A Stepwise Biogeophysical and Social Analysis Approach to Site Selection of Biorefineries

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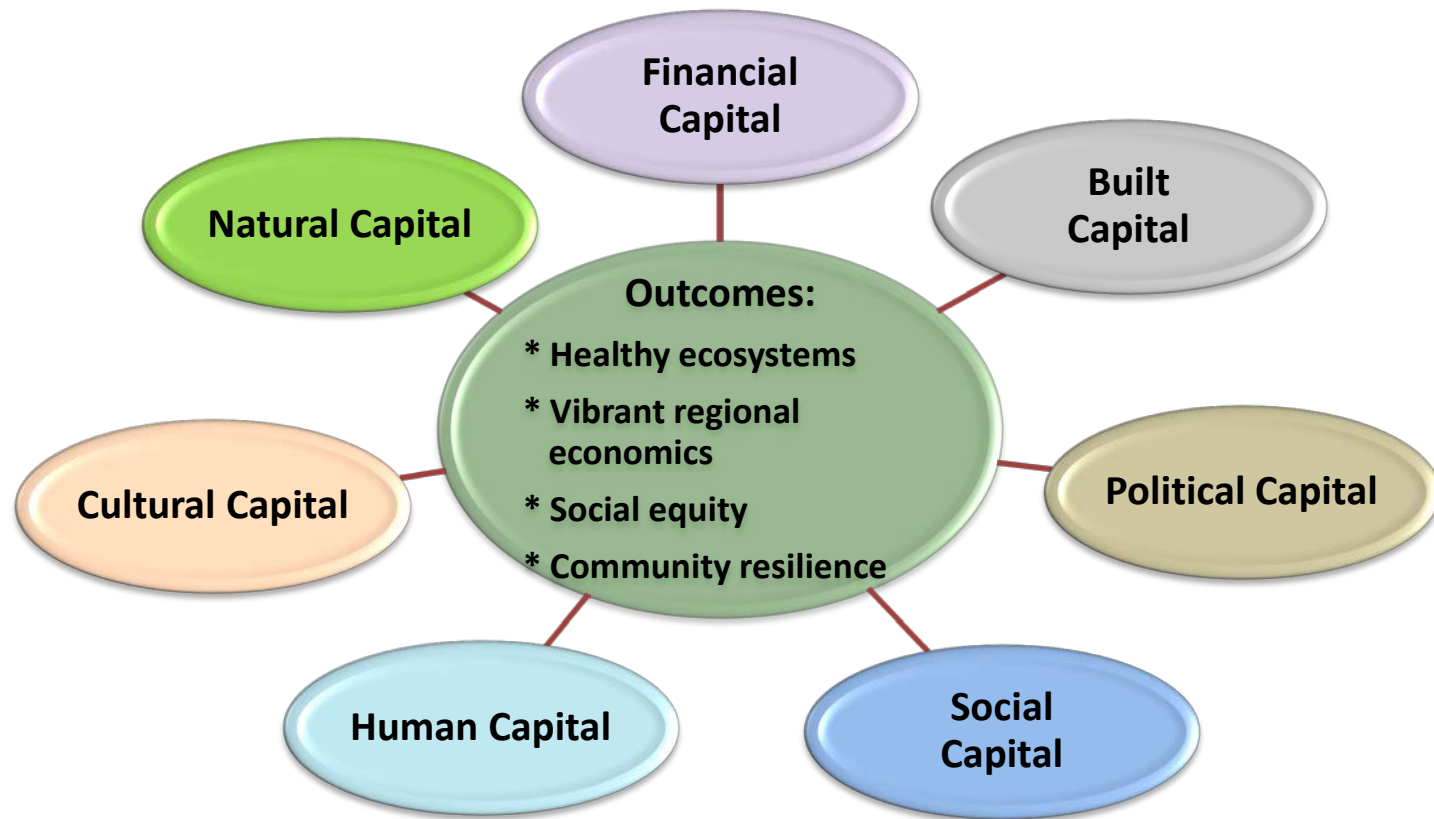
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The Community Capitals Framework

Drawn from: Emery, Mary and Cornelia Flora. 2006. "Spiraling Up: Mapping Community Transformation with the Community Capitals Framework." *Journal of the Community Development Society*, Vol. 37, p. 22.

