

# Waste to Wisdom: Environmental and Economic Analysis of Biomass Conversion Processes

## Economic Impact Analysis of Biomass Conversion Technology in Western States

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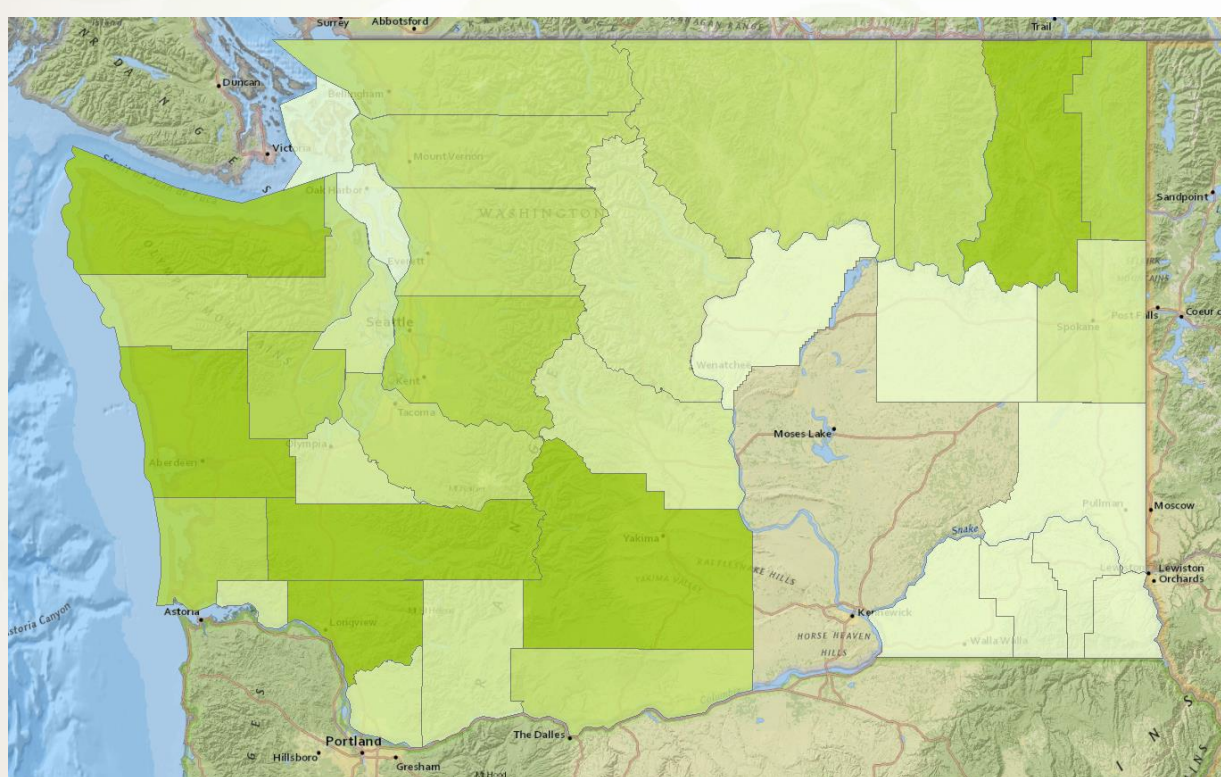
# Economic Impacts of Forest Biomass Collection

- The volume of forest biomass to collect is influenced by the value of biomass (\$/BDT) because of the operation cost
- BCT can increase the selling price of bioenergy/soil amendment products and can reduce the operation cost
  - More forest biomass collection
  - Revitalization of Rural Economy

Questions: How much forest biomass collection can impact rural economies on West Coast?

# Available Biomass in Washington State

- Annual Post-Timber Harvest Biomass is about 5.0-5.5 MM BDT in Washington State from 2015 to 2020



