RE in the SW:

Place based and at-scale renewable energy in the Southwest

Regional Virtual Workshop Brief - 01.09.23

University of Arizona
Pacific Northwest National Laboratory

RE in the SW: Place based and at-scale renewable energy in the Southwest

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Prepared by:
Kirk Dimond, University of Arizona
Will Glockner, University of Arizona
Krista Planinac, University of Arizona

Reviewed by:
Danielle Preziuso, Pacific Northwest National Laboratory
Katie Arkema, Pacific Northwest National Laboratory
Simon Gore, U.S. Department of Energy
Jonathan Bean, University of Arizona
Kenneth Kokroko, University of Arizona
Omar Youssef, University of Arizona
Adriana Zuniga-Teran, University of Arizona

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Summary:

Problem solving through comprehensive design thinking, appropriate to place, is increasingly critical as we tackle the grand challenge of decarbonization. Traditional energy system development in the 20th century has prioritized maximizing energy and economic outputs at unprecedented scale and across landscapes resulting in significant environmental, social and economic impacts. This has driven significant imbalances between energy development, communities, urbanization, and landscapes. The beginnings of our renewable energy transition are following suit and are driving rapid changes to land use at concerning rates, hallmarked by community resistance and conflicts that impede the progress of implementation. Despite being a landscape and community challenge, renewable energy development teams have long lacked involvement from landscape architects and other design professionals that holistically consider social and environmental factors in place-based development planning at appropriate scales. This regional workshop serves to help foster the co-creation of strategies and principles to be shared with colleagues at the Pacific Northwest National Laboratory, the U.S. Department of Energy, and other energy professionals and decision makers toward fostering a new perspective for our region and nation. One in which renewable energy development optimization is place-based and appropriately scaled with an enhanced sensitivity and understanding of the impacts on the diverse communities and landscapes in which we live, work, and play. We seek your expertise to aid in this important conversation and transition toward more comprehensive design thinking for renewable energy infrastructure.

Audience:

The purpose of the Southwest Regional Virtual Workshop is to connect landscape architects and related design professionals with energy system professionals seeking to make a difference in the renewable energy transition, specifically in the Southwest United States. Our mission is to co-create new principles and perspectives on place-based, at-scale renewable energy infrastructure to help shape future efforts in our region and nation, and to broaden the scope of services that landscape architects may actively provide in future renewable energy projects. The main pre-requisite for prospective workshop participants is a willingness to hear and share in a transdisciplinary environment toward the goal of fostering place-based approaches to renewable energy development.

Please register for the Workshop here:
https://arizona.zoom.us/meeting/register/tZ0udO6pqTMsH9Y2RhTCC-1JdcXDLpZ1cQlg

About the Sponsor:

Pacific Northwest National Laboratory (PNNL) is a national laboratory operated by Battelle for the United States Department of Energy (DOE) in Richland, Washington. PNNL is an elite research laboratory with distinctive strengths in chemistry, environmental sciences, biology, national security, and data science. Across PNNL's history, the lab has been at the forefront of both nuclear and renewable energy technology and it has continued to produce groundbreaking discoveries to the present day. PNNL represents the forefront of energy research in the Northwest and you can visit their page at https://www.pnnl.gov/ to discover more.

Workshop Challenge:

Objectives

The primary objective of our workshop is to co-create new principles and perspectives on place-based and appropriately scaled renewable energy infrastructure specific to the Southwest United States to be shared with PNNL and the DOE.

The workshop will be framed by six pathways to place-based renewable energy landscapes at scale established in collaboration with PNNL (See pages 7-8). These will be applied to contexts of the Southwest United States to abstract regional principles and perspectives in a co-creation process. Context descriptions, provided at the end of this document, are intended to function as a primer to solicit design experience and expertise from various participants within groups under the six pathways. The emerging principles and perspectives from the six groups will then each be paired with a second pathway group to evaluate synergies and trade-offs. The final phase will consider the findings from the three resulting groups for synthesis. Information gathered at all three levels will inform the resulting report.

