Cellulosic-based biofuels are strengthening rural investment & development in the United States
or
Opportunities for wood pellet production for energy in the Southeast US

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Sustainable Landscape Management for Bioenergy and the Bioeconomy

Joint IEA Bioenergy Task 43 & FAO Workshop
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THE UNIVERSITY OF TENNESSEE KNOXVILLE

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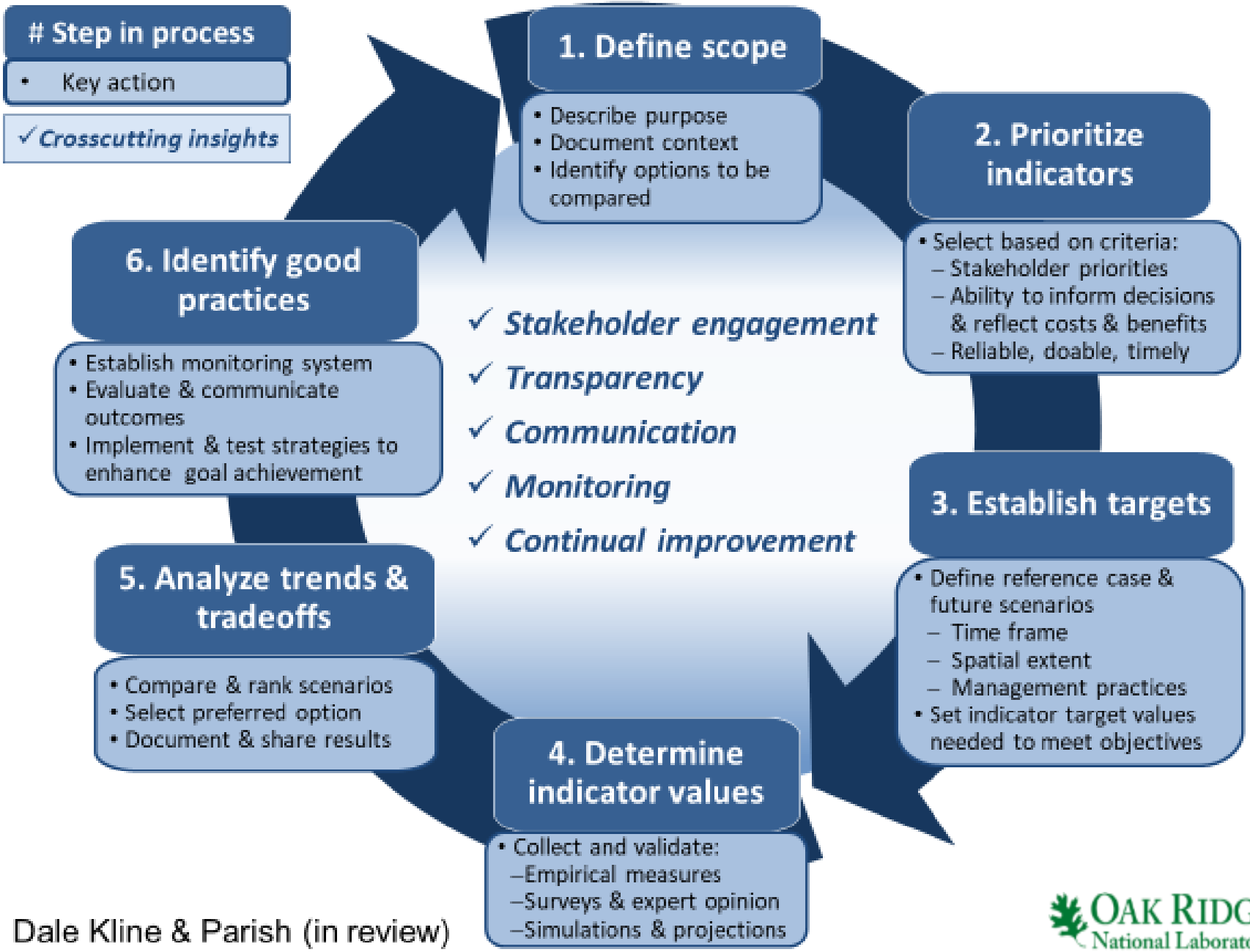
US DOE assessment approach is similar to that of FAO



Dale Kline & Parish (in review)

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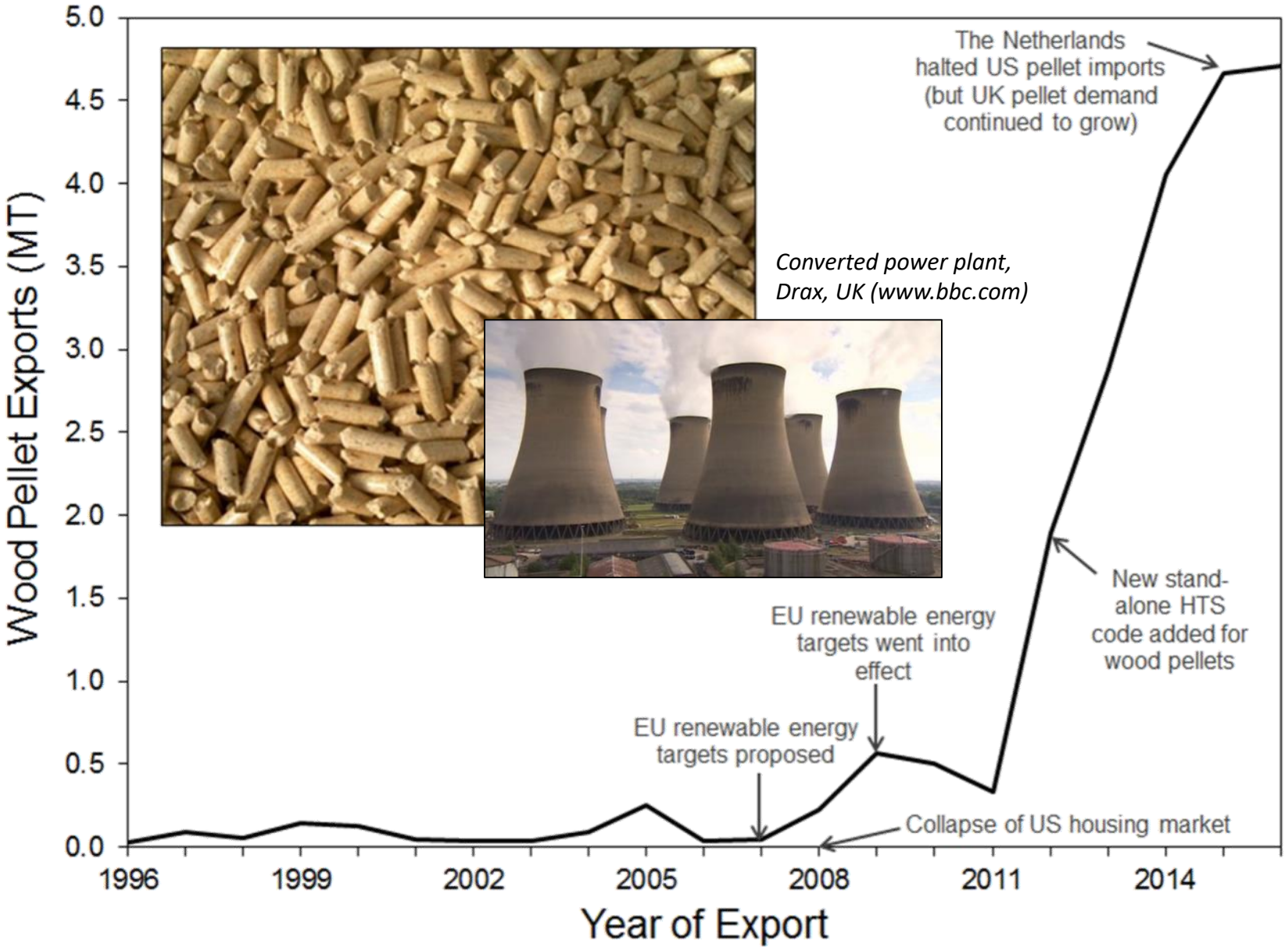
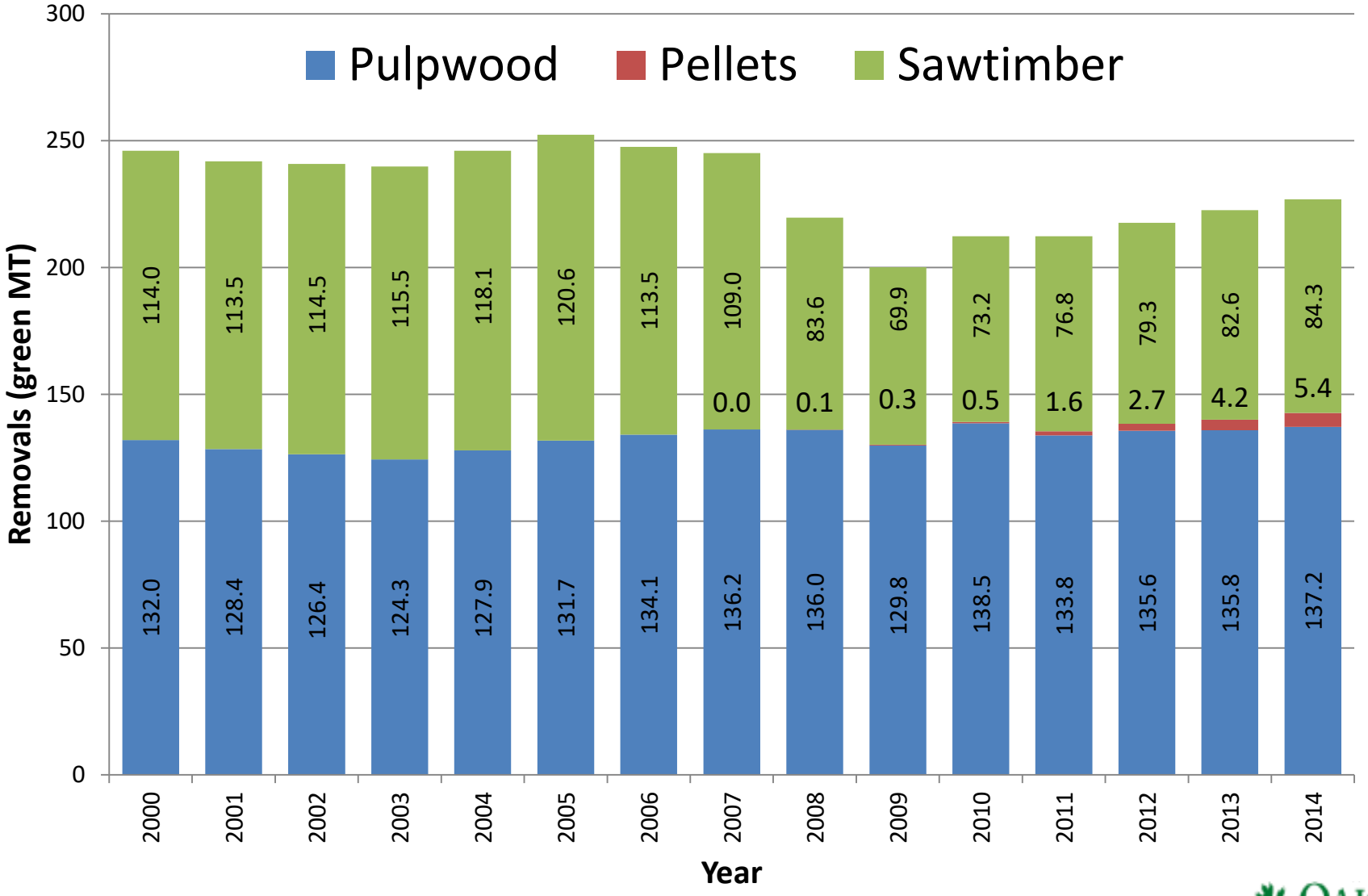
Application to growing US industrial wood pellet trade

