London Economics International LLC

Nexus between transmission investment and renewable development

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Julia Frayer,
Managing Director
julia@londoneconomics.com

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Truths and Myths…

- **A common belief is that the need for new transmission can be deferred with more generation and that more transmission can substitute for generation**
- **Transmission and generation are in fact components of a single system -- consumers receive reliable electricity service specifically as a result of the co-existence of generation and transmission**
- **More often than not, we see transmission investment spurring new generation investment, and new generation opportunities serving as catalysts for more transmission investment**
  - Even in the face of consumers becoming "prosumers" – through distributed generation – we will continue require a robust transmission system to deliver reliable electricity service
- **Economic evaluation techniques need to move beyond conventional transmission planning frameworks in order to help identify such inter-dependencies and unlock value**
- **New Mexico and Desert Southwest region is a natural "case study" in the value of such creative resource management**
  - substantial renewable generation potential but insufficient local demand and inadequate transmission
  - A high level analysis shows that there is "investable" potential for new generation and new transmission, that would benefit the local region as well as neighboring markets

London Economics International LLC ("LEI") is an applied economic consulting firm specializing in electricity sector and other infrastructure industries

Asset Valuation, Price Forecasting & Market Analysis

- Exhaustive sector knowledge and a suite of state-of-the art proprietary quantitative modeling tools
  - Wholesale electricity market models
  - Valuation and economic appraisal
  - Due diligence support
  - Cost of capital database
  - Contract configuration matrices

Regulatory Economics, Performance -based ratemaking & Market Design

- Market design, market power and strategic behavior advisory services
- Incentive ratemaking
  - Quantify current and achievable efficiency levels for regulated industries
  - Convert findings into efficiency targets mutually acceptable to utilities and regulators

Expert Testimony & Litigation Consulting

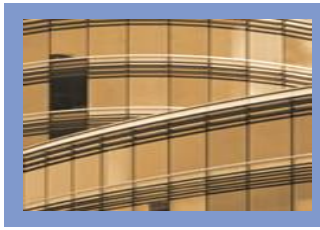
- Reliable testimony backed by strong empirical evidence
- Expert witness service
  - Material adverse change
  - Materiality
  - Market power
  - Contract frustration
  - Cost of capital
  - Tax valuations

Transmission

- Creating detailed market simulations to identify beneficiaries and quantify costs and benefits from proposed transmission lines
  - Valuing transmission
  - Transmission tariff design
  - Procurement process and contract design

Renewable Energy

- Renewable energy policy design, procurement, modeling, and asset valuation
  - Solar, wind, biomass, and small hydro
  - Demand response
  - Energy efficiency
  - Emissions credits trading
  - Energy storage technologies

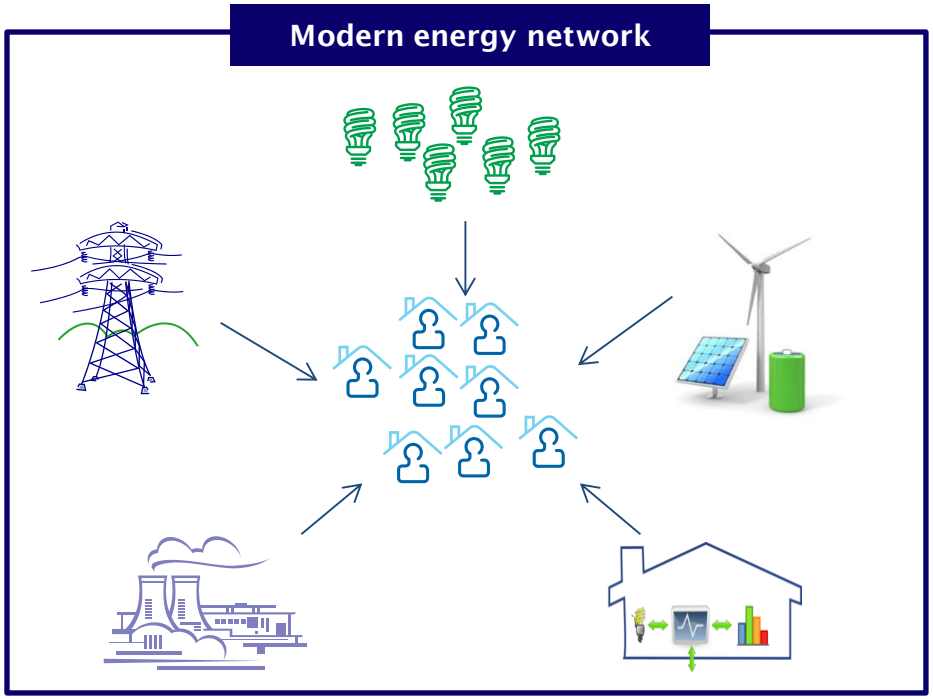


Procurement

- Designing, administering, monitoring, and evaluating competitive procurement processes
  - Auction theory and design
  - Process management
  - Document drafting and stakeholder management

The electric power system is an integrated machine: reliable service at the lowest cost requires that we maintain and invest in both generation and wires infrastructure

