AMPLIFYING CLEAN ENERGY WITH CONSERVATION

PART TWO: LEVERAGING ELECTRIC TRANSMISSION LINES FOR STEWARDSHIP

A REPORT BY CODY SMITH,
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November 2020

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Part Two: Leveraging Electric Transmission Lines for Stewardship

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I. INTRODUCTION

A. RENEWABLE ENERGY GROWTH DEMANDS CONNECTION

Across the U.S., many cities, counties, and states are taking advantage of affordable renewable energy sources, such as solar and wind energy. Over the past nine years, the price of installing solar energy projects has decreased by 70 percent, while the average cost of constructing a wind energy project has fallen by more than 67 percent per kilowatt hour since 1983.[1,2] This rapid decline in cost has empowered Americans to embrace affordable, clean, and renewable energy. See Figure 1 on page 2. Meanwhile, several jurisdictions are setting ambitious clean energy goals aimed at reducing their carbon footprint in the face of a changing climate. Across the nation, more than 150 cities, 10 counties, and 7 states have adopted goals and policies to reach 100 percent clean energy.[3]

As the renewable energy economy continues to expand, projects bring jobs and tax revenue with them—stimulating local economies in ways which may have been previously unattainable, especially in rural communities. In 2019 alone, the U.S. wind energy industry invested $14 billion in new wind projects and paid $912 million in taxes to state and local governments, providing a new revenue stream for rural counties that is difficult to find elsewhere.[4] During the same year, the industry distributed $706 million in payments to landowners who host projects.[5] Meanwhile, wind energy has ballooned to provide 7.2 percent of the nation's electricity and supports, or directly employs, approximately 146,000 Americans.[6]

The solar energy industry is also in the midst of an unprecedented boom. Supportive public policies, such as the federal Investment Tax Credit, have continued to spur investment in this renewable energy source. The industry has expanded by 52 percent since the enactment of the Investment Tax Credit in 2006, empowering the solar energy workforce to employ more than 250,000 people across the U.S. and generate more than 2.5 percent of the nation's electricity.[7,8] In addition to jobs and tax payments to states and counties, the solar industry generated $18 billion in investment to the U.S. economy in 2019 alone.[9] This rapid growth, paired with expectations that installed solar generation capacity will double over the next five years, is leading many farmers, small business owners, municipalities, utilities, and corporations to expand their investments in solar energy.[10]

To effectively utilize the rapidly-growing construction of new renewable energy generation facilities, investments must be made in the electric transmission grid. For consumers and producers, a reliable and secure electric grid must be able to safely distribute and transmit the electricity to a site where consumption can occur. Large power lines which transmit electricity, referred to as electric transmission lines, are a critical piece of energy infrastructure that connects renewables, such as wind and solar, to population centers, industrial facilities, and other areas of high-intensity energy usage. Transmission lines, which connect new electric generation facilities, often span hundreds of miles. More than 600,000 circuit miles of these electric "runways" are established throughout the U.S., 240,000 of which are considered high-voltage lines (230 kilovolts and greater).[11]

As more renewables are brought online, the electric grid will need to be upgraded to meet the task of handling this increased and widely-distributed electric generation. Many of these projects will be constructed in rural areas of the U.S. and lead to

1 "Solar Industry Research Data." Solar Energy Industries Association, 2020, seia.org/solar-industry-research-data. Accessed August 2020.

2 Wiser, Ryan and Mark Bolinger. "2018 Wind Technologies Market Report." U.S. Department of Energy, Office of Energy Efficiency & Renewable Energy, August 2019, energy.gov/sites/prod/files/2019/08/f65/2018%20Wind%20Technologies%20Market%20Report%20FINAL.pdf. Accessed August 2020.

3 "Committed." Sierra Club, 2020, sierraclub.org/ready-for-100/commitments. Accessed August 2020.

4 "2019 U.S. Wind Industry Market Reports." American Wind Energy Association, awea.org/resources/publications-and-reports/market-reports/2019-u-s-wind-industry-market-reports. Accessed August 2020.

5 Ibid.

6 Ibid.

7 "Solar Investment Tax Credit (ITC)." Solar Energy Industries Association, 2020, seia.org/initiatives/solar-investment-tax-credit-itc. Accessed August 2020.

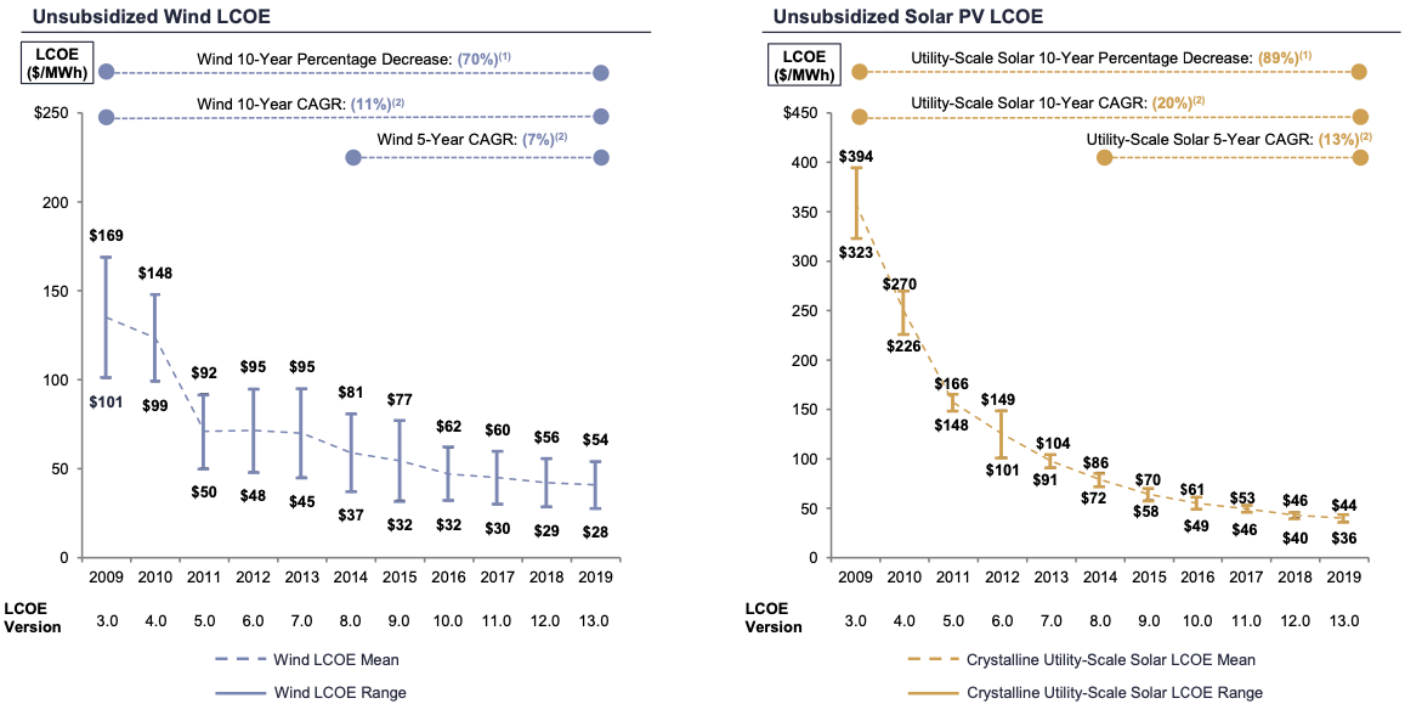
8 "Solar State By State." Solar Energy Industries Association, 2020, seia.org/states-map. Accessed August 2020.

