Strategic Transmission and Renewables (STAR) Report

(per October 22, 2010)

I. Description. The STAR Report:

1) Is a follow-up to the GEO's Renewable Energy Development Infrastructure (REDI) Report, released in December, 2009: http://www.rechargecolorado.com/index.php/programs_overview/renewable_energy_development_infrastructure/

2) Is utilizing the services of ION Consulting, who is providing report drafting, and other services to the GEO.

3) Will produce a variety of results that provide a vision of Colorado's electric power sector in the years 2030 and 2050, given a variety of credible assumptions and constraints.

4) Is utilizing new modeling output from Dr. Saeed Barhaghi, who conducted the modeling for the REDI Project. A description of Dr. Barhaghi's modeling work is available at: http://rechargecolorado.com/images/uploads/pdfs/redi_ucd_college_of_engineering%5B1%5D.pdf

5) Is using the carbon dioxide reduction goals of Governor Ritter's November 2007 Climate Action Plan as the primary metric for analysis (a 40% reduction in CO2 by 2030 and an 80% reduction in CO_2 by 2050).

6) Selects a generation mix that minimizes the net present value over the 45 years planning horizon, with emphasis on years 2030 and 2050 after the Climate Action Plan's CO_2 reduction goals have been met.

7) Uses fuel costs derived from regulatory filings and widely-accepted data sources.

8) Utilizes an updated (compared to the REDI Report) power generation technology cost and performance deck for modeling purposes. The deck uses reliable, published data from a variety of sources (including the FERC, the EIA's National Energy Modeling System, NREL, and Colorado utilities' regulatory filings). The technology deck contains capacity costs, life expectancies, heat rates, availability factors, variable O&M, fixed O&M costs, and emission rates for CO_2, NOx, and SO_2.

9) Will develop deliverables that contain detailed expositions of the Colorado's generation and transmission challenges and opportunities.

10) Will make specific recommendations that address the most efficient and effective actions that Colorado, and regional transmission stakeholders, should consider to effectively meet these challenges during calendar year 2011 and beyond.

11) Will be released in December 2010.

II. Draft STAR Report Outline. The following topical areas encompass the primary features of the STAR Report:

1. The extent of demand side measures may have a material impact on the need for new generation. Load growth assumptions play a critically important function in determining ultimate outcomes, driven in large part to the growth of the economy in Colorado. And depending on the generation mix selected to meet strategic goals, demand side measures will have an impact on the extent of new transmission required to support the generation.

2. Strategic expansion of Colorado's high voltage backbone to Colorado's renewable resource Generation Development Areas (GDAs) is needed to meet the needs of a reliable, responsible electric power sector into the foreseeable future.

3. Meeting the goal to strategically plan for Colorado's electric power sector in 2030 and 2050 will require significant investments in natural gas generation and pipeline infrastructure.

4. The price of natural gas into the future will be a significant variable that will ultimately determine the economic competiveness of renewable energy sources.

5. In order to fully realize the state's strategic electric power sector and transmission objectives, Colorado would benefit by examining, and potentially reforming, its land use, siting, and permitting procedures.

6. Colorado should implement changes to its long range generation and transmission planning processes, featuring closer cooperation between utilities and citizens. Utilities and policy decision-makers will benefit by focusing on strategic results that minimize environmental impacts, minimize water consumption, and stabilize long-term costs by foregoing avoidable fuel costs and mitigating financial risks associated with potential new environmental regulations.

7. Cost recovery and cost allocation policies and procedures need to be revised and clarified to fully develop Colorado's renewable energy potential and to stimulate more investment in high-voltage transmission.

8. Either a physically larger balancing authority or a virtual larger balancing authority is needed to support increased development of renewable energy and lower overall transmission costs (e.g. capacity charges, ancillary services, and rate pancaking).

9. Development of export oriented transmission projects should be part of a long term conceptual generation and transmission plan's vision.

10. Greater adoption of new technologies and new approaches to support Colorado's electric power sector is needed (storage, smart grid, etc.).

