Wisconsin Distributed Generation Initiatives

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Renewable Energy Program

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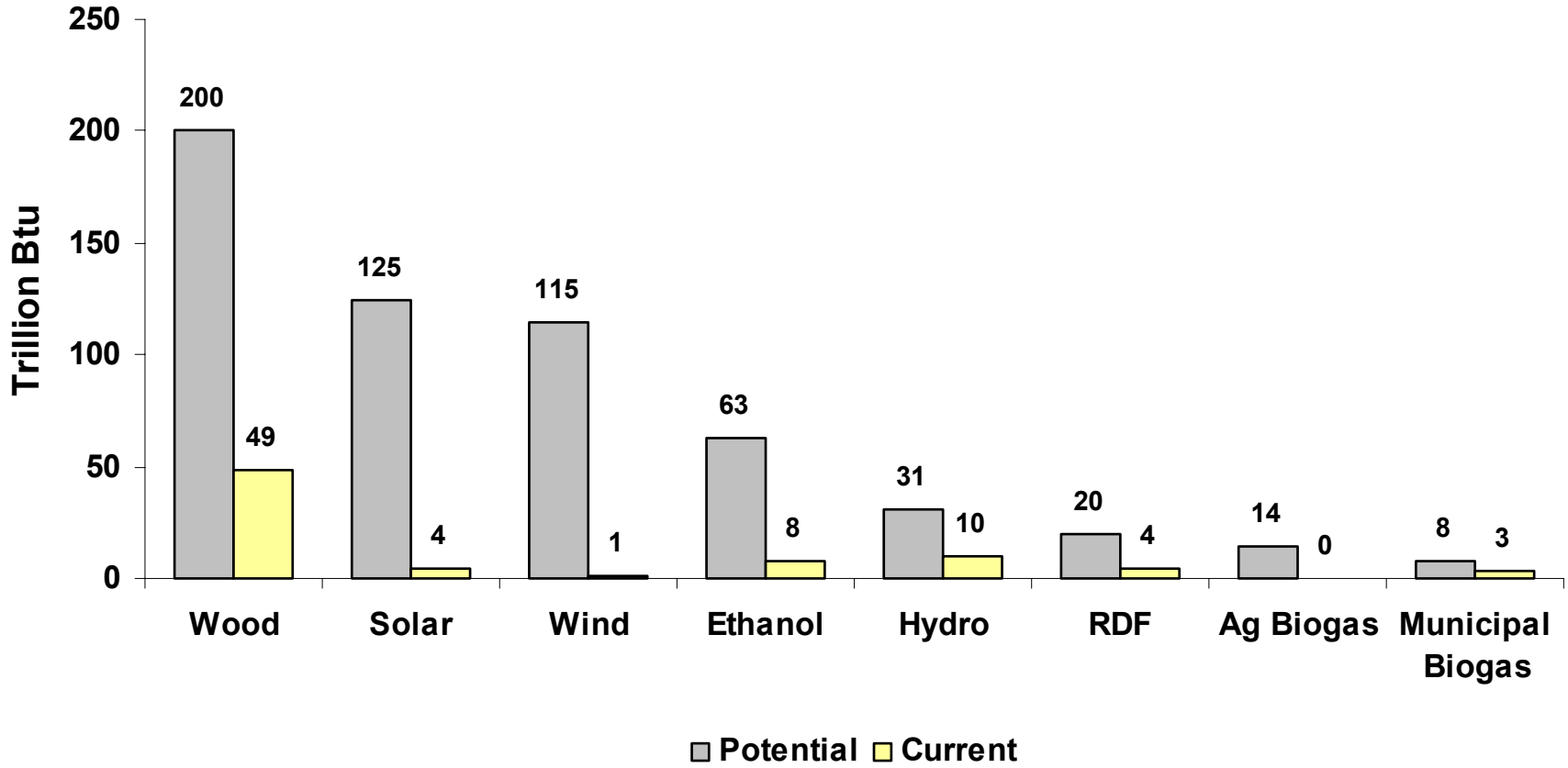
Wisconsin Renewable Energy Potential and Current Use



