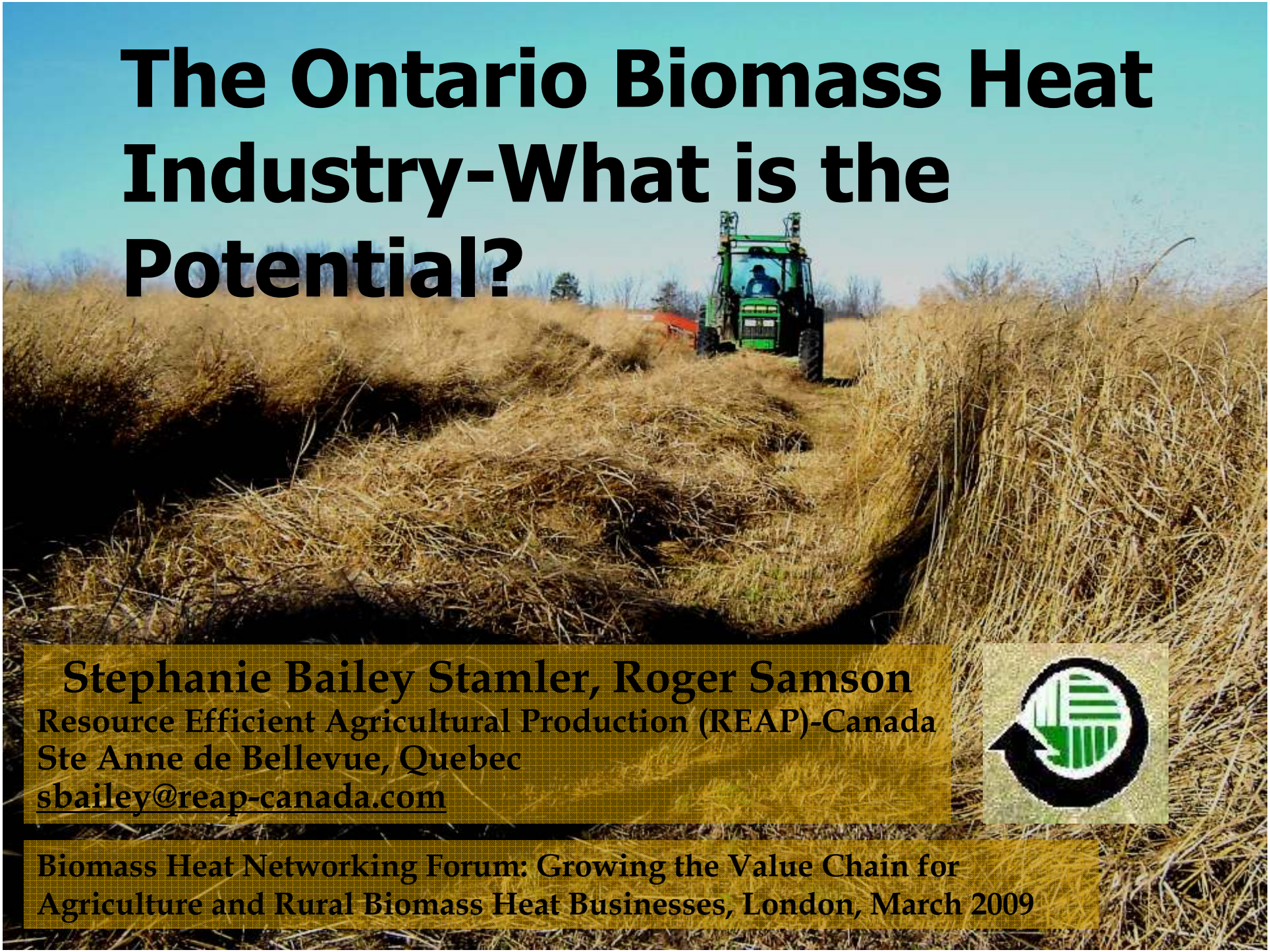
The Ontario Biomass Heat Industry-What is the Potential?



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Biomass Heat Networking Forum: Growing the Value Chain for Agriculture and Rural Biomass Heat Businesses, London, March 2009

REAP-Canada

- Providing leadership in the research and development of sustainable agricultural biofuels and bioenergy conversion systems for greenhouse gas mitigation
- 18 years of R & D on energy crops for liquid and solid biofuel applications
- Working in China, Philippines and West Africa on bioenergy and rural development projects

