CLIMATE ACTION RESERVE

GHG Emission Reduction Quantification on Farms and Ranches:

The Offset Registry Perspective

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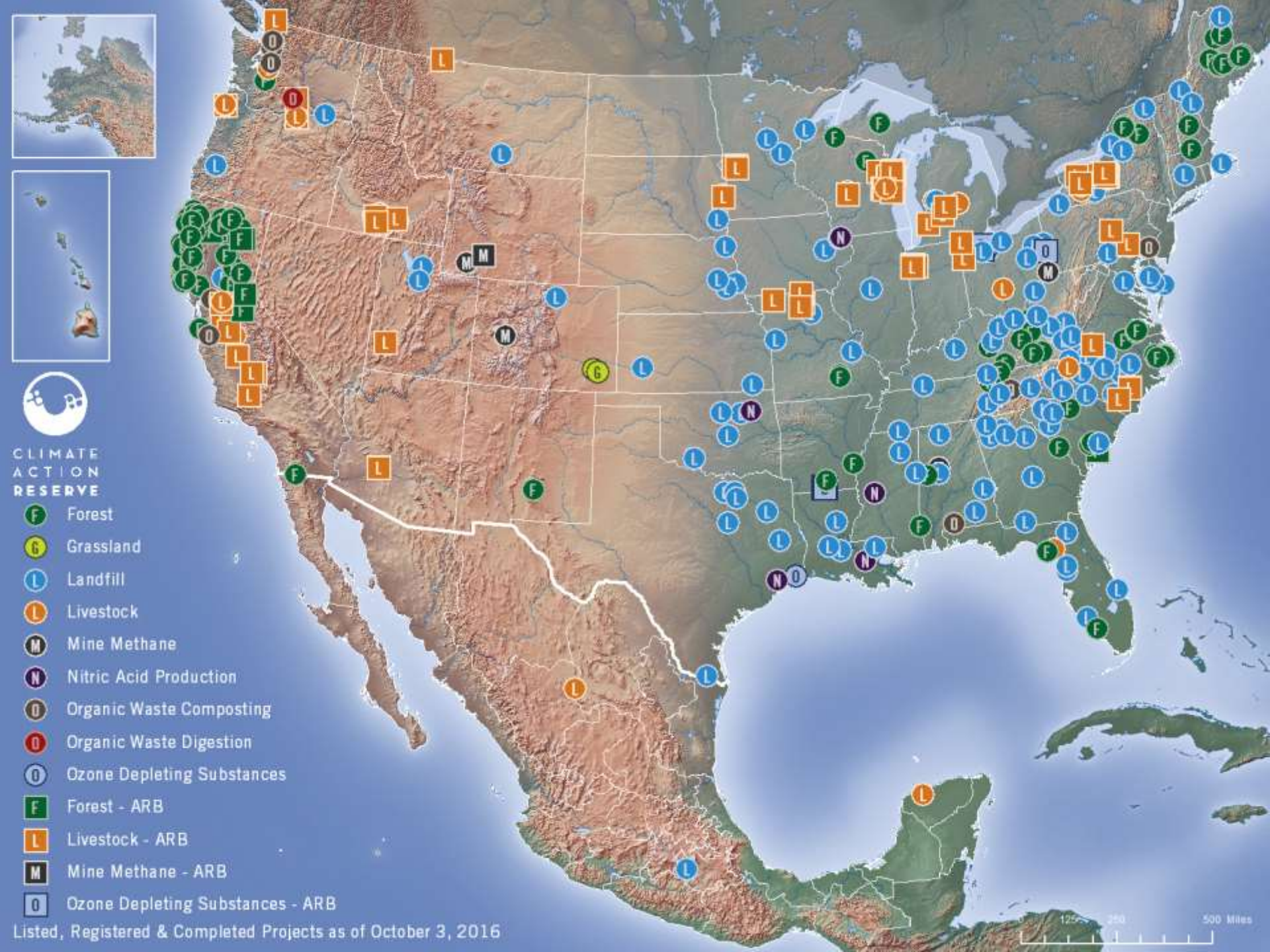
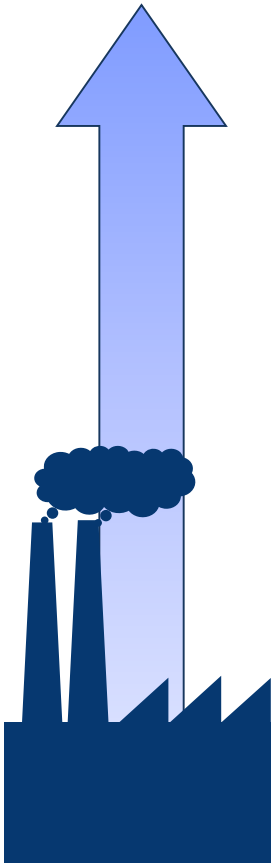
Climate Action Reserve

