# The Paradigm Shift in the Role of the Transmission Network

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## Outline of the presentation

- What is the paradigm shift?
- Valuing the benefits of transmission expansion
  - The traditional vertically-integrated utility paradigm
  - Competitive wholesale power markets with open access transmission service
- Impacts of new public policies on transmission needs and transmission planning
  - Access to renewable generation
  - Policy-driven transmission planning under uncertainty about future needs
  - Competitive opportunities to build rate-based transmission
- California ISO initiatives and perspectives

## What is the paradigm shift?

1. From traditional, vertically-integrated, regulated monopoly utilities, to competitive wholesale energy markets and open-access transmission service operated by ISOs and RTOs ("electric restructuring")
2. From gradual, incremental transmission expansion to meet load growth and occasional new generation, to a massive turnover of the supply fleet in response to environmental policy directives
3. From expansion based on traditional reliability and economic-benefits criteria, to a new public-policy-driven basis for approving transmission additions, with uncertainty about future needs
4. From all transmission being built by incumbent utilities to new opportunities for independent developers



## Major federal reforms affecting transmission planning and investment

| | | |
|---|---|---|
| 1996 | Order 888 | - transmission open access<br>- encouraged but did not require transmission planning |
| 1999 | Order 2000 | - established regional scope, planning and inter-regional coordination functions of RTOs, but RTO formation remained voluntary |
| 2003 | Order 2003 | - standardized generation interconnection processes |
| 2006 | Order 679 | - rate incentives for transmission investment |
| 2007 | Order 890 | - required transmission providers (such as CAISO) to have coordinated, open, and transparent regional transmission planning process |
| 2011 | Order 1000 | - builds on Order 890 to include: processes for identifying policy-driven transmission needs; procedures to include non-incumbent transmission owners; inter-regional coordination and cost allocation |

## Principal potential benefits of a proposed transmission addition or upgrade

- Increased system reliability
- Improvements in system operation, capacity utilization
- Lower costs of energy and operating reserves
- Lower costs of generation capacity to meet peak load (particularly with non-coincident peak loads)
- Lower environmental emissions (unless expansion increases utilization of more polluting generation) and better spatial dispersion of emissions
- Possible improvements in system losses
- NEW – Accommodation of major shifts in the supply fleet driven by public policy objectives (e.g., 33% RPS)

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## Valuing transmission in the Vertical Integrated (VI) Utility Paradigm

- To meet demand growth in an area with no reduction in reliability (regulatory mandate), the utility can either construct local generation or expand transmission
  - Utility's retail price of electricity is regulated, so it maximizes profits by pursuing the least-cost solution
- Example of utility benefit calculation for transmission expansion
  - Local generation costs $50/MWh, and imported energy $20/MWh
  - => transmission upgrade of 10 MW of capacity yields benefit of $300/hr = [($50/MWh - $20/MWh)*10 MWh] each hour
  - An economic benefit of transmission is the generation cost savings from increased ability to exploit locational cost differences
- Alternatively, utility may maximize profits by installing new high-cost local generation that operates only in high-demand hours
  - Combustion turbine costing $150/MWh but needed only for a small number of hours may be more cost effective than transmission upgrade

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## Transmission versus generation risk considerations

- Transmission upgrade with low-cost distant generation entails significant regulatory risk
  - Longer time horizon to construct new transmission
  - Can require large amount of distant generation to realize efficient utilization of new transmission line
  - Challenge to obtain regulatory siting and environmental permits
  - Commitments of previous regulator must be honored by current and future regulators
- Relying on local generation maintains permanent “load pockets” – regions with insufficient transmission capacity to meet all demand with imported energy
  - San Francisco Bay Area, San Diego Area
  - May be strong local opposition to building new generation



## Paradigm Shift to Wholesale Markets

- Elements of the new market paradigm
  - Generation sector is subject to competition
  - Transmission service is subject to non-discriminatory (open access) requirements, mainly under ISOs/RTOs
  - VI utility retains distribution system, and may or may not face competition to serve retail customers in its territory
  - Transmission planning and new generation interconnection are under the transmission system operator
- Wholesale markets are the vehicle for generation competition and non-discriminatory transmission service
  - Market structure includes day-ahead and real-time (intra-day) energy and reserve services
  - May include forward locational capacity to ensure adequacy under peak-load conditions
  - System is optimized based on participants bids and offers, rather than on actual costs that were available to the VI utility

