Benefits of Applying Agronomic Practices with Solar

Enhancing:

Farming, Soil, Environment and Way of Life

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Soil and Ecological Solutions

Disclaimer

- ✓ This presentation is going to make the following people upset.
  - ✓ Solar Developers
  - ✓ Solar Owners
  - ✓ Landowners/Tenant Farmers
  - ✓ Pro-Solar individuals
  - ✓ Anti-Solar individuals
  - ✓ Community Leaders
  - ✓ Agencies
  - ✓ Politicians
- ✓ This presentation is intended to create more questions than answers.
- ✓ The goal of this presentation is to shape a discussion.

Who am I

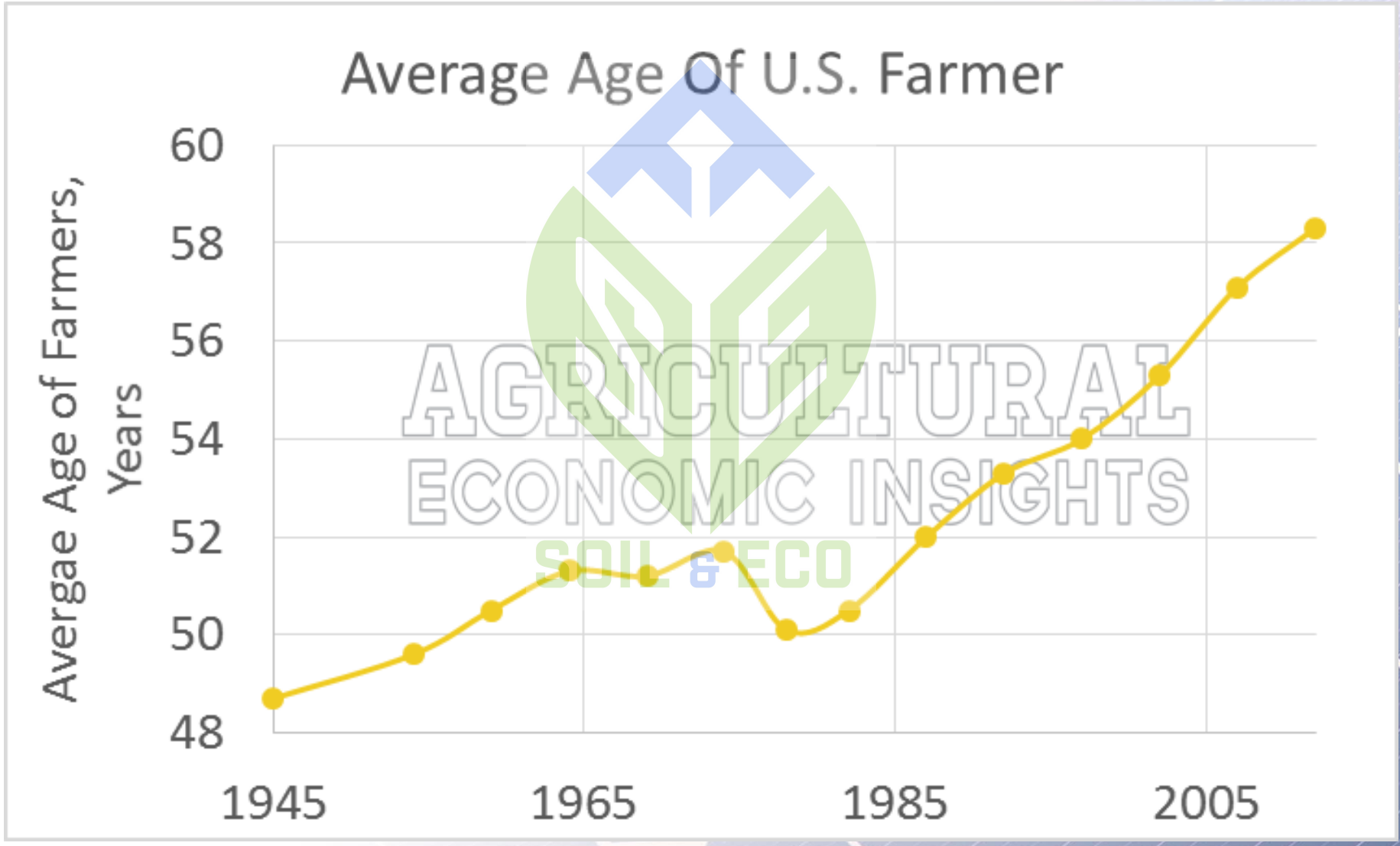
- ✓ Aaron DeJoia
  - ✓ Grew up in North Central Kansas
  - ✓ Graduated in a class of 24 students
  - ✓ First job was roguing soybeans
  - ✓ Raised hogs and sheep
  - ✓ Farm was hobby and could not support me
- ✓ Received BS and MS from Kansas State University
  - ✓ Agronomy - Soil and Water Science
  - ✓ Soil Science

