

DECEMBER 4TH, 2017
IN YUMA, CO



DISTRIBUTED GENERATION
WORKSHOP: COLORADO

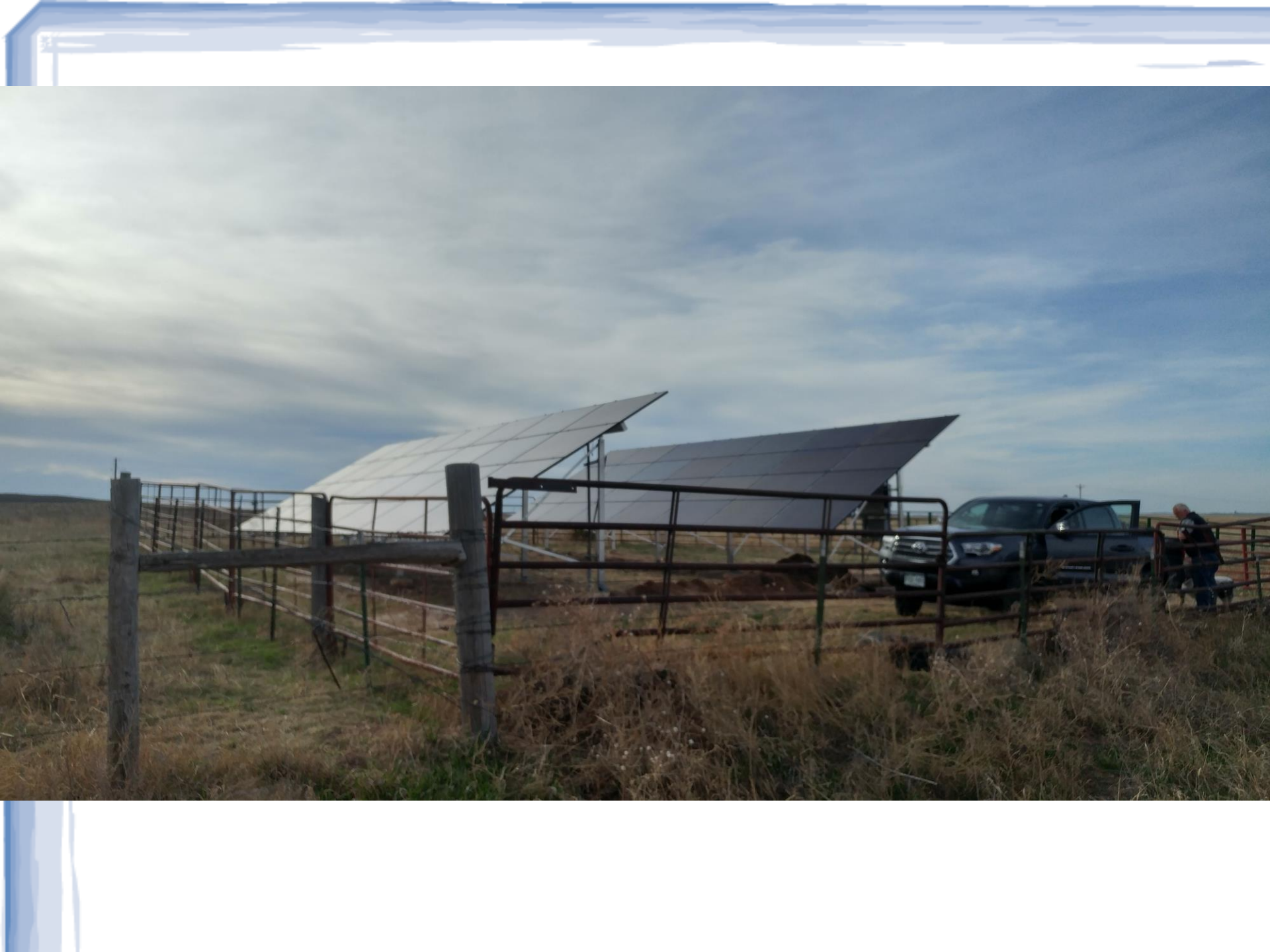
Fundamentals of DG: Building the Colorado Market

Don Parker, Golden Solar

Trevor Atkinson, Northern Power Systems

Patrick Kelly, Hoss Consulting Inc.

Dominick Morone, HOMER Energy





Getting a PV System

For Your Home or Business

Don Parker, Owner
Golden Solar





The Technical

Turns sunlight directly into electricity

Use the DC power directly or convert to AC

Well developed technology

No moving parts



11/19/2011



The Financial

Payback typically 8-12 years
Depends upon cost of electricity
ROI typically 7-12%
Maintenance costs
Warranties
Check on insurance cost

Installation Cost

- Grants/Rebates
- 30% Federal Tax Credit
(But reduces after 2019)









Boosting Profits with Wind Power Savings

How commercial operations in the dairy, farming, and industrial industries benefit from making their own electricity with the wind



About Northern Power

Northern Power Systems – Company Overview

Providing distributed energy & renewable solutions globally for over 40 years

Based in Barre, Vermont, USA

Offices in:

Boston ▪ Italy ▪ United Kingdom ▪ Switzerland

Distributed Wind Turbines



100 kW, 60 kW
~800 turbines
with over 18
million run hours
98% availability

MW Scale Wind Technology



Partnered with
WEG
Over 100MW
installed

Integrated design and controls



For microgrid
applications
>25 projects
globally

Power Converter Systems



500 kVA – 2.5
MVA units
FlexPhase™
technology

Turnkey Energy Storage



ESS site
controller
BMS integration
Monitoring &
data acquisition

Business
core

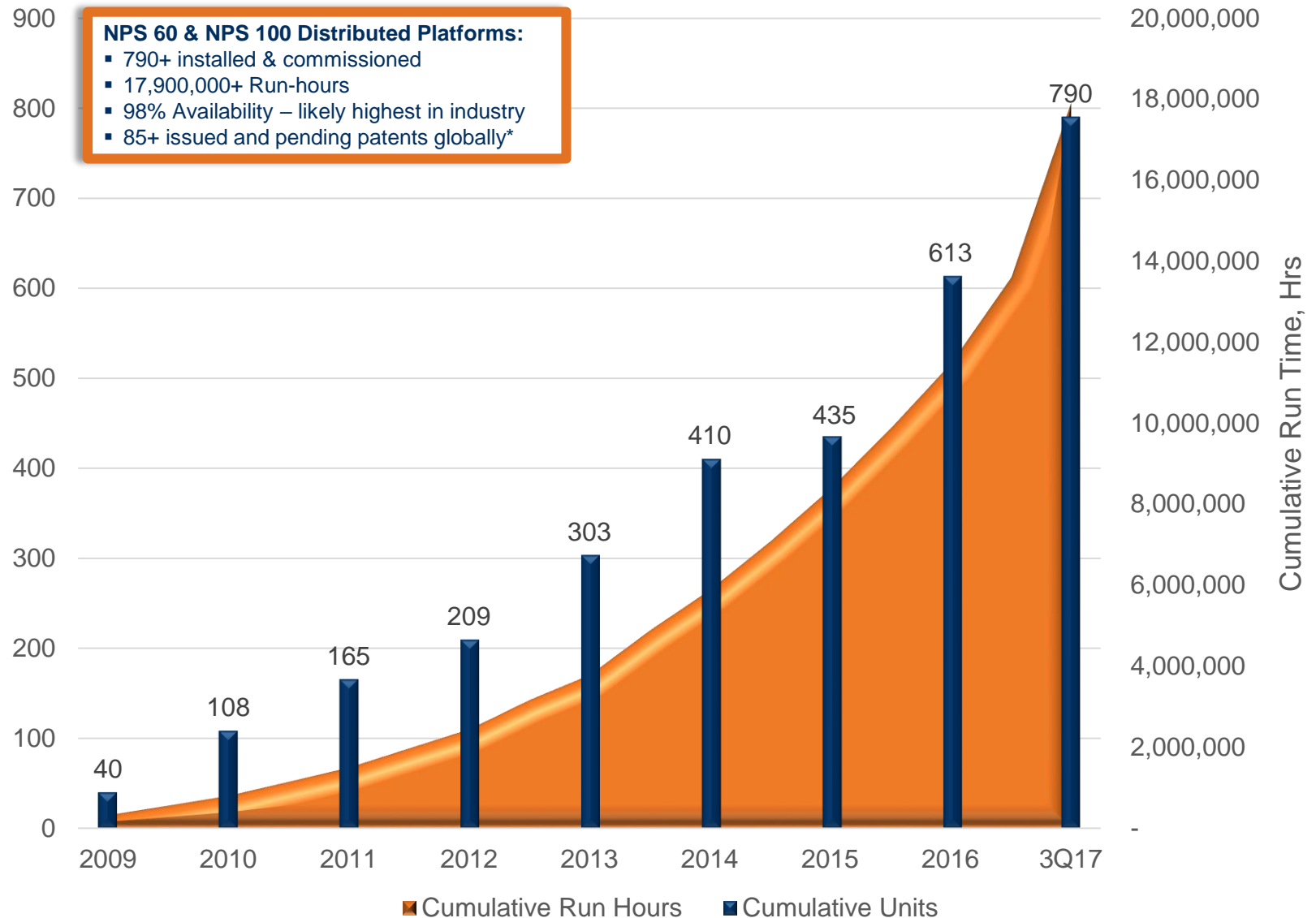
Leveraging history into distributed solutions



NPS Global Footprint



NPS Wind Turbine Deployment & Run Hours



NPS Services & Global Footprint

❖ Regional support assets for full service across the value stream:

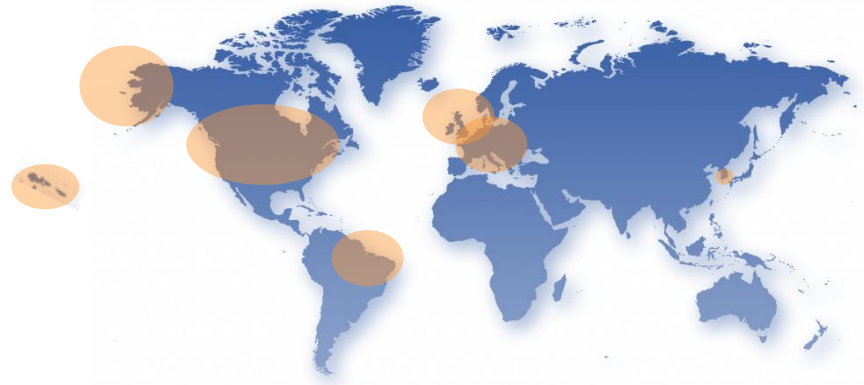
- Application Development & Support
- Permitting and site management
- Project Management and site construction
- Installation & Commissioning Teams
- Warranty & Maintenance Inventory
- 24/7 performance and condition monitoring
- Product and performance upgrades



24/7 monitoring and service support

95% of customers have rated the Northern Service Team as either “Very Knowledgeable” or “Extremely Knowledgeable”

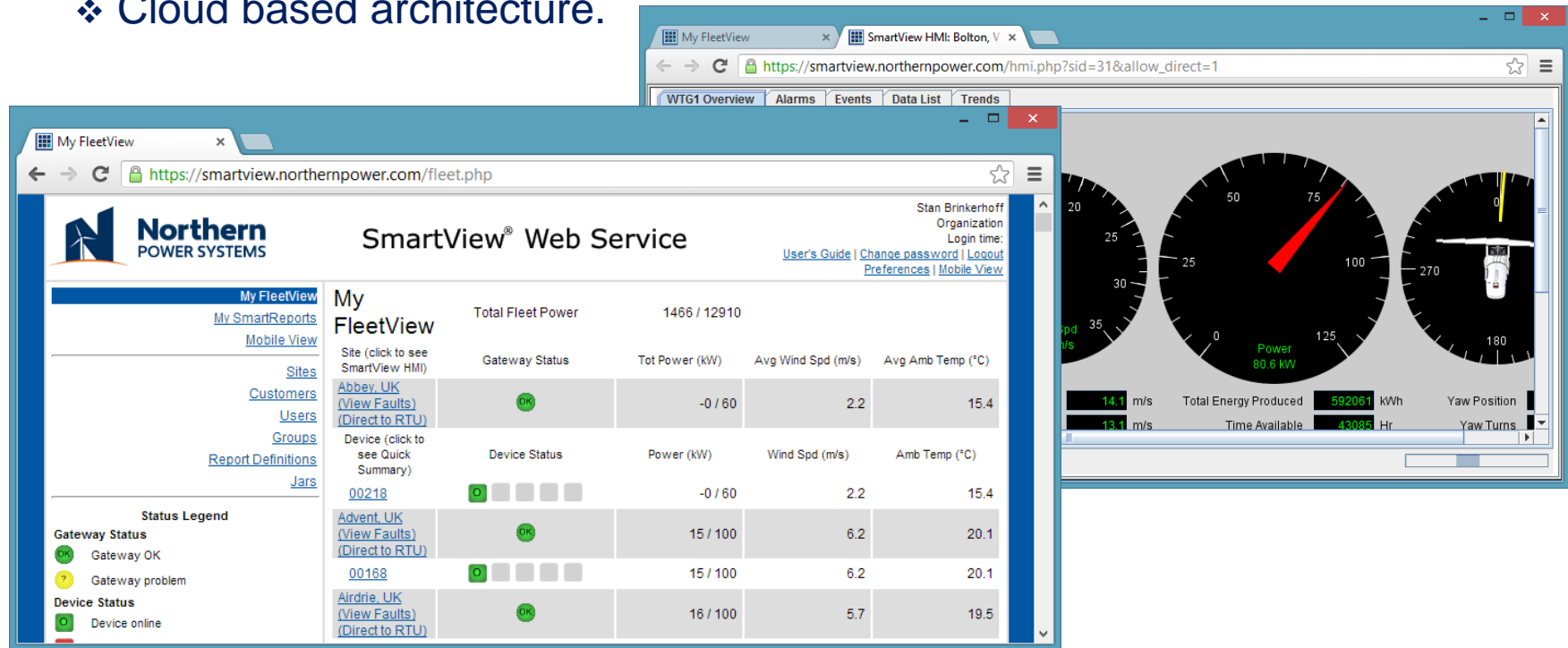
Source: Jan 2017 NPS customer survey



SmartView: FleetView

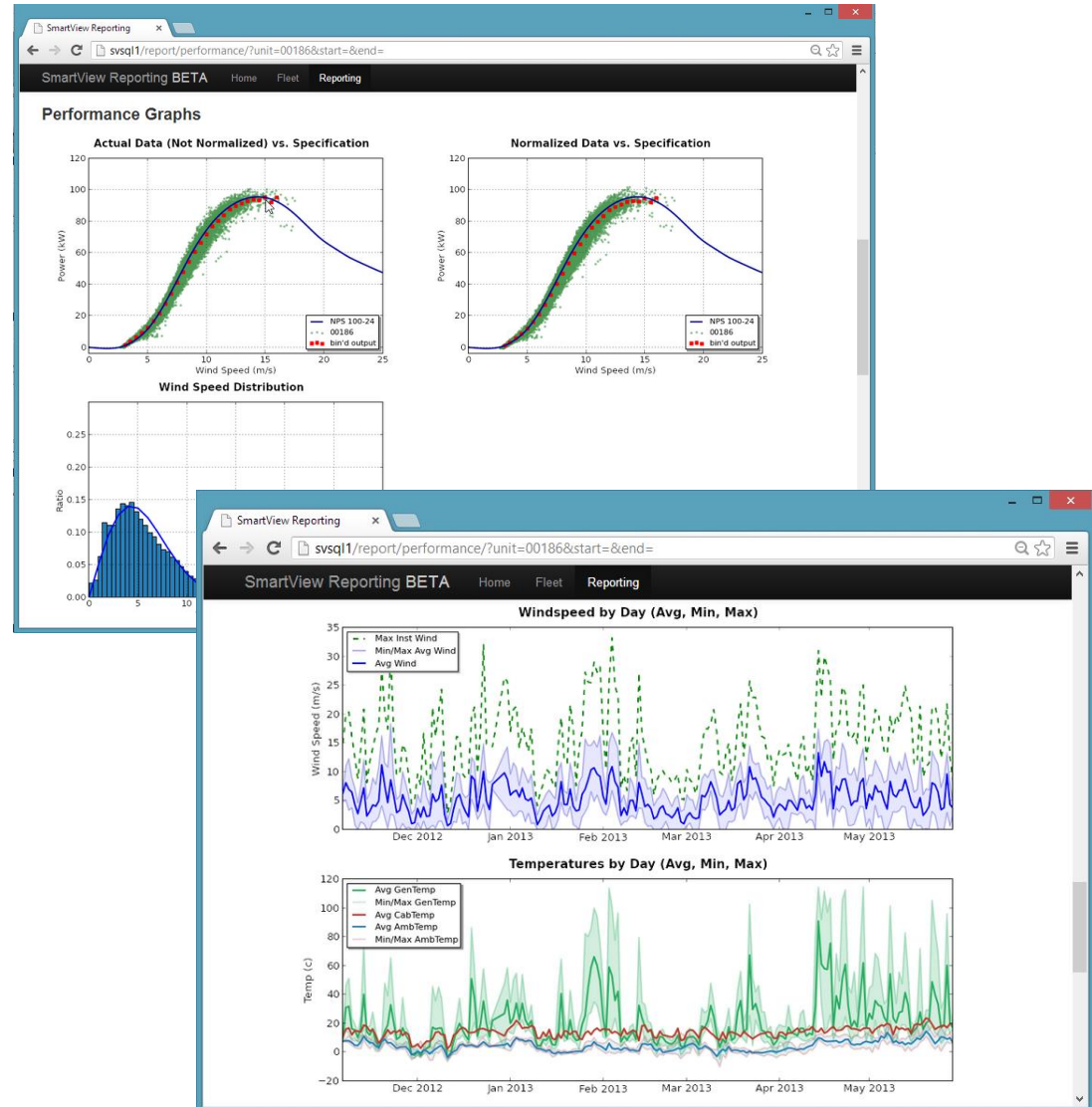
Fleetwide Monitoring and Remote Access

- ❖ Customer and internal facing fleet overview.
- ❖ Central web based monitoring platform for anytime access.
- ❖ Role based security (operators, end users) with encryption.
- ❖ Cloud based architecture.



SmartView: Performance Analytics

- ❖ Dynamic single unit and aggregate fleet performance toolset.
- ❖ Customizable and scalable.
- ❖ Integrated with ERP, Fleet Management, and other databases.
- ❖ Microsoft Office integration.