Converted power plant, Drax, UK (www.bbc.com)



Parish et al. (2018) *Ecology & Society*

Wood based pellets are <3% of wood products from SE US



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Dale et al. (2017) Forest Ecol & Mgmt

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Stakeholders associated with different parts of wood based pellet production in the SE US

Feedstock production → Feedstock logistics → Conversion to pellets → Biofuel logistics → End uses

Stakeholders concerned with parts of supply chain:

- Landowners
- Loggers
- Saw mills
- Pulp mills
- Truckers
- Pellet mills
- Trains & shipping companies
- Member nations that use bioenergy to displace coal

Stakeholders with cumulative perspective:

- Environmental NGOs
- EU policy makers

Influences on SE US export wood pellet production

Environmental setting →

Prior land use:
most forests previously cleared for agriculture

Soils:
red clay or sandy

Temperate climate:
hot, humid summers, & cool winters

Disturbances:
insect outbreaks, droughts, fire, ice storms, hurricanes, & tornados

Rare historical photo of large trees in SE US

Davis (1996), Varner et al. (2005), Wear & Greis, (2013), Parish et al. (2017)

Influences on SE US export wood pellet production

Environmental setting → **Forest conditions**

Prior land use: most forests previously cleared for agriculture

Soils: red clay or sandy

Temperate climate: hot, humid summers, & cool winters

Disturbances: insect outbreaks, droughts, fire, ice storms, hurricanes, & tornados

Regeneration: planted or natural via seeds or sprouts

Ownership: mostly private

Stand ages: 0-100 years

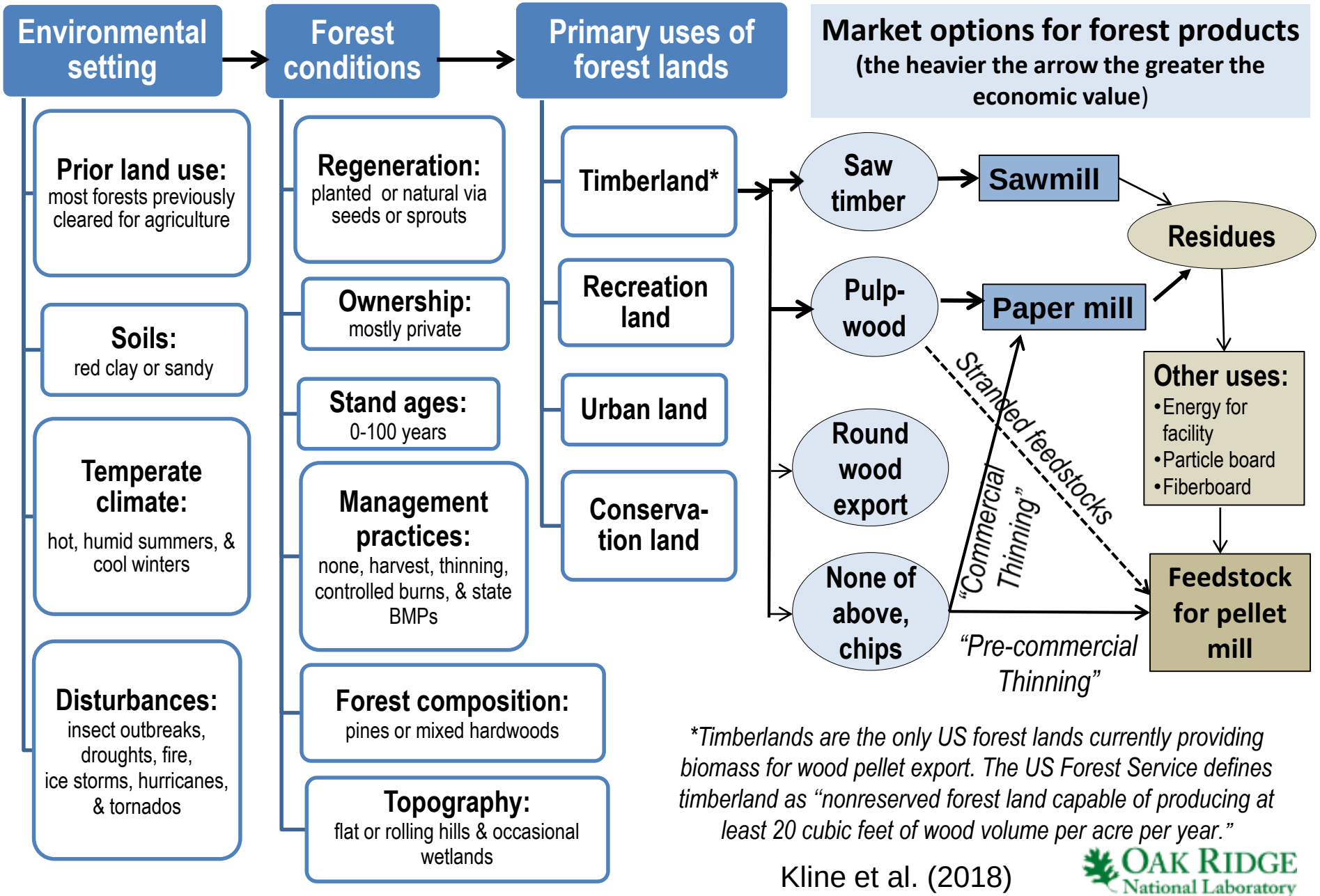
Management practices: none, harvest, thinning, controlled burns, & state BMPs

Forest composition: pines or mixed hardwoods

Topography: flat or rolling hills & occasional wetlands

Forest management decisions largely driven by demand for higher price forest products than pellets

Influences on SE US export wood pellet production



**Timberlands are the only US forest lands currently providing biomass for wood pellet export. The US Forest Service defines timberland as "nonreserved forest land capable of producing at least 20 cubic feet of wood volume per acre per year."*

Kline et al. (2018)

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Biomass stranded without markets ("unloved wood")

