



DLZ'S HYDROGEN OVERVIEW

Ohio Hydrogen Technology Forum



JUNE 6, 2025



Bruce Bauchmire
Director Renewable Energy Services

A little about us.

DLZ is family and employee-owned
Architecture/Engineering consultant.

1,000+
Employees
company-wide

30
Office Locations
Nationwide

#11
Top Midwest
Design Firms

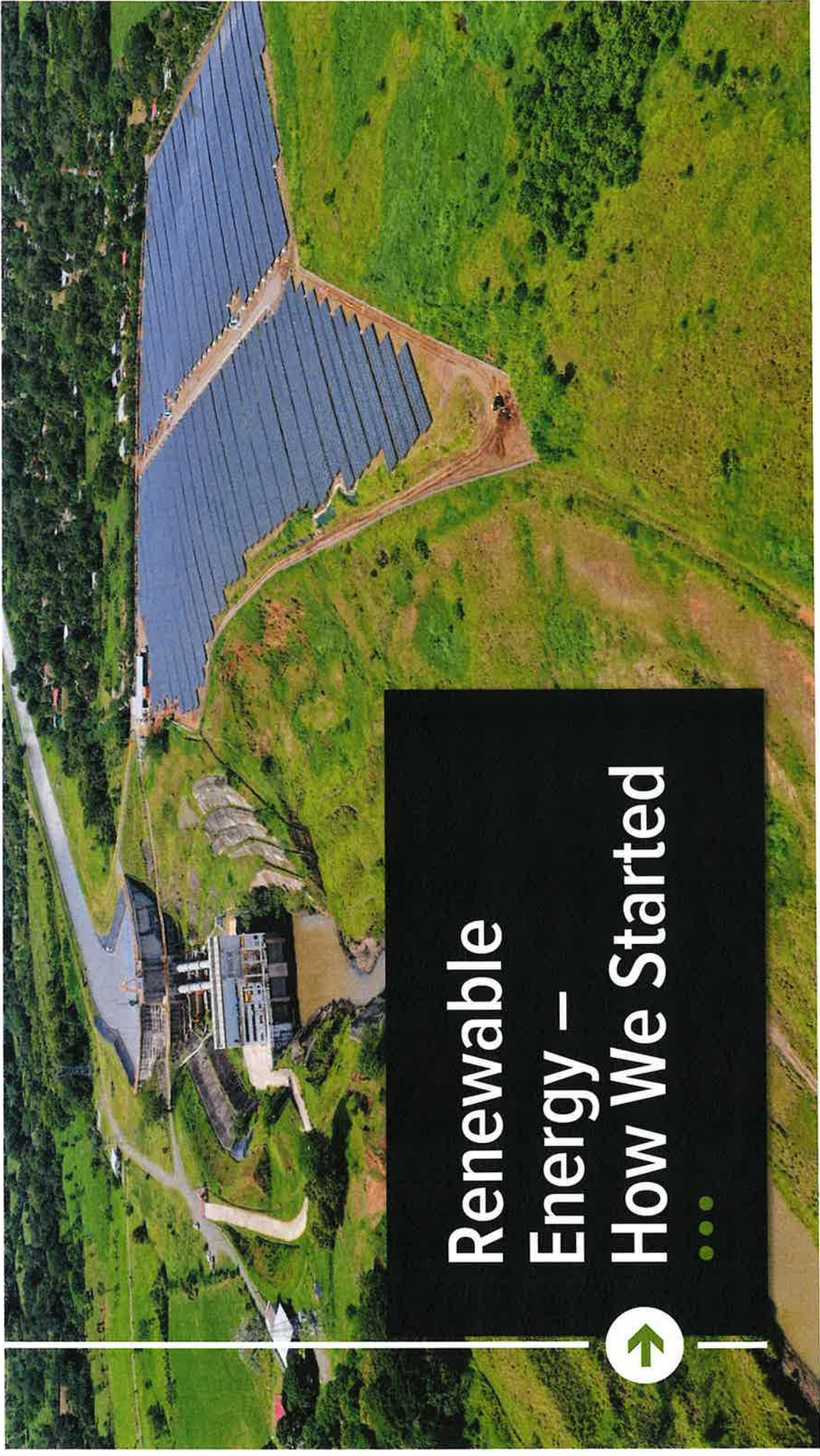


What We Do.



***Clean* and *Green Energy* have been integral to DLZ's mission for decades.**

We have heavily invested in renewable energy and consider this a key area of expertise. With a growing demand for sustainable and renewable energy sources, our team of experts can assist you in transitioning to clean, green energy sources.