9 "Solar Industry Research Data." Solar Energy Industries Association, 2020, seia.org/solar-industry-research-data. Accessed August 2020.

10 Ibid.

11 "Transmission." Edison Electric Institute, eei.org/issuesandpolicy/transmission/Pages/default.aspx. Accessed August 2020.

FIGURE 1. LEVELIZED COST OF ENERGY (LCOE) COMPARISON, HISTORICAL ALTERNATIVE ENERGY LCOE DECLINES



substations surrounding population centers so the energy can be "stepped down" and distributed for at-home and in-business consumption. Estimates point to 70 to 220 gigawatts of new electric generation required as early as 2030 to meet growing demand. This will require an annual buildout of transmission infrastructure to service this new electric generation, on top of investments necessary to merely maintain the electric grid.[12]

As the nation continues to embrace a clean energy future, fueled by renewable sources like wind and solar, many Americans will be searching for ways to make sure these investments benefit everyone in their communities.

12 Weiss, Jurgen, et al. "The Coming Electrification of the North American Economy: Why We Need a Robust Transmission Grid." WIRES, The Brattle Group, March 2019, wiresgroup.com/the-coming-electrification-of-the-north-american-economy. Accessed October 2020.

As the industry continues to plan, site, construct, and maintain an ever-growing amount of renewable energy generation projects, the construction of more electric transmission infrastructure is non-negotiable. Working with local stakeholders can ensure the value of these new projects is amplified by investments in the conservation of our shared natural resources.

B. A CLEAN ENERGY FUTURE IS BRIGHTER WITH CONSERVATION

With new investments in transmission lines, robust planning for the operation and maintenance of these projects will more effectively serve the needs of all stakeholders. Project developers, site managers, utilities, and other renewable energy industry professionals can work together with local communities and natural resources professionals to ensure new and existing transmission projects provide value for both the landowner hosting the project and their neighbors.

By combining native and naturalized, non-invasive species of vegetation with transmission projects, this new, necessary infrastructure can also provide habitat for honey bees, native bees, and other critical species of pollinators, such as monarch butterflies. Wildlife, including upland nesting birds like ring-necked pheasants, quail, and at-risk birds such as the sedge wren, also benefit from these new investments. Furthermore, perennial vegetation can improve water quality and build soil health with deep, complex root systems that filter out nutrients (i.e. nitrogen and phosphorus) before they leech to lakes, rivers, and streams. Perennial vegetation has also been shown to reduce peak stream-flows by up to 40 percent during flood events, building resiliency in times of stress.[13]

Designing these projects to achieve key environmental outcomes ensures ratepayers both around the projects and those far away from generating resources receive the greatest possible value for renewable energy infrastructure investments. Furthermore, robust planning can help stimulate local economies while also reducing long-term operation and maintenance costs for project developers and site managers.

C. POWERING ECOSYSTEM SERVICES

While all investments in conservation promote environmental improvement, developers can follow a few best practices to ensure project success. For example, native seed mixes offer the greatest return on investment when aiming to provide ecosystem services, such as habitat for pollinators and wildlife, as well as improved water quality and soil health. If possible, project developers should prioritize native seed selections over naturalized, non-invasive species of vegetation. However, equipment, cost, and on-site limitations may make the selection of naturalized, non-invasive species, like clover, a more practical or cost effective option. "Naturalized, non-invasive species" refers to vegetation which is not native to the region, but still offers value for achieving environmental outcomes. For example, clover is not native to the region but is a valuable source of pollen for honey bees in central Iowa.

If the decision is made to seed naturalized, non-invasive species on a site, developers should note these plants will move to other areas of the project and compete with native species, regardless of where they were planted. Additionally, if these species are included in a mix, they will likely not provide the same level of environmental benefits and the cost of the mix should be lower. Setting goals for the project and a holistic evaluation of all factors will help equalize costs for a project while balancing ecological outcomes.

In all, pairing native and naturalized, non-invasive vegetation with electric transmission infrastructure projects saves developers money, conserves natural resources, and provides ratepayers with the greatest return on investment—ultimately, amplifying the value of a quickly-approaching renewable energy future.

The easements required for above-ground electric transmission lines offer a prime opportunity to jumpstart populations of at-risk pollinators and wildlife while improving water quality and building soil health. Even with modest investments in habitat creation, honey bees, native bees, monarch butterflies, ring-necked pheasants, and quail can experience vibrant and measurable expansions in overall population.

Pollinators play a critical role in the robust food, fuel, and fiber production economy of the Midwest. By pollinating agricultural crops, this group of insects is crucial to ensuring economic and food security. Research shows the populations of all pollinators, including honey bees, native bees, and monarch butterflies, were three-and-a-half times greater on sites with investments in the reestablishment of native vegetation in central Iowa when compared to control sites.[14] Meanwhile, the same team at Iowa State University found a significant increase in the number of adult monarchs in late August on sites with native vegetation, due in part to a greater abundance of flowering resources at that point in the growing season.[15] See Figure 2 on page 4.[16]

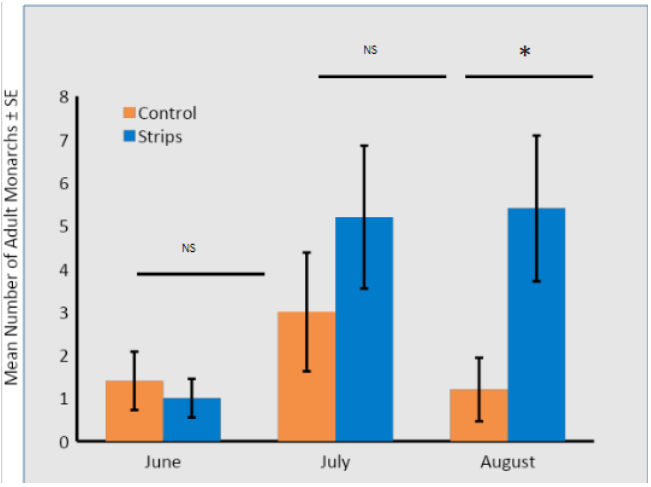
13 "Iowa Watershed Approach." Iowa Flood Center, The University of Iowa, iowafloodcenter.org/projects/iowa-watershed-approach-hydrologic-network-4/. Accessed August 2020.

14 Schulte, Lisa A., et al. "Prairie strips improve corn–soybean croplands." Proceedings of the National Academy of Sciences of the United States of America, October 2017, 114 (42) 11247-11252; DOI: 10.1073/pnas.1620229114.

15 "Research Highlight: Prairie strips help honey bees and wild pollinators." Iowa State University, February 2020, nrem.iastate.edu/research/STRIPS/files/publication/strips_ffar_infosheet_20200203.pdf. Accessed August 2020.

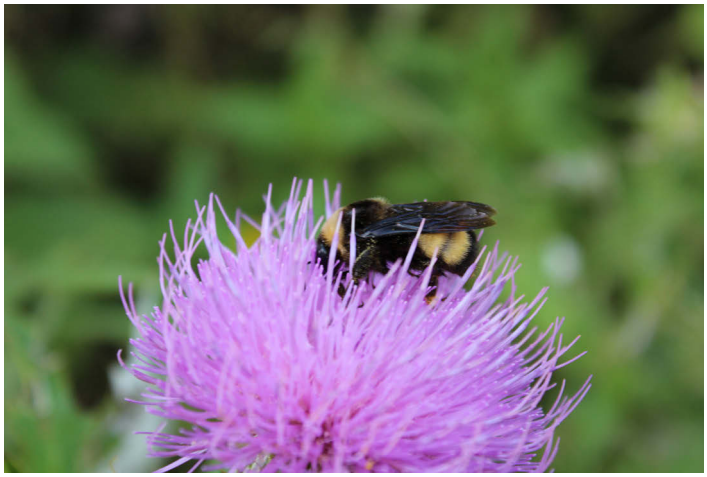
16 Ibid.