## Implications of the shift to markets for transmission planning

- Economic value of transmission expansion is increased ability to exploit locational *price* differences
  - Prices may differ from costs due to any factors that reduce the competitiveness of supply resources
  - E.g., local market power may exist in load pockets, where load exceeds the capability of transmission to import energy from cheaper external resources
  - Such constraints may exist in the wholesale market paradigm because they were optimal under the prior VI utility paradigm
- A new potential benefit of a transmission upgrade is to limit the exercise of local market power by increasing competition, thus reducing the cost of energy, reserves and resource adequacy capacity

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## Another aspect of the shift to markets – new transmission ownership and operating structures

- **Transco:** Consolidated ownership and operation of all divested transmission assets in a region or subregion, subject to regulated rate of return (e.g., for-profit ISO)
- **Transmission-owning utility or independent transmission company:** Ownership of some or all transmission in a subregion, subject to regulated rate of return, under independent operator such as ISO
- **Merchant transmission owner:** Owner of individual transmission assets, subject to market-based revenue and regulation, under the independent operator
- *Note: All structures are consistent with open access requirements whether under ISO or RTO or not*

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## The shift to public policy-driven transmission planning under uncertainty

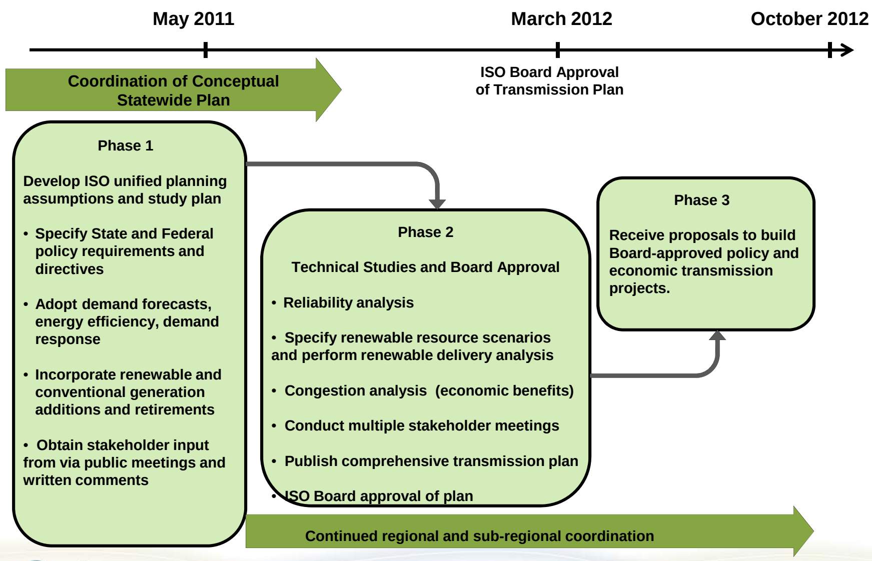
- Environmental policy mandates – such as 33% RPS by 2020 – require massive changes to the supply fleet
  - Numerous resource rich areas (wind, solar radiation) beyond the reach of existing transmission and far from load centers
  - Needed transmission does not qualify under traditional reliability or economic-benefit criteria
  - Dozens of GW of generation project proposals far exceed needed capacity, creating uncertainty about actual geographic pattern of future generation development
  - Transmission development takes much longer than generation development, so transmission decisions cannot wait for certainty
- Competing objectives for transmission planners
  - Enable sufficient transmission to be built and energized in time to meet 33% RPS by 2020 policy mandate, but …
  - Minimize risk to ratepayers of funding under-utilized transmission



