

# Assessing the Sustainability of Virginia's Commercial Wood Supply

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# Is Virginia's wood usage sustainable?

- Virginia's forests have
  - Economic importance
  - Environmental importance
- Forests require a long-term view
- Spatial distribution is critical
- Ownership matters



Photo credit: Charlie Becker



# Is Virginia's wood usage sustainable?

- Current demands on forests
- Anticipated changes in forest area
- Data-driven baseline assessment, considering
  - Spatial distribution of resource
  - Forest ownership patterns
  - Analyzing what's available
  - Relevant metrics
- Modeling the future



Photo © Gary P. Fleming



# Current Demands on Forests

## Pulp & Paper



Photo credit: David B. Hollingsworth, Virginian-Pilot

## OSB



Photo Credit: PRNewswire

## Saw and Veneer



Photo Credit: Fitzgerald log & lumber co.



# Current Demands on Forests

Biomass for Renewable Energy



Photo credit: ESI

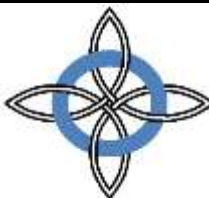
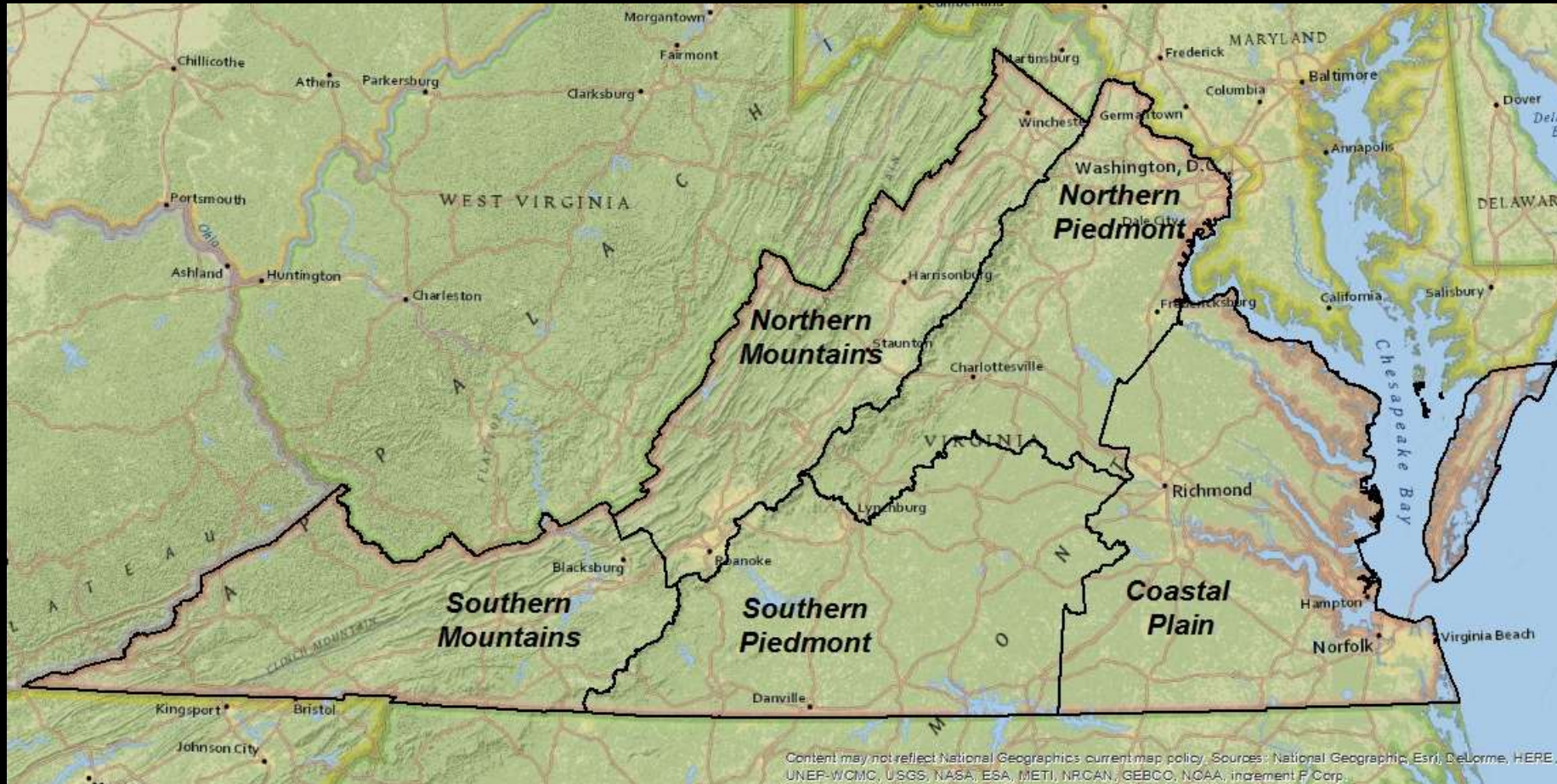
Wood pellets



