



**A Summary of the
SB07-091 Task Force Report on
Renewable Resource Generation
Development Areas**

to the
**Colorado Clean Energy
Development Authority**

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Governor's Energy Office

December 18, 2007

connecting colorado's
renewable resources to the market

Report of the
Colorado Senate Bill 07-091
Renewable Resource Generation
Development Areas
Task Force

WIND



SOLAR



HYDROELECTRIC



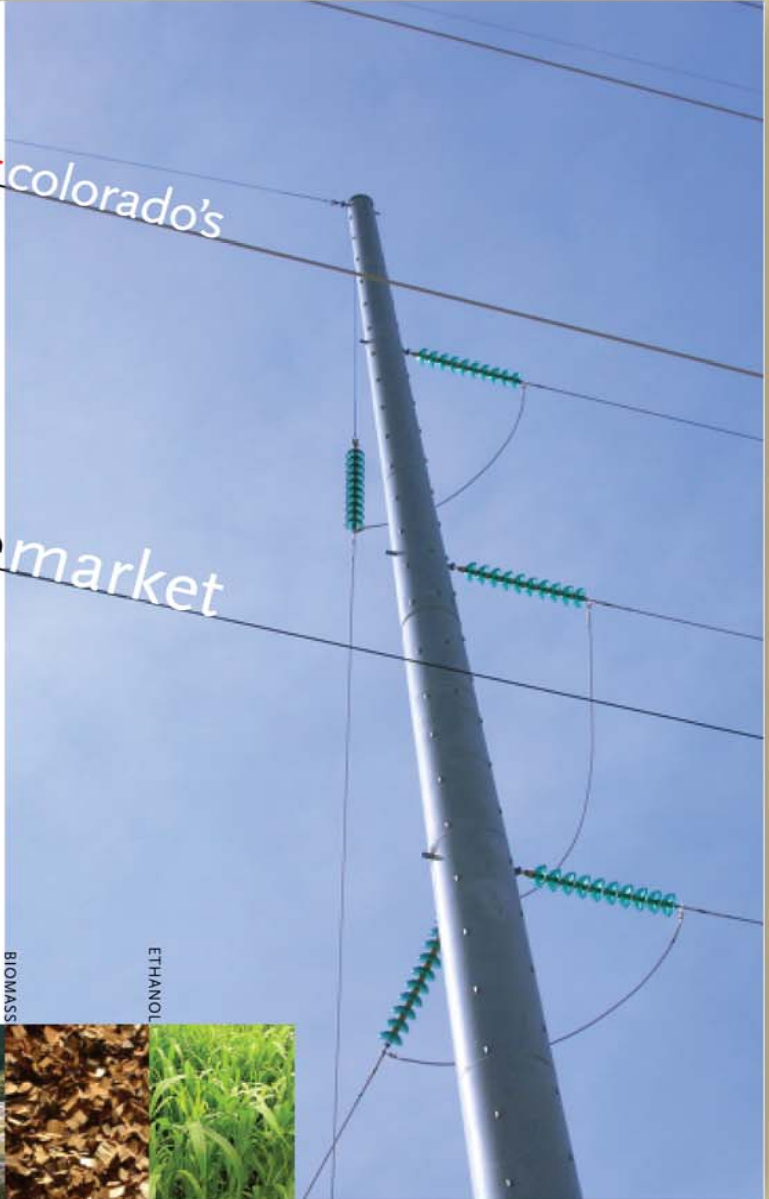
GEOTHERMAL



BIOMASS



ETHANOL



Members of the SB07-091 Renewable Resource Generation Development Areas Task Force

Chair:

Dan McClendon, Delta-Montrose Electric Association

Vice-Chair:

Barbara Walker, Independent Bankers of Colorado

John Bleem, Platte River Power Authority

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Ron Lehr, American Wind Energy Association

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John Nielsen, Western Resource Advocates

Frank Prager, Xcel Energy

Richard Smart, Community Hydropower Consulting

Morey Wolfson, Governor's Energy Office



The Task Force on Renewable Resource Generation Development Areas, created by SB07-091, has mapped the renewable resources throughout the State of Colorado.

The 64-page report contains maps of these resources and identifies “Generation Development Areas” where the resources can be developed with competition among developers for utility-scale wind and solar projects.



The Task Force assessed utility scale wind and solar opportunities, and the attendant transmission requirements to bring these resources to market.

In addition, the Task Force discussed local development opportunities. These consist of a broad diversity of smaller electric power generation projects. Colorado's distributed solar, hydroelectric, biomass, and geothermal resources will play an increasingly vital role once developed to their potential.

By December 28 the report will be posted on the Governor's Energy Office website at www.colorado.gov/energy



Colorado has renewable resources in such abundance that the state can meet the current minimum utility Renewable Energy Standard by tapping a small portion of our total renewable resources.

Even after we meet a much larger portion of our growing electric power needs with Colorado's renewable resources, the state has abundant renewable resources for export to regional electricity markets.

This will be a challenge, but Colorado is preparing to succeed in this endeavor.



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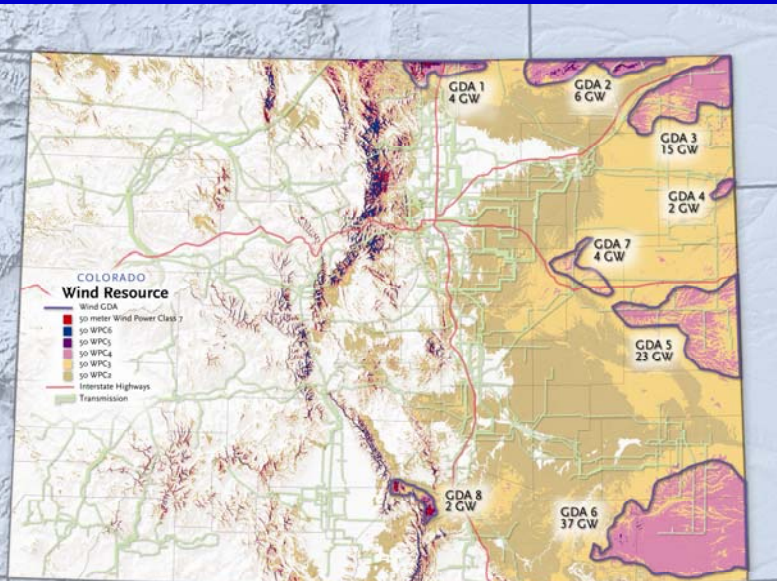
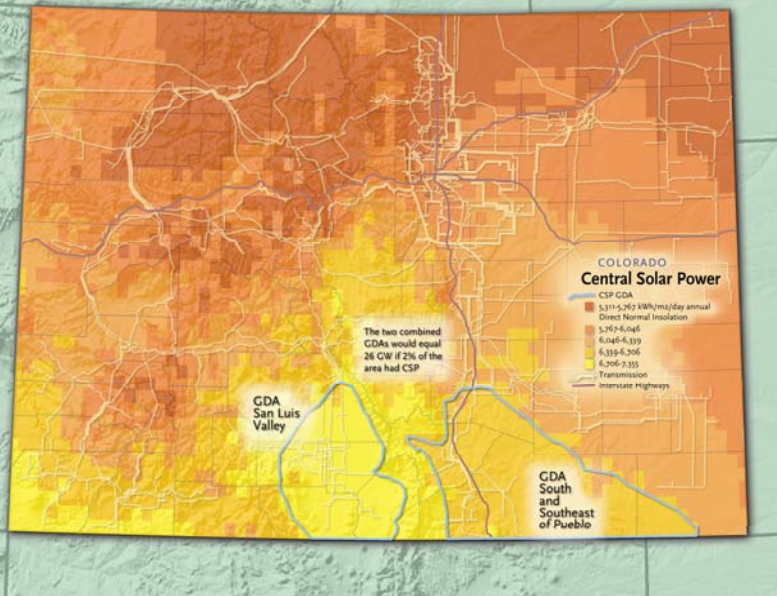
Summary

Acknowledgments

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Definition of a Generation Development Area (GDA)

The Task Force defined a GDA as a concentration of renewable resources within a specific geographic sub-region in Colorado that provides a minimum of 1 gigawatt (GW) of developable electric generating capacity that could connect to an existing or new high voltage transmission line.



For a rough comparison, Colorado's statewide summer electric generation peak is approximately 11 GW.

COLORADO Wind Resource

- Wind GDA
- 50 meter Wind Power Class 7
- 50 WPC6
- 50 WPC5
- 50 WPC4
- 50 WPC3
- 50 WPC2
- Interstate Highways
- Transmission

