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BLACK & VEATCH

CAISO Integration of RETI Results in 2010 Transmission Planning

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Goals

- Coordinate RETI with CAISO transmission expansion and queue interconnection processes
  - Incorporate RETI-defined transmission into CAISO 2010 Transmission Planning Process
  - Identify transmission requirements to interconnect renewables to meet 33% of California energy demand by 2020 for 2010 TPP
- Facilitate prioritized transmission development for RETI

CAISO Transmission Planning Process

- CAISO 2010 Planning Process happening now

  Need to identify all case elements this week

- Study result by September that can be used to support transmission development applications
  - Specific deliverables TBD
- Goal to have specific transmission segments for CAISO board to consider in Jan., 2010

RETI Transmission Line Prioritization

- **Using CREZ and transmission segment information developed in RETI, create <u>transmission strategy</u> to interconnect queue resources**
  - Comprehensive plan that is greater than the sum of the parts
  - Use real and feasible information provided by utilities to develop plan
- **Develop 3 timeframes for study:**
  - 2013: Only currently-approved transmission included
  - 2016: Transmission to access best resources and CAISO queue resources
  - 2020: Expansion to access additional resources
- **Only prioritized lines defined by RETI**

Transmission Prioritization Methodology

- Group CREZ ranking criteria into quartiles based on economic and environmental scores
- Aggregate CREZ into “transmission corridors” based on electrical interconnection
- “Rank” transmission corridors into development buckets:
  - High, Med., and Low
- Qualitative assessment on what transmission to develop and when
  - Will 2016 build-out support 2020 (and beyond) development ?
  - Corridor that will access 20 PPAs more desirable than one with 5 PPAs

