Biomass Gasification: A Comprehensive Demonstration of a Community Scale Biomass Energy System

UNIVERSITY OF MINNESOTA
MORRIS

A renewable, sustainable education.

Public liberal arts and land grant

- Develop intellectual capacity in civically engaged, informed citizens who are stewards of the environment
- Intentional and provocative campus life
- Access and inclusivity
- Model local solutions for global problems and improve the local economy

University of Minnesota, Morris today

- 1,900 undergraduate students
- Selective in admissions requirements
- 20+ per cent students of color
- 12 per cent American Indian students
- 1 in 3 students are first generation
- Nationally ranked

By **David Joles**, Star Tribune

National rankings, 2011-2012

- **US NEWS AND**
- **WORLD REPORT**

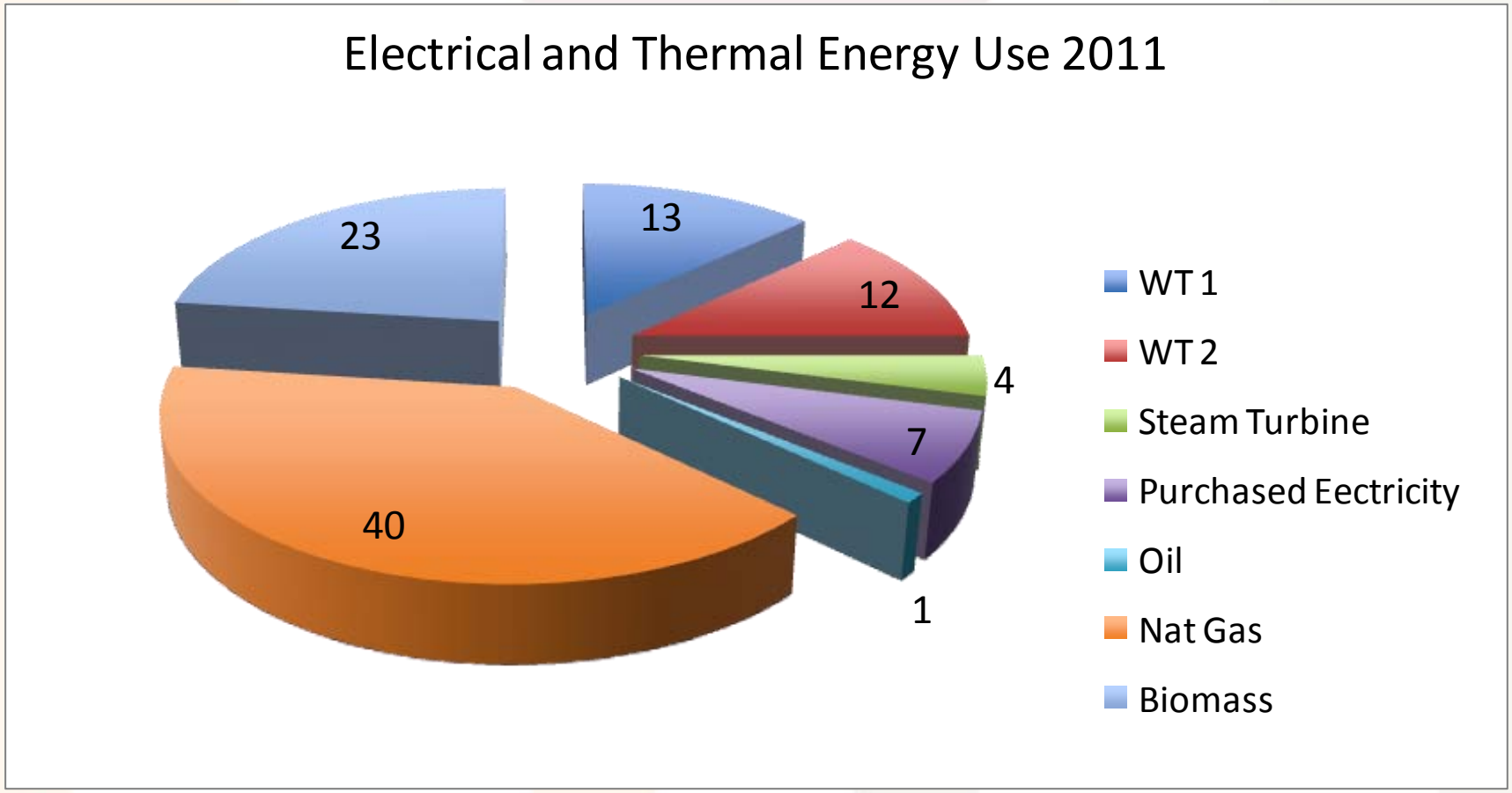
EPA Top 20

Kiplingers

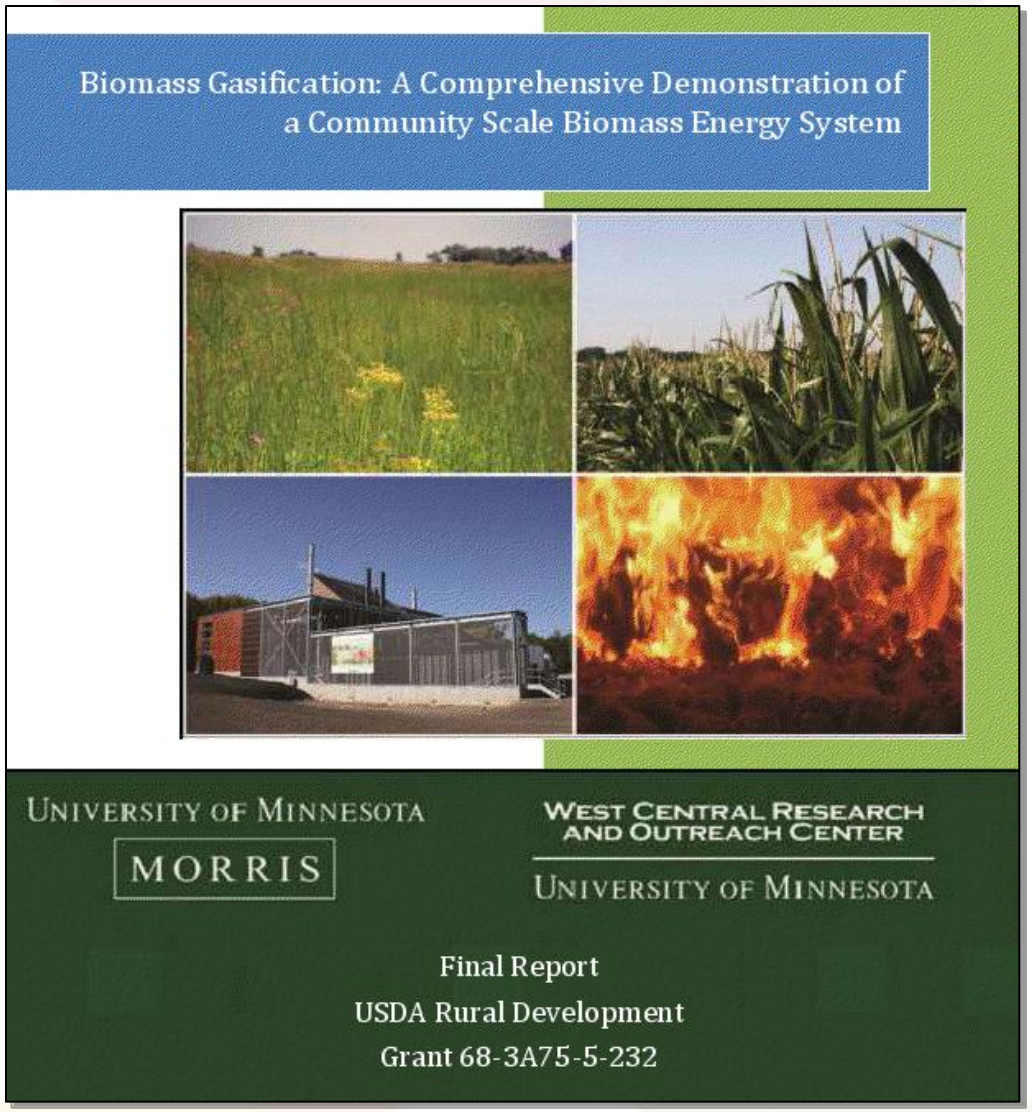
Campus Commitment

- Morris is one of only 31 institutions to achieve an AASHE (STARS) gold certification.
- The University of Minnesota, Morris is No. 20 on the U.S. Environmental Protection Agency's (EPA's) Top 20 On-site Generation list of the largest green power users
- (LEED) Gold rating to the Welcome Center at the University of Minnesota, Morris.
- Preservation Alliance of Minnesota's Sustainable Design Award
- Morris is one of the most environmentally responsible colleges in the U.S.A. and Canada, listed in The Princeton Review's Guide to 322 Green Colleges: 2012 Edition.

