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BLACK & VEATCH

Renewable Energy Transmission Initiative Phase 1A Status Report

Black & Veatch

Stakeholder Steering Committee

February 27, 2008

Today's Objective

Update the Stakeholder Steering Committee on the Progress and Decisions of the Phase 1A Workgroup

Agenda

- Review of Phase 1 Scope
- Schedule
- Review of Phase 1A Work Group Progress and Decisions
  - Methodology
  - Assumptions
- Phase 1B Scope of Work

RETI Phase 1

- Objective: Identify Competitive Renewable Energy Zones
- Phase 1A:
  - Deliverables
    - List of sources – Jan. 22 (available on RETI web site)
    - March 14 Report
      - Assumptions
      - Methodology
      - Resource screening for Phase 1B
- Phase 1B:
  - Project & CREZ identification and characterization

Phase 1 Schedule

Jan. 22	Stakeholder Steering Committee
Feb. 27	Stakeholder Steering Committee – report out work group progress to SSC
Mar. 14	Phase 1A Draft Report Issued
Mar. 19	Stakeholder Steering Committee – Discussion of Phase 1A report
TBD	Phase 1A Draft Report Comments Due
TBD	Final Phase 1 A Report Issued
TBD	Stakeholder Steering Committee – Phase 1B kick-off

Disclaimers

- Please don’t read anything into any of the examples
  - To demonstrate form only
  - Completely hypothetical and probably not realistic

Phase 1A Workgroup

Phase 1A Work Group Overview and Organization

- Overview
  - Review and advise on the methodologies and assumptions used by B&V in RETI analysis
  - Provide input to B&V on methodology and assumptions
- Organization
  - 11 Members – Utilities, Generators, Agencies, Counties
  - Weekly Meeting – 4 held so far

Phase 1A Work Group Members

Spokesperson - Mike DeAngelis, SMUD	
Steven Kelly – IEP	Anne Gillette - CPUC
Linda Brown – SDG&E	Greg Morris – Biomass
John McCaull – Geothermal	Rainer Aringhoff - Solar
Joe Bertotti – Counties	Clare Laufenberg – CEC
Gary Allen – SCE	Dariush Shirmohammadi - Wind

Thanks!

They have saved all of us time by volunteering

RETI Phase 1A – Scope of Work

1. Data sources (delivered Jan. 22)
2. Assumptions
3. Methodology
4. Resource screening by geographic region

Assumptions

Assumptions

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

Renewable Generation Ownership

- Working Group decision on generation ownership assumption:
  - Default: IPP with long-term PPA
  - Utility ownership for specific projects
  - Model will have ability to toggle ownership type

Assumptions – Financial assumptions for use in modeling

- For each technology -
  - Ownership structure (IOU ownership, PPA, etc.)
  - Inflation
  - Debt to equity ratio
  - Debt interest rate
  - Equity return rate
  - Debt term
  - Tax rate
  - Project economic life
  - Discount rate

Example of the Form of Financial Assumptions

CONCEPTUAL – FOR EXAMPLE ONLY

Technology	Ownership	Project Life	Percent Debt	Percent Equity	Debt Term	Interest Rate	Cost of Equity	WACC	Tax Life	Tax Rate
Biomass Digester	IPP	15	70.0%	30.0%	10	8.0%	15.0%	10.1%	12	40.0%
Biomass Landfill Gas	IPP	15	70.0%	30.0%	10	8.0%	15.0%	10.1%	12	40.0%
Biomass Cofiring	Utility	20	70.0%	30.0%	20	7.5%	11.0%	8.6%	20	40.0%
Biomass Direct	IPP	20	70.0%	30.0%	15	8.0%	15.0%	10.1%	5	40.0%
Geothermal	IPP	20	70.0%	30.0%	15	8.0%	15.0%	10.1%	5	40.0%
Hydro	IPP	30	70.0%	30.0%	15	8.0%	15.0%	10.1%	20	40.0%
Solar Photovoltaic	Commercial	20	70.0%	30.0%	20	7.5%	11.0%	8.6%	5	40.0%
Solar Dish	IPP	20	70.0%	30.0%	15	8.0%	15.0%	10.1%	5	40.0%
Solar Trough	IPP	20	70.0%	30.0%	15	8.0%	15.0%	10.1%	5	40.0%
Concentrating Solar Photovoltaic	IPP	20	70.0%	30.0%	15	8.0%	15.0%	10.1%	5	40.0%
Transmission	Utility	20	70.0%	30.0%	15	8.0%	15.0%	10.1%	15	40.0%
Wind Offshore	IPP	20	70.0%	30.0%	15	8.0%	15.0%	10.1%	5	40.0%
Wind Onshore	IPP	20	70.0%	30.0%	15	8.0%	15.0%	10.1%	5	40.0%

Important to distinguish differences in technologies. For example, financing for wind projects is relatively mature and competitive

(Not yet reflected in table above)

Assumptions – Renewable Energy Incentives

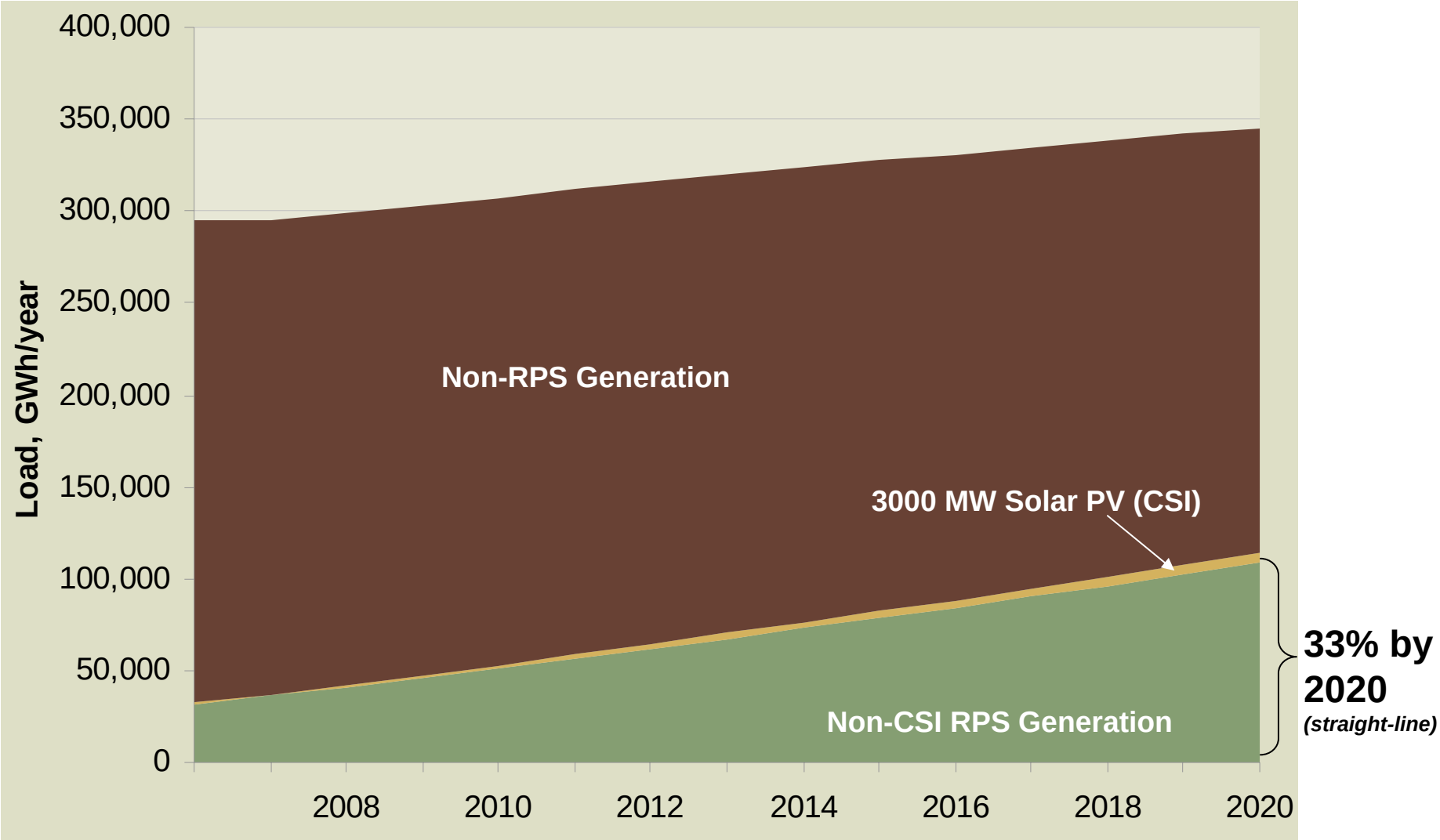
- Renewable incentives include:
  - Federal production tax credit
  - Federal investment tax credit
  - Federal accelerated depreciation
  - Substantive state-level incentives
- Working Group decision on federal tax credits:
  - Base Case – credits available through 2020
  - Model will have ability to toggle tax credits

Assumptions – Renewable energy demand

- Working Group decision on renewable energy demand:
  - Electrical Load: CEC 2008-2018 Forecast
    - All California utilities
    - Black & Veatch will extrapolate for 2019 and 2020
    - http://www.energy.ca.gov/2007publications/CEC-200-2007-015/CEC-200-2007-015-SF2.PDF
  - RPS – We propose a simplified approach
    - 20% in 2013 (includes flexible compliance)
    - 33% in 2020 (no assumed flexible compliance)
    - Applies to all California load
  - Use CEC Eligibility Rules for RPS Resources

