Overcoming Barriers to Deployment of Short Rotation Woody Crops

T.A. Volk
SUNY ESF, Syracuse, NY

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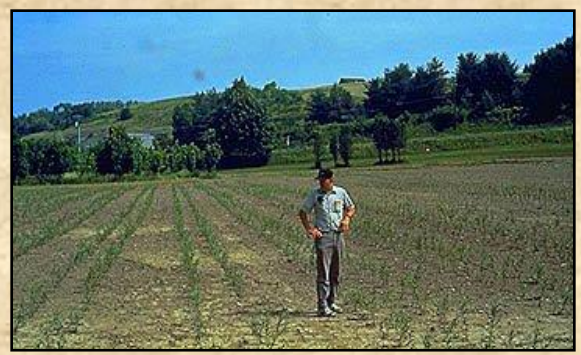
Overview

- Willow as an example short rotation woody crop
- Regional distribution of yield trials
- Overcoming barriers
  - Harvesting
  - Yield and importance of long term data
  - Landowner attitudes and objectives
  - Getting more value from each ton of biomass
  - Incentives

Willow Biomass Production Cycle

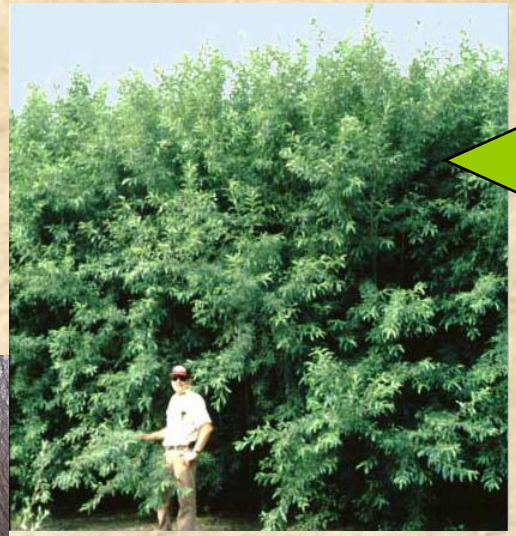
Planting



First year growth

Coppice

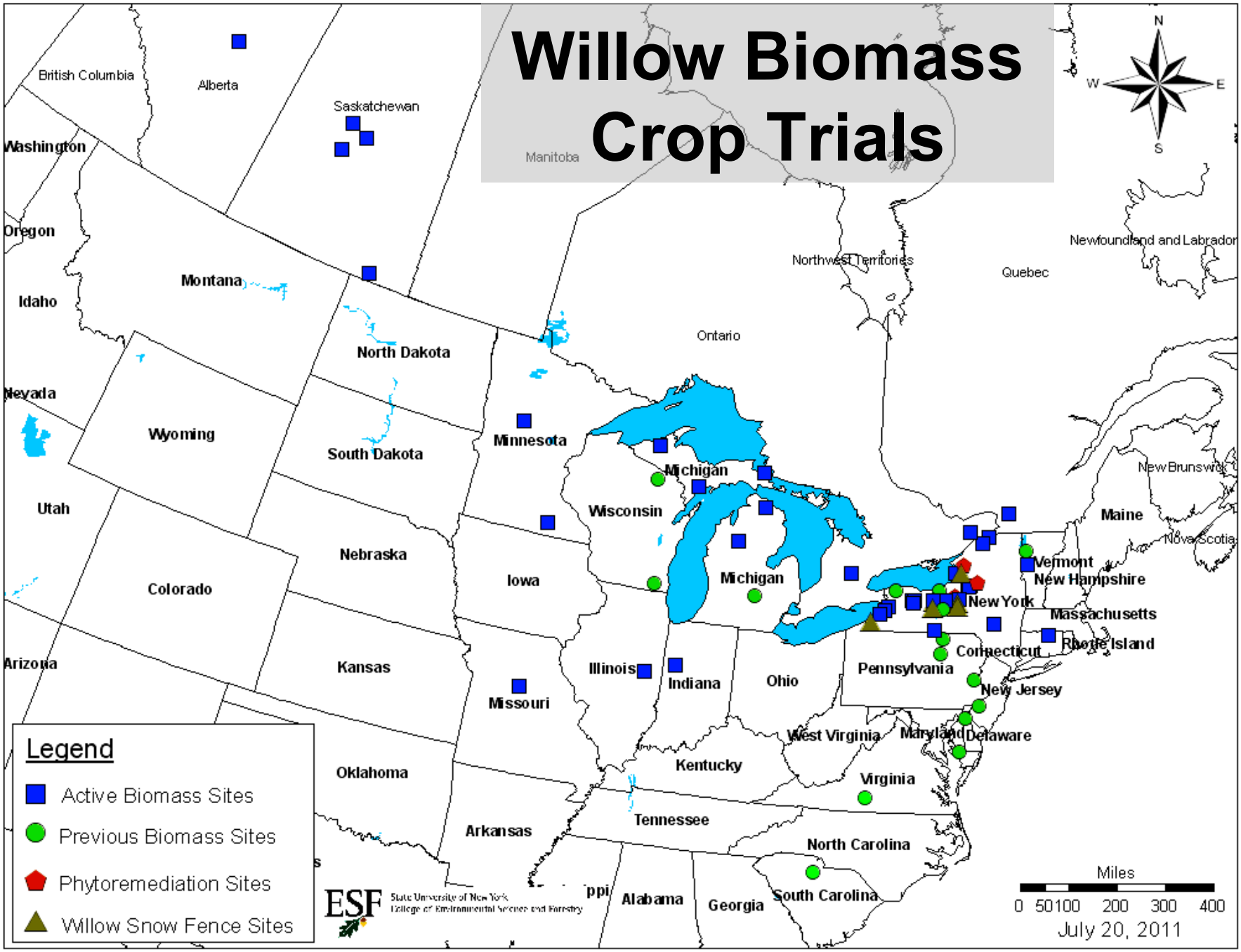
Early spring after coppicing