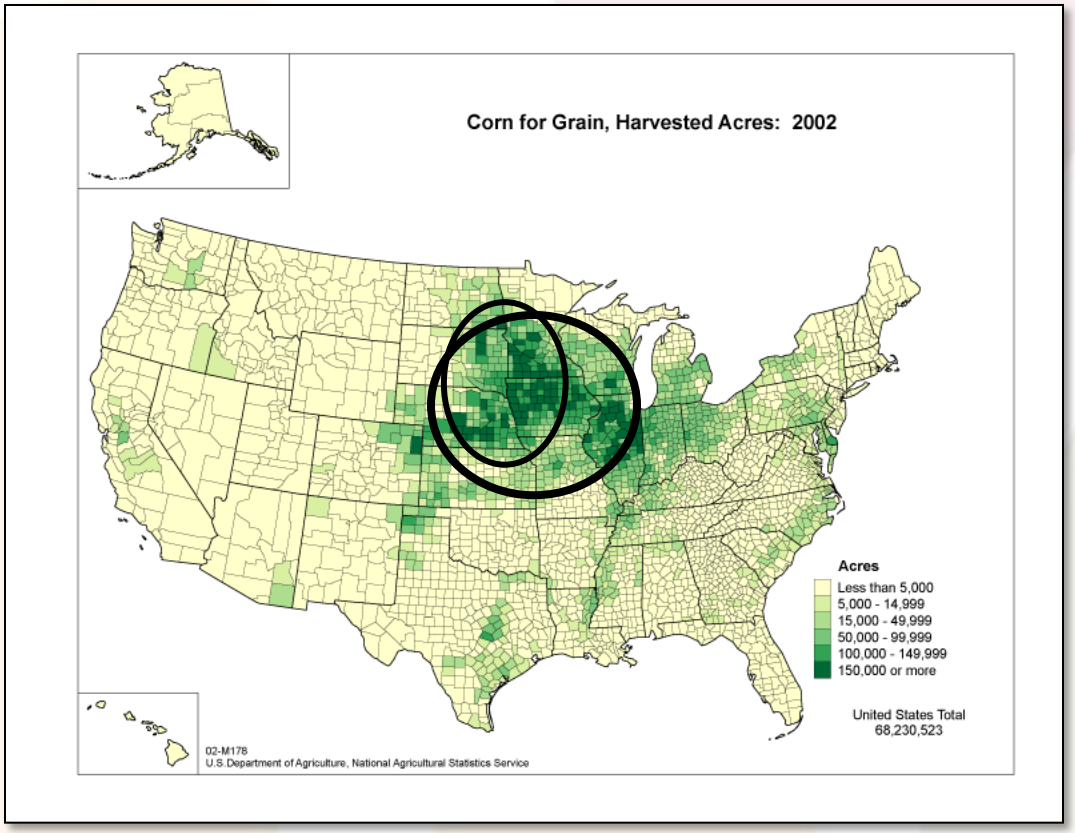
The Energy Wedges



The Development of an Energy Ecosysytem

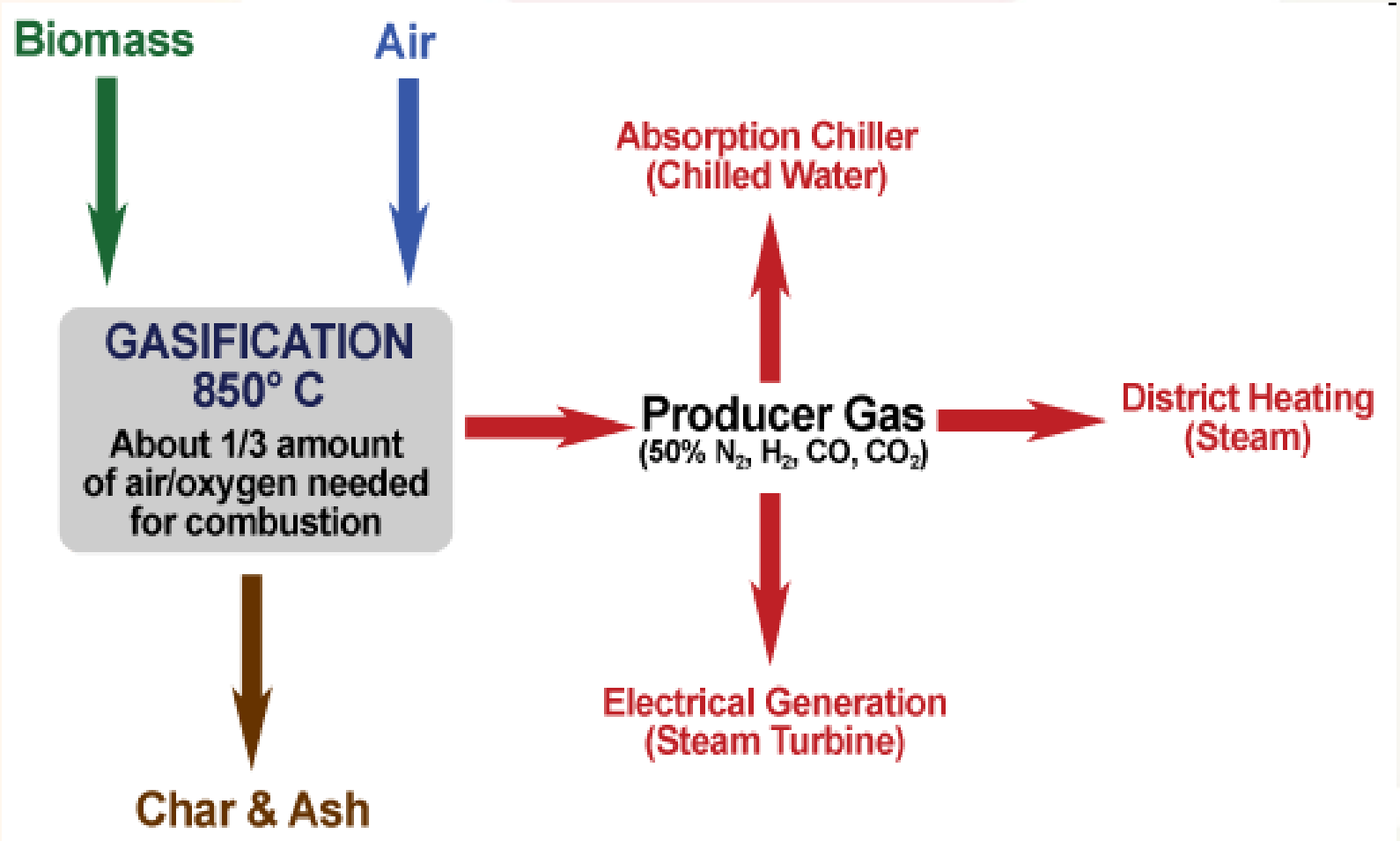


Strategic Asset Allocation



Understanding how the natural resources in the region could provide a roadmap to carbon management.

