

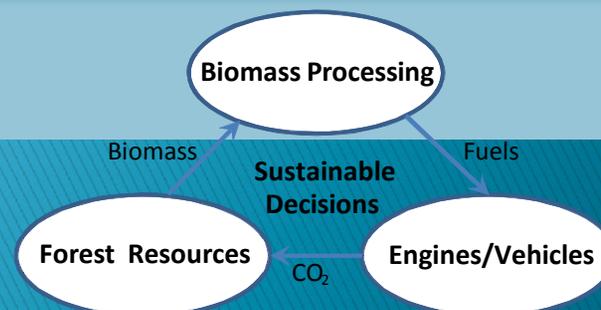
Social Dimensions of Sustainable Bioenergy Development



Dr. Kathleen E Halvorsen
Michigan Technological University



Wood to Wheels Program
Michigan Technological University



Outline

- ▶ Our projects
 - ▶ Public support
 - ▶ Tradeoffs
 - ▶ Community impacts
 - ▶ Feedstock availability
 - ▶ Policies and diffusion of innovation
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Our projects

- ▶ MTU Wood to Wheels group
- ▶ Climate change–related beliefs and support for bioenergy
- ▶ Willingness to pay for cellulosic ethanol
- ▶ Overcoming obstacles to biomass utilization
- ▶ Federal policies and diffusion of cellulosic ethanol technology
- ▶ Non–industrial forest landowners, sustainability, and bioenergy



Initiatives

- ▶ Social science landscape:
 - Concerns about environmental sustainability and bioenergy
 - Concerns about community and landowner sustainability and bioenergy
 - Concerns about how to overcome obstacles to large scale, sustainability bioenergy development
- ▶ 2010 Special Issue Biomass and Bioenergy: Social Dimensions of US Bioenergy Development



Public Support for Bioenergy



US Public's Climate Change Perceptions

How much do you personally worry about the "greenhouse effect" or global warming?

	Great deal	Fair amount	Only a little	Not at all	No opinion
	%	%	%	%	%
2008	37	29	16	17	1
2007	41	24	18	16	1
2006	36	26	21	15	1
2004	26	25	28	19	2
1999	34	34	18	12	2
1990	30	27	20	16	6
1989	35	28	18	12	7

Do you think that global warming will pose a serious threat to you or your way of life in your lifetime?

	Yes	No	No opinion
2008	40%	58	2
2006	35%	62	2
2002	33%	65	2
2001	31%	66	3
1997	25%	69	6

Source: Gallup 2008

Research Design

- ▶ Research questions: What climate change-related beliefs does the upper midwestern public hold? How do these beliefs affect their support for energy-related mitigation strategies (biofuel, energy tax, conservation)?
- ▶ Phase I: Interviews (Fall 2006–Summer 2007)
 - 86 interviews with lay citizens and state and national specialists
- ▶ Phase II: MI, WI, MN Statewide Mail Surveys (Fall 2007–Spring 2008)



Survey Design

- ▶ Questions drawn from interviews and prior studies (Dietz et al. 2007; Kempton et al. 1995; Leiserowitz 2006)
- ▶ Mail survey of 1 500 MN, WI, MI residents
7 mailing waves (Clendenning et al. 2004)
- ▶ 52% response rate (1 432 good addresses)
- ▶ Phone survey of 62 non-respondents (9%)
- ▶ Tracking and comparison between early and late responders