11. A variety of entities are assessing important electric power sector issues.

12. Colorado utilities and others have considerable transmission planning and proposed implementation activities under way. However, more transmission infrastructure, including higher voltages, is needed beyond what is currently being planned.

13. Recent Colorado General Assembly legislation may have an influence on new transmission requirements.

14. Promising techniques are being explored to help meet the challenge of wind integration.

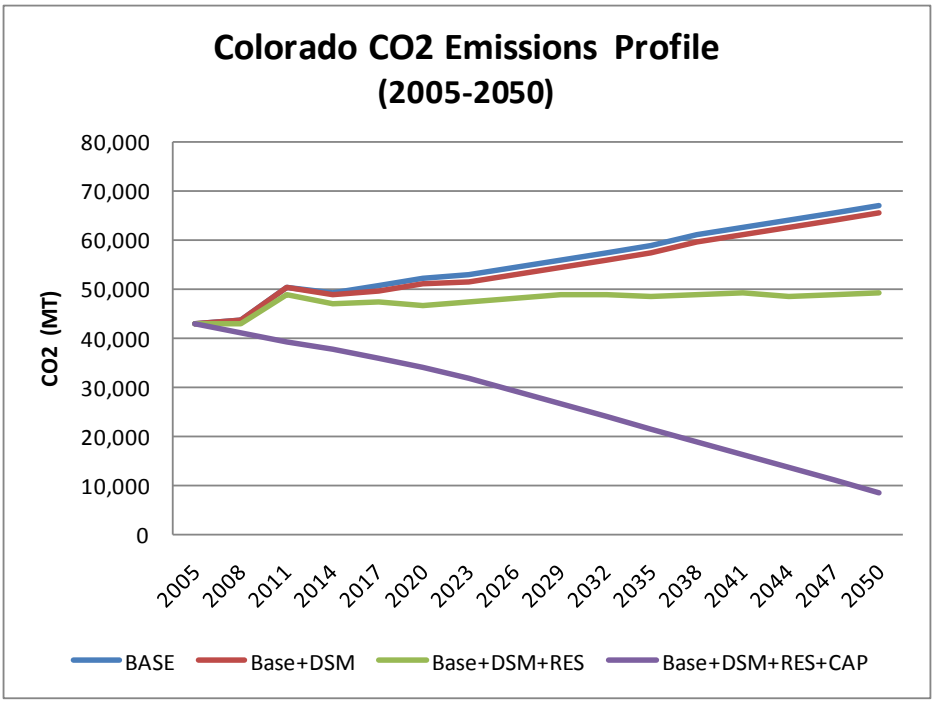
15. Colorado should explore what benefits and issues would arise should the state open entry into the transmission market to independent transmission companies.

Description of the STAR Project's Modeling Work

The following are primary modeling assumptions (subject to change):

1. An aggregate, statewide annual average load growth of 1.7% to 2030 and beyond to 2050. We will model a sensitivity of 3% (high load growth), and will not include a sensitivity run on the 1.2% (low forecast).
2. All of PSCo's SB07-100 transmission lines will be in service by 2030.
3. All Colorado coal-fired generating stations at the age of 45 will be retired during the end of the year when they turn 45 or older beginning in 2017 consistent with HB10-1365 (see below for list of all coal power plants, date of commercial operation, and potential capacity changes subject to retirement at a given year).
4. The HB10-1001 Colorado renewable electricity standard will be met or exceeded (30% renewables by 2020 for investor-owned utilities; 10% renewables by 2020 for applicable rural electric cooperatives and municipal utilities).
5. The model will constrain wind generation to 33% penetration through year 2035, increasing the penetration to 40% by year 2050.
6. Wind resources in GDAs 1 & 8 will have an average 42% capacity factor. GDA 2 is modeled with an average capacity factor of 36.6% and all other GDAs are modeled at 34% capacity factor. However, based on 80 meter hub heights, capacity factors of GDAs increase by some appreciable amount which is not modeled at this time.
7. Coal-fired generation without CCS technology will not be modeled.
8. Nuclear power will be modeled given current cost and performance data.

The initial STAR modeling run produced these preliminary results:



Definitions:

Base means no DSM or RES or CAP. The model builds just to meet the forecasted load.

