February 22, 2019

Mr. Chris Warrick
County of San Bernardino
Land Use Services Department
385 N. Arrowhead Avenue
San Bernardino, CA 92415-0182

Via Email: Chris.Warrick@lus.sbcounty.gov

Subject: Scoping Comments for the Calcite Solar Power Project in Lucerne Valley.

Dear Mr. Warrick:

The Board of the MBCA and its supporters takes this opportunity to respond with scoping comments to the Notice of Preparation for the Calcite Solar Energy and Storage Project located in Lucerne Valley. This letter incorporates by this reference the comments presented by LVEDA Chuck Bell President on 2/21/2019, Bill Lembright, Lucerne Valley on 2/22/2019, and the MBCA comments on the Ord Mountain EIR submitted 11/16/2018.

PROJECT DESCRIPTION(S) AND GOVERNING ORDINANCE

The proposed Calcite Solar Project (Project) is a 100 MW alternating current (AC) photovoltaic (PV) solar energy facility with five non-contiguous units spread across approximately 664 acres in Lucerne Valley on either side of SR 247. The acreage of each unit is not provided.

The Calcite units are to the west and south of the proposed 50 MW Ord Mountain Solar energy facility on 483 acres. The Calcite Substation on 75 acres is a separate unit analyzed in the Ord Mountain EIR. The comment period for the EIR is closed.

The 450 MW Sienna Solar North, South, East, and West facility has four separate units spreading across 1,630 acres. An Initial Study (IS) is anticipated to be out by Spring 2019.

In total, the three PV solar energy projects and the substation represent 11 separate units totaling 2,852 acres (4.45 square miles) spread across 11.4 square miles in the North Lucerne Valley basin. See Figures 1, 2, and 3.

The three projects are subject to review under the Amended Solar Ordinance 4213 (2014) Chapter 84.29 Renewable Energy Generation Facilities.

84.29.010 Purpose
These regulations are intended to ensure that renewable energy generation facilities are designed and located in a manner that *minimizes visual and safety impacts on the surrounding community*.

**PLANNING COMMISSION CONSIDERATIONS AND FINDINGS**

**84.29.035 REQUIRED FINDINGS FOR APPROVAL OF A COMMERCIAL ENERGY FACILITY**

(a) “In order to approve a commercial solar energy generation facility, the Planning Commission shall...determine that the location of the proposed commercial solar energy facility is appropriate in relation to the desirability and future development of communities, neighborhoods, and rural residential uses, and shall not lead to loss of the scenic desert qualities that are key to maintaining a vibrant desert tourist economy by making each of the findings of fact to subdivision (c).” See Figure 4

(b) “In making these findings of fact, the Planning Commission shall consider:

1. the characteristic of the commercial solar energy facility development site and its physical and environmental setting, as well as the physical layout and design of the proposed development in relation to nearby communities, neighborhoods, and rural residential uses; and See figure 3

2. the location of other commercial solar energy generation facilities that have been constructed, approved, or applied for in the vicinity, whether within a city or unincorporated territory, or on state or federal land.” See Figure 3 and 4. Bold added for emphasis.

**SCOPING COMMENT RE CUMULATIVE IMPACTS OF THREE SOLAR PROJECTS:**

Our comments will include the following impact analyses:

Figures 1, 2, and 3 – Aesthetics. The 11 units comprising the three solar energy facilities – Calcite with substation, Ord Mountain, and Sienna are visualized across 11.4 square miles within the confined basin connecting several fault blocked ranges. County Scenic Highway SR 247 is shown. Figures 2 and 3 were constructed using the Arcscene program.

Aesthetics. The 11 units of the projects are analyzed for their cumulative visibility across 317 square miles. Scenic SR 247 is shown as is SR 18 connecting Lucerne Valley to the Big Bear area. Figure 4

Air Quality and Soils. The 11 units are seen on the soils ranked by their potential to produce aeolian dust when disturbed. Figure 5

Biological Resources. The 11 units, plus the Aurora Sorrel Solar and Daggett Solar (not discussed here) are shown to clearly obstruct the Desert Wildlife Linkage Network (DRECP) Figure 6

**IT IS CLEARLY DEMONSTRATED THAT:**

1. Each of the 11 units must be analyzed separately within their respective Project EIRs.

2. The Planning Commission, under 84.29.035 (2) is charged, when finding on a specific project, to consider the cumulative impacts of all the 3 projects (11 units including the substation) to the Lucerne Valley Community and the environment.  