Total California Load (Nov. 2007 CEC Load Forecast)

CONCEPTUAL – FOR EXAMPLE ONLY



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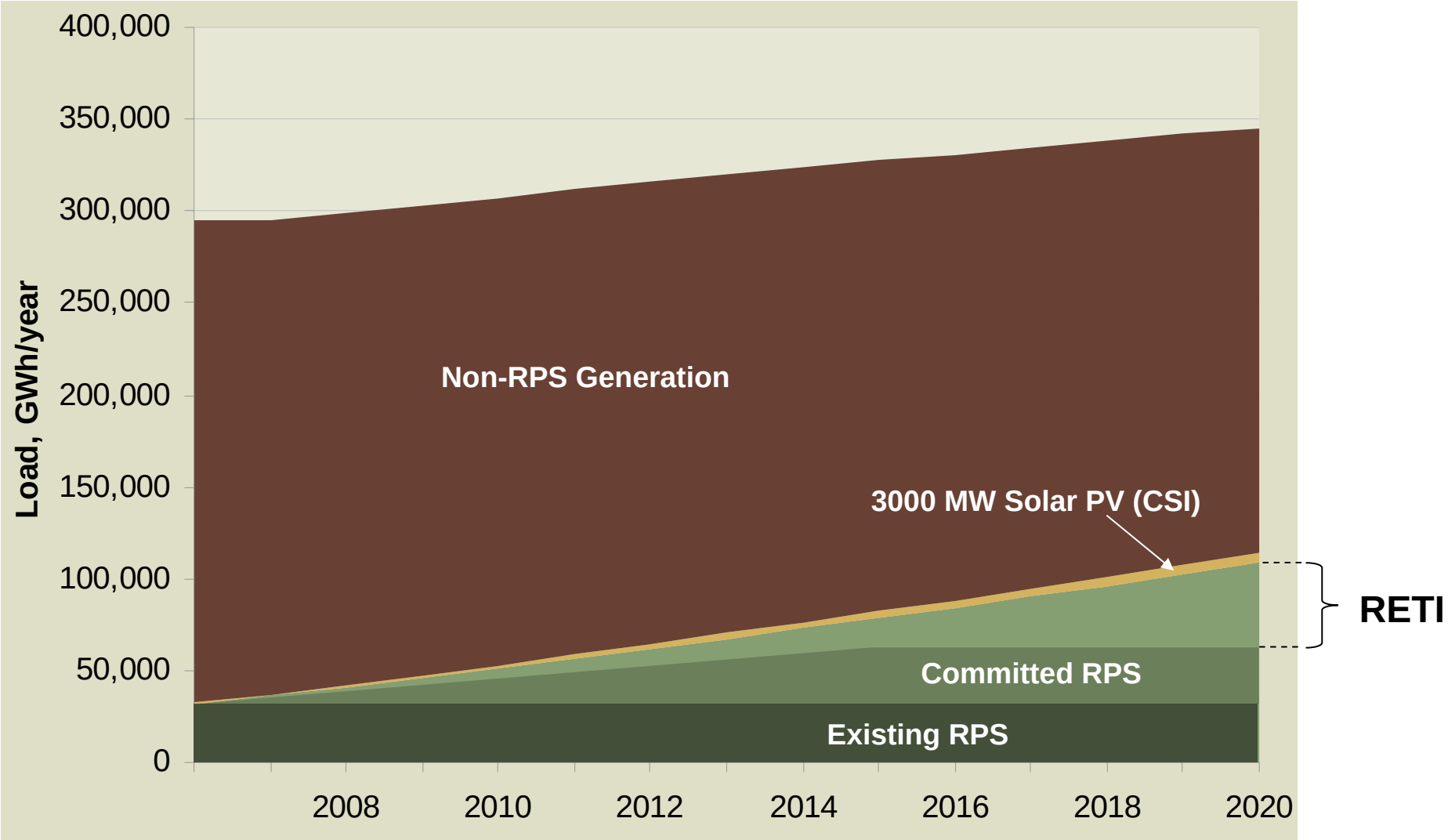


California Solar Initiative Resources

- Working Group decision on CSI assumptions:
  - CA will achieve CSI goal of 3000 MW installed by 2016
  - Half of installed CSI capacity will be available to utilities for RPS compliance
    - Approximately 0.7% of CA demand

Methodology

Methodological Issues

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

Resource Valuation Methodology

- Valuation is a way to measure disparate resources consistently. Valuation is designed to identify:
  - Lowest cost renewable resources

    and

  - Highest value renewable resources
- Values will be used to:
  - Develop resource supply curves
  - One of criteria used to develop and rank CREZ's

RETI valuation methodology to be consistent with process utilities use to procure renewable resources

Resource Valuation Methodology

Ranking Cost = Costs - Value

Costs	Value
Generation Cost + Transmission Cost + Integration Cost	Energy Value + Capacity Value

Generation Cost

- Levelized Cost of Energy (LCOE) - $/MWh
  - Calculated using a pro forma cash flow model for each project
  - Model is consistent with that used by the CPUC for MPR calculation

Technology – Specific Assumptions	
Capital Cost	Incentives
Fixed O&M	Net Plant Output
Variable O&M	Capacity Factor
Fuel Costs	Economic Life
Heat Rate	

General	Discount Rate Inflation

Transmission Cost

- 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**

Integration Cost

- Integration cost will be neglected in the base case
  - CEC has not adopted integration values
  - CAISO identifies integration requirements but not cost

May be revisited in RETI Phase 2

Energy Value

Energy value = (resource generation) x (zonal, T.O.D. market price), where:

- Market Price – hourly forecast (2008-2020) using commercially available production cost model
- Zonal prices – energy priced in zone where resource is located (15 zones):
  - 8 in California, 7outside California
- TOD factors – based on WECC trade periods
  - Super-peak
  - On-peak
  - Off-peak

Price Zones

N. California (NP15)	Imperial I.D.	N. Nevada
C. California (ZP26)	Imperial V. - NG	S.Nevada
SCE	CA/OR Border (COB)	Palo Verde
LADWP	Pacific Northwest	Arizona
SDG&E	British Columbia	N. Baha (Mex.)

Capacity Value

Capacity value = (Resource availability) x (Annual value of capacity),

where:

- Resource Availability - projected average resource generation during 12:00 - 6:00 p.m. period (*summer* months)
  - Consistent with current Resource Adequacy practice
- Annual value of capacity – fixed carrying costs of the gas turbine

  (Capital Costs, Fixed O&M, fixed charges)

Example:

If the fixed costs of a GT = $128/kW-year, the value of different renewable resources would be…

Example Resource	12:00-6:00 CF (%)	Cap. value ($/kW-year)
Solar (1)	41	52.48
Solar (2)	33	42.24
Wind (1)	38	48.64
Wind (2)	24	30.72
Bio	87	111.36
Geo	93	119.04

Conceptual - For Example Only!

Resource Value Example- Energy and Capacity

Conceptual - For Example Only!

	Wind	Solar	Biomass (or Geothermal)
Energy Component			
Marginal Energy Value Forecast ($/MWh)			
Day	$85	$85	$85
Night	$50	$50	$50
Average Production per Period (MWh/yr)			
Day	1,000	3,000	1,500
Night	2,000	-	1,500
Total	3,000	3,000	3,000
Annual Value of Energy ($/yr)			
Day	$ 85,000	$ 255,000	$ 127,500
Night	$ 100,000	$ -	$ 75,000
Total	$ 185,000	$ 255,000	$ 202,500
Average Energy Value ($/MWh)	**$ 61.67**	**$ 85.00**	**$ 67.50**
Capacity Component			
Annual Capacity Factor	35%	35%	90%
Capacity Credit	25%	90%	100%
Simple Cycle NG Capacity value, $/kW-yr	$100	$100	$100
Capacity Value, $/kW-yr	$25	$90	$100
Capacity value, $/MWh	**$ 8.15**	**$ 29.35**	**$ 12.68**
Total Value ($/MWh)	**$ 69.82**	**$ 114.35**	**$ 80.18**

Resource Valuation – Working Group

- Working Group has reviewed this proposed methodology
- Further detail to be provided in Phase 1A report

