Rob Davis

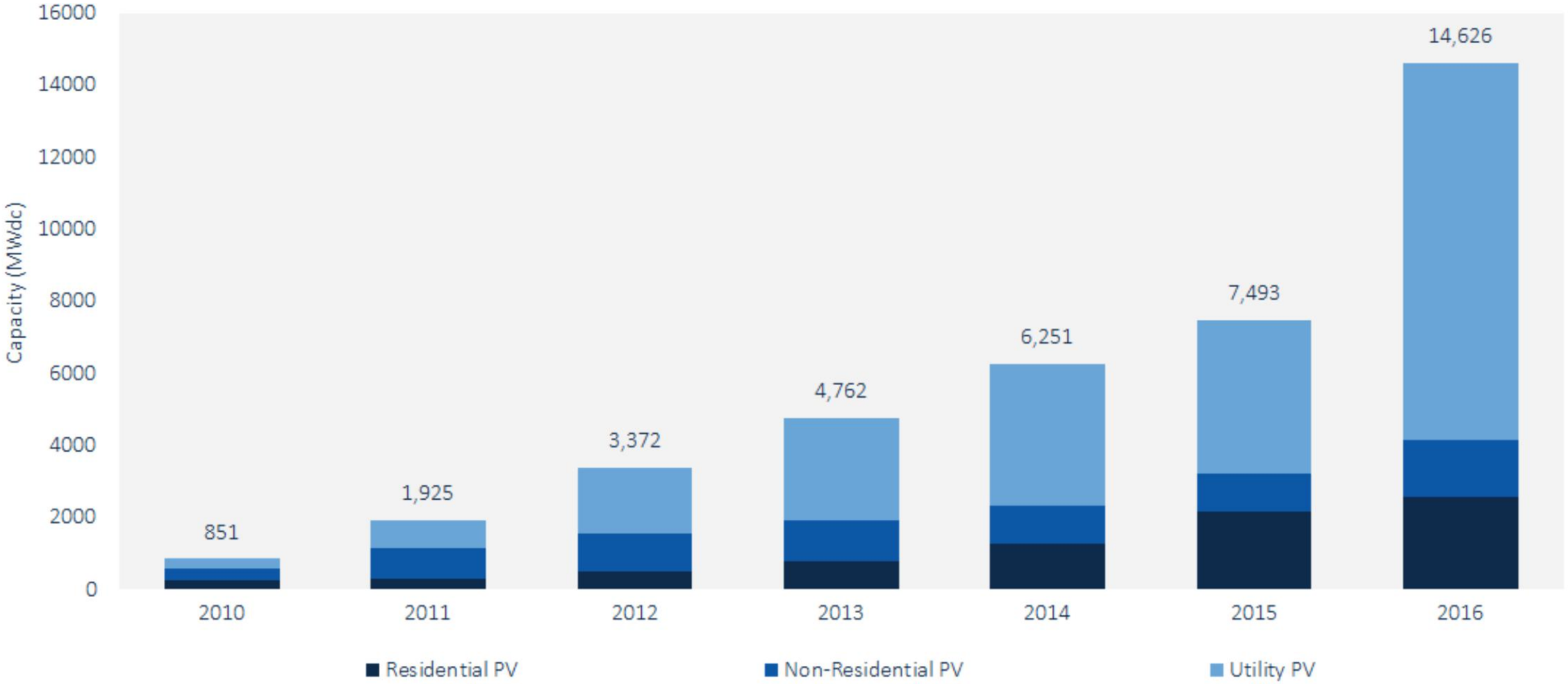
Director of Media & Innovation Lab

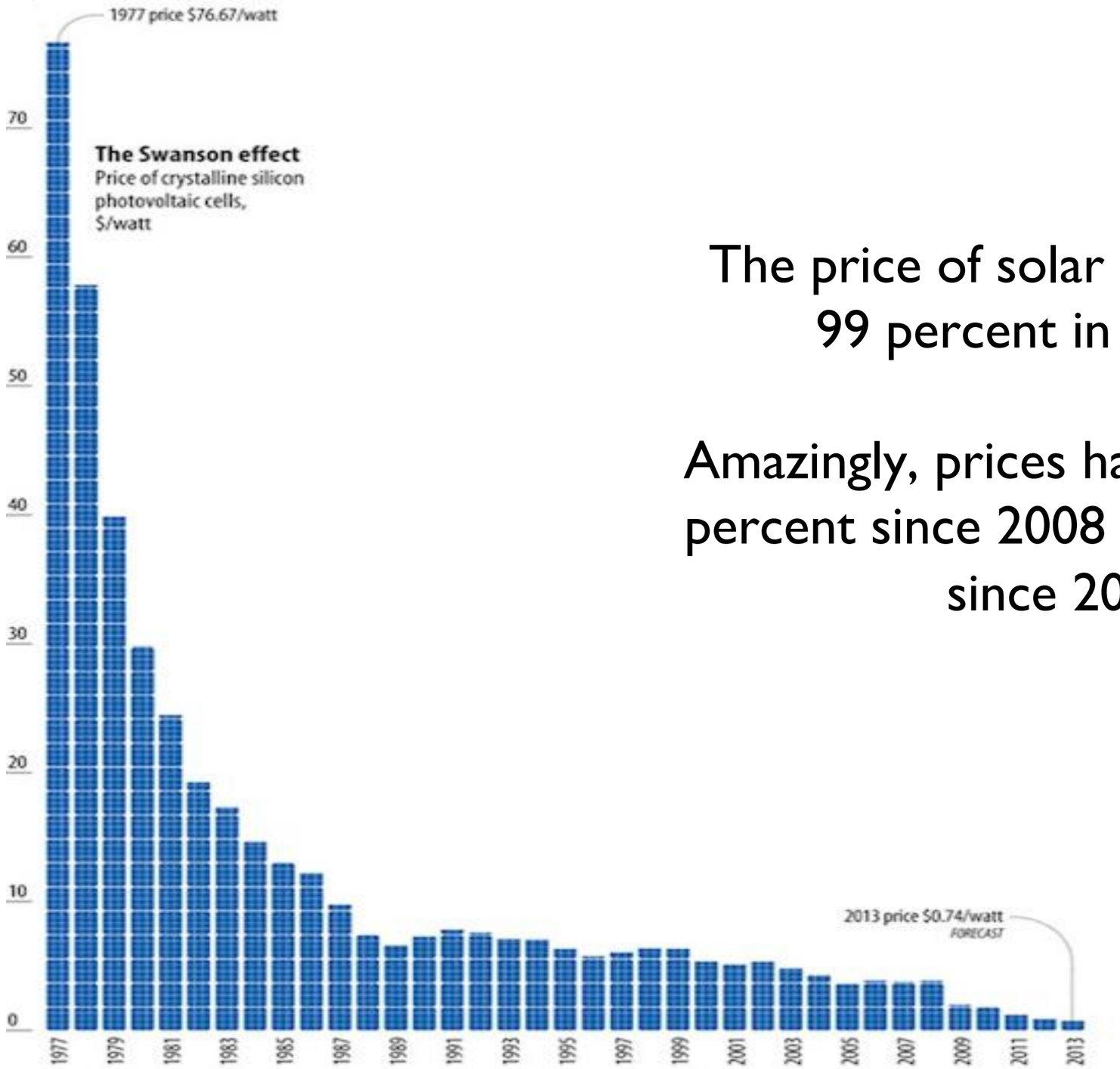
@robfargo (yes, Fargo)