Farming

- Can’t be put any better than Paul Harvey “So God Made A Farmer”
- Land is not Real Estate it is Family
- Not understood by non-farming community
  - There are days but not weekends
  - Take your child to work is not a day and usually not enjoyed by the child, at that moment
- Farming Pays Well (2022 Data)
  - Commercial - $178,000 ($252,000 Household)
  - Intermediate - -$125 ($73,000 Household)
  - Residence - -$2,370 ($112,000 Household)
- Farming Pays Forward[1]
  - Every $1 of agriculture GDP generates $1.14 additional non-agricultural GDP

1 The Economic Contributions of Agriculture to the New York State Economy: 2019 Todd M. Schmit

Farming is a Young Mans Game

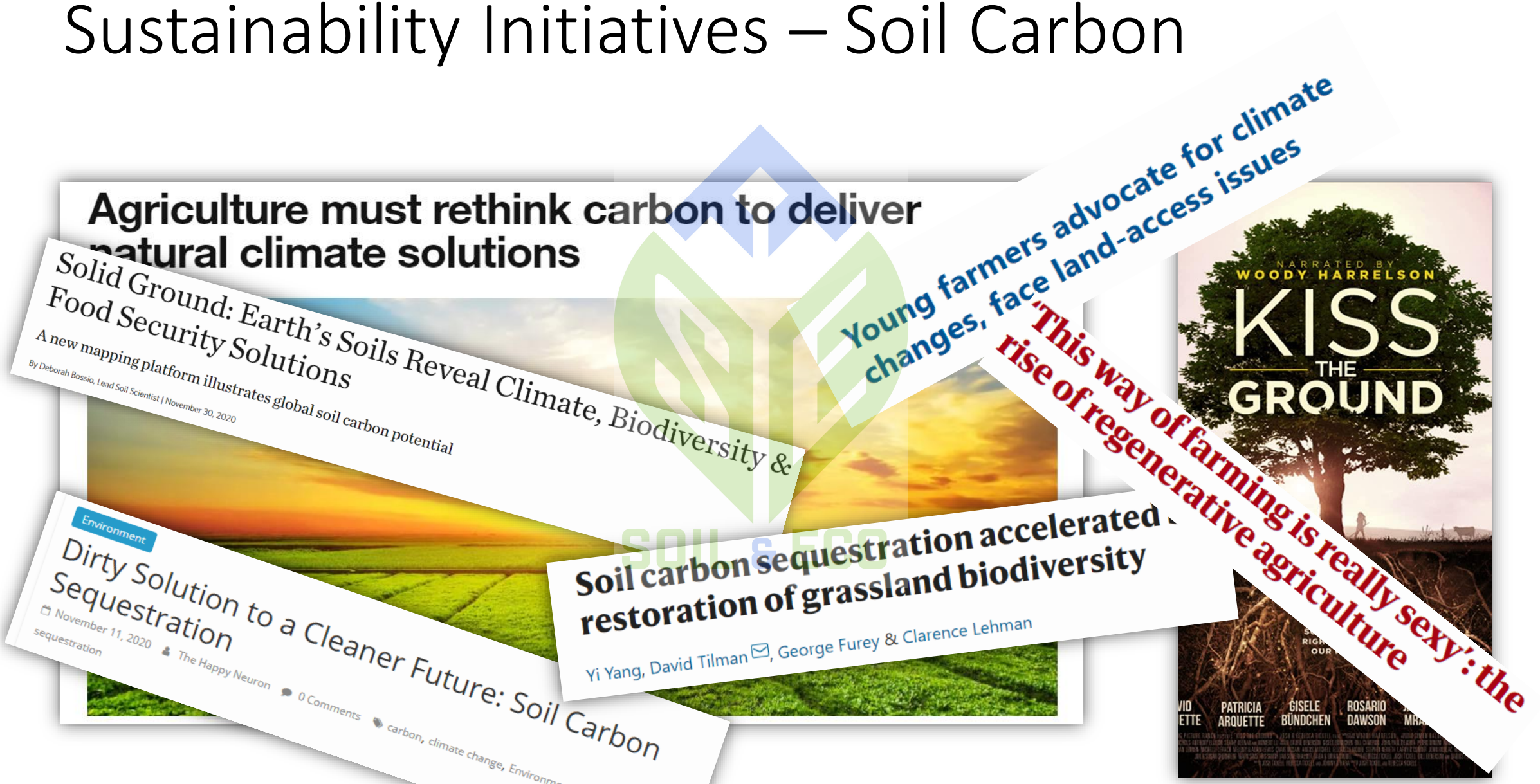


Rural Priorities

Priority	Farm	Non-Farm	Total (Rank/15)
Drinking Water Quality	4.42	4.5	4.52 (1)
Increase Rural Jobs	4.06	3.97	3.98 (3)
Improve Flood Control	3.87	3.98	3.96 (4)
Aquatic Life Water Quality	3.84	4.08	4.05 (2)