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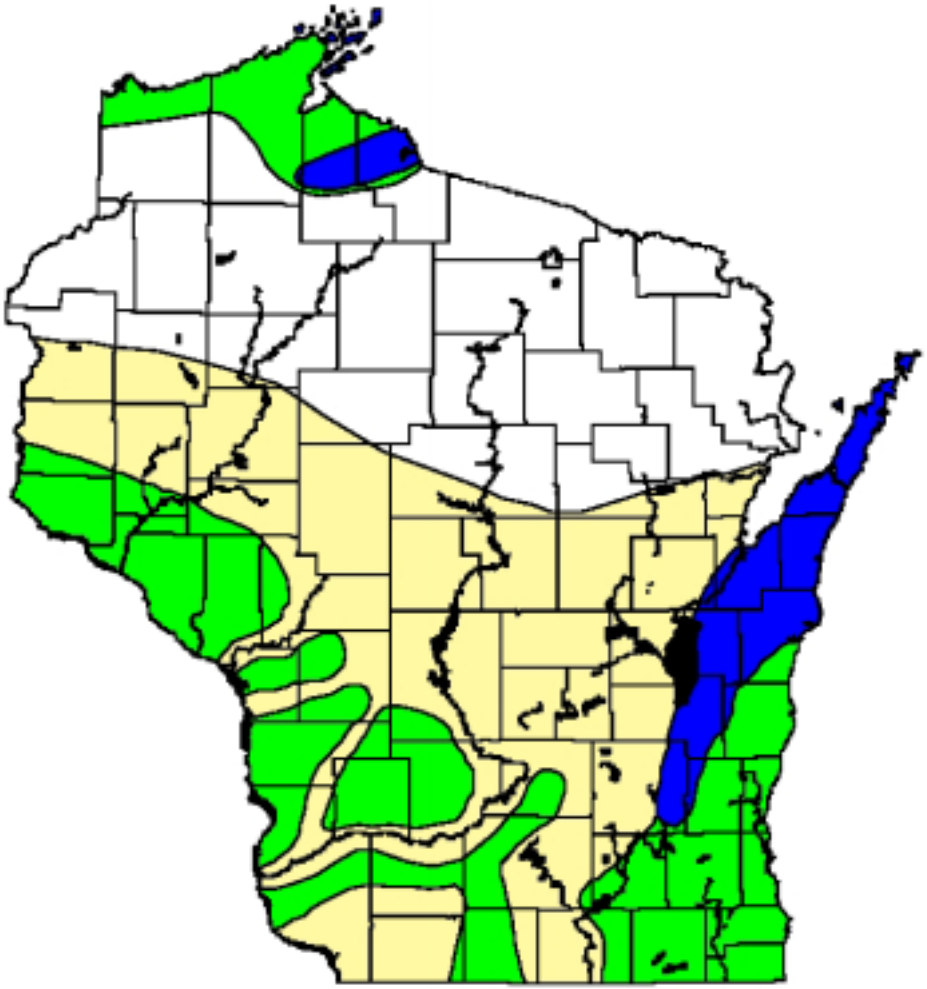
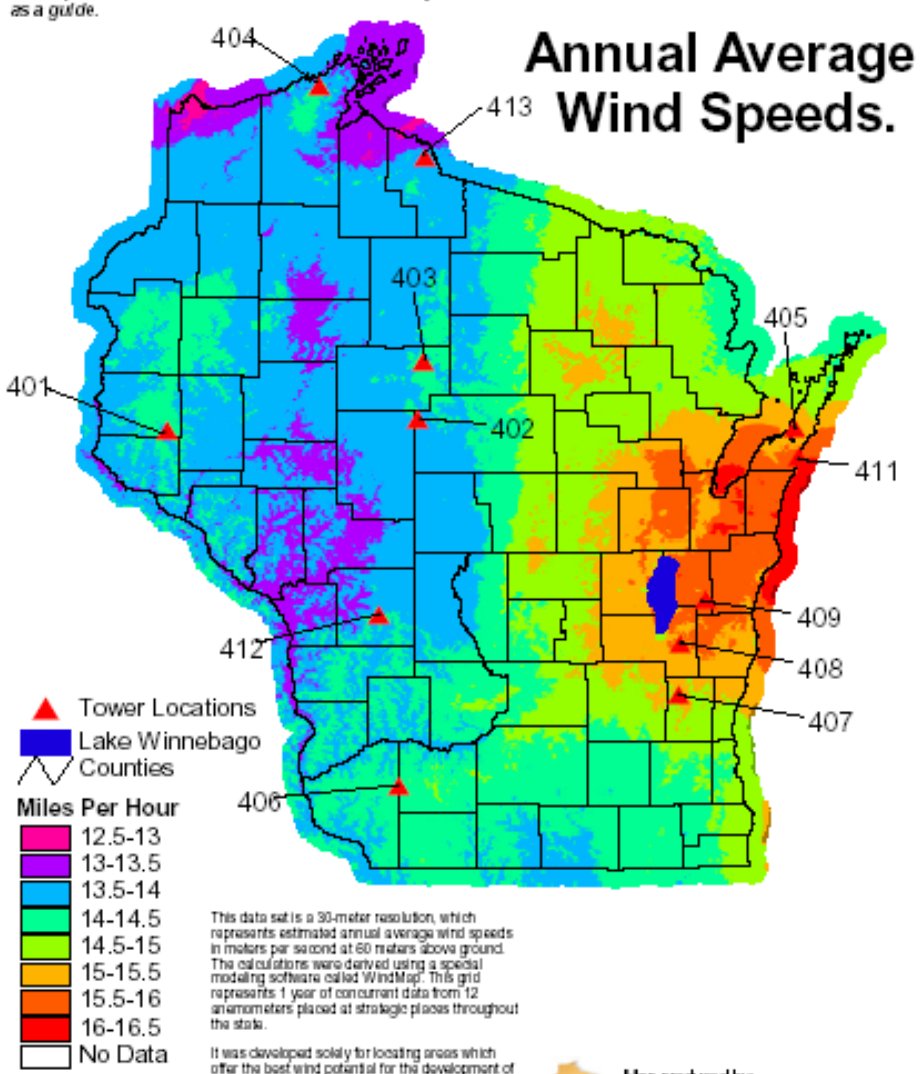
Wind Resource



This map displays areas where annual average wind speeds at some sites (extrapolated to a height of 110 feet) measure:

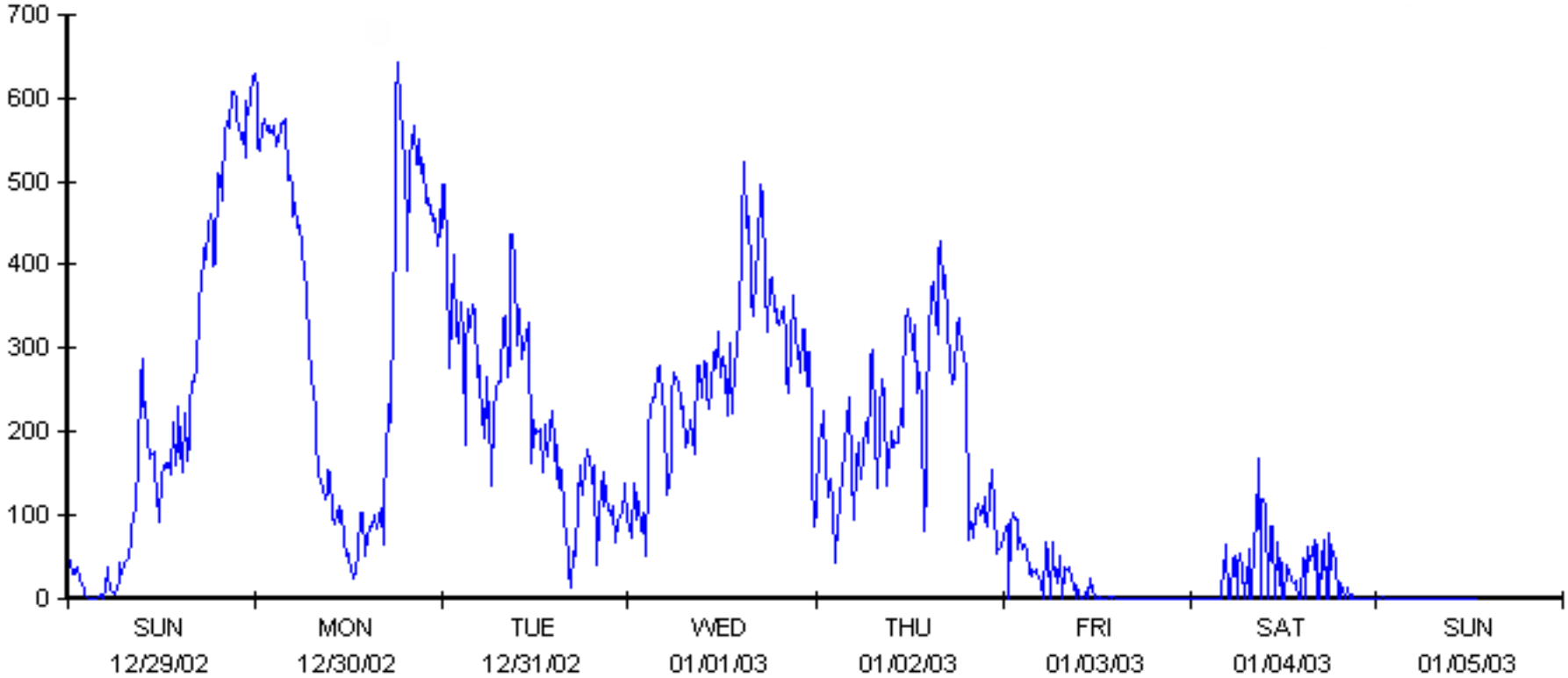
- Best - 13 to 14 mph
- Good - 12 to13 mph
- Fair - 11 to 12 mph
- Poor - Less than 11 mph

Warning! Field observations are still necessary to help determine if a particular site is suitable for the development of wind farms. This is to be used only as a guide.



