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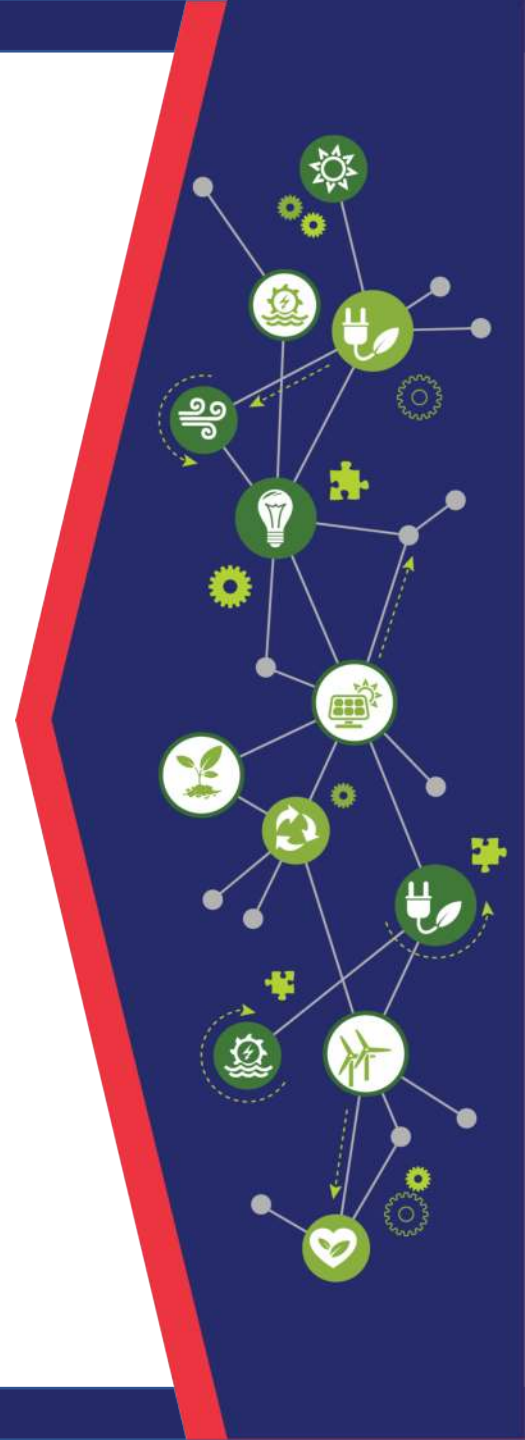
MAINSTAY TECHNOLOGIES

EXHIBITORS: MadgeTech Inc. and Vergent Power Solutions CHP/ Cogen



Renewable Natural Gas Facility

At Casella's Bethlehem, NH Landfill

Presented by

Russell Anderson, Casella Waste Systems

12/7/22

casella

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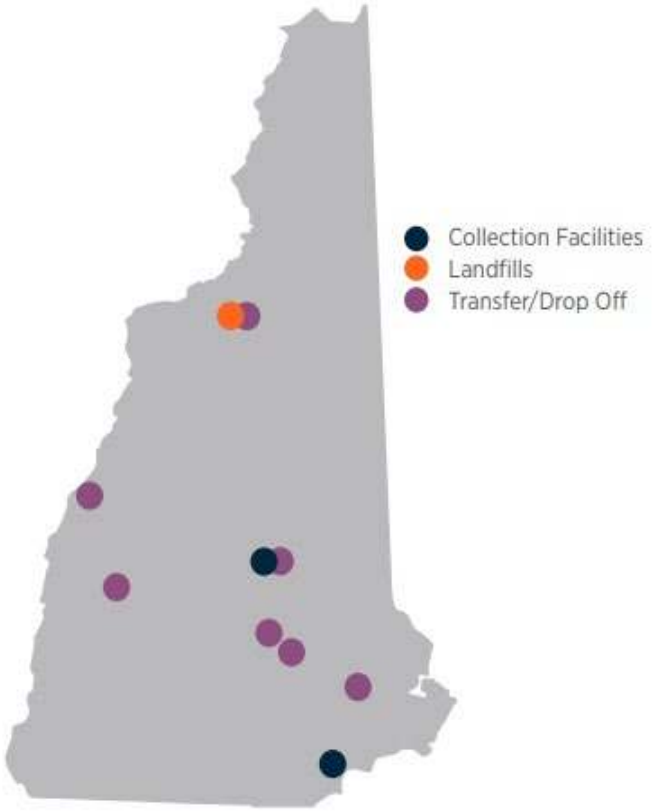
Renewable Natural Gas Project

Introduction

Renewable Natural Gas Facility at Casella's North Country Landfill in Bethlehem, NH

About Casella Waste Systems

- Founded by John & Doug 1975,
- Based Rutland VT
- NASDAQ: CWST
- Operations: ME, NH, VT, MA, CT, NY, PA



New Hampshire Business

- NH Employees +175
- Manage over 500,000 tons of NH waste
- Over 75,000 tons of recycling & organics diversion in NH
- Serve over 12,000 NH Residences, businesses and public customers

What Is Renewable Natural Gas?