An aerial photograph showing a large hydroelectric dam with multiple spillways, situated in a lush green valley. To the right of the dam, a large solar farm with rows of photovoltaic panels is visible. The surrounding landscape is a mix of green fields and dense forest. A road and some small buildings are located near the dam.

Renewable Energy – How We Started



Renewable Projects:



India Hydropower Locations

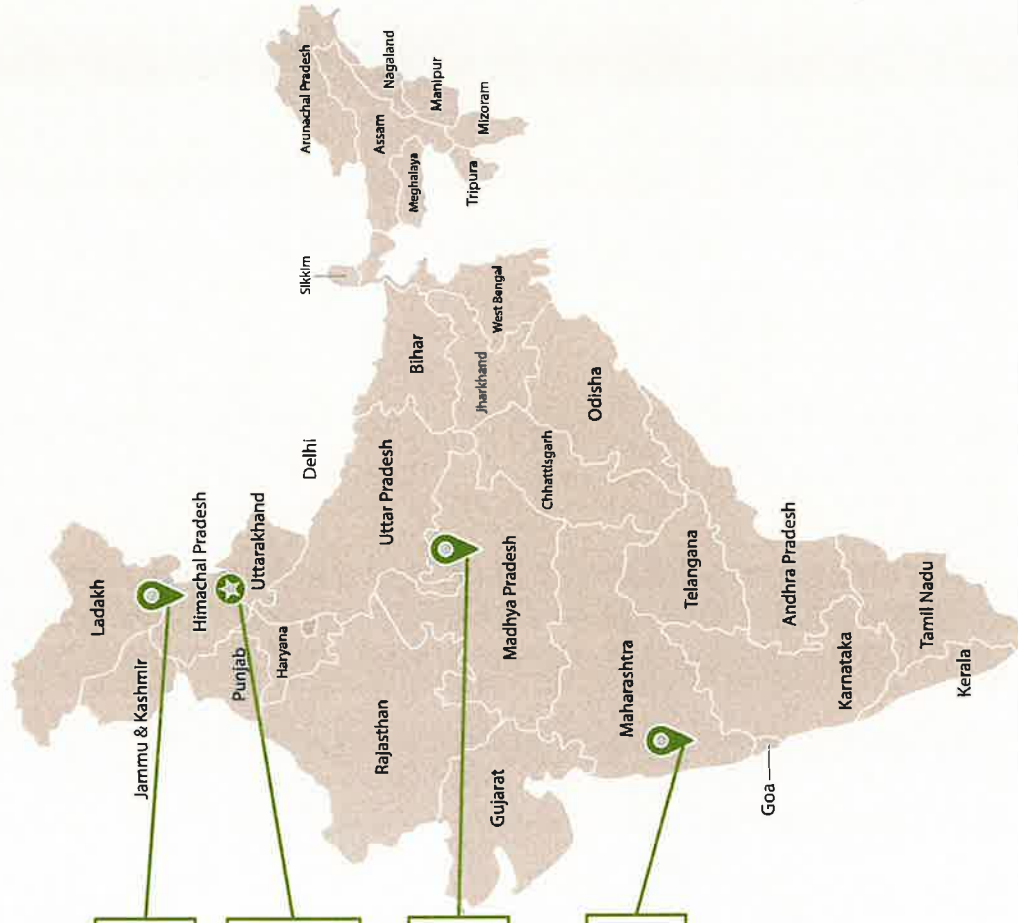


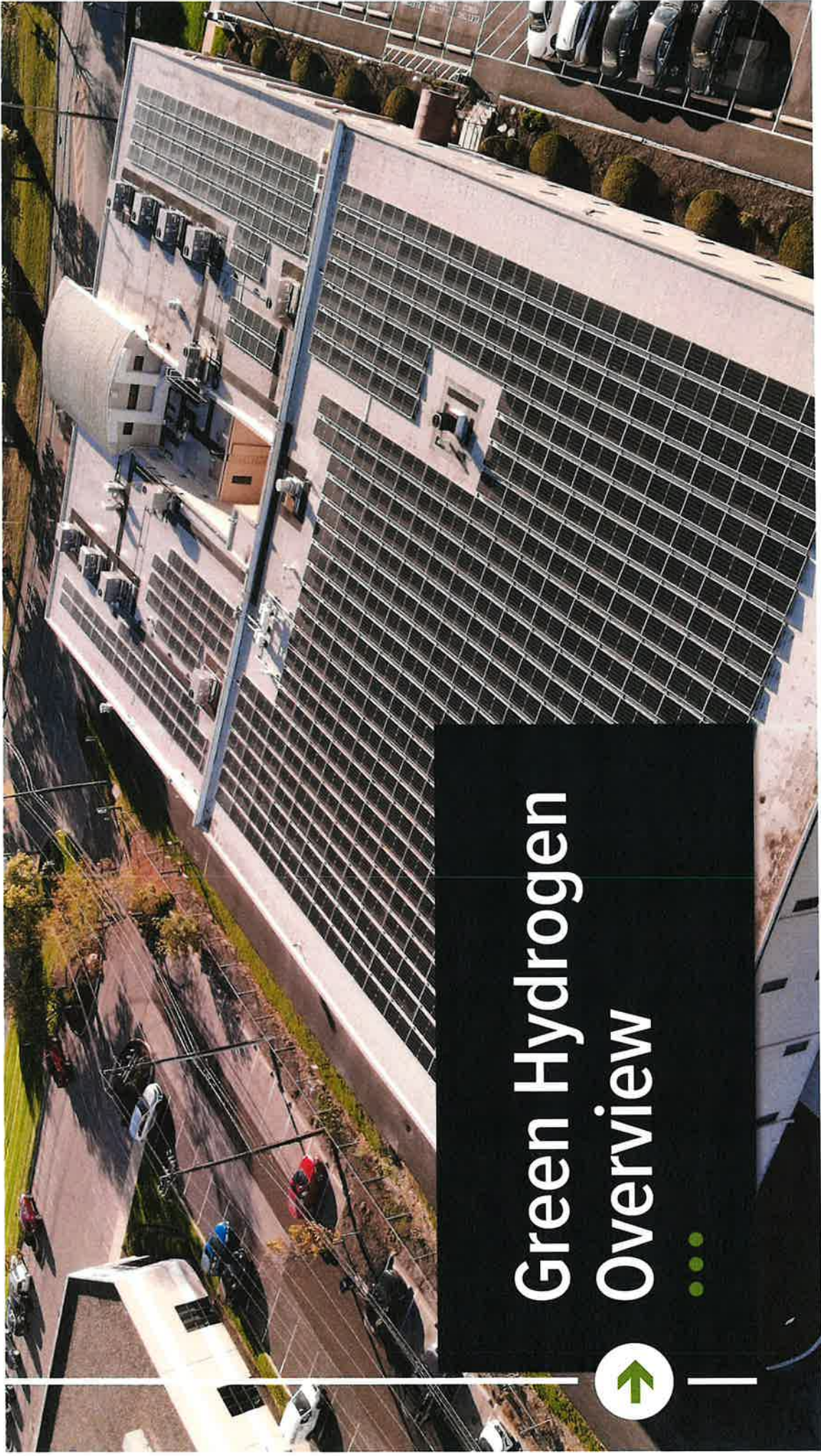
Sechi, Panwi, Raura
21 MW Small Hydro

Chilla Canal 25 KW
installed –
Hydrokinetic

Birsinghpur
2.5 MW – Small Hydro

BH1, BH2, Darna
51 MW



An aerial photograph of a large, modern building with a flat roof. A significant portion of the roof is covered with a grid of solar panels. The building is surrounded by a parking lot with several cars, some greenery, and a road. A black rectangular overlay is positioned in the lower right corner of the image, containing white text and a green arrow icon.

