



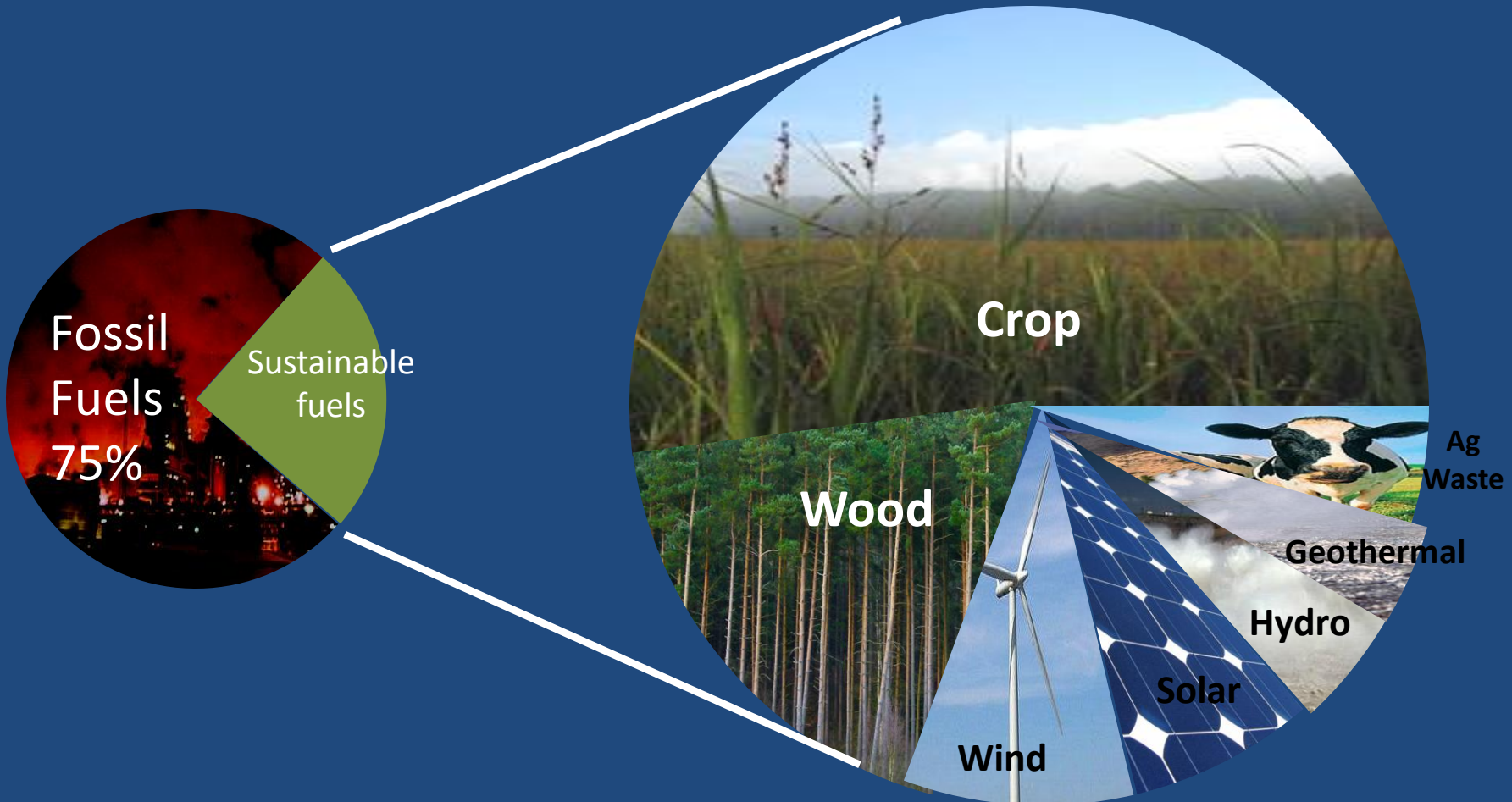
Crop Biomass Value Chain; Making it Work