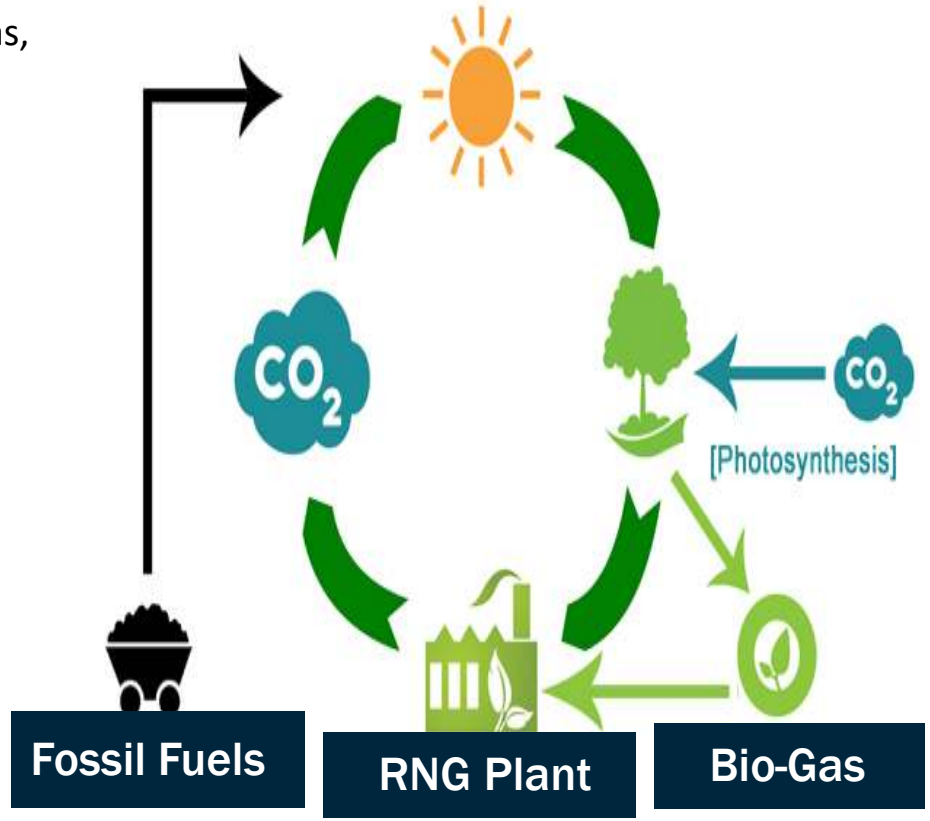
Natural Gas (NG): Also termed fossil gas or petroleum based; primarily methane (CH_4), roughly 1050 BTUs/standard cubic foot

Renewable Natural Gas (RNG): Methane derived from anaerobic decomposition of organics i.e. digestor, farm gas, landfill gas (i.e. biogenic carbon or biomass).

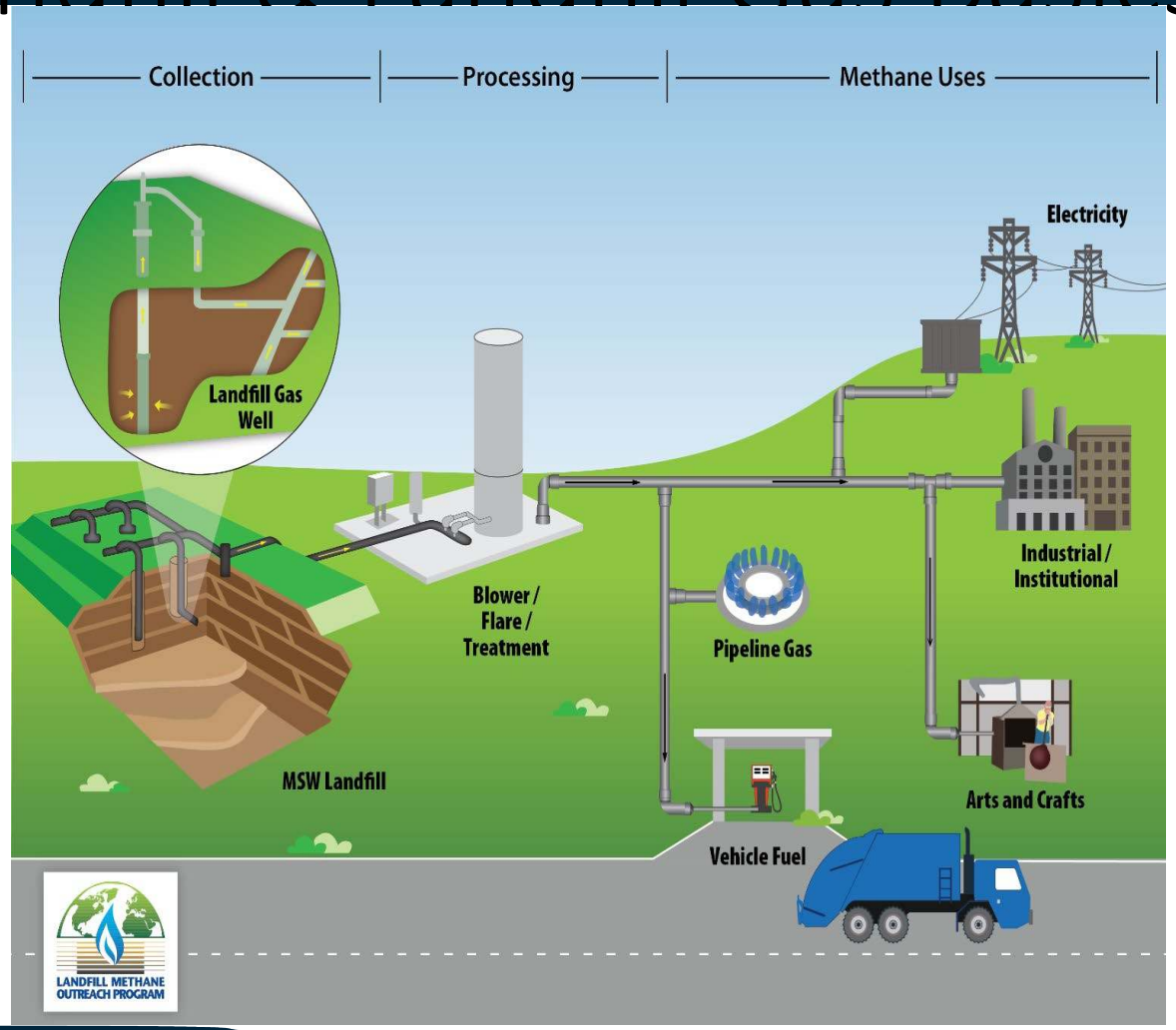
- When combusted, NG and RNG methane produce similar amounts of CO_2
- The key difference is CO_2 from combustion of petroleum-based NG causes a net increase in atmospheric CO_2. Whereas CO_2 from the biogenic sources such as RNG are a part of the earth's natural carbon cycle.
- RNG has some GHG emissions from grid-supplied power/processing, transport & distribution
- RNG has approximately 35-50% the GHG footprint compared to fossil NG.

