Land-Use Evaluation for Busbar Mapping

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Overview

- General Approach for Land Use Evaluation around a Substation
    - Total Area with Technical Resource Potential
    - Environmental Impacts: Components of Core Land-Use Screen
    - Adjustments for Each Technology
    - Buffer Distances

- New Metric for Solar Technology: Parcelization
    - Methods
    - Possible Application

- Land-Use Metrics Calculation for each Substation

Statewide Core Land-Use Screen

Legend:
- Solar Base Exclusions
- Biological Planning Priorities
- High Cropland
- High Intactness
- Technical Resource Potential
- Counties

- CEC staff recently completed an update to the statewide land-use screens for electric system planning.

- Recent assessment of California land designations, physical characteristics, natural and working lands priorities

- Explicit geospatial data layers to estimate distribution and magnitude of areas with resource potential
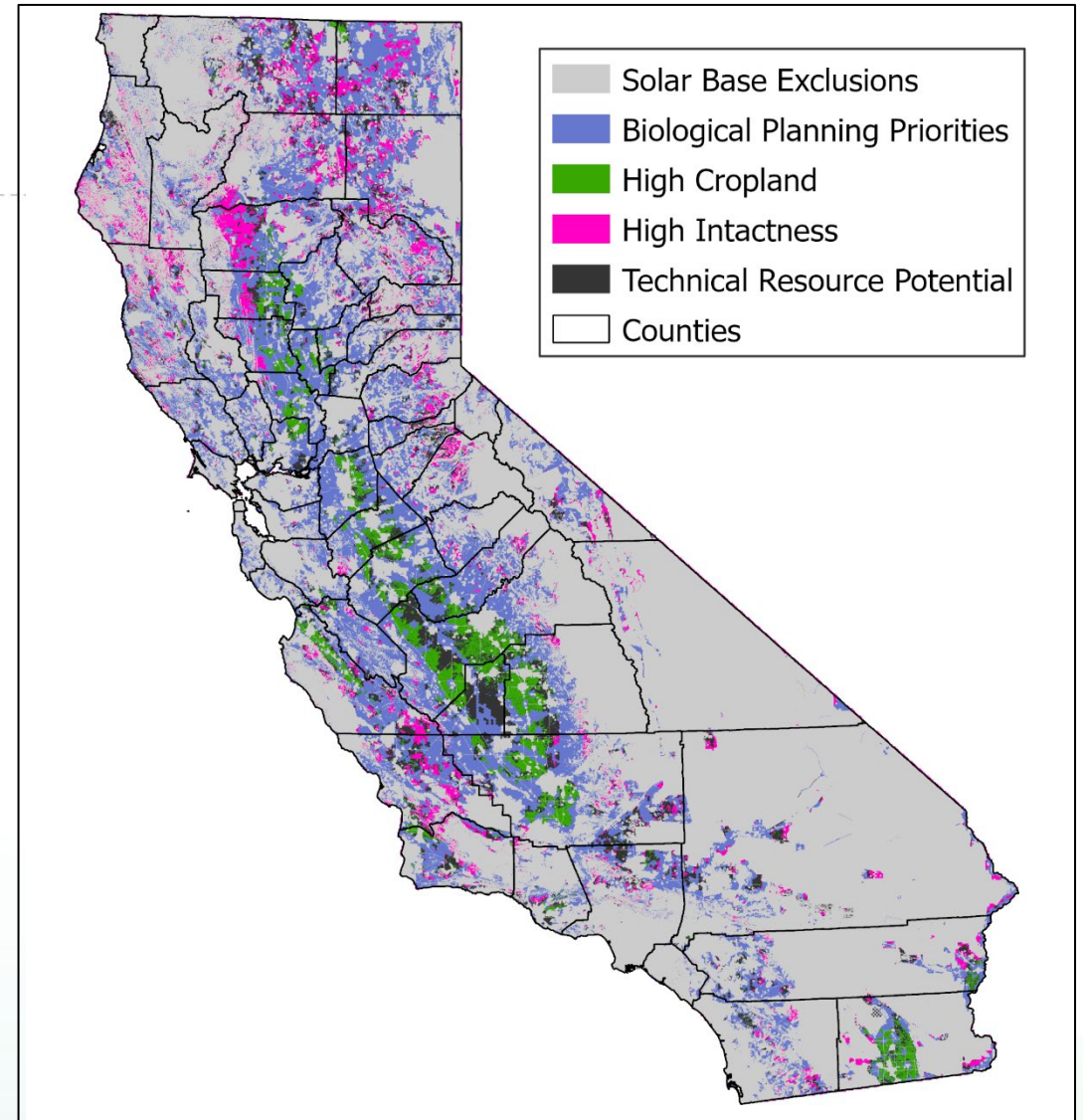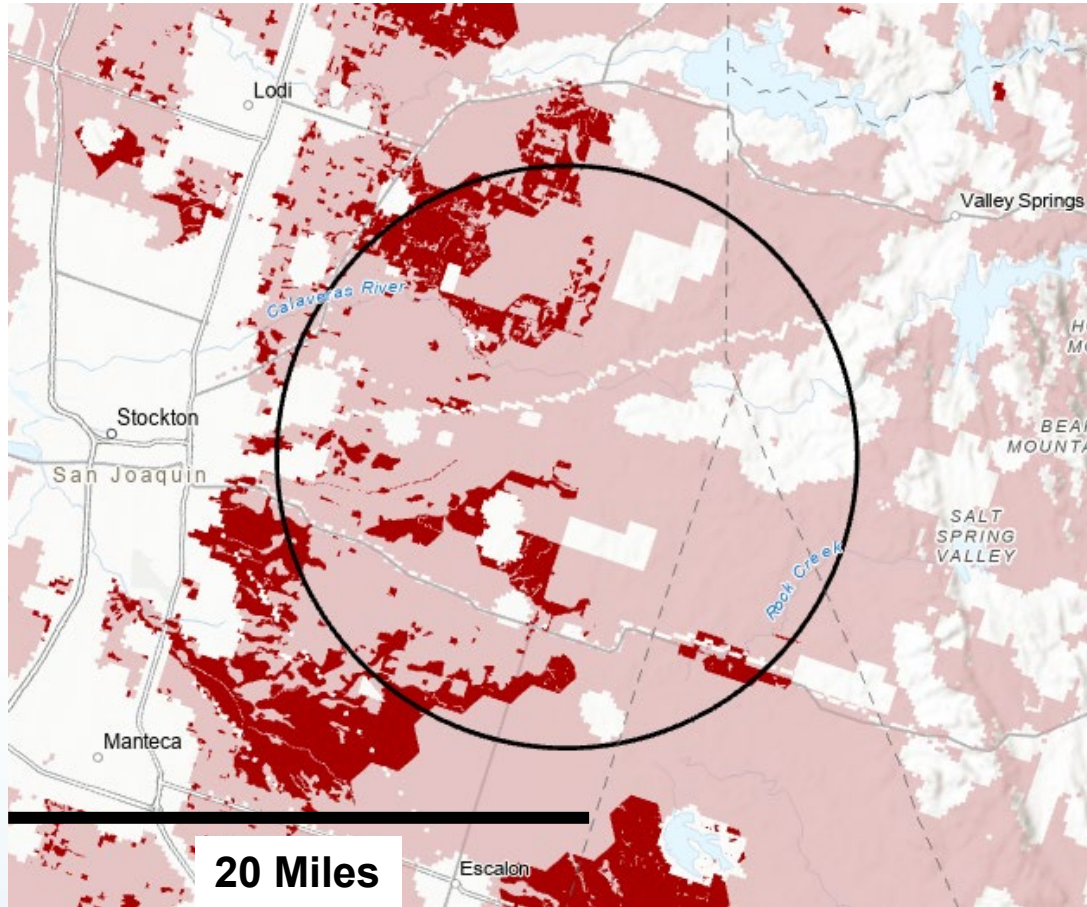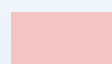
Base Exclusions consist of the protected area layer and the techno-economic exclusion layer. Areas of the state that remain with technical resource potential outside of the base exclusions are termed the Resource Potential Basemap (RPB).