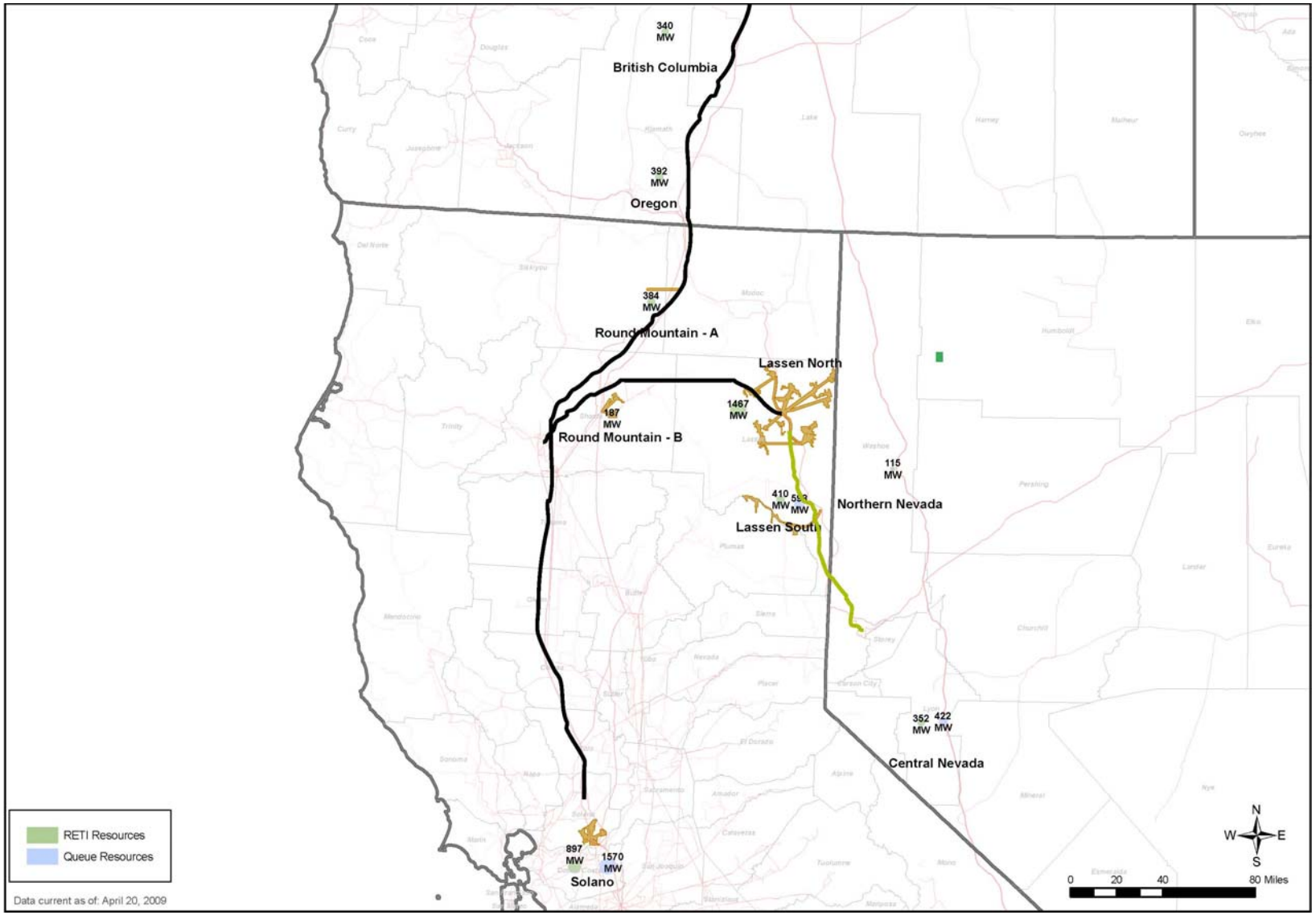
CREZ Economic & Environmental Ranking

CREZ Name	Phase 2A Capacity (MW)	Phase 2A Energy (GWh)	Econ. Rank	Env. Rank	Econ. Quartile	Env. Quartile
Baja	2,368	8,034	-30	7.2	1	3
Barstow	2,336	5,856	-2	8.7	3	4
British Columbia	340	1,849	-24	7.2	1	3
Carrizo North	1,600	3,395	1	8.4	4	3
Carrizo South	3,000	6,440	4	6.2	4	2
Cuyama	400	892	-2		3	2
Fairmont	3,518	10,355	-23	10.4	1	4
Imperial East	1,623	3,959	0	5.7	3	2
Imperial North - A	1,370	10,626	-22	2.7	2	1
Imperial North - B	1,830	4,507	0	9.3	3	4
Imperial South	3,715	9,167	2	6.8	4	2
Inyokern	2,432	6,322	-15	7.6	2	3
Iron Mountain	5,662	13,383	-1	5.2	3	1
Kramer	6,412	16,553	-16	5.8	2	2
Lassen North	1,467	3,784	9	7.8	4	3
Lassen South - A	411	1,106	2	19.4	4	4
Mountain Pass	1,658	4,336	-3	3.5	3	1
Needles	461	1,187	5	10.0	4	4
Nevada Central	352	2,624	-39	7.2	1	2
Nevada North	115	822	-31	7.2	1	2
Oregon	392	3,062	-41	7.2	1	2
Owen's Valley	1,400	3,613	-19	5.2	2	1
Palm Springs	770	2,595	-36	8.0	1	3
Pisgah	1,800	4,509	-6	4.0	2	1
Riverside East	10,200	24,628	-4	5.1	3	1
Round Mountain - A	384	2,691	-30	3.4	1	1
Round Mountain - B	187	742	17	8.4	4	4
San Bernardino - Baker	3,670	8,707	1	6.7	4	2
San Bernardino - Lucerne	3,030	8,143	-2	7.7	3	3
San Diego North Central	281	739	0	22.2	3	4
San Diego South	678	1,926	-12	5.5	2	2
Santa Barbara	433	1,180	1	9.2	4	4
Solano	897	2,874	-39	7.6	1	3
Tehachapi	10,837	29,473	-20	4.6	2	1
Twentynine Palms	1,805	4,616	-10	4.8	2	1
Victorville	1,636	4,271	-9	8.2	2	3