The following issues require that cumulative assessments be prepared for Planning Commissioners in advance of findings for Ord Mountain, Calcite, and Sienna Solar:

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1 The 2,850-acre Aurora Sorrel Solar Project and Daggett Solar (3,500 acres) also fall under the cumulative need to include when calculating the regional effects on air quality, biological resources, greenhouse gas emissions, and mandatory findings of significance. The Aurora Sorrel Solar Project is on State Lands and all other projects are on private lands in the County.
aesthetics, air quality, biological resources, geology and soils, greenhouse gas emissions, hydrology and water quality, land use and planning, public services, transportation and traffic, tribal and cultural resources, and mandatory findings of significance.

**Figure 1:** Landscape view of Calcite, Ord Mountain and Sienna Solar project units spread over 11.4 Square Miles in the North Lucerne Valley basin.

The County mailed out 147 notices to residents within 1,300 feet of the Calcite Project boundary(s). These multiple boundaries added to the proposed Ord Mountain and Sienna Solar boundaries are within a rural residential area in a geologic basin. See also Figures 2 and 3.

How many recipients of notice were also informed about Ord Mountains Solar or will be informed about Sienna Solar?

**LAND USE AND PLANNING**

The EIR should document how the 11 units will physically divide this rural community. Roads are not the only issue. It is important to be able to see your neighbor and walk across the land to visit.

**AESTHETICS**

The Calcite Project Initial Study (IS) checks all the boxes - the Project would have *potentially significant impacts* on scenic vistas, scenic resources, and the visual character or quality of the site and its surroundings. The substantiations, however, argues against significant impacts because, we are told, the area is not an undisturbed natural area, contains scattered rural residents with accessory structures, paved SR247 as well as several paved and unpaved roads, and a high voltage transmission line supported by tall steel towers. Additionally, it states (incorrectly) that the area is without significant geologic features or scenic vegetation. Despite the above, the EIR is directed to analyze further and take lots of pictures.

The County General Plan does not designate scenic vistas although scenic routes are designated. For the two solar projects that have released studies (Calcite, Ord Mountain), the 2007 General Plan Open Space Element (GPOSE), Policy OS 5.1 was used to evaluate whether features in the project area can be considered undisturbed and scenic. 4

**Scoping Comment RE Aesthetics**

For all these Projects – Calcite, Ord Mountain, and Joshua Tree Solar - GPOSE Policy OS 5.1 was incorrectly used to give a pass or fail grade in Scenic Vistas to the Project areas. They all fail because Policy OS 5.1 applies to wilderness and other undisturbed protected areas. Essentially, apples were used to analyze oranges.

The correct policy to analyze scenic vistas throughout the county’s rural areas is Policy OS 5.3. It introduces the lists of County designated Scenic Highways.

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2 Chris Warrick, Senior Planner, email February 15, 2019

3 The IS for the Joshua Tree Solar Farm can be included in this list – same use of Policy OS 5.1 for a tortuous analyze of the landscape traversed by Scenic Highway SR 62.

4 2007 General Plan, Page VI-12
“The County desires to retain the scenic character of visually important roadways throughout the County. A “scenic route” is a roadway that has scenic vistas and other scenic and aesthetic qualities that over time have been found to add beauty to the County. Therefore, the County designates the following routes as scenic highways and applies all applicable policies to development on these routes.”

The list for the Desert Region of scenic routes includes

“(o) State Route 247 (Old Woman Springs Road/Barstow Road) from the Town of Yucca Valley north to Barstow.”

Currently, there is a committee of residents working with the County and Caltrans toward State Scenic Highway designation for SR 247. The state does not require undisturbed natural areas for designation.

