



Colorado and the Clean Power Plan: Baseline and Emissions Gap Analysis

Daniel Steinberg and David Hurlbut

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and Environment

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Outline

- Analysis Objectives
- General Observations
- Colorado and the CPP
- Emission Gap Analysis
- Considering “Leakage” – Analysis of New vs. Existing NGCCs

Objectives of Project and Analysis

- Create a database/catalogue of generation units in Colorado from publicly available sources
 - Existing, under construction, and planned units
 - Capacity, generation, emissions, prime mover, fuel type, online year, retirement year, etc.
- Create a common baseline of Colorado's carbon emissions and emissions rate
 - Quantify the gap between existing emissions and emissions rate and the CPP targets

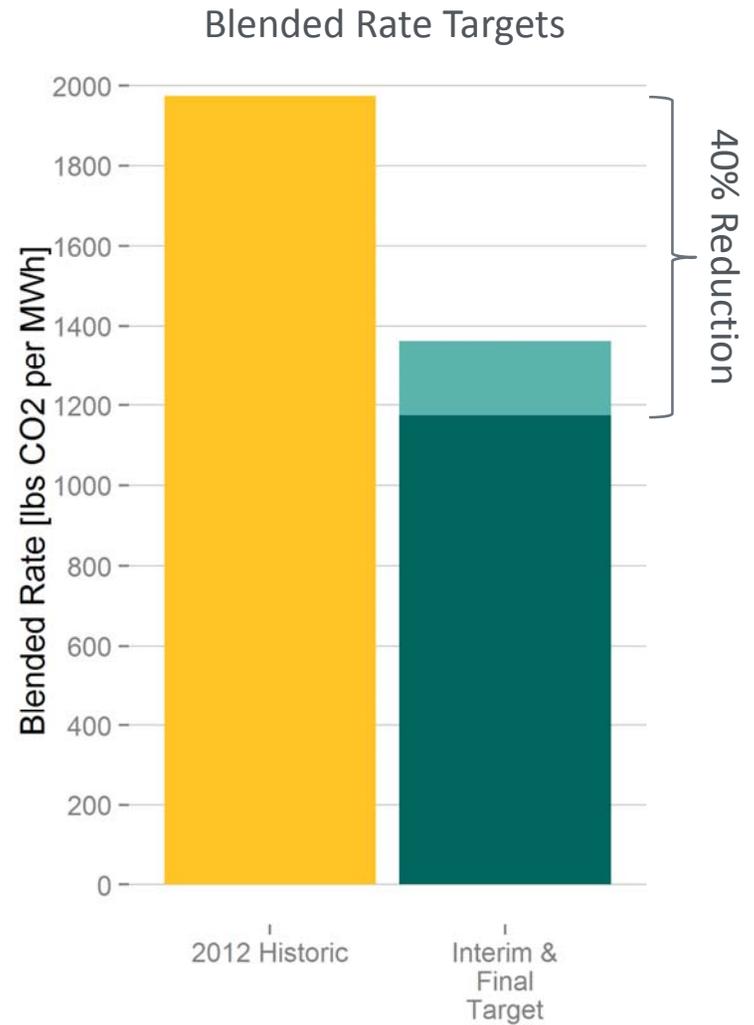
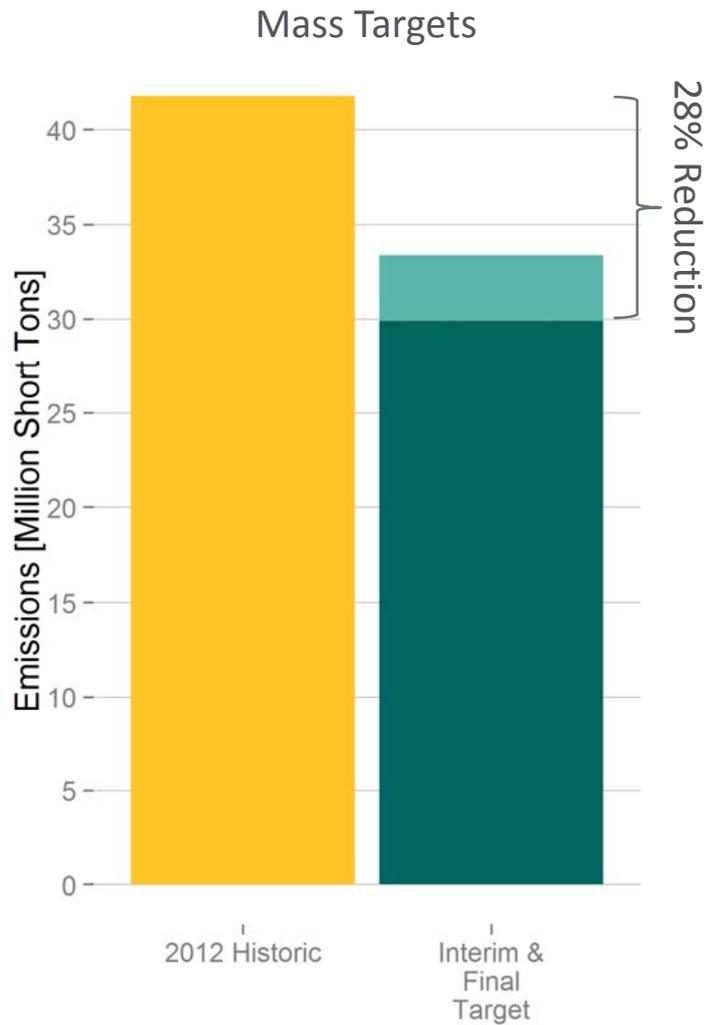
Momentum Towards Lower CO₂ Emissions