General Approach for Busbar Mapping

20 Miles

Area outside of the Base Exclusions
(Resource Potential Basemap [RPB])

Area outside of the Core Screen

- Create a circular buffer around each substation

- Calculate:

  1. The total acres outside of the Core Land Use Screen

  2. The total acres outside of the Base Exclusions (Resource Potential Basemap [RPB])

  3. The percent of the RPB that has high environmental characteristics

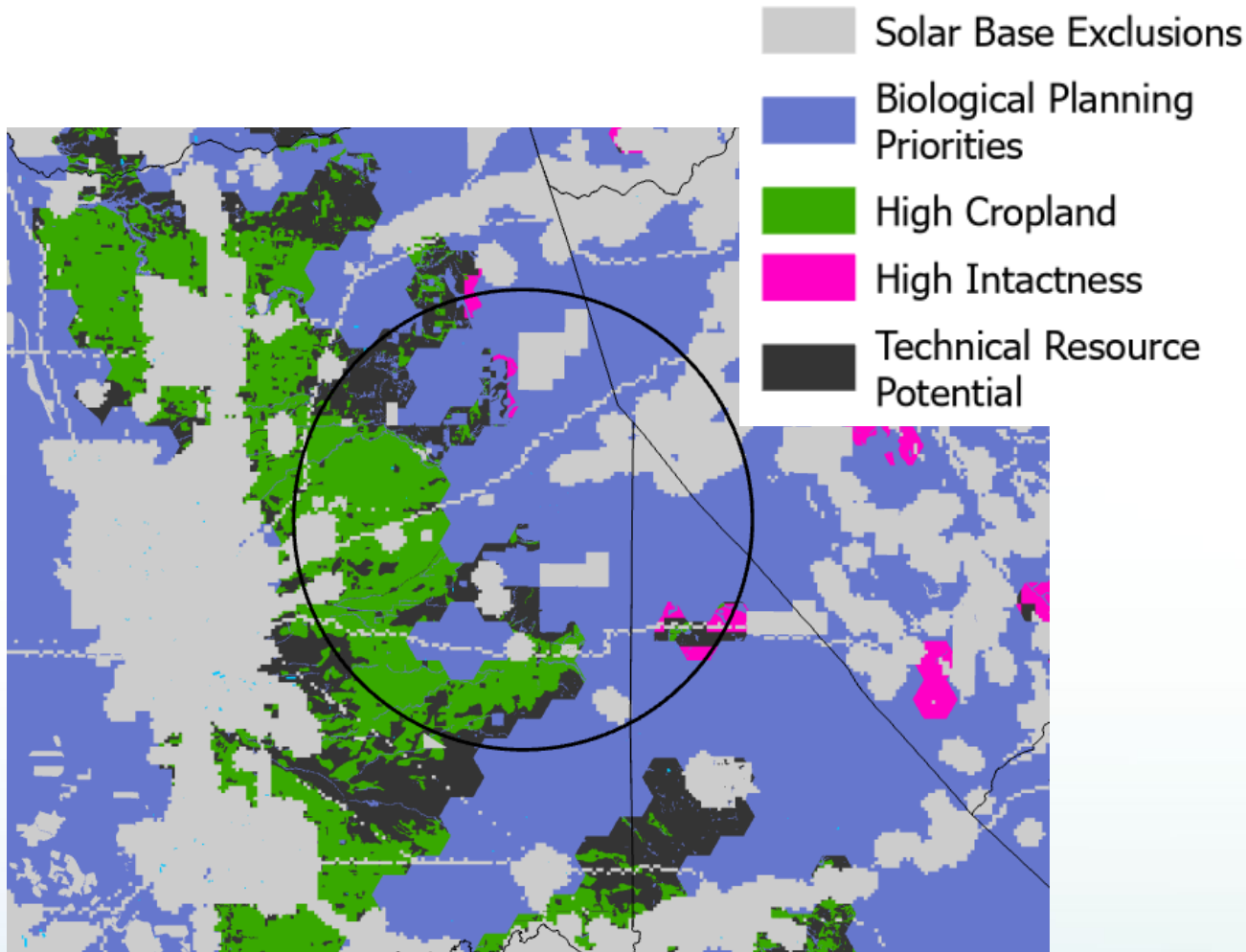   a. The total acres of the high environmental characteristic within the RPB

These calculations form the basis of the land-use metrics that CEC shares with CPUC to help inform resource allocations

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Percent of High-Environmental Characteristics

Legend:
- Solar Base Exclusions (light gray)
- Biological Planning Priorities (blue)
- High Cropland (green)
- High Intactness (magenta)
- Technical Resource Potential (dark gray/black)

- Biological Planning Priorities Used in Reporting to CPUC:
  - ACE Biodiversity Rank 5
  - Connectivity Ranks 4 and 5
  - Irreplaceability Ranks 4 and 5
  - Wetlands
- Critical Habitat is <u>not</u> included in reporting because the majority of it overlaps with the Base Exclusions and the ACE screen components (92% for solar, 96% for wind)
- High Landscape Intactness
- High CEC Cropland Index Model
- High Fire Threat District (Tiers 2 and 3, High and Extreme)

Base Exclusions consist of the protected area layer and the techno-economic exclusion layer. Areas of the state that remain with technical resource potential outside of the base exclusions are termed the Resource Potential Basemap (RPB).
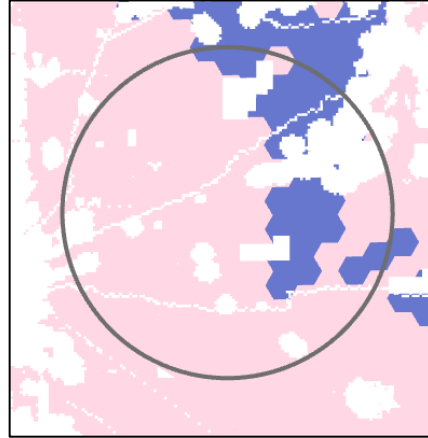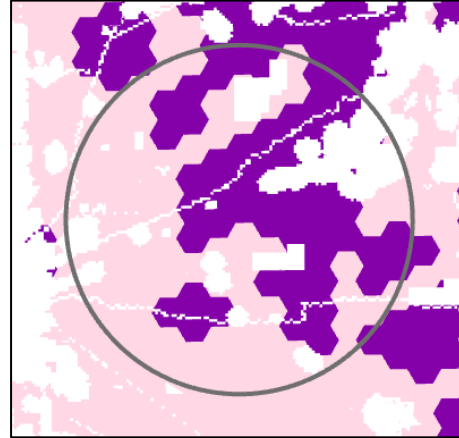
Data Sources for Metrics

- ACE Biodiversity Rank 5
  https://caenergy.maps.arcgis.com/home/item.html?id=d0bf5ee8dd0945f4aaaa98c5d8b3ecb5

- ACE Connectivity Ranks 4 and 5
  https://caenergy.maps.arcgis.com/home/item.html?id=6379aba13aa5405b86ea4bb8de0e0abb

- ACE Irreplaceability Ranks 4 and 5
  https://caenergy.maps.arcgis.com/home/item.html?id=3f94d0384f7542dcba2216635e8d103e

- Wetlands
  https://caenergy.maps.arcgis.com/home/item.html?id=fe5a4336db404333887c3b54a3985ece

- Landscape Intactness (>Mean)
  https://caenergy.maps.arcgis.com/home/item.html?id=4311305423d847189205b8245dd435fb

- CEC Cropland Index Model (>Mean)
  https://caenergy.maps.arcgis.com/home/item.html?id=83d4c6a2e9b04c0a925d5aa61d235437

- CPUC Fire-Threat Map
  https://www.cpuc.ca.gov/industries-and-topics/wildfires/fire-threat-maps-and-fire-safety-rulemaking

- Base Exclusions (to derive Resource Potential Basemap):
  https://caenergy.maps.arcgis.com/home/item.html?id=5648df9222964820a2431ffc897da5a3 and
  https://caenergy.maps.arcgis.com/home/item.html?id=d57834feacea4606b1dc6ac8dc5f72d5
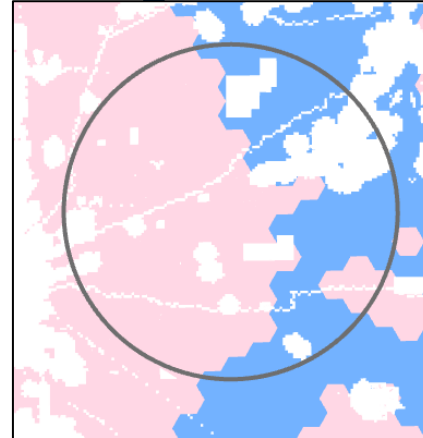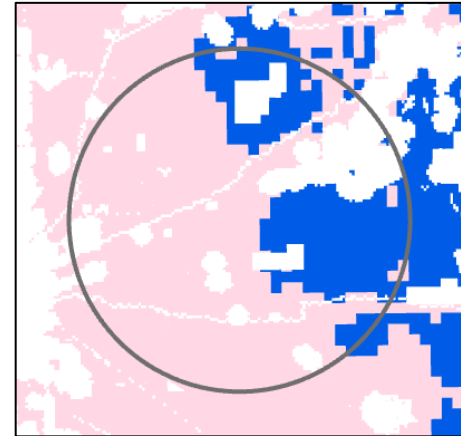
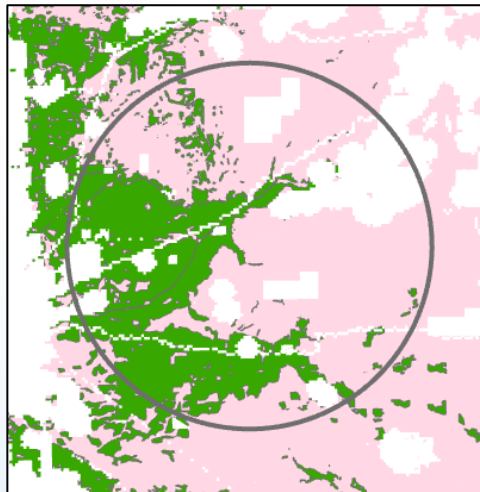# Individual Components of Environmental Implications
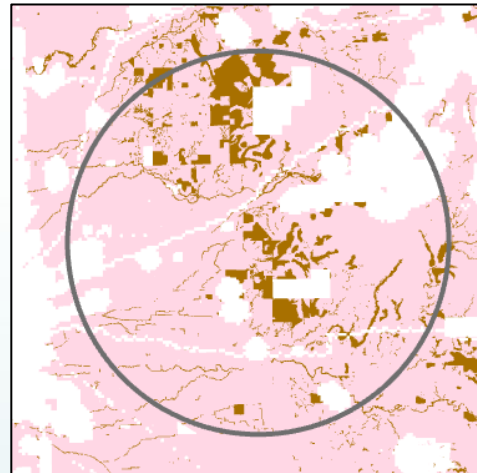

Biodiversity

Irreplaceability

Connectivity

Landscape Intactness

Cropland

Wetlands

Resource Potential Basemap (RPB)

Resource Potential Basemap (RPB) = Areas outside of the base exclusions (technoeconomic layer + protected area layer) with technical renewable resource potential.