Combined Heat and Power



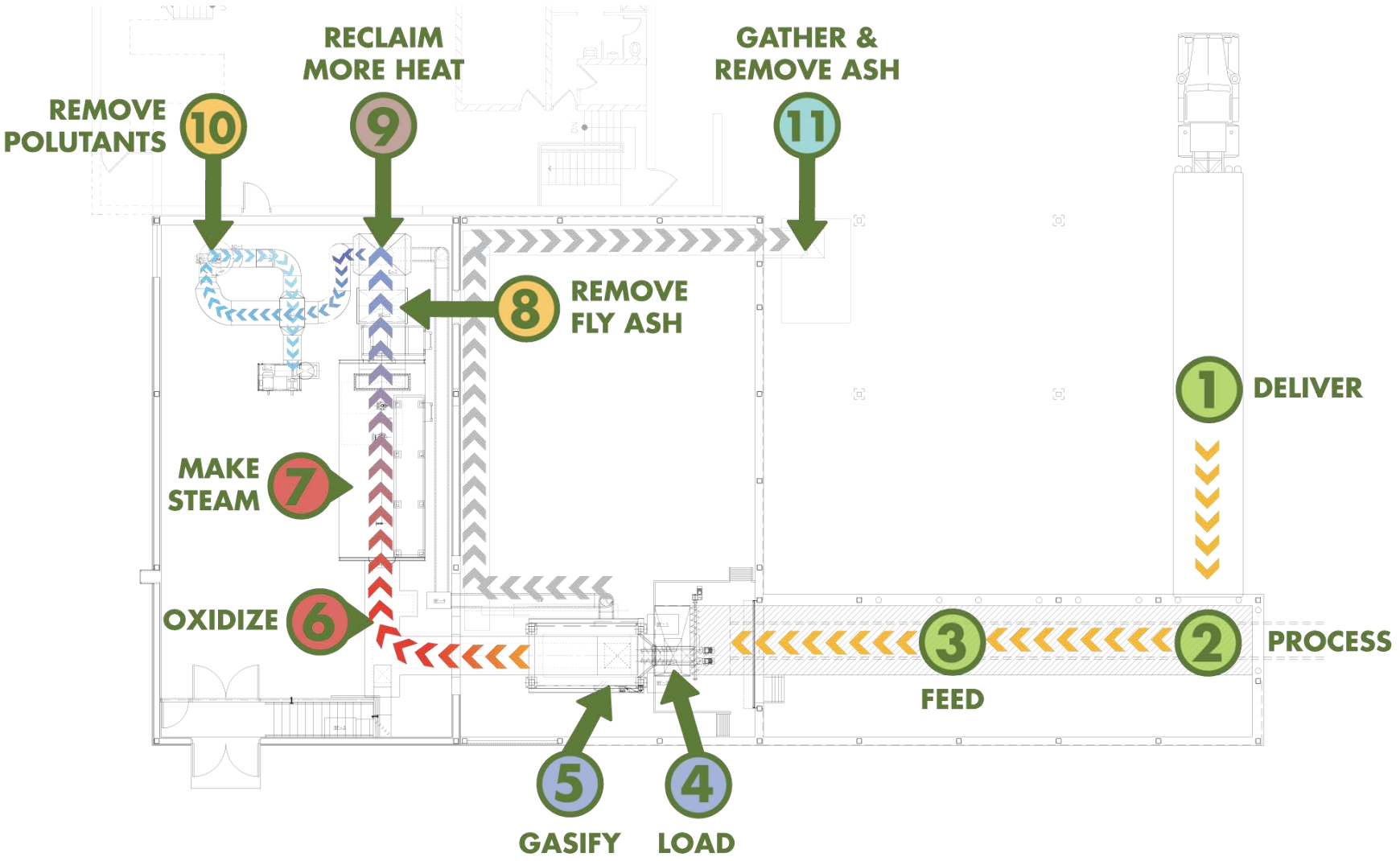
Challenges

- Small number of available suppliers for the appropriate size of gasification system
- Minimal experience of engineers and suppliers with agricultural residues
- Lack of efficient and cost effective biomass handling and processing systems
- Cost overruns due to added design and facility requirements
- No experience of the permitting agencies with agriculture residues in biomass energy systems
- Design issues with both the facility and the equipment
- Risk management due to the disruptive nature of the technology