The workshop is also intended to offer opportunities to network and think critically about how place-based and appropriately scaled design decisions can help steer our society toward a more sustainably balanced future. By the end of the workshop, it is our hope that participants will have:

- Networked with professionals with similar goals toward responsible renewable energy landscapes,
- Gained and contributed to deeper insights of the six pathways to place-based renewable energy landscapes at scale,
- Developed an understanding of the opportunities and constraints as well as synergies and tradeoffs in place-based renewable energy landscapes,
- Become an informed and active voice in helping shape the future of renewable energy projects in our region.

Background

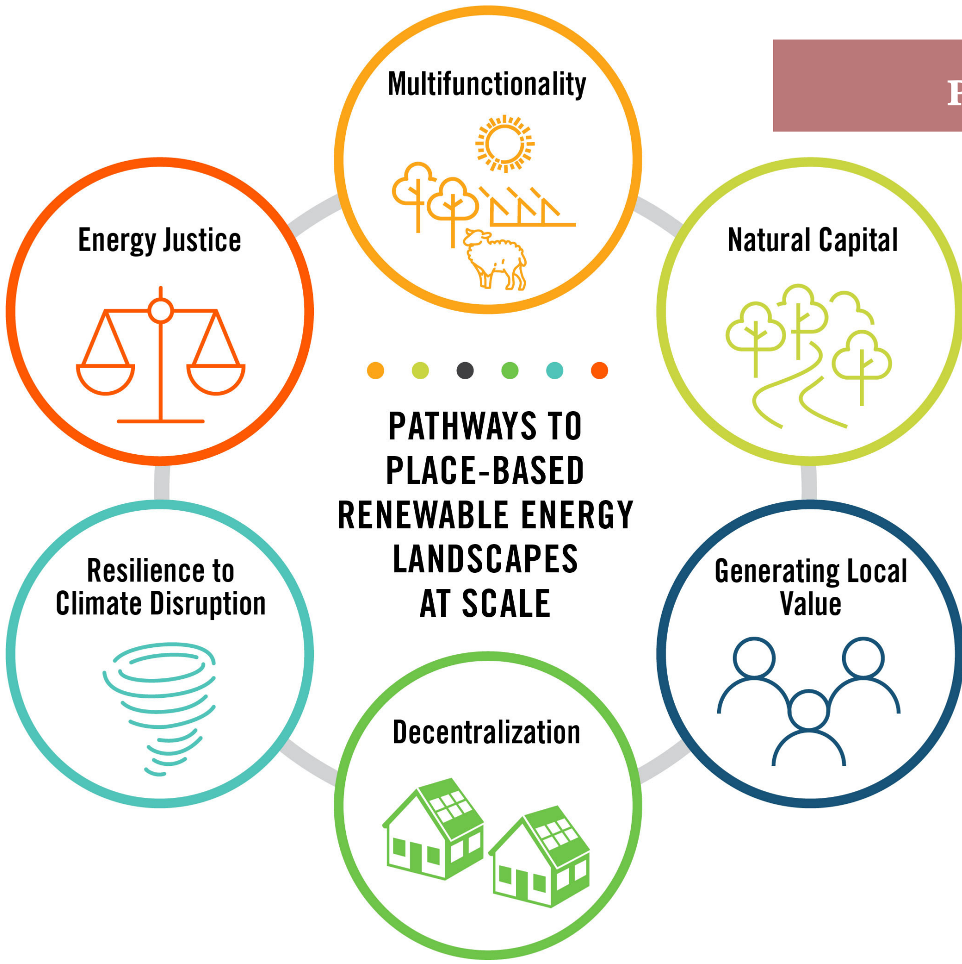
In June of 2021 Landscape Architecture Magazine published an article titled "Power Player" which highlighted the "American Jobs Plan" and targets for the renewable energy transition, suggesting we will see vast increases in the development of renewable energy infrastructure in the coming years. With the increased speed and scale of development, five design principles were proposed as ways designers can play a part in the renewable energy transition:

- Prioritizing multifunctional land use,
- Respecting the feel and scale of nearby scenery,
- Planning sites with direct community and stakeholder input,
- Considering the ecological impact of developments and adjusting accordingly,
- Ensuring that the community directly benefits financially from development.

Colleagues from PNNL picked up the article and reached out to the authors representing landscape architecture programs from three distinct regions of the United States (Pacific Northwest, Northeast, and Southwest). Collaborations ensued to build on the ideas in "Power Player" and have been published in a co-authored white paper outlining six pathways to place-based renewable energy landscapes at scale.

