

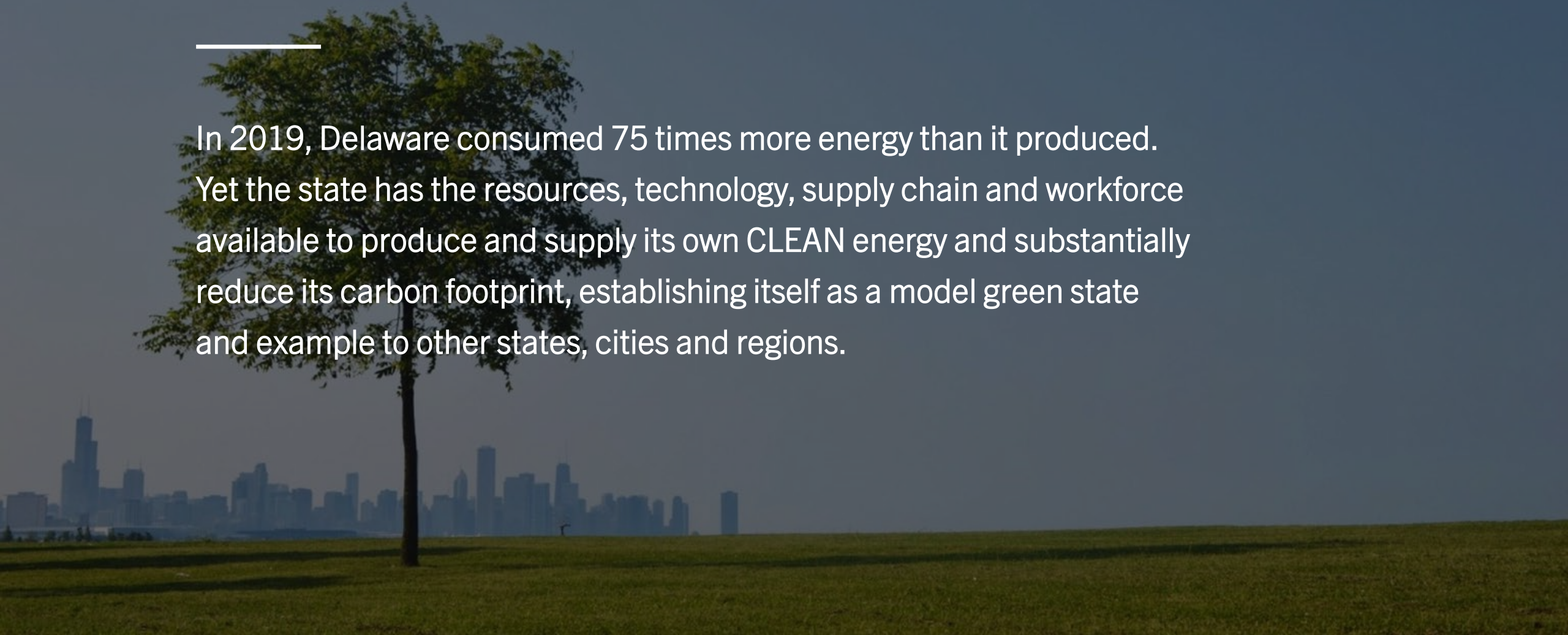
A photograph of laboratory glassware, including Erlenmeyer flasks and test tubes, containing green and blue liquids. The image is slightly blurred and has a dark overlay, serving as a background for the text.

DELAWARE & THE HYDROGEN ECONOMY

A New Era of Economic Development

DID YOU KNOW?

In 2019, Delaware consumed 75 times more energy than it produced. Yet the state has the resources, technology, supply chain and workforce available to produce and supply its own CLEAN energy and substantially reduce its carbon footprint, establishing itself as a model green state and example to other states, cities and regions.



WHY HYDROGEN?

ABUNDANT AND CLEAN

- Hydrogen is the lightest and most abundant element in the universe.
- A clean-burning gas that contains **3x more energy per unit of weight than fossil fuels**.
- As more and more nations seek to meet international climate targets and reduce the volatility associated with traditional oil and gas pricing, hydrogen is becoming a key area of focus in national agendas.

WHY HYDROGEN?

MULTIPLE APPLICATIONS

- Hydrogen is an energy carrier that can not only be used to store energy for long periods of time but also transport that energy over large areas geographically.
- This allows it to cut across sectors and applications:
 - Industry: Refining, Steel & Glass, Chemical, etc
 - Transportation: Heavy duty trucking, buses
 - Heat & Power: Commercial, residential

HYDROGEN PRODUCTION METHODS

1. STEAM METHANE REFORMING

- Most widely used
- Methane from natural gas or other hydrocarbon derivatives is heated with steam and combined with a catalyst to produce a final output of CO_2 and H_2 .
- Incorporation of carbon capture & utilization allows for cleaner H_2 production.