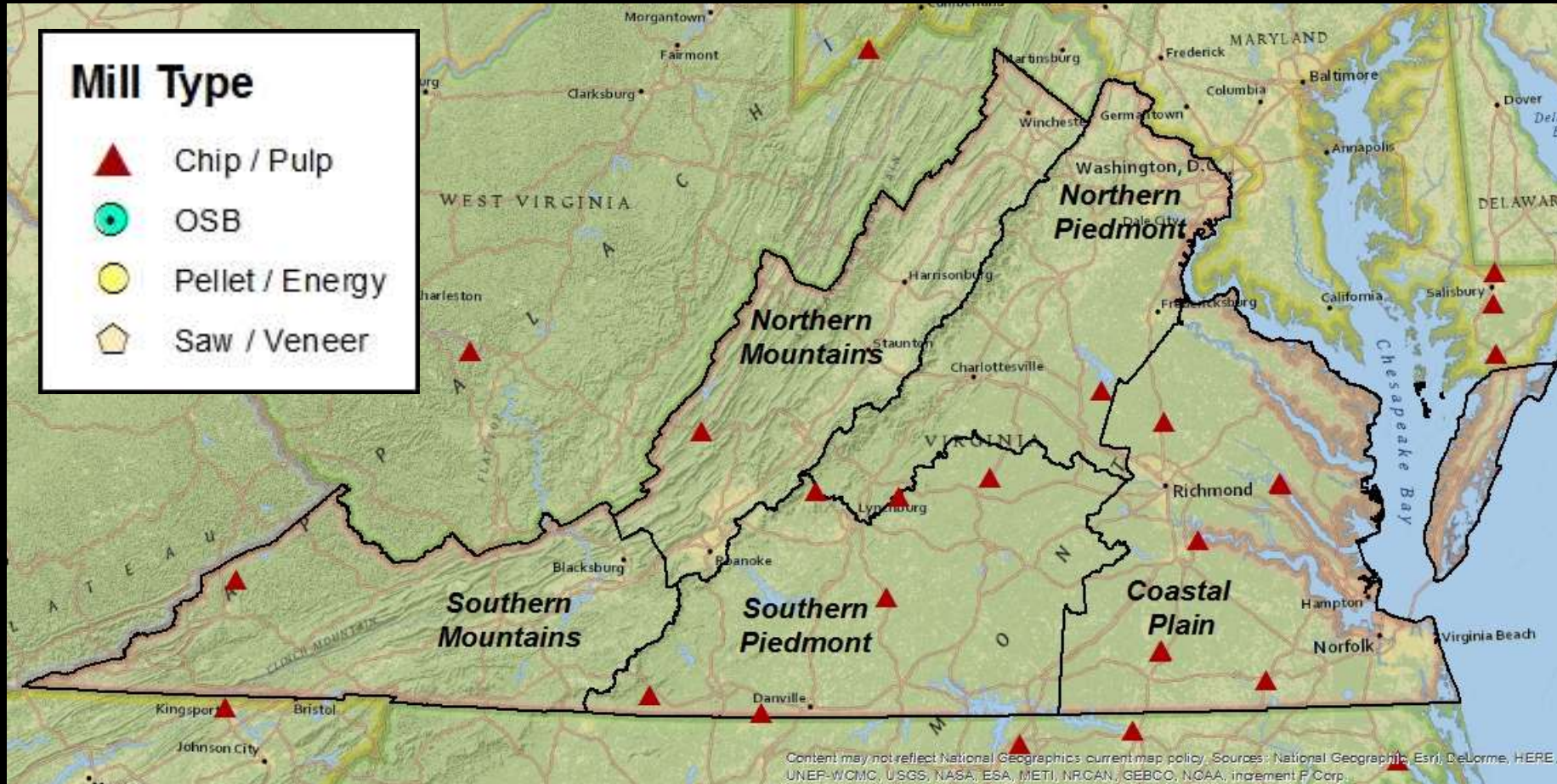
Photo credit: Enviva



# Current Demands on Forests



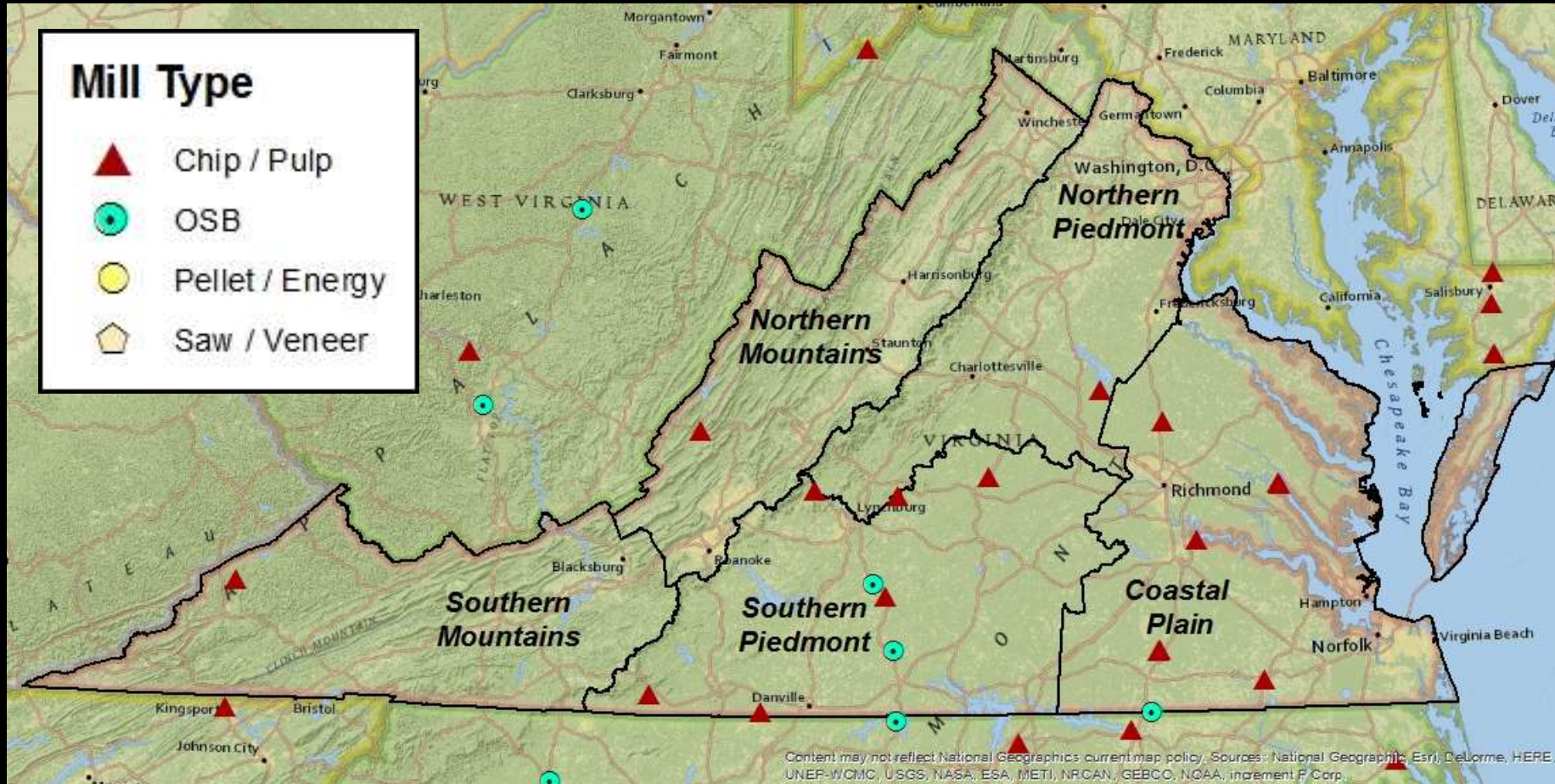
# Current Demands on Forests



Mill data source: UGA Wood Demand Research Program



# Current Demands on Forests

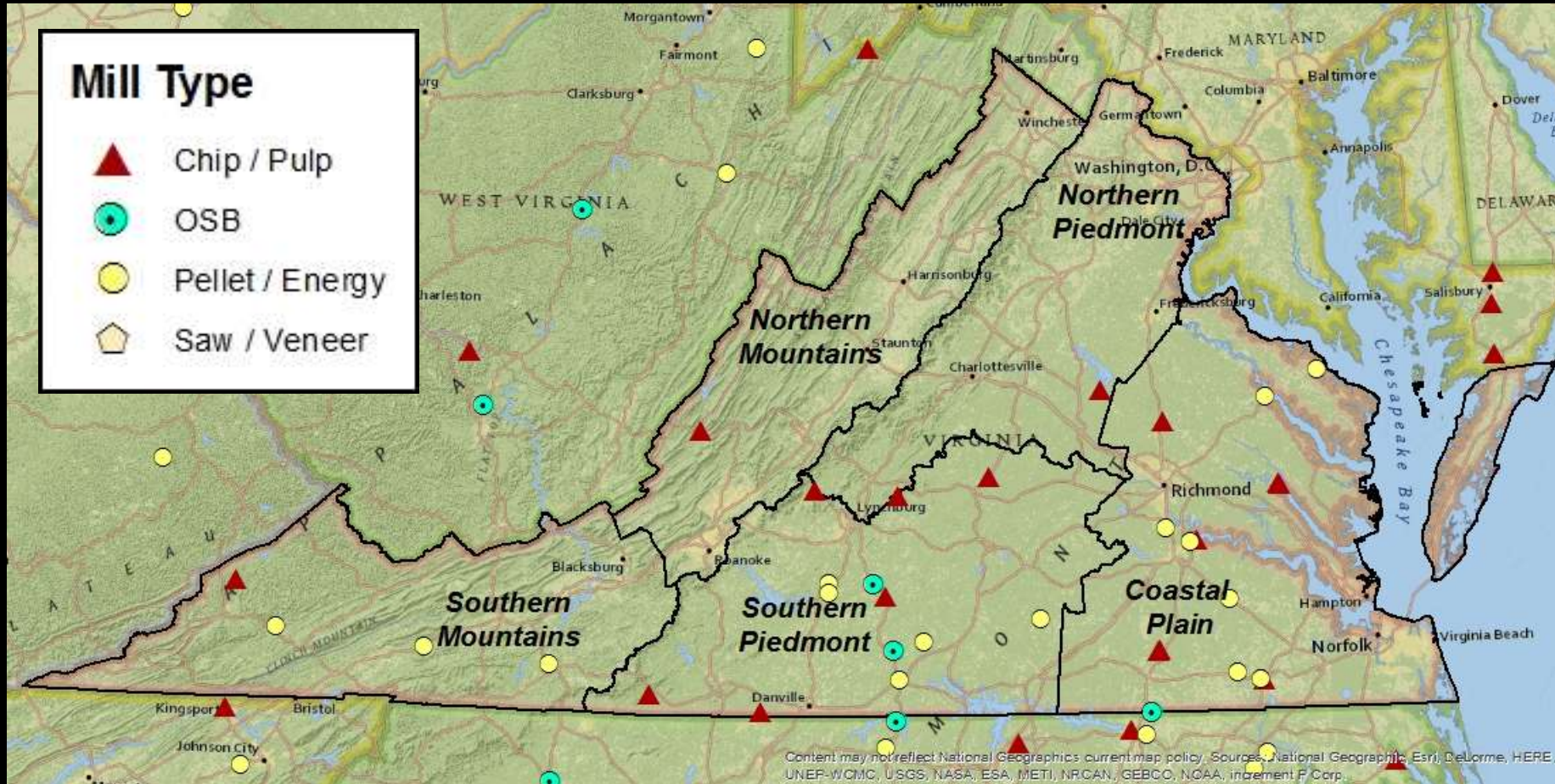


Mill data source: UGA Wood Demand Research Program

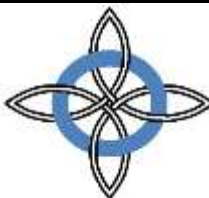




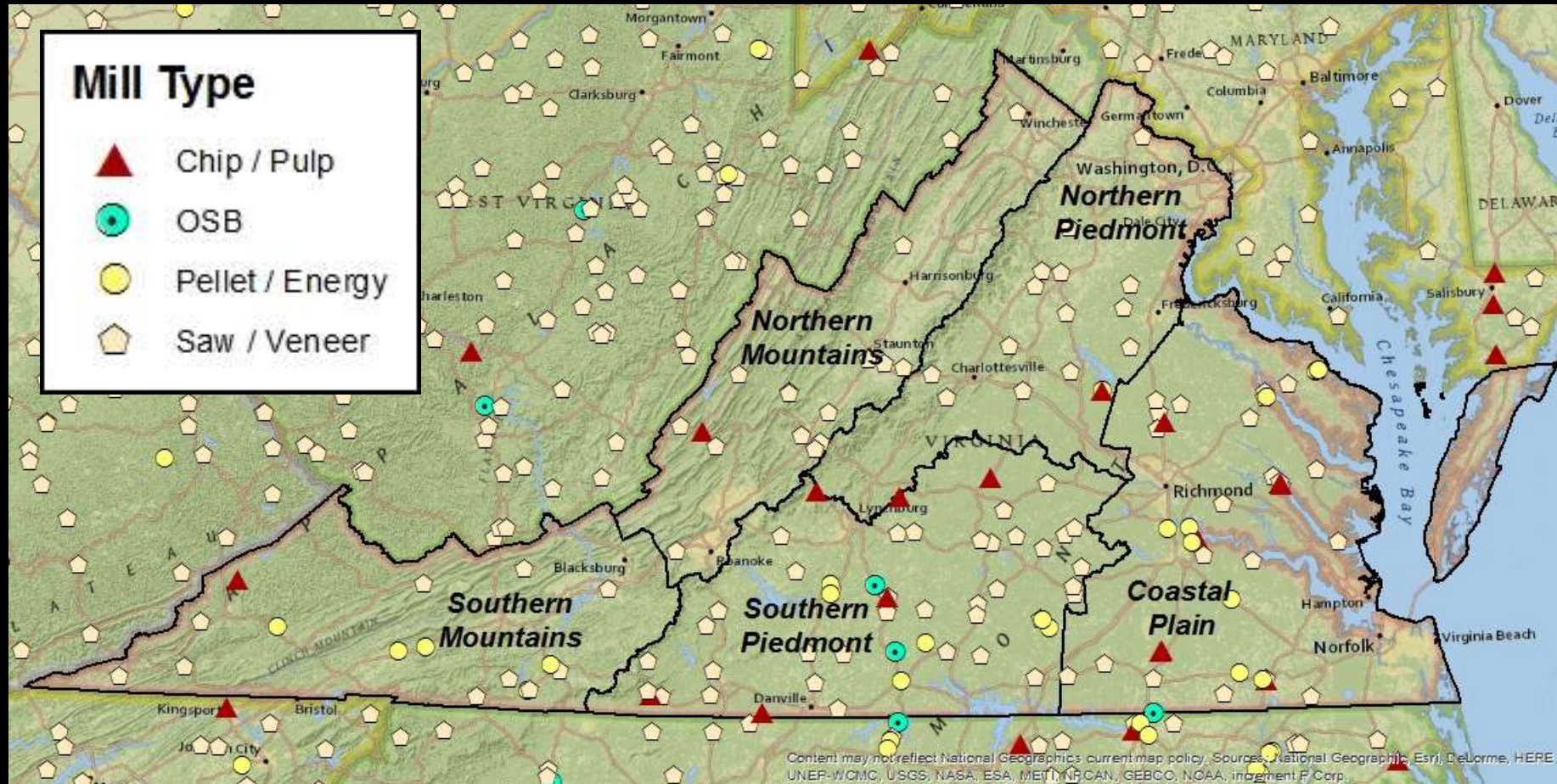
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Mill data source: UGA Wood Demand Research Program



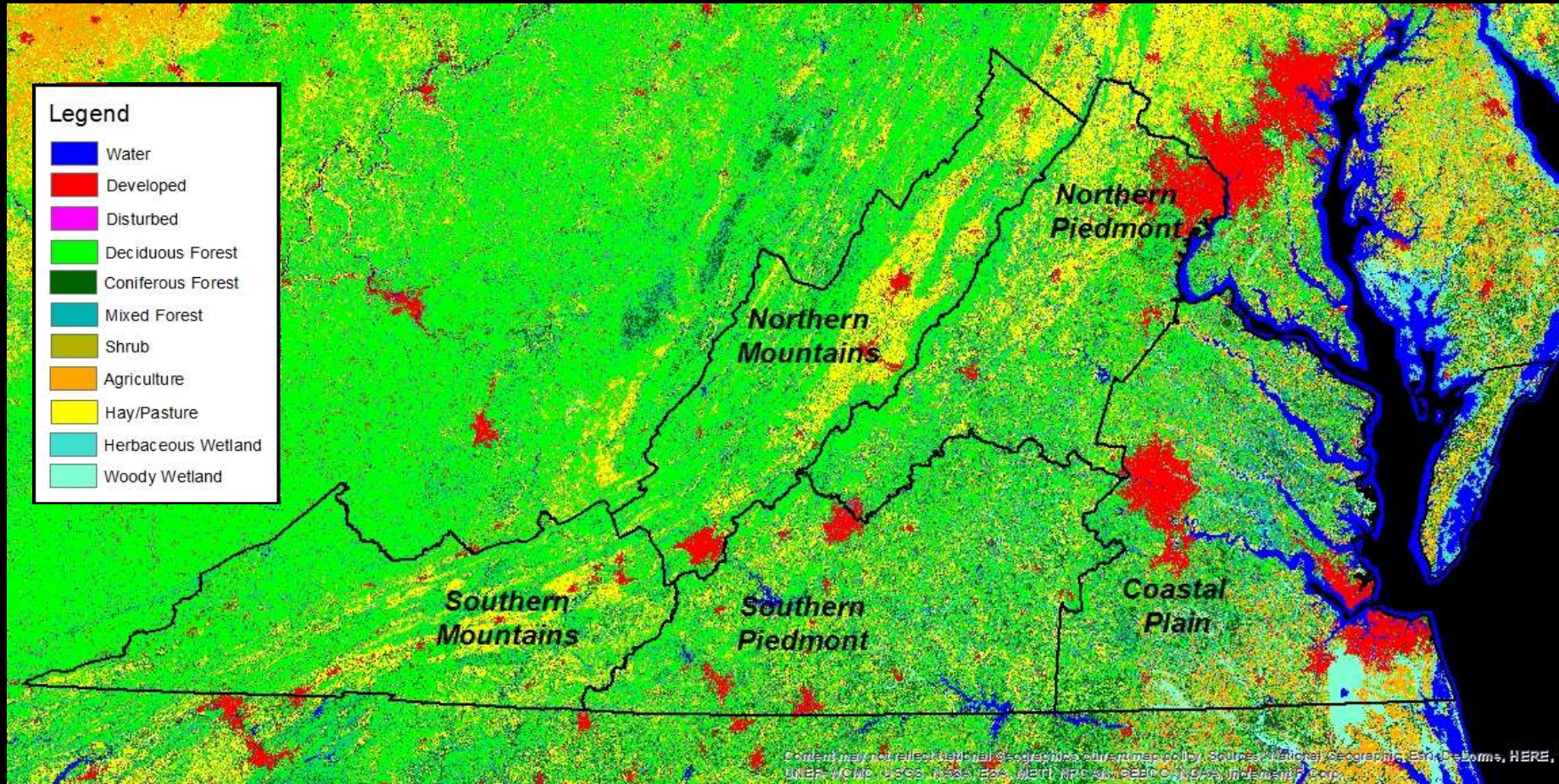
# Current Demands on Forests



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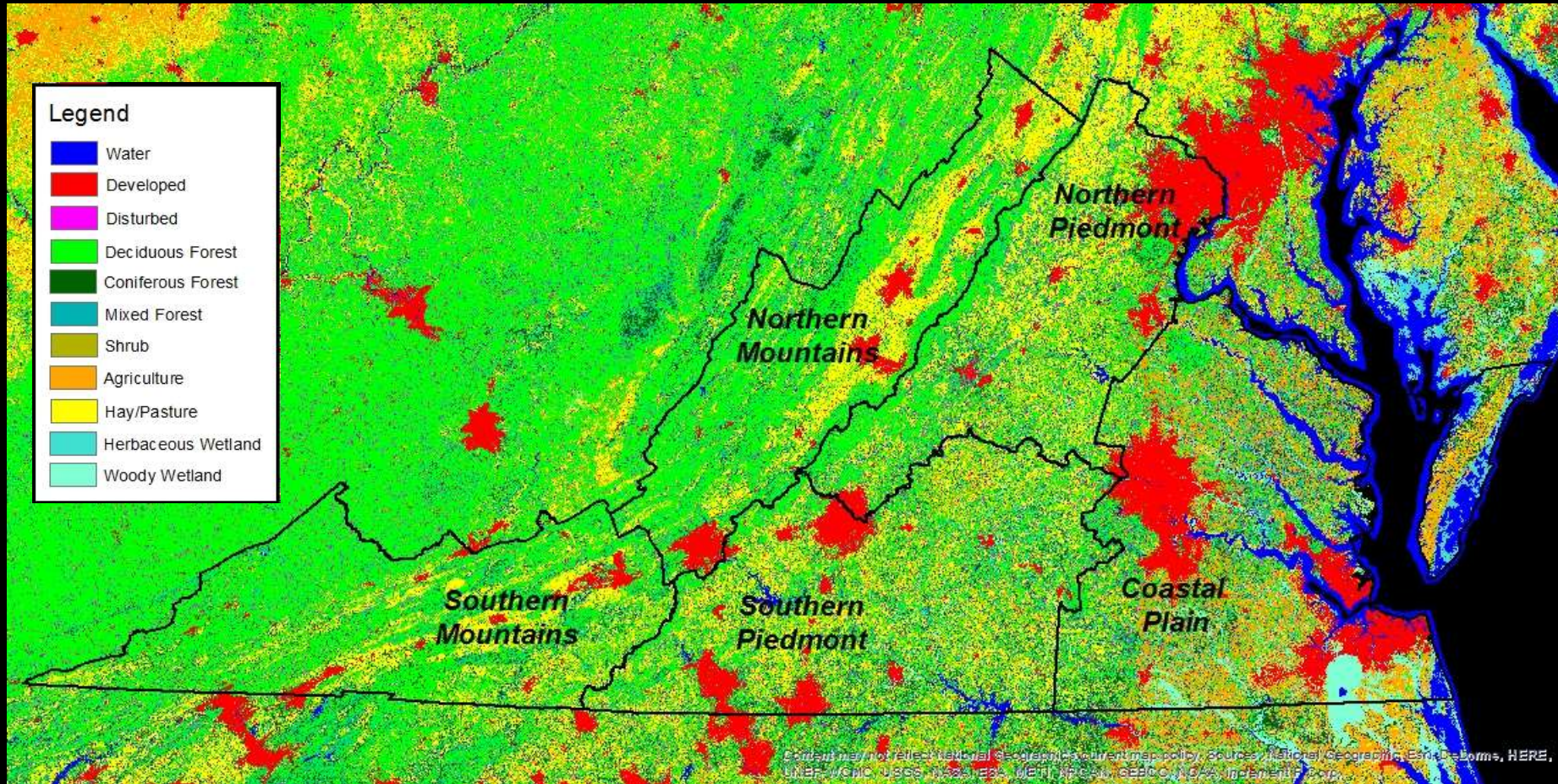
# Anticipated changes in forest area