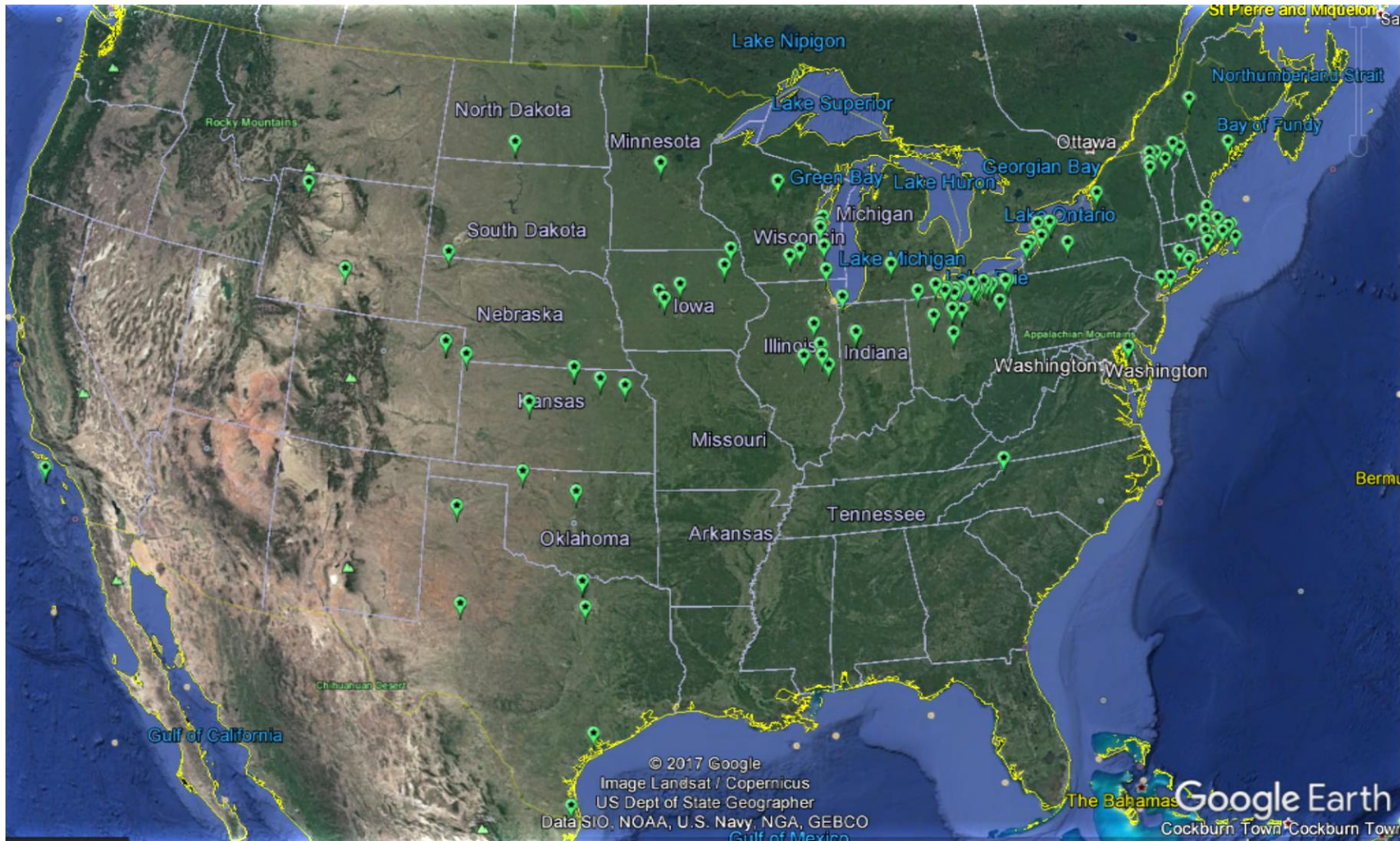
Why Northern Power?



Proven Track-Record of Performance and Safety
Engineered and assembled in America



NPS 100 in the United States





Why Wind Power?

Saving Money with Wind Power

If a business is in a site with good wind, investing in a turbine is a smart idea.

For an NPS 100 wind turbine, this means:

- ❖ Immediate tax credit opportunity:
 - almost \$100K over 1-5 years
- ❖ Savings from electricity bill every year:
 - depending on wind and rate, savings range from \$15,000 to \$35,000 per year (year 1 value)

**50% lifetime savings
directly boost profits**



Note: 10% no-money-down savings also available



Non-financial Benefits of Wind Power

- ❖ Stable and more predictable cost of power
- ❖ Energy independence / Self Reliance
- ❖ Small Footprint
- ❖ “Green” Values Made Visible – marketing value
- ❖ Educational value – local kids and communities learn about renewables
- ❖ Set the Example for Others



Why Distributed Wind Now? (from 10 years ago)

❖ NPS 100 Reduced Installed Cost

- \$500,000+ → as low as \$350,000*
- 30% reduction in cost

❖ NPS 100 Increased Production

- 21 meter rotor → 24 meter rotor
- 183,000 kWh/yr → 240,000 kWh/yr**
- Over 30% improvement in performance

With these powerful cost and productivity improvements, wind power makes economic sense, even with reduced incentives...



Miller Sunshine Acres Dairy Farm, NY

* Based on grouping 8-10 turbine installations

** Based on 5.5 m/s wind regime





Large Ag, Commercial and Industrial Applications

Large Ag / Commercial & Industrial Applications

❖ Large / Commercial Agriculture

- Dairy farms with 500+ head
- Dairy processing facilities
- Farms with electricity-based processes (e.g. drying)
- Vineyards
- Nursery businesses

❖ Industrial Applications

- Telecommunications Companies
- Recycling Facilities
- Printing Operations



Farm-based 100kW turbines



*Arends
Brothers
John Deere
Sales, IL*



Blairmains Farms, Scotland



Burco Farms, IA



Audets / Blue Spruce Farm, VT

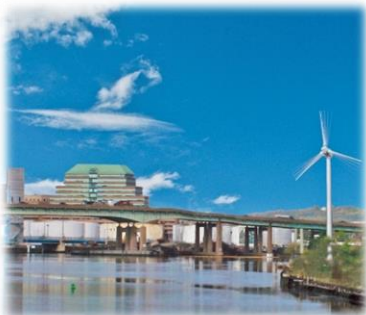
**Northern Power has over
200 100 kW farm/ag-
based turbines
worldwide**

- ❖ ~100 in the UK
- ❖ ~100 in Italy
- ❖ ~15 in the US



Wind power – not just for farms

Commercial & Industrial



Phoenix Press
Connecticut, USA



Bolton Valley
Vermont, USA



Village of Cascade Water
Treatment Facility
Wisconsin, USA



Medford High School
Mass. USA



Cloud County Community
College, Kansas, USA



Hyannis Country Gardens
Mass. USA



Triad Recycling & Energy
New York, USA



Energy Park, Hempstead
New York, USA



Camden Hills HS
Maine, USA



Alfred State College
New York, USA



CASE STUDY: GBT Communications

Location

Rush Center, KS

Project

distributed wind generation system at a commercial business, net metered on a monthly basis

Model

NPS 100-21 wind turbine, 37 meter tower

Year Commissioned:

2014

Average wind speed

6.26 m/s

Annual Energy

Production

257,000 kWh (2016)

Annual Carbon Offset

Saved carbon emissions equivalent to burning 209,000 lbs of coal

Source: <https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator>

Electricity is critical to Golden Belt's business operations. The central office and TV head-end distribute services 24 hours a day, 7 days a week. All of these electronics generate so much heat that air conditioners are required to keep the systems and surrounding office cool. Electricity also represents a major expense item, impacting bottom line profits every month.

Performance:

- ❖ Monthly bills: from \$4000-5000 to as low as \$1100
- ❖ 1st half 2017 = 145,500 kilowatt-hours / over \$19,000 worth of energy (valued at 13.6 cents)
- ❖ Yearly savings: approx. \$30,000 per year in utility bill savings

Hedging against rising costs

- ❖ 2014 rate: 11.3 cents/kWh
- ❖ 201 rate: 13.6 cents/kWh

“The reason we built the turbine was to save on expenses, but also take advantage of the wind patterns in Kansas.”

Beau Rebel
Golden Belt Communications



Energy on a Dairy Farm

A typical dairy farm consumes between 800 and 1,200 kilowatt hours (kWh) per cow every year.

“With the energy cost savings that result from the use of these [renewable] technologies... farmers will then be able to sustain and expand their agricultural operations over the long term, and have confidence in handing it off to the next generation.”

Renewable Energy World Magazine

July 6, 2017, “Congress Introduces Bill to Catalyze Economic Development for Rural and Agricultural Communities through Energy Investment”

Electricity helps dairy farms be more productive:

- Milk cooling
- Water heating
- Vacuum pumps
- Ventilation



CASE STUDY: KS / CO Ag and Dairy Business

Location

Yuma, CO (2 units)
St. Francis, KS (1 unit)

Project

Net metered distributed
wind generation system at
two farm locations

Model

3 NPS 100-24 wind
turbines, 37 meter tower

Year Commissioned:

2016

Average wind speed

6.38 m/s (14.3 mph)
6.49 m/s (14.5 mph)
5.92 m/s (13.24 mph)

Annual Energy Production

750,000+ kWh
(extrapolated from 1st half
of 2017 data)

Annual Carbon Offset

Saved carbon emissions
equivalent to burning over
298,000 lbs. of coal

Source:

<https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator>

An agricultural businessman with dairy and cattle operations in three disparate locations. Electricity is one of the line items that make a difference to the bottom line.

Wind power was particularly attractive as a renewable energy choice because it required minimal land (cattle can graze immediately around the 10' x 10' foundation pad required for an NPS100), and also because wind turbines do not need regular cleaning – which requires the use of scarce and valuable water – to keep producing at efficient levels.

Performance:

- ❖ 1st half 2017 = 395,000 kilowatt-hours / approx. \$40,000 worth of energy (valued at 10 cents)
- ❖ Yearly savings: approx. \$80,000 per year in utility bill savings



“Dairies work 24 hours a day,
and they use energy that
whole time.”

Owner, Confidential Client



CASE STUDY: Miller Sonshine Acres Dairy Farm

Location

Corfu, NY

Project

Net metered distributed wind generation system at a farm

Model

2 NPS 100-24 wind turbines, 37-meter towers

Year Commissioned:

2014 and 2016

Average wind speed

5.02 m/s (11.3 mph) and 5.44 m/s (12.2 mph)

Annual Energy Production

360,000+ kWh

Annual Carbon Offset

Saved carbon emissions equivalent to burning 270,000 lbs. of coal

Source:

<https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator>

When Dan Miller installed his first 100kW turbine, Miller Sonshine Acres Farm was a bustling dairy operation with over 2800 milking cows. His electricity bills were \$6000 per month. He knew that if he wanted his business to be sustainable, he would have to find a way to control costs now and well into the future.

Performance:

- ❖ Monthly bills: from \$6000+ to approx. \$2000
- ❖ 1st half 2017 = 180,00 kilowatt-hours / over \$35,000 worth of energy (valued at 10 cents)
- ❖ Yearly savings: approx. \$35,000 per year in utility bill savings

Miller's Branded Turbine promotes the company

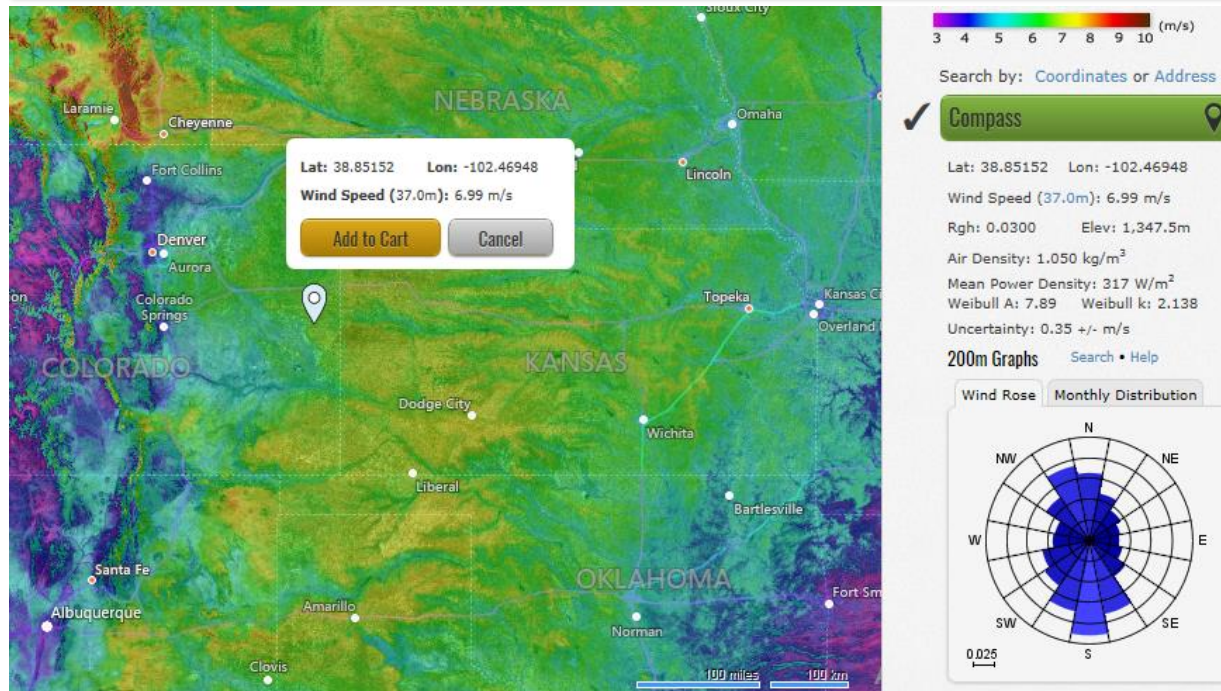


"I'm concerned about climate change and see the value in renewable energy, but the bottom line is, I thought I could save some money. This has proven to be a great way to do that."

Dan Miller, Owner, Sonshine Acres Farm

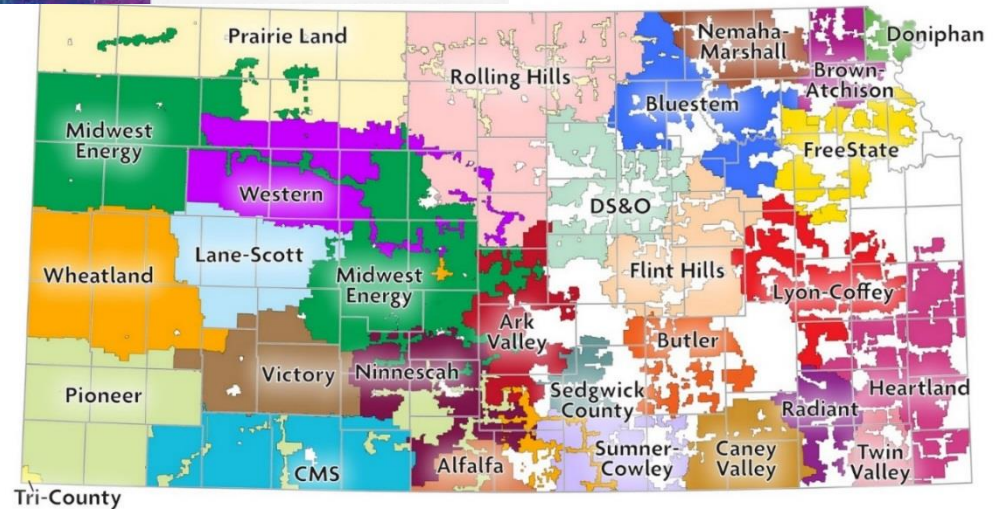


Colorado & Kansas



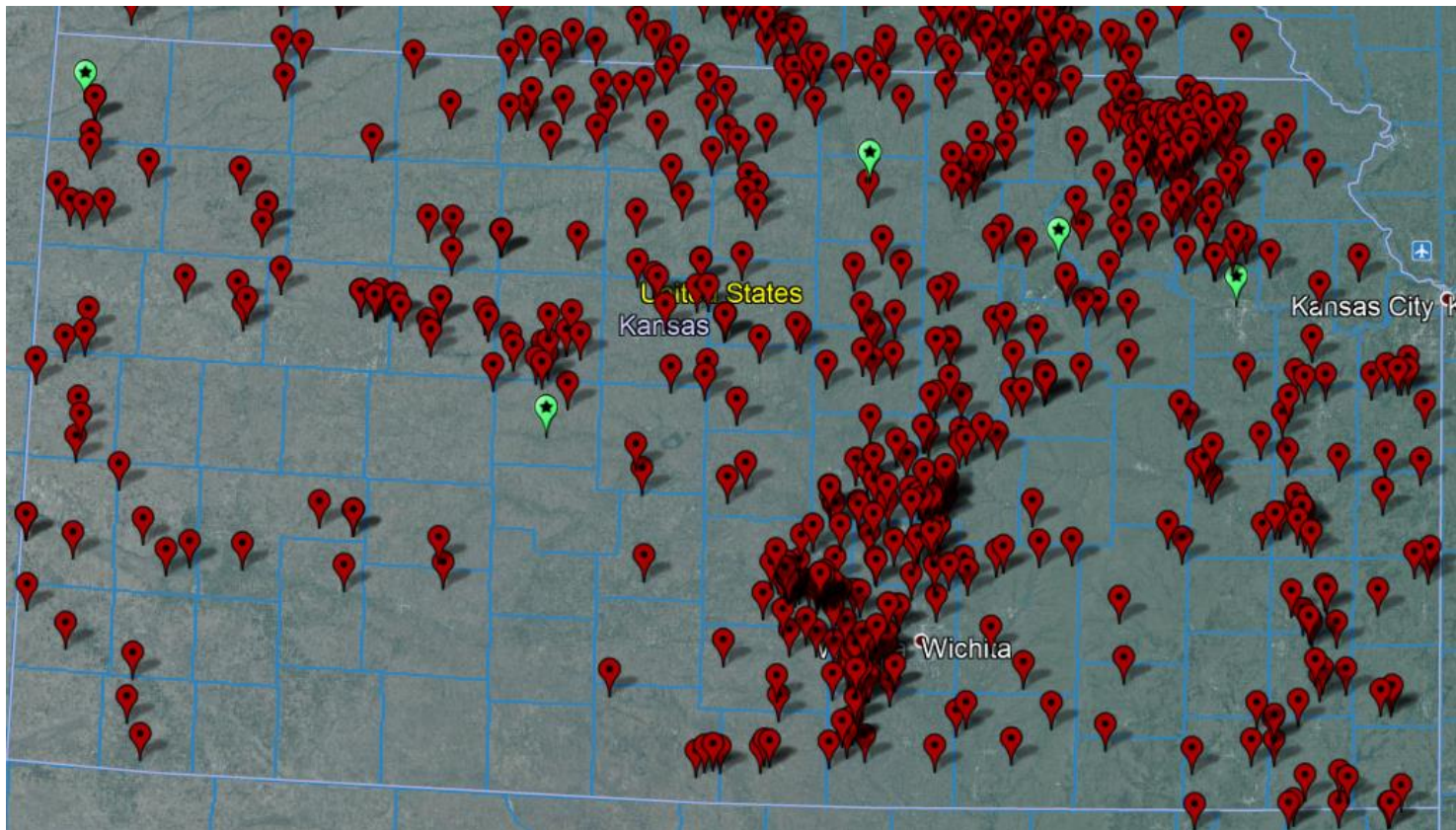
Excellent Wind Resource!

Many Utilities, but fairly uniform net metering programs



Many Opportunities in the region

- ❖ From a purchased list of dairy-related businesses, over 500 showed good economic returns.
- ❖ Additional opportunities in business/industrial sector





Wind Power Economics Overview

What Makes a Good Wind Project?