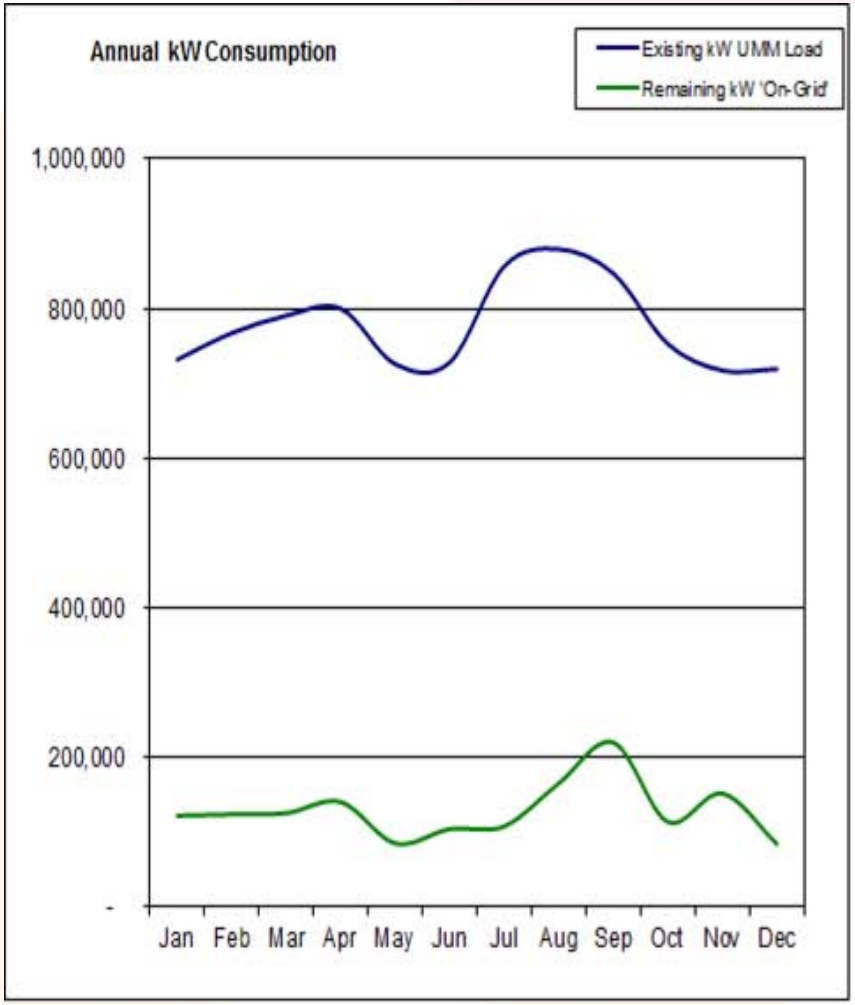
Challenges

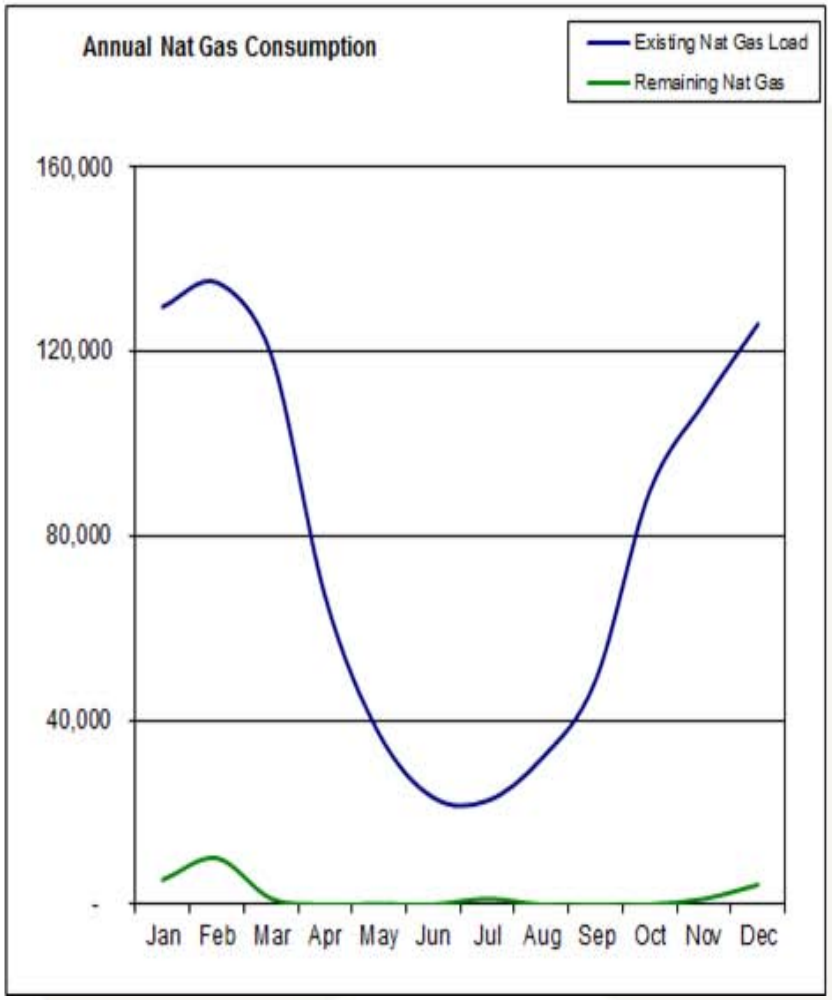
- Limited knowledge of appropriate operation parameters to achieve gasification for diverse feed stocks
- Feedstock storage, handling, processing, and densification issues
- Control limitations on the gasification equipment
- Limited understanding of staffing requirements for both gasifier operation and supply of biomass
- Difficulty in balancing multiple goals of research, demonstration, and commercial operation
- Diverse feed stocks characteristics including moisture and density