Adjustments for Each Technology

Resource Potential Basemap (RPB): For solar and wind, remove existing projects

Solar Footprints in California
- Ground (green)
- Parking (blue)
- Rooftop (red)
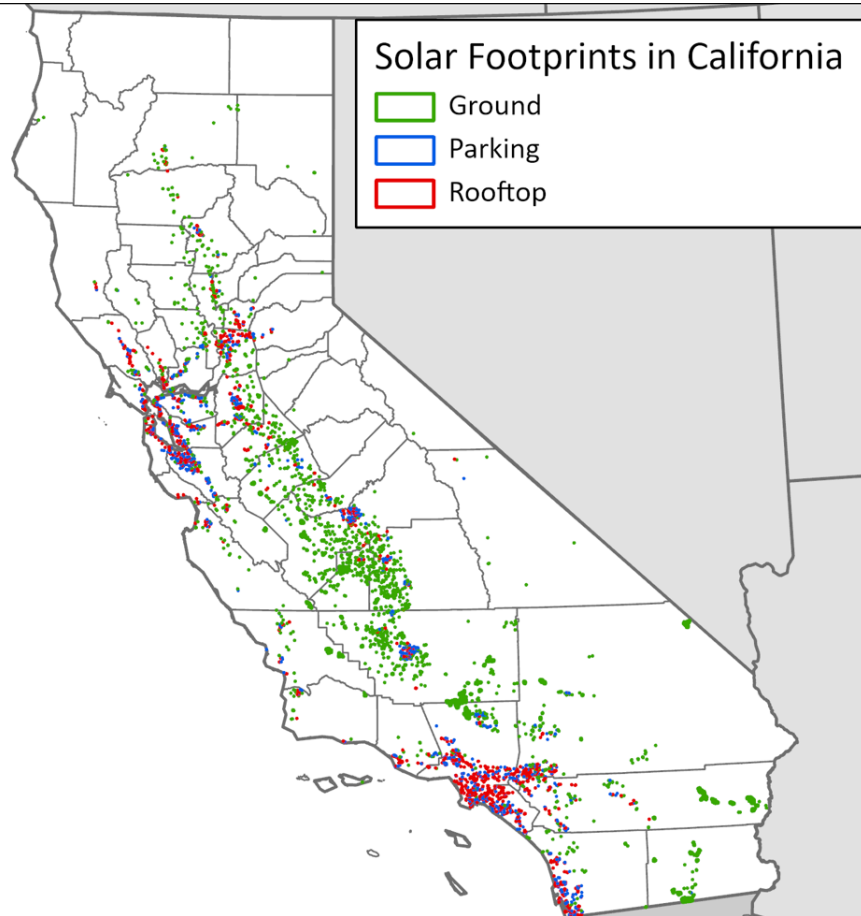
Existing Solar Projects

Wind

- For technical resource potential under the Core Screen, use revised map with additional screens
  - 0.5-km square minimum contiguous polygons
  - Higher capacity factor threshold (28%)
- Remove existing projects
  - US Wind Turbine Database with 750m buffer

Geothermal

- Resource potential for entire geothermal resource area is used even if small overlap with substation buffer
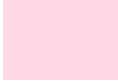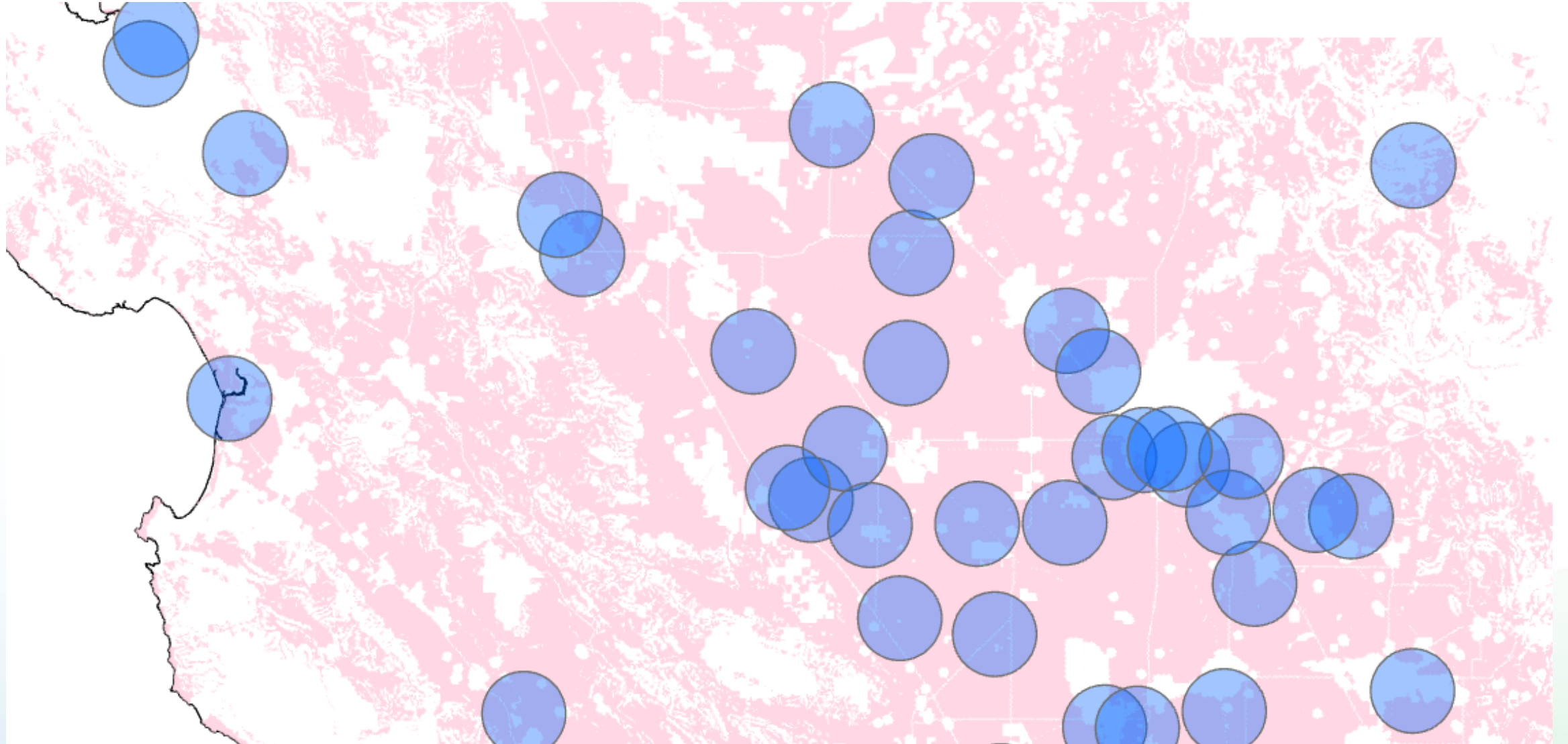
Buffer Distance

