The ecoEnergy Business Case for the Active Farm

Eco Farm Day

27 February 2010

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Your Energy Perspective

Consumer

- Hot Water
- Space Heat
- Process Heat
- Electricity

Producer

On-Site (Behind the meter)	Off-Site (Export)
• Solar Water	
• Solar Air	
• Geothermal	
• Biomass	• Biomass
• Biogas	• Biogas
• Wind	• Wind
• Solar Electric	• Solar Electric

Business Case Considerations

- Your values – personal & business
- Know your needs!
  - what kind, how much, how often, how long
- Best Practice / general strategy:
  - Conservation <u>before</u> Efficiency <u>before</u> Generation
- Understand the difference between
  - "Behind the Meter" (self-supply)
  - "Qualified Facility" (export sales)

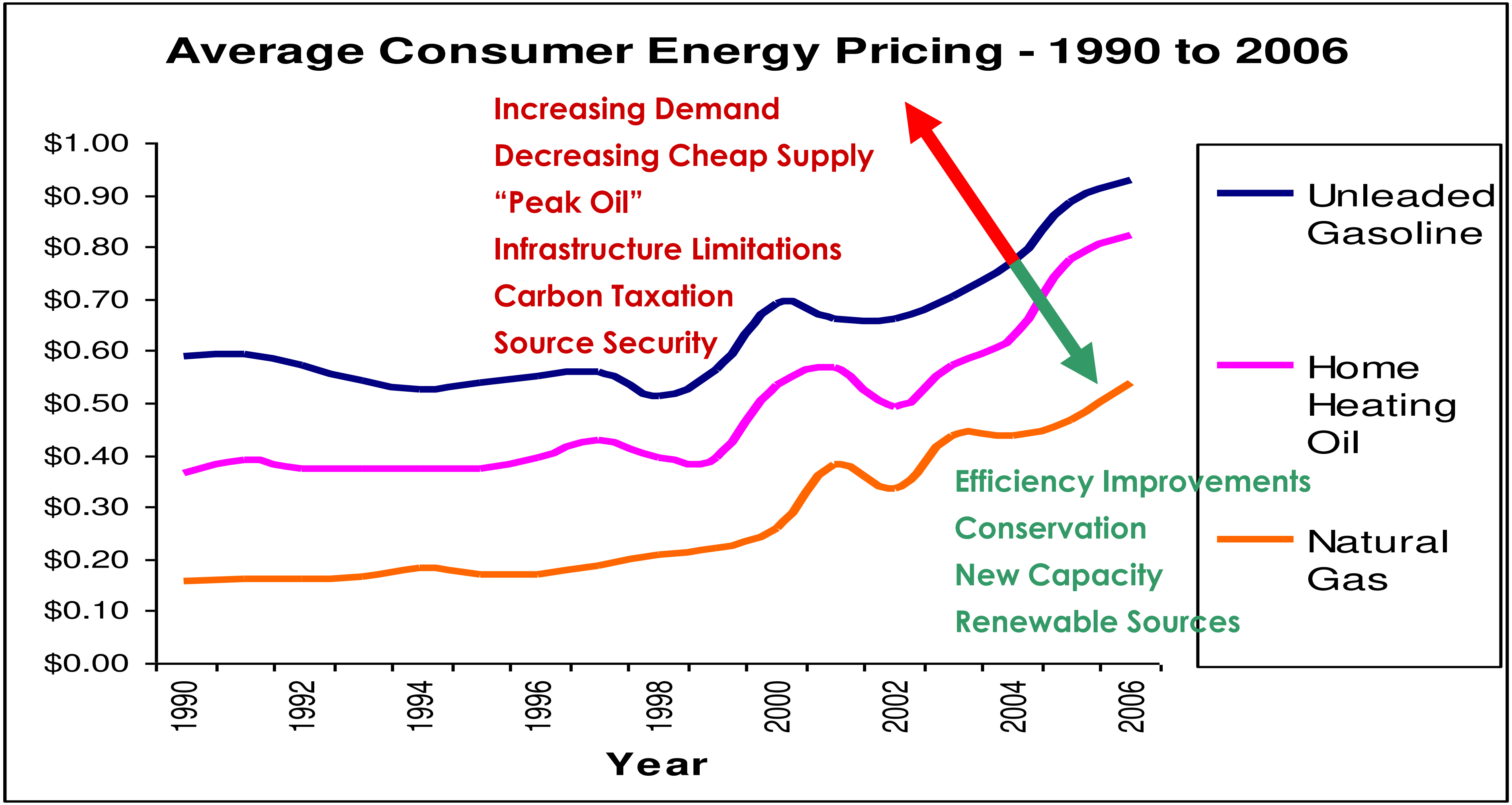
Business Case Considerations

- Market interventions (game-changers)
  - Subsidies, grants, tariffs, rebates
- Energy prices and economic models:
  - Past
  - Present
  - Future
- Carbon content