Fresh Energy @freshenergy


Birds
Butterflies
Bees

Solar PV Installations 2010-2016



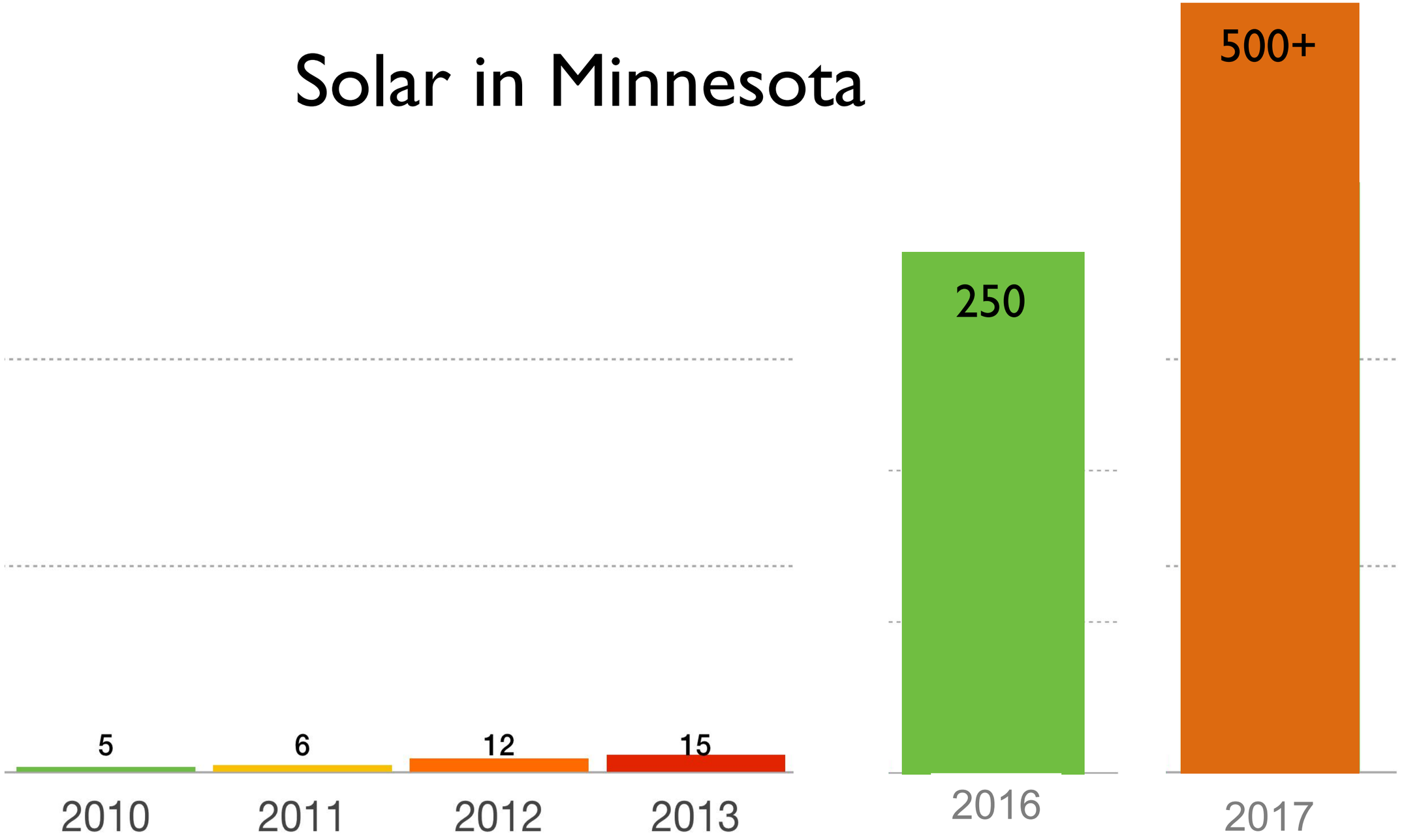


The price of solar cells has fallen 99 percent in 25 years.

Amazingly, prices have dropped 80 percent since 2008 and 60 percent since 2011.