- Provide resource potential for an array of buffer distances
  - Solar: 5, 10, 15, 20 mile buffers
  - Wind: 20 and 30 mile buffers
- Limitation with larger buffer distances: after 10-15 miles, majority of substations show overlap, and may be closer to another substation
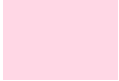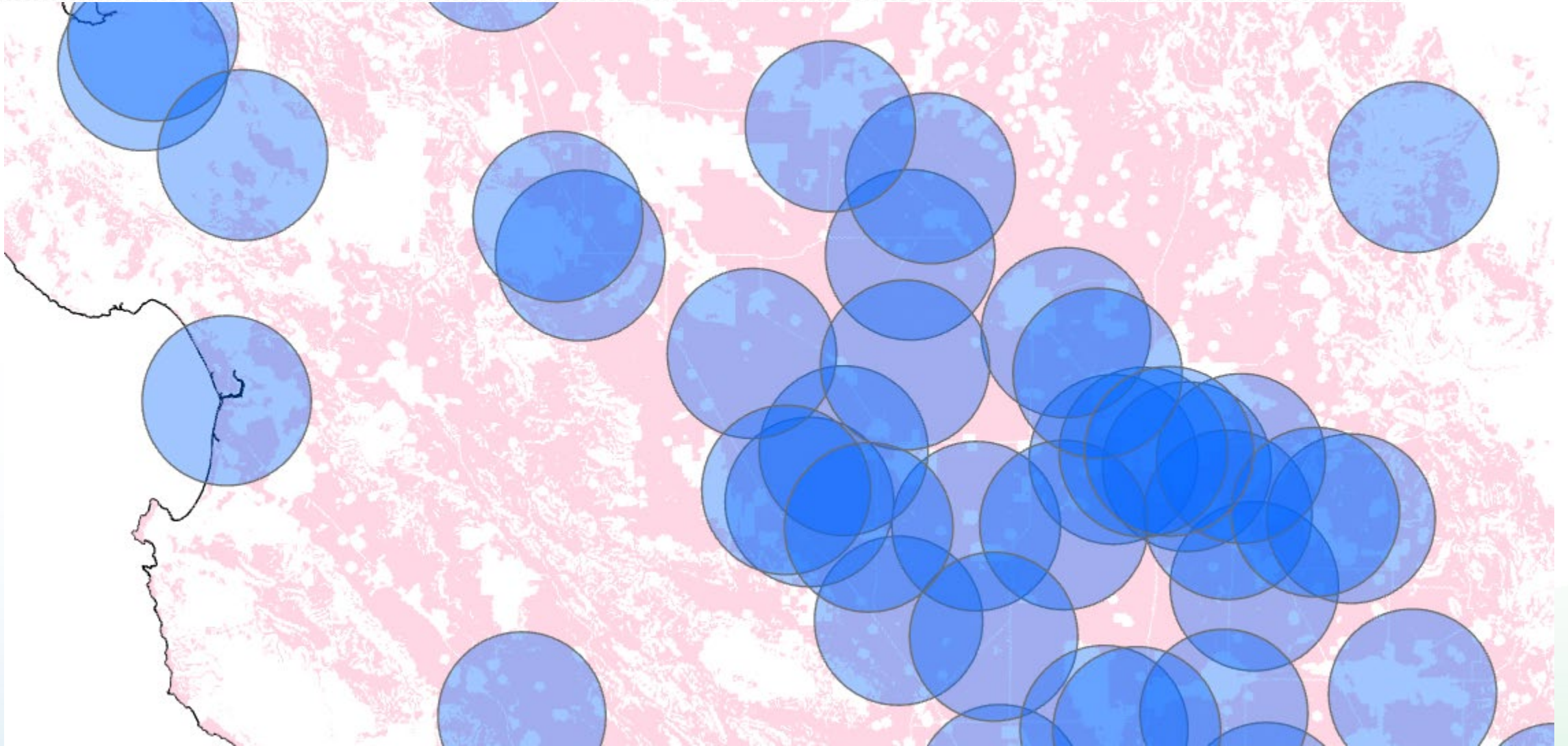
5 Mile Buffer

10 Mile Buffer

Resource Potential Basemap (RPB)
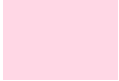
Buffer around CAISO Preferred Substations

15 Mile Buffer

Resource Potential Basemap (RPB)

Buffer around CAISO Preferred Substations

20 Mile Buffer
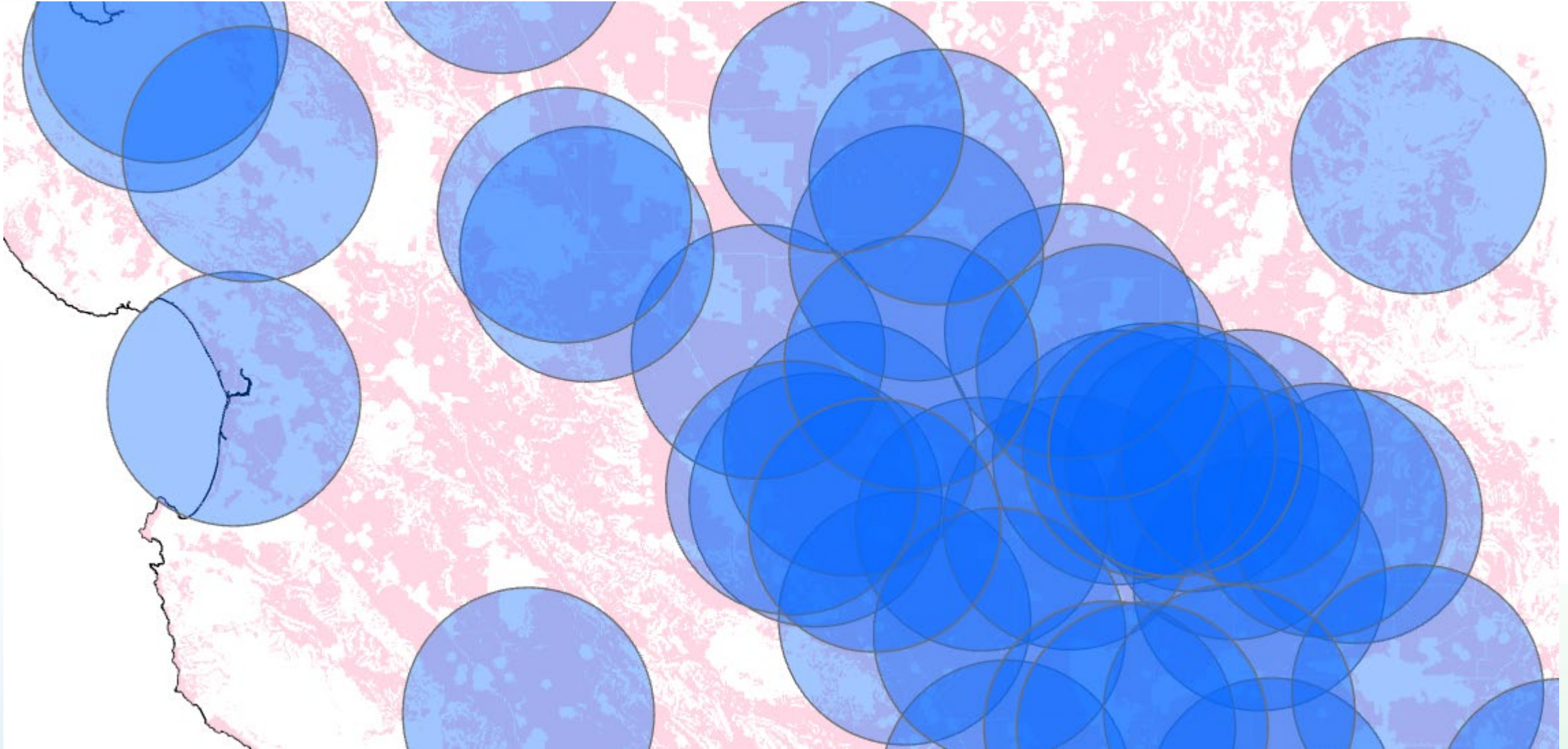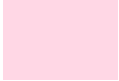
Resource Potential Basemap (RPB)

Buffer around CAISO Preferred Substations
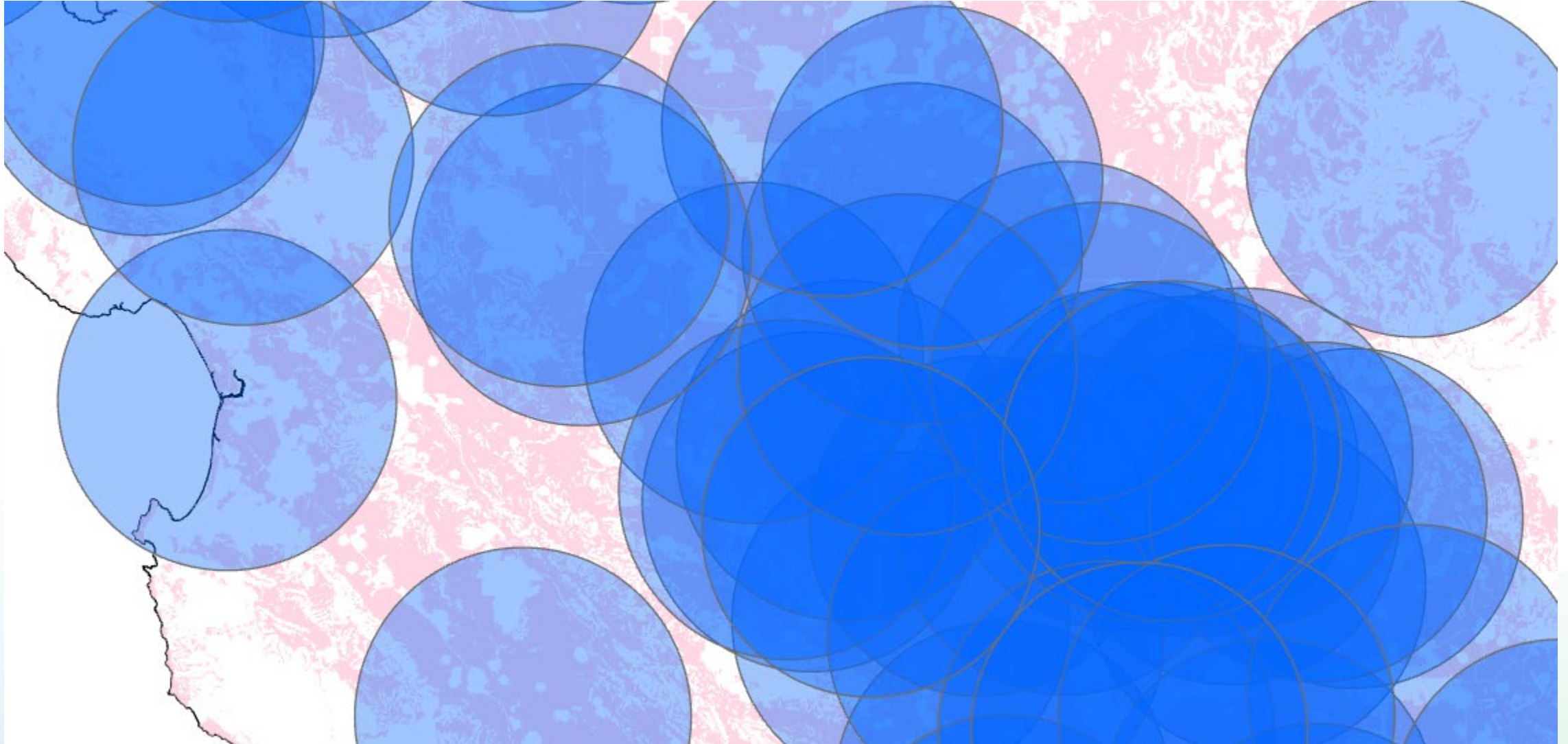
Existing Ground-Rural Solar Footprints