- Eventually burns or decays
- Reduces incentives to keep private lands forested

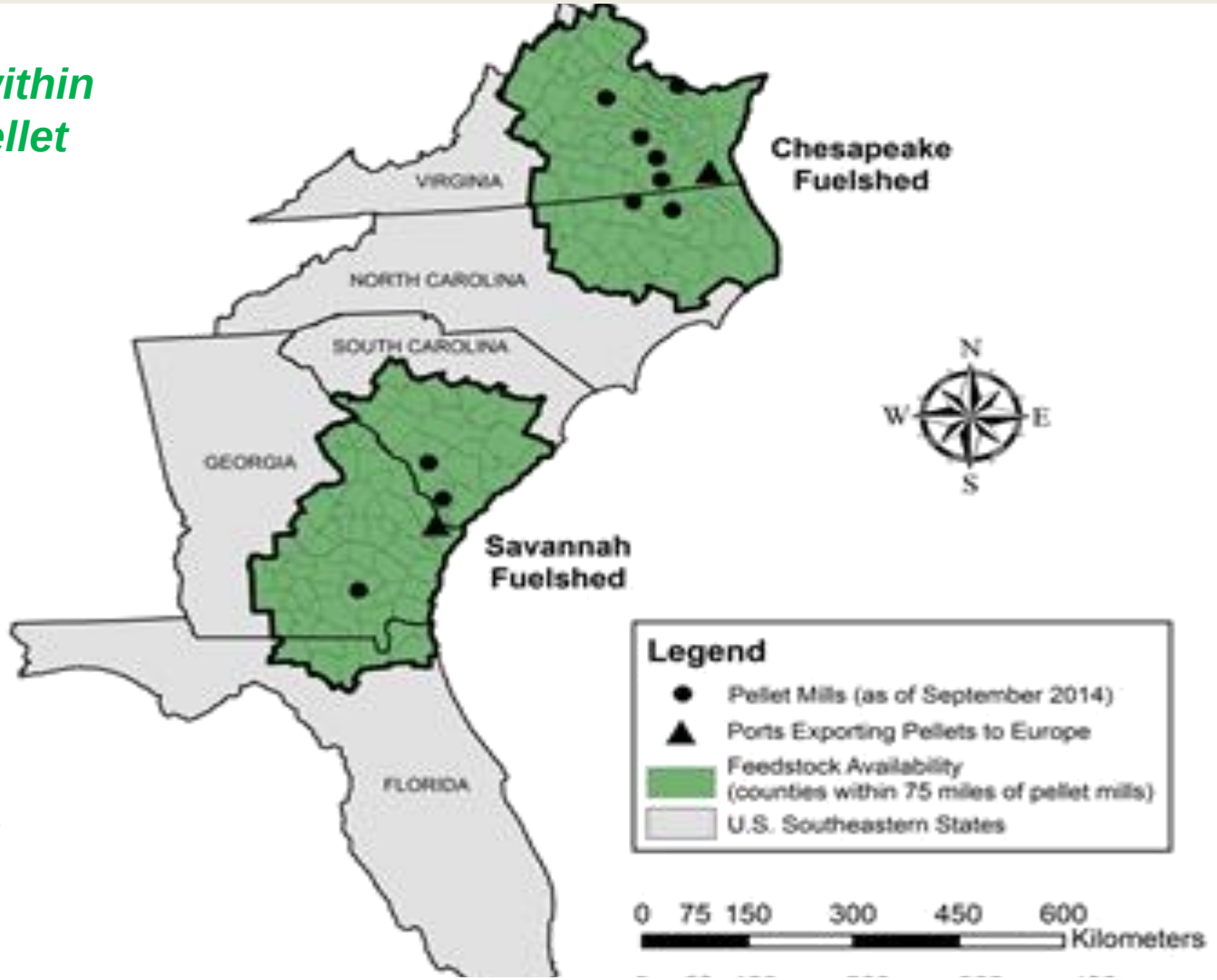
Considered 2 case study areas supplying wood to 2 major ports:

- Savannah: mostly intensively managed pine plantations
- Chesapeake (Norfolk): both pine & mixed hardwoods

Fuelsheds: Counties within 120 km (75 miles) of pellet mills that supply ports

Each fuelshed area has an area of ~12 million ha.

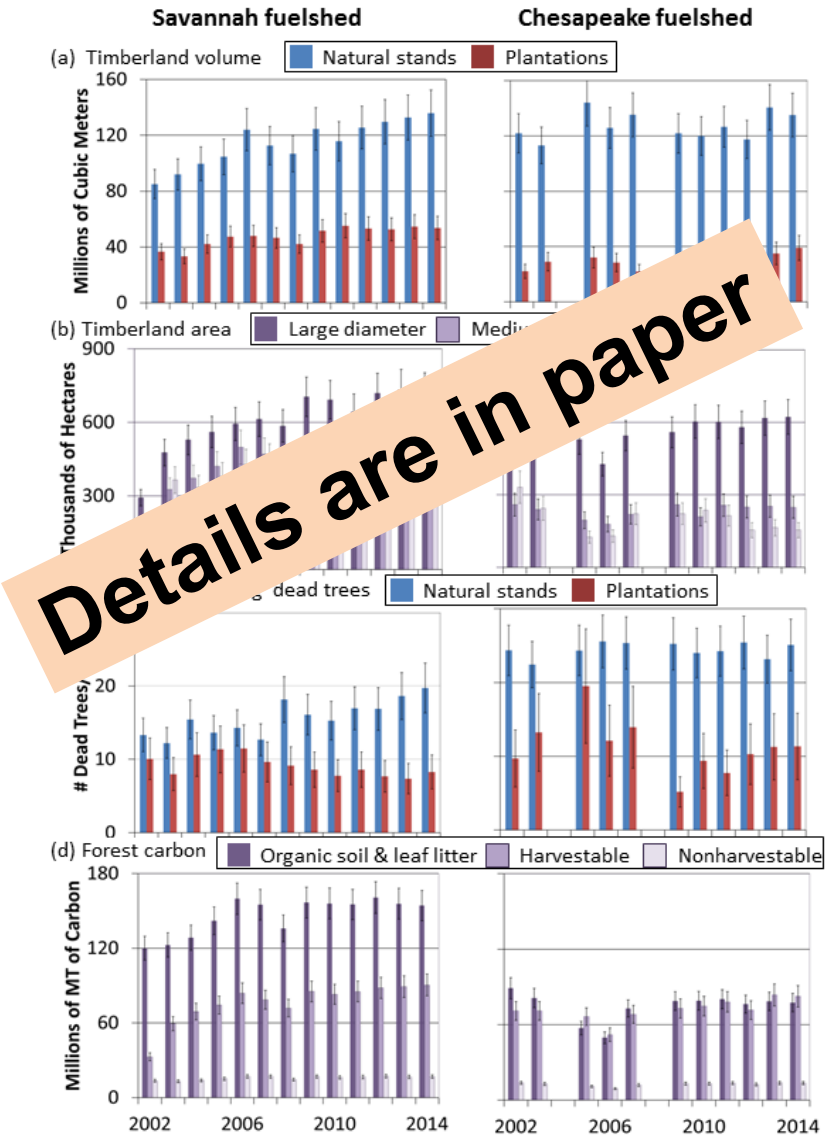
Analyses
1. Compared forest conditions before & after periods when pellets were produced using the FIA
2. Examined National Woodland Owner Survey & conducted survey for these fuelsheds



Dale et al. (2017) *Forest Ecology and Management*
Hodges et al. (in review)

Results from analysis of FIA data for two fuelsheds

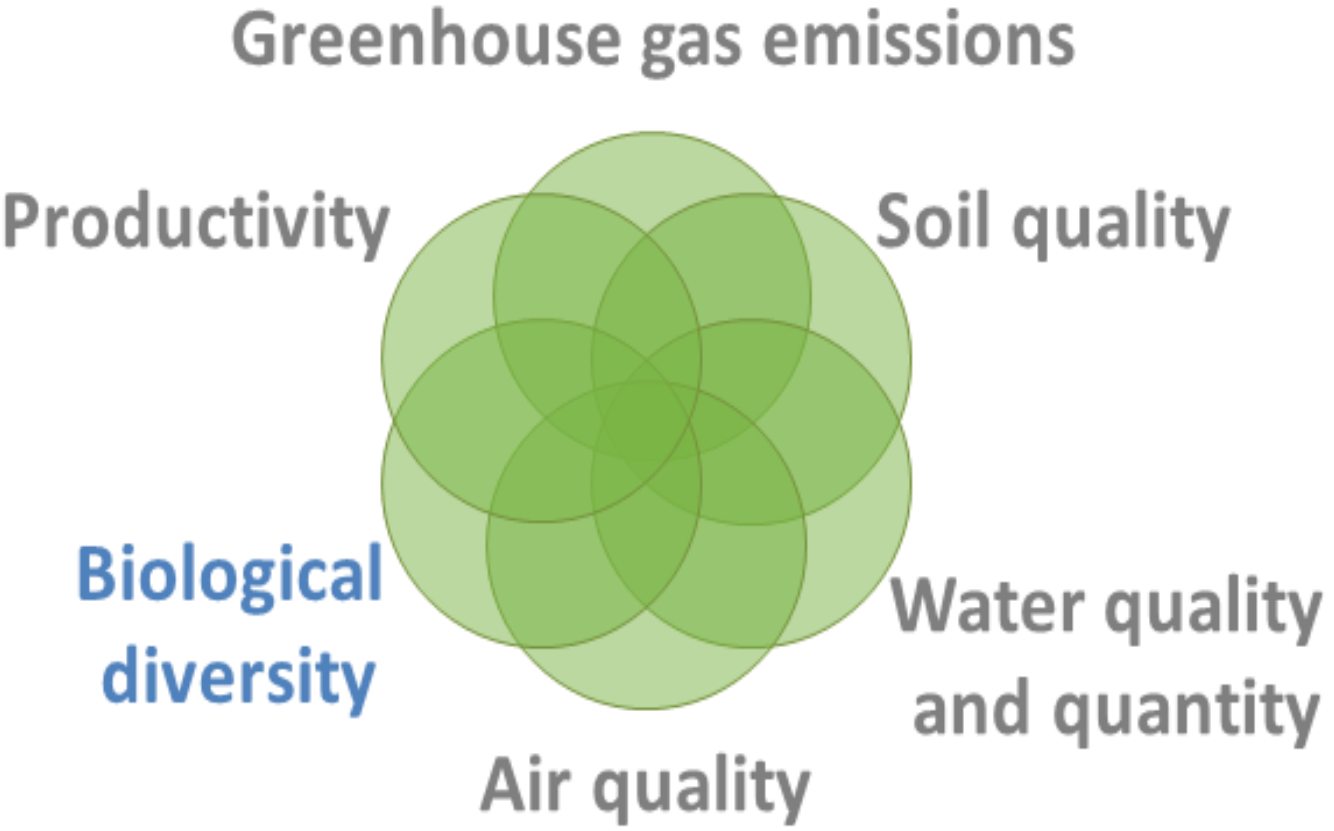
- **Significant increases in**
  - GHG sequestration
  - Timberland volume in plantations
  - Areas with large trees
  - # standing dead trees/ha in naturally regenerating stands
- Savannah fuelshed had declines in # standing dead trees/ha in plantations