Figure 2: North Lucerne Valley is located within a Basin and Range landform. The geologic features include a sediment filled basin separating the fault block ranges. The historic land ownership, grazing, agriculture, and the housing & neighborhood pattern are based on settlement under the Homestead Act beginning in the 1800s.

Figure 3: Lucerne Valley is bisected by County Scenic Route 247, also called Barstow Road. The route is bounded by units of the proposed Ord Mountain, Calcite, and Sienna Solar energy projects. Some of the solar units are located within neighborhoods. The open dry lake areas are used for movie scenes and various competitions requiring open space. Lucerne Valley’s economic development depends on the maintenance of these open spaces.
The Solar Ordinance 84.29.035, clearly states the location of a commercial solar facility must be “appropriate in relation to the desirability and future development of communities, neighborhoods, and rural residential uses, and shall not lead to loss of the scenic desert qualities that are key to maintaining a vibrant desert tourist economy”.

Clearly, the three solar projects, viewed separately or cumulatively, do not meet the needs of the Lucerne Valley Community as expressed in their Community Plan, the quality of life for residents, or the tourist economy. The Calcite IS copied verbatim the Ord Mountain EIR Aesthetics Section 3.1 using the GPOSE OP 5.1 criteria for wilderness characteristics. In both CEQA documents the rationalizations were deceptive with identical tortuous justifications and conclusions for the lack of scenic qualities.

**IT IS CLEARLY DEMONSTRATED THAT**

3. The Calcite Solar EIR must use Policy OS 5.3 to analyze the aesthetic impacts of the Calcite Project. The impacts are significant and unmitigable.

Lucerne Valley is an economically disadvantaged community dependent on its desert tourist economy. Should the homes become imbedded within the projects, (Figures 2 and 3) surrounded by 12′ high rotating solar panels, the owners will lose twice - the value of their homes and their quality of life: the community get togethers and the peace that comes from sitting on the porch, enjoying quiet long view, as clouds move over the mountain crests.

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**IT IS CLEARLY DEMONSTRATED THAT**

4. The impact(s) of the projects will be disastrous and unmitigable. A Finding of overriding consideration is required.
Figure 4: Range of visibility of the 11 total units in the 3 proposed Solar Projects across 317 square miles. Clearly, the industrialization of this rural open space is significant and cannot be disguised or hidden.

Figure 5: Calcite Solar Project has 5 units\(^5\) on soil types with different potentials for aeolian dust. \(^6\) Only units 4 & 5 on playa soils have a slight potential for dust. Sienna Solar has a high potential for 2 units and mixed high and moderate for 2 units. Ord Mountain is on high potential for aeolian dust. PM10 and PM2.5 are criteria pollutants known to cause severe health problems and are regulated by the USEPA and CA Air Resources Board. The Mojave Desert Air Basin is not in compliance with state and federal standards for PM10 and 2.5.

Aeolian dust is the result of soil disturbance. The Project(s) emission baselines for PM10 and 2.5 use data from the Victorville monitoring station, approximately 35 miles to the west of the project, the direction from which the wind blows i.e. Victorville, with rare exception, doesn’t taste Lucerne Valley dust so cannot measure it.

The Mojave Desert Planning Area does not have EPA approved dust monitors east of Victorville except at the

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\(^5\) See Calcite Solar IS Figure 2 Vicinity Map

\(^6\) Soil data USDA Soil Conservation Service (2009)
Lucerne Valley Middle School. The Lucerne Valley, much of the project area is a stabilized linear dune. Native plant roots, primarily mature *Atriplex polycarpa*, (saltbush) host microbial associates that stabilize the soil. When the plants are removed, the sand and dust fly. All residents, many visitors, the County, MDAQMD and Cal ARB know from experience and citizen reports and photos that Lucerne Valley basin can raise massive high moving clouds of dust with sustained winds as low as 20 mph, gusting much higher. This reality, the certainty, that solar projects in the basin are on soils with a moderate to high hazard for dust during construction, operation, and following decommissioning must be thoroughly addressed.