Distribution of Distance to CAISO Preferred Substations (Miles)

CEC Solar Footprints in California: https://cecgis-caenergy.opendata.arcgis.com/datasets/CAEnergy::solar-footprints-in-california/explore
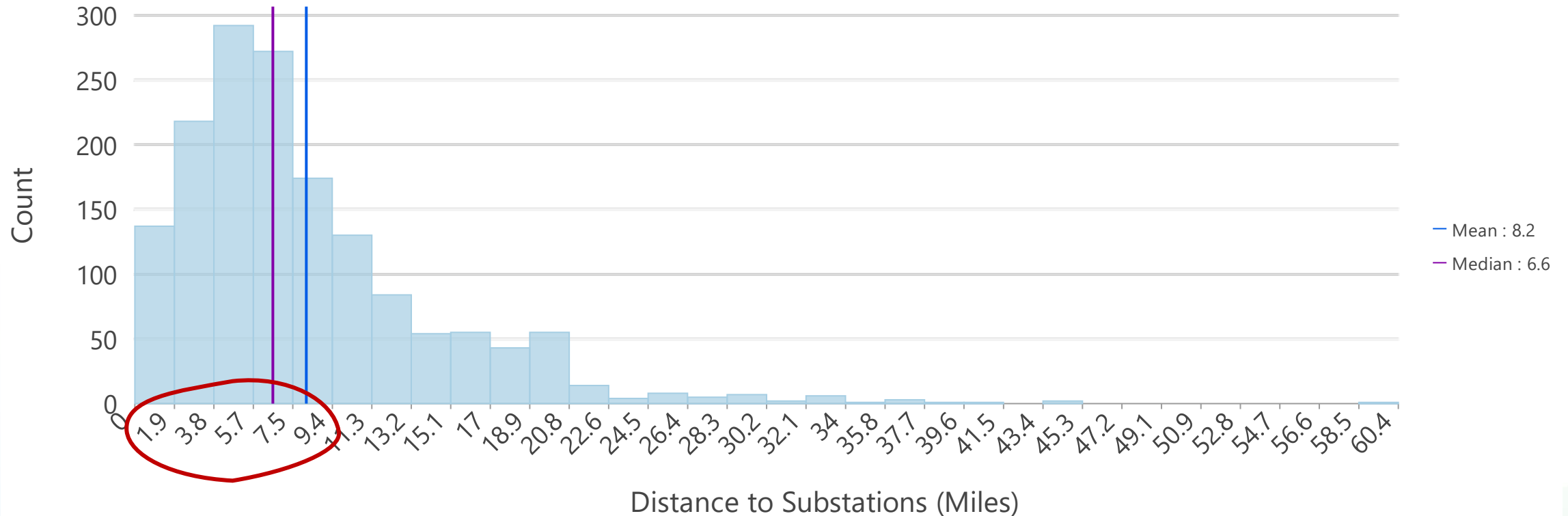
Parcelization

Proposed Metric for Solar Technology

- Parcelization is an important development feasibility factor
- High parcelization can indicate potential development constraints
- If a substation is allocated a large amount of new solar resource, land area around that substation needs to be suitable
  - Enough land with technical resource potential
  - Lower implication areas (environmental criteria)
  - Lower levels of parcelization

- Based on methodology developed by ICF (consultants to LSA)

Definition of Parcelization: Average number of unique parcels 0.5 miles from anywhere within the parcel

Calculate Parcelization

Step 1:
Rasterize Parcels Polygons to 90m resolution

Step 2:
'Nibble' cells that are null with raster value that is closest to each cell

Step 3:
Using Focal Statistics tool, calculate the number of unique values within ½ mile radius of each cell

Step 4:
Using the Zonal Statistics as Attribute Table, for each group of unique ID/APN stored in the nibbled raster, calculate the mean of the focal statistics output

Step 5:
Join the mean parcelization value for every APN to the original parcels polygon data

Rasterize Parcels
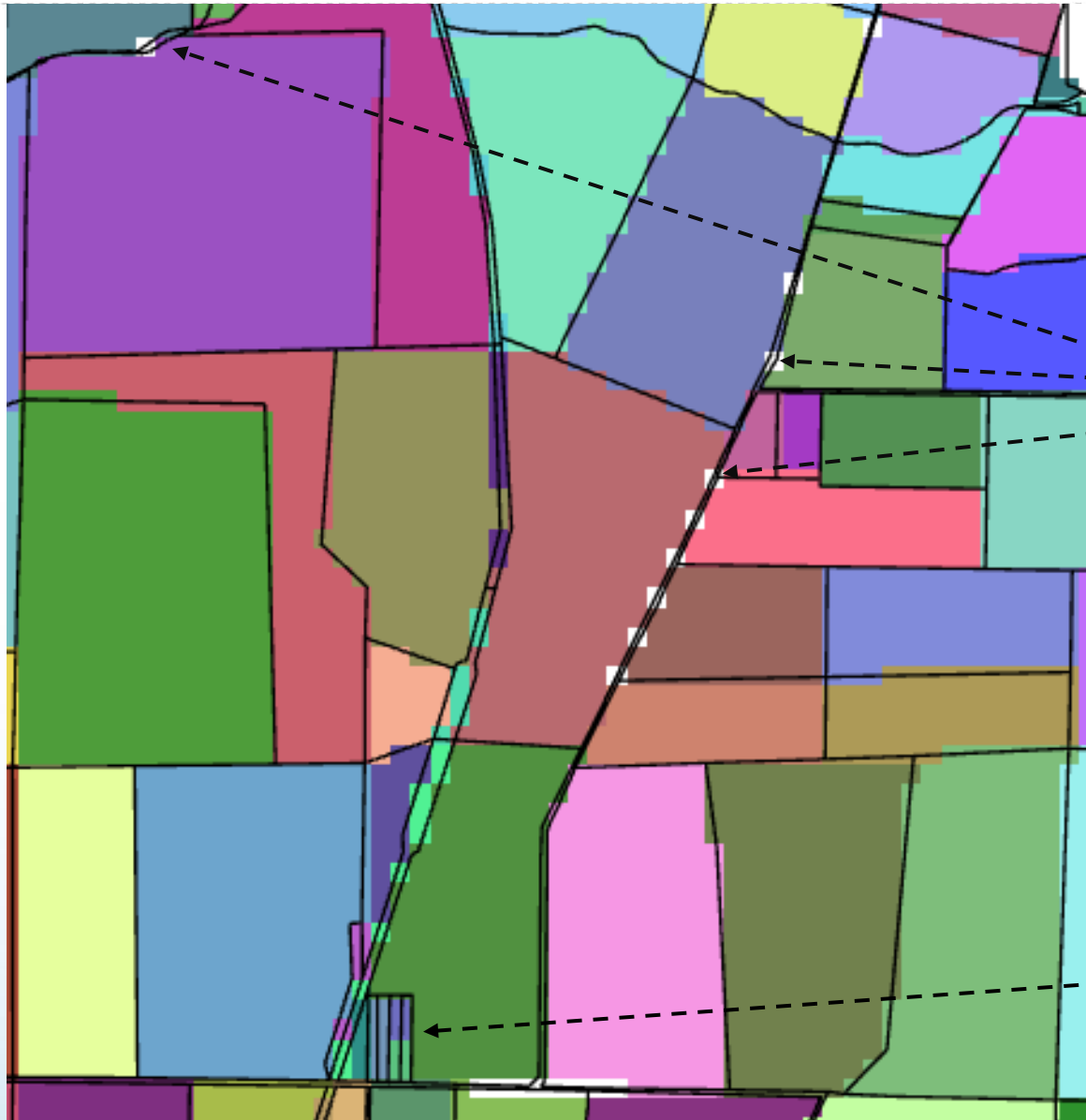
Null/NoData

Sub-resolution Parcels not captured during conversion to raster

- Polygon to Raster tool: Unique value given for every Parcel APN value that are resolved at 90m resolution.