❖ Project Economics depend upon:

- Wind Resource
 - How much wind is there at your site?
 - The higher the wind, the more you can make
- Energy Cost (Utility Rates)
 - How much is wind-generated energy worth?
 - The higher your current cost, the greater the value of the energy you can make on your own



❖ The quick math

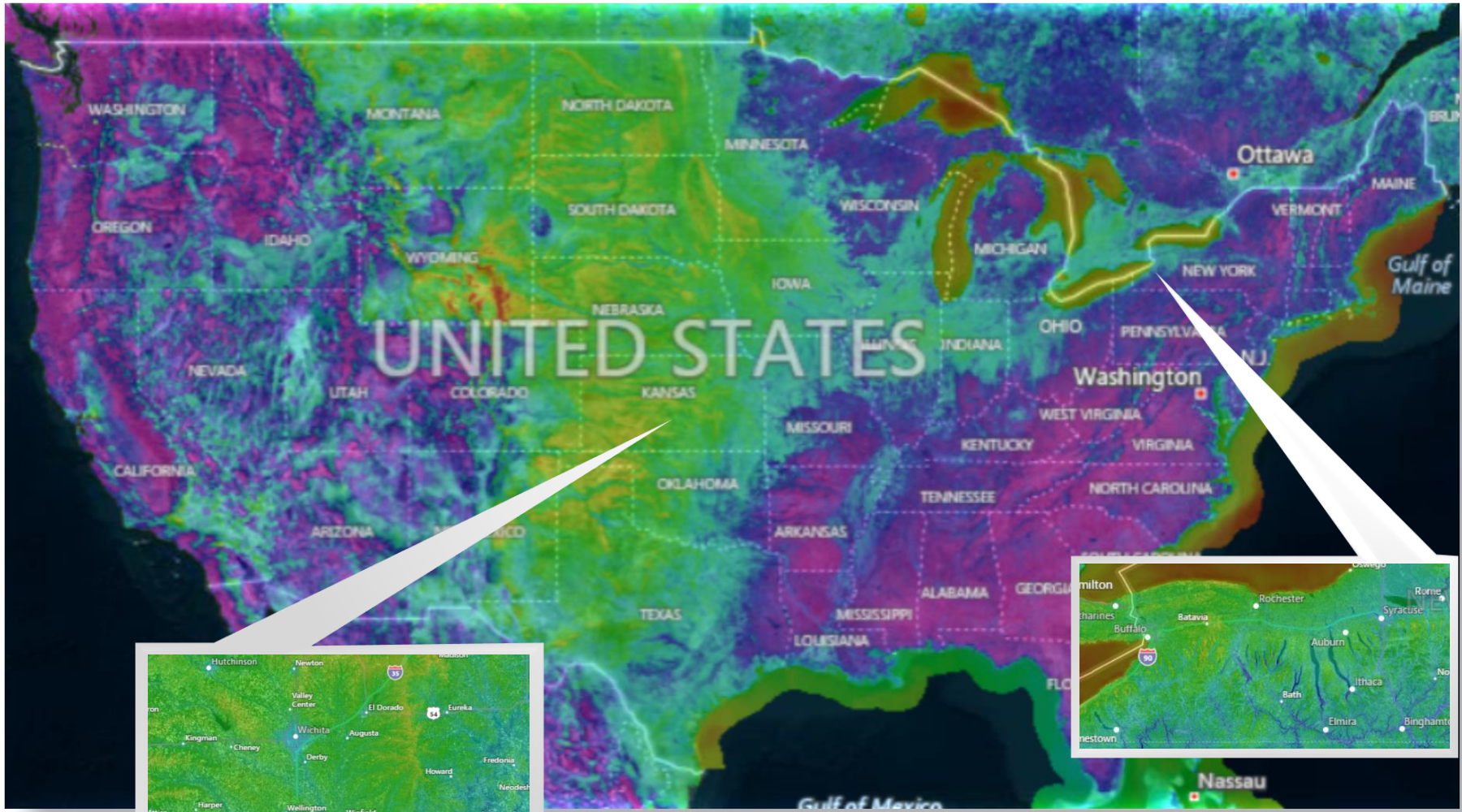
- Up front cost = \$250K or less up front cost (after tax credits/incentives)
- The turbine can make \$15-40k worth of electricity in a year. *

Same approach for all turbine sizes



** Production value depends on your wind and utility price*

- ❖ Light blue / green / yellow / red are high quality wind regimes

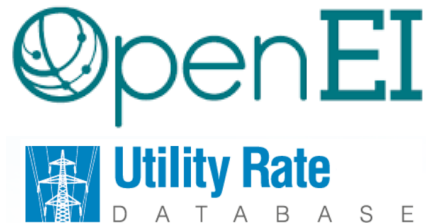


Micro-siting is crucial!



Energy Costs

- ❖ Electricity Rates can be complex
 - Commercial Rates
 - Ag Rates
 - Every bill is different – the one at the right is actually pretty simple!
- ❖ Good resources to estimate rates for economic analysis, including:



Bill Period: Jun 26, 2017 to Jul 27, 2017
 ACCOUNT NUMBER: 12637-94119
 PLEASE PAY BY: Aug 20, 2017
 AMOUNT DUE: \$ 3,775.09
 PAGE 2 of 4

Enrollment Information
 To enroll with a supplier or change to another supplier, you will need the following information about your account:
 Customer: 1364
 Acct No: 12637-94119 Cycle: 30 GEYD

Electric Usage History

Month	kWh	Month	kWh
Jul 16	14198	Feb 17	11028
Aug 16	14168	Mar 17	11428
Sep 16	14361	Apr 17	12827
Oct 16	13081	May 17	10026
Nov 16	11882	Jun 17	15395
Dec 16	12119	Jul 17	15654
Jan 17	13689		

Notice About Electronic Check Conversion
 By sending your completed, signed check to us, you authorize us to use the account information from your check to make an electronic fund transfer from your account for the same amount as the check. If the electronic fund transfer cannot be processed for technical reasons, you authorize us to process the copy of your check.

DETAIL OF CURRENT CHARGES

Delivery Services

Service Period	No. of days	Current Reading	Previous Reading	Total Usage
Jun 26 - Jul 27	31	51582	35928	15654 kWh

METER NUMBER: 351548800 NEXT SCHEDULED READ DATE ON OR ABOUT: Aug 29

NATE: Electric SC1 T&D Non Heat

Basic Service (not including usage)		17.00
Delivery	0.04758874 x 15654 kWh	744.95
Consolidated Billing Credit		-1.24
Res Agricultural Discount	-0.025193 x 15654 kWh	-394.37
RCM	0.00084 x 15654 kWh	13.15
Incr State Assessment	0.00007969 x 15654 kWh	1.25
SBC	0.007948 x 15654 kWh	124.42
Legacy Transition Chrg	0.001128 x 15654 kWh	17.66
Transmission Rev Adj	-0.00338 x 15654 kWh	-52.91
Tariff Surcharge	2.04082 %	9.59
Total Delivery Services		\$ 479.51

Supply Services

SUPPLIER: Hudson Energy Services LLC
 4 Executive Blvd
 Suite 301
 Suffern, NY 10801
 PHONE: 1-877-Hudson 9 ACCOUNT NO: 242792

Electricity Supply	0.06212115 x 15654 kWh	972.44
Sales Tax	11.0 %	106.97
Total Supply Services		\$ 1,079.41



Load Matching

- ❖ Once you know the value is there, it is important to “match” the electric load with the correct turbine size
 - Make sure amount of electricity that is used on a regular basis is more than what a turbine will make.
 - Why? excess power is generally not credited at a retail rate

Turbine size	Dairy Herd Size	Electricity Bill range	Reference point: How many homes?	Notes
2-6 kW	<100 head	<\$350/month	1	
25 kW	100 – 500 head	\$350/month - \$1000/month	5-10	
100 kW	500 – 3000+ head	>\$1000/month	20-30	
MW-scale	>3000 head	>\$10,000/month	100+	Be aware of Permitting considerations





Wind Power Savings Report – What's it to you?

What's it to you?

*Analyzing Wind Speed,
Energy Production, &
Utility Rates at Precise
Locations*

**Northern Power will
run this report for
your specific location**

**Northern
POWER SYSTEMS**
HOME GROWN IN AMERICA




Wind Power Savings Report for:
John Smith
123 Dairy Lane
Dairyland, KS 12046

Thank you for requesting a Wind Power Savings Report from Northern Power Systems. According to the site-specific data we pulled for your site, you could **SAVE OVER 60%** on your long term energy costs – or get a **GUARANTEED IMMEDIATE 10%** with no money-down. Turn the page to explore your savings potential...



Wind Power Savings Report

- ❖ Visual Meters for
 - Wind speed
 - Electricity Rate
 - Lifetime savings
- ❖ Wind speed
- ❖ Utility rate
- ❖ Annual production
- ❖ Translate above to
 - Current year equivalent savings
 - Value 10 years from now
- ❖ Initial project Cost
- ❖ Financing Options

Assessment of wind at your site Based on estimated wind speed. Key: 4-4.9 m/s = poor; 5-5.9 m/s = good (yellow); 6-6.9 m/s = great (green); over 7 m/s = excellent (dark green) <small>m/s = meters per second (1 m/s = 2.2 mph)</small>	
Value of the electricity you could make using an NPS100 Based on current utility cost. Key: less than 8 cents/kWh = poor (red); 8-10 cents/kWh = good (yellow); 10-12 cents/kWh = great (green); Over 12 cents/kWh = excellent (dark green)	
Long term value of producing electricity from the wind using an NPS100 Based on long term savings, straight purchase scenario, page 4) Key: less than 20% = poor (red); 20-49% = good (yellow); 50-60% = great (green); Over 60% = fantastic (dark green)	



Wind Power Savings Report for:

John Smith
123 Dairy Lane
Dairyland, KS 12046

Thank you for requesting a Wind Power Savings Report from Northern Power Systems. According to the site-specific data we pulled for your site, you could **SAVE OVER 60%** on your long term energy costs – or get a **GUARANTEED IMMEDIATE 10%** with no money down. Turn the page to explore your savings potential...





Financing

Flexible Financing Options



Power
Purchase
Program
(10% savings
from day 1)



Lease to own
(7 or 9 years)



Corporate
bank



Cash
Investment



Flexible Financing Options

	POWER PURCHASE PROGRAM	LEASE-TO- OWN OPTION	LOAN OPTION	CASH INVESTMENT
Key financing feature	Immediate savings on current costs (10%)	Own the turbine after 7-9 years of lease payments	Own the turbine with financing by your local lender	
Predictable and stable energy costs	✓	✓	✓	✓
3rd party monetizes tax benefits and passes savings to you	✓	✓		
You monetize 100% of tax benefits directly (MACRS and ITC)			✓	✓
Own the asset and its value		✓	✓	✓





Thank You

Trevor Atkinson

Cell 203-427-3606

tatkinson@northernpower.com

Distributed Generation Project Development: Key Elements of a Successful Colorado Project

Patrick Kelly
Hoss Consulting Inc.

Project Development Process

- Project Design/Siting
 - Location
- Interconnection
 - Established load size
 - Governing rules (utility)
 - Need for exceptions
 - Following the rules
- Zoning/Permitting
 - Governing rules
 - Need for variance
 - Following the rules
- Installation



Market Comparison

Mature Market (Sunrun/Denver)

- History of developed projects
- Speed/Efficiency
- No surprises (cookie cutter)
- High degree of trust
- Timing = few months

New Market

- Few to no development examples
 - Being first is OK
- Deliberate pace (not wanting to get the first one wrong)
- Everything is a surprise (lots of learning)
- No history for trust to build on
- Timing = potentially long (risk of losing momentum)

A (quick) note about timing

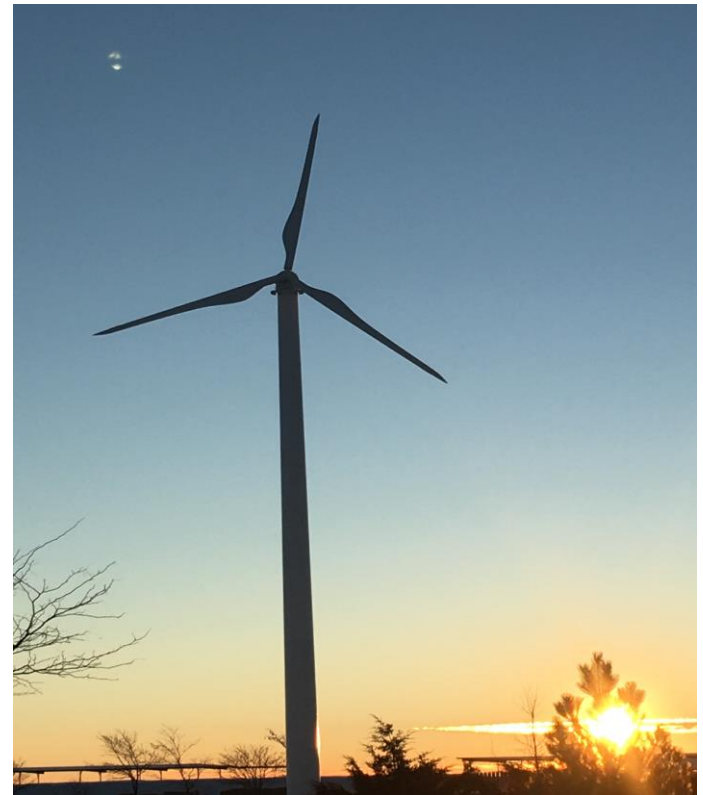
- Momentum is hard to establish
- Windows that close have their own schedules (timing is everything)
- Losing momentum = loss of local support
- Lost momentum is hard regain

Ingredients for a Successful Project

- Project Champion
 - Provide idea and initial push
- Good Site
 - Resource
 - Load
- Local Development Partner
 - Established/experienced local
- Landowner
 - Local champion
 - Utility customer
 - Own the land (relationship w/ zoning/permitting)
- Utility
 - Hold keys to the kingdom
 - Established rules
 - Process for exceptions
- Local Permitting Authority
 - Established rules or rule-making process (conditional use permit)

Local (example) successful project

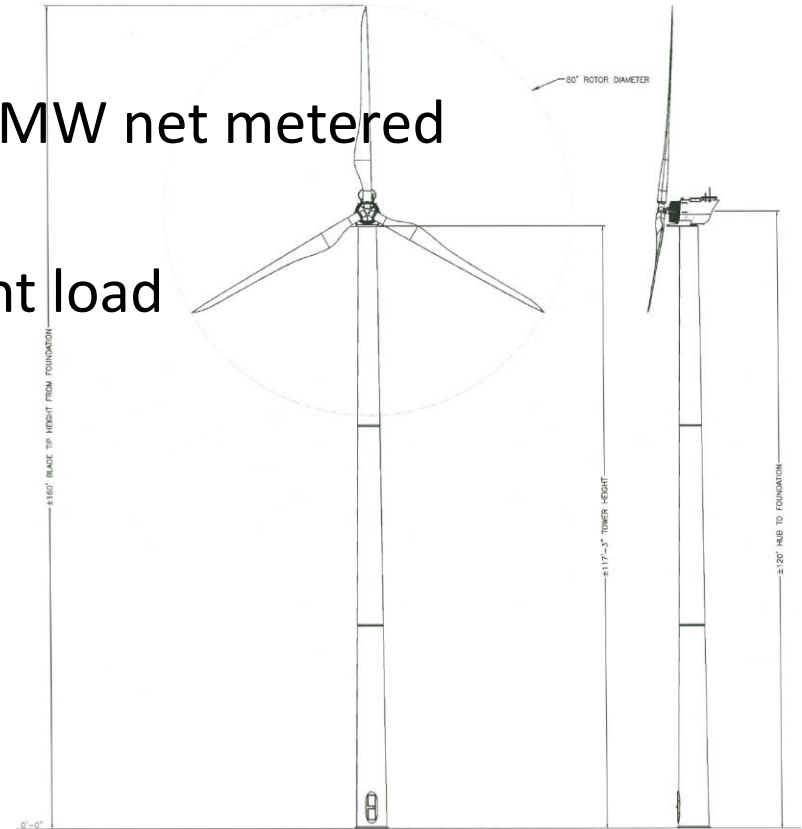
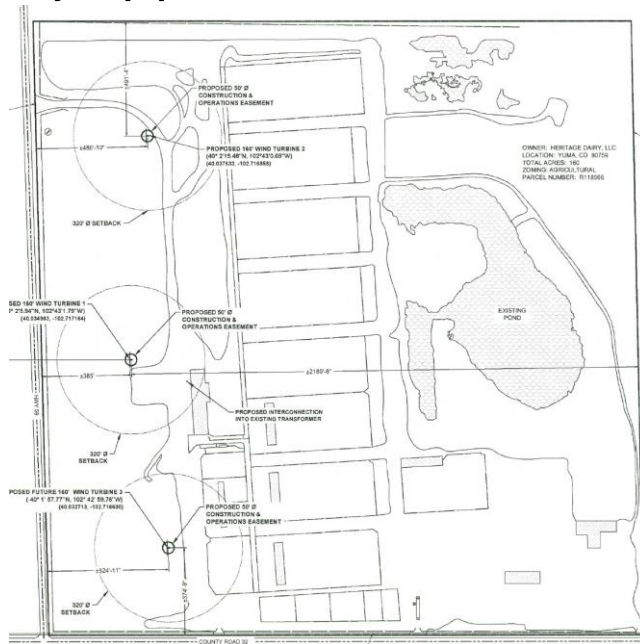
- Project Champion (United Wind)
- Landowner (Erick Farmer)
- Local Development Partner (Hoss and Ethos)
- Permitting/Zoning (Yuma County - Rich Birnie)
- Interconnection (Y-W)





Initial Project Design established by United Wind and developed by Ethos

- 2 x 100 kW (NPS)
- Colorado SB252 permitted up to 2MW net metered projects
- Dairy application – 24 hr. consistent load



Landowner

- Initial concerns
 - Operations impact to the dairy
 - How remedied (quick story)
- Erick as a dream landowner
 - Why?...because he was flexible, had the vision and passion
 - Met feel-good and financial criteria (Erick is civic-minded)



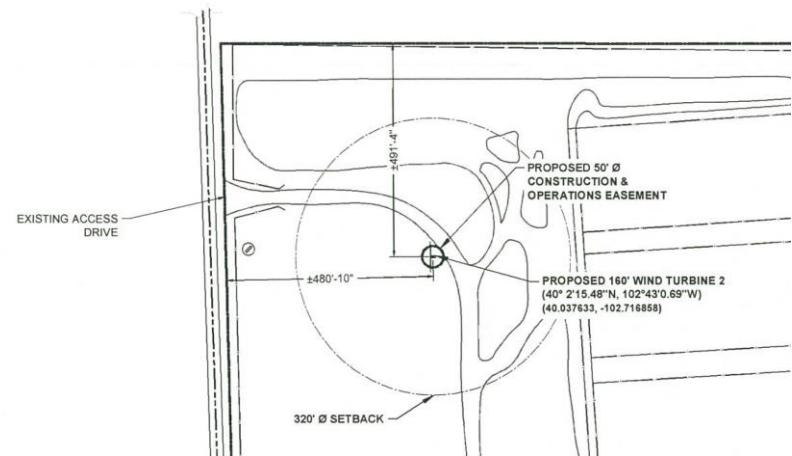
A reminder about Northern Power

- Direct Drive
 - Local, specific configuration is possible – learned in Alaska with diesel generators. Installed projects worldwide...



Permitting and Zoning

- Yuma County code set around utility-scale (huge setbacks)
- Application of local code eliminated all locations on property
- Rich Birnie
 - Certain parts of code made sense
 - Other parts of code needed variance (common sense approach)
 - CUP hearing (supported by Rich)
 - » Pre-work by Rich with board
 - » Nothing unreasonable



Interconnection

- Anything over 25kW required board vote
- Utility installed research meter to confirm match between load and proposed project size
- Utility provided guidance on thresholds that did not trigger advanced study requirement (189.6kW)
- Andy Molt(Dir. Member Services)/James Ziebarth(System Eng.)/Terry Hall(GM)
 - Ensured completeness of Board package
 - Supported project w/ the Coop Board

Lessons learned

- Champion
 - Champion must respect need for momentum
- Local Developer
 - Must have connections to local talent
- Local Talent
 - Does the leg work
 - Must have relevant experience
 - Must know what info is needed by whom and where to get it
 - Must have ability to immediately establish credibility with process stakeholders
 - Must be flexible but must steward original vision
 - Must know how to surmount hurdles without losing momentum
- Utility
 - Must have knowledgeable staff
- Permitting/Zoning
 - Know their rules and be companionate about local opinions



Sunset View and Thanks

It's all About the Economics

Modeling Microgrids, On and Off the Grid

Dominick Morone – Vice President of Sales



HOMER
Energy

The Microgrid Modeling Experts

- Leader in economic simulation/optimization modeling software for microgrids and DER
- Created at the American National Renewable Energy Lab (NREL) in 1992; privatized in 2009
- Over 80,000 people have downloaded and used HOMER Pro.
- Taught in over 500 universities



HOMER = Hybrid Optimization of Multiple Energy Resources

The global standard for optimizing microgrid design in all sectors,
from village power and island utilities to grid-connected
campuses and military bases.