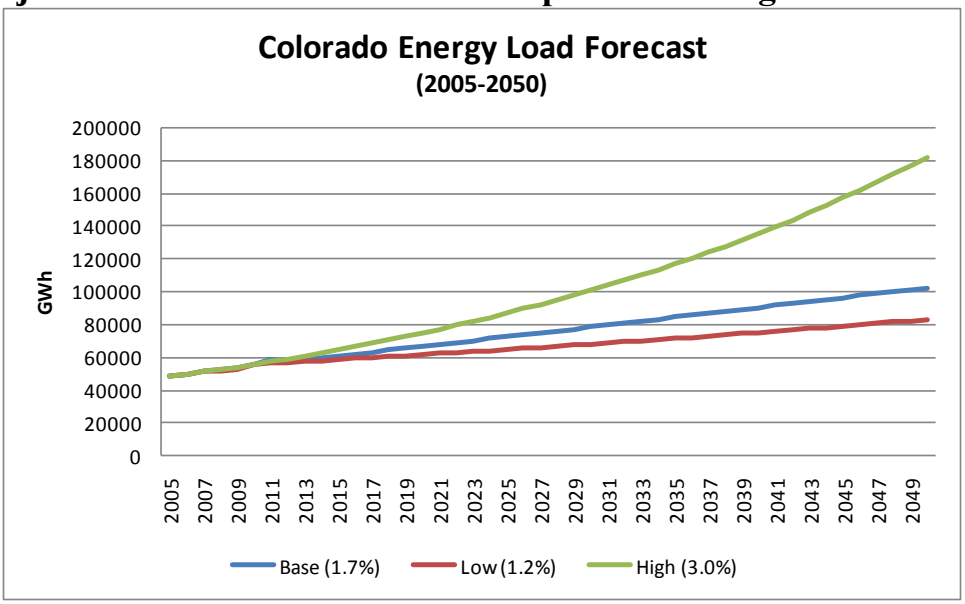
B+ DSM means incrementally add the IOUs' DSM requirements.

B+D+RES means incrementally add the RES requirements after adding the DSM requirements. We refer to this case as the **Reference Case**. The Reference Case is when the power sector in Colorado builds to meet the load considering DSM requirements (that applies to IOUs only), and the RES (30% for IOUs and 10% for non-IOUs) requirements by 2020.

Ref+CAP is Colorado's Climate Action Plan scenario applied to the Reference Case. This means that Colorado's power sector's CO2 emissions meet the CAP goals by 2020, 2030, and 2050.

The initial STAR modeling run produced these preliminary results (cont.):

Aggregate electric load growth using information submitted by Colorado's major utilities to the CCPG's Conceptual Planning Work Group



Colorado Energy Load Forecast in Gigawatt-hours

Year	Base (1.7%)	Low (1.2%)	High (3.0%)
2010	55,845	55,845	55,845
2020	66,661	62,921	75,052
2030	78,562	70,892	100,863
2040	90,486	79,874	135,552
2050	102,410	89,993	182,170

