Wood-based Bioenergy: Status of science and policy

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Virginia Forestry Association Annual Convention, April 16-18, 2010
Wintergreen, VA

Overview

- Rationale for & science of woody bioenergy
- Current policy environment
- Effect of woody bioenergy market on other forest product markets
- Challenges of and opportunities for bioenergy

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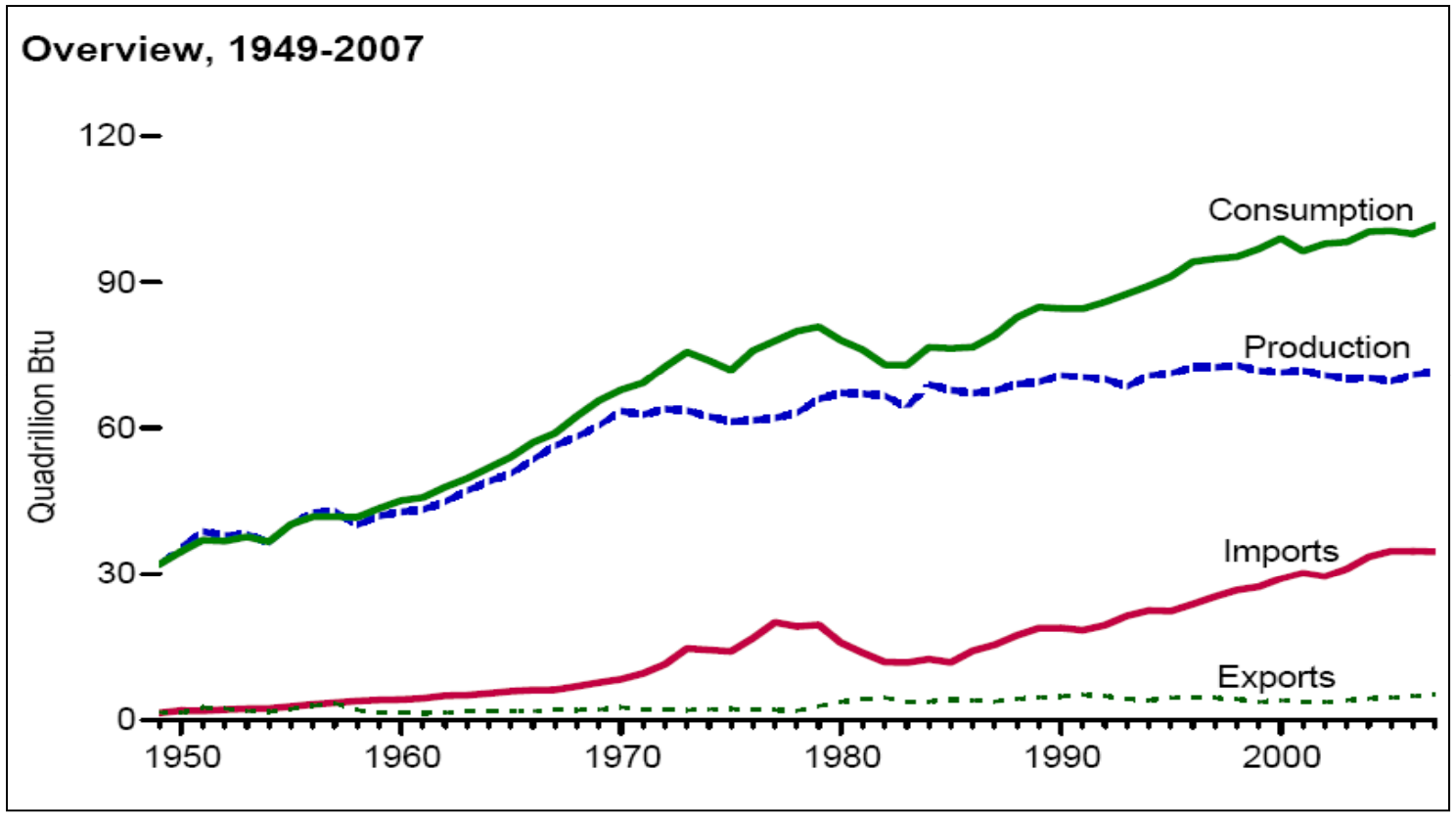
Rationale and Science behind wood-based bioenergy

U.S. Energy overview



- 85% of primary energy consumption comes from fossil fuels
- ~40% energy is from petroleum and major portion is imported

Source: EIA 2007

Prompting factors for alternative energies

- Unstable oil prices – Economic growth concerns
- High dependency on foreign oil – National security concerns
- High greenhouse gas emissions - Environmental concerns

Rationale for bioenergy

- Increase economic growth
- Improve national energy security
- Improve environmental benefits
- New markets, economic growth, and jobs