Increase Crop Production	3.50	3.38	3.39 (9)
Restore Native Grasses	3.31	3.02	3.27 (12)
Increase Livestock Production	3.3	3.23	3.24 (13)
Reduce Greenhouse Gases	3.12	3.52	3.47 (7)
Increase Nongame Habitat	3.04	3.35	3.31 (10)

Prairie strips improve biodiversity and the delivery of multiple ecosystem services from corn–soybean croplands
Lisa A. Schultea,1, Jarad Niemib, Matthew J. Helmersc, Matt Liebmand, J. Gordon Arbucklee, David E. Jamesf, Randall K. Kolkag, Matthew E. O'Nealh, Mark D. Tomerf, John C. Tyndalla, Heidi Asbjornseni, Pauline Drobneyj,Jeri Nealk, Gary Van Ryswykl, and Chris Wittec

Sustainability Initiatives – Soil Carbon

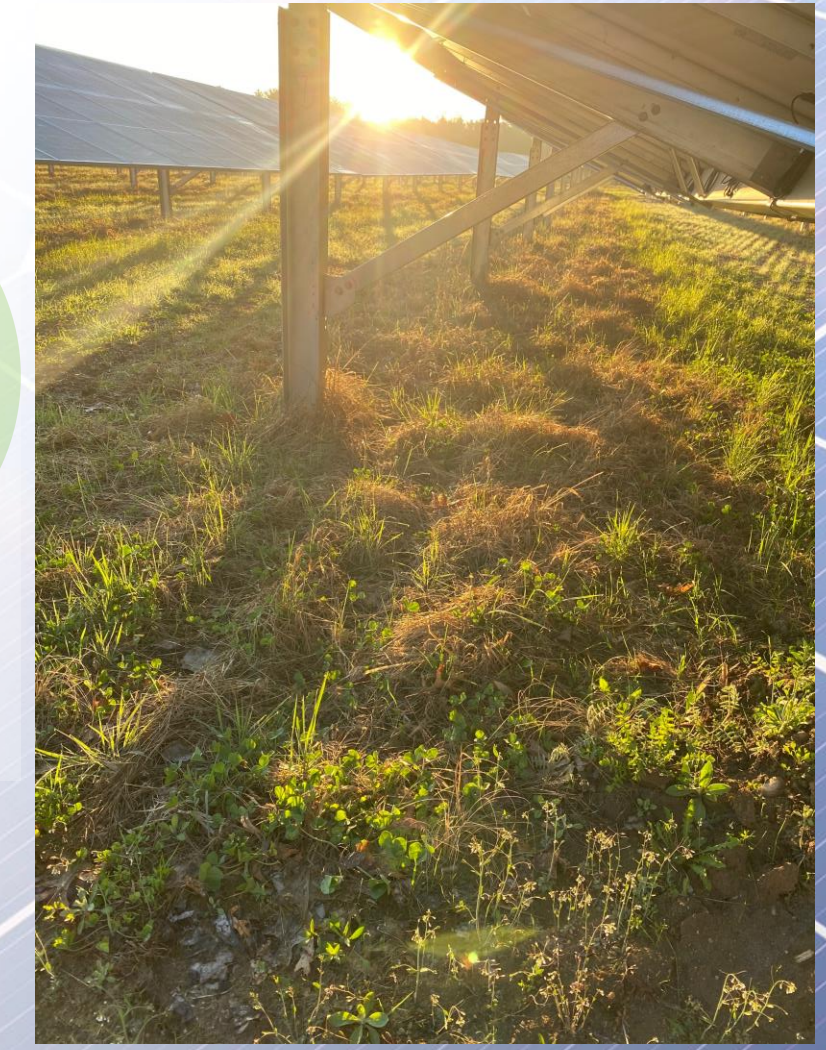


What is Farming

- Agronomic
  - Row Crop Agriculture
  - Hay/Pasture Production
  - Fiber
  - Vegetable Production
  - Entertainment?
  - CRP Land?
  - Biomass for fuel?
- Animal
  - Animal Protein
  - Milk
  - Fiber
  - Apiaries?
  - Entertainment?

