

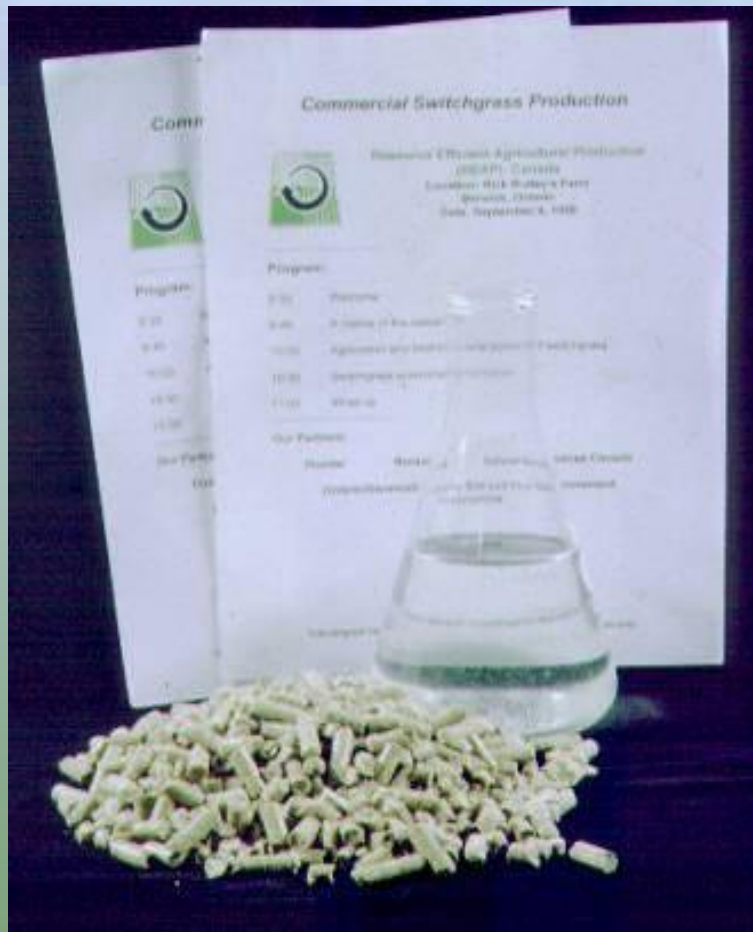
Developing Market Opportunities for Warm Season Grasses in Ontario



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Warm Season Grasses: Multi-use Biomass Crops in Ontario



1. Biofibre

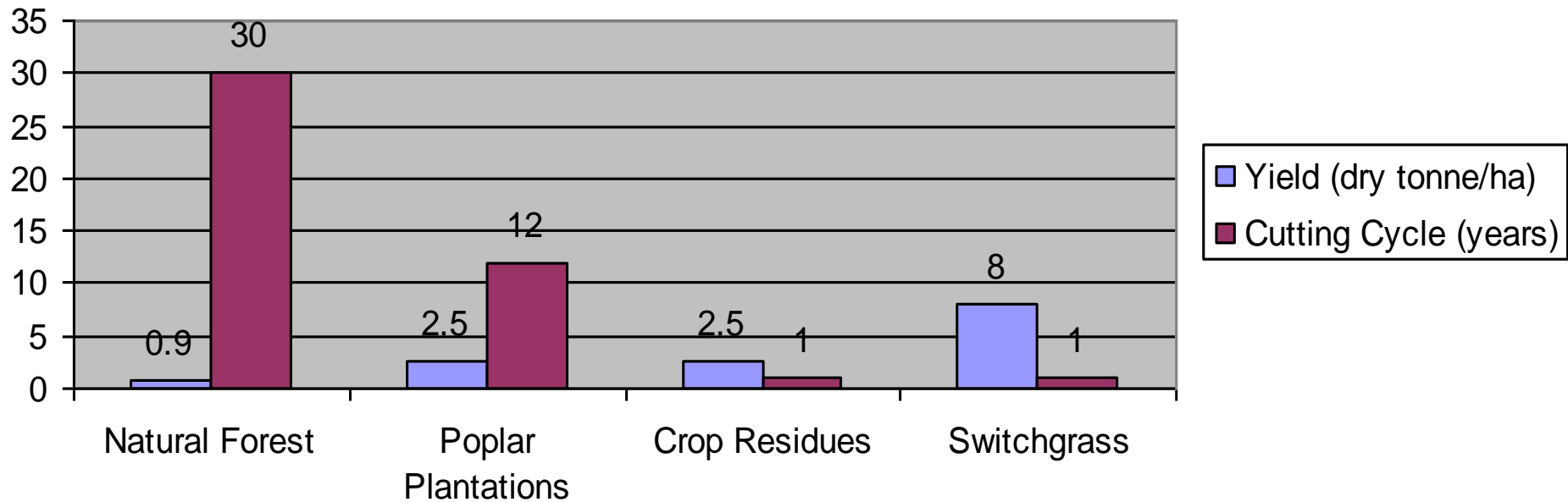
- Livestock bedding
- “Straw bale” housing
- Mushroom production
- Paper/cardboard
- Composites