- Some assets are more difficult to quantify
  - Measures of social cohesion, networks, creativity, and trust qualitative in nature
  - Lack of reliable, comparable data
- Research shows these elements are critical for the sustainability of complex economic and environmental projects.
- Research often ignores, or cursorily addresses these assets:
  - poor quantitative proxies, or
  - examine only one facet of these assets, support.
- Including more robust measures of these assets enhances likelihood of success
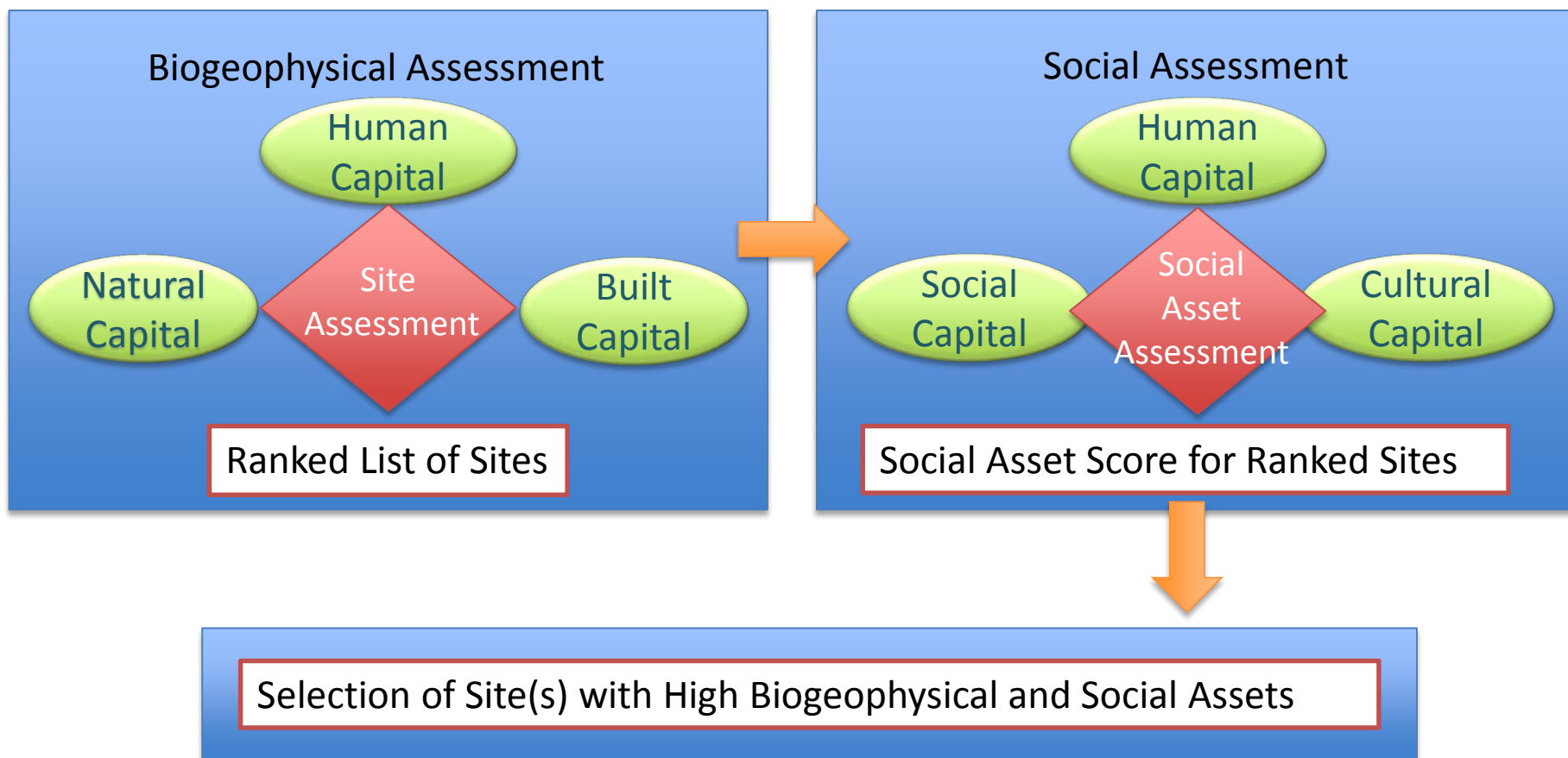
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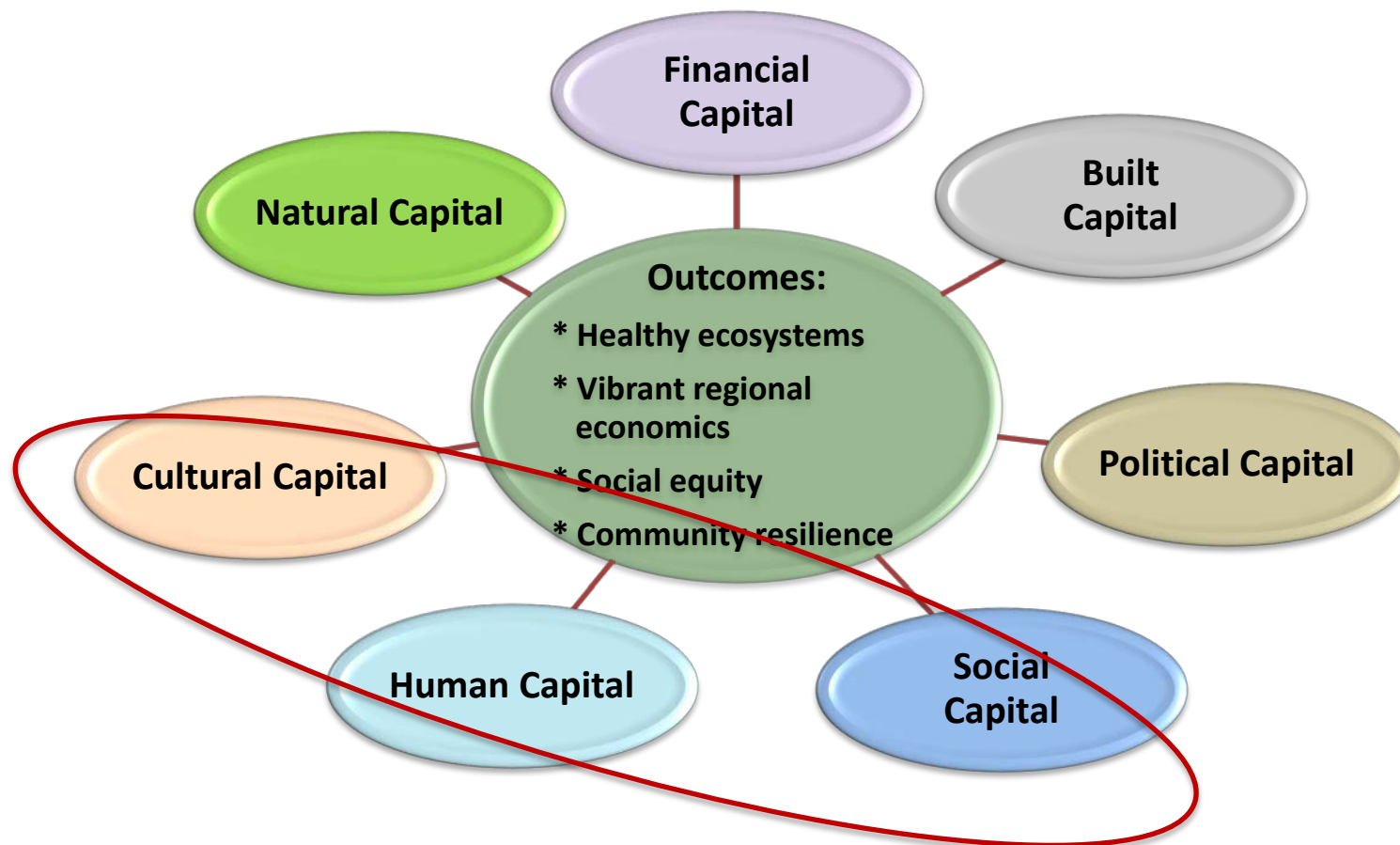
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Conceptual Framework for Stepwise Analysis