- **Transmission and market resource alternatives (generation and other non-transmission components) together create the functional ability for consumers to have electricity on demand**
  - transmission depends on generation being available and operating and consumers' demanding electricity service
  - Likewise, generation is useful only if there is a transmission system that connects the generator to customers (load)



- **The role of renewable has become more prominent even as US is flush with relatively low cost gas**
  - Renewable have been bolstered by public policy – many states have set goals for renewable energy usage, and at the federal level, these technologies have been supported by various tax related schemes
  - Technological advances have also made renewable resources cost competitive with more conventional utility generation
  - Wholesale power markets provide pathways for the private sector to finance such initiatives and programs; and more opportunities are arising as we attempt to curb emissions

In a 2014 report prepared the WIRES organization, LEI stressed the importance of comprehensive economic and technical evaluation of investments in order identify and take advantage of complementarity

- **In the last two decades, system planning has become increasing complex due to decoupling of the transmission and generation investment decision through deregulation and market restructuring**
  - with the evolution of deregulated wholesale power markets, which rely on private investment decision-making, system planners must now plan transmission investment with relatively limited certainty on the magnitude and location of future generation in the long-term and also greater uncertainty on load

- **Despite the deregulated and decentralized world we now live in, evaluation of transmission and market resources cannot be segregated – in order to fairly compare feasible investments and select the best choices, LEI has proposed a framework ("toolkit") that creates a neutral setting for evaluating the he services and benefits of various technologies individually and collectively**
  - generation should be judged on the same criteria for reliability and economic benefits as proposed transmission investment
  - technical requirements (to ensure reliability) are not "optional"
  - a robust cost-benefit analysis should measure and quantify the uncertainties and risks associated with investment
  - relying on least cost analysis is not sufficient - comprehensively measuring the benefits is necessary in order to distinguish among many possible solutions

Analytical framework

Phase 1: Needs Assessment
Determine the investment needed to maintain system reliability and resource adequacy

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Phase 2: Identification of Feasible Solutions
Determine if proposed solutions meet reliability criteria and/or stated requirements

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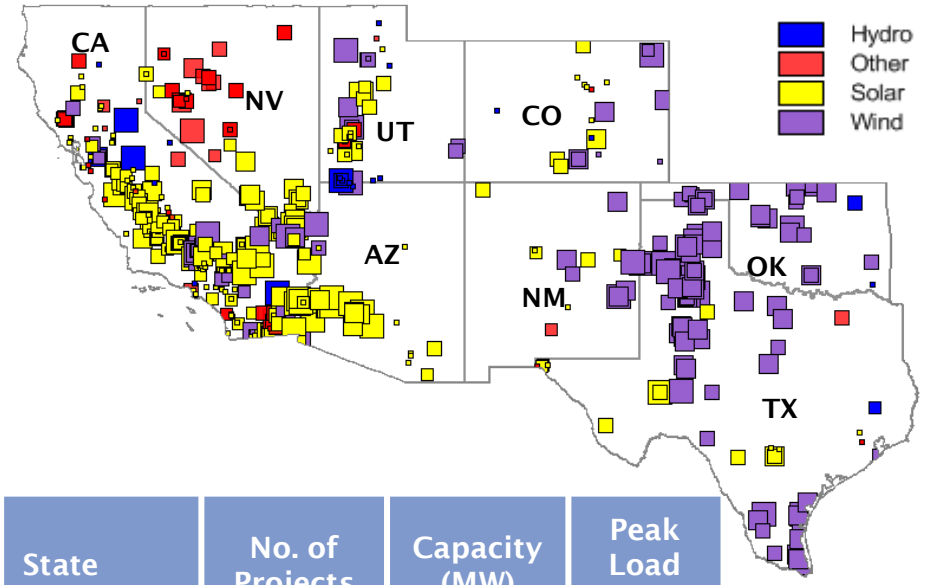
Phase 3: Cost-Benefit Analysis
Comprehensive analysis of costs and benefits to determine net benefits of the proposed solution in the long run

As of March 2015, over 650 renewable generation projects, totaling approximately 80 GW of capacity, have been announced in the Southwest US

Regional development of renewable resources



State	No. of Projects	Capacity (MW)	Peak Load (2013)
California	340	26,170	60,195
Texas	96	18,194	77,257
Arizona	42	15,625	17,776
Nevada	61	6,696	8,099
Utah	46	3,623	5,123
Oklahoma	25	3,470	13,982
New Mexico	25	3,222	3,698
Colorado	24	1,564	10,779

Source: Third party commercial database; NREL. "Beyond RPS." August 2013.