Green Hydrogen Overview



Hydrogen Facts

- ✓ Hydrogen is the **most abundant** element in the universe
- ✓ **90%** of all atoms in the universe are hydrogen
- ✓ It is the **lightest element** and when released, it dissipates rapidly into the atmosphere
- ✓ Hydrogen cars, trucks and trains have **zero carbon emissions**
- ✓ The by-product “exhaust” of a hydrogen fuel cell is water that is **clean enough to drink**

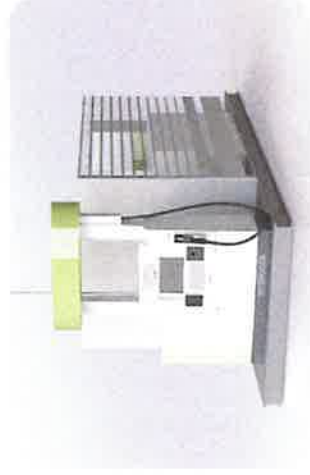
Types of Hydrogen Fuel

terminology	technology	feedstock/ electricity source	ghg footprint*
production via electricity	Electrolysis	Wind Solar Hydro Geothermal Tidal	Minimal
		Nuclear	
		Mixed-origin grid energy	Medium
production via fossil fuels	Natural gas reforming + CCUS Gasification + CCUS	Natural Gas Coal	Low
	Pyrolysis	Natural Gas	Solid Carbon (by-product)
	Natural gas reforming		Medium
	Gasification	Brown Coal (Lignite)	High
		Black Coal	