FIGURE 2. NUMBER OF ADULT MONARCHS FOUND ON-SITE



In addition to facilitating notable expansions in pollinator and other desirable insect populations, investments in native and naturalized, non-invasive vegetation create habitat for a variety of upland nesting birds. Ring-necked pheasants and quail, as well as other grassland birds like the sedge wren and dickissel each benefit from these efforts. These investments in habitat are critical to species success given the loss of habitat in recent years for these wildlife species. Between 1990 and 2018, upland wildlife (i.e. ring-necked pheasants) lost more than 1.8 million acres of habitat in Iowa alone.[17] This group of wildlife species lost nearly 3,000 square miles of habitat during that period, an area nearly 400 square miles larger than the state of Delaware.[18] Pollinator-friendly solar projects, transmission line corridors, and wind energy projects offer previously unavailable opportunities to invest in this critical wildlife habitat.

Site managers of transmission line corridor projects can improve water quality and build soil health with investments in native and naturalized, non-invasive vegetation. Beyond clearly-visible impacts, such as reducing on-site erosion, this practice offers a multitude of benefits for soil and water quality. For example, this practice has been proven to significantly reduce surface water runoff, helping retain toxic nutrients, such as nitrogen and phosphorus on the landscape and preventing them from leaching to lakes, rivers, and streams. Excess nutrients in water bodies lead to hypoxia, or a lack of oxygen-caused by the bloom and decay of algae and other aquatic plant life.[19] Strips of perennial native vegetation have been shown to reduce nitrogen loss by 60 percent and phosphorus loss by 90 percent.[20] The deep root systems of native plant species can absorb and filter more water, making it an effective flood reduction practice as well. In fact, perennial vegetation has been shown to reduce peak streamflows by up to 40 percent during flood events.[21]



Pollinator-friendly solar projects, transmission line corridors, and wind energy projects offer previously unatainable opportunities to invest in critical wildlife habitat.

With native and naturalized, non-invasive vegetation, site managers of renewable energy infrastructure projects can help power a variety of ecosystem services. These services include the creation of habitat for at-risk pollinators and vulnerable wildlife species, as well as helping promote cleaner water and healthier soils in the surrounding areas. Holistically, these investments help ensure that surrounding local stakeholders, project developers, and landowners hosting projects each see a broad range of benefits from electric transmission infrastructure.

17 Bogenschutz, Todd, et al. "2019 Iowa August Roadside Survey." Iowa Department Of Natural Resources. September 2019.

18 Ibid.

19 Schulte, Lisa A., et al. "Prairie strips improve corn–soybean croplands." Proceedings of the National Academy of Sciences of the United States of America, October 2017, 114 (42) 11247-11252; DOI: 10.1073/pnas.1620229114.

20 "A Landowner's Guide to Prairie Conservation Strips." Iowa State University, extension.iastate.edu/alternativeag/info/Landowners%20Guide%20to%20Prairie%20Conservation%20Strips.pdf. Accessed August 2020.

21 "Flood Resilience Program." Iowa Watershed Approach, Iowa Department of Homeland Security and Emergency Management, 2017, iowawatershedapproach.org/programs/resilience/. Accessed August 2020.

II. TRANSMISSION INFRASTRUCTURE LINKS RENEWABLES AND THE ENVIRONMENT

A. CONNECTING CLEAN, RENEWABLE ENERGY TO CONSUMERS

Electric transmission plays an essential role in connecting consumers with reliable electricity. As new sources of renewable and clean energy, such as wind and solar, become operational, transmission line project developers will have to update and expand the electric grid to ensure regular operations will not be impacted. As regional transmission organizations, such as the Southwest Power Pool, Midcontinent Independent System Operator, and PJM Interconnection, evaluate the expansion and placement of distributed renewable sources of electric generation, thousands of miles of new transmission lines and upgrades will be required.

B. TRANSMISSION CORRIDORS DELIVER OPPORTUNITY

With more than 600,000 miles of transmission lines already operational throughout the U.S., there is a significant opportunity for investments in conservation.[22] By establishing native and naturalized, non-invasive vegetation in these project corridors, project developers can add value to these crucial components of electric grid infrastructure for those on the receiving end of transmission, as well as local stakeholders who live, work, and farm around them. Through consultation with local stakeholders, project developers can avoid impacts to vulnerable species while creating migratory corridors and habitat for vulnerable populations of pollinators, such as the monarch butterfly, and wildlife, like the sedge wren.

Innovative, relatively unexplored opportunities for rural economic development are also available for communities and developers in transmission line project corridors. Coupling these renewable energy infrastructure projects with beekeeping and honey production, the grazing of livestock, recreational trails, and public-facing educational opportunities could facilitate greater local buy-in while stimulating rural economies.

22 "Transmission." Edison Electric Institute, eei.org/issuesandpolicy/transmission/Pages/default.aspx. Accessed August 2020.

1. PLANNING, SEEDING, AND MANAGING CONSERVATION INVESTMENTS

Planning — Maintaining the reliability of the electric grid requires constant updates and investment. Properly managing vegetation in accordance with local, state, and federal codes helps avoid issues which could lead to disruptions in service. In fact, one of the most significant blackouts in the U.S.—affecting more than 50 million people in the U.S. and Canada—was caused by overgrown trees.[23] In addition to avoiding disruptions, planning for regular, sufficient management of vegetation within a right of way will provide easier access to transmission lines, and reduce the likelihood of wildfires or erosion to the surrounding area.[24] Transmission line project developers should consult legal experts to ensure any investments in native and naturalized, non-invasive vegetation are in compliance with regulations.

Seeding — When planning for implementation of native and naturalized, non-invasive vegetation within a transmission line project corridor, project developers will need to consider methods in which they will seed their desired mix of species. Accounting for the size of the project area will help guide seeding methodology. Similar to pollinator-friendly solar sites, transmission line corridors could be seeded by using a drill or broadcast to distribute the seeds on site. Hand-broadcast methods are likely impractical given the length of the corridor, but could be used on smaller tracts of land where vegetation is to be established. Considerations of corridor length, width, and other movement restrictions can help guide decisions about the proper seeding equipment and machinery needed to distribute seeds. Project developers should keep in mind that native grass seeds need good seed-to-soil contact and should never be planted deeper than one-fourth of an inch in the soil. Ideally, newly-cast native prairie seeds should rest on top of the soil.[25]

23 "Pesticide Environmental Stewardship Program: Benefits of Integrated Vegetation Management on Rights-of-Way." U.S. Environmental Protection Agency, epa.gov/pesp/benefits-integrated-vegetation-management-ivm-rights-way. Accessed August 2020.

24 Ibid.

25 "Management Overview, Science-Based Trials of Row Crops Integrated with Prairie Strips." Iowa State University, 2019, nrem.iastate.edu/research/STRIPS/content/management-overview. Accessed December 2019.

By establishing native and naturalized, non-invasive vegetation in project corridors, project developers can add value to these crucial components of electric grid infrastructure for those on the receiving end of transmission, as well as local stakeholders who live, work, and farm around them.

The timing of seed placement is a key consideration to ensure project success. As with other native seedings, frost-seeding between Nov. 1 and June 1 is ideal for maximum germination and ensuring the vegetation can establish a strong stand.[26] Native plants need adequate time to establish their deep root systems which enable them to be more effective than other species of vegetation at water filtration and nutrient cycling. Frost seeding enables the desired vegetative species to have a full growing season to establish themselves before cold temperatures and frost arrive.