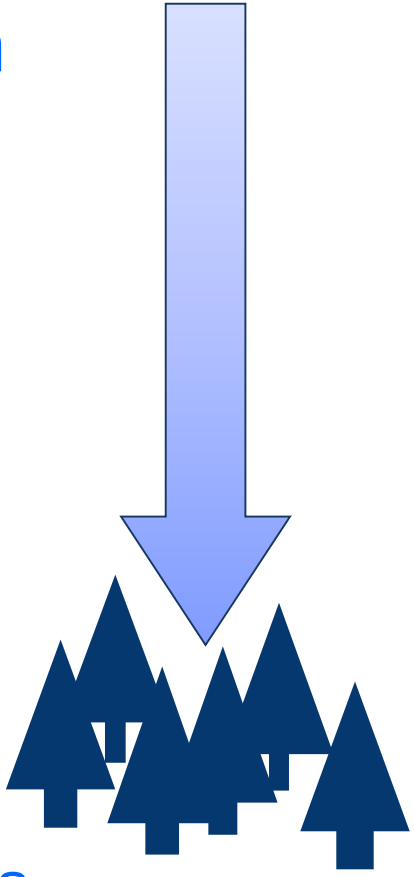
- Largest, most trusted carbon offset registry in North America
  - 85+ Million offset credits issued
  - Approximately 400+ projects in our system, including 170+ ARB Compliance Offset Projects
- Collaborative and Inclusive
  - Work with industry, government, environmental, and academic sectors in open, transparent workgroups when developing protocols
  - Aim to create protocols that are robust, rigorous, accurate, usable, and standardized


CLIMATE ACTION RESERVE
Forest
Grassland
Landfill
Livestock
Mine Methane
Nitric Acid Production
Organic Waste Composting
Organic Waste Digestion
Ozone Depleting Substances
Forest - ARB
Livestock - ARB
Mine Methane - ARB
Ozone Depleting Substances - ARB
Listed, Registered & Completed Projects as of October 3, 2016
125
250
500 Miles

What is a (Carbon) Offset?



- Voluntary emission reductions in sectors without GHG regulation
- Buyers seek to offset their own emissions
  - Driven by both voluntary and compliance purposes
- 1 credit = **1metric ton CO_2e**
  - Focus on GHG reductions
  - Other positive ancillary co-benefits



Overview of Registry and Agriculture Protocol Landscape

- 3 Registries each with their own protocols
  - CAR (“the Reserve”), ACR, VCS
- 1 Compliance market (CA) with its own protocols
- 19 total agricultural protocols for the voluntary market across the registries, covering:
  - Livestock operations (manure management)
  - Avoided conversion of grasslands,
  - Rice cultivation management,
  - Nitrogen fertilizer management (“nutrient management”)
  - Organic waste management and application to grazed grasslands

Offset quality

Real	• Scientific basis for quantification • Monitoring during the project
Additional	• Additionality defined by each protocol through standardized tests and thresholds
Permanent	Stored carbon must be maintained for 100 years following issuance
Verified	Credits issued based on opinion of approved verification body
Owned unambiguously	• ROCs are publicly tracked by OPRs • ARBOCs are tracked by CITSS

Quantifiable (technically feasible)

- Robust body of scientific evidence must support the notion that the specific project activity will actually generate GHG emission reductions
- As the complexity of the system impacted by the project activity increases, associated increase in
  - the cost and efforts required to measure and quantify the GHG benefits
  - uncertainty of quantification method
- Quantification methodologies must be
  - Conservative
  - Able to trace each offset credit to a specific activity and facility
  - Measurement & quantification approaches must be accurate & reliable

Quantifiable (financially feasible)

- Critical to balance accuracy with cost
  - Must be financially feasible to measure and quantify the GHG benefits with a level of certainty that is acceptable for the creation of GHG offsets
    - Soil samples: increase accuracy but also increases cost. Use of remote sensing as an alternative in Grasslands
    - Meters for methane measurements: costly but necessary
  - The cost of measuring and reporting GHG reductions must be some amount less than the potential revenue from the sale of the credits.
- Potential volume of GHG reductions influences the unit cost of creating offsets
  - Higher volume projects likely have a lower unit cost; justifies additional quantification expenses

Verifiable

- Must be technically and financially feasible for a third party technical expert (verifier) to audit project activities and quantification
- Verifiers must be able to reach reasonable assurance that the project activity and quantification were in conformance with the requirements of the project protocol.
- Reserve (and others) have been focused on improving guidance and flexibility for verification of projects
  - Seeking to develop protocols which rely on remote sensing, minimal level of measurements; multiple documents used to triangulate/prove certain activities

Challenges

- Data collection issues:
  - Sufficient documentation and data from grower
    - Some data already collected by other agencies (ie. FSA)
    - Attempt to be flexible and creative in triangulating evidence of a given project activity
  - Scientific data collection / paired field experiments
    - Growing body of data collected on GHGs from agriculture, but need paired tests to compare the effect of the “project activity” in the baseline and project
    - No single data repository (some sectors have good meta-analyses of data but rarely comprehensive)

Challenges

- Modeling vs. Measuring
  - Models too have varying degrees of complexity, from DNDC and COMET-farm (Tier 3) to a simplified emission factor (Tier 2) approach
  - More complex models have more significant data inputs. Model results can only be as accurate as the inputs to the model (input uncertainty)
    - Measurement is typically one option for inputs, but can be costly. Must weigh whether the measurement is the best/only possible input, or whether other inputs (i.e. remote sensing) can suffice
    - Rarely is measurement an option for the emission reductions themselves (ie. gas spectrometer)
  - The uncertainty of the model's ability to estimate GHG emissions must also be assessed (structural uncertainty) through calibration and validation
    - This process also requires independent, robust data sets

High Quality Credits

- Require a robust, scientifically sound quantification methodology, which meets key offset criteria
- Verified (by 3rd party auditor)
- Premium paid for
  - Credits used for compliance markets
  - "Charismatic offsets" with significant co-benefits.
    - For example:
      - Nitrogen management projects can improve water quality, reduce hypoxia
      - Grasslands, rice fields, forests provide important habitat
    - Co-benefits not necessarily the focus for a carbon offset project but can be a key factor for buyer/price

Questions?

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