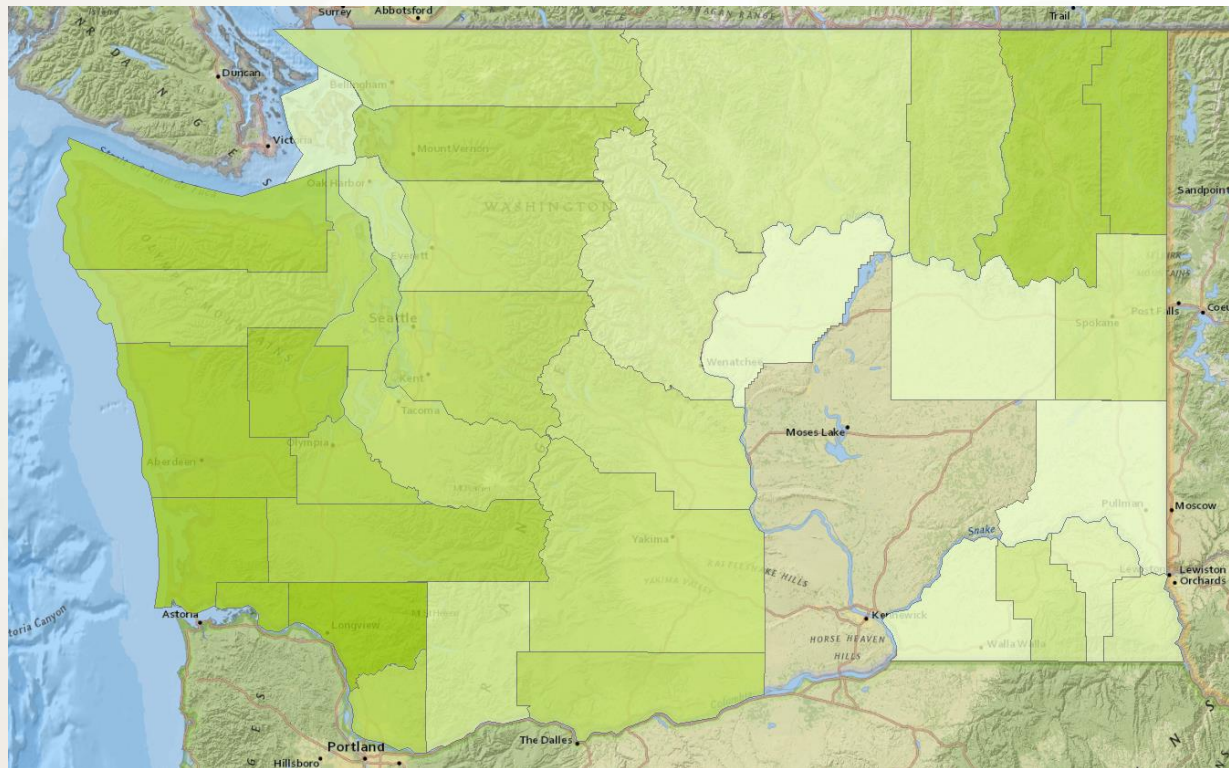
- Grays Harbor 498 BDkt
- Stevens 440 BDkt
- Lewis 410 BDkt
- Yakima 370 BDkt
- Cowlitz 367 BDkt
- Clallam 338 BDkt
- Pacific 282 BDkt
- Pend Oreille 248 BDkt



# Biomass per area in Washington State

Biomass per area →

Pacific Coast > Columbia Mts > Other Inlands



[ unit = BDT/sq mi ]

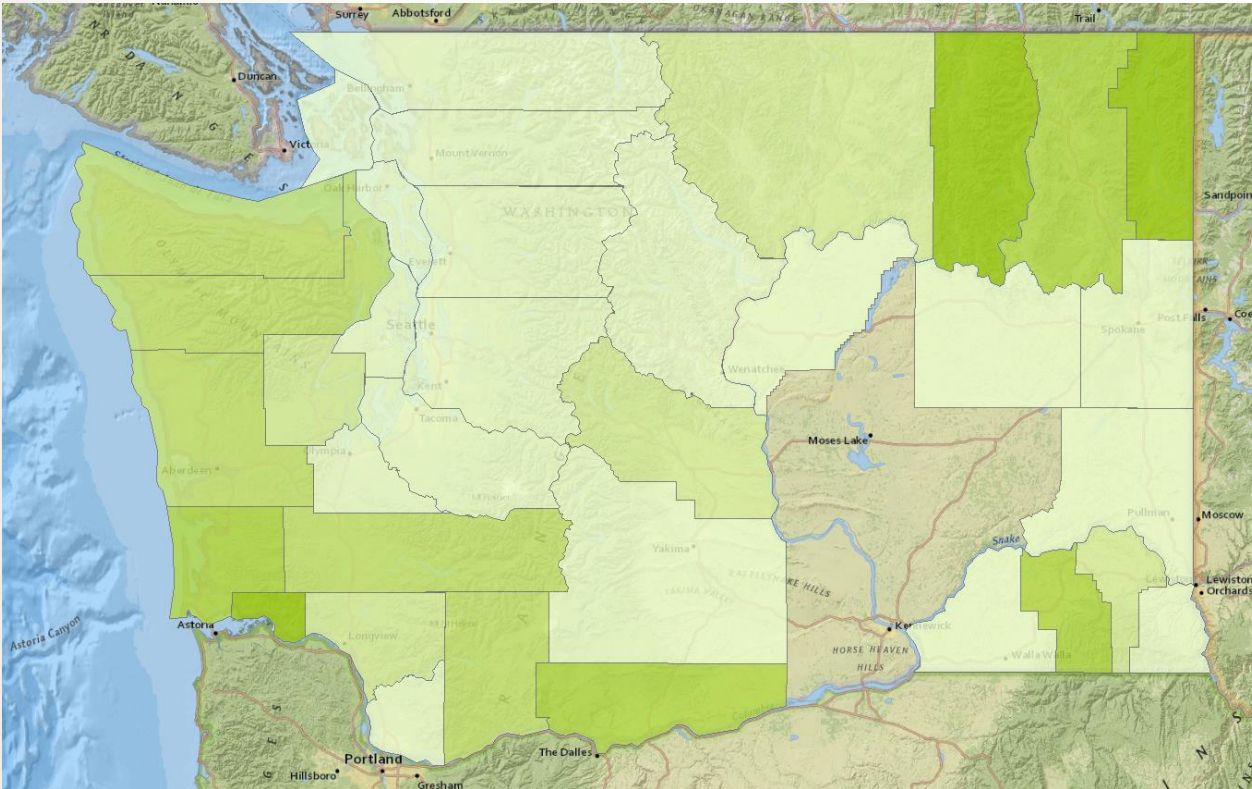
1. Cowlitz 323
2. Pacific 289
3. Wahkiakum 267
4. Grays Harbor 261
5. Mason 242
6. Clallam 193
7. Stevens 178
8. Pend Oreille 177
9. Lewis 170
10. Thurston 137

# Biomass per person in Washington State

- Rural areas in Pacific Coasts and Columbia Mountains have a lot of biomass resource per person.