Southwest Highest-Value Resource Paths by Index Score (NREL)

High value potential

Moderate value potential

	Index Score[a]
Wyoming wind to Nevada	0.79
Wyoming wind to Utah	0.84
New Mexico wind to Arizona	0.94
Wyoming wind to Arizona	0.95
Wyoming wind to California	0.97
Wyoming wind to Washington	1.04
Wyoming wind to Oregon	1.04
New Mexico wind to California	1.06
Nevada solar to California	1.07
Idaho geothermal to California	1.11
Montana wind to Nevada	1.12
Arizona solar to California	1.13
Montana wind to Utah	1.17
Montana wind to Oregon	1.18
Montana wind to Washington	1.19

Wind resource
Solar resource
Geothermal resource

An index score less than 1.0 indicates a resource with a delivered cost that is still below the relevant state benchmark even if current transmission costs are doubled

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Not surprising, most of the renewable generation projects "under development" in New Mexico are wind based

Owner	Project Name	Capacity (MW)	Type	Unit Status	Online Date
Macquarie Bank Limited	Brahms Wind	480	Wind	Proposed	12/31/2015
Tri Global Energy	Frio Energy Wind	400	Wind	Proposed	12/31/2016
Caithness Energy LLC	Mescalero Ridge Wind Project	320	Wind	Permitted	6/1/2017
Berrendo Wind Energy LLC	Dunmoor Wind Farm	280	Wind	Proposed	12/31/2015
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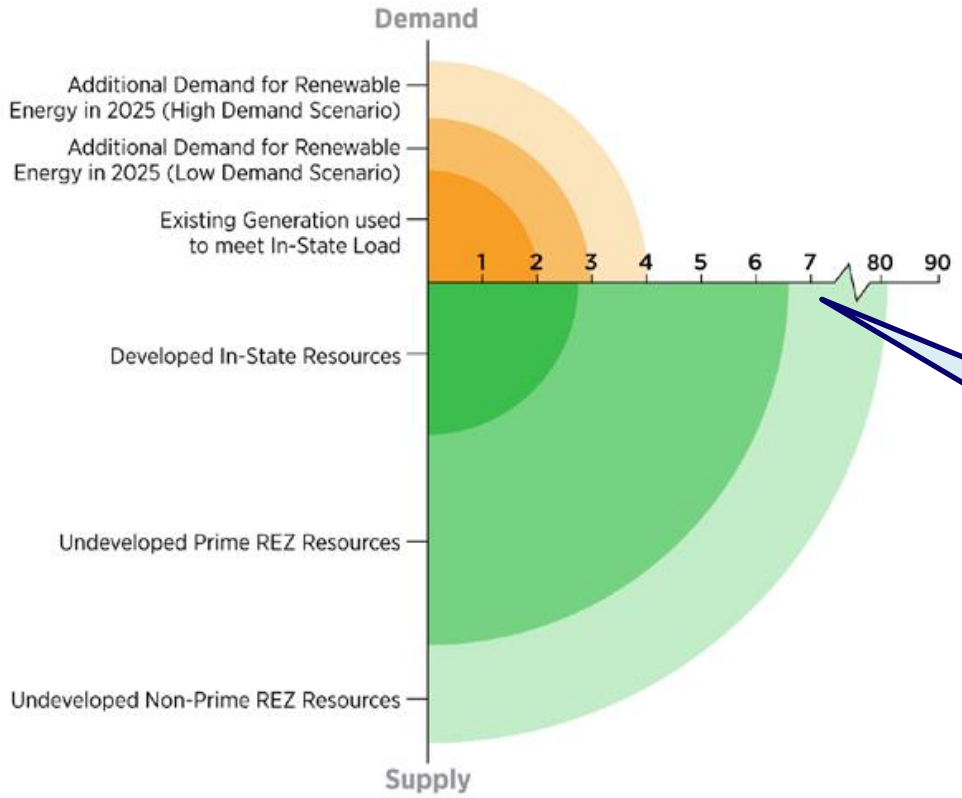
Triangle Gallegos LP	Gallegos Wind Farm	251	Wind	Proposed	1/1/2017
EDF Group	Roosevelt Wind Project	250	Wind	Under Const	12/31/2015
Triangle Gallegos LP	Gallegos Wind Farm	249	Wind	Proposed	1/1/2018
Caithness Energy LLC	Mescalero Ridge Wind Project	180	Wind	Permitted	12/31/2019
Berrendo Wind Energy LLC	Dunmoor Wind Farm	140	Wind	Proposed	12/31/2019
Berrendo Wind Energy LLC	Valencia Hills Wind Farm	75	Wind	Proposed	12/31/2015
Berrendo Wind Energy LLC	Valencia Hills Wind Farm	75	Wind	Proposed	12/31/2016
EDF Group	Milo Wind Project	50	Wind	Under Const	12/31/2015
Wind Total		**3,030**			
PNM Resources Inc	San Juan Generating Station	40	Solar	App Pending	3/31/2018
Infigen Energy	Aragonne Solar	38	Solar	App Pending	12/31/2016
Infigen Energy	Caprock Solar	24	Solar	App Pending	12/31/2016
PNM Resources Inc	PNM Central NM Solar 1	20	Solar	Permitted	12/31/2016
PNM Resources Inc	PNM Central NM Solar 2	20	Solar	Permitted	12/31/2016
PNM Resources Inc	Meadow Lake Solar Energy Cen	9	Solar	Under Const	1/31/2015
PNM Resources Inc	PNM Albuquerque Solar 2	8	Solar	Permitted	6/30/2015
PNM Resources Inc	Sandoval County Solar Energy (	6	Solar	Under Const	1/31/2015
Ruidos NM (City of)	Sierra Blanca Arpt Solar	2	Solar	Proposed	3/1/2015
Los Alamos County	Los Alamos Smart Grid Demo	1	Solar	Proposed	6/30/2015
Solar Total		**168**			
United States Dept of Defense	Black Bear Biomass	20	Biomass	Proposed	6/30/2015
Waste Connections Inc	Camino Real Landfill (LFG)	3	Biomass	Permitted	6/1/2015
Biomass Total		**23**			