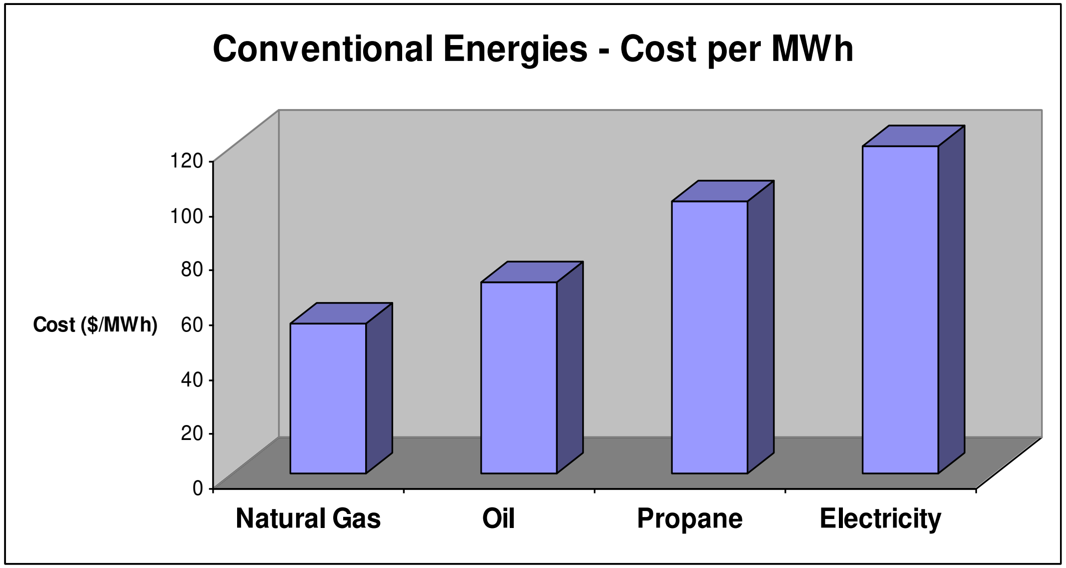
Energy Prices: 1990 to 2006

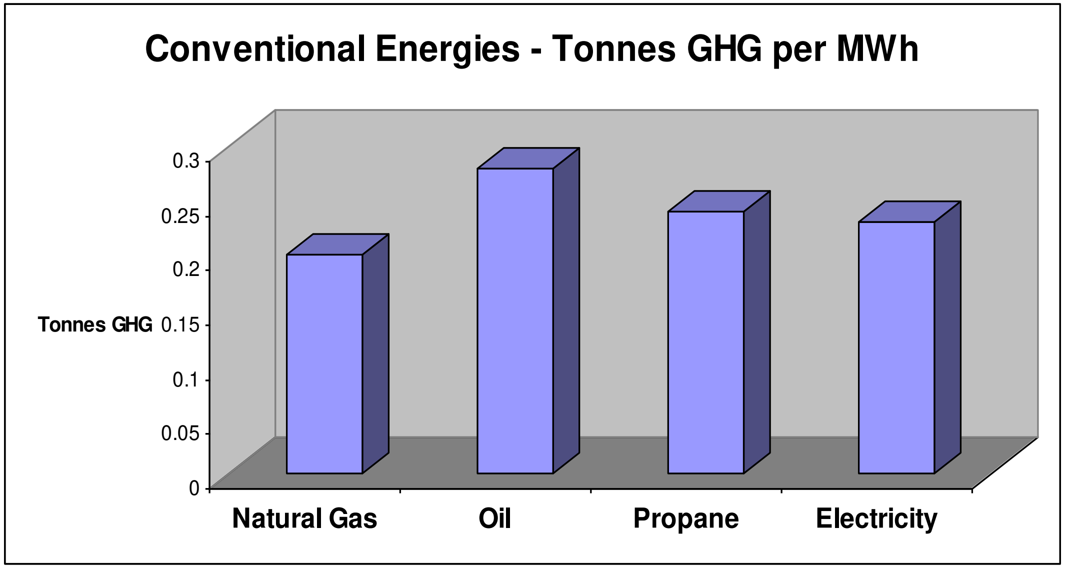
5 Year Annual Rate (2000-2006):

- Unleaded: 7.00%
- Heating Oil: 7.65%
- Natural Gas: 7.20%



Conventional Energies: Costs & Carbon





Conservation

- Investment:
  - Time & effort
  - Behavioural change

- Reward:
  - Reduced cost
  - Reduced footprint

Efficiency

- Building Envelope
  - Retrofit
  - Replacement
- Heat Recovery
  - Drainwater
  - Milk
  - Ventilation
- Pipes
- Lighting
- Appliances
- Motors
- Natural Ventilation

