MINIJOS NAFTA CLEAN POWER PROJECT

INNOVATION FUND WORKSHOP

19 SEPTEMBER

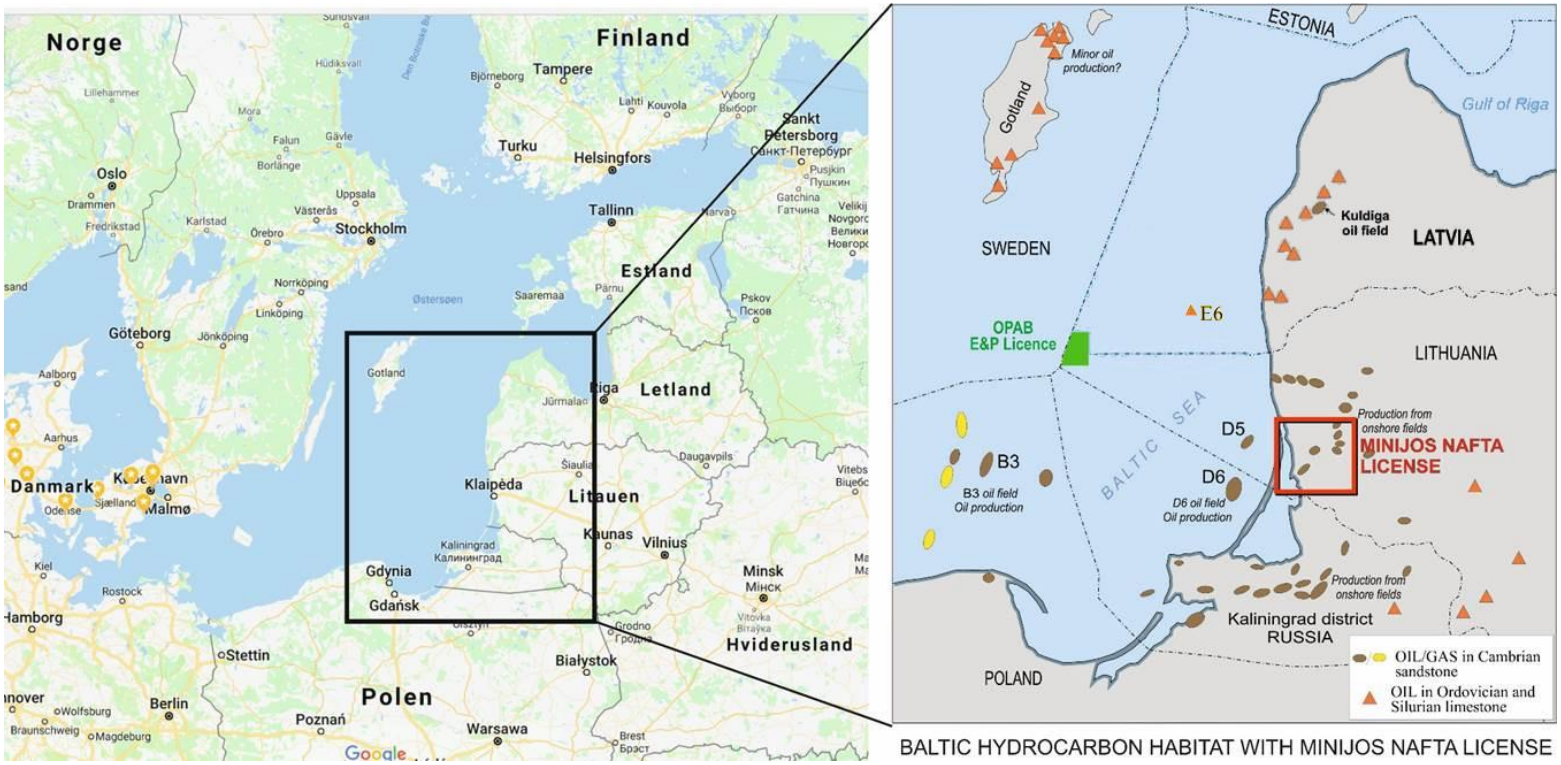
BRUSSELS

The Project

- ✓ Build an Allam cycle power plant in western Lithuania
- ✓ Capture the CO2
- ✓ Use the CO2 for EOR (Enhanced Oil Recovery)
- ✓ Recycle and permanently sequester CO2
- ✓ Provide a storage site for other major GHG emitters in Lithuania