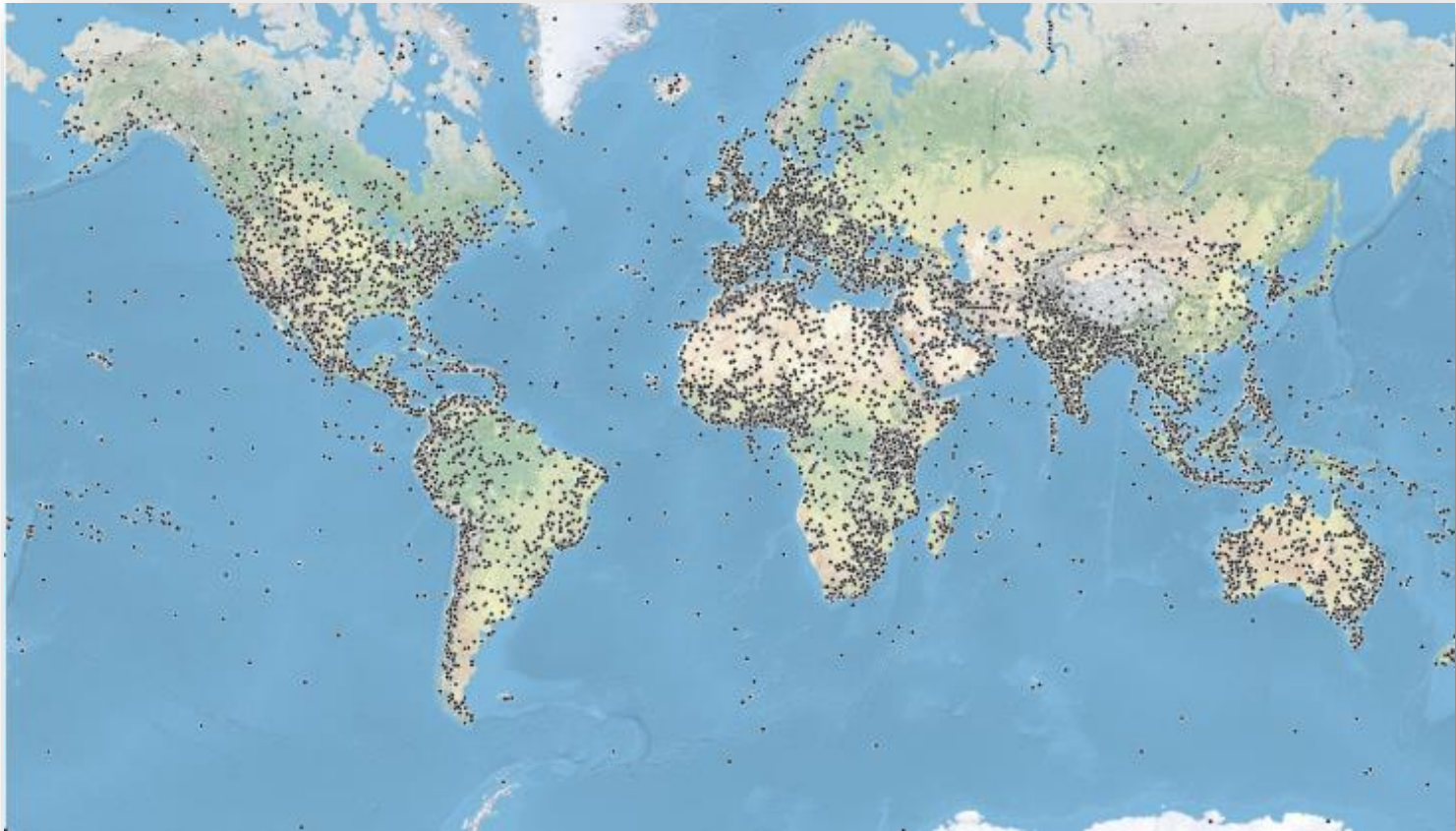


The HOMER “Engine”

- Combines engineering and economics
- Allows users to quickly determine least-cost options
- Simulates real-world performance and delivers a choice of optimized design



Over 36,000 microgrids modeled in HOMER[®] Pro



Today's modern microgrid

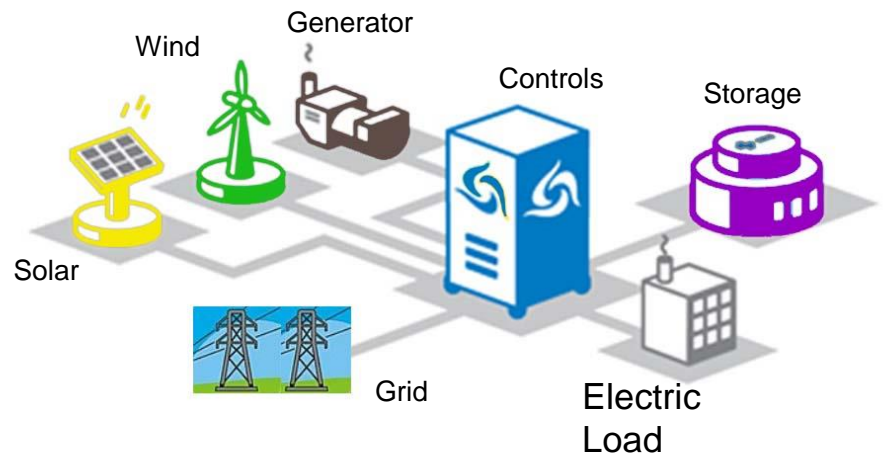
A microgrid is a single or multiple generation/storage resource that can continuously provide energy for a specific application.

A microgrid can be connected to a larger grid or operate independently without the need of the main grid.

Reasons for microgrids:

- Improved application resiliency
- Economics
- Clean energy mandate
- Grid firming
- Peak demand reduction

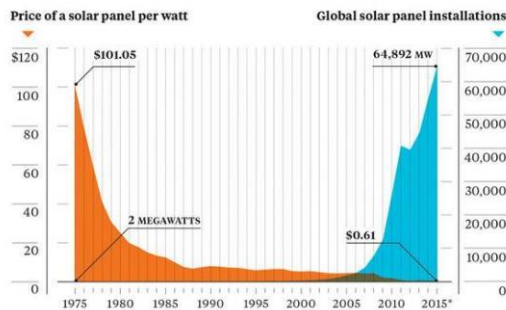
A microgrid ranges in size from 2-3 KW to over 100 MW and comprises of any combination of the following technologies:



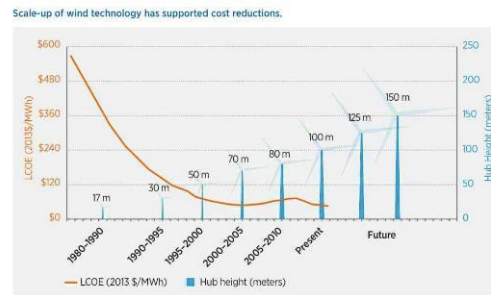
Renewables & Storage are driving Change

A standard Power Purchase Agreement for:
Wind: \$.04/kWh
Solar: \$.06/kWh

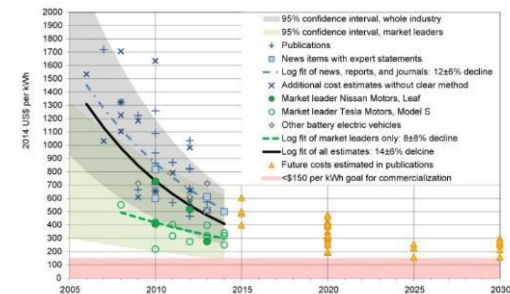
Modern day microgrid exist today because of just one reason, ECONOMICS



SOLAR



WIND



Storage

In just the last decade, the cost of solar and wind have declined by as much as 90% and storage over 50%. They are Fast becoming mature, bankable resources.

But What's Best?

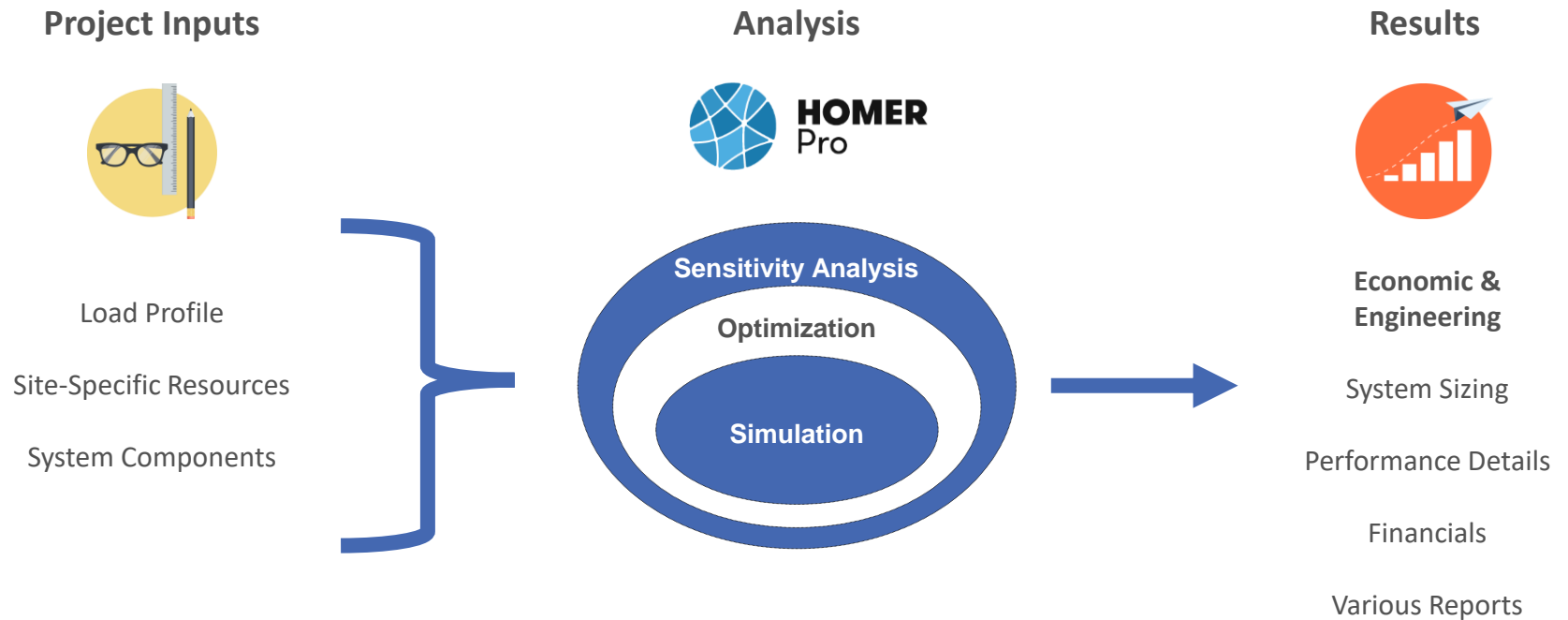
The question is how much of what energy generation and Storage technologies make the most economic sense?

- It depends on:
 - Available resources
 - Size and variability of loads
 - Equipment prices
 - Equipment performance
 - Grid or no grid

**How you get there is through Economic
Optimization Modeling**

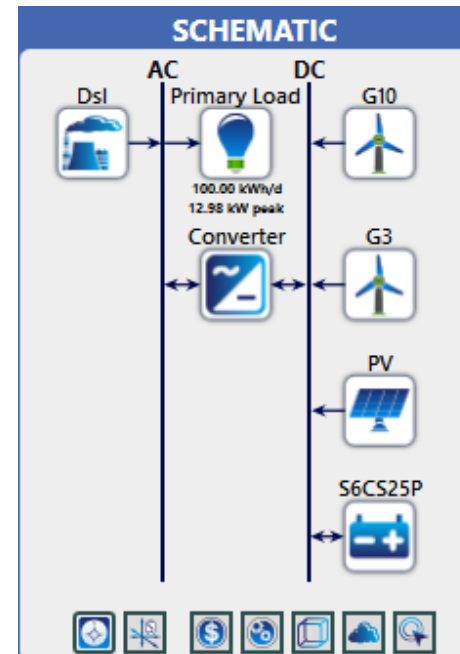


How HOMER Works

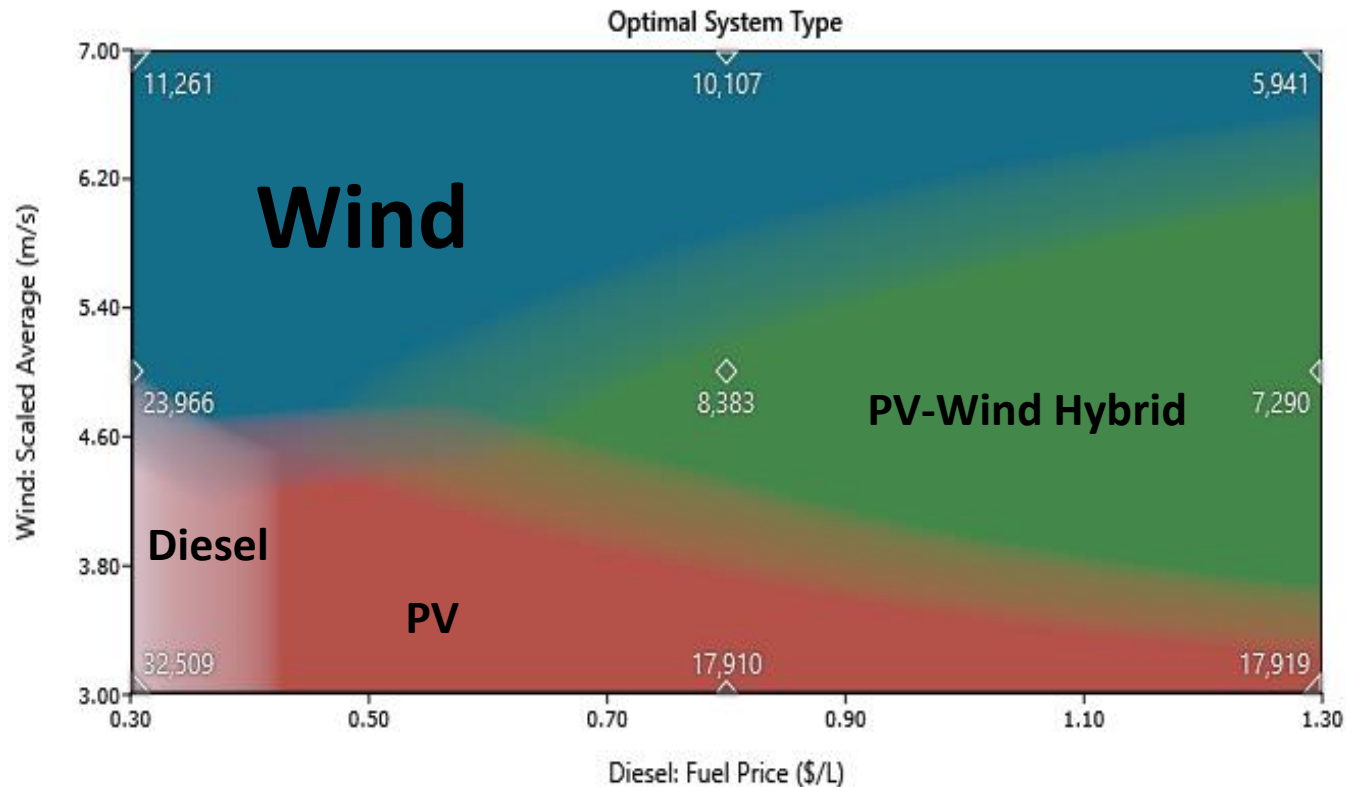


HOMER

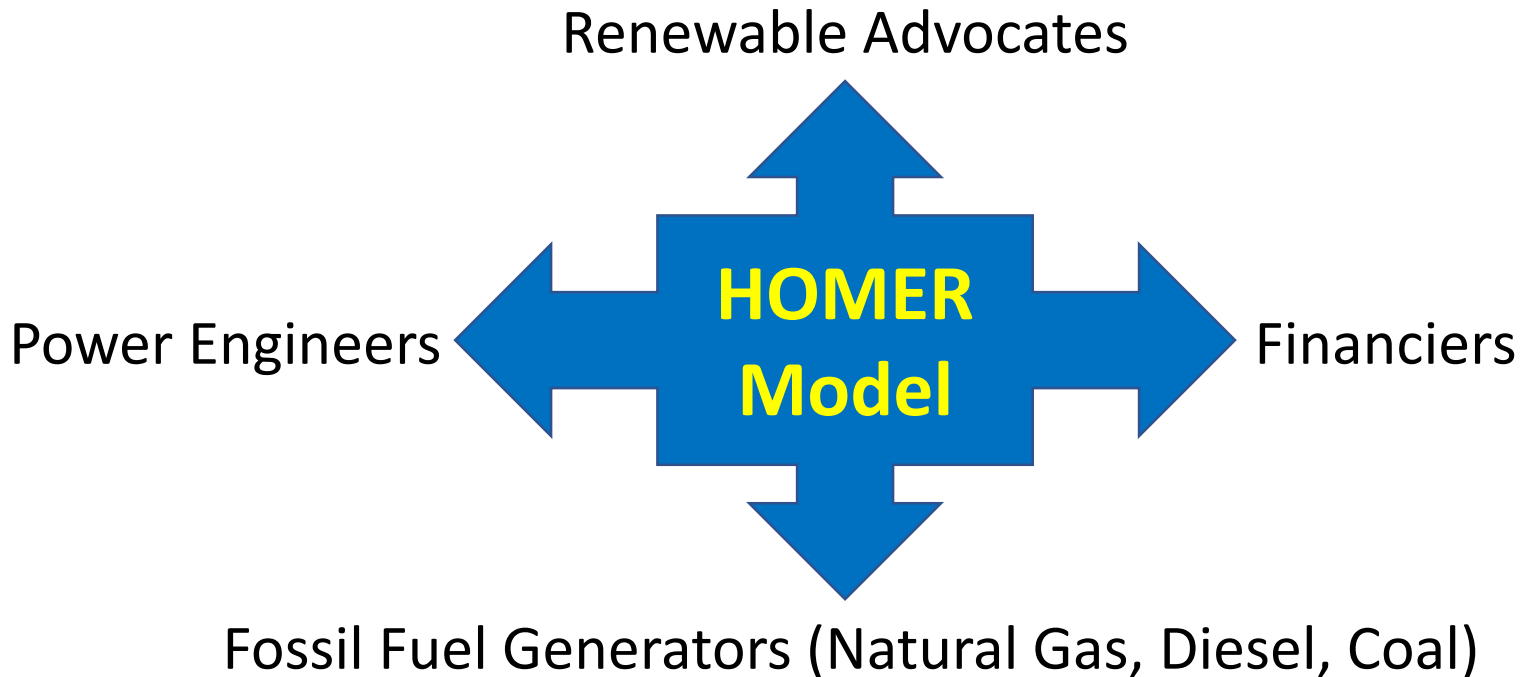
- Industry standard for hybrid micro-grids
 - Conventional resources
 - Renewable resources
 - Storage
 - Load Management



When does a technology make sense?