Small Wind Turbines

Large Wind Turbines



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Community Based Wind

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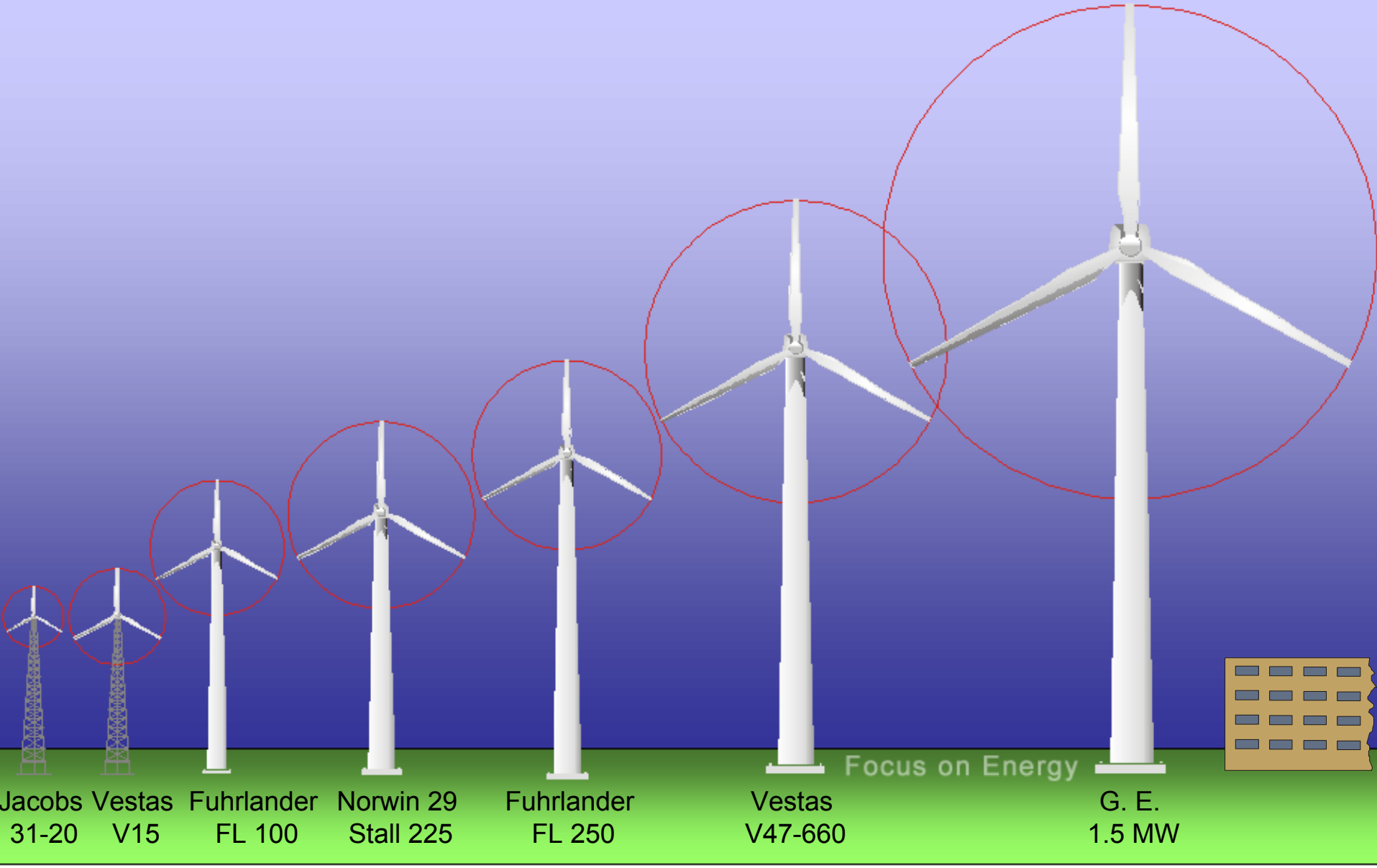

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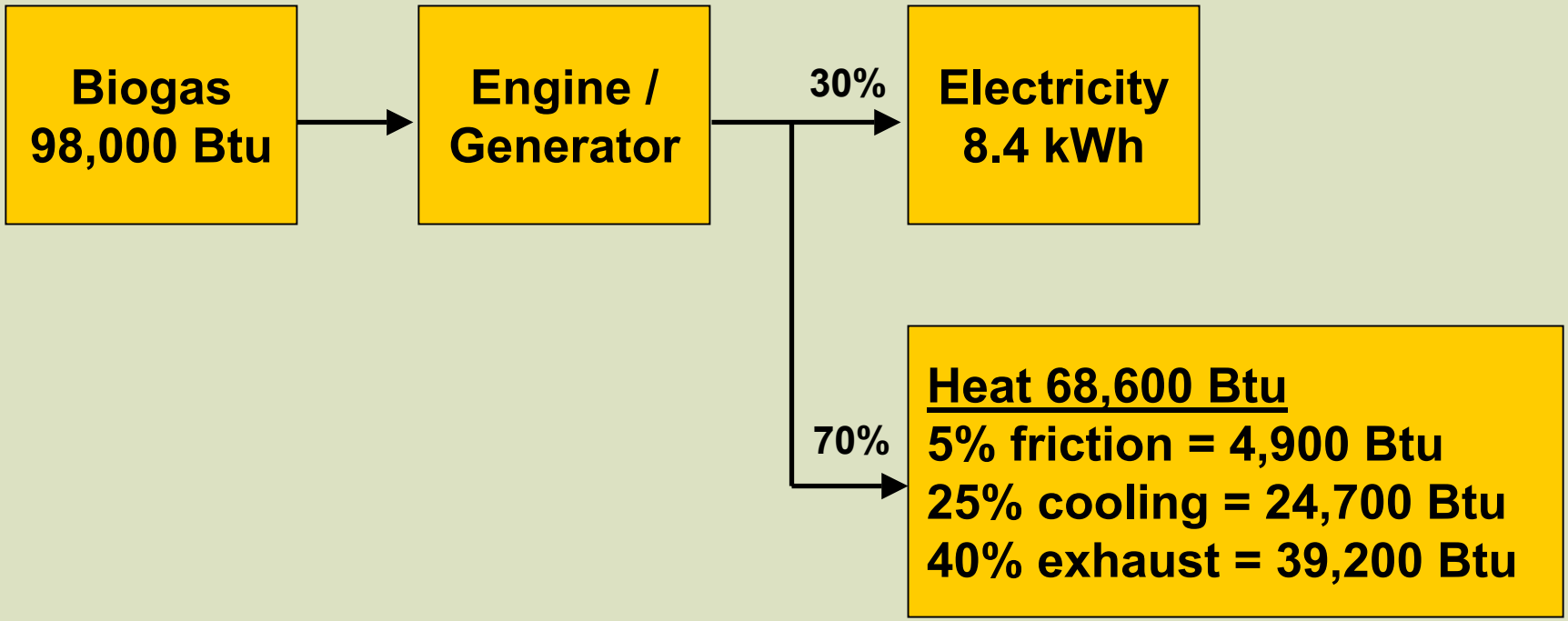
Manure Digester