Flow Diagram



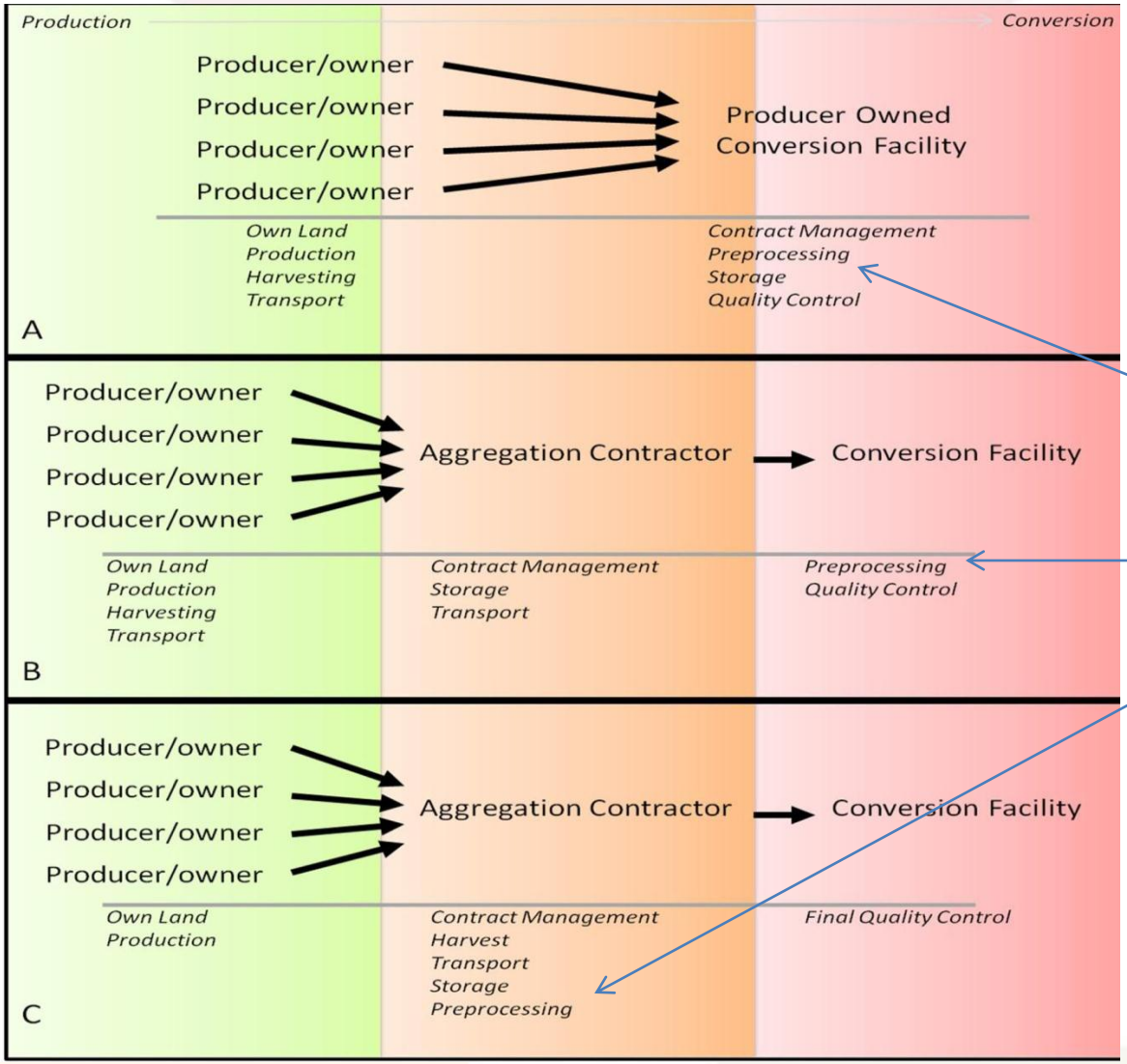
Hybrid renewable energy platform *





* McKinstry Data

Biomass Supply Chain



Preprocessing charges : $20-60/ton

Local Fuels

UMM just completed a RFP for up to 3,000 tons of Corncobs.

This will shift up to $200,000 from natural gas to the regional economy

In addition the RFP stipulates the local suppler will purchase the ash and apply it back to his fields.