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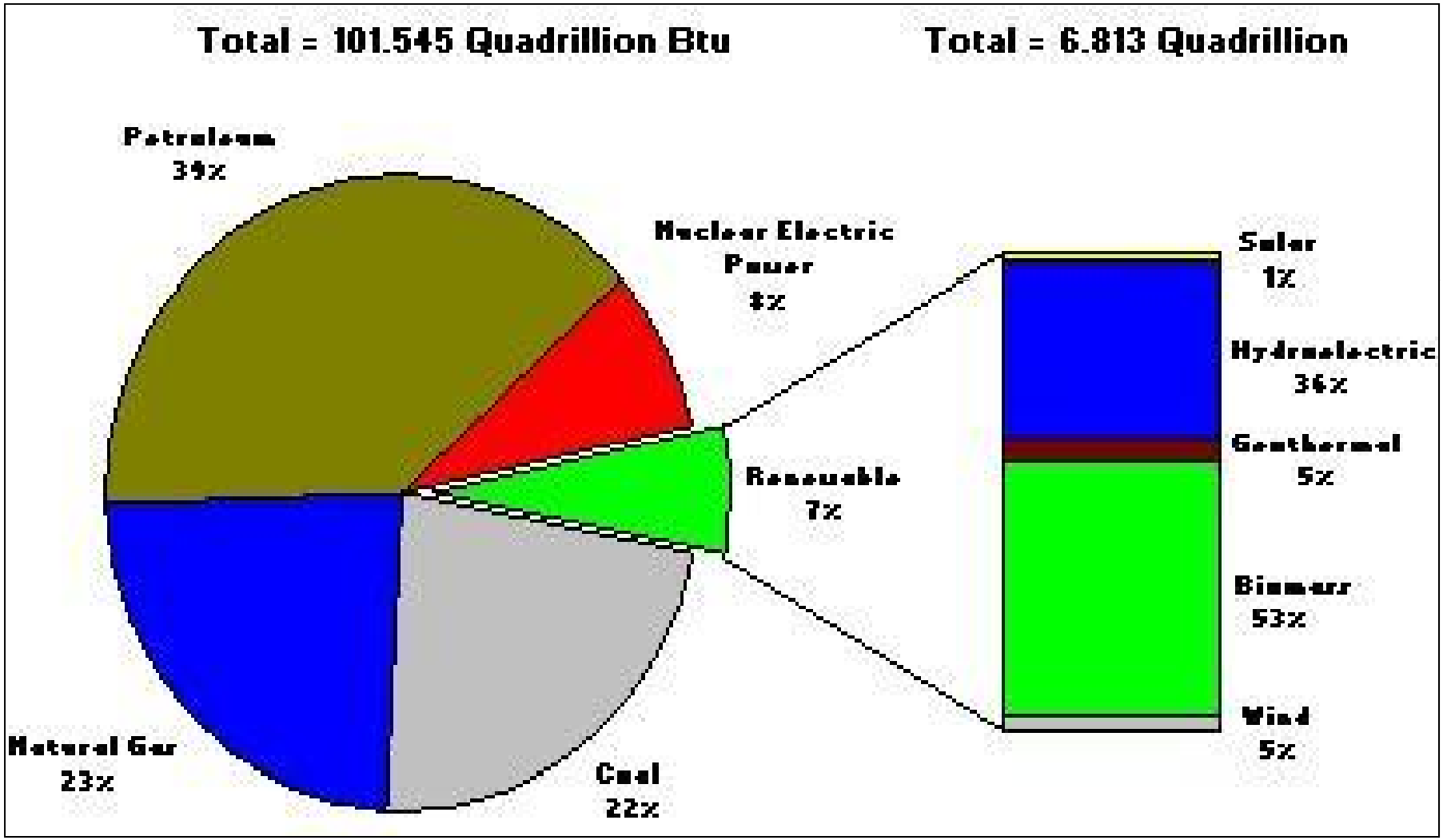
U.S. Energy situation