GDA 1
4 GW

GDA 2
6 GW

GDA 3
15 GW

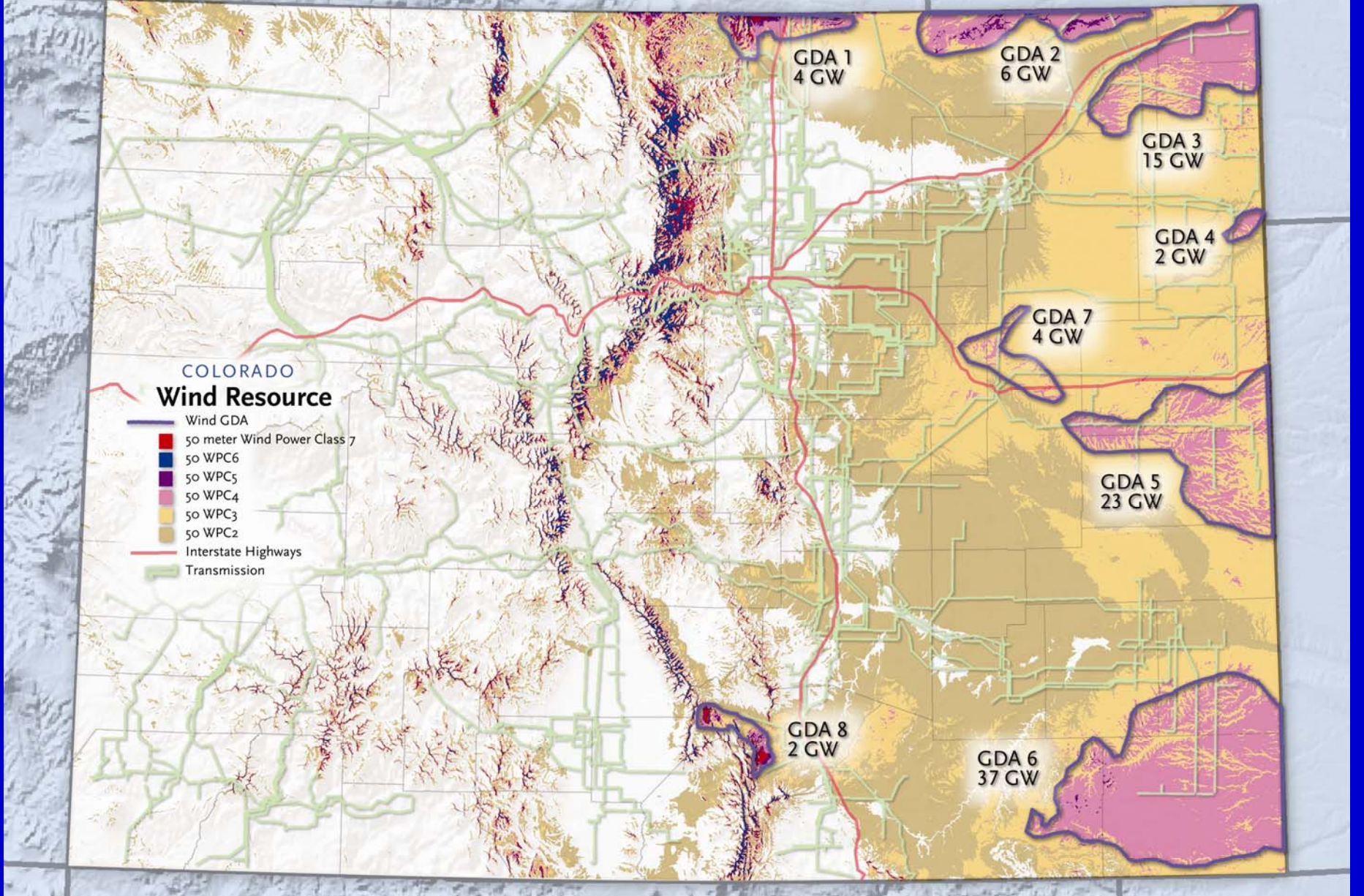
GDA 4
2 GW

GDA 7
4 GW

GDA 5
23 GW

GDA 8
2 GW

GDA 6
37 GW



Colorado Wind

Interwest Energy Alliance reports that with 1,067 MW of installed wind capacity at the end of 2007, Colorado has vaulted into sixth place nationally in wind capacity, trailing only Texas, California, Iowa, Washington and Minnesota.

Colorado's strong showing was made possible by the installation in 2007 of 775 MW of new wind capacity:

- 400 MW at Peetz Table in Logan County
- 300 MW at Cedar Creek in Weld County
- 75 MW at Twin Buttes in Bent County

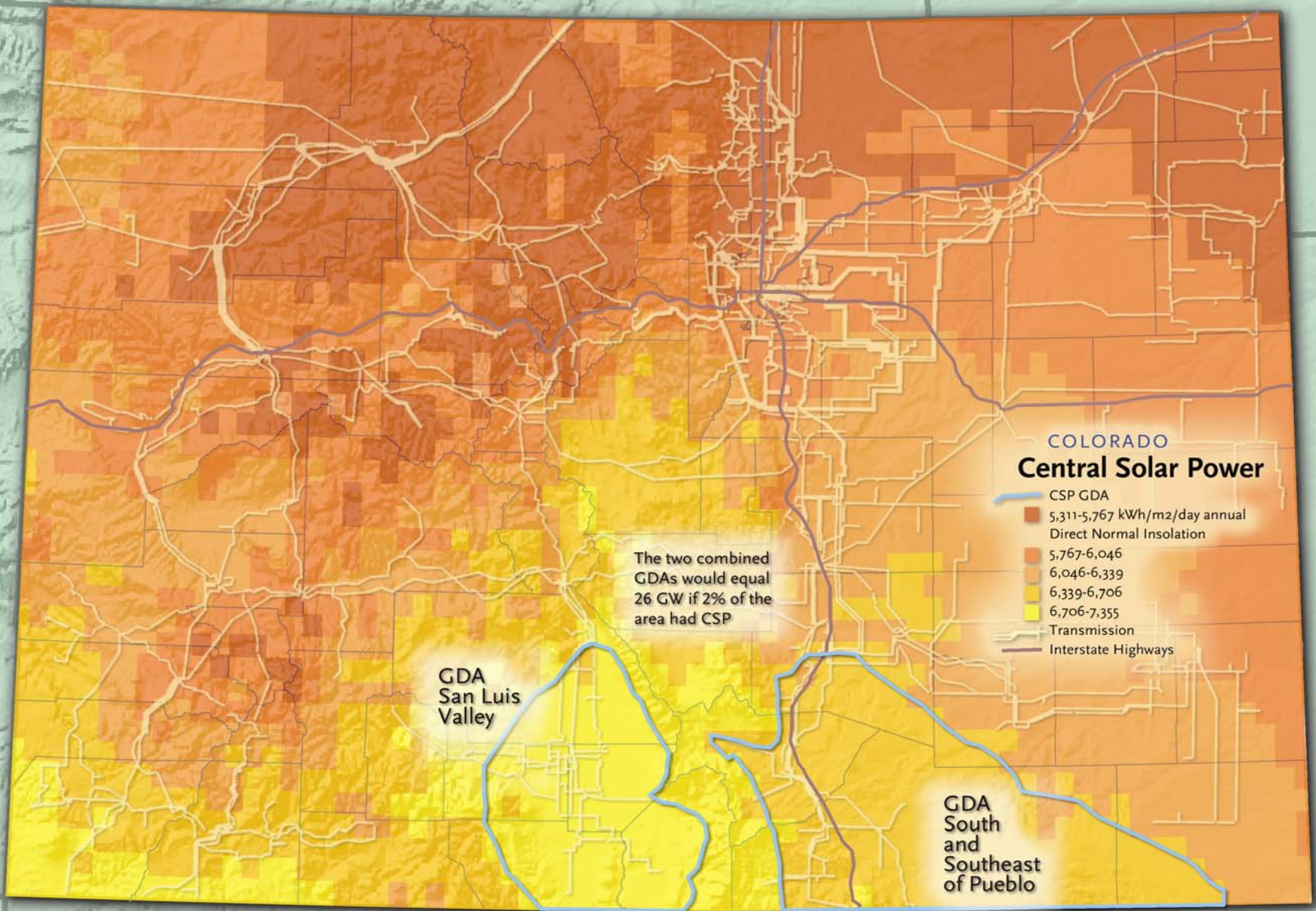


Colorado Wind GDAs

<u>GDA #</u>	<u>Location</u>	<u>GW of capacity</u>
1	North-central	4
2	North-west	6
3	North-east	15
4	East-central	2
5	East-central	23
6	South-east	37
7	Front Range- east	4
8	Walsenburg area	<u>2</u>
	Total	96

The eight wind GDAs have the potential for development of over **96 GW** of capacity.

This roughly equates to over eight times Colorado's current peak electricity use.



COLORADO
Central Solar Power

- CSP GDA
- 5,311-5,767 kWh/m²/day annual Direct Normal Insolation
- 5,767-6,046
- 6,046-6,339
- 6,339-6,706
- 6,706-7,355
- Transmission
- Interstate Highways

The two combined GDAs would equal 26 GW if 2% of the area had CSP

GDA San Luis Valley

GDA South and Southeast of Pueblo

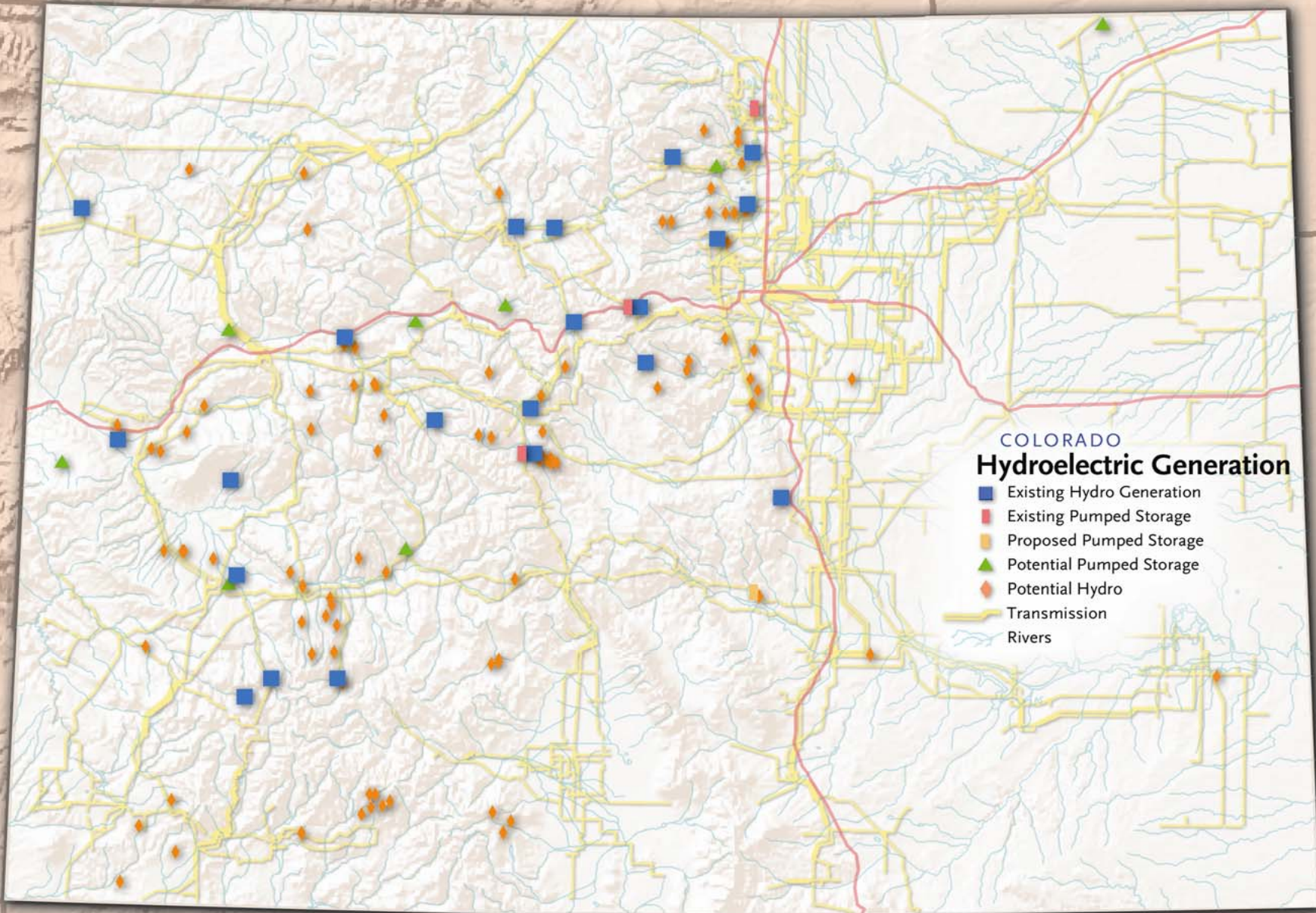
Central Solar Power (CSP) GDAs



Without screening for the highest direct normal insolation and without screening for terrain slope, the two CSP GDAs represent a hypothetical of producing 1300 GW if the entire GDAs were covered with equipment.