[ unit = BDT/person ]

1. Ferry 25
2. Pend Oreille 19
3. Wahkiakum 18
4. Pacific 14
5. Stevens 10
6. Klickitat 10
7. Columbia 8
8. Grays Harbor 7
9. Jefferson 7
10. Lewis 5



## Economic Impact

- **Direct Effects:** result from expenditures associated with the bio-refinery facility.
- **Indirect Effects:** result from the suppliers of the bio-refinery to meet demand.
- **Induced Effects:** result from the employees of the facility and the suppliers at a household level.

The part supplied by imports from foreign country and other region is regarded an **economic leakage**

→ no economic impact for the region



# Biomass Collecting Operation



## Direct Effects



Purchase  
Materials  
/Service

## Suppliers in the County



## Induced Effects



## Employees



## Indirect Effects

## Models and Data

- **Leontief's Input-Output (I/O) Model** to estimate the economic impacts
- Assumptions: Economic structure of the region is deterministic. (i.e., Constant returns to scale. No substitution among inputs is possible in the production of any good.)

### Data Used:

- Inter-industrial transaction data purchased from IMPLAN
- Data from Biomass Calculator by Luke Rogers et al.

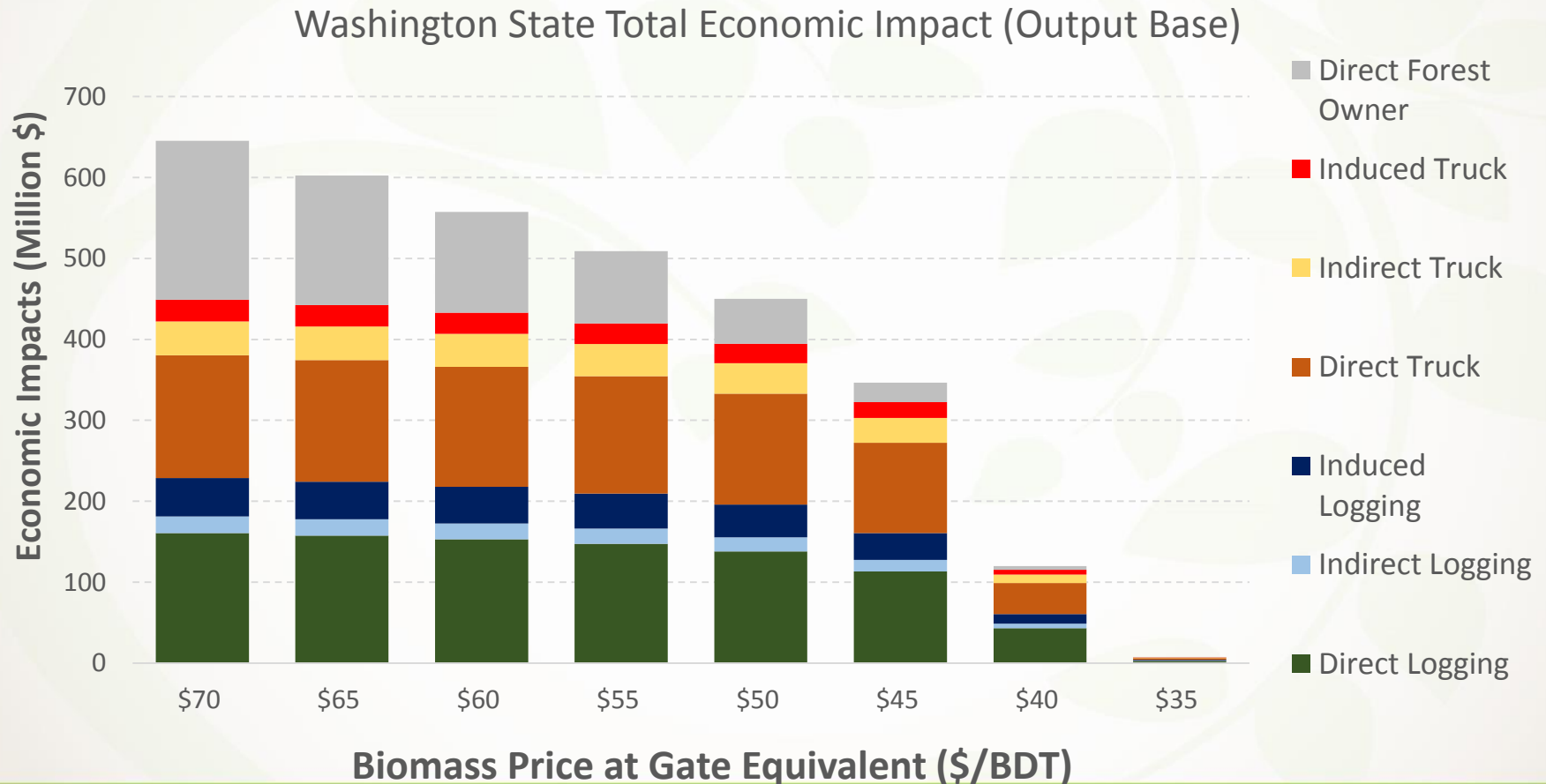


# Methodology and Assumption

- **Conservative estimation of economic impacts of forest biomass collection activities**
- Cost of operation is fixed by Biomass Calculator:
  - mobilization cost \$120/hr
  - load/unload cost \$26/BDT
  - haul cost \$95/hr
  - forest health cost \$45/BDT
  - truck load 16BDT/car
- Truck Transportation ← haul cost and  $\frac{1}{2}$  of load/unload cost
- Commercial Logging ← the other cost
- Forest owners will receive the remainder value as proprietors' income.

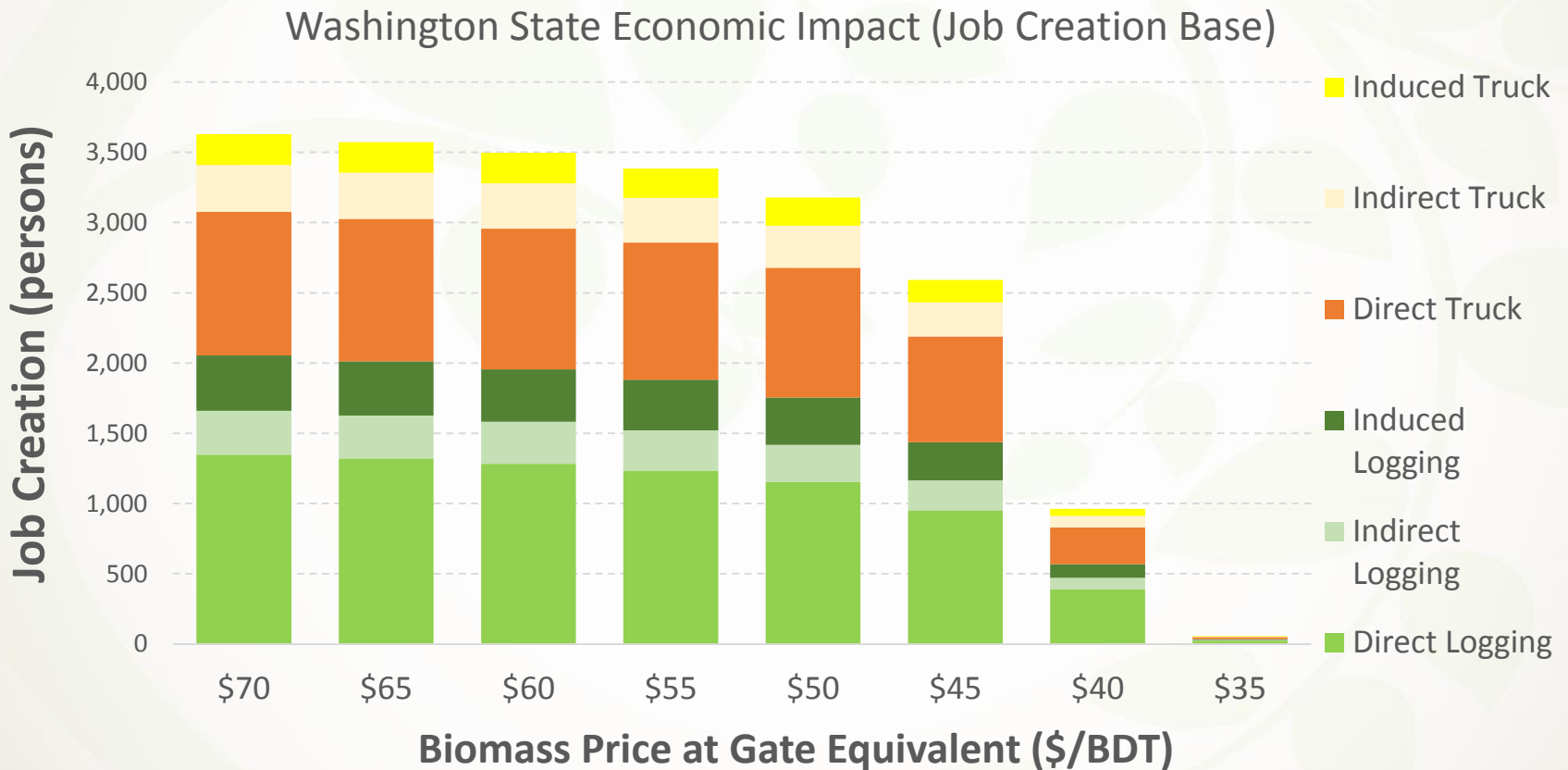
# Results: Output Impacts

- Volume to collect is almost same once they exceed \$50/BDT.
- Indirect: about 20% Induced: about 24% of Direct Effect