What is Solar Farming

- Harvesting light energy
- Soil health improvement
  - Carbon sequestration
  - Reduced erosion
- Ecosystem Services
  - Surface Water Quality
  - Groundwater Quality
  - Biodiversity (Plant, Animal, Other)
- Grazing
  - Sheep, Chicken, Rabbits
  - Cattle (Changes Required)
- Crop Production (Changes Required)
  - Hay and forage
  - Row crops (Soy, Wheat, Barley, etc)



Soil Health Improvements (Native Grass)

- Carbon Sequestration
  - Potential to store 1 t/a/yr
- Reduced Fertilizer Inputs
  - Increased Nutrient Cycling
  - Increased Microbial Biomass
- Reduced Soil Loss from Erosion
  - Increased vegetative cover
  - Increased aggregate stability

Soil Resources

Not all soils are the same

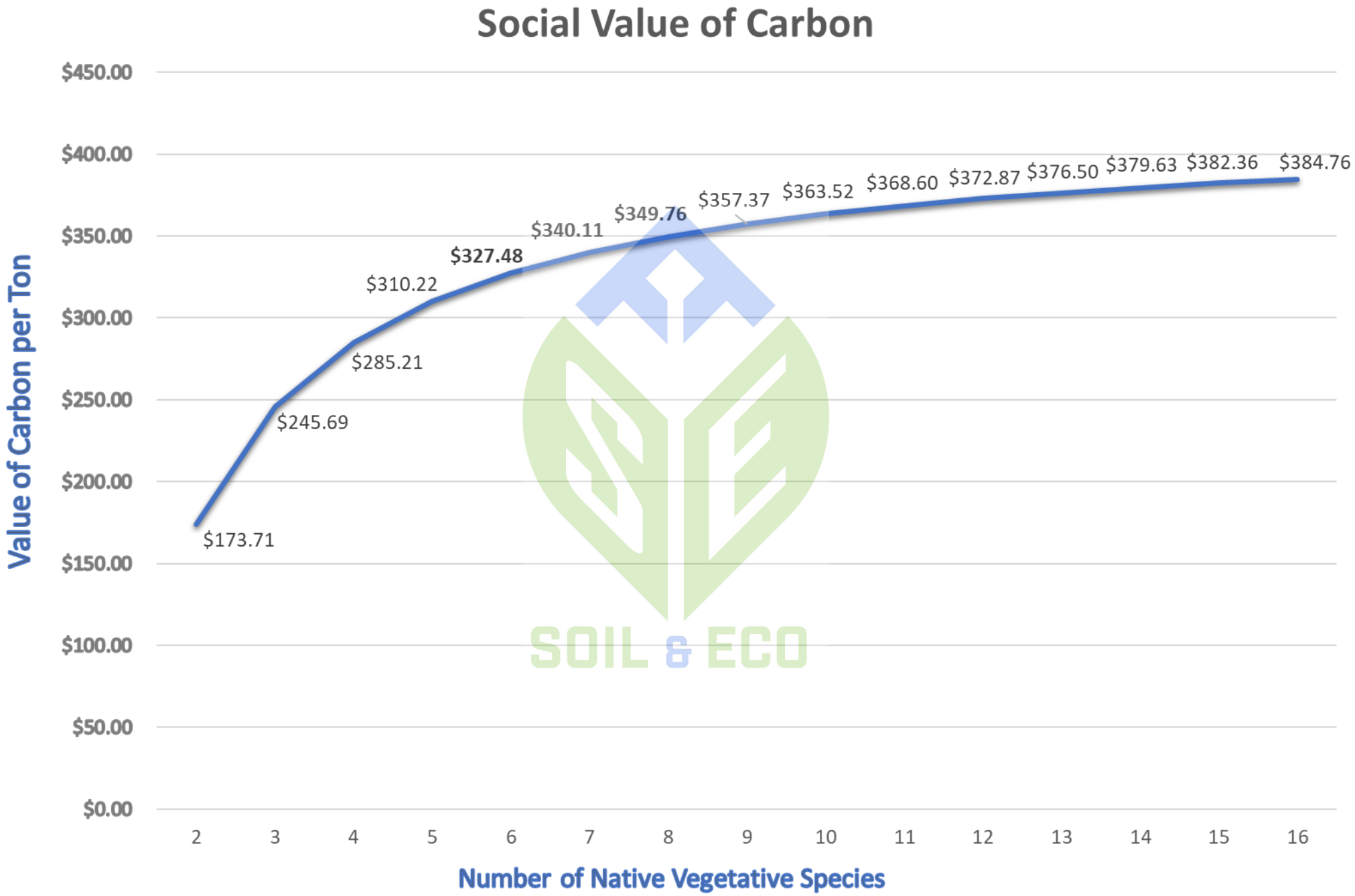
- **Unique regional differences**
- **Changes at all scales**
- **Different soils change ecosystem functionality**