Biogeophysical Assessment

- Human Capital
- Natural Capital
- Site Assessment
- Built Capital

Ranked List of Sites

Social Assessment

- Human Capital
- Social Capital
- Social Asset Assessment
- Cultural Capital

Social Asset Score for Ranked Sites

Selection of Site(s) with High Biogeophysical and Social Assets

- 1) BGP Analysis of pulp mills using weighted decision matrix
- 2) Social asset analysis utilizing quantitative benchmark comparisons

Model Refinement

Stepwise process to identifying communities for a biorefinery in PNW

Community Assets	Initial Model	Refined Model
Natural & Built Capital	Cities selected by: Population greater than 1,000, located within 1.6 km of major road and rail, near large quantities of biomass, near petroleum terminals	Facilities assessed based on: annual biomass availability, labor quality, electricity rate, proximity to multi-modal transportation infrastructure, and facility type.
Social Capital • Rupasingha et al, 2006 • 2009 data used	# Rent-Seeking Groups: political, labor, professional and business organizations	# Rent-Seeking Groups: political, labor, professional and business organizations # Non-Rent Seeking Groups: civic organizations, bowling centers, golf clubs, fitness centers, sports organizations and religious organizations # Non-Profit Organizations % Voter Turnout
Cultural Capital • WESTAF	$ Average annual revenues of arts-related goods and services based on all revenues between 2002 and 2010	# Arts related organizations # Arts related business # Occupational employment in the arts $ Revenues of arts related goods and services

Human Capital
 	
• County Health Ranks
	% Self-reports of poor health condition (physically and mentally)	Health:
		    % Low birth-weight
		    % Premature deaths
		    % Obese (BMI >30)
		    % Self-reports of poor health condition (physically and mentally)
		Poverty
		    % Poverty (and % children in poverty)
		    % Uninsured
		    % Unemployed
		    % No access to health due to costs

All counts (#) and amounts ($) are calculated as a rate of the population per 10,000		

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Assessment Metrics

	Community Assets	Refined model
Biogeophysical	**Natural Capital**	*Annual biomass availability
	Built Capital	*Multi-modal transportation *Facility Type *Electricity Rate
	Human Capital	*Labor Quality
Social Analysis	**Human Capital**	Health: % Low birth-weight % Premature Deaths % Obese (BMI > 30) % Self-reports of poor health condition (physically and mentally)
	Social Capital	# Rent-Seeking Groups: political, labor, professional and business organizations # Non-Rent Seeking Groups: civic organizations, bowling centers, golf clubs, fitness centers, sports organizations and religious organizations # Non-Profit Organizations % Voter Turnout
	Cultural Capital	# Arts related organizations # Arts related business # Occupational employment in the arts $ Revenues of arts related goods and services

All counts (#) and amounts ($) are calculated as a rate of the population per 10,000

- Decision matrix used to assess each facility

- Measured on scale of 1 to 5 for each criteria, and weighted according to percentage of cost relative to total cost of building/operating a greenfield biorefinery.