Nutrient Removal

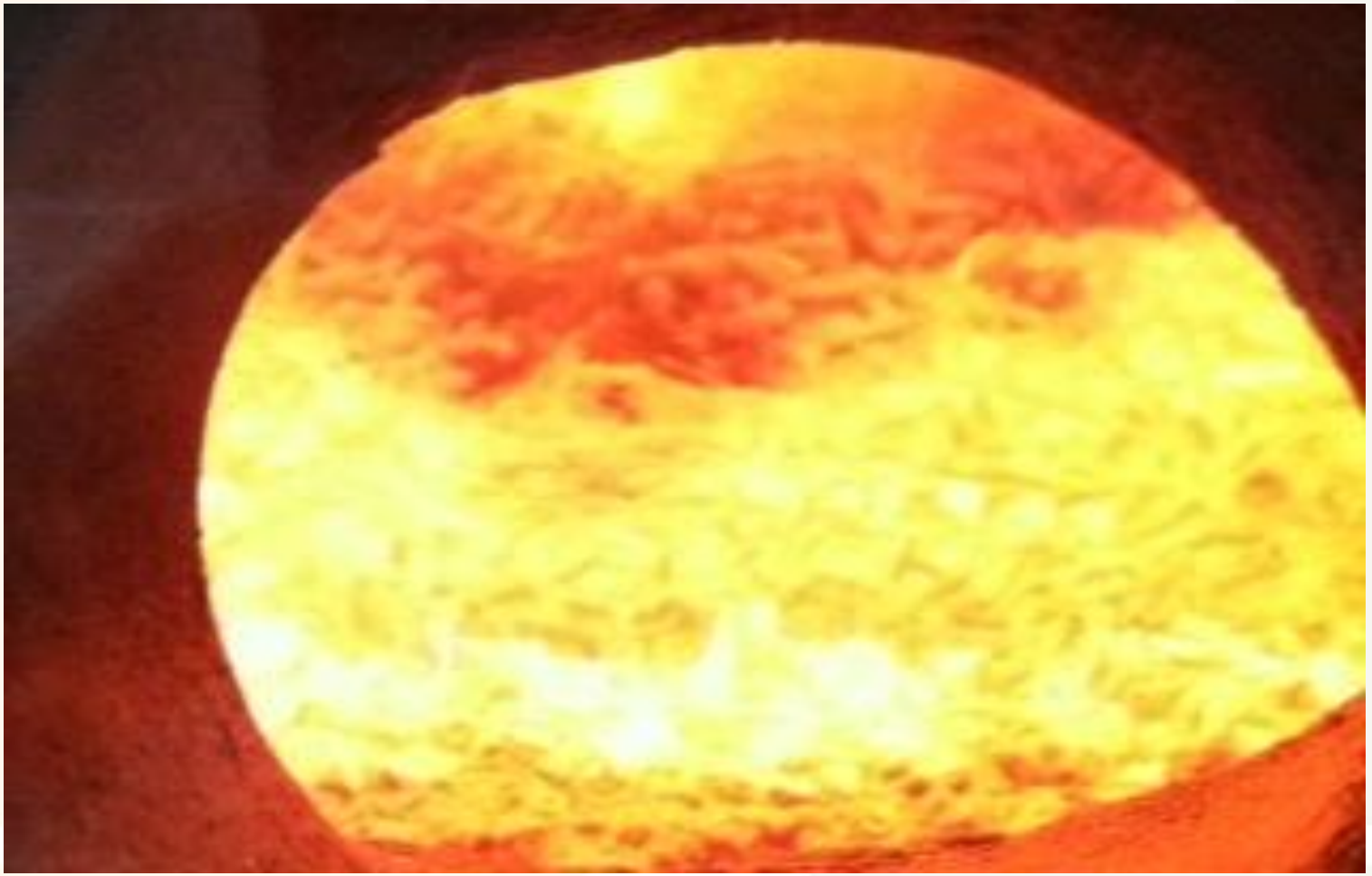
- Table 1. Concentration of elemental N, P and K in several residues.

Residue:	N	P	K
Corn stover	0.74	0.13	1.15
Corn cobs	0.56	0.05	0.63
Wheat straw	0.68	0.10	0.78
Soybean straw	1.5	0.18	1.3
Perennial grasses	0.75	0.08	0.39