Landfill Gas

Methane from Municipal Wastewater

Combined Heat and Power

For example: daily energy production per cow



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Relative Scale of Renewable Generators

Approx. Cost	Type of Renewable Electric Generator	Homes Powered
$1,500,000	1.5 MW Wind Turbine	325
$750,000	660 kW Wind Turbine	145
$46,000	20 kW Wind Turbine	3.5
$9,000	1 kW Solar Electric (PV)	0.15
$550,000	Manure Digester (600 cows)	130
	Landfill-Methane Genset	1,560
	Wood Biomass Power Plant	19,390

Implementation Issues for Interconnection

What is Interconnection?

The physical connection of a distributed generation facility to the distribution system so that parallel operation can occur.

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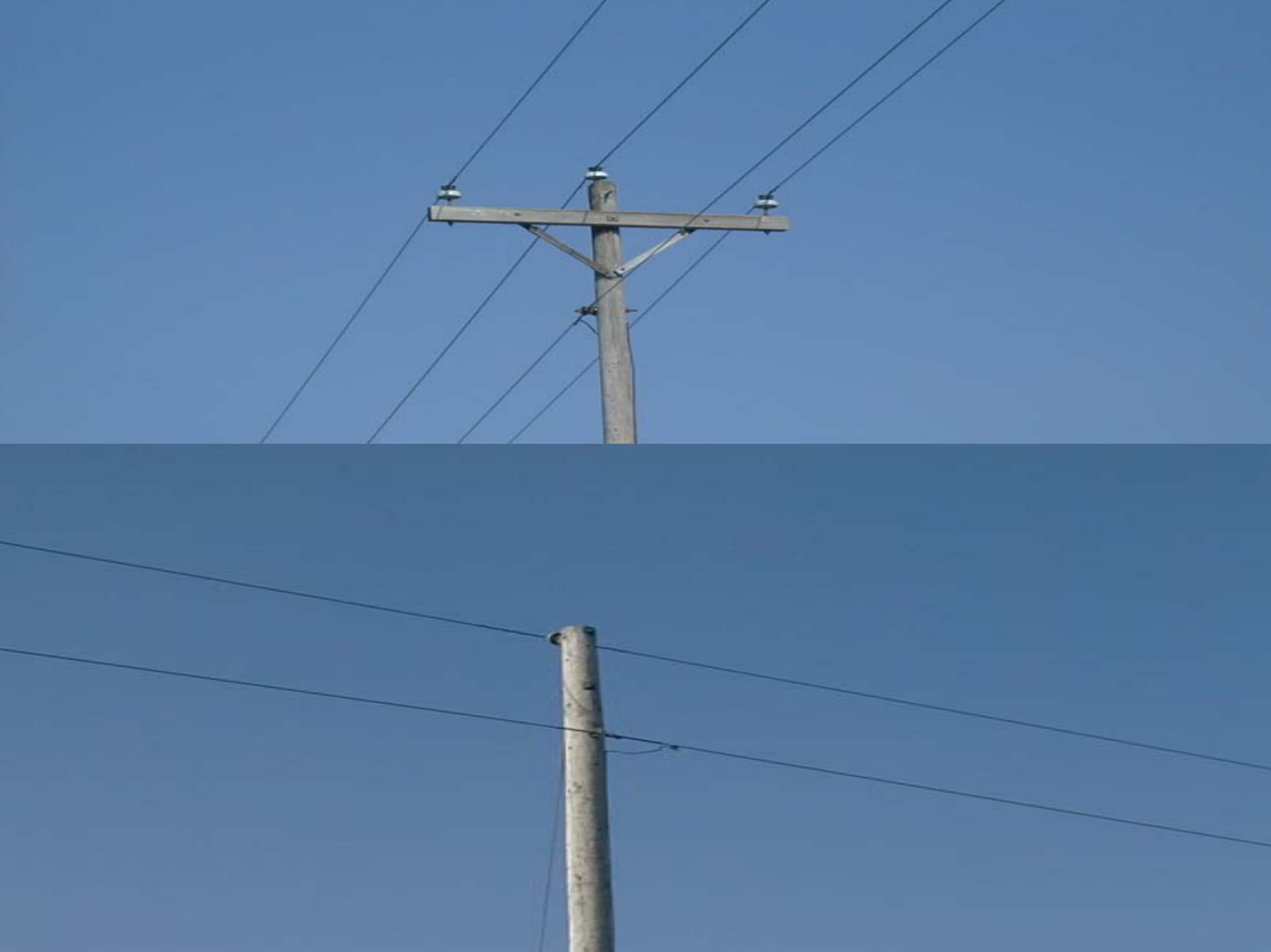