This workshop further explores these six pathways within the context of the Southwest United States, and runs parallel to a similar effort in the Pacific Northwest. It imagines greater involvement from landscape architects and design professionals in finding concrete ways to advance a design agenda in renewable energy planning and development. Outcomes from the workshop will be conglomerated and compared with those emerging from the Pacific Northwest workshop and shared with PNNL and DOE.

The emergence of clean energy goals and policies during the last 20 years has prompted shifts in approaching energy infrastructure, but with outstanding questions of how efforts involve and affect local communities and culture. Landscape design and planning approaches offer new tools for engagement, visualizations, and analysis among other efforts that can aid in prioritizing communities and landscapes in energy projects over merely maximizing peak energy output.



The six pathways to place-based renewable energy landscapes at scale were developed as part of the Energy Transitions Initiative Partnership Project, sponsored by the Department of Energy's Office of Energy Efficiency and Renewable Energy Water Power Technologies Office and is found at:

https://www.pnnl.gov/projects/renewable-energy-landscapes

The intent is to foster processes toward alignment of renewable energy technologies and infrastructures with community objectives and contexts. Pathways include:

Multifunctionality

Multifunctionality embraces collocating renewable energy with other technologies and land uses in urban, suburban, rural, and coastal communities. The resulting configuration of collocation will depend on the type of site, renewable energy, and components that comprise the system. While multifunctionality may result in trade-offs in efficiency for energy generation, the more efficient use of land can promote place-based deployment at scale.

Natural Capital

Like other types of infrastructure, renewable energy development can have an impact on ecosystems and the societal and economic benefits they provide to people. Well-planned and thoughtfully designed installations can capitalize on the positive social-ecological values while mitigating harm. Assessing natural capital while siting projects will allow communities to meet objectives that serve both people and nature.

Generating Local Value

Generating local value through renewable energy landscapes requires attention to the uniqueness of place. To understand what communities value requires redesigning community engagement strategies and economic structures, as well as reaching a broader typology of data-supported benefits and mitigation efforts. Continuous and durable actions will generate this value. A thorough design process can bring attention to place and align energy development with that value.

Decentralization

With distributed energy resources and decentralized energy systems poised to play a key role in decarbonization, there is a need to develop design approaches that integrate technologies into communities and their built environments. Reflecting the physical and social environments of a landscape in energy development can open more physical opportunities for technology adoption through innovation and a reimagining of space.

Resilience to Climate Disruption

Prioritizing the benefits of increased climate and energy resilience through design can motivate communities to become early adopters of renewable energy in their nearby landscapes. By understanding the critical services—water, sustenance, cooling, heat, communication, and protection from hazards—that support communities, energy developments can be designed to serve them.

Energy Justice

Designing for energy justice in renewable energy landscapes means both configuring the physical infrastructure in a way that distributes the benefits and costs of the installation as well as fairly constructing the financing schemes and ownership models for energy projects. Doing so can put vulnerable or historically burdened communities at the forefront of renewable energy deployment, utilizing design-based approaches to support them in envisioning their energy futures and realizing the value that can accompany it.

Context

The Southwest United States is a place of extremes where the connections between life and resources are readily visible. The incredible natural resource of abundant sunlight necessitates an extreme connection to water which is evident in the physical, biological, social, cultural, and political attributes of the region. It should be no surprise then that when considering energy systems in the Southwest, it is difficult to separate energy from water.

The physical landscapes of the Southwest are extreme from the high snowcapped peaks to the low-lying deserts, along with rivers, coasts and canyons of most exquisite beauty and function. Mineral resources are readily extractable within the various strata of deposits that have taken hundreds of millions of years to settle and transform. Parched and barren earth contrast with fertile flood plains that have been fed by the expansive watersheds, groundwater and the seasonal monsoon with its earth carving winds and rains, that too contrasts the piercing sun that dominates the majority of the year. As climate change continues, extremes are taken further with record heat, prevalence of forest fires, diminishing snowcaps, and an ever so strained supply of life supporting water.

The physical extremes of these landscapes in the Southwest have produced much biodiversity. Unexpected of the desert, there is a myriad of fauna and flora with lessons of survival and dependencies, from the spreading ironwoods and mesquite nurse trees that harbor iconic Saguaros from the heat and cold when young, to the great riparian stands of cottonwoods that support continental bird migrations, and everything in between. Each have developed adaptation to the conservation of energy and water resources.

