



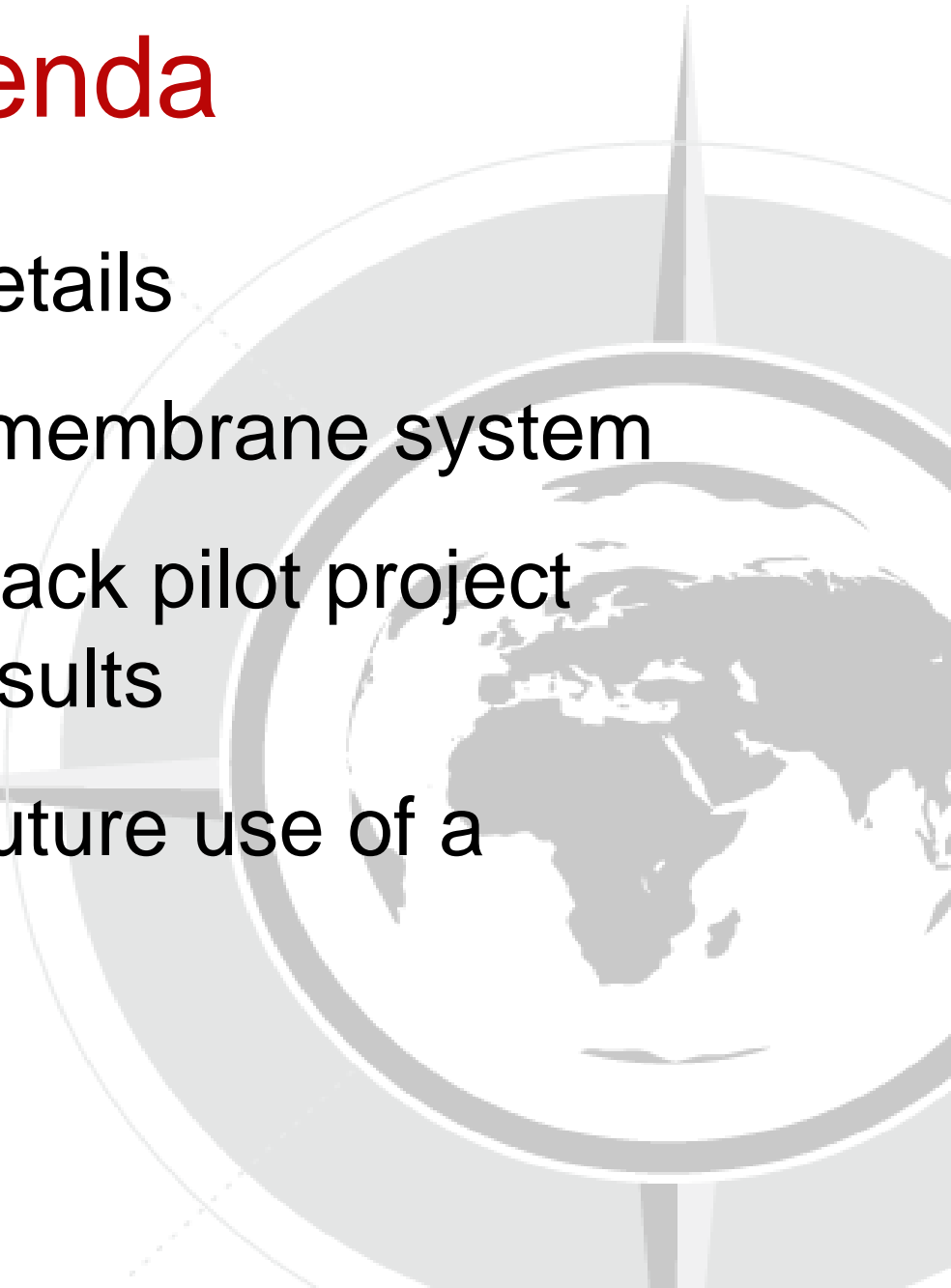
Reducing Vented Flowback Emissions from CO₂ Fractured Gas Wells Using Membrane Technology