Obviously, only a small fraction of the land area would ever be contemplated for CSP farms.

For illustrative purposes, if only 2% of the land area in the solar GDAs was used, 26 GW of CSP capacity could be developed.



Colorado Hydroelectric

There are 62 operating hydropower facilities in Colorado with a combined installed capacity of approximately 1162 MW. They range in size from 5 kW to 300 MW and include three pumped storage facilities.

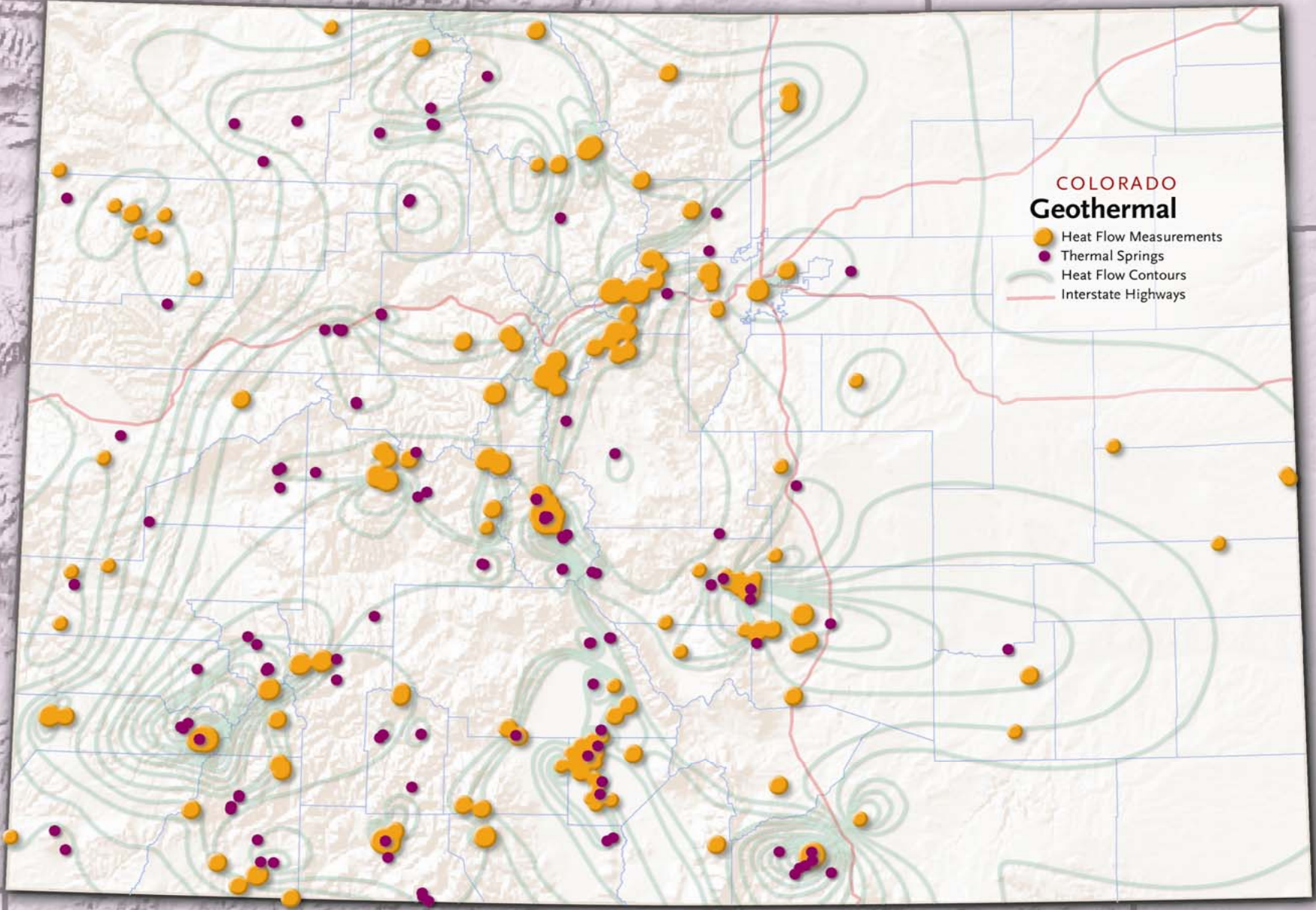


Existing impoundments and other water diversion features without hydropower represent opportunities for new hydropower development. 91 such sites have been identified, with an estimated capacity of about 782 MW.

An initial review suggests several MW of power may be available at existing municipal water systems.

COLORADO Geothermal

- Heat Flow Measurements
- Thermal Springs
- Heat Flow Contours
- Interstate Highways



Colorado's Geothermal Power

Geothermal power is a potentially vast resource. However, Colorado's geothermal development potential remains largely unknown.

There is significant movement of heat from the Earth's interior to its surface in Colorado, and this heat is a potential source of renewable energy.

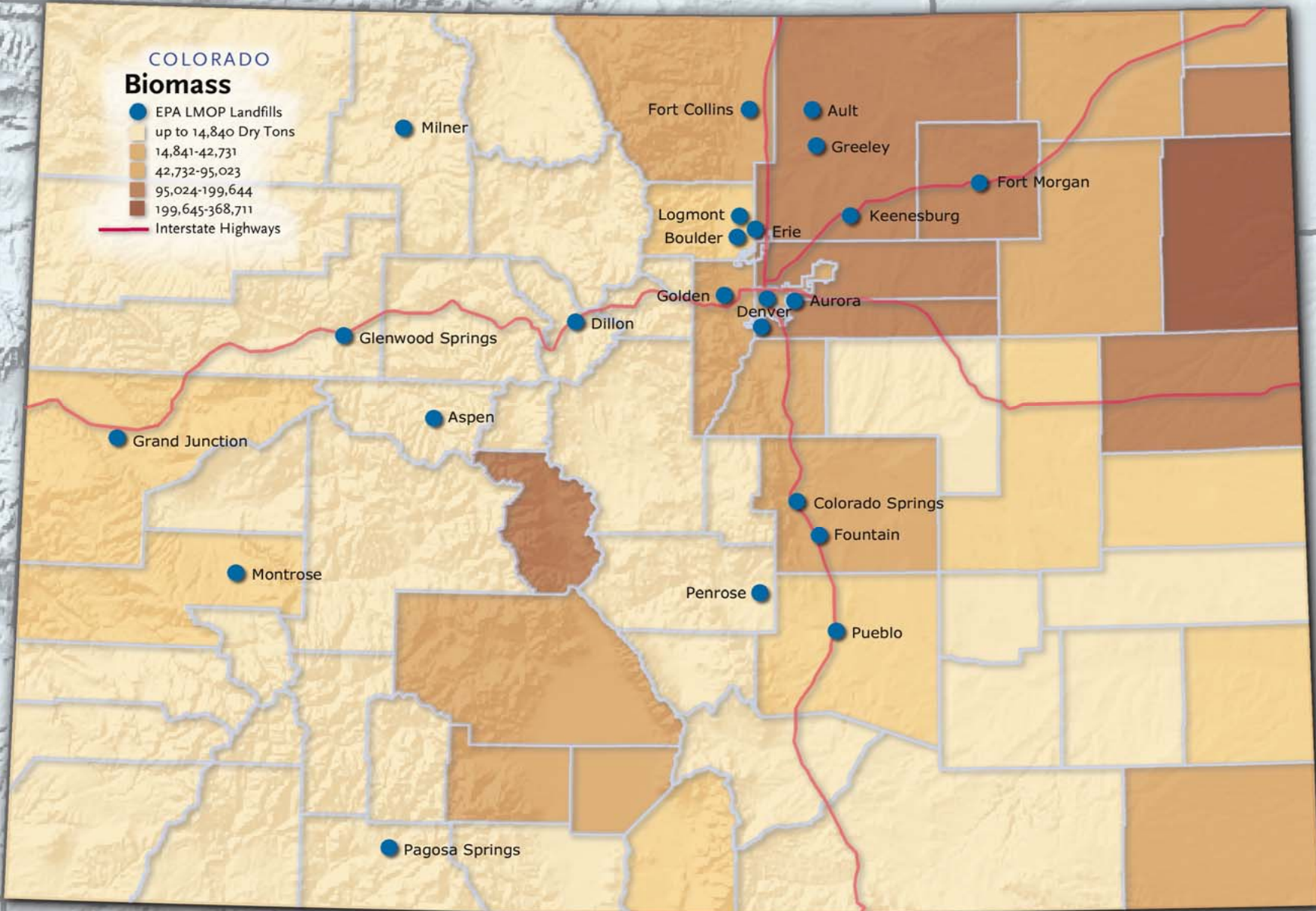
Areas with relatively high heat flow include regions around Buena Vista, Ouray, Pagosa Springs, Trinidad, Canon City, Leadville, Georgetown and west of Rocky Mountain National Park.

Other areas of the state may have high heat flow, but a lack of heat flow data limits identification.