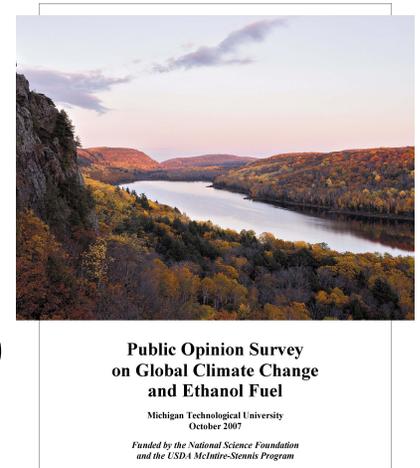
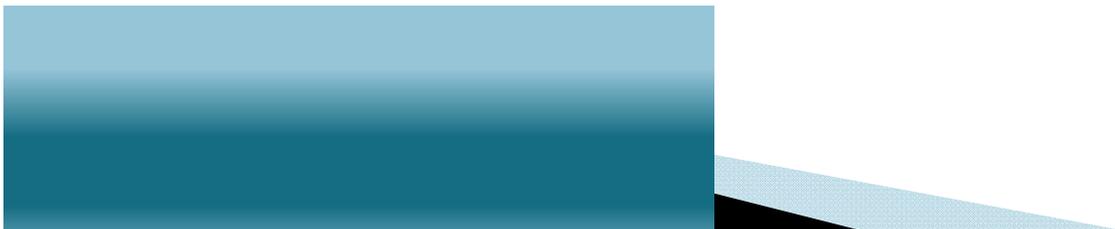


Photo by M.J. Shupe



Results: Indices (Johnson et al 2009)

Indices (N)	Items	Mean ^a	Chronbach's Alpha
Familiarity with climate change topic (722)	3	4.6	0.83
Concern about climate change (618)	5	3.6	0.81
Belief that climate change will have serious impacts (587)	6	4.0	0.96
Climate change existence and causes skeptic (626)	6	2.5	0.81
Accurate knowledge of climate change causes and solutions (550)	5	3.7	0.90
Inaccurate knowledge of climate change causes and solutions (570)	3	3.6	0.77
New Environmental Paradigm beliefs (613)	6	3.9	0.79
Willingness to support mitigation strategies (personal sacrifice) (biofuels, energy tax, conservation)? (628)	8	3.0	0.88

^a Using a Likert scale of 1-5, 1 = Disagree strongly to 5 = Agree strongly, included "Don't know" option.

Linear regression model of concern about climate change (adj R² 0.67)

	Unstandardized Coefficients		Sig.
	B	Std. Error	
(Constant)	1.659	.244	.000
Familiarity with climate change concept	.016	.027	.545
Belief that climate change will have serious impacts	.411	.029	.000
Climate change existence and causes skeptic	-.262	.030	.000
Accurate knowledge of climate change causes and solutions	.029	.041	.477
Inaccurate knowledge of climate change causes and solutions	-.027	.037	.462
New Environmental Paradigm beliefs	.220	.038	.000
Age	-.030	.017	.081
Income	-.025	.014	.079
Education level	.007	.013	.604
Gender	-.033	.045	.464
Political orientation	.073	.022	.001

Linear regression model of willingness to support mitigation (adj R² 0.40)

	Unstandardized Coefficients		Sig.
	B	Std. Error	
(Constant)	-1.120	.363	.002
Familiarity with climate change concept	.036	.039	.353
Concern about climate change	.196	.054	.000
Belief that climate change will have serious impacts	-.040	.047	.398
Climate change existence and causes skeptic	.017	.045	.705
Accurate knowledge of climate change causes and solutions	.141	.059	.017
Inaccurate knowledge of climate change causes and solutions	.077	.054	.152
New Environmental Paradigm beliefs	.341	.056	.000
Age	.061	.025	.013
Income level	.096	.021	.000
Education level	.035	.019	.065
Gender	.100	.064	.122
Political orientation	.145	.032	.000

Willingness to pay more for cellulosic ethanol

Table 6. Bid curve analysis: estimated FS lognormal regression model.

Variable	Estimated coefficient	t- statistic
Constant	0.253	0.922
Income	0.132	2.351 *
Gender	0.134	2.385 *
Political Views	0.064	1.105
Climate change beliefs	0.197	3.237 **
Climate change solutions	0.340	5.466 **
F statistic	18.486**	
Adjusted R ²	0.25	
N	262	

** Significant at the 0.01 level.

* Significant at the 0.05 level.

