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BLACK & VEATCH



# Renewable Energy Transmission Initiative Phase 1A Work Group Meeting 5

**Black & Veatch**

**Phase 1A Work Group**

**February 28, 2008**

## Agenda

- Actions taken last meeting
- Carry-over items from 2/21/08 meeting
  - Resources included in base case
- Transmission assumptions
- Resource assessment methodology
- Technology development methodology

## Actions Taken Last Meeting

- Reviewed economic assumption used
- Reviewed resource valuation methodology
- Discussion of resources included in base case
  - Treatment of existing and short-listed contracts and transmission queue

## Assumptions

- Financial assumptions for use in modeling
- Renewable energy incentives
- Renewable energy demand
- Transmission
- Economic assumptions to support resource valuation
- Renewable technology-specific assumptions

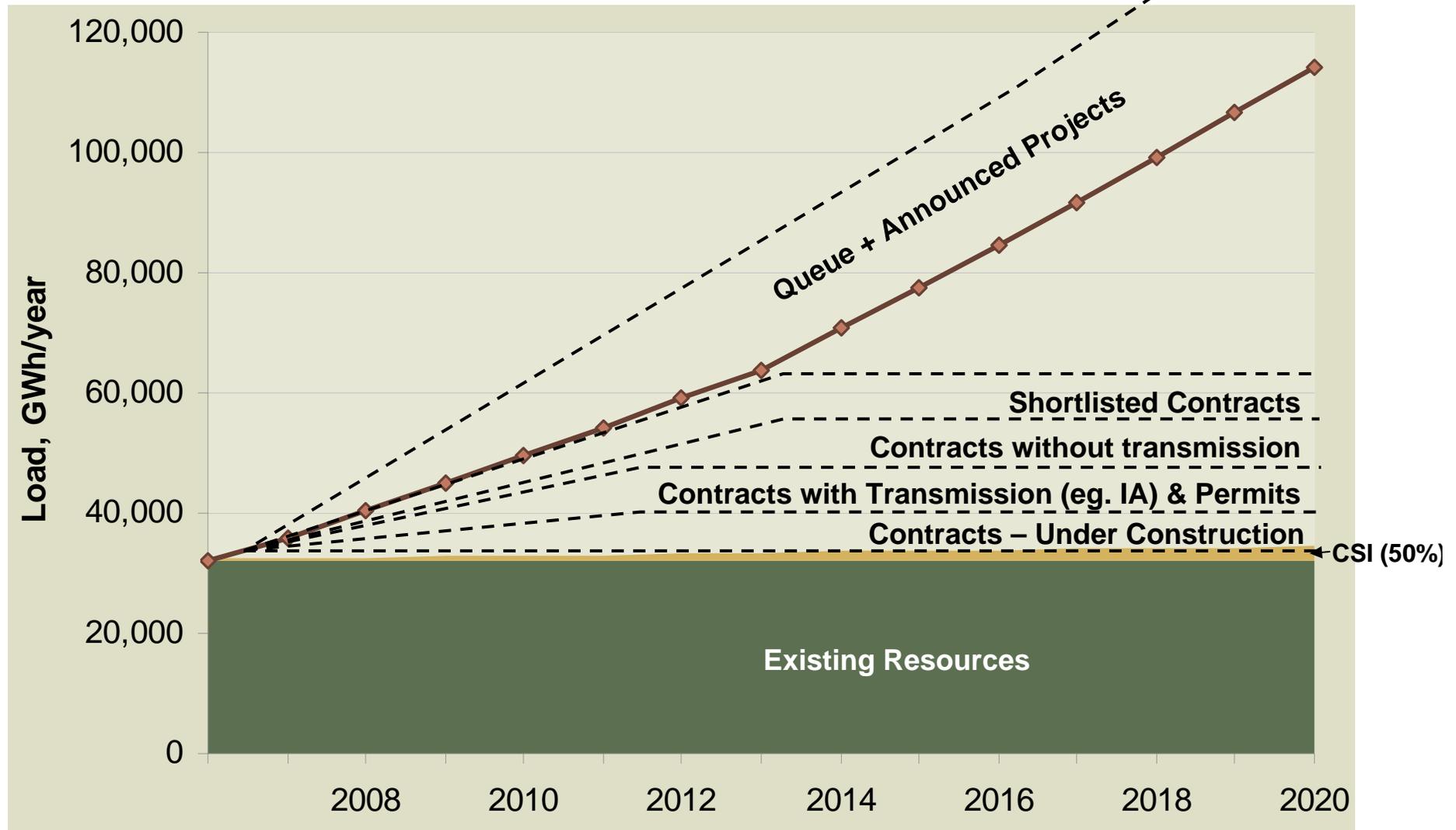


1 week

# Methodological Issues

- Resource assessment 
- Project identification, characterization and screening 
- CREZ identification, characterization and economic ranking 
- Treatment of existing and short-listed contracts and transmission queue 
- Technology development 
- Resource valuation 
- Supply curve creation

# What other Resources to Assume are “Existing”?



**CONCEPTUAL – FOR EXAMPLE ONLY**

## Renewable Generation Included in RETI

	Proposed
<b>“Existing” Resources in the Base Case</b>	<b>YES</b>
Existing projects	<b>YES</b>
Under-construction projects	<b>YES</b>
Projects with all three of: PPA, siting approval, Interconnection Agreement	<b>YES</b>
<b>Potential Resources with near-term Commercial Interest (an expected on-line date has been identified, 03/08)</b>	<b>NO</b>
PPA (approved, pending)	<b>NO</b>
Short-listed projects	<b>NO</b>
<b>Additional Potential Resources, but no pre-defined on-line date</b>	<b>NO</b>
Proposed projects with no PPA	<b>NO</b>
ISO queue projects	<b>NO</b>
All other resources	<b>NO</b>

*Same criteria used for California and non-California resources*

# Transmission Methodology and Assumptions

## Transmission Included in the Base Case

- Similar to generation, need to determine criteria for adding transmission in the base case
- Potential transmission to included in base case:
  - Existing transmission
  - Transmission projects under construction
  - Transmission projects approved by **ALL** necessary regulatory agencies (FERC, CEC, CPUC, CAISO, etc.)
  - Transmission resources approved by one or more agencies, but approval pending from other agencies

*Same criteria used for California and non-California transmission projects*

## Existing Transmission Assumptions

- For existing lines, available transmission capacity:
  - For California IOU lines, use TRCR data (less any new resources to be added in base case since the TRCR report)
  - For California non-IOU lines, use other public data or utility-provided data
  - Non-California lines – WECC and transmission owner information

## New Transmission Assumptions

- Will depend on what's included in base case
- Potential transmission additions:
  - Current proposed California projects
  - Current proposed WECC projects
  - Identify additional transmission that may be required (after CREZ development)
- Transmission project timing will be important
  - Need to develop realistic assumptions regarding when Can transmission be approved and built

# Transmission Cost Assumptions

- Existing transmission requiring upgrades, use utility TCRC data
- New transmission facility cost information
  - Use public numbers if available
  - B&V will develop cost estimates as needed:
    - Transmission – dependent on location  
(urban, rural, mountain, desert, etc.)
    - Substations
    - Gen-tie - Interconnection cost from facility to grid
- Transmission access / wheeling costs:
  - All California generation – CAISO rates (simplified assumption)
  - Non-California – local wheeling cost + CAISO rates

# Transmission Cost Methodology

- Levelized Cost of Transmission (LCOT) - \$/MWh
  - Calculated with economic model consistent with that used by California IOUs

## Fixed Costs

- Resource interconnection costs
- Network upgrade costs
- Trunk line costs

## Variable Costs

- Transmission access / wheeling charges
  - Assume CAISO charges for all projects
  - Pancake wheeling rates for out-of-state resources
- FTR/CRRs – no cost / value assumption

# Transmission Cost Methodology

- Transmission costs will be additive
- Except wheeling, transmission costs will be allocated on a per-MW basis.