High capacity factors and low development costs makes New Mexico a potential region of "robust competition among wind projects" aiming to serve the California and Southwest markets - NREL

New Mexico's peak load growth – notionally around 3 GW per year - is not sufficient to unlock all of the new wind potential

- Load growth across the region (New Mexico, Arizona and Nevada) is similarly too low compared to the new wind and solar generation opportunity in these states
- According to one study, the total potential for renewable development across these three states is more than eight times the documented need for renewable energy by 2025

New Mexico Renewable Energy Supply/Demand (TWh)



Annual supply/demand of renewable energy by state (TWh)

	Need for renewable energy by 2025	Projects existing or under development (2012)	Development potential
New Mexico	3.0 - 4.0	2.0	78.8
Arizona	7.9 - 8.5	3.2	46.7
Nevada	5.6 - 6.6	3.5	49.5
Total	**16.5 - 19.1**	**8.7**	**175.0**

Expected supply (TWh) of renewables in New Mexico far exceeds demand

Source: NREL. "Beyond RPS." August 2013.

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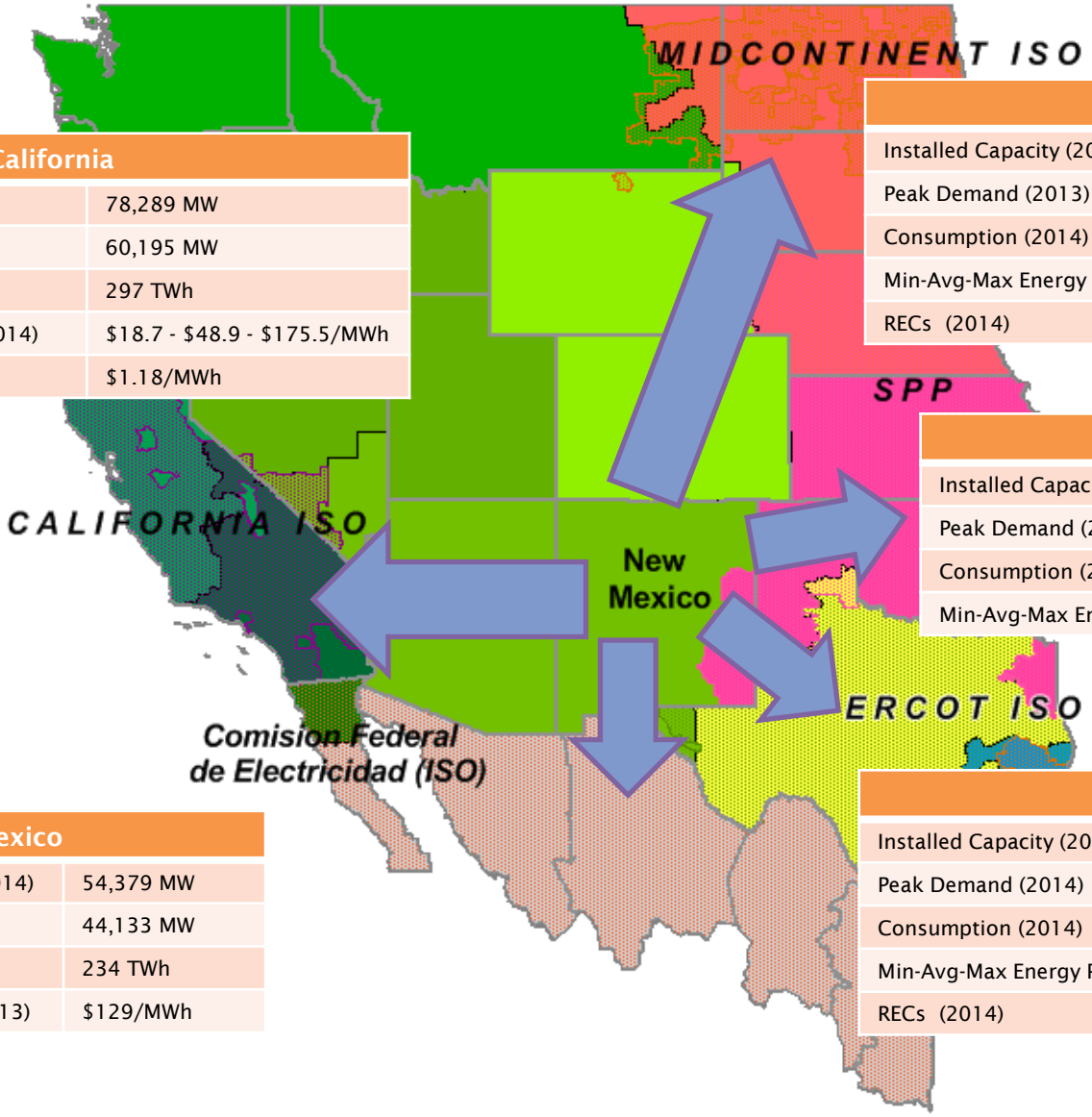
Proposed transmission projects could facilitate increasing exports of renewable energy from the Desert Southwest to other states