## The strategy for transmission planning under the new paradigm

- Create new “public policy-driven” transmission category
- Adopt the given policy mandate as a planning objective
  - Final transmission plan and expected resource fleet must allow 33% of MWh consumed on an annual basis to come from renewable resources (8760-hour production simulation)
- Specify several alternative scenarios of potential renewable resource development, and identify transmission for each
  - Identifying preferred resource areas requires collaboration between ISO and state authorities that oversee resource procurement by load-serving entities and environmental generation permitting
- Approve transmission facilities found needed under multiple scenarios to minimize risk of under-utilized transmission
  - Defer approval of other facilities pending new information in next planning cycle

## CAISO's 2011/2012 Transmission Plan Cycle

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## A key challenge – how to specify the set of feasible generation development scenarios

- California's Renewable Energy Transmission Initiative (RETI) identified and analyzed all Competitive Renewable Energy Zones (CREZes)
- RETI results and other regulatory assessments were used in state-wide (CTPG) and CAISO planning processes
  - (CTPG = California Transmission Panning Group)
- Evidence of commercial interest in each CREZ the CTPG considered:
  - Renewable resources in the CPUC's "discounted core" and in portfolios of publicly owned utilities (POUs)
  - The positions of the same resources in the generator interconnection queues of the ISO and the POUs
  - Environmental scores and "discounted core" information was developed within the CPUC's 2010 Long Term Procurement Planning process
- End result: Potentially viable CREZes still too numerous to provide enough certainty to transmission planning decisions

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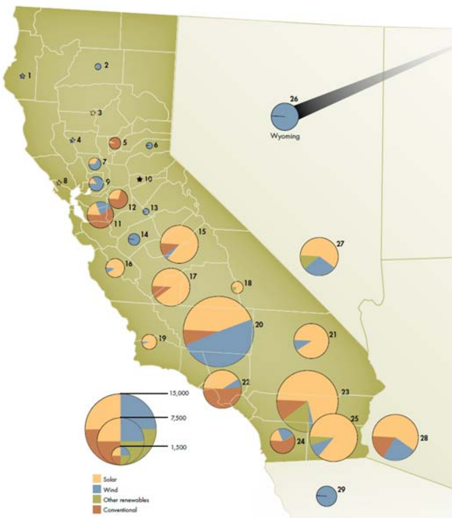
# Interconnection queue far exceeds policy needs




Interconnection queue by county

| County | | Number of Projects | Renewables MW | Conventional MW | Total MW |
|---|---|---|---|---|---|
| 1 | Humboldt | 1 | 50 | | 50 |
| 2 | Shasta | 2 | 165 | | 165 |
| 3 | Butte, Glenn, Tehama | 5 | 122 | | 122 |
| 4 | Lake, Colusa | 1 | 66 | | 66 |
| 5 | Sutter, Yuba | 2 | 20 | 600 | 600 |
| 6 | Placer | 1 | 220 | | 220 |
| 7 | Yolo | 5 | 587 | | 587 |
| 8 | Marin, Sonoma | 3 | 92 | | 10 |
| 9 | Solano | 11 | 908 | | 908 |
| 10 | Amador | 1 | 18 | | 18 |
| 11 | Alameda, Contra Costa, Santa Clara | 16 | 1,110 | 1,698 | 2,808 |
| 12 | San Joaquin | 11 | 325 | 1,020 | 1,345 |
| 13 | Stanislaus, Tuolumne | 5 | 202 | | 202 |
| 14 | Merced | 7 | 612 | | 612 |
| 15 | Fresno, Madera | 79 | 4,474 | 594 | 5,067 |
| 16 | Monterey, San Benito | 4 | 1,550 | | 1,550 |
| 17 | Kings | 38 | 4,614 | 625 | 5,239 |
| 18 | Inyo, Tulare | 13 | 625 | | 625 |
| 19 | San Luis Obispo, Santa Barbara | 6 | 896 | | 896 |
| 20 | Kern | 109 | 13,802 | 1,100 | 14,902 |
| 21 | San Bernardino | 21 | 4,395 | | 4,395 |
| 22 | Los Angeles, Orange | 50 | 2,390 | 2,650 | 5,040 |
| 23 | Riverside | 34 | 10,667 | 1,420 | 12,087 |
| 24 | San Diego | 29 | 1,094 | 1,453 | 2,545 |
| 25 | Imperial | 27 | 7,683 | | 7,683 |
| In-state Totals | | 481 | 56,787 | 11,159 | 67,947 |
| 26 | Wyoming | 1 | 3,000 | | 3,000 |
| 27 | Nevada | 18 | 5,252 | | 5,252 |
| 28 | Arizona, New Mexico | 10 | 5,878 | 1,250 | 7,128 |
| 29 | Mexico | 3 | 1,628 | | 1,628 |
| Out-of-state Totals | | 32 | 15,758 | 1,250 | 17,008 |
| TOTAL ALL PROJECTS | | 513 | 72,545 | 12,409 | 84,955 |