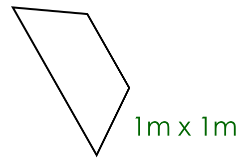
Efficiency Incentives

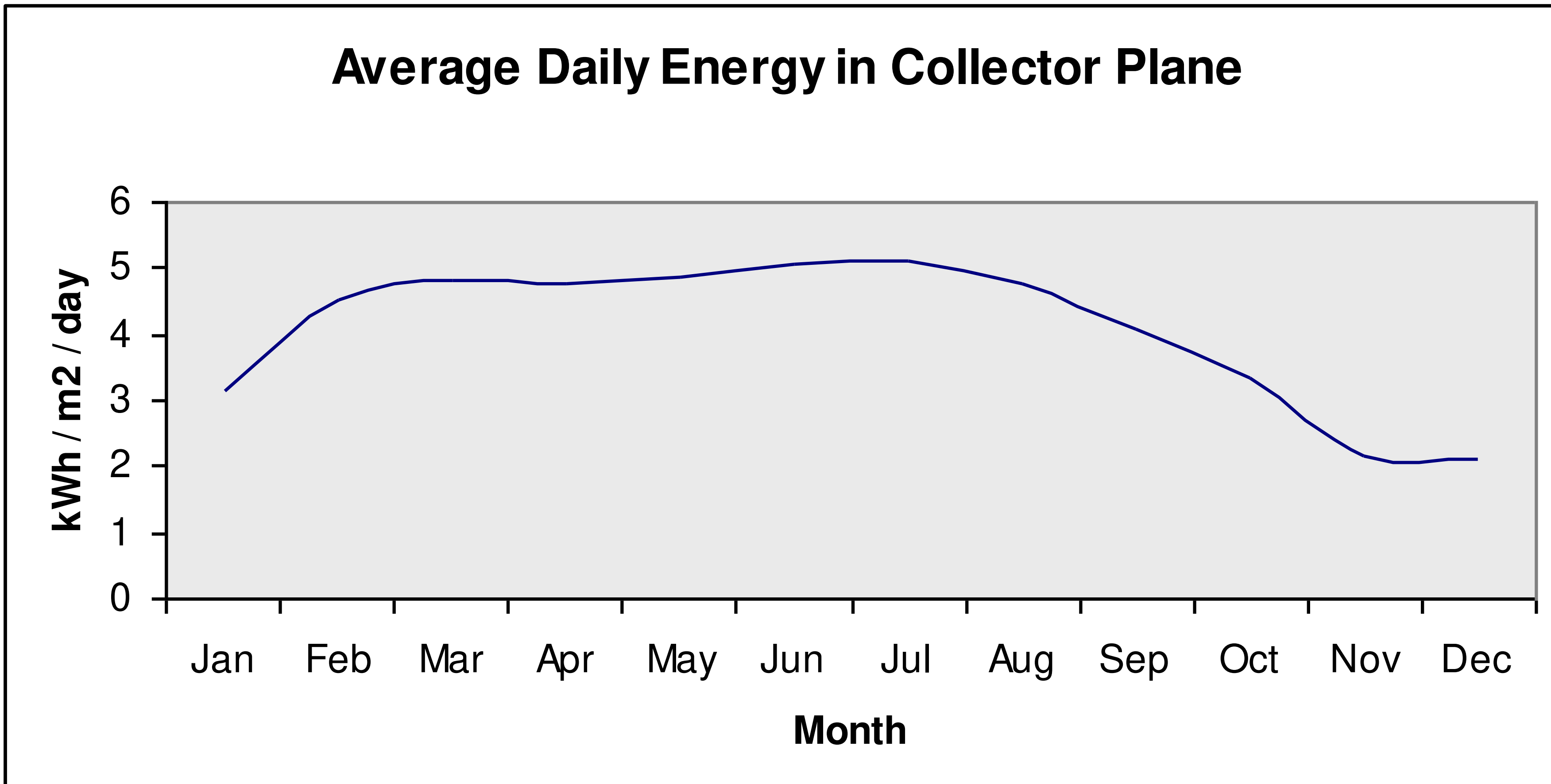
- ecoENERGY Retrofit Incentive for Buildings
  - $10/GJ, ≤ 25%, ≤ $50K
- OPA / EKC / HPNCP (incl retrofits)
  - $50-$400 per saved kW / $60 per appliance
  - Modeling costs ≤ $10K
- OPA / EKC / ERIP (check LDC)
  - Ventilation fans, swine creep heat & controls, livestock waterers, lighting, sensors, motors, DWHR

Renewable Energy Generation

Solar Resources

- 1,000 watts per m^2





Solar Air Heating

- Heat fresh or re-circulated air
- Process heat (crop drying)
- Rapidly Developing:
  - Building Cladding
  - Passive cooling
  - PV / Thermal ("PV/T")