<u>RNG is an important transitional step towards carbon neutrality</u>:

RNG in the Carbon Cycle



Landfill & Landfill Gas Basics



- Modern Landfills are highly engineered & controlled waste containment systems designed to prevent environmental exposure
- The Landfill is essentially an anaerobic digestor: Organic fraction (food, wood, paper etc.) decomposes anaerobically via methanogenic bacteria,
- LFG collected by vacuum applied to waste; gas conveyed to a control device such as a flare to combust methane,
- Combustion of LFG in a flare is considered wasted energy resource; Traditional LFG projects convert gas to electricity
- Landfill Gas is highly regulated in federal and state regulations; extensive operation, monitoring & reporting req'd.

How is Renewable Natural Gas Made

Simplified RNG Production Process Description

Raw LFG Collected, 50% Methane- Directed to RNG Plant

Compress, Dewater, scrubbed VOCs, Sulfides, CO_2 separation via membrane, N_2, O_2 Separation via PSA - 95% Methane Product

Product RNG Compressed for Tanker Delivery to Utility

RNG used as Green CNG Vehicle Fuel

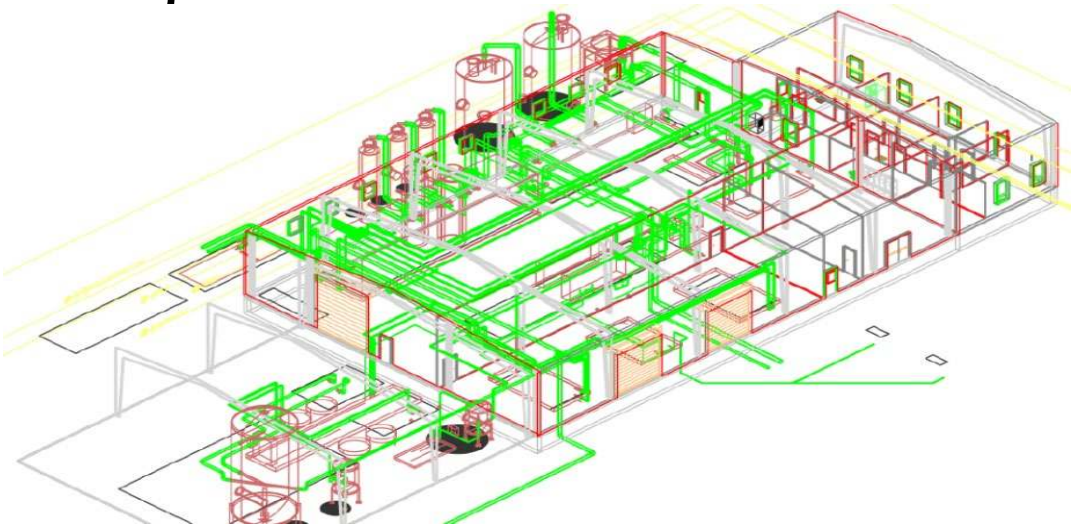
North Country Landfill RNG Project

- **Why RNG**? Traditional LFG Electrical generation project infeasible due to electric grid interconnect ability
- **This is The First of it's kind** Landfill Energy project in NH
- **RUDARPA** selected as Casella's RNG Project Development Partner
- **Casella:** Manages LFG collection, monitoring and supply of raw gas to RNG project
- **RUDARPA Project Role**:
  - Plant design & construction
  - RNG Plant facility operation
  - CRNG Transport & Utility injection
  - Product gas marketing/sales

