by converting flared gas into fuel.

RAVENSR