Our Equivalent to Fracking

Automated Fuel Bunker

Cob Gasification

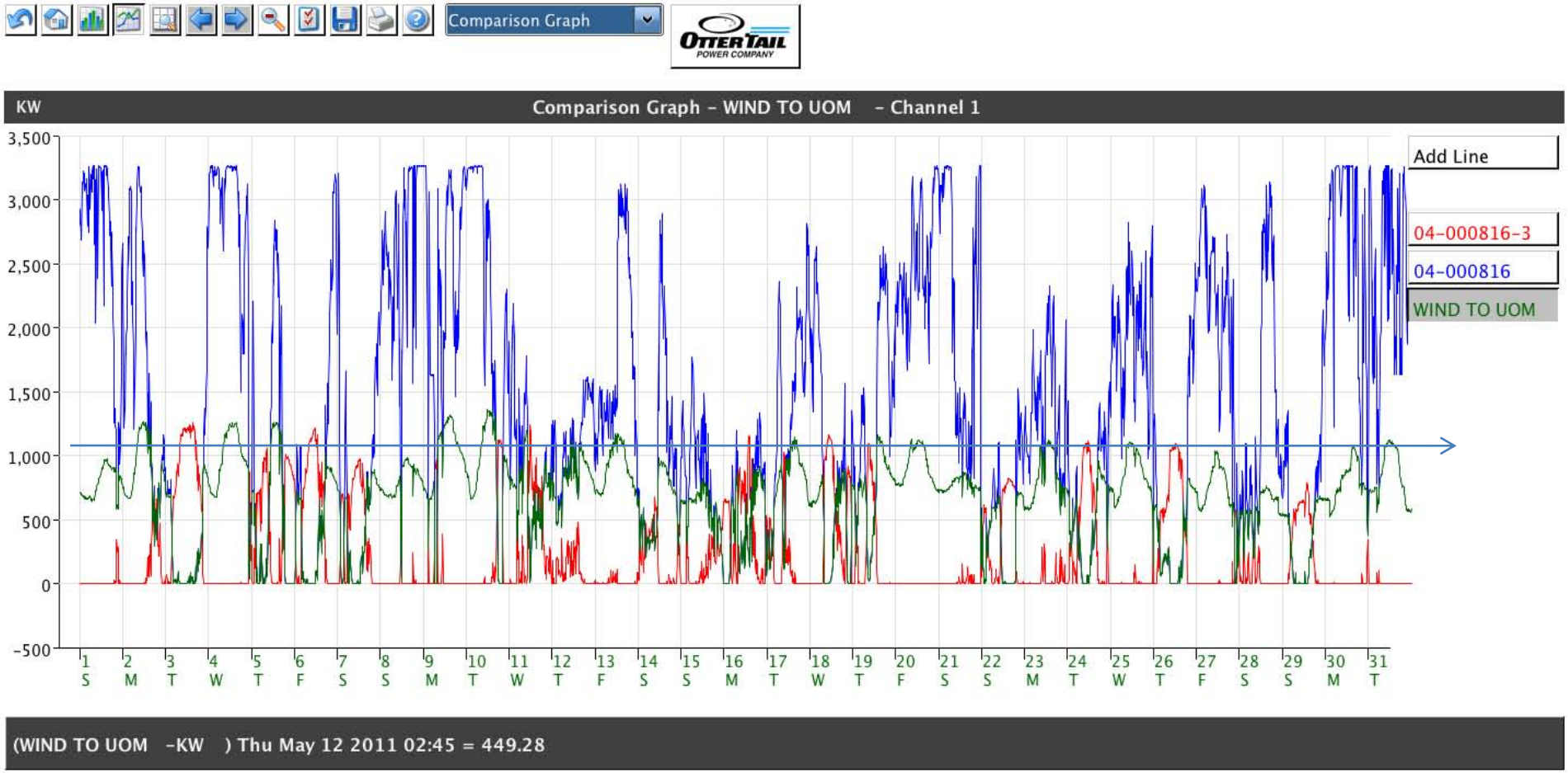


Not without its challenges

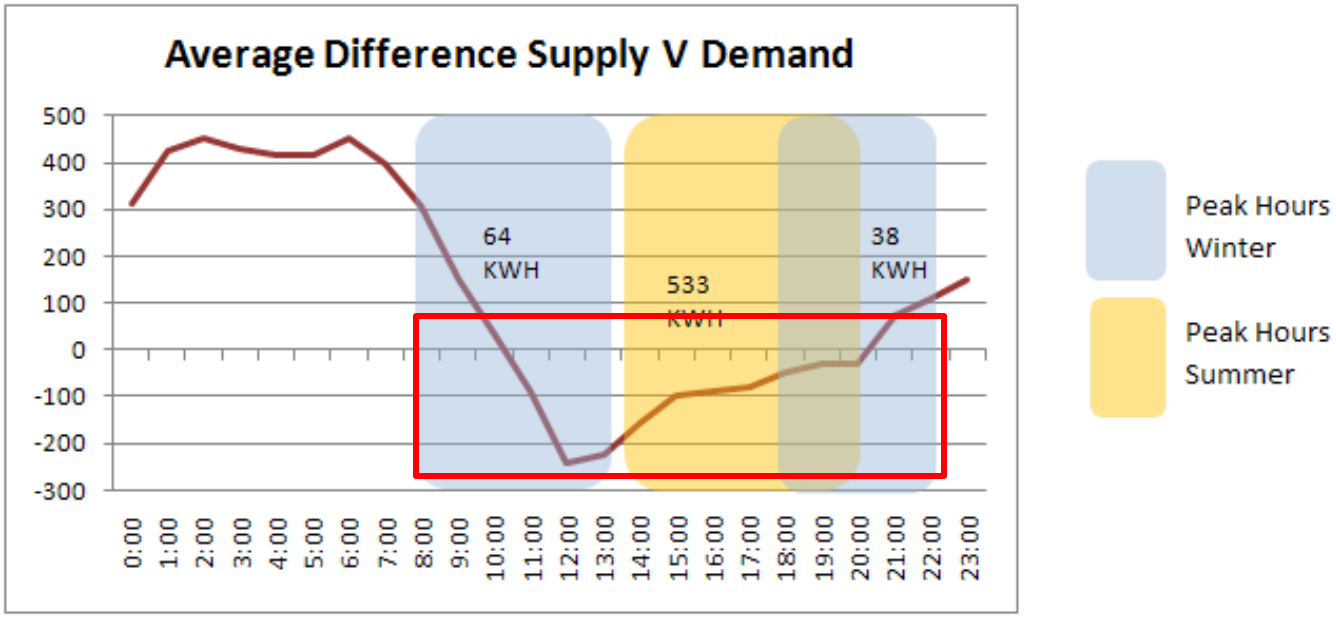
2011/12 Fuel Efficiencies.
Production data from Morris Biomass Plant

- Natural Gas:
  - Avg price: 5.704 dollars/cuft (40 % hedged)
  - $/MMBTU 5.704 dollars
- Corn Cobs:
  - Avg price: 87.87/dry ton (Three year contract)
  - $/MMBTU 5.781 dollars
- Wood Chips:
  - Avg price: 101.08/ton
  - $/MMBTU 6.35 dollars
- Supply chain risk.