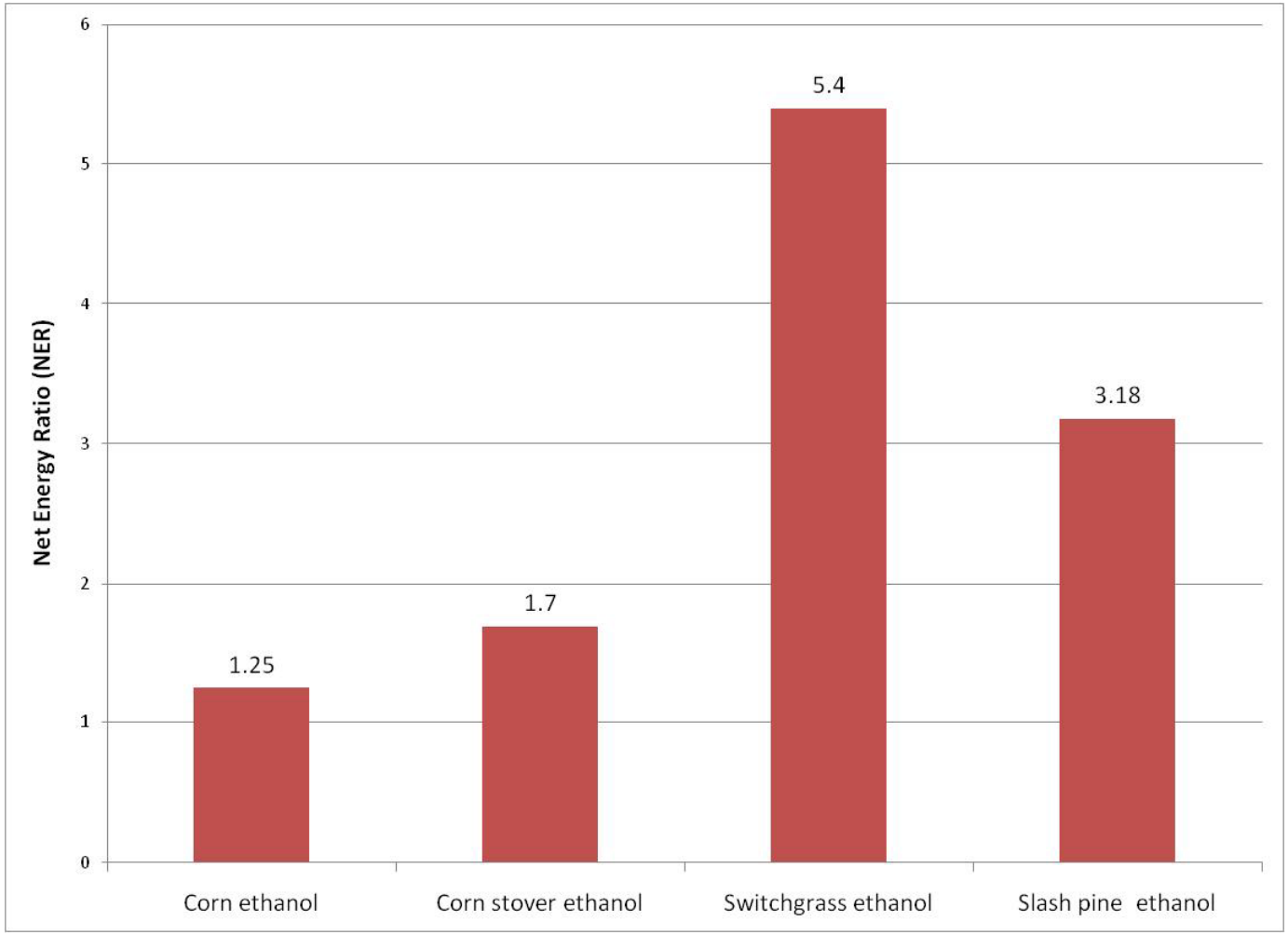


Source: EIA (2007)

Why wood-based bioenergy?

- Limited or no competition with food based feedstock
- Utilization of small diameter forest biomass improves forest health (Healthy Forest Initiative)
- Biomass markets improve profitability of forestlands

Energy output



Source: Dwivedi, P., J.R.R. Alavalapati, T. Nesbit, and A. Lindner (in review)

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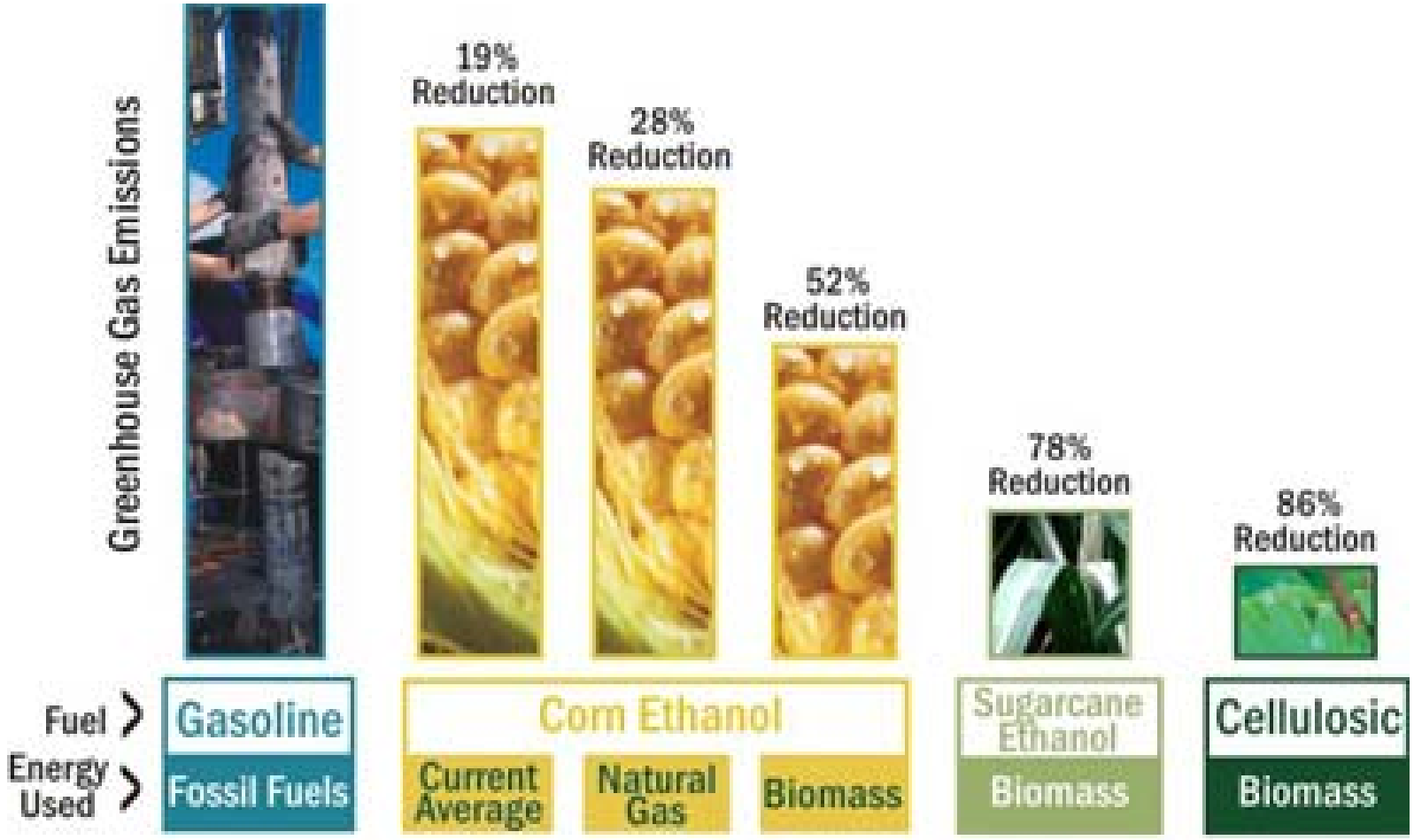
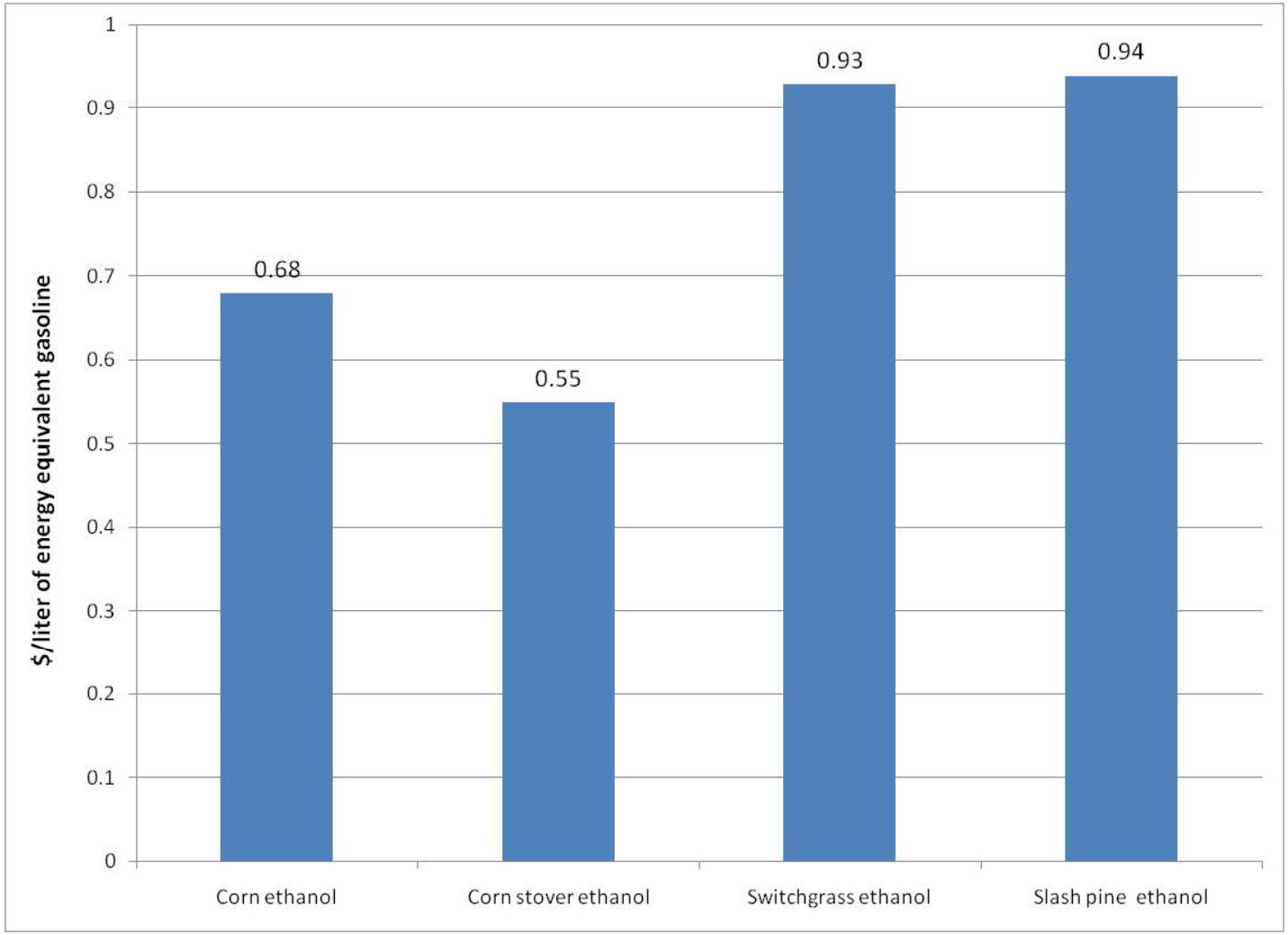
Ethanol GHGs emissions