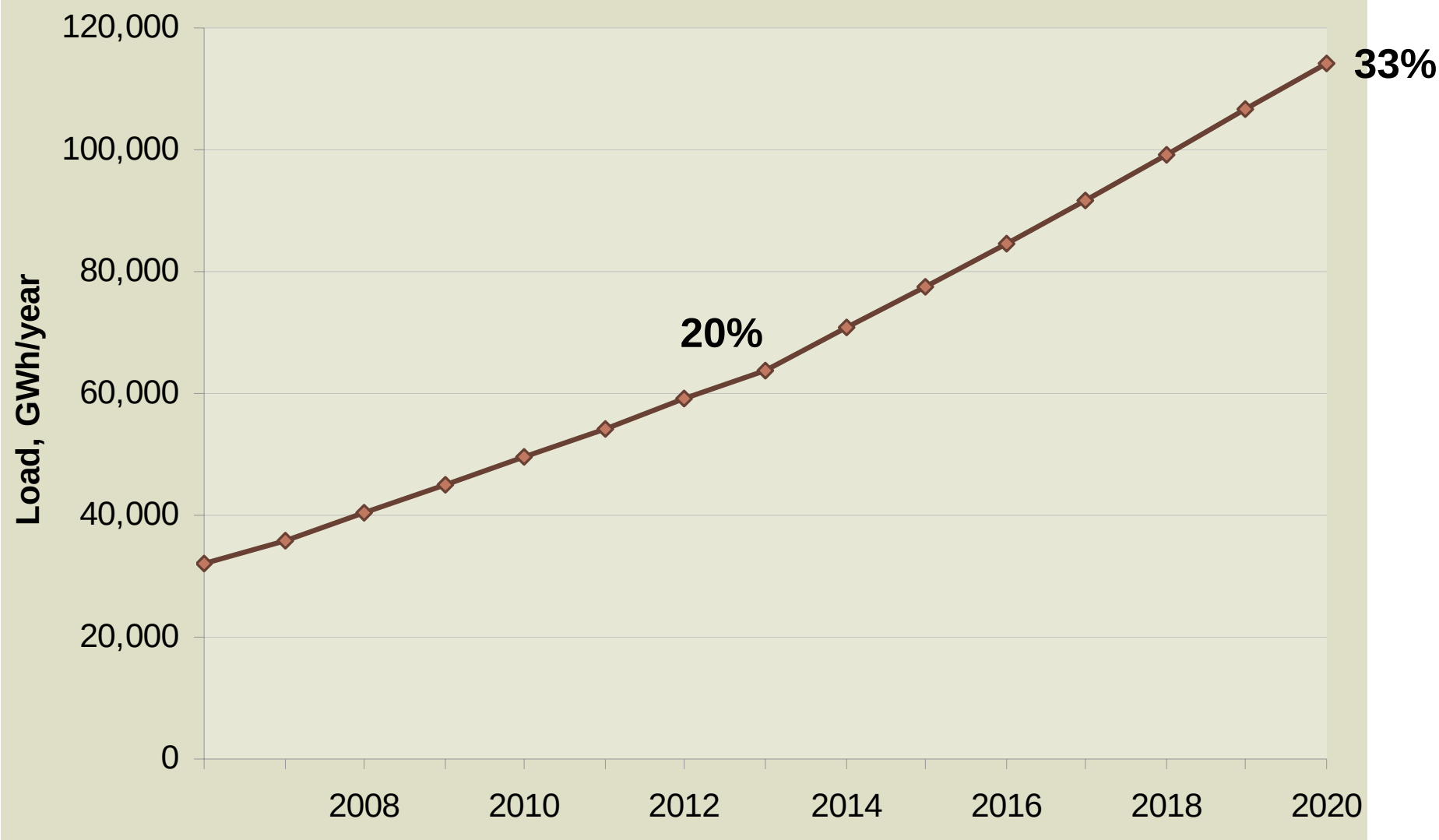
Treatment of existing contracts, short-listed contracts and transmission queue

- We need to establish a **RETI Base Case** – generation projects assumed to be “built”
  - Impacts RPS demand forecast (RETI “net short”)
  - Impacts Project Identification
  - Impacts Transmission Availability

- **What does it mean to be in the "Base Case"?**
- Project is operating or has very high probability it will go into service
- Transmission associated with the project(s) will be constructed
- The RPS “net short”, or need for renewable resource additions, will be reduced by the quantity of renewable resources in the base case
- Resources and transmission included in the base case will not be subject to feasibility or cost-effectiveness analysis

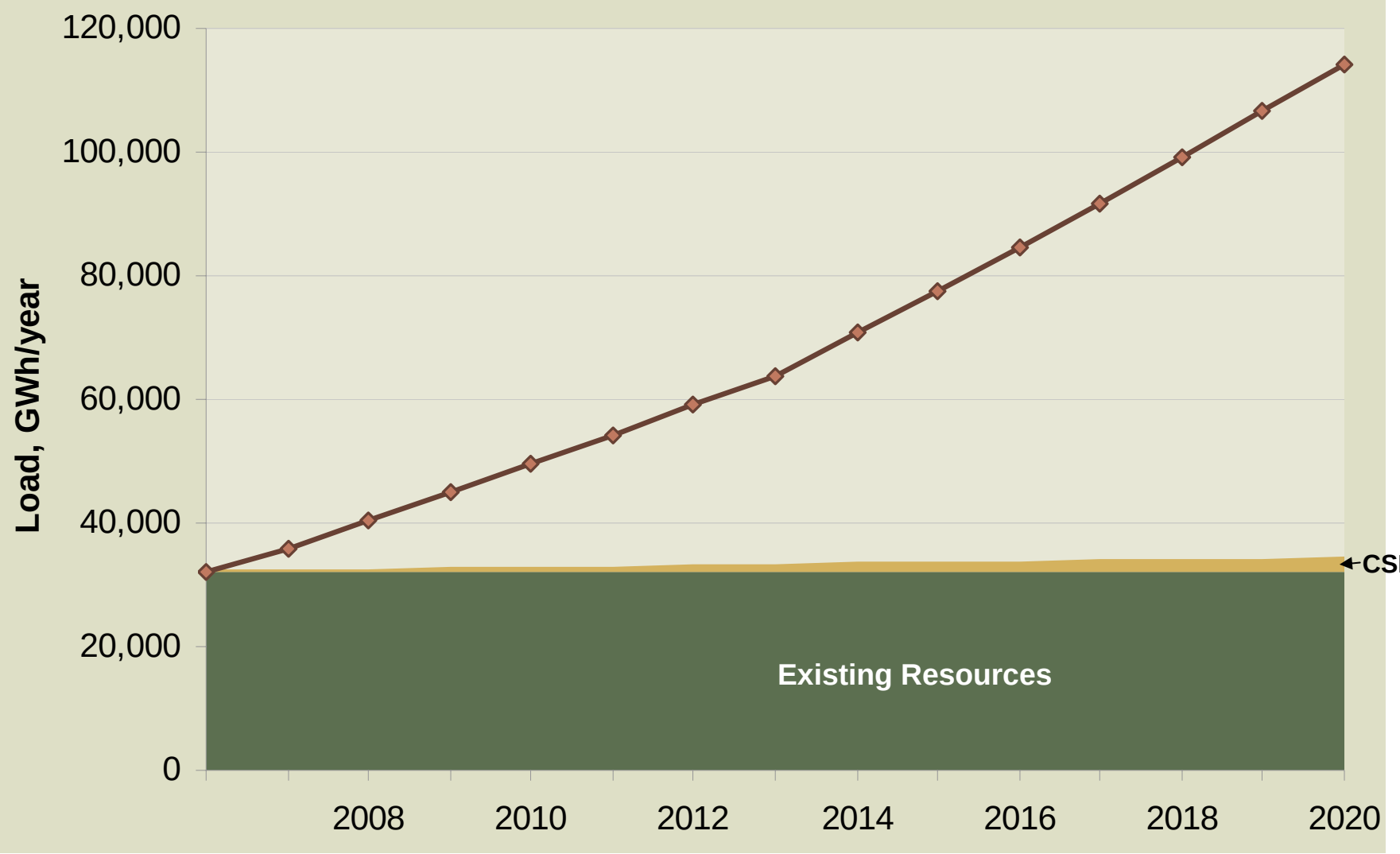
- **What happens to resources not included in the base case?**
- Projects not included in the base case will be considered as potential resources and included in the analysis
- Potential projects will be used to fill the RPS net short based on the cost effectiveness of the resource
- Projects will be added to resource supply curve
- Projects will be added to CREZ based on cost-effectiveness