H2 Infrastructure Solutions



All-in-1 Dispensers
(electrolysis)



Dispenser
with
Gas/Liquid
supply

H3.5/H70 Dispenser Skid
Fast Fill

Various Supply
Options

- Delivered GH₂
- Mobile Pipeline
- On-Site GEN +
Compressor & Ground Storage
- Delivered LH₂ +
Dewar, Vaporizer & Cryopump



Hydrogen vs. EV

(Our Experience!)



	Electric Battery Vehicle	Hydrogen Fuel Cell Electric Vehicle
Range	200-300 miles	400+ miles
Cold Weather	Significant Range Impact	Limited Range Reduction
Energy Density	Poor	Hydrogen is roughly 3-4 times more energy dense per kilogram than lithium batteries
Idle Time	Batteries charge deplete over time	Hydrogen energy does not deplete over time
End of Life	Toxic materials hard to recycle	Less battery capacity to recycle
Duty Cycle	Great for low duty-cycle	High duty-cycle / high energy applications
Charging	Average electric car battery depleted – takes 8 hours to charge	Hydrogen car depleted takes 6 minutes to fill tanks

New Record Setting Hydrogen Truck!

New world record by traveling 1,806 miles
on a single fill of hydrogen fuel.



The truck completed its record-setting journey in California

Powered by a Cummins Accelerera fuel cell engine and a 250-kilowatt traction motor:

- » the truck carried **175 kilograms of hydrogen**;
- » **consumed 168 kilograms** while navigating rush hour traffic, between 50 to 55 mph, on public roads;
- » **operated in temperatures varying from 60 to 80 degrees Fahrenheit**

By using hydrogen in this type of truck—which is typically used in emergency response, military, and utility applications – can displace...

- ✓ approximately 1,825 gallons of fuel
- ✓ reduce greenhouse gas emissions by 2.5 metric tons annually



1st Private Company In Ohio Hydrogen Generation & Refueling Station for Corporate Fleet