Solomon and Johnson, 2009

Tradeoffs



Needs

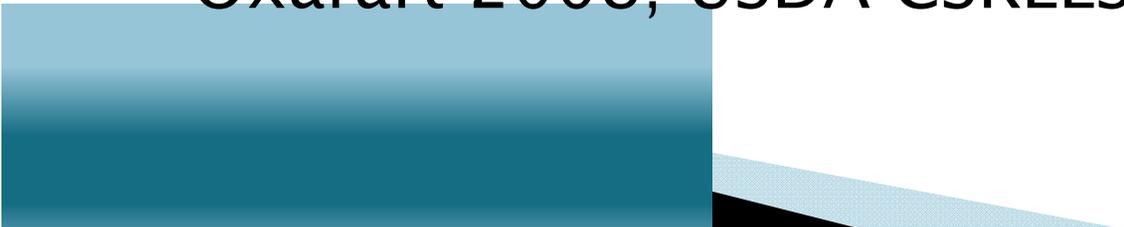
- ▶ Enhanced public and community dialogue
- ▶ Realistic information regarding costs and benefits of bioenergy development
- ▶ Public agency and academic role in facilitation (Monroe et al 2009)



Community Impacts



Community Vulnerability and Capacity

- ▶ Existing grain ethanol development can be problematic (Selfa 2008)
 - ▶ Future development may benefit communities and small landowners (Dyer et al 2008; Hinrichs 2008; Meyer 2008; Meyer and Hinrichs 2007; Nechodom and Becker 2008; Solomon 2008)
 - ▶ Need to enhance community capacity to choose (Luzadis and Volk 2008; Monroe et al. 2008; Oxarart 2008; USDA CSREES 2007)
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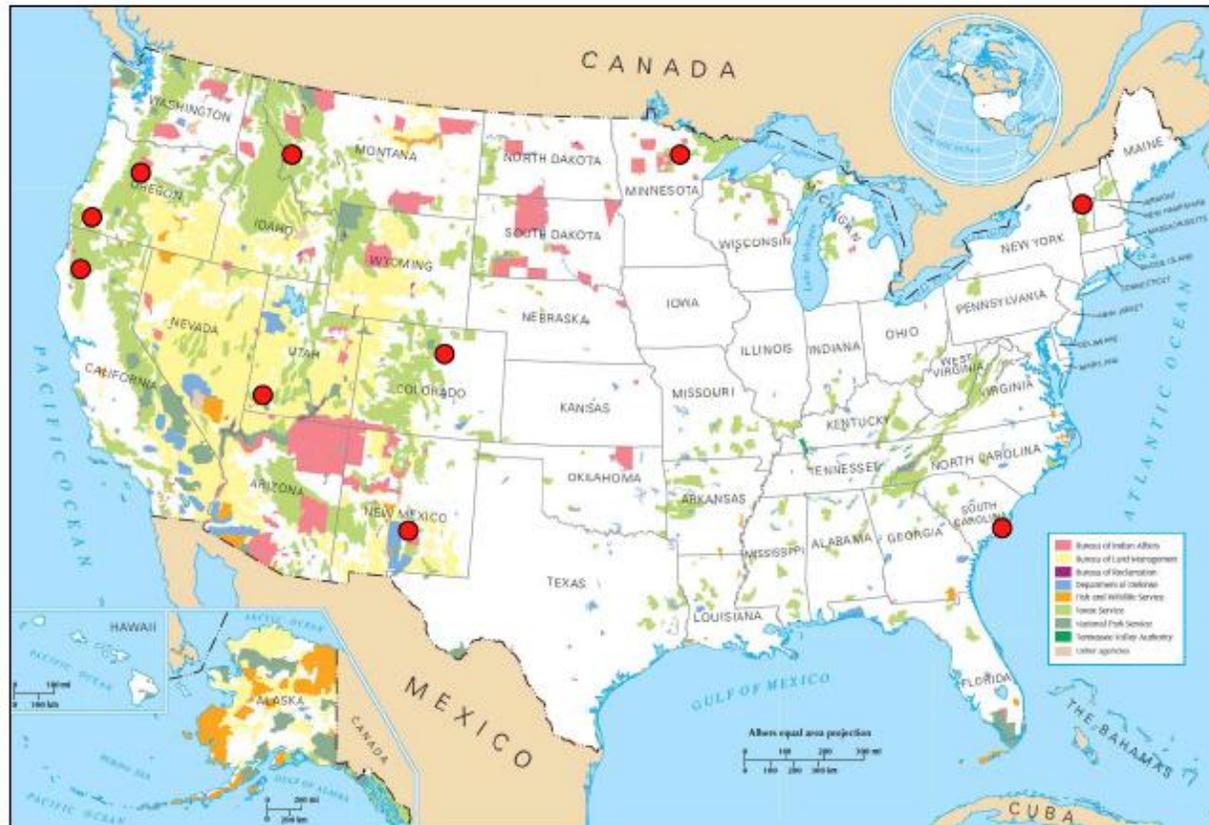
Feedstock availability