Source: Bloomberg New Energy Finance

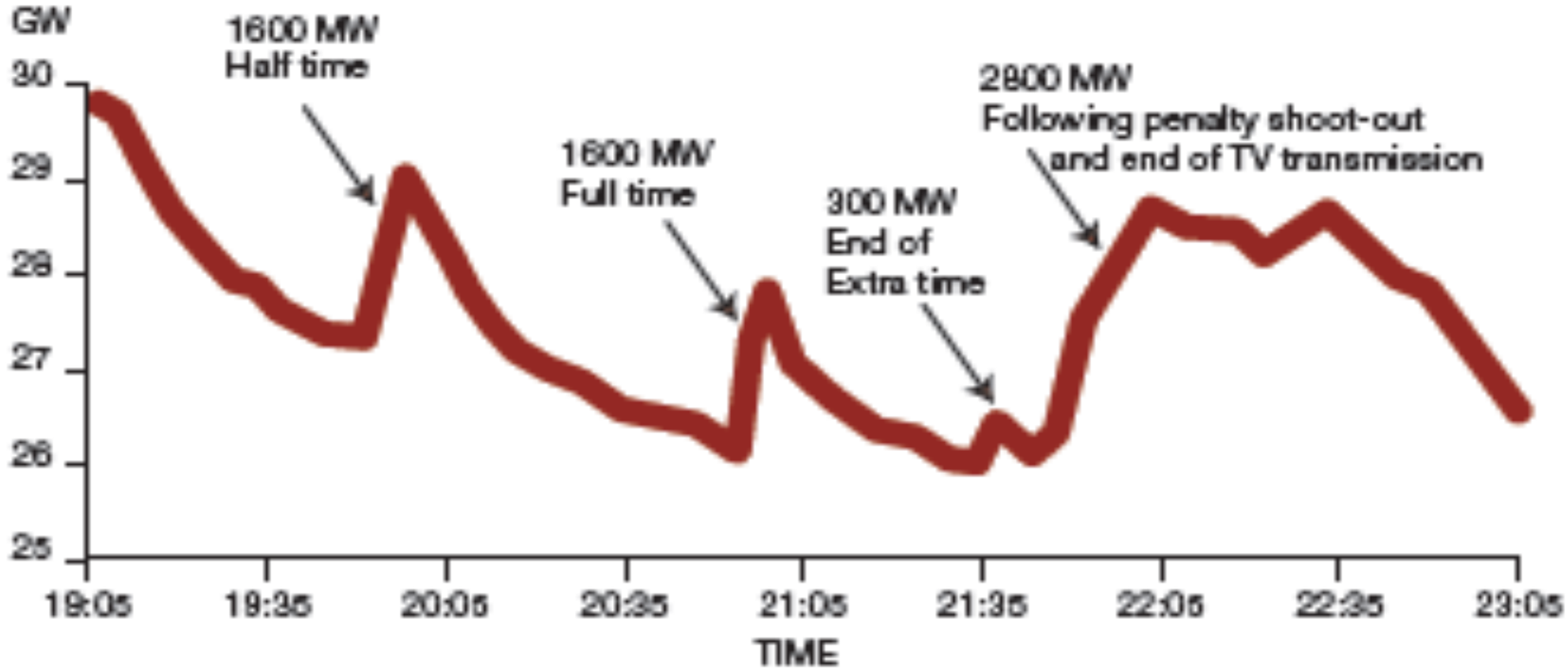
Solar in Minnesota



MN DEED & MN Public Utilities Commission

Variability & Uncertainty: Nothing New

England vs. Germany 1990, World Cup Semi-Final, Kick-off 19:00



Source: AWEA

City signs up for more solar

Nearly $2 million in savings projected over 25 years

By Mark Fischenich mfischenich@mankatofreepress.com Feb 16, 2017

Mankato Free Press

The city of Mankato is a major subscriber in a trio of solar arrays being developed in Blue Earth County by Geronimo Energy that, combined, are about 20 percent larger than this array in Alamosa, Colorado.File photo

RICHARD BEAVEN FOR THE WALL STREET JOURNAL

Energy from more than 1,200 solar panels powers Benjamin Freund's 650-acre dairy farm and home in East Canaan, Conn.

Solar Projects Sow Tension

As panels supplant crops on more farms, states weigh limits on big renewable fields

By Joseph De Avila

The boom in solar energy is forcing states and farming communities to grapple with where large renewable-energy projects should be built.

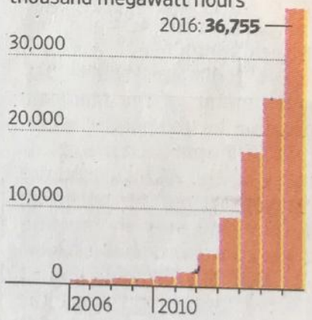
In Connecticut, a state senator has proposed a bill that would discourage the use of farmland for solar projects. Counties in North Carolina and Washington have already imposed temporary restrictions on large solar projects, citing concerns about loss of farmland and the impact on rural character. Massachusetts, tion of Counties.

The pressure in rural areas stems, in part, from simple economics. Some farmers are installing solar panels on a patch of their land to help offset energy costs. Other farmers are renting out entire fields to solar companies that can afford to pay premium prices for access to clear fields that don't require much work or money to prepare for a solar project.

"Of course, there can be local tension in terms of what people are used to on the farmland, what people like to see in a rural environment," said Amit Ronen, director of the George Washington University Solar Institute. "But I don't see it as a long-term constraint on continuing to expand solar fairly dramatically."

On the Bright Side

U.S. solar power generation in thousand megawatt hours



Source: Department of Energy

THE WALL STREET JOURNAL.

North Carolina Clean Energy Technology Center.

But large solar installations don't always sit well with local communities

whelming opposition," said Mr. Scanlon. The county denied the application.

Benjamin Freund, who has a dairy farm in East Canaan, Conn., in recent years installed more than 1,200 solar panels on a patch of his land and on top of his dairy barn. The generated power offsets his entire $6,000 monthly energy bill.

He said he doesn't like competing with solar companies when he needs access to other farmland, but he also doesn't like being told what he can build on his property.

"From a property rights standpoint, this is a heavy-handed way to say that my property no longer has this development potential simply because of the fact that it's arable land," Mr. Freund said.