California RPS Target



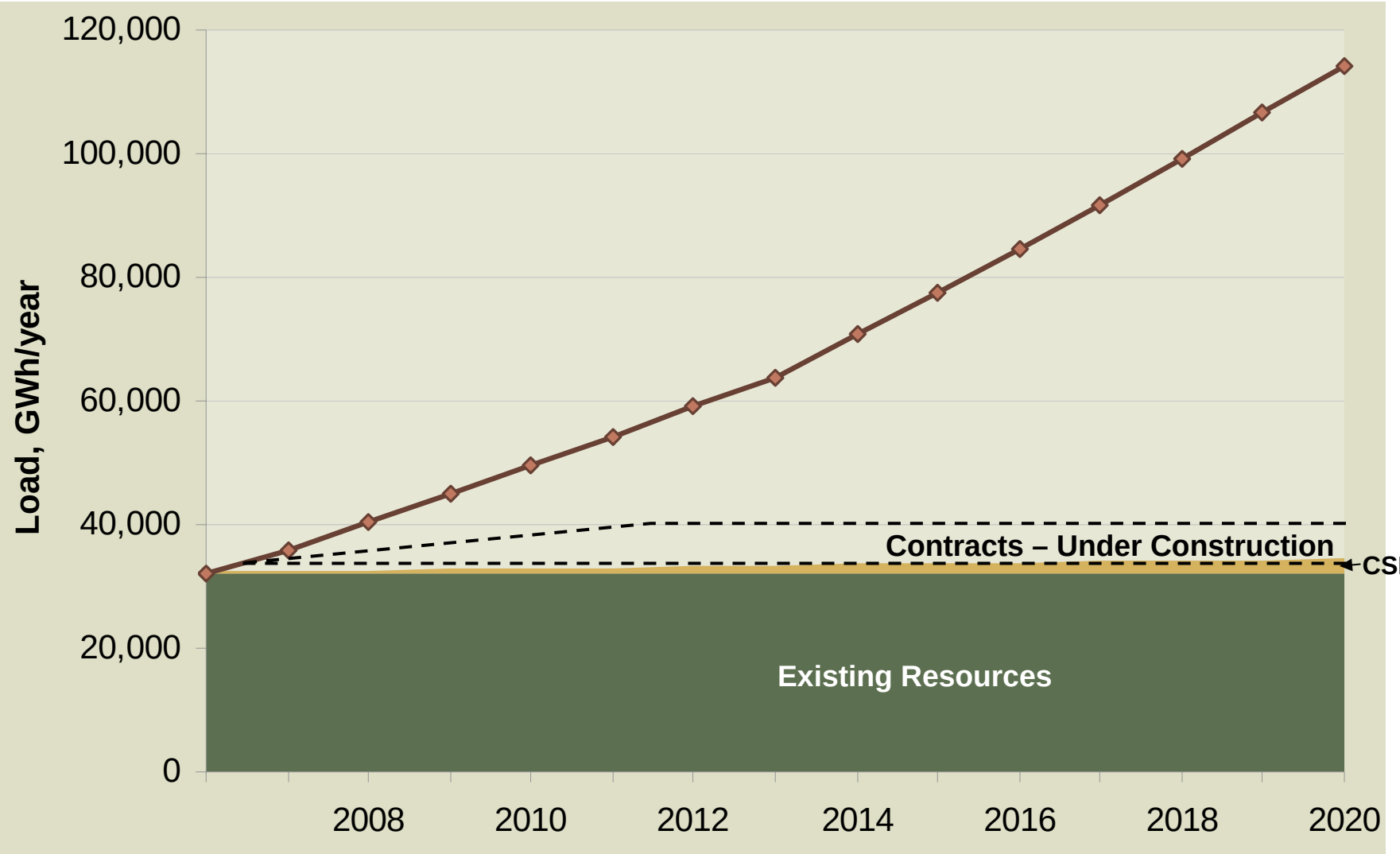
CONCEPTUAL – FOR EXAMPLE ONLY

Existing Resources + CSI



CONCEPTUAL – FOR EXAMPLE ONLY

What other Resources to Assume are "Existing"?



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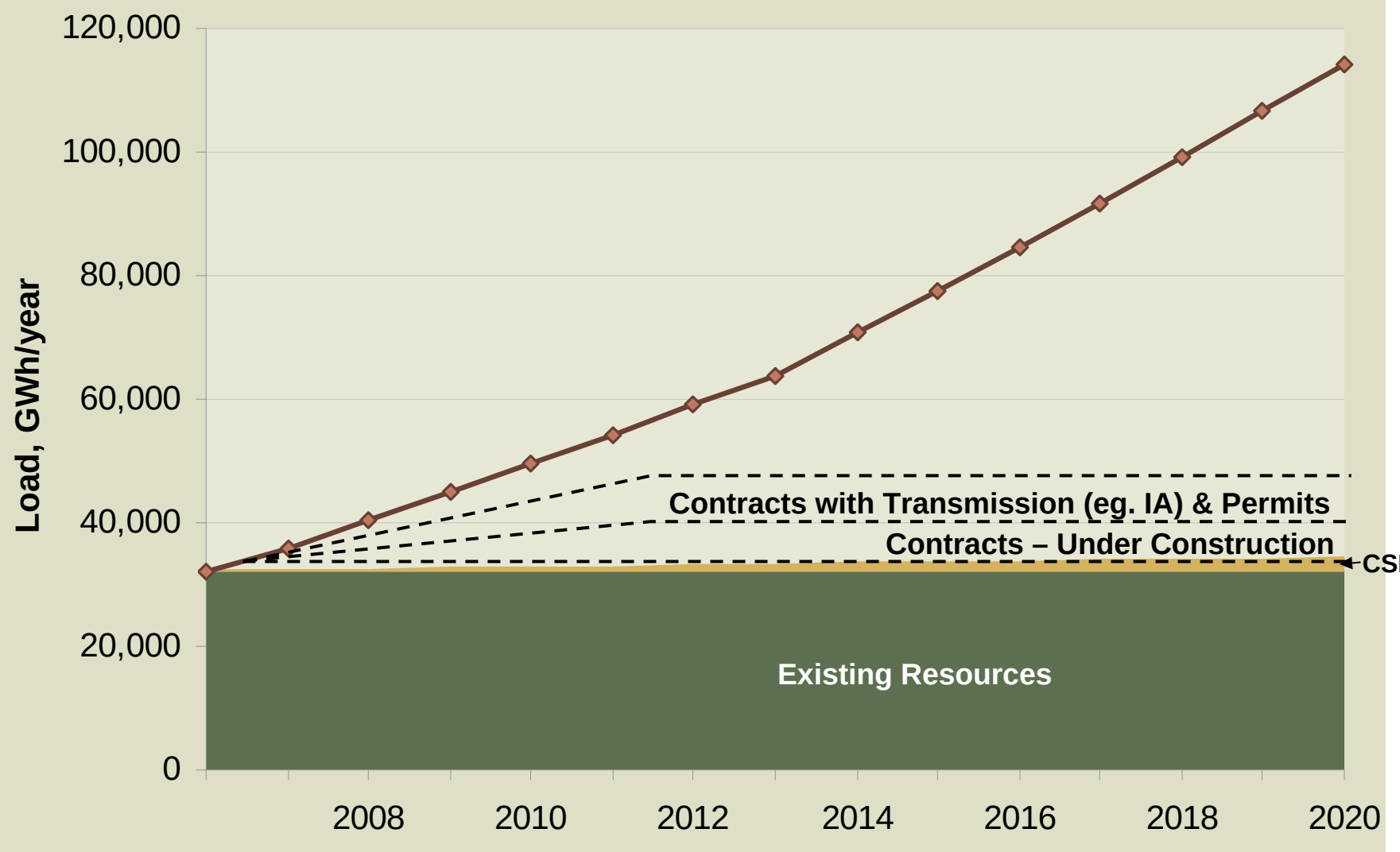

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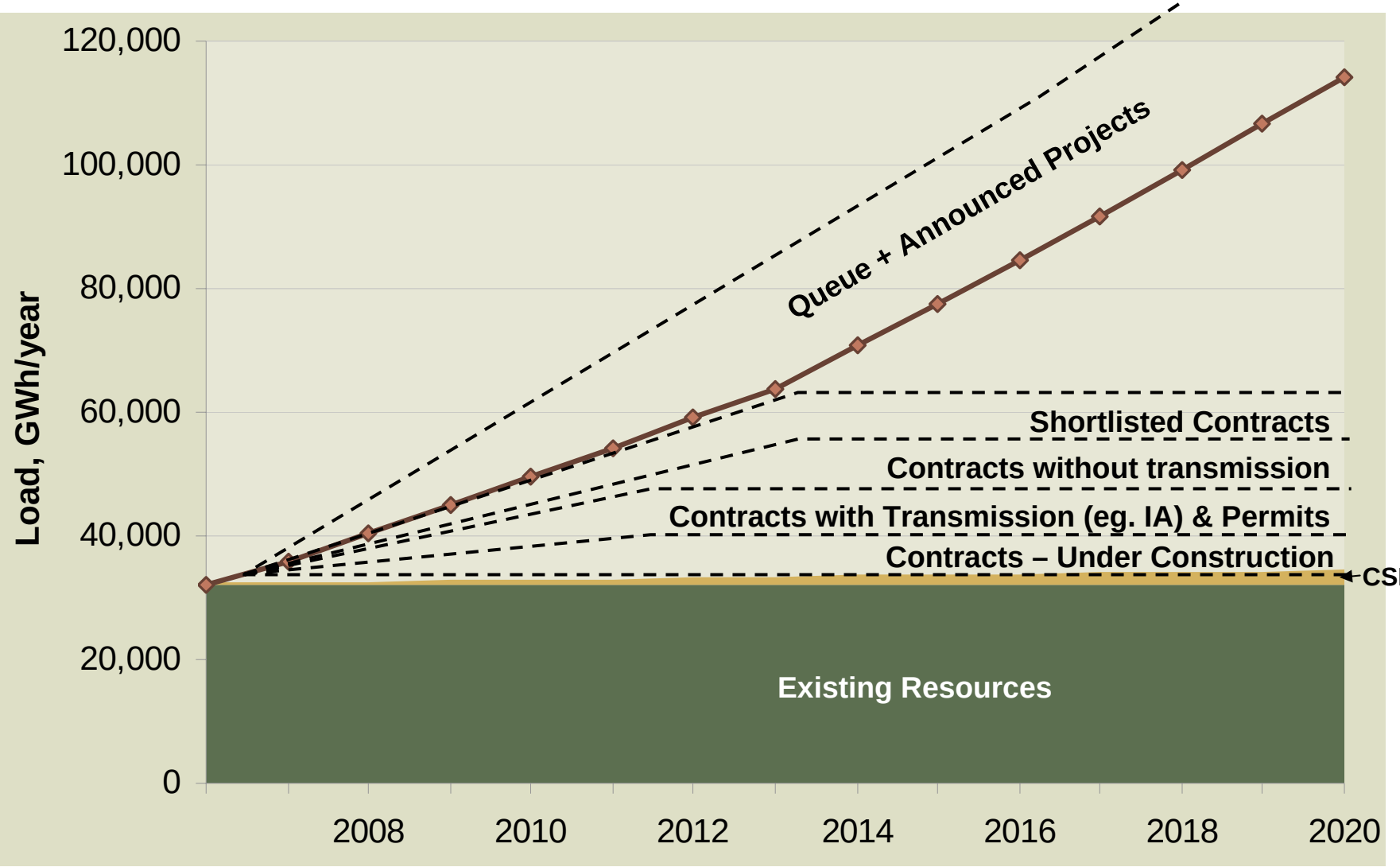


CONCEPTUAL – FOR EXAMPLE ONLY

Renewable Generation Included in RETI

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

Same criteria used for California and non-California resources

Transmission Included in the Base Case

- Existing transmission
- Transmission projects under construction
- Transmission projects approved by all necessary regulatory agencies (FERC, CEC, CPUC, CAISO, etc.)