*(This is a planning assumption, not a rate-making proposal)*

Potential Transmission Costs

Transmission Type	Interconnection Costs (\$/MW-mile based on location)	Network Upgrade Costs (\$/MW)	Substation development cost (\$/kW)	New transmission / trunk line costs	Non-CAISO wheeling costs (\$/MWh)	CAISO transmission access (\$/MWh)
California project connecting to existing transmission facilities	Yes	Yes	No	No	No	Yes
California project connecting to new transmission	Yes	No	Yes	Yes		Yes
Non-California projects delivering power to California	Yes	Depends	Depends	Yes	Yes	Yes

## Transmission Cost Methodology

- Transmission costs for new facilities will be allocated to generators based on expected build-out of a region

*Example:*

A region has the potential for 3000 MW of cost-effective generation

1500 MW to be installed in 2012

1500 MW expected to be installed in 2015

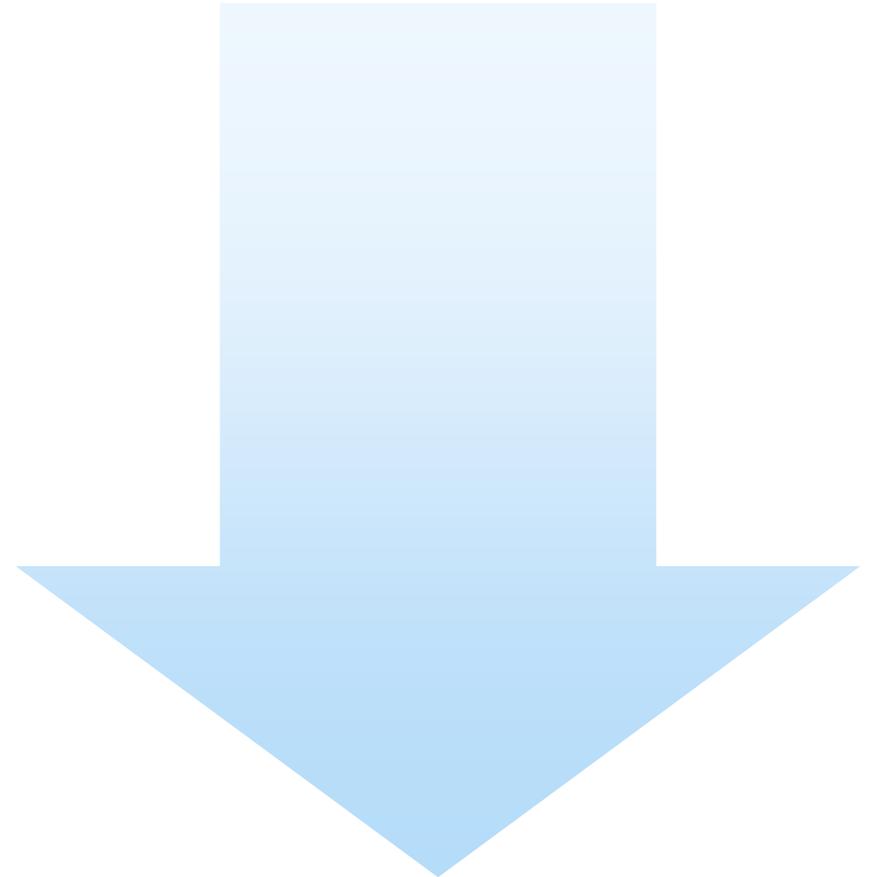
***RETI would add transmission in 2012 to accommodate all 3000 MW***

***The cost allocated to each MW would be the same, whether it went on-line in 2012 or 2015***

# Resource Assessment Methodology

# Resource Assessment Methodology

1. Resources
2. Developable Projects
3. Competitive Renewable Energy Zones



# Example Geothermal High-Level Resource Assessment

State / Province	Currently Installed Capacity (Gross MW)	Reasonable Estimate of Additional Capacity Within 10 Years (Gross MW)	Total Capacity (Currently Installed + Reasonable Additions) Within 10 Years (Gross MW)
California	1,884 <sup>a</sup>	2,375 <sup>b</sup>	4,259
Nevada	297 <sup>d</sup>	1,488 <sup>b</sup>	1,785
Baja California, Mexico	730 <sup>e</sup>	80 <sup>f</sup>	810
British Columbia	0	610 <sup>c</sup>	610
Oregon	0	380 <sup>b</sup>	380
Washington	0	50 <sup>b</sup>	50
Arizona	0	50 <sup>f</sup>	50
<b>Total</b>	<b>2,911</b>	<b>5,033</b>	<b>7,944</b>