# Results: Job Impacts

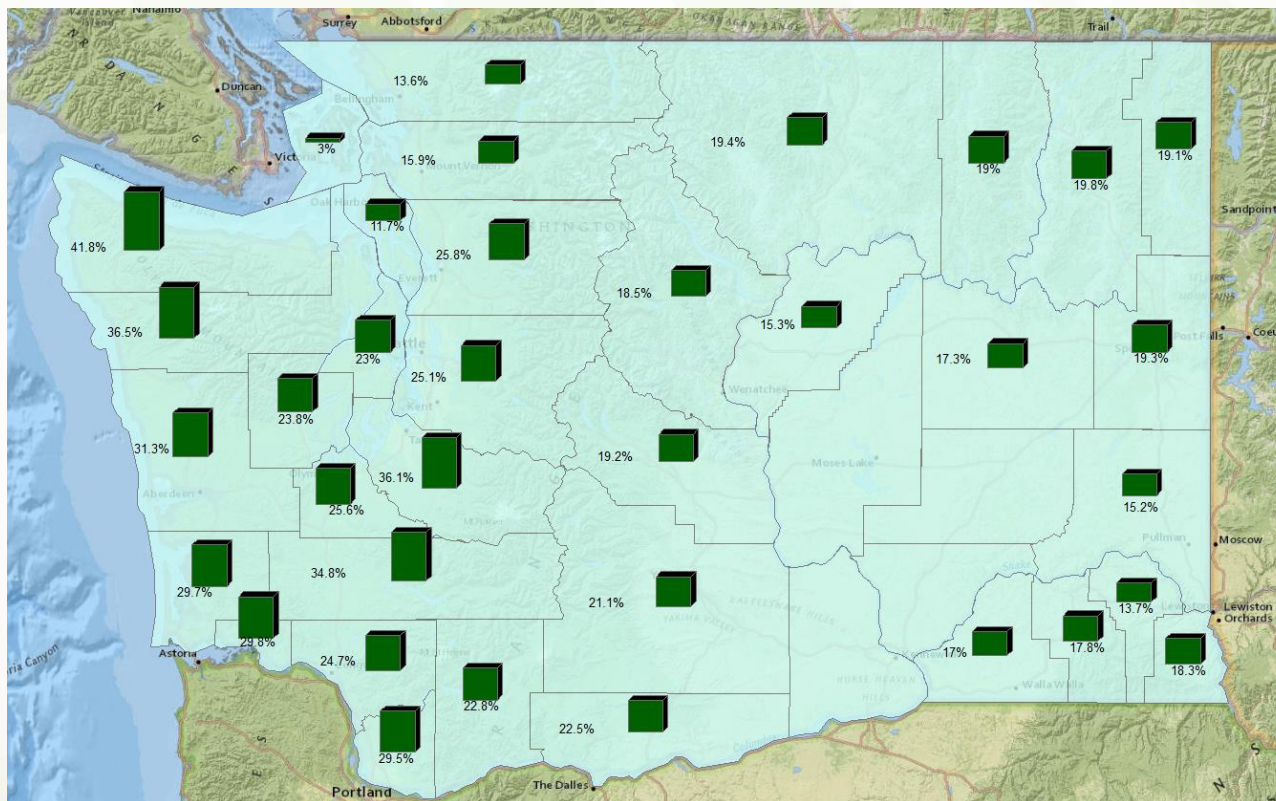
- Once biomass exceeds \$50, job growth is leveled off.
- Indirect: about 27%    Induced: about 26% of Direct Effect