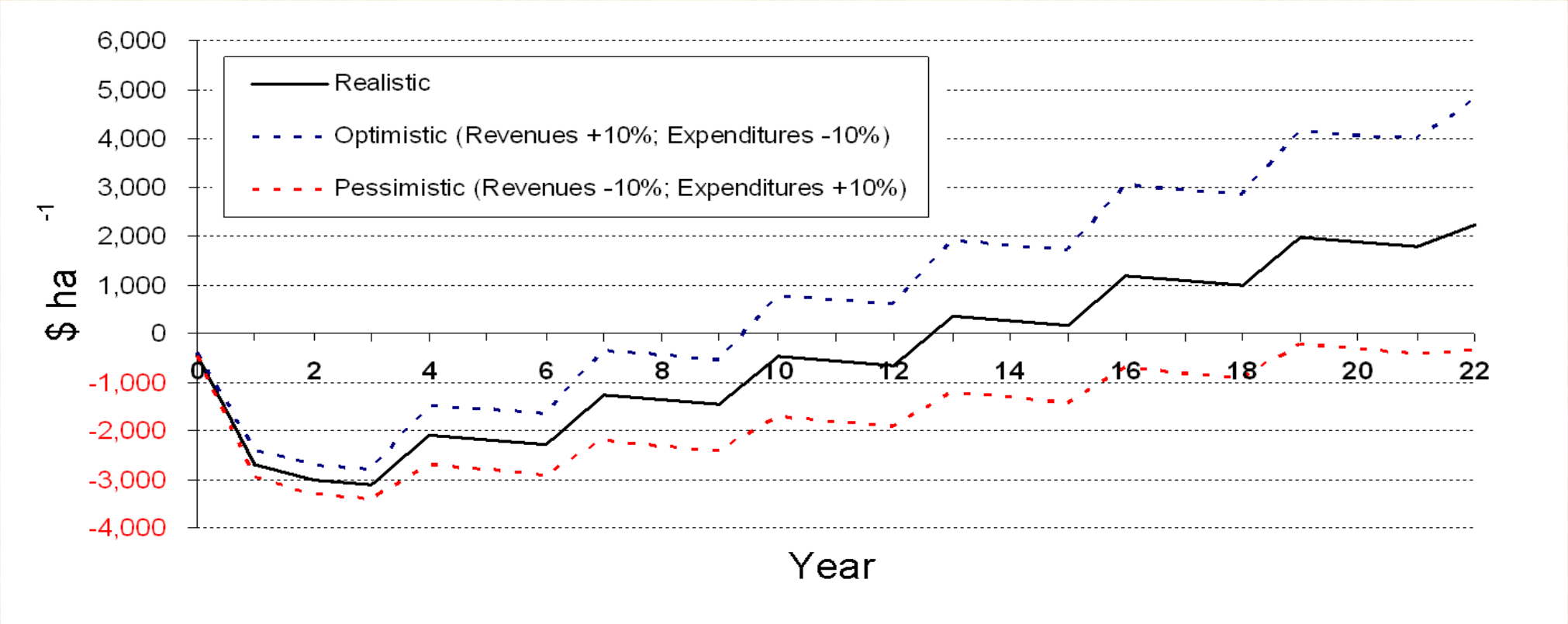
Three-year old after coppice

One-year old after coppice

Willow Biomass Crop Trials



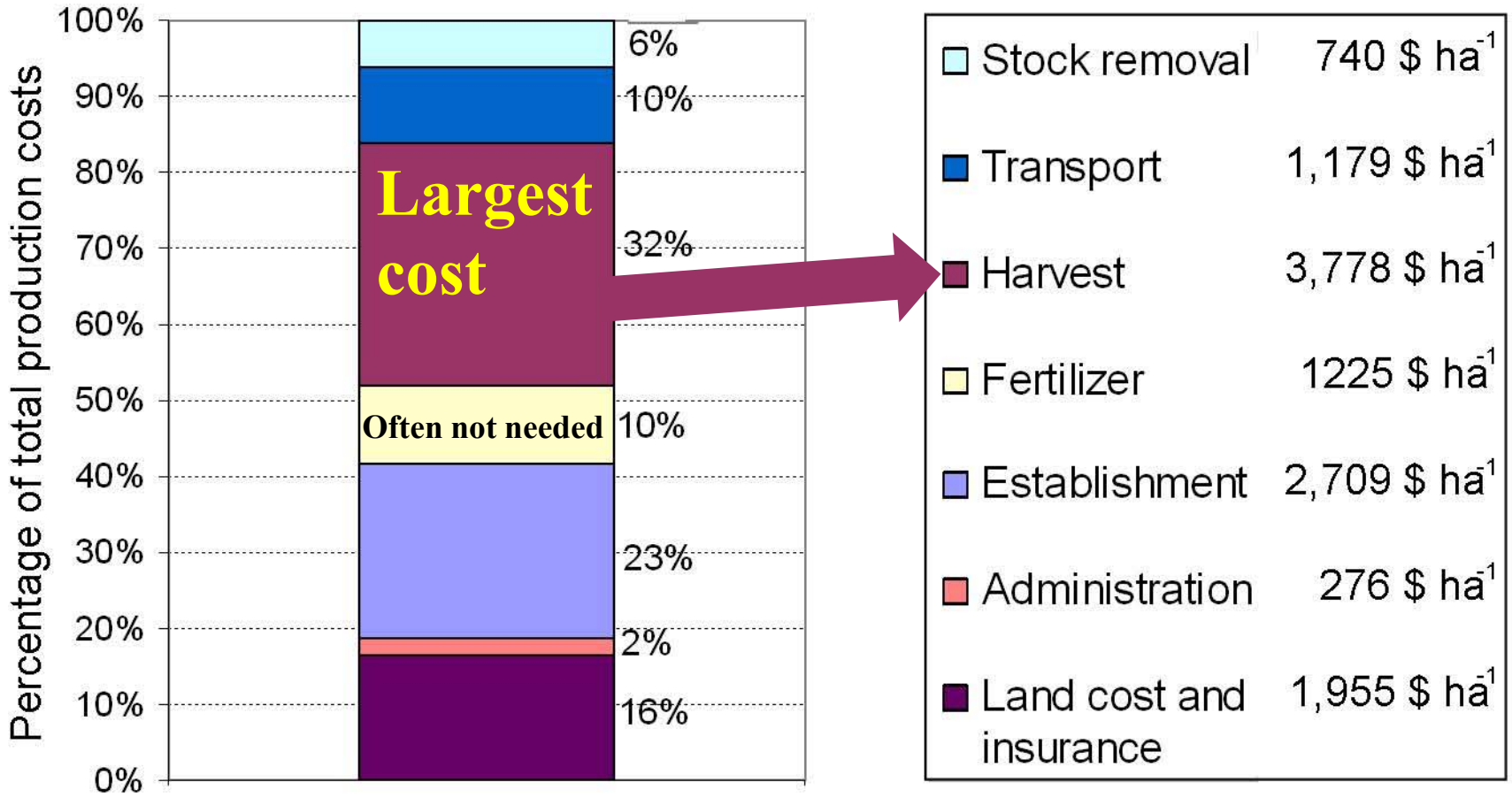
Economics of Willow Over 7 Rotations



	NPV $ ha^{-1}	IRR (%)
Realistic	116	5.5
Optimistic	1,571	10.8%
Pessimistic	-1,338	-1.4%

(Buchholz and Volk 2011)

Distribution of Costs over 23 Years



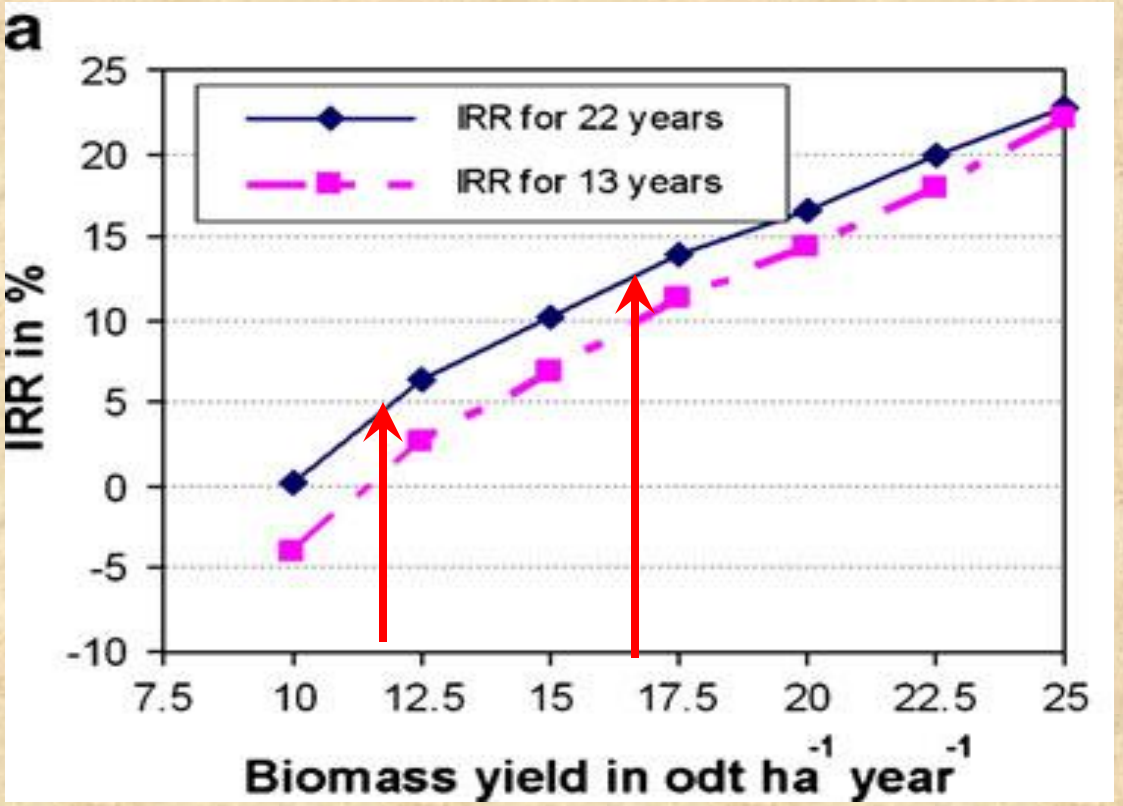
(Buchholz and Volk 2011)

Harvester Development

Harvesting three year old willow with a NH 130FB header designed for short rotation woody crops & NH FR9060 forage harvester

- Developing dormant season, single pass cut and chip harvesting system based on New Holland (NH) forage harvester with support from DOE and NYSERDA
- Increasing rotation from 3 to 4 years improves IRR from 5.5 to 8.8%
- Latest trials indicate that this system is effective and can harvest stems up to 12.5 cm (5 inches) in diameter

Effect of Increased Yield



Effect yield on IRR of willow biomass crops (Buchholz and Volk 2011)

- A 50% increase in yield more than doubles the IRR
- Improve yield through
  - breeding ,selection and matching clones to sites
  - Improved crop management including weed control, nutrient management, spacing, rotation length etc
- Collection of long term data is important for modeling production of perennial crops