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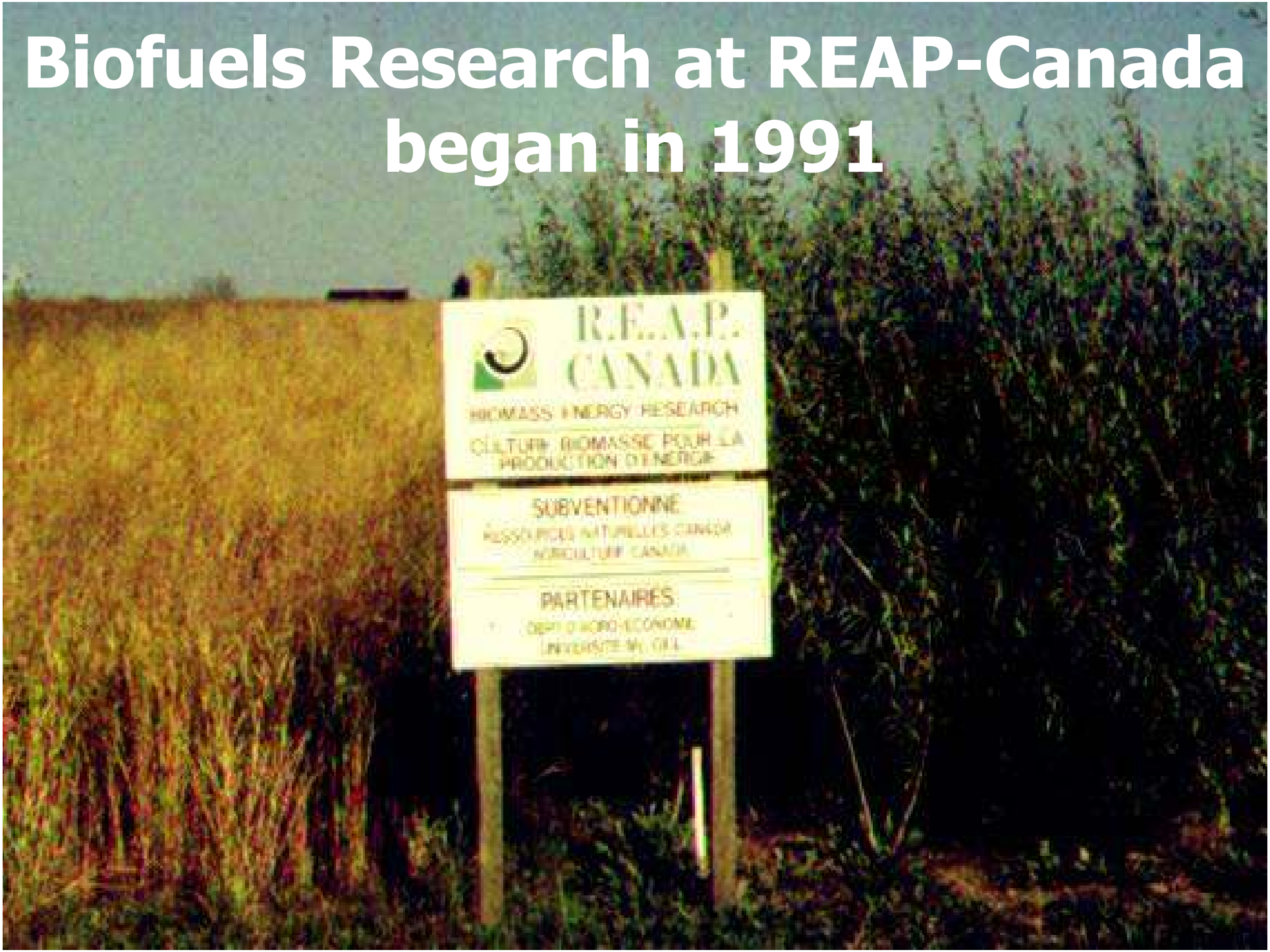
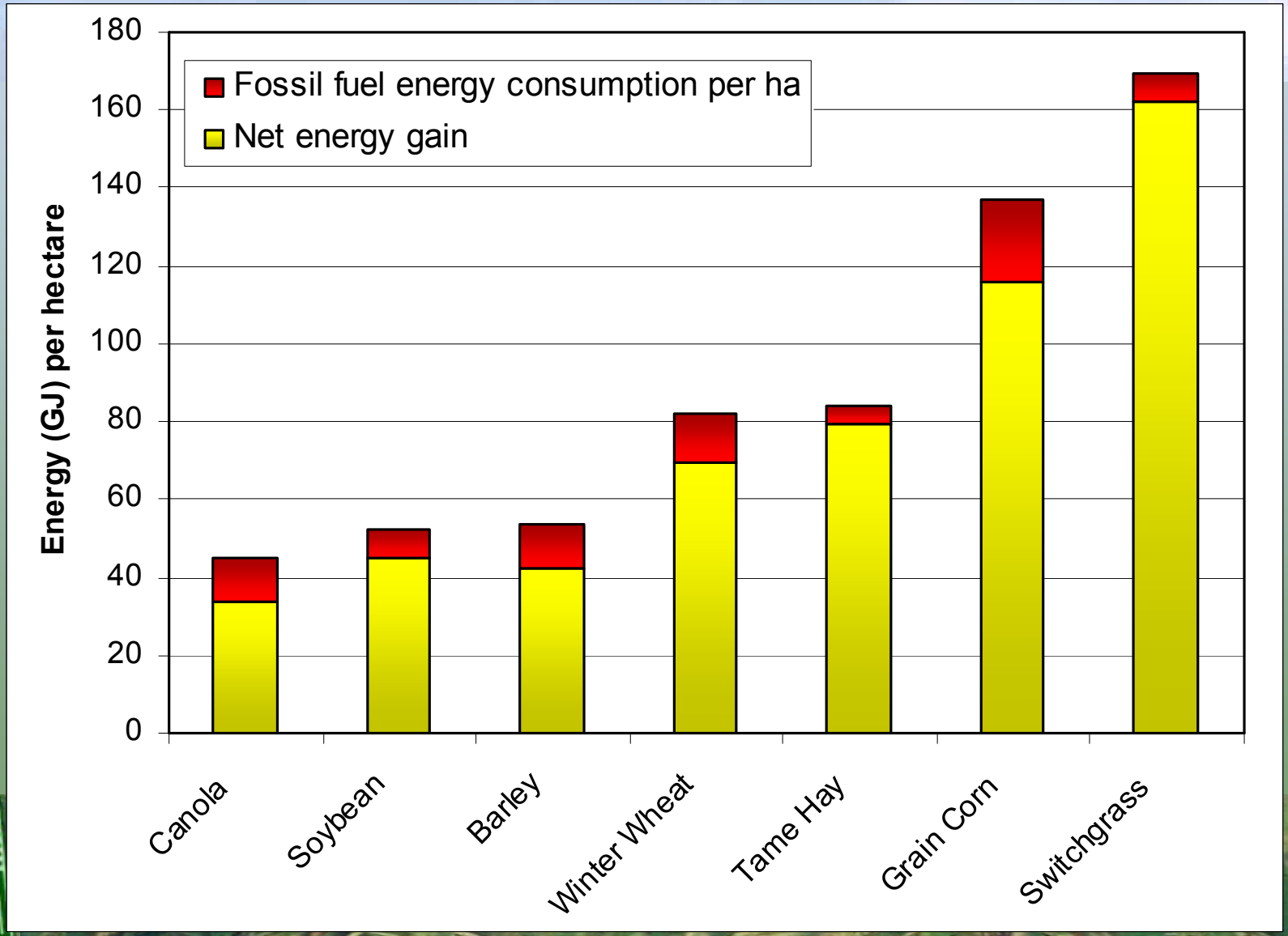
Biofuels Research at REAP-Canada began in 1991