A8 • STAR TRIBUNE • FRIDAY, JUNE 19, 2015
ADVERTISEMENT
Local Energy
Local Benefits
Solar sites create habitat for bees, monarchs, songbirds, and pheasants – all while creating a clean energy future for our kids.
Sign the petition asking all solar developers to create pollinator habitat on solar sites.
www.pollinatorpledge.com
Local Economic & Environmental Benefits
• Financial support for county services to help lower property taxes
• Diversified income for Minnesota farmers
• Strengthens the resiliency of the electric system
• Jobs in construction and maintenance/operation
• Zero emissions
Pope urges bold
to halt climate change
Did he get the science right?
New name.
Same loving community.
Our caring communities have some new company.
With 17 recently renamed communities in your area officially part of the Brookdale family, you're sure to find one nearby. We offer comfortable lifestyles and caring environments, with opportunities to improve wellness, fulfill lifelong wishes and stay connected with friends and loved ones.
Residents at Brookdale enjoy life enriching care that supports their individual needs:*
• Independent Living
• Assisted Living
• Alzheimer's & De
• Skilled Nursing


Dr. Karen Oberhauser
University of Minnesota
Dr. Marla Spivak
University of Minnesota

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Washington Post
@washingtonpost

Follow

Since 1990, nearly a billion monarch butterflies have vanished wapo.st/1DWXMnk

MN Department of Agriculture

"Pollinators are an irreplaceable public resource."

"Insect pollinators, such as bees, butterflies, wasps, flies, and beetles, are critical for the pollination and production of crops and the health of native flora and landscapes."

Commissioner Dave Fredrickson

Minnesota Department of Agriculture

Announcing New Steps to Promote Pollinator Health

MAY 19, 2015

Summary: Pollinators are critical to the Nation's economy, food security, and environmental health.

Incomplete Pollination

- 70% of crops
- 100's of billions / year

Costs & Savings. Less mowing. More meadow.

What We See When We Look at a Flower

What A Bee Sees …Check out the Pollen

When a Bee Sees this…

It looks like this through a Bee’s eyes
…no pollen

Solar Site Vegetation & Performance

- Performance profile for solar site vegetation:
  - Resilient to droughts
  - Resilient to intense downpours
  - Insulation / reduce risk of frost heave
  - Minimal maintenance
  - Low-growing
  - Full-sun & shade tolerant
  - Beneficial to the pollinators needed for agriculture


HEY, YOU GOT POLLINATOR HABITAT IN MY SOLAR FARM.
HEY, YOU GOT SOLAR FARM IN MY POLLINATOR HABITAT.

ENERGY GANG PODCAST…

Jigar Shah
So as many of our listeners know, I'm a huge fan of Michael Noble and the work of Fresh Energy up in Minnesota. What they've recently done, which I think is really impressive, is that their agricultural leaders got together with Fresh Energy and Audubon, and others to establish a state-wide standard for use of the land under and around ground-mounted solar projects.

And so I just want to commend those guys. I mean, now that solar's really becoming an industrial product that is spreading across the land, it's important to have these kinds of standards in place.

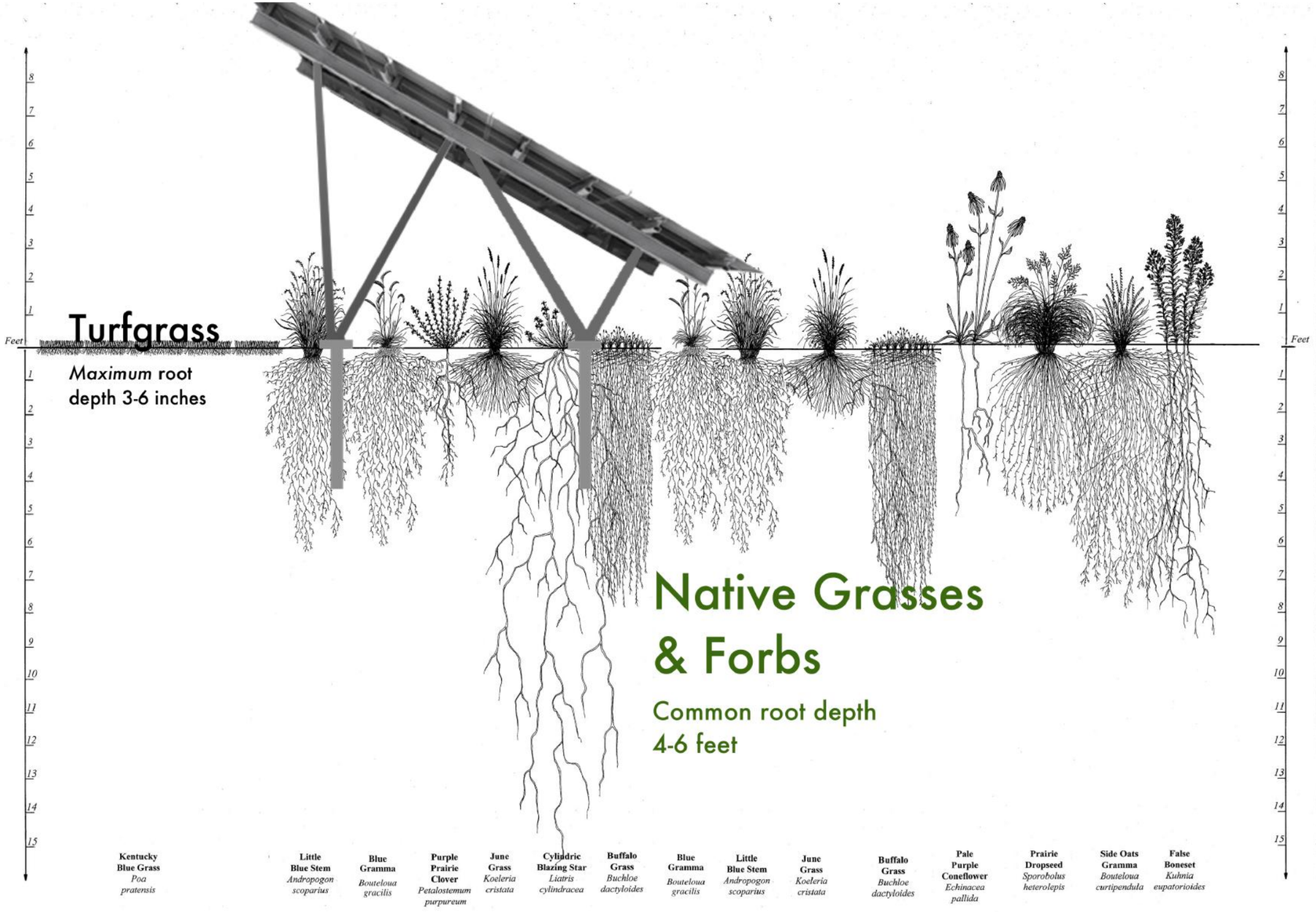
Katherine Hamilton
That's great to know because I found just working in the wind industry also **that siting and permitting issues can be much more expensive than just the installation of the project**.
So, that's terrific.