To establish the needed firm seedbed, conventional methods include discing at least twice, and culti-packing, although these decisions should be made based upon the conditions of each site. Patience is key during this period and project developers should remember that maintenance costs will be steeper during the one to three year establishment period, but will eventually offer impressive cost savings.

> "In year one prairie sleeps, in year two prairie creeps, and in year three prairie leaps."[27]

Best practice: Project developers should keep in mind each seedbed is different and may not need discing or other disturbance—these decisions should be made in partnership with a natural resources professional while reviewing site-specific information such as existing vegetation, moisture levels, and soil type.

Management — Project developers should be sure to adjust any previously-planned timelines to fit the needs of each project site to ensure maximum project value. Working with private landowners, natural resources professionals, and other local stakeholders, project developers should evaluate the ratio of native and desirable species to invasive weeds and other undesirable species before

26 "Habitat How-To." Iowa Monarch Conservation Consortium, Iowa State University, 2019, monarch.ent.iastate.edu/habitat-how. Accessed December 2019.

27 Personal communication, Matt O'Neal, entomologist at Iowa State University, March 2020.

making management decisions, such as mowing. Again, project developers should plan to allocate more resources to management of these corridors during the establishment period of one to three years. Budgeting $700 per acre for a seed mix and $100 per acre for seed-bed preparations should allow for adequate resources for managing a transmission line corridor.[28]

As a result of the unique infrastructure in transmission line corridors and the often narrow width of projects, which could be surrounded by farmland and/or heavily-forested areas, project developers should consult with local natural resources officials and project engineers to determine management options for a project site seeded with native and naturalized, non-invasive vegetation. With proper safety measures in place, including establishing firebreaks and coating the base of transmission towers with water and/or flame retardant, project developers may be able to use prescribed burning as a management option for transmission line corridors. However, another effective option includes mowing and bailing of sites. Holistically, an integrated approach of mowing and bailing, burning, and/or grazing will help ensure project success. Thinking of management on an annual basis could help with planning and guide quality control of on-site vegetation.

- Year one: Project developers should expect to conduct regular mowings (three to four times) during the first growing season. This prevents weeds from shading out seedlings and going to seed which facilitates greater spread. The first mowing should be at a height of 4 to 6 inches soon after seeding, and the next two mowings should be at a height no less than 8 inches.[29]

- Year two: After a successful planting, years subsequent to seeding and establishment provide the opportunity for project developers to enjoy less overall maintenance and begin to realize measurable cost savings. During year two, sites need only an occasional disturbance to encourage desirable species.[30] At this point, mowing or burning based on the needs of a site is appropriate, but these decisions should be made in conjunction with a natural resources professional and should consider the ratio of desirable to undesirable species prior to management actions being taken.

- Years three and four: Project developers can expect to begin realizing substantially less maintenance needs during this period. At this point, mowing and baling or conducting a prescribed burn approximately every three years will help eliminate invasive and undesirable species.[31]

Seeding a site with native and naturalized, non-invasive vegetation presents opportunities for the introduction of livestock grazing for management. For example, pollinator-friendly solar sites have seen success with rotational grazing of sheep as a management option. Sheep are recommended for pollinator-friendly solar projects because goats and cattle could cause damage to on-site equipment. However, transmission line corridors are less likely to be impacted by goats jumping on equipment and chewing of wires, or cattle leaning against equipment, making these species of livestock a lower-risk option for transmission line corridors in contrast to solar sites.

Project developers should work with local stakeholders and private landowners if they wish to add value to their transmission line projects with this management practice. However, waiting until after the establishment period of one to three years before using this practice avoids risk of overgrazing and failed establishment. Additionally, special considerations for fencing and water access will need to be deciphered before this practice is introduced and robust rotational grazing plans should be followed.

2. TIMING IMPACTS FOR WILDLIFE AND POLLINATORS

Transmission lines offer longer, often contiguous habitat and migratory corridors for wildlife and pollinators than pollinator-friendly solar project sites. However, management actions should follow similar timelines to avoid negatively impacting the life cycles of a variety of pollinators and wildlife. Doing so will help avoid reductions in overall project value and ensure a project is successful in meeting the goals of the project developer and the surrounding stakeholders.

After year two, project developers should avoid or minimize mowing and/or burning between

28 Personal communications with Amy Yoakum of Conservation Corps Iowa & Minnesota, and Tim Younguist, Iowa State University STRIPS Project, March 2020.

29 "Habitat How-To." Iowa Monarch Conservation Consortium, Iowa State University, 2019, monarch.ent.iastate.edu/habitat-how. Accessed December 2019.

30 Ibid.

31 "Iowa Monarch Conservation Consortium." Iowa State University, monarch.ent.iastate.edu/. Accessed December 2019.

April 1 and Aug. 1 to reduce impacts during the nesting season of upland birds, such as pheasants and quail.[32] Delaying management actions even further to late September facilitates a more welcoming habitat for migrating pollinators such as monarch butterflies. This date is preferred because the highest population of monarch eggs is often found on milkweed plants in late July and early August.[33] However, it is appropriate for project developers to use spot mowing and/or herbicide application during this period if the site conditions require management actions.

Best practice: Every site is unique and all timelines should be adjusted to the needs of a project rather than arbitrary timelines. Evaluating the ratio of native and desirable species to weeds and invasive vegetation before making mowing, prescribed burning, and other management decisions will help project developers reach their goals more quickly. If native and desirable species of vegetation are struggling to establish a strong stand, management action is likely necessary; if the opposite is occurring, taking action may not be in a site's best interest.

3. MAXIMIZING MANAGEMENT COST SAVINGS

Project developers may shy away from the implementation of native and naturalized, non-invasive species of vegetation after reviewing up-front seeding and management costs during the establishment period of one to three years. However, a fair evaluation of all cost factors and robust long-term planning reveals that developers can save a substantial amount of financial resources as a result of major declines in long-term operation and maintenance expenses compared to other species of vegetation, such as turfgrass. Analyses in progress indicate that over a 10-year period, the costs of establishing and maintaining pollinator habitat are substantially less than the costs of managing turfgrass.[34]

4. SEED MIX SELECTIONS FOR TRANSMISSION CORRIDORS

While there are equipment and efficiency challenges which can reduce the height of native and naturalized, non-invasive species of vegetation on pollinator-friendly solar project sites, transmission line corridors offer a less restrictive opportunity for conservation investments. Though project developers must follow vegetation management rules set by the Federal Energy Regulatory Commission on vegetative height restrictions to avoid disruptions in service, most native and naturalized, non-invasive species of vegetation that facilitate pollinator and wildlife habitat reach a peak height well below those requirements. Additionally, these guidelines are usually applicable on high-voltage transmission lines and heights vary based on total voltage and whether the line is conducting alternating current or direct current.[35] Developers should work with regulators and in-house legal experts to ensure compliance during the seed mix selection and project planning processes.

The following steps are intended to assist project developers through the seed mix selection process.

Step one: Consult with natural resources professionals to evaluate the following site-specific information:

- Project location (i.e. floodplain, steep slopes).
- Soil type and moisture (i.e. wet, wet-dry, dry, etc.).
- Site history (past vegetation, previous uses).
- The species of vegetation native to the area (local ecotype varies by region).
- Planned management methods for the site (mowing, grazing, equipment).
- Location of existing infrastructure in the project corridor (railroads, water bodies, highways, farm fields, etc.)