Details are in paper

Dale et al. (2017) For Ecol & Mgt

Among environmental indicators, our focus now is on biological diversity



Based on checklist of indicators identified by McBride et al. (2011)

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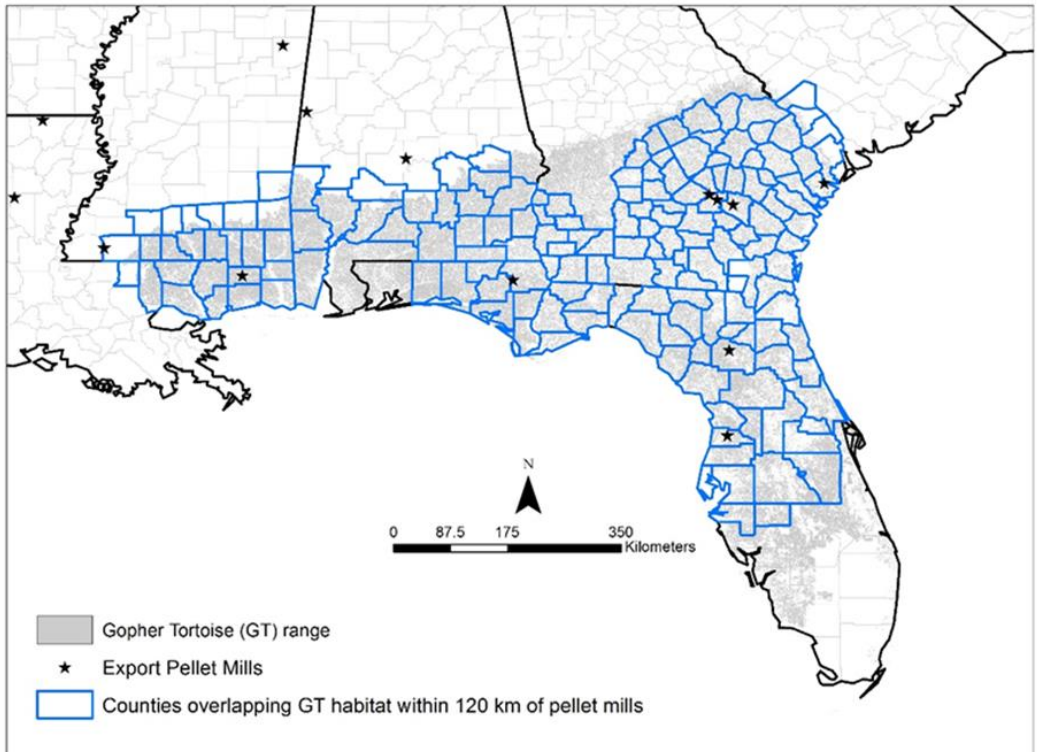
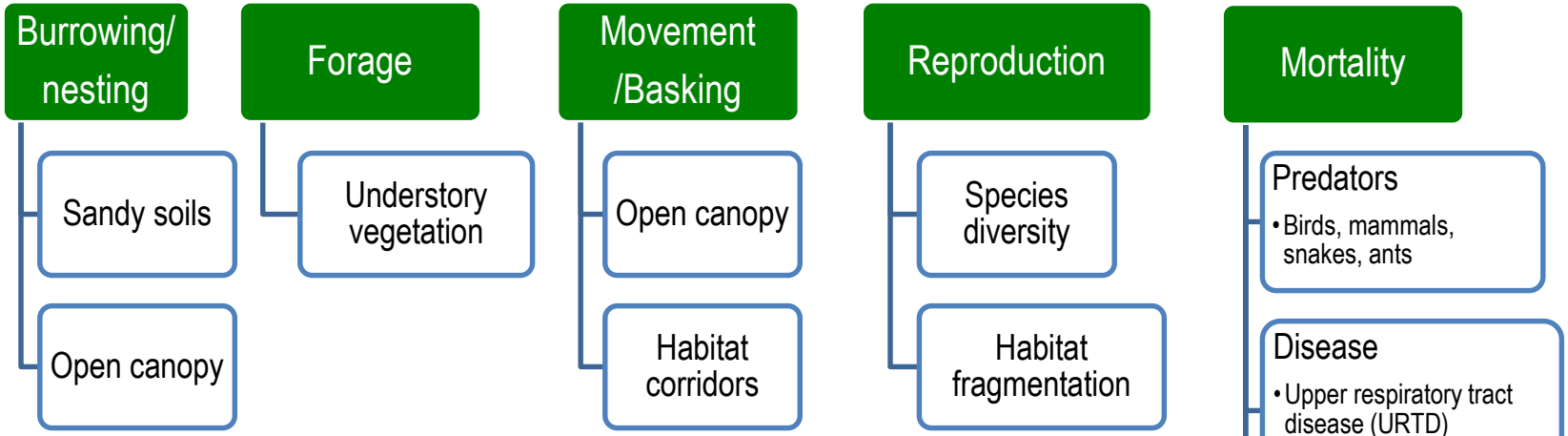
Example: Gopher tortoise *(Gopherus polyphemus) [GT]*

- Species of conservation concern
- Keystone species
- 80% of their range overlaps countries that source pellets

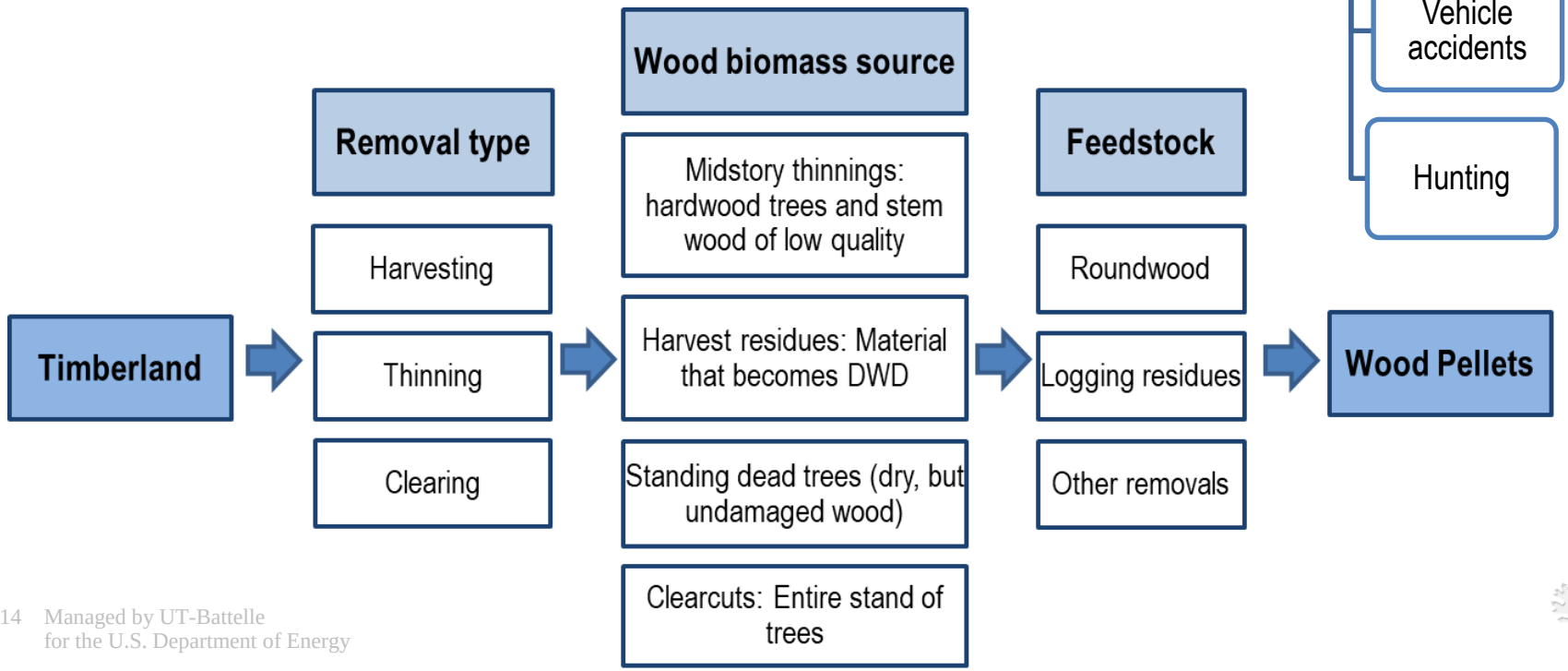
(Source: www.fws.gov)