2. Bioenergy

- Biofuel pellets and briquettes

Farming Fibre Has a Promising Future in Ontario

Average Productivity of Fibre Sources and their Associated Harvest Cycles



Switchgrass for Straw Bale Housing

- First house in Canada made from switchgrass in 2000 in Kanawakhe, QC
- ~ 15 houses in Canada
- Advantages over straw are its is dry, less prone to decomposition (low N) and has less pest and rodent issues



Switchgrass for Livestock Bedding

- Absorption properties at least as good as wheat straw
- Usually drier than cereal straws
- Good structural strength prevents the pack from going lumpy
- Adequately soft if pre-chopped
- Doesn't rot as quickly



Switchgrass pulping quality

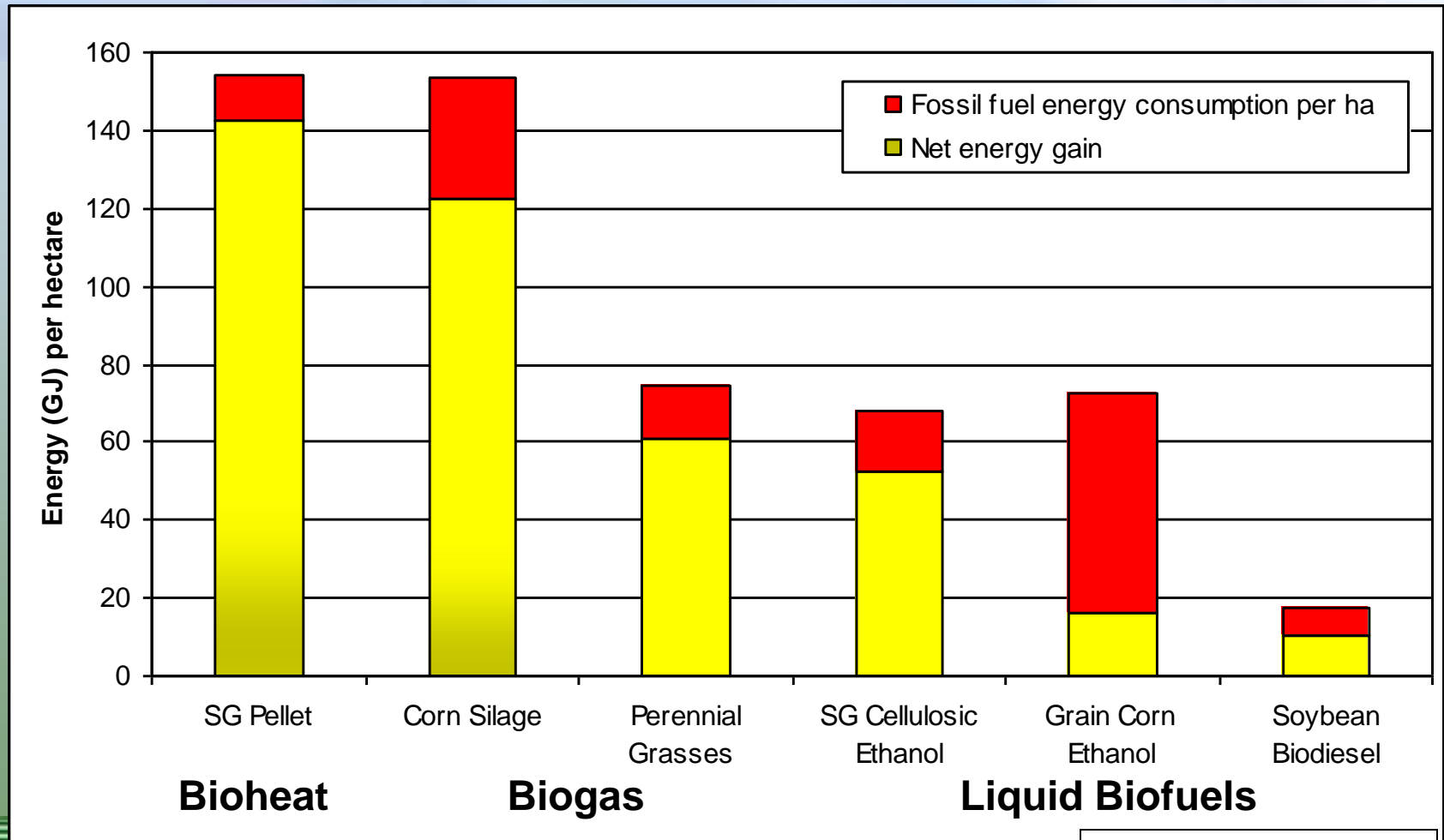
Kraft Pulping of Individual Components of Switchgrass