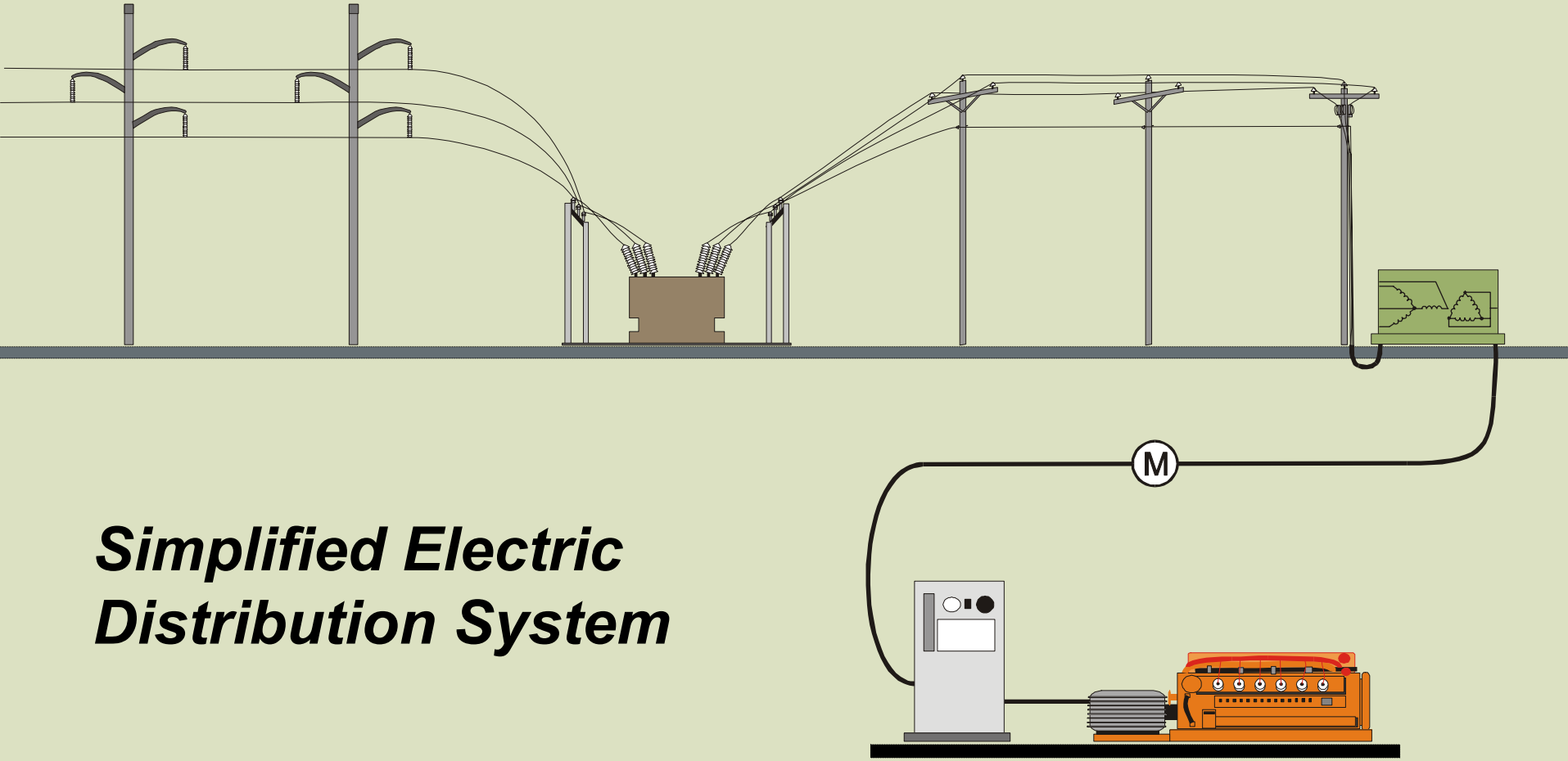

Simplified Electric Distribution System

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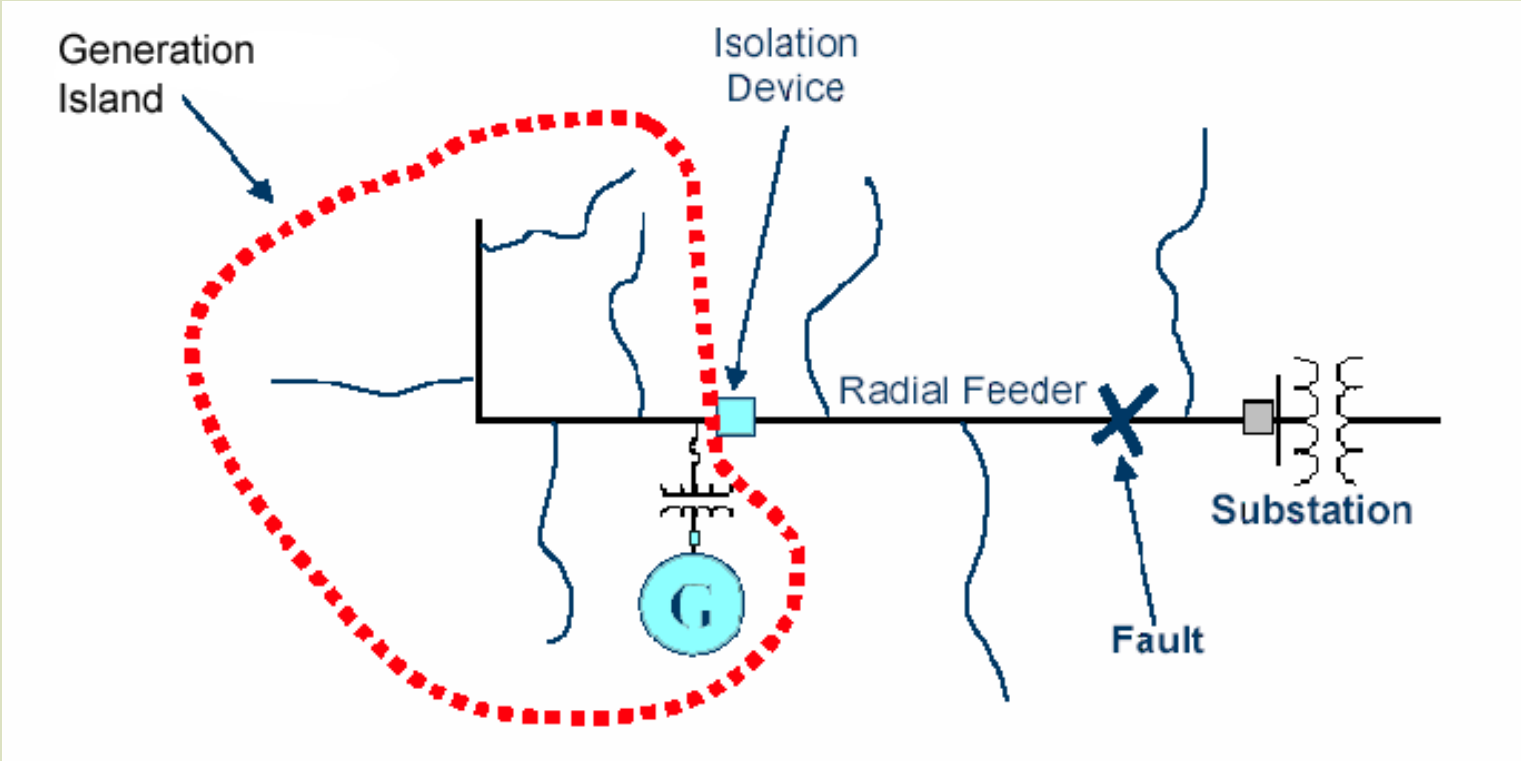
Why Interconnection Practices Are Important

- **Power Quality**
- **Safety e.g., islanding prevention**
- **Coordination with Distribution System**



Current Status of Distributed Generation Interconnection Rules in Wisconsin

Outdated Interconnection Standards

"Requirements for Utility Rules for Interconnection of Small Customer-Owned Generation Facilities with the Utility System",

Wis. Admin. Code § 113.0207,

… has been in effect since October 1, 1982 and does not address current needs.