Compared life-history characteristics of the gopher tortoise



To management practices for pellets



Benefits vs costs to GT of practices associated with pellets production (example)

(Source: www.srs.fs.usda.gov)

- Midstory thinning
  - Better cover, burrowing sites, & conditions for thermoregulation
  - Improved conditions for movement
  - Higher survival rates from disease
  - Loss of herbaceous vegetation due to equipment traffic
- Removing standing dead trees
  - Improved conditions for movement
  - Collapse or damage to burrows
  - Loss of herbaceous vegetation due to equipment traffic
  - Decreased clutch sizes and/or egg quality resulting from low quality forage
  - Increase in exposure to predators

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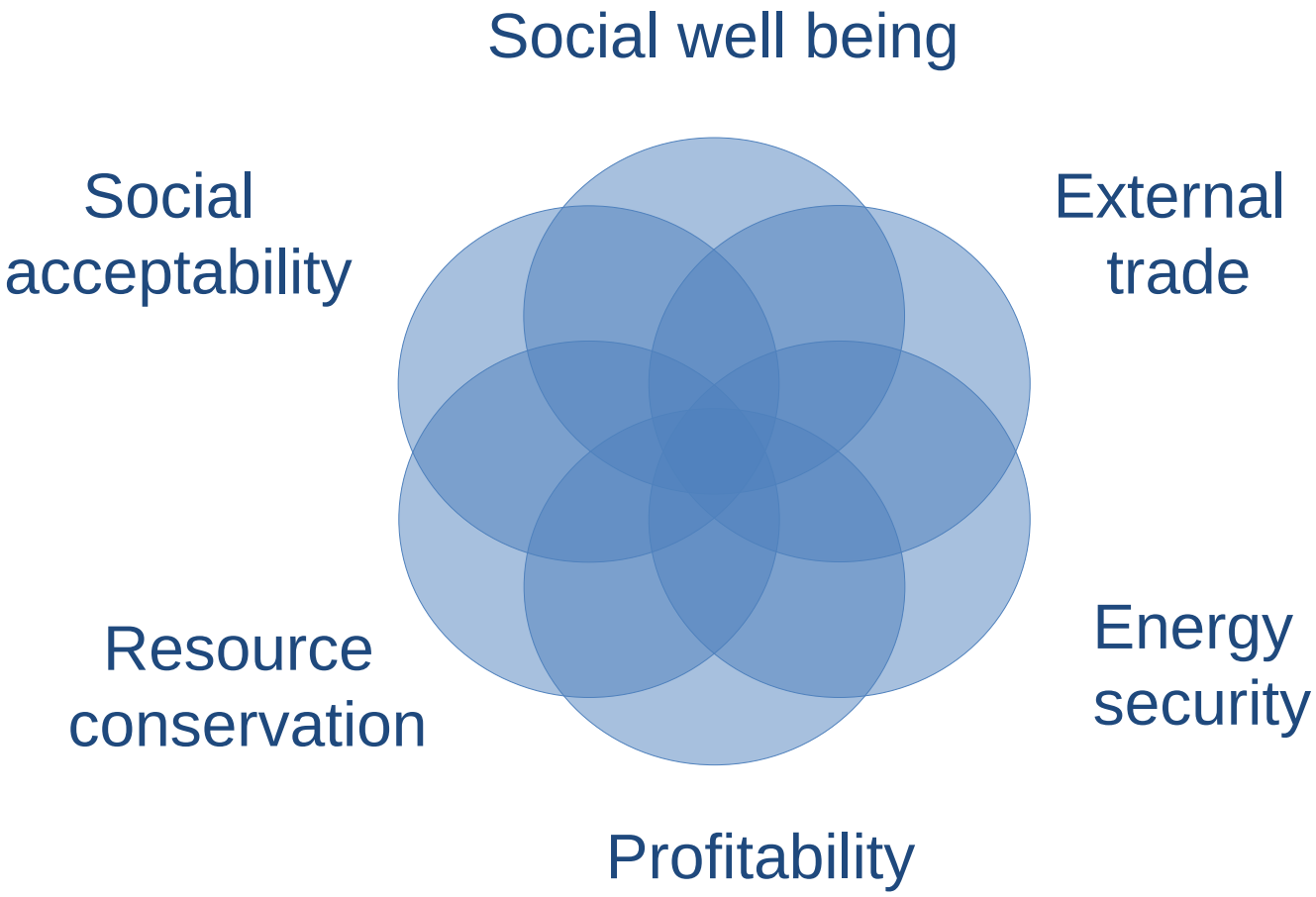
Solution:

Identify & implement practices to protect gopher tortoise

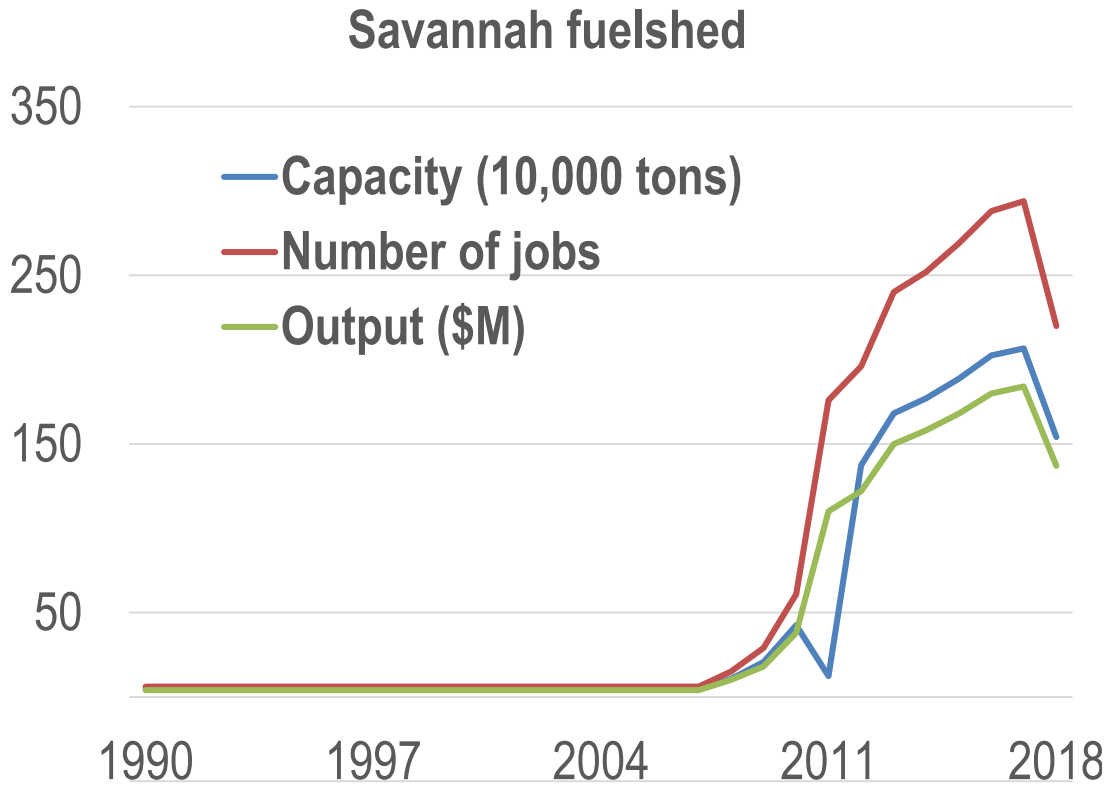
- Avoiding vehicle activity within a 4-m buffer from burrow
- Thinning or prescribed fire
- Low intensity harvesting
- Maintaining habitat corridors
- Increasing habitat connectivity