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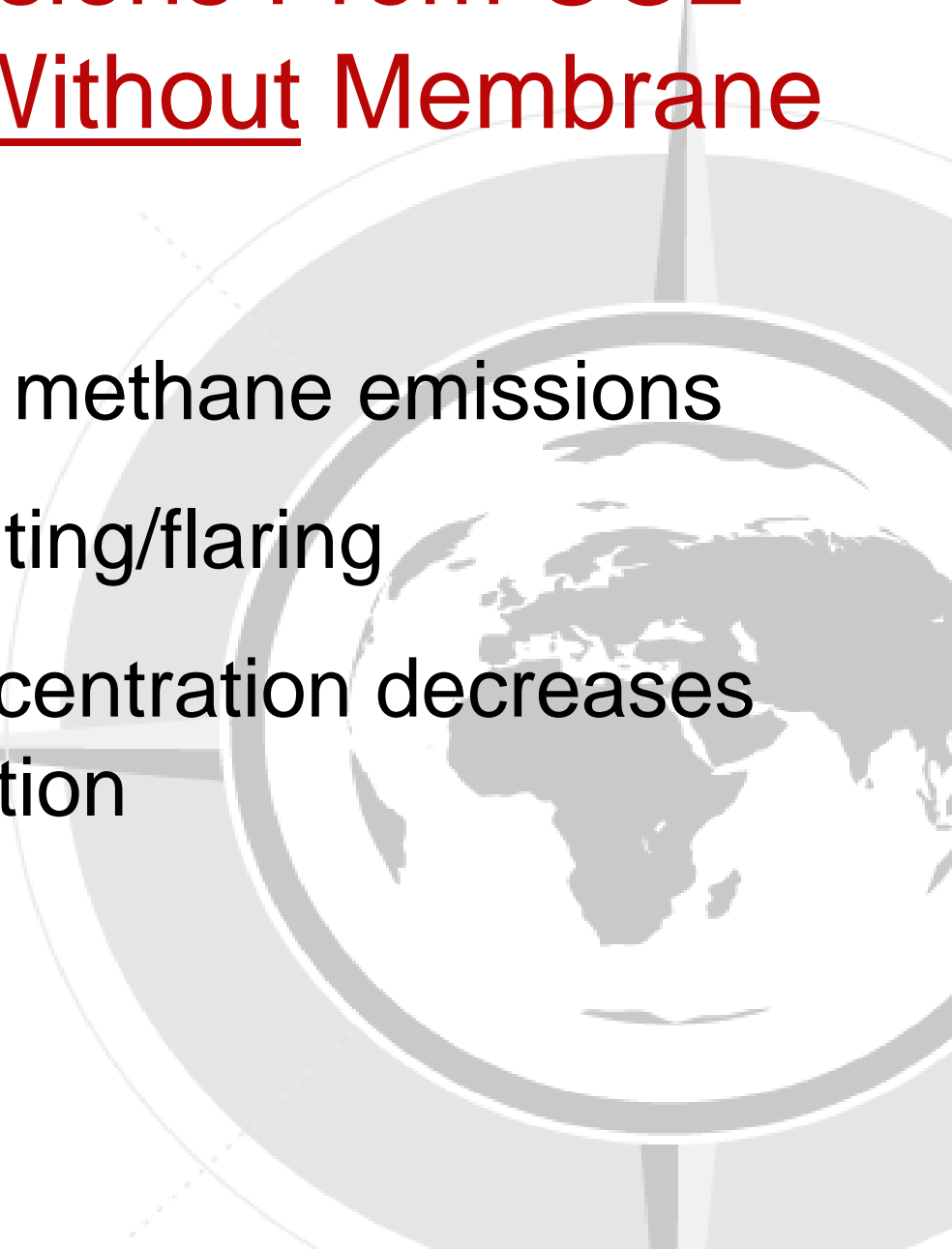
Agenda

- General flowback details
- Benefits of using a membrane system
- Noble's green flowback pilot project assumptions and results
- Factors that affect future use of a membrane system