- Since 2012 (the benchmark for calculating emission reduction targets), the amount of coal used in Colorado's generation fuel mix has fallen while the use of combined cycle natural gas and renewables has increased, resulting in emissions reductions¹
- The combination of planned retirements/conversion of existing coal-steam units and renewable energy projects that are newly completed, under construction, or in advanced planning will likely lead to additional emissions reductions over the next three years
- Electricity consumption has slowed considerably, indicating greater energy efficiency in Colorado's economy; if energy efficiency continues to improve emissions will be further

¹ Note that these reductions only include changes in combustion emissions and do not consider emissions upstream of combustion such as leakage of methane from natural gas infrastructure

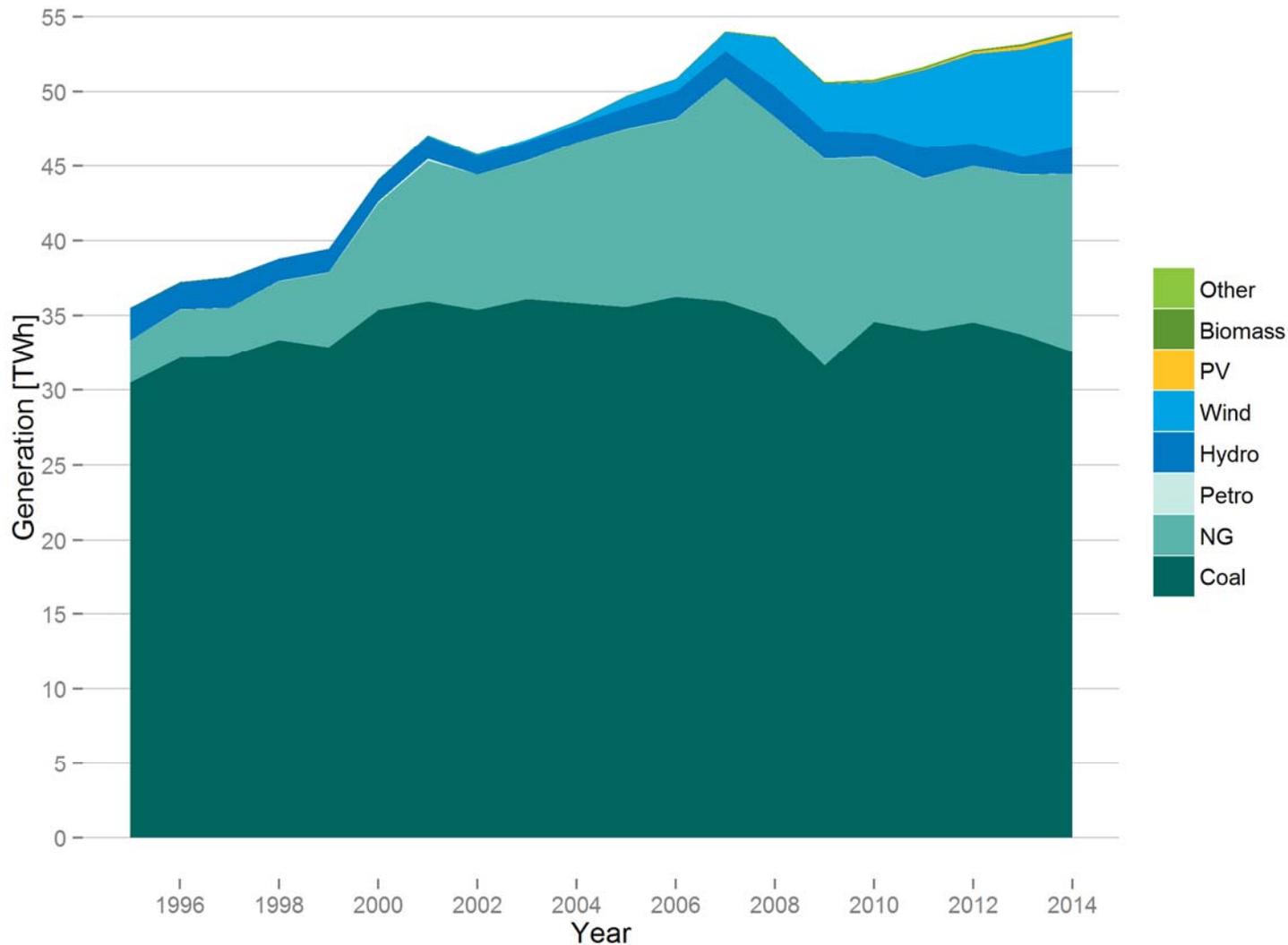
Colorado and the Clean Power Plan