Minijos Nafta License Area

- Infrastructure is already in place.
- Access to major natural gas trunk (~5 km connection) line and high voltage transmission line.
- Oil field suitable for CO_2 EOR identified. Close to shipping port and refining facility.



BALTIC HYDROCARBON HABITAT WITH MINIJOS NAFTA LICENSE

Approximately 880 sq. km

- **Access to major natural gas trunk (~5 km connection needed) line and high voltage transmission line**
- **Oil field suitable for CO_2 EOR identified (30 – 40 km CO_2 pipeline required)**
- **Nearness to shipping port and refining facility**

Major electrical (yellow) and gas pipelines (red)

MINIJOS NAFTA

The supercritical CO_2 Allam Cycle is simple

Historically, CO_2 capture has been expensive, whether using air combustion or oxy-combustion

Air combustion:

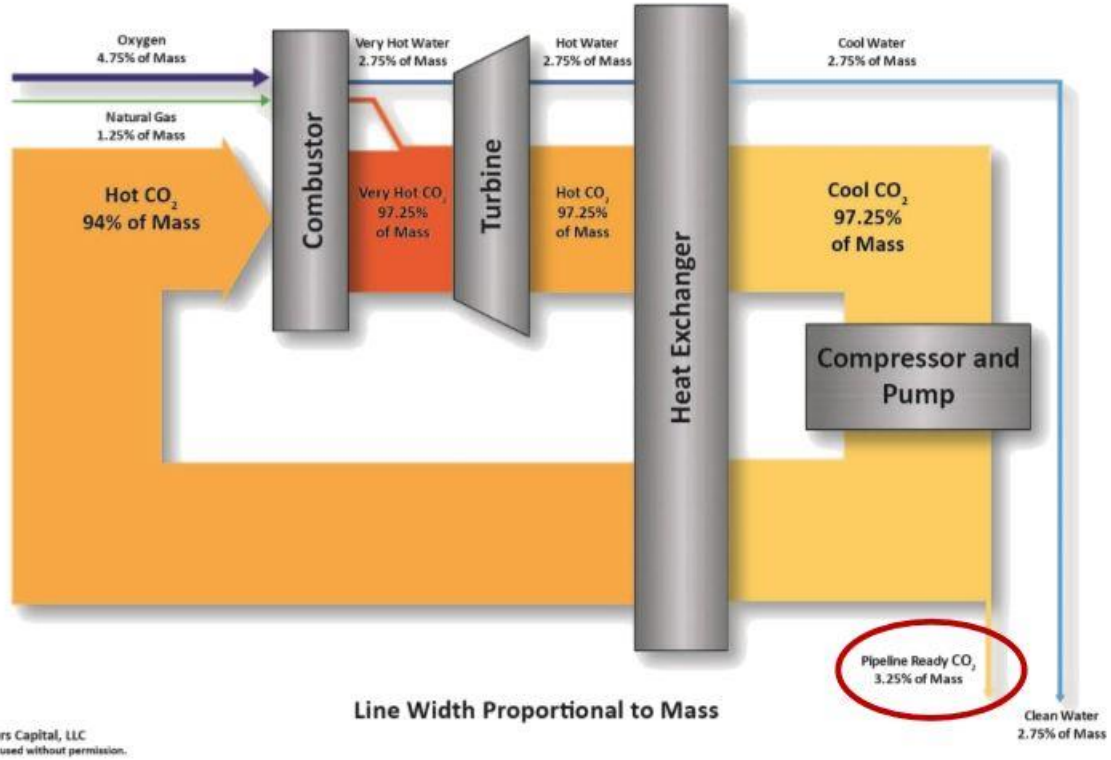
$$\underbrace{8N_2 + 2O_2}_{air} + CH_4 \rightarrow \underbrace{8N_2 + CO_2}_{expensive\ to\ separate} + 2H_2O$$