Source: Wang et al, *Environmental Research Letters*, Vol. 2, 024001, May 22, 2007

Unit cost of ethanol production



Source: Dwivedi, P., J.R.R. Alavalapati, T. Nesbit, and A. Lindner (in review)

Increase in profitability under bioenergy scenarios

Scenarios	No thinning scenario		Thinning scenario for pulpwood		Thinning scenario for bioenergy	
Risk\salvage	k=0.8	k=0	k=0.8	k=0	k=0.8	k=0
λ = 0.03	649.26	556.19	679.19	537.05	686.82	543.36
λ = 0.02			748.27	641.49	756.79	649.03
λ = 0.01			822.29	762.33	831.80	771.29
λ = 0			901.11	901.11	911.69	911.69

(Susaeta, Alavalapati, and Carter 2009)

Public willingness to pay

- Willingness to pay a premium for E10 and E85 blending to realize forests environmental benefits (Florida, Arkansas, Virginia)

Mean WTP for E10 ($/gallon)	Mean WTP for E85 ($/gallon)
0.54	0.95

Source: Susaeta, Alavalapati, Lal, and Mercer (2009)

Policy environment

Policy Environment

- Clean Air Act Amendments 1990.
- American Jobs Creation Act of 2004.
  - A tax credit of $0.51 for every gallon of ethanol produced.
- The Energy Policy Act of 2005: Renewable Fuels Standard.
  - 7.5 billion gallons of renewable fuels by the year 2012.
- The Energy Independence and Security Act of 2007.
  - 36 billion gallons of renewable fuels by the year 2022.
  - 21 billion gallons of advanced biofuel.