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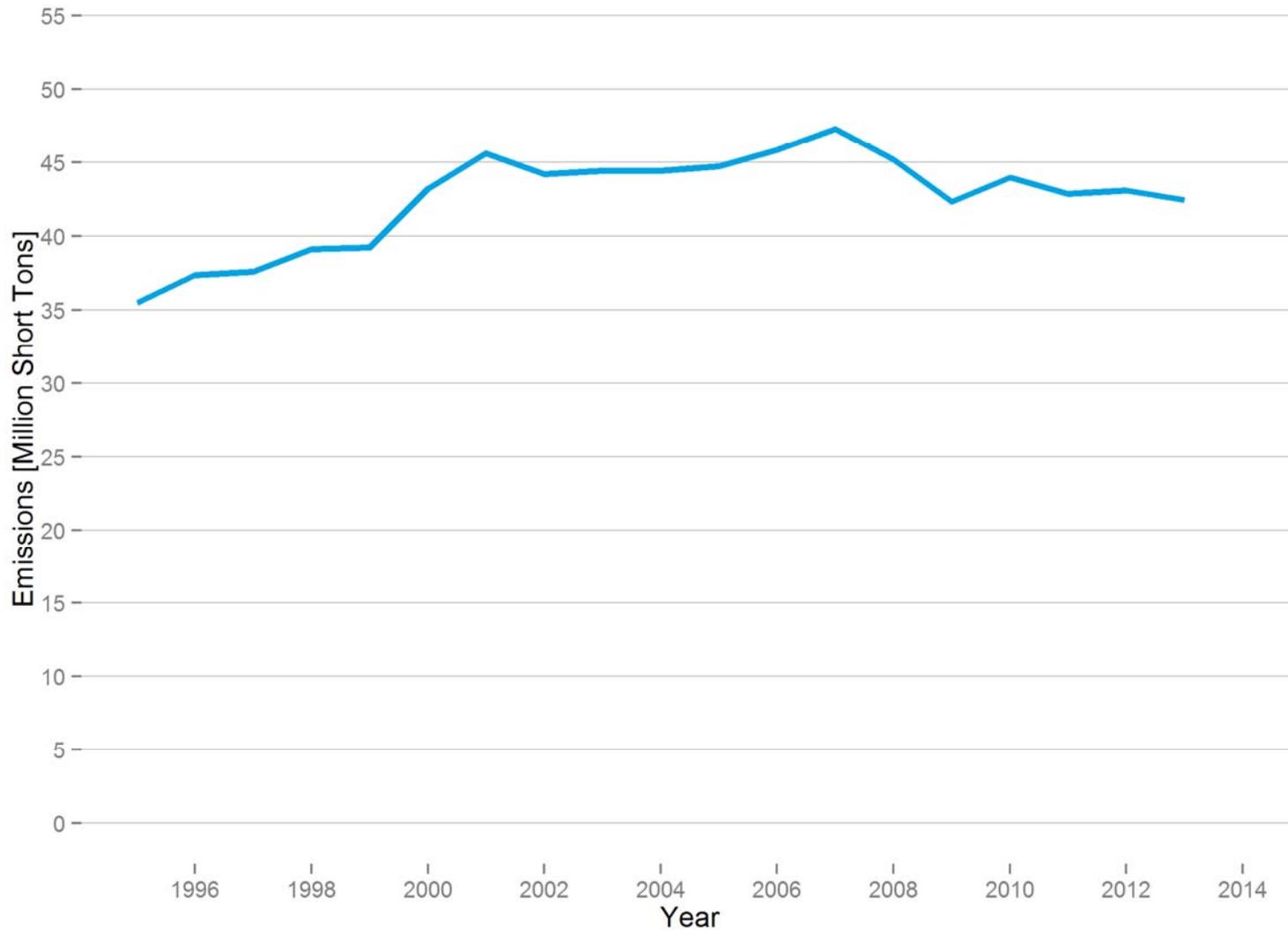
Light green indicates the interim target and dark green shows the final target

Colorado Generation Mix



Data Source: EIA; PV capacity represents utility-scale PV and does not include distributed systems

CO Power Sector Emissions



Data Source: EIA

Changes to the Colorado System since 2012

- Decreased generation from retired coal units: Cherokee 1 & 3, Arapahoe 3 & 4
- New NGCC capacity and increased generation: Cherokee 5, 6, & 7
- New RE capacity and increased generation:
 - Wind: Colorado Highlands, Limon, Spring Canyon, Carousel, and Golden West Power Partners
 - PV: Hooper Solar + a number of small systems <2MW

	2012	2015	Change
Coal (TWh)	34.5	31.5	(3.0)
NGCC (TWh)	8.8	9.9	1.1
RE (TWh)	7.6	9.2*	1.6*

* A significant amount of wind and solar capacity came online late in 2015. Accounting for a full year of operation of those facilities would increase the change in RE to ~3.7 TWh.