Same criteria used for California and non-California transmission projects

RETI Base Case – Working Group

- Working Group is reviewing proposed methodology
- Further detail to be provided in Phase 1A report

Resource Assessment Review

Assumptions – Renewable technologies

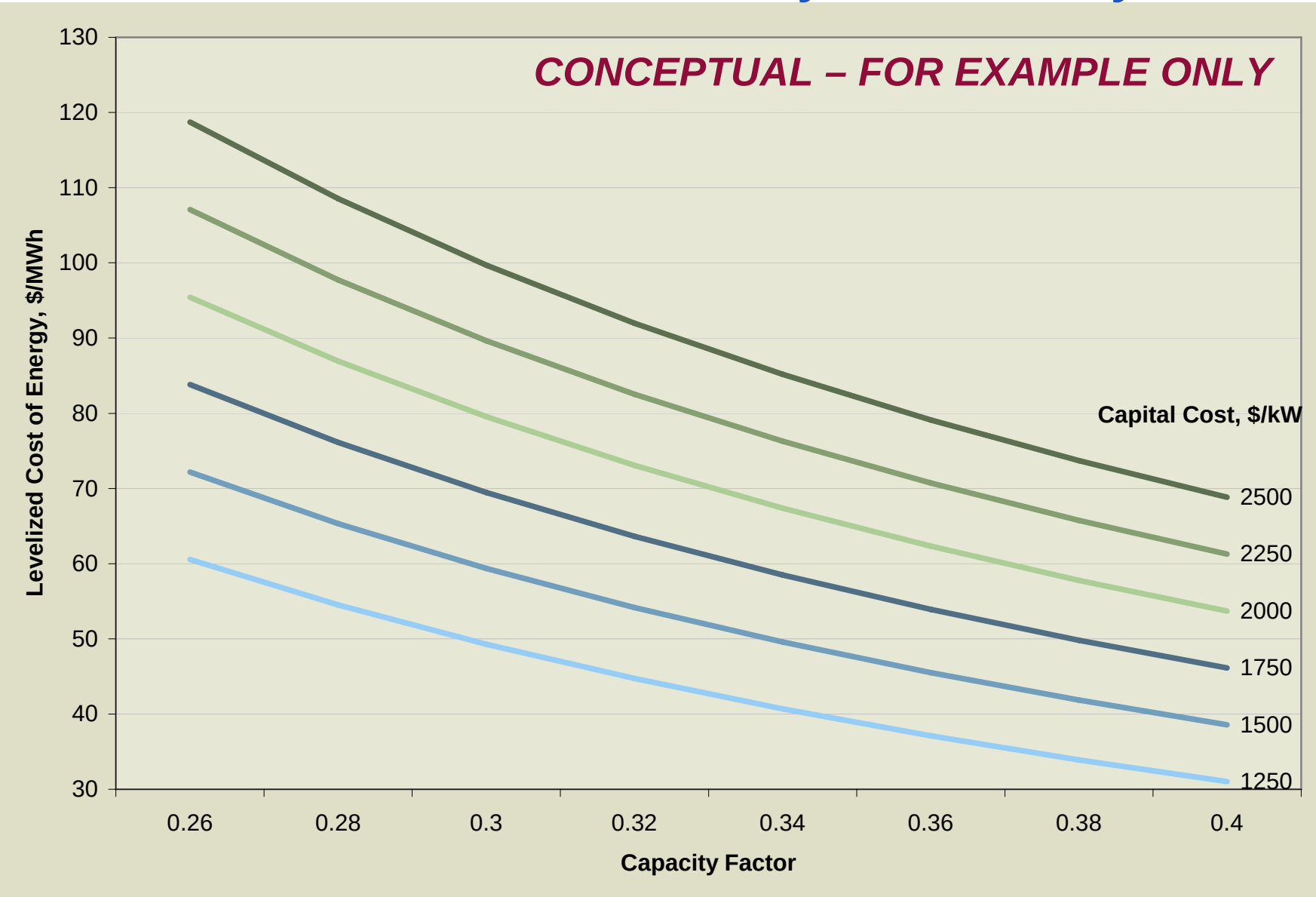
- Commercial / developmental status
- Efficiency (if applicable)
- Capacity factor
- Typical size(s)
- Applicable current incentives (e.g., federal production tax credit)
- Capital cost
- Operating and maintenance costs
- Typical fuel costs (if applicable)
- Typical development and construction schedule length (years)
- General levelized cost of energy ranges

Assumptions – Renewable technologies

- Renewable technology assumptions will be generic at first (Phase 1A), for example:

Technology	**Wind**
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

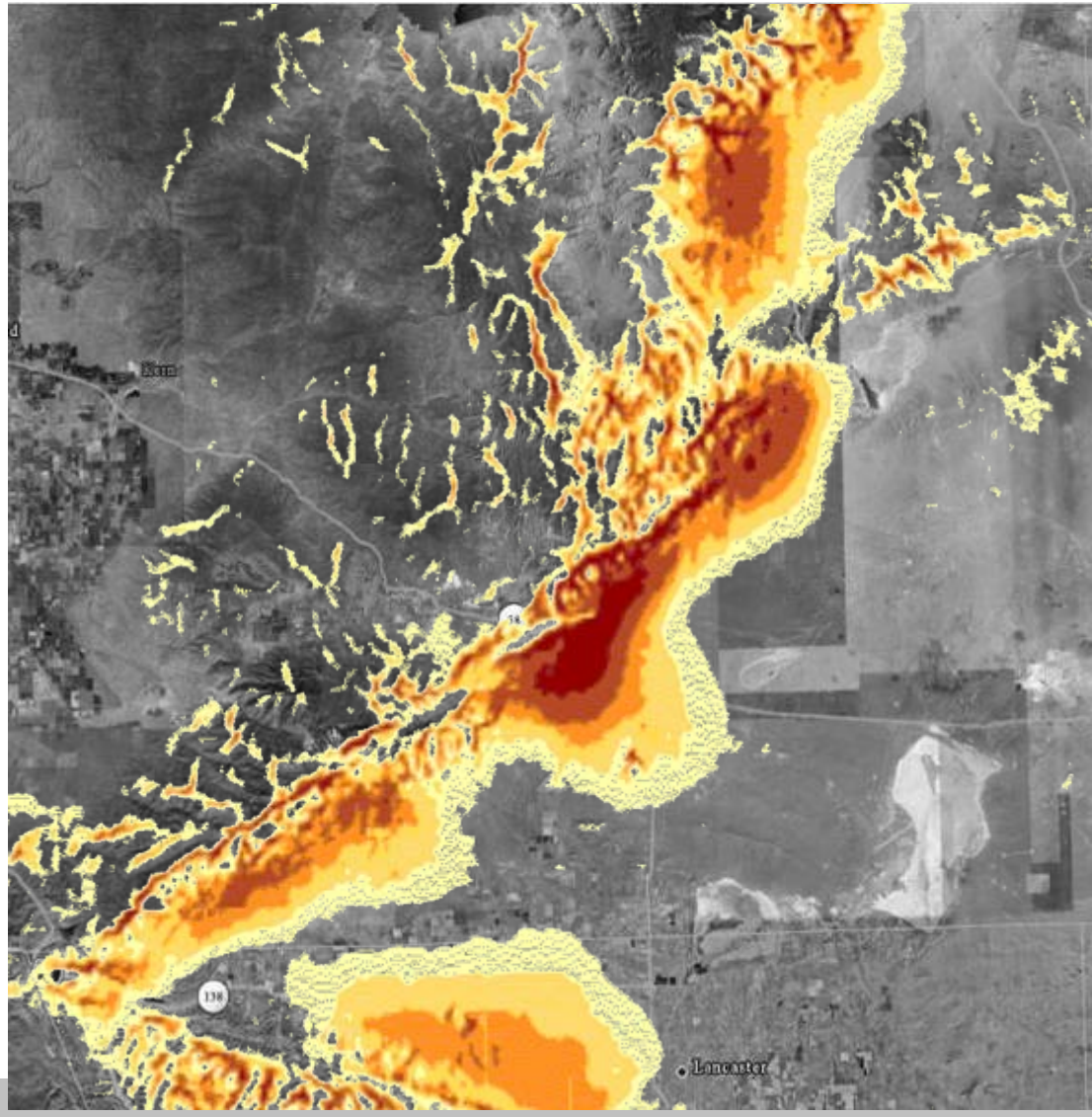
However, the Economics of Wind Vary Substantially



Source: Black & Veatch

Phase 1B will Require more Resolution on cost variations

- Tehachapi example



Tehachapi California Area Wind Resources

Wind Power Density at 50m (Source: AWS)