- Facility score, F_m, calculation

$$F_m = \left(\sum_{j=1}^{n} w_j * scale_j \right)$$

	Site Selection Criterion				
	Natural Capital	*Human Capital*	*Built Capital*	*Built Capital*	*Built Capital*
	Biomass Availability (BDMt)	**% Persons w/ Less than H.S. Diploma**	**Electricity Rate ($/kWh)**	**Infrastructure (Pulp Mill Type)**	**Distribution**
Weight	*4.1*	*2.6*	*1.1*	*10.3*	*2.0*
Scale	**Greater Than**	**Less Than**	**Less Than**	**Equal To**	**Equal To**
5	1,360,500	4	0.04	MgS	Rail, port, and < 5 mil to major road
4	907,000	8	0.0475	CTMP	Rail, port, and > 5 mil to major road
3	757,345	12	0.055	NSSC or Kraft + NSSC	Rail or port & < 5 mi to major road
2	453,500	16	0.0625	Kraft	Rail or port & > 5 mi to major road
1	0	20	0.07	TMP	No rail or port
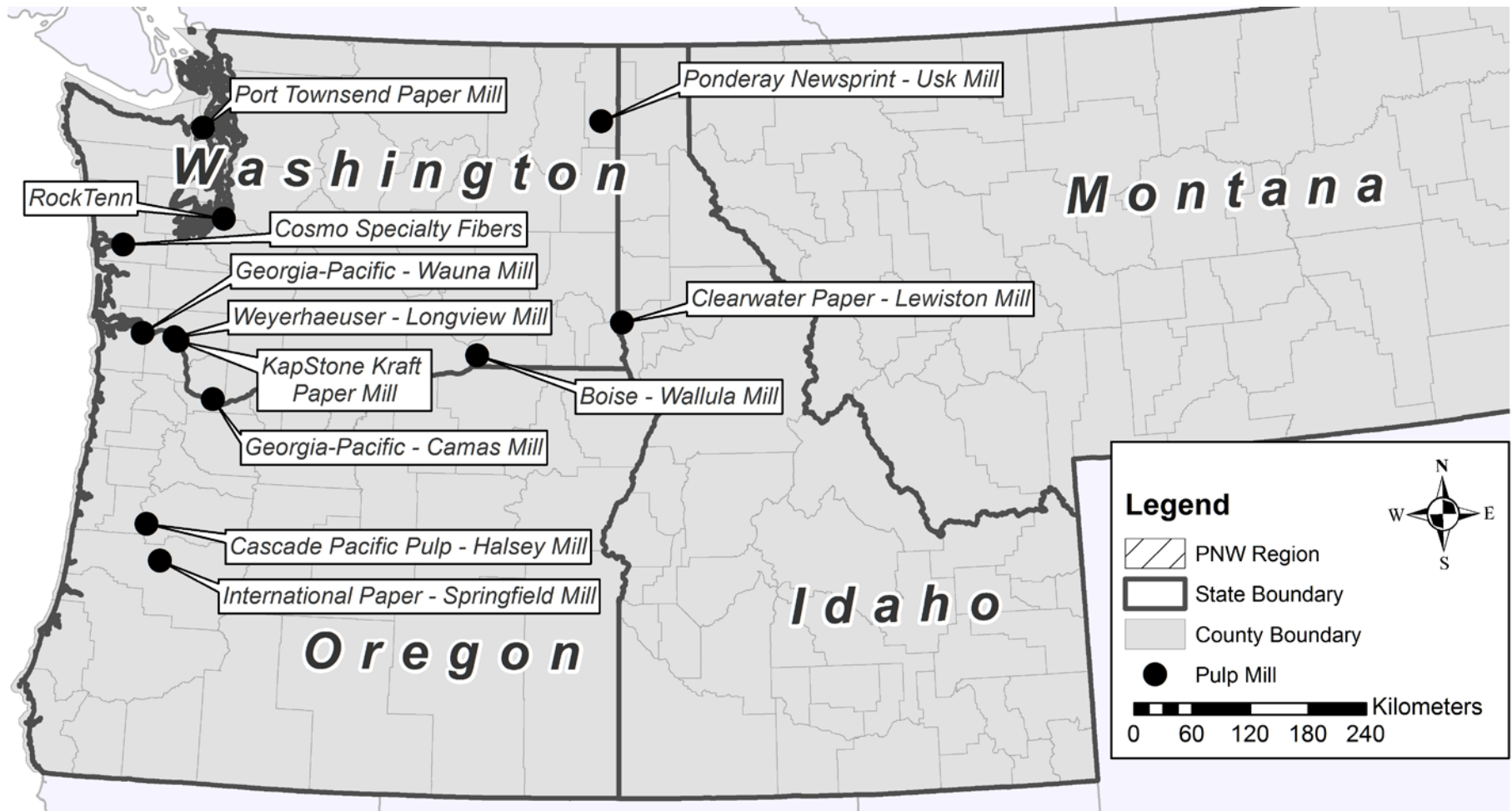
Biorefinery Scenario