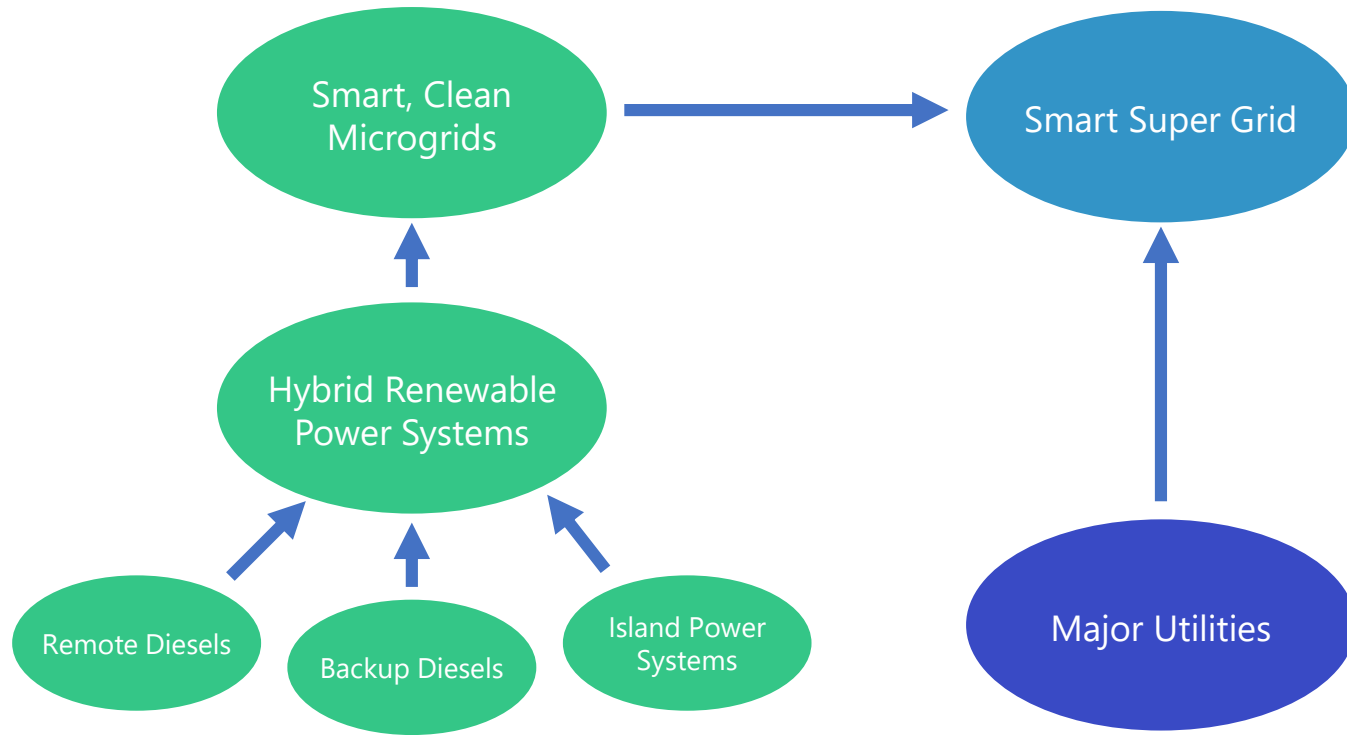
HOMER as a Communication Tool



HOMER bridges different worlds

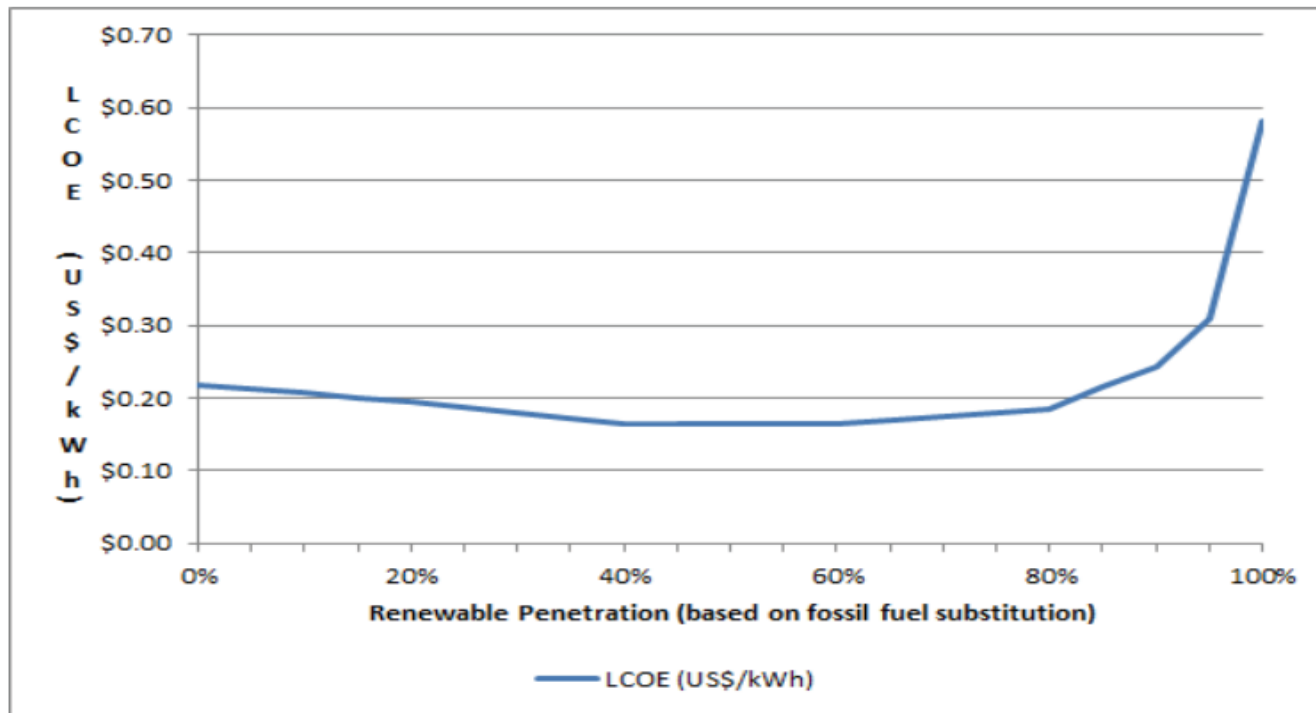
<http://www.homerenergy.com>

Clean Power Evolution



Penetration Analysis from HOMER

Cost of Electricity Based on Renewable Penetration



A Smart Super Grid

Decentralized energy production serving local electrical loads while supporting traditional centralized infrastructure.



HOMER Energy Training



- Instructor-led training, available in-person or online.
- Train front-line sales engineers to use HOMER Pro to qualify incoming leads.
- Train inside engineers to use HOMER Pro to conduct competitive analysis of other products.
- Train engineers to use HOMER to establish the primary microgrid design.

HOMER Energy Consulting

- HOMER's staff have deep experience with the design and market dynamics of the microgrid/DER segments
- Services include co-authoring of case studies and other analyses
- Typically used for:
 - Mini-trainings on any feature within HOMER Pro
 - File verification for quality assurance
 - Microgrid design questions
 - Or... give us the data, and we will create your HOMER file



Questions?

Dominick Morone, Sales

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Boulder, CO 80301 USA

Office: +1 720.565.4046

Dominick.Morone@HOMEREnergy.com

www.homerenergy.com

DECEMBER 4TH, 2017
IN YUMA, CO



DISTRIBUTED GENERATION
WORKSHOP: COLORADO

DG in Colorado: Coloring the Landscape

Andy Molt, Y-W Electric Association

Richard Birnie, Yuma County

Geoffrey Hier, Colorado Rural Electric Association

Michael Turner, Colorado Energy Office

Colorado Distributed Generation Workshop

December 4, 2017

Geoffrey Hier | Director of Government Relations

Colorado Rural Electric Association
5400 Washington Street
Denver, CO 80216

Ghier@coloradorea.org | 303-601-0978



Colorado Rural Electric Association

- Member Services & Education
- Publications Department
- Loss Control/Safety Training
- Government Relations



- Member owned, locally elected boards
- 22 Distribution cooperatives headquartered in Colorado
 - White River, 3,300 meters | Intermountain Rural Electric Association (IREA) 150,000 meters
- One G&T – Tri-State (43 members – 18 member co-ops in CO)
- Four Xcel wholesale members
- Over 70% of land mass
- 20% of population
- Average 7.8 consumers/mile of line
- Investor Owned Utilities average 35, Municipal Utilities average 47
- Fewer consumers = less revenue
- CREA Board of Directors, 26 members





HB 08-1160 – Cooperative net metering statute

- 10 kW residential, 25 kW commercial/industrial up to 120% cap
- Monthly excess rolled over, annual true up
- Nondiscriminatory rates
- PUC interconnection standards

RENEWABLE ENERGY STANDARD (RPS)(RES)

HB07-1281, SB13-252, HB15-1377, HB15-046

- Electric distribution cooperatives under 100,000 meters 10% renewables by 2020
- Electric distribution cooperatives over 100,000 meters 20% by 2020
- Wholesale G&T cooperatives 20% by 2020
- Cooperatives 10,000 and over meters 1% DG by 2020
- Cooperatives under 10,000 meters .75% DG
- At least half of DG must be from “Retail DG”
- Industrial sales excluded from DG calculation
- Solar/renewable gardens count as “Retail DG”



COOPERATIVE (TRI-STATE)	PROJECT #	FUEL TYPE	SIZE (kW)
DELTA-MONTROSE	4	HYDRO & SOLAR	7,670
EMPIRE ELECTRIC	5	HYDRO & SOLAR	5,032
GUNNISON COUNTY	3	SOLAR & WIND	10.39
HIGHLINE ELECTRIC	1	WASTE HEAT RECOVERY	3,700
LA PLATA ELECTRIC	7	WASTE HEAT RECOVERY, HYDRO & SOLAR	7,243
MOUNTAIN PARKS ELECTRIC	1	HYDRO	1,200
PVREA	8	HYDRO & SOLAR	18,200

COOPERATIVE (TRI-STATE)	PROJECT #	FUEL TYPE	SIZE (kW)
SAN ISABEL	1	WIND	8,000
SAN LUIS VALLEY	3	HYDRO & SOLAR	3,102
SAN MIGUEL	6	HYDRO & SOLAR	3,070
SANGRE DE CRISTO	1	SOLAR	2,000
SOUTHEAST POWER	1	SOLAR	4,000
UNITED POWER	6	METHANE RECOVERY & SOLAR	40,420
WHITE RIVER	4	HYDRO & SOLAR	14,480

COOPERATIVE (XCEL)	PROJECT #	FUEL TYPE	SIZE (kW)
GRAND VALLEY POWER	4	SOLAR	165
HOLY CROSS	9	BIOMASS, HYDRO & SOLAR	24,136
IREA	1	SOLAR	12,381
YAMPA VALLEY	3	HYDRO & SOLAR	1,771

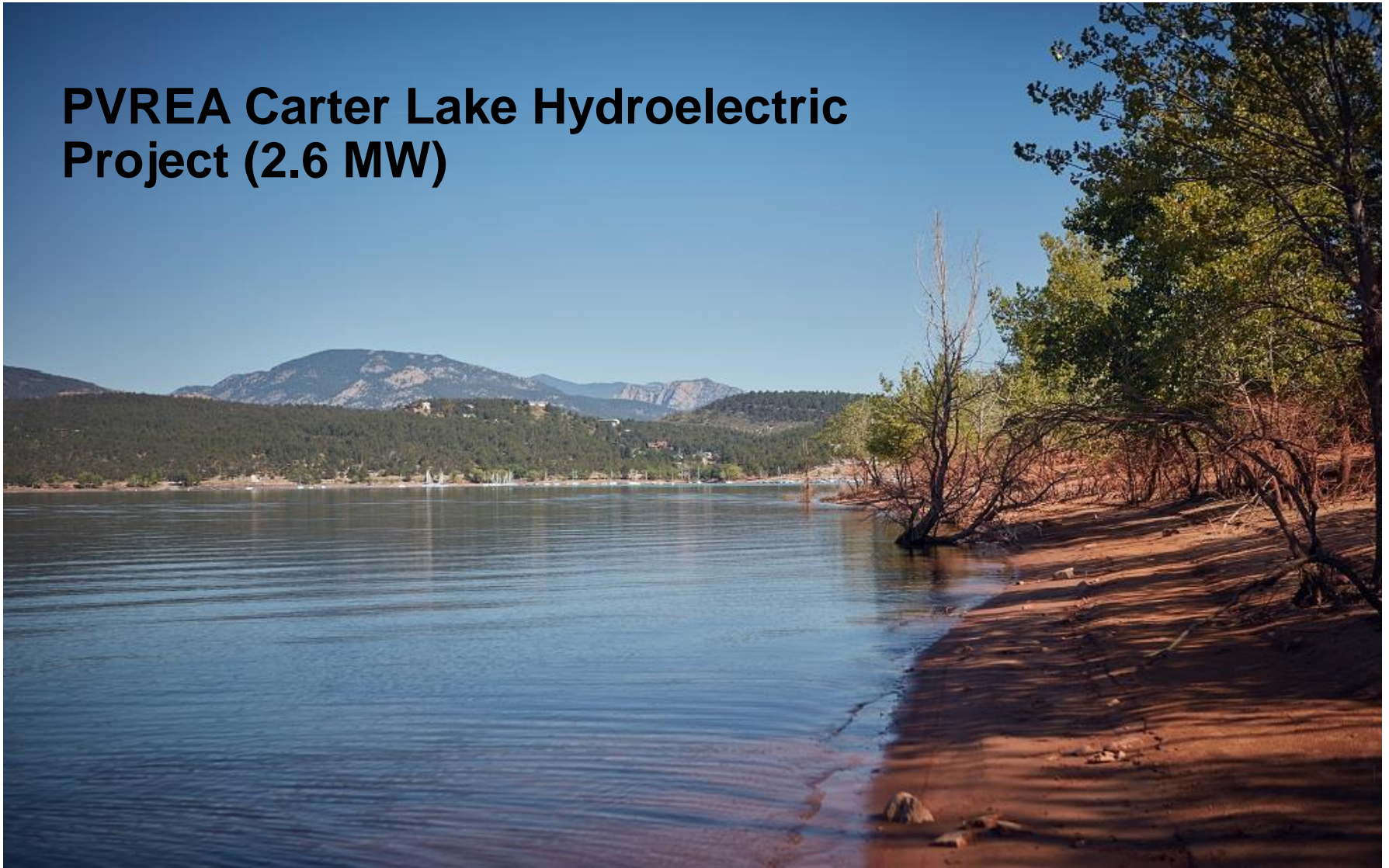
San Isabel Electric Huerfano County Wind Farm (8MW)



United Power Solar Garden (21KW)



PVREA Carter Lake Hydroelectric Project (2.6 MW)



Delta-Montrose Electric Hydro Project (6 MW)



La Plata Electric Association Williams Four Corners Waste Heat Recovery Project (5.8 MW)





**Holy Cross coal mine
methane project (3 MW)**

Questions?

DECEMBER 4TH, 2017
IN YUMA, CO



DISTRIBUTED GENERATION
WORKSHOP: COLORADO

Telling the Tale of DG in Colorado

Mike Bergey, Bergey Windpower Co.

Eric Lovely, Sunrun Inc.

Charles Newcomb, Hoss Consulting Inc.

Small Wind in Colorado

DWEA Colorado Distributed Generation Workshop

Mike Bergey
Bergey Windpower
Norman, OK

December 4, 2017



Walmart
Aurora, CO

Bergey Windpower Co.

The World Leader in Small Wind

- ❖ Small wind turbines, up to 15 kW: On-grid and off-grid for distributed applications
- ❖ 40 years, 10,000 installations, covering all 50 States and over 120 countries
- ❖ Pioneered “sophisticated simplicity”
- ❖ Turbines have 2-4 moving parts, require no scheduled maintenance



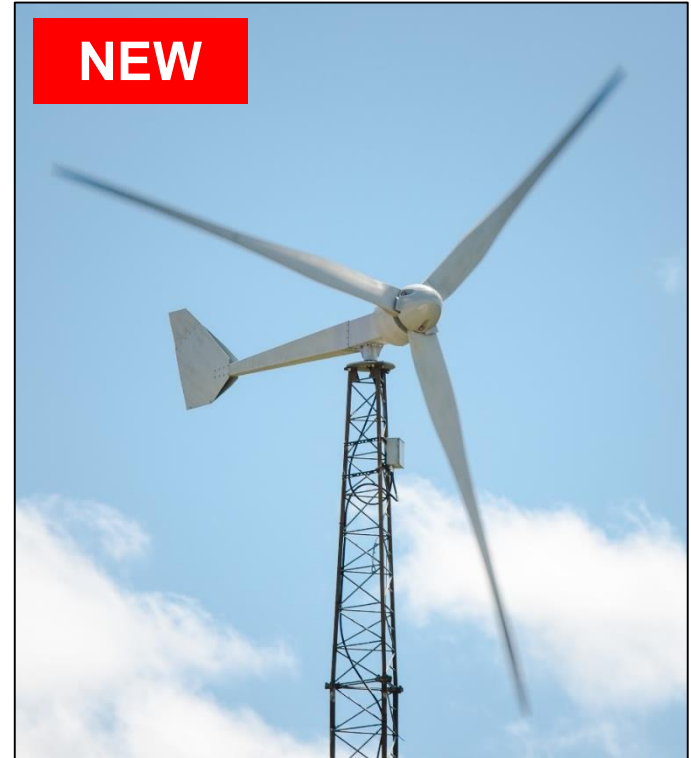
Bergey WindPower Products



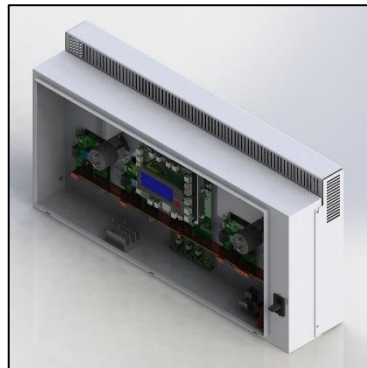
1 kW
8.2 ft Dia.



10 kW
23 ft. Dia.



15 kW
31.6 ft Dia.



**Inverters
& 48 VDC Battery
Charger**

Many Standard Tower Options 60 – 160 ft.