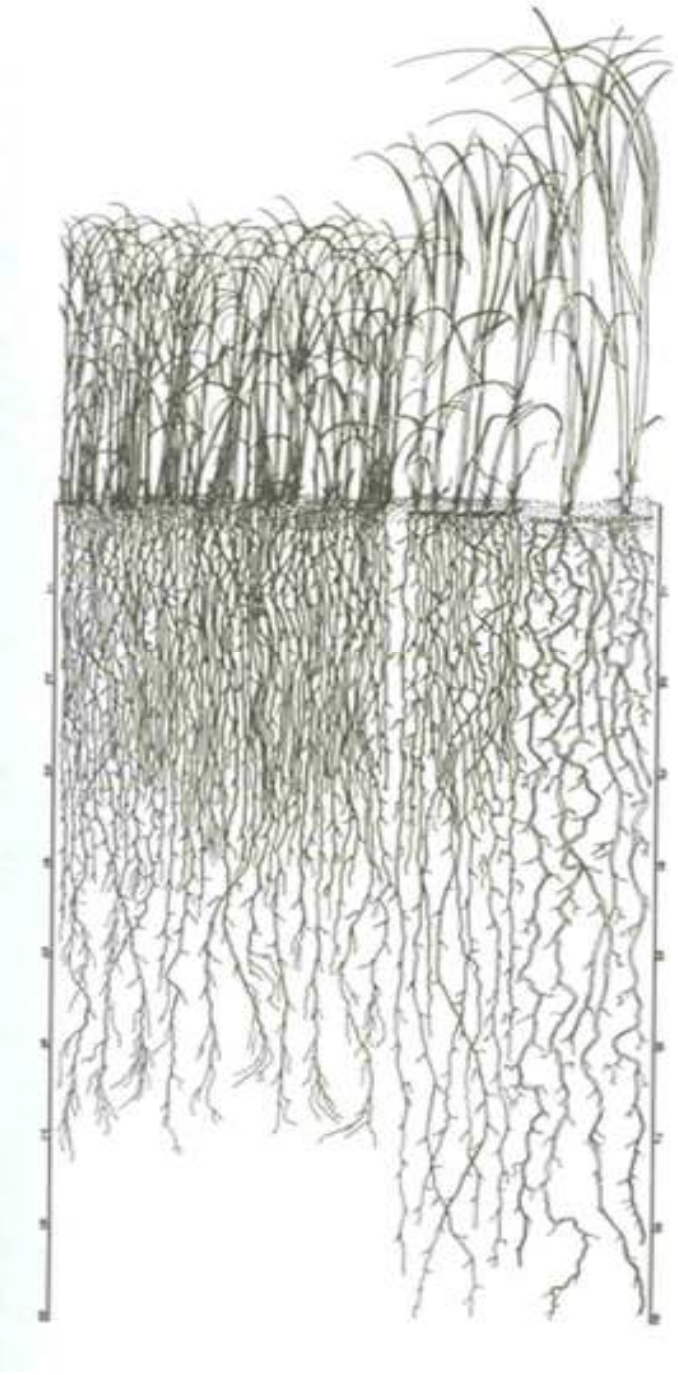
Solar Energy Collection and Fossil Fuel Energy Requirements of Ontario Crops/ha (Samson et al., 2005)



Sources of Agriculture Fuels for Combustion

- Field crop residues (soybean straw, rye straw, wheat straw, etc.)
- Feed grains (wheat, rye, barley etc.)
- Crop milling residues (oat hulls, wheat middlings, soybean hulls)
- Dedicated energy crops (warm season grasses)