Policy Environment

- The Food, Conservation, and Energy Act of 2008.
  - A tax credit of $0.45/gallon of starch-based ethanol produced.
  - A tax credit of $1.01/gallon of cellulosic ethanol produced
- Biomass Crop Assistance Program ($517M for 2010)
  - Provide support to grow, collect, harvest, storage, and transportation of biomass for energy
- Research/education/outreach 2010
  - Biomass Research and Development Initiative (~$33M per year)
  - Plant Feedstock Genomics for Bioenergy (~6M per year)
  - AFRI-Sustainable Bioenergy (~40M per year)

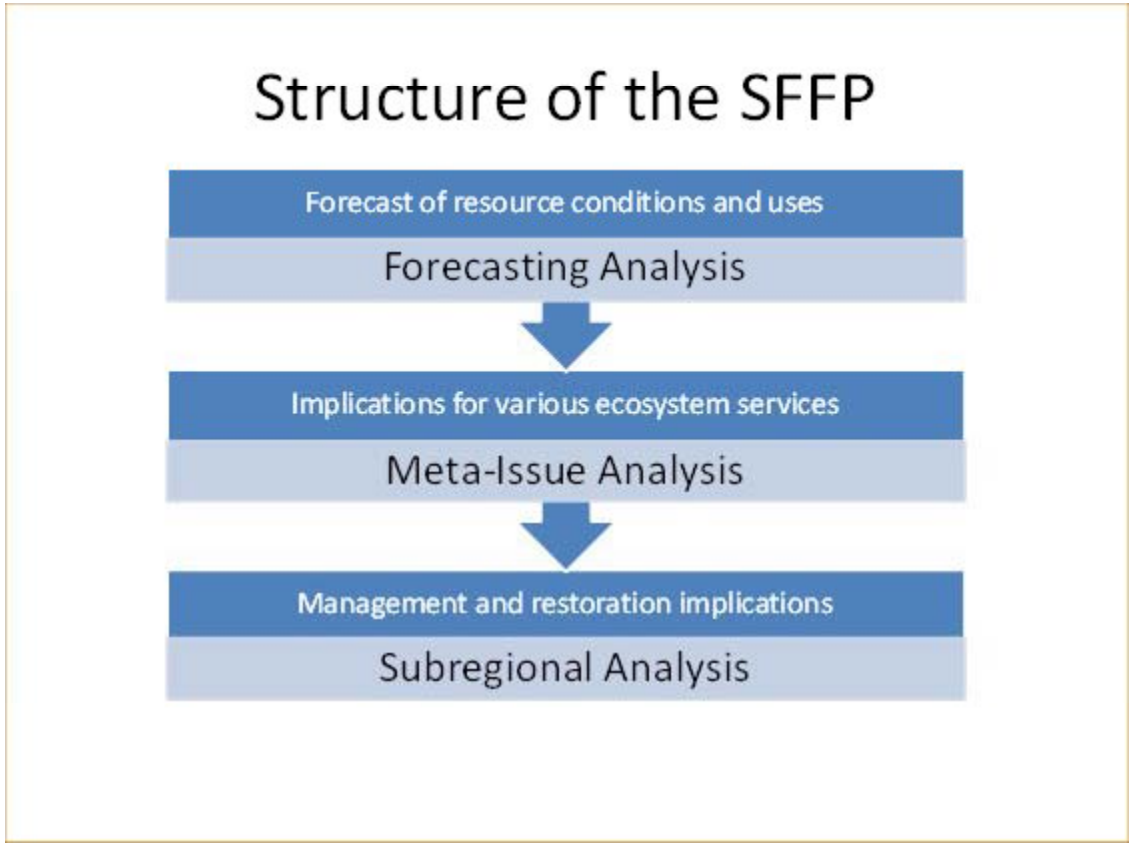
Regional Efforts on Wood based Bioenergy

National dialogue 2009: Sustainability of wood-based bioenergy in the US South

(Pinchot Institute & Heinz Center)

- Effective development of forest biomass supply estimates
- Development of sustainability standards for forest biomass
- Supporting a sustainable “build out” of the wood-based bioenergy industry

Southern Forest Futures Project 2009-10



- Bioenergy has been identified as one of the 8 meta-issues
- http://www.srs.fs.usda.gov/futures

Challenges and opportunities

Challenges for wood based bioenrgy

- Lack of a unified biomass definition
- High cost of production (liquid fuels and electricity) relative to fossil fuels and corn ethanol
- Lack of consensus on pragmatic sustainability guidelines
- Limited understanding about future impacts of bioenergy on forest products industry

Effect of a 30% increase in demand for forest biomass in FL

Variable	Baseline	Price/output	% change
$ ft^{-3} (Sawtimber)	1.65	1.75	6.02
$ ft^{-3} (pulpwood)	0.23	0.26	13.05
$ ft^{-3} **(Biomass)**	0.10	0.15	45.94
Mft^3 (Sawtimer)	130431.01	129657.73	-0.59
Mft^3 (Pulpwood)	321458.95	310739.40	-3.33
Mft^3 (Biomass)	69035.81	89746.55	30

Source: Susaeta, Alavalapati, and Lal (2010)

Effect of a 30% increase in demand for forest biomass in FL ($000)

Forest product	Baseline stumpage	Stumpage value increase	% change
Sawtimber	216127.7	227782.4	5.4
Pulpwood	74682.7	81619.5	9.3
Biomass	7323.8	13898.1	8.9
Total	298134.3	323300.0	8.4

Source: Susaeta, Alavalapati, and Lal (2010)

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Economic impacts of bioenergy policies in the U.S. South ($millions)

	Numbers of HH (% of total HH)	Bioenergy Substitution RPS	Bioenergy Substitution RFS	Bioenergy Incentive	Technological Progress
Low HH	5,963,404 (15.88%)	-73.45	-131.06	-8.35	-0.56
Medium HH	12,165,184 (32.39%)	-190.26	-298.05	40.37	2.10
High HH	19,432,041 (51.73%)	-117.82	-177.97	40.58	2.25

NOTE: 1% of RPS and RFS are simulated assuming that forest biomass will be used as a feedstock