COLORADO Biomass

- EPA LMOP Landfills up to 14,840 Dry Tons
- 14,841-42,731
- 42,732-95,023
- 95,024-199,644
- 199,645-368,711
- Interstate Highways

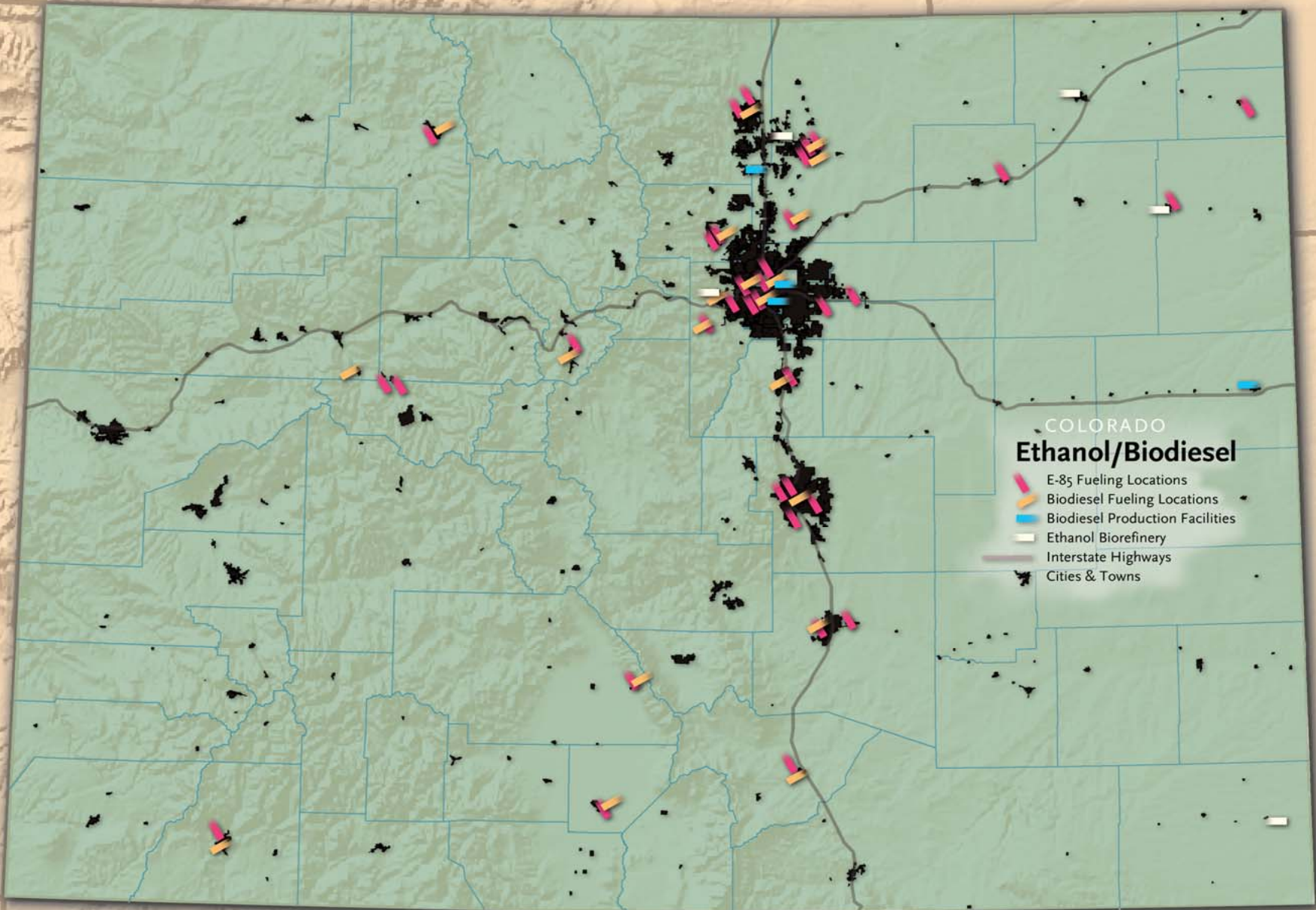


Colorado's Biomass

Colorado's biomass includes forest resources, agricultural residues and products, and resources from municipal waste streams including solid wastes, bio-solids, sewage, and waste buried in landfills.

NREL data shows that there is about 6 MW of capacity from wastewater plants, and about 14 MW of capacity from landfill gas.



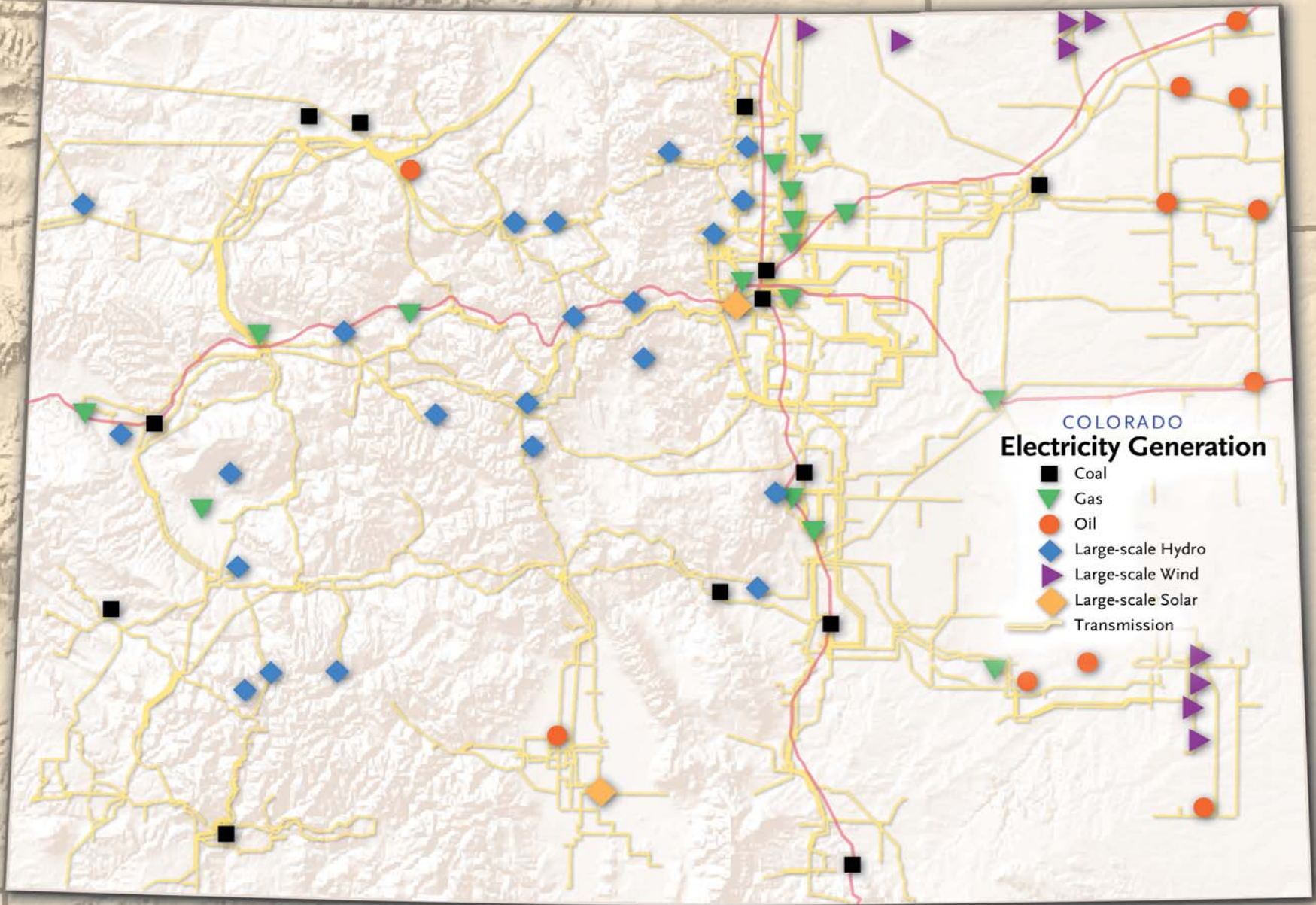


Colorado's Ethanol



Ethanol and biodiesel are used in the transportation sector, not electric power generation. The SB07-091 Task Force was charged to assess electric power generation. Accordingly, ethanol and biodiesel GDAs were not created.

Colorado's ethanol fuel facilities produce an estimated 350 million gallons per year at seven locations on the Front Range. There are 20 biodiesel fueling locations and more than 30 E-85 fueling locations across the state.



COLORADO
Electricity Generation

- Coal
- ▼ Gas
- Oil
- ◆ Large-scale Hydro
- ▲ Large-scale Wind
- ◇ Large-scale Solar
- Transmission

Colorado Generation

- The report lists all Colorado power plants over 1 megawatt in size.
- Over 200 in number, they run the spectrum from the large plants (coal, hydro, wind, and gas) to small plants (oil, diesel fuel, methane, and solar)

Transmission

The report presents:

- A description of the Western Interconnection, and Colorado's place in the Interconnection.
- Key recommendations from the 2006 Transmission Study.
- Details regarding proposed transmission expansion plans in Colorado.
- Details regarding the ratings of the lines and the constraints we face.

Primary considerations discuss Colorado's:

- Ability to ensure continued affordable, reliable electricity and to build a vibrant economy depends on sufficient transmission capability.
- Lack of high voltage transmission limits the ability to leverage our renewable resources.



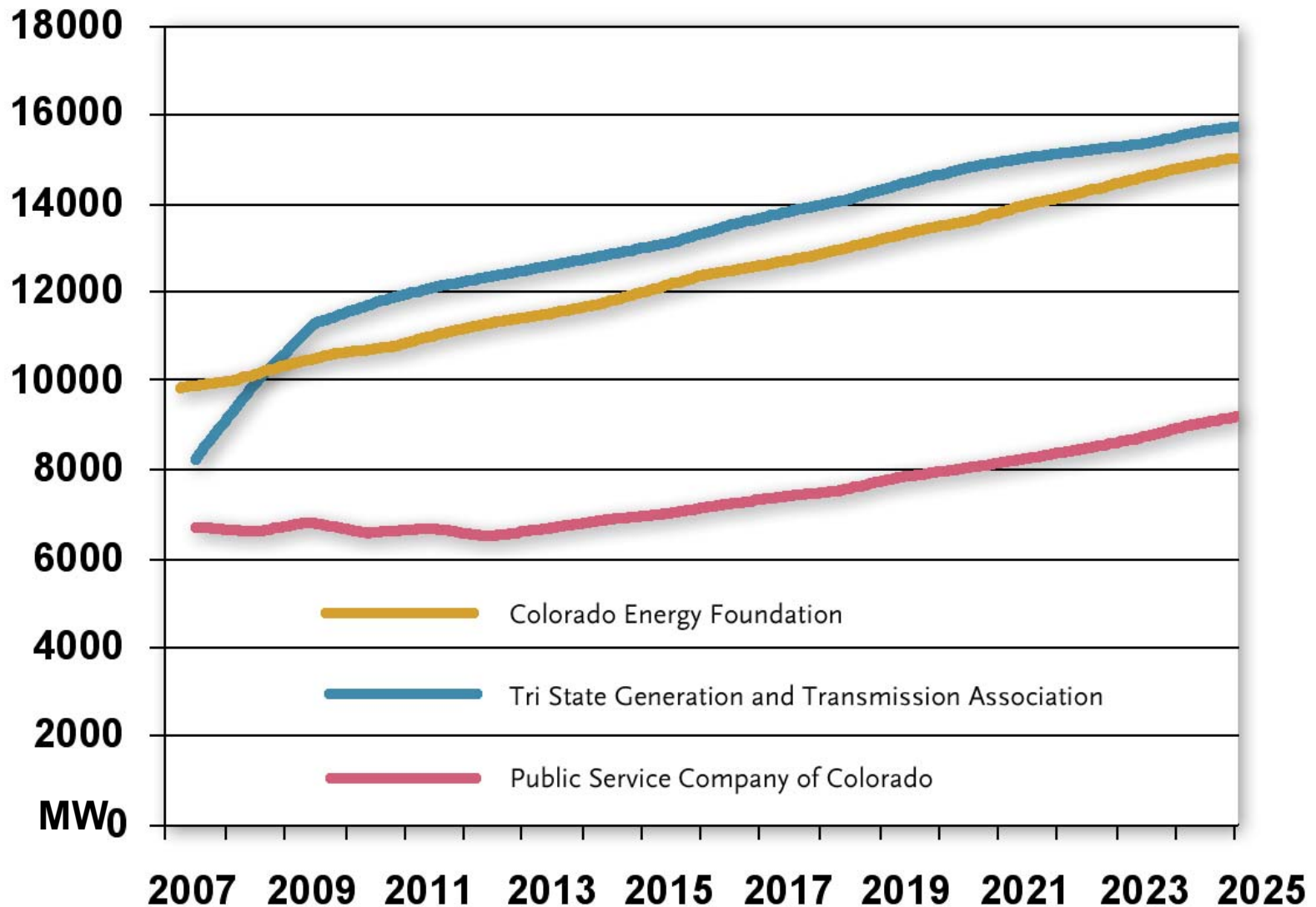
Colorado Public Policy

The report discusses:

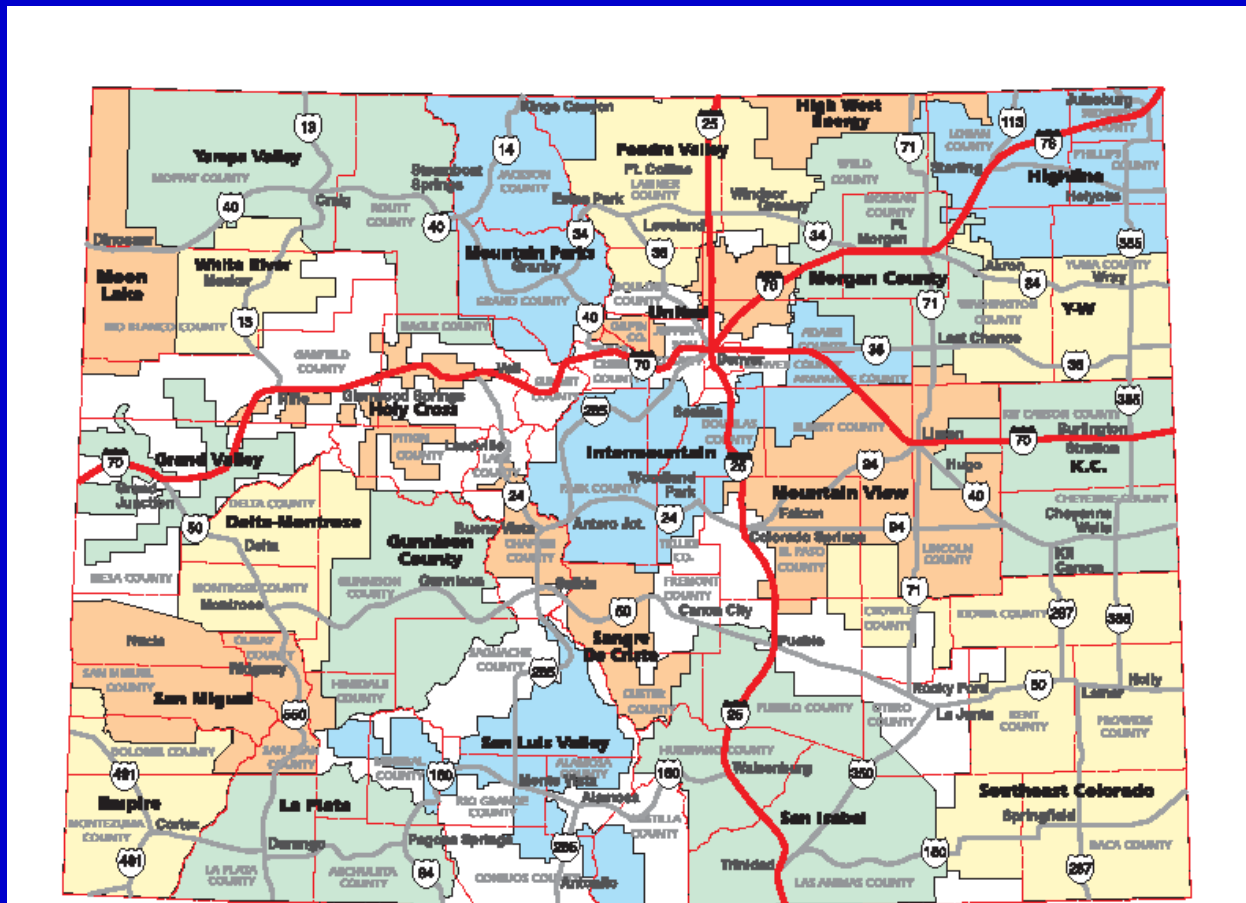
- Renewable Electricity Standards
- Amendment 37
- 2007 expansion of A37
- Energy Zones and Transmission build-out
- Clean Energy Development Authority
- PUC Distributed Generation policy
- Interconnection
- Net Metering
- Federal legislation



The report presents electric demand forecasts from Xcel Energy, Tri-State, the Colorado Energy Forum, and Platte River Power Authority



The report provides a profile of Colorado's electric utility industry. The profile describes the different types of utilities and the variety of approaches regarding renewable energy and energy efficiency incentives.



Appendix (18 pages)

The Electricity Context for Colorado Renewable Resource Development

National and Regional Electricity Industry

North American Electrical Interconnection Regions

WECC Historical and Projected Electrical

Capacity and Energy

Primary Components of the WECC Transmission Grid

Transmission Capacity between WECC Control Areas

Electric Statistics

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Colorado Generation

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Transmission Costs

Approximate Overhead Transmission Line Costs

Transmission Rates Vary Depending on Utilization

Future Transmission Plans

High Plains Express

Eastern Plains Transmission Project

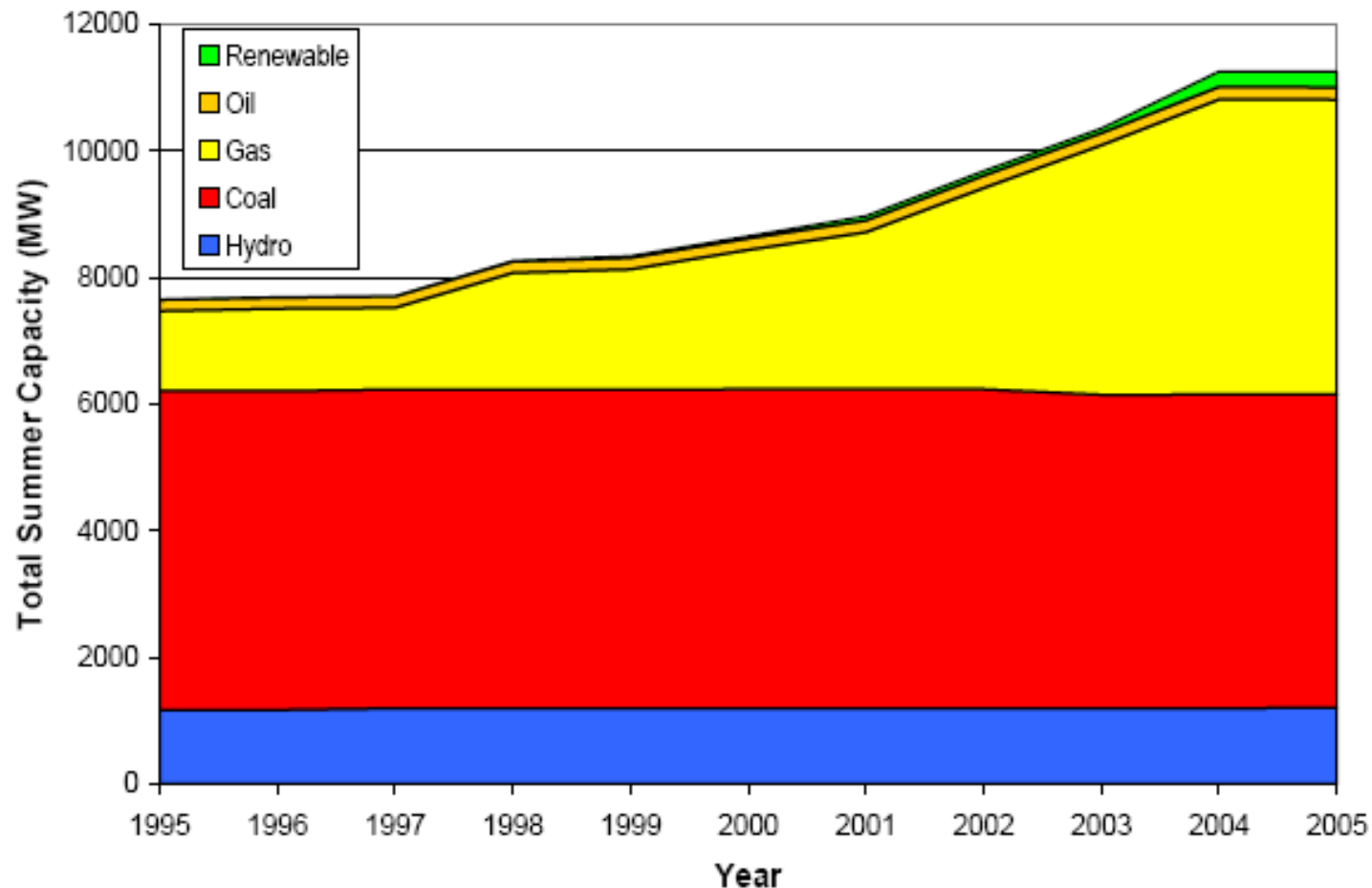
Wyoming-Colorado Intertie Project

NREL Analysis of GDAs for Wind and Concentrating Solar Power

Supply Curves for Wind GDAs

Supply Curves for Concentrating Solar Power GDAs

The report indicates the growth of natural gas capacity in Colorado. It describes the current and potential future price consequences that stem from this increased reliance.