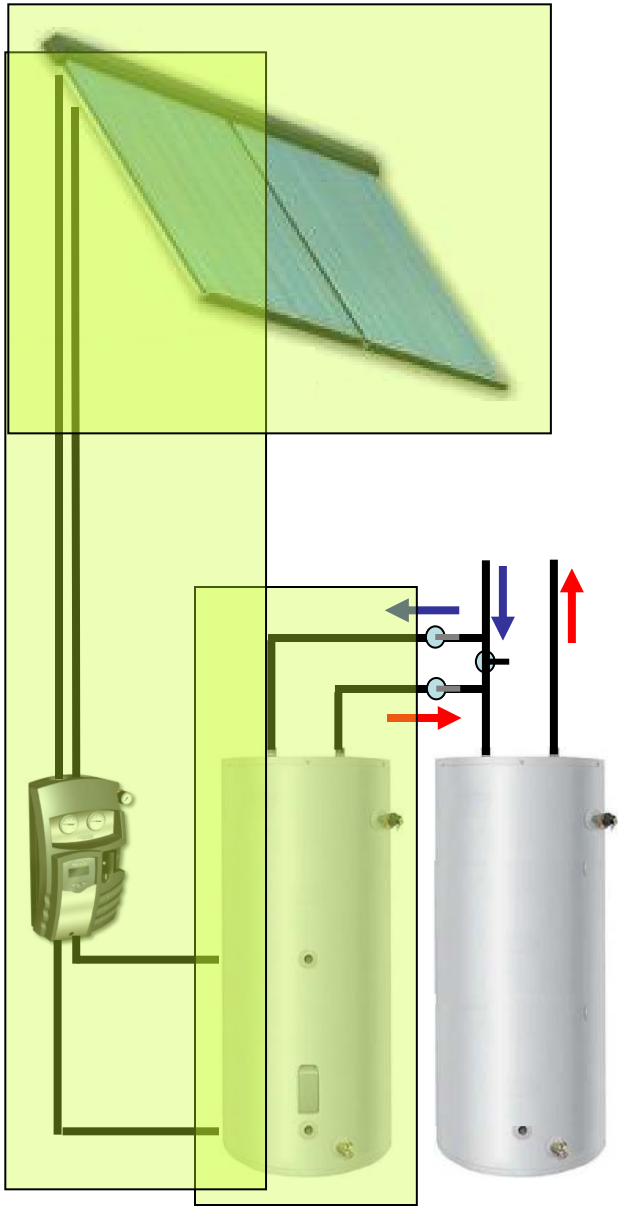
Solar Air Heating - Economics

- ecoENERGY Renewable Heat:
  - Fed: $35/m^2
  - Prov: $35/m^2
- Glazed:
  - $1.38/kWh/yr
  - 5-10yr simple payback
- Unglazed:
  - $0.18/kWh/yr
  - 1-2yr simple payback

Example: *Allan's Tool Shed*

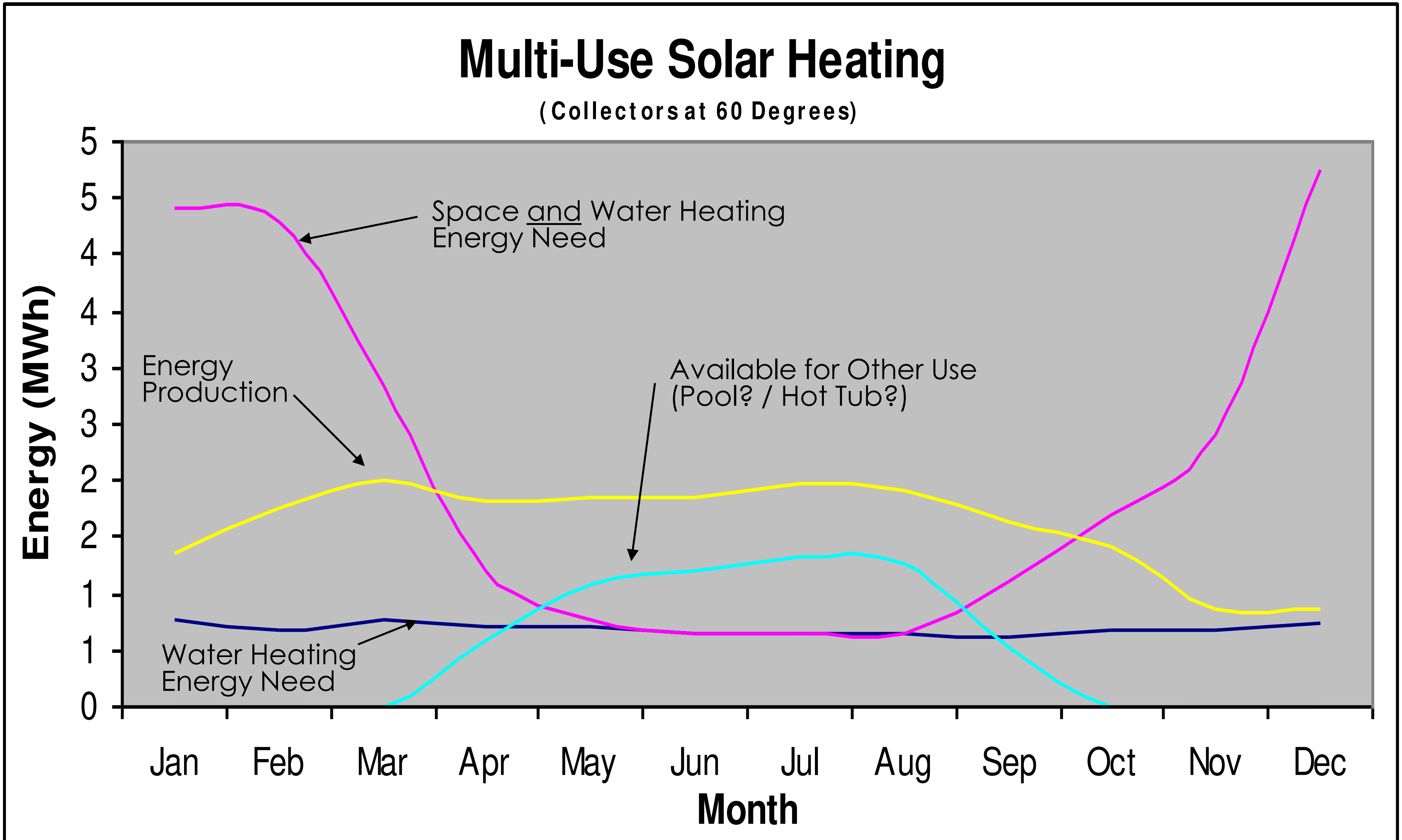
- Homemade solar wall
- 12' x 30'
- 33% to 50% heat

Solar Water Heating



- Pre-heat system
- Proven technology
- Different from Solar Electric - turns sunlight into heated water
- The most cost-effective solar energy system
- Solar Fraction

Can I Heat My Home?