New Mexico has a natural competitive advantage to supply renewables based electricity to neighboring markets



California	
Installed Capacity (2013)	78,289 MW
Peak Demand (2013)	60,195 MW
Consumption (2013)	297 TWh
Min-Avg-Max Energy Price (2014)	$18.7 - $48.9 - $175.5/MWh
RECs –Unbundled (2014)	$1.18/MWh

MISO	
Installed Capacity (2013)	179,454 MW
Peak Demand (2013)	109,336 MW
Consumption (2014)	662 TWh
Min-Avg-Max Energy Price (2014)	-$88 - $41- $1,966/MWh
RECs (2014)	$1.3 - $1.5/MWh

SPP	
Installed Capacity (2013)	74,390 MW
Peak Demand (2013)	45,256 MW
Consumption (2014)	231 TWh
Min-Avg-Max Energy Price (2014)	$24 - $26- $31/MWh

Mexico	
Installed Capacity (2014)	54,379 MW
Peak Demand (2012)	44,133 MW
Consumption (2012)	234 TWh
Avg. Energy Price (2013)	$129/MWh

ERCOT	
Installed Capacity (2014)	75,106 MW
Peak Demand (2014)	68,096 MW
Consumption (2014)	336 TWh
Min-Avg-Max Energy Price (2014)	$5 - $39 -$1,325/MWh
RECs (2014)	~$1/MWh

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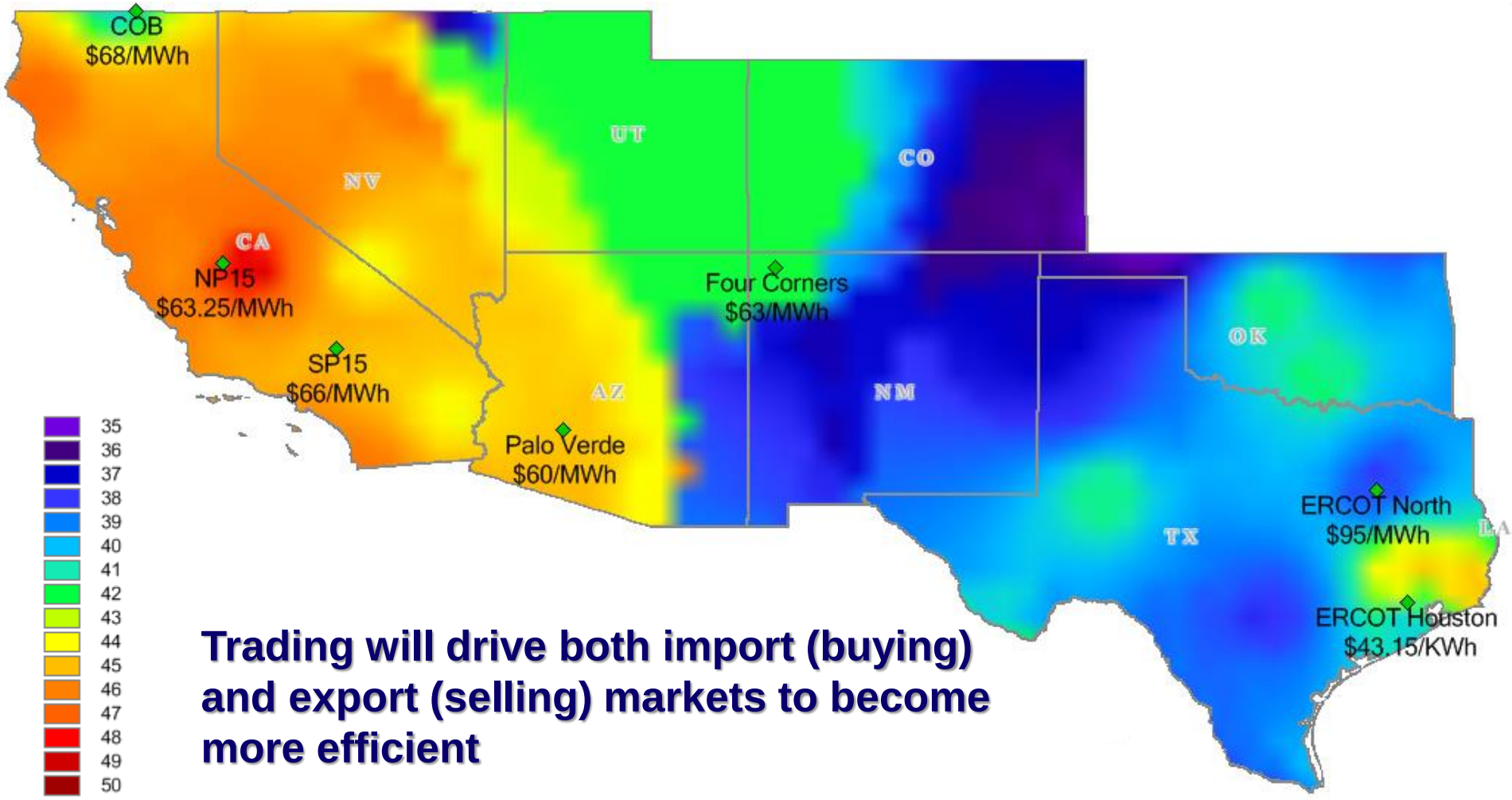
Actual energy market prices already suggest that there are arbitrage opportunities that could be harnessed by New Mexico's "cross roads" position