***PRELIMINARY DRAFT (GeothermEx)***

*Notes on next page...*

# Geothermal High-Level Resource Assessment (Notes and Sources)

## Sources:

- a California Geothermal Energy Collaborative/GeothermEx, 2006. California Geothermal Fields and Existing Power Plants. Map and table. Available on the Web at:  
<http://ciece.ucop.edu/geothermal/documents/FinalGeothermalFactSheetAndMap.pdf>
- b Western Governors' Association, 2006. Geothermal Task Force Report, Clean and Diversified Energy Initiative. Table A-5. Available on the Web at:  
<http://www.westgov.org/wga/initiatives/cdeac/Geothermal-full.pdf>
- c BC Hydro, 2002. Green Energy Study for British Columbia; Phase 2: Mainland. Report No. E44. Chapter 5.2: Geothermal Energy, pp. 18-22. Reasonable estimate taken as average between low and high estimates, ranging from 150 to 1,070 MW.
- d Geothermal Energy Association, 2007. Geothermal plant information posted on web site:  
<http://www.geo-energy.org/information/plants.asp>.
- e Gutierrez-Negrin, L.C.A., and J. L. Quijano-Leon, 2005. Update of geothermics in Mexico. World Geothermal Congress, Antalya, Turkey. Paper No. 0102
- f GeothermEx estimate

***PRELIMINARY DRAFT (GeothermEx)***

# Phase 1A Deliverable: List of Screened Resources

	CA	OR	WA	NV	AZ	MX	BC
Landfill Gas							
Digester Gas							
Solid Biomass							
Solar Photovoltaic							
Solar Thermal							
Hydropower							
Onshore Wind		<input type="checkbox"/>					
Offshore Wind							
Geothermal							
Wave Energy							
Marine Current							

# Phase 1A Deliverable: Example Wind Detail

California				
	S. Coast	N. Coast	S. Interior	N. Interior
Onshore Wind				
Class 3				
Class 4				
Class 5				
Class 6				
Class 7				

**CONCEPTUAL – FOR EXAMPLE ONLY**

## Proposed Phase 1A Resource Assessment Screening Factors

- Technically viable
- Commercially available by 2020
- Most economical over the study timeframe
- Resources with significant potential to meet CA RPS
- Excluded RETI Resources:
  - Customer sited
  - Distribution-level resource additions (<10 MW)
  - *Will be accounted for, but not directly considered as potential projects*