Sources: EIA-860, EIA-923, SNL, Velocity Suite

Planned Changes to the Existing System through 2017

- Further decreases in generation from coal units:
 - Retirement of Valmont 5; Martin Drake 5
 - Conversion of Cherokee 4
- New RE capacity and increased generation
 - Wind: Trishe Wind, Wray Wind
 - PV: Comanche PV, Lincoln Alamosa County

Generator Type	2016-2017
Coal (TWh)	(3.1)
NGCC (TWh)	?
RE (TWh)	1.0 *

* Only includes projects that are under construction or permitted

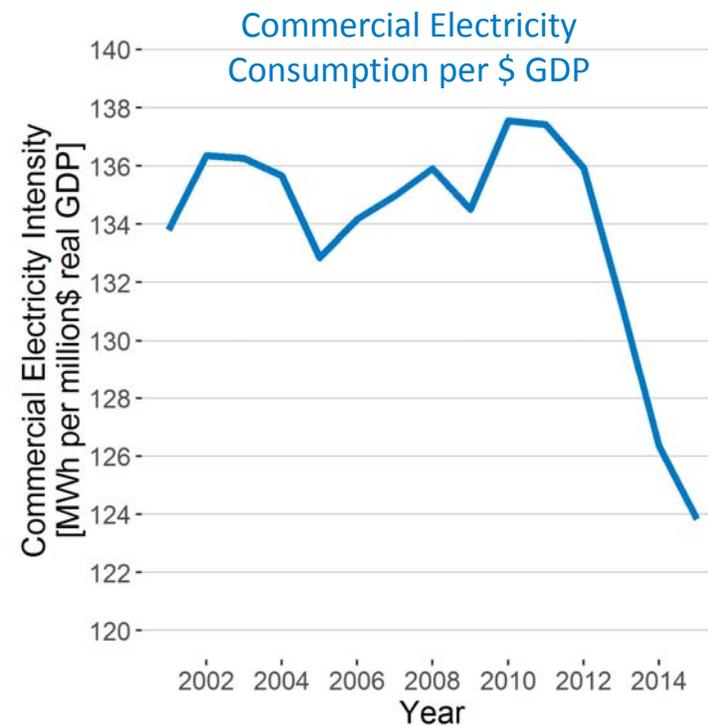
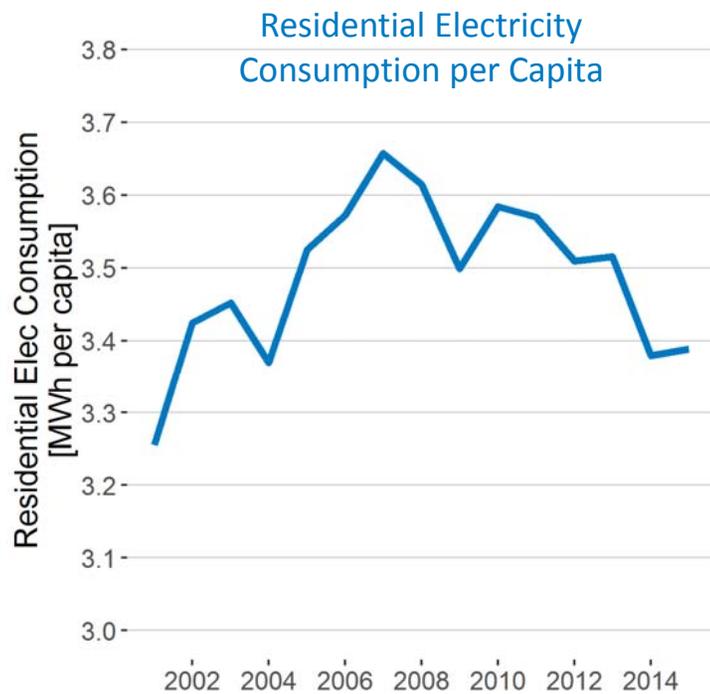
Sources: EIA-860, EIA-923, SNL, Velocity Suite

Energy Efficiency

Energy Efficiency Resource Standard (EERS) Targets:

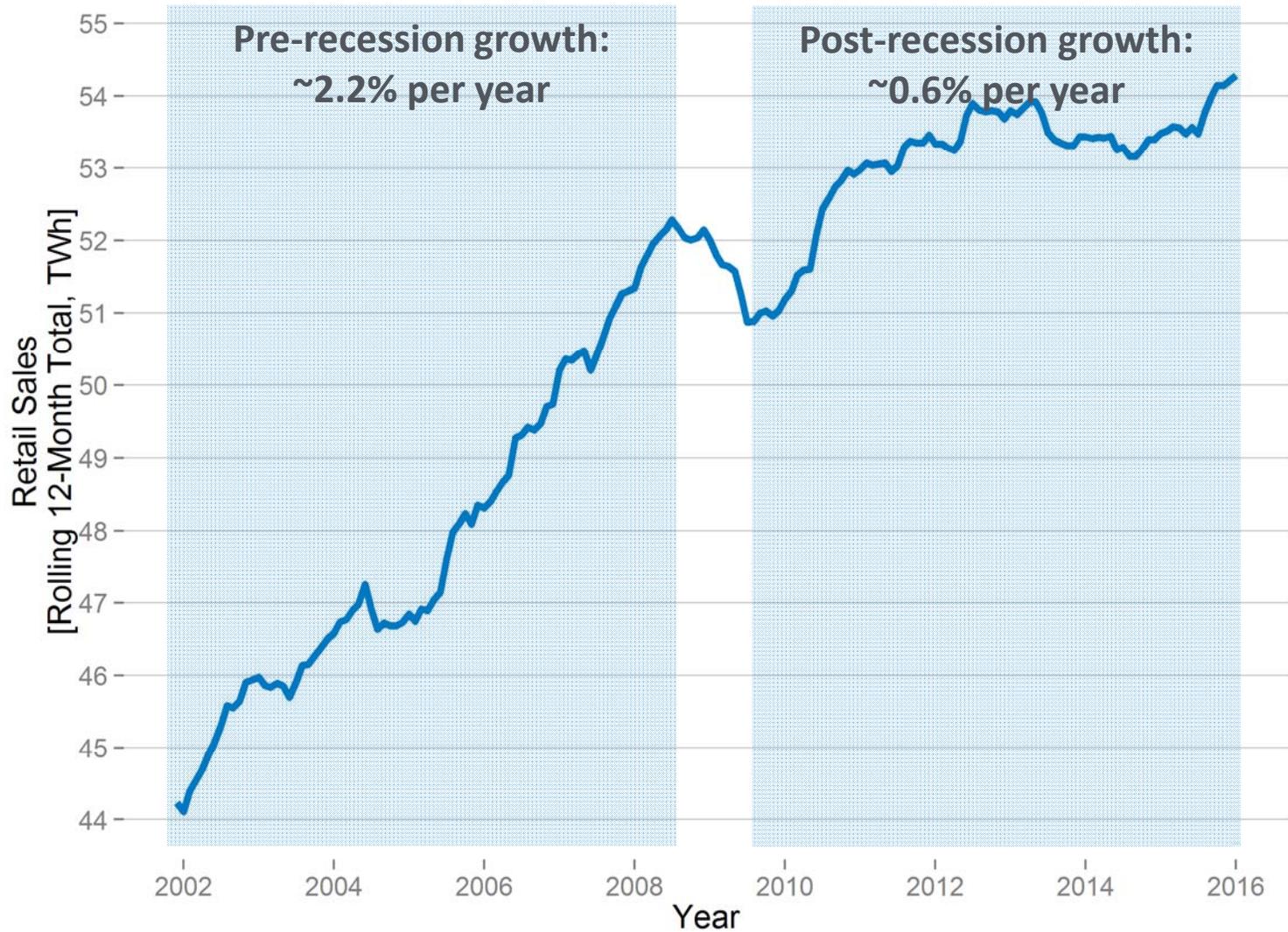
- Xcel: 400 GWh annual incremental savings through 2020
- Black Hills: ~20 GWh annual incremental savings through 2018