- Some Nulls exist (if cell center falls on road, river, area with no Parcel APN value)

Focal Statistics: "Variety"

Calculates for each input cell location a statistic of the values within a specified neighborhood around it.
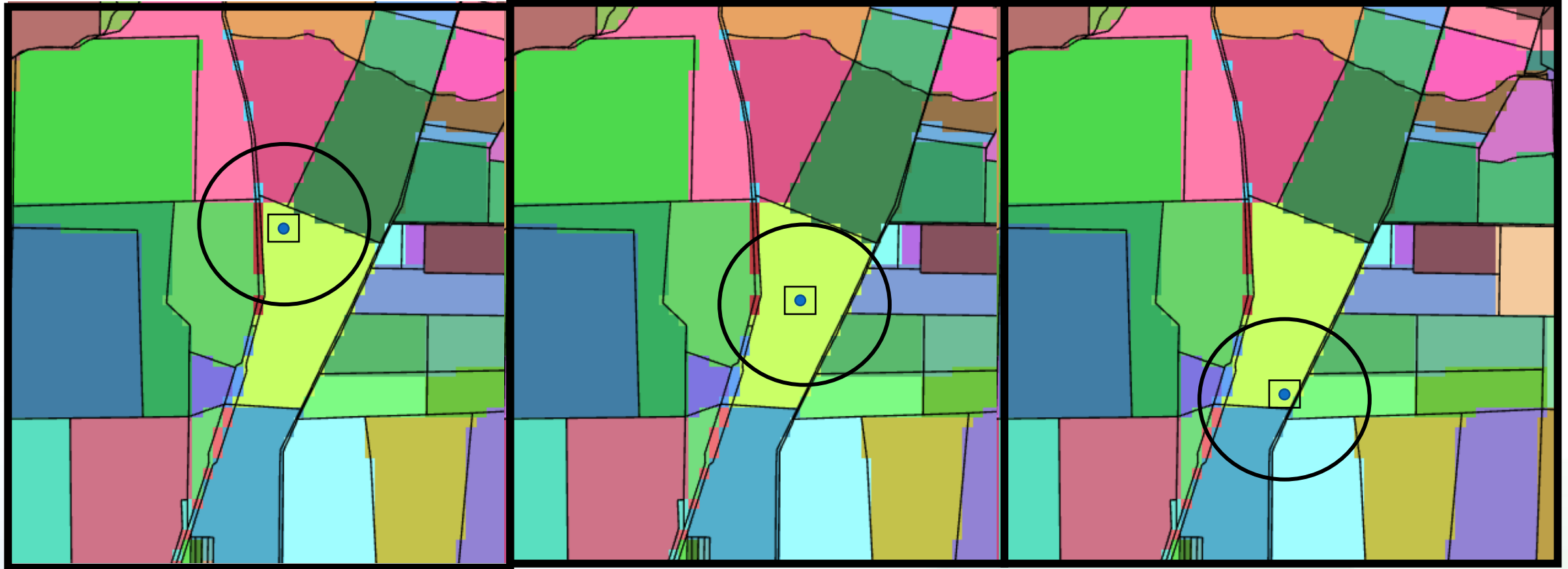
Count the number of unique APNs within 0.5 Mile of a raster cell

Join Parcelization Value Back to Original Parcels Polygons

- Sub-resolution parcels remain null

- To address this, could increase resolution of rasterization to capture more of the smaller parcels.

- Or apply nearest resolved parcel's value
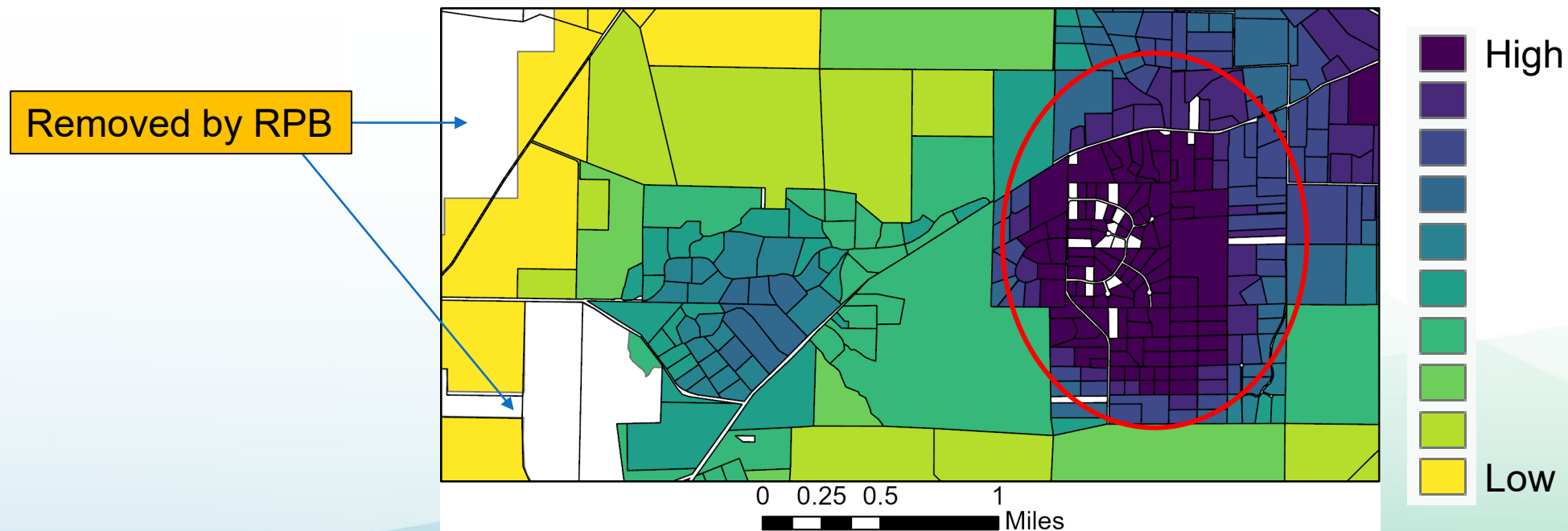
Statewide Parcelization (in RPB)

Parcelization Value
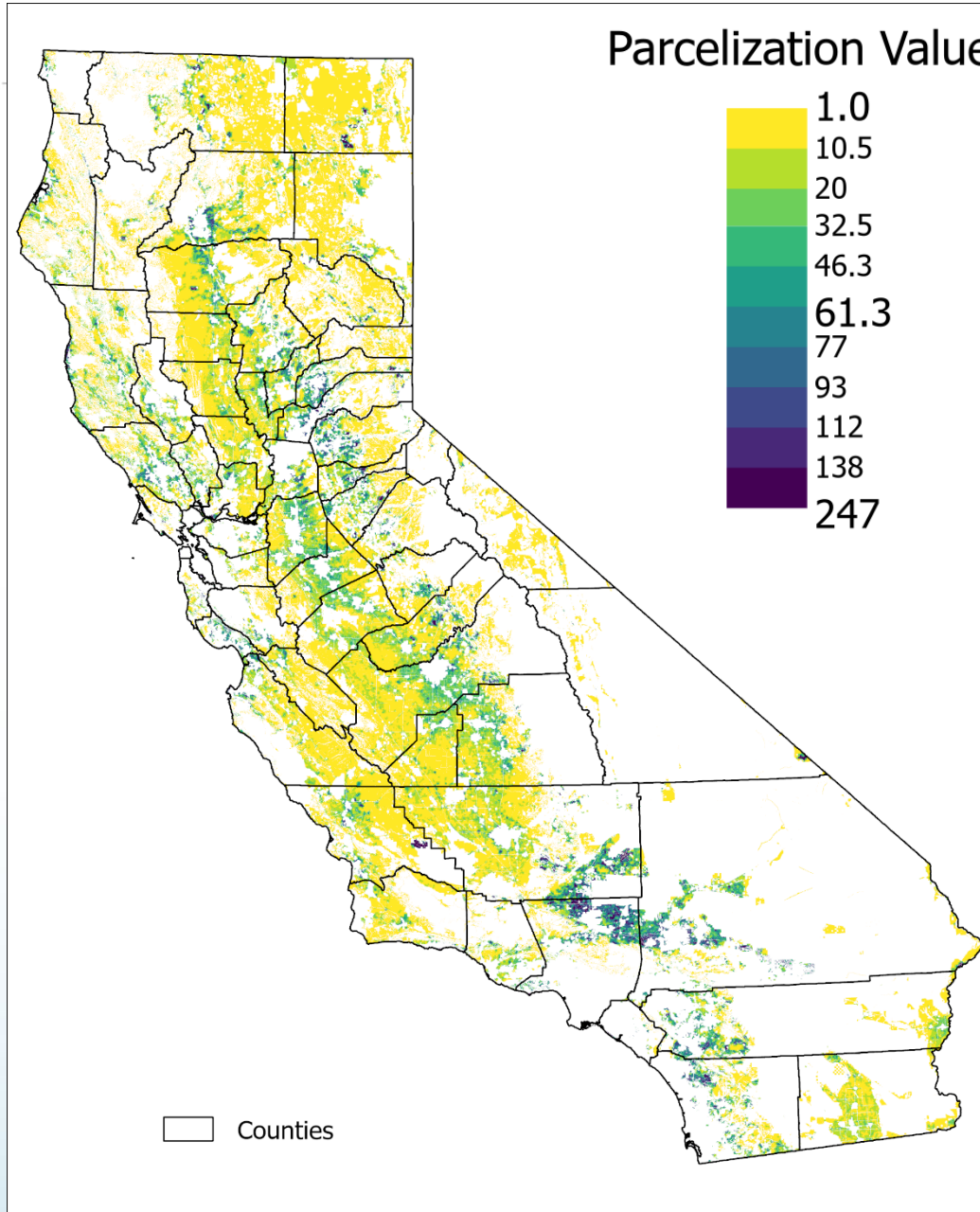
Region	10th Percentile	Total Acres (Millions) Less than 10th Percentile
Resource Potential Basemap	10.5	21.3
15 Mile Buffer of Transmission Lines ≥ 500 kV	12.0	16.0
10 Mile Buffer of Preferred Substations	12.8	7.2

Resource Potential Basemap (RPB) = Areas outside of the base exclusions (technoeconomic layer + protected area layer) with technical renewable resource potential.