Solar Water Heating - Economics

- ecoENERGY Renewable Heat:
  - Fed: $275/m²
  - Prov: $275/m²
- EKC / ERIP (existing electric HW):
  - $240/m²
- $1.40 /kWh/yr
  - 5-10 yr simple payback

Solar Water Heating - Example

- $15,000 - $6,720 = $8,280
- 6,150 kWh/yr = $800 / yr
- 10 year simple payback

Geothermal

- One unit for heating & cooling
  - can heat water economically
  - forced air, radiant or both
  - uses electricity
- Ground source:
  - open loop: ground or surface water source
  - closed loop: vertical or horizontal
- COP: 3.2+ (delivers more than three times the energy used)
- Start around $15K….
- Upgrade envelope first!

Geothermal - Incentives

- ecoENERGY Retrofit Incentive for Buildings
  - $10/GJ, ≤ 25%, ≤ $50K (~ $110/ton)
- OPA / EKC / ERIP
  - $250/ton, COP ≥ 3.5

Electricity from the Sun

Photovoltaic – PV:

- Very long life
- Virtually no servicing
- On or Off-Grid applications
- Peak production matches peak grid demand
- Ontario: microFIT
  - pays 80.2¢ / kWh

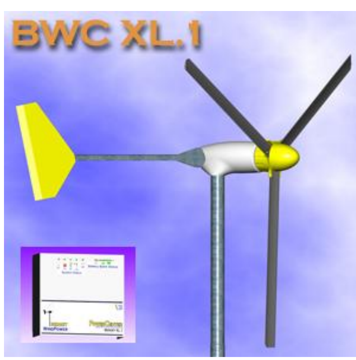
Grid-Tied microFIT - Economics

- microFIT 10kW Grid Tied Dual-Axis Tracker :
  - Purchase: ~$100K
  - Annual Generation: ~19+ MWh
  - Annual Revenue: ~$15.2K+

- Business Case:
  - Borrow: $100K
  - Cost of Borrowing: ~$5K
  - Overhead: ~$0.5K
  - Depreciation / Paydown: ~$9.7K (10 ½ years)
  - Residual Life (after microFIT): ~20yrs

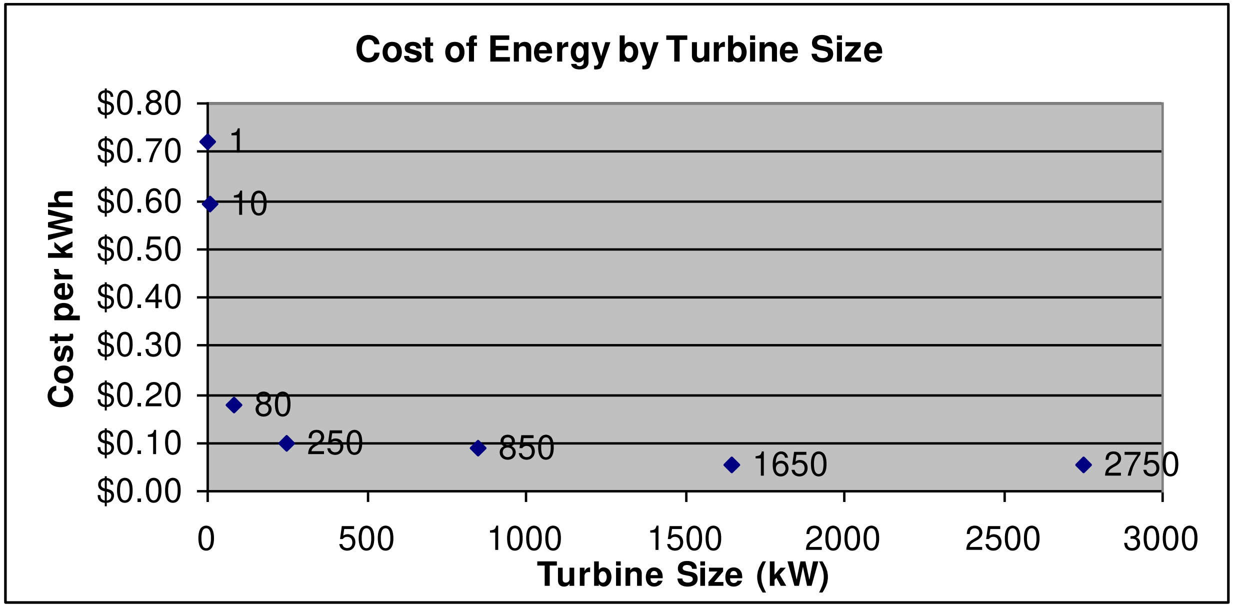
Small Wind Turbines

- Off-Grid: good complement to PV
  - Typically 1kW to 10 kW
- Primary factor: wind resource
- Larger = better economies
- microFIT:13.5¢ / kWh