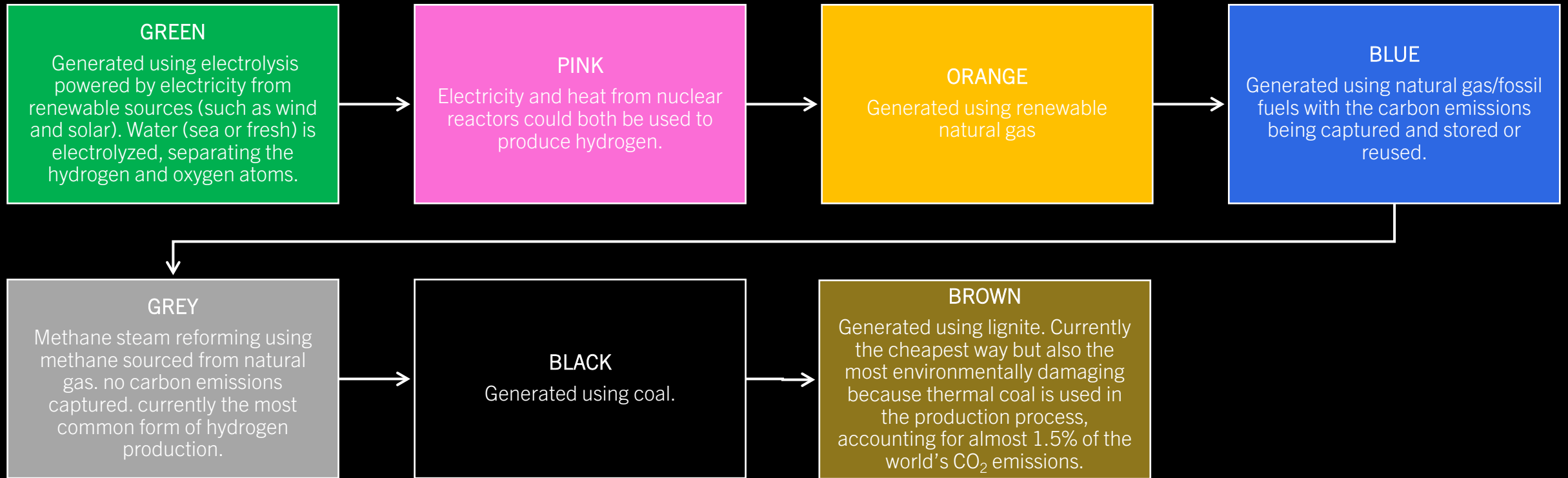
2. ELECTROLYSIS

- Uses electricity to split water into hydrogen and oxygen in an electrolyzer.
- When electricity is generated from wind, solar, or nuclear electrolysis delivers green hydrogen.

3. WASTE GASIFICATION

- Uses high temperatures to break down waste into hydrogen, carbon dioxide and a solidified material.
- When produced in conjunction with carbon capture waste gasification is another source of clean hydrogen.

THE COLORS OF HYDROGEN



NOTE: TURQUOISE: Generated using a method known as methane pyrolysis that produces hydrogen and solid carbon. This particular process is not proven at scale and concerns exist around methane leakage.

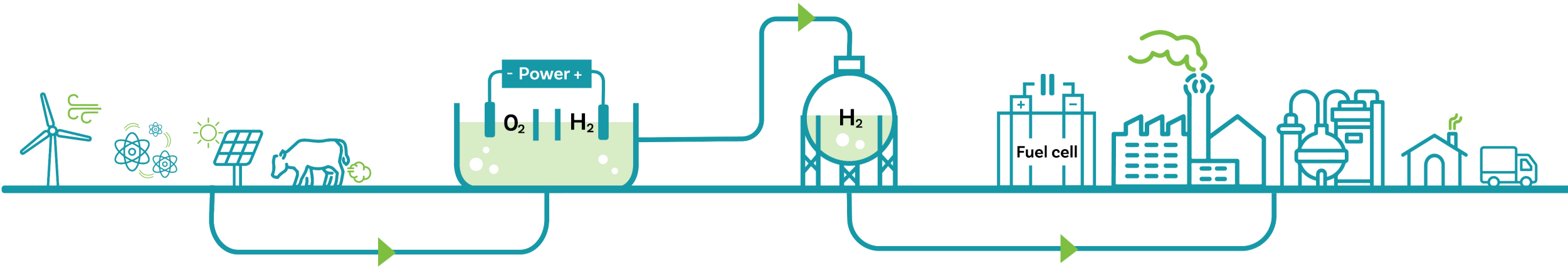
HOW WILL MACH₂ PRODUCE HYDROGEN?

Using energy produced by clean energy sources like wind, solar, nuclear

...Low to zero carbon electricity could produce hydrogen from water through electrolysis.

Hydrogen is stored safely for when needed.

Clean hydrogen could be used for power generation, transportation fuel, refining and other industrial processes.