North Country RNG Project

Project Overview

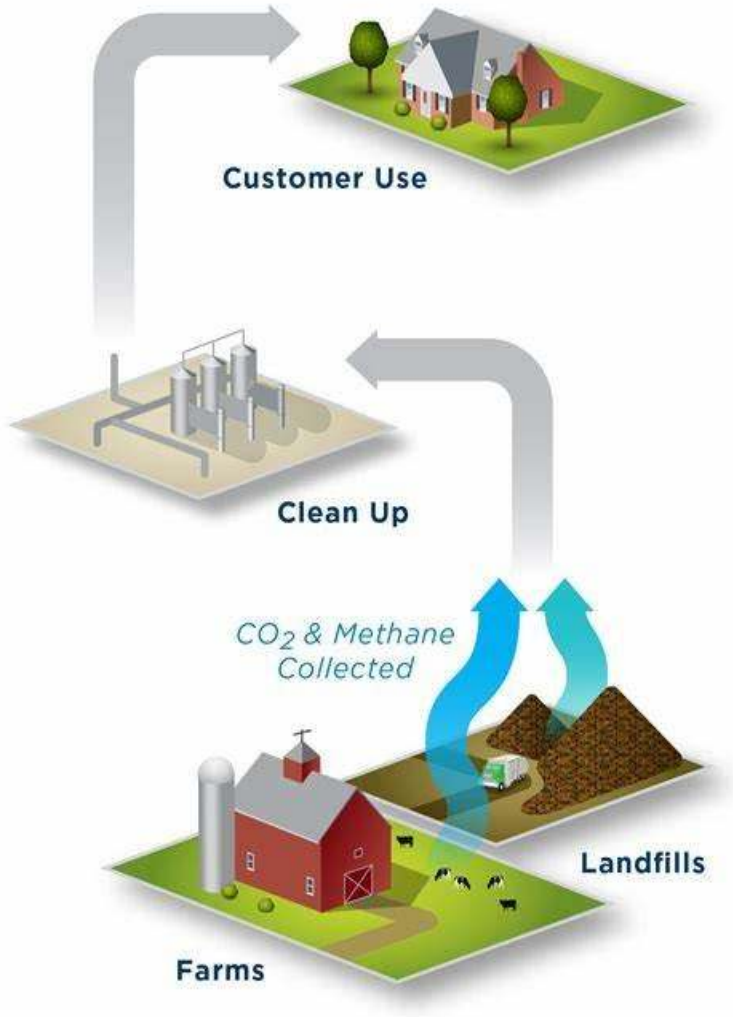
- 4+ Years of Project Development
- Currently in Final Stages of Construction, Began in May/21’
- Commercial Operation Projected Q1/2 2023
- $30+ Million Capital
- Product RNG sold to meet compliance obligations of Renewable Fuel Standard (RFS) Program D3 RINs



Federal Renewable Fuel Standard (RFS)

The RFS (2007) is a Federal compliance program promoting use of low-carbon fuels to displace fossil fuels in the transportation market, *i.e. Ethanol at your gas pump*

- RFS obligated parties are fossil fuel producers, importers, refiners
- Renewable fuels tracked by a RIN (Renewable Identification Number). Each RIN is an ethanol-gallon equivalent fuel (appr. 80,000 btu/gal)
- RINS are akin to RECS in the power market
- RNG displaces CNG in transportation sector; Biogas qualifies as a D3 RIN; a high value class (approx. $2.5/D3 RIN)
- The RFS has been transformational in Biogas energy sector- promoting biogas capture & use
- New EPA Rule 12/1/2022 – RFS/RINS insures the future of this program



North Country Landfill RNG Project

RNG Project Production Details

- LFG Recovery from Landfill:
  - Landfill Produces 2,500 SCFM CH_4 at 50%
  - 1.3 billion SCF/year raw gas collected
  - 650,000 Million BTUs (MMBTUs or Decatherms) per year Flared
- RNG Project Size:
  - RNG Production of 600,000 MMBTUs/yr OR 600 Million cubic feet, OR 6 Million Therms each year of renewable gas at 95%+ CH_4
  - Energy equivalent of 4.3 Million gal/yr of diesel fuel
  - Enough energy to heat 4000+ NH homes/yr (i.e. 1000 gal/yr oil used)

RNG Project Benefits Summary

Environmental Benefits

- Net GHG Reduction 75,000 tpy CO_2e
- Equiv. to 12,000 cars removed
- Injects 6 million therms of RNG into LDC- Liberty (i.e. capacity)
- RNG/Green Gas highly desired by NG Utilities

Economic Benefits

- Project Construction +$30 Million invested in equipment & local trades labor (30+ jobs)
- Creates New Tax Base in Local Community
- Provides 8-10 Full-time local NH jobs
- Plant Operation expected to be economically viable for 15-25 years

North Country RNG Project

Questions?