	Stems	Leaves	Sheaths
	----- % -----		
Total yield	50.2	39.8	45.5
Brightness	45.3	26.6	38.3

Goel *et al.* 1995

- High cellulose content and longer fibre length make grass stems a high quality fibre for pulping and other applications

Harvesting Energy from Ontario Farmland for Biofuel Applications (Samson *et al.* 2008)



SG=Switchgrass

Governments Intervening Unfairly in Bioenergy Markets

- Ethanol subsidies by provincial and federal governments effectively create a corn price subsidy and drive up land rentals
- US subsidies for wood residue utilization (\$45/ton) and stimulus spending on plants creating wood pellet glut
- Wood pellet sector in Canada receiving capital grants, lots of building happening
- Ontario values green power but not green heat (no subsidy)
- Feds don't value renewable energy

Two Main Energy Market Options



- Grass briquettes/cubes maybe best fit for commercial and industrial boilers
- High quality C4 grass pellets could be developed for residential pellet applications

Prairie Bioenergy in Manitoba

- Marketing flax shive, wood and straw cubes into commercial boiler market



Pelco Boiler

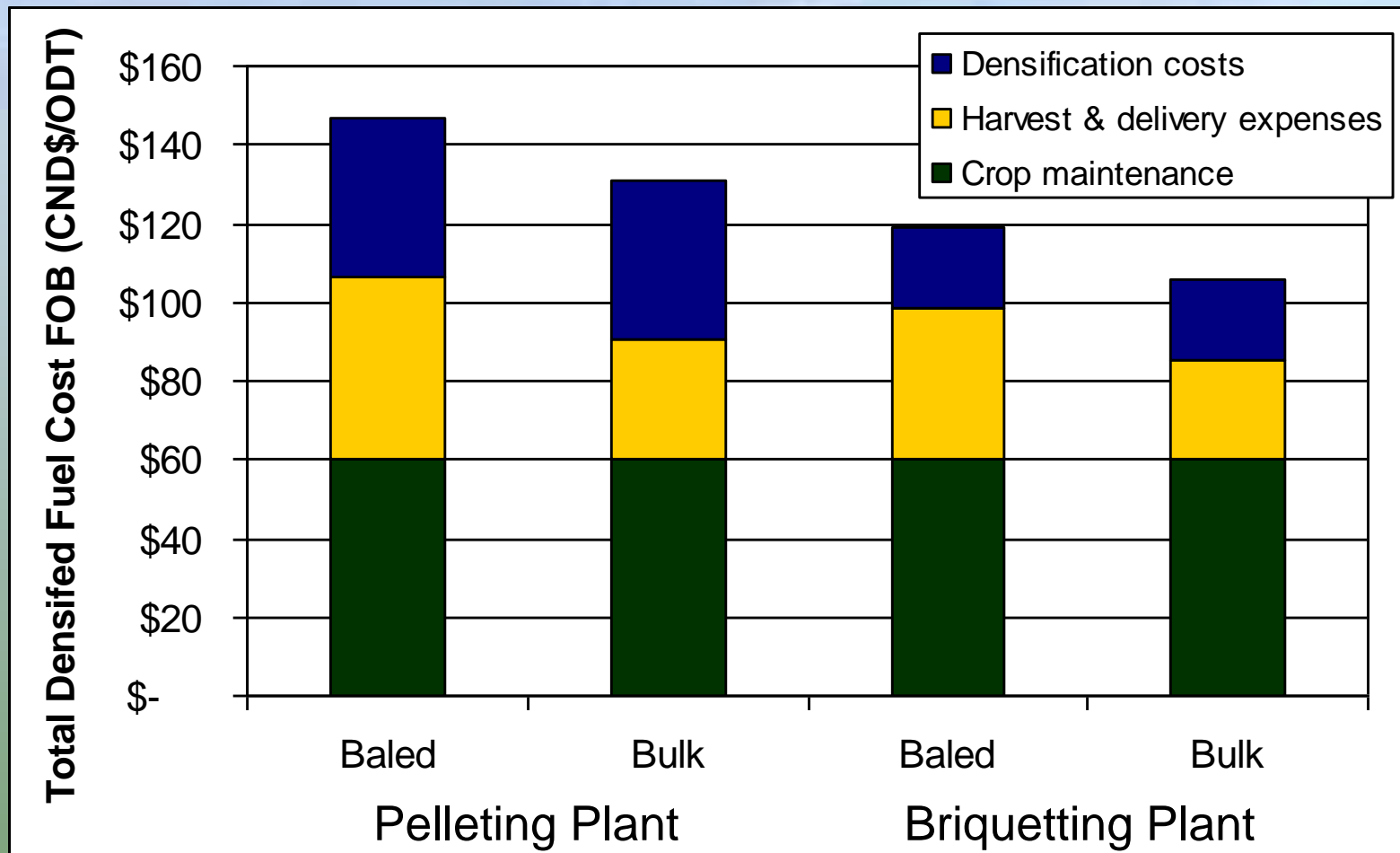
35 kw





**3 x 800 kw
Dekker Brand
boilers heating a
1.5ha greenhouse**

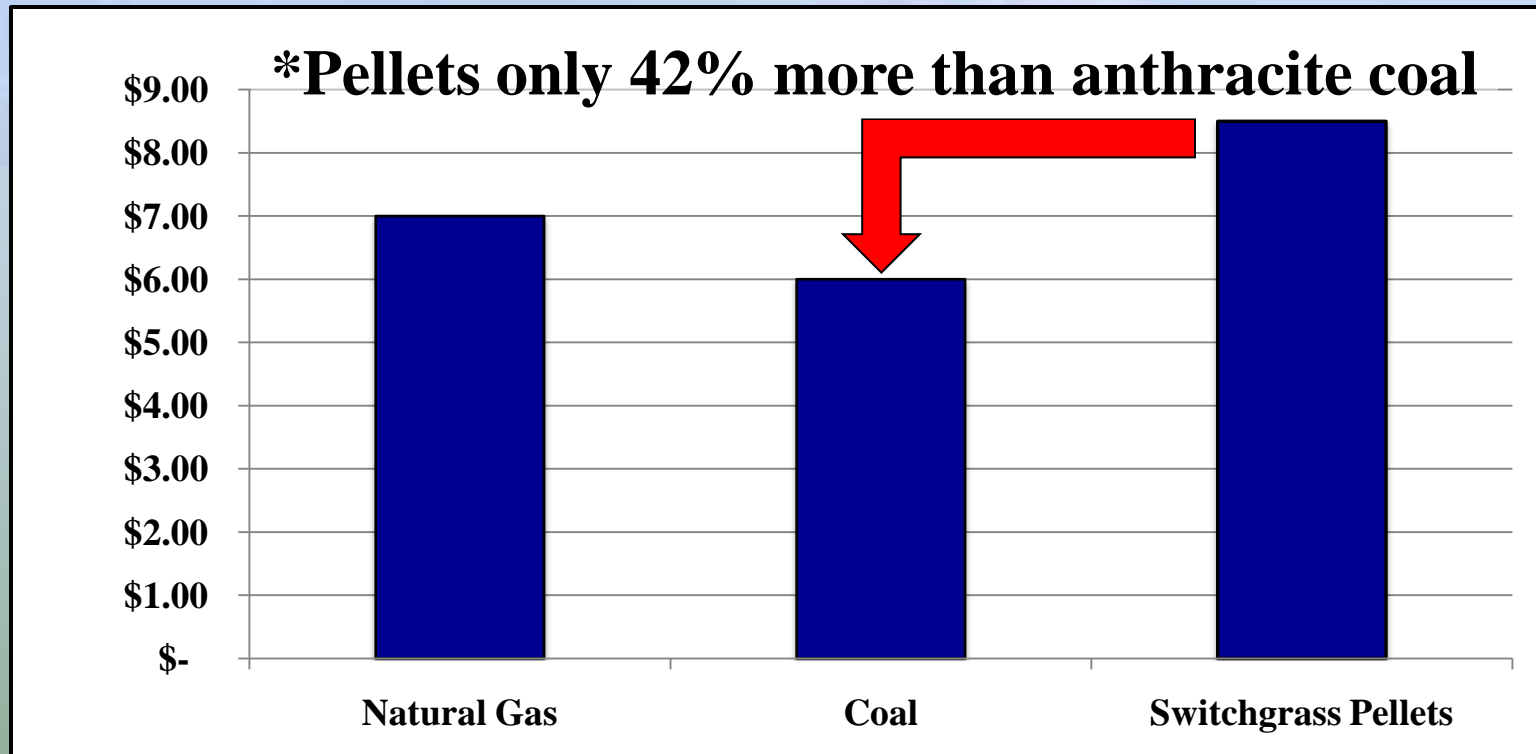
Estimated Densified Fuel Costs in Ontario