▶ Public Lands

- Federal lands and EISA RFS renewable biomass definition
- Logistics: experience with state and federal fire risk reduction demonstrates difficulties in efficient, large-scale biomass removal

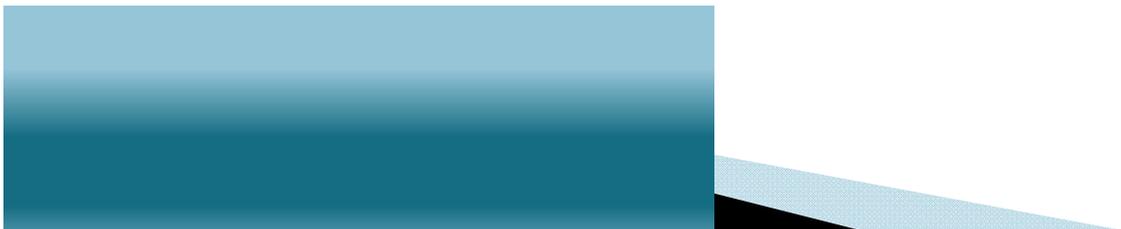


Lessons Learned from Biomass Utilization projects



Conventional Wisdoms (Becker et al 2009)

- ▶ Guaranteed supply of woody biomass
- ▶ The value of biomass
- ▶ Transportation costs
- ▶ Collaboration to accomplish utilization
- ▶ Environmental concerns



Feedstock availability

- ▶ Private lands: industrial forests, non-industrial forests, farms
- ▶ Extensive industry experience, market dependent



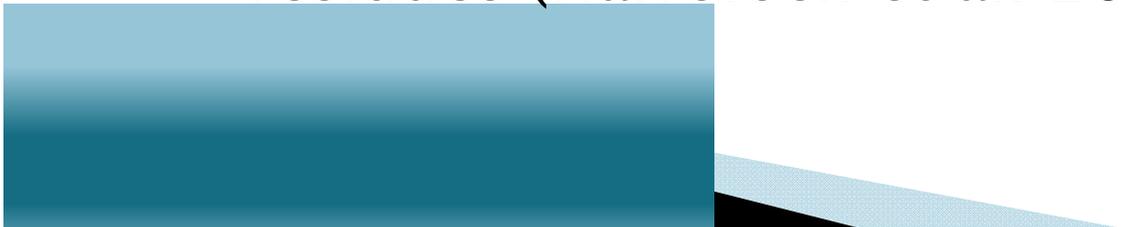
Sociopolitical dimensions of feedstock availability

- ▶ Non-industrial private or family forests
 - Most no harvest or poor management (Germain 2008; Munsell and Germain 2007)
 - Supply dependability difficult
 - Energy independence argument powerful (Germain 2008)
 - UMW NIPF survey (N=74): 55% residue removal good fit; 45% CE development helpful; 70% likely to sell residues (Halvorsen et al. 2008^d)