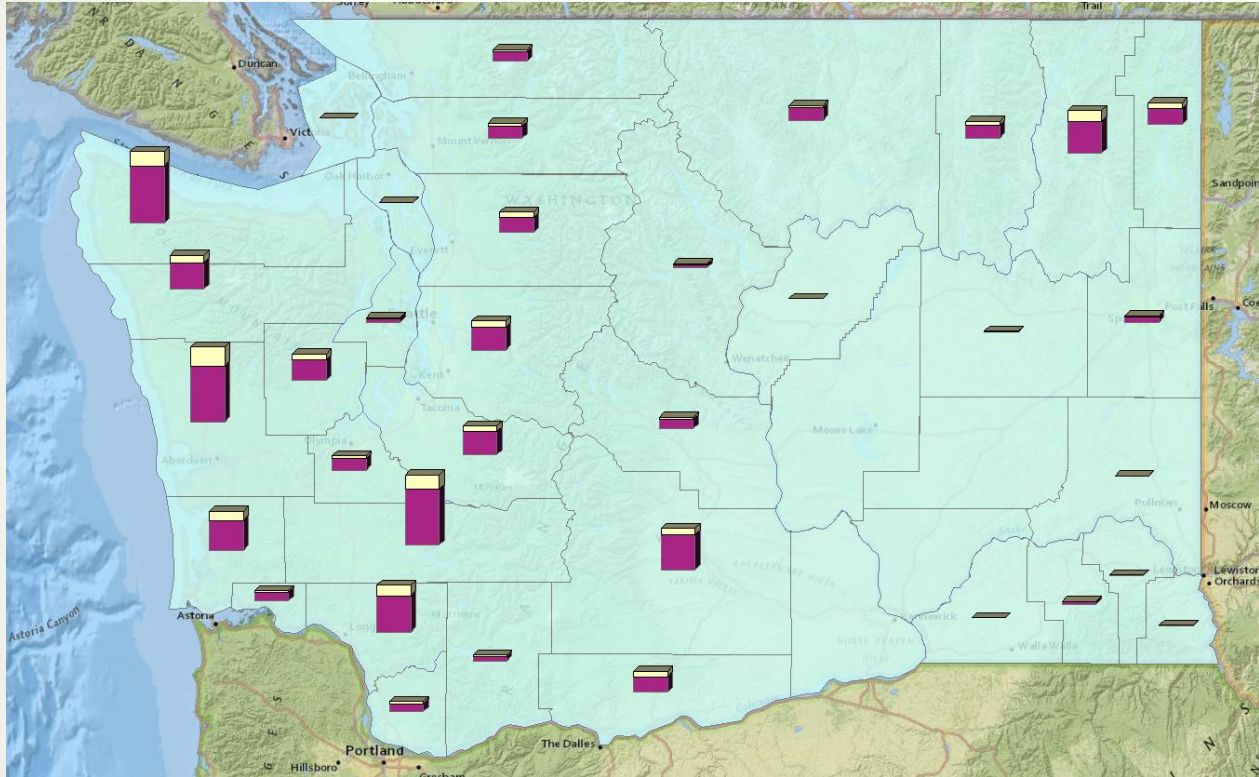


# Results: Percentage to Collect @ \$60

- 26.0% of post-harvested biomass can be collected.
- The ratio varies from 11.7% to 41.8% in each county.
- W2W project can increase the ratio as the operation cost decreases.



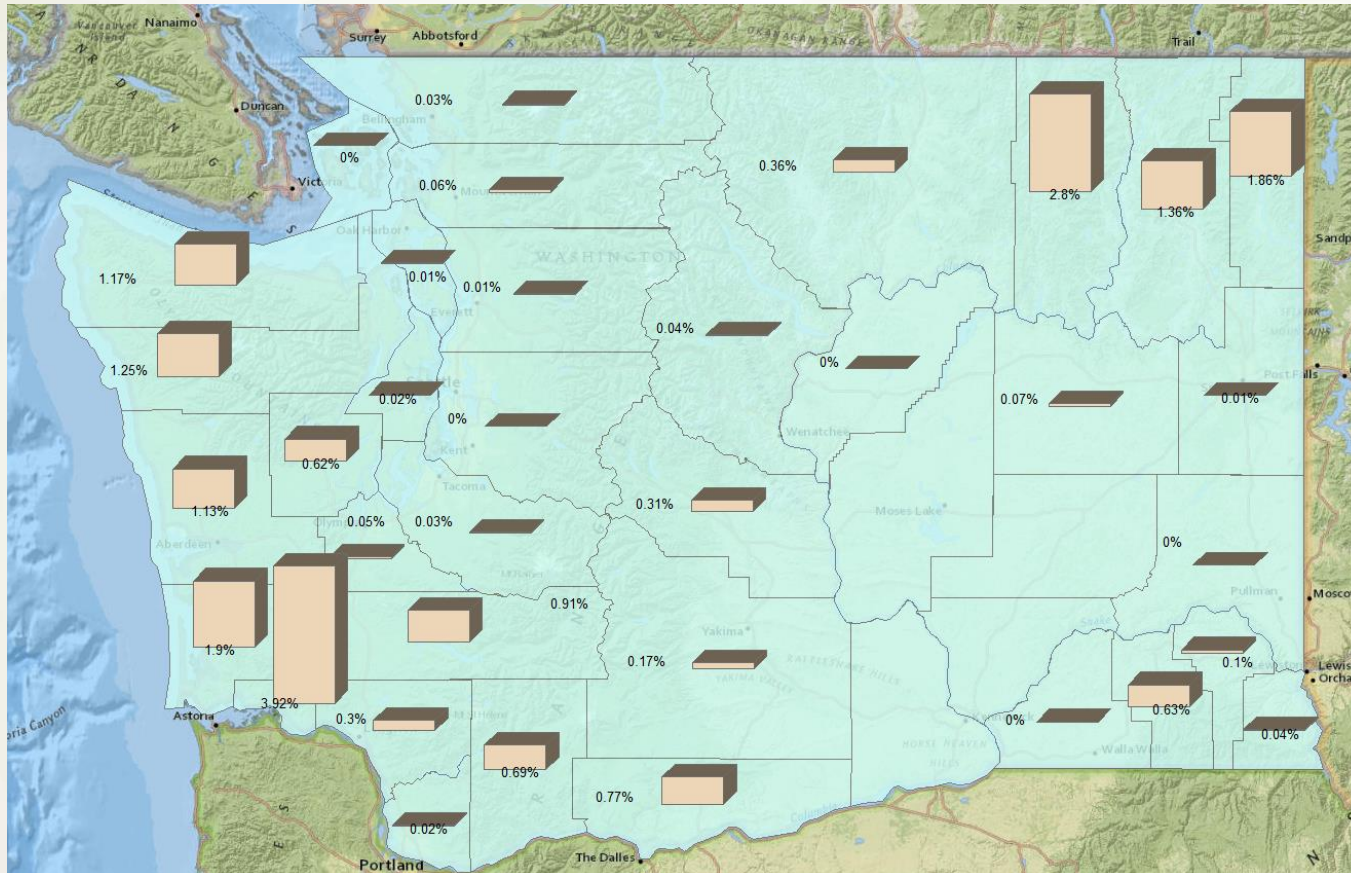
# Results: Economic Impacts by County @ \$60