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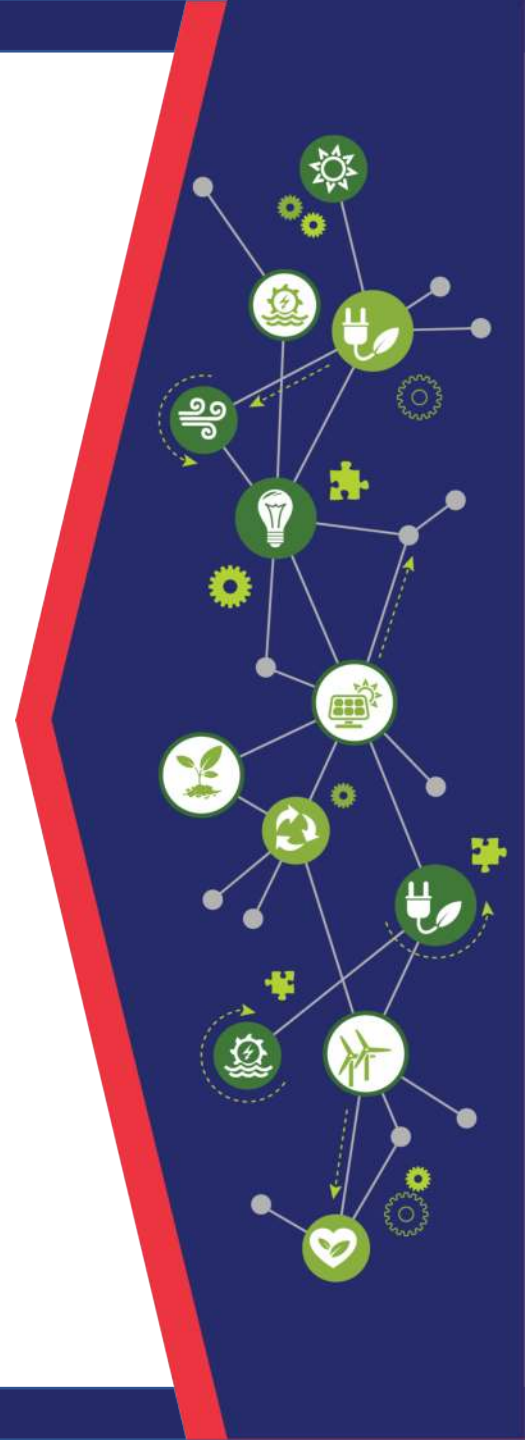
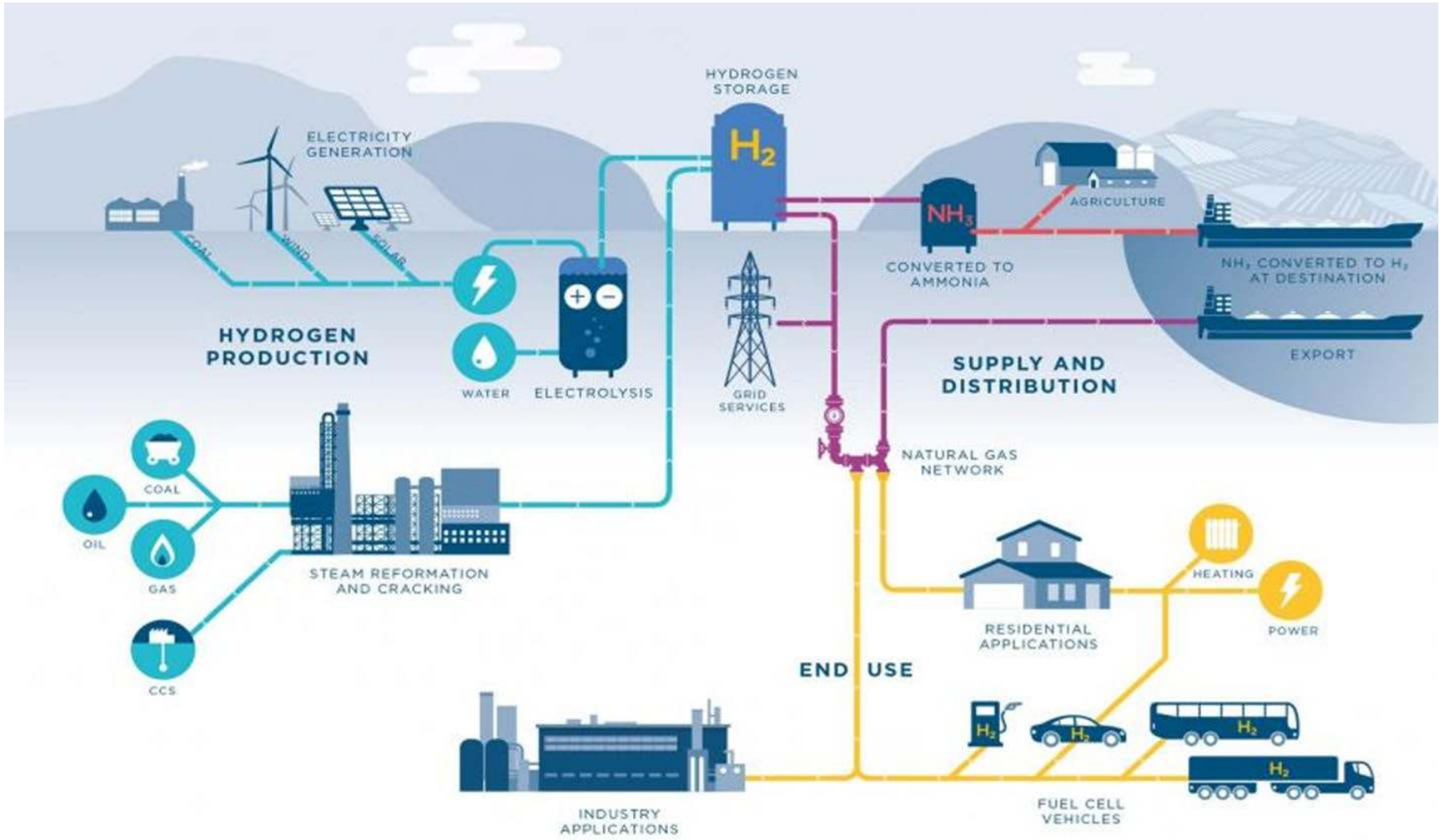