Source: Huang and Alavalapati (2010)

Opportunities for wood based bioenergy

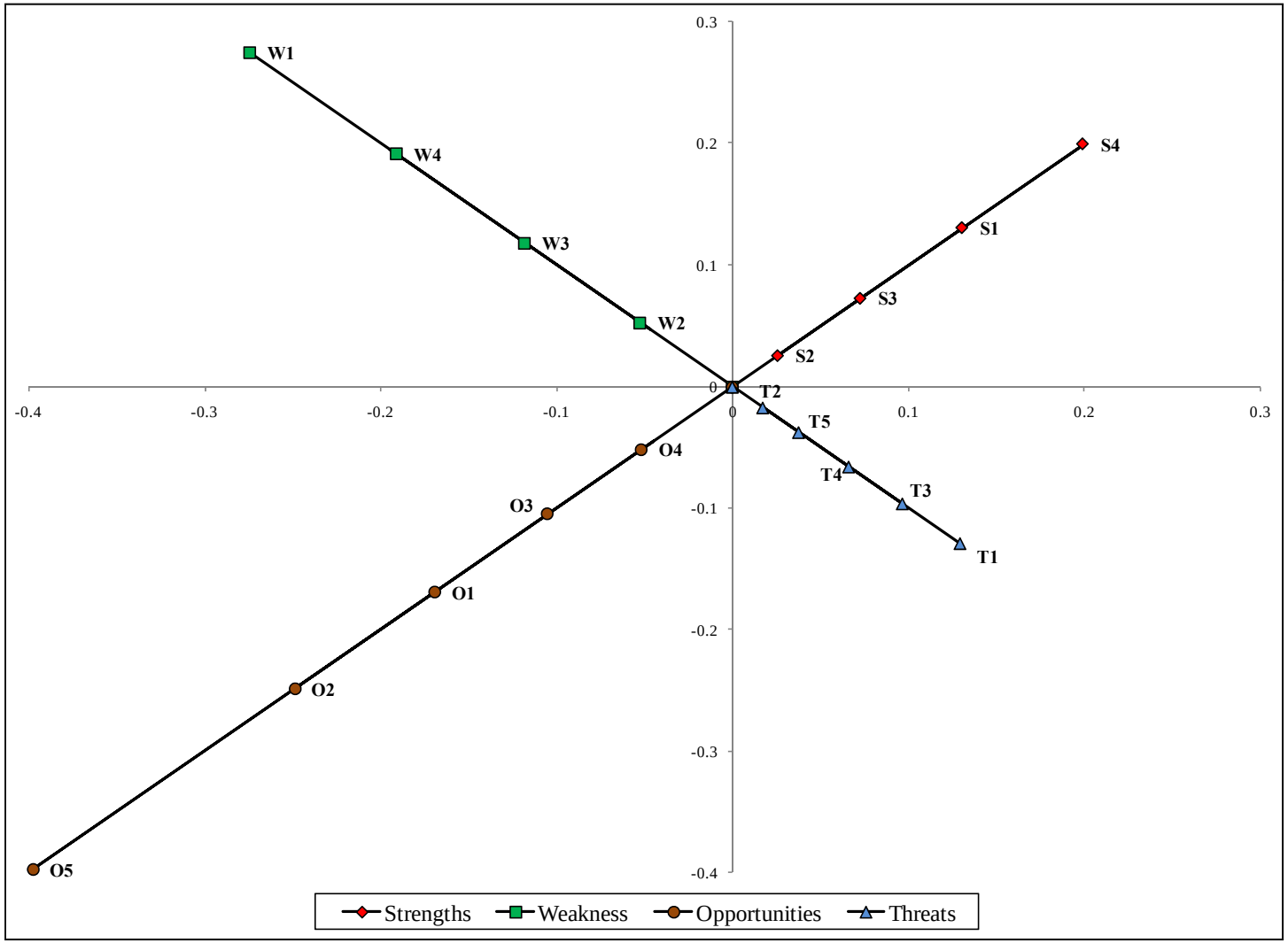
Opportunities for wood based bioenrgy

- Pellets and electricity generation are becoming competitive
- Research efforts for third generation biofuels (also called *drop-in-fuels*) are on the rise
- Stakeholders support for woody bioenergy is on the rise

Experts groups views on forest bioenergy

Strengths
S1: Promotes Energy security
S2: Reduces greenhouse gas emissions
S3: Less or no competition with food production
S4: Sufficient forest biomass availability
Opportunities
O1: Emerging future carbon markets
O2: Presence of government support/commitment
O3: Favorable public opinion
O4: Improves the sustainability of forests
O5: Rural development
Weaknesses
W1: Conversion technologies are still under trial
W2: Uncertainties related to forest biomass production
W3: Still not competitive with coal, gasoline and corn based ethanol
W4: Uncertain future of bioenergy markets
Threats
T1: Competes with conventional forest products industry
T2: Competition from other renewable energy sources
T3: Possible damages to forest ecology
T4: Reduction in prices of fossil based energy resources
T5: Cheap imports from other countries