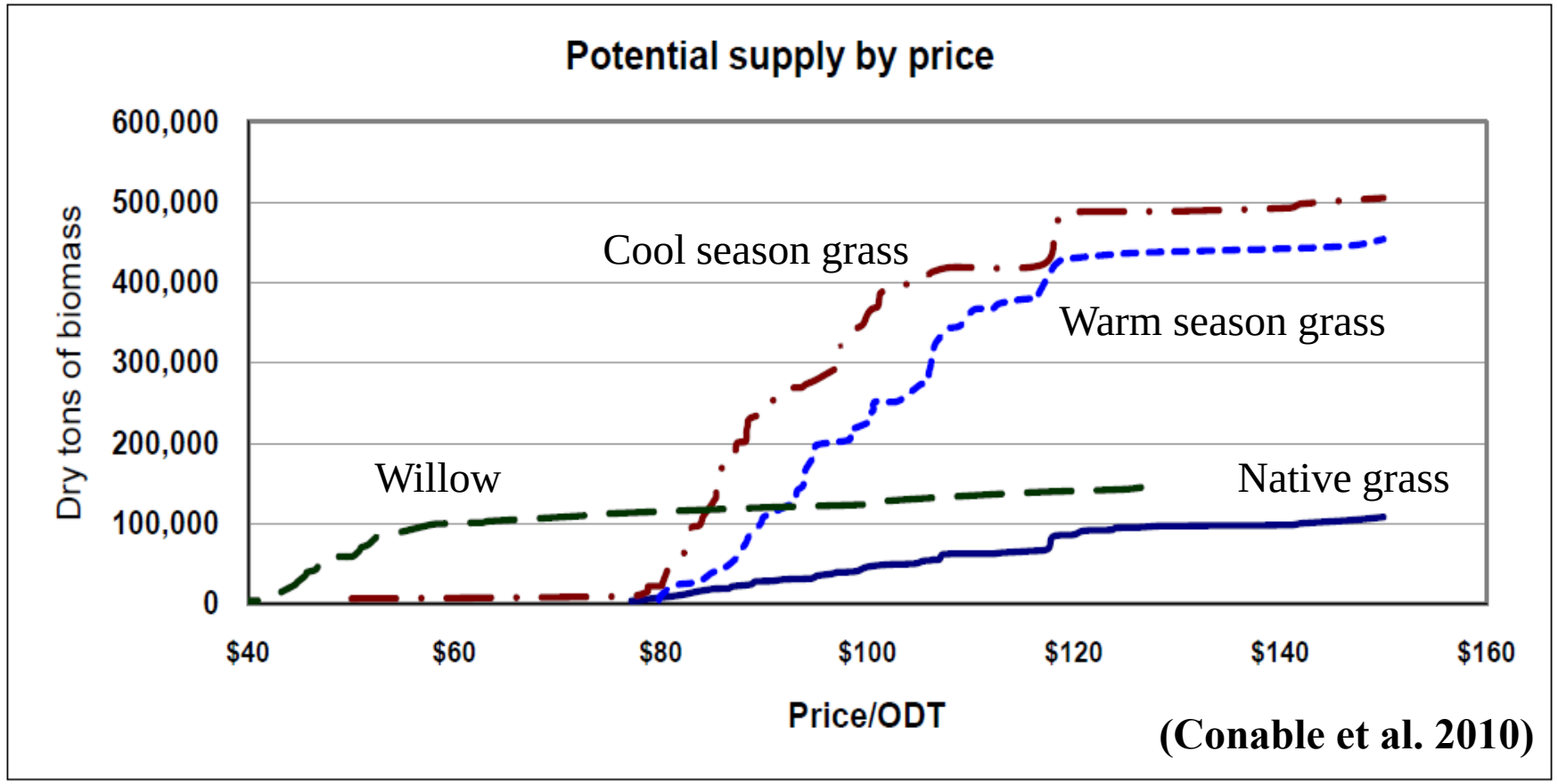
Improving Yields & Estimates

- Across nine trials the top three new clones had 23.1% greater yield than the reference clones
- In trials with older willow clones monitored over four rotations the yield of the four commercialized clones (also used a reference clones) increased by 21.6% from the 1st to 2nd rotation and by 30.8% from the 1st to the 4th rotation

Importance of Improved Varieties and Long Term Data

	Mean Yield from First Rotation – Old clones	Mean Yield from First Rotation - New clones	Mean Yield Over 7 Rotations Using Increase from 1st – 2nd Rotations	Mean Yield Over 7 Rotations with Increase from 1st – 2nd and 1st – 4th Rotations
	(odt ha^{-1} yr^{-1})			
Top Clone	15.6	17.2	18.6	21.4
3 Reference vs Top 3 Clones	9.2	11.5	14.1	14.7