Even people have survived in the area for 12,000 years, and the awe and splendor, resources, and climate continue to attract millions of residents to the Southwest today at increasing rates, double that of the nation as a whole over the last 70 years. While indigenous peoples have been able to live in harmony with the land over thousands of years, it is only by the incredible energy inputs and technological advances that has facilitated the habitability of current populations and extensive agriculture in this hottest and driest region of the U.S. Massive undertakings capitalizing on the expanses of public lands facilitated such marvels as the Hoover and Glenn Canyon dams among others. Those, along with abundant coal resources, fueled centralization of large power plants with extensive networks of power lines, as well as aqueducts transporting water over miles and miles to agricultural and municipal centers.

Twentieth century energy development, led by government agencies and powerful private institutions, favored massive engineering marvels and extractive energy developments without consequences for landscapes and communities affected by environmental degradation. The injustices, corruptions, and shortcomings in favoring the politically advantaged at the expense of communities connected to the land cannot be sustained or ignored. As we transition to renewable energy, we must reckon with the past and approach the future differently. We must consider the challenges of this new technology and knowledge context compared to that of conventional practices of previous generations.

Despite the message behind why we must transition to renewable energy, there is much less clarity about how to transition to renewable energy. So far, we have tended toward conventional infrastructures and implementation with a top-down or legacy approach to energy design. One that prioritizes large singular-use sites in remote regions that benefit a series of distant urban centers serviced by hundreds of miles of power lines. These disturb, destroy, and displace important ecological and social functions with the sprawling renewable infrastructure.

Therefore, there is urgency in reframing this renewable energy transition toward being place-based and at scale to appropriately fit within our Southwest communities and landscapes. In support of this goal and in face of our regional challenges of climate change increasing in intensity, population growth, and deepening water scarcity, we ask:

- How do we avoid draining our natural capital and sustainably use our energy and water resources within this incredibly diverse landscape?
- How can the benefits and revenues from renewable energy be distributed more equitably, especially among those most affected by former neglect?
- How do we create more profound land-uses as opposed to stripping landscapes down to singular uses of energy production?
- How do we reckon with the power-density short comings of renewable energy across such vast networks?
- How do we reduce energy and water system vulnerabilities in face of climate disruptions?

Workshop Overview:

Schedule:

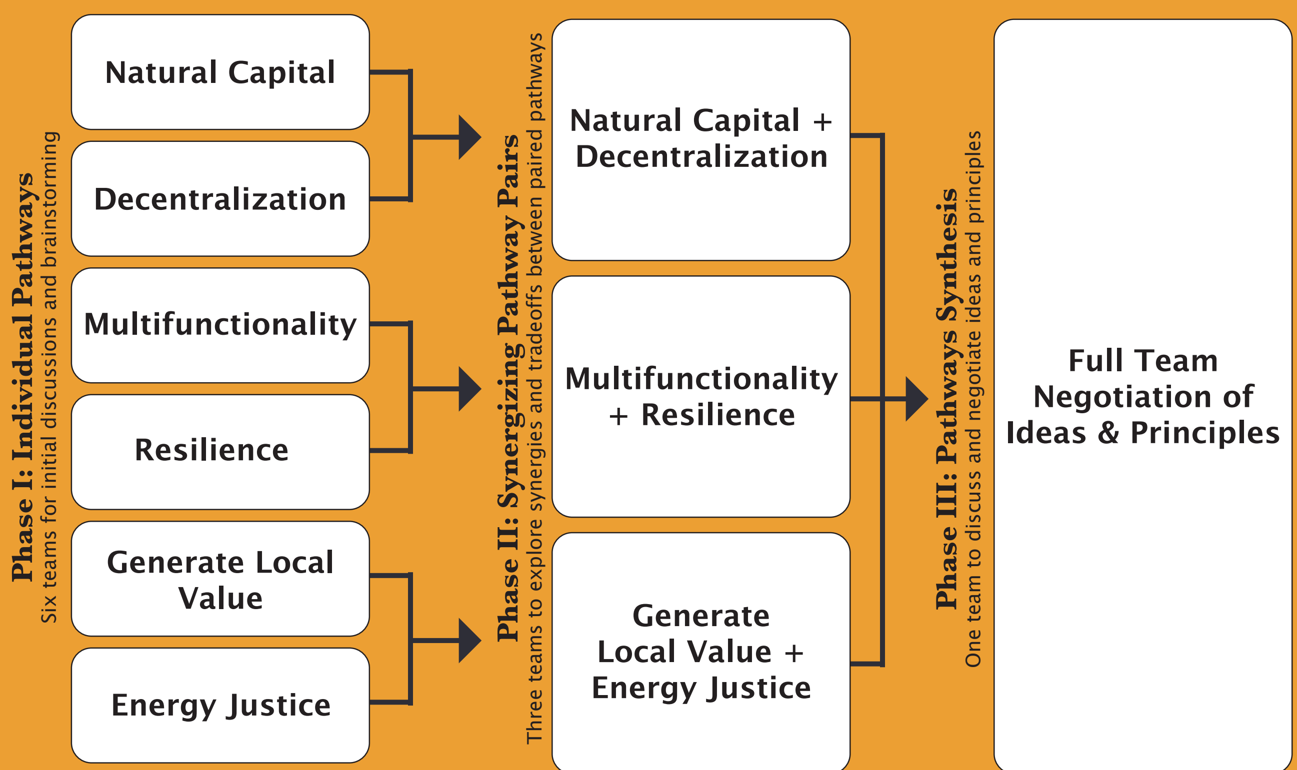
The virtual workshop will be held via zoom on Monday, January 9th from 9:00am to 2:30pm MST (Arizona). It aims to produce new principles and perspectives on place-based, at-scale renewable energy infrastructure to help influence future efforts in the Southwest region. The program will proceed as follows (subject to change):