Perception map for NGOs – AHP analysis



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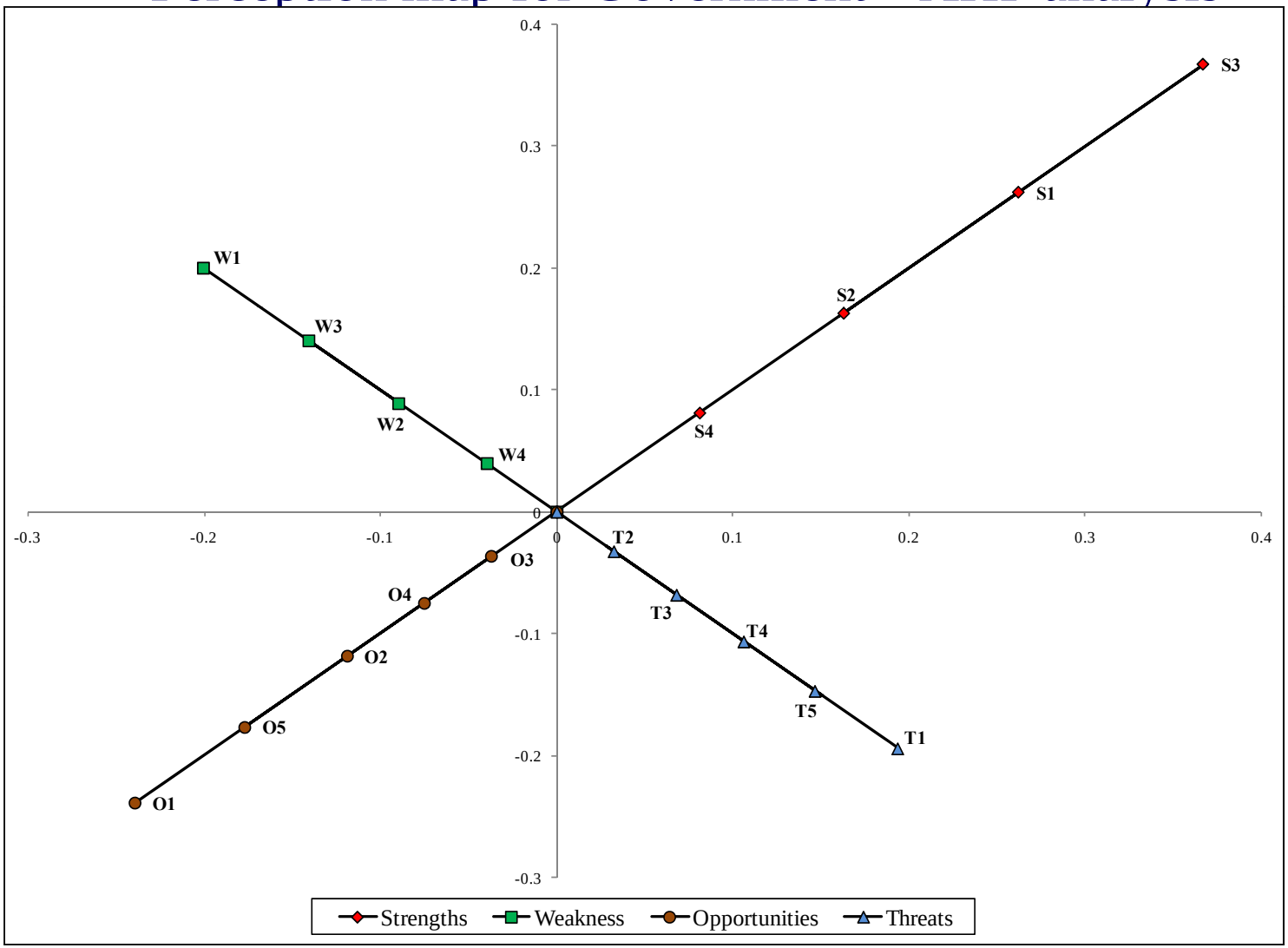
Perception map for Government – AHP analysis



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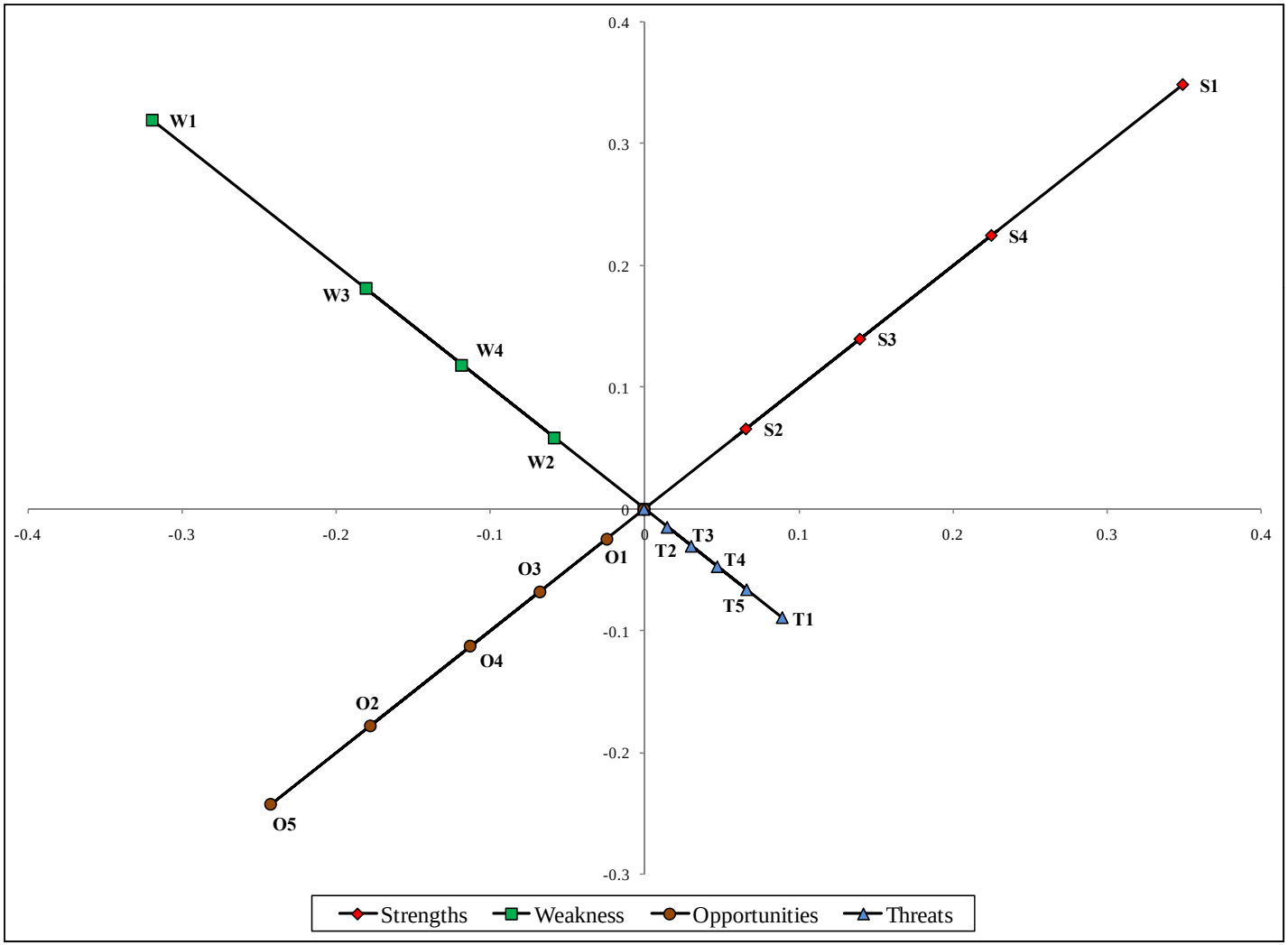
Perception map for private sector – AHP analysis