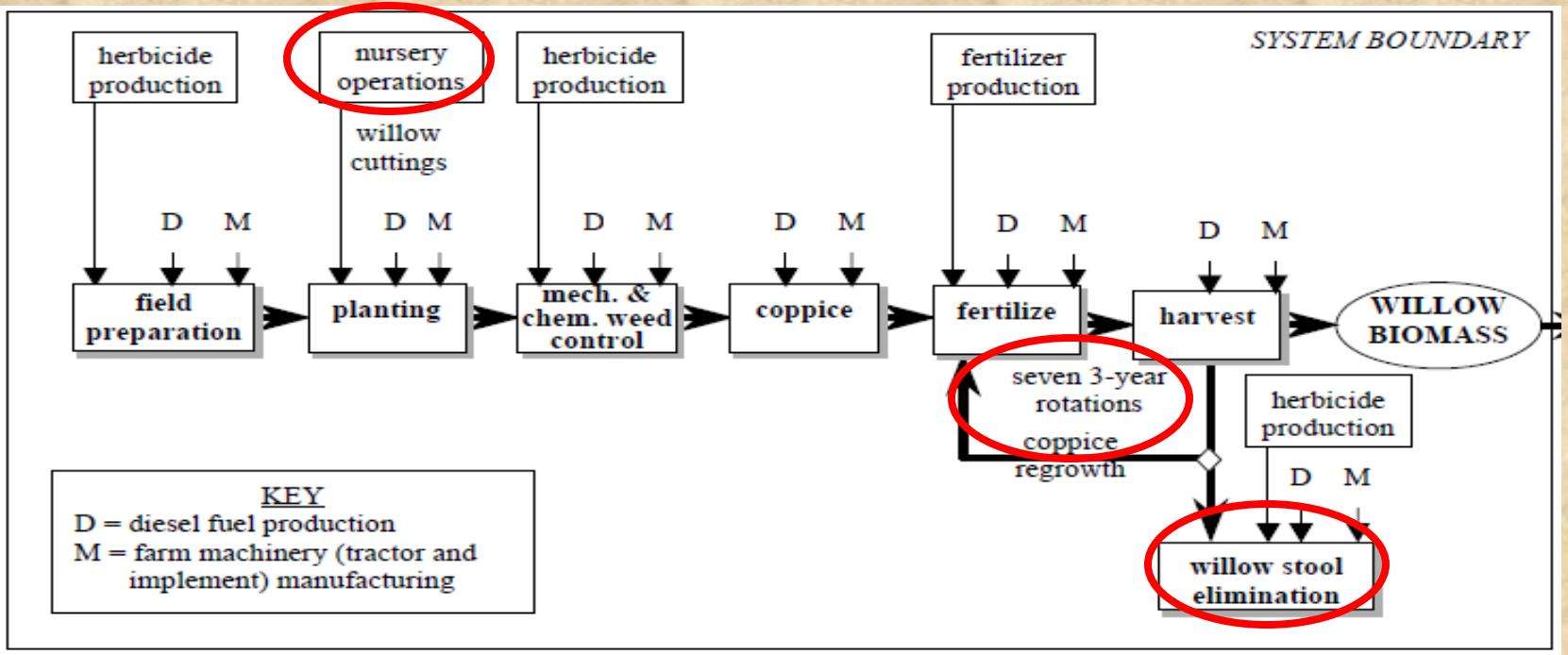
Cost Curves for Central NY



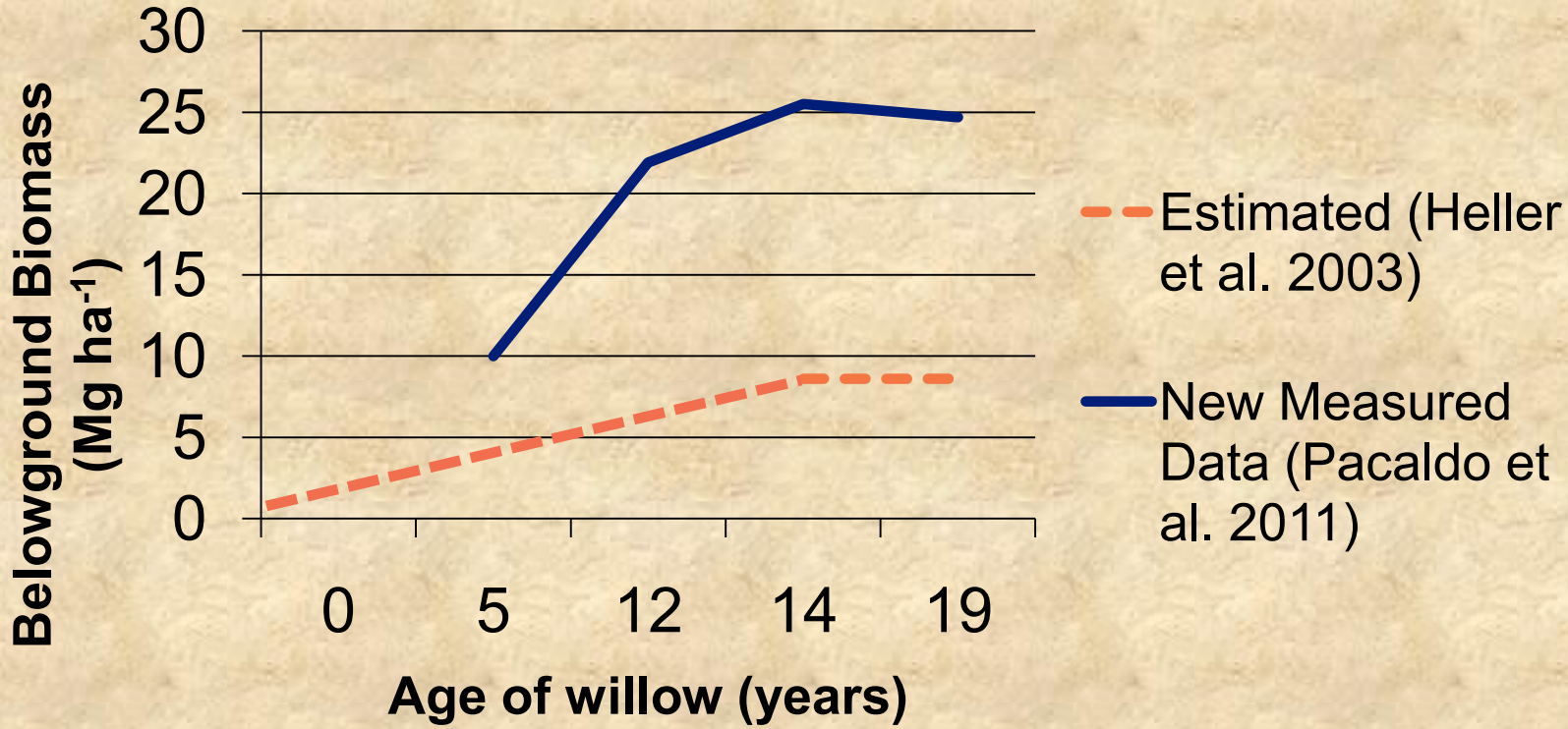
- Getting a handle on production prices but need larger scale trials
- Need a much better understanding of landowner opinions and attitudes

Willow GHG Balance

- Previous Life Cycle Analysis (LCA) (Heller et al. 2003)
- Low carbon fuel source – 3.7 Mg CO_{2eqv} ha^{-1} emissions over 7 rotations
- Updating previous LCA using new data