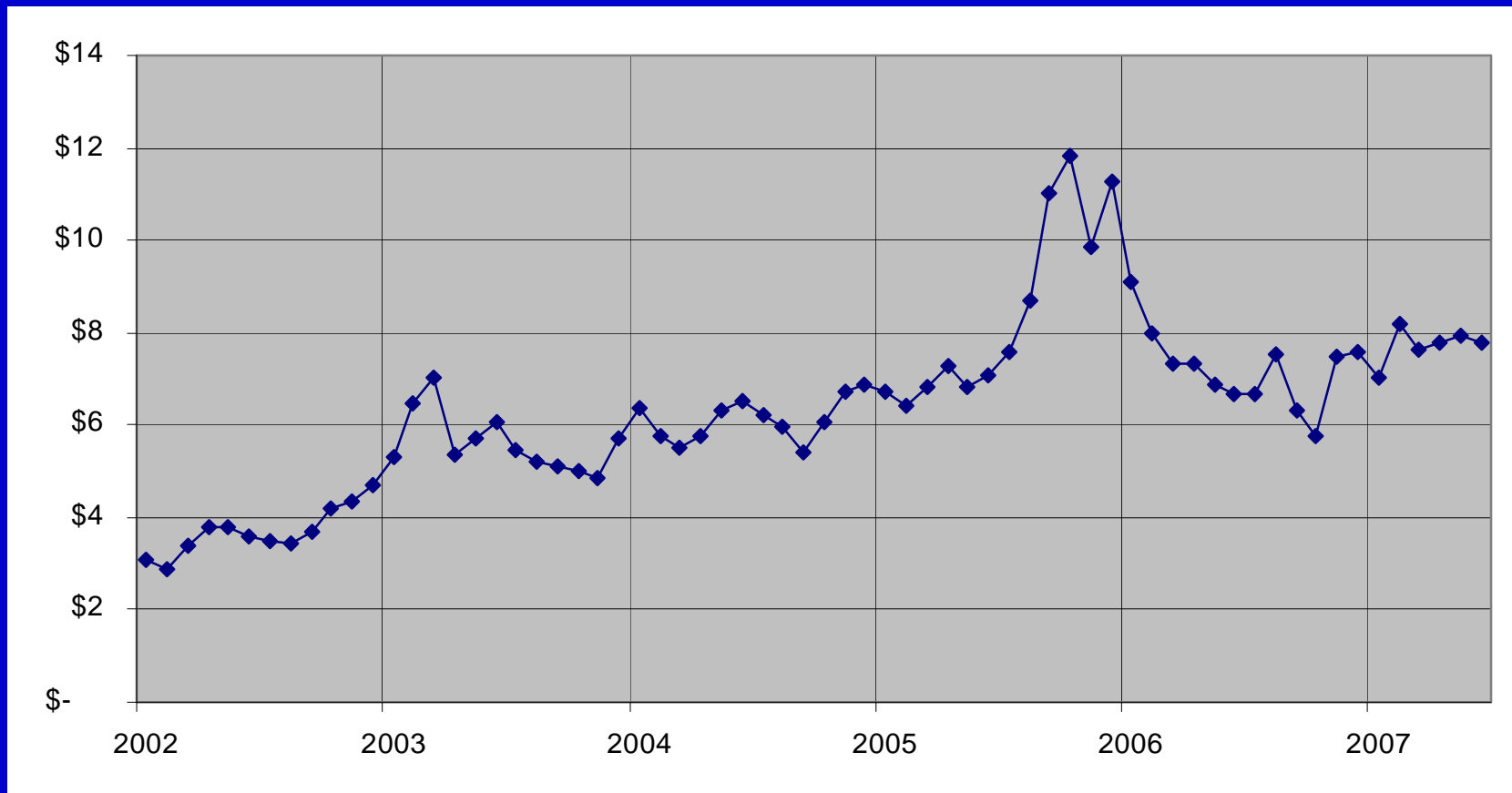


Source: Energy Velocity data compiled from Global Energy Primary Research, Websites, State & Federal Agencies, EIA 860, NERC ES&D, CFE, StatsCanada.

The report discusses the price of natural gas, and what may be the future price of electricity from fossil fuels under different carbon pricing scenarios.

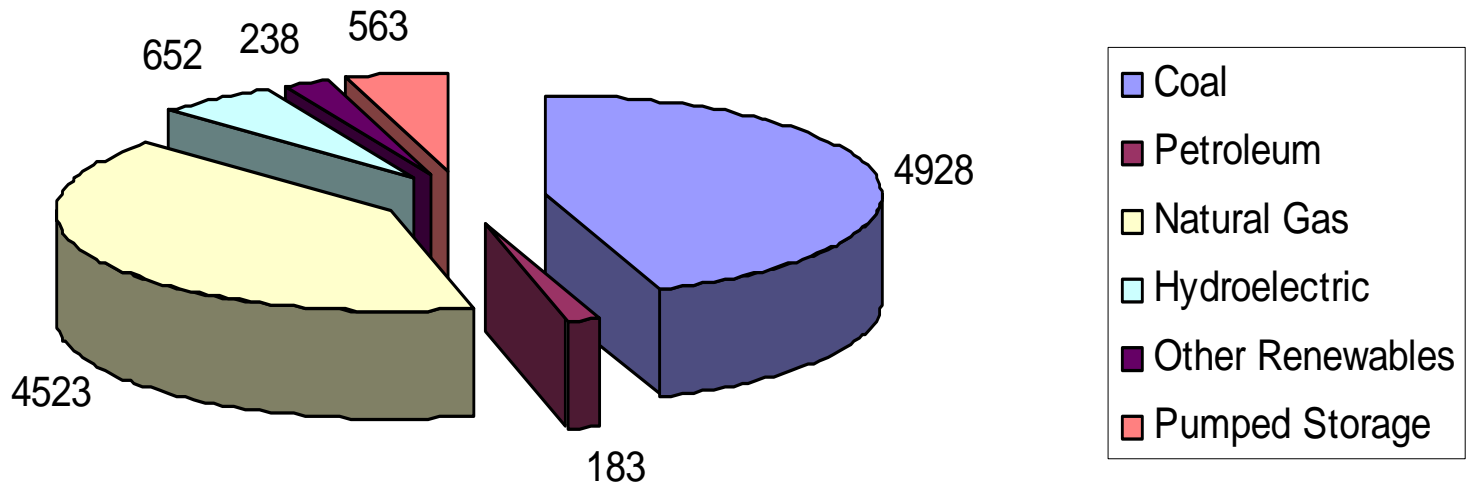
Price of Gas for Electricity (\$/mmBtu)

(Source: EIA/DOE)



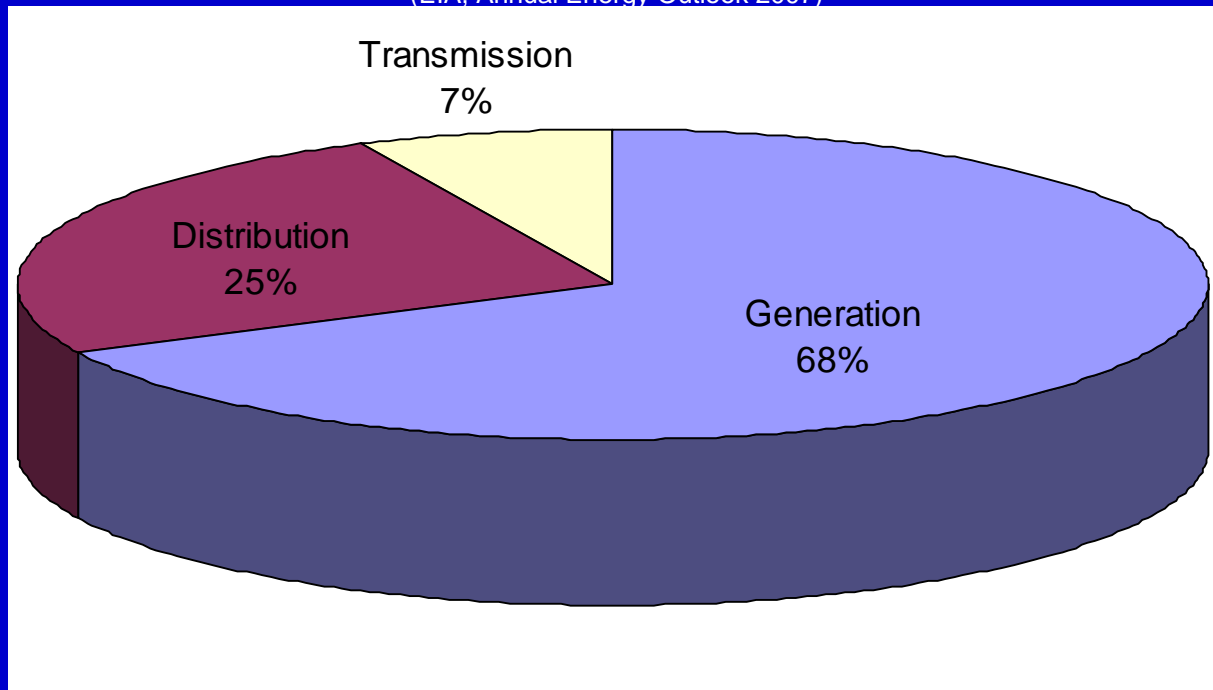
The report describes how Colorado's non-hydro renewable generating capacity has grown from 183 MW in 2005 to over 1000 MW today.