USGS Land Cover Projection - 2010



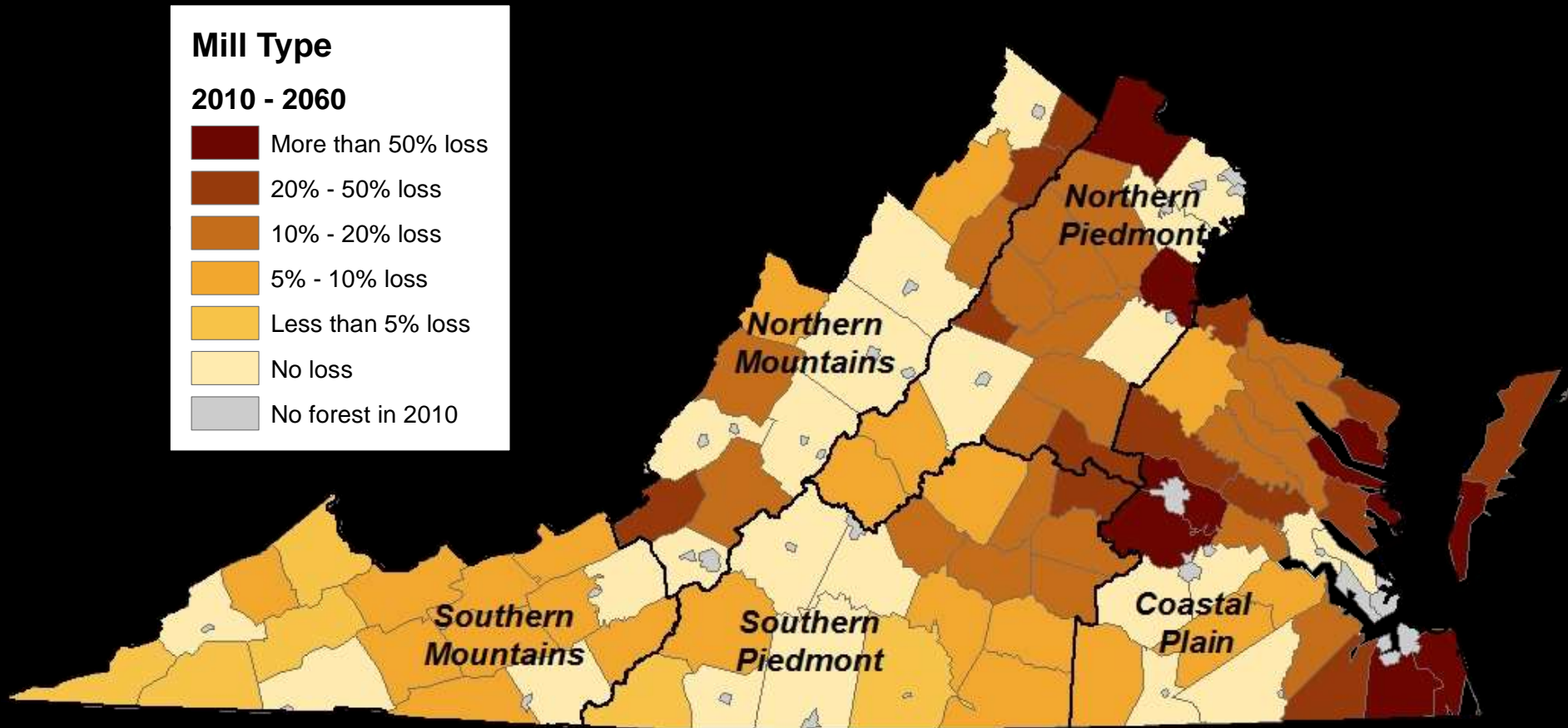
# Anticipated changes in forest area



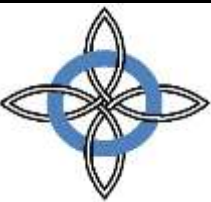
USGS Land Cover Projection - 2060



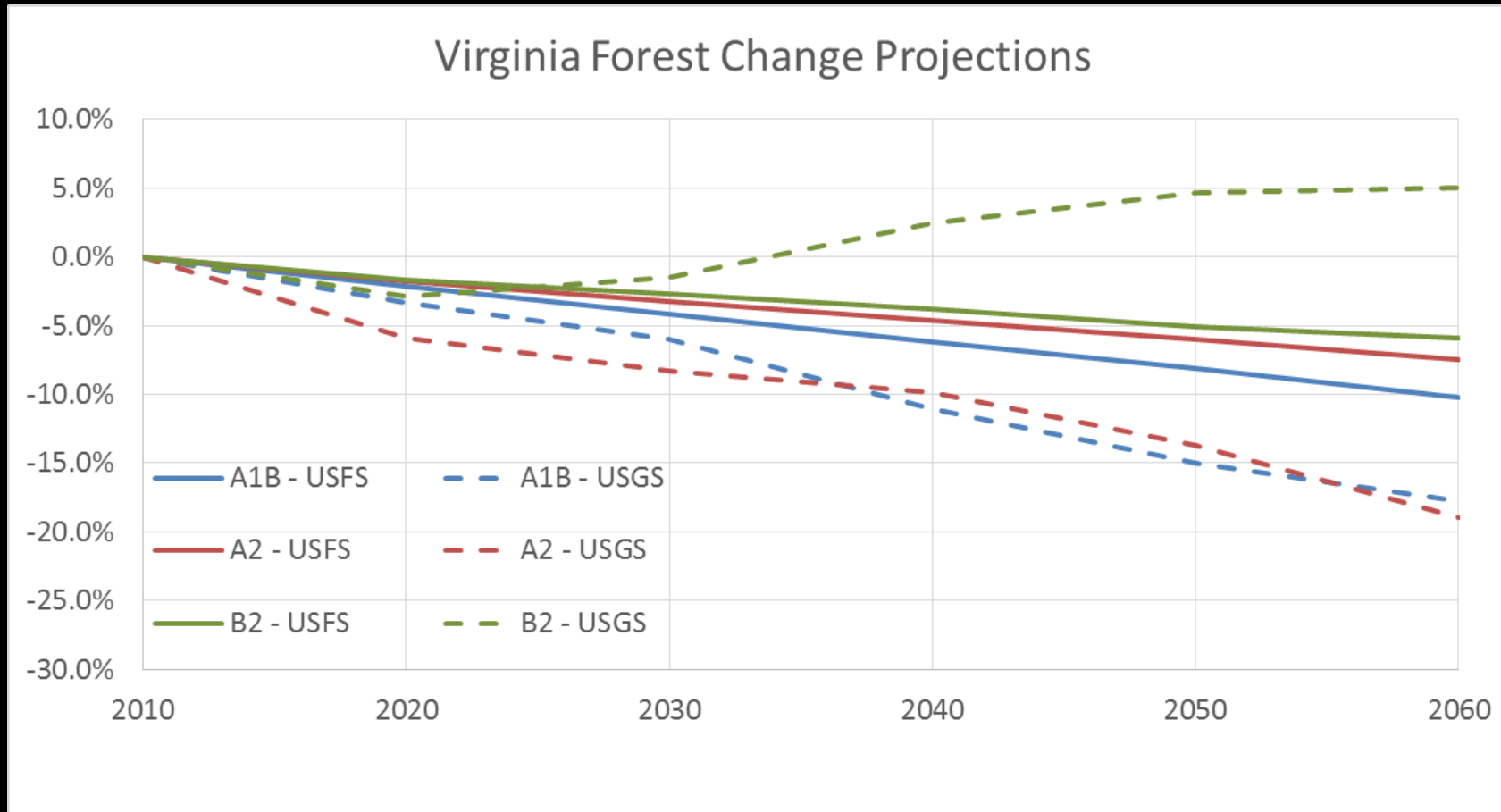
# Anticipated changes in forest area



USFS Forest Cover Projection 2010 - 2060



# Anticipated changes in forest area



USFS: RPA Assessment

USGS: LandCarbon

A1B, A2, B2:  
IPCC Scenarios



# Data-driven baseline assessment



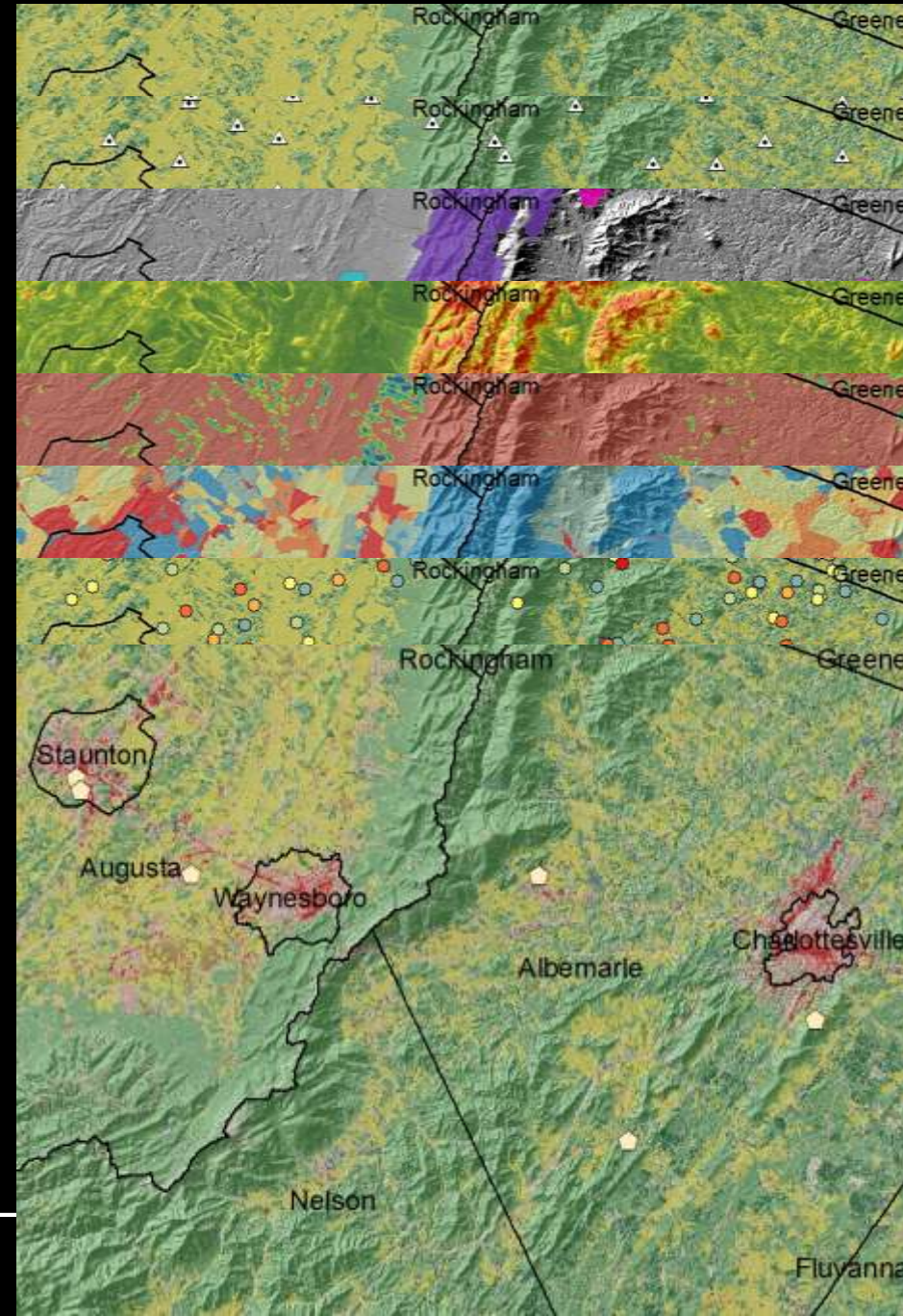
Photo credit: John Pemberton

- Quantify inventory, growth and removals (harvest)
- Forest area & distribution
- Focus on the private forest
- What portion of inventory is “available”?
- Relevant metrics about supply/demand, growth/removals