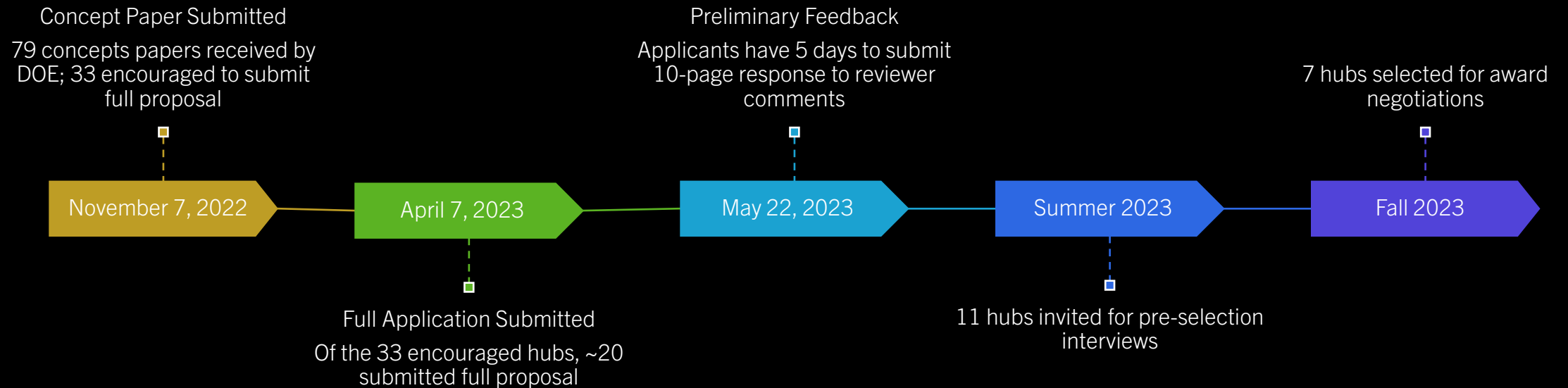
HYDROGEN & THE US- THE IRA

- Signed into law on August 16, 2022 includes federal spending directed towards reducing carbon emissions. Will likely drive significant deployment of new clean energy resources.
- Offers funding, programs and incentives to accelerate transition to a clean energy economy.
- Taking advantage of these incentives (eg tax credits) are key to lowering GHG emissions footprints and accelerating clean energy transition.
 - Investment Tax Credit and Production Tax Credit
 - Environmental Justice ITC Adder
 - Clean Energy ITC / Clean Energy PTC
 - Tax Credit Monetization

HYDROGEN & THE US – H2HUBS

REDUCE	REDUCE CARBON EMISSIONS by achieving clean hydrogen production standard for carbon intensity
PRODUCE	PRODUCE, PROCESS, DELIVER, STORE clean hydrogen
CONNECT	CONNECT to other regional hubs for a national clean hydrogen network/clean hydrogen economy

HYDROGEN & THE US: H2HUBS



HYDROGEN ACTIVITIES IN DELAWARE: MACH2

MACH 2: THE BASICS

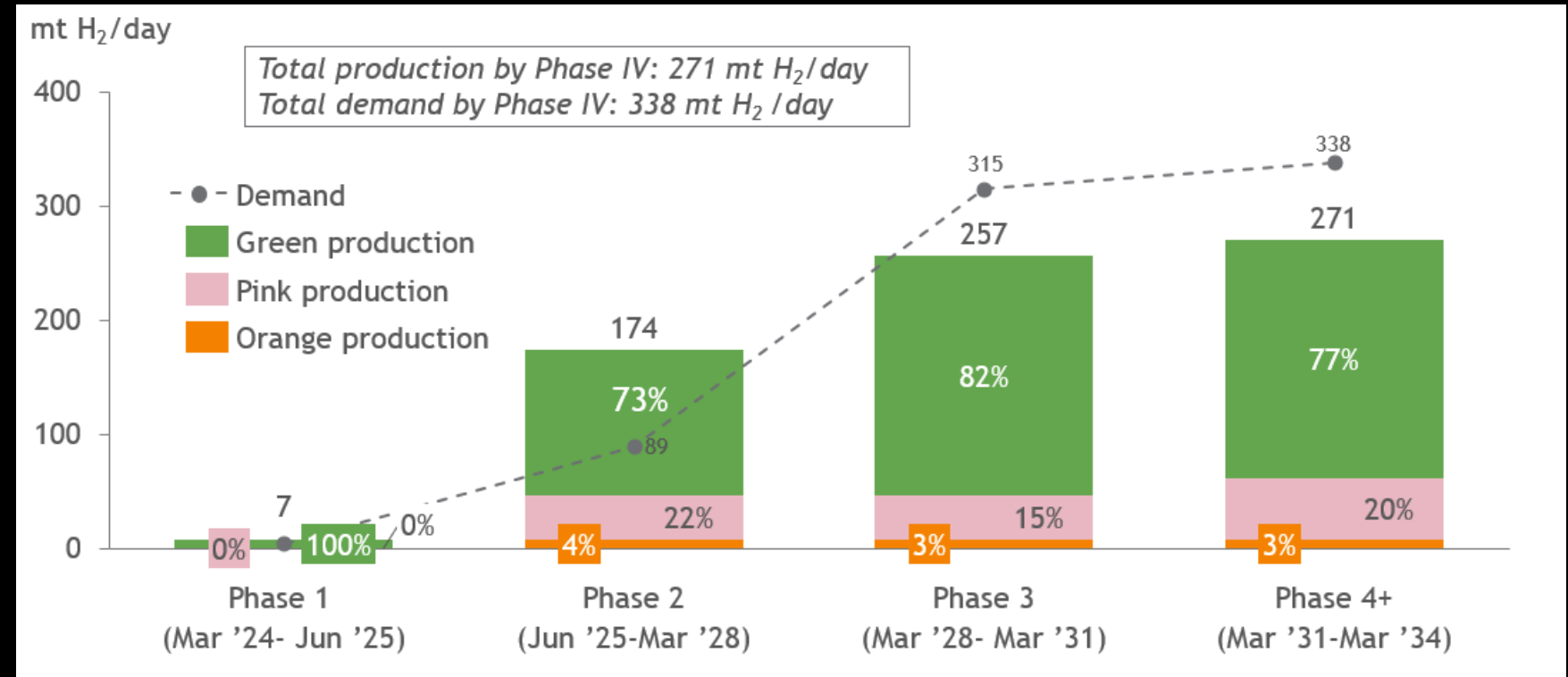
Funding award:
\$750M over 10
years

Projected H₂
production: 170
mtpd by end of
Phase II (2028-
2029) and 270
mtpd by 2034