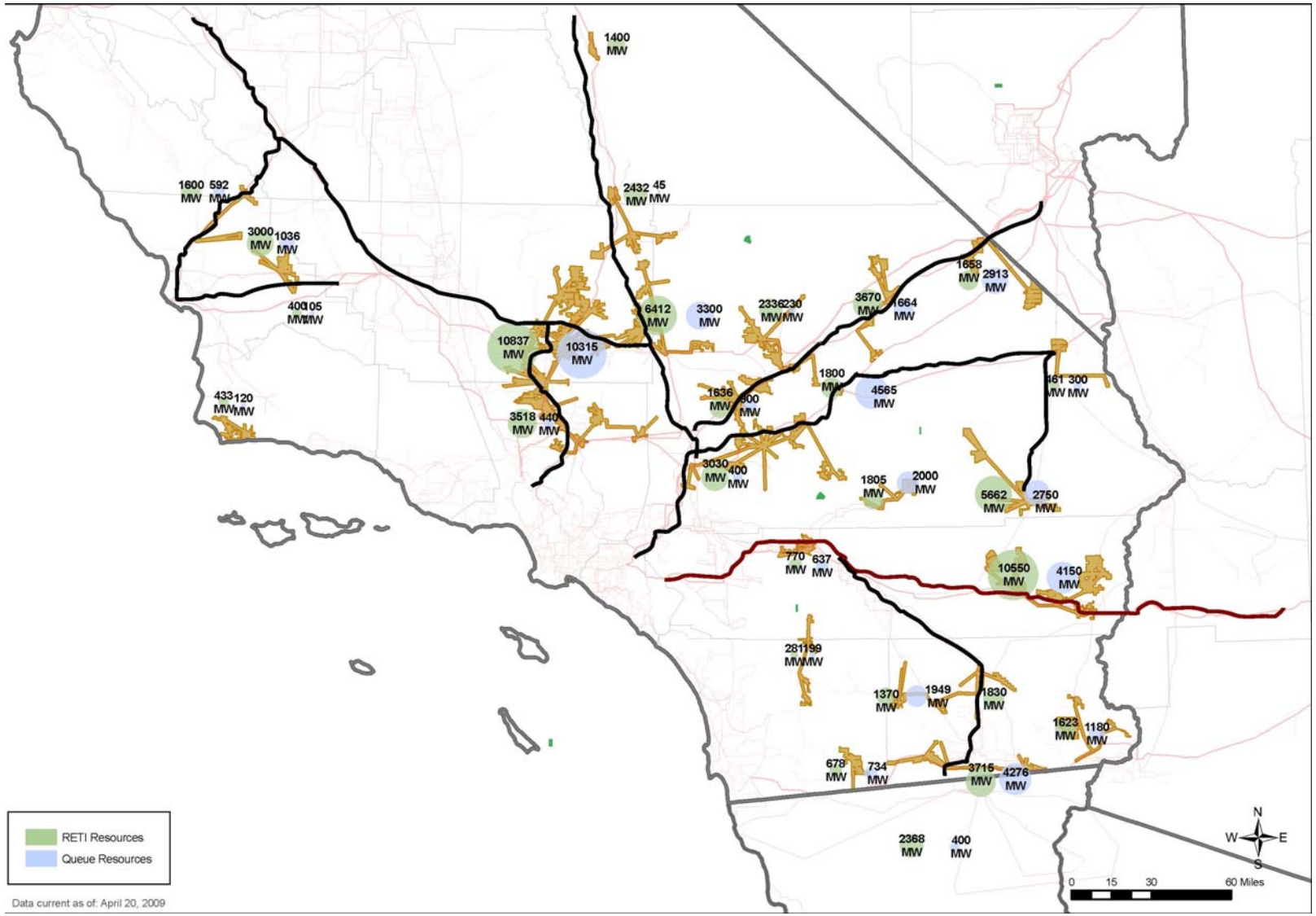
Transmission Corridors

Carrizo	Carrizo North
	Carrizo South
	Cuyama
	Santa Barbara
Kramer/Inyo /Owen	Inyokern
	Kramer
	Nevada Central
	Owen's Valley
Barstow	Barstow
	Mountain Pass
	San Bernardino - Baker
	Victorville
Pisgah	Iron Mountain
	Needles
	Pisgah
	San Bernardino - Lucerne
Tehachapi - S.CA	***Fairmont***
	Tehachapi
Tehachapi - N.CA	***Fairmont***
	Tehachapi
DPV	Palm Springs
	Riverside East
	Twentynine Palms
CaMex	Baja
	Imperial East
	Imperial South
	San Diego South
Imperial	Imperial North - A
	Imperial Norh - B
Solano	Solano
N. CA	Lassen North
	Lassen South - A
	Nevada North
	Round Mountain - A
	Round Mountain - B
OOS North	British Columbia
	Oregon

Transmission Corridors – N. California



Transmission Corridors – S. California



Transmission Prioritization

Ability to interconnect to highly desirable CREZ, considering both resource and transmission assessments

- **CREZ Rankings:**
  - Economic score
  - Environmental score
  - # of PPAs and PPA energy (IOU and POU)
  - # of resources in transmission queues (IOU and POU)
  - Ability to contribute to achieving RPS goals
- **Transmission Segments**
  - RETI Phase 2 rank score
  - Ability to connect highly ranked CREZ
  - Ability to construct in near, mid, and long-term