Wind: Economics of Size

Q&A



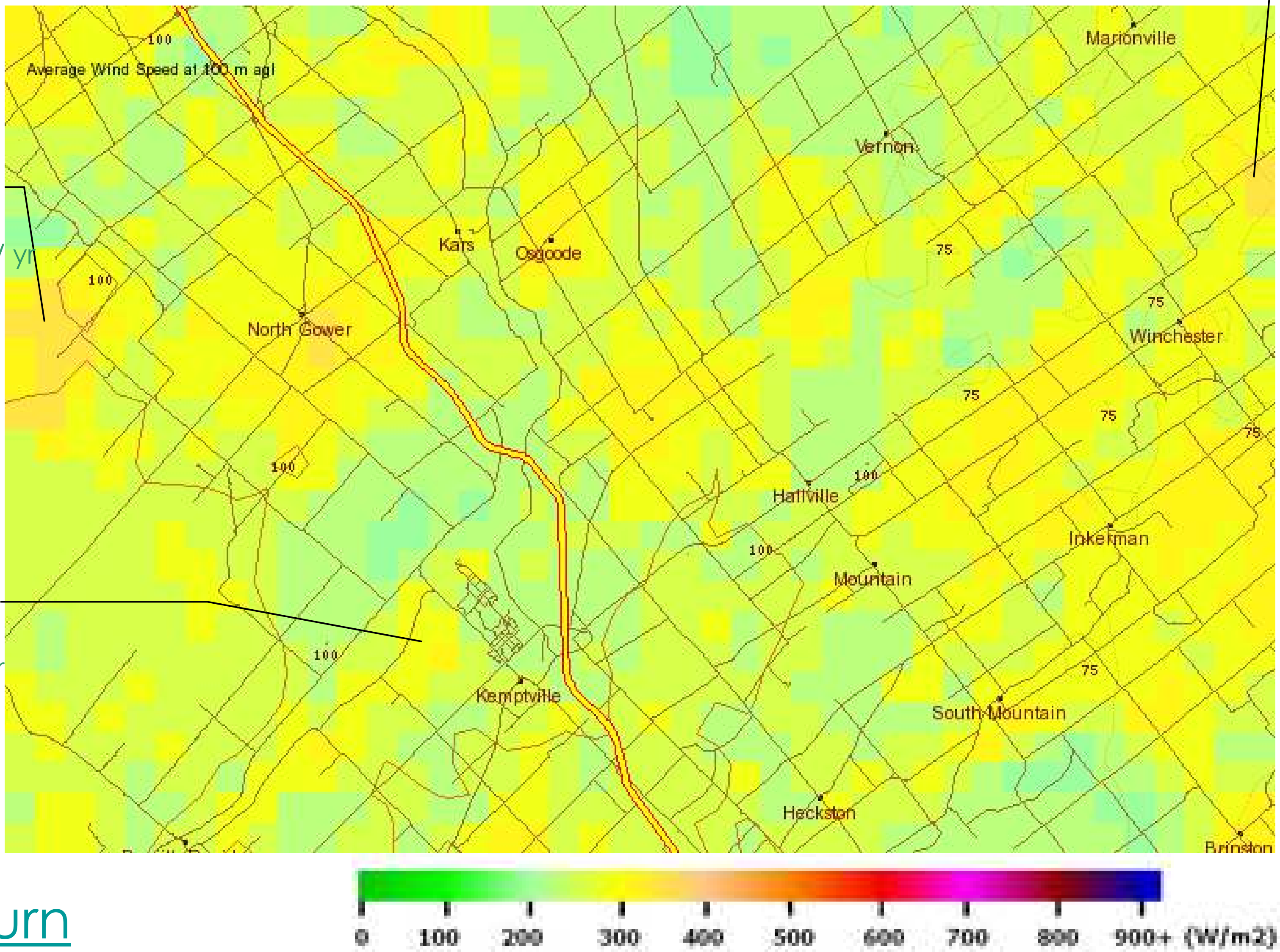
Size	kW	1	10	80	250	850	1650	2750
Height	m	18	30	30	50	50	80	100
Cost	$	$8K	$70K	$250K	$750K	$3M	$5M	$6.5M
Energy Output	MWh / Yr	1	8	79	378	1330	3771	4690
Lifetime	Yrs	10	15	18	20	25	25	25
Cost/kWh	$/kWh	72¢	59¢	18¢	7¢	10¢	5¢	6¢
Simple Payback	Yrs	64	68	28	12	18	12	12

Case Study: Rural Wind

#3
8,790 kWh/yr
$1,055/yr

#1
10,700 kWh / yr
$1,284 / yr

#2
7,770 kWh/yr
$932/yr



[Return](#)