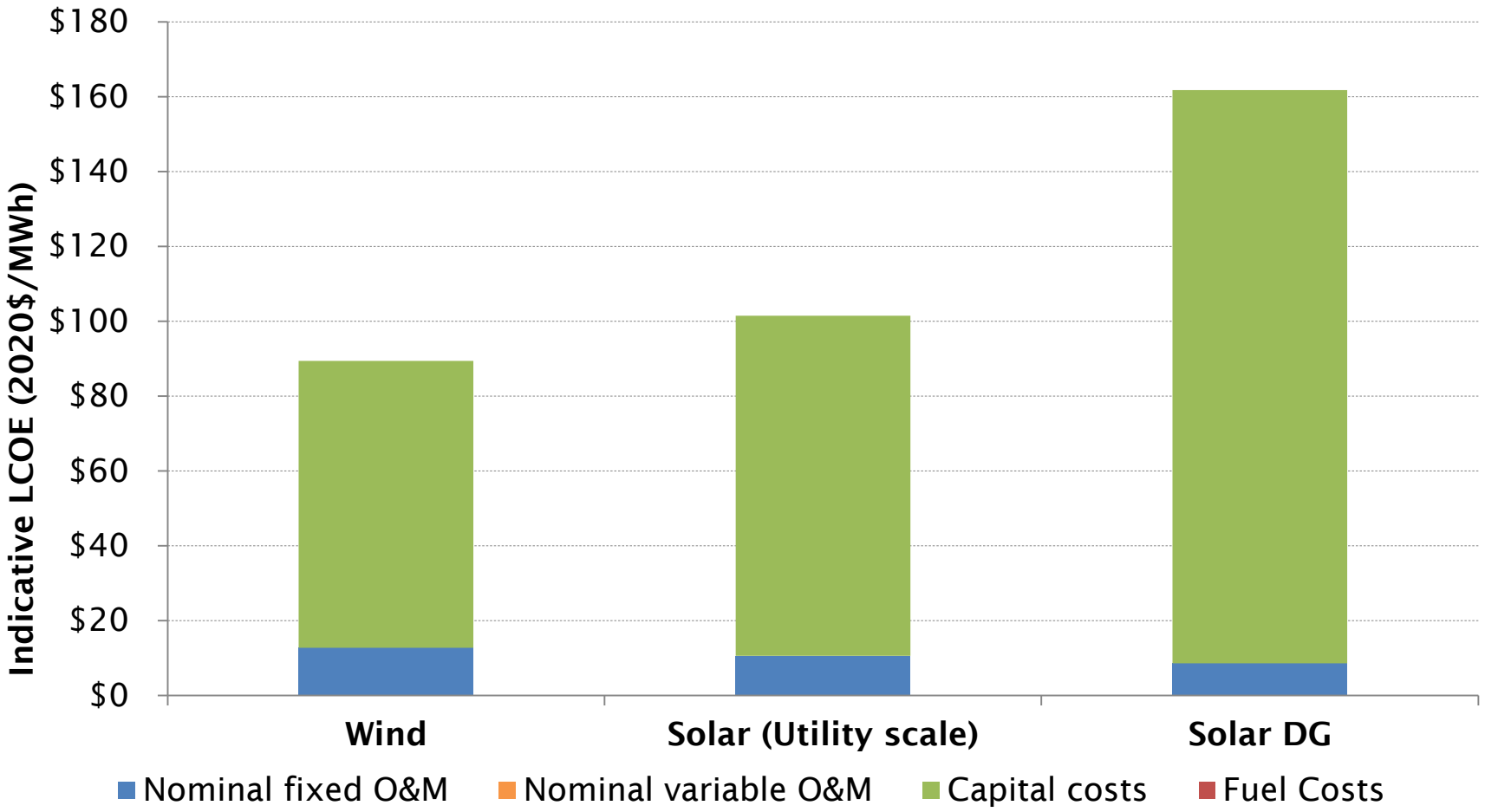
Heat map of average 2014 energy prices and key nodes showing summer peak prices