**IT IS CLEARLY DEMONSTRATED THAT**

5. All utility solar projects require a 2 year baseline study of PM10 and 2.5: the County must require developers, at their expense, to install BAM dust monitors at pre-determined locations to get this long term data. This Best Management Practice (BMP) is essential to protect people and the environment from unlivable air quality during construction and operation and following decommissioning. At this time, particulate matter data acquired using regulatory standards is not available. That being the case, there can be no defensible plan to control the PM. This problem is not going away, it can only get worse if projects are approved without oversight. The County is negligent in its oversight responsibilities.

The MDAQMD 403.2 Fugitive Dust Control regulatory measures rely on frequent watering, slow driving speeds on dirt roads, stopping construction when wind speeds reach 25 mp, and possibly the application of a chemical stabilizers. Experience has demonstrated that these measures are inadequate. The Dust Control measures, adopted in 1996, were never intended to deal with large scale energy projects. New regulations are under review but not finalized and approved.

**SOIL STABILITY AND CARBON SEQUESTRATION**

The Calcite IS does not name the dominant plant community in Units 1, 2, and 3. Units 4 and 5 are on the plantless playa. The community is *Atriplex polycarpa*, a saltbush, and it is known to prolifically produce seeds (poly carpa) but is a weak root sprouter. However, the developer, in order to slow the wind and cut down on erosion and dust, intends to leave the roots behind when clearing the vegetation with mowing equipment. This is an uninformed decision lacking scientific justification. This will kill the plants and their associated mycorrhizal partners that stabilize the soil. The dust will blow.

The mycorrhizal fungi and their linked associates are also known to sequester carbon from the atmosphere and store it. Robin Kobaly, desert botanist and the executive director of the Summertree Institute, provides a synthesis of the research on the stabilizing and carbon storage phenomena in her paper “Groundbreaking

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7 The PM10 monitoring station at the Lucerne Valley Elementary School was located to measure dust from the limestone mines to the west in the San Bernardino Mountains. The 2017 Annual Mean was 21.1µg/m3, which exceeds the CARB standard of 20.0ug/m3. The Highest Hourly Mean was 985µg/m3 on 3/17 at 3:00 PM. The Highest Daily Mean was 199.6 µg/m3 on 7/30/16. The Highest Mean Monthly was 33.3 µg/m3 for October 2017.


9 Evans RD et al. (2014) Greater ecosystem carbon in the Mojave Desert after ten years exposure to elevated CO2. Nature Climate Change. DOI: 10.1038/NCLIMATE2184. [https://www.nature.com/articles/nclimate2184](https://www.nature.com/articles/nclimate2184)


11 Calcite IS, Page 39

12 See Footnote 8. *Atriplex* species as hosts to mycorrhizae.
Discoveries Under Our Feet: How Desert Underground Systems Affect Our Land-Use Decision & Drive Lasting Consequences. She points out in the introduction:

*Research around the world is showing that the biggest contributors to soil stability in deserts are the smallest of microorganisms. Tiny microbes hold our desert landscape together. The valuable role of hidden microorganisms in keeping our air cleaner, preventing dust storms, controlling erosion, and helping us reduce carbon dioxide levels in our atmosphere is enormous but that role is mostly overlooked when we make land-use decisions in our desert.*

Far from being disturbed, much of the Atriplex community is undisturbed and not only sequesters carbon but the disturbance of the underground caliche layers during construction will release ancient stored carbon.

**IT IS CLEARLY DEMONSTRATED THAT**

6. **The active carbon sequestration and stored carbon in caliche must be accounted for in the EIR.**

**DECOMMISSIONING PLAN**

*Upon removal of the proposed solar and energy storage Project components the site would be left as disturbed dirt generally consistent with the existing (pre-development) conditions, subject to a Closure Plan in accordance with SBCC 84.29.60 (IS Page 16)*

Based on this statement, the intent with decommissioning is to save time and money for the developer at the expense of any living breathing animals and plants.