# Data-driven baseline

- USGS Land cover (NLCD)
- Forest inventory (USFS FIA)
- Land Ownership (DCR)
- Terrain (USGS DEM)
- Soil drainage classes (NRCS)
- Population density (US BOC)
- Harvest locations (VDF)
- Mill locations (UGA WDRP)



Land Cover

Inventory plots

Ownership

Terrain

Soil drainage

Population

Harvests

Mills

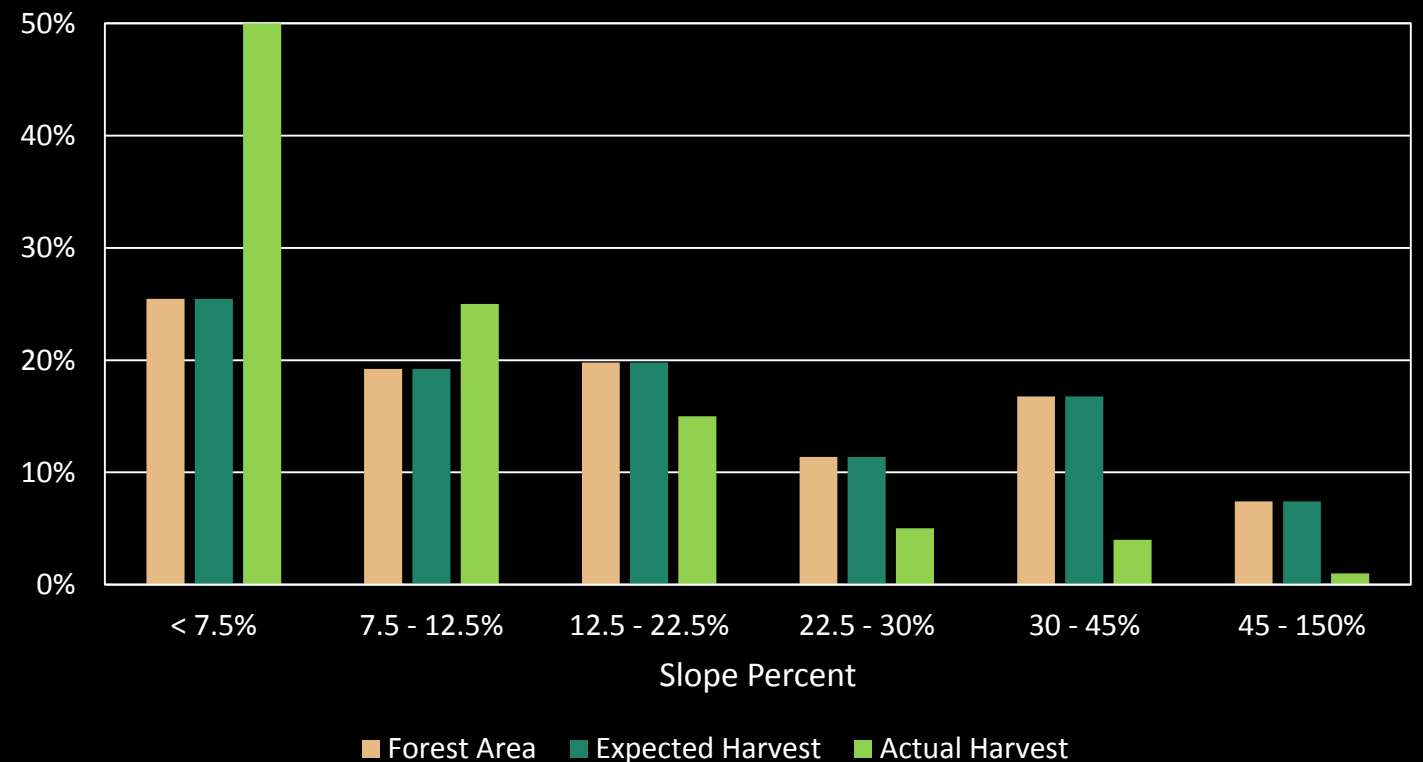




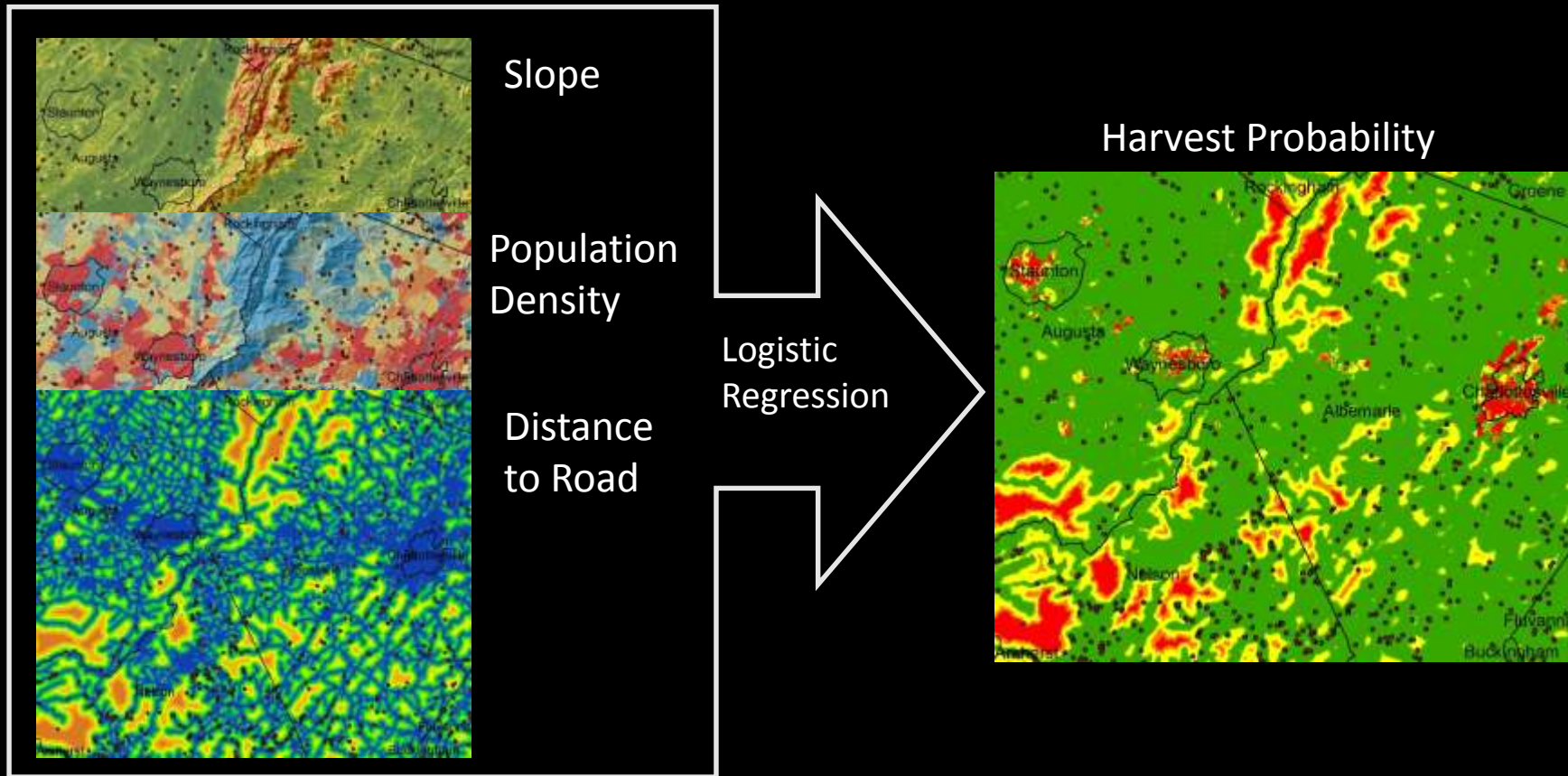
# Analyzing Availability

- Identify “available”:
  - VDF Harvest data shows where harvests have occurred
  - Are some landscapes less likely to experience harvest?
  - E.g., slope steepness shows decreasing harvest likelihood with increasing terrain slope

Forest and Harvest Distribution by Slope Class



# Analyzing Availability



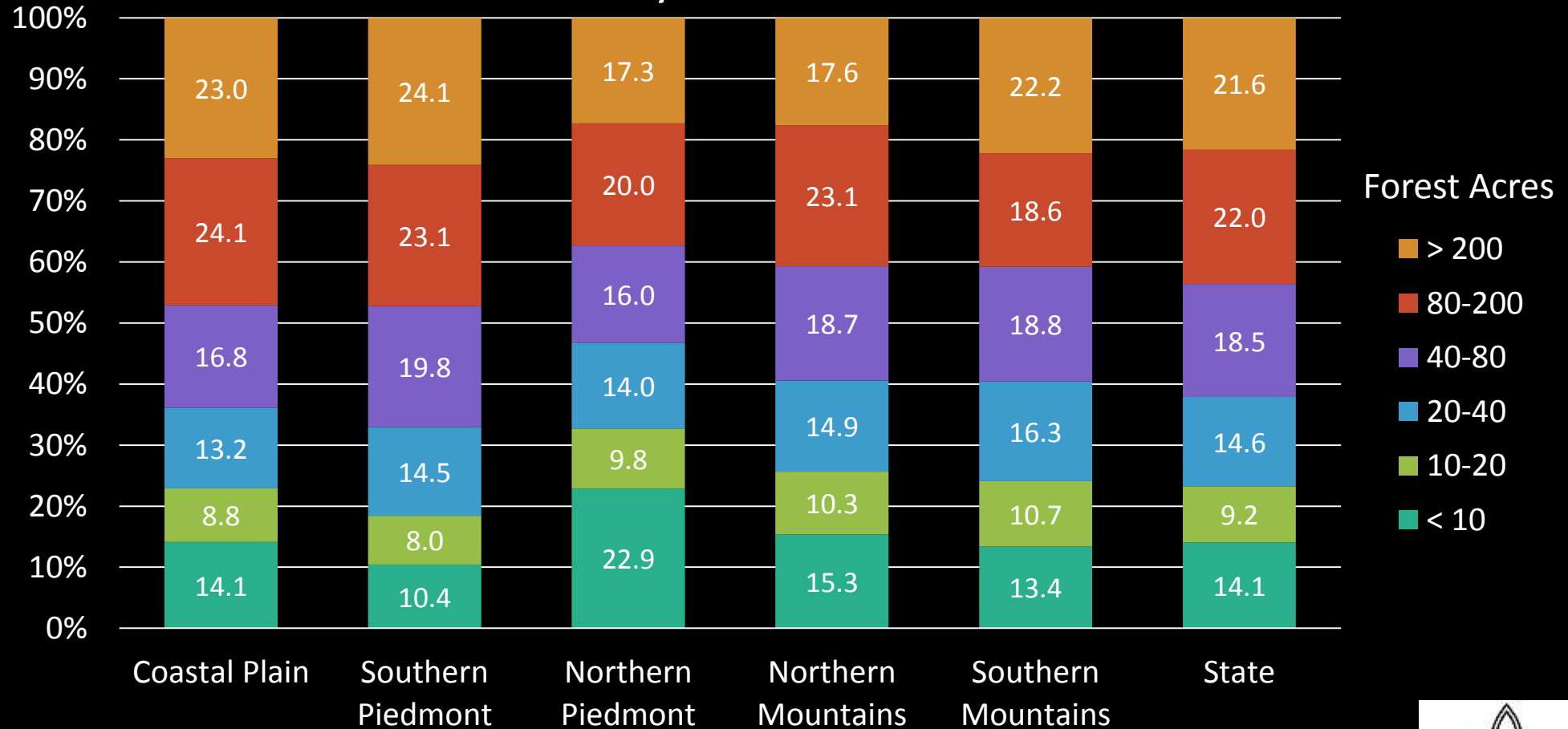
# Forest ownership patterns

- 82% of Virginia's forests are privately owned
- Forest tract size has significant impact on harvesting efficiency and options available
  - How much private forest is in small parcels?
  - What proportion of harvests occur in these small parcels?
  - To what extent are landowner decisions about harvesting related to size of parcels owned?