Transmission line corridors often span substantial lengths, requiring a holistic approach that incorporates the needs of different tracts of land within the corridor. Working closely with natural resources professionals can help project developers determine the best suited seed mixes for what can be vastly different site conditions. Tailoring a seed mix to similar site conditions within a corridor can ensure the

32 "Native Seed Program." Iowa Pheasants Forever, 2019, iowapf.net/native-seed-program. Accessed December 2019.

33 "Habitat How-To." Iowa Monarch Conservation Consortium, Iowa State University, 2019, monarch.ent.iastate.edu/habitat-how. Accessed December 2019.

34 Janke, et al. In review. Iowa State University, 2020.

35 "FAC-003-4 Transmission Vegetation Management." Federal Energy Regulatory Commission, ferc.gov/sites/default/files/2020-04/fac-003-4.pdf. Accessed May 2020.

avoidance of failed establishment and facilitate the maximizing of public benefits from projects; opposed to a one-size-fits-all approach which could lead to unintended consequences.

Step two: Set goals to help guide decision making

To select a seed mix that is suitable for a transmission corridor, project developers should carefully set goals, such as providing pollinator and monarch butterfly habitat, to help guide decision making. Project developers should work with local stakeholders to help identify goals that will add the most value to a transmission line project. Some goals may include special considerations for a variety of desired outcomes.

Wildlife generally responds more to the structure of vegetation instead of specific plant species. For example, seed mixes which contain too many grasses could restrict the navigability of the site for upland nesting birds, such as ring-necked pheasants and quail, negating the value of the site to these birds. When formulating a seed mix, project developers should evaluate the ratio of grasses to forbs to inform their seed selection process. A desired seed mix for upland nesting birds would be closer to 30 percent grasses and 70 percent forbs.

When managing a site to achieve value for a variety of pollinators, including native bees, honey bees, and monarch butterflies, a diversity of flowering plants that bloom during the entire growing season is crucial to provide pollen and nectar resources. This can help improve overall honey production in beehives placed on a project site as well as provide crucial resources for migrating monarch butterflies. Additionally, monarch butterflies only lay eggs on milkweed plants, making this species of vegetation a crucial component of a seed mix intended to maximize project value for this flagship species.

Other pollinator considerations:

- Grasses, such as Little Bluestem, have limited value for pollinators.
- Clovers are very valuable for honey bees, recognized as a source of nectar for honey production and have been identified as the most common source of pollen for honey bees in central Iowa.
- Goldenrods (Solidigos) and Birdsfoot Trefoil (Lotus corniculatus) have been proven to be used as a source of pollen for honey bees.

Wild bees benefit from vegetation native to the location; however, naturalized, non-invasive species (i.e. clover) could offer similar or enhanced value. Honey bees have been proven to benefit from both native and naturalized, non-invasive species.[36] Table 1 on page 10 displays some species which offer valuable nectar and pollen resources for this species. The table also shows pollen from flowering plants in strips of prairie and control sites which were used by honey bees as a source of pollen in central Iowa.

If project developers are considering livestock grazing as a management option, careful consideration of the species of vegetation which could make the site more valuable for rotational grazing is important. While many species of livestock, including sheep and goats, are flexible grazers, appropriate forage resources will maintain proper animal nutrition. Project developers should work with natural resources professionals and livestock managers to secure proper resources for these animals. Additionally, if electric fencing is installed to corral the livestock within a corridor, special steps may need to be taken to make sure the wires are not "grounded out" as a result of contact with vegetation.

Step three: Determine seed source and suitability

Once the plant species within a mix have been identified, selecting a retailer who can source the seeds is a key project need. Retailers who offer local ecotype seeds, meaning they are best suited for establishment within the site's conditions and native to the region, are recommended to ensure maximum project value. Seeds should be uncontaminated by herbicide residue or mixing with undesirable weed seeds. By identifying local sources of native seed expertise, developers can review lists of suppliers provided by those entities. For projects in Iowa, consulting a list from the Tallgrass Prairie Center at the University of Northern Iowa can help identify a seed retailer.[37]

36 Moorhouse, Amy Lynn. "Evaluation of CRP contour buffer and filter strips as habitat for native bees and predatory ground beetles." Iowa State University, 2016, nrem.iastate.edu/research/STRIPS/files/publication/moorhouse_2016_msthesis_-_eval_of_crp_contour_buffer_and_filter_strips_as_bee_and_beetle_habitat.pdf. Accessed August 2020.

37 "2020 Iowa Seed and Service Provider List." Tallgrass Prairie Center, University of Northern Iowa, March 2020, tallgrassprairiecenter.org/sites/default/files/ia_prairie_seed_service_providers_03-20.pdf. Accessed May 2020.

TABLE 1. PLANT TAXA REPRESENTED IN BEE POLLEN AND FOUND IN A PRAIRIE STRIP

Plant taxa	Native or non-native	Control sites	Prairie strips
Chamaecrista fasciculata	Native	22.24±6.21	35.7±7.08
Melilotus spp.	Non-native	11.48±5.11	8.41±2.69
Trifolium pratense	Non-native	19.92±5.91	15.52±4.51
Trifolium repens	Non-native	10.87±2.86	11.05±2.46
Solidago spp.	Native	4.23±2.47	3.69±2.79
Dalea purpurea	Native	4±2.36	3.09±1.23
Helianthus, Heliopsis, and Silphium spp.	Native	2.91±1.23	2.59±0.85
Eryngium yuccifolium	Native	0.03±0.03	0.04±0.04
Solidago rigida	Native	1.5±0.82	0.73±0.39
Echinacea spp.	Native	2.5±1.01	0.78±0.3
Monarda fistulosa and Pycnanthemum virginianum	Native	4.35±3.1	1.35±0.88
Pastinaca sativa	Non-native	0.04±0.03	0.08±0.04
Taraxacum officinale	Non-native	0.26±0.19	0.1±0.06
Cirsium spp.	Non-native	1.73±0.95	0.13±0.05
Convolvulus arvensis	Non-native	0.01±0.01	0±0
Lotus corniculatus	Non-native	1.01±0.75	1.39±1.2

When consulting with retailers about a seed mix, the following factors should be considered:

- Is the seed locally-sourced?
- Given my site history, do you have suggestions for how I can ensure desirable species?
- What is your recommended seeding rate?
- What is the total cost per acre for this seed mix?

Step four: Consult with geographically-relevant stakeholders to inform a seed mix