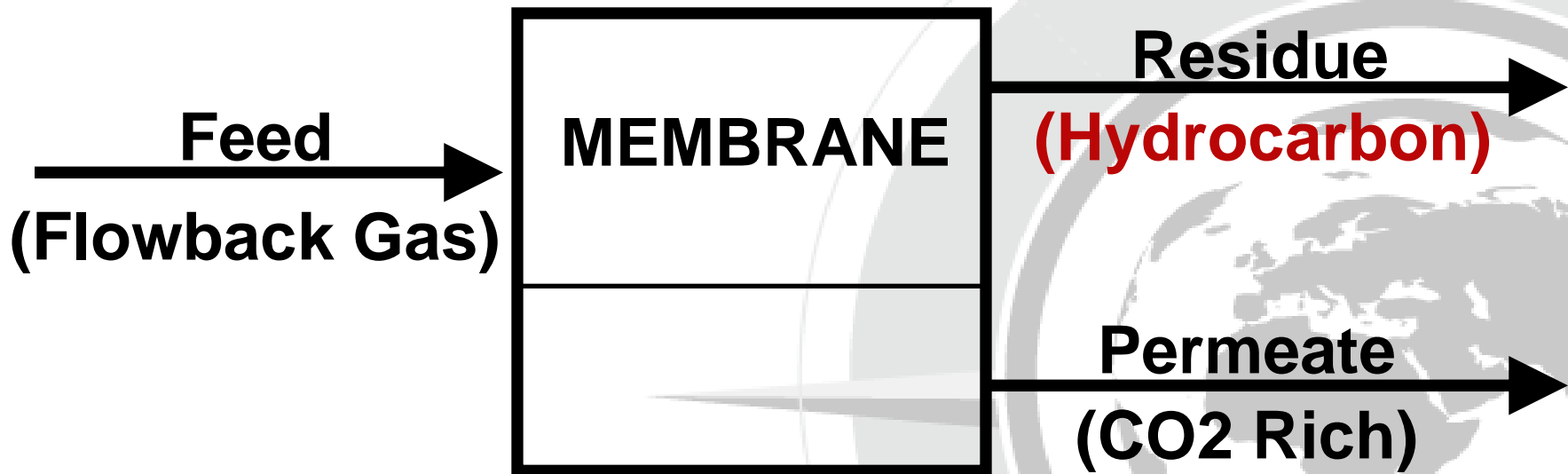


Flowback Emissions From CO2 Fractured Well: Without Membrane

- Mixture of CO2 and methane emissions
- Multiple days of venting/flaring
- Sold once CO2 concentration decreases to pipeline specification