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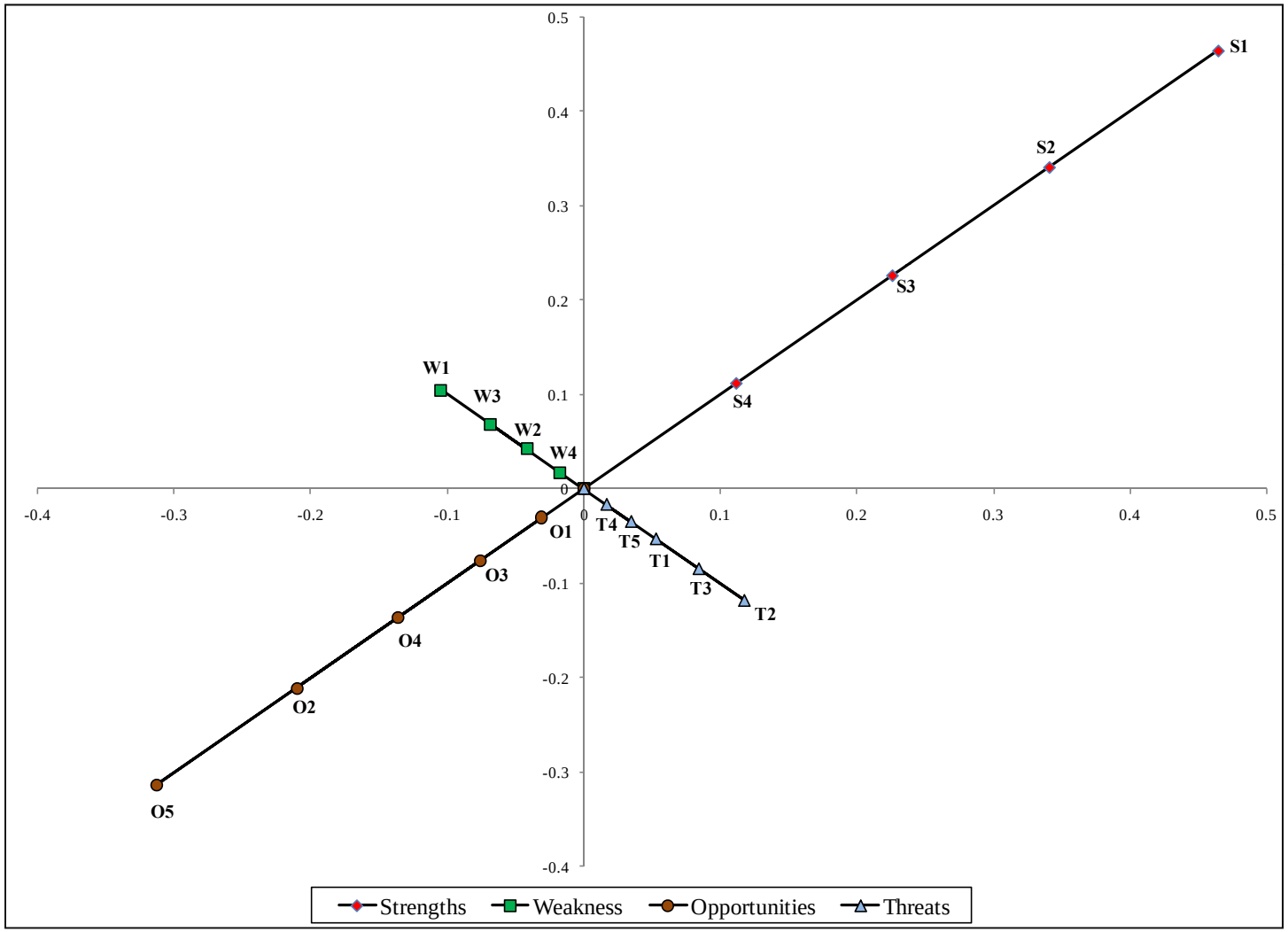
Perception map for Academia – AHP analysis



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Conclusions

- Bioenergy markets are complex and hard to predict their future
- Public perceptions (positive and negative) would shape the future of bioenergy markets
- New policies and research are on the rise

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THANKS