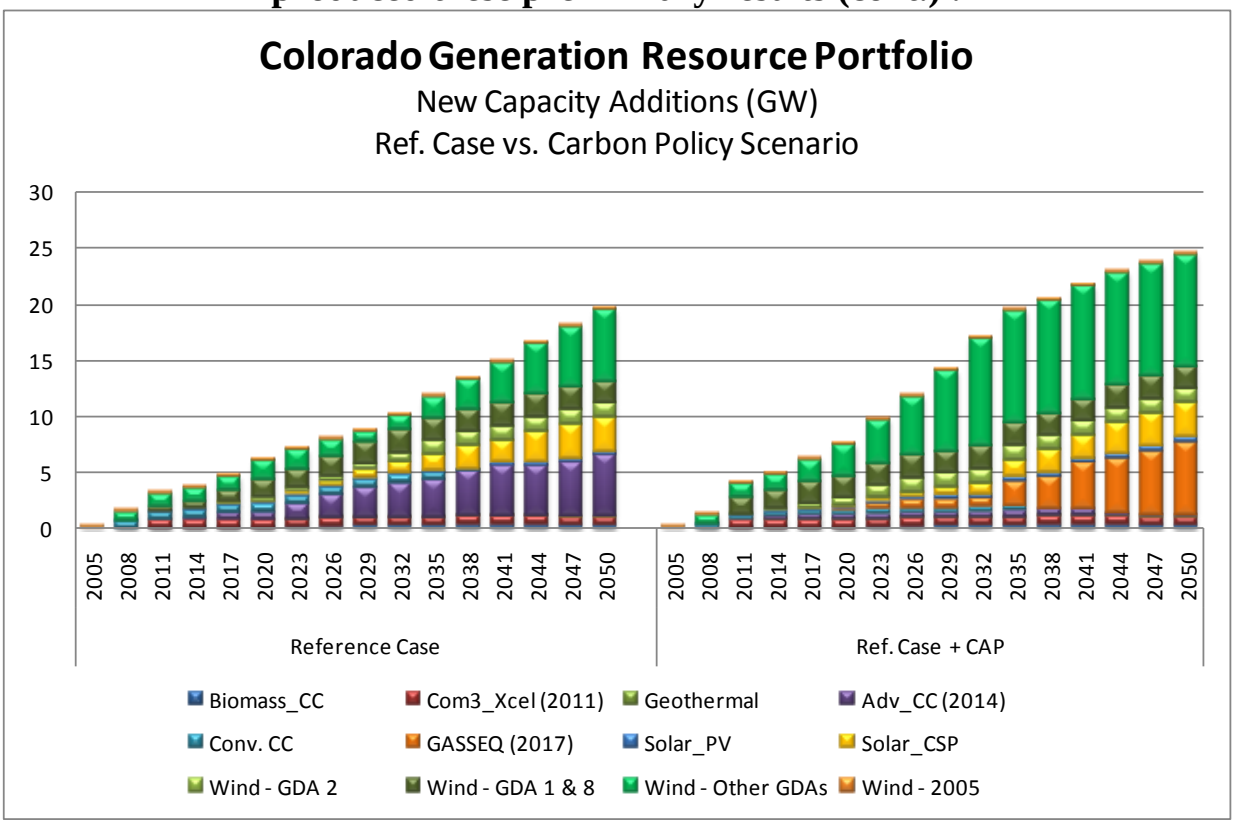
The STAR modeling assumes an aggregate, statewide annual average load growth of 1.7% to 2030 and beyond to 2050. We will model a sensitivity of 3% (high load growth). The modeling effort will not include a sensitivity run on the 1.2% (low forecast).

The initial STAR modeling run produced these preliminary results (cont.) :

New Capacity Additions

Technology/Scenario	2020 CAPACITY PORTFOLIO (GW)				2030 CAPACITY PORTFOLIO (GW)				2050 CAPACITY PORTFOLIO (GW)			
	Base	B+DSM	B+D+RES	Ref+CAP	Base	B+DSM	B+D+RES	Ref+CAP	Base	B+DSM	B+D+RES	Ref+CAP
Biomass_CC	0	0	0.06	0.06	0	0	0.24	0.24	0	0	0.26	0.26
Com3_Xcel (2011)	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
Geothermal	0	0	0	0.01	0	0	0.01	0.02	0	0	0.04	0.04
Adv_CC (2014)	1.97	1.32	0.70	0.46	4.68	4.04	2.7	0.46	12.03	11.19	5.46	0.16
Conv. CC	1.37	1.18	0.68	0.35	1.37	1.18	0.68	0.35	0	0	0	0
GASSEQ (2017)	0	0	0	0.06	0	0	0	0.81	0	0	0	6.43
Solar_PV	0	0	0.13	0.17	0	0	0.15	0.33	0	0	0.38	0.5
Solar_CSP	0	0	0.11	0.11	0	0	0.67	0.68	0	0	3.00	3.00
Wind - GDA 2	0	0	0.35	0.73	0	0	0.53	1.28	0	0	1.28	1.28
Wind - GDA 1 & 8	0	0	1.53	2.00	0	0	2.00	2.00	0	0	2.00	2.00
Wind - Other GDAs	0	0	1.73	2.75	0	0	0.84	7.11	0	0	6.29	10
Wind - 2005	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26
Total New Capcity Addition	4.35	3.51	6.3	7.71	7.06	6.23	8.83	14.29	13.04	12.2	19.72	24.68

The initial STAR modeling run produced these preliminary results (cont.) :



Guidance when reading the bar charts:

Read the bar chart from top to bottom.