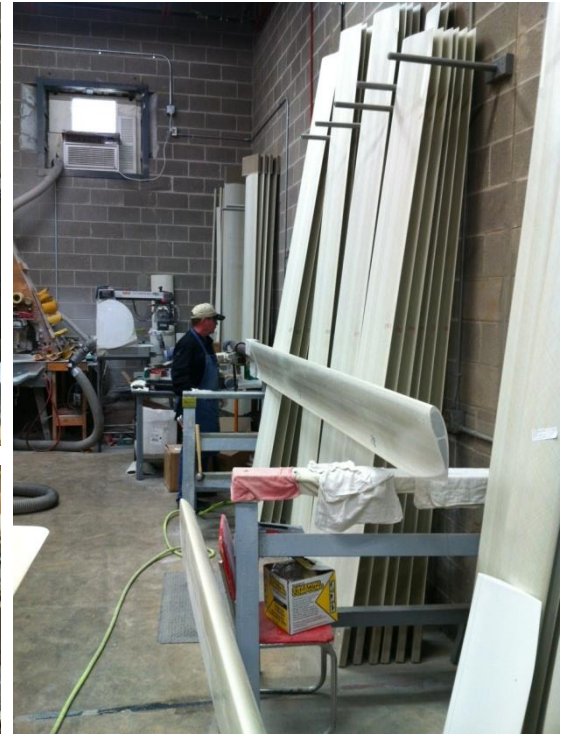
Guyed Lattice

Self-Supporting
Lattice



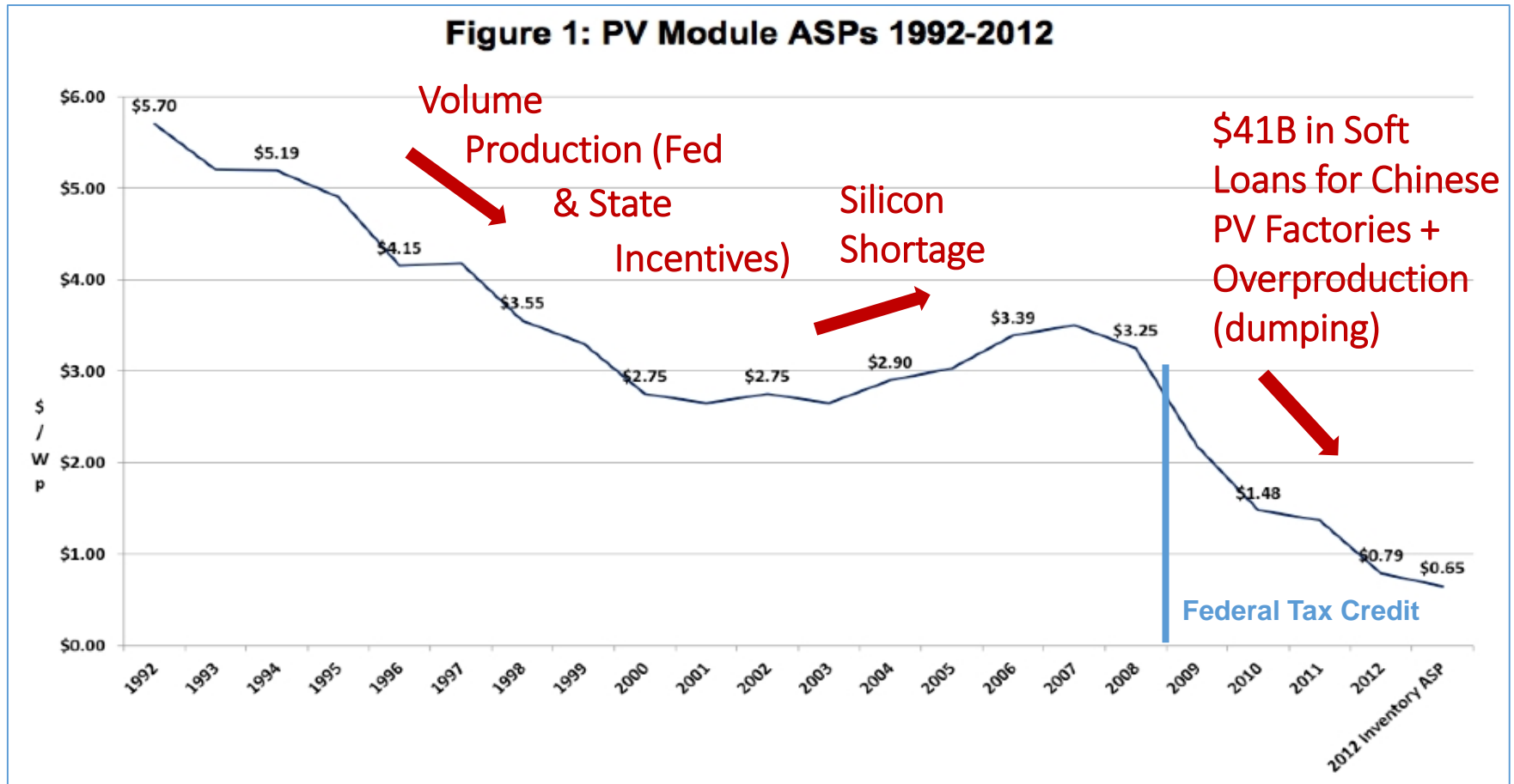
Monopole

Made in America



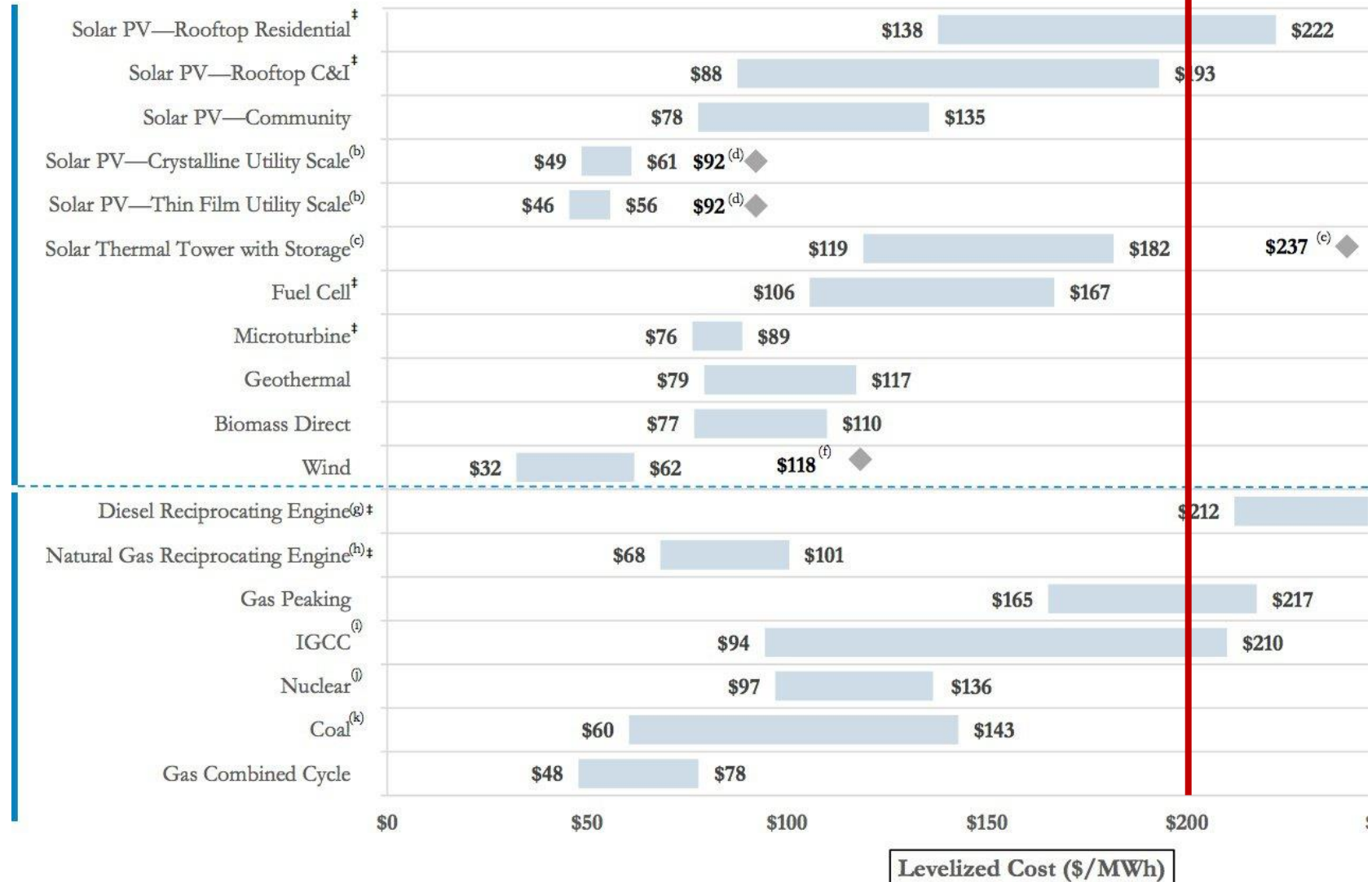
Domestic Content: >90%

Invasion of the Chinese Solar Modules

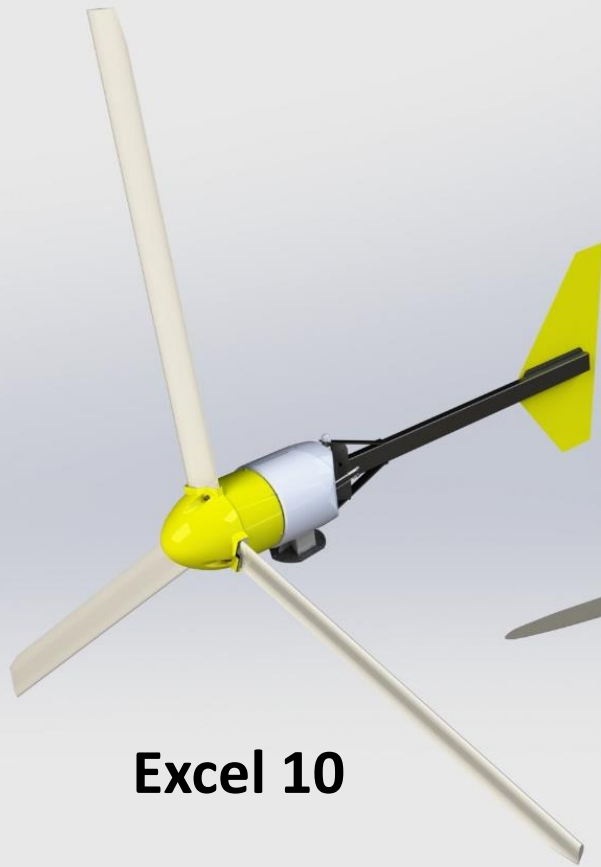


Levelized Cost of Energy (LCOE)

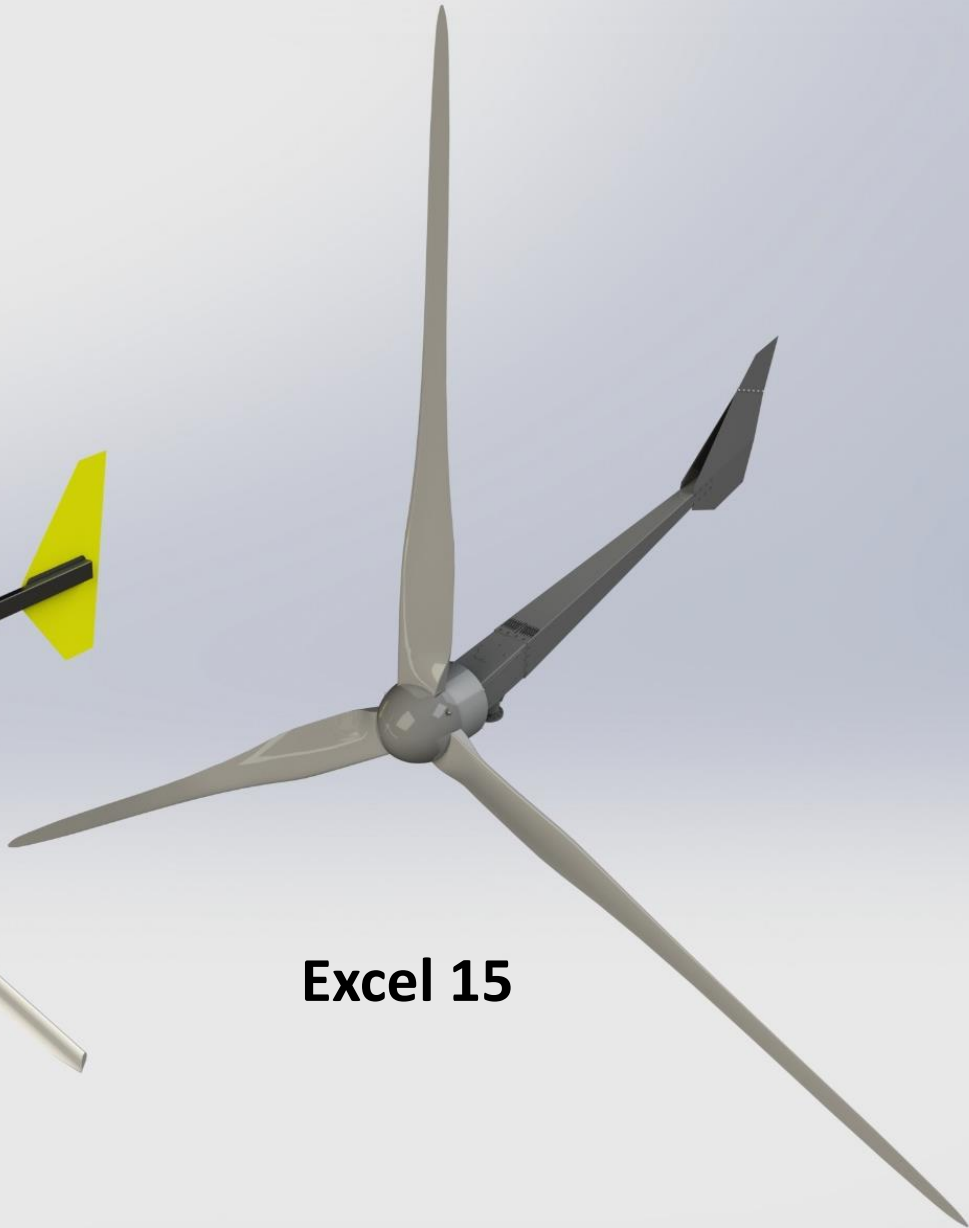
Excel 10, 30m SSL (\$200)



NextGen Small Wind: Bergey Excel 15



Excel 10



Excel 15

Excel 15's Advanced Technology



- 31.5 ft. Diameter
- Rated Power: 15.6 kW*
- Rated AEO: 30,100 kWh*
- Stall regulation (inverter + dump load)
- 25 kW Intergrid inverter
- 2 moving parts
- Same towers as Excel 10
- Supported by US-DOE/NREL
- Currently in certification

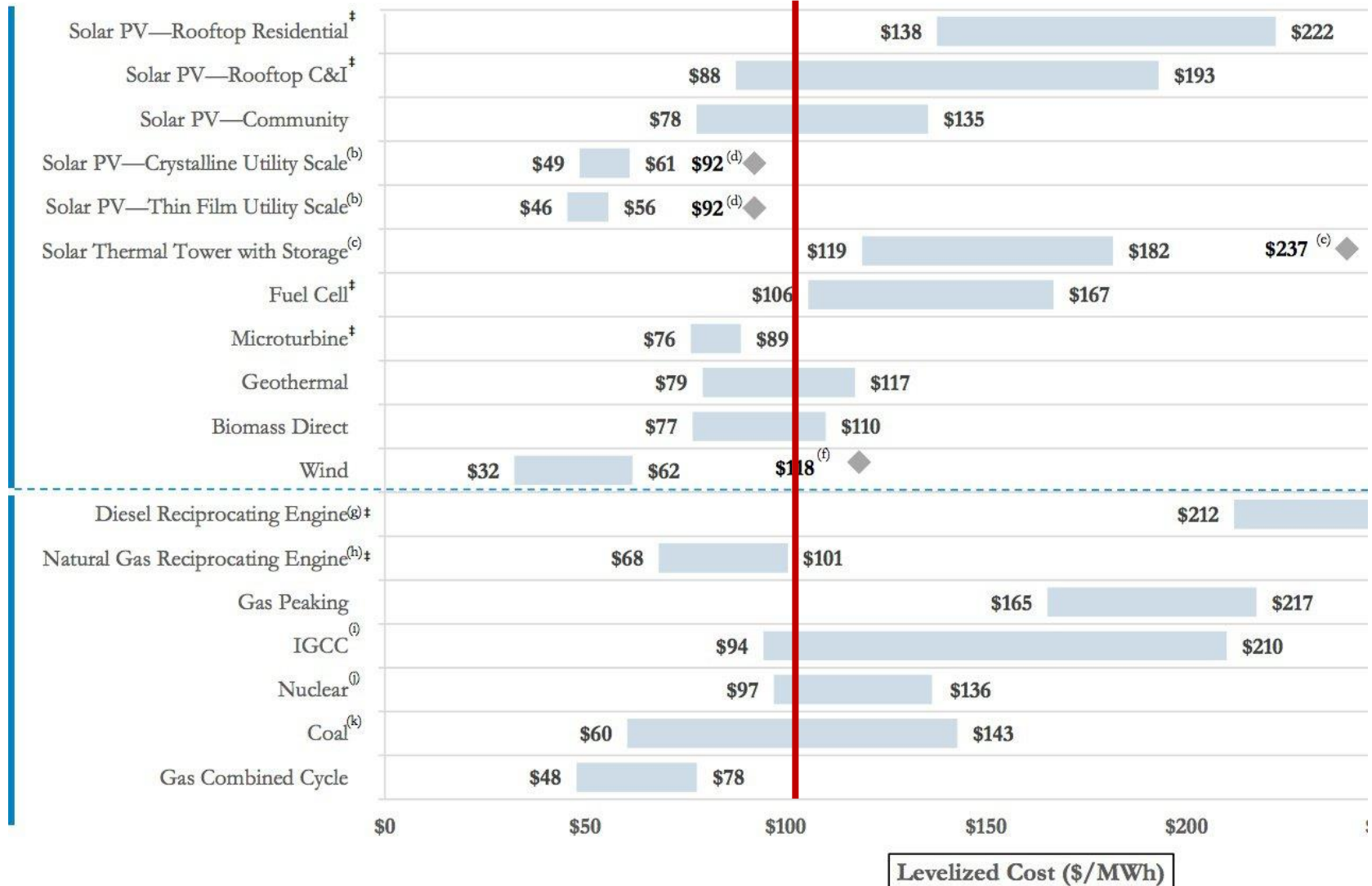
* - Preliminary, Pre-Certification

Excel 15 – Superior Economics

	Excel 10	Excel 15	Change
Rotor Diameter	7m (23 ft)	9.6m (31.5 ft)	+ 37%
Rotor Area	38.5m ²	72.4m ²	+ 88%
Ref. Power (11 m/s)	8.9 kW	15.6 kW	+ 75%
Max. Cp	0.30	0.42	+ 40%
Max. RPM	450	140	- 69%
AEO at 6 m/s (NREL LCOE)	18,825 kWh (CF = 21.5%)	39,300 kWh (CF = 30%)	+ 109%
MSRP, with inverter	\$31,770	~ \$37,500	+ 18%
Retail CAPEX, 30m SSL Tower	\$71,530	\$77,760	+ 9%
Retail NREL LCOE, 30m SSL Tower	20.0¢	10.2¢	- 49%

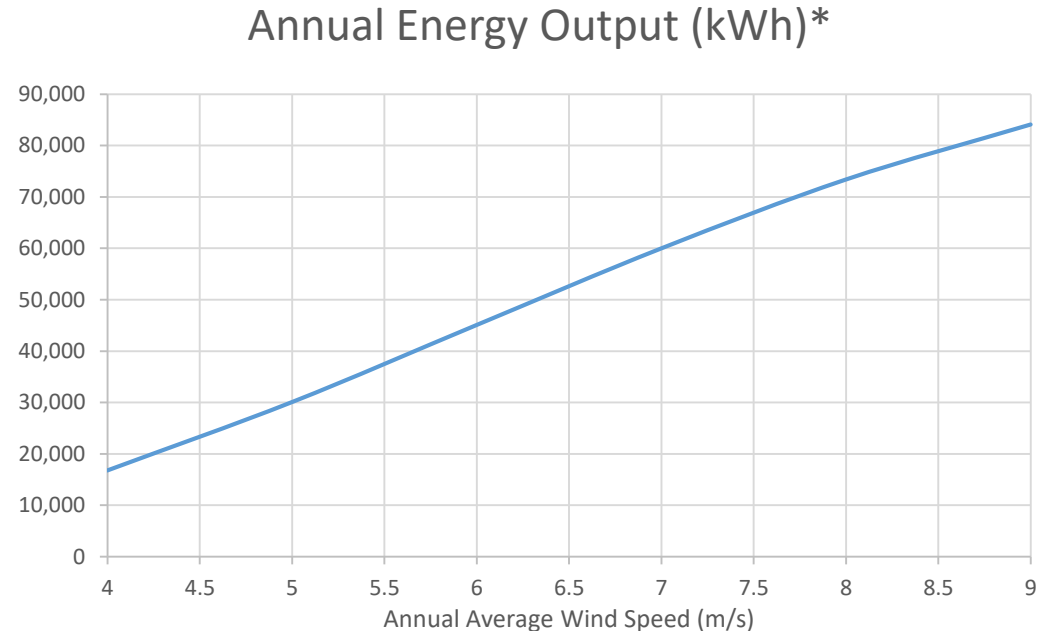
Levelized Cost of Energy (LCOE)

Excel 15, 30m SSL (\$102)



Excel 15 – Performance

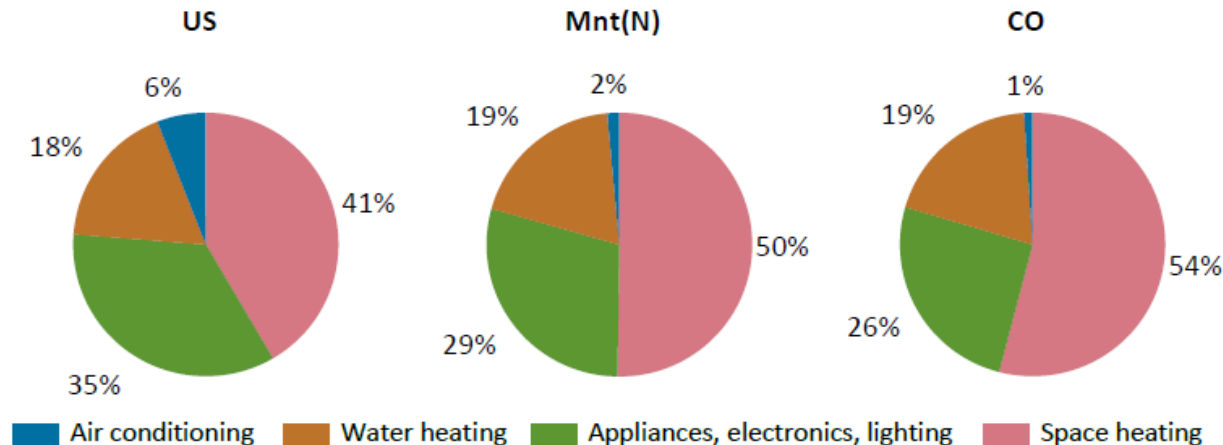
Annual Average Wind Speed (m/s)	AEO (kWh)*
4	16,800
5	30,100
6	45,100
7	60,000
8	73,400
9	84,100



Powerful enough to support electric cars and electric heat

* - Preliminary, Pre-Certification

Importance of Residential Heating



CONSUMPTION BY END USE

Since the weather in Colorado is cooler than other areas of the United States, space heating accounts for more than half of household energy use (54%), while air conditioning accounts for only 1% of energy use.