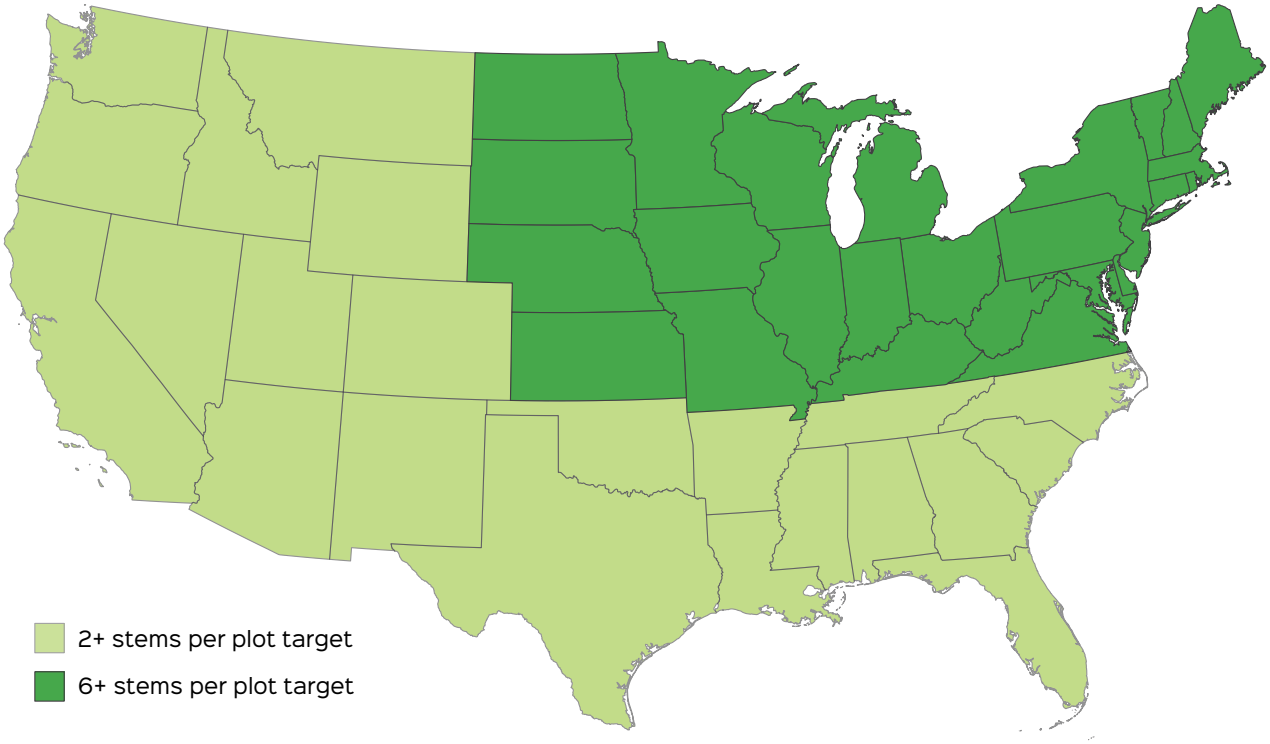
Seed mixes for transmission line projects should be compiled after consultation with local stakeholders and natural resources professionals. As a project developer moves throughout a transmission line corridor, the species of vegetation native to the area could change, as well as soil moisture and type, weather conditions, and other site-specific factors. For site managers working to cover the entire transmission line corridor, identifying sources of local natural resources expertise can maximize project value. In the Midwest, the following list contains some examples of organizations with whom project developers could consult with.

- County conservation boards, natural resource districts, etc.;
- Soil and water conservation districts;
- State agriculture and natural resources agencies (state departments of agriculture and natural resources, etc.);
- Natural Resources Conservation Service (NRCS);
- University extension and outreach professionals; and
- Private conservation groups (Pheasants Forever, Xerces Society, etc.).

C. POLICY CONSIDERATIONS FOR PUBLIC AND PRIVATE STAKEHOLDERS

In the approval of transmission line projects, there are opportunities for developers, state regulatory bodies, federal authorities, private landowners, and other stakeholders to work together to implement native and naturalized, non-invasive vegetation within project corridors. By working with transmission developers, state and federal regulators can identify strategies for making investments in native and naturalized, non-invasive vegetation. Throughout the project approval process, these entities can help inform the creation of previously unimaginable stretches of wildlife and pollinator habitat and migratory corridors by encouraging best practices.

FIGURE 3. GEOGRAPHIC EXTENTS OF MINIMUM MILKWEED STEM TARGETS WITHIN THE NATIONAL MONARCH AGREEMENT



1. NATIONAL MONARCH AGREEMENT SHOWS PROMISE

Federal authorities, including the U.S. Fish and Wildlife Service, play a key role in the siting and environmental review of transmission line projects and have considerable influence on vegetation management practices within project corridors. In April 2020, the U.S. Fish and Wildlife Service and the University of Illinois at Chicago announced an unprecedented partnership with more than 45 organizations in the energy and transportation sectors to invest in habitat creation and conservation efforts to protect the monarch butterfly. Urgency for protecting the monarch butterfly is reinforced by the fact that more than 3,758,201 acres of grasslands, shrublands, and wetlands (which serve as habitat) were converted to corn and soybean production across the Midwest between 2008 and 2016.[38]

The Monarch Butterfly Candidate Conservation Agreement with Assurances with integrated Candidate Conservation Agreement (MCCAA/CCA) for energy and transportation lands is a partnership that gives regulatory certainty under the Endangered Species Act to energy and transmission companies and state departments of transportation if they voluntarily make investments to create and maintain habitats for the monarch butterfly. With these voluntary conservation efforts, utilities and departments of transportation are avoiding costs and operational delays which would occur if the monarch butterfly were listed as endangered or threatened under the Endangered Species Act. For Eastern and Midwestern states, adopted acres are anticipated to support milkweed densities of at least 150 and 156 stems per acre in the energy and transportation sectors, respectively. See Figure 3.[39]

38 Lark, Tyler. "Monarch and waterfowl habitat loss from recent cropland expansion." University of Wisconsin-Madison, Feb. 28, 2018, gibbs-lab.com/wp-content/uploads/2019/03/Habitat_impacts_of_recent_crop_expansion.pdf. Accessed August 2020.

39 "Nationwide Candidate Conservation Agreement for Monarch Butterfly on Energy and Transportation Lands." U.S. Fish and Wildlife Service, March 2020, fws.gov/savethemonarch/pdfs/Final_CCAA_040720_Fully%20Executed.pdf. Accessed August 2020.

Developers could also work with private landowners within transmission line corridors to adopt practices like prairie strips to meet the goals they have agreed to in the MCCAA/CCA. "Applicants may enroll properties in the Agreement, including owned, leased, and easement lands, and lands owned by permits and/or other agreements within the covered area as set forth in this section."[40]

Collaborators in the development of the CCAA from the Midwest include the state departments of transportation in Illinois, Indiana, Iowa, Minnesota, Nebraska, Ohio, and regional energy companies including Alliant Energy, Duke Energy, FirstEnergy, NextEra Energy, and more.[41] If transmission line project developers are looking to make major conservation investments on their project corridors, they could consider joining the MCCAA/CCA to attain regulatory certainty under the Endangered Species Act while providing enhanced value for local stakeholders hosting and surrounding projects. More information about joining can be found at rightofway.erc.uic.edu/national-monarch-ccaa/.

2. THE CASE FOR PRAIRIE STRIPS

At Iowa State University, the Science-Based Trials of Rowcrops Integrated with Prairie Strips, or "STRIPS" project, has developed recommendations for re-establishing native plants to deliver ecosystem services. A prairie strip replaces agricultural land with a mix of native grasses, flowers between a minimum width of 30 feet and a maximum width of 120 feet, and is placed around or through a farm field or within a terrace channel. See Figure 4 on page 13. Eight years of field data show that converting just 10 percent of a crop field to prairie strips could reduce soil loss by 95 percent, phosphorus runoff by 90 percent, nitrate-nitrogen runoff by 84 percent, and water runoff by 44 percent.[42]

The STRIPS project can offer a model for transmission line project developers given the similarity of size and placement as well as intended goals to establish wildlife and pollinator habitat while improving water quality and soil health.