Hydrogen Generation & Refueling Station

Installed solar
panels to produce
green electricity



Hydrogen Generation & Refueling Station

Installed solar
panels to produce
green electricity



Hydrogen refueling
station for vehicles
– can produce 20
kg per day



Hydrogen Generation & Refueling Station



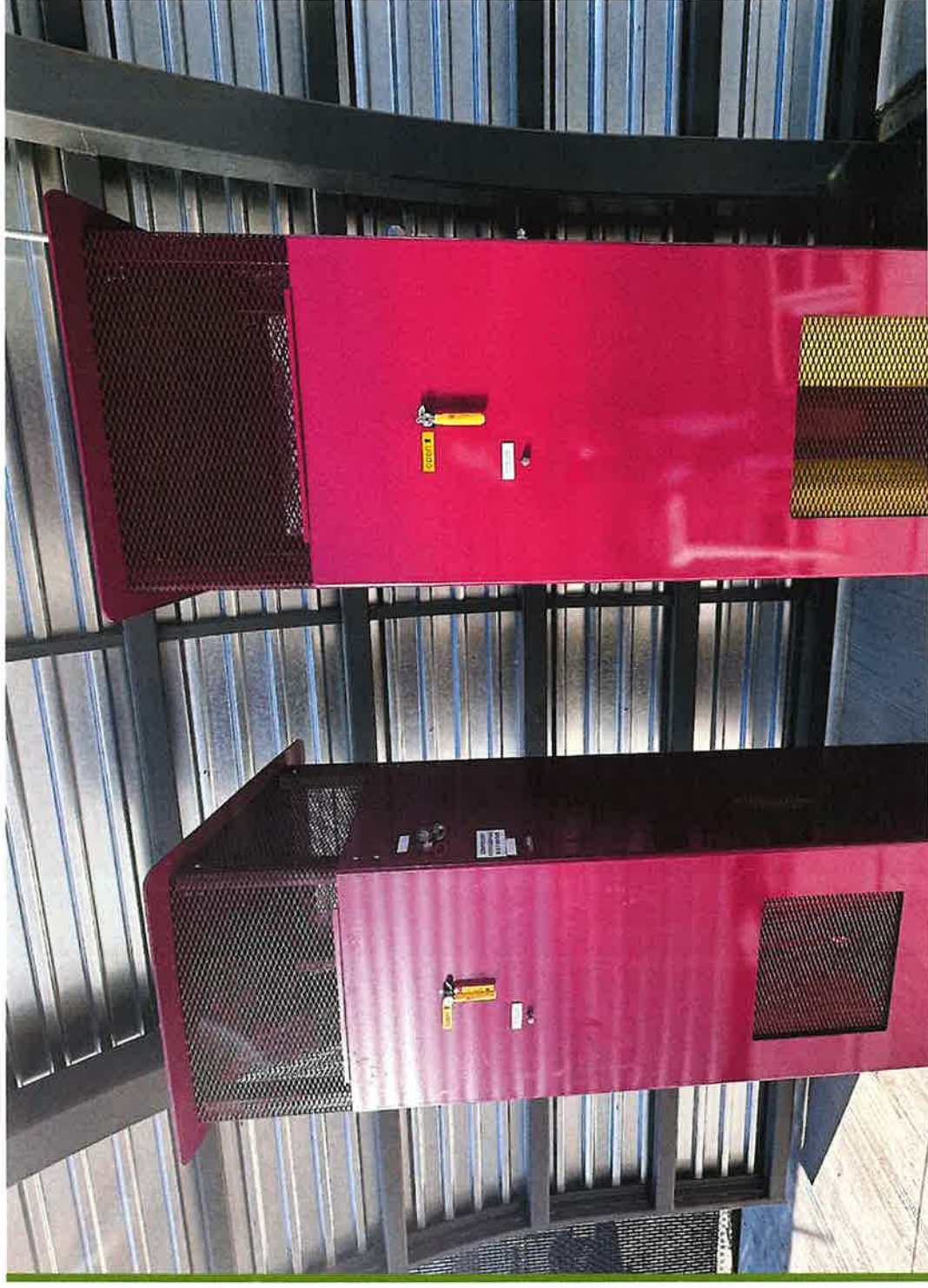
Installed solar
panels to produce
green electricity



Hydrogen refueling
station for vehicles
– can produce 20
kg per day



Hydrogen storage
up to 18 kg



Hydrogen Generation & Refueling Station



Installed solar
panels to produce
green electricity



Hydrogen refueling
station for vehicles
– can produce 20
kg per day



Hydrogen storage
up to 18 kg



Can support
10-15 vehicles



Project Challenges



Project Challenges

1

Supply Chain

- » Delays in pumps, compressors
- » Contractual issues w/Solar Installation

Project Challenges

1

**Supply
Chain**

2

**Local
Permitting**

- » Collaboration with local building code
- » Fire Protection
- » Structural Engineering (canopy, solar)
- » Signage

Project Challenges

1

**Supply
Chain**

2

**Local
Permitting**

3

**Grid
Interconnection**

» Net Metering Agreement
with Local Utility

Project Challenges



Project Summary



DLZ installed solar panels on its corporate office roof tops to generate clean energy



Installed a hydrogen generation/refueling station to produce hydrogen and refuel hydrogen fuel cell vehicles



Purchased six hydrogen fuel cell cars for its corporate fleet



Able to produce hydrogen for **\$12 / kilogram**

Hydrogen Transportation Related Funding Opportunities

Funding Opportunity

Clean Hydrogen Production
Tax Credit (45v)

Gives up to \$3 per kilogram of produced whose process significantly reduces life cycle greenhouse gas emissions

Hydrogen Fuel
Cell Vehicles

Up to \$7,500 for hydrogen fuel cell electric vehicles

Alternative Fuel Refueling
Property Credit

Tax credit up to 30% of the cost of alternative fuel refueling property up to \$100,000

Qualified Commercial Clean
Vehicle Credit

Up to 30% credit for commercial fuel cell electric vehicles through 2032 capped at \$40,000