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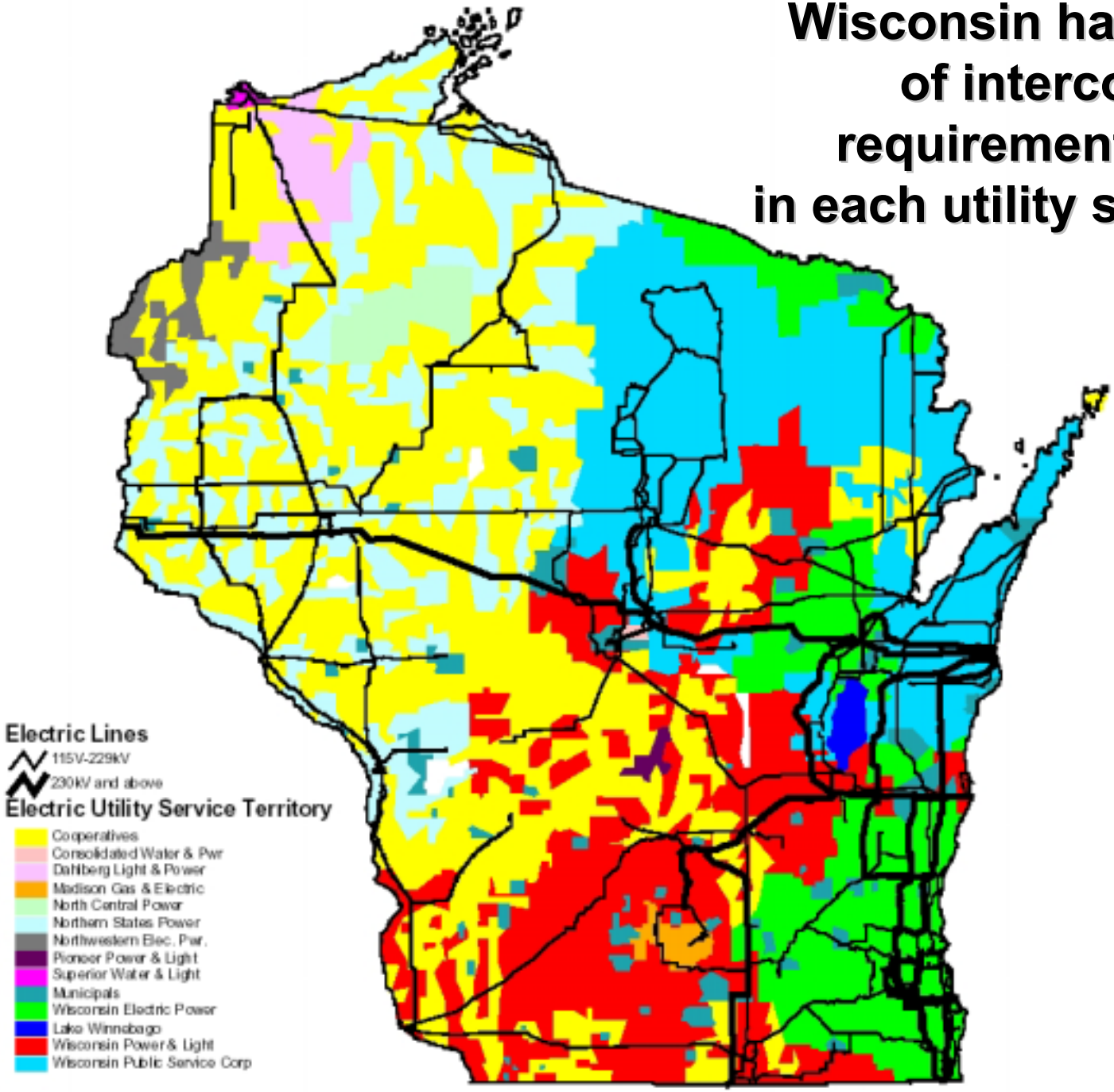
Wisconsin has a patchwork of interconnection requirements that differ in each utility service territory.



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Legislation 2001

§ 196.496 Distributed Generation Facilities

- Capacity of no more than 15 MW
- Located at a point where electricity will be used OR at a location that will support the electric distribution grid
- Develop rules establishing standards for interconnection
- Standards shall be uniform and promote distributed generation
- Standards shall address engineering, electric reliability safety concerns, and methods for determining the charges to interconnect
- Formation of advisory committee

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Distributed Generation Size Categories - In Wisconsin

- **Category 1: 20 kW or less**
- **Category 2: 20 kW+ to 200 kW**
- **Category 3: 200 kW+ to 1 MW**
- **Category 4: 1 MW+ to 15 MW**

Designated Point of Contact

A contact at each public utility where interested parties can obtain a copy of the interconnection guidelines and the appropriate standard Public Service Commission application and interconnection agreement forms.

Definitions in the Interconnection Process

- **Application Review – to determine if an engineering review is needed**
- **Engineering Review – to determine if an facility is correctly designed for proper operation and safety**
- **Distribution System Study – to determine if distribution system upgrades are needed to accommodate the facility**

Application Process

STEP 1:

Public utility provides within 5 working days of inquiry.

- **standard application form**
- **copy of interconnection guideline**

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Application Process

STEP 2:

Applicant completes and submits standard application form to public utility with application review fee.

Category	Size	Review Fee
1	20 kW or less	none
2	20 kW+ to 200 kW	$250
3	200 kW+ to 1 MW	$500
4	1 MW+ to 15 MW	$1,000

Application Process

STEP 3:

Public utility gives notice whether the application is completed properly within 10 working days.

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Application Process

STEP 4:

Within 10 working days of receiving a complete application:

- **public utility completes application review**
- **notifies customer if an engineering review is needed.**

Application Process

STEP 4:

If engineering review is needed, then:

- **cost estimate is given for engineering review**
- **cost estimate is valid for one year**

Category	Size	Engineering Review Fee
1	20 kW or less	none
2	20 kW+ to 200 kW	$500 max.
3	200 kW+ to 1 MW	cost based
4	1 MW+ to 15 MW	cost based

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Application Process

STEP 5:

If engineering review is needed, then:

- **customer gives public utility OK to proceed with engineering review**
- **customer pays engineering review fee**

Category	Size	Time for Engineering Review
1	20 kW or less	10 working days
2	20 kW+ to 200 kW	15 working days
3	200 kW+ to 1 MW	20 working days
4	1 MW+ to 15 MW	40 working days

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Application Process

STEP 6:

<u>If engineering review indicates that a distribution study is needed, then:</u>

- **public utility will provide a written cost estimate**
- **cost estimate is valid for one year**
- **customer notifies public utility to proceed with distribution study**
- **customer pays distribution study fee**

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Application Process

STEP 7:

If distribution study is agreed upon, then:
public utility completes distribution system study

Category	Size	Time for Distribution System Study
1	20 kW or less	10 working days
2	20 kW+ to 200 kW	15 working days
3	200 kW+ to 1 MW	20 working days
4	1 MW+ to 15 MW	60 working days