Trading will drive both import (buying) and export (selling) markets to become more efficient

Based on current technology, all-in costs for new utility-scale renewables in New Mexico come in around $100 per MWh

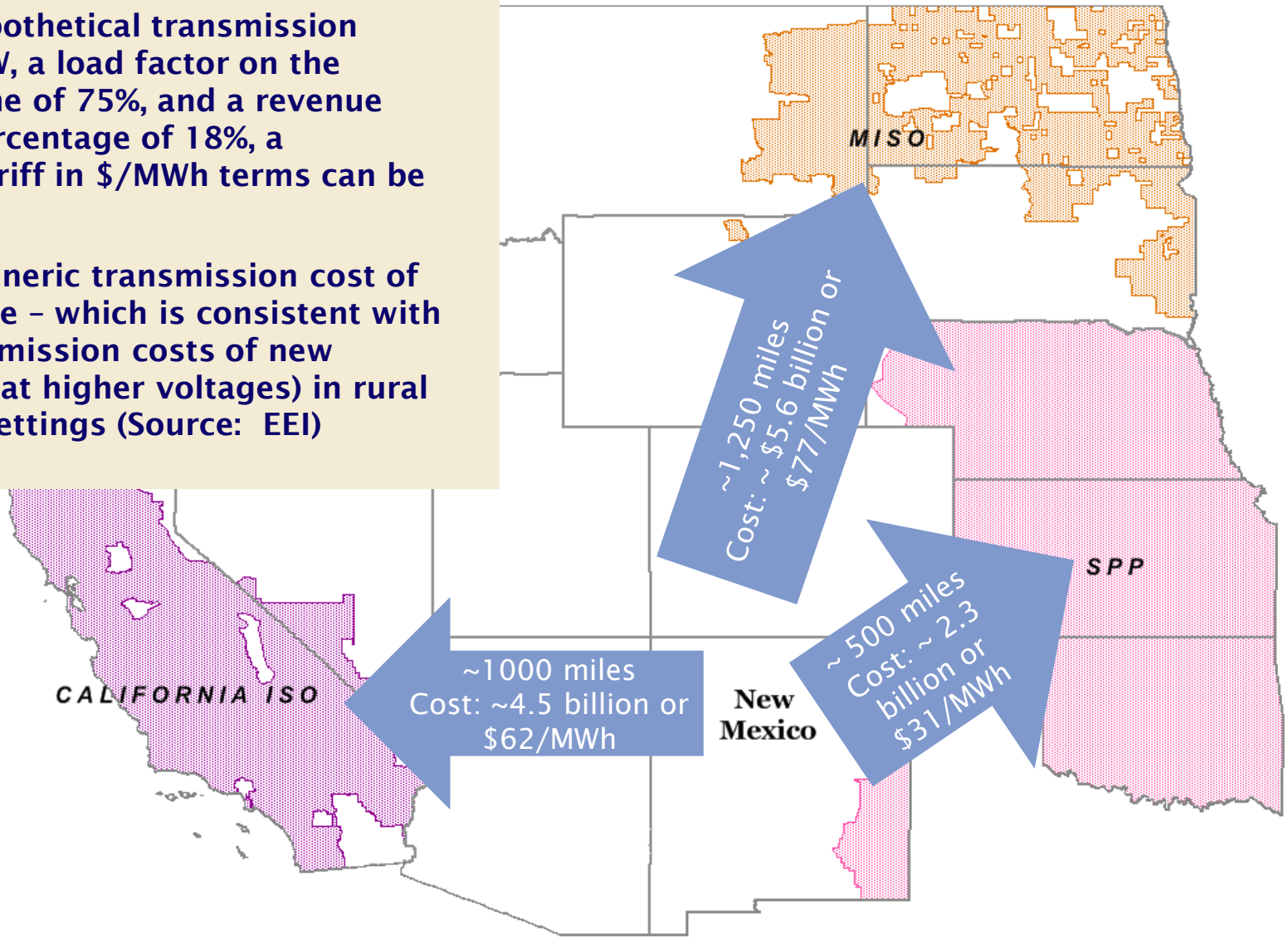
	Wind	Solar	Solar DG
Capacity Factor	40%	30%	30%
Capital costs (2020$/kW)	$2,205	$2,000	$4,500
Indicative LCOE (2020$/MWh)	$89	$101	$162