Regional Hydrogen Hubs

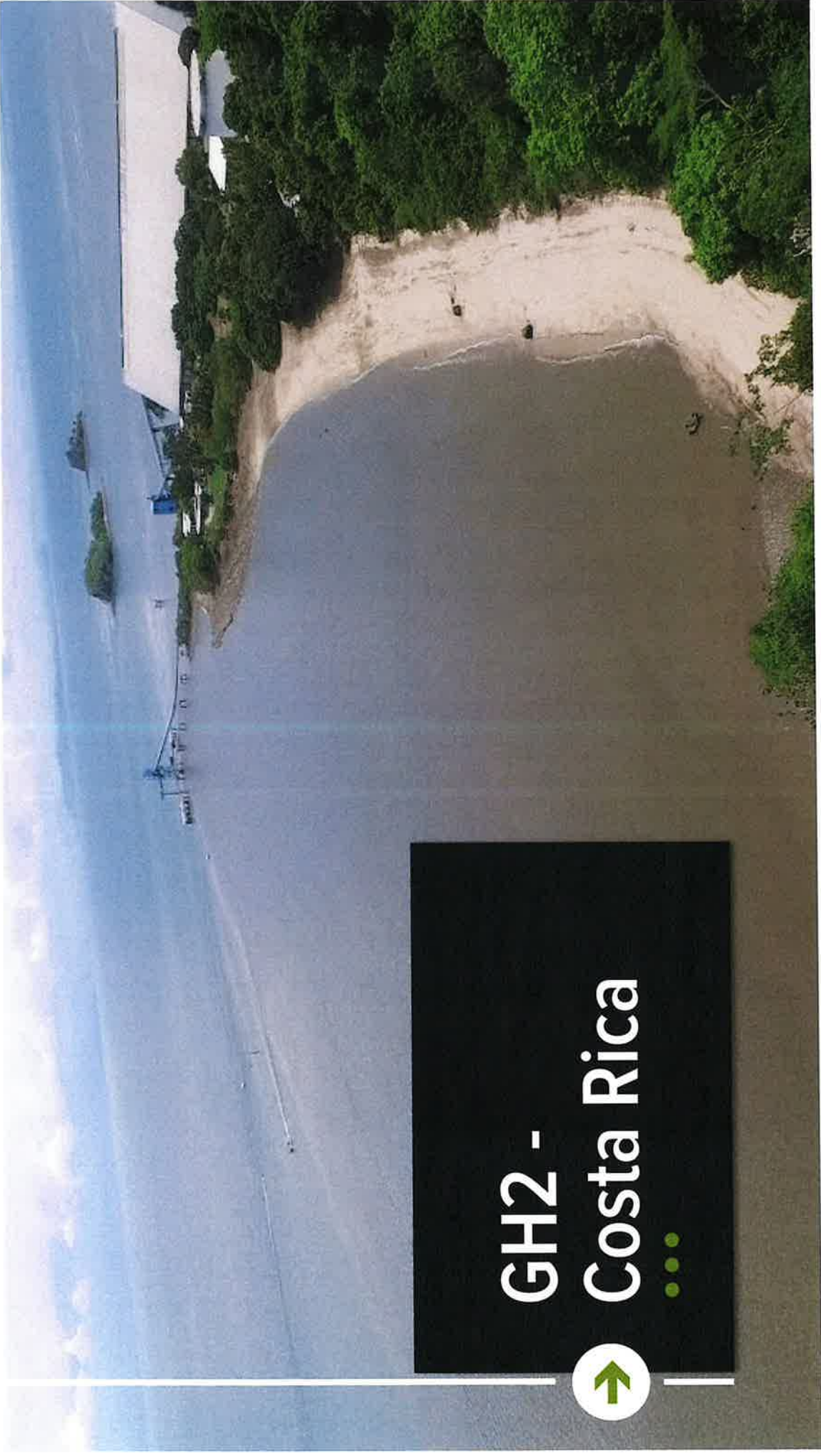
Hydrogen projects may be partially funded by the Regional Clean Hydrogen Hubs

Department of
Transportation

Charging at fueling infrastructure Discretionary Grant Program - Strategically deploying public accessible electric vehicle charging and alternative fueling infrastructure in the places people live and work.

Department of Energy

DOE Hydrogen and Fuel Cell Technologies Office (HFTO) will administer this (NOFO) Notice of Funding Opportunity Focusing on: Domestic hydrogen fuel cell electric motorcoach bus development and demonstration