Colorado Electric Generating Capacity by Fuel Type (MW) 2005

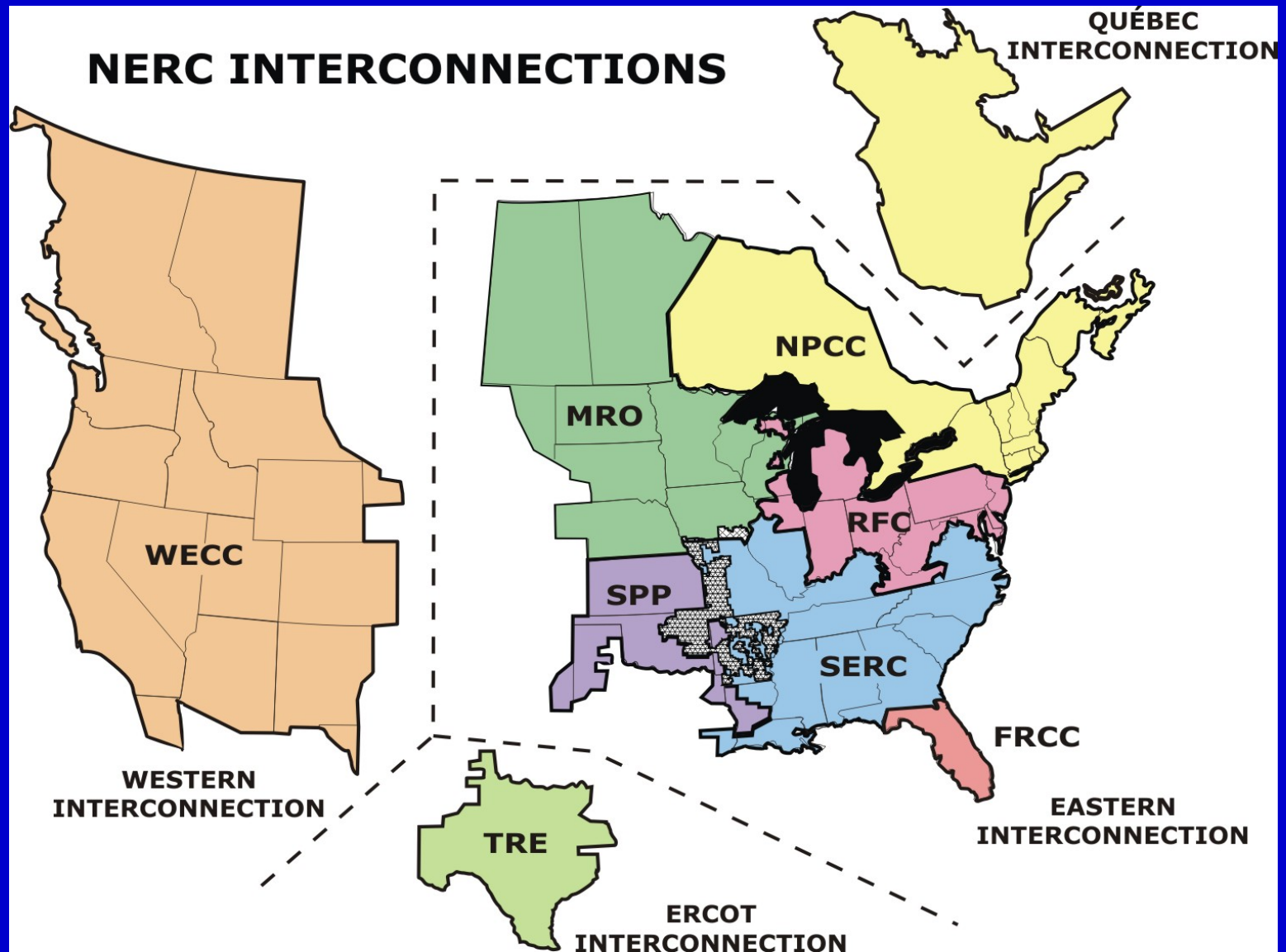


The report addresses how investment in transmission in Colorado has been lacking over the past two decades, due primarily to the widespread deployment of natural gas-fired generating stations located near load centers.

National Average Cost of Electricity Breakdown
(EIA, Annual Energy Outlook 2007)



The report describes how North America historically developed into four virtually separate interconnections, and how costly AC-DC-AC interties transfer only a relatively minor amount of power between the interconnections.



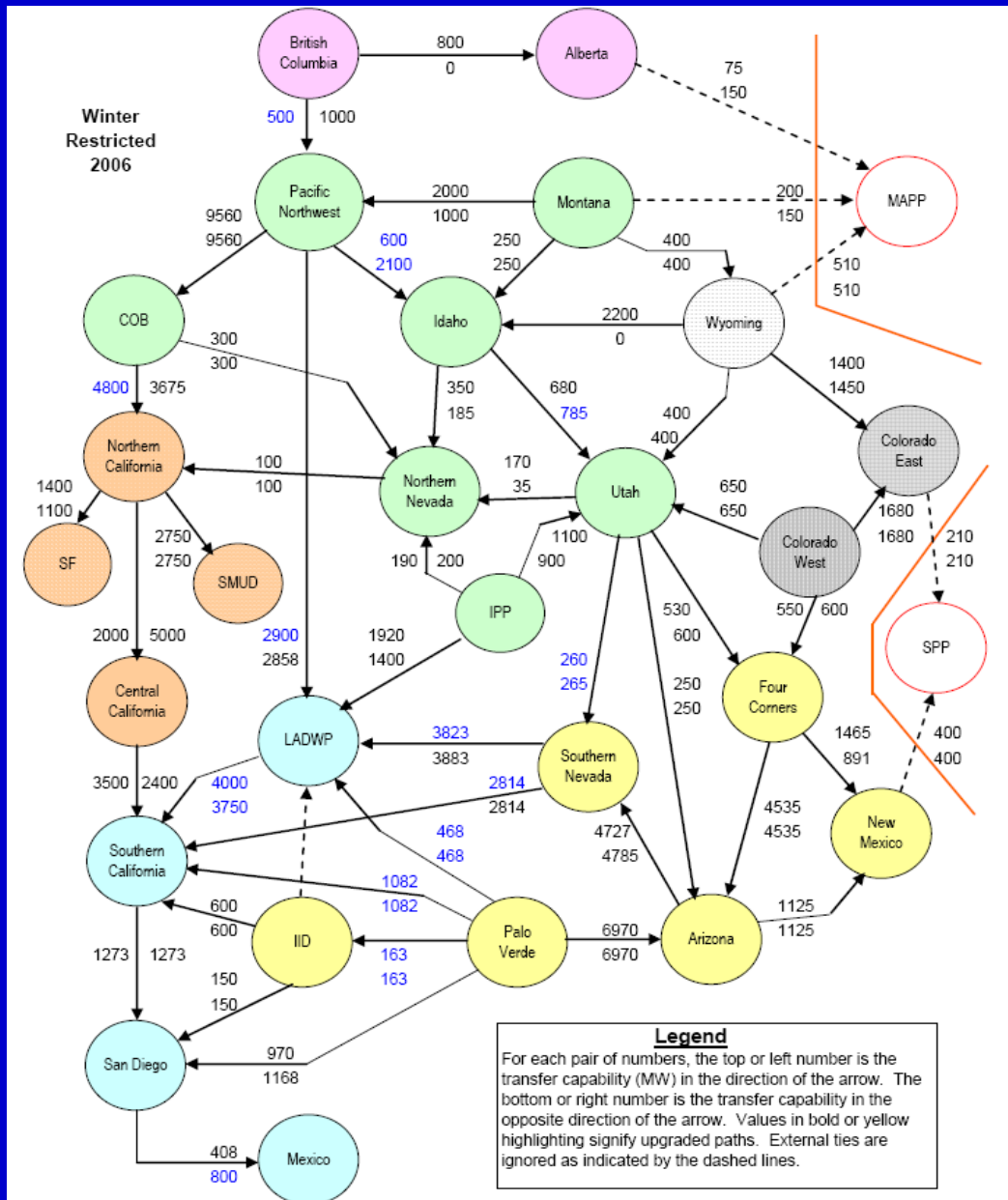
The report describes how the Eastern half of the Western Interconnection needs to be re-balanced through the expansion of high voltage transmission.

Primary Components of the WECC Transmission Grid

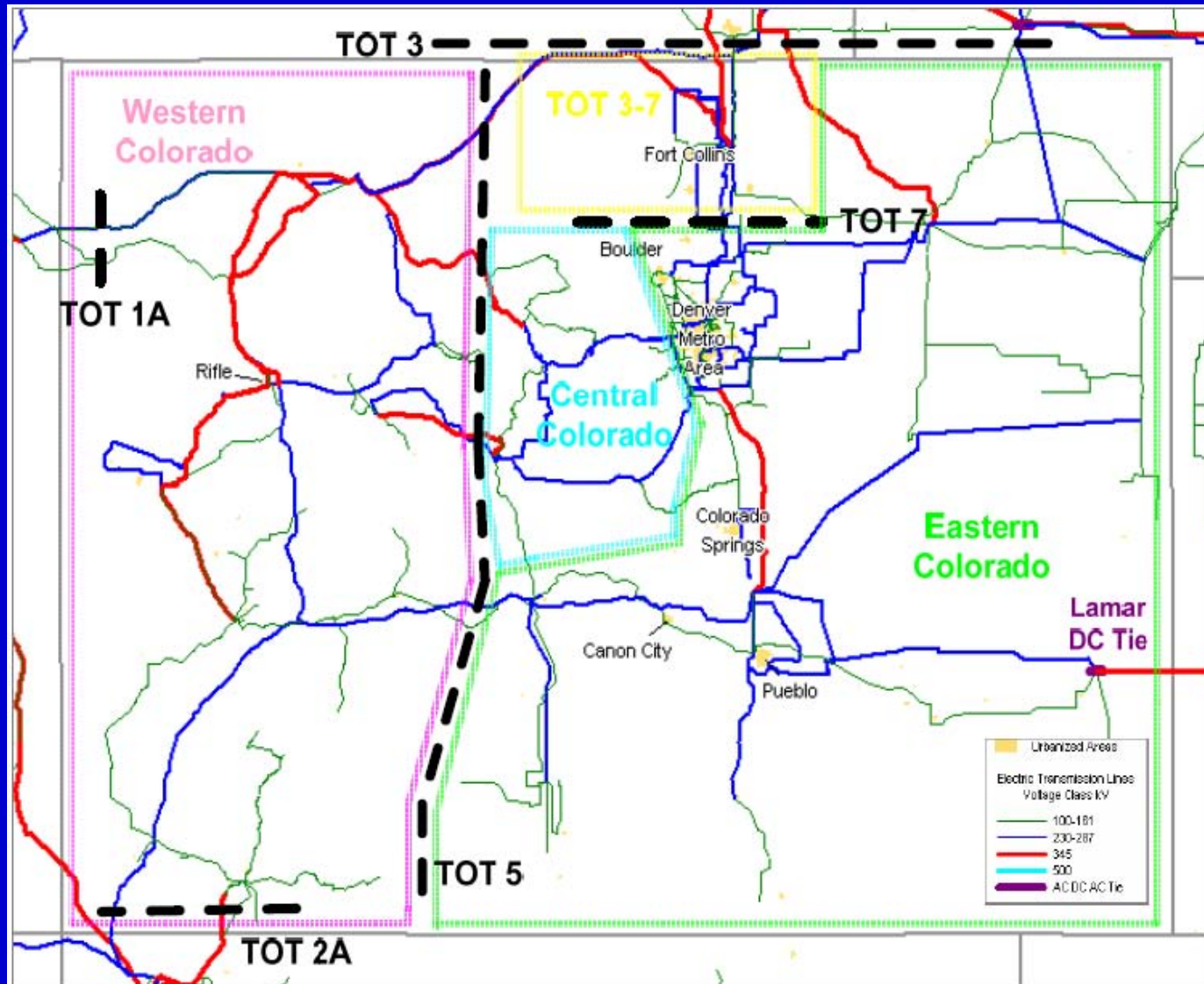
(Source: Rob Kondziolka, Salt River Project)



The report describes how Colorado has very limited transfer capability.



The report provides detailed information on the transmission constraints in Colorado.