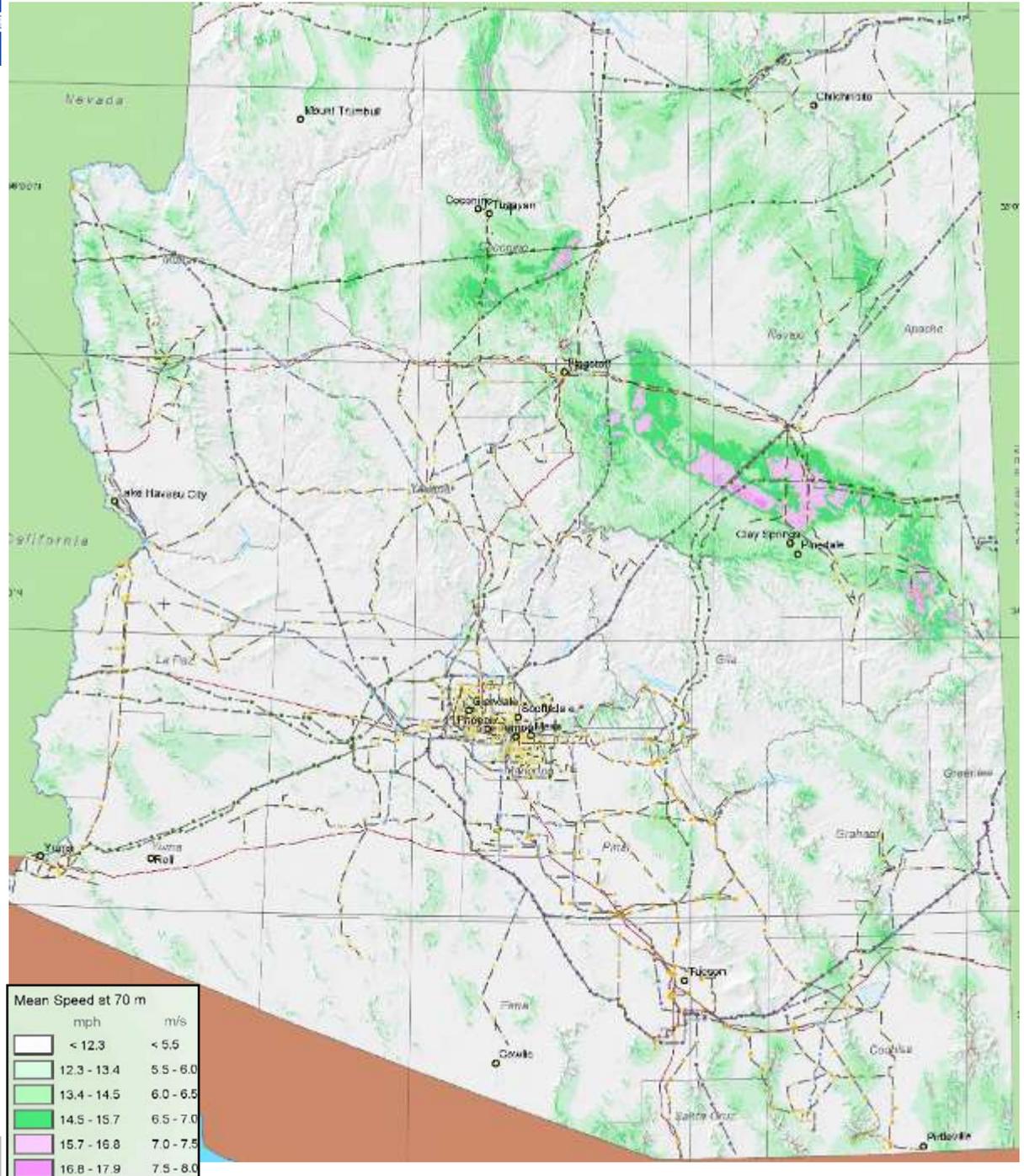
## Screening / Ranking Topics

- **Tasks (Phase 1A)**

1. **Working Group: Agreement on Phase 1A Screening Factors (TODAY)**
2. Black & Veatch: Apply screening factors and recommend technologies/regions to cut

