NARA

Identifying Suitable Sites for Wood-based Biofuels Facilities in Western Oregon and Washington

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Northwest Advanced Renewables Alliance



NARA Supply Chain Team

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NARA RAs, UI

30 IDX students, WSU & UI

Presentation Roadmap

NARA Supply Chains

Supply Chain Goals

Framework/Methodology

Site Selection Criteria

Supply Chain Analysis

MC2P Case Study Sites

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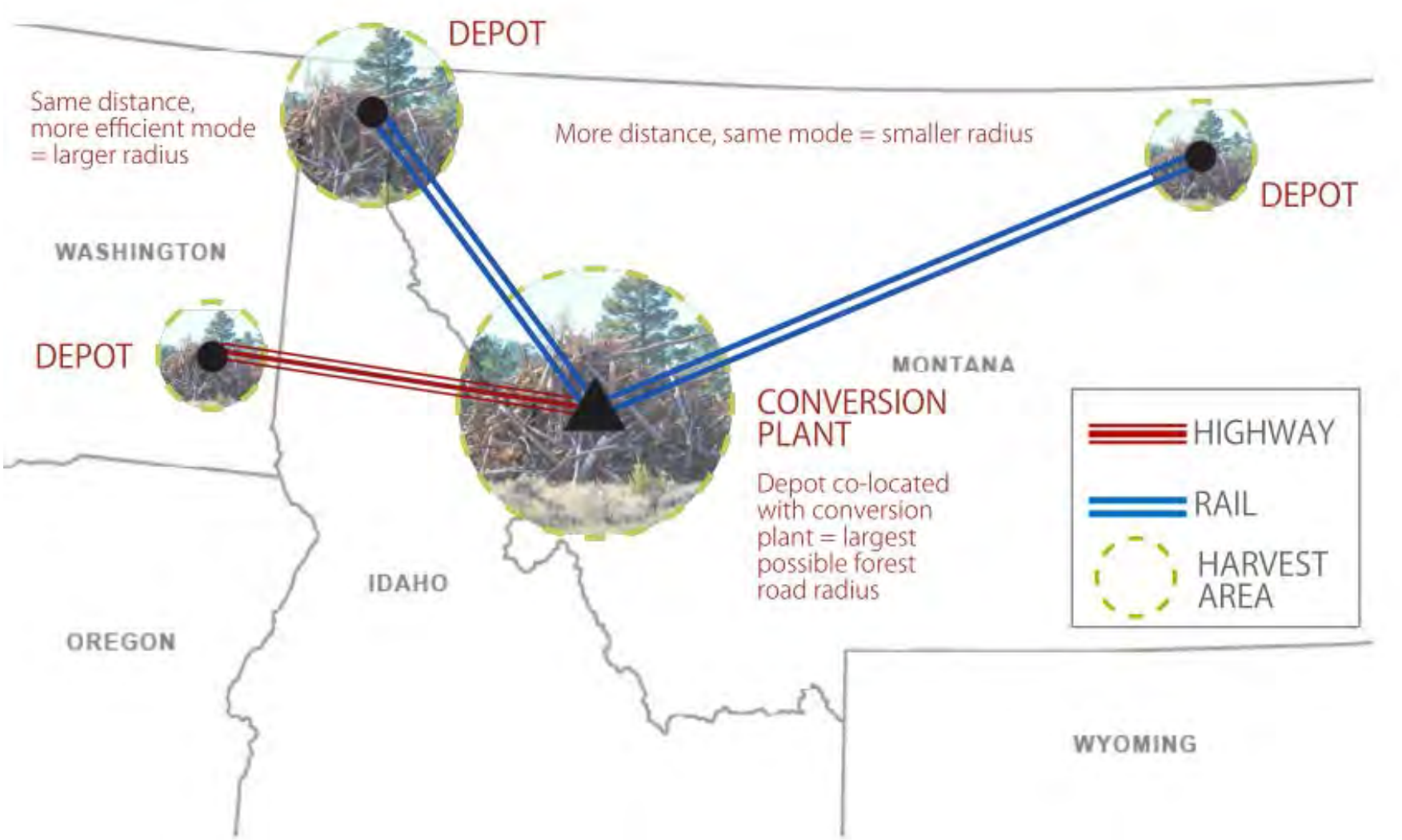
Supply Chain Analysis Goals



Northwest Advanced Renewables Alliance Team

Feedstock | Conversion | Sustainability | Stakeholders | Education

Corporate
Catchlight Energy
Gevo, Inc
GreenWood Resources
TSI Inc.
Weyerhaeuser Corp

NGO
Facing the Future
Nat'l Center Genome Res.

University
Montana State Univ
Oregon State Univ
Pennsylvania State Univ
Salish Kootenai College
University of Idaho
University of Minnesota
University of Montana
University of Washington
Washington State Univ

Government
USFS – Forest Prod Lab
USFS – PNW Res. Station

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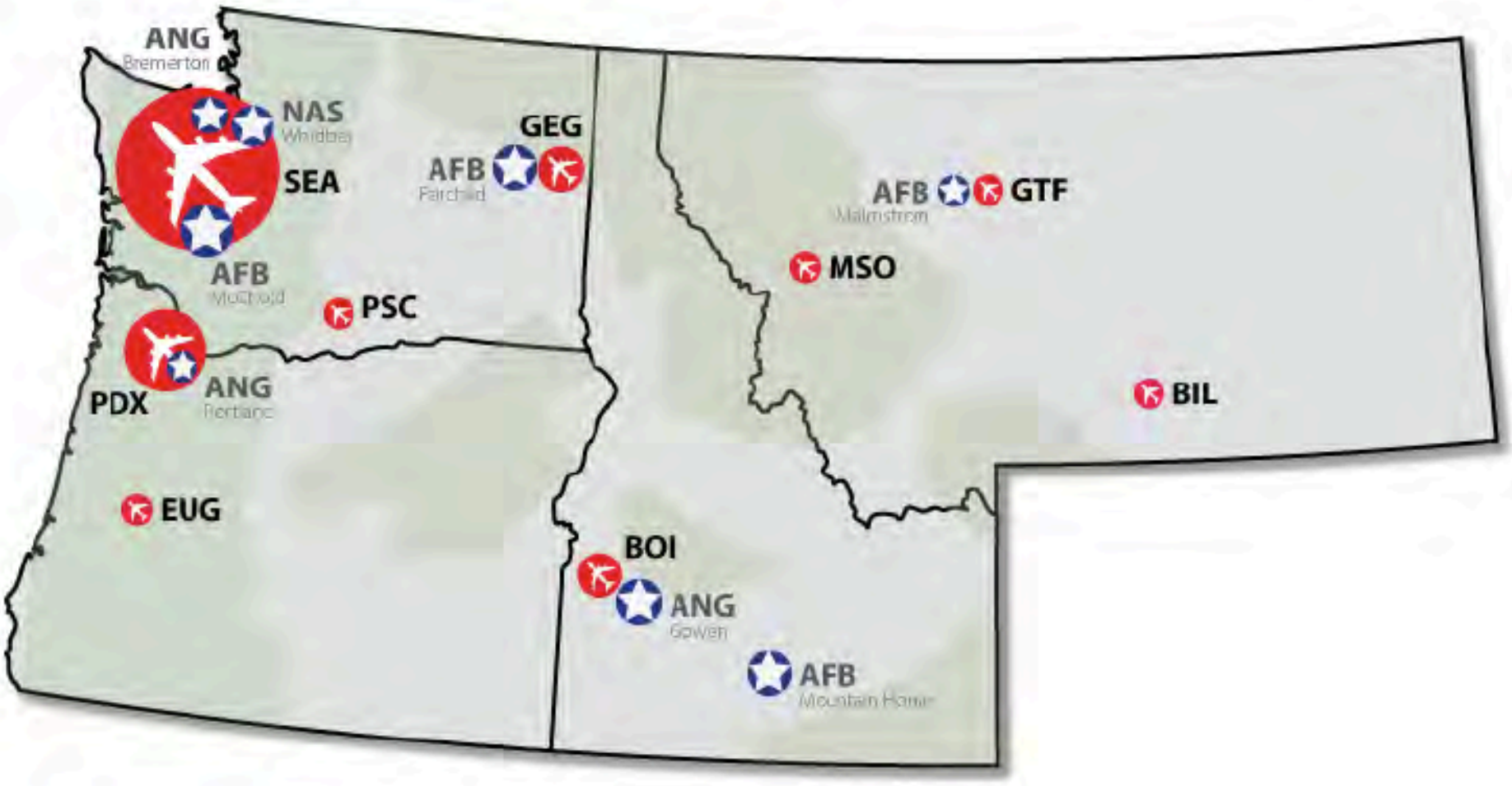
Aviation Fuel Demand Centers