Possible Application in Busbar Mapping
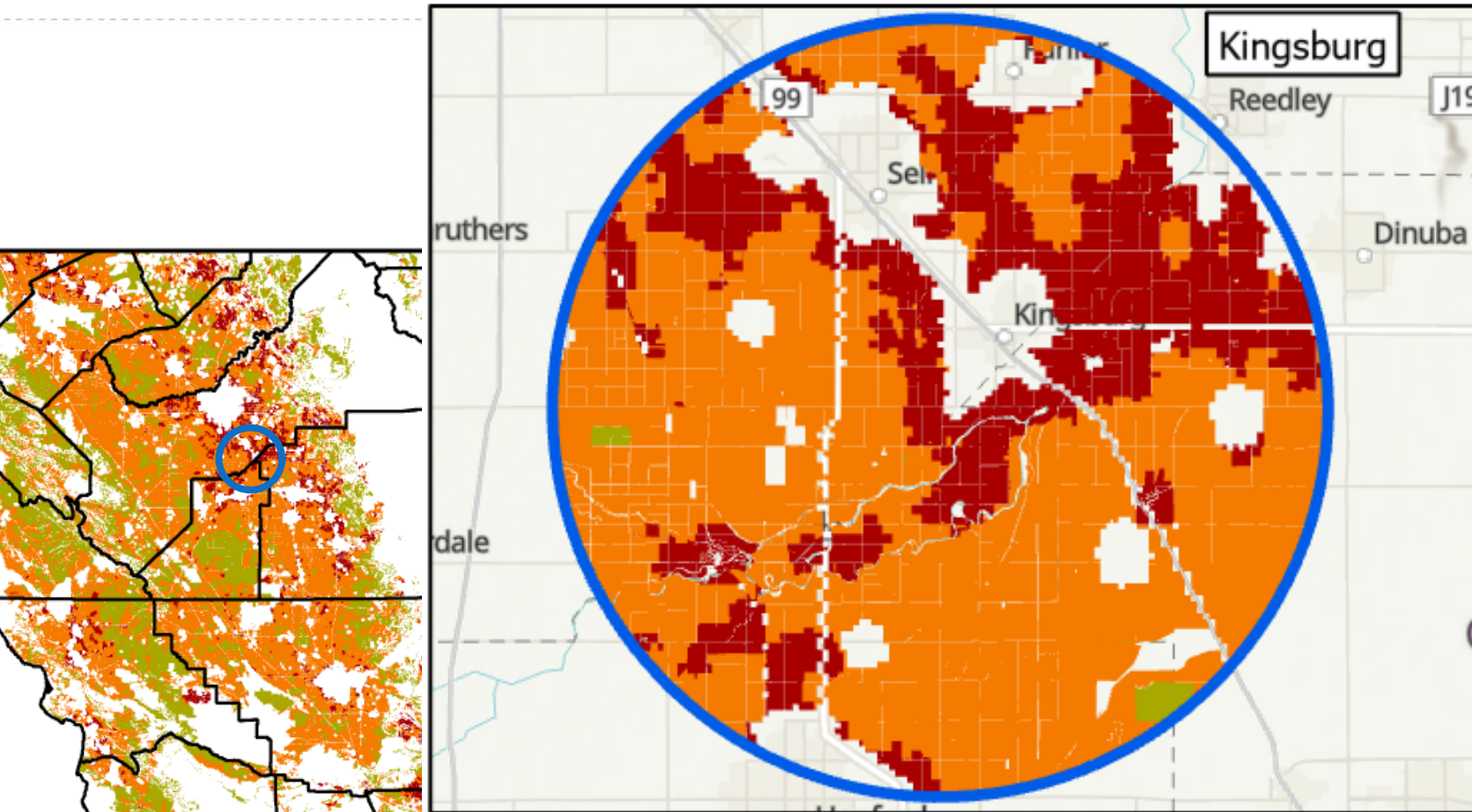
- Amount of acreage with low parcelization
- 10th percentile parcelization value

○ 10 mile buffer from Kingsburg Substation

Parcelization

■ (olive)	≤ 6.0
■ (orange)	6.1 - 30
■ (dark red)	> 30

Two Metrics for Full Assessment

10th Percentile Parcelization
- 1.093580 - 10.000000
- 10.000001 - 30.000000
- 30.000001 - 73.000000

Parcelization of Existing Solar Footprints
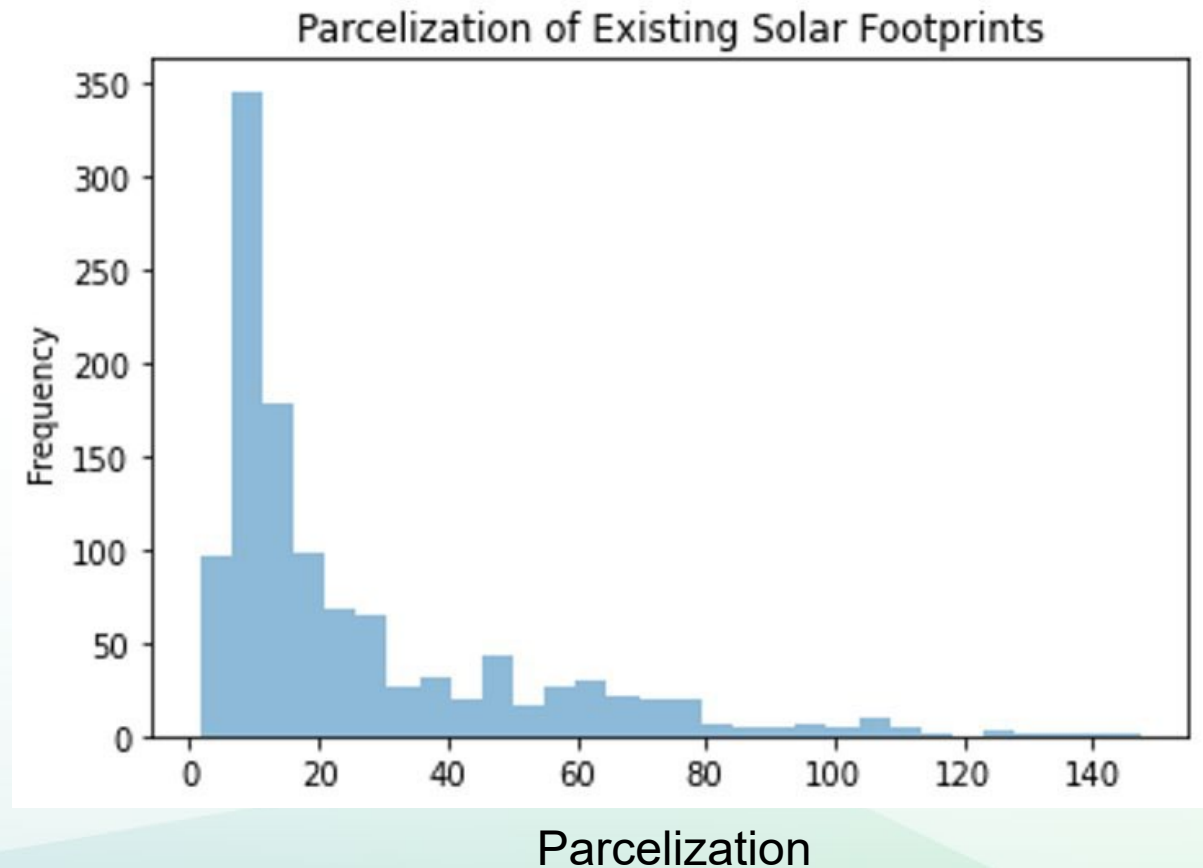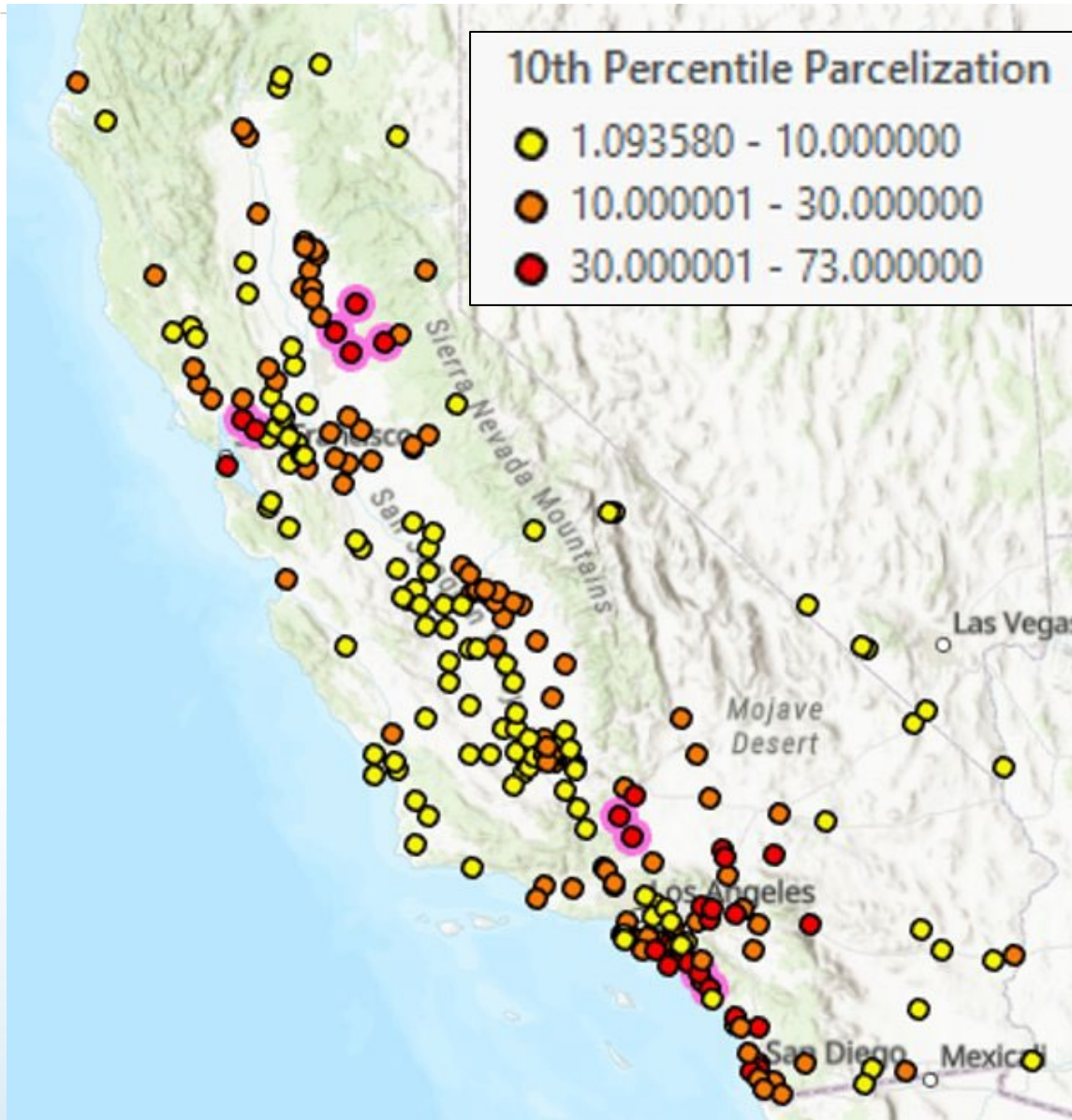
Parcelization