# Forest ownership patterns

## Forest Area by Forest Parcel Size Class

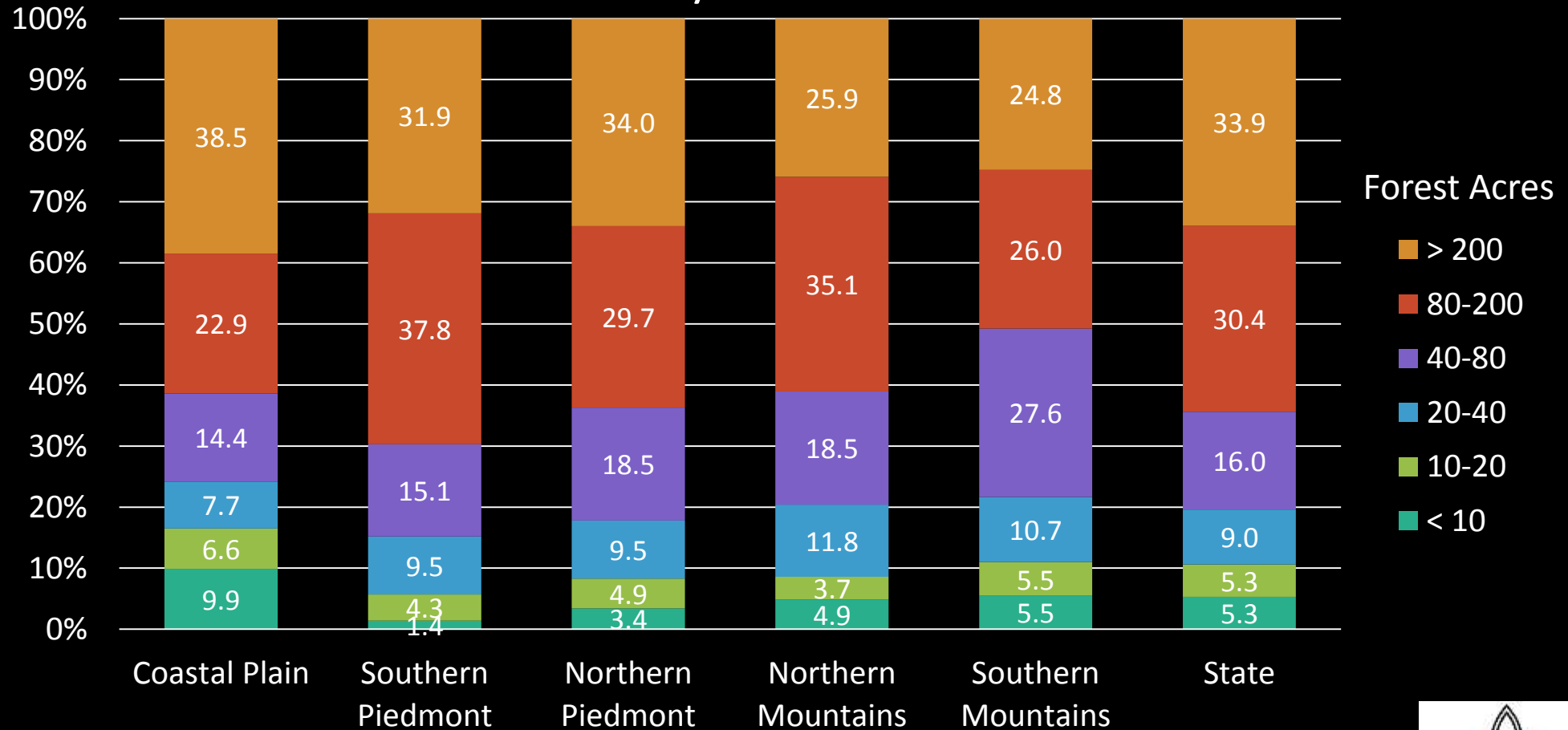


*Statewide, 23% of private forest occurs in parcels with less than 20 acres of forest.*



# Forest ownership patterns

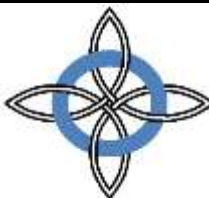
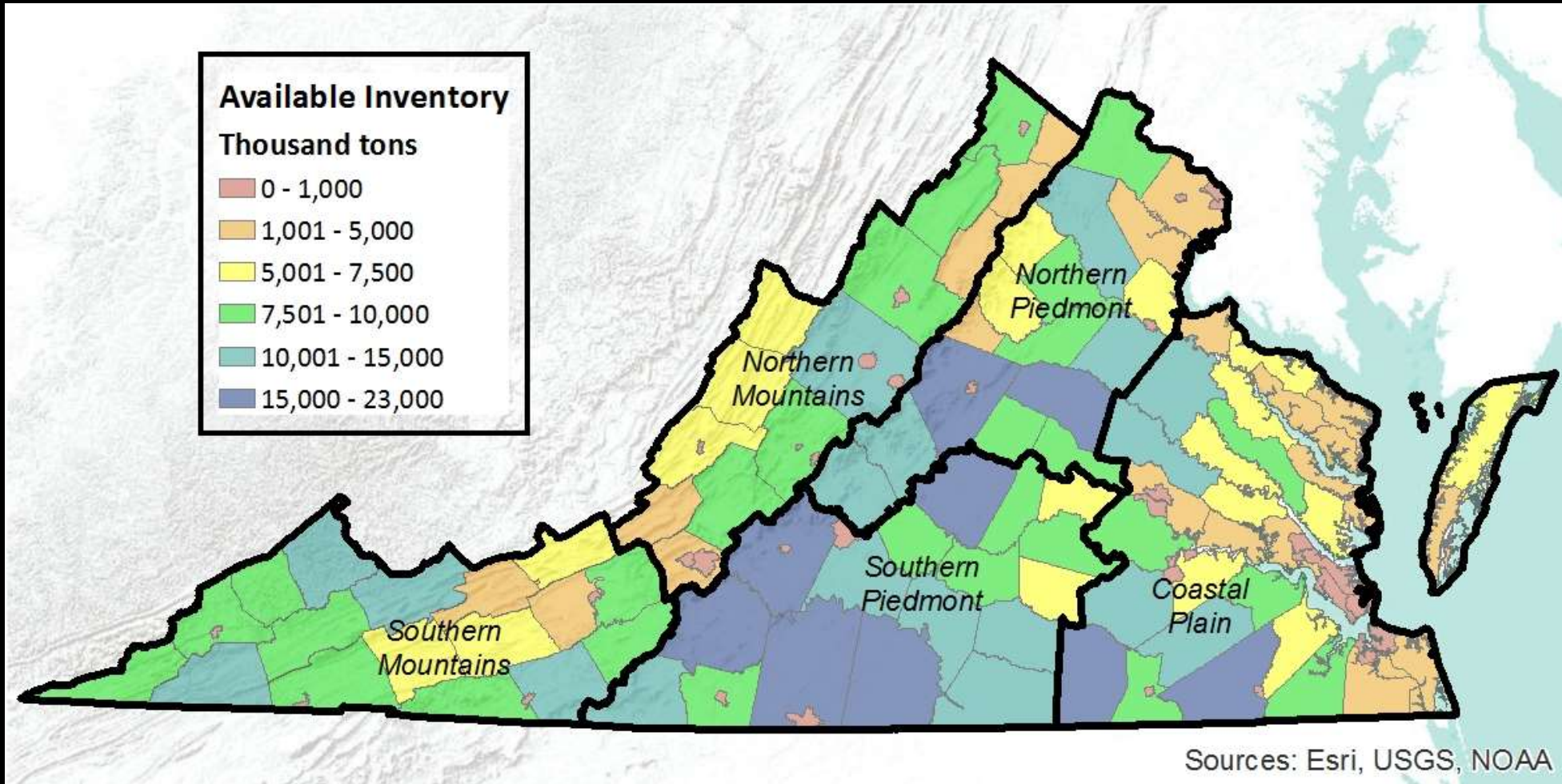
## Harvest Acres by Forest Tract Size Class



*Statewide, only 10.6% of forest harvest occurs in patches of less than 20 acres.*



# Analyzing Available Supply



# Relevant metrics- results by region

Metric	Coastal Plain	Southern Piedmont	Northern Piedmont	Northern Mountains	Southern Mountains	STATE
Private Inventory (k tons)	235,809	216,971	175,551	106,823	179,005	914,158
Available private Inventory (k tons)	225,898	210,431	162,476	93,046	146,276	838,126
Growth on Available (k tons)	9,301	8,369	4,494	2,519	4,066	28,748
Removals/Harvest (k tons)	5,517	5,757	1,722	1,228	1,191	15,414
Growth:Removals ratio	1.7	1.5	2.6	2.1	3.4	1.9
Surplus growth (k tons)	3,784	2,612	2,772	1,291	2,875	13,334



# Relevant metrics – results by product

- Inventory measures trees; standardized definition for sawtimber
- Markets measure products
  - Distinction between sawtimber and pulpwood can change over time, across regions, etc.
- Balancing growth from inventory with removals by product cannot be exact





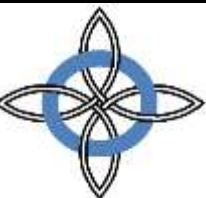
# Relevant metrics – results by product

Data Source	Thousand Tons				STATE
	Softwood Sawtimber	Softwood Pulpwood	Hardwood Sawtimber	Hardwood Pulpwood	
All removals (FIA, 2012)	3,798	3,432	5,106	3,971	16,308
Removals from private land (FIA, 2012)	3,385	3,216	4,467	3,179	14,247
Timber Product Output (USFS, 2011)	2,614	5,851	3,360	4,066	15,891
Harvest Data (VDOF, 2011)	3,189	5,609	5,076	2,967	16,841
UGA Wood Demand Res. Pgm. (2013)	4,516	6,821	2,889	5,429	19,655



# Relevant metrics- results by product

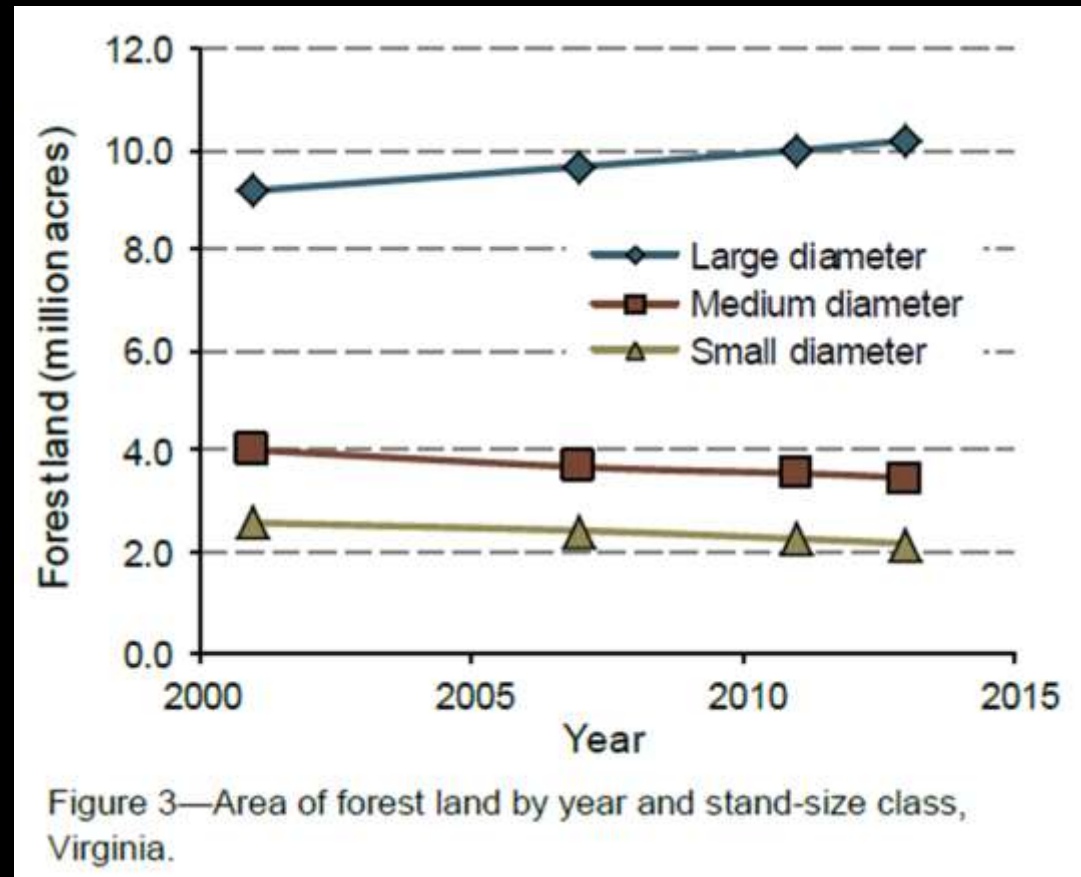
Metric	Softwood Sawtimber	Softwood Pulpwood	Hardwood Sawtimber	Hardwood Pulpwood	STATE
Private Inventory (k tons)	131,192	74,813	409,936	298,217	914,158
Available private Inventory (k tons)	124,681	71,435	371,518	270,493	838,126
Growth on Available (k tons)	8,576	3,200	12,908	4,065	28,748
Removals/Harvest (k tons)	2,536	5,676	3,259	3,944	15,414
Growth:Removals ratio	3.4	0.6	4.0	1.0	1.9
Surplus growth (k tons)	6,040	(2,476)	9,649	121	13,334



# Relevant metrics- results by product

- Corroborates results from Rose, 2015:

*“Forest land in Virginia is maturing. Area of large-diameter stands has been increasing, while that of medium and small diameter stands has been decreasing.”*



Rose, A.K. 2015. Forests of Virginia, 2013



# Modeling the future

- Baseline assessment is a look at the recent past
- Need a model that looks into the future
- Our approach: the Spatial Wood Supply Simulator (SWSS)
  - Agent-based model
  - Large, spatially-defined datasets
  - Simulates wood supply chain
  - Accommodates scenario analysis



# Modeling the future

- Mill locations/demands within and near Virginia
- Forest inventory/location
- Transportation network: costs
- Simulation of bidding behavior by wood buyers
- Growth of forest volume over time