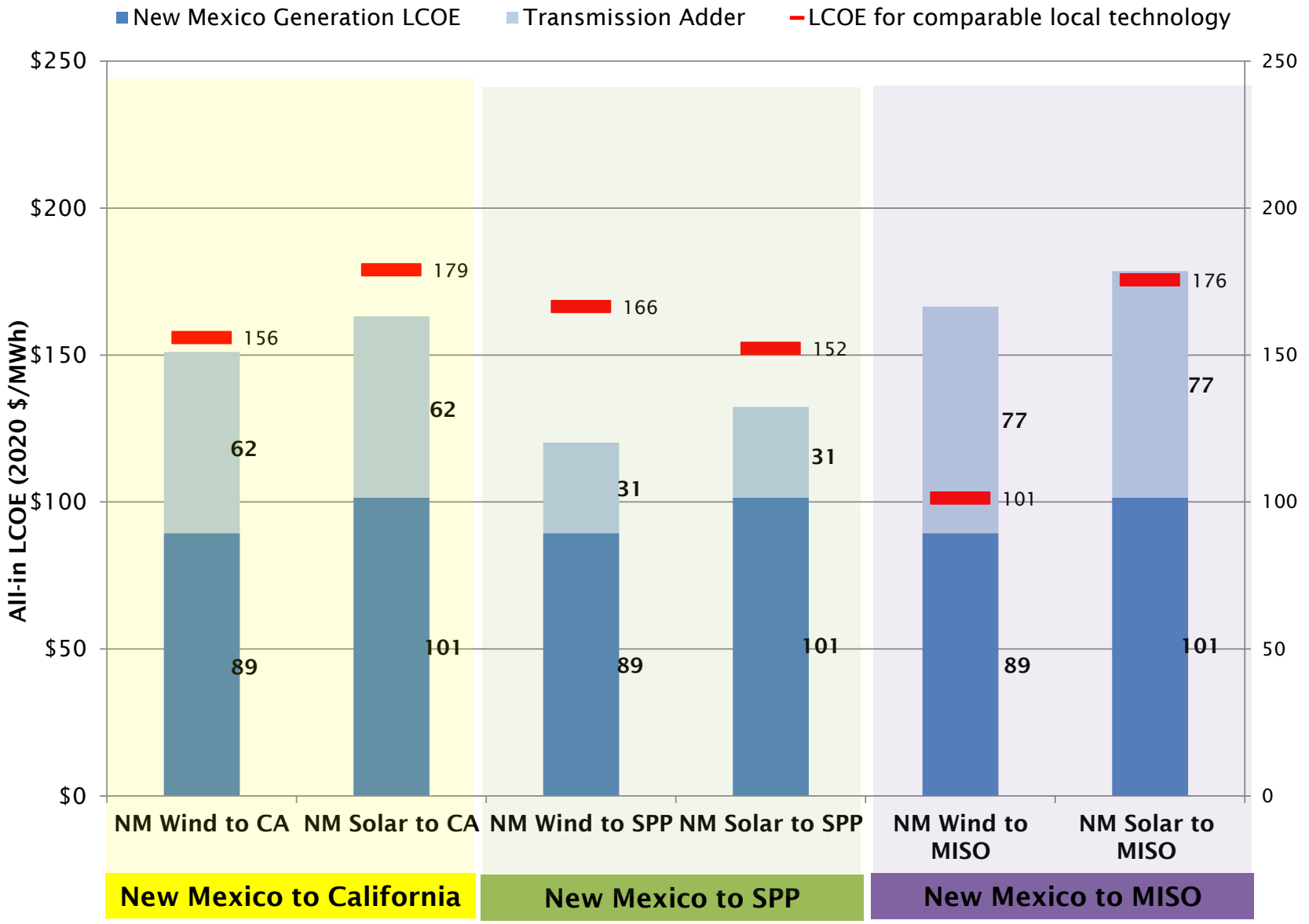
The costs of new transmission need to be factored into the export opportunity assessment

Assuming a hypothetical transmission capacity of 2 GW, a load factor on the transmission line of 75%, and a revenue requirement percentage of 18%, a transmission tariff in $/MWh terms can be calculated …

LEI assume a generic transmission cost of $4.5 million/mile – which is consistent with estimated transmission costs of new overhead lines (at higher voltages) in rural and suburban settings (Source: EEI)



Based on a high level analysis, the combined cost of new generation and new transmission appears to be economic relative to local alternatives in both California and SPP



Through an integrated analysis, we can find meaningful and economic investment opportunities for local renewable development

- **Much of New Mexico is naturally suited for renewable generation resources including solar, wind and geothermal**
- **Favorable wind and solar capacity factors coupled with lower development costs provides renewable energy projects based in New Mexico a competitive edge over other regions in the Desert Southwest**
- **New Mexico is well positioned to take advantage of this vast potential provided that government and private investment is guided into new infrastructure projects**
  - Sometimes unlocking potential, requires the need to dream big
  - Current load in New Mexico is not sufficient motivator – hence need to take into consideration load pockets in surrounding area, e.g. California and Texas
- **Unlocking existing potential will require creating a favorable investment climate for not just inward looking investments but also outward looking investments and leveraging opportunities where the transmission and generation investments can work together**

What needs to be done to get these opportunities commercialized?

1. **project specific feasibility studies with more detailed costs and detailed analysis of returns for project sponsors and consumer benefits,**
2. **permitting and siting – are the project ideas "feasible"?**
3. **negotiations of risk sharing arrangements between developers/project sponsors and entities representing consumers so as to allow for financing of the new infrastructure construction, etc.**