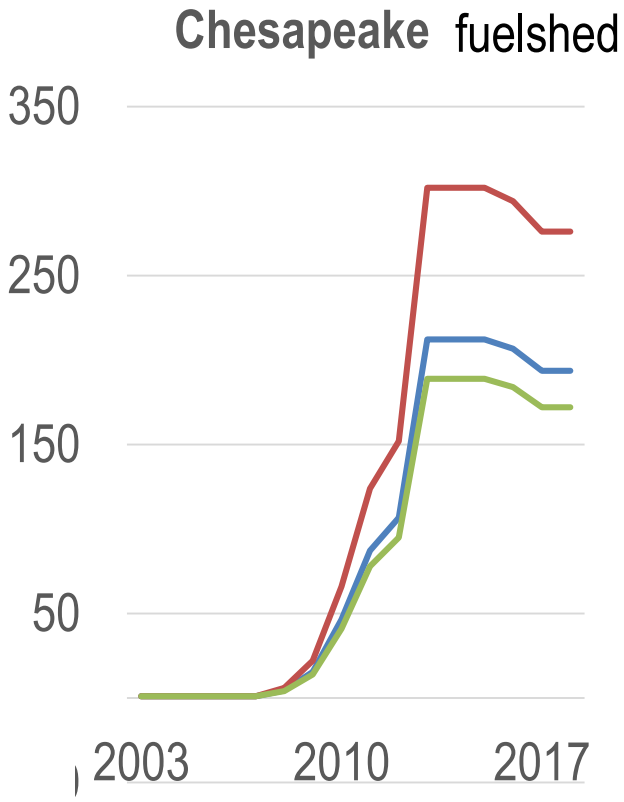
Considered categories for indicators of progress toward socioeconomic sustainability



Based on checklist of indicators identified by Dale et al. (2013)

As pellet production (by capacity) increased, so did jobs & economic output





Source: US Energy Information Agency (EIA) surveys of mills producing densified biomass (https://www.eia.gov/biofuels/biomass/#table_data) & Josh et al. (2013) Table 4

Consideration of noncorporate forest land owners' perspectives regarding wood-based energy

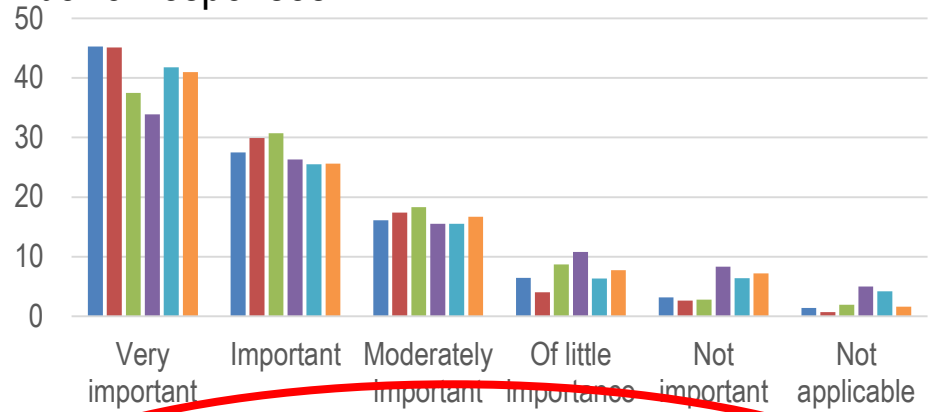
Survey of ~900 family forest land owners in eastern US on biomass for energy:

- **Concern for the environment is paramount**
- **Potential impacts on existing industries are a concern**
- **There was a willingness to support use of biomass for energy as long as**
  1. Land health is not compromised
  2. The price is right

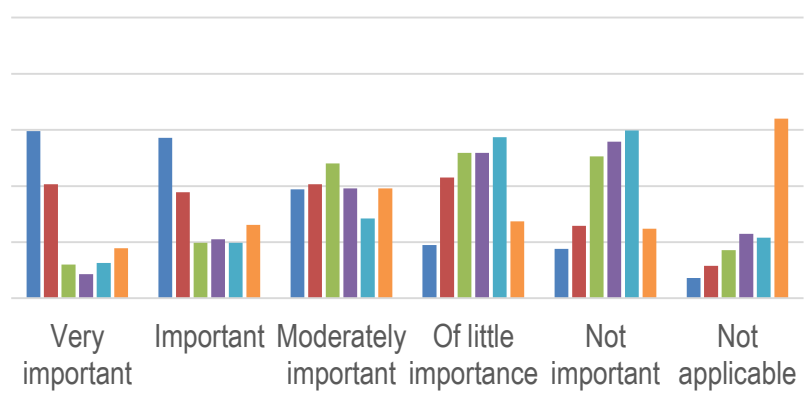
Hodges et al. (2016) based on data from the Forest Service National Woodland Owner Survey (Butler et al. 2016)

Recent mail survey reveals diverse reasons that landowners keep their land in forest in two fuelsheds

Number of responses



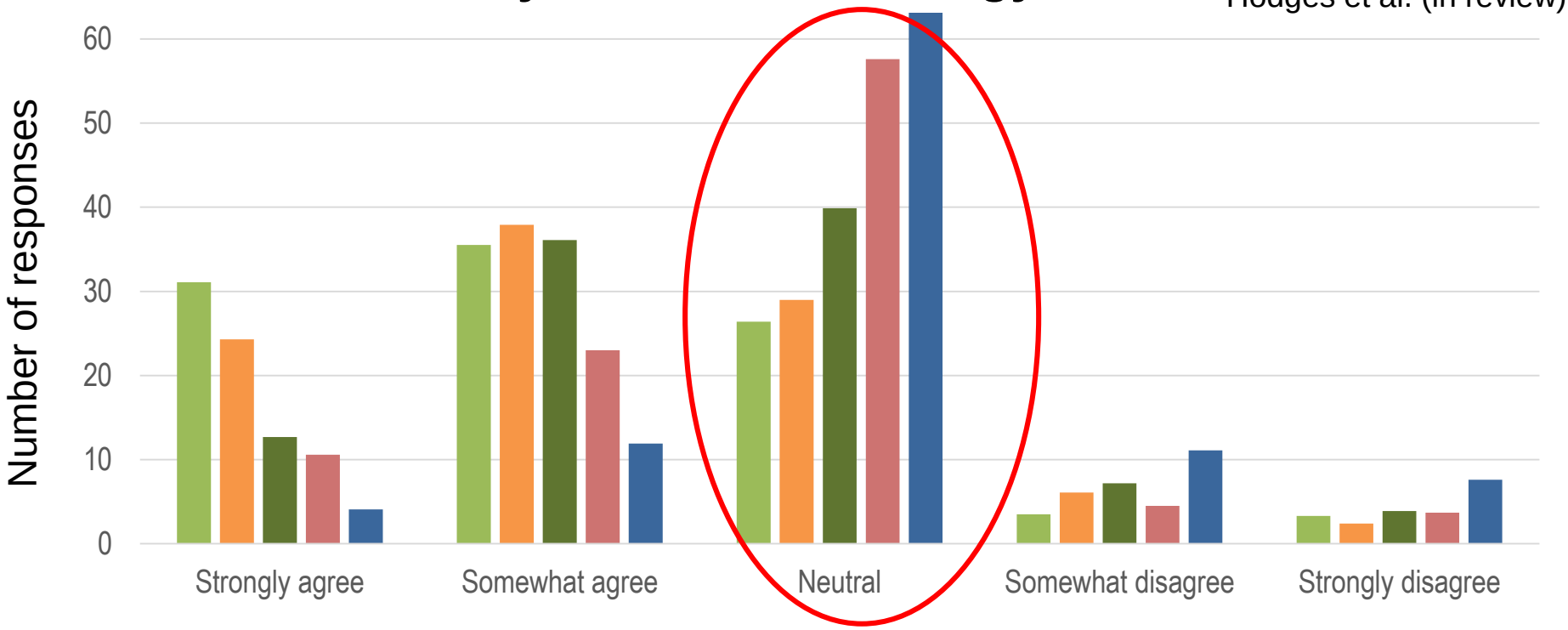
Hodges et al. (in review)



- **To enjoy beauty or scenery**
- **To protect nature for biological diversity or wildlife habitat**
- For land investment
- For privacy
- **To pass land on to my children or other heirs**
- **For timber products****
- For hunting or other recreational use**
- For tax benefits
- For firewood
- For woody biomass for energy other than firewood
- For NTFP
- I have no other higher valued option for the land

Largely neutral forest landowners' responses regarding awareness of woody biomass for energy

Hodges et al. (in review)