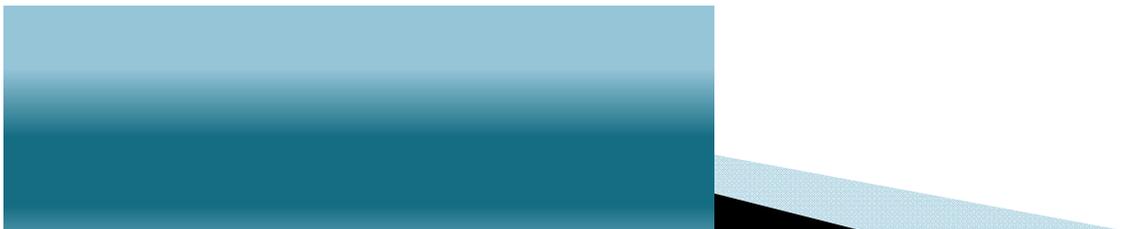
Sociopolitical dimensions of feedstock availability

- ▶ Agricultural lands (Hinrichs 2008; Meyer 2008; Meyer and Hinrichs 2007)
 - Interest, skepticism, caution among farmers (Meyer 2008; Meyer and Hinrichs 2007)
 - Conversion profitable w/carbon credits (Miller 2008)
 - UMW farmers (N=65) 40% removal residues fits well; 41% CE development helpful; 65% would sell residues (Halvorsen et al. 2008d)



Diffusion of innovation, federal policies, and cellulosic ethanol (Jensen et. al 2009)

- ▶ Cellulosic ethanol is cost-competitive with gasoline and grain ethanol (Solomon et. al 2008; Solomon et. al 2007)
- ▶ Analysis of EPA (2005); EISA (2007); FCEA/Farm Bill (2008)
- ▶ Assessment of sections focused on speeding diffusion, enhancing communication, reducing risk
- ▶ Three life cycle stages: landowners, producers, consumers
- ▶ Majority of components focus on reducing risk to producers; landowners and consumers overlooked
- ▶ Landowner oversight particularly problematic



Current work: NIPFs

- ▶ Michigan Center for Energy Excellence (MEDC, MTU, MSU, Mascoma/Frontier)
- ▶ Goals: deepen understanding of obstacles to cellulosic ethanol development in Michigan, deepen understanding of ways to overcome them

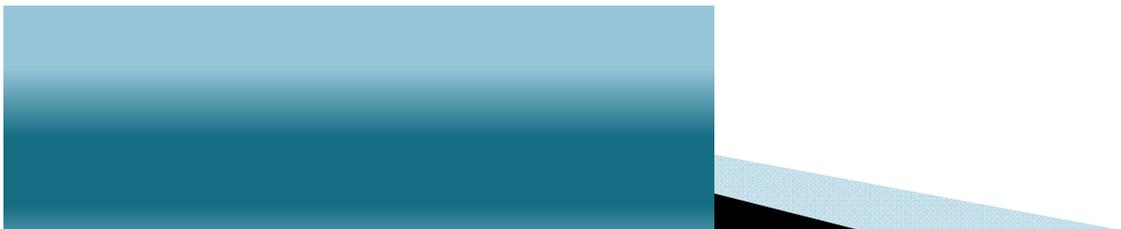


NIPF interviews

- ▶ Forest management experience, future plans
 - ▶ Values, beliefs, and goals regarding sustainability (wildlife, soils, wetlands, timber, invasive species)
 - ▶ Values, beliefs and goals regarding woody bioenergy opportunities, cellulosic ethanol markets
 - ▶ Willingness to pursue energy cropping
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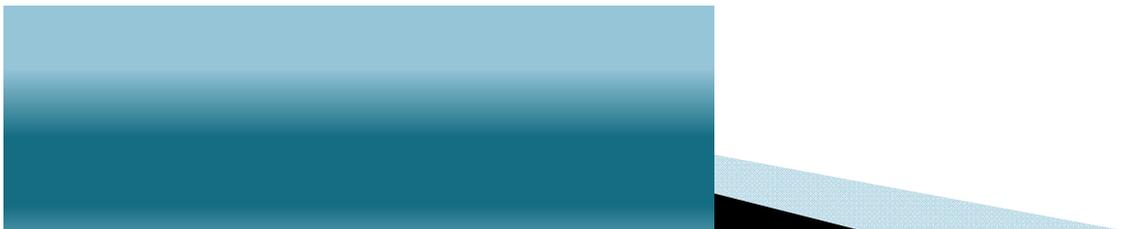
Key bioenergy and sustainability social science questions