Before

After

Side-Oats Grama seed being prepared for bagging

Growing seed and plant material and managing native vegetation creates jobs.



Solar Site Management for Soil, Storm Water, and Pollinator Benefits

Connexus Energy
Performance Characteristics:

1. Visual appeal
2. Maintenance free for existing grounds crew
3. No loss of solar performance
4. Ecological services highlighted in company marketing materials

Seeded in Oct. 2014. Pictured in July, 2016.

Newsletter

Connexions

A member update.

CONNEXUS® ENERGY

September 2016

Pollinator haven at Connexus solar garden

For honey bees and butterflies, it doesn't get much better than the pollinator-friendly habitat found in Connexus Energy's community solar garden. Recently, Fresh Energy, with the help of Prairie Restoration, assessed our site, and we received a perfect 100 score on the Solar Site Pollinator Habitat Assessment. That means our solar garden not only provides solar energy for our members, but it also provides exceptional habitat to help struggling pollinators.

What is pollinator-friendly habitat?

Pollinators, such as honey bees, butterflies, hummingbirds, and bats, assist plants in reproduction by transferring pollen. This allows the plant to produce berries, nuts, and other foods important to the survival

HASTINGS STAR GAZETTE

Seat of Dakota County, where more than 100 solar projects are proposed

News Headline:

Local solar project to turn land into pollinator haven

“EGP-NA saw the integration of a vegetation plan into the overall site design as an exciting opportunity to proactively support the local farming ecosystem and communities,” EGP-NA representatives wrote in an email interview. “For example, the Aurora solar project uses pollinator friendly seed mix and native plant species and wildlife which results in prairie grasses and flowers throughout the site that contribute to the growth of pollinator species populations. These species like bees and monarch butterflies are critical to supporting the pollination and production of local crops and the preservation and health of farmland and native landscapes.”

http://bit.ly/AuroraEGP

Minnesota Power & Camp Ripley

Solar Farm Short Native Mix	Species	PLS/acre	Height(in)
Short height general dry prairie native mix.	Sideoats Grama	3.00	18-30
	Little Bluestem	3.00	18-30
	Buffalograss	3.00	18-30
	Kalm's Brome	0.50	24-36
	Blue Grama	1.00	12-15
	Junegrass	0.25	6-12
	Prairie Dropseed	0.25	18-30
	Grass Total	**11.00**	
	Black Eyed Susan	0.20	18-24
	Purple Prairie Clover	0.20	18-24
	Partridge Pea	0.20	18-24
	Purple Coneflower	0.20	18-24
	Yarrow	0.01	12-18
	White Prairie Clover	0.10	18-24
	Large Flowered Beard Tongue	0.04	12-24
	Butterfly Milkweed	0.05	18-24
	Total PLS/Acre	**1.00**	
	Oats	25.00	
	Total PLS/Acre	**37.00**	

Aurora Solar

100 MW distributed solar array

16 sites

1,000 acres

Pollinator-friendly seed mix used on all sites

Sample General Composition of Seed Mix for use within Solar Panel Array

No Mow Turf with Forbs; Seeding Rate: 42 seeds per Sq. ft./ac	Height	Bloom Time	oz./acre	Seeds/oz.	Seeds/sq. ft.
Cover Crop					
Avena sativa (Oats)[1]	3'	NA	20lbs/ac	1,100	8.9
Grasses					
Bouteloua curtipendula (Side oats grama) PLS	1-2'	Jun-Nov	8.0	6000.00	1.10
Bouteloua gracilis (Blue grama) PLS	1'	Jul-Oct	4.0	40,000.00	3.67
Buchloe dactyloides (Buffalo grass--BOWIE cultivar) PLS	5"	Apr-Dec	128.0	3,600.00	10.58
Carex bicknelli (Copper shouldered oval sedge) PLS	1-3'	Mar-May	2.0	17000.00	0.78
Koeleria macrantha (Junegrass) PLS	10-20"	Apr-Jun	4.0	200,000.00	18.37
Sporobolus heterolepis (Prairie Dropseed) PLS	2-3'	Jun-Aug	4.0	16,000	1.47
Forbs					
Allium canadense (Wild garlic)	1-2'	May-Jul	8.0	560.00	0.10
Allium stellatum (Prairie onion)	8-18"	Jul-Aug	1.00	11,000.00	0.25
Anemone canadensis (Canada Anemone)	1-2'	May-Jun	1.00	8,000.00	0.18
Anemone patens (Pasqueflower)	3-18"	Apr-May	1.00	18,000.00	0.41
Asclepias tuberosa (Butterfly-weed)	1-2'	Jun-Aug	2.00	4,300.00	0.20
Echinacaea angustifolia (Narow leaved Purple Coneflower)	1-2'	Jun-Jul	2.00	7000	0.32
Sisyrinchium campestre (Prairie blue-eyed grass)	4-16"	May-Jun	1.00	45,000.00	1.03
Solidago nemoralis (Gray goldenrod)	1-2'	Aug-Oct	0.50	300,000.00	3.44