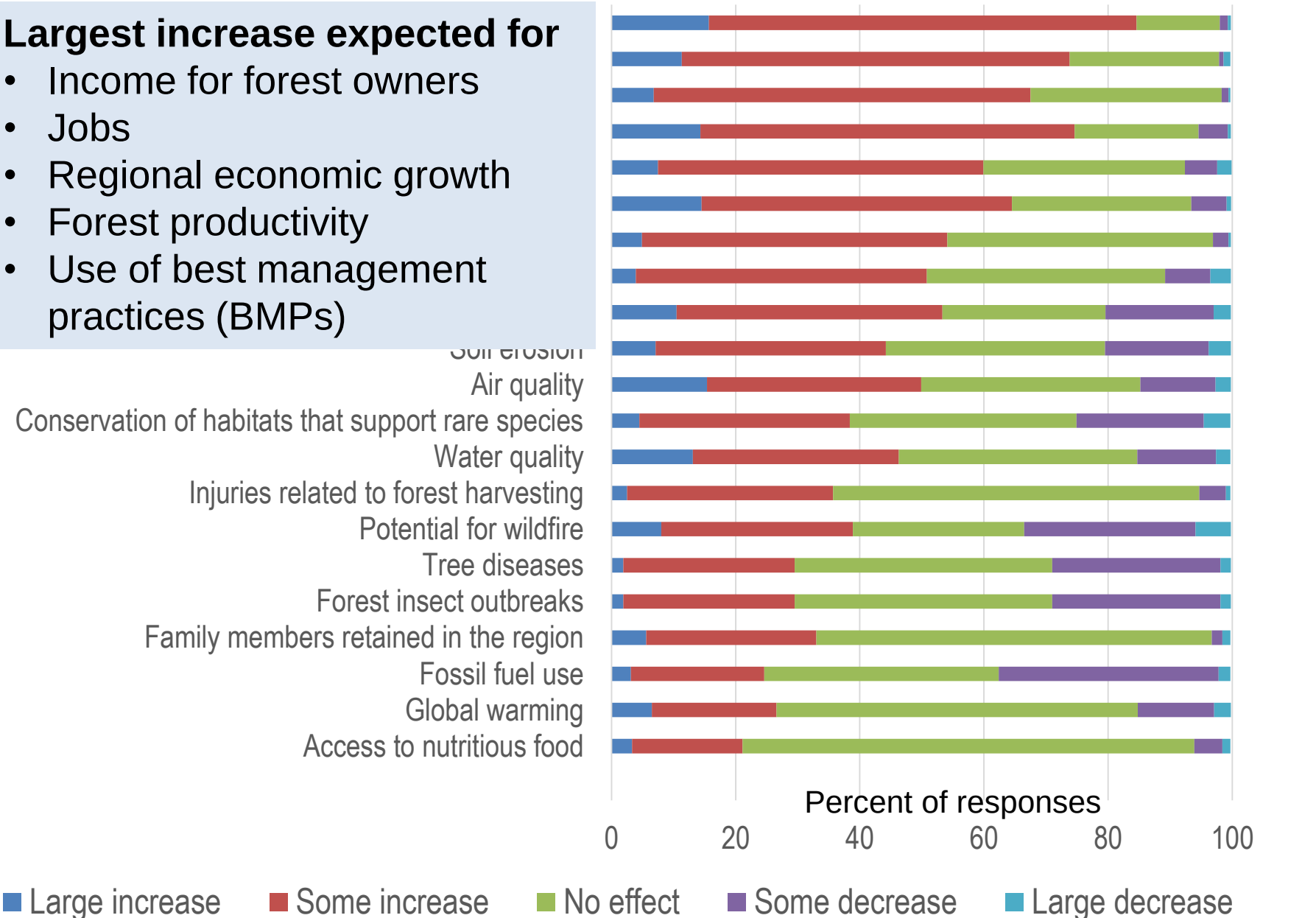


Diverse landowners' perspectives regarding potential effects of bioenergy production

Hodges et al. (in review)

Largest increase expected for

- Income for forest owners
- Jobs
- Regional economic growth
- Forest productivity
- Use of best management practices (BMPs)



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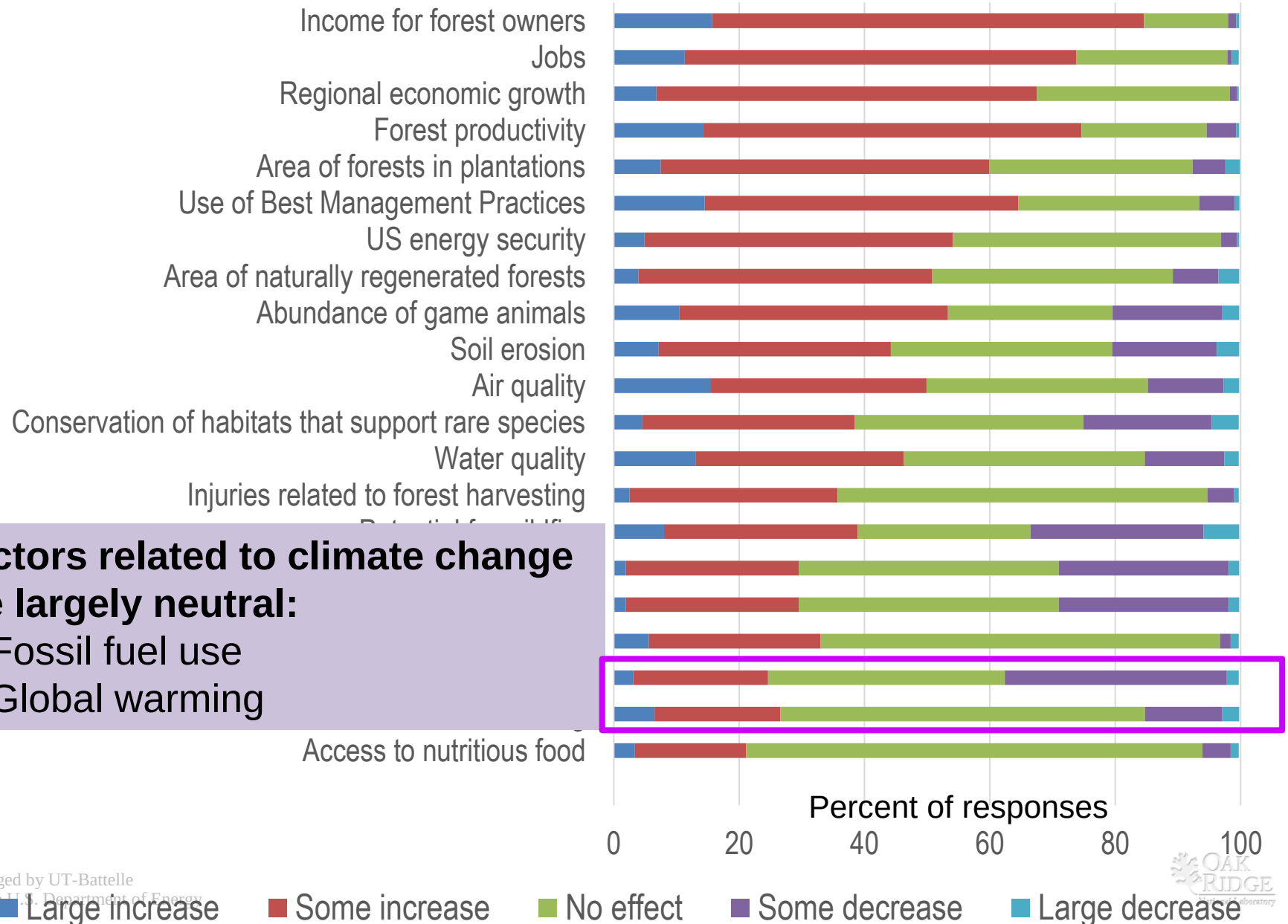
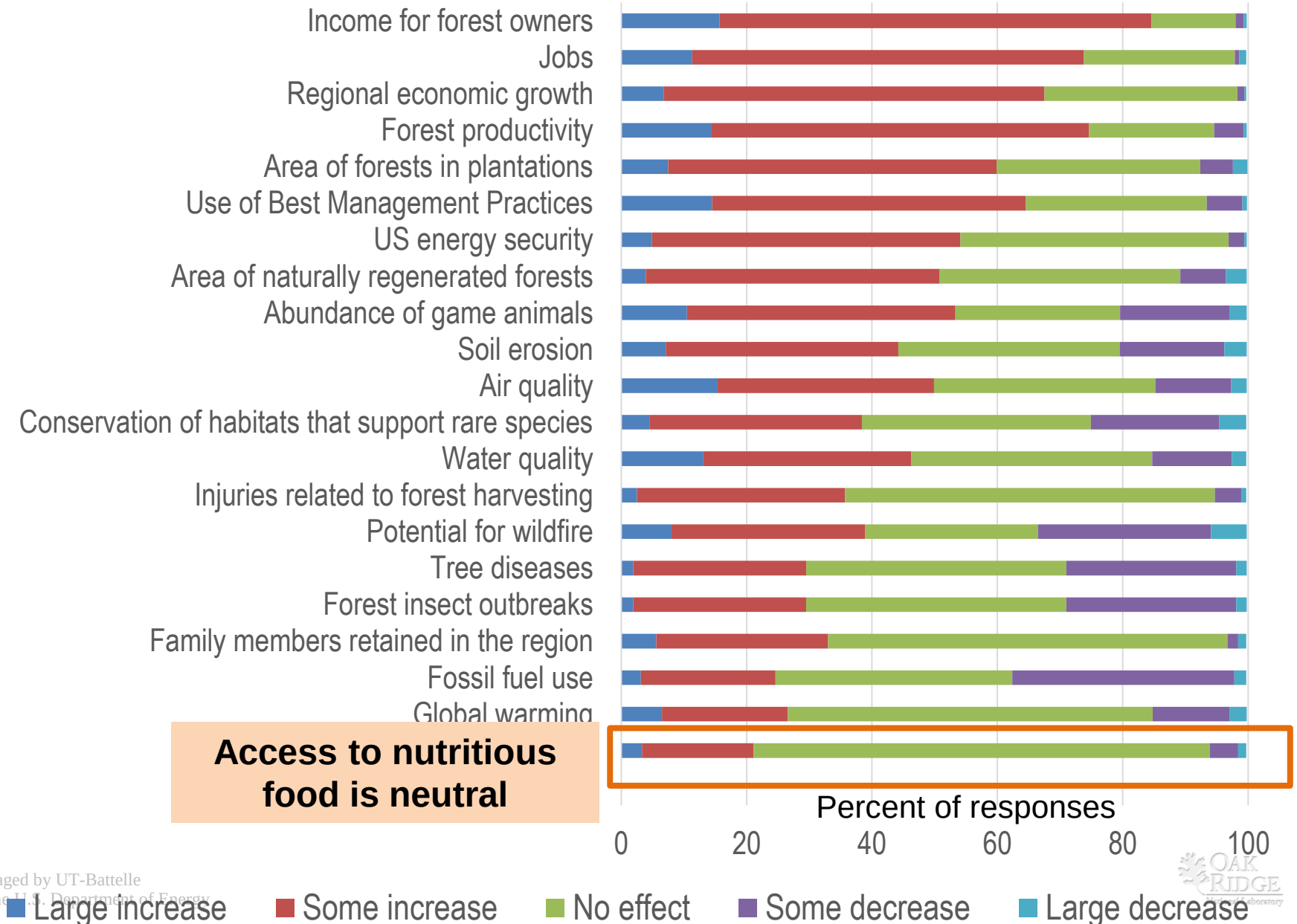