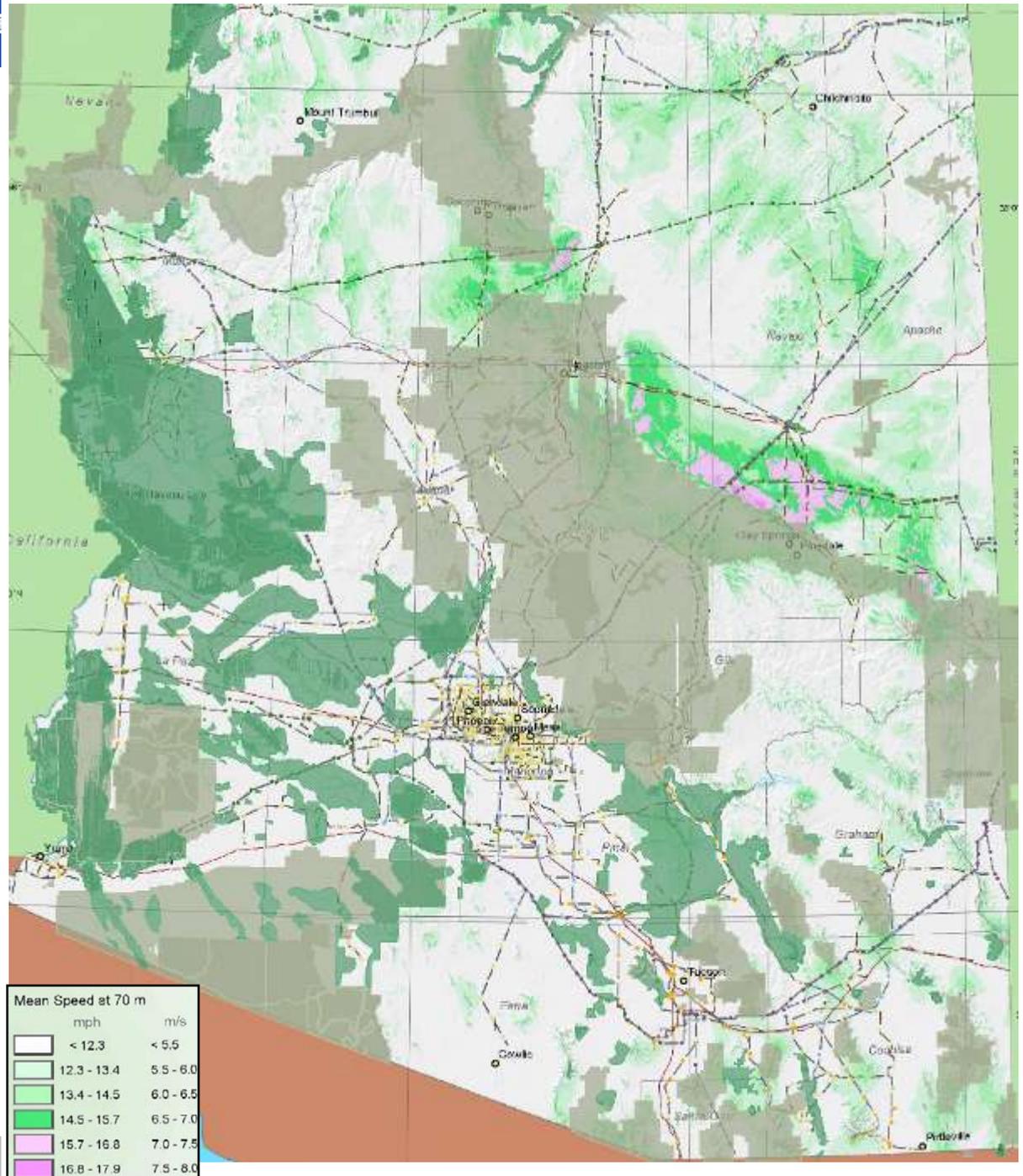
# Example: Arizona Wind Project Screening