Vegetation Starts at Soil

- **Topsoil Salvage**
- **Appropriate Grass/Crops**
- **Necessary Amendment/Fertilizers**
- **Reclamation**

Soil Health Improvements (Native Grass)

- ✓ Builds and saves soils for future generations
  - ✓ 8x more biomass below ground
  - ✓ Increases Soil carbon by 37%
  - ✓ Increased microbial populations
  - ✓ Increased soil aggregate stability
  - ✓ Decreases erosional losses by 70% versus similar row crops
- ✓ Can be used for grazing or haying if site is appropriate


Social Value of Carbon
$450.00
$400.00
$350.00
$300.00
$250.00
$200.00
$150.00
$100.00
$50.00
$0.00
Value of Carbon per Ton
$173.71
$245.69
$285.21
$310.22
$327.48
$340.11
$349.76
$357.37
$363.52
$368.60
$372.87
$376.50
$379.63
$382.36
$384.76
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15
16
Number of Native Vegetative Species
SOIL & ECO

Ecosystem Services (Native Grass)

- Revegetation with a purpose
  - Potential to store 1 t/a/yr
- Opportunity to restore unique habitat
  - Grasslands
  - Dunes
- Increase:
  - Biodiversity
  - Water Quality
- Decrease:
  - Water Runoff
  - Eutrophication

Ecosystem Services (Native Grass)

- ✓ Can be reconverted to row crop system at end of project
- ✓ Protects Area Groundwater Quality
  - ✓ Reduces Nitrate Leaching
- ✓ Improves Surface Water Quality
  - ✓ Decreases soil erosion
  - ✓ Decreases phosphorus runoff
- ✓ Reduces Urbanization
  - ✓ Maintains crop productivity on the site for life of project
- ✓ Increases Biodiversity
  - ✓ Sanctuary for pollinators and beneficial Insects
  - ✓ Returns the field to native production

Ecosystem Farming

- What is Farming?
  - Is CRP farming?
  - Is a biomass fuel crop farming?
  - Is a vegetative filter strip farming?
- Does having solar above ground change any of the above?
- Does increasing resilience against changing weather patterns protect communities and farms?

Conversion From Traditional Agriculture Ecosystem Centric Solar

- Can be reconverted to traditional agriculture at end of project
- Land is preserved for future generation of farmers to determine best use
- Vegetation can be used to improve environmental quality
- Vegetation can be used to increase soil organic matter and improve soil health
- Vegetation can be used to promote pollinator habitat
- Vegetation can be used for haying or grazing

Ecosystem Farming (BMPs)

- Protect Topsoil
- Manage erosion until vegetation established
- Manage weeds
- Promote benefits
- Plan for areas “traditional” agriculture

Steps to Successful Solar Agricultural Use

- Planning
  - Agricultural use during energy production must be part of the initial design.
- Site Evaluation
  - What soil resources are available and what is the highest and best agricultural use for the solar facility.
- Grading and Leveling
  - Only grade where absolutely necessary and consider protection of soil resources throughout.
- Crop/Grass Establishment
  - The earlier the site is vegetated the potential for storm water erosion and runoff.
- Construction
  - Continue to maintain vegetation throughout the entire construction process
- Revegetation and Monitoring
  - Continue to revegetate the site and begin monitoring to ensure the site agriculture is performing as intended