Resources by CREZ – Prioritized based on CREZ

Name	CREZ Included	Econ. Score	Env. Score	Corridor Rank	RETI GWh	PPA GWh	# PPA	Queue GWh	# Queue Applicants	Notes
Carrizo	Carrizo North	4	3	Low	11,907	2,336	5	3,730	22	May not need much transmisison
	Carrizo South	4	2							
	Cuyama	3	2							
	Santa Barbara	4	4							
Kramer/Inyo /Owen	Inyokern	2	3	Med	29,112	-	-	10,189	18	6 projects in S. Nevada interconnecting to CAISO
	Kramer	2	2							
	Nevada Central	1	2							
	Owen's Valley	2	1							
Barstow	Barstow	3	4	High/Med	23,169	731	2	18,724	24	5 projects in S. Nevada interconnecting to LADWP
	Mountain Pass	3	1							
	San Bernardino - Baker	4	2							
	Victorville	2	3							
Pisgah	Iron Mountain	3	1	High/Med	27,222	5,135	4	22,530	17	Most energy and contracts in Pisgah, which ranks high
	Needles	4	4							
	Pisgah	2	1							
	San Bernardino - Lucerne	3	3							
Tehachapi - S.CA	***Fairmont***	1	4	High	39,828	8,494	10	29,991	48	This would deliver energy to S.CA
	Tehachapi	2	1							
Tehachapi - N.CA	***Fairmont***	1	4	High	39,828	8,494	10	29,991	48	This would deliver energy to N.CA
	Tehachapi	2	1							
DPV	Palm Springs	1	3	High/Med	31,839	339	1	17,280	24	
	Riverside East	3	1							
	Twentynine Palms	2	1							
CaMex	Baja	1	3	Med	23,086	2,105	2	19,865	37	6 projects in AZ, 6 in Baja interconnecting to CAISO
	Imperial East	3	2							
	Imperial South	4	2							
	San Diego South	2	2							
Imperial	Imperial North - A	2	1	Med	15,133	-	-	3,469	15	
	Imperial Norh - B	3	4							
Solano	Solano	1	3	High	2,874	999	2	4,743	14	Limited upgrades
N. CA	Lassen North	4	3	Med.	9,145	990	4	5,194	TANC	Queue info. from TANC; Round Mtn. A has 2600 GWh
	Lassen South - A	4	4							
	Nevada North	1	2							
	Round Mountain - A	1	1							
	Round Mountain - B	4	4							
OOS North	British Columbia	1	3	High	4,911	4,985	8	N/A	N/A	
	Oregon	1	2							

Queue Information (CAISO / LADWP / IID)

			Interconnection Queue (CAISO/LADWP/IID) GWh					
Crez		Units	ST	PV	Wind	Geoth.	Other*	Total
1	Lassen South	GWh			1,612.2			1,612.2
2	Lassen North	GWh						0.0
8	Solano	GWh			4,708.0		35.0	4,743.0
14	Carrizo North	GWh	332.7	901.8			37.5	1,271.9
16	Santa Barbara	GWh			327.2			327.2
17	Cuyama	GWh		234.0				234.0
18	Carrizo South	GWh	442.2	1,781.8				2,224.1
25	Owen's Valley	GWh						0.0
26	San Diego North Central	GWh			157.9		140.2	298.0
27	San Diego South	GWh			2,006.9			2,006.9
29	Imperial East	GWh	2,173.5					2,173.5
30	Imperial South	GWh	1,227.8		302.0	700.8	3,207.9	5,438.5
32	Palm Springs	GWh			394.5		1,752.0	2,146.5
34	Needles	GWh			802.4			802.4
36	Riverside East	GWh	5,552.1	4,466.8				10,018.9
37	Iron Mountain	GWh	6,497.9					6,497.9
38	Twentynine Palms	GWh		5,115.0				5,115.0
40	Mountain Pass	GWh	730.8	730.8	174.7			1,636.2
41	San Bernardino - Baker	GWh	3,947.7					3,947.7
43	Pisgah	GWh	4,421.3				9,811.2	14,232.5
44	San Bernardino - Lucerne	GWh		997.7				997.7
45	Barstow	GWh		240.4	345.6			586.0
46	Victorville	GWh	762.1		1,682.8			2,444.9
47	Fairmont	GWh	656.4	498.9				1,155.3
50	Kramer	GWh	6,175.1	2,315.7				8,490.8
51	Inyokern	GWh	117.7					117.7
52	Tehachapi	GWh	5,882.0	6,152.6	16,801.1			28,835.7
31a	Imperial North - A	GWh				3,296.3	172.7	3,469.1
31b	Imperial North - B	GWh						0.0
3a	Round Mountain - A	GWh						0.0
3b	Round Mountain - B	GWh						0.0
CA non-CREZ			236.5					236.5
crez_out of st*								0.0
	Total	**GWh**	**39,155.8**	**23,435.4**	**29,315.1**	**3,997.1**	**15,156.6**	**111,060.1**
	Baja	GWh			10,246.1			10,246.1
	Nevada Central	GWh				1,580.4		1,580.4
	Nevada North	GWh				1,501.1		1,501.1
								0.0
	Arizona	GWh						0.0
	British Columbia	GWh						0.0