COMMUNITY ENERGY SOLAR

North Star Solar

100 MW solar array

1,000 acres

Largest single-site array in the Midwest

Pollinator-friendly seed mix from Minnesota Native Landscapes used throughout

	Scientific Name	Common Name	% of Mix	PLS lbs/ac	Total PLS lbs	Seeds/ Sq Ft
Grasses:	Bouteloua curtipendula	Side-Oats Grama	35.00	2.80	2.80	10.23
	Bouteloua gracilis	Blue Grama	12.00	0.96	0.96	14.10
	Carex bicknellii	Bicknell's Sedge	1.50	0.12	0.12	0.75
	Carex radiata	Eastern Star Sedge	1.50	0.12	0.12	1.81
	Carex vulpinoidea	Fox Sedge	1.25	0.10	0.10	2.98
	Koeleria macrantha	Junegrass	1.25	0.10	0.10	7.35
	Schizachyrium scoparium	Little Bluestem	14.50	1.16	1.16	6.39
	Sporobolus cryptandrus	Sand Dropseed	4.00	0.32	0.32	23.51
	Sporobolus heterolepis	Prairie Dropseed	5.00	0.40	0.40	2.35
Forbs:	Achillea millefolium	Yarrow	0.40	0.03	0.03	2.06
	Agastache foeniculum	Fragrant Giant Hyssop	0.25	0.02	0.02	0.66
	Allium stellatum	Prairie Onion	0.50	0.04	0.04	0.16
	Anemone canadensis	Canada Anemone	0.25	0.02	0.02	0.06
	Aquilegia canadensis	Columbine	0.25	0.02	0.02	0.28
	Asclepias syriaca	Common Milkweed	0.75	0.06	0.06	0.09
	Asclepias tuberosa	Butterfly Milkweed	0.75	0.06	0.06	0.09
	Asclepias verticillata	Whorled Milkweed	0.25	0.02	0.02	0.08
	Aster oolentangiensis	Sky-Blue Aster	1.25	0.10	0.10	2.94
	Aster laevis	Smooth Blue Aster	0.75	0.06	0.06	1.21
	Aster lateriflorus	Calico Aster	0.80	0.06	0.06	5.88
	Astragalus canadensis	Canada Milk Vetch	0.75	0.06	0.06	0.37
	Coreopsis palmata	Prairie Coreopsis	0.50	0.04	0.04	0.15
	Dalea candida	White Prairie Clover	3.00	0.24	0.24	1.67
	Dalea purpureum	Purple Prairie Clover	3.00	0.24	0.24	1.32
	Desmodium canadense	Canada Tick Trefoil	1.00	0.08	0.08	0.16
	Helianthus pauciflorus	Stiff Sunflower	0.40	0.03	0.03	0.05
	Monarda fistulosa	Wild Bergamot	0.75	0.06	0.06	1.54
	Liatris aspera	Rough Blazing Star	0.75	0.06	0.06	0.35
	Lupinus perennis	Wild Lupine	0.25	0.02	0.02	0.01
	Penstemon gracilis	Slender Beardtongue	0.40	0.03	0.03	7.05
	Potentilla arguta	Prairie Cinquefoil	0.25	0.02	0.02	1.69
	Pycnanthemum virginianum	Mountain Mint	0.50	0.04	0.04	3.23
	Ratibida columnifera	Long-Headed Coneflower	1.00	0.08	0.08	1.23
	Rudbeckia hirta	Black Eyed Susan	1.25	0.10	0.10	3.38
	Solidago nemoralis	Old Field Goldenrod	0.50	0.04	0.04	4.41
	Solidago rigida	Stiff Goldenrod	1.50	0.12	0.12	1.81
	Verbena stricta	Hoary Vervain	1.25	0.10	0.10	1.03
	Zizia aurea	Golden Alexanders	0.75	0.06	0.06	0.24
Cover Crop:	Triticum aestivum	Winter Wheat		10.00	10.00	

Species subject to change based on price and availability at the time of planting

Dairyland Portfolio Seed Mixes — Acreage Summary

Project	Total Acreage	Dry-sandy Seed Mix	Dry-mesic Seed Mix	Mesic To Wet Seed Mix
Warren	16.4		14	2.4
Downsville	9.5		4.5	5
Arcadia	7.51		7.51	
Lafayette	8.87		8.87	
Whistling Wings	10.81	10.81		
Ash Ridge	5.4		5.4	
Mt Hope	10.6		10.6	
Liberty Pole	9.3		6	3.3
Sauk	8.56		8.25	0.31
Medford	15.93			15.93
Conrath	7.87			7.87
Total	**110.75**	**10.81**	**65.13**	**34.81**

Co-location of solar & agriculture

Pollinator Habitat Benefits Agriculture

- Nature Conservancy completed an economic analysis of wild pollinator contribution to 10 major crops.
- In nearly all cases and especially for tomatoes, blueberries, melons, cucumbers, squash, apples, peaches, and bell peppers, gross revenues increase directly because of the installation of pollinator habitat—and that's even after subtracting out implementation costs.

http://bit.ly/BeesCrops

Ag Leaders Established a Vegetation Standard for Pollinator-friendly Solar

State Rep. Rod Hamilton (R)

Chair, Agriculture Finance Committee
Member, Agriculture Policy Committee

State Senator Dan Sparks (DFL)

Chair, Agriculture Policy Committee
Member, Commerce & Consumer Protection Policy and Finance Committee

Statute 216B.1642

Subd. 2. Recognition of beneficial habitat**.** An owner of a solar site implementing solar site management practices under this section may claim that the site provides benefits to gamebirds, songbirds, and pollinators only if the site adheres to guidance set forth by the pollinator plan…

https://www.revisor.mn.gov/statutes/?id=216B.1642

Solar Site Pollinator Habitat Assessment Form

For solar companies to claim pollinator/wildlife habitat benefits on solar sites

Minnesota Board of Water & Soil Resources

1. PERCENT OF SITE DOMINATED BY WILDFLOWERS

- ☐ 1-15 percent — 10 points
- ☐ 16-30 percent — 15 points
- ☐ 31-45 percent — 20 points
- ☐ 46-60 percent — 25 points
- ☐ 61+ percent — 30 points

Total points ☐

Note: Project may have "array" mixes and diverse border mixes; forb dominance should be averaged across the entire site. Forb dominance should exclude native ragweeds.