Annual Feedstock Demand – 757,500 BDMt (835,000 BDT) forest residuals

Site size requirement – at least 150 acres

Mild bisulfite pretreatment technology

Facility Name	Site Selection Criterion					Facility Score
	Biomass Availability (BDMt)	% Persons w/ Less than H.S. Diploma	Electricity Rate ($/kWh)	Infrastructure (Pulp Mill Type)	Distribution	
Weight	*4.1*	*2.6*	*1.1*	*10.3*	*2.0*	
Cosmo Specialty Fibers, Inc.	4	1	4	5	3	80.9
KapStone Kraft Paper	5	2	5	2	5	61.8
Weyerhaeuser Longview Mill	5	2	5	2	5	61.8
Georgia Pacific – Wauna Mill	5	2	4	2	5	60.7
Georgia-Pacific - Camas	4	4	1	2	5	58.5
International Paper Springfield Mill	4	3	4	2	3	55.2
RockTenn	3	3	4	2	5	55.1
Boise Wallula Mill	1	3	1	3	5	53.9
Cascade Pacific Pulp Halsey Mill	4	3	2	2	3	53.0
Clearwater Paper Lewiston Mill	1	3	3	2	3	41.8
Port Townsend Paper Mill	1	4	1	2	2	40.2
Ponderay Newsprint Usk Mill	1	3	5	1	2	31.7

Stepwise Process Step 2: Social Asset Analysis

- Apply quantitative county-level capital measures of social capital, cultural capital, and human capital to BGP ranked facilities.

- Utilize regionally developed "benchmarks" to identify counties that perform better than the regional average on these three key assets

Asset	National	West	Pacific Northwest (PNW)
	N = 3,108	*N = 413*	*N = 128*
Social Capital			
Avg. Score (2009)	**-0.0043**	**0.0413**	**0.0820**
Minimum score	-4.29	-3.06	-2.51
Maximum score	23.08	7.88	3.52
Missing counties	40	35	0
Creative Capital			
CVI score (2010)	**0.491**	**0.686**	**0.5734**
Human Capital			
Avg. Health (2013)	**0.0838**	**-1.4247**	**-1.5927**
Minimum score	-7.66	-7.66	-6.11
Maximum score	12.50	6.21	2.71
Missing counties	632	82	15
Note: missing values are mostly all counties in Alaska and Hawaii, plus seven counties in Georgia			

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Combining Social Asset and BGP Analyses

| Rank	Site name	Facility Score	County and State	Social Capital	Creative Capital	Human Capital Health
1	Cosmo Specialty Fibers	80.9	Grays Harbor County, WA	-0.30 (-0.03)	0.308 (-0.602)	1.49 (1.72)
2	KapStone Kraft Paper Mill	61.8	Cowlitz County, WA	-0.66 (-0.59)	0.331 (-0.550)	1.67 (1.82)
2	Weyerhaeuser - Longview Mill	61.8	Cowlitz County, WA	-0.66 (-0.59)	0.331 (-0.550)	1.67 (1.82)
4	Georgia-Pacific – Wauna Mill	60.7	Clatsop County, OR	0.64 (0.45)	0.985 (0.934)	-2.61 (-0.57)
5	Georgia-Pacific – Camas Mill	58.5	Clark County, WA	-1.29 (-1.09)	0.600 (0.060)	-2.40 (-0.45)
6	International Paper - Springfield Mill	55.2	Lane County, OR	-0.15 (-0.19)	0.961 (0.879)	-1.62 (-0.01)
7	RockTenn	55.1	Pierce County, WA	-1.10 (-0.94)	0.655 (0.185)	-0.91 (0.38)
8	Boise Wallula Mill	53.9	Walla Walla, WA	-0.56 (-0.51)	0.690 (0.265)	-2.25 (-0.37)
9	Cascade Pacific Pulp Halsey Mill	53.0	Linn County, OR	-0.46 (-0.43)	0.300 (-0.620)	-0.71 (0.49)
10	Clearwater Paper Lewiston Mill	41.8	Nez Perce County, ID	-0.08 (-0.13)	0.526 (-0.107)	-0.79 (0.45)
11	Port Townsend Paper Mill	40.2	Jefferson County, WA	1.47 (1.11)	1.505 (2.113)	-2.45 (-0.48)
12	Ponderay Newsprint Usk Mill	31.7	Pend Oreille County, WA	0.11 (0.03)	0.262 (-0.706)	-0.10 (0.84)

- – Based on step-wise analysis combining 5 capitals: Georgia-Pacific Wauna Mill is ranked as **the highest potential** for retro-fitted biorefinery.

- – Port Townsend Paper Mill and Boise Wallula Mill perform well on social asset measures, but biomass availability does not fit this scenario.