Oxy-combustion:

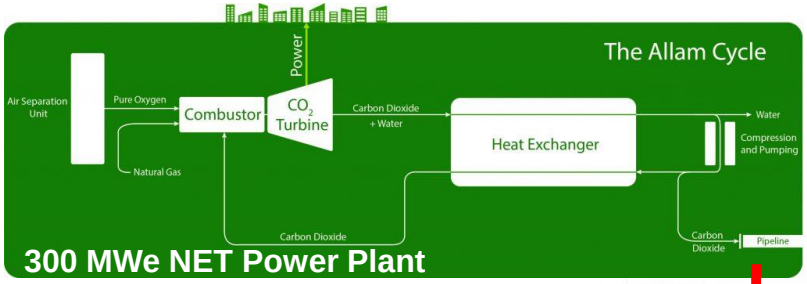
$$\underbrace{2O_2}_{expensive\ to\ produce} + CH_4 \rightarrow CO_2 + 2H_2O$$

The Allam Cycle makes oxy-combustion economic by:

1. Relying on a more efficient core power cycle
2. Recycling heat within the system to reduce O_2 and CH_4 consumption, and associated costs of the air separation unit (ASU)

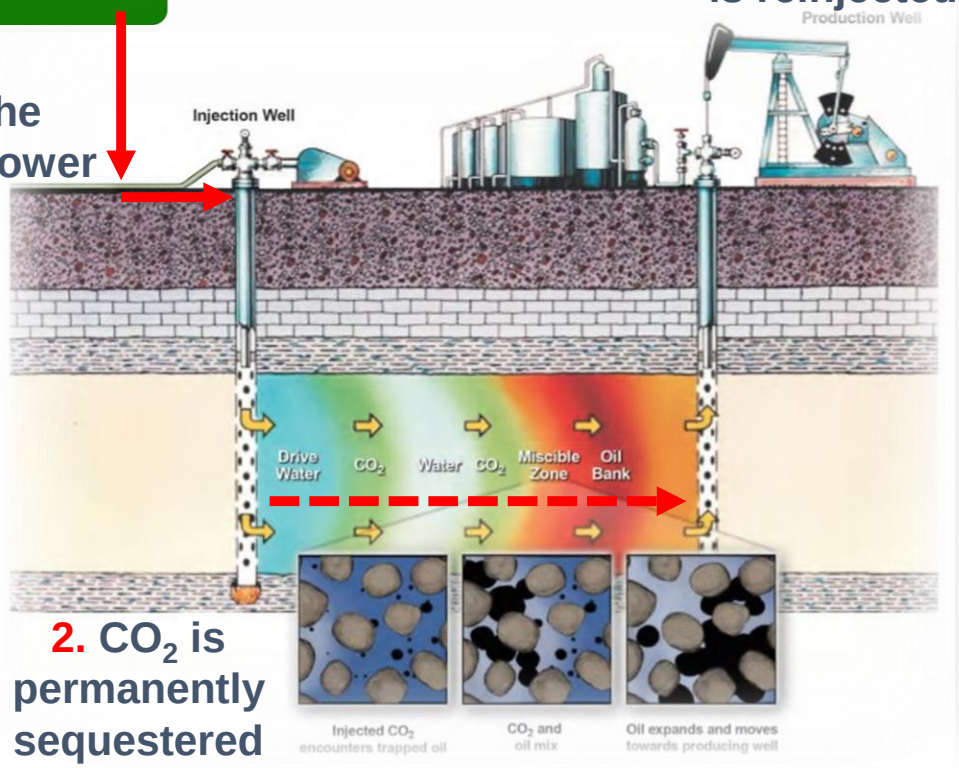


Carbon Capture & Storage - CO_2 Injection Process



1. CO_2 from the NET Power Plant

3. Recovered CO_2 is reinjected



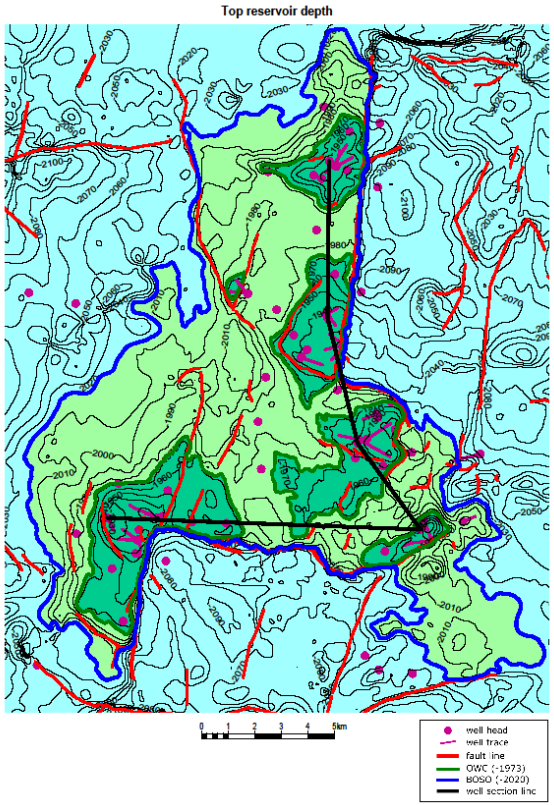
2. CO_2 is permanently sequestered