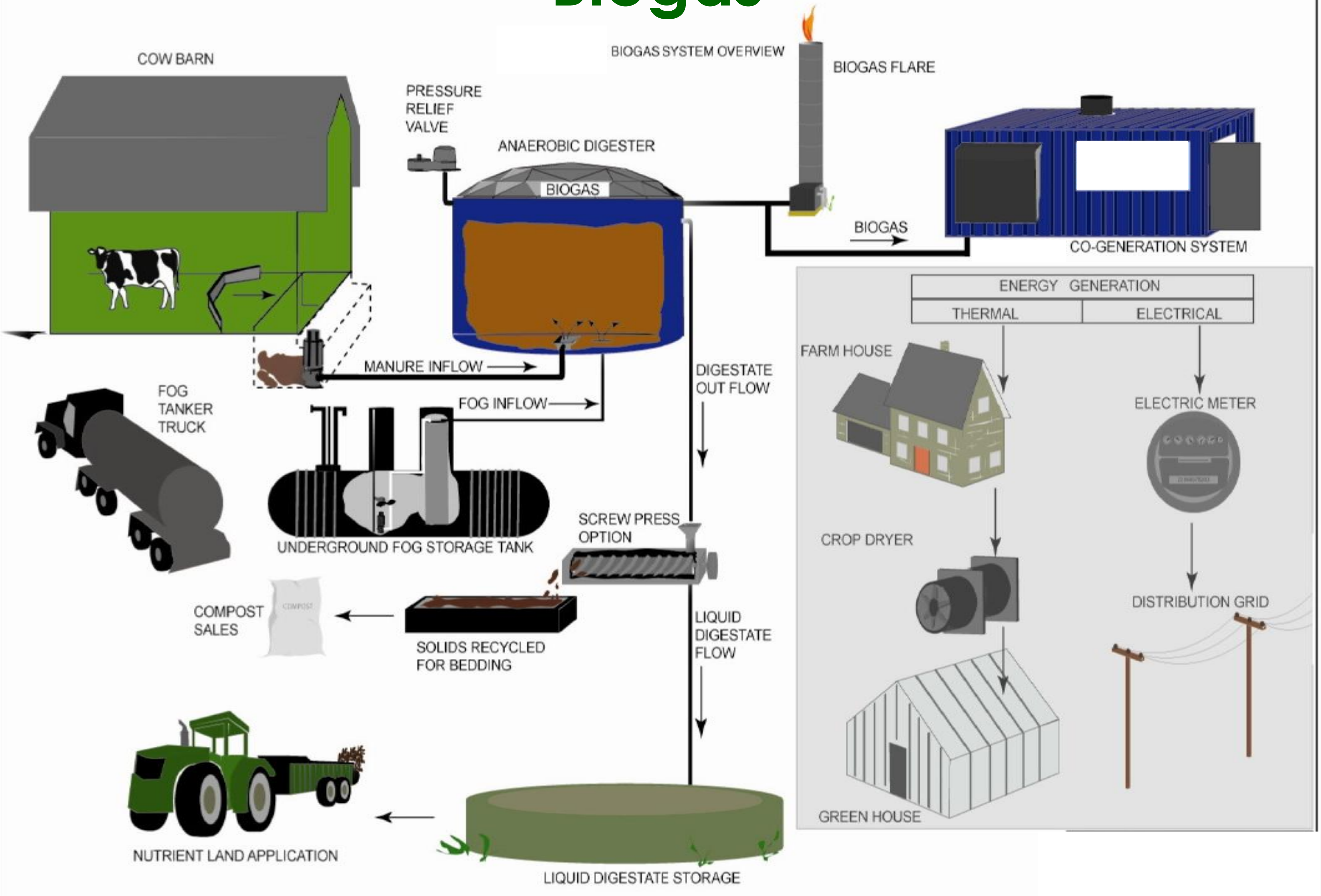
Biomass

- Forest & Agriculture sources
- Agriculture:
  - Energy crops (switchgrass, reed canarygrass)
  - Crop residues (straw & stalks)
  - Better revenue from marginal lands vs beef
- 2012: OPG sourcing 2M tonnes/yr
  - Farmgate value: $200,000,000.00/yr ($100/tonne)