Residential and Commercial Electricity Consumption



Sources: EIA-860, EIA-923, SNL, Velocity Suite

Electricity Consumption



Emissions Gap Analysis

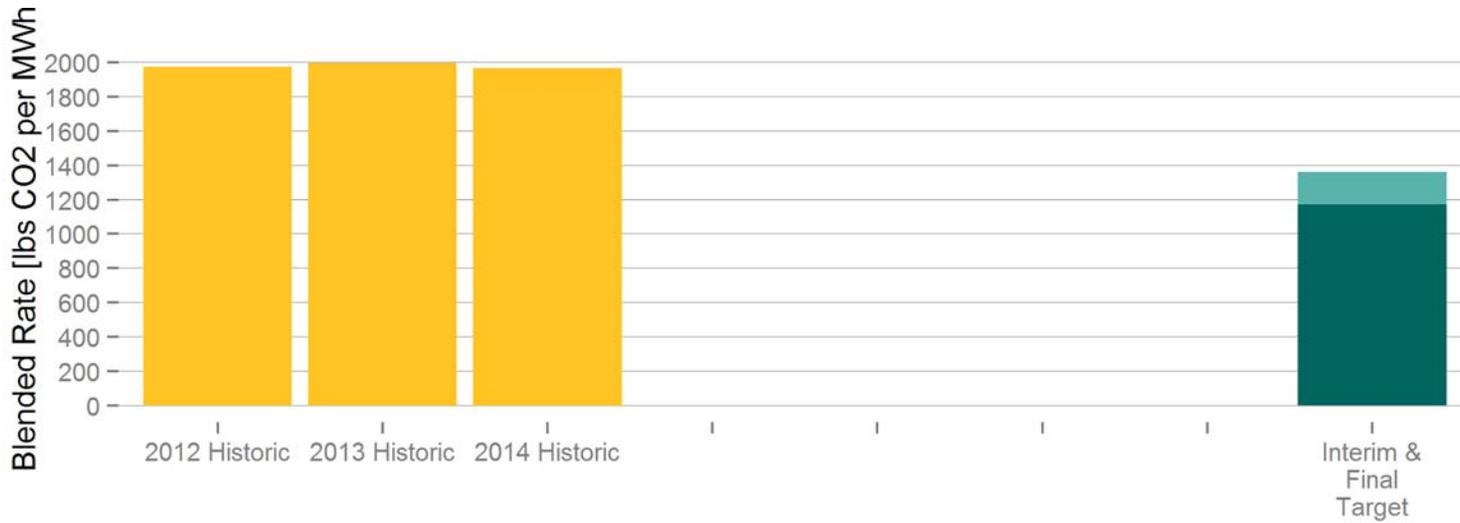
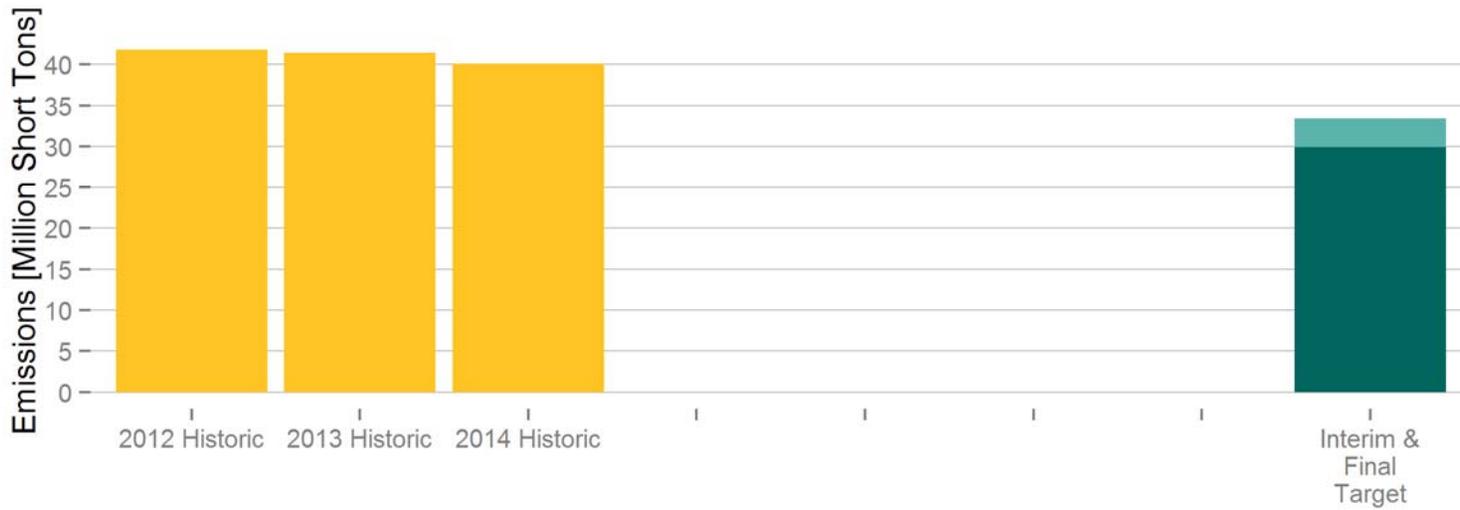
General Approach

- Calculate the total covered emissions and blended emissions rate for historical years: 2012-2014
- Estimate emissions and blended emissions rate accounting for recent and planned retirements and additions:
 1. **All Operational** – accounts for recent retirements, currently online renewable and NGCC capacity
 2. **All Operational and Planned Retirements** – accounts for the retirement of Valmont, Cherokee 3, and Drake 5, and conversion of Cherokee 4
 3. **All Operation, Planned Retirements, and Under Construction RE**
 4. **All Operational, All Operation, Planned Retirements, Under Construction RE, and Permitted RE**