We are disappointed in Land Use Services’ careless disregard for the County’s unincorporated residents and land. This appears to be pro forma based on the Ord Mountain Decommissioning Plan in the IS and Ord Mountain EIR where the exact wording is found as used in the Calcite quote above. We also noticed that the Closure Plan is in accordance with SBCC 84.29.70, not the referenced 84.29.60.

Conclusion: The County will allow the 683-acres on the Calcite units a ‘disturbed dirt’ future to match the 484-acres on the Ord Mountain site. We anticipate that Sienna, mainly planned on erosive soils, will also be left as ‘disturbed dirt’. In 35 years, for anyone still able to breathe, life will be even worse with 2,777 acres just left to blow in the wind. Dust, unlike sand, travels high - up to thousands of feet, and far - up to thousands of miles.

**It is clearly demonstrated that**

7. **All solar projects require a real Decommissioning Plan based on the science of restoration and backed by sufficient funds in the bank earning interest.**

**BIOLOGICAL RESOURCES**

The issues under Biological Resources b) are interference with movement of resident or migratory species or with established native resident or migratory wildlife corridors. The IS discussion is difficult to follow although it is stated correctly that the Project units are on the Pacific Flyway. Incorrectly, the habitat is characterized as low quality and disturbed: i.e., it isn’t much of a wildlife corridor, however, the topic will be analyzed further in the EIR. Again, the substantiations in the IS appears to be setting the reader up for what to expect in the EIR.

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13 Appendix A, this comment letter
14 Ord Mtn IS Page 15
15 Ord Mountain EIR Page 2-38
Figure 7: Black throated sparrow investigating Cascade Solar Field in the Joshua Tree basin.

The Project is on the Pacific Flyway and although there are no lakes in the vicinity now, were any of the projects to be approved and built the fields of solar panels would give the impression of water – the ‘lake effect’ – when birds are flying over. This might be especially true at night when the panels are stowed face up and reflect moon and starlight. Because many birds migrate at night any of the solar units would be attractive, together they are an 11 square mile haven for rest and feeding. Given the magnitude of these projects, it would be a BMP to visit other solar fields at night (starlight only, full moon, waning moon) and fly a drone with a camera to see just how much light is reflected. During the day the solar fields can present an attractive landing place as seen in Figure 7.

**LINKAGE DESIGN**

The value of the unit sites for wildlife linkage areas is incorrectly dismissed as ‘low quality disturbed habitats’ but it will be analyzed. There is an extensive policy framework that supports the protection of wildlife corridors within the County. The desert wildlife linkage adopted by the DRECP is also part of the Apple Valley HCP, linking the Bernardino Mountains with the fault block mountains to the north, east and west. Importantly the linkage design also connects to Fort Irwin and China Lake NWS to the north. These military bases work to prevent their lands from becoming biological islands. See Figure 8.

Research for full disclosure in the EIR should include the California Department of Fish and Wildlife (CDFW) Area of Conservation Emphasis, an effort to analyze large amounts of map-based data, in their planning efforts so decisions can be informed around important conservation, habitat connectivity and climate change resiliency goals. ACE 3.10 was released in February of 2018 and the datasets relevant to wildlife linkages and connectivity are the Terrestrial Connectivity Dataset, which should be used in conjunction with datasets on biodiversity, significant habitats and climate resiliency.16

**IT IS CLEARLY DEMONSTRATED THAT**

8. To support the protection of wildlife linkages it is important to utilize the CDFW Area of Conservation Emphasis ACE 3.10, adding updates as needed, to analyze habitat connectivity and climate change resiliency goals. Update all County Open Space and Conservation maps.

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Figure 8: Desert Linkage Network (DRECP) showing linkage between mountain blocks, ACECs, and the Military bases.

ENERGY STORAGE SYSTEMS
The Calcite and Ord Mountain Projects state that they would install an energy storage facility and appurtenances that would provide energy storage capacity for the electric grid. They name a number of technologies that they could choose from but have not made a selection. There have been concerns raised with fire in battery storage systems\(^ {17} \) and, if this project is approved and constructed the surrounding community should be aware of this danger.