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Application Process

STEP 8:

<u>If a distribution study is performed, then:</u>

- **public utility notifies customer of findings**
- **customer is provided with a cost estimate for any distribution system upgrade costs**

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Application Process

STEP 9:

<u>If a distribution system upgrade is needed, then:</u>

- **customer agrees to distribution system upgrade and pays costs**
- **mutually agreed completion time for upgrade**
- **customer and public utility sign a standard interconnection agreement**

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Application Process

STEP 10:

When generation facility construction is completed:

- **customer notifies public utility**
- **public utility has 10 to 20 working days to:**
  - **witness initial system testing**
  - **verify anti-islanding test**
  - **verify protective equipment settings**
  - **or waive its right, in writing, to witness or verify testing**

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Application Process

STEP 11:

- **within 10 working days public utility reviews results of any testing and grants permission to interconnect or requests corrective actions**
- **public utility provides written approval to operate generation facility**

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Standard Interconnection Agreement

PSC Form 6030 Insurance Requirements:

Category	Size	Minimum Liability Insurance Coverage
1	20 kW or less	$300,000
2	20 kW+ to 200 kW	$1,000,000
3	200 kW+ to 1 MW	$2,000,000
4	1 MW+ to 15 MW	Negotiated

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Technical Requirements

- Interconnection disconnect switch
- Proper grounding practices
- Operating limits: islanding & power quality
- Minimum protection requirements
- Telemetry (where required)
- One-line schematic diagram
- Site plan

Rules will apply to distribution system interconnections operating at 50 kV or less.

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Interconnection design requirements will follow a national standard:

IEEE P1547

Standard for Distributed Resources Interconnected with Electric Power Systems

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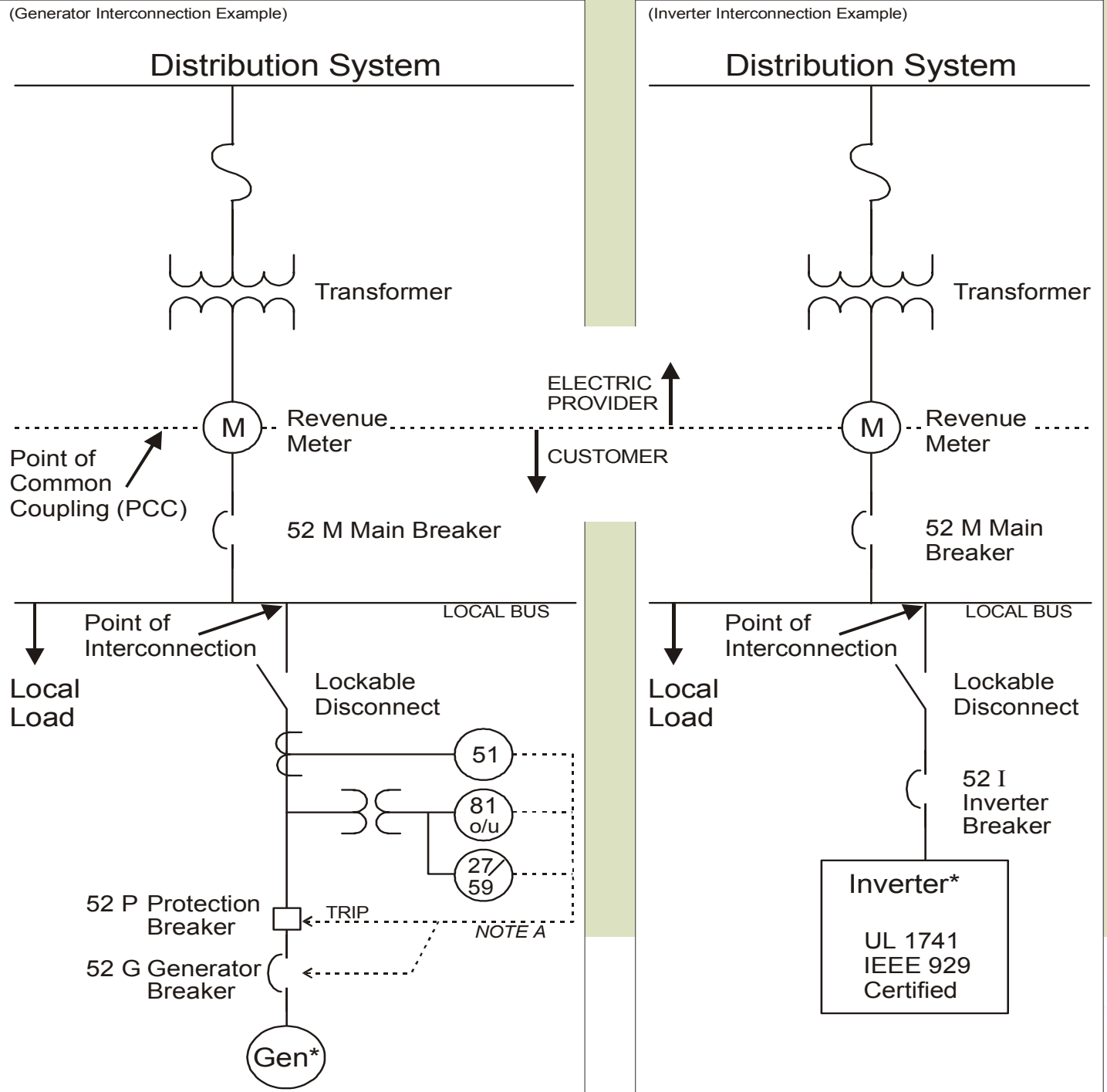
Example One-line Schematic Diagram

Category 1 (20 kW or less)