Project developers could use prairie seed calculators, such as the Iowa NRCS Prairie Seed Calculator or the Tallgrass Prairie Seed Calculator offered by the Tallgrass Prairie Center at the University of Northern Iowa, to create seed mixes to begin a dialogue with retailers and local natural resources professionals.[43,44]

3. WORKING WITH LANDOWNERS TO IMPLEMENT HABITAT AND MIGRATORY CORRIDORS

Many transmission line developers have seen great success in partnering with local conservation organizations, such as county conservation boards in Iowa, to implement native and naturalized, non-invasive vegetation on publicly-owned land within project corridors. However, making these investments on private lands often poses unique challenges. Publicly-managed lands are usually better resourced which facilitates greater adoption of conservation practices, whereas private landowners often continue to utilize their land within a project corridor in other ways, such as farming. But, changes adopted in the 2018 farm bill have opened a new opportunity for the creation of wildlife and pollinator habitat within transmission line corridors on private lands, particularly land that is currently, or was recently, being used for agricultural production.

In the 2018 farm bill, lawmakers approved prairie strips as an eligible practice under the Conservation Reserve Program (CRP), which is a federal conservation program administered by the U.S. Department of Agriculture's (USDA) Farm Service Agency with a goal of enrolling 8.6 million acres of agricultural land nationwide. Through continuous CRP enrollment, prairie strips are listed as conservation practice 43 (CP-43) within the Clean Lakes, Estuaries, And Rivers (CLEAR) Initiative. With this new eligibility, farmers can enter into 10- or 15-year contracts to implement the practice. Land must be cropland that is considered planted in an agricultural commodity four of the six most recent crop years and is physically and legally capable of being planted (no planting restrictions due to an easement or other legally binding instrument) in a normal man-

40 Ibid.

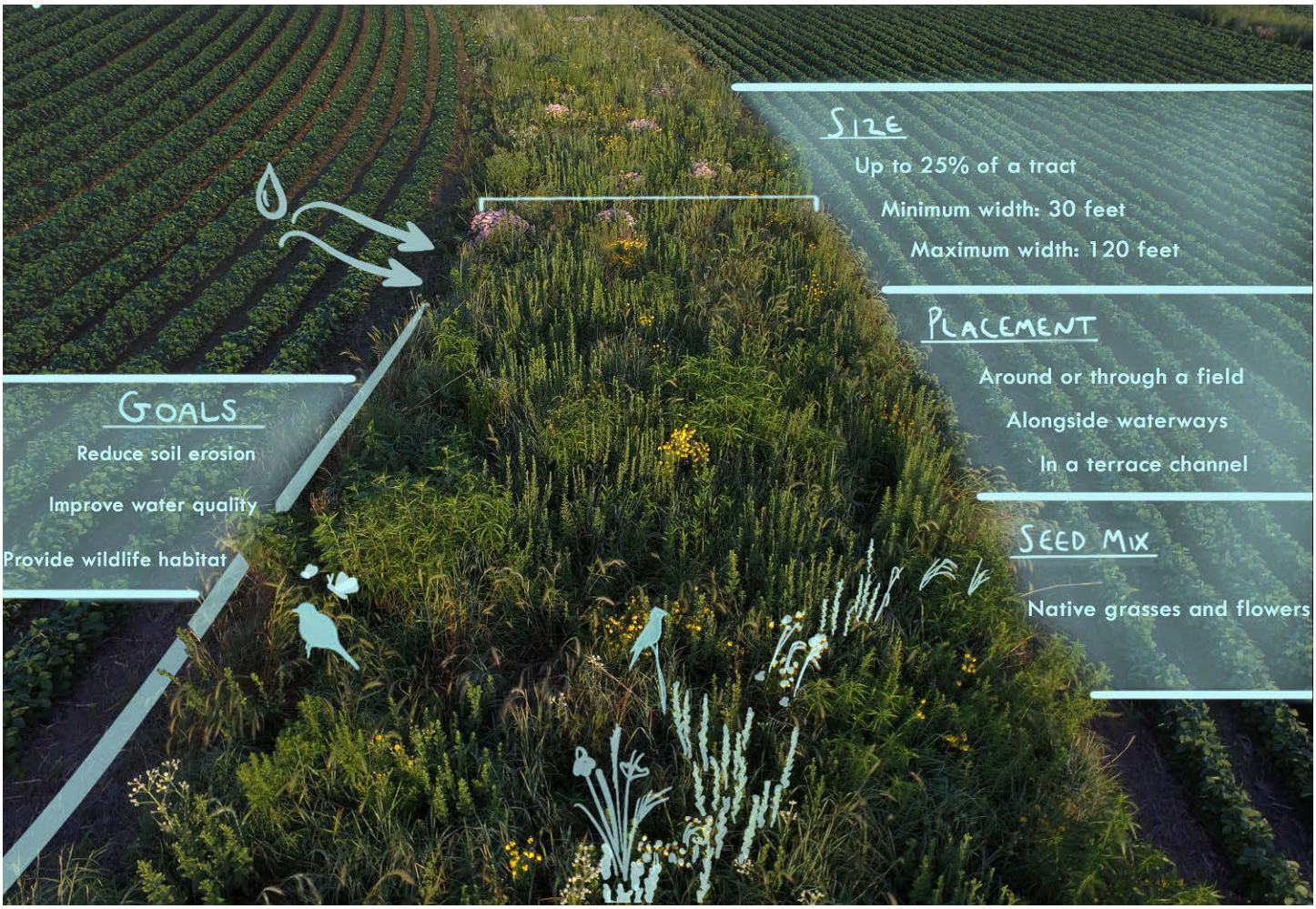
41 "Nationwide CCAA for Monarch Butterfly." Rights-of-Way as Habitat Working Group, University of Illinois at Chicago, rightofway.erc.uic.edu/national-monarch-ccaa/. Accessed August 2020.

42 "Science-Based Trials of Row Crops Integrated with Prairie Strips, FAQ: Why would I plant prairie strips on my farm?" Iowa State University, 2020, nrem.iastate.edu/research/STRIPS/content/faq-why-would-i-plant-prairie-strips-my-farm. Accessed August 2020.

43 "Biology/Plants/Wildlife, Native Prairie Seeding Calculator." Natural Resources Conservation Service Iowa, U.S. Department of Agriculture, April 17, 2020, nrcs.usda.gov/wps/portal/nrcs/ia/technical/ecoscience/bio/. Accessed May 2020.

44 "Tallgrass Prairie Seed Calculator." Tallgrass Prairie Center, University of Northern Iowa, tallgrassprairieseedcalculator.com/. Accessed August 2020.

FIGURE 4. PRAIRIE STRIPS IN THE CONSERVATION RESERVE PROGRAM



ner to an agricultural commodity. Cost-share benefits through CRP include annual rental payments for the duration of the contract and payments of up to 50 percent of the cost of practice establishment.[45] Practices within continuous CRP also receive a 5 percent Practice Incentive Payment and a signup incentive payment equal to 32.5 percent of the first full year's annual rental payment.[46]

There are some additional considerations for landowners and project developers to contemplate when evaluating the adoption of prairie strips on private lands within transmission line corridors. For example, the minimum acceptable width of a prairie strip is 30 feet and the maximum width is up to an average of 120 feet, but the width of an individual prairie strip may be adjusted to accomplish the purpose of the practice. Prairie strips may not exceed 25 percent of the cropland area per field; however, they may be used as a turnaround for normal farming operations. See Figure 5 on page 14 for an example of a conservation-friendly transmission line corridor. Notably, machinery traffic should be limited as using prairie strips for equipment storage and/or travel lanes would be in violation of CRP contract requirements.[47]

Transmission line project developers should work directly with farmers through direct consultations, or the inclusion of CRP eligibility resources within lease agreements, to inform private landowners within their project corridors of this opportunity for conservation investments.[48] Landowners and

45 "Conservation Reserve Program, Clean Lakes, Estuaries, And Rivers (CLEAR) Initiative Prairie Strip Practice." U.S. Department of Agriculture, Farm Service Agency, December 2019, fsa.usda.gov/Assets/USDA-FSA-Public/usdafiles/FactSheets/2019/crp_clear_initiative_prairie_strip_practice-fact_sheet.pdf. Accessed May 2020.