2. % OF SITE DOMINATED BY NATIVE SPECIES COVER

- ☐ 1-25% — 5 points
- ☐ 26-50% — 10 points
- ☐ 51-75%. — 15 points
- ☐ 76-100% — 20 points

Total points ☐

3. COVER DIVERSITY (# of plant species with >2% cover)

- ☐ 1-9 species — 5 points
- ☐ 10-19 species — 10 points
- ☐ 20-39 species — 15 points
- ☐ > 40 species — 20 points

Total points ☐

Exclude invasives from species totals.

4. SEASONS WITH AT LEAST 3 BLOOMING SPECIES PRESENT (check/add all that apply)

- ☐ Spring — 10 points
- ☐ Summer — 5 points
- ☐ Fall — 5 points

Total points ☐

See BWSR Pollinator Toolbox for Information about bloom season

5. AVAILABLE HABITAT COMPONENTS WITHIN .25 MILES (check/add all that apply)

- ☐ Native bunch grasses for nesting — 5 points
- ☐ Trees and shrubs for nesting — 5 points
- ☐ Clean, perennial water sources — 5 points

Total points ☐

6. AVAILABLE HABITAT COMPONENTS ON-SITE (check/add all that apply)

- ☐ At least 2% milkweed cover — 5 points
- ☐ At least 3% native shrub cover — 5 points
- ☐ Detailed mgmt. plan developed (see example plan) — 10 points
- ☐ 3 or more signs legible at twenty or more feet stating pollinator friendly habitat — 5 points

Total points ☐

7. INSECTICIDE RISK (% of project adjacent to insecticide use such as non-organic cropland, or on-site use)

- ☐ 1-25% — -10 points
- ☐ 26-50% — -15 points
- ☐ 51-75% — -20 points
- ☐ 76-100% — -25 points
- ☐ On-site use — -30 points

Total points ☐

This doesn't include herbicide being used for weed control

Grand Total ☐

Provides Exceptional Habitat **85 TO 100**
Meets Pollinator Standards **70-84**

Developer: _____

Project Location: _____

Project Size: _____

Target Seeding Date: _____

Send completed forms to: Dan.Shaw@state.mn.us

Note: Measurements of percent "cover" should be based on "absolute cover" defined as the percent of the ground surface that is covered by a vertical projection of foliage as viewed from above. To measure cover diversity it is recommended to use plots, and/or transects in addition to meander searches for accurate measurements. Wildflowers in

In 2016…

Public Policy:
Pollinator-Friendly Solar

>2,300 acres

0.014 percent of farmland

HHHH
HHHHHHHHH
HHHHHH
HHHHH
HHHH
HHHHH
HHHHHH
HHHHHHH

Equivalent to

>1.4 million

6’x12’ pollinator gardens

By end of 2018…

>188,000 acres

0.067 percent of farmland

Would be equivalent to

>100 million

6’x12’ pollinator gardens

NREL
NATIONAL RENEWABLE ENERGY LABORATORY

Co-Location of Solar and Agriculture: Benefits and Tradeoffs of Low-Impact Solar Development

Jordan Macknick (NREL)

Site preparation costs and impacts

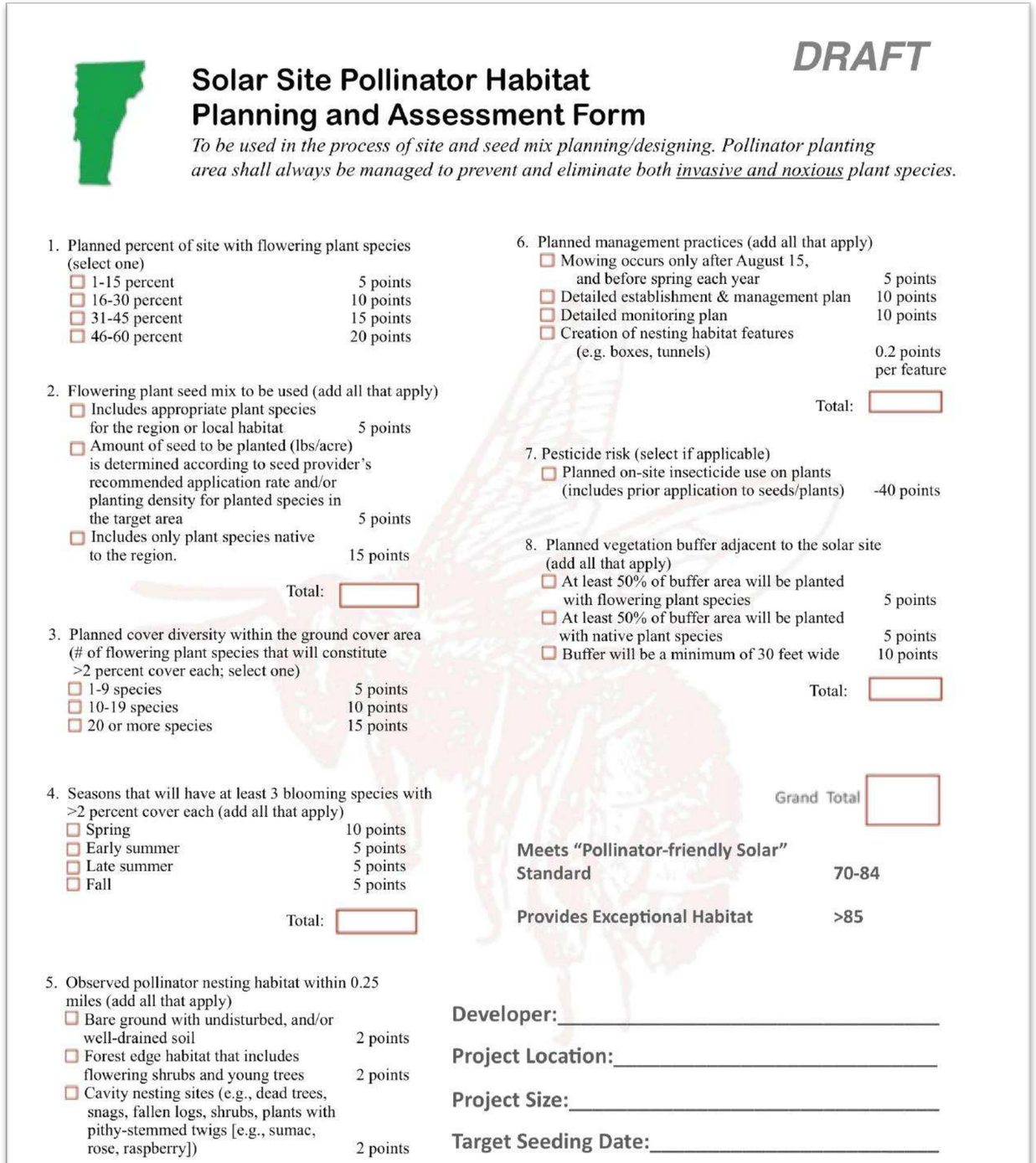
Site preparation costs for utility-scale solar projects are expected to account for 20% of utility-scale PV installed costs in 2020.