Net effect of distributed generation



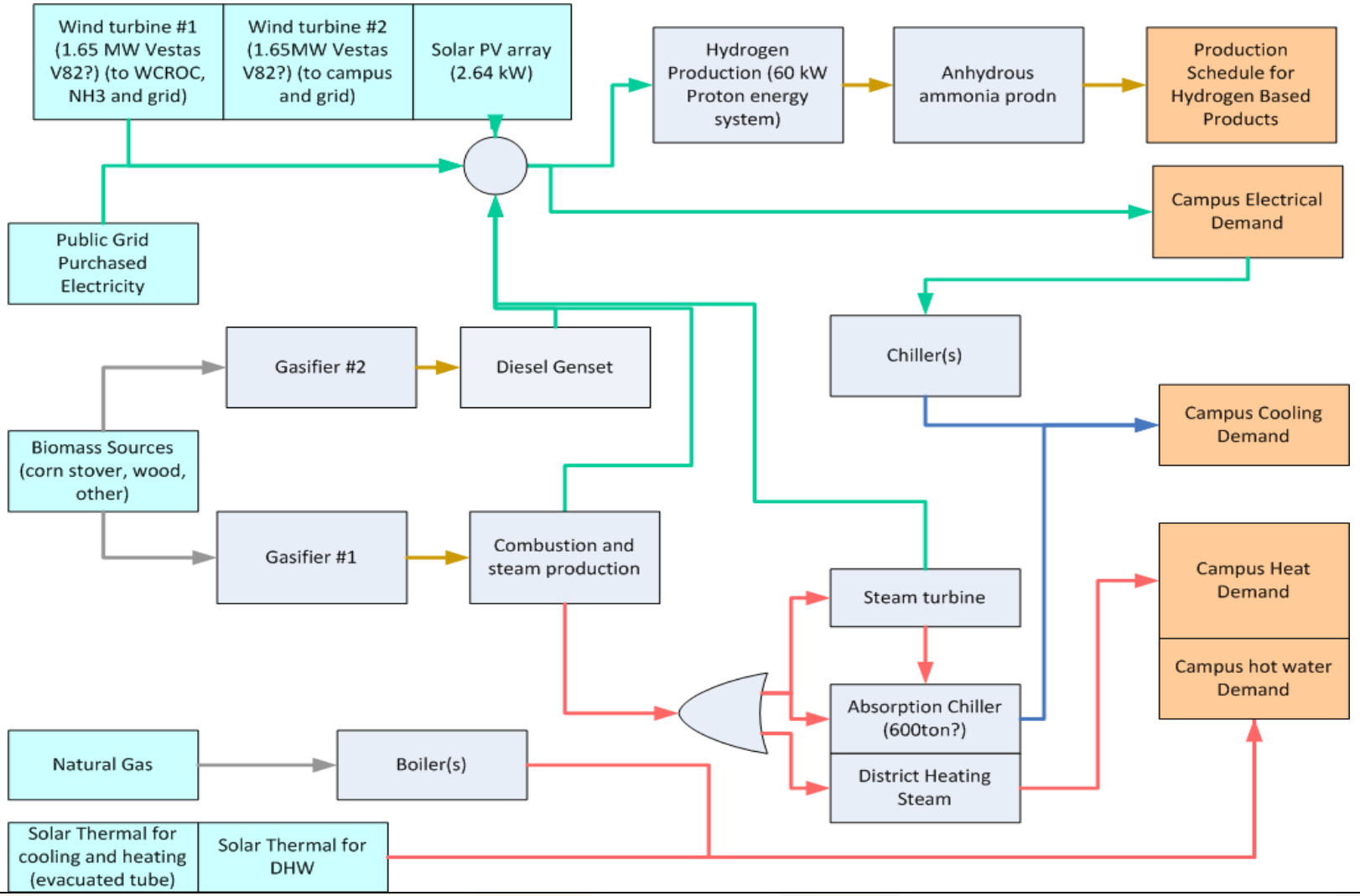
Solving the Peak Demand Problem



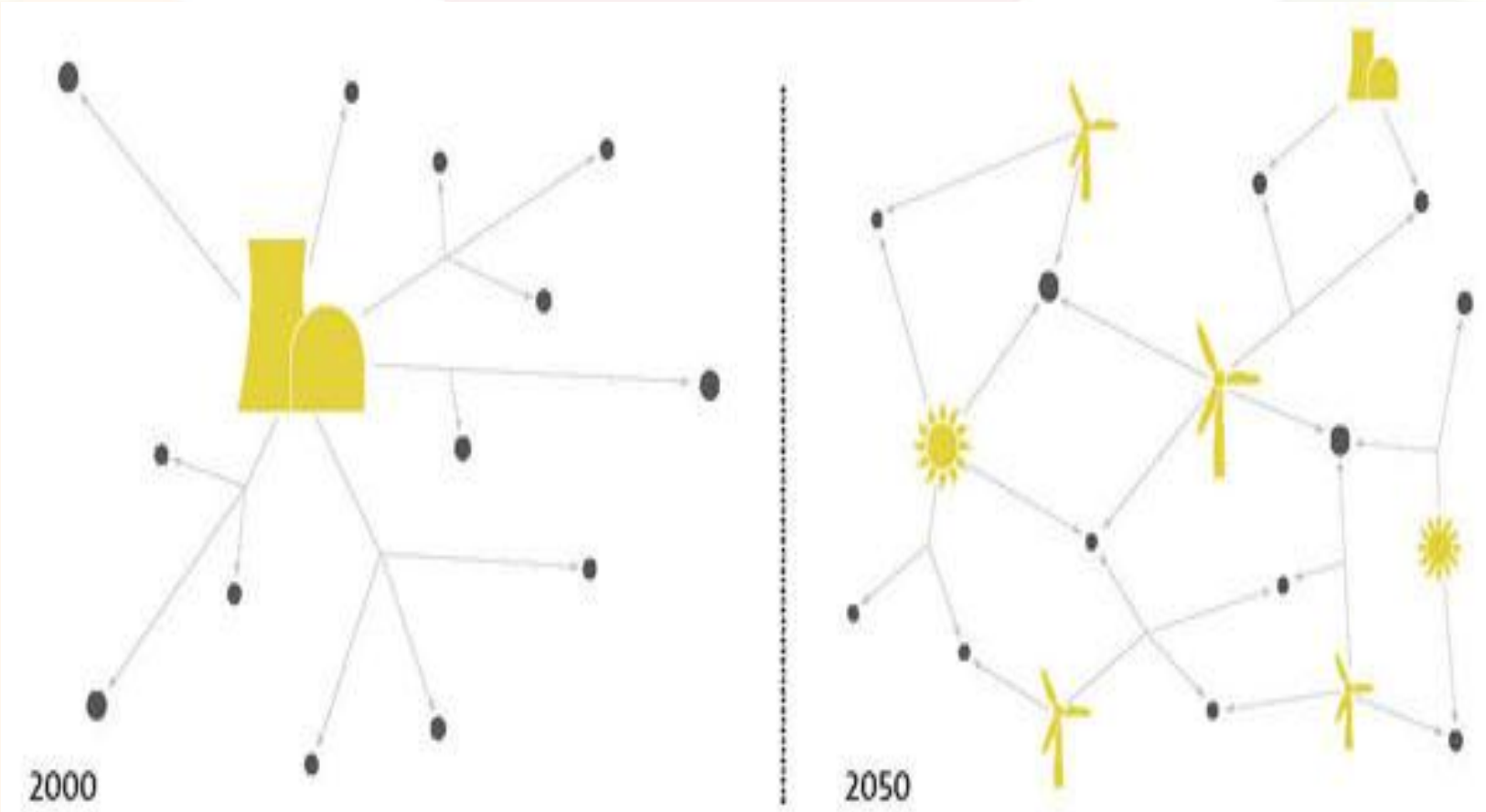
- Three Options: Store, Produce, Reduce
  - Store excess electricity produced off-peak
  - Produce electricity during peak demand and cost times
  - Reduce electricity usage to cut demand

Morris campus microgrid

Honeywell



Understanding the grid of the future



Building Sustainable Clusters

- Think differently about stakeholders
  - What's in it for traditional Investor Owned Utilities?
  - What's in it for educational outcomes?
  - Does it create local wealth?
  - Does it create local opportunities?
  - Does it build regional stability?
  - Does it allow for individual participation? (consumer feed back and behavioral change)
  - Will it bring down the cost of education for future generations?
- Does it teach students how to excel in a new carbon constrained environment?
- Does it substitute natural resources for declining state and federal resources?

Local Jobs, Local Economy, Local Resources