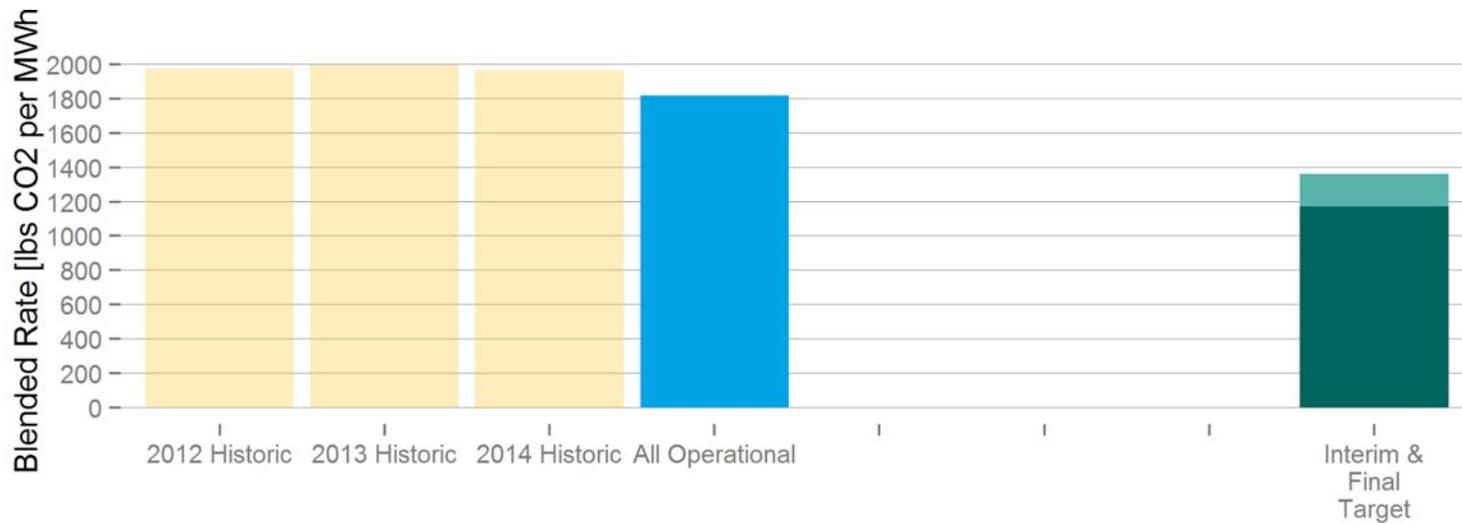
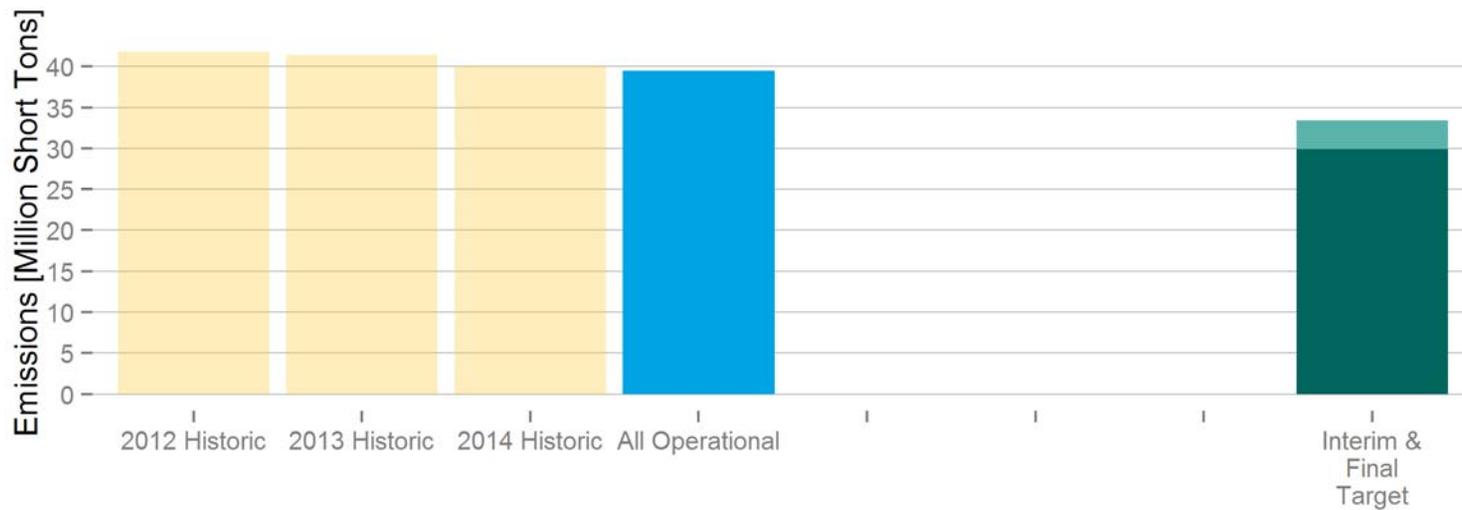
Key Assumptions and Limitations for this Analysis

- Historical generation from retired coal capacity is assumed to be replaced with generation from an efficient NGCC unit
- New renewable generation is assumed to be additional to all current generation (no generation is offset)
 - Implicit assumption is that new RE covers load growth
- Energy efficiency is not considered
- Based on historical generation and expected new generation – not optimized dispatch