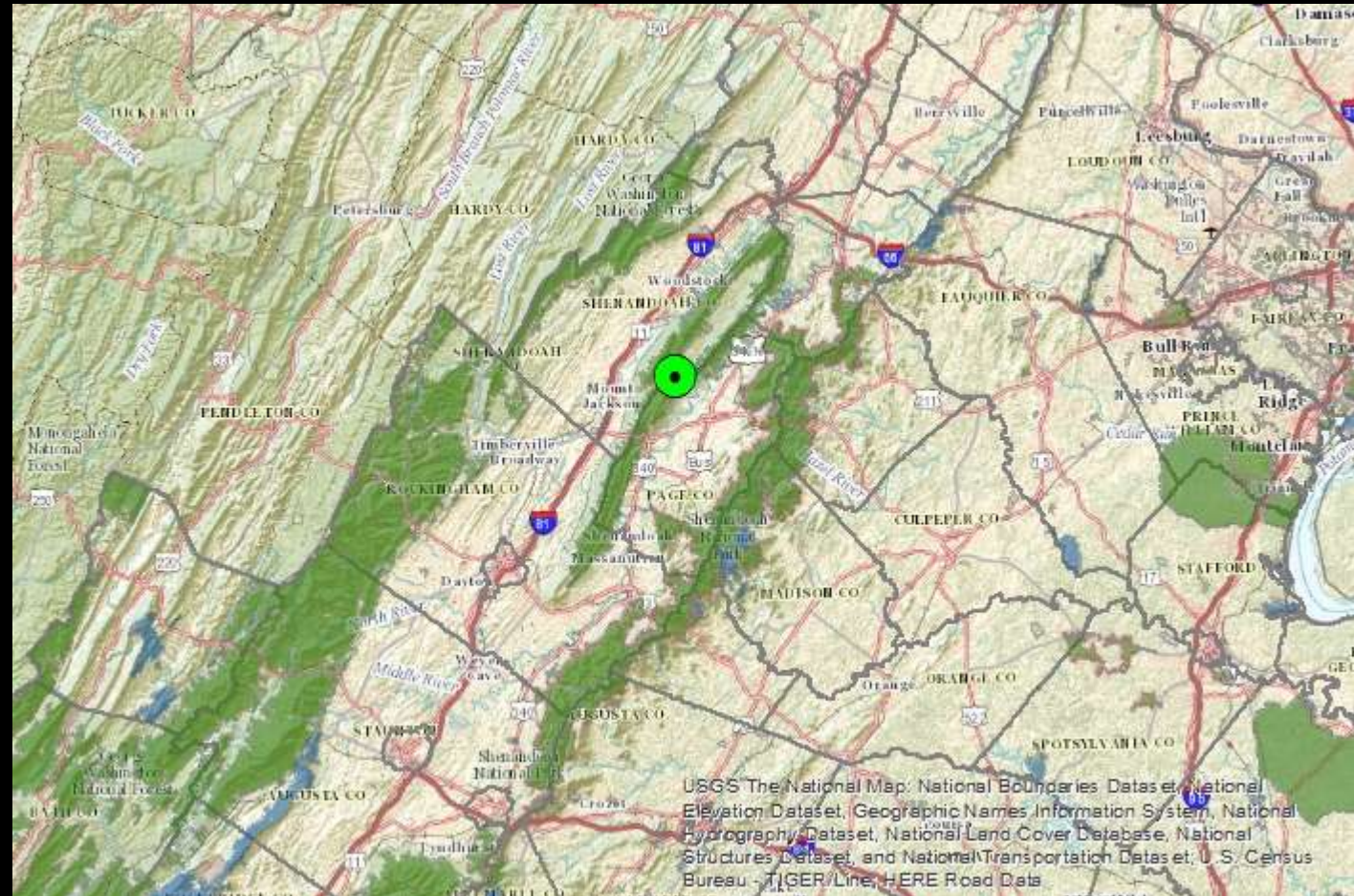
- 869 mills/demand points
- 292,902 forest patches/plots
- Quarterly time steps for 30 years = 120 cycles
- Multiple simulation runs to assess variability



# Modeling the future

## Timber sale in Shenandoah County, VA

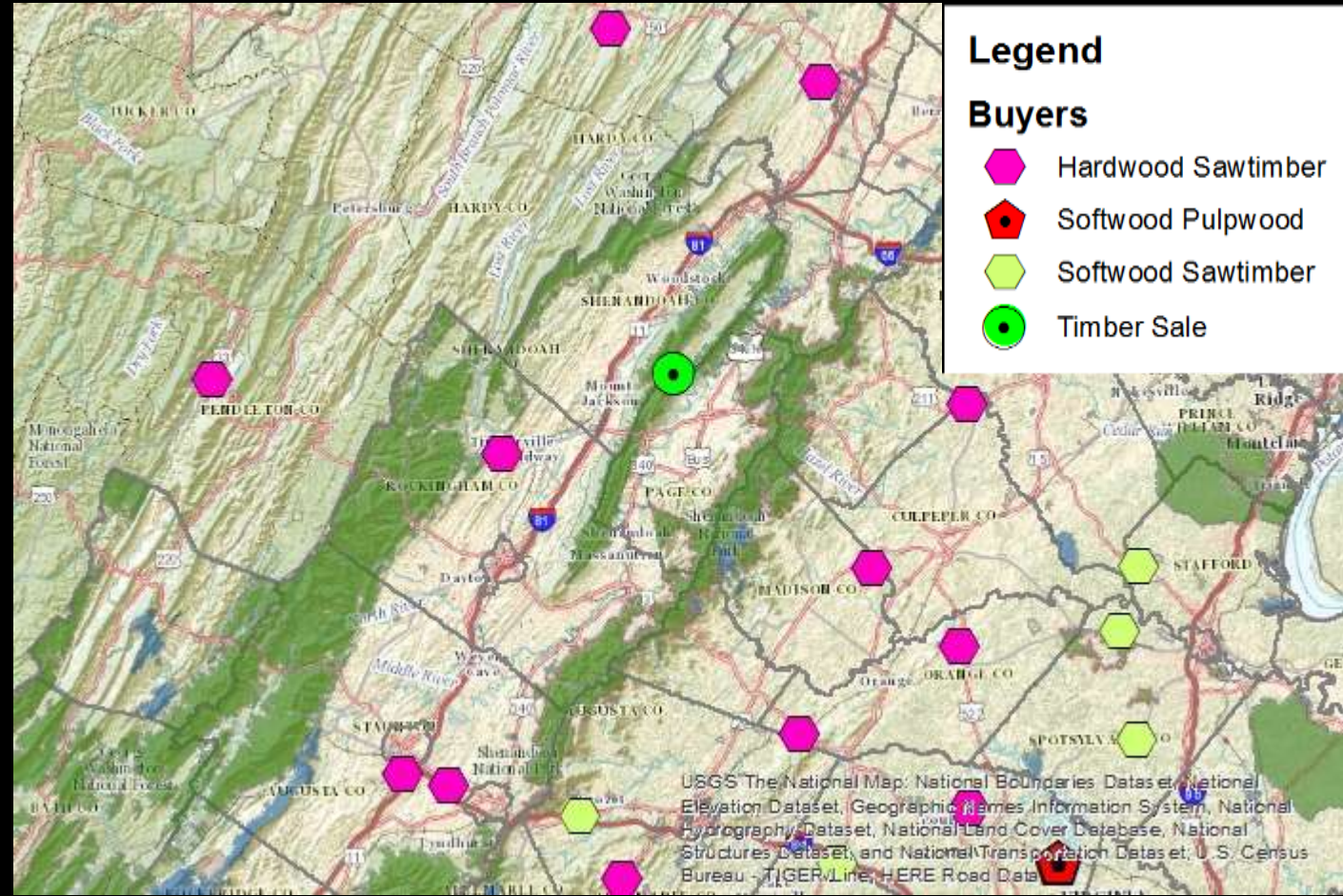
- 103.5 acres
- 1,023 tons hardwood sawtimber
- 3,027 tons hardwood pulpwood
- 839 tons softwood sawtimber
- 1,736 tons softwood pulpwood



# Modeling the future

Timber sale in Shenandoah County, VA:  
Buyers within 100 miles:

- 15 hdwd sawtimber buyers
- 0 hdwd pulpwood buyers
- 7 sftwd sawtimber buyers
- 1 sftwd pulpwood buyer

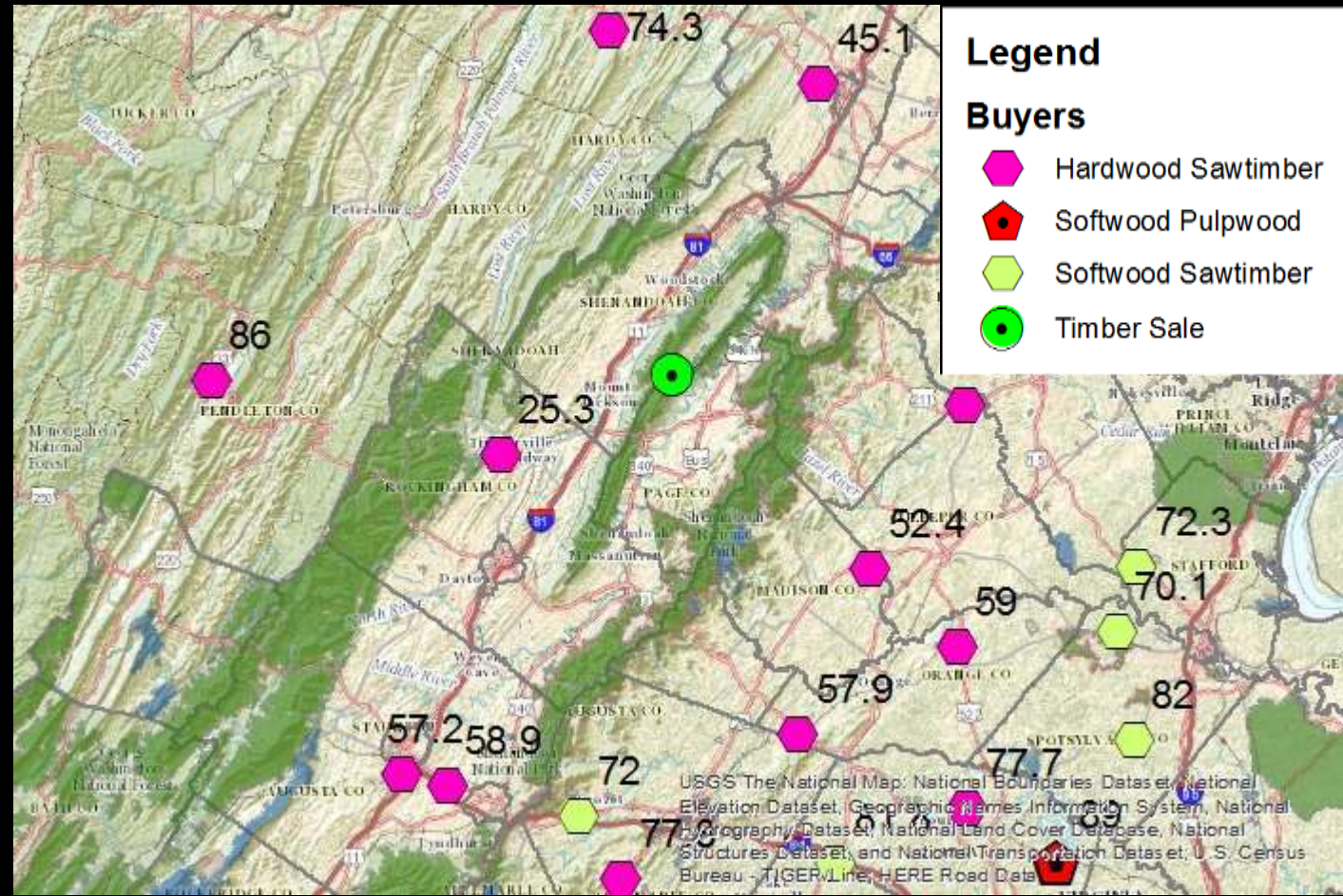


# Modeling the future

## Timber sale in Shenandoah County, VA

- 15 hdwd sawtimber buyers
- 0 hdwd pulpwood buyers
- 7 sftwdsawtimber buyers
- 1 sftwd pulpwood buyer