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Sustainable Energy Goals

RENEWABLE
ENERGY
RESOURCES



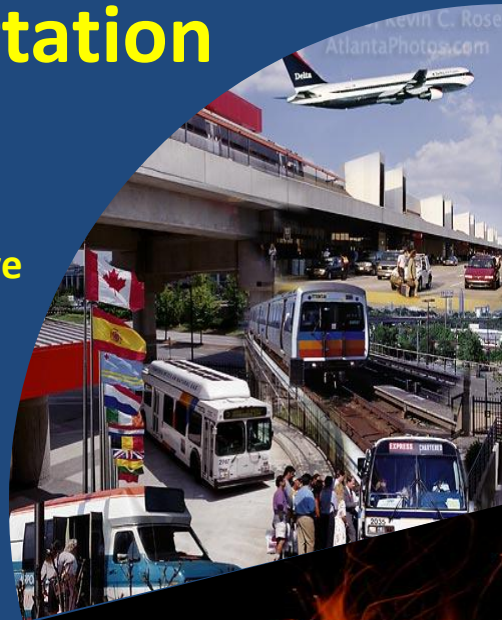
Goal --- increase the use of sustainable fuels from 6% today to 25% by 2025

Energy Use in NE-USA

RENEWABLE
ENERGY
RESOURCES

Transportation

- > Liquid fuels
- Biomass
- > Ethanol
- > Energy intensive