Job creation:
>13,000 jobs
retained and/or
created at all
levels

Levelized cost of
hydrogen:
\$3.86/kg (below
target of \$4.50
/kg needed by
consumers for
viable purchase)

MACH2 IS PRIMARILY A GREEN AND PINK HUB



Definition:

Hydro, Solar or Wind
powered electrolyzer

Nuclear powered
electrolyzer

Biogas or biomethane in
SMR (e.g., RNG)

Carbon intensity:

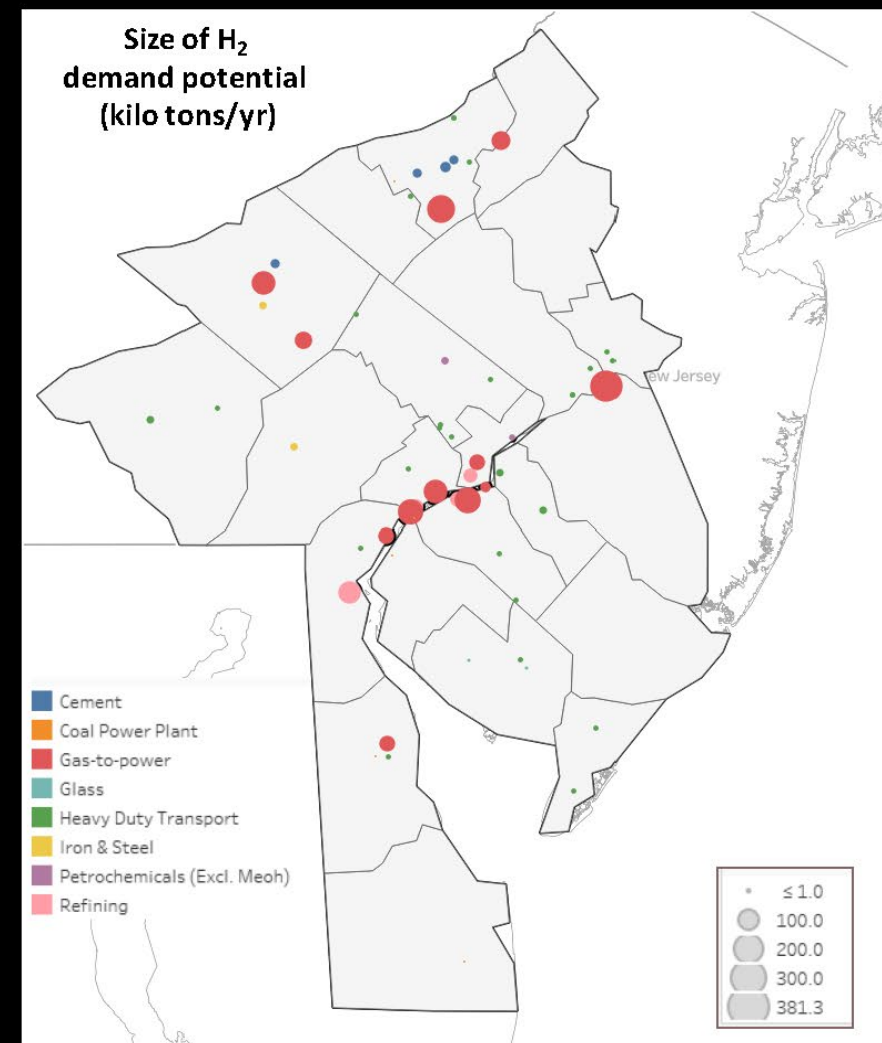
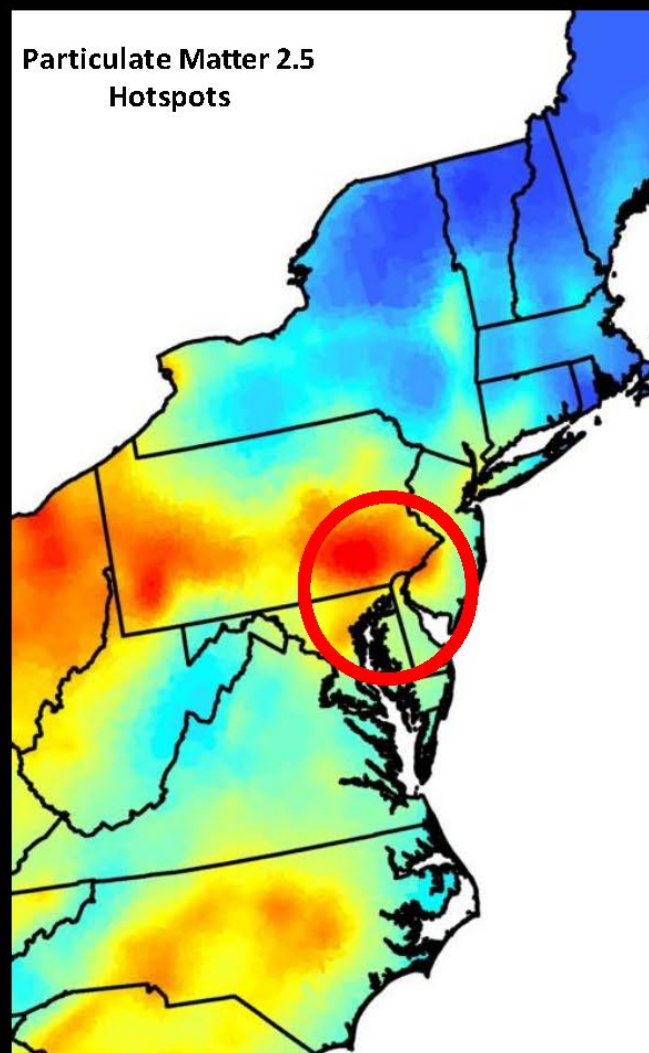
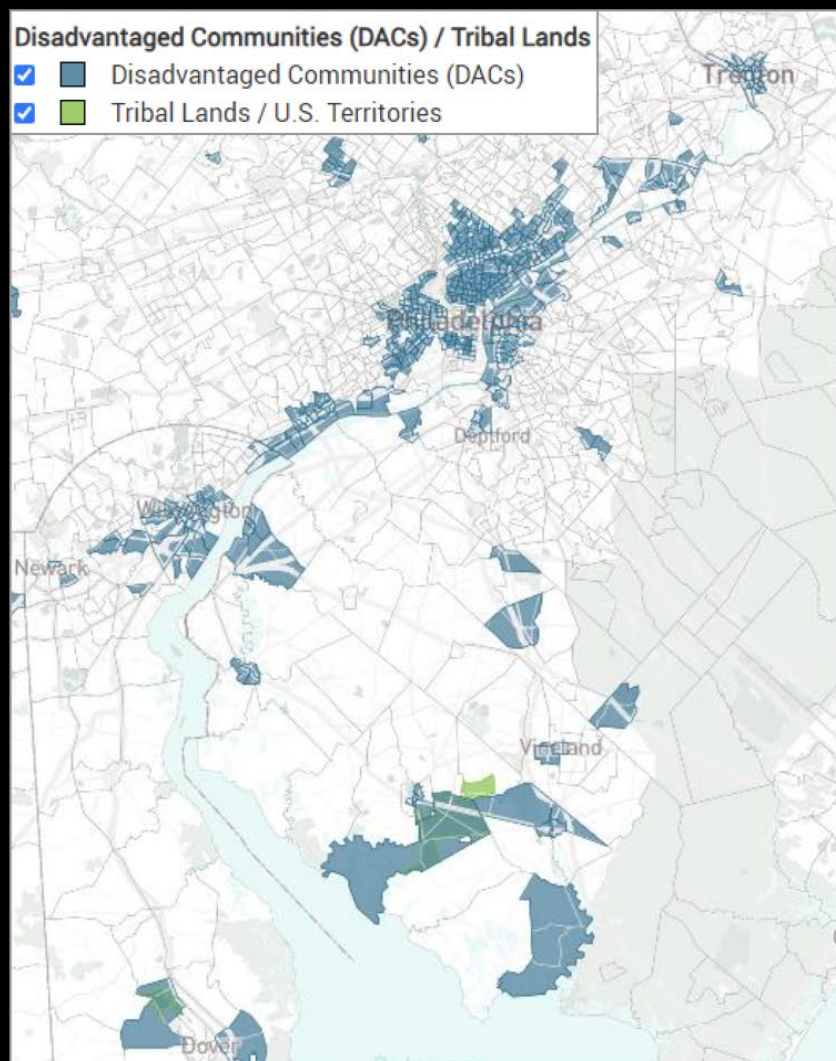
0 kg CO_{2e}/kg H₂