Eliminate 30 million tons of CO_2 emissions. Provide additional CO_2 storage capacity allowing the 5 biggest emitters in Lithuania to sequester their emissions (5M - 6M tons CO_2 / year)

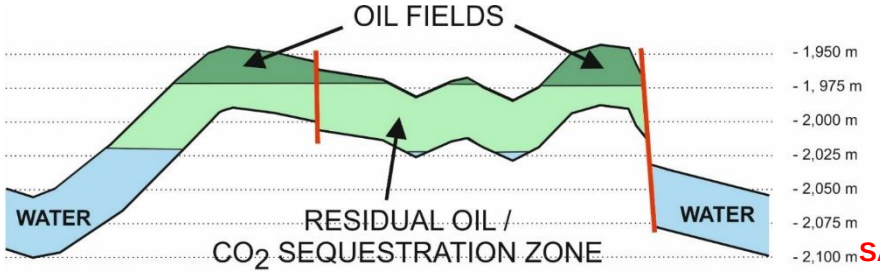
The Oil Fields and ROZ

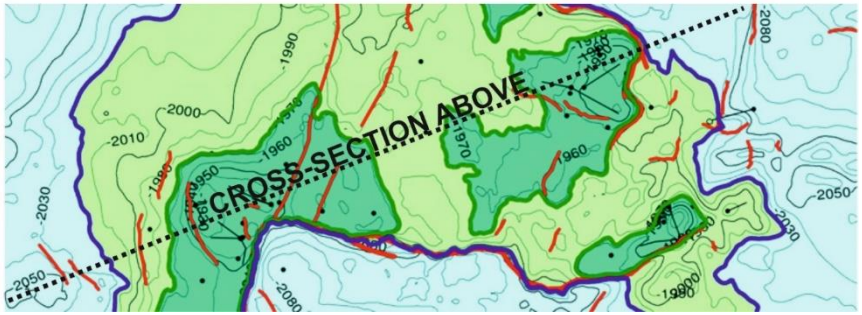
Additional Injection and Oil Recovery area in Light Green

- Total area for CO_2 storage is over 245 square km (Blue Outline).
- The increased Oil recovery using CO_2 is in the order of 145 Million Barrels of Oil.
- Capacity to sequester more than 250 million tons CO2



Top of the Injection Reservoir





The lower unproduced Residual Oil Zone has considerable oil saturation (40 to 60%) that can be recovered with CO_2.