Transmission Segment Selection

- Phase 2 defined segments used for build-out
- Transmission segments added to connect renewables based on capacity – ***not optimized for energy deliveries***
- Additional transmission may be necessary:
  - Reliability
  - Economic
  - Support services

Transmission Segments – Defined by RETI

Transmisison Segment			Proposed Developmnet		
Upgrade Identification Name	Segment	Score	2013	2016	2020
Devers 2		N/A	x		
GreeenPath - Imperial - Devers		N/A	x		
Sunrise		N/A	x		
Tehachapi 4-11		N/A	x		
Mirage-Devers_1_upgrade	MIRG_DEVR_1	30.40		x	
Mirage-Devers_2_upgrade	MIRG_DEVR_2	30.40		x	
CoachellaValley-Mirage_1_upgrade	CHCV_MIRG_1	28.43		x	
Kramer-Lugo_1	KRAM_LUGO_1	27.39			
JulianHinds-EagleMountain_2	JULH_EGMT_2	25.33			
JulianHinds-EagleMountain_1	JULH_EGMT_1	25.33			
Midway-Vincent_3_upgrade	MIDW_VINC_3	24.73		x	
CoachellaValley-Mirage_2_upgrade	CHCV_MIRG_2	24.50		x	
LucerneValley-Lugo_1	LUCV_LUGO_1	21.95		x	
ImperialValley_xfmr_2_upgrade	IMPV_XFMR_2	21.79			
ElCentro-Highline_1	ELCN_HILN_1	19.36			
ElCentro-Highline_2	ELCN_HILN_2	19.36			
Carrizo-Midway_1_upgrade	CARZ_MIDW_1	19.32			
Bannister-Geo_1	BANN_GEO_1	19.21		x	
Bannister-Geo_2	BANN_GEO_2	19.21		x	
Lugo-Victorville_2	LUGO_VICT_2	18.34		x	
Kramer-Windhub_1	KRAM_WNDH_1	18.24		x	
CoachellaValley-DeversII_1	CHCV_DVR2_1	16.19		x	
CoachellaValley-DeversII_2	CHCV_DVR2_2	16.19		x	
ImperialValley_xfmr_3	IMPV_XFMR_3	16.12			
Pisgah-LucerneValley_1	PISG_LUCV_1	15.82		x	
MorroBay-Gates_1_upgrade	MBAY_GATE_1	15.62		x	
Bannister-ElCentro_1	BANN_ELCN_1	11.77		x	
ElCentro-ImperialValleyII_2	ELCN_IMPV_2	11.05		x	
ImperialValley_Devers_1	IMPV_DEVR_1	8.82		x	

Transmisison Segment			Proposed Developmnet		
Upgrade Identification Name	Segment	Score	2013	2016	2020
Midway-Gregg_2	MIDW_GREG_2	8.31			
Midway-Gregg_1	MIDW_GREG_1	8.01			
IronMountain-JontryJunction_2	IRMT_SCEJ_2	7.77			
IronMountain-JontryJunction_1	IRMT_SCEJ_1	7.76			
Devers-DeversII_1	DEVR_DVR2_1	7.46			
Dixieland-Bannister_rebuild	DIXL_BANN_1	7.03		x	
JontryJunction-Pisgah_2	SCEJ_PISG_2	6.98			
JulianHinds-DesertCenter_2	JULH_DESC_2	6.88			
JulianHinds-DesertCenter_1	JULH_DESC_1	6.87			
JontryJunction-Pisgah_1	SCEJ_PISG_1	6.82			
Bannister-CoachellaValley_1	BANN_CHCV_1	6.54			
Barstow_Lugo_1	BARS_LUGO_1	5.48			x
Midway-Kramer_1	MIDW_KRAM_1	5.33			
Midway-Kramer_2	MIDW_KRAM_2	5.33			
Midway-Geo_1	MIDW_GEO_1	5.32		x	
Midway-Geo_2	MIDW_GEO_2	5.32		x	
Bannister-Ave58_1_rebuild	BANN_AV58_1	5.06			
Inyokern-Kramer_1	INYK_KRAM_1	4.50			x
Collinsville-Pittsburgh_1	COLL_PITT_1	3.89			
LonePine-Inyokern_1_rebuild	LPIN_INYK_1	3.84			x
Collinsville-Pittsburgh_2	COLL_PITT_2	3.50			
MountainPass-Barstow_1	MTPS_BARS_1	3.26			x
JontryJunction-Camino_1_rebuild	SCEJ_CAMI_1	2.89			
DesertCenter-Devers_1	DESC_DEVR_1	2.84			
Control-LonePine_1_rebuild	CONT_LPIN_1	2.39			
Pisgah-MiraLoma_1	PISG_MIRA_1	2.21		x	
Ave58-CoachellaValley_1_rebuild	AV58_CHCV_1	2.01			
Devers-Valley_3	DEVR_VALL_3	1.35		x	
Midpoint-DesertCenter_1	MDPT_DESC_1	1.10			
NEO-Collinsville_1	NEO_COLL_1	0.13			