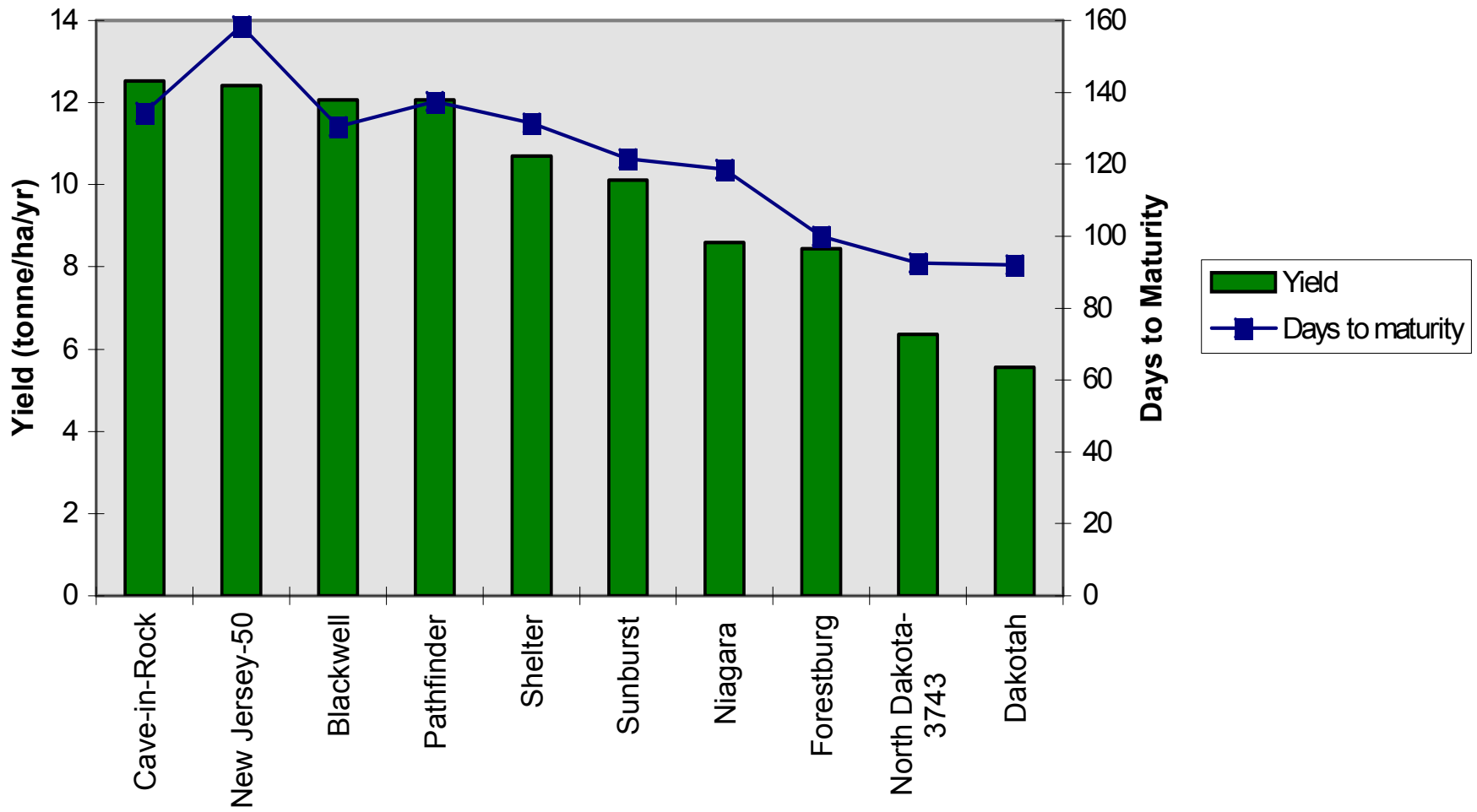
Switchgrass



Praire Cordgrass


Big Bluestem
in New York

Fall Yield of Switchgrass Cultivars at Ste. Anne de Bellevue, Quebec (1993-1996)



Crop Milling Residue Quality

Milling Residue	Energy (GJ/ODt)	Bulk Density (kg/m^3)	N (%)	Ca (%)	K (%)	Cl (%)	S (%)	Ash (%)
Wheat Bran	NA	216	2.72	0.13	1.4	0.05	0.24	7
Wheat Middlings	16.5	310	3.04	0.15	1.4	0.05	0.2	5
Oat Hulls	19.5	128	0.64	0.16	0.6	0.08	0.14	7
Pin Oats	NA	NA	1.28	0.12	0.6	NA	0.24	6
Corn Screenings	NA	NA	1.6	0.04	0.4	0.05	0.12	2

Target values of maximum 0.2% K and 0.1% Cl created for biofuels in Denmark (Sander, 1997)

Biomass Quality of Switchgrass vs. Wood Pellets and Wheat Straw

Unit	Wood pellets	Wheat straw	Switchgrass	
			Fall harvest	Overwintered Spring harvest
Energy (GJ/t)	20.3	18.6-18.8	18.2-18.8	19.1
Ash (%)	0.6	4.5	4.5-5.2	2.7-3.2
N (%)	0.30	0.70	0.46	0.33
K (%)	0.05	1.00	0.38-0.95	0.06
Cl (%)	0.01	0.19-0.51	n/a	n/a

Source: Samson *et al.*, 2005

The Potential of Biomass Heat in Ontario?