More information

- Forthcoming draft paper on parcelization method will be available for public comment.

- Will be posted in CEC docket number 17-MISC-03 (Environmental Information for Energy Planning) (https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=17-MISC-03)

Summary of Proposed Modifications

- Technical Resource Potential* and Resource Potential Basemap follow the recently updated Core Land-Use Screen construction.
  - (Wind Technical Resource Potential is further reduced as in the 22-23 Integrated Resource Planning Inputs and Assumptions document [June 2023])
- Environmental evaluation around substations follows datasets used in updated CEC Land-Use Screens
- Critical Habitat and Important Bird Areas are no longer reported on because the majority of their footprints are represented by the Base Exclusions and the ACE Biodiversity, Connectivity and Irreplaceability Layers
  - 95% and 97% of the Audubon Important Bird Areas are represented by the Core Screen for solar and wind, respectively
- Existing Project Footprints are removed from the resource potential basemap and technical resource potential under the Core Screen
- Parcelization metric is added for solar
- Provide technical resource potential acreage for an array of buffers

Areas of the state that remain with technical resource potential outside of the base exclusions are termed the Resource Potential Basemap (RPB).
*Technical Resource Potential refers to the areas with renewable resource potential remaining after application of the Core Screen.

Summary of Metric Modifications

Previous Cycle of Busbar Mapping
Percent Build Out: Depends on Low Implication Environmental Model Results (Solar), Custom Renewable Energy Zones (Wind), KGRA and BLM Geothermal Leasing Areas (Geothermal)
Environmental Factors:
Biodiversity
Connectivity
Landscape Intactness
Natural Landscape Blocks
Irreplaceability
Native Species Richness
Rarity
Stand-Alone Metrics:
High Fire Threat Districts
Important Bird Areas

Upcoming Cycle of Busbar Mapping
Percent Build Out: Depends on technical resource potential available under Core Land-Use Screen (solar and geothermal), CPUC's further reduced technical resource potential available under Core Land-Use Screen (Wind)
Environmental Factors:
Biodiversity
Connectivity
Irreplaceability
Landscape Intactness
Wetlands from CA Nature Habitat and Land Cover (FVEG Derived)
High CEC Cropland Index Model
Stand-Alone Metrics:
High Fire Threat Districts
Development Feasibility:
Parcelization

Metrics Analysis I

- **Application of Core Land-Use Screen: Of the low implication land available in the solar resource potential map, how much land area will the allocated MW require?**
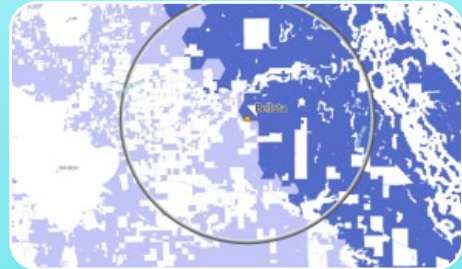
Percent Low Implication Build

- Total Acreage of Allocated Resource
  - 1,430 MW Allocated Resource → 7 Acres/MW → 10,010 Acres
- Total Acreage of Low Implication Land

Solar capacity density to convert
MW to acres and vice versa
Wind: 40 acres/MW
Geothermal: 5 acres/MW

Metrics Analysis II

- **Individual Environmental Components: Of the total resource potential land available, what percentage of it is occupied by highly ranked scores of the individual data variables that make up the Core Land Use Screen and other environmental or land-use factors?**
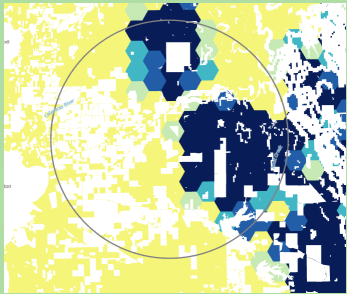
Percentage of High Characteristic

- Total Acreage of Highly-Ranked Biodiversity, Connectivity, Irreplaceability, Landscape Intactness, Wetlands…
- Total Acreage of Resource Potential

5 ACE
4 Irreplaceability

Metrics Analysis III

- **Stand-Alone Data Sets: Of the total buffer area around the substation, how much of the area intersects a High Fire Threat District?**
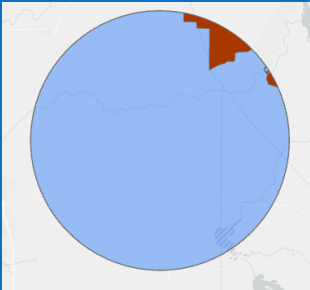
High Fire Threat Tiers 2 and 3

Percentage of High Fire Threat Areas

- Total Acreage of High Fire Threat Tier 2 and Tier 3
- Total Acreage of Buffer

Metrics Analysis IV (Solar Only)

- Development Feasibility: What is the 10th percentile of parcelization values around the substation, and how much area does the lowest and mid-level categories of parcelization provide around the substation?
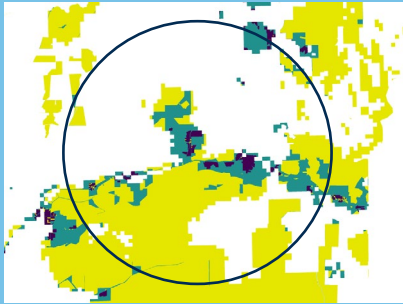
Parcelization

- 10th Percentile
- Total Acreage of Low, Medium and High Parcelization Levels

Final Result Shared with CPUC

For all CAISO preferred substations

Example Substation	Metrics Group I: Percent of Technical Resource Potential that would be used by Allocated Resource (Build Out)		
	19%		
	Metrics Group II: Percent High Characteristic of Ecological, Environmental and Biological Factors		
	Biodiversity	55%	
	Connectivity	41%	
	Irreplaceability	51%	
	Landscape Intactness	42%	
	Wetlands	1%	
	CEC Cropland	34%	
	Metrics Group III: Stand Alone Dataset		
	Sum of Tiers 2 and 3 (High and Extreme Fire Threat)	3%	
	Metrics Group IV: Development Feasibility		
	Parcelization	Low: 10%; Med: 28%	Low: 2,000 acres; Med: 40,000 acres

Final Result Shared with CPUC – as shown in Busbar Mapping Dashboard

For all CAISO preferred substations

Example Substation	Percent of Low Implication Build		
	19%		
	Environmental Impacts		
	Biodiversity	55%	
	Connectivity	41%	
	Irreplaceability	51%	
	Landscape Intactness	42%	
	Wetlands	1%	
	CEC Cropland	34%	
	Sum of Tiers 2 and 3 (High and Extreme Fire Threat)	3%	
	Development Feasibility		
	Parcelization	Low: 10%; Med: 28%	Low: 2,000 acres; Med: 40,000 acres

Thank you!

Quick References

- Final CEC Staff Report: *Land-Use Screens for Electric System Planning*
  - Will be available soon in CEC docket no. 21-SIT-01. https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=21-SIT-01

- CEC 2023 Land-Use Screens for Electric System Planning
  - Data viewer displaying the land-use screen components to help elucidate methods and results described in the CEC *Land-Use Screens for Electric System Planning* staff report
  - Will be available soon in the California Energy Planning Library: https://www.energy.ca.gov/data-reports/california-energy-planning-library/land-use-screens