Electricity

Hydro
Wind
Solar



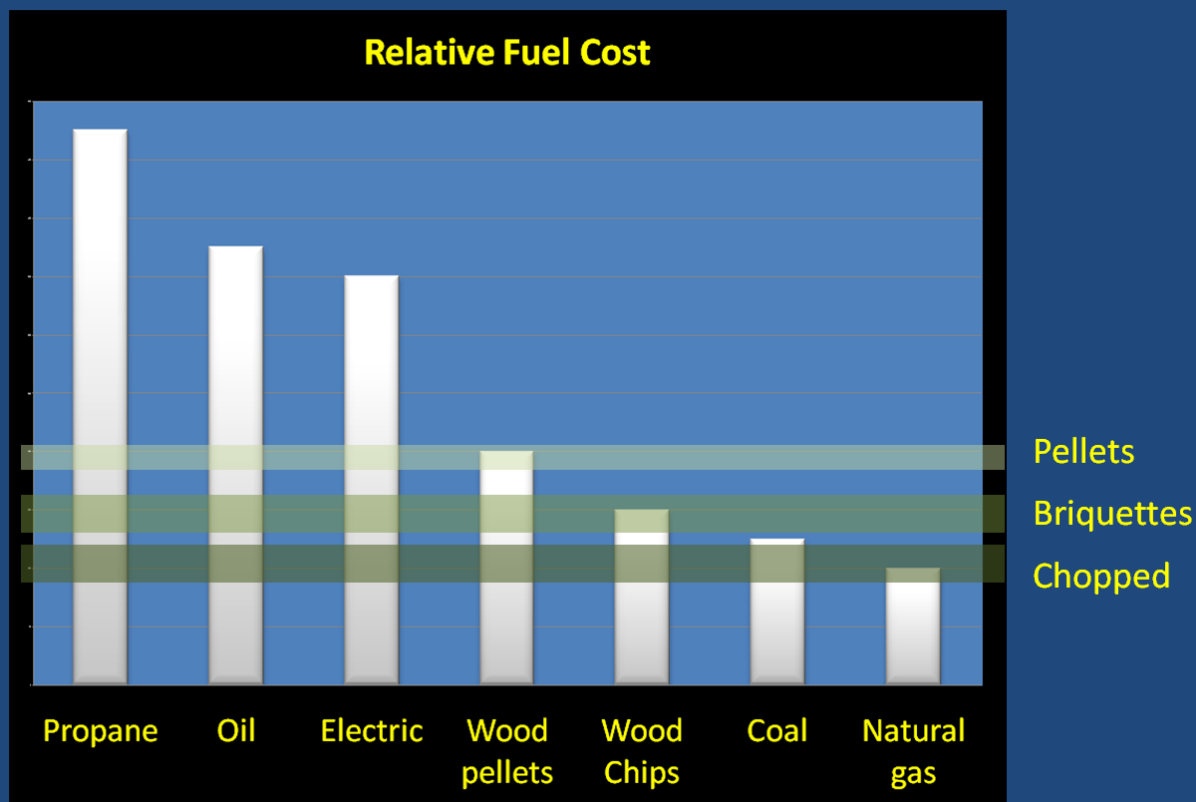
Heating

- Biomass
- > Direct combustion
- > Highest efficiency



Combined Heat
& Power

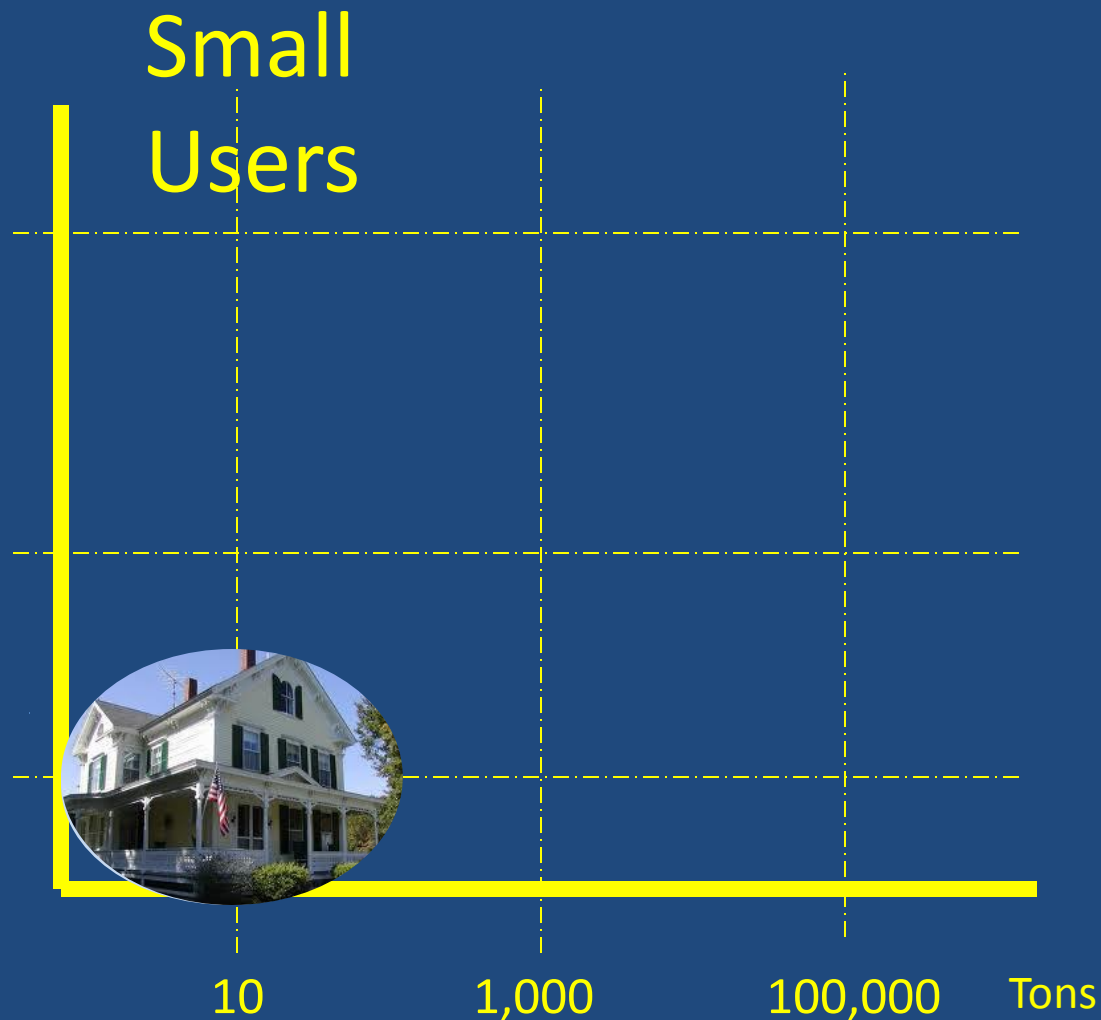
Potential Customers



- **Customer motivation**
 - Cost may not be the most important issue
 - Reduction in greenhouse gases
 - Support local farmers