Road distances in miles



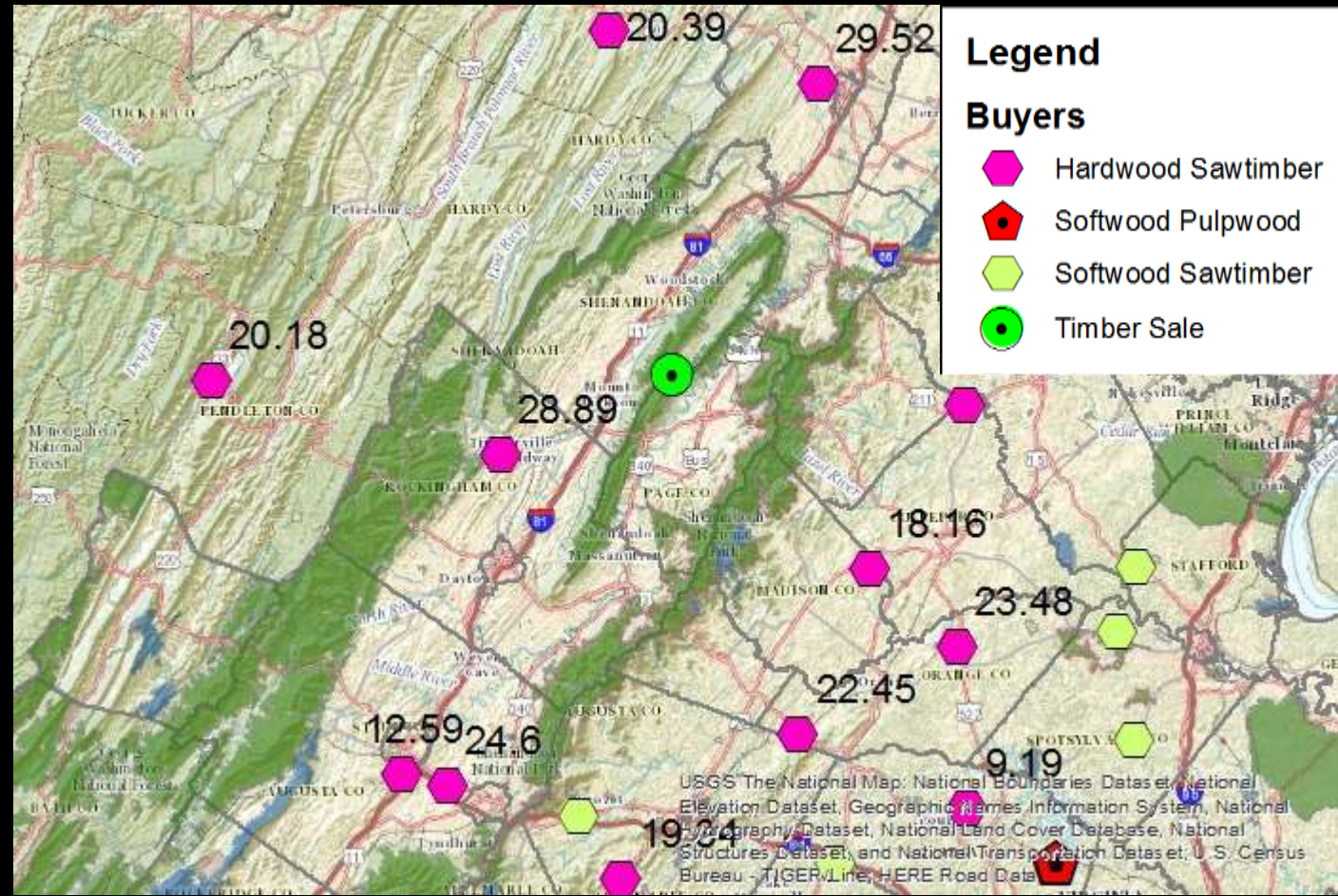


# Modeling the future

## Timber sale in Shenandoah County, VA

- 15 hdwd sawtimber buyers
- 0 hdwd pulpwood buyers
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- 1 sftwd pulpwood buyer

Simulated bid prices per ton for hardwood sawtimber

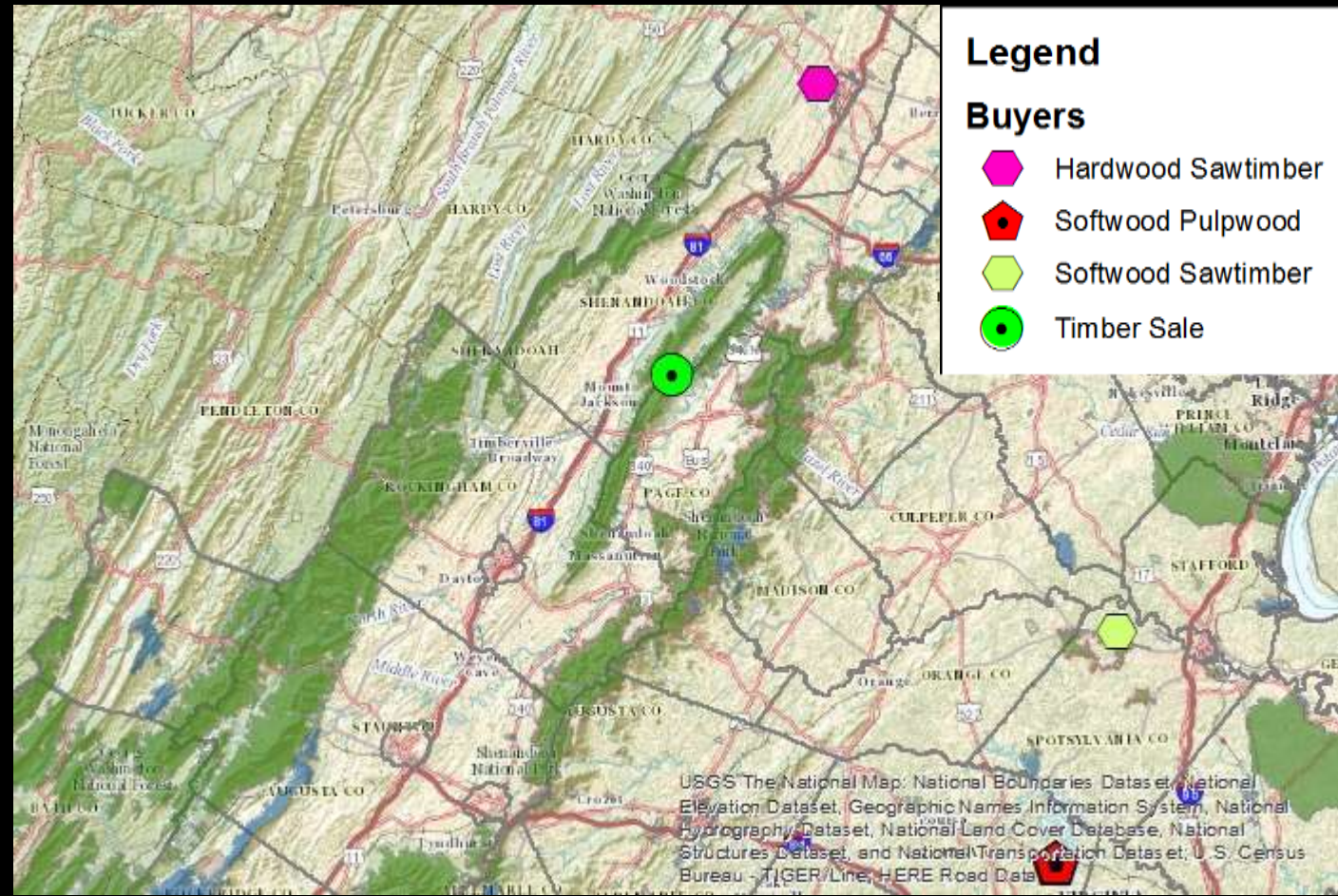


# Modeling the future

Winning bidders for each product

Compute:

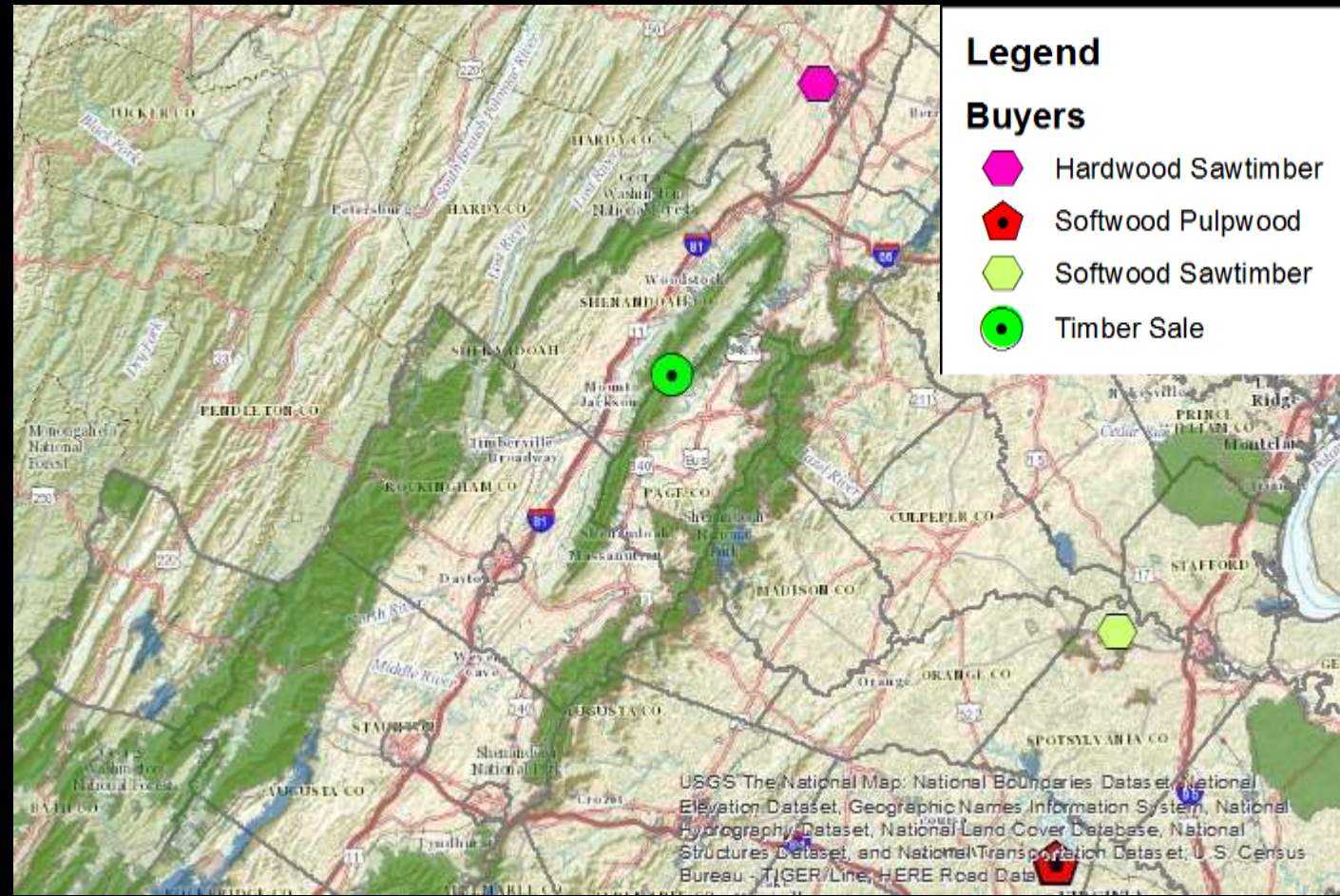
- Total stumpage revenue to landowner,
- Harvesting and transportation costs,
- Delivered prices to mills



# Modeling the future

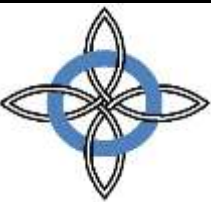
Mills update inventory

If clearcut harvest, stand is regenerated, age reset to zero



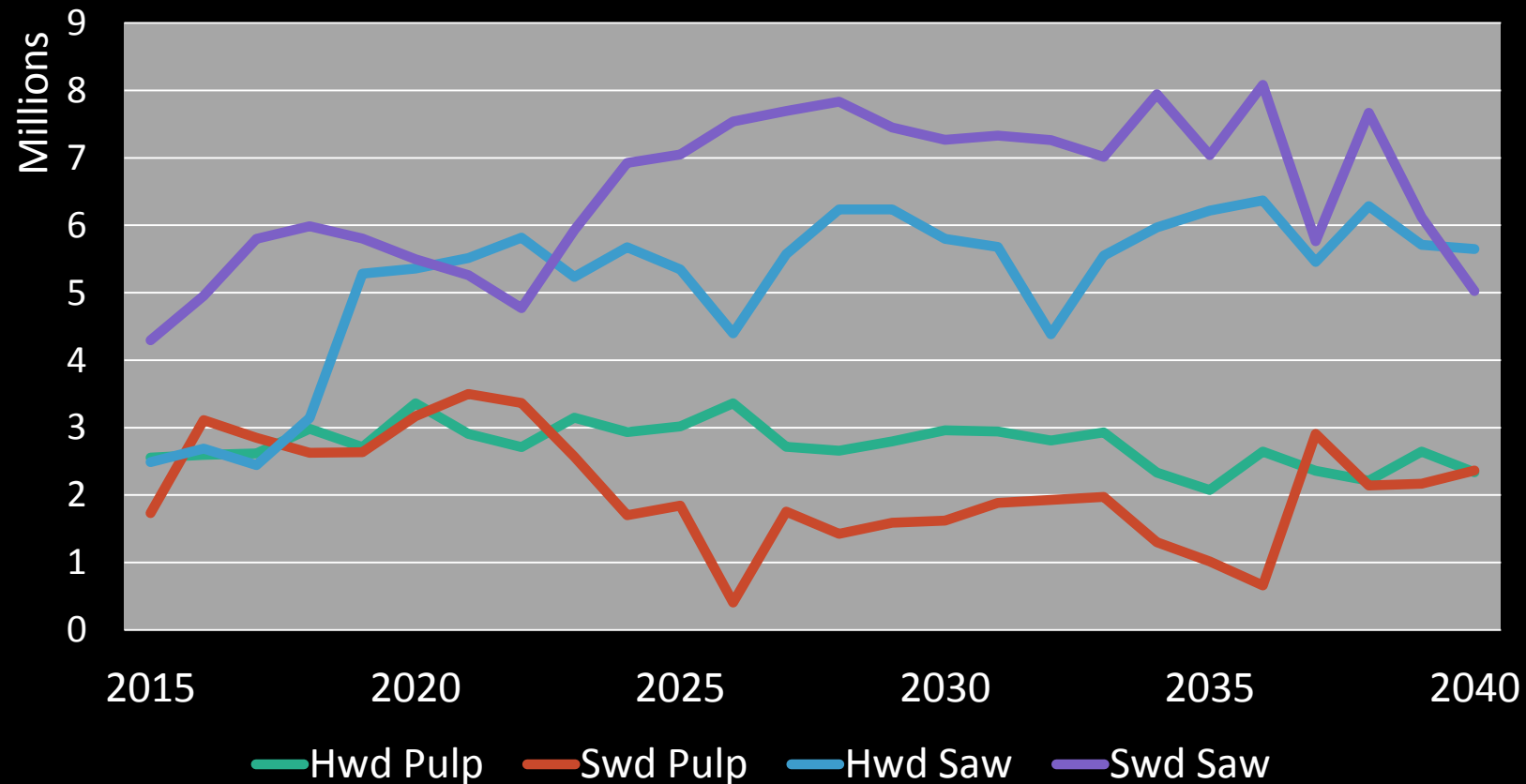
# Modeling the future

- Repeat bidding process for:
  - 869 mills/demand points
  - 292,902 forest patches/plots
  - Quarterly time steps for 30 years = 120 cycles
  - Multiple simulation runs to assess variability
- Repeat analyses with different assumptions regarding:
  - Anticipated future demand
  - Impact of new facilities
  - Changes in policies to incentivize reforestation
  - Etc.