0.2 kg CO_{2e}/kg H₂

0.2 kg CO_{2e}/kg H₂

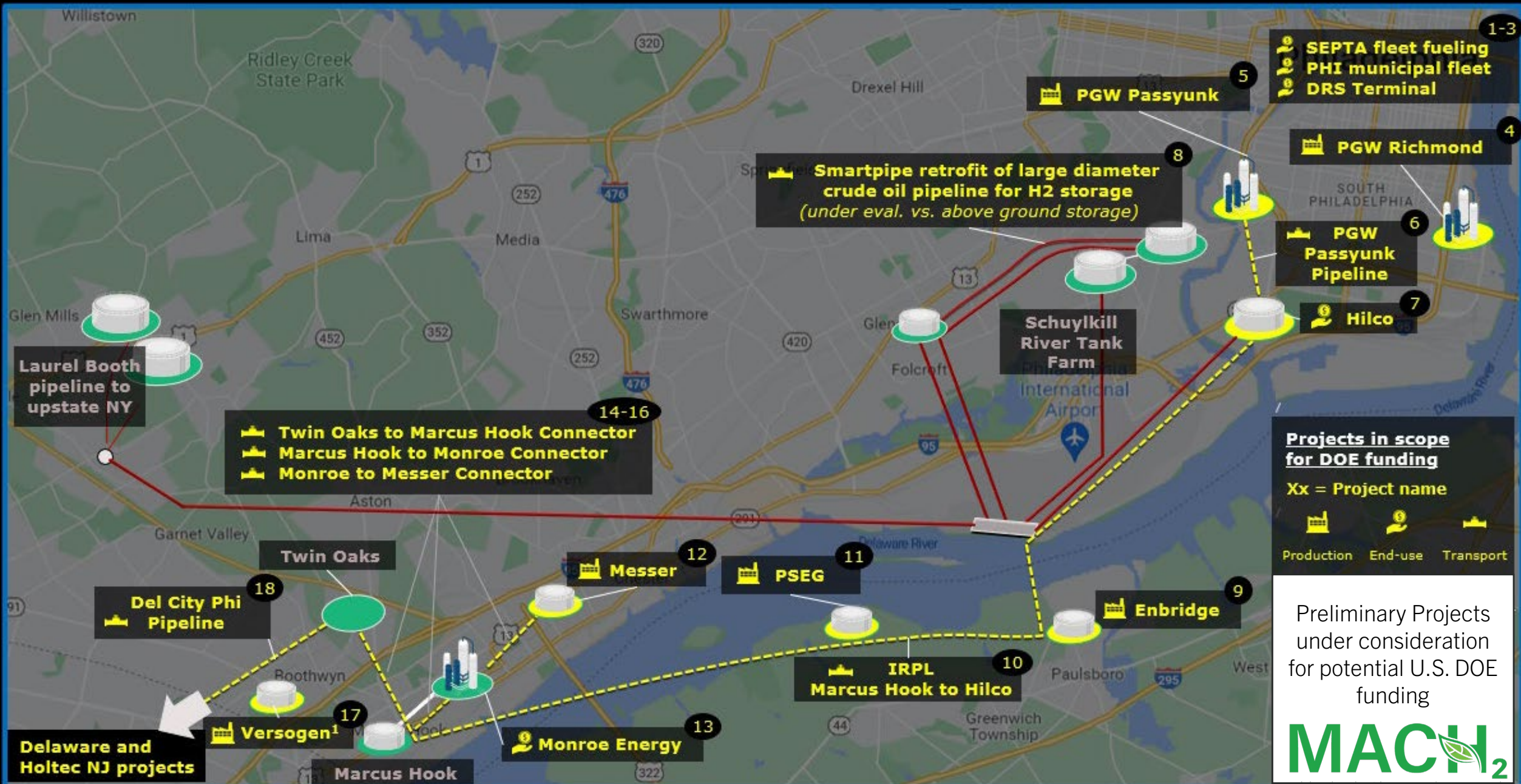
Justice40: MACH₂ will significantly reduce air pollution