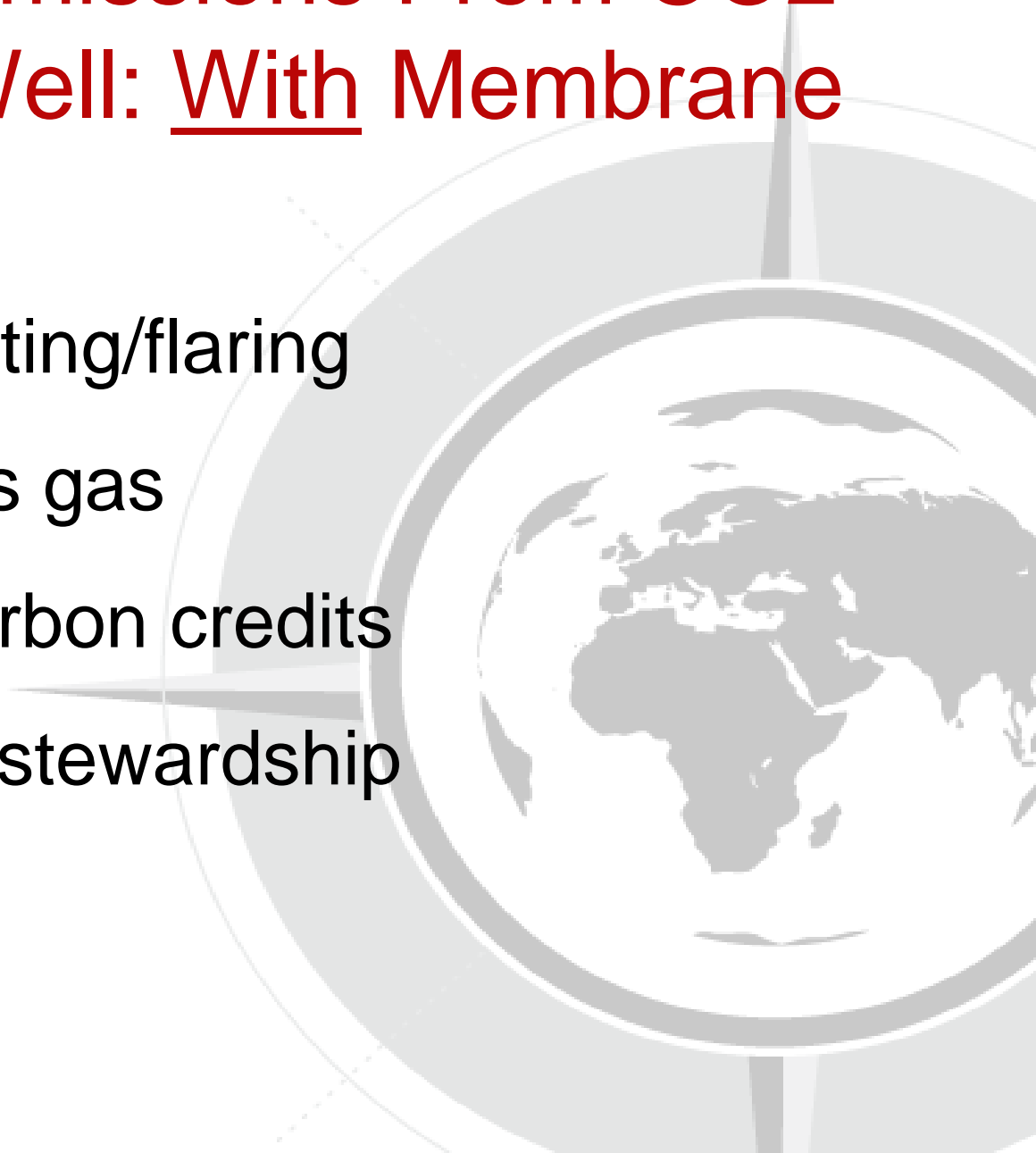


Membrane Separation Process



Flowback Emissions From CO₂ Fractured Well: With Membrane

- Decreased venting/flaring
- Increased sales gas
- Potential for carbon credits
- Environmental stewardship