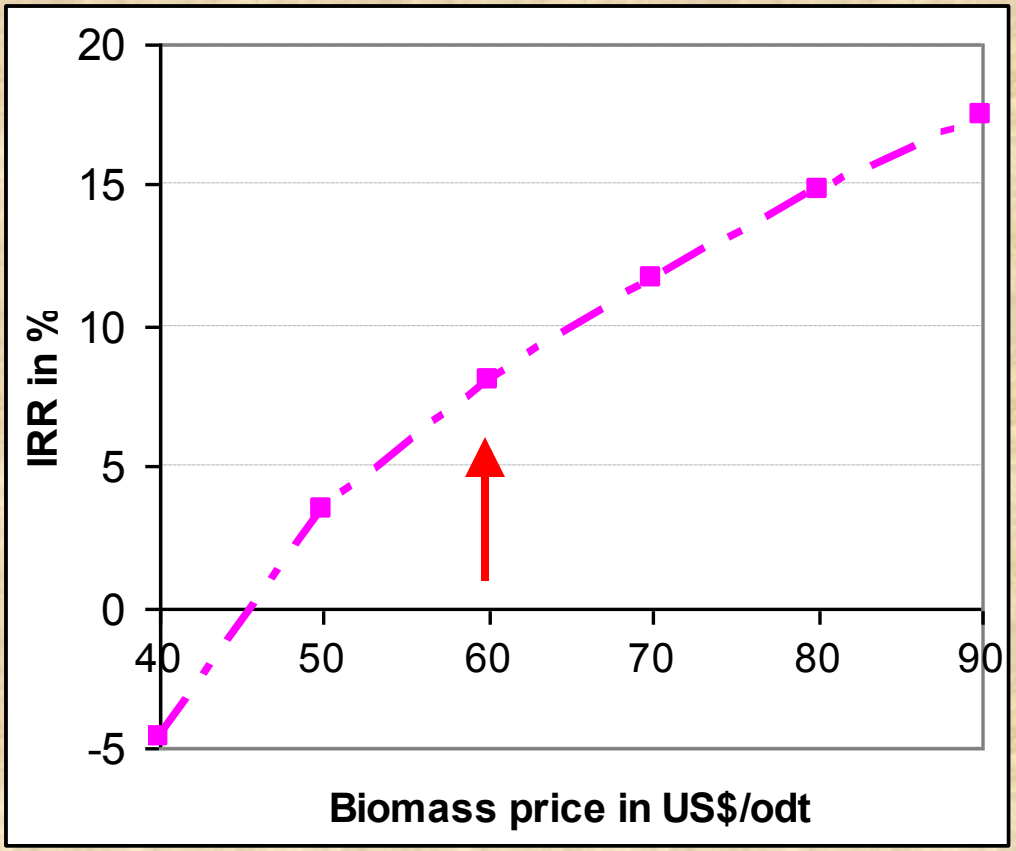


New Belowground Biomass Data



- New data changes willow biomass crop system from a low carbon fuel (3.7 Mg $CO_{2\ eq}$ ha^{-1}) over 22 years (Heller et al. 2003) to a system that sequesters carbon (-27.7 Mg $CO_{2\ eq}$ ha^{-1})
- Need for long term monitoring of these systems is important