2013 System Transmission Additions (CAISO)

Segment Name
Tehachapi 4-11
Sunrise
Devers 2
GreenPath

CREZ Accessed

Tehachapi

Fairmont

Palm Springs

Twentynine Palms

Riverside East

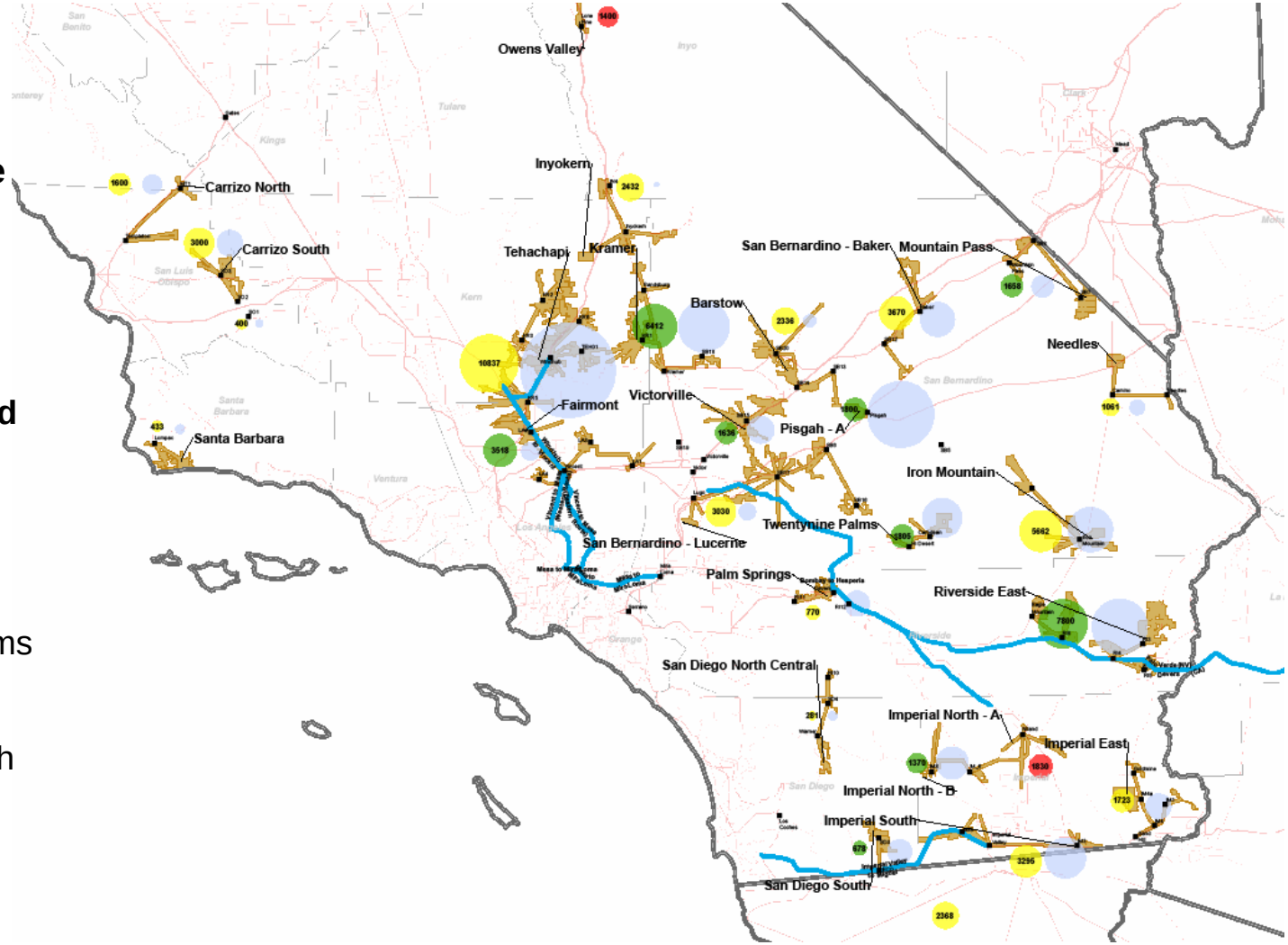
San Diego South

Imperial South

Imperial North

Imperial East

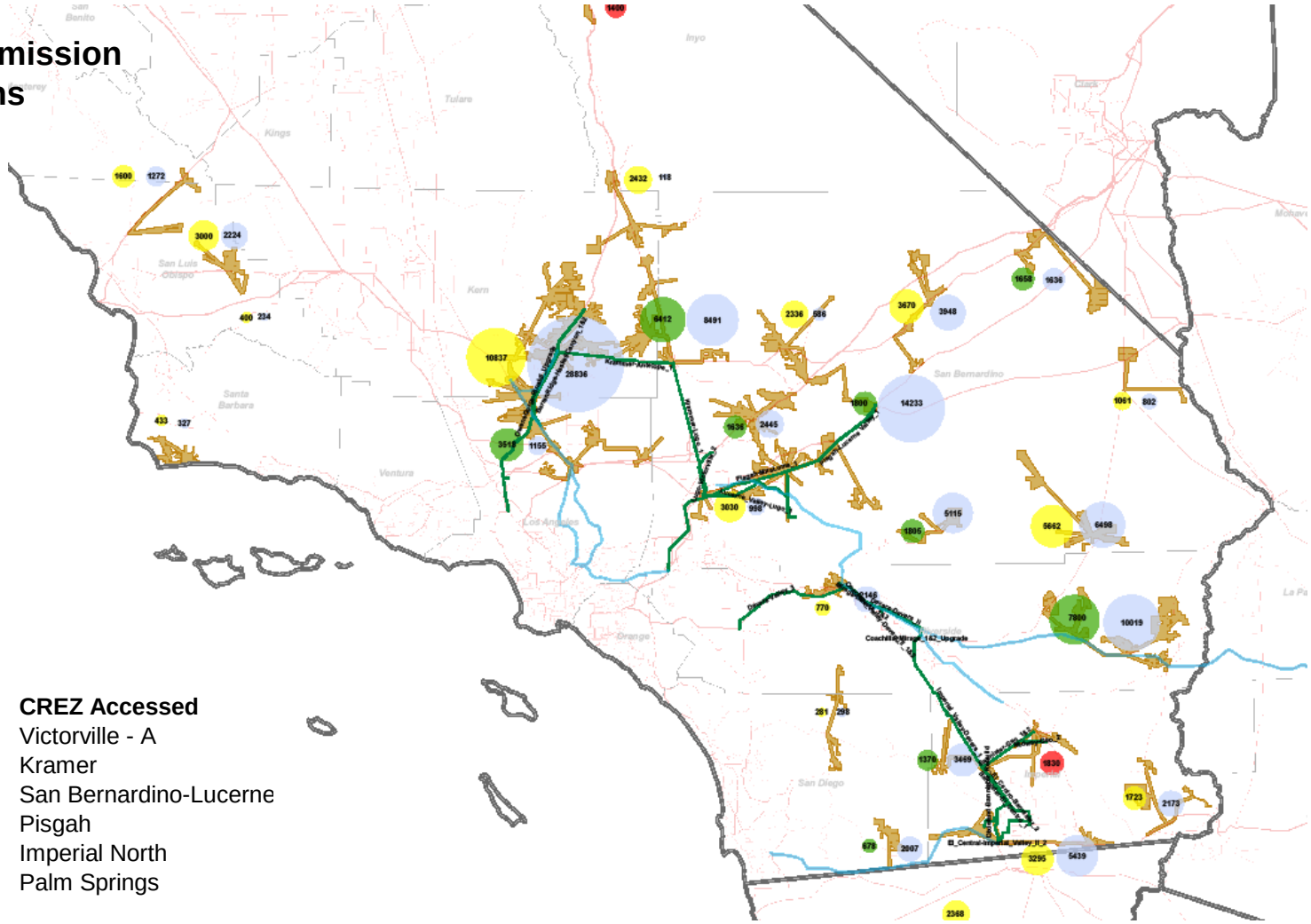
Baja



2016 System Transmission Additions - CAISO

2016 CAISO Transmission Additions

Segment Name
Lugo - Victorville 2
Pisgah - Mira Loma 1
Lucerne_Valley-Lugo 1
Pisgah - Lucerne Valley_1
Coachella_Mirage_1_Upgrade
Coachella_Mirage_2_Upgrade
Coachella_Valley-Devers_II_1
Coachella_Valley-Devers_II_2
El Centro-Bannister 2
Midway_Geo 1
Midway_Geo 2
Bannister-Geo_1
Bannister-Geo_2
Bannister-El Centro_1
El Centro-Imperial ValleyII_2
Dixieland-Bannister_Rebuild
Devers_Valley_3
Mirage-Devers_1 Upgrade
Mirage-Devers_2 Upgrade
Imperial Valley_Devers_1