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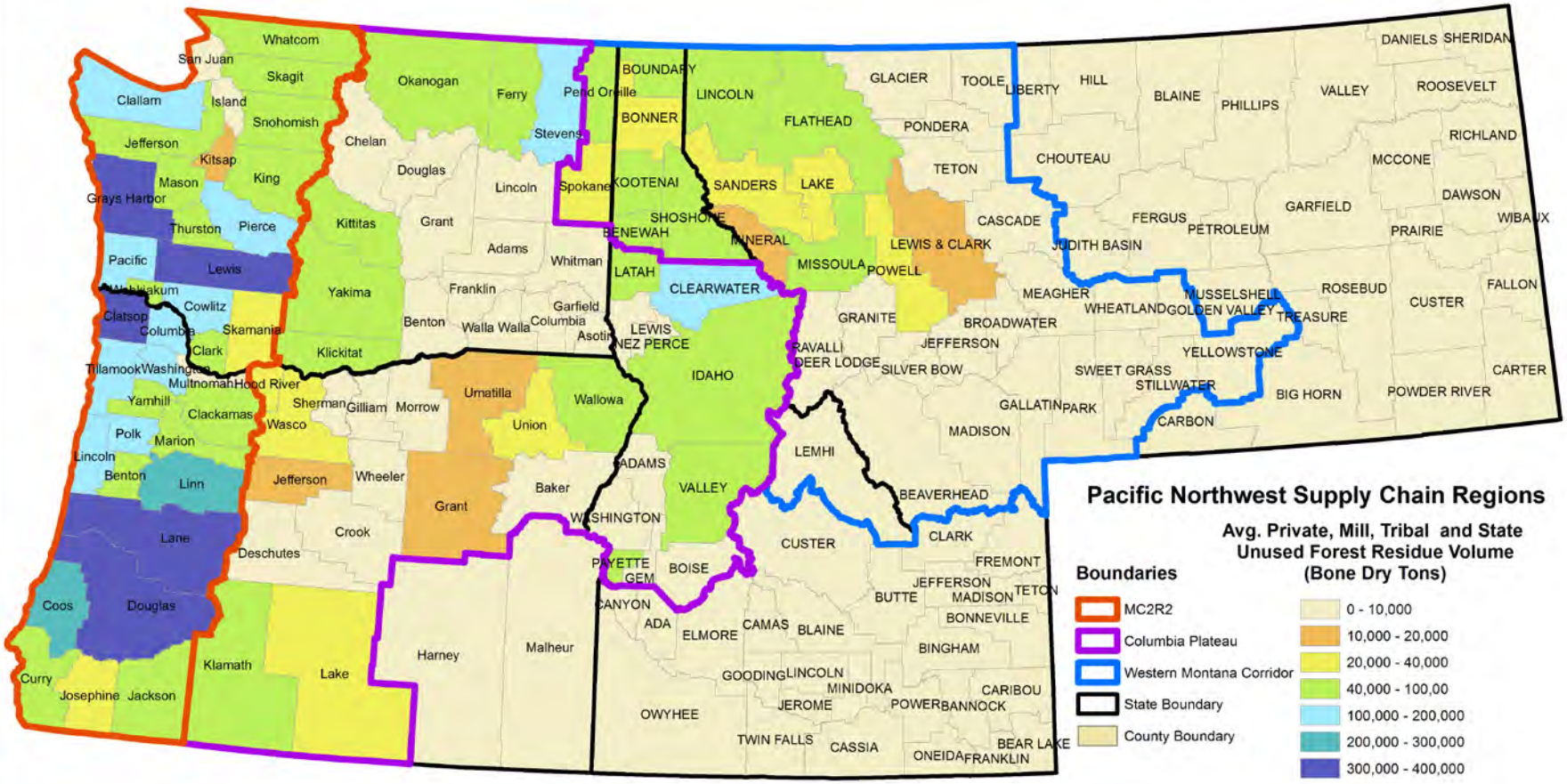
NARA Supply Chain Regions



State forest residue volumes are approximated using Timber Product Output (TPO) datasets from the University of Montana Bureau of Business and Economic Research (BBER). They sample Oregon, Montana and Idaho on a bi-decadal basis. Washington is sampled by the Washington State Department of Natural Resources, and the numbers are reported to the BBER.

Dates Used for State Forest Harvest Volume Averaging:

Oregon -- 2003, 2008 Washington -- 2002, 2010
Montana -- 2004, 2009 Idaho -- 2001, 2006

0 50 100 150 Miles

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SUPPLY CHAIN

FRP

FOREST RESIDUES PREPARATION

Primary feedstock targets include forest residues from logging and thinning operations. We are also considering mill residues and discarded woody material from construction and demolition, in regions where these materials are under utilized.

ONE BONE DRY **TON** WOODY BIOMASS +

T

TRANSPORTATION

Feedstocks are transported from the collection site to a conversion facility. Chipping can take place at the loading or in a preprocessing facility.

DIESEL +

PT

PRE-TREATMENT

Wood chips are treated to make the sugar polymers (polysaccharides) accessible to degrading enzymes. These processes allow the lignin to be available for separation.

HEAT, WATER, & CHEMICALS =

EH

ENZYMATIC HYDROLYSIS

Specific enzymes are added to hydrolyze (cleave) the polysaccharides and generate simple sugars (monosaccharides).

~600 POUNDS LIGNIN AND

F

FERMENTATION

Specialized yeast convert the monosaccharides into isobutanol.

~59 GALLONS ISOBUTANOL OR

BCP

BIOJET & CO-PRODUCTS

Aviation fuels can be generated from the platform molecules derived from wood sugars. Lignin can be used to generate co-products such as epoxies, structural materials and bio-based plastics. As an alternative, lignin can be burned to produce renewable energy.

~45.6 GALLONS BIOJET

NARA is led by Washington State University and supported by the Agriculture and Food Research Initiative Competitive Grant no. 2011-68005-30416 from the USDA National Institute of Food and Agriculture.