Large emitters in hub area are sources of H₂ demand

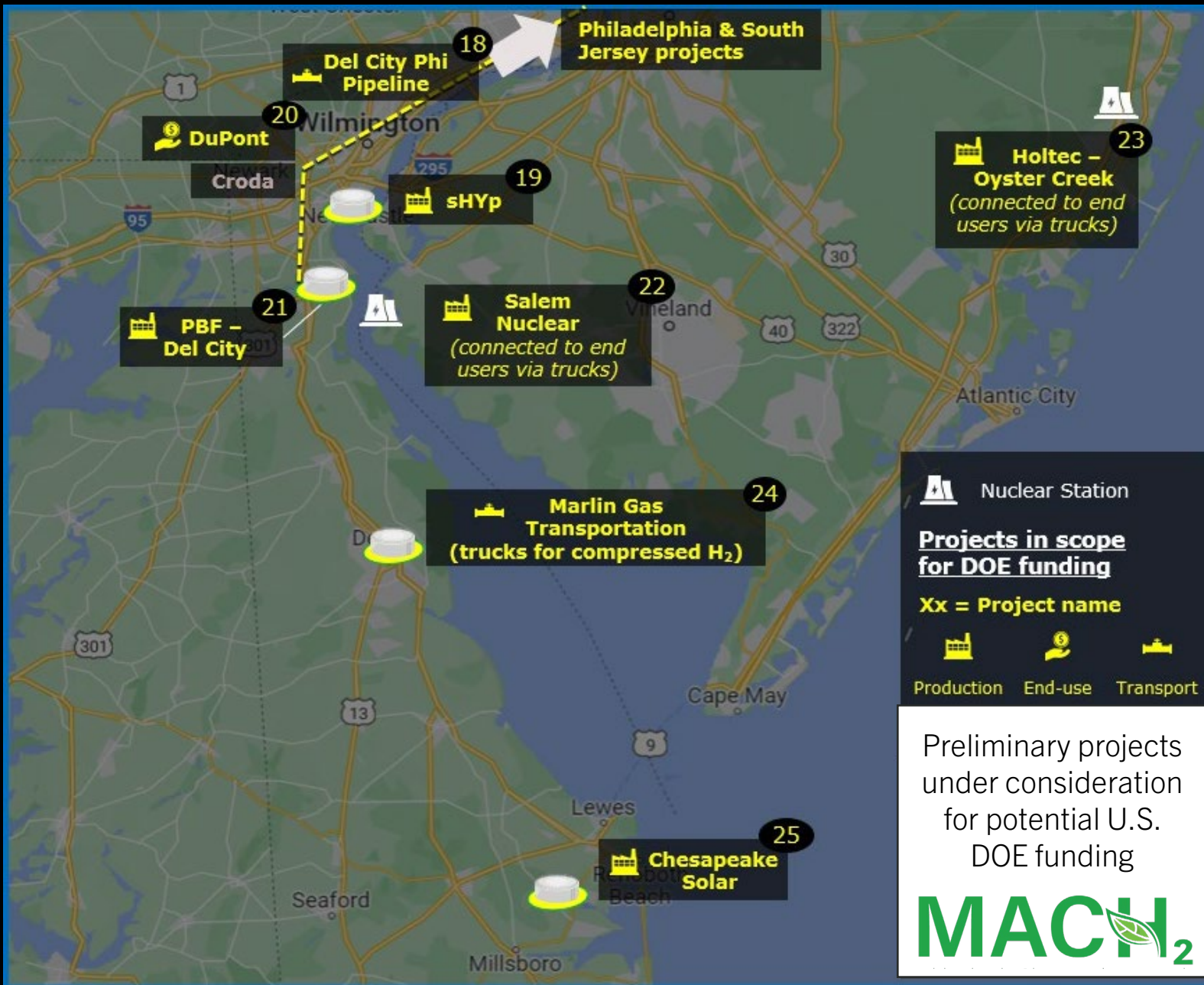


Source: EIA AEO, EPA 2019 Emission Inventory, DOE AFDC

PRELIMINARY DRAFT CONCEPT FOR DISCUSSION



PRELIMINARY DRAFT CONCEPT FOR DISCUSSION



THE MACH2 ECOSYSTEM

Labor, Workforce & Community Outreach

- PA AFL-CIO
- DE AFL-CIO
- Building Construction Trades
- Pipefitters & Steamfitters
- Delaware Prosperity Partnership
- DESCA
- DE Workforce Development Board
- Philadelphia Works
- University of Delaware
- Rowan
- UPenn
- Drexel
- Delaware State University

H₂ Producers & Innovators