The report provides estimates for the cost of transmission. The data indicates that higher voltage lines provide better value (dollars per MW) as they become more fully subscribed, potentially with renewable resources.

Approximate Overhead Transmission Line Costs
(Source: Trans-Elect)

Voltage	\$000/Mile	Other*	MILES - APPROX. INSTALLED COST (\$MM)				
			100	200	300	400	500
230	\$750	30%	\$98	\$195	\$293	\$390	\$488
345	\$1,000	30%	\$130	\$260	\$390	\$520	\$650
500	\$1,500	30%	\$195	\$390	\$585	\$780	\$975

Voltage	Capacity (MW)	MILES - APPROXIMATE \$/MW				
		100	200	300	400	500
230	400	\$244	\$488	\$731	\$975	\$1,219
345	750	\$173	\$347	\$520	\$693	\$867
500	1,500	\$130	\$260	\$390	\$520	\$650

* Substations, SVC, Series Compensation, Phase Shifters, etc.

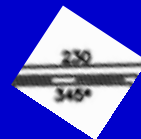
Wyoming-Colorado Intertie Project (TOT3)



200 miles
230 kV
450 MW

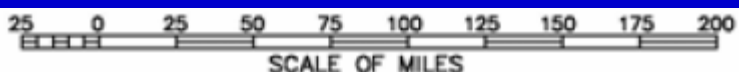
180 miles
345 kV
900 MW

- Recommended by RMATS
 - TOT3 Constraint
 - 6 Lines w/ 1,600 MW Capacity
- Public/Private Partnership
 - Wyoming Infrastructure Authority, Trans-Elect & WAPA
- Potential HPX building block
- Wind & Coal Resources
- Customers: LSEs & Generators
- Provides mechanism to tap non-firm capacity across TOT3
 - 100 MW @ 99% of the Time
 - 500 MW @ 75% of the Time
- Open Season Auction Jan-08
- ~2013 on-line date
- Project Website:
 - www.wyia.org/wci

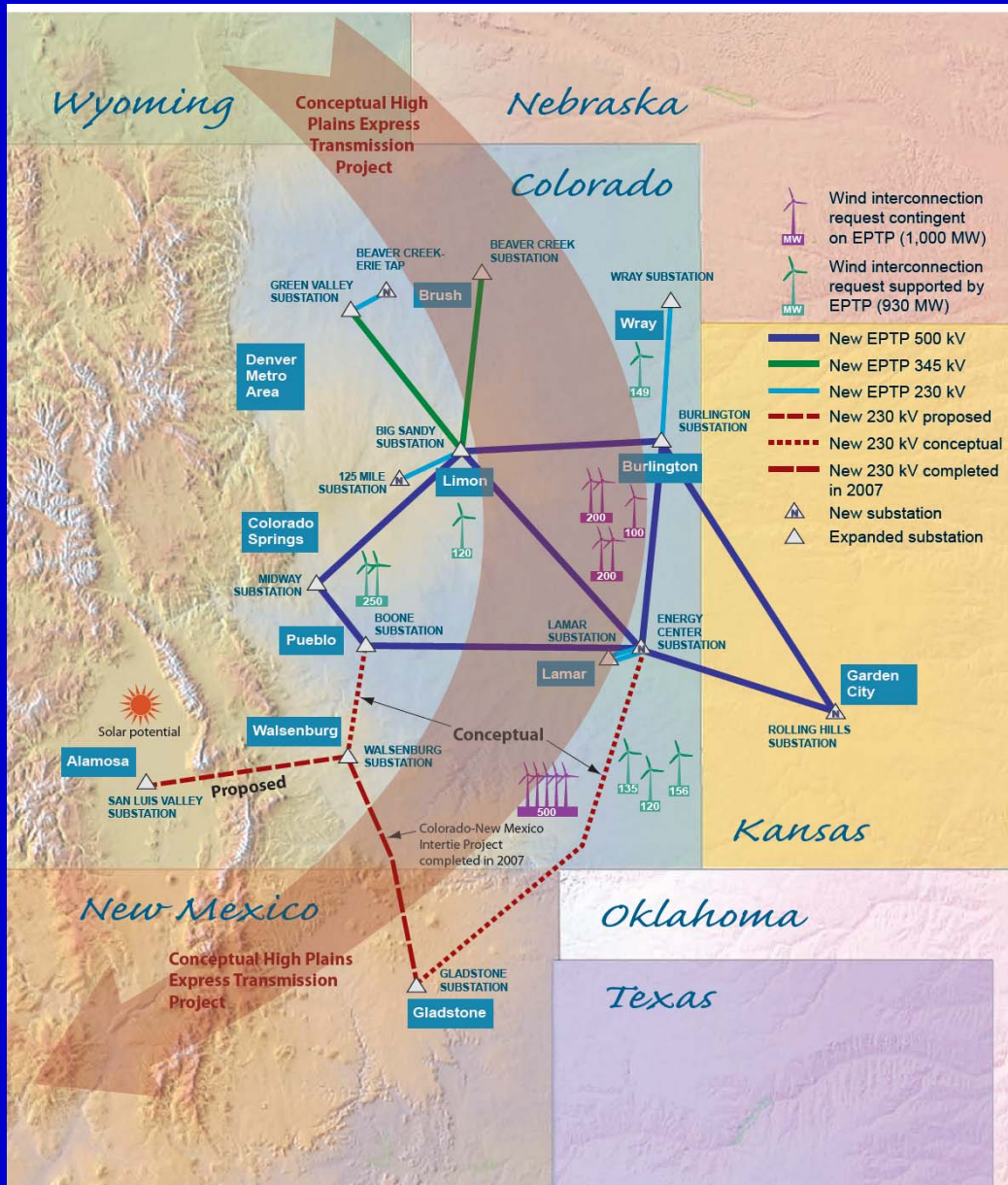


Existing Transmission Lines

New Lines Under Development

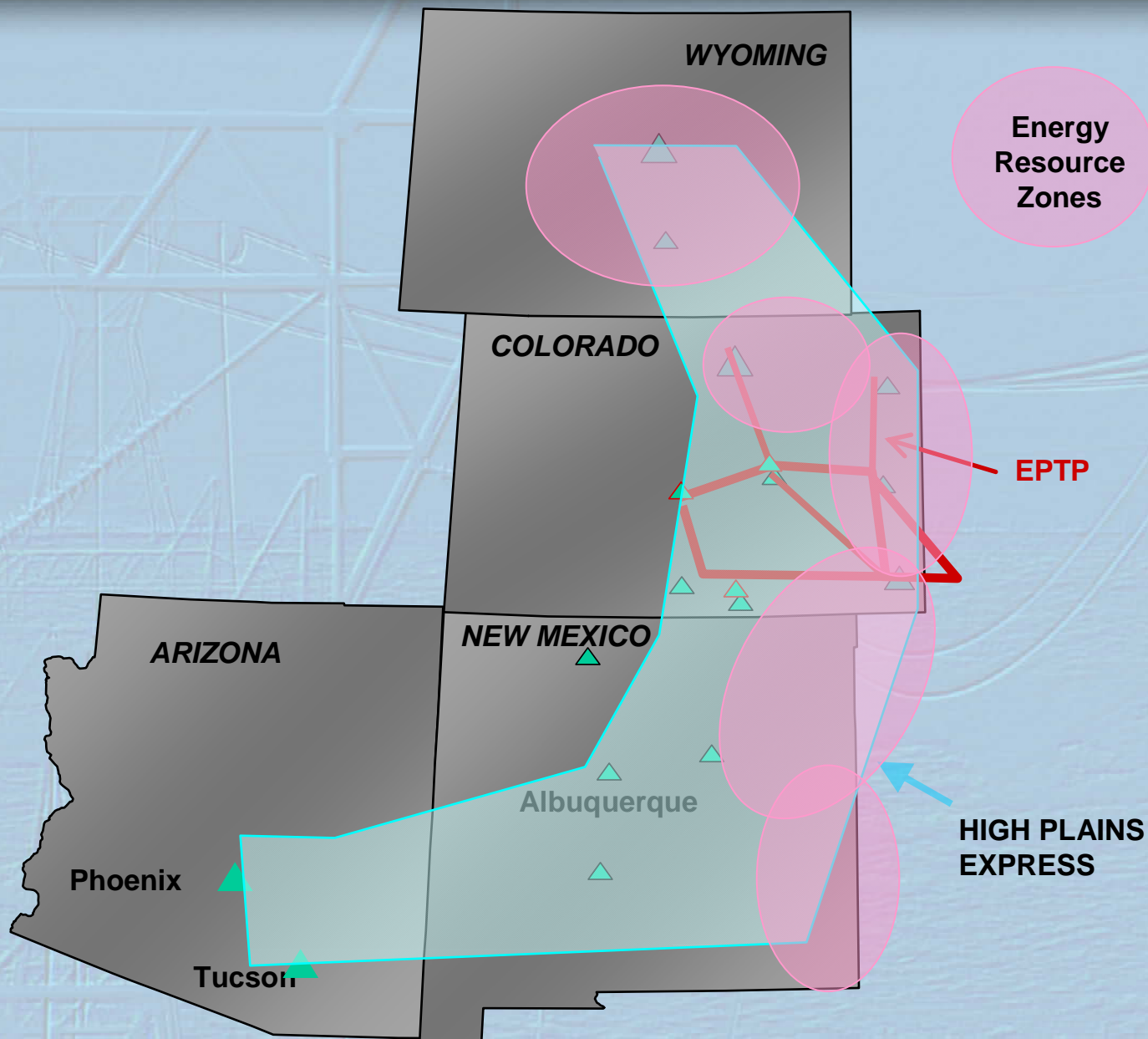


Eastern Plains Transmission Project





High Plains Express Transmission Project



NREL Analysis of the Wind and CSP GDAs

Detailed economic and technical assumptions to support the key findings regarding:

- 96 GW of wind in the 8 wind GDAs
- 26 GW of CSP in the 2 CSP GDAs



Next steps for Colorado

Renewable Resource Developers and
Electric Utility Coordination

Colorado Coordinated Transmission Planning

Clean Energy Development Authority

Public Utilities Commission

Regional Electric Power Cooperation

Legislative Oversight

Public Participation

Distribution of the report

Printed copies of the report will be available by December 28.

Copies will be distributed to:

- Legislative leadership
- The Governor's Office
- Task Force Members
- Key state agencies
- Task Force contributors
- CEDA Board Members

The Report will be posted on the GEO website. A link to the GEO web page will be emailed to all those on the CEDA and SB91 distribution lists.

GEO will issue a press release.

GEO will summarize the report in its electronic newsletter.

Large posters of the maps will be produced.

thank you

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