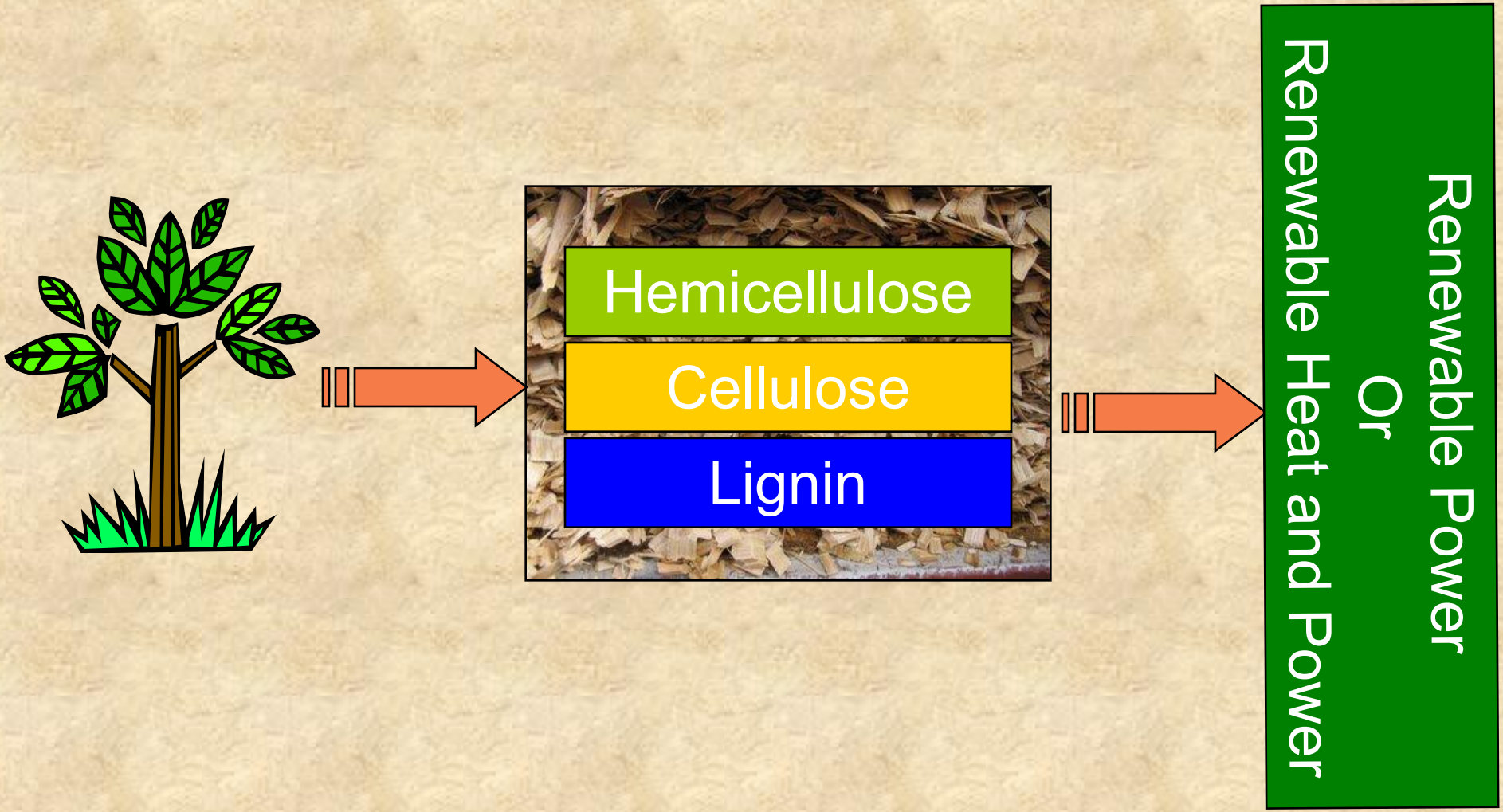
Price for Biomass



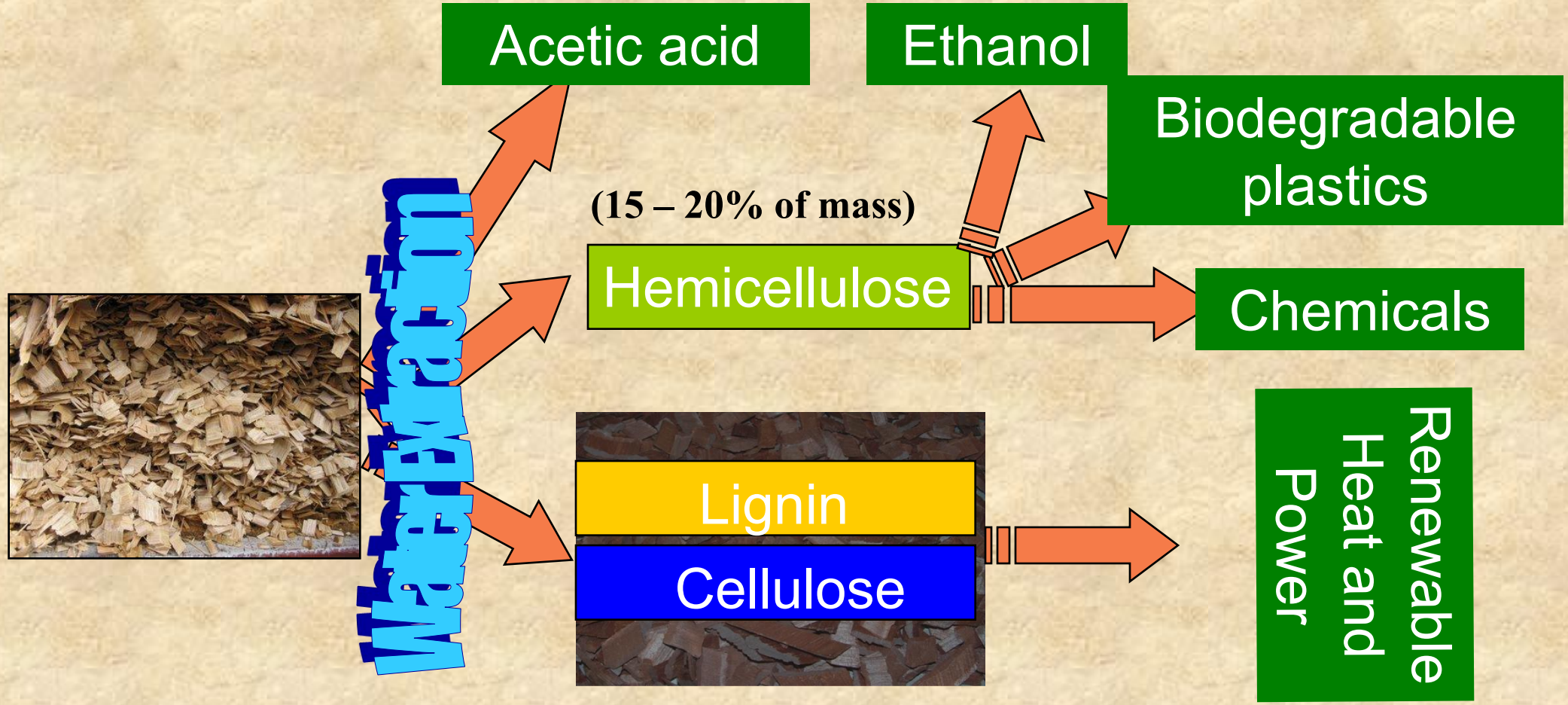
Effect of changes in the price for willow biomass on the crops IRR (Buchholz and Volk 2011)

- Biomass is a collection of complex compounds
- Need to make better use of these compounds for higher value products
- Increasing value can have a dramatic effect on IRR for willow biomass crops