Start	End	Duration	Activity
9:00 AM	9:05 AM	0:05:00	Welcome
9:05 AM	9:20 AM	0:15:00	Introduction; DOE/PNNL Kickoff
9:20 AM	9:35 AM	0:15:00	Pathways Overview
9:35 AM	10:00 AM	0:25:00	Student Ideas Competition Winners Lightening Talks
10:00 AM	10:10 AM	0:10:00	Break
10:10 AM	10:20 AM	0:10:00	Explain breakout teams, goal of this time
10:20 AM	11:05 AM	0:45:00	Breakout team work session I (6 groups)
11:05 AM	11:50 AM	0:45:00	Lunch
11:50 AM	12:00 PM	0:10:00	Regroup, explain goal of session II
12:00 PM	1:20 PM	1:20:00	Breakout team work session II (3 groups) explore synergies and tradeoffs between two pathways
1:20 PM	1:30 PM	0:10:00	Break
1:30 PM	2:00 PM	0:30:00	Team session III (1 group) 3 groups present findings
2:00 PM	2:15 PM	0:15:00	Open discussion and negotiations of ideas and principles
2:15 PM	2:30 PM	0:15:00	Final thoughts, next steps, summary, thank you

Please register for the Workshop here:
https://arizona.zoom.us/meeting/register/tZ0udO6pqTMsH9Y2RhTCC-1JdcXDLpZ1cQlg

Process

The Workshop will follow a co-creation process to facilitate the sharing and evolution of ideas between participants with diverse experience and perspectives. The process will center around three general contexts in the Southwest United States, described on pages 14-16, that will serve to stimulate and situate conversation referencing physical attributes, social infrastructure, and technology trends and potential. The workshop will begin with an introduction and overview of the challenge, along with lightening talks from the student ideas competition winners as a primer to the breakouts. The workshop will then move into team breakouts, each focused on one of the six pathways. A digital white board will be used throughout to facilitate the sharing of thoughts and visuals. In a second phase, teams will be paired to further the discussions and evaluate synergies and tradeoffs between the subject pathways. In the concluding phase, each of the three combined teams will present their findings to the full team with open discussions to negotiate ideas and principles before the conclusion of the workshop.