- Raw Wind Resource



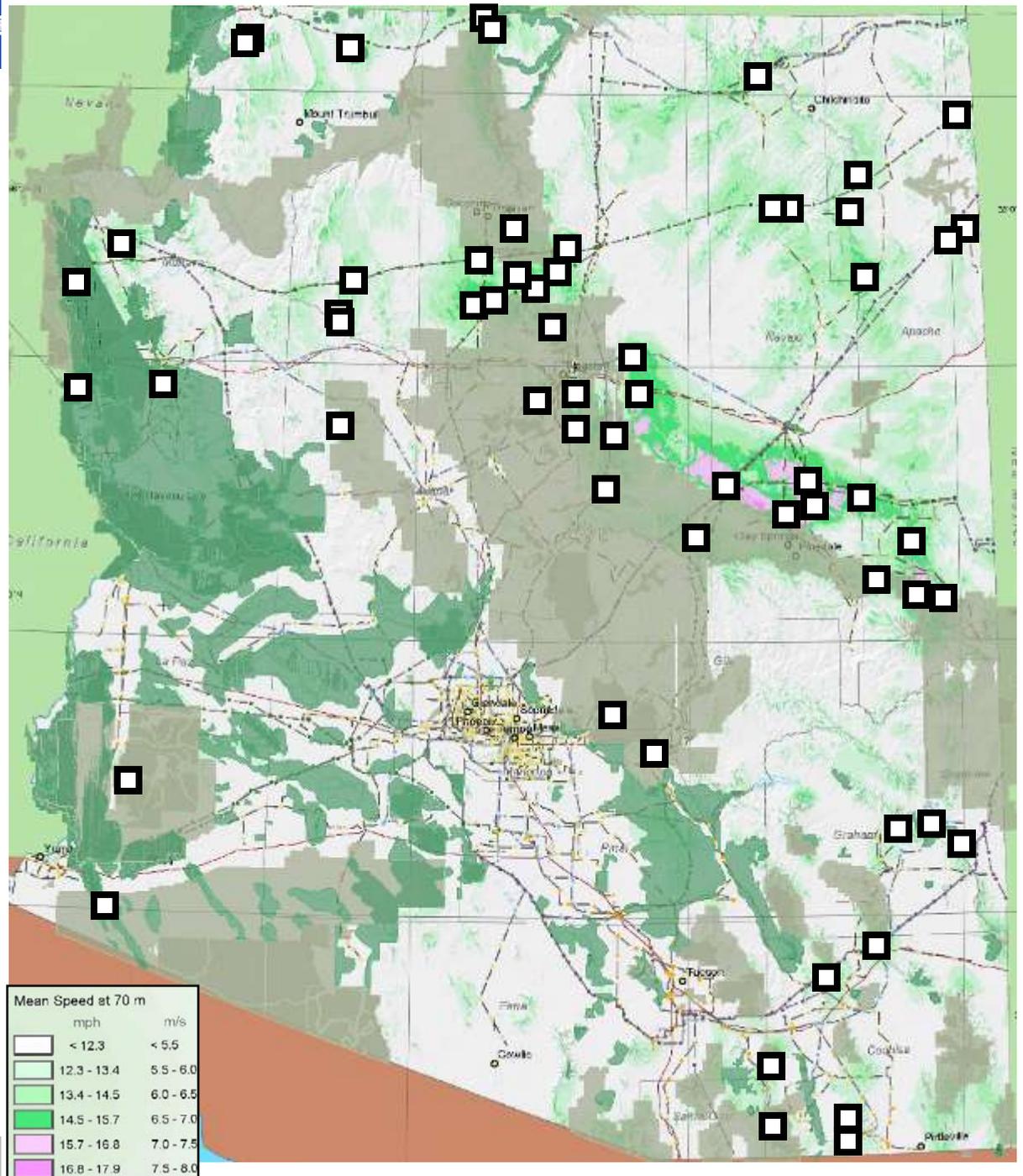
## Example: Arizona Wind Project Screening