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# Transmission underway to meet 33% RPS in 2020


**Total cost = $7.2 billion**

| | Transmission upgrade | Approval status | | Renewable Potential | | Online |
|---|---|---|---|---|---|---|
| | | ISO | CPUC | MW | TWh/Yr | |
| 1 | Carrizo-Midway | Pending LGIA | Not yet filed | 900 | 2.1 | 2012 |
| 2 | Sunrise Powerlink | Approved | Approved | 1,700 | 4.1 | 2012 |
| 3 | Eldorado-Ivanpah | LGIA | Approved | 1,400 | 3.6 | 2013 |
| 4 | Pisgah-Lugo | LGIA | Not yet filed** | 1,750 | 4.1 | 2017 |
| 5 | Valley-Colorado River | Approved | Approved* | 4,700 | 8.6 | 2013 |
| 6 | West of Devers | LGIA | Not yet filed | | | 2017 |
| 7 | Tehachapi | Approved | Approved | 4,500 | 15.2 | 2015 |
| 8 | Tehachapi Wind/Solar Diversity | N/A | N/A | 1,000 | 3.0 | 2015 |
| 9 | Cool Water-Lugo | Pending LGIA | Not yet filed | 600 | 1.4 | 2018 |
| 10 | South Contra Costa | LGIA | Not yet filed | 300 | 0.8 | 2015 |
| 11 | Borden-Gregg | LGIA | Not yet filed | 800 | 2.0 | 2015 |
| 12 | Path 42 | Pending approval | Not yet filed | 1,400 | 3.5 | 2015 |
| Other-Outside of ISO Grid | | N/A | N/A | 3,300 | 8.4 | |
| | | | | **Total** | **56.8** | |
| | ***TWh/year needed in ISO area to meet 33% goal:*** | | | | ***44*** | |

** Petition to modify CPCN pending. ** Large Generator Interconnection Agreement*

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## 33% RPS scenarios for 2020 cover a reasonable range renewable and load conditions

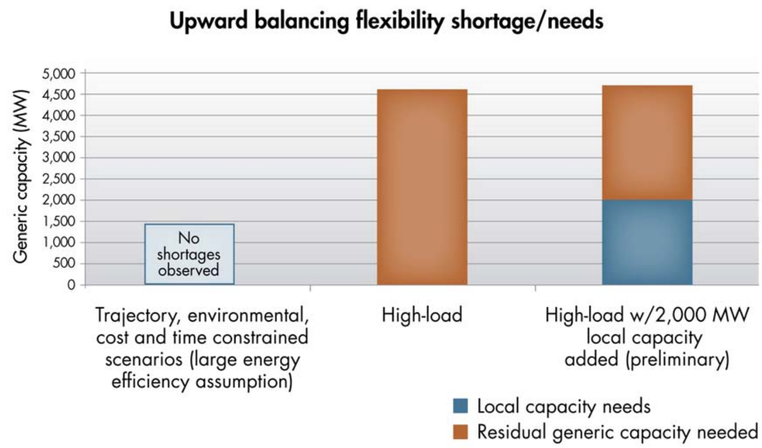
| Case | Case Title | Description |
|---|---|---|
| 1 | 33% Trajectory | Based on contracted activity |
| 2 | Environmental Constrained | High distributed solar |
| 3 | Cost Constrained | Low cost (wind, out of state) |
| 4 | Time Constrained | Fast development (out-of-state) |
| 5 | 20% Trajectory | For comparison |
| 6 | 33% Trajectory High Load | Higher load growth and/or energy program under-performance |
| 7 | 33% Trajectory Low Load | Lower load growth and/or energy program over-performance |