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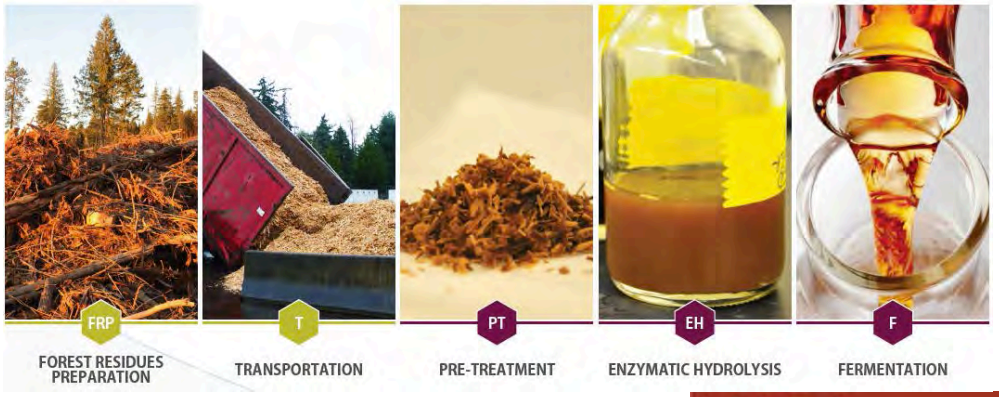
NARA Facility Types

Solid Depot

Liquid Depot

Integrated Bio-refinery (IBR)



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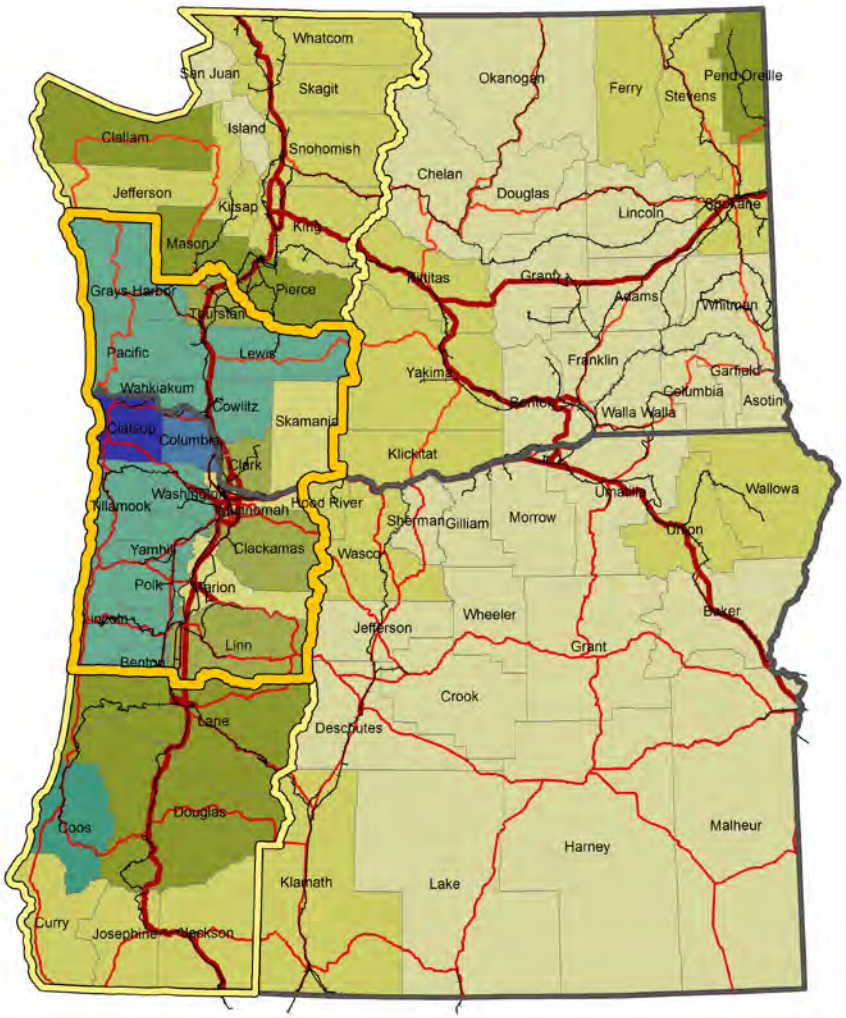
Mid Cascade to Pacific (MC2P) Region



Legend

- Mid C2P Study Area
- C2P Region
- County Boundary
- State Boundary
- Active Rail
- U.S. Interstates
- U.S. Highways

Biomass Density [BDT/sq. mi.]

- 0.00 - 10.00
- 10.01 - 50.00
- 50.01 - 100.00
- 100.01 - 200.00
- 200.01 - 300.00
- 300.01 - 320.00

Density is calculated as the county forest biomass residue volume / area of county [square miles]

N W E S

0 50 100 150 Miles

NOTE: The Mid Cascades to Pacific (MC2P) Region was delineated for the Fall 2013/Spring 2014 IDX study period. In consideration of the time available for studying supply chains within the entire C2P region, this smaller supply chain was selected to be studied based on proximity to biomass, road, rail, barge, and refineries. Lessons learned from this study will be applied to other supply chains within the region the following year.

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Site Selection Framework

Community Capitals Framework

Site Selection Methodology

Feedstock Availability

- Examine feedstock availability in supply chain regions
- Considerations:
  - landownership (private, state, federal)
  - Transport options (highway, rail)

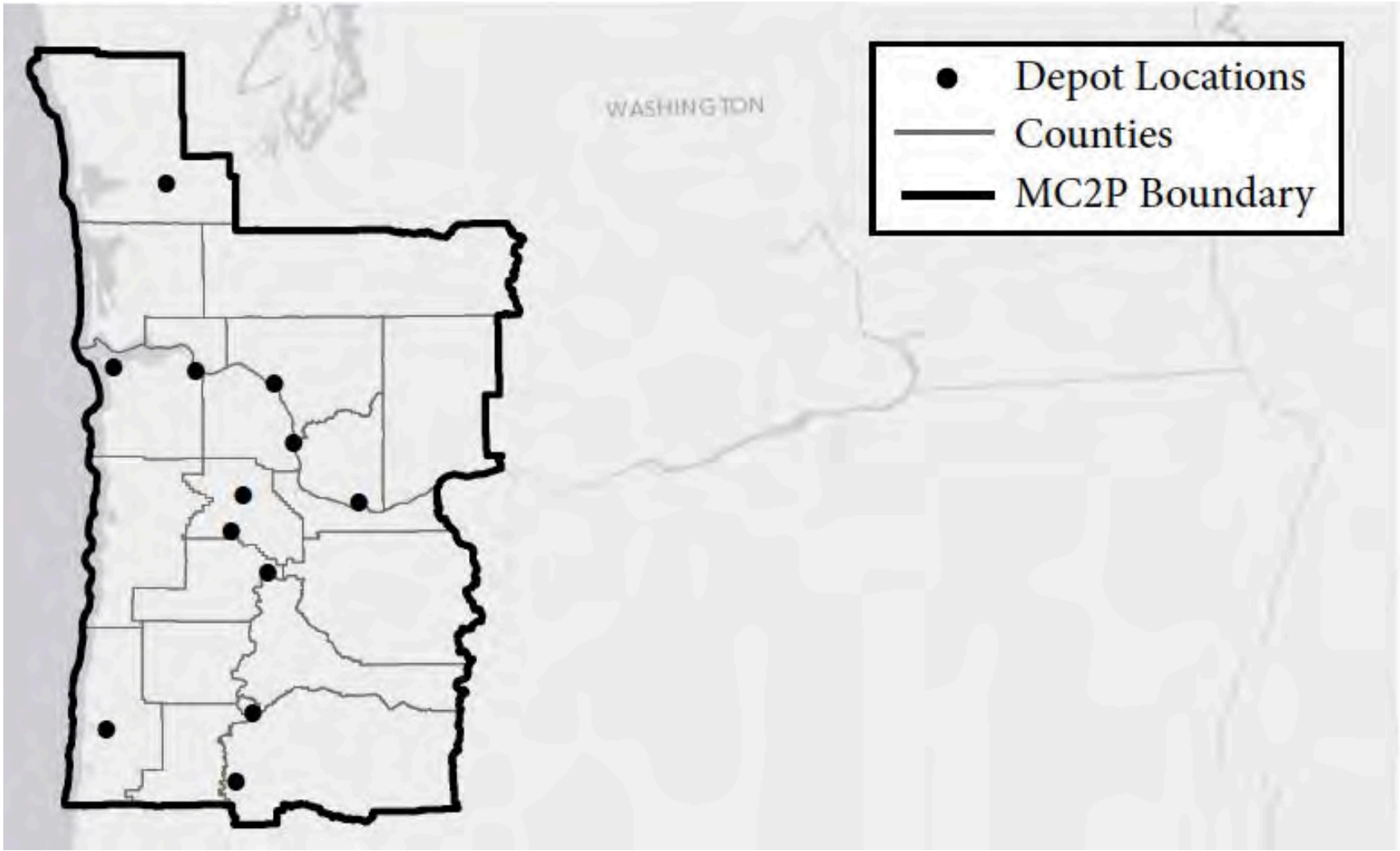
Site Selection

- Identify key assets critical for selecting sites
- Weight assets based on relative importance
- Select sites based rank