1. Grays Harbor \$60M
2. Clallam \$57M
3. Lewis \$56M
4. Cowlitz \$38M
5. Stevens \$34M
6. Yakima \$33M
7. Pacific \$31M
8. Jefferson \$27M
9. Pierce \$23M
10. King \$23M



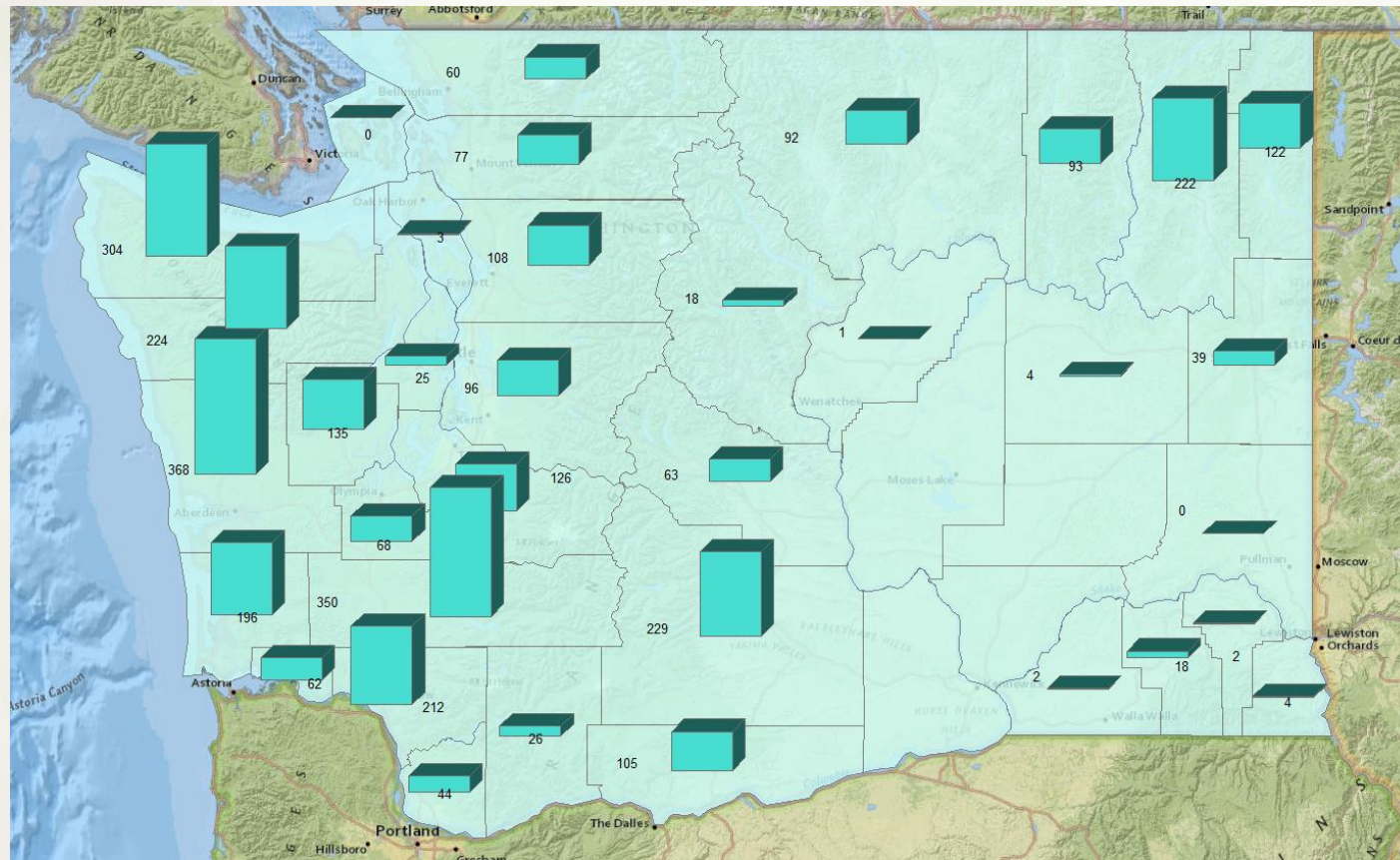
# Results: Output Contribution @ \$60



1. Wahkiakum 3.9%
2. Ferry 2.8%
3. Pacific 1.9%
4. Pend Oreille 1.9%
5. Stevens 1.4%
6. Jefferson 1.3%
7. Clallam 1.2%
8. Grays Harbor 1.1%
9. Lewis 0.9%
10. Klickitat 0.8%