Agenda

1. **Hydrogen 101**
2. **Hydrogen Production**
   - Steam Methane Reforming
   - Electrolysis
3. **Hydrogen Utilization**
4. **DOE Hydrogen Shot**
5. **Hydrogen Hubs**
6. **IRA Bill**



Hydrogen

Hydrogen is a clean alternative to methane and is the most abundant chemical element in the universe.

Hydrogen can be produced from a variety of resources, such as natural gas, nuclear power, biogas and renewable power like solar and wind.

- Non-toxic, colorless, odorless, tasteless

	Natural Gas	Hydrogen
Chemical Formula	CH_4	H_2
Molecular Weight	16 g/mol	2 g/mol
Flammability Limits	7% & 20%	4% & 75%
Lower Heating Value	32.6 MJ/m^3	9.9 MJ/m^3
Lower Heating Value	50.0 MJ/kg	118.8 MJ/kg

Hydrogen is less dense, less viscous, and more energy dense per unit mass than natural gas.

Common Hydrogen Production Methods

Steam Methane Reforming (SMR)

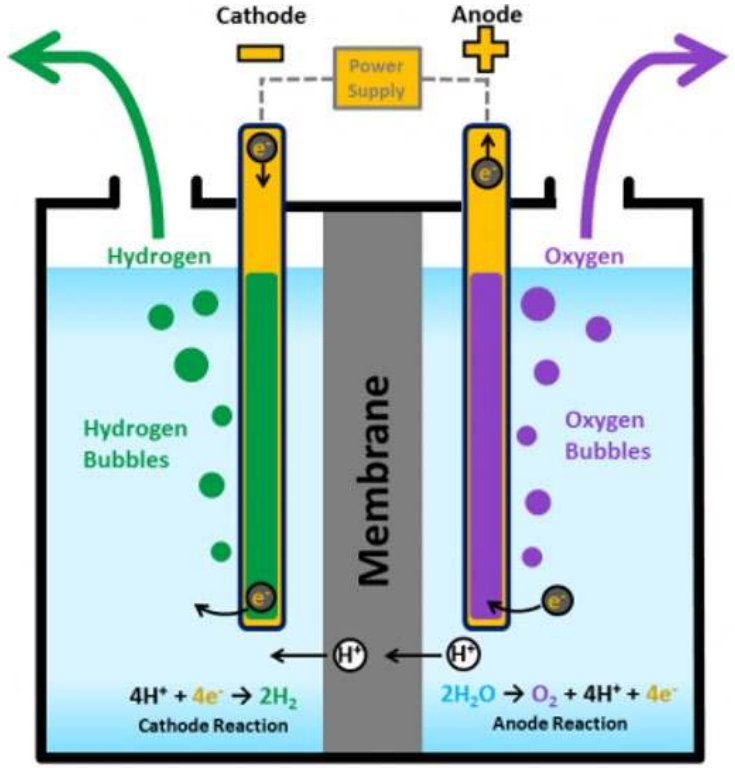
- Most common & least expensive (produces CO2)
- Methane reacts with steam under pressure in the presence of a catalyst to produce hydrogen, carbon monoxide, and a relatively small amount of carbon dioxide

Electrolysis

- No direct emissions (energy and large amounts of water required)

Pyrolysis

- Thermal decomposition of methane

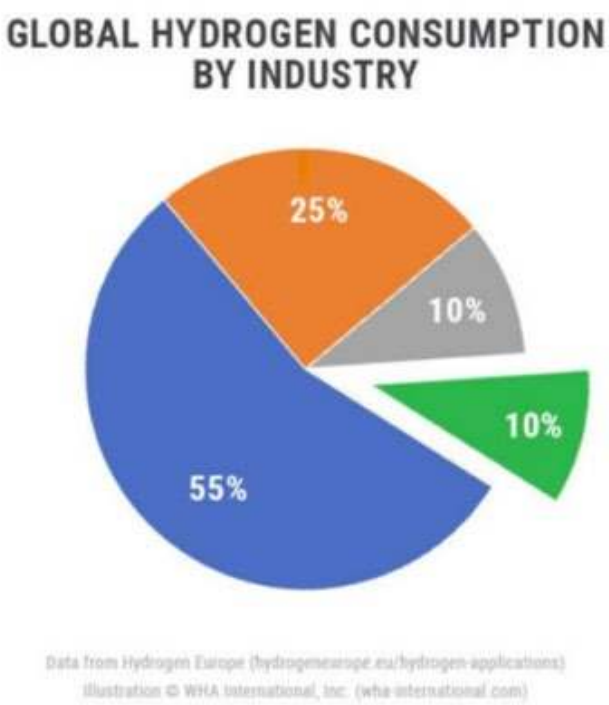


Hydrogen Utilization

- **Producing fertilizer**
  - Over 50% of the hydrogen produced worldwide is used for ammonia production
- **Refining Petroleum**
  - To lower the sulfur content of fuels
- **Treating metals**
- **Processing food**