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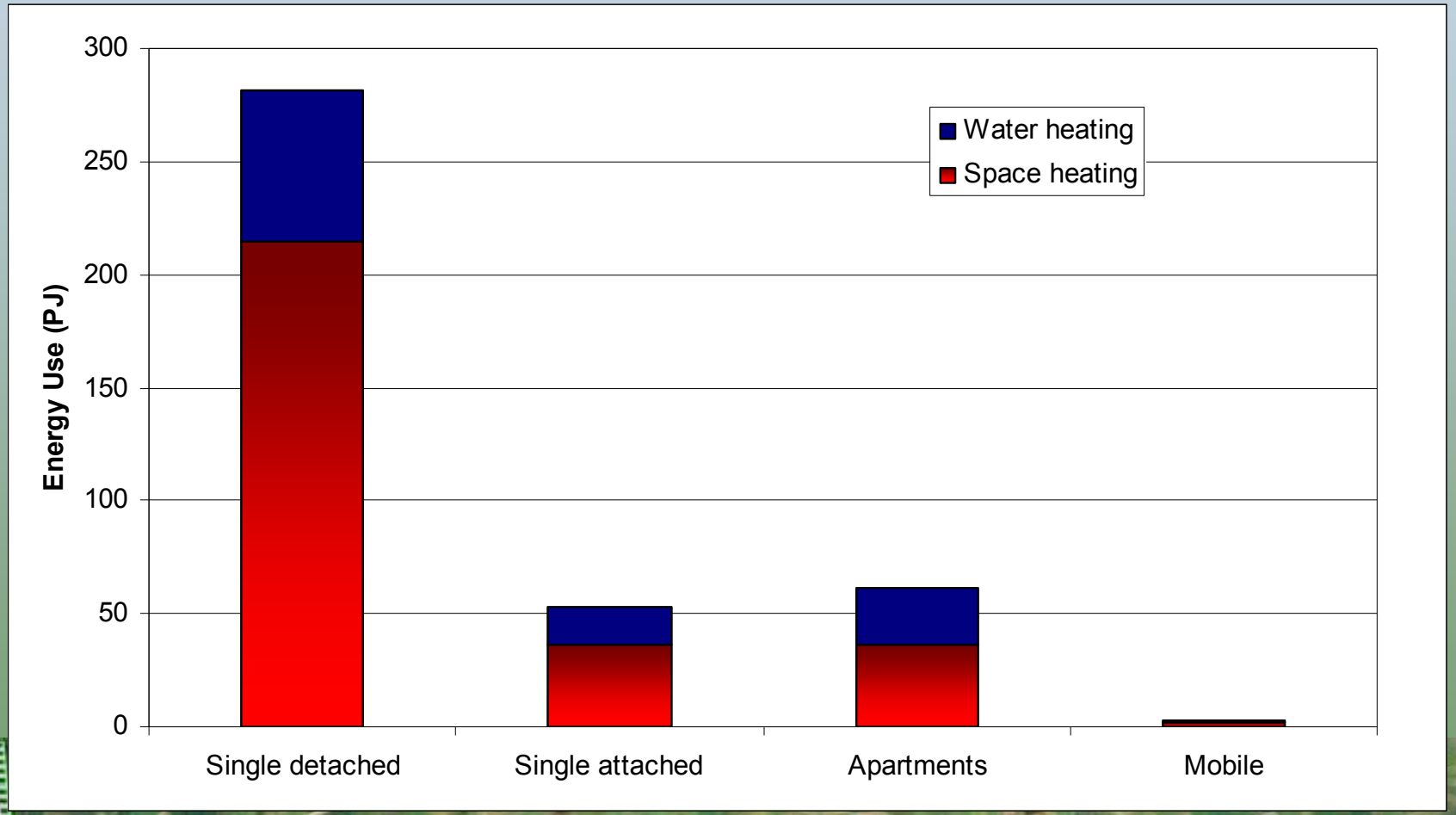
Space and Water Heating in the Residential Sector by Type of Building in Ontario (2006)