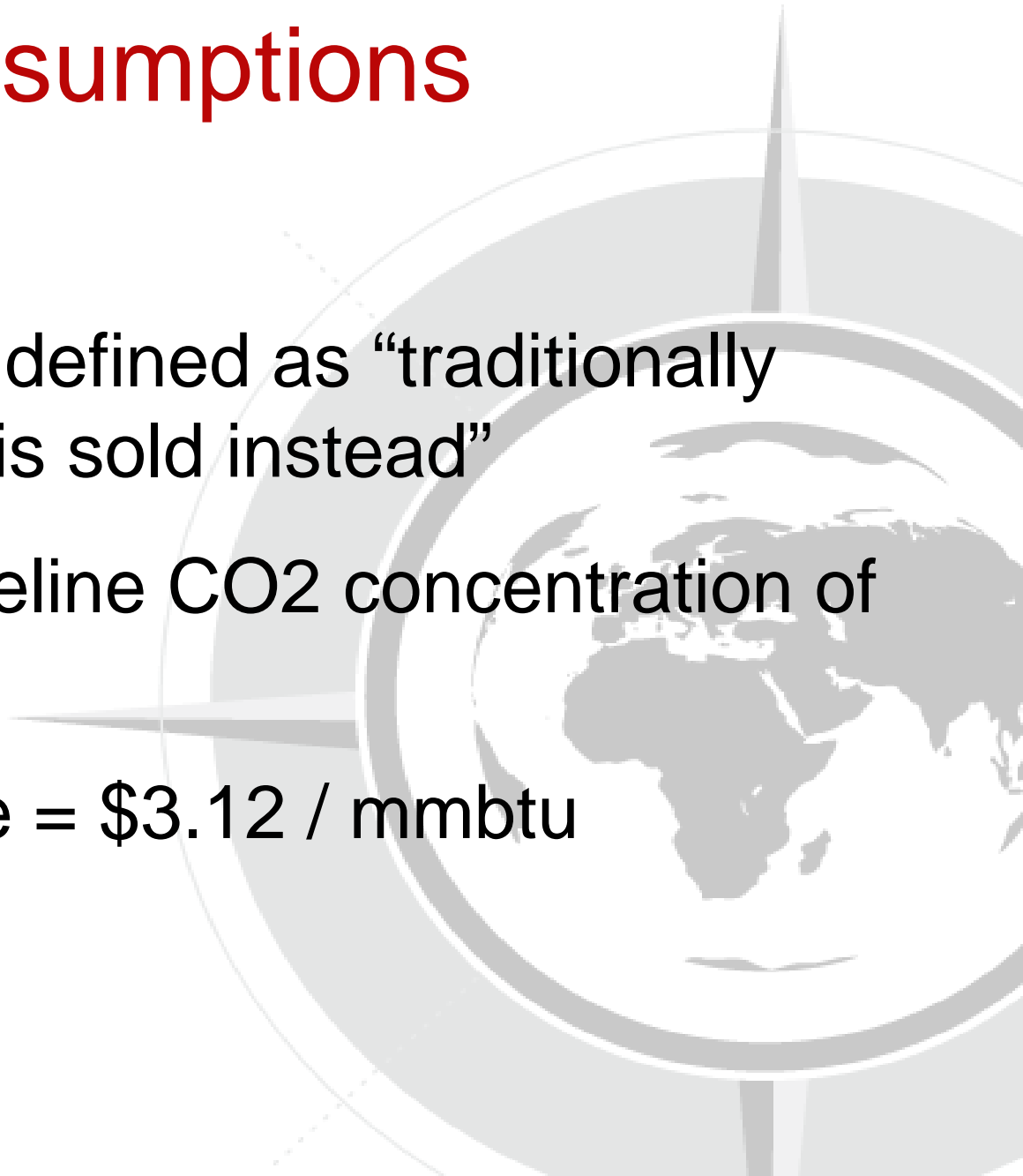
Portable Membrane System



CO2 separation unit

Assumptions

- Gas savings is defined as “traditionally flared gas that is sold instead”
- Acceptable pipeline CO₂ concentration of 4%_v
- Gas sales price = \$3.12 / mmbtu