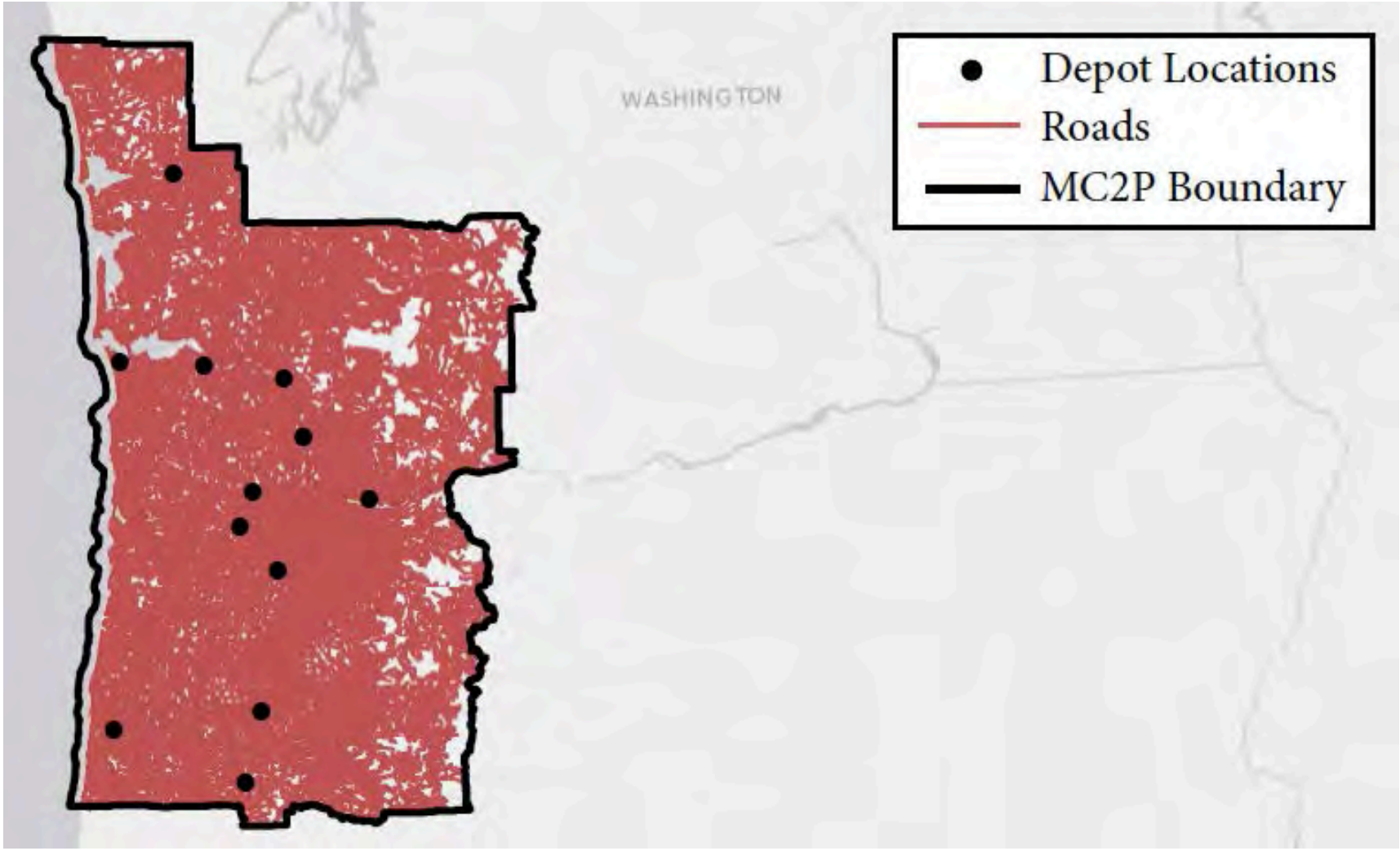
Site Selection Criteria

Site Type	Natural Capital	Physical Capital	Human Capital	Financial Capital	Policy Capital
Solid Depot	*Biomass Availability	*Transport Access (Highway, Rail Barge) *Onsite Assets (Boiler, Chipper, Acreage)	*Unemploy-ment Rate	*Electrical Rates	*Land Ownership of forest residuals
Liquid Depot	*Biomass Availability *Water Availability	*Transport Access *Onsite Assets (Boiler, Acreage, Wastewater Treatment)	*Unemploy-ment Rate	*Utility Rates (electric/natural gas)	*Land Ownership of forest residual
IBR	*Biomass Availability	*Transport Access *Onsite Assets (Boiler, Hydrolysis & Fermentation, Process Chemistry, Wastewater Treatment	*Labor Force	*Cost of Living *Utility Rates	*Land Ownership of forest residuals