Markets

- Customers
 - Domestic
 - Small industrial
- Fuels
 - Convenience
 - Pellets
- Boiler features
 - Must be able to handle higher ash
 - Not all small boilers will work

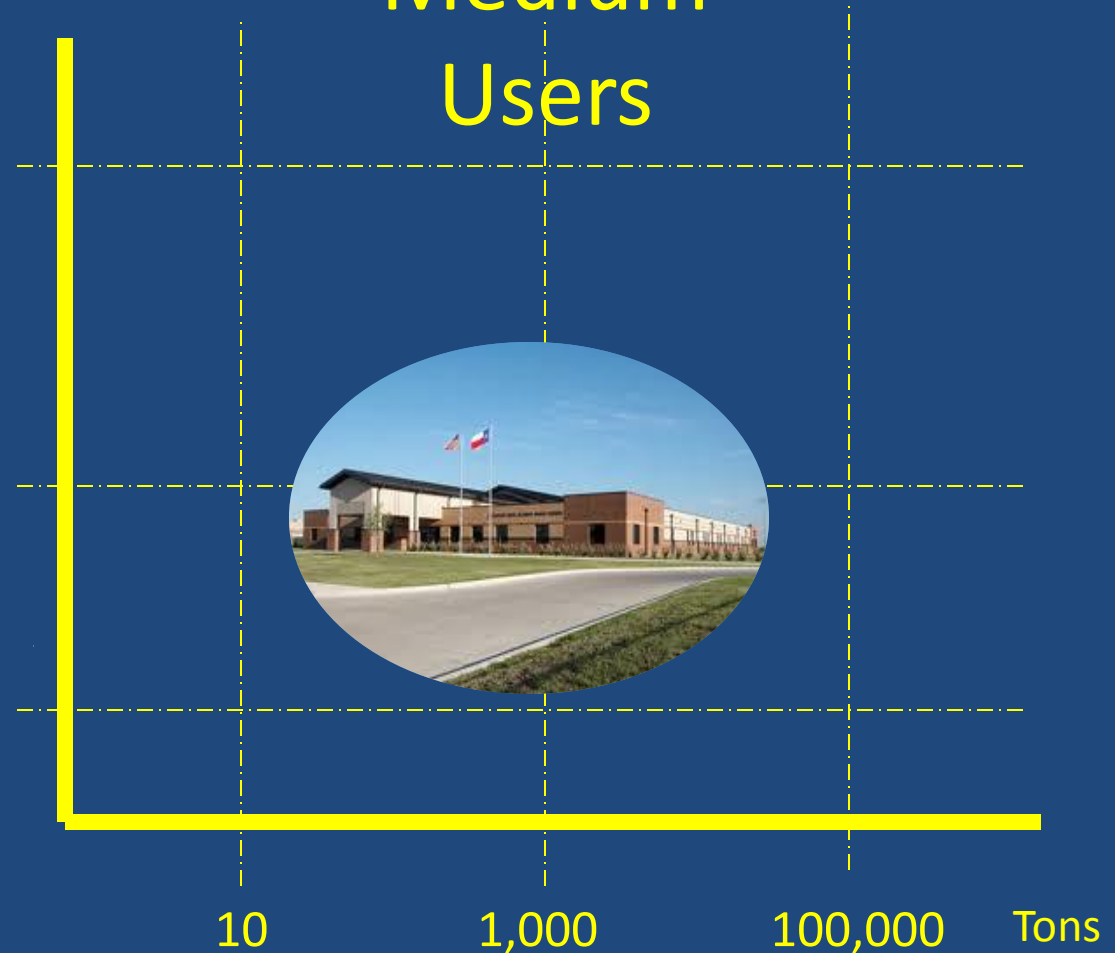


Annual fuel use of a typical customer

Markets

- Customers
 - Industrial
 - Schools
 - Colleges
 - Hospitals
 - Prisons
- Fuel
 - Grass-Bales/chopped
 - Grass Briquettes
 - Wood Chips
- Boiler features
 - Multi-fuel
 - Automatic controls
 - Automatic ash removal