Petroleum Refining
25%

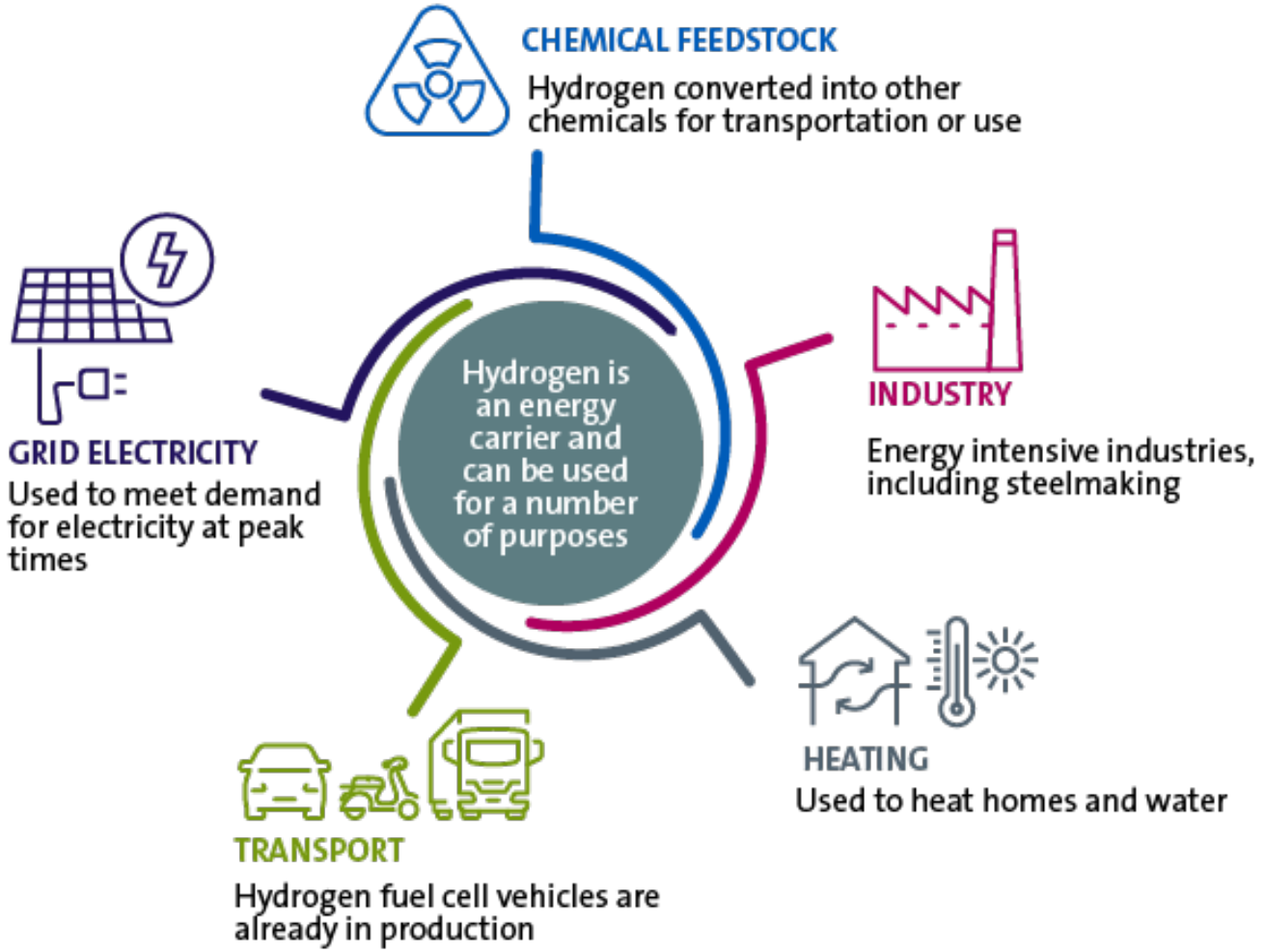
Ammonia Production
55%



Methanol Production
10%

Other
10%

Other Hydrogen Uses



DOE Hydrogen Shot

The U.S. Department of Energy's (DOE's) Energy Earthshots Initiative aims to accelerate breakthroughs of more abundant, affordable, and reliable clean hydrogen solutions within the decade.

If the Hydrogen Shot goals are achieved, scenarios show the opportunity for at least a 5-fold increase in clean hydrogen use.