Factors related to climate change are largely neutral:

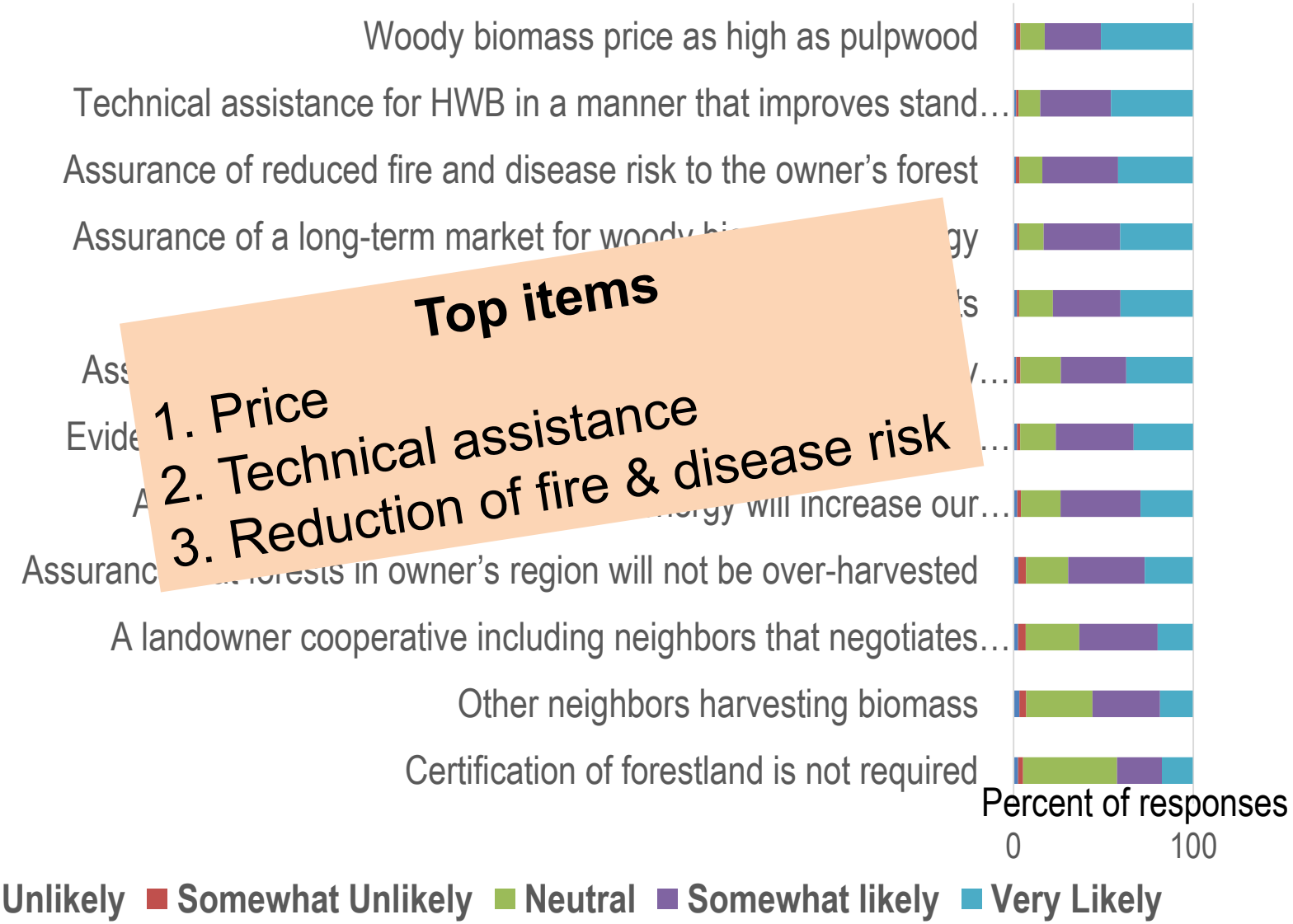
- Fossil fuel use
- Global warming

Diverse landowners' perspectives regarding potential effects of bioenergy production

Hodges et al. (in review)



Diverse views on effects of markets & policy on willingness to sell biomass for energy

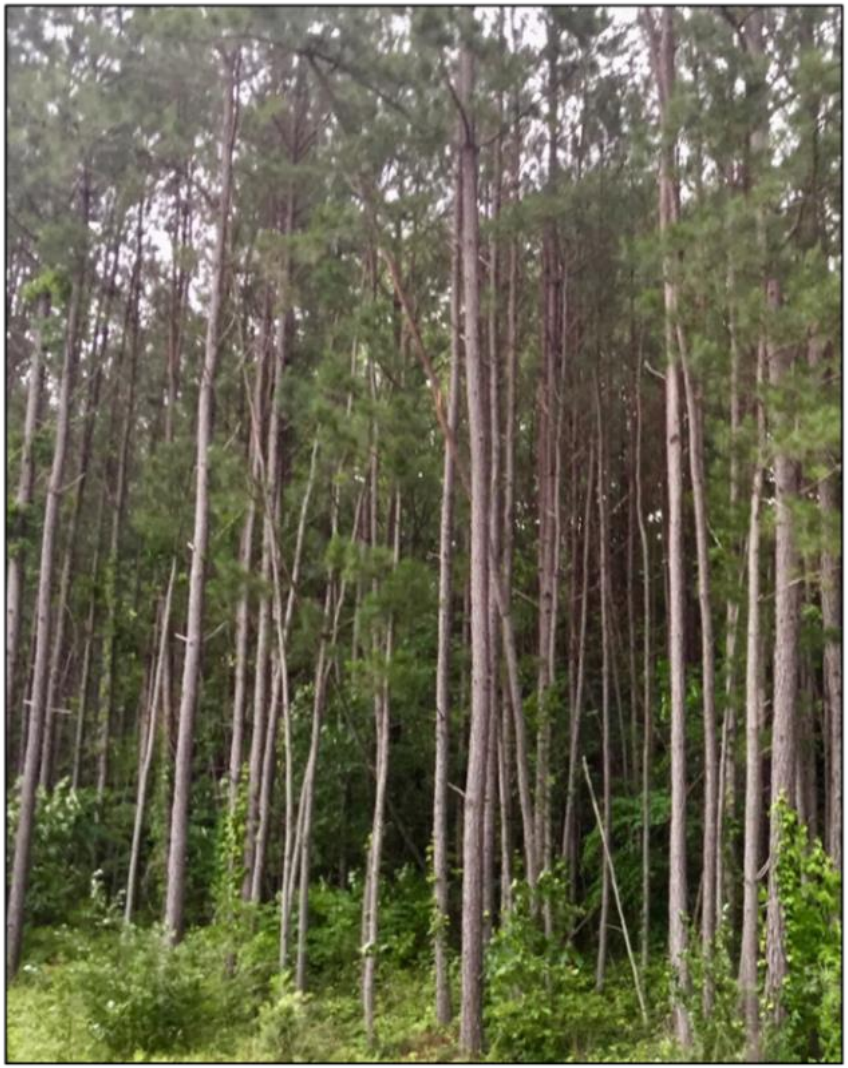


(HWB = harvesting woody biomass)

Hodges et al. (in review)

Pellet production allows forest owners to conduct forest management (e.g., thinning) that reduces risks of fire & insect outbreaks

A



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Parish, Dale, Kline (2017) *World Biomass*

Benefits of producing wood pellets in the SE US

- **Provide rural jobs**
- **Mitigate climate change**
  - By replacing coal
  - By enhancing forest sequestration in forests with improved management
- **Reduce inefficiencies**
- **Improve forest habitat**
- **Retain forests**
  - As demand for wood increases, net forest area typically expands
- **Decrease risks of**
  - Insect outbreaks & disease
  - Destructive wildfire

- *Cowie et al. (2013) IEA Bioenergy*
- *Dale + 34 authors (2017) GCB Bioenergy*
- *Dale et al (2017) Forest Ecol & Mgt*
- *Forest2Market (2017)*
- *Miner et al. (2014) Journal of Forestry*
- *Parish et al. (2018) Ecology & Society*

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Thank you!

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