- Restricted Lands
- Environmentally Sensitive Areas



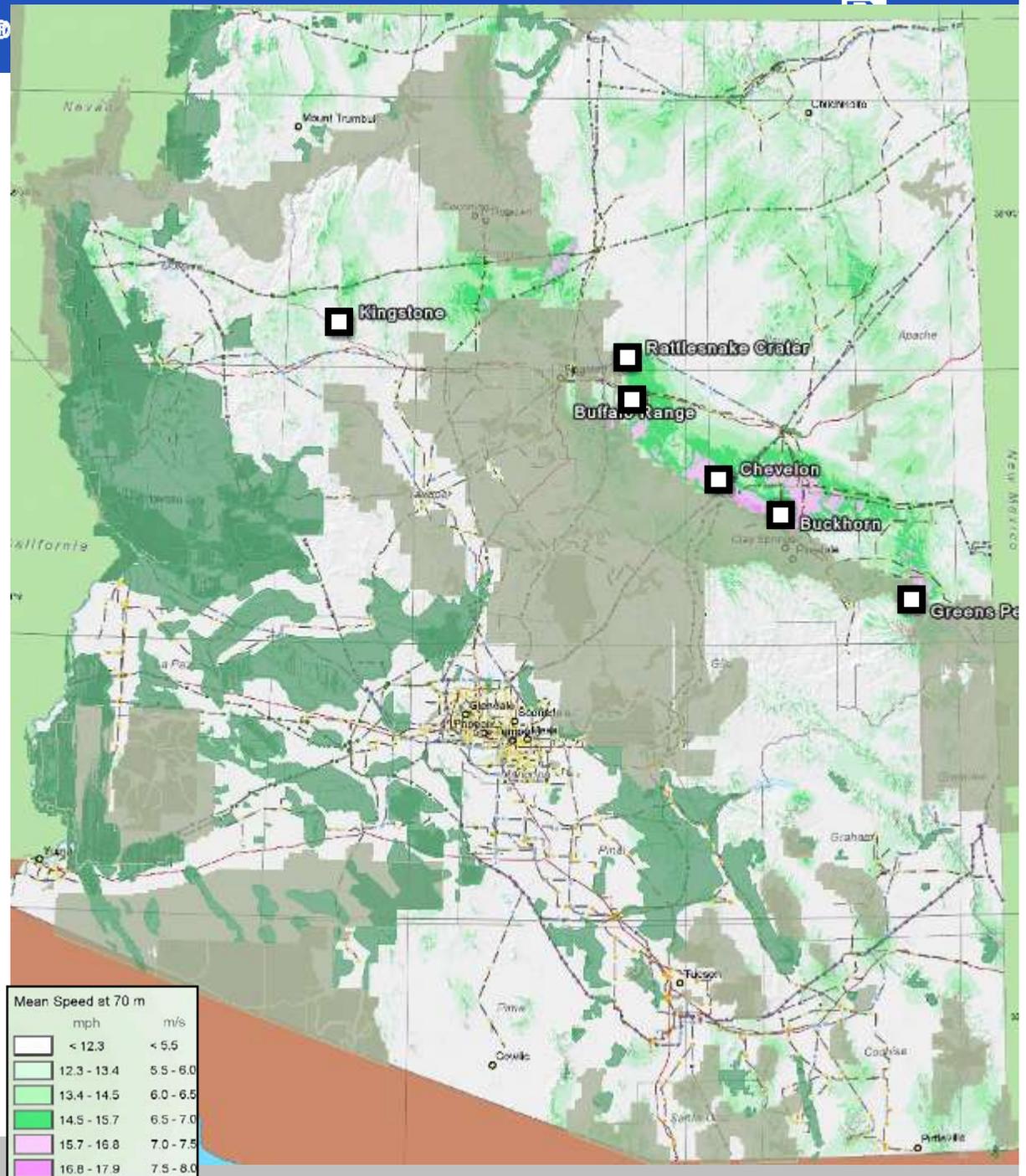
# Example: Arizona Wind Project Screening

- Potential Projects



## Example: Arizona Wind Project Screening

- Transmission Proximity
- Wind Resource
- Constructability
- Candidate Projects





# Technology Development

## Generic Assumptions for Technologies Will be Established with 2010 as a Basis

<b>Technology</b>	<b>Wind</b>
Output, MW	100
Capital Cost, \$/kW	2,000-2,500
Capacity Factor	30% - 40%
O&M, \$/kW-yr	50
Busbar Levelized Cost of Energy, \$/MWh	52-98

**CONCEPTUAL – FOR EXAMPLE ONLY**

## Forecasted Technology Development

### **Non-Mature Technologies have Potential to Improve over next 10 years**

- Capital cost
- Operating and maintenance costs
- Efficiency
- Capacity factor
- Levelized cost of energy

# Renewable Technologies Under Consideration

- **Fully Mature**

- Landfill Gas
- Digester Gas
- Solid Biomass
- Hydropower
- Onshore Wind
- Geothermal

**Technology performance and cost will show no substantial improvement through 2020**

- **Developing**

- Solar Photovoltaic
- Solar Thermal
- Offshore Wind
- Wave Energy
- Marine Current

**Technology has potential to improve substantially**

***Conversely:* Commercial applications may not be ready / meaningful before 2020**

# Technology Development

- **Tasks (Phase 1A)**

1. **Working Group: Agreement on “fully mature” and “developing” categories**
2. Black & Veatch: Develop approach to assessing and perhaps forecasting developing technologies (although some may be cut completely from the study, e.g., perhaps offshore wind)

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# Thank You!

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