## Fossil Plant Retirement – Once-Through-Cooling


| Unit | Capacity (MW) | Area |
|---|---|---|
| Harbor | 237.5 | LDWP |
| Haynes 1-6 | 1570 | LDWP |
| Scattergood 1-3 | 803 | LDWP |
| Contra Costa 6-7 | 674 | PG&E_BAY |
| Pittsburg 5-6 | 629 | PG&E_BAY |
| Potrero | 206 | PG&E_BAY |
| Humboldt Bay 1-2 | 135 | PG&E_VLY |
| Morro Bay 3-4 | 650 | PG&E_VLY |
| Moss Landing 6-7 | 1510.03 | PG&E_VLY |
| Alamitos 1-6 | 2010.38 | SCE |
| El Segundo 3-4 | 670 | SCE |
| Huntington Beach 1-4 | 901.55 | SCE |
| Mandalay 1-2 | 430.29 | SCE |
| Ormond Beach 1-2 | 1516.27 | SCE |
| Redondo Beach 5-8 | 1343.01 | SCE |
| Encina 1-5 | 946 | SDG&E |
| South Bay 1-4 | 693 | SDG&E |

## Potential need for 4,600 MW of upward flexible resources observed in the high-load scenario

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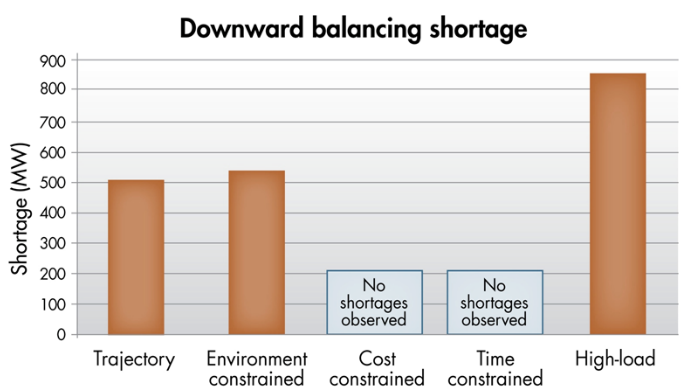
## Out of approximately 3,500 MW downward balancing requirements, observed some hours of shortages




Note: Downward balancing may be more effectively and efficiently managed using curtailment or storage rather than less economic dispatch of flexible resources to higher level to maintain downward flexibility

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## CAISO transmission planning initiatives, challenges and perspectives

- More comprehensive transmission planning process that considers reliability needs, economic benefits, renewable integration, distributed energy resources, once-through-cooling policy, air emissions policy
- Better integrate generation interconnection with transmission planning
  - Rely more on transmission planning to drive significant upgrades
  - Use policy-driven category to meet interconnection needs for preferred resource development areas
  - Assign cost for additional upgrades to generation developers
- Improve process for specifying resource portfolios used for planning
  - Incorporate findings of state environmental analysis
- Manage interconnection queue to eliminate inactive or excessively delayed projects, reducing upgrade needs for projects later in queue

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## … continued

- Ensure availability of flexible capacity needed for reliable operation with larger amounts of variable renewables
  - Incorporate "integration resources" in resource scenarios so that transmission planning can account for operational needs
- Accelerate market design initiatives to procure, compensate and help support sustained commercial viability of needed flexible resources
  - Expand opportunities for generation alternatives – such as demand response and storage – to participate in CAISO markets, with the goal of meaningful levels of deployment before 2020
- Refine local capacity studies for 2020 to inform procurement decisions in the 2011-2012 CPUC procurement cycle
  - Target procurement of capacity with needed flexibility and ramping capability, including new investment
- Inter-regional (i.e., west-wide) coordination in transmission planning – required by FERC Order 1000; compliance due in 18 months

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