Samson *et al.* 2008

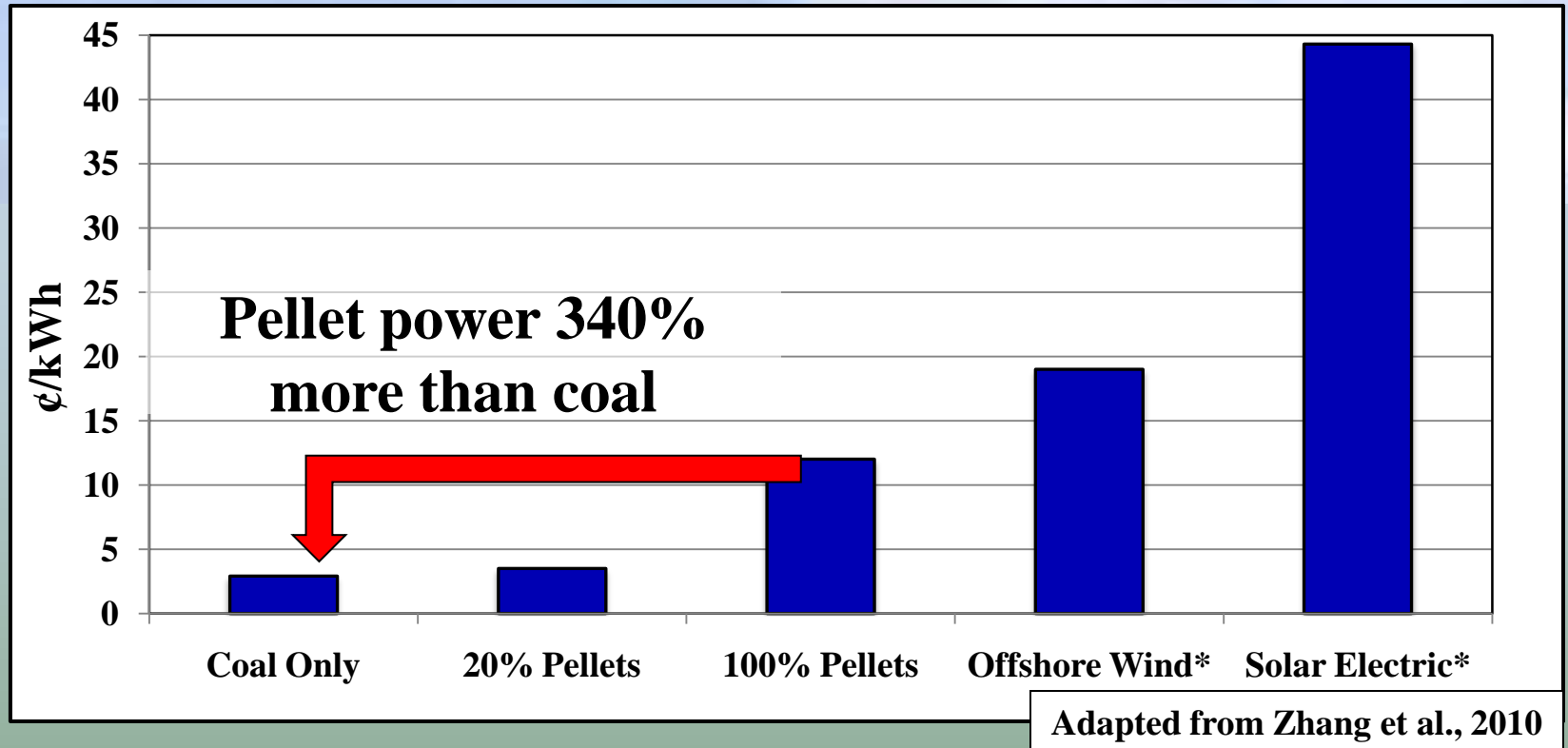
Greenhouse Heating Comparison

(fuel cost prior to conversion)



- \$40/tonne pellet or grass subsidy would close the gap
- Coal-\$180/tonne @ 13,000btu/lb=30GJ/T; SG Pellets \$150/T @ 7% moisture=17.5GJ/T

Electricity Costs in Ontario



- *If Ontario can pay big premiums for new renewables, why not CHP from energy crops which is likely our best long term biomass power option?*
- Ontario's FIT Program: Wood pellets @ \$160/tonne or Agri-fibre pellets @ \$150/tonne

WSG Pellet Burning Stoves



Residential pellet industry

- Typically wood pellets
FOB plant \$3.75-4.00/bag
and retail \$5.75-6.00
- High quality grass pellets
could sell for 10% less and find
a premium value market if
multi-fuel stoves can burn them
- Need R & D on biomass
quality



Swedish consumer priorities in ranking heating systems (Mahaptra and Gustavsson, 2009)

- Annual cost of heating
- Functional Reliability
- Convenience



Pellets last in functional reliability and convenience, but provide good economy and technology improving

Lesson for Canada: we need to work on reducing fuel costs, more robust equipment and move to bulk handling

Ash and Energy Content of Overwintered Switchgrass

Plant Component	Ash Content	Energy Content (GJ/ODT)
Stems	1.03%	19.6
Seed Heads	2.38%	19.5
Leaf Sheaths	3.07%	18.7
Leaves	6.98%	18.4

***Overall weighted SG average ash content of 2.75% and 3.25% on sandy and clay sites respectively**

Big Bluestem: a Lower Ash Pellet than Switchgrass?

Big Bluestem

Native ecovars 60% stem



Switchgrass

Native ecovars 45-50% stem



REAP-Canada is currently breeding improved stem to leaf ratio big bluestem and switchgrass ecotypes



Can We Make a Wood Pellet Substitute from Grass?