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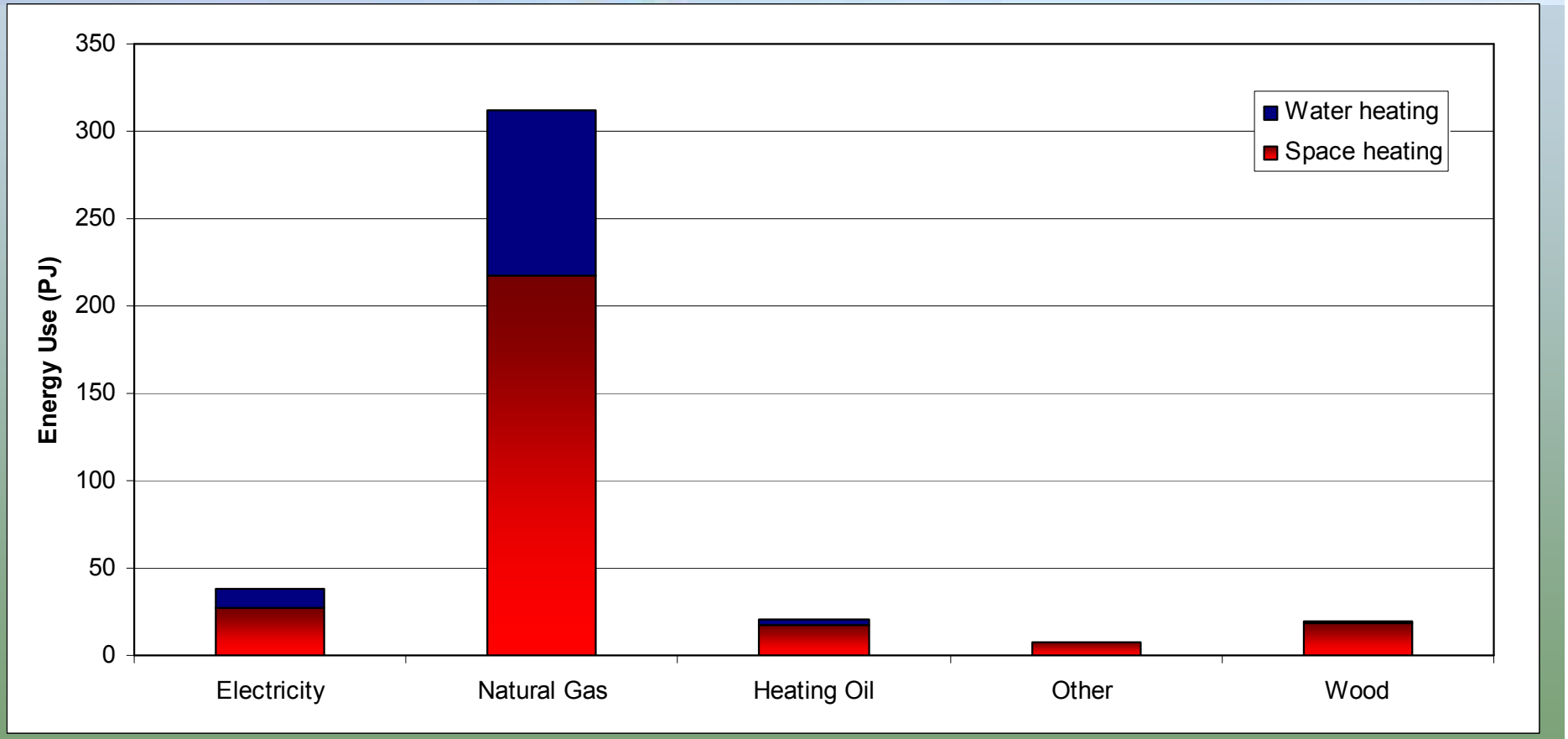
Residential Space and Water Heating Energy Use in Ontario (2006)