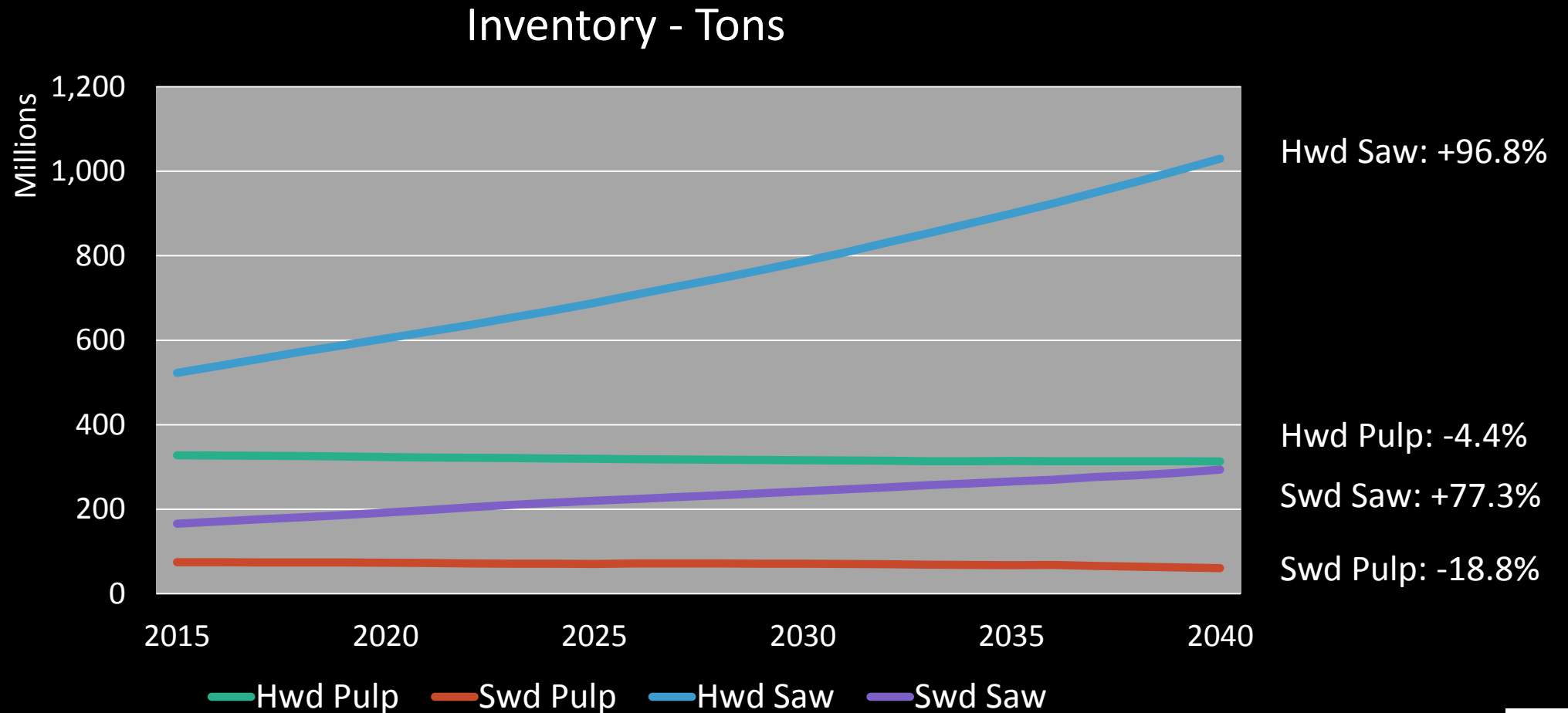


# Modeling the future: example outputs

## Harvest Removals - Tons

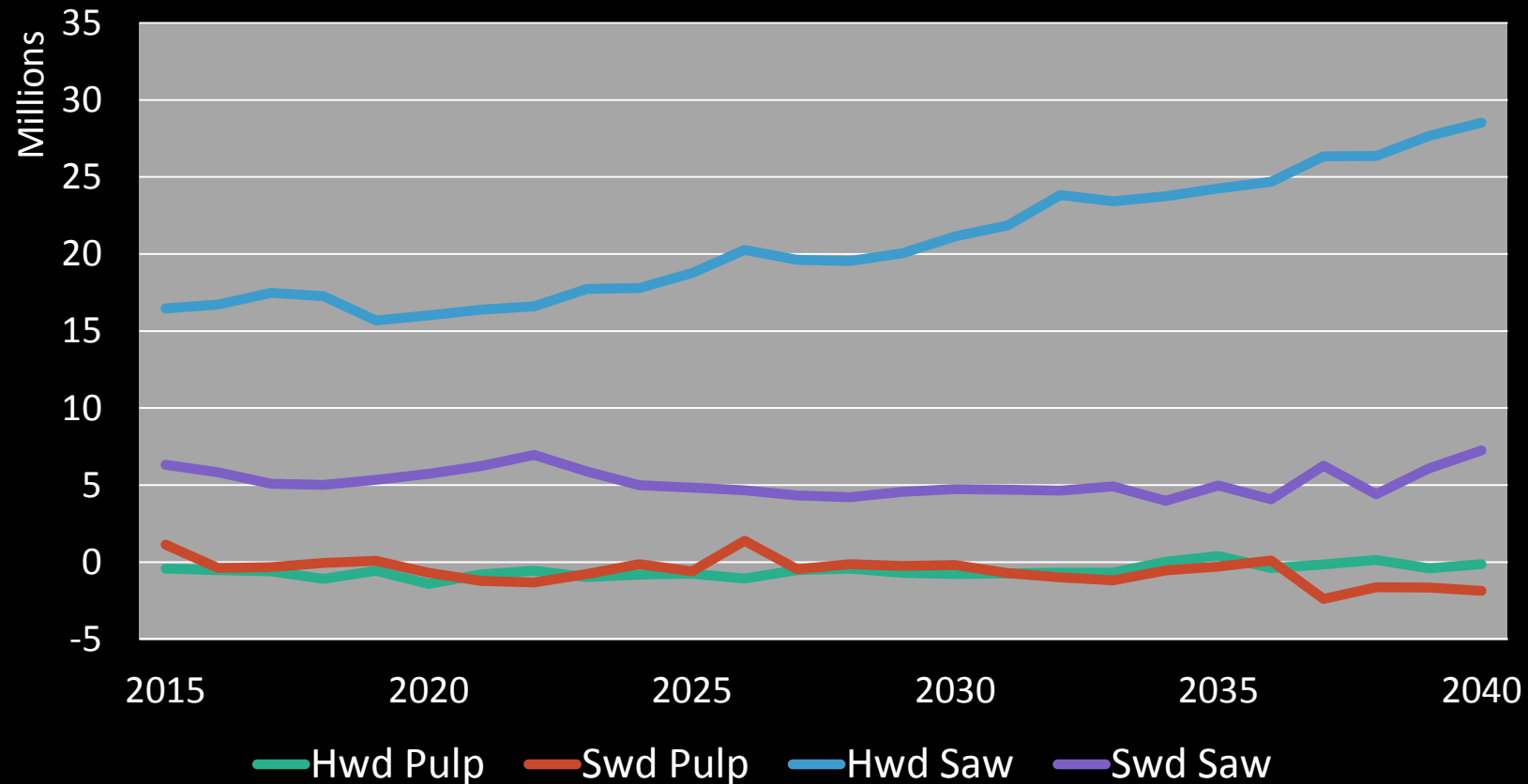


# Modeling the future: example outputs



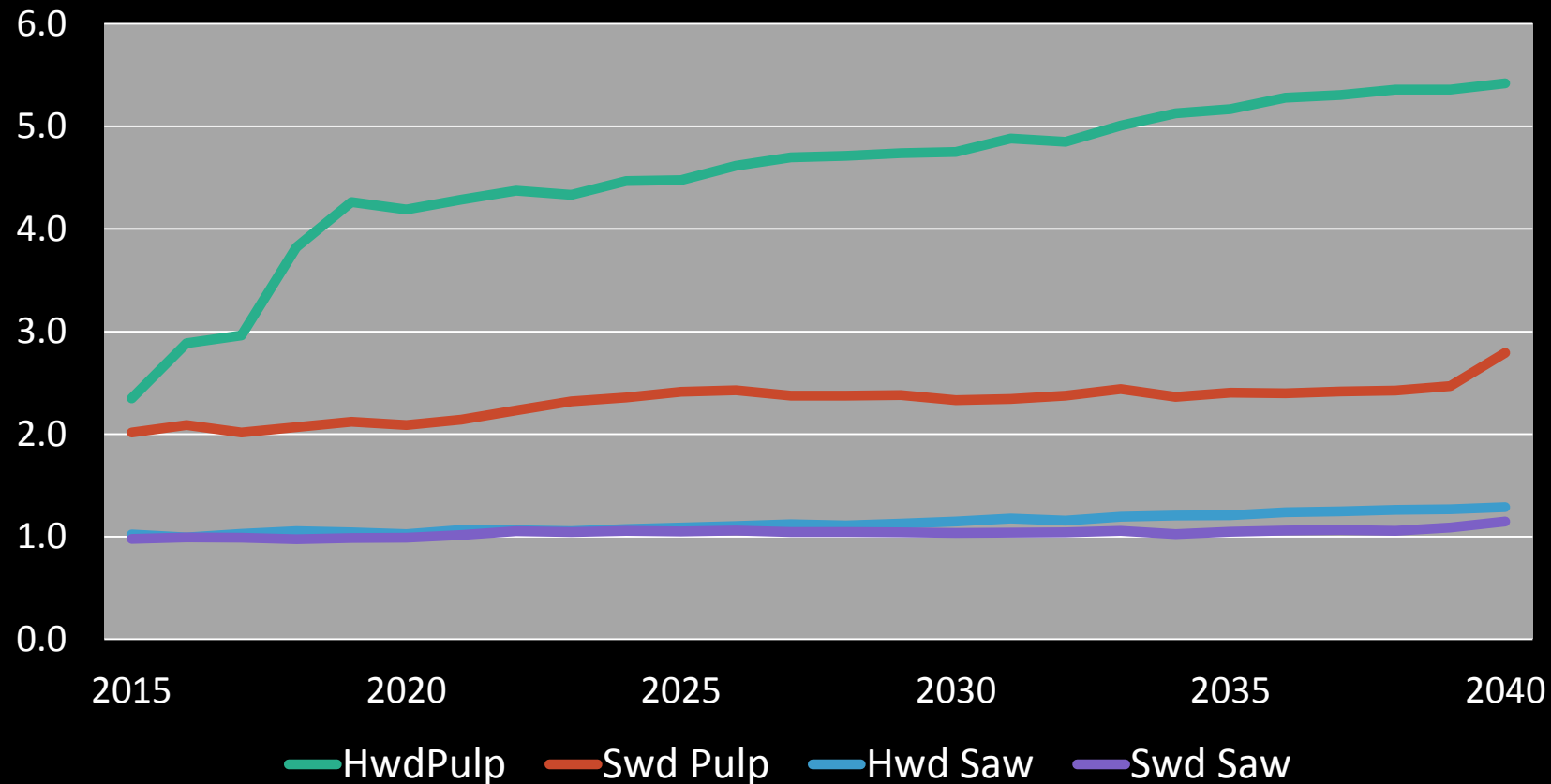
# Modeling the future: example outputs

## Surplus Growth - Tons



# Modeling the future: example outputs

Product Price Index (1.0 = 2012)





# Summary

- Forest sustainability is crucial
  - Environmentally
  - Economically
- Thorough assessment requires:
  - Huge datasets
  - Spatial specificity
  - Dynamic approach
- Work continues...



# Acknowledgements

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- Forest Resource Management
- US Forest Service
- Virginia Department of Forestry
- Virginia Forestry Association



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