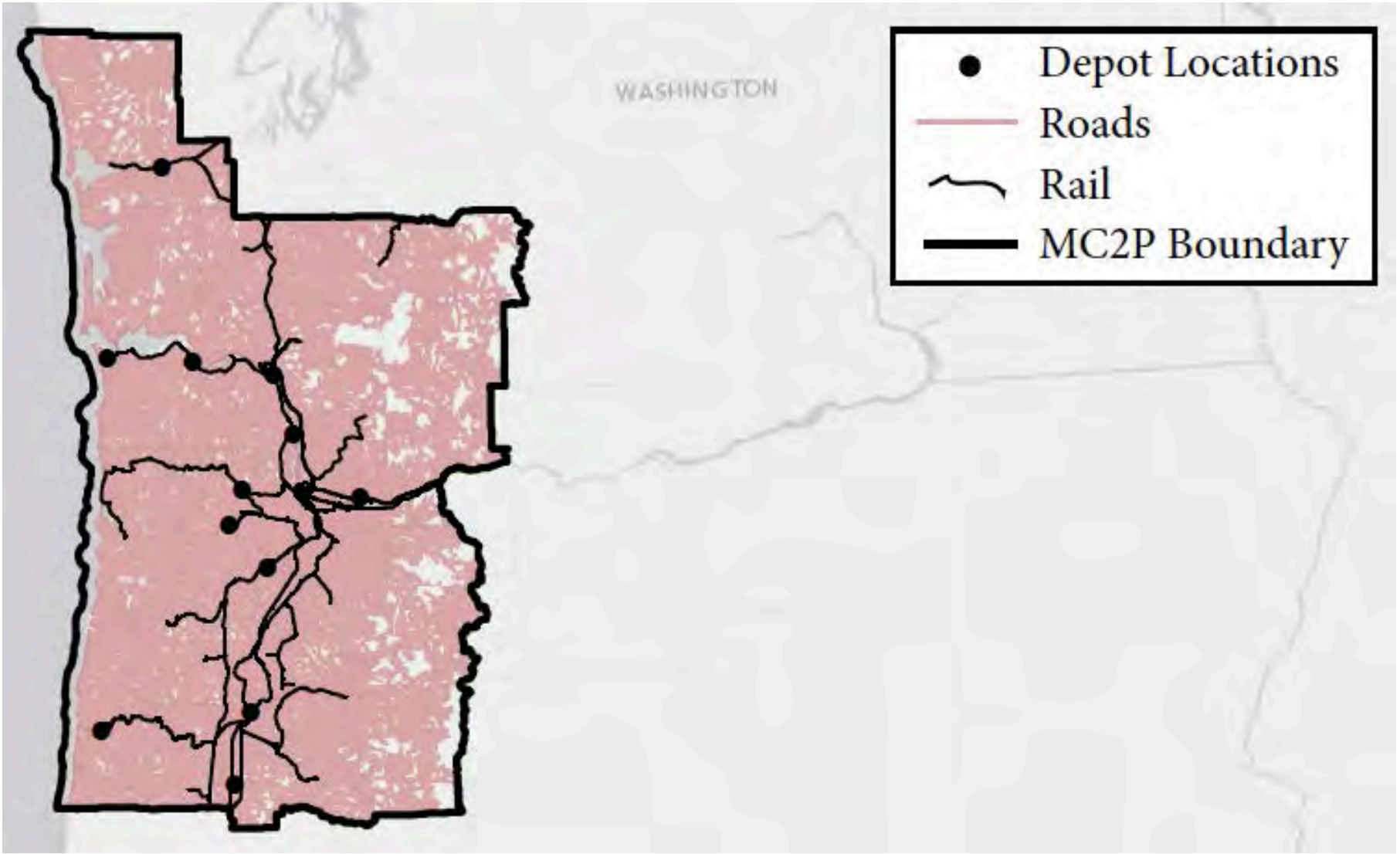
Mills



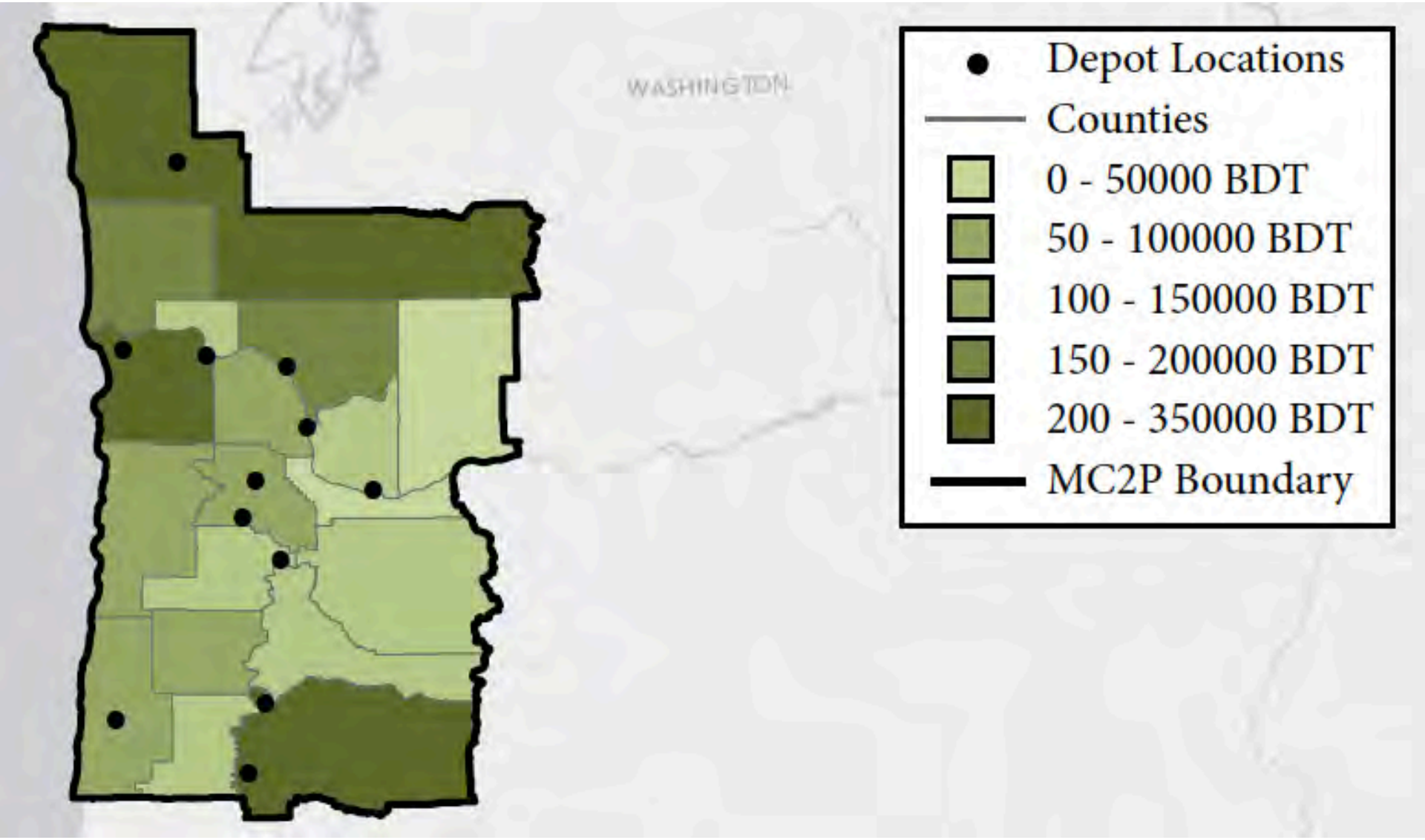
Road Transportation



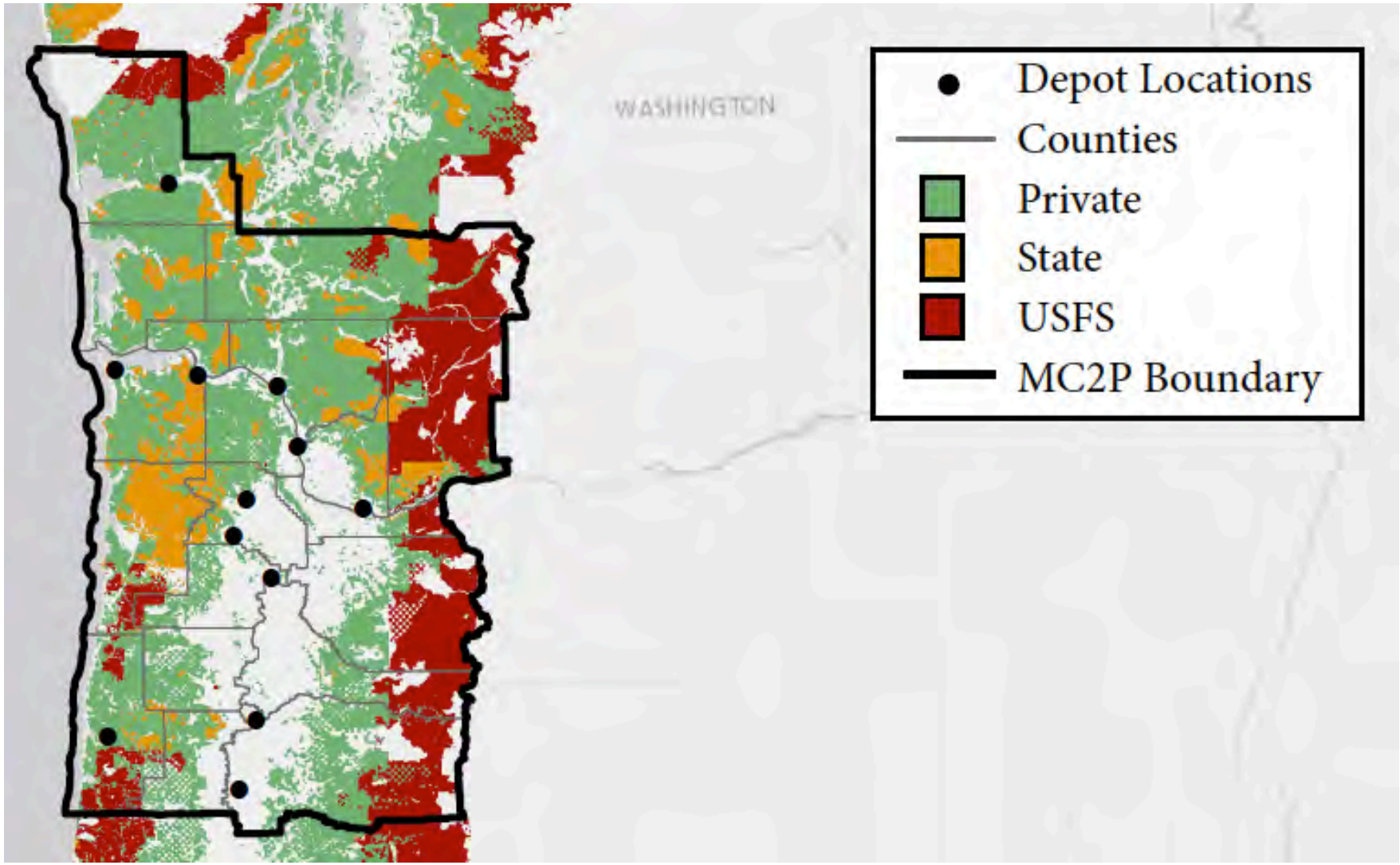
Rail Transportation



Feedstock Availability