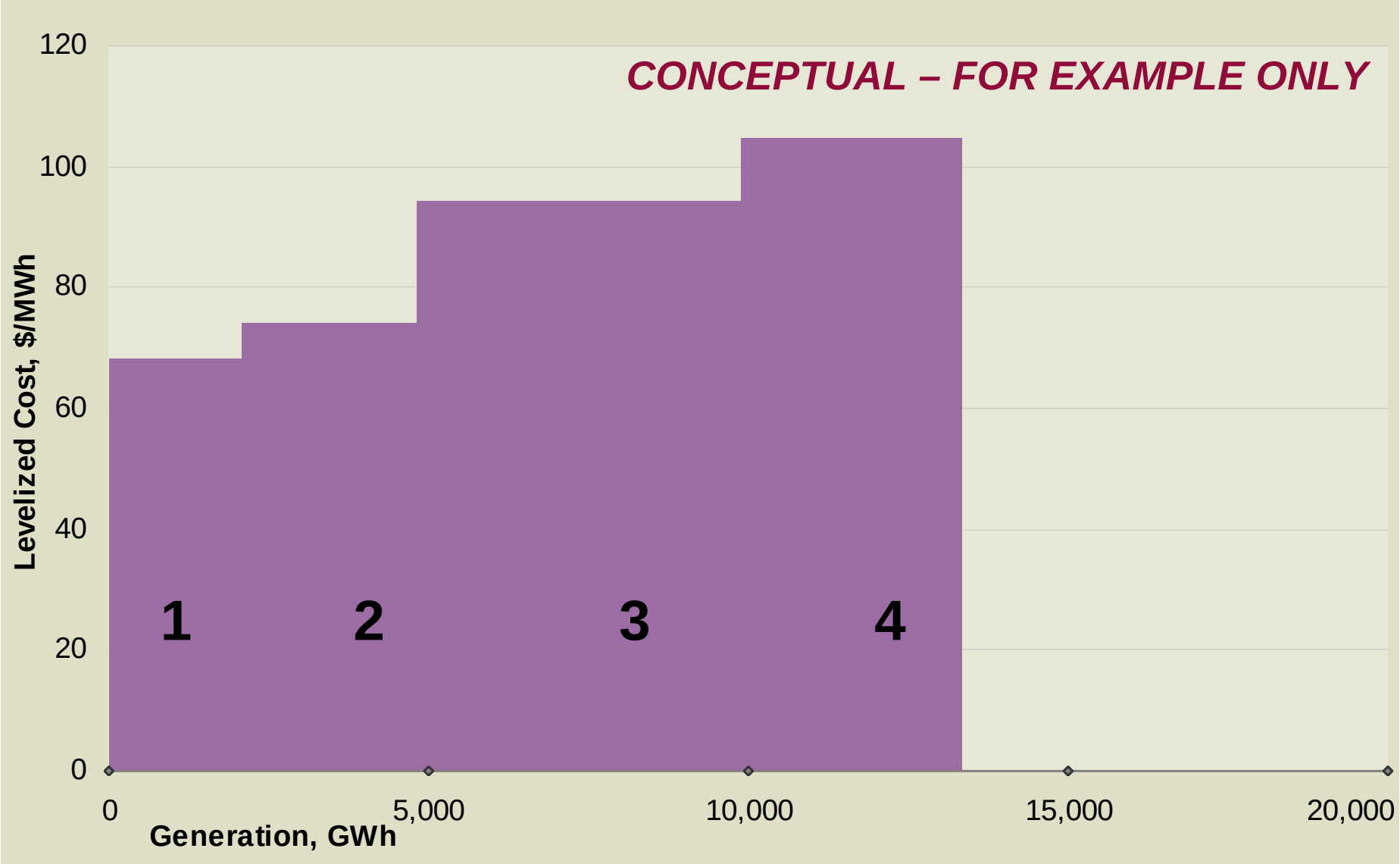
Hypothetical Tehachapi Assumptions

Premise: Best Resources Developed First

Phase	MW	Capacity Factor	Wind, $/kW	Transmission, $/kW
1	700	36%	1,900	296
2	900	35%	2,000	312
3	1700	34%	2,200	611
4	1200	33%	2,400	625

*****CONCEPTUAL – FOR EXAMPLE ONLY***

Simplified Tehachapi Wind Supply Curve



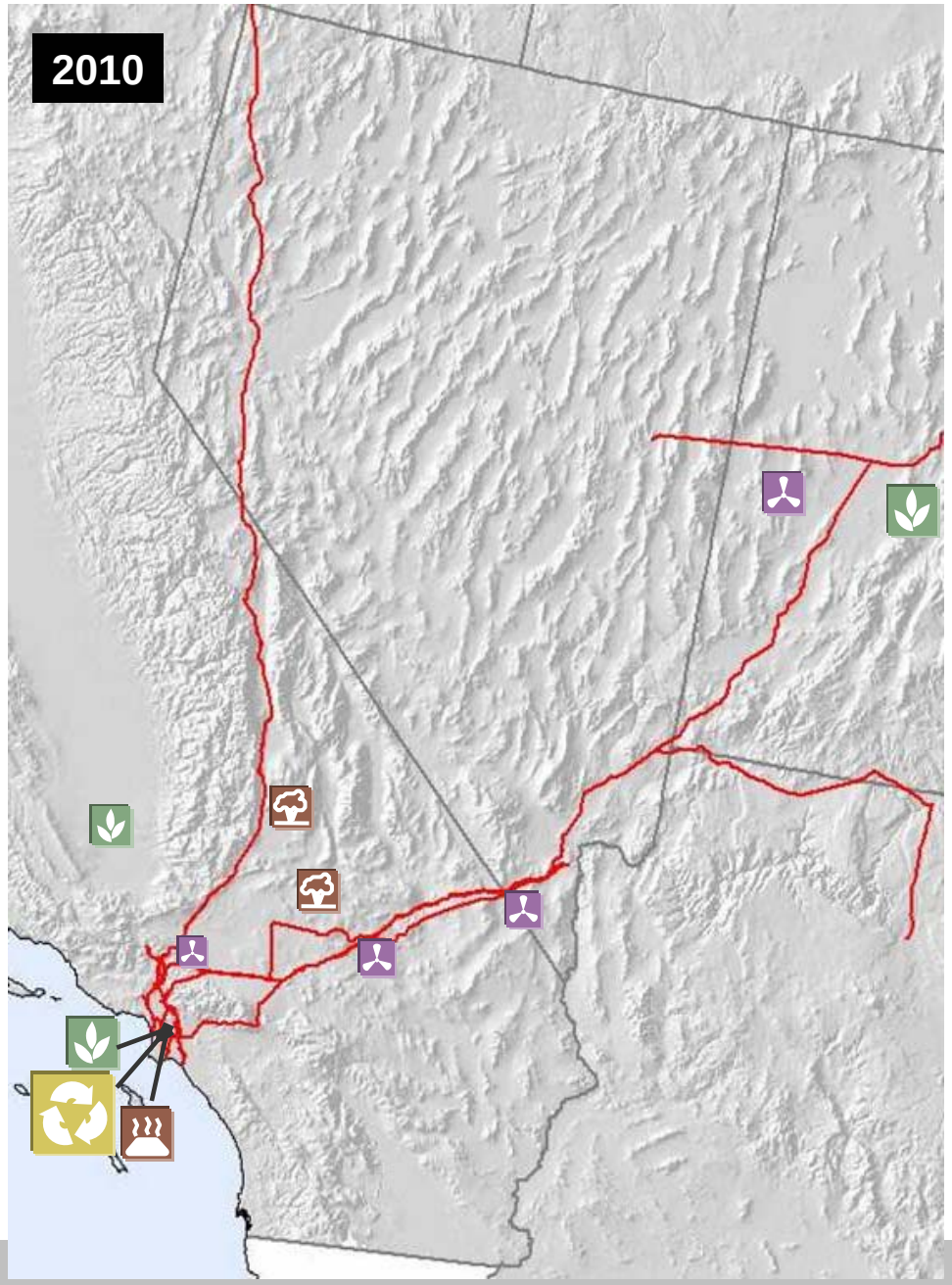
RETI Phase 1B
April – August, 2008

Phase 1B Scope

- Project identification and characterization
  - Specific projects where information available
  - “Generic” projects based on developable potential of resource and location
- Resource valuation
- Development of supply curves
- System integration modeling
- CREZ identification

Example Project Build Scenario

- Hydro
- Wind
- Biomass
- Landfill Gas
- Waste to Energy
- Solar
- Geothermal



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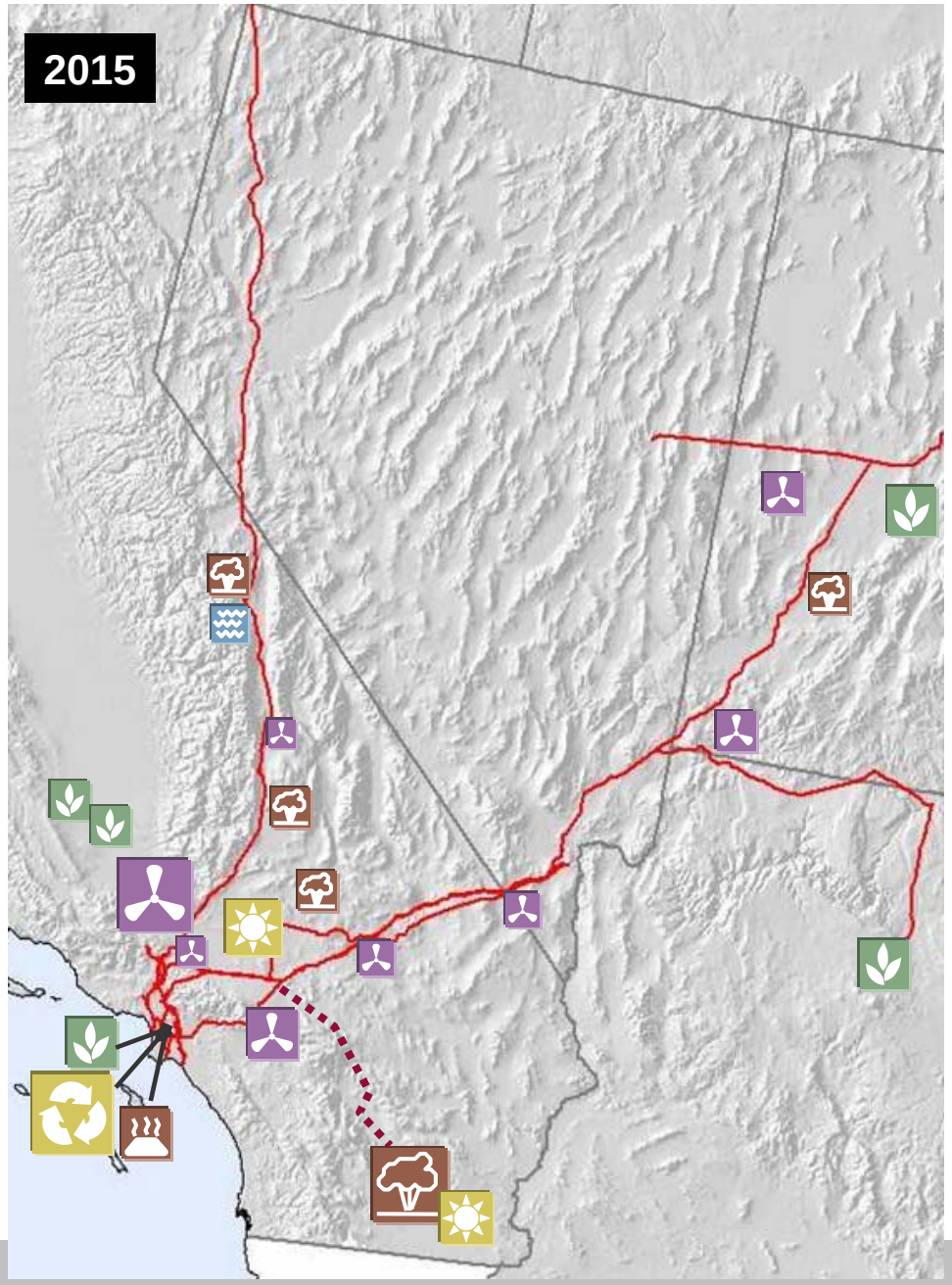