GH2 - Costa Rica

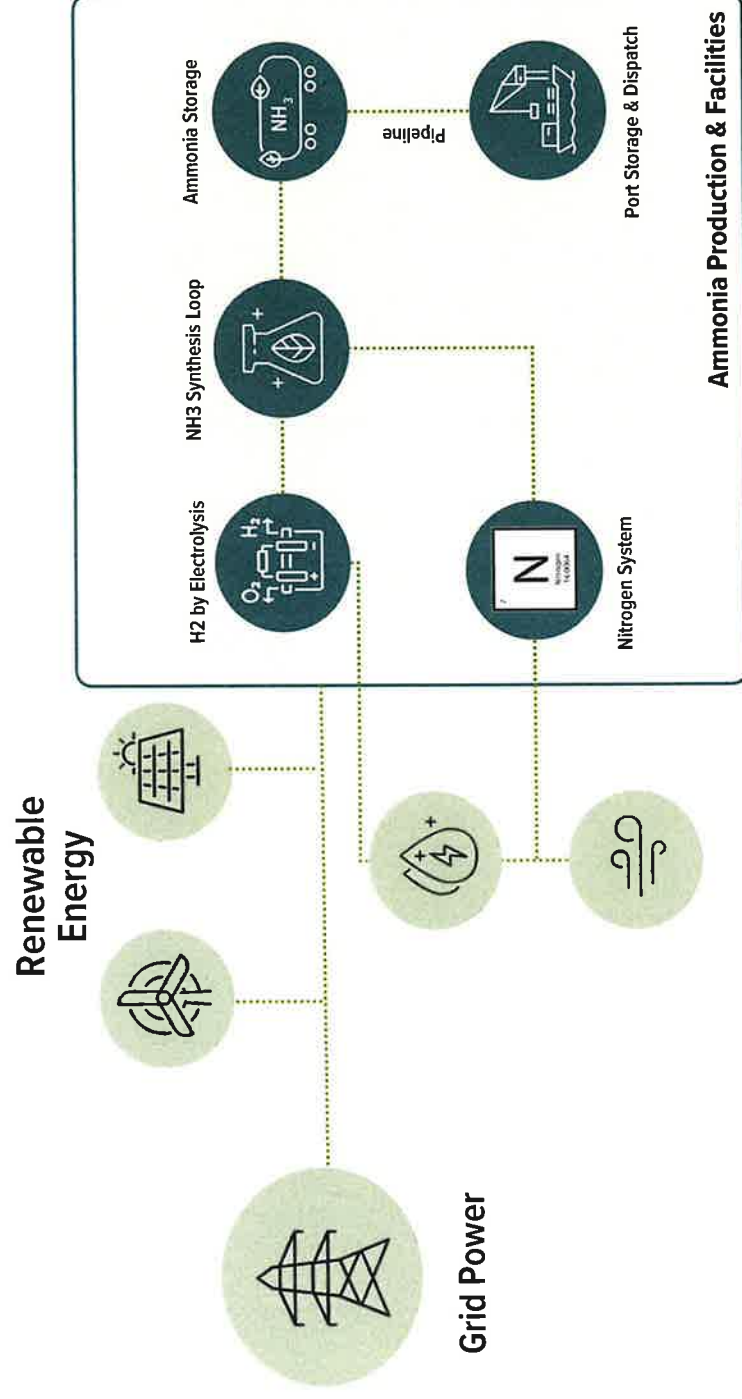


Project Overview



- » GH2 is a proposed green ammonia plant in Costa Rica
- » Target production of approximately 1,200 metric tons per day of green ammonia, aimed at both local and international markets.
- » Green hydrogen will be produced via water electrolysis in 500 MW alkaline electrolyzers. Nitrogen, extracted from air through an air separation unit, will combine with hydrogen in an ammonia loop to create anhydrous ammonia.
- » 1.3 GW of solar energy and 250 MW of wind energy will power the electrolyzers and ammonia production.
- » Any additional power requirements will be met through a PPA with the national utility, which sources 98% of its energy from renewable resources.
- » The solar facility will be co-located with the ammonia loop, while the wind farm, situated 80 km north due to optimal wind conditions, will connect to the site via an existing transmission line. This solar-wind mix optimizes capital costs, energy generation, and tariff efficiency.
- » Ammonia will be transported through a 6-kilometer pipeline alongside a national road to the nearby Punta Morales port for export, including access to the Atlantic via the Panama Canal.

The Process



Project Highlights



Resource Abundance

Strategically positioned solar and wind projects will supply the majority of the project's power needs.



Green Energy Matrix

Costa Rica's energy matrix is predominantly renewable, led by hydroelectric power



Governmental Support

Costa Rica's government has endorsed the green H₂ and ammonia production sector, with only two companies, including DLZ, developing such projects



Strong Market Demand

The global ammonia market, valued at USD 205.34B in 2022, is projected to grow at a CAGR of 5.4% through 2030. The green ammonia market, estimated at USD 300M, is expected to reach USD 17.9B by 2030, with a CAGR of 72.9%, driven by eco-friendly fertilizer demand and maritime decarbonization.