- Air Liquide
- **PBF Energy**
- Bloom Energy
- PGW
- **Monroe Energy**
- **Enbridge**
- **Versogen**
- **Holtec**
- **PSE&G**
- **Chesapeake Utilities**
- **sHYp**
- Hydropore

Feedstock Diversity & Infrastructure

- PECO
- PSE&G
- US Wind
- **Buckeye**
- **IRPL**

MACH₂

Industrial & Commercial Applications

- **Monroe Energy**
- Braskem
- **DuPont Experimental Station**
- **PSE&G**
- **Enbridge**
- **Hilco**
- HyAxiom
- Amazon
- Ameresco

Transportation Applications

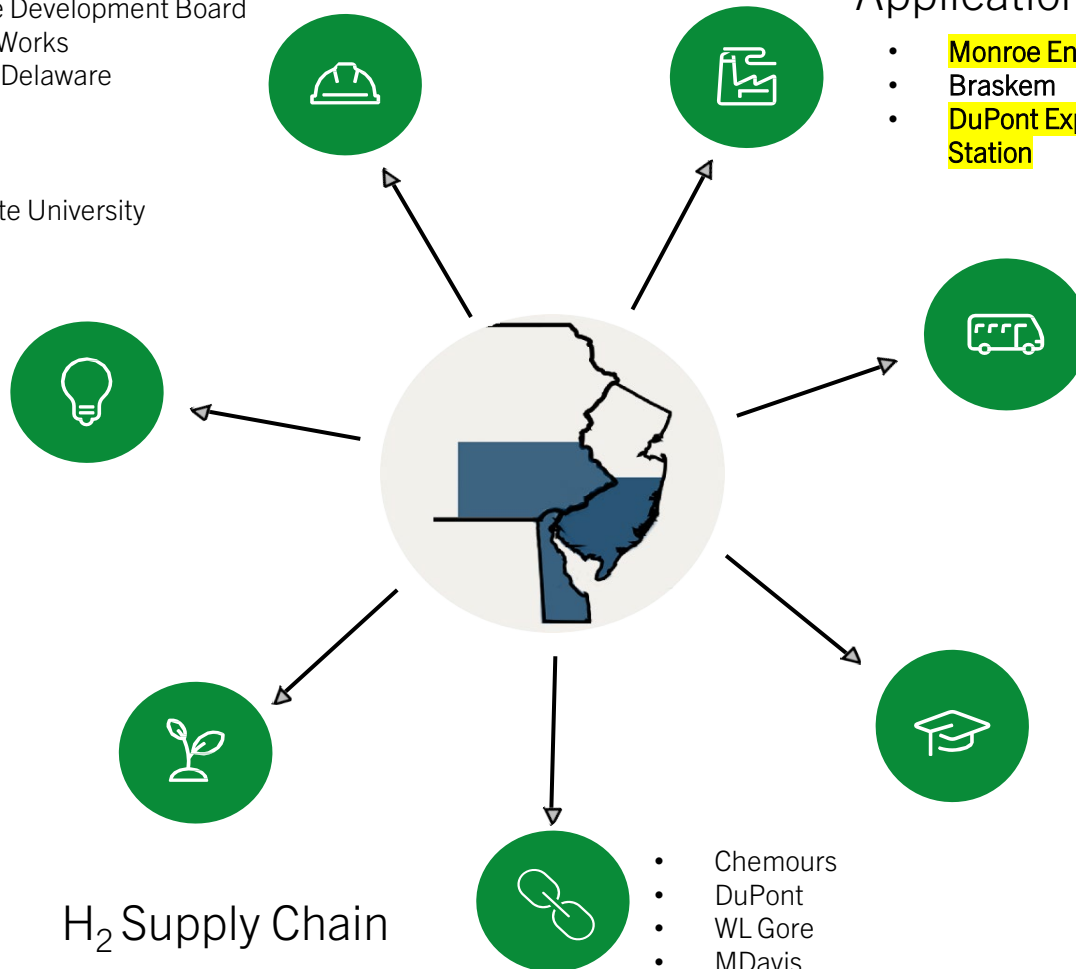
- **SEPTA**
- DART
- NJ Transit
- Philadelphia Municipal Fleets