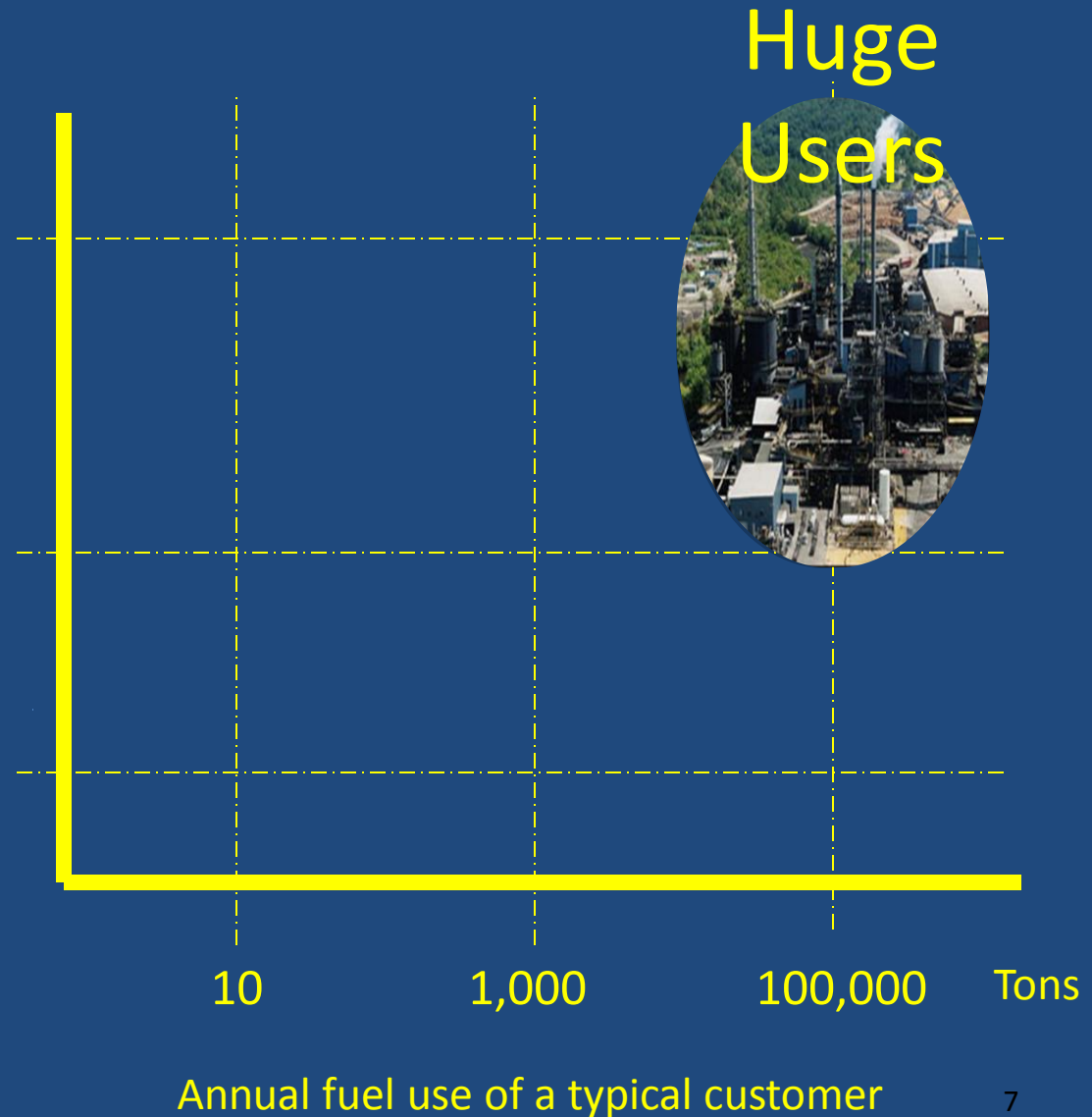
Medium Users



Annual fuel use of a typical customer

Markets

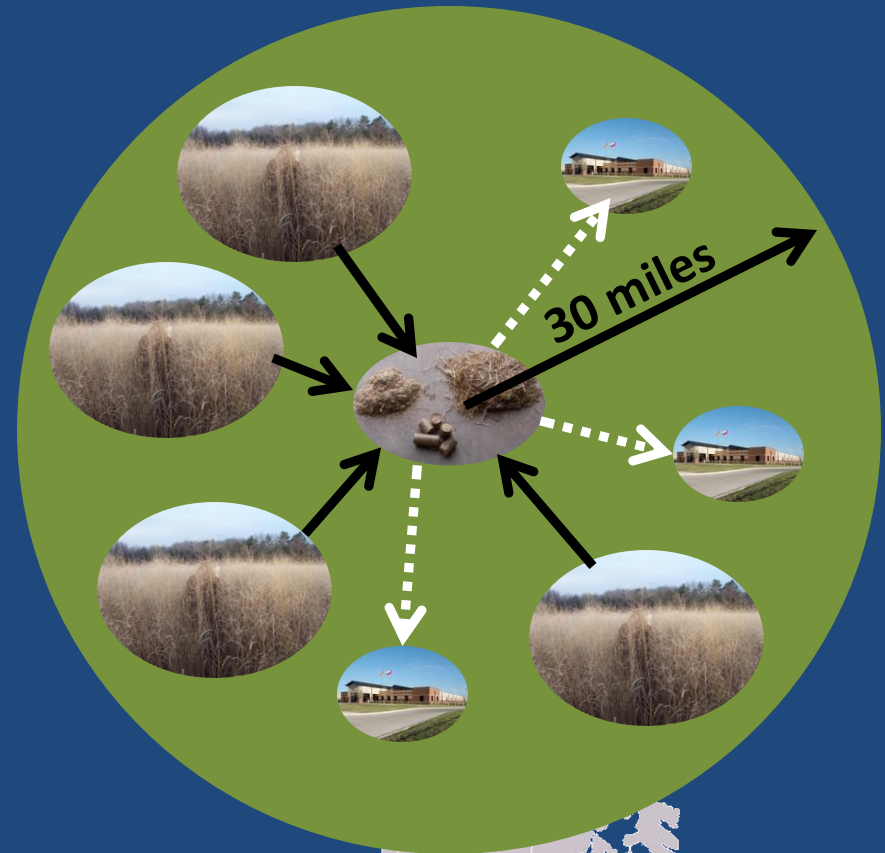
- Customers
 - Power plants
 - Process industries
- Fuel
 - Lowest cost
 - Government policy
 - Chopped grass



Business Model

RENEWABLE
ENERGY
RESOURCES

- Local
 - 30 mile radius
 - Limited by transportation cost
 - Farmers
 - Need to make \$\$\$
 - Farm-gate price \$75-\$90/ton
 - Transportation
 - Low density
 - Expensive
 - Processing
 - 2 ton/hr
 - 5,000-10,000 tons/yr
 - Customers
 - The correct equipment
- Investors
 - Growth
 - Operate in several areas
 - Franchise



Plant Science

- Increase \$\$/acre
 - Increasing yield
 - Faster germination
 - Reduce cost of establishment
 - Crop selection
 - Disease resistance
 - Crop mix
 - Prairie
- Harvesting standards
 - Biomass different from forage



Transportation

- Grass is low density
 - Expensive to transport
 - Limits distance
 - Need to Compact
 - 15-28 lb/ft³ to reach GVW



Compaction

- Increases density
 - Ease of handling
 - Reduces storage volume
 - Reduces transportation costs
- Reduces emissions
 - Unless specifically designed for chopped grass
- Costs
 - Briquettes \$155/ton
 - Pellets \$210/ton



Combustion

- Boiler features
 - Multi-fuel
 - Grass-Bales/chopped
 - Grass Briquettes
 - Wood Chips
 - Automatic controls
 - Automatic ash removal
- Emissions
 - Standards more demanding
 - Improved boiler design
 - Fuel Quality
 - Controls on stack
 - Cyclone, Bag house Electrostatic precipitator



Money

Project must be financially viable and show customers a positive benefit

| | | | |
|------------------------------|----------|---|----------|
| Annual cost of fuel | F | | |
| Guaranteed saving/motivation | GS | | |
| Budget | $F - GS$ | = | B |