LOW DESERT

CONTEXT:
Temperature Range: -18 to 120F
Rainfall: 1-10 inches per year
Estimated Size: 300k Square Miles
Population Density: Very Low
Major Metropolitan Centers: Phoenix, Las Vegas, Tucson

CONSTRAINTS:
-High heat
-Limited water

TECHNOLOGIES:
-Solar photovoltaic
-Concentrated photovoltaic
-Wind

The low desert is one of the largest biomes in the Southwest United States by area. Seasons are generally hot throughout the year with peak highs of 120 F, but with winter lows dropping below freezing. Precipitation tends to be concentrated in short time periods punctuated by long rainless periods (1 to 12 inches per year). Evaporation rates often exceeds the rainfall rate resulting in an arid climate with few to no canopy trees, and is dominated by ground-hugging shrubs and short wooded trees.

The low desert's social infrastructure is dominated by few high population centers with small towns surrounded by vast regions of agriculture and desert. Roughly 14.6 Million people live in just 40 counties across 5 Southwestern states and farming interests utilize roughly 79% of the water resources of the region. Historically, indigenous people have thrived in the region for thousands of years with innovations in irrigation and architecture, including cliff dwellings and earthen structures.

In low deserts solar technologies such as solar photovoltaics and concentrated photovoltaics prevail due to the abundant sunlight and limited obstructions (low vegetation and flat land). Wind power can also be viable near canyons. The low desert is also home to many important water infrastructure projects such as the Central Arizona Project that pumps water hundreds of miles across the desert to population centers. Additionally, low deserts are mineral rich, and especially support the copper mining industry.

The chaparral biome is found across the Southwest United States and is characterized by a hot and dry climate with slightly colder, wetter winters. The chaparral is usually located near coastlines, but can be found further inland, most often characterized by gentle rolling hills with densely packed shrubs. The landscape is prone to fire due to the high density of shrub species combined with low rainfall and dry coastal weather.

The mild climate, terrain, and coastal location, fosters a desirable setting for human settlement. Nearly 70% of California's population lives in coastal areas. The chaparral in Southwestern California is punctuated by the two major population centers of Los Angeles and San Diego including highways that connect metropolitan development in a nearly continuous corridor of development interspersed with pockets of protected native landscapes on public land.

The terrain, climate and location of the chaparral enables the use of many forms of renewable technology. The topography enables wind and pumped hydro-storage, reliable sun exposure encourages solar technologies, and the coastal proximity provides potential for wave power. It is also a common region for mining interests, including recent interests in lithium discovered near the Salton Sea.

CONTEXT:

Temperature Range: 30 - 100 F
Rainfall: 10-17 inches per year
Estimated Size: 61 Million acres
Population Density: High
Major Metropolitans: Los Angeles, San Diego

CONSTRAINTS:

-High Property Costs
-Fire Risk
-Land Use

TECHNOLOGIES:

-Solar photovoltaic
-Pumped hydro-storage
-Wave
-Biomass

CONTEXT:

Temperature Range: 30 - 100 F
Rainfall: 10-20 inches per year
Estimated Size: 174 k square miles
Elevation Range: 1,800-7,000 feet
Major Metropolitan Centers:
High Plains: Lubbock, Amarillo,
High Desert: Albuquerque, El Paso

CONSTRAINTS:

-Fire Risk
-Agricultural interests

TECHNOLOGIES:

-Wind
-Solar photovoltaic
-Geothermal

The high deserts and plains of the Southwest United States generally consist of flat grassland or scrub plant communities. The biomes are sunny and experience wide ranges of temperature from just below freezing to roughly 100 degrees. High deserts are semi-arid with 10-15 inches of precipitation a year, with high plains receiving slightly more at around 20 inches. The high plains are consistently windy with speeds on average 4-5 mph greater than the rest of the United States. Amarillo (avg. Wind speed 14.3 mph) is the windiest city in the continental United States, and Lubbock and Abilene also routinely rank in the top windiest cities.

The high deserts and plains contain few moderately sized metropolitan centers supported by agriculture, particularly cattle ranching, and are also well suited to growing wheat, corn, and sunflowers, among other crops, supporting active rural communities throughout. The Puebloans historically relied on the fertile plains of the Rio Grande for growing maize, squash and beans to support their communities. The regions also play a large role in the oil and natural gas industry with rich deposits and, consequently, are extensively developed by commercial energy interests.

The high deserts have great solar, wind and geothermal potential. Similarly the high plains have potential for solar, but particularly wind. Many wind projects are already in operation with plans to support much more with the coming of extensive interstate transmission upgrades.

HIGH DESERTS AND PLAINS

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