Available Forest Coverage (Ownership)



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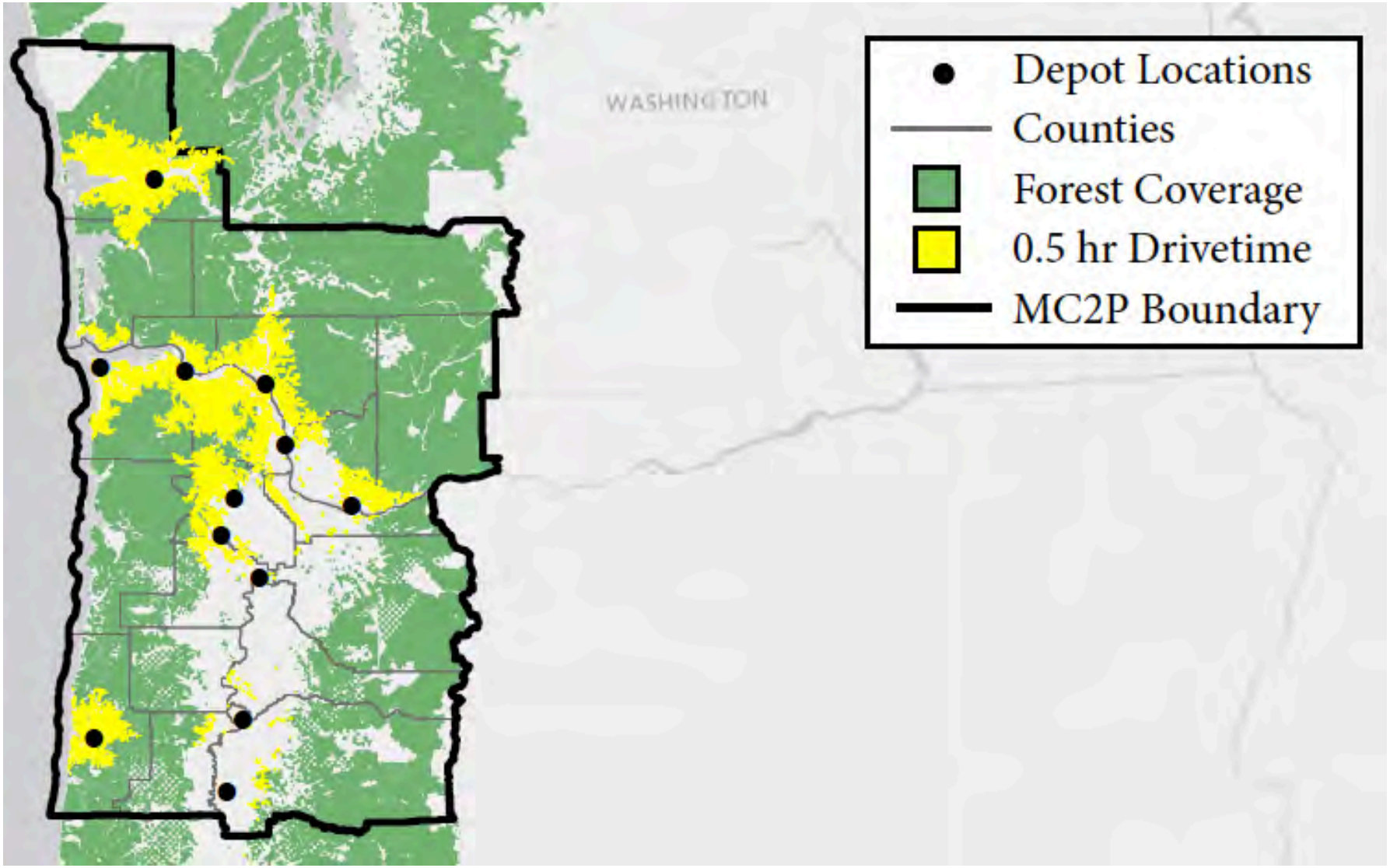
Solid Depot – Direct Drive Time - 30 Minutes