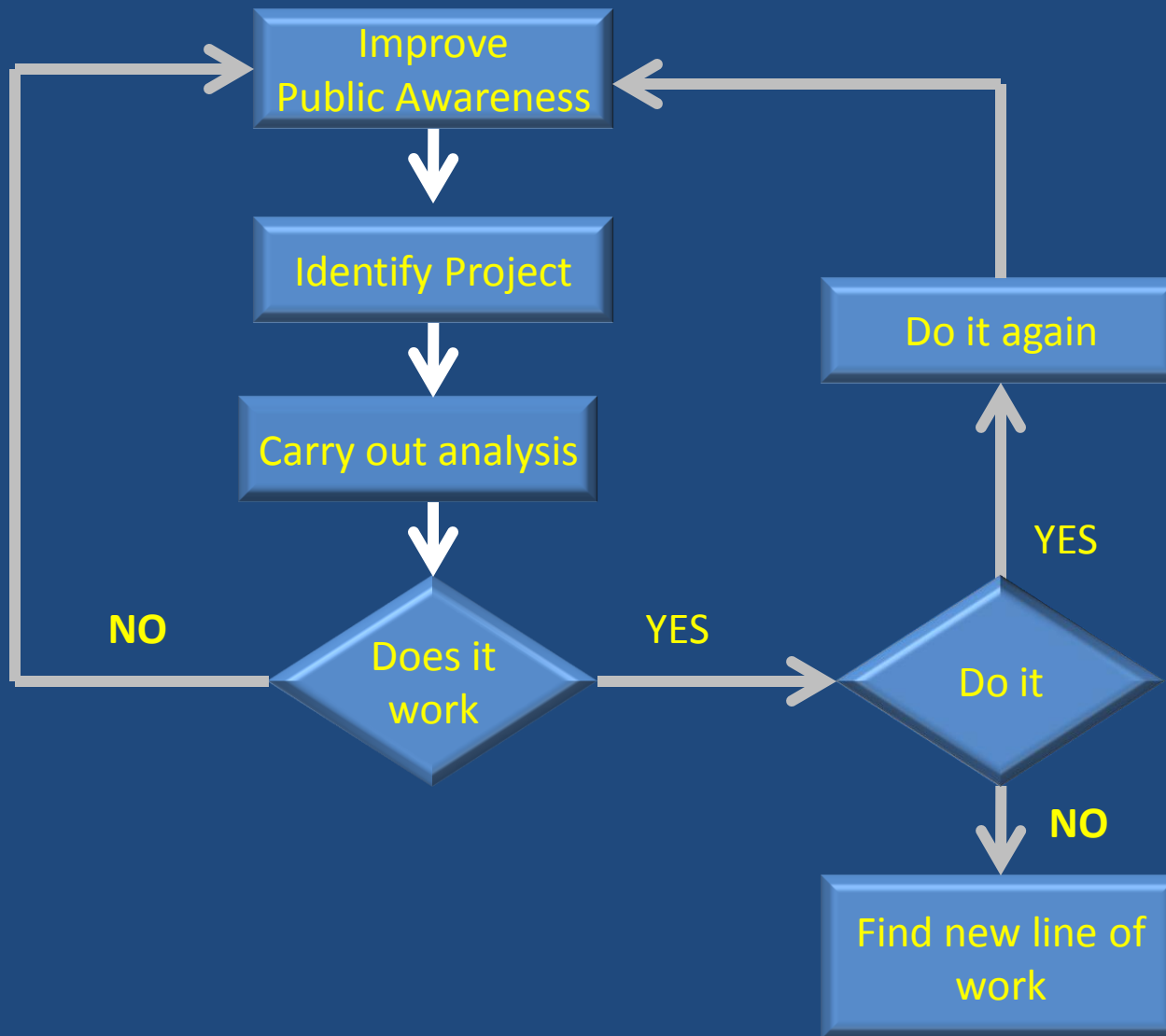
Capital cost of equipment CC

| | | | |
|---------------------|--------------------|---|---|
| Loan Repayment | LR | | |
| Fuel cost | FC | | Ignore tax incentives since government policy changes |
| Labor & Maintenance | LM | | |
| Profit | P | | |
| Annual Cost | $LR + FC + LM + P$ | = | AC |

if X positive do the job

$$B - AC = \underline{\underline{X}}$$

Roadmap





I look forward to your comments and questions

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