The hydrogen Shot would catalyze innovation in any hydrogen pathway with potential for meeting the targets—such as renewables, nuclear, and thermal conversion—providing incentives to diverse regions across the country.

https://www.energy.gov/policy/energy-earthshots-initiative

https://www.energy.gov/eere/fuelcells/hydrogen-shot

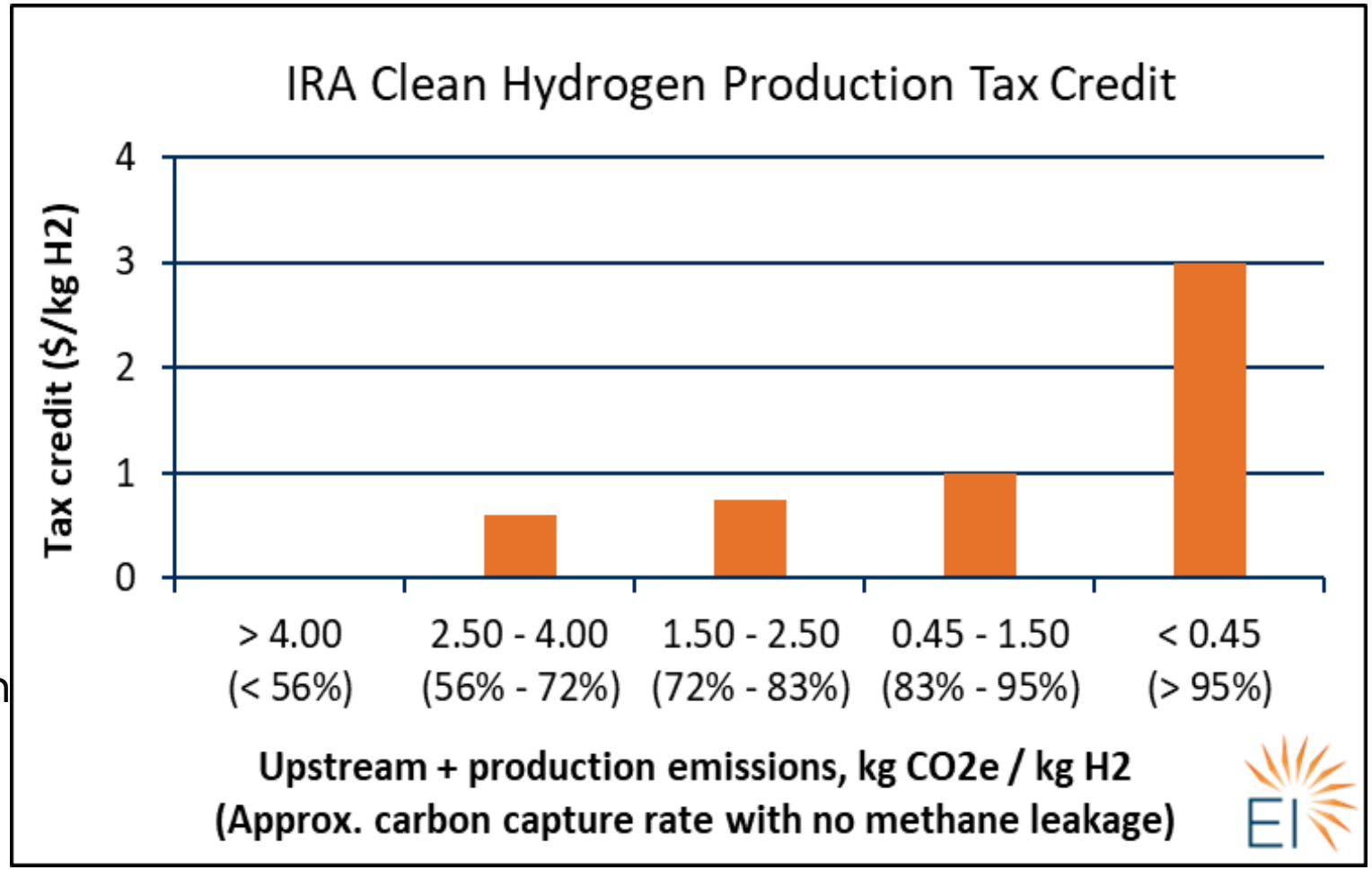
Hydrogen Hubs

The Regional Clean Hydrogen Hubs program includes up to $7 billion to establish 6 to 10 regional clean hydrogen hubs across America.

1. Clean hydrogen hubs will create networks of hydrogen producers, consumers, and local connective infrastructure to accelerate the use of hydrogen as a clean energy carrier that can deliver or store tremendous amounts of energy.
2. The production, processing, delivery, storage, and end-use of clean hydrogen, including innovative uses in the industrial sector, are crucial to DOE's strategy for achieving a 100 percent clean electrical grid by 2035 and net-zero carbon emissions by 2050.

Inflation Reduction Act (IRA) Bill

- The Inflation Reduction Act (IRA) of 2022 makes the single largest investment in climate and energy in American history.
- This includes a 10-year production tax credit for “clean hydrogen” production facilities.
- Incentives begin at $0.60/kg for hydrogen produced that captures more than half of carbon emissions. The PTC’s value rises to $1.00/kg with higher carbon capture rates before jumping to $3.00/kg for hydrogen produced with nearly no emissions.



Renewables

Hydrogen

Bill Clark,

Sr Director, Business Development

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