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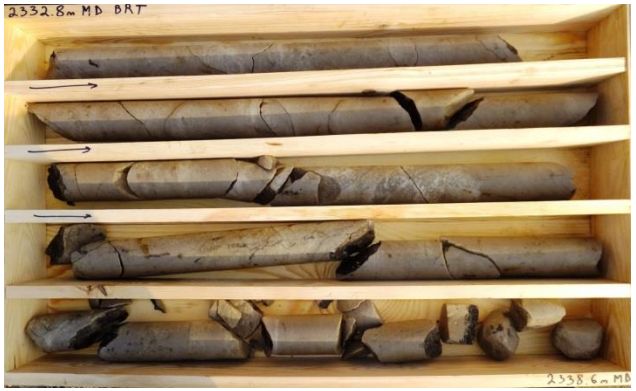
CO2 Injection Test Within the ROZ

Well Core within the ROZ and CO2 Injection Equipment



Well was drilled and completed only within the ROZ

Initial production produced only water

After injection of CO2 in the ROZ produced oil

IT DOES WORK

MOU Signed for Clean Power project in Lithuania

Build a NET Power emissions-free gas fired electric power plant in Lithuania which would:

- ✓ Sequester 30 million tons of CO_2 emissions. Provide additional storage capacity for CO_2 allowing the 5 biggest emitters in Lithuania to sequester their emissions (5M - 6M tons CO_2 / year)
- ✓ Activate the **largest private investment ever** in Lithuania
- ✓ **Replace 50% of electricity imports,** greatly enhancing Lithuania's **energy independence** (providing 33% of Lithuania's electricity needs)
- ✓ **Lower the cost of electricity and natural gas**
- ✓ Utilize the **LNG import** terminal to import an additional **484M Nm^3 gas annually**
- ✓ **Enable the production of 100-150 million barrels oil by using CO2 for EOR and permanent sequestration of 200 million tons CO2**

From L to R: Damian Beauchamp (Chief of Staff, 8 Rivers), Žygimantas Vaičiūnas (Lithuanian Energy Minister), Dan R. Brouillette (U.S. Dep. Sec. of Energy), and Bill Brown (CEO, NET Power)

Memorandum of Understanding toward NET Power project in Lithuania signed between NET Power, 8 Rivers, and the Lithuania Ministry of Energy at CERA Week in Houston, TX on March 14, 2019. Signing observed by United States Deputy Secretary of Energy, Dan R. Brouillette.

Project Key Features

- ✓ The innovative part of this project is the Allam cycle power plant and combining this with EOR in the EU
- ✓ CAPEX is around EUR 800 million, sale of electricity pays operating costs, additional annual value of industrial gas—200 million, oil—250 million, ETS—30 to 200 million
- ✓ Permanently sequester up to 200 million tons CO2
- ✓ Pre-FEED, FEED, CCS/EOR study to be complete end 2022, FID in 2023, project operation 2026
- ✓ Project is dependent on suitable legislation in Lithuania and granting of a CCS license to Minijos Nafta

Executive Summary

THIS A PROJECT THAT WILL WORK. ALL ELEMENTS HAVE BEEN TESTED.

IT IS READY TO BE IMPLEMENTED IMMEDIATELY.

DEMONSTRATE A BUSINESS MODEL FOR CCS WHICH CAN EASILY BE REPLICATED THROUGHOUT EUROPE