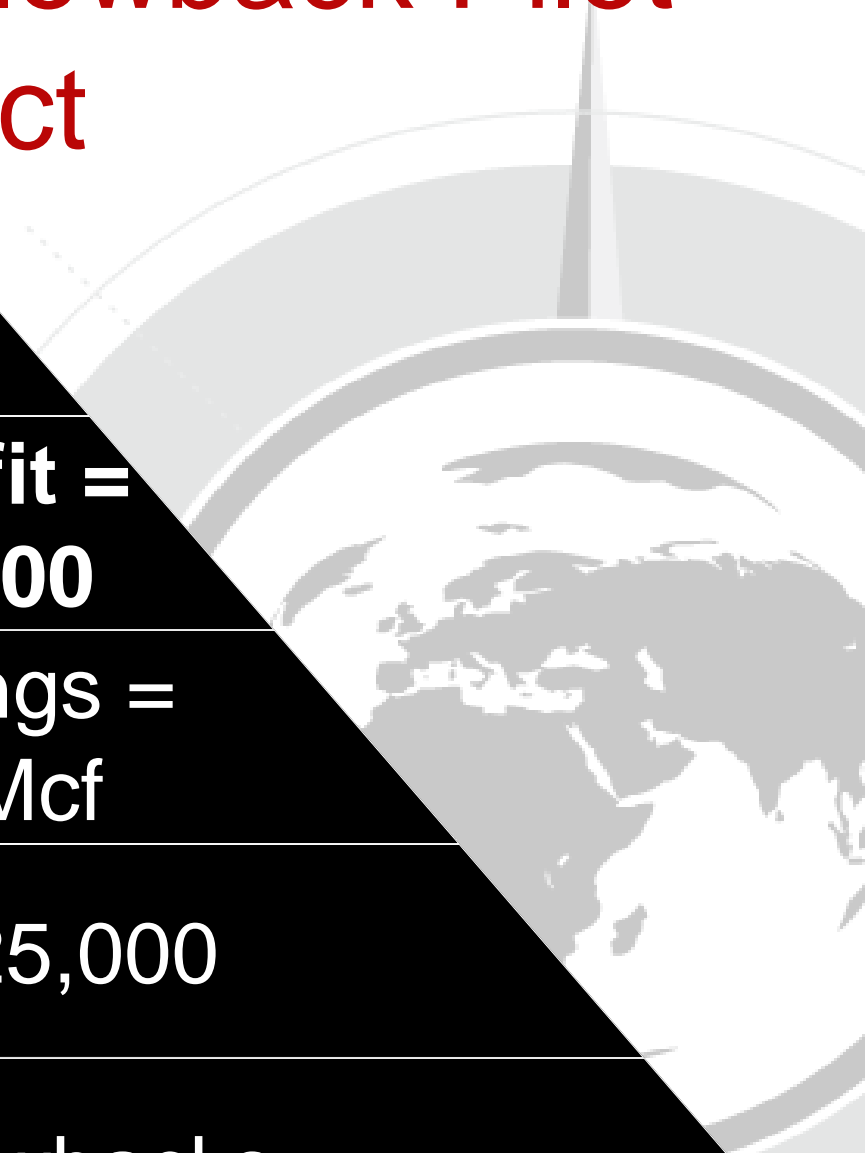
Noble's Green Flowback Pilot Project

**Net profit =
\$340,000**

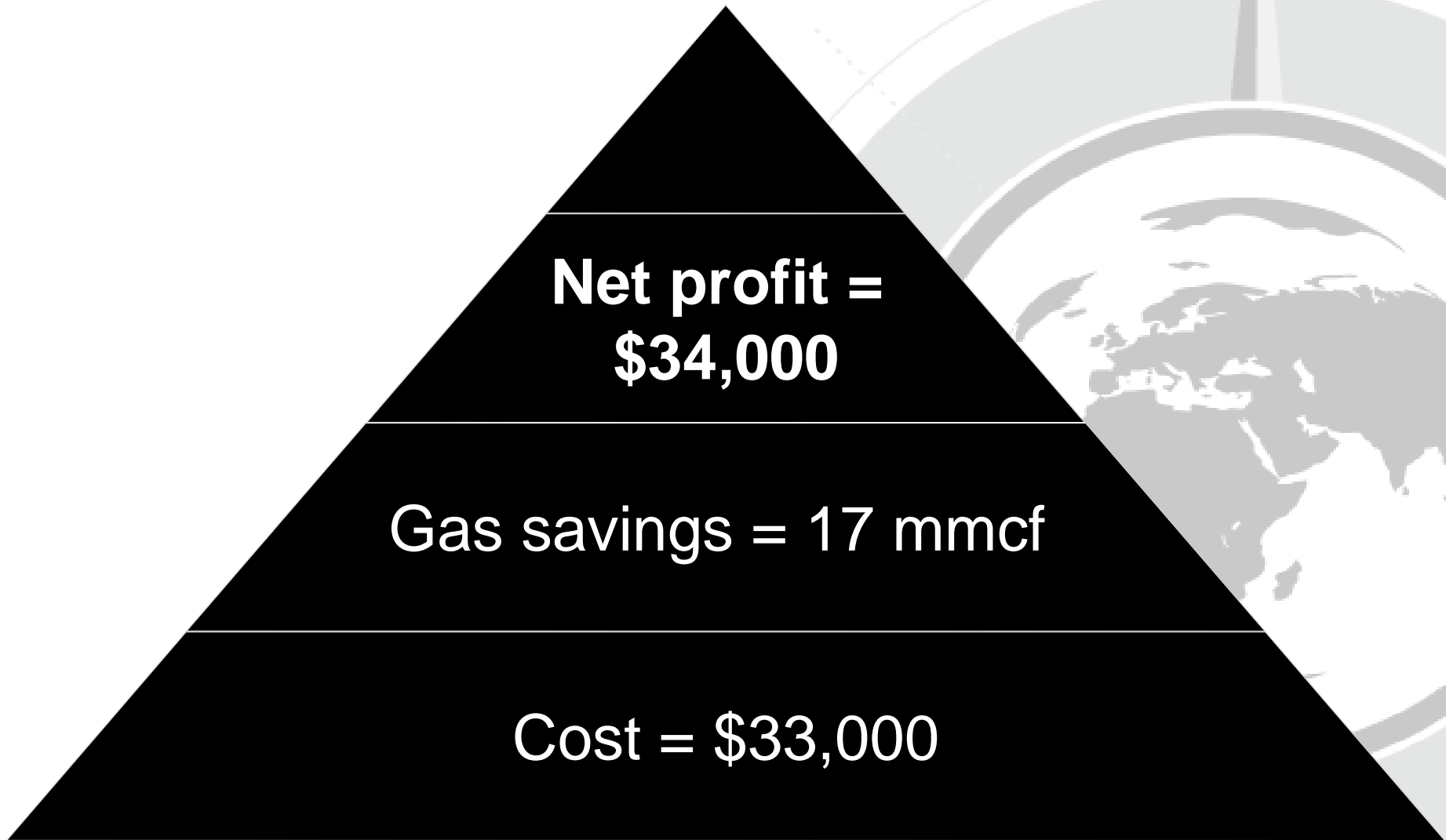
**Gas savings =
170 MMcf**

Cost = \$325,000

10 Noble flowbacks



Noble's Green Flowback Pilot Project – Average Per Flowback



Potential For Carbon Credits

$$\text{Potential Carbon Credits} = \text{Flowback Emissions} - \text{Flowback Emissions Without Membrane}$$

$$\text{Flowback Emissions With Membrane} = \text{Gas Savings}$$

1300 to 5300 tonnes CO₂eq earned per flowback

Many Factors Affect Future Membrane Use

- Commodity prices
- Rental cost
- Availability of unit
- Ability to improve logistics
- Ability to comingle flowbacks from multiple wells



Questions



Colorado Platteville TriState