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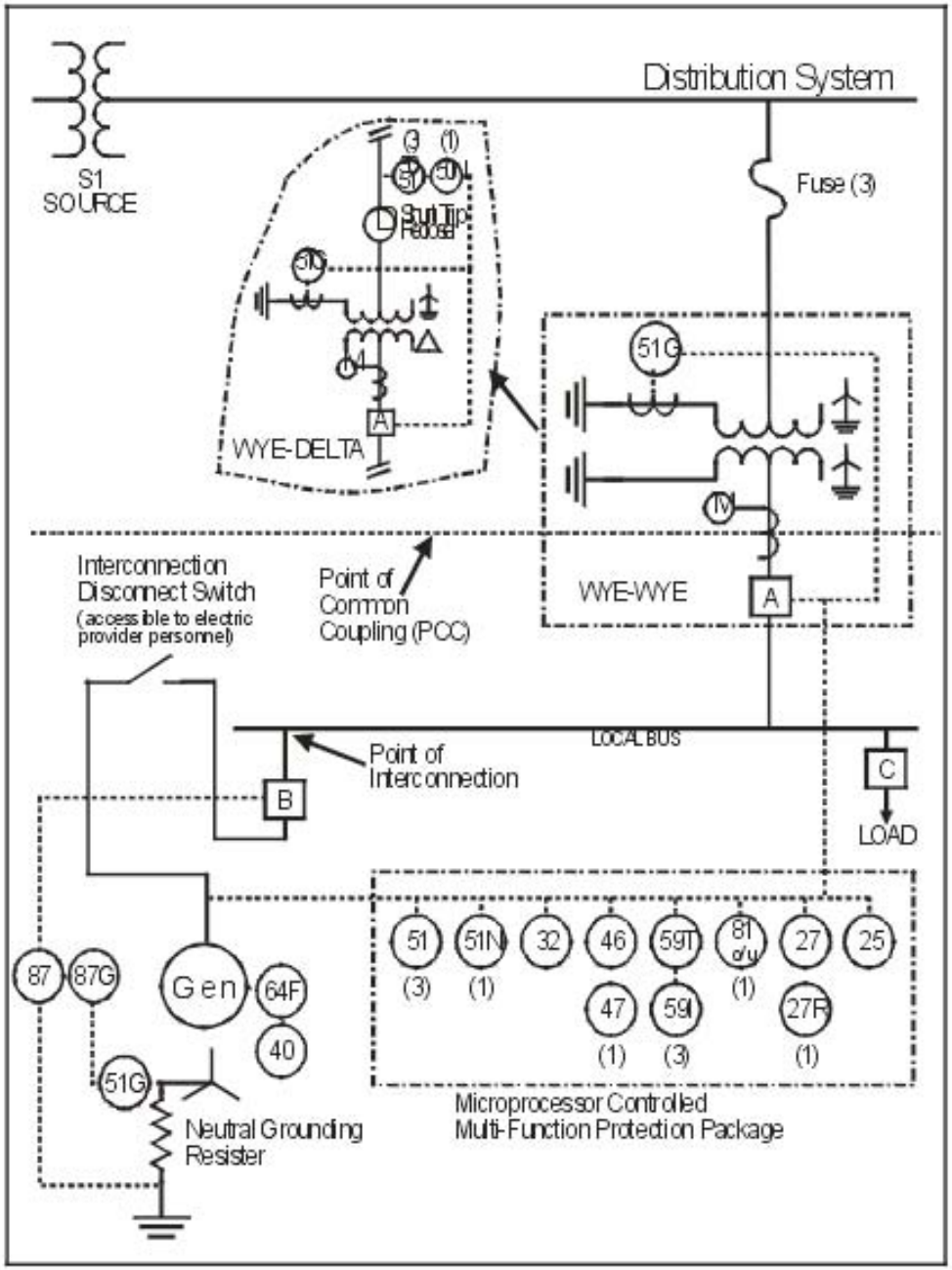

Example One-line Schematic Diagram

Categories 2 - 4

(20 kW+ to 15 MW)

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Rules for Interconnecting Distributed Generation Facilities

Approximate Timeline

May 2003	PSC order adopting final rules
May – May 2003	Review by Legislative committee (30 days)
June 2003	Rules filed
July 2003	Publication in Wis. Admin. Register
July 30, 2003	New rules become effective

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Focus on Energy Program Goals Wisconsin Act 9 (1999)

- **Increase customer use of renewable energy**
- **Rural economic development**
- **Electric system reliability**
- **Research technology transfers of renewable energy**
- **Educate consumers & businesses about renewable energy**
- **Provide environmental protection**

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Feasibility Study Grants

Eligible Activities

- **Feasibility studies**
- **Economic assessments**
- **System design**
- **Commissioning**

Maximum Award: $20,000

Cost Share: 50%

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Business and Marketing Grants

Eligible Activities

- **Business plans**
- **Market assessments**
- **Marketing campaigns**
- **Business or staff certification**
- **Web page, brochures, etc.**

Maximum Award: $20,000

Cost Share: 50%

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Photovoltaic Cash-Back Reward

- **Cash-back reward based on energy produced in a year multiplied by $2/kWh (for one year):**

  1 kW system produces about 1,200 kWh/year

- **Maximum Reward: $50,000 or 50% of installed cost, whichever is less**

Examples:

- **2 kW system at 14% capacity factor generates about 2,450 kWh/year Approx. Reward = $5,200**
- **10 kW system at 14% capacity factor generates 12,260 kWh/year Approx. Reward = $24,530**

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Biomass/Biogas Cash-Back Reward

- **Bioenergy reward based on energy produced in a year:**
  Award = 2100 x (kW x CF)$^{0.63}$
- **Maximum Reward: $50,000 or 50% of installed cost, whichever is less**

Examples - engine gensets operated on biogas:

- **100 kW system at 90% capacity factor generates 1,482,192 kWh/year Approx. Reward = $35,760**
- **375 kW system at 90% capacity factor generates 2,956,500 kWh/year Approx. Reward = $82,230**
  Actual Reward = $50,000

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Small Wind Turbine Cash-Back Reward

- **Wind turbine reward based on the rated capacity of the turbine in kW; AND**
- **An estimate of the amount of electricity (in kWh's) that the turbine will produce in an average year.**
- **Maximum Reward: $50,000 or 50% of installed cost, whichever is less**

Examples:

- **Bergey Excel S - 10 kW will produce about 15,800 kWh/year Reward ($1.15/kWh x 15,800 kWh) = $18,170**
- **Jacobs 31-20 - 20 kW will produce about 31,500 kWh/year**

Reward ($0.50 x 31,500 kWh) = $15,768

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Large Wind Turbine Cash-Back Reward

- **Vestas V-15, 65 kW (110 ft tower) → 102,500 kWh/year**
  Reward ($0.35 x 102,500 kWh) = $35,875
- **Fuhrlander 100 kW → 175,000 kWh/year**
  Reward ($0.30 x 175,000 kWh) = $52,500 → $50,000
- **Fuhrlander 250 kW → 438,000 kWh/year**
  Reward ($0.25 x 438,000 kWh = $109,500 → $50,000
- **Vestas V47-660 → 1,387,584 kWh/year**
  Reward ($0.20 x 1,387,500 kWh) = $277,500 → $50,000
- **Vestas V52-850 → 1,787,000 kWh/year**
  Reward ($0.15 x 1,787,000 kWh) = $268,050 → $50,000
- **GE 65m-1.5 → 3,154,000 kWh/year**
  Reward ($0.10 x 3,154,000 kWh) = $315,400 → $50,000

Future Renewable Program Directions:

Commercial:

- Zero-net-energy buildings incorporating multiple renewable energy technologies

Agricultural:

- Community wind projects
- Agricultural waste added to manure in anaerobic digesters

Industrial:

- Biomass fired stoker boilers
- Biomass co-firing with fossil fuel for boilers
- Biomass gasification
- Utilize existing and future waste heat streams to generate electricity
- Energy crops / bio-refineries / value added products

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