- ▶ Realistic assessment of feedstock availability given complex constraints and landowner goals
- ▶ How to provide community and public capacity to weigh tradeoffs, make bioenergy decisions?
- ▶ Linkages between cutting edge biophysical science findings re:bioenergy sustainability and public values



Summary

- ▶ Understanding of climate change links to support for cellulosic ethanol
- ▶ High willingness to support cellulosic ethanol
- ▶ Need for new tools for public/community dialogue and information regarding tradeoffs
- ▶ Feedstock availability from public and private lands is key issue
- ▶ Federal policies don't focus enough on landowners or consumers



Partial Bibliography

- ▶ Becker, D.R., K. Skog, A. Hellman, K.E. Halvorsen, and T. Mace. An Outlook for Sustainable Forest Bioenergy Production in the Lake States. *Energy Policy* Accepted August 2009.
- ▶ Becker, Dennis, R., Dalia Abbas, Kathleen E. Halvorsen, Pamela J. Jakes, Sarah M. McCaffrey, and Cassandra Moseley. 2009. Characterizing Lessons Learned from Federal Biomass Removal Projects. Joint Fire Science Program (USDA Forest Service and USDI Bureau of Land Management). JFSP Project 07-3-2-08.
- ▶ Halvorsen, K.E., D.S. Becker, C. Hinrichs, and T.A. Selfa (eds). 2009. Special Issue of *Biomass and Bioenergy: Socioeconomic Dimensions of U.S. Bioenergy* Planned for publication 2010. Under review.

Halvorsen, K.E., J.R. Barnes*, and B.D. Solomon. 2009. Upper Midwestern USA Ethanol Potential from Cellulosic Materials. *Society and Natural Resources* 22(10).
- ▶ Jensen*, J.E., K.E. Halvorsen, D.R. Shonnard. 2009. Cellulosic Ethanol, U.S. Federal Energy and Agricultural Policy, and the Diffusion of Innovation. Submitted for Special Issue of *Biomass and Bioenergy: Socioeconomic Dimensions of U.S. Bioenergy* Under review.
- ▶ Johnson, D., K.E. Halvorsen, B.D. Solomon. 2009. U.S. Upper Midwestern Consumers and Ethanol: Knowledge, Beliefs and Consumption. Submitted for Special Issue of *Biomass and Bioenergy: Socioeconomic Dimensions of U.S. Bioenergy* Under review.
- ▶ Shonnard, D.R., J. Jensen*, J. Naber, Q. Zhang, A. Maclean, K.E. Halvorsen, J.W. Sutherland, and T.L. Jenkins. 2008. Wood to Wheels: A Multidisciplinary Research Initiative on Sustainable Transportation Utilizing Fuels and Co-Products from Forest Resources. *SAE (Society of Automotive Engineers) Convergence*. Peer Reviewed SAE Technical Paper 2008-21-0026.
- ▶ Solomon, B. D., J.R. Barnes*, and K.E. Halvorsen. 2007. Grain and Cellulosic Ethanol: History, Economics, and Energy Policy. *Biomass and Bioenergy*. 31(6)216-25.
- ▶ Solomon, B.D., J.R. Barnes* and K.E. Halvorsen. 2008. From grain to cellulosic ethanol: History, economics and policy. In B.D. Solomon and V.A. Luzadis, eds. *Renewable Energy From Forest Resources in the United States* (Oxfordshire: Routledge). Pp. 49-66.
- ▶ Solomon, BD, and NH Johnson. 2009. Valuing climate protection through willingness to pay for biomass ethanol *Ecological Economics*, Volume 68, Issue 7, Pages 2137-2144

Questions?