Education, Research & Development

- University of Delaware
- Rowan
- UPenn
- Drexel
- Delaware State University
- DESCA

H₂ Supply Chain

- Chemours
- DuPont
- WL Gore
- MDavis
- Compact Membrane Systems



POST AWARD
ORGANIZATIONAL
STRUCTURE
EMBEDS COMMUNITY
BENEFITS, WORKFORCE
DEVELOPMENT & EJ40
ACTIVITIES AT ALL
LEVELS INCLUDING
BOARD, ADVISORY
COMMITTEES,
EXECUTIVE TEAM &
COMMUNITY BENEFITS
STAFF



WHAT DOES MACH2 MEAN FOR DELAWARE?



DELAWARE-SPECIFIC COMPANIES
SLATED TO GET ~\$276.4M IN DOE
FUNDING



SAME COMPANIES WILL BE INVESTING
~\$1.09B (NOT INCLUDING INVESTMENTS
BY SUPPLY CHAIN COMPANIES AND
NON-RECIPIENT PARTNERS)



FUNDS ALSO BUDGETED FOR DELAWARE-
SPECIFIC WORKFORCE DEVELOPMENT
EFFORTS AND COMMUNITY AND
ENVIRONMENTAL JUSTICE OUTREACH

HYDROGEN ACTIVITIES IN DELAWARE: CHESAPEAKE UTILITIES

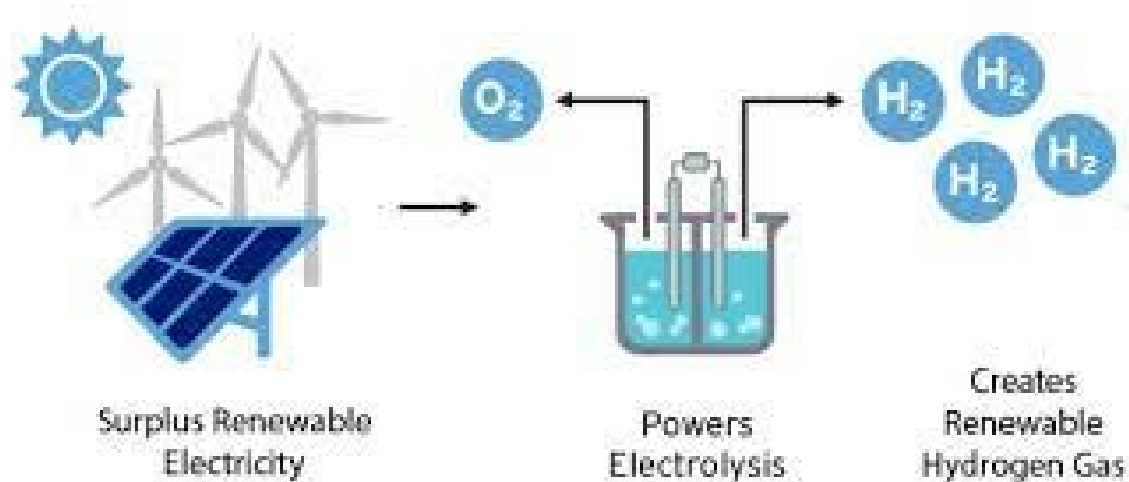
160+ Years of Local Service

- 1859** - Dover Gas Light Company formed
- 1947** - Chesapeake Utilities Corporation incorporated in Delaware
- 1959** - ESNG begins Delmarva pipeline transmission service-Natural Gas Services begin
- 1985** - Common Stock listed on NASDAQ
- 1993** - CPK listed on New York Stock Exchange
- 2009** - Acquired Florida Public Utilities
- 2018** - AFV fueling station installed - Dover
- 2019** - Eastern Shore Natural Gas completes its largest system expansion project to date
- 2022** - First Sustainability Report released
- 2023** - Renewable Natural Gas (Full Circle, Planet Found)

LOCKERMAN STREET FROM POSTOFFICE—DOVER, DELAWARE.

HYDROGEN ACTIVITIES IN DELAWARE: CHESAPEAKE UTILITIES & MACH2

- Production
- Storage
- Fueling
- Delivery (on-road)
- Safety and Workforce Training



A photograph of a hydrogen fueling station. In the foreground, a silver car is parked at a fueling station. In the background, a white bus is parked. The image is overlaid with a semi-transparent dark grey rectangle containing white text.

HYDROGEN ACTIVITIES IN DELAWARE: DART

WHY WE NEED A HYDROGEN HUB

- Fleet Composition, Storage Facility
- Mid-County - 60 Buses
- Monroe – 108 Buses
- 25Kg per bus a day 6 days =
25,200Kg a week (25.2 mt / week)
- 50 Hydrogen Fleet vehicles will add
even more need for a Hydrogen Hub
- 2022 Low-No FTA Grant Mid-County
Hydrogen Fueling station, and 4-40'
FCEB Buses.
- 2023 Low-No FTA Grant 4-40' FCEB
Buses.

THANK YOU



Q & A