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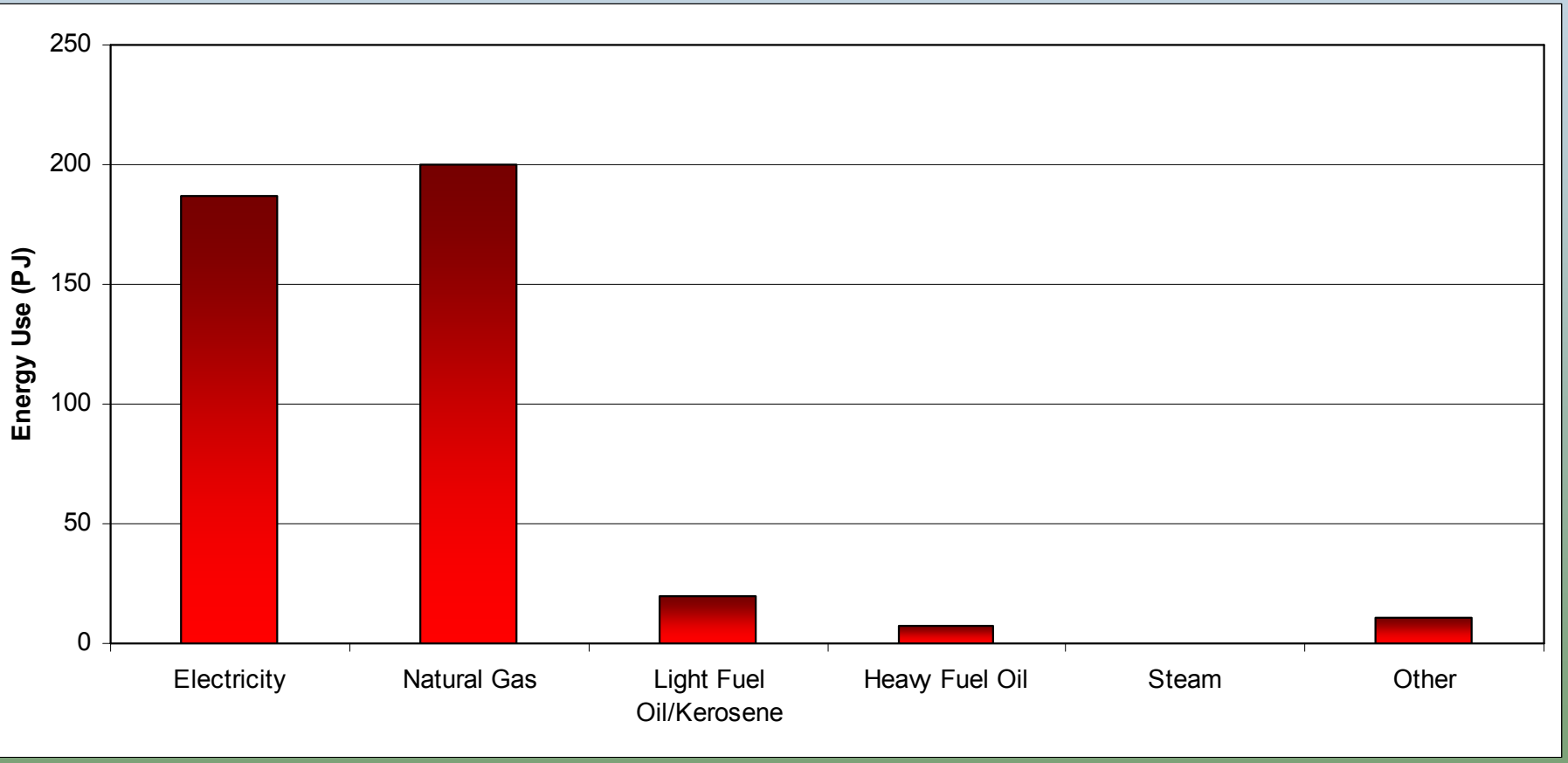
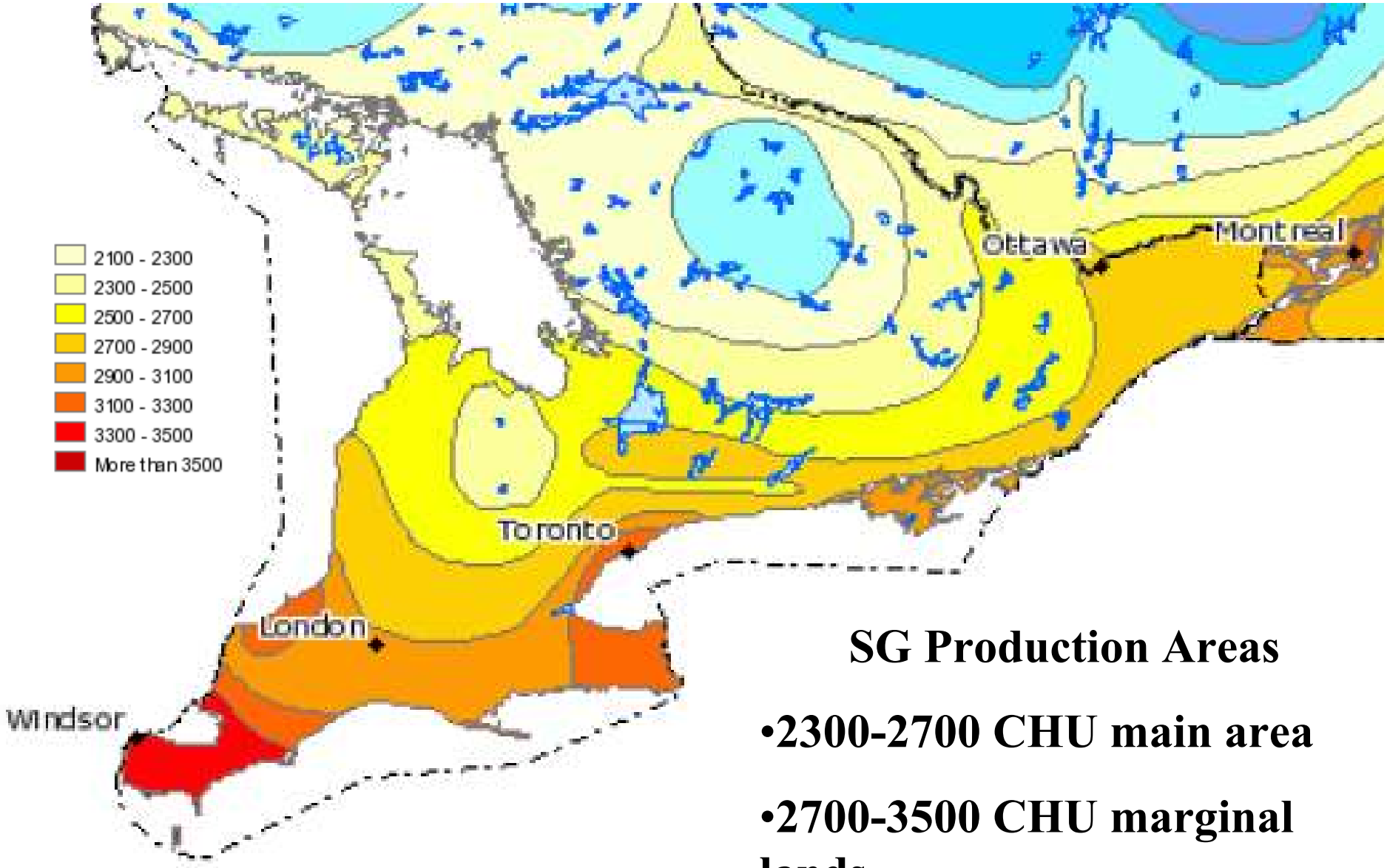
Commercial Energy Use in Ontario (2006)



Identifying a Land Base



SG Production Areas

- **2300-2700 CHU main area**
- **2700-3500 CHU marginal lands**

Farmland in Ontario & Quebec for Energy Crop Farming

	Land use	Land area ('000 ha)	Area for biofuels* ('000 ha)	Potential grass yield** ('000 tonnes)	Total potential grass yield ('000 tonnes)
Ontario	Crop land	2,254	450	4,192	**8,883**
	Forage	1,261	504	4,691	
Quebec	Crop land	940	188	1,748	**5,221**
	Forage	933	373	3,473	
				Ontario & Quebec Total	***14,104***