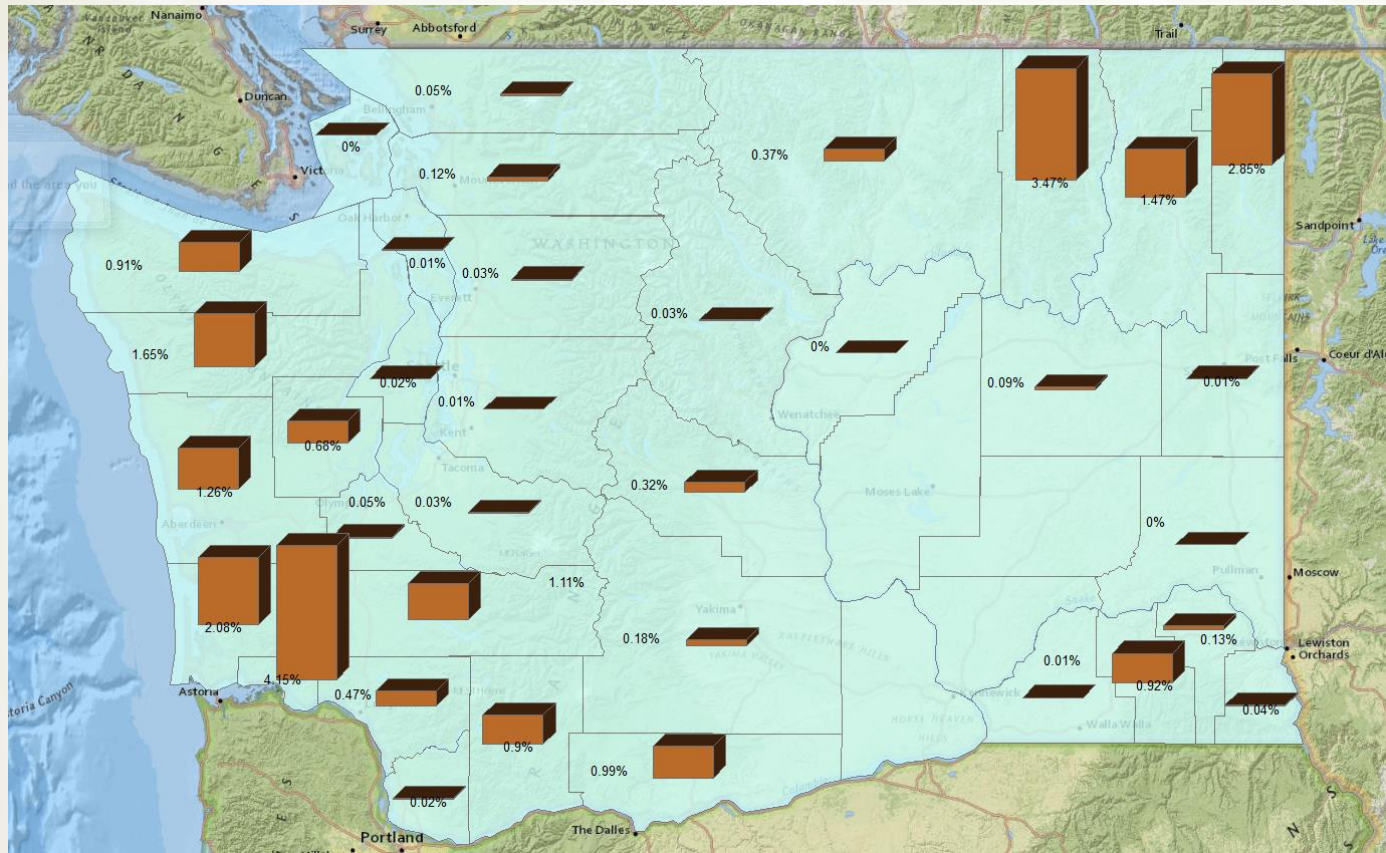


# Results: Job Creation by County @ \$60



1. Grays Harbor 368
2. Lewis 350
3. Clallam 304
4. Yakima 229
5. Jefferson 224
6. Stevens 222
7. Cowlitz 212
8. Pacific 196
9. Mason 135
10. Pierce 126

# Results: Job Contribution @ \$60



1. Wahkiakum 4.2%
2. Ferry 3.5%
3. Pend Oreille 2.9%
4. Pacific 2.1%
5. Jefferson 1.7%
6. Stevens 1.5%
7. Grays Harbor 1.3%
8. Lewis 1.1%
9. Klickitat 1.0%
10. Columbia 0.9%

# Conclusion

- Biomass collection can contribute a lot for rural economies in WA, especially Pacific Coast and Columbia Mountains region. Large indirect and induced effects.
- When biomass is \$50/BDT or more, WA can create 3,000-3,500 jobs with \$400-450M outputs under the current cost assumption. About 26% of the biomass out of 5.47M BDT can be collected in WA.
- W2W projects can reduce the cost structure of the biomass collection; hence, more biomass can be collected and this can impact rural economy further.
- The biomass data of Oregon and California will be provided by Luke Rogers' GIS team.