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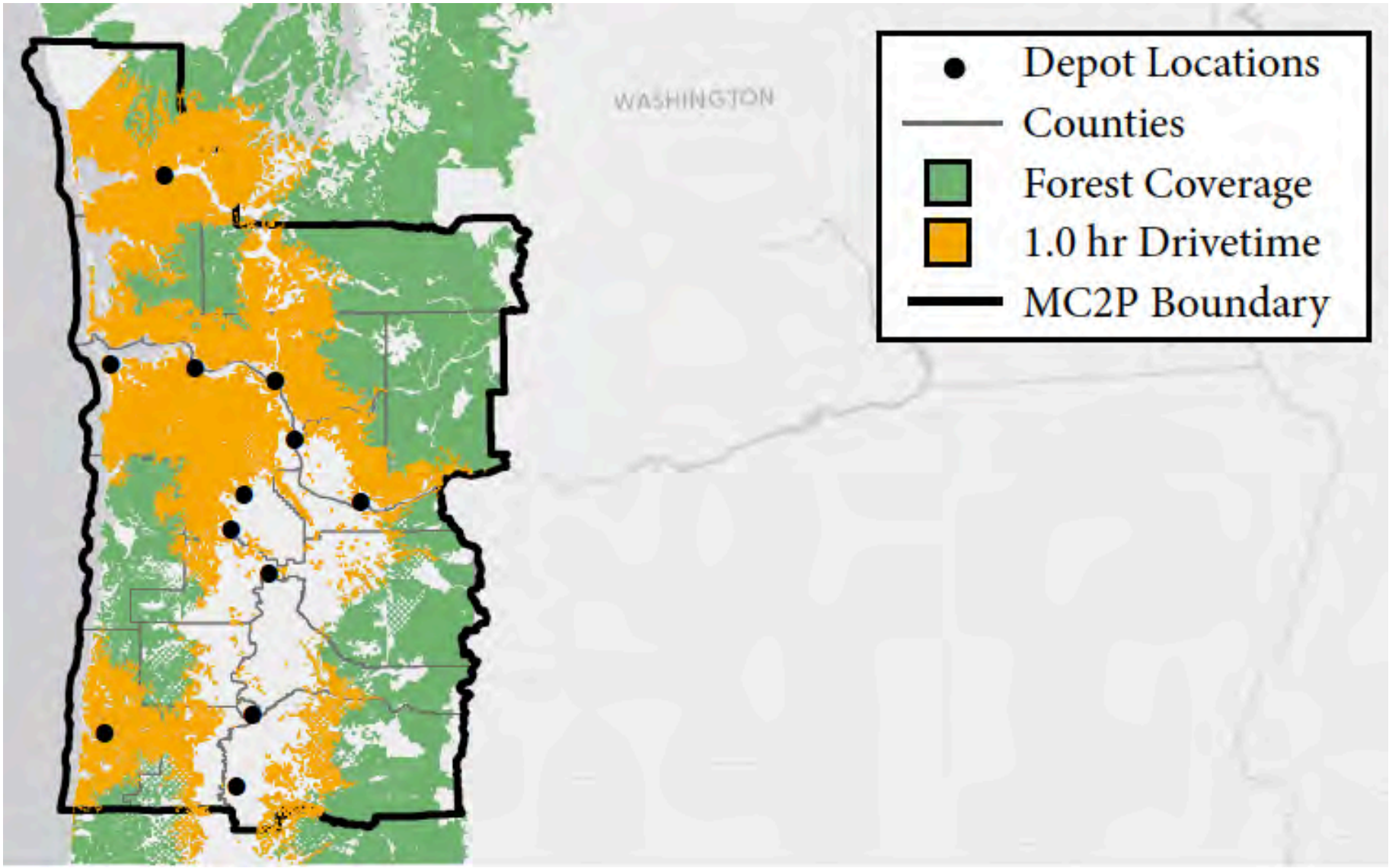
Solid Depot – Direct Drive Time - 60 Minutes



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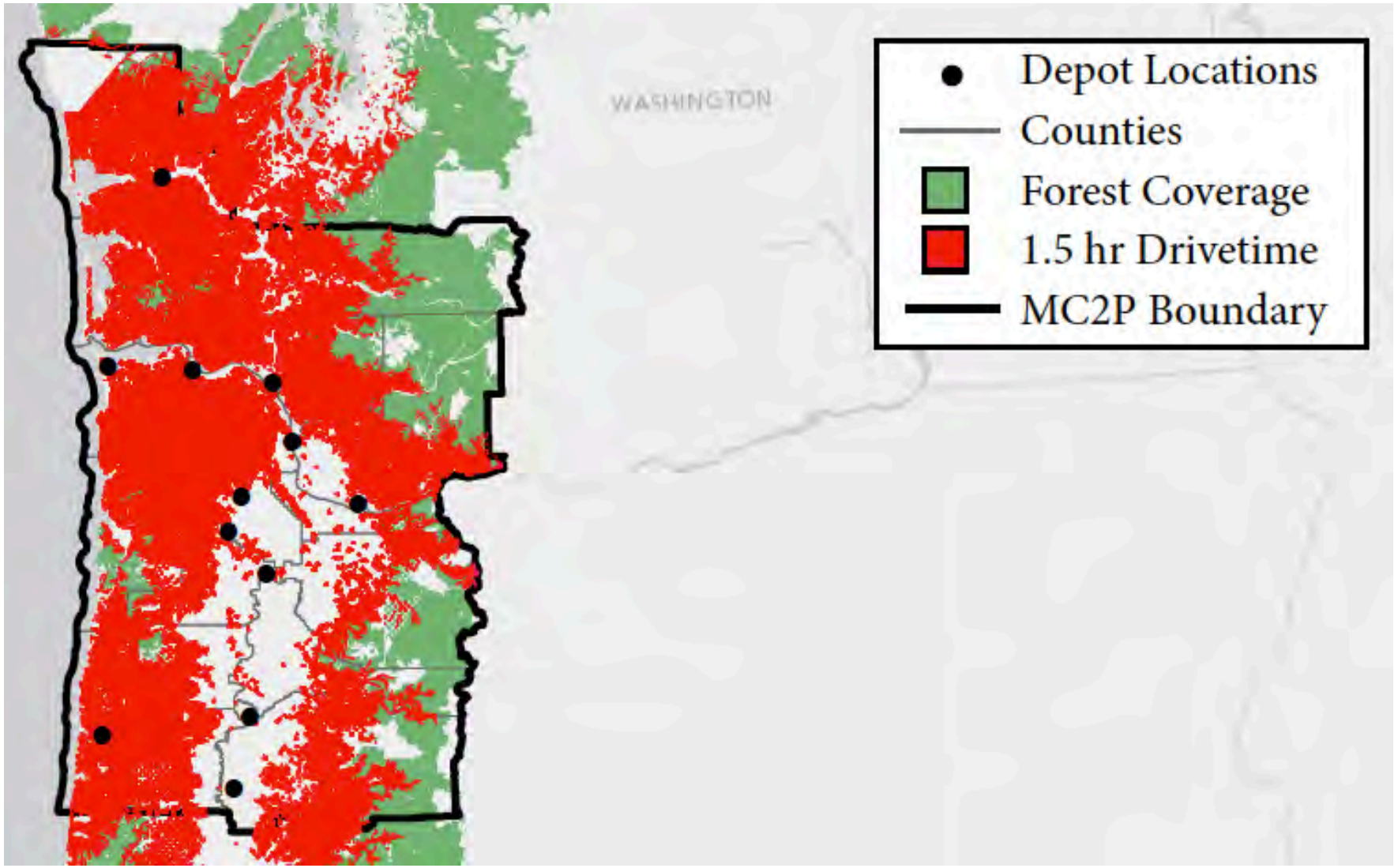
Solid Depot – Direct Drive Time - 90 Minutes