Environmental Benefits – Native Grass

- Increases Soil Carbon
- Reduced erosion by 25 fold
- Reduce N export by 6 fold
- Reduced P export by 10 fold
- Maintains crop productivity
- Increases infiltration by 5x
- Increases biodiversity

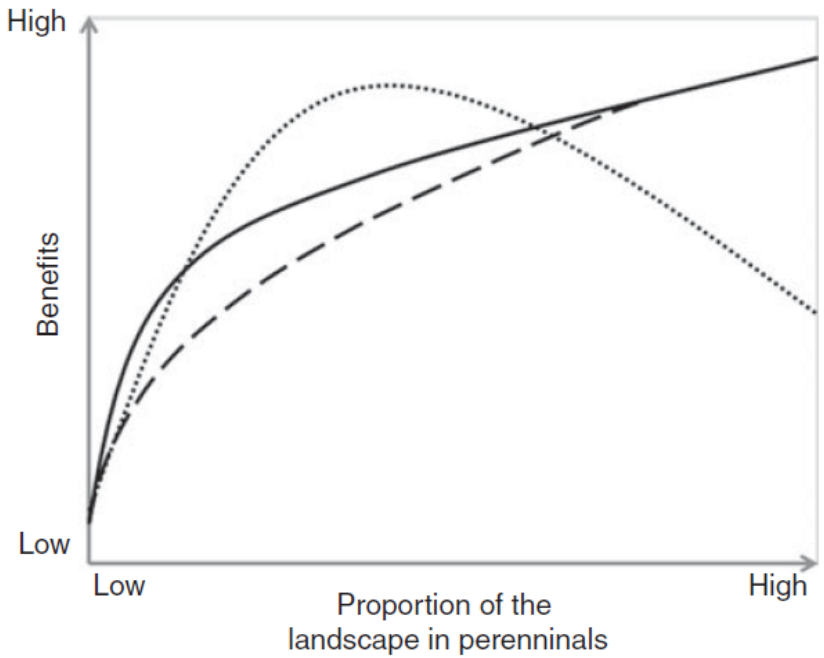

Figure 1. Disproportionate benefits hypothesis: perennial vegetation is expected to produce benefits disproportional to its extent within landscapes; ecosystem benefits of non targeted perennial cover (dashed line), ecosystem benefits of targeted perennial cover (solid line), and socio-economic benefits (dotted line). Examples of ecological benefits include clean water, flood control, pollination, pest suppression and outdoor recreational opportunities. Examples of social benefits include inspiration, connectedness and civic engagement.

Bees and Prairie Grass

- ✓ **Native prairie strips and honey bees**
  - ✓ Increase winter survival
  - ✓ Increase populations
  - ✓ Increase colony weight
- ✓ **Crop dependence**
  - ✓ Soybeans have shown to increase yields by 18%
  - ✓ Soybean are considered self-pollinating
  - ✓ Fruit trees, blueberries and cranberries are moderately dependent
  - ✓ Melons and squash are highly dependent
- ✓ **Prairie help bees which helps agricultural crops**

Larger Agricultural Community Benefits

- ✓ **A compact 1,000 acre solar project will have positive agricultural impacts on over 7,200 acres**
  - ✓ Increase predatory insects reducing need for insecticide use
  - ✓ Increase pollinator species in the area
  - ✓ Reduce Nitrate and soluble phosphorus from entering drainage systems
- ✓ **A properly designed and maintained solar project will have positive impacts on the greater area**
  - ✓ Improves environmental quality
  - ✓ Increases biodiversity
  - ✓ Decreased infrastructure demands
- ✓ **A properly designed and maintained solar project will provide farmer opportunities to for future generations**
  - ✓ Improve soil quality
  - ✓ Allow for agricultural use during and after project

Solar “Farm” Goals

- ✓Choose priority
- ✓Synergistic effects
- ✓Community involvement
- ✓Must be planned

What Moves Solar “Farms” Forward

- ✓Right Planning
  - ✓Solar design
  - ✓Water
  - ✓Facilities
  - ✓Consider farming needs
- ✓Right Zoning
  - ✓Screening
  - ✓Set-backs
- ✓Right Regulations
  - ✓Storm Water

Challenge

- How can solar help next generation enter agriculture?
  - Solar removes rentable acres
  - Community provide incentives for solar to rent outside of fence to farmers younger than 30
- Can solar reduce soil degradation?
  - New terrain following trackers becoming available
- How can solar better utilize interior portions of array for true agriculture?
  - Utilities provide preference to bidders that have a clear farming goal