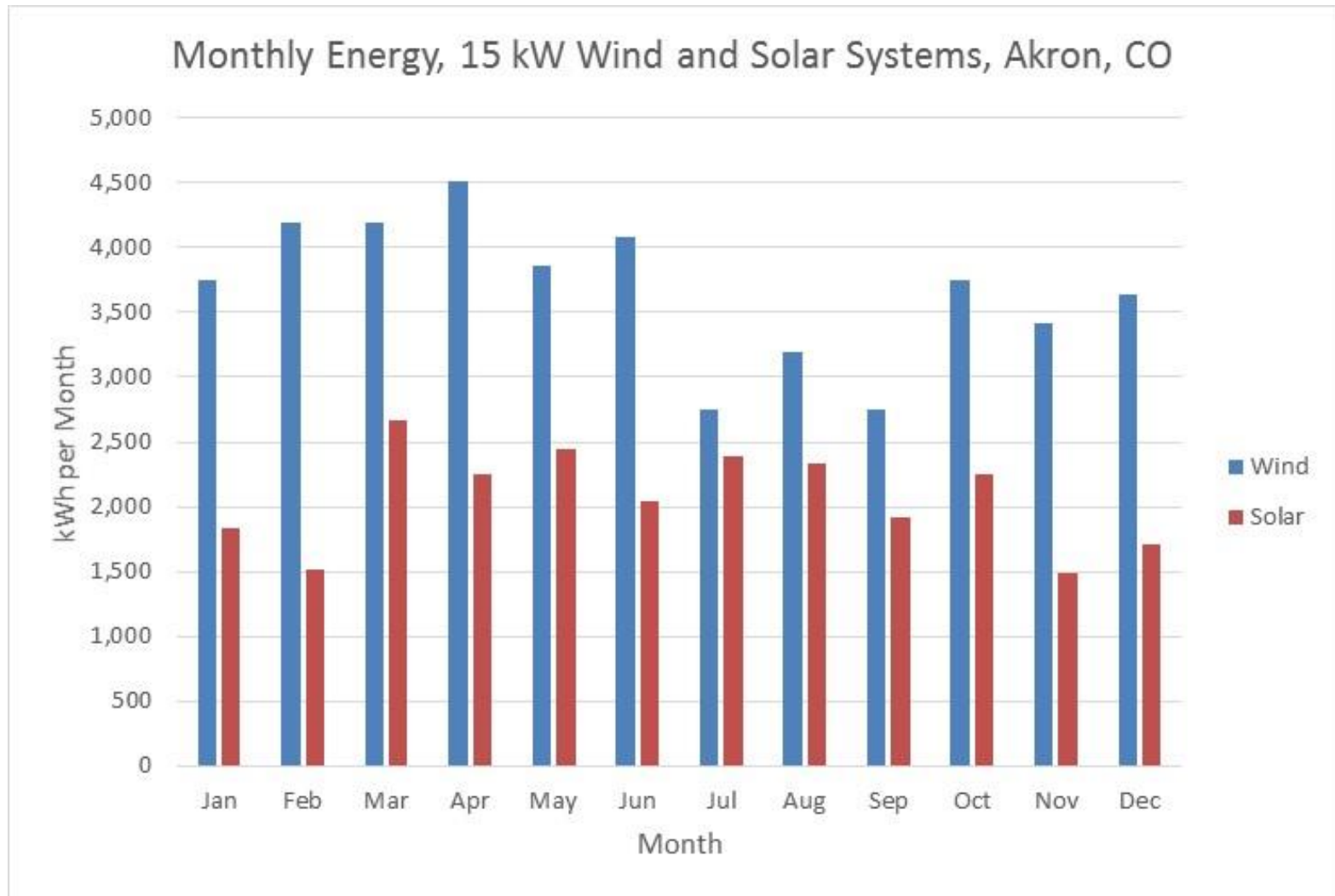
Source: EIA, 2009 Census Data

EIA Prediction of 2017 Winter Heating Expenditures

Change in forecast fuel expenditures from last winter			
Fuel	Base Case	If 10% warmer than forecast	If 10% colder than forecast
Heating oil*	17%	5%	32%
Natural gas	12%	3%	19%
Propane *	18%	2%	41%
Electricity	8%	4%	12%

Source: EIA Winter Fuels outlook, Oct. 2017

Small Wind and Solar in Eastern CO



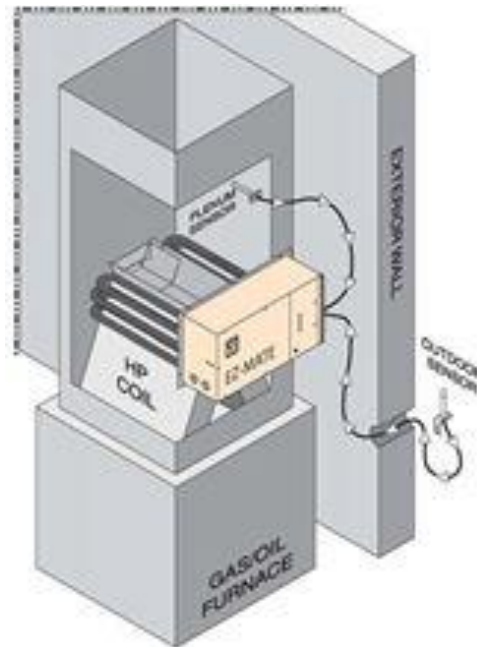
Wind: 44,000 kWh, CF = 33.5%

Solar: 24,800 kWh, CF = 18.9%

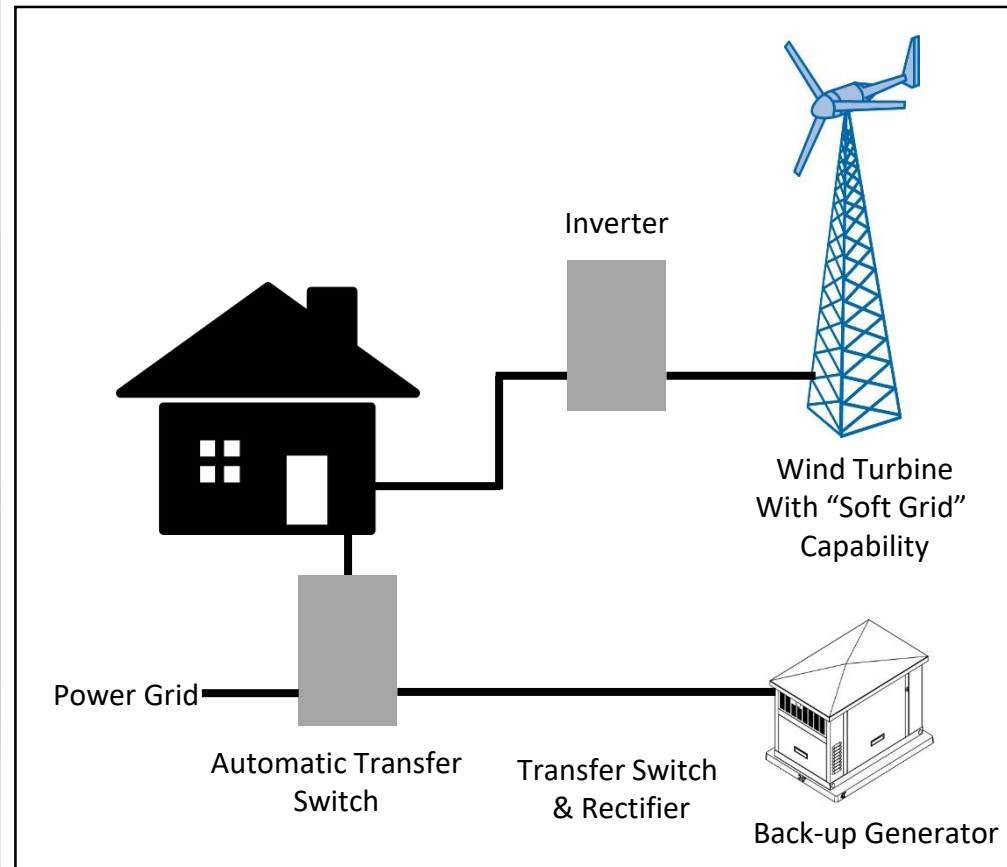
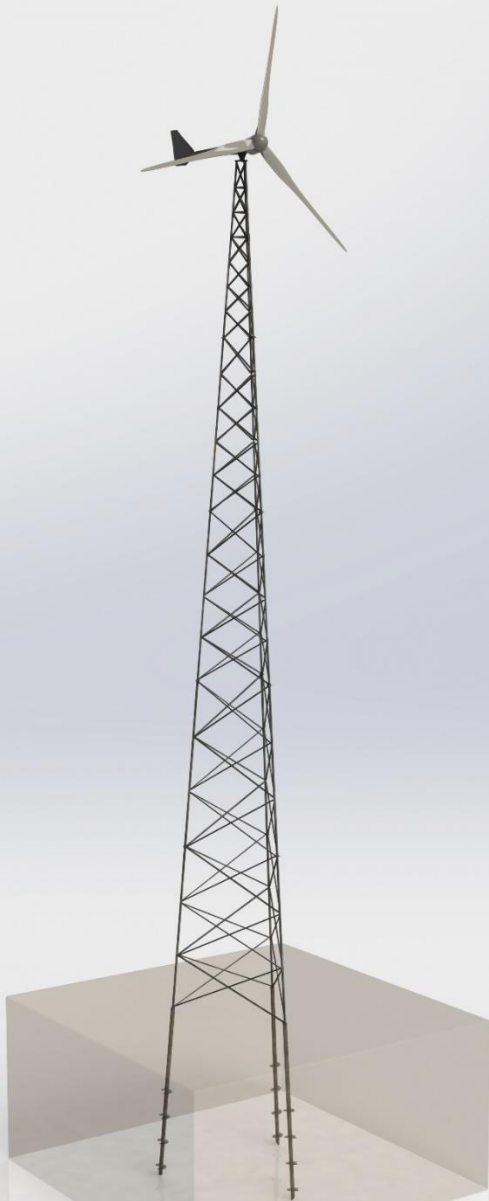
Fuel Switching to Electric Heat



- 15 kW Electric Plenum Heater; ~ \$1,000
- Retrofit to existing propane forced air heaters, estimated at \$3,500
- Bergey 10 kW customers in NY have switched to electric heat & hot water



Excel 15 – Continuing R&D



**Parallel Operation with
Standby Generators**

Helical Anchors

Bullish on Small Wind in Eastern CO



- Excellent wind resources in Eastern CO
- New technology and new financial models
- Movement towards electrified heating and transportation
- Opportunities for local economic development



DG with Solar PV in Colorado

Eric Lovely

December 4th 2017

Create a planet run by the sun



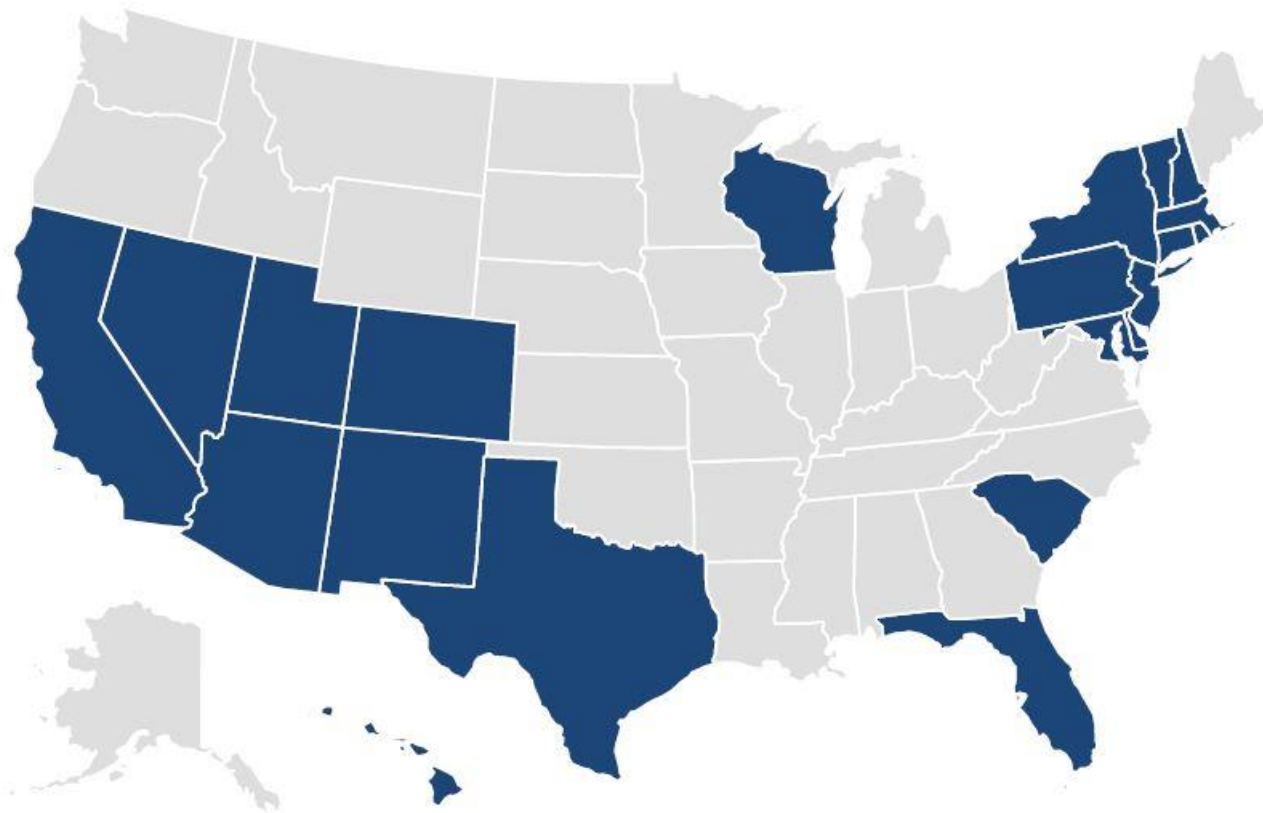
Actual neighborhood of Sunrun customer homes

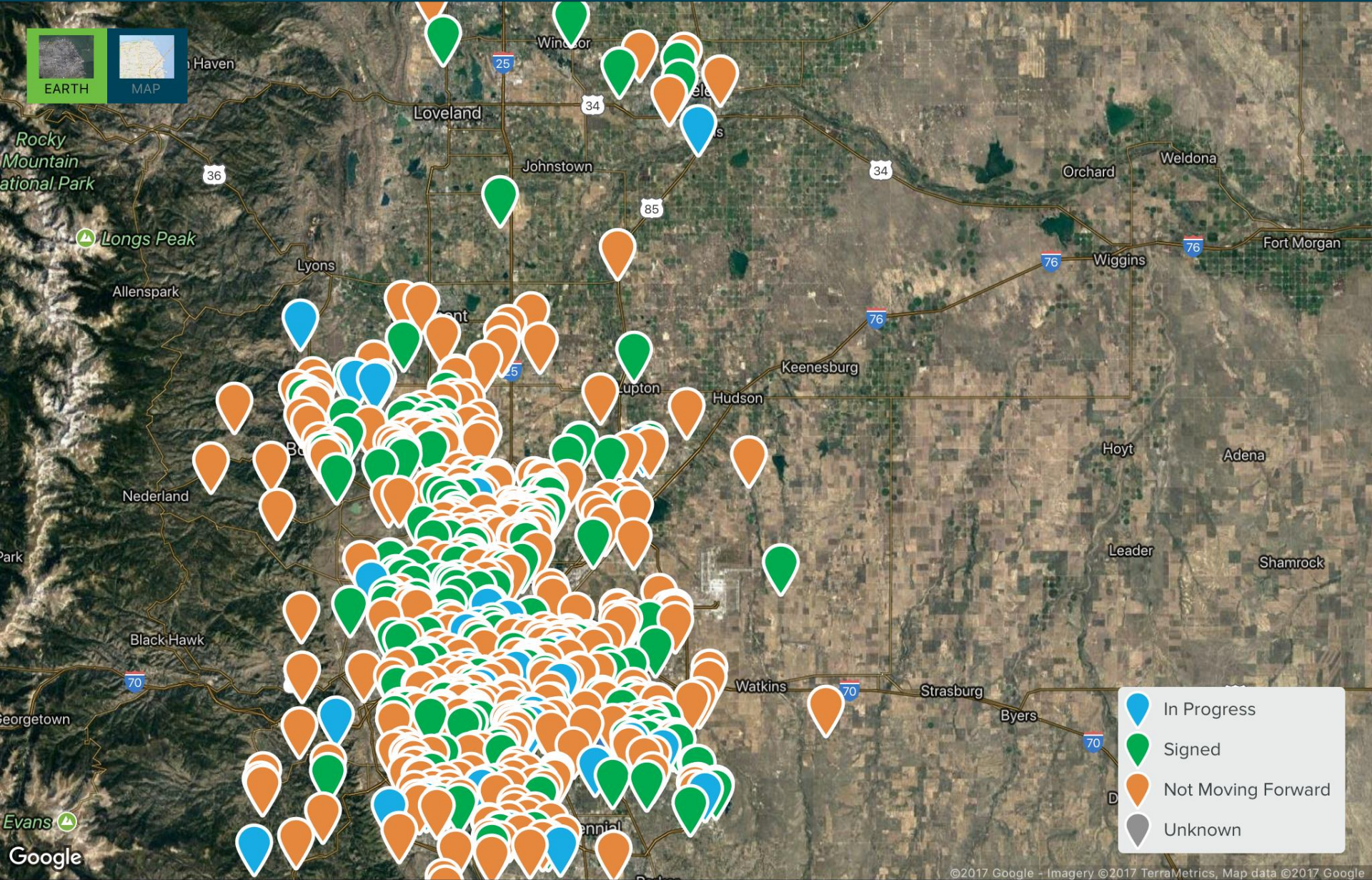
Who is Sunrun?