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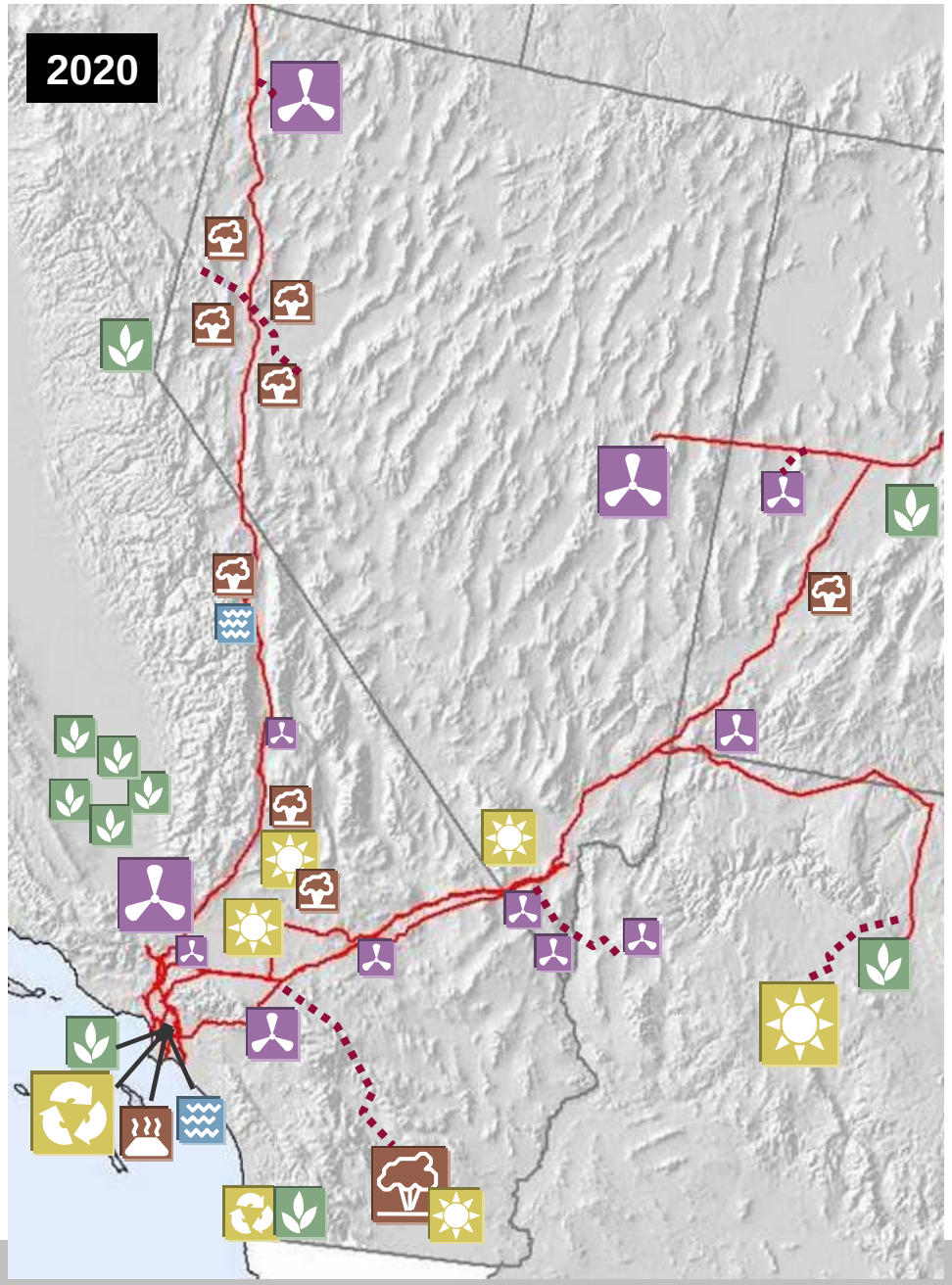

CONCEPTUAL – FOR EXAMPLE ONLY

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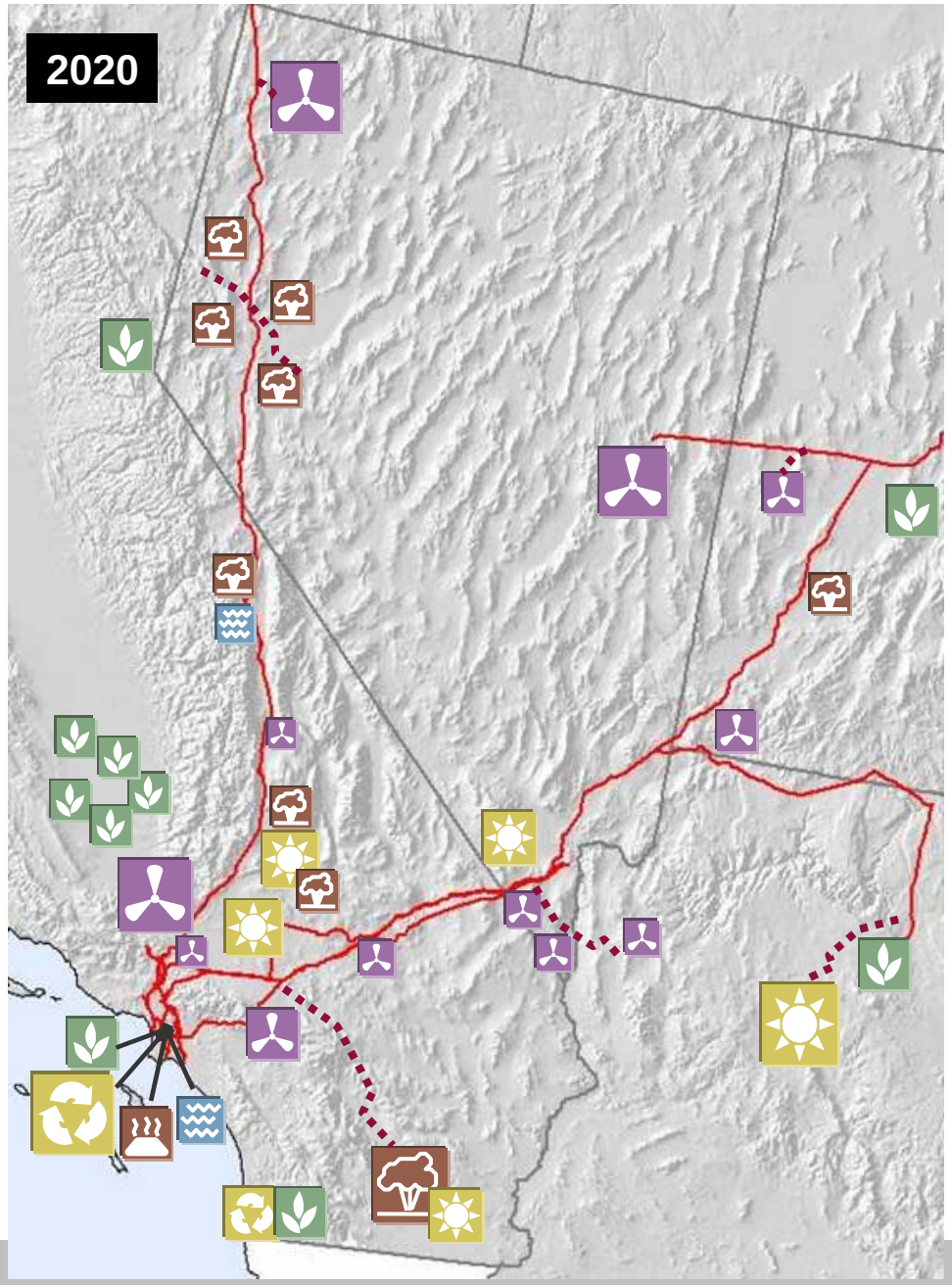