*Estimated 20% crop land and 40% forage land converted to bioenergy production

**Assumed yield of 9.3 tonnes/ha

Potential for Bioenergy Production

Land use	Agricultural Land (million ha)	Area for biofuel production* (million ha)	Perennial grass production** (million tonnes)	Millions Barrels of Oil Equivalent (MBOE)/day
Canada	68	13.6	80.2	.69
U.S.A.	377	75.4	610.7	5.23
North America	**445**	**89**	**691**	**5.92**

The grass farmers of North America can produce the energy equivalent of 7.2% of the worlds oil supply (82 million barrels of oil/day)

*** Estimated 20% land converted to bioenergy grasses**

**** Assumed bioenergy hay yields of 5.9 tonne/ha in Canada and 8.1 t/ha in the US and 18.5GJ/tonne of hay**

Heat Generation GHG Offsets

Fossil Fuel		Renewable Fuel		Net offset (%)
	kg CO_2e/GJ		kg CO_2e/GJ	
Coal	93.4	Switchgrass pellets	8.2	91
LNG	87.9	Switchgrass pellets	8.2	90
Natural gas	61.6	Switchgrass pellets	8.2	87

Samson and Bailey Stamler, 2009

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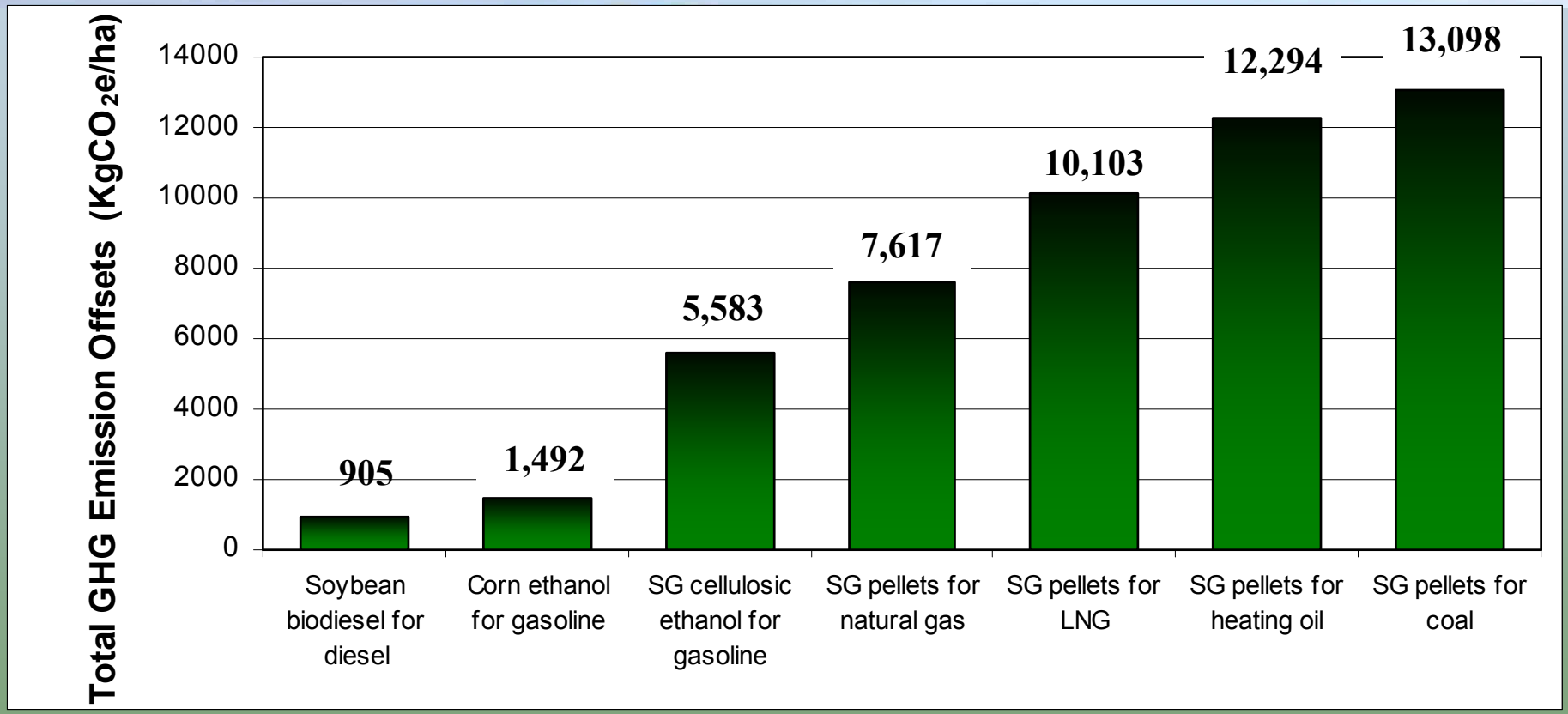
GHG Offsets From Ontario Farmland Using Biofuels



SG= switchgrass; LNG= liquified natural gas

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Summary and Conclusions

- Warm season grasses represent the most resource efficient way to capture solar energy through crop production
- WSG biomass quality for combustion can be improved through cultural management and breeding
- Biggest emerging application is thermal energy to replace coal, natural gas and LNG

Summary (Continued)

- There are no technical barriers to develop the grass pellet industry
- There is a need for renewable energy subsidy reform to enable the most efficient renewable energy technologies to emerge


Thank You!
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