IT IS CLEARLY DEMONSTRATED THAT

9. The EIR should address the danger of fire from battery storage systems even if the technology has not yet been chosen.

OUR CONCLUSIONS AND MANDATORY FINDINGS OF SIGNIFICANCE
As we have discussed, the Calcite Solar Project is just one of three projects under review with a total of 11 separate units spread across 2,852 acres in North Lucerne Valley.

b) The impacts of the Calcite Project would be significant and the cumulative effect of the three projects will be considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of any future projects.

c) The environmental effects will cause significant adverse effects on human beings both directly and indirectly through the creation of hazardous dust pollution to the loss of property values and the regional

tourism economic base. Currently the air quality problems are not mitigatable and there has been no discussion of compensation for property values with the 147 homes owners which received notices.

Since mitigation on or off site is not possible, a discussion based on over-riding considerations is appropriate and necessary. What are the considerations?

Our conclusions again reference the MBCA Ord Mountain Letter of November 16, 2018 and the comments submitted on behalf of LVEDA by Chuck Bell, February 21, 2019

Sincerely,

Pat Flanagan, Director – Desert Heights

• President – Steve Bardwell – Pioneertown
• Vice-President – David Fick – Joshua Tree
• Secretary – Laraine Turk – Joshua Tree
• Treasurer – Marina West – Landers
• Director – Sarah Kenningen – Pioneertown
• Director – Meg Foley – Morongo Valley
• Director – Mike Lipsitz – Landers
• Director – Ruth Rieman – Flamingo Heights
• Director – Seth Shteir – Joshua Tree

Attachments:
Appendix A: Groundbreaking Discoveries Under Our Feet by Robin Kobaly
Appendix B: Maps: Figures 1, 4, 5, 7

Cc:
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Appendix A

GROUNDBREAKING DISCOVERIES UNDER OUR FEET
How Desert Underground Systems Affect Our Land-Use Decisions
& Drive Lasting Consequences
by Robin Kobaly
Feb. 21, 2019

We are witness to assaults on our desert landscape every day, but we usually recognize only what we see above ground. In fact, these surface alterations result in critical changes below ground that have far-reaching implications that are mostly unnoticed or unappreciated. If we could see the intricate systems that hum along invisibly underground, we would likely fight even harder to protect our desert landscapes from unnecessary disturbance.

Research around the world is showing that the biggest contributors to soil stability in deserts are the smallest of microorganisms. Tiny microbes hold our desert landscape together. The valuable role of hidden microorganisms in keeping our air cleaner, preventing dust storms, controlling erosion, and helping us reduce carbon dioxide levels in our atmosphere is enormous, but that role is mostly overlooked when we make land-use decisions in our desert.

Biological Soil Crusts: Stabilizing Soil and Influencing Water Runoff

Across arid soils, a thin crust often forms within the top few centimeters of the soil surface. Surprisingly, these crusts are not exclusively formed from excess minerals, as is often thought, but are created by microscopic and somewhat larger macroscopic organisms that live together in a tiny but profound world.

Whenever it rains, a cast of soil creatures (including cyanobacteria, formerly called blue-green algae, plus bacteria, fungi, and other microbes) that have been patiently sleeping wakes up like a scene in Sleeping Beauty’s castle. Released from the spell of drought, these microscopic creatures start making food and creating miniature subway tunnels as they move through the soil, reproducing as long as the soil is moist. Tunnels of sticky mucilage around algae filaments allow the algae to move into new frontiers while moisture paves their way.

As the soil dries out after rain, a slumber again falls over the entire community, and the soft, gluey tunnels start to dry out – but not before tightly binding all the soil grains they have touched. The value of this thin, living “skin” across our desert soil is not only expressed during its wet “waking hours,” but also during its dry dormant time when it performs the critical role of gluing soil particles together against wind and water erosion.