Read the legend from the bottom right to the left, and then move up and read from right to left.

For example, for Ref+CAP in 2050, the "Wind-2005" is at the top, followed by "Wind-Other GDAs," followed by "Wind-GDA 1 & 8," followed by "Wind-GDA 2," followed by "Solar-CSP," and so on. The last one is "Biomass_CC."

Definitions

The Reference Case is when the power sector in Colorado builds to meet the load considering DSM requirements (IOUs only), the RES (30% for IOUs and 10% for non-IOUs) requirements by 2020.

The Reference Case + CAP is the carbon policy scenario applied to the Reference Case. This means that the power sector's CO2 emissions in Colorado meet the CAP goals by 2020, 2030, and 2050.

Biomass CC is a biomass combined cycle plant.

Conv. CC is a natural gas combined cycle plant.

GASSEQ is a natural gas advanced combined cycle plant with 90% carbon capture and sequestration. "2017" means that we have modeled the introduction of the technology by 2017.

Wind- 2005 means that all wind generation in the base-year 2005. The model will take it as existing renewable generation and build incrementally beyond that, as needed.

The initial STAR modeling run produced these preliminary results (cont.) :

Colorado Coal-Fired Power Plants Subject to Retirement - Vintage of 45 yrs. or higher (2017 and Beyond)#																
Plant	Unit	Commercial Operation	2011	2014	2017	2020	2023	2026	2029	2032	2035	2038	2041	2044	2047	2050
Cameo*	1	1957	-	22	-	-	-	-	-	-	-	-	-	-	-	-
Cameo*	2	1960	-	44	-	-	-	-	-	-	-	-	-	-	-	-
Cherokee	1	1957	-	-	125	-	-	-	-	-	-	-	-	-	-	-
Cherokee	2	1959	-	-	125	-	-	-	-	-	-	-	-	-	-	-
Cherokee	3	1962	-	-	170	-	-	-	-	-	-	-	-	-	-	-
Cherokee	4	1968	-	-	381	-	-	-	-	-	-	-	-	-	-	-
Hayden	1	1965	-	-	143	-	-	-	-	-	-	-	-	-	-	-
Hayden	2	1976	-	-	-	-	103	-	-	-	-	-	-	-	-	-
Martin Drake	5	1962	-	-	50	-	-	-	-	-	-	-	-	-	-	-
Martin Drake	6	1968	-	-	75	-	-	-	-	-	-	-	-	-	-	-
Martin Drake	7	1974	-	-	-	132	-	-	-	-	-	-	-	-	-	-
Nucla	1	1959	-	-	-	-	-	-	-	-	-	12	-	-	-	-
Nucla	2	1959	-	-	-	-	-	-	-	-	-	12	-	-	-	-
Nucla	3	1959	-	-	-	-	-	-	-	-	-	12	-	-	-	-
Nucla	ST4	1991	-	-	-	-	-	-	-	-	-	79	-	-	-	-
Valmont	5	1964	-	-	192	-	-	-	-	-	-	-	-	-	-	-
Arapahoe*	3	1951	-	48	-	-	-	-	-	-	-	-	-	-	-	-
Arapahoe*	4	1955	-	112	-	-	-	-	-	-	-	-	-	-	-	-
Comanche	1	1973	-	-	-	383	-	-	-	-	-	-	-	-	-	-
Comanche	2	1975	-	-	-	-	396	-	-	-	-	-	-	-	-	-
Comanche	3	2010	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Comanche	3	2010	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Craig	1	1980	-	-	-	-	-	80	-	-	-	-	-	-	-	-
Craig	1	1980	-	-	-	-	-	45	-	-	-	-	-	-	-	-
Craig	1	1980	-	-	-	-	-	107	-	-	-	-	-	-	-	-
Craig	2	1979	-	-	-	-	-	80	-	-	-	-	-	-	-	-
Craig	2	1979	-	-	-	-	-	45	-	-	-	-	-	-	-	-
Craig	2	1979	-	-	-	-	-	107	-	-	-	-	-	-	-	-
Craig	3	1984	-	-	-	-	-	-	-	463	-	-	-	-	-	-
Pawnee	1	1981	-	-	-	-	-	-	552	-	-	-	-	-	-	-
Rawhide	ST1	1984	-	-	-	-	-	-	-	294	-	-	-	-	-	-
Ray D Nixon	ST1	1980	-	-	-	-	-	207	-	-	-	-	-	-	-	-
Modeled Potential Retirement (MW)			-	226	1,261	515	499	671	552	757	-	114	-	-	-	-