- – These mills may be suitable for scenarios needing lower biomass availability
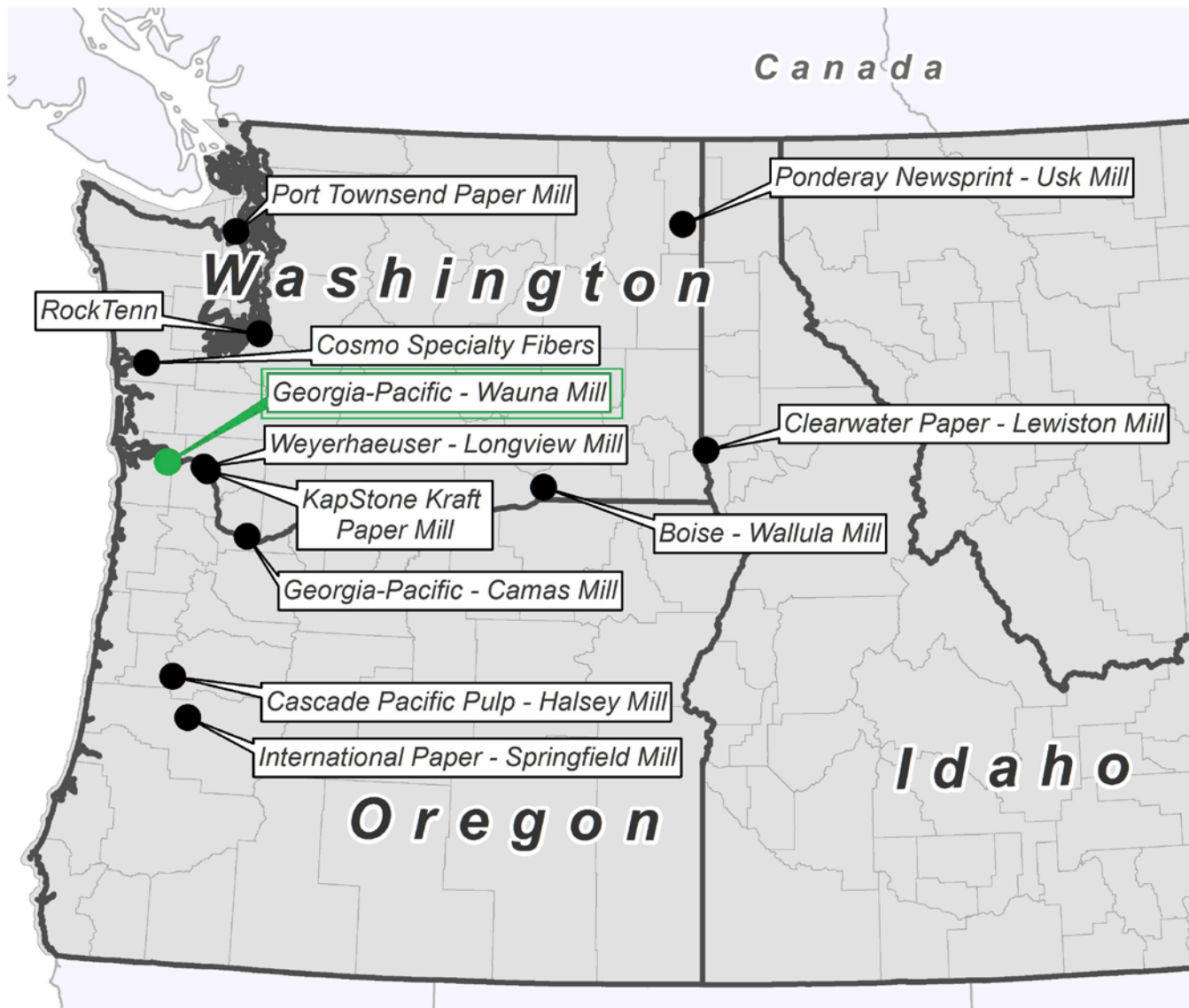
– Better assessment of community suitability for biorefinery by combining 5 out of 7 key "capitals" or assets

- Natural, built, cultural, social and human capitals

– First quantitatively-derived measures of integrated key BGP and social assets:

- Reliability tested

- Nationally-available datasets for expanded use

– Further refinement of social asset benchmarks

– Necessary to evaluate community support for proposed projects

– Creating political support measures from key voting data

– Applying social asset benchmarks and step-wise analysis to Midwest and other regions.

Questions?

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