During the following months or years of drought, these sticky tunnels continue to bind soil grains together. The result of this microscopic community is a protective seal across the soil surface called a biological soil crust that keeps dust, particulate matter (PM10s and PM2.5s), and harmful fungal spores like valley fever from being blown up into the air wherever soil has not been disturbed. These living soil crusts take hundreds of years to develop into effective soil sealants, but when they are allowed to remain intact, they not only hold back wind and water erosion, but also supply nutrients to neighboring higher plants, improve water infiltration, prevent choking dust storms, and help keep our air clean and healthy. Plus, they do all this for us while they are sleeping.
Mycorrhizae: A Strategic Partnership Between Plants and Fungi

Working both above and below this marvelous crust, plants are breathing in massive amounts of carbon dioxide from the air, reassembling the carbon into sugar, then transporting it underground to grow roots. Byproducts from this growth (photosynthesis) become locked in hidden carbon storage vaults underground, both living and non-living, for many hundreds of years. Small shrubs like Blackbrush can live at least 400 years, while Mormon Tea can live over 250 years. Our Mojave Yuccas are youngsters at 500 years old, and may live to several thousand years old, and even more impressive are Nolinas, Desert Ironwood trees, and California junipers that may live to over 1000 years.

Roots from these carbon-eating plants reach far underground, some as much as 150 feet deep (roots of succulents like cacti and yuccas are not as deep; they have other survival tricks). Roots this deep are essential to reach soils still moist from rains that may have fallen many years ago, and these deep, living “straws” create an upside-down forest of craggy wood, resulting in a greater mass of living tissue below ground than what we see above ground.

All these deep roots are not separate and alone in their quest to gather water and nutrients to survive. Eons ago, they struck upon a partnership with fungus that helps them absorb moisture and nutrients from an arid soil that is almost devoid of either. Over 90% of plants on earth belong to this “root partners’ club,” a lifelong membership that grants participating plants special privileges.

Moisture and valuable resources like phosphorus and nitrogen are all gathered and delivered to the plant partner through thin threads of widely dispersed fungal hyphae called mycelium. In exchange, the plant host supplies sugars to their “mycorrhizal” fungal root partners, which, for all their near-magical powers, cannot make their own food. A good trade indeed. This partnership has been called a “subterranean swap meet.”

But the fungal partner offers still more to this relationship; it offers immune-boosting compounds and antibiotics, and bitter-tasting chemicals that deter animals and insects from eating its host’s leaves. Even more mind-boggling, fungal threads from neighboring plants can merge with adjacent fungal threads to connect plant to plant in a massive community network that “exchanges information” between plants for the good of the whole community.

Without seeing anything above ground, the mycelia below ground inform of dangers like insect attacks, and initiate the production of pest-repelling compounds in the leaves of all plants connected to this “root partner’s club.” No single plant has to fight an intruder on its own. This information-sharing network of fungi has been dubbed “nature’s internet,” or the “Wood Wide Web.”

The benefits of this hidden relationship extend beyond the exchange of resources between plants and fungi. Both the root and the fungus are breathing out carbon dioxide in the dark (plants breathe in carbon in the light, and breathe out carbon in the dark). Right at the point where a tiny fungal thread connects to the plant root, some of the carbon dioxide exhaled by roots and fungi reacts with calcium in the soil to form crystals of calcium carbonate, or what is called caliche. Carbon in these crystals becomes locked into the soil.

Over time, large chunks or even vast layers of caliche are built up underground, capturing carbon from our atmosphere in an underground lock-box and reducing its potential escape into the atmosphere.
This transfer of carbon from air to leaf to root to fungal partner and into caliche deposits is one of nature’s ways to sequester carbon and hold it in natural storage underground.

All that we need to do to keep the carbon safely stored in the underground caliche is to allow the desert plants to keep living and sequestering carbon. It is thought that some of the vast caliche beds in our southwest desert soils may have been formed over thousands of years. Some of our longest-lived desert plants may have germinated right after the last ice age receded 10,000 years ago, and are still growing today, capturing carbon underground over millennia (King Clone, a cloning creosote in Johnson Valley estimated to be almost 11,000 years old, is one example).