- Need to keep stems somewhat thin (3.5- 5 mm thick and stem wall (0.7mm thick) (thick stems like miscanthus problematic for aerosol pollution)
- Cultivate on sandy soils (have lower silicic acid content than clay soils which makes lower ash fuels)
- Increase stem fraction through breeding and species choice
- Separate stems from leaves through air fractionation



A Dynamic Global Pellet Market

- Market has expanded rapidly in recent years
- Production expanding faster than consumption causing short term glut: need consumption support
- In 2009 Europe had 650 plants producing 8.5 million tonnes (4% production increase in 2009)
- North American production increasing at 25-35%/yr (1.1 million tonnes in 2001 to 3.2 million tonnes in 2008)
- NA consumption increase is marginal

Carbon market uncertainty

- Failure of Copenhagen
- No appreciable interest by the federal government and the US has fiscal constraints
- Post-Kyoto (2012), no agreement
- Carbon prices in Europe declining and so is the Euro
 - ◆ 2008 carbon was worth 18.87 Euros/tonne
 - ◆ 2009 carbon was worth 11.40 Euros/tonne
 - ◆ Jan 2011 Presently 11.30 euros/tonne (\$15.40/tonne CO₂)



Export Pellet Market to Europe is Challenging

- Bulk industrial prices delivered into Rotterdam (fall 2009) 122 euro/tonne (~\$171/tonne)
- Carbon and euro value decline having a major impact on the viability of the export market
- Roughly a tonne of pellets in a power offset was worth \$60 in 2008 and now \$30 in 2011

Conclusion

Fibre Markets

- Fibre markets offer the greatest short term economic opportunities
- Need strong R & D effort to develop the opportunity

Energy markets

- Market needs government intervention to develop
- Ontario and federal governments need to strengthen their policy interventions in bioenergy sector
- Need comprehensive R & D effort to develop market opportunities