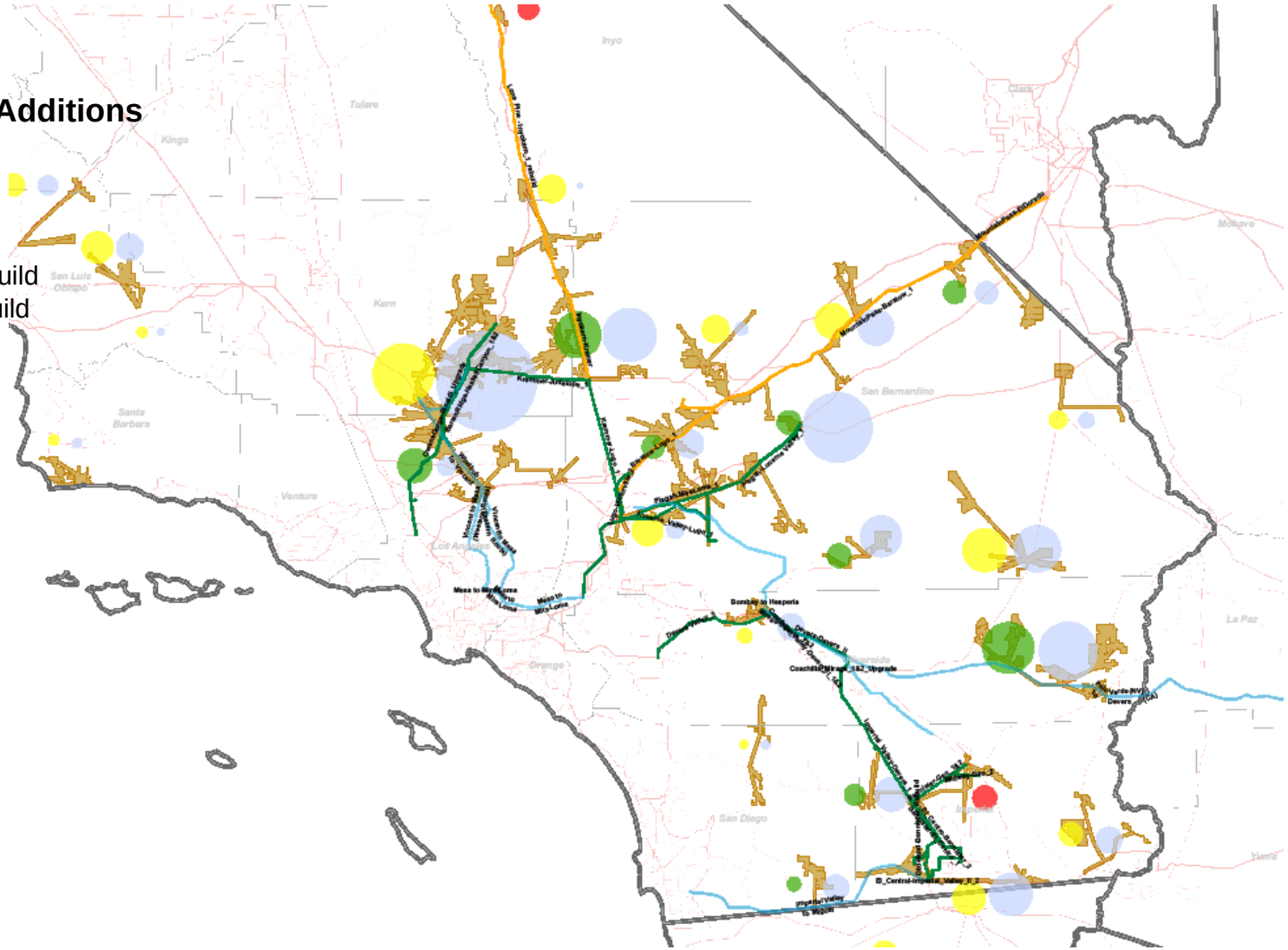
CREZ Accessed
Victorville - A
Kramer
San Bernardino-Lucerne
Pisgah
Imperial North
Palm Springs

2020 System Transmission Additions - CAISO

2020 Transmission Additions

Segment Name
Inyokern-Kramer_1
LonePine-Inyokern_1_rebuild
Control-Lone Pine_1_rebuild
Barstow-Lugo_1
MountainPass-Barstow_1
MountainPass-ElDorado

CREZ Accessed
Inyokern
Owens Valled
Central Nevada
Barstow
Mountain Pass
Southern Nevada



Next Steps for CAISO TPP

- Finalize RETI segments to access CREZ energy
- Identify additional transmission for:
  - power delivery
  - reliability
  - economically beneficial
- Input into 2010 TPP
  - load flow analysis
  - economic analysis