Biogas

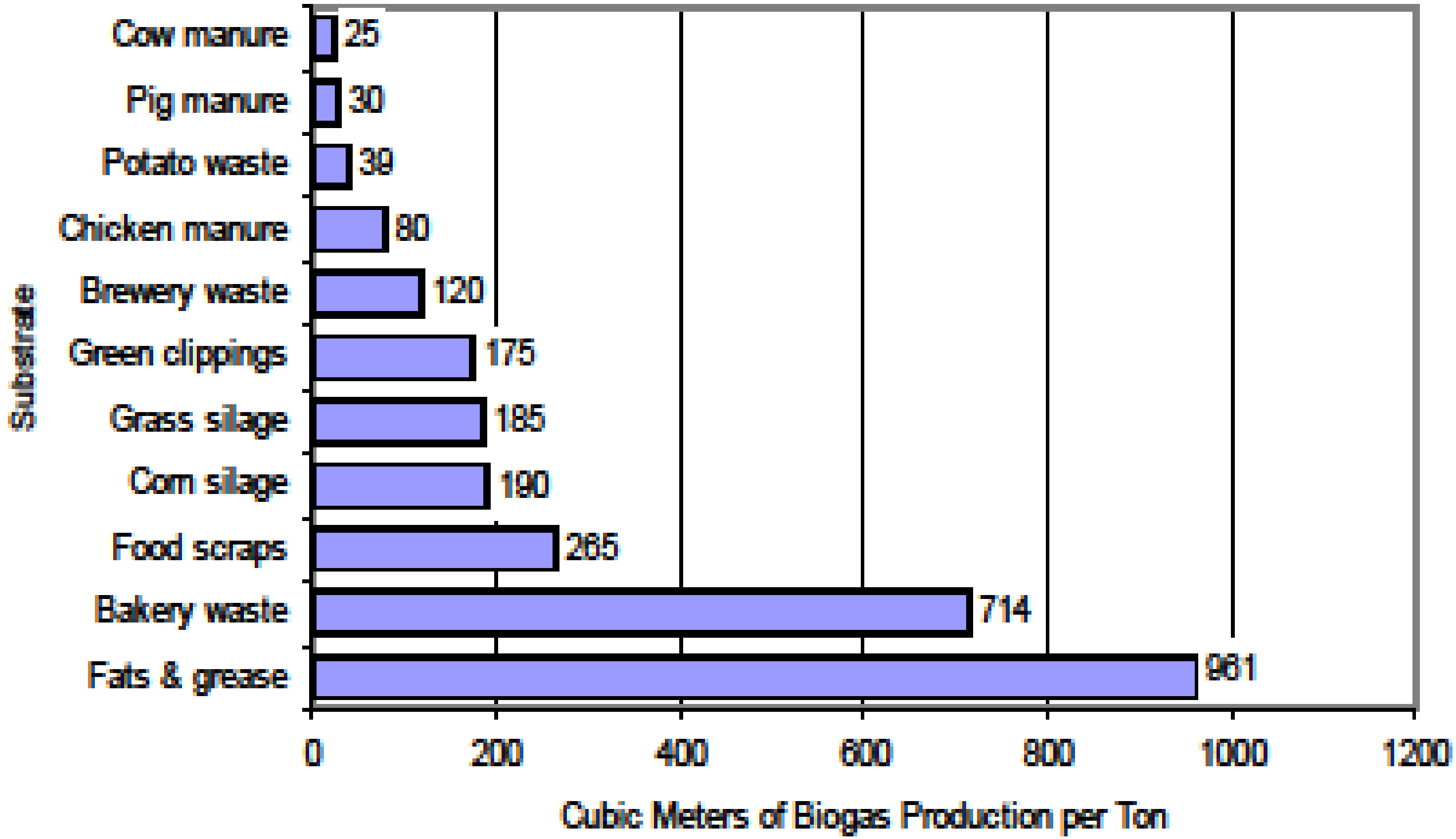
- Anerobic biodigester
- 100kW – 500kW, or larger
- 100 - 400 milkers, or larger
- CHP: Electricity & Heat output!
- Useful, safe, clean, odourless nutrient
- CO_2 20:1 less GHG than methane
- Factors:
  - Sources of additional feedstock (FOG)
  - Electric service capacity

Biogas


BIOGAS SYSTEM OVERVIEW
COW BARN
PRESSURE RELIEF VALVE
ANAEROBIC DIGESTER
BIOGAS
BIOGAS FLARE
BIOGAS
CO-GENERATION SYSTEM
MANURE INFLOW
FOG INFLOW
FOG TANKER TRUCK
UNDERGROUND FOG STORAGE TANK
DIGESTATE OUT FLOW
SCREW PRESS OPTION
COMPOST SALES
SOLIDS RECYCLED FOR BEDDING
LIQUID DIGESTATE FLOW
NUTRIENT LAND APPLICATION
LIQUID DIGESTATE STORAGE
ENERGY GENERATION
THERMAL
ELECTRICAL
FARM HOUSE
ELECTRIC METER
CROP DRYER
DISTRIBUTION GRID
GREEN HOUSE

Biogas

Figure 3 – Biogas Generation Potential of Substrates



Source: Data derived from www.biogas-energy.com, © 2007 Biogas Energy, Inc., translated from: Basisdaten Biogas Deutschland, Marz 2005,: Fachagentur Nachwachsende Rohstoffe e.V.

250 kW Co-Generator (inside)

Biogas - Economics

- OMAFRA / BSFAP
  - Feasibility study ≤ $35K
  - Construction & Implementation
    - Each ≤ $400K, ≤ 40%
- 100kW, 100x milkers:
  - $750K - $300K = $400K installed
  - $133K / yr (@16¢/kWh)
- 500kW, 300x milkers:
  - $2M - $400K = $1.6M installed
  - $667K / yr (@16¢/kWh)
- Significant Operating Costs
- ~7 year payback / 20 year contract

Summary

The Business Case

Hard Metrics:	$/kWh
Assumptions:	%/yr
Values:	Natural
Limitations:	Budget
Human Dimension:	Aesthetics
Bottom Line:	No Formula

Your Energy Perspective

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• Hot Water	• Solar Water	
	• Geothermal	
• Space Heat	• Biomass	• Biomass
	• Biogas	• Biogas
• Process Heat		
	• Wind	• Wind
• Electricity	• Solar Electric	• Solar Electric

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