Passing SolarCity/Tesla for most deployed 3rd party owned PV systems in Q4 2017.

- Sole business is residential solar PV
- Founded 'solar as service', aka Lease, business model in 2007
- Over 150,000 Customers nationally, over 6,000 in Colorado
- Founded in 2007, acquired REC Solar/Mainstream Energy in 2014
- Direct and partner sales
 - Over 50% sales come from partner sales companies
- Lynn Jurich, co-founder and CEO, is personally invested in energy plus storage.





Q3 2017 Operating Highlights



- Total deployments of 90 MW, an increase of 12% year-over-year and exceeding the company's guidance of 88 MWs
- Net Present Value (NPV) of \$93 million created, an increase of 21% year-over-year
- Unlevered NPV of \$1.15 per watt, the highest level in the company's history
- Cumulative MW deployed of 1,117 MW, an increase of 39% year-over-year
- Net Earning Assets of \$1.2 billion, reflecting a 24% increase year-over-year

Residential Solar PV in Colorado



Publically Regulated and Deregulated Utilities

- Xcel and Black Hills Energy are regulated
- Mixed experience with deregulated co-ops
- IREA is pushing back

Awesome solar resource

- Up to 1600kWh per kW/yr installed for PV in Colorado
- 300 days of SUN!
- Really good skiing not far away

Low Cost of Energy

- Residential rates of 10.7 to 15 cents per kWh
- Black Hills around Pueblo is most expensive

Sunrun Solar PV in Colorado



Westminster Branch Operations

- 4MW annual installations
- <70 day sign to installation average
 - Record is 28 days!!!
- \$1.59/watt installation cost!!!
- New customer Net Promoter Score (NPS) = 80
- 5 installation crews, 2 full sales teams + support staff
=70 local ops staff

Denver Corporate Offices

- **Over 500 hired since December 2015!!!**
- Electrical engineering design center
- Customer Care
- Financial services including Credit approval, Collections
- Project management
- Contract review

Sunrun solar options



Monthly Service

- aka Lease
- 10.1 cents/kWh with 2.9% escalator
- 13.1 cents/kWh fixed
- Sunrun covers design, installation, insurance, monitoring, maintenance, and repair
- Money back performance guarantee
- Option to own or have Sunrun responsible for removal after 20 years

Prepaid Service

- Prepay 20 years of service for big discount
- As low as 8 cents/kWh fixed for 20 years!
- Sunrun realizes tax benefit but customer doesn't have to wait
- Sunrun has more tax advantage than common consumer
- What is the opportunity cost?

Purchase

- ~\$3.40/watt
- 30% federal tax credit
- Most process through Costco for best price and benefits
- 25 year performance warranty via manufacturer
- Option to include 20 years of service for higher cost (no insurance).

Power On!



Net Metering

- One to one kWh credit rollover
- Low grid connection fees
- Protection from higher tiered rates

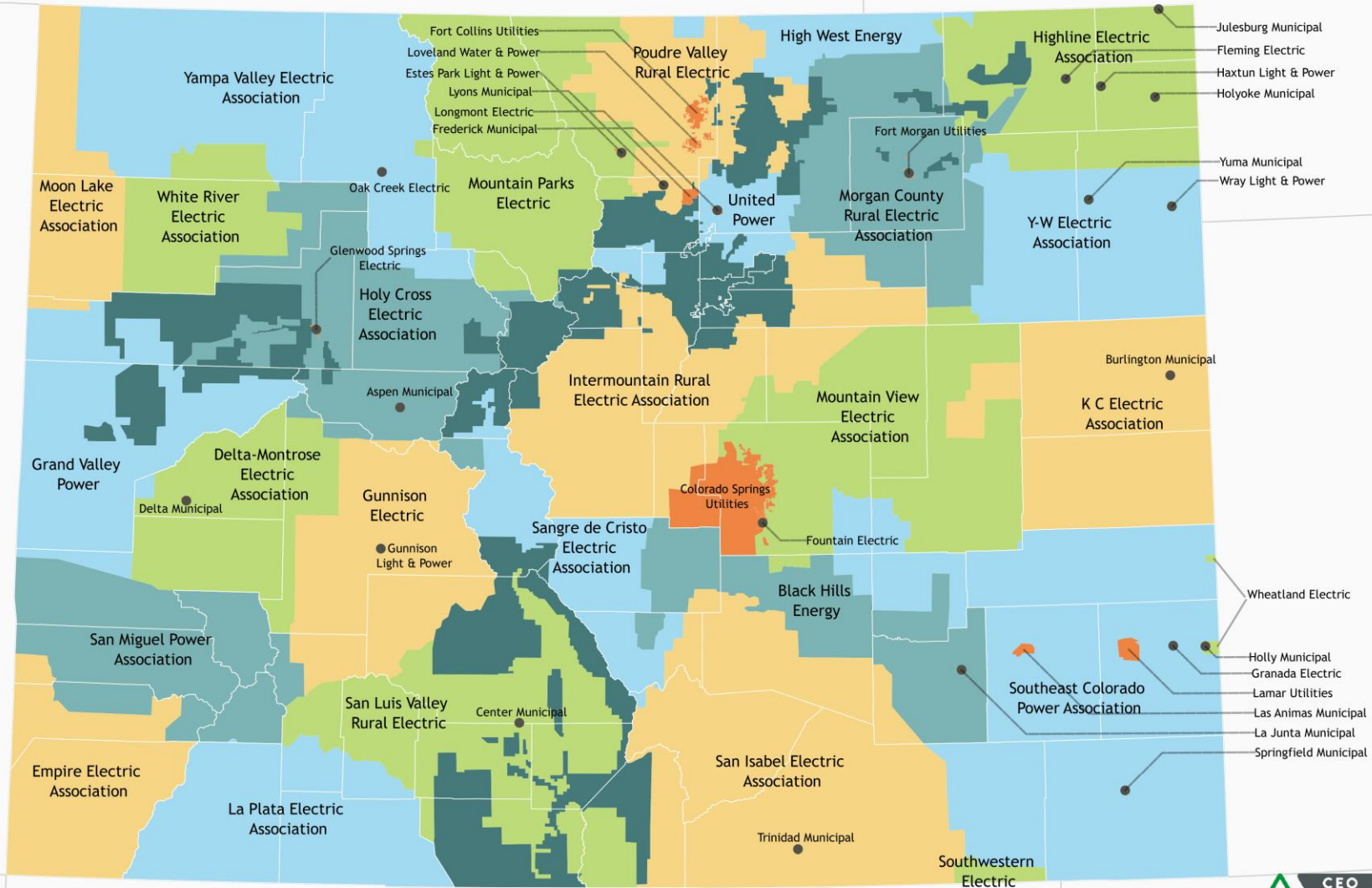
Net Metering *

- One to one kWh production credit at least when producing
- High grid access fees
- Instantaneous Demand Charges.
- Time of Use rates

Battery Backed DG

- Two way energy management
- Battery owner negotiates kWh credit value.
- >Grid resiliency
- **\$8k for 10kWh battery** keeps this at bay in Colorado for moment

Colorado Electric Utility Service Territories



A tale of two utilities...



Xcel

- One to one kWh credit rollover
- Low grid connection fees
- Protection from higher tiered rates
- Tried to come up with high grid access fees
- Restricted by PUC
- New 'Voluntary' rate programs

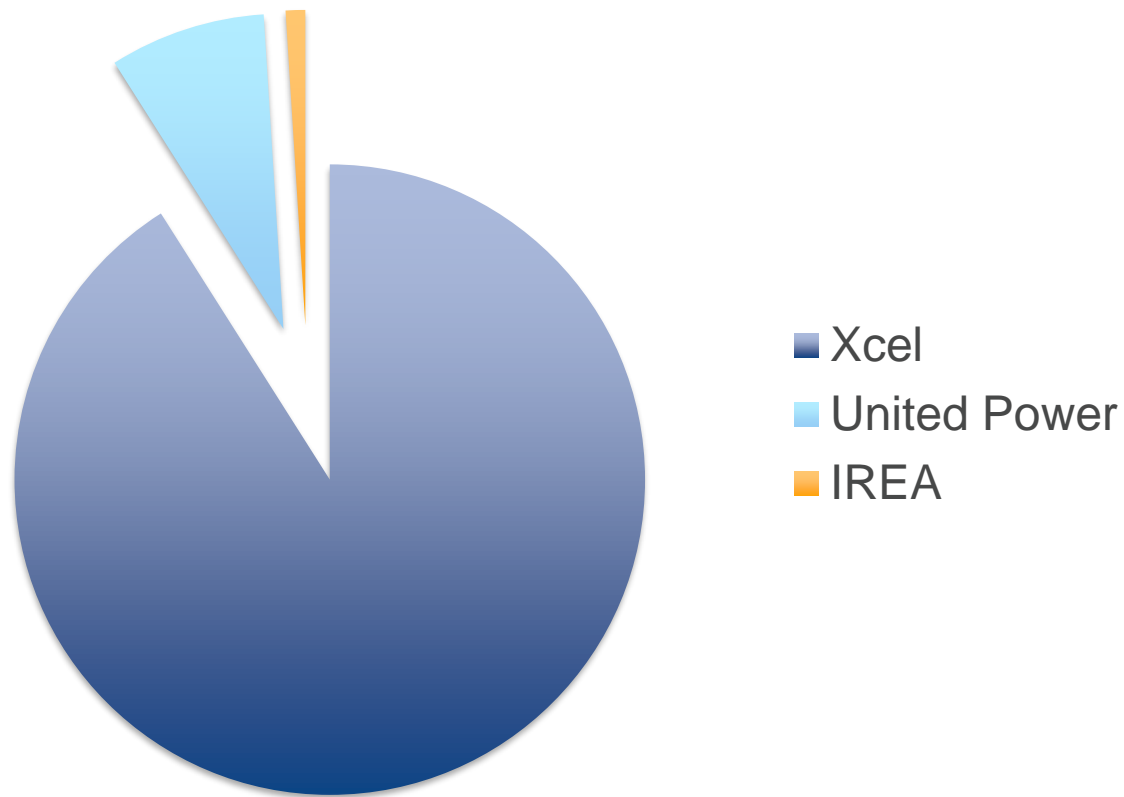
IREA

- One to one kWh production credit at least when producing
- Instantaneous Demand Charges.
- No Time of Use stamp on meter read!

Sunrun sales in Colorado by Utility



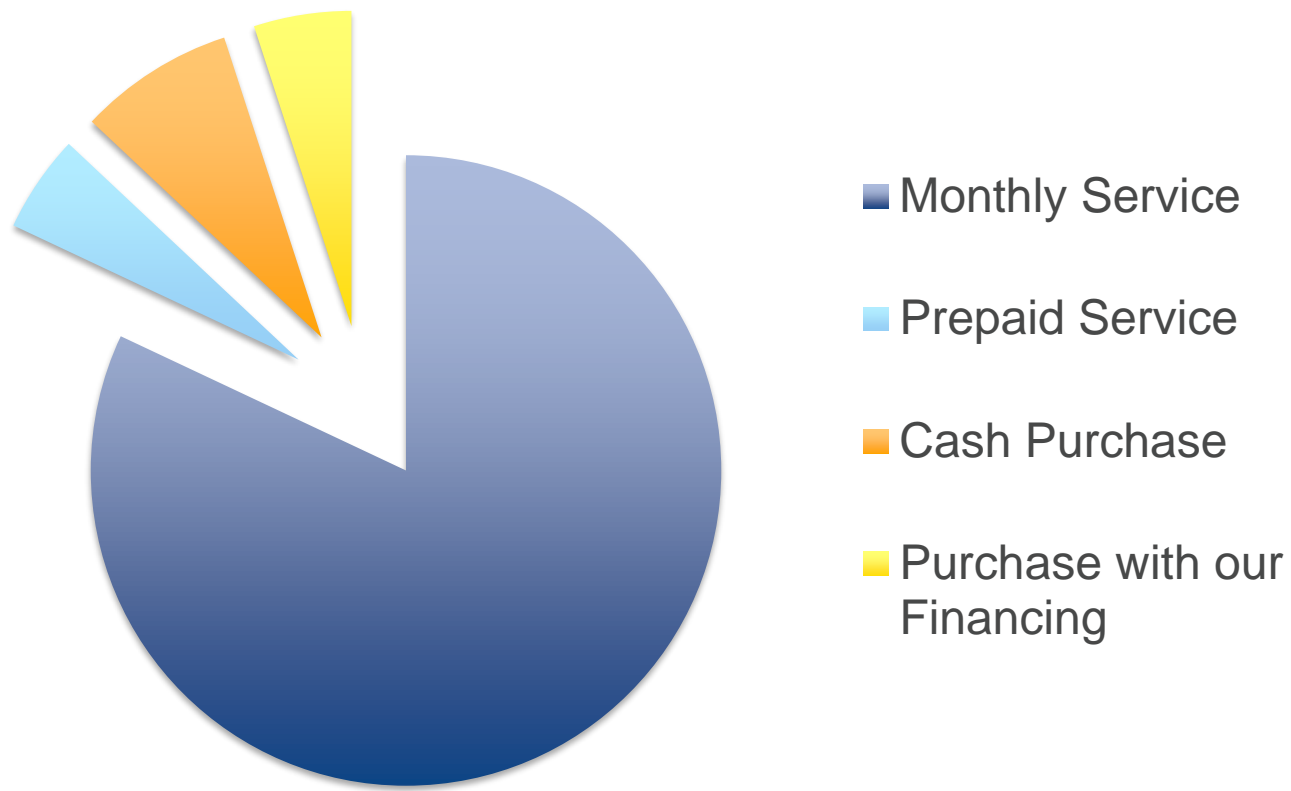
2017



Sunrun sales in Colorado



2017



Sunrun BrightSave™ Agreement



Take Control of Your Electric Bill

\$0

Deposit due
Today

20 Years

Agreement Term Length
(2.9% annual increase
in monthly bill)

\$118.00

Monthly Bill for Year
One (plus taxes, if applicable;
includes \$7.50 discount for
Auto-Pay enrollment)

\$0.101

Year 1 Cost per kWh
(excluding upfront
payment, if any)

WE'VE GOT YOU COVERED WITH OUR WORRY-FREE SERVICE



We provide a 95% performance guarantee; you will not be charged for the extra electricity.



We warrant, insure, monitor, maintain and repair the system. We also provide a 10-year roof warranty.



Selling your home? We guarantee the buyer will qualify to assume your agreement.



We'll remove the system at the end of the term, free of charge.



A SOLAR SYSTEM DESIGN FOR YOUR HOME

You get a 11.97 kW DC Solar System

With 42 Solar Panels and 1 Inverter(s)

Which will produce an est. 14,024 kWh in its first year

And offset approx. 99% of your current, estimated electricity usage

YOUR SALES REPRESENTATIVE:
Eric Lovely
eric.lovely@sunrun.com

Imperfect roof? No problem!



- 800kWh/kW/yr minimum for any roof plane
- Will install on North roofs up to 6/12 pitch or 26deg

brightbox™
RESIDENTIAL SOLAR + BATTERY STORAGE



BrightBox Battery Availability



Make your home a Brilliant Home with Sunrun BrightBox™



Thank you for your time!

Telling the Tale of DG Wind

DWEA Distributed Generation Workshop

Yuma, CO

December 4, 2017

Charles Newcomb

Hoss Consulting

Projects: Getting Them Right

- Team
- Technology
- Approach
 - (what's the right development/ownership model?)
- A few things to look for

Approach

- Development models
 - DIY
 - Work with a installer/developer/leasing company
- Ownership models
 - Own
 - Lease
 - Hybrid



DIY

- Incredible learning experience
 - There are people who can help
- More workable for smaller projects
- The industry is starting to gain traction in CO
- Timing is everything
- Getting it wrong affects more than just your project

Working with an Installer/Developer

- Experienced
 - Designing/Siting/permitting/interconnection
 - Project design/engineering
 - Project management
 - Construction management
- Connected
 - Able to leverage relationships
 - Equipment/services/subcontractors
- Efficient
 - Timing is everything

Choosing an Ownership Model (own)

- Independence/On your own terms
- You are responsible for how incentives are leveraged
 - You can find help for this
- You'll need to be responsible for working with the manufacturer/developer if things go wrong
- You'll be responsible for financing the project
- You can still leverage the experience of a developer

Choosing an Ownership Model (lease)

- Leasing companies usually have scale behind them
 - rinse/repeat
 - "transactionally" efficient
 - leverage development ecosystem/infrastructure
 - efficient monetization of incentives
- You are insulated from problems
- You still need to participate
 - You are the utility customer/landowner/local

Choosing an Ownership Model (hybrid)

- Early buy-out
- All/most of the benefits of a lease
- A great way to insulate from infant mortality issues
- Most lessors will still warranty long-term

Changing Gears (asking questions of “partners”)

Track Record

- Ask for references
 - Same size/complexity
 - Similar setting
 - Utility
 - Environmental
 - Soil/terrain/weather
- Familiarity with local requirements



Approach

- Tranche
 - Do they need a certain number of projects before proceeding?
 - How long is the development window open?
 - What else can trigger (or halt) the development?
 - Are there incentive risks?
- Rolling basis
 - What can change the strike decision (moving)
 - How long would the project be at risk

Pace

Timing is (still) everything

- What are the expectations
 - Timing
 - How long will the project take to develop?
 - Based on...?
 - How is progress reported (frequency?)
 - Product
 - Specifications
 - Energy production
 - Renewable fraction (of bill)
 - Price escalator
 - Purchase options
 - Remedies
 - Roles
 - Who does what to keep things moving?
 - What will they need from you?



What if...

- Policy risk
 - How much does the project depend on incentives?
- Market risk
 - What if the market landscape changes?
- OEM Risk
 - What if they cease to support the project?
- Developer Risk
 - What if they change their focus?

What happens when...

- The equipment fails to work
- There are complaints
- The project reaches the end of its life



What about...

- Project Development details
 - Will I lose power? For how long?
 - How will my site be disrupted
- Monitoring/Maintenance
 - How will you know how much is being produced?
 - What sort of reports will be available?
 - Who will maintain the equipment?
 - Am I allowed to turn it off?

What about...

- What about Force Majeure?
 - How long could I be down?
 - What about extended outages?
- Is there an “abandonment” clause?



QUESTIONS?

DECEMBER 4TH, 2017
IN YUMA, CO



DISTRIBUTED GENERATION
WORKSHOP: COLORADO

State of the State: Panel Discussion

Sam Sours, Community Energy Inc.

Paul Roamer, Ethos Distributed Solutions

Roger L. Freeman, Attorney & COSEIA Board Member

Jennifer Jenkins, DWEA