Notes:

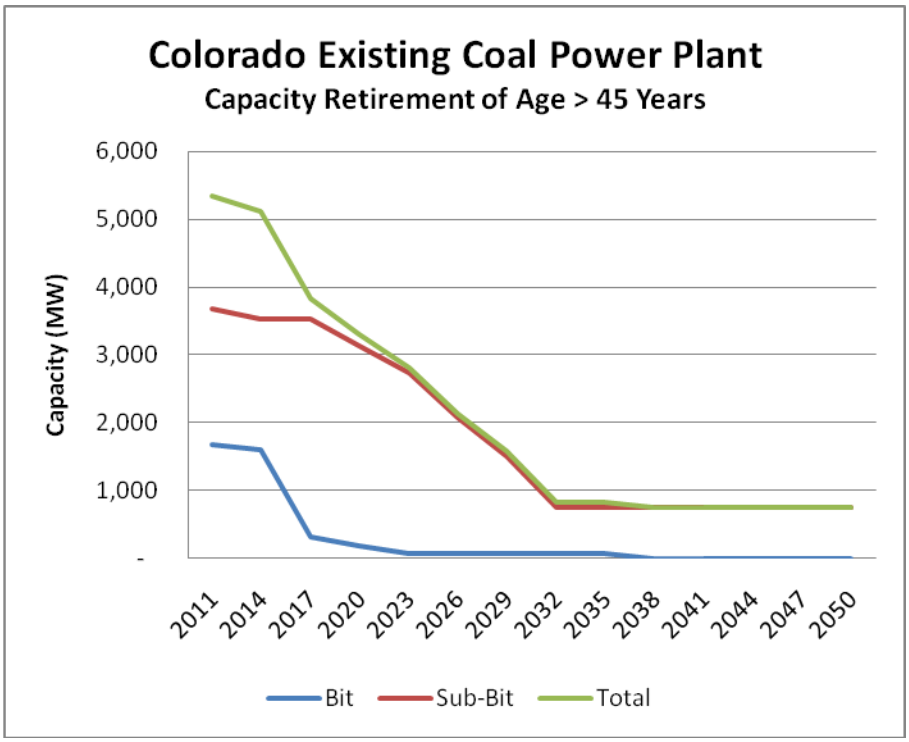
* Scheduled by Xcel to retire prior to 2017.

Retirement/Repowering begins at 2017 even if the age of power plants are higher than 45 years prior to 2017.

Note: Nucla's smaller three units are delayed to retire to coincide with the retirement date of Nucla Unit 4, which was repowered in 1991.

The initial STAR modeling run produced these preliminary results (cont.) :

Modeled retirements, distinguished by coal types



Notes:
Bit = Bituminous coal – plant capacity identified using this type coal as primary source of fuel.
Sub-Bit = Sub-bituminous coal – plant capacity identified using this type of coal as primary source of fuel.
Comanche 3 is the only coal-fired generating station remaining in the resource mix in 2050 and beyond.
The "Total" (green line) shows total amount of potential capacity subject to retirement at a given year. Note that the modeled retirement scenario begins in 2017 and beyond, as represented in the preceding table.