46 Ibid.

47 Ibid.

48 "Agricultural Resource Conservation Program." U.S. Department of Agriculture, Farm Service Agency, fsa.usda.gov/Internet/FSA_File/2-crp.pdf. Accessed June 2020.

FIGURE 5. EXAMPLE OF A CONSERVATION-FRIENDLY TRANSMISSION LINE CORRIDOR

operators who are interested in the adoption of prairie strips on their land within a transmission line corridor can get technical assistance with implementation, management, and cost-share eligibility at their nearest USDA service center. Visit farmers.gov/service-center-locator to find a local service center.[49]

Setting a "moonshot-style" goal for a number of acres covered by a certain date could help guide the implementation of prairie strips within transmission line project corridors. Additionally, evaluating opportunities for standardized adoption within corridors, such as recommendations for management actions and seed mix selections based on an ecological gradient, could help developers overcome logistical challenges. For example, making management and seed mix recommendations based on major land resource areas as defined by the USDA's NRCS could help standardize this process. Figure 6 on page 15 shows the Major Land Resource Areas in Iowa.[50]

49 "Find Your Local Service Center." U.S. Department of Agriculture, farmers.gov/service-center-locator. Accessed May 2020.

50 "Soils, Major Land Resource Area (MLRA) Regions Map of Iowa." Natural Resources Conservation Service Iowa, U.S. Department of Agriculture, nrcs.usda.gov/wps/portal/nrcs/ia/soils/. Accessed June 2020.

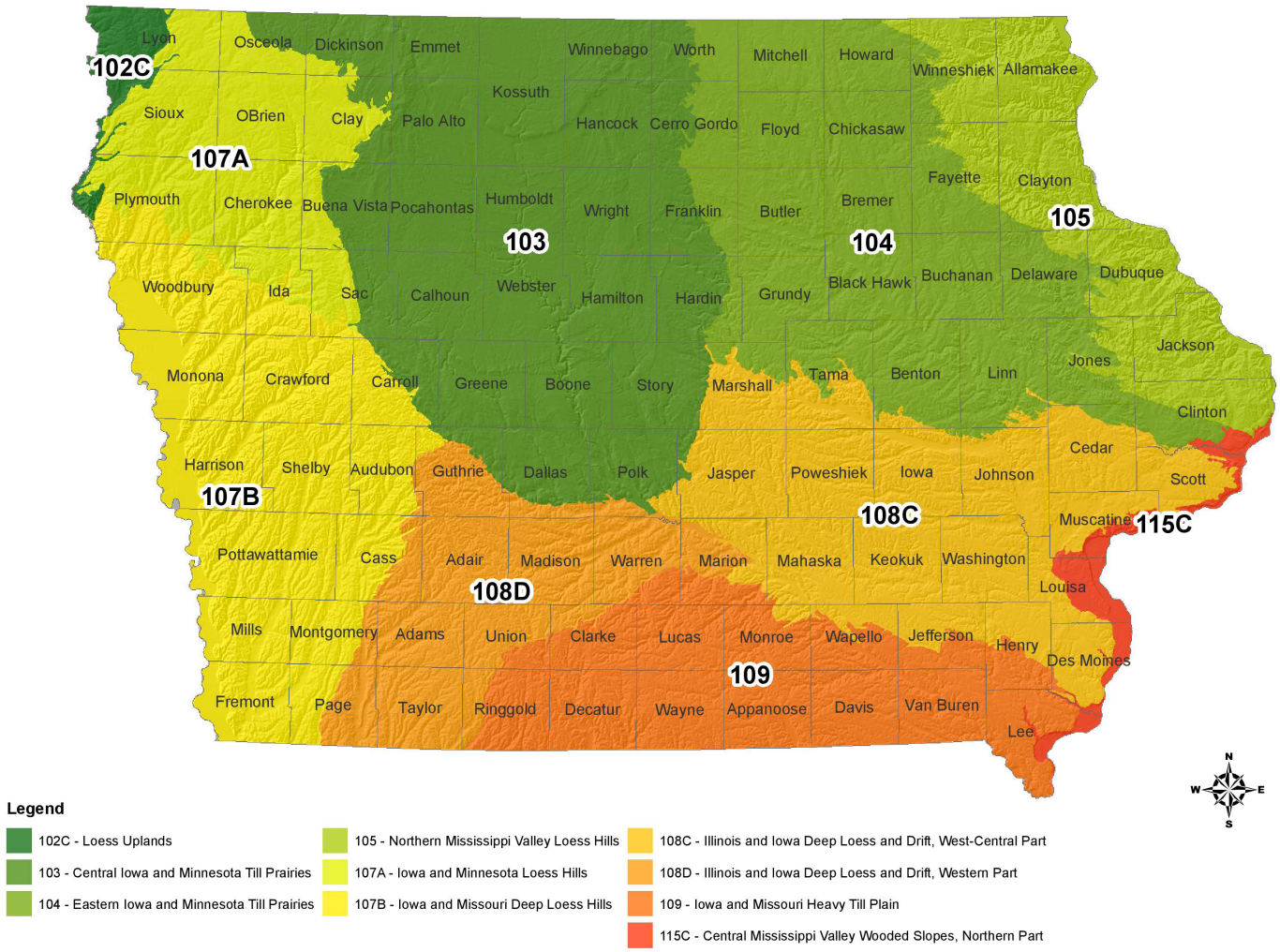
III. CONCLUSION

Renewable energy sources, such as wind and solar, are growing rapidly. As the industry continues to create hundreds of thousands of jobs, stimulate local and state tax revenue, and reduce greenhouse gas emissions, new investments in electric transmission infrastructure will inevitably occur. By developing resources for site managers of renewable energy infrastructure, public officials at all levels are well positioned to add value to these projects. Investments in native and naturalized, non-invasive vegetation ensure habitat for at-risk pollinators, including the monarch butterfly, while creating habitat for vulnerable wildlife species. These species are crucial for economic and food security in the Midwest and underwriting renewable energy projects with perennial vegetation improves quality of life for all.

Coupling conservation with electric transmission infrastructure projects and reducing financial stress are not mutually exclusive. In fact, research has demonstrated these investments can save project developers up to three times the cost of managing traditional turfgrass sites.[51] The combination of native and naturalized, non-invasive vegetation with

51 Argonne National Laboratory, produced for the U.S. Department of Energy's InSPIRE Study. Obtained via personal communication with Fresh Energy, April 2020.

FIGURE 6. MAJOR LAND RESOURCE AREAS OF IOWA



large renewable energy infrastructure projects opens the door to numerous, scarcely-explored economic development opportunities, particularly in the rural Midwest. Leveraging project sites for beekeeping, building the local native seed supply chain by investing in local retailers and service providers, developing recreational trails within easements, and other unexplored uses can help stimulate struggling rural economies.

In all, when investments in conservation are made on electric transmission infrastructure sites, the benefits of these projects are amplified. For stakeholders looking to add value for ratepayers, vulnerable pollinators and wildlife, soil and water quality, and economic stimulation, there rarely comes such a clear and practical option. As the Midwest looks forward to a future powered by a clean energy economy, these investments will only grow in relevance.

About the Center for Rural Affairs

Established in 1973, the Center for Rural Affairs is a private, nonprofit organization with a mission to establish strong rural communities, social and economic justice, environmental stewardship, and genuine opportunity for all while engaging people in decisions that affect the quality of their lives and the future of their communities.