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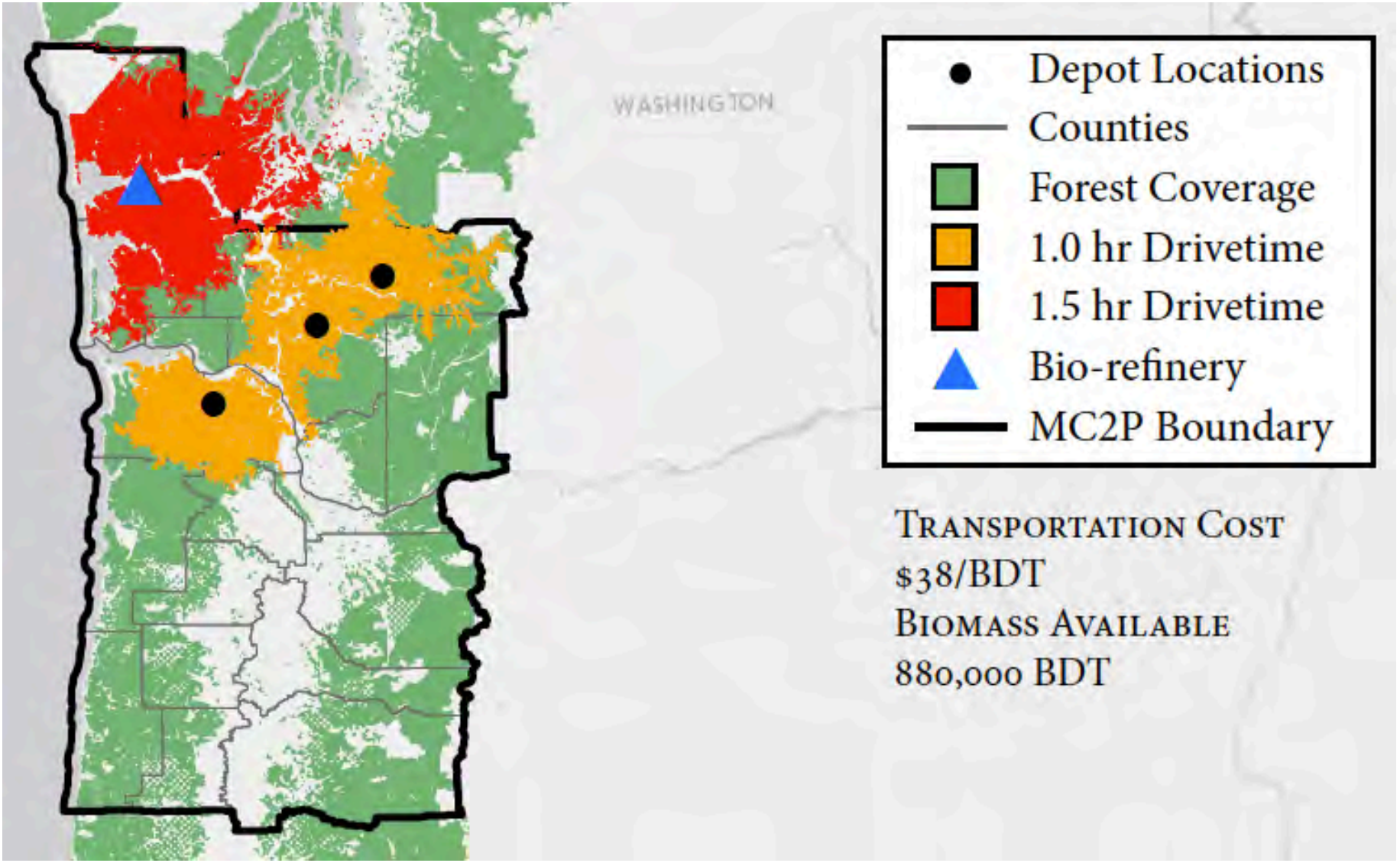
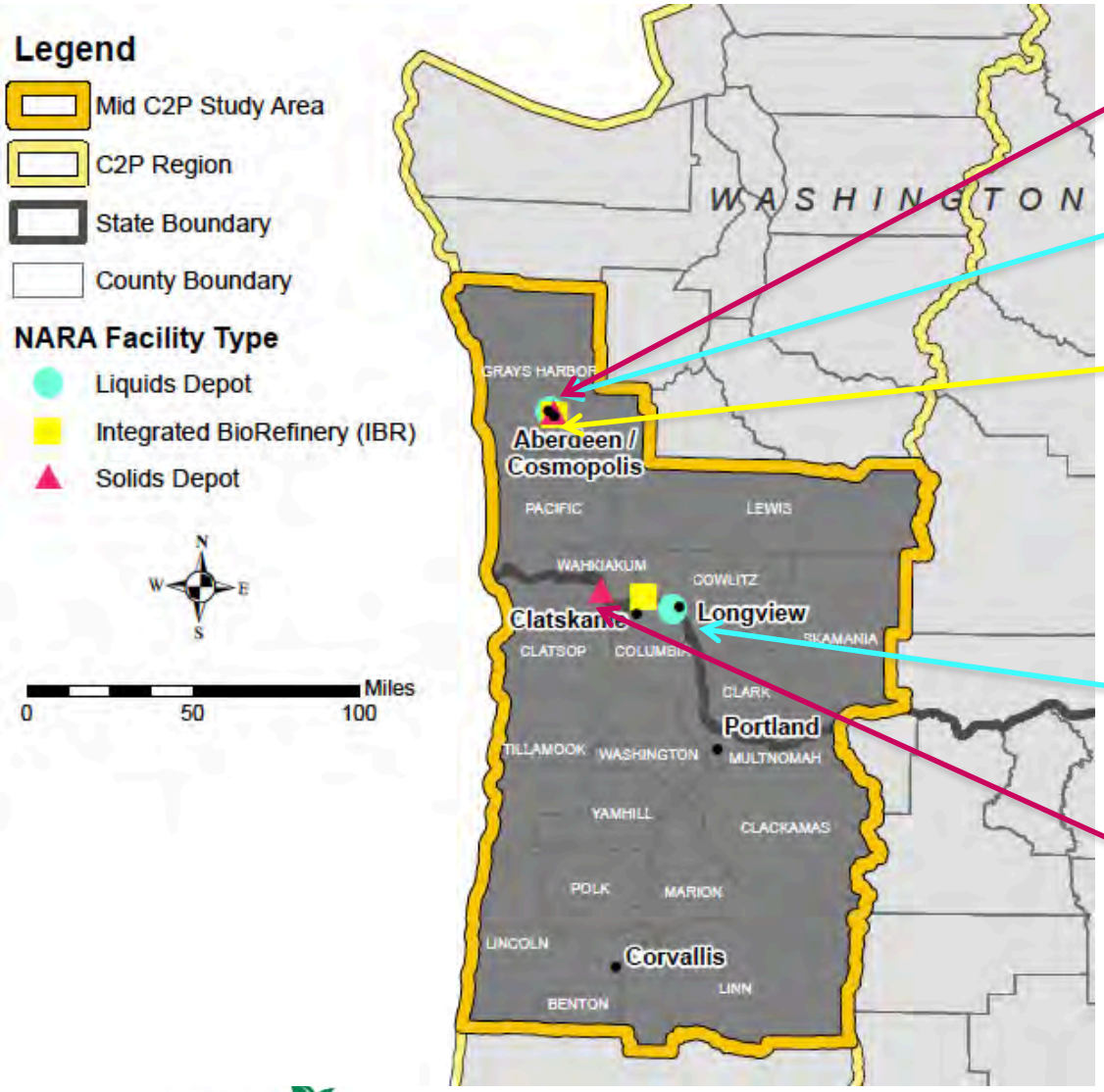
Biorefinery/Depot Model



MC2P Case Study Sites

Site	Greyfield	Co-located
Solid Depot	Former Bradley-Woodward Lumber Co. Sawmill, Bradwood, OR	Sierra Pacific Industries Aberdeen, WA
Liquid Depot	Weyerhaeuser Bay City Log Yard, Aberdeen, WA	Kapstone Pulp and Packaging Longview, WA
Integrated Biorefinery		Cosmo Specialty Fibers Cosmopolis, WA

MC2P Case Study Sites



Sierra Pacific Industries, Aberdeen, WA

Weyerhaeuser Bay City Log Yard, Aberdeen, WA

Cosmo Specialty Fibers, Cosmopolis, WA

Kapstone Pulp and Packaging, Longview, WA

Former Bradley-Woodward Mill Bradwood, OR

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Regional Perceptions

What benefits, if any, might come from using woody biomass to create liquid biofuels in your state?

More Information @ Poster Session

- Jon Potter - Supply Chain Analysis (Poster #: 33)
- Laurel Graves
  - MC2P Site Selection Methodology (28)
  - Site Specific Designs for an Integrated Biorefinery (29)
- Drew Savas - NARA Liquid Depot (25)
- Vincent McIntyre - Site Selection design for a Liquid Depot (26)
- Carson Zednick - Solid Depot (27)

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