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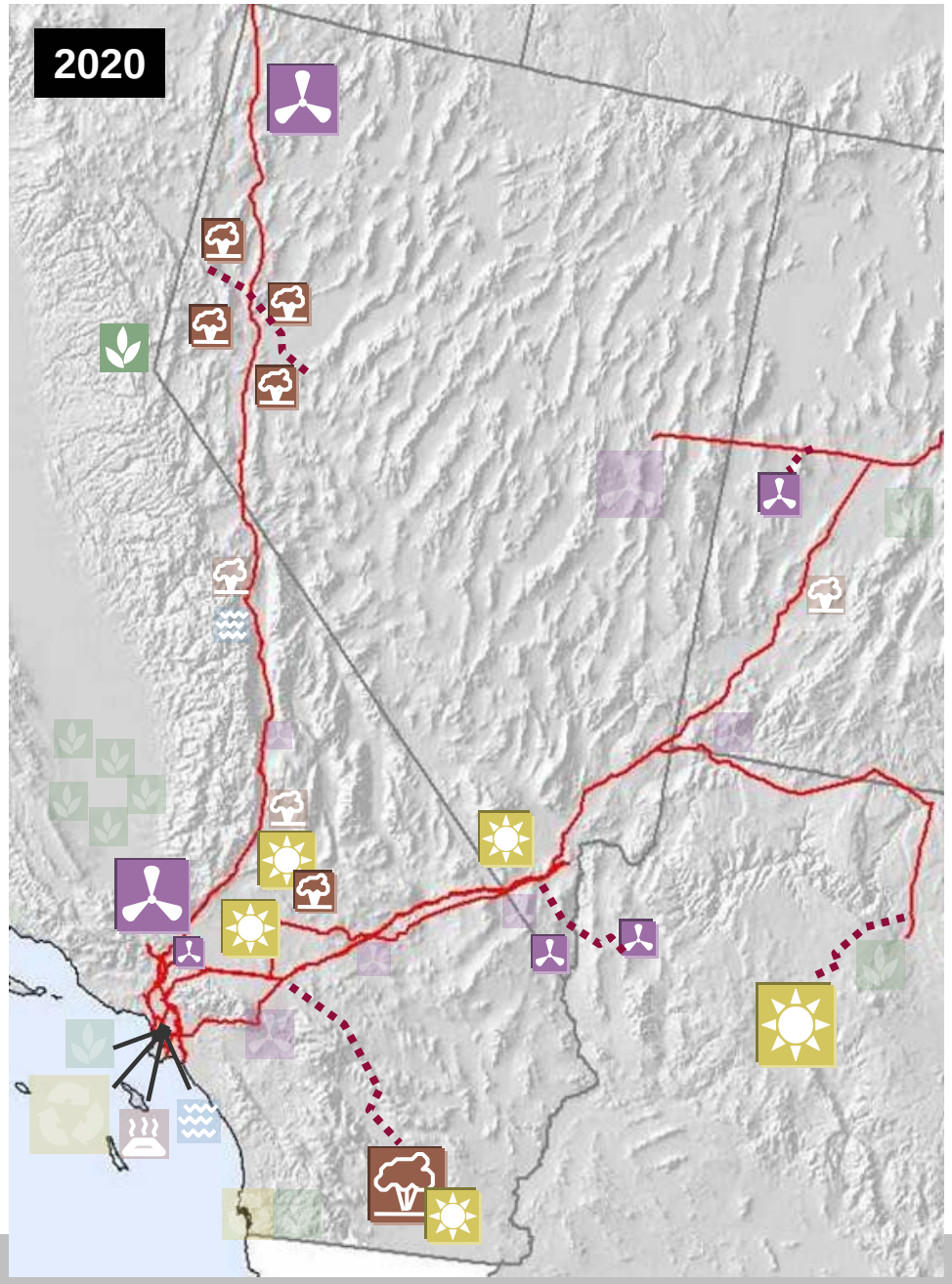

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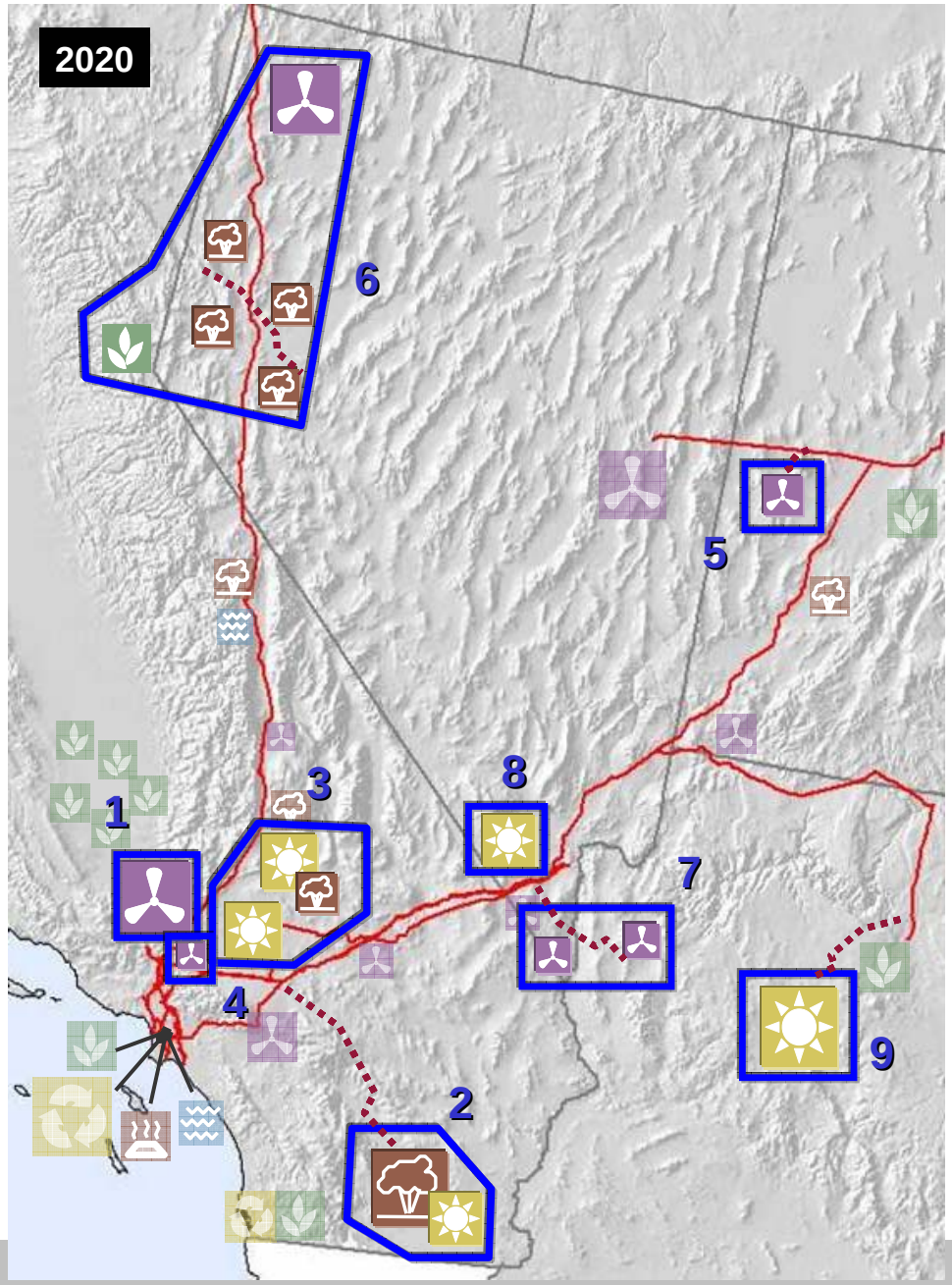

CONCEPTUAL – FOR EXAMPLE ONLY

Example CREZ Characteristics Table

	First Year	Annual Generation (GWh)				Location		Resource Valuation (2008$/MWh)					Ranking
	Available	Wind	Geo	Solar	Hydro	State	County	Gen	Trans.	Energy	Capacity	Integr.	Cost
CREZ 1	2012		300			CA	Imperial	75	5	75	14	0	-9
CREZ 2	2011	255				CA	Humboldt	75	0	73	7	1	-4
CREZ 3	2013		500			CA	Imperial	78	10	75	14	0	-1
CREZ 4	2013		150			CA	Imperial	84	12	75	14	0	7
CREZ 5	2018	1,350	1,100			NV	Washoe	75	20	70	10	2	17
CREZ 6	2012				135	CA	Merced	88	2	65	7	0	18
CREZ 7	2011	2,250				CA	Kern	85	12	70	7	2	22
CREZ 8	2013	3,300				CA	Kern	88	15	70	7	3	29
CREZ 9	2014	2,400				CA	Kern	91	17	70	7	4	35
CREZ 10	2015	900		1,350		CA	Kern	113	22	85	17	4	37
CREZ 11	2015	600		1,800		CA	Kern	130	20	90	24	3	39
CREZ 12	2018	2,280				NV	Washoe	107	5	70	7	5	40
CREZ 13	2013			750		CA	S. Bern.	150	10	95	27	2	40
CREZ 14	2013			750		CA	S. Bern.	152	15	95	27	3	48
CREZ 15	2014			1,200		CA	S. Bern.	152	15	95	27	3	48
CREZ 16	2014			1,350		CA	S. Bern.	153	15	95	27	4	50

CONCEPTUAL – FOR EXAMPLE ONLY

Thank You!

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