**Glomalin: Hiding Place for a Third of the World’s Carbon**

There is still more to this incredible story. Every hyphae (the thread-like “root” of a fungus) of the most common kind of root-partnering fungus in our desert (arbuscular mycorrhizal fungi) is coated with a waterproof sealant called “glomalin.” This coating of sticky protein around each fungal thread prevents leakage when water and nutrients move through the hyphae. Glomalin is made directly from carbon gathered by its plant partner, so again atmospheric carbon is being moved from air into soil for long-term storage.

Remarkably, each hyphae’s coating of glomalin persists in the soil after the fungal thread dies (when the growing root section matures and barks over). For another 30 to 100 years, the sloughed off glomalin glues soil grains together in packets containing carbon, nitrogen, phosphorus, and other valuable nutrients. This waxy coating of glomalin helps to form tiny soil clumps called “aggregates,” and prevents nutrients vital to plant growth from being leached out of the soil. Glomalin will continue to hold carbon underground long after death of the hyphae that produced it – helping us in our quest to reduce greenhouse gases in our atmosphere.

This entire kingdom of incredible creatures works twenty-four hours a day, year after year, without any input from humans, unseen by us and mostly unappreciated by us. These life-forms in mutual partnership will continue to glue our soils together and capture our excess carbon in perpetuity . . . unless we remove the plants and disturb the soil that makes all this magic work.

We are now faced with decisions about whether to allow thousands of acres of functioning desert systems to be sacrificed for solar energy developments – on the premise of reducing carbon dioxide levels in the atmosphere. Scientists estimate that after the removal of desert vegetation and disturbance of the top soil, the pre-existing plant community requires about fifty to three hundred years before it returns to pre-disturbance cover and biomass, but requires about three thousand years before the disturbed area returns to the function it had before disturbance. The ancient nature of both the plants and the living soil crust organisms make this a credible prediction.

We once thought that carbon was held in meaningful amounts only in ocean creatures and forest trees and humus. Now we know that soils, including desert soils, are a significant storage facility for carbon. Without these biological partnerships, significant amounts of carbon would be released from the soil back into the atmosphere, and no additional carbon would be sequestered. Not only are desert soils holding carbon in caliche deposits, they also store vast amounts of organic carbon in soil organisms, including root-partnering fungi with their coating of glomalin. The importance of glomalin’s carbon storage capacity is stated by a USDA scientist this way:

“As carbon gets assigned a dollar value in a carbon commodity market, it may give literal meaning to the expression that good soil is black gold. And glomalin could be viewed as its ‘golden seal.’”
Wherever possible, we need to steer developments, especially large-scale projects like utility-scale solar facilities, to pre-disturbed, severely impacted soils or pre-developed sites such as parking lots and roofs. Then, we get the best of all options: progress with preservation.

Leave these microscopic soil magicians alone to do their work. The desert’s underground life-support systems can only function if the aboveground systems (desert plants and living soil crusts) are kept alive and intact. We must be their voice and their champion in protecting them – so they can silently continue to protect our potential for carbon sequestration, our air quality, our health, our economy, our landscape, our ecotourism, our property values, and our quality of life. To ensure our own sustainable future, we need to keep our desert soils intact and alive...it benefits everyone. The choice is ours.

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With a Master’s Degree in biology, Robin Kobaly had a twenty-year career as a botanist with the BLM, and continues to work in botany, wildlife biology, and natural history interpretation. She is currently executive director of the SummerTree Institute, a 501(c)3 nonprofit corporation dedicated to providing responsible viewpoints toward our environment, our place in it, and our responsibility to it.

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Appendix B  Maps
Maps courtesy of Brian Hammer
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Figure 1:
Landscape view of Calcite, Ord Mountain and Sienna Solar Projects spread over 11.4 Sq. Mi. in the North Lucerne Valley basin.
Figure 4: Range of Visibility of the 11 total units in the 3 proposed Solar Projects across 317 Sq. Mi.
Figure 5: Solar Projects on Soil Types with Aeolian Dust Potential
Figure 7: Desert Linkage Network (DRECP)