Current Wood to Energy Facilities



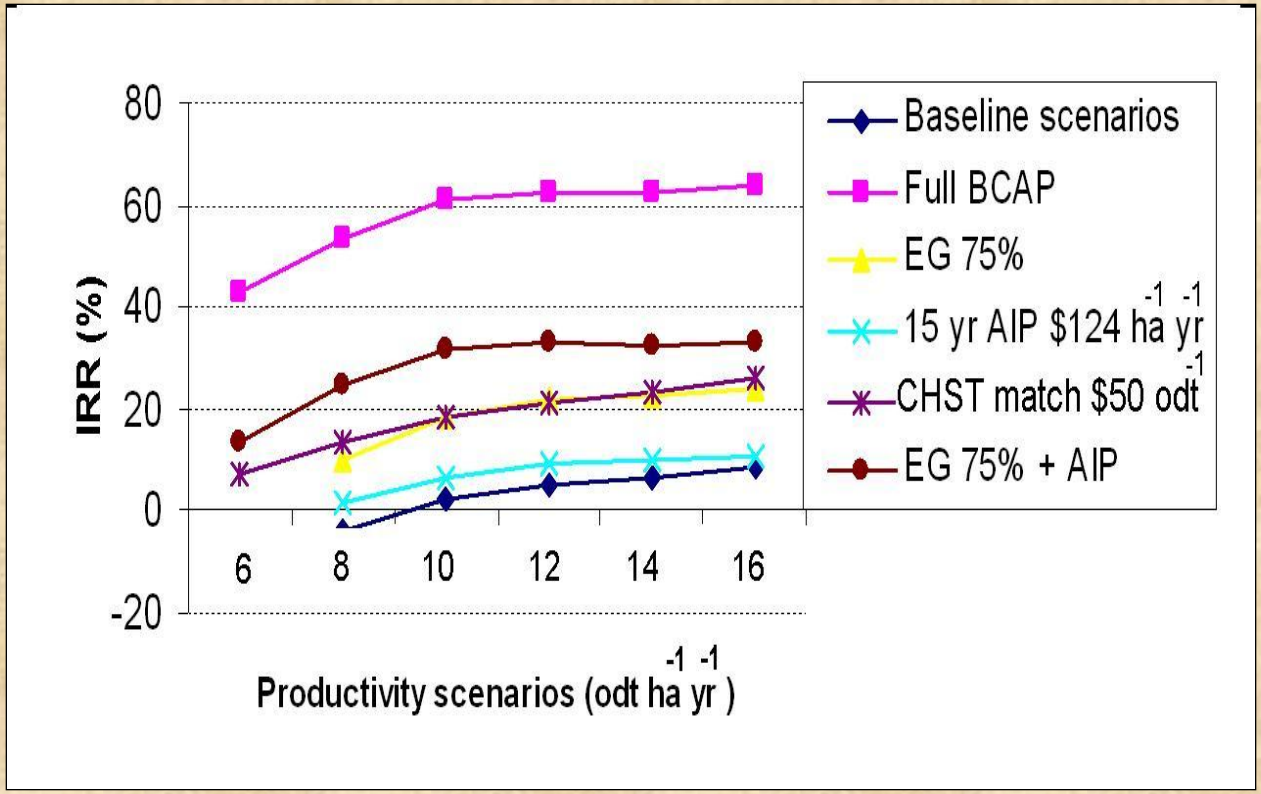
Wood to Energy Biorefinery



Incremental deconstruction of wood to produce a range of higher value products

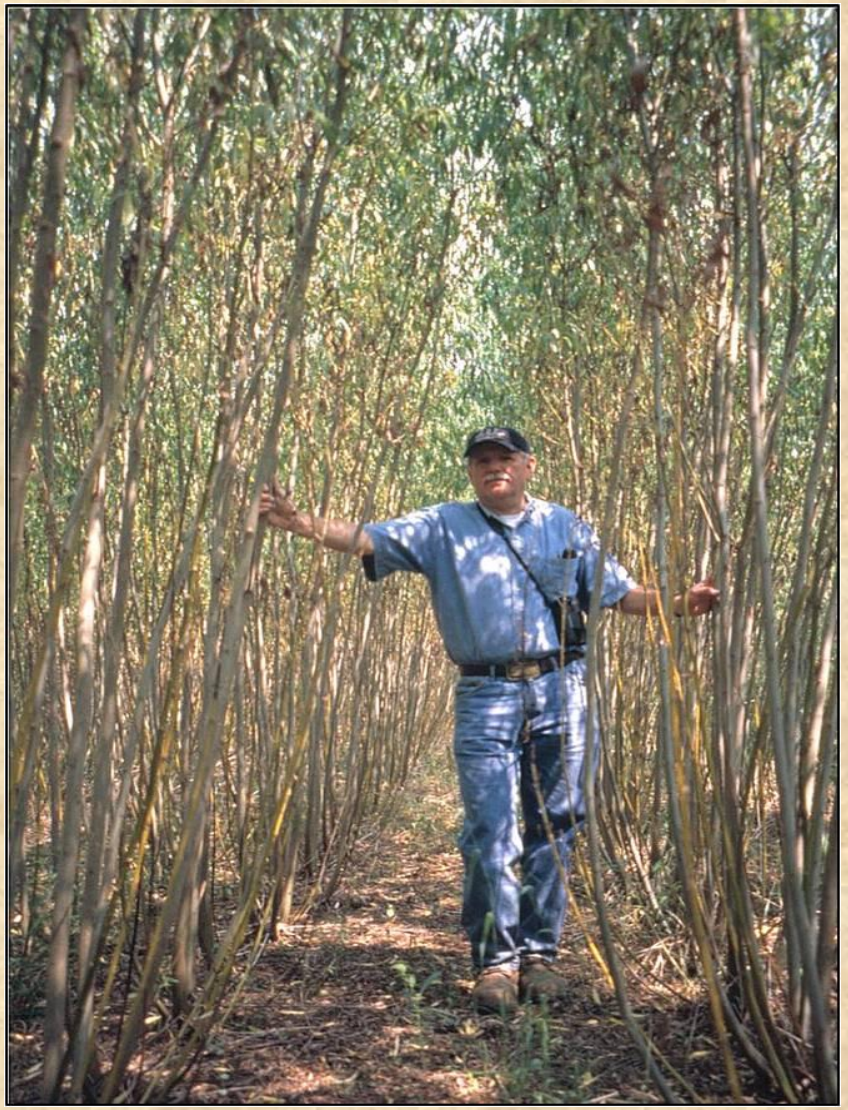
Changing Returns with Incentives

- Incentive programs can help overcome growers concerns about up front costs and risks with a new crop
- The type of incentive has a large impact on returns
- Incentives that are too large can result in crop failures rather than expansion



Impact of different incentive options on the internal rate of return of willow biomass crops (Buchholz and Volk 2010)

The Future for SRWC

- SRWC are in their infancy in terms of development and deployment
- Need to improve the economics through breeding and crop management
- Need long term monitoring of trials and larger trials
- Have to understand landowners attitudes and objectives
- Get more value from each ton of biomass
- Incentive are useful to launch the industry but need to be designed and implemented effectively

Discussion & Questions