Job Creation

The project will generate construction jobs & highly skilled operational jobs. Follow up expansion phases are expected to generate additional construction jobs



Proximity to Off-takers

Costa Rica's location provides strategic access for exporting green hydrogen and ammonia to Europe and Asia.



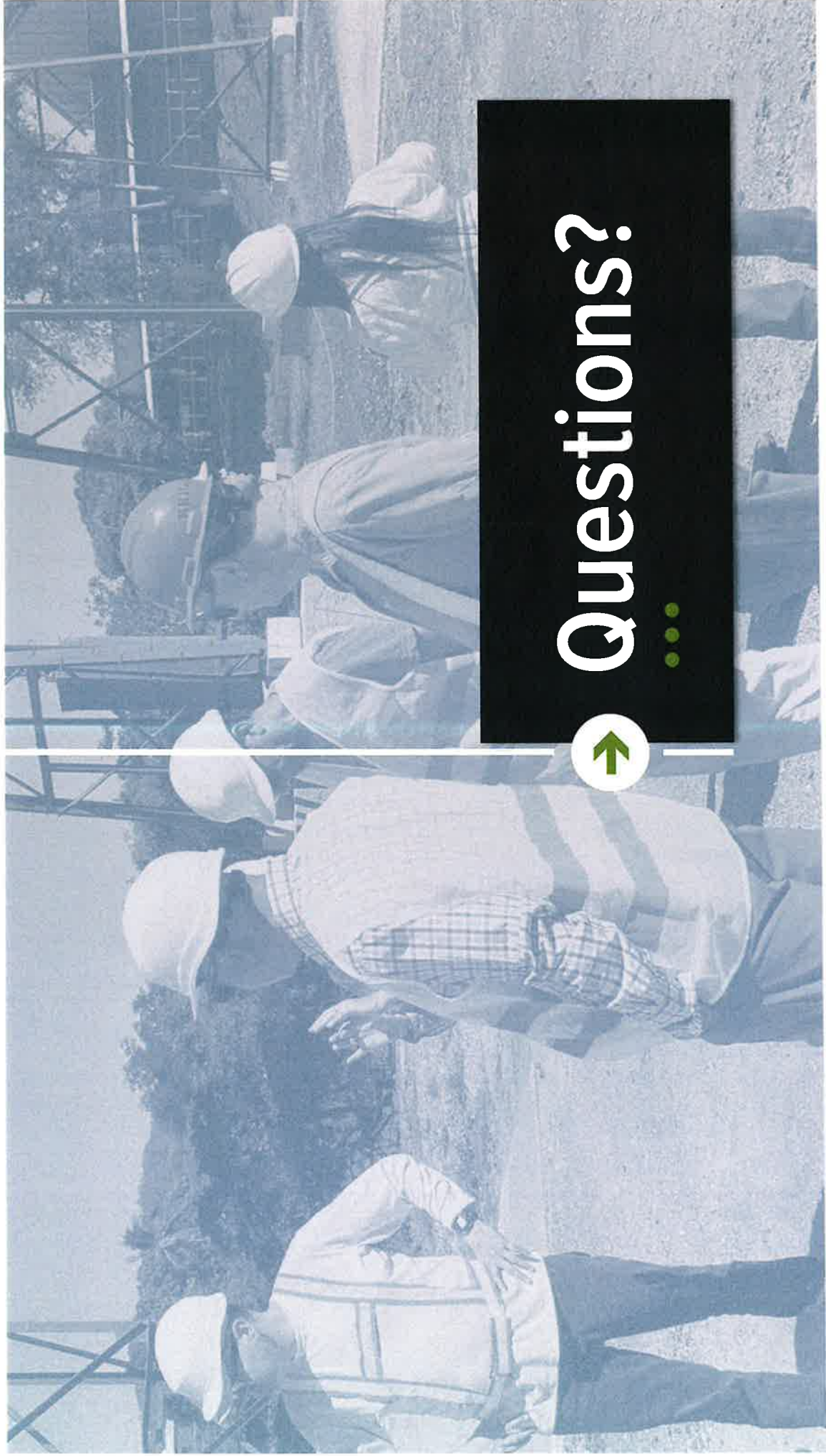
Free Trade Zone

DLZ is securing a free trade zone status in Costa Rica, granting substantial tax benefits for an initial 15-year period, renewable. The free trade zone regime represents 15% of Costa Rica's GDP.



Existing Infrastructure

DLZ will leverage the existing port facility at Punta Morales. This established infrastructure minimizes the need for significant upgrades, enabling a streamlined adaptation for green ammonia export.



Questions?