Reducing site preparation costs via low-impact site development can lead to cascading reductions in other environmental-related costs and risks.

Site Preparation Practice	Cost Contribution	Estimated Reductions
Geotechnical Investigation	2.6% (0.7%)	0% - (25%)
Clearing and Grubbing	4.3% (1.2%)	25% - 90%
Soil stripping and stockpiling	1.5% (0.4%)	20% - 90%
Grading	4.2% (1.2%)	50% - 90%
Soil Compaction	1.9% (0.5%)	50% - 75%
Foundation for vertical support	22.1% (6.3%)	2% - 5%

Cost contribution values represent percent of total civil works costs; values in parentheses represent total installed capital costs for 100MW utility-scale PV

Other Cost Categories	Expected Impact
Land Acquisition	5-10% reduction in land requirements
Permitting	1-5% reduction in permitting costs
O&M for weed control	2-7% reduction in O&M
Degradation	1-3% improvement in annual panel degradation
Efficiency	1-3% improvement in efficiency due to temperature impacts



DRAFT

Solar Site Pollinator Habitat Planning and Assessment Form

To be used in the process of site and seed mix planning/designing. Pollinator planting area shall always be managed to prevent and eliminate both invasive and noxious plant species.

1. Planned percent of site with flowering plant species (select one)
   - ☐ 1-15 percent — 5 points
   - ☐ 16-30 percent — 10 points
   - ☐ 31-45 percent — 15 points
   - ☐ 46-60 percent — 20 points

2. Flowering plant seed mix to be used (add all that apply)
   - ☐ Includes appropriate plant species for the region or local habitat — 5 points
   - ☐ Amount of seed to be planted (lbs/acre) is determined according to seed provider's recommended application rate and/or planting density for planted species in the target area — 5 points
   - ☐ Includes only plant species native to the region. — 15 points

   Total: ☐

3. Planned cover diversity within the ground cover area (# of flowering plant species that will constitute >2 percent cover each; select one)
   - ☐ 1-9 species — 5 points
   - ☐ 10-19 species — 10 points
   - ☐ 20 or more species — 15 points

4. Seasons that will have at least 3 blooming species with >2 percent cover each (add all that apply)
   - ☐ Spring — 10 points
   - ☐ Early summer — 5 points
   - ☐ Late summer — 5 points
   - ☐ Fall — 5 points

   Total: ☐

5. Observed pollinator nesting habitat within 0.25 miles (add all that apply)
   - ☐ Bare ground with undisturbed, and/or well-drained soil — 2 points
   - ☐ Forest edge habitat that includes flowering shrubs and young trees — 2 points
   - ☐ Cavity nesting sites (e.g., dead trees, snags, fallen logs, shrubs, plants with pithy-stemmed twigs [e.g., sumac, rose, raspberry]) — 2 points

6. Planned management practices (add all that apply)
   - ☐ Mowing occurs only after August 15, and before spring each year — 5 points
   - ☐ Detailed establishment & management plan — 10 points
   - ☐ Detailed monitoring plan — 10 points
   - ☐ Creation of nesting habitat features (e.g. boxes, tunnels) — 0.2 points per feature

   Total: ☐

7. Pesticide risk (select if applicable)
   - ☐ Planned on-site insecticide use on plants (includes prior application to seeds/plants) — -40 points

8. Planned vegetation buffer adjacent to the solar site (add all that apply)
   - ☐ At least 50% of buffer area will be planted with flowering plant species — 5 points
   - ☐ At least 50% of buffer area will be planted with native plant species — 5 points
   - ☐ Buffer will be a minimum of 30 feet wide — 10 points

   Total: ☐

Grand Total ☐

Meets "Pollinator-friendly Solar" Standard 70-84

Provides Exceptional Habitat >85

Developer:_____

Project Location:_____

Project Size:_____

Target Seeding Date:_____

- University of Vermont Gund Institute of Ecological Economics
- Monarch Joint Venture
- Energy Action Network
- VT Agency of Agriculture, Food, & Markets,
- VT Agency of Natural Resources
- U.S. Dept of Agriculture
- Green Mountain Power
- Encore
- Green Lantern Group
- VHB (environmental site consultants)
- Audubon
- Ernst Conservation Seeds

Thank you

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