Colorado's Emissions Gap

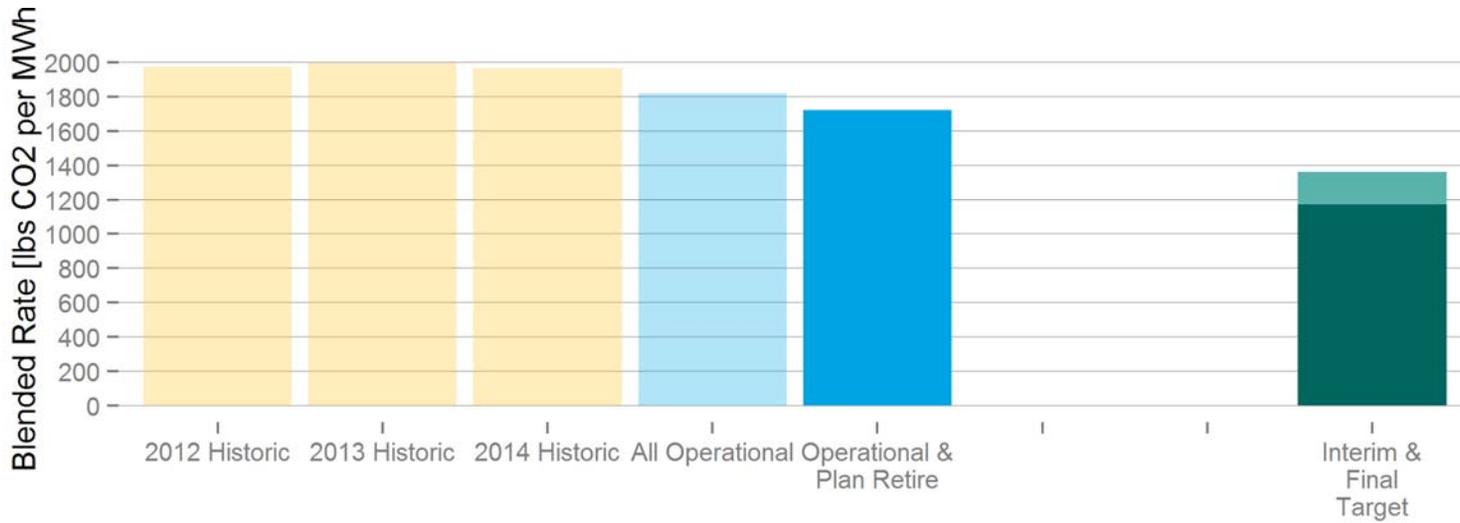


Colorado's Emissions Gap

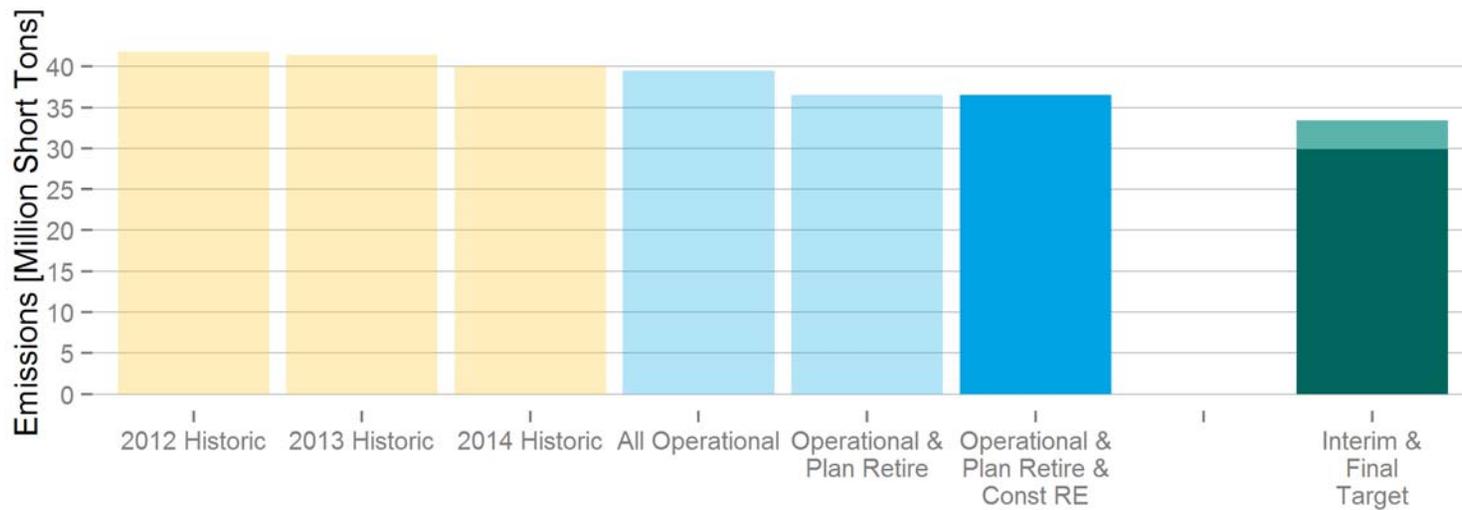


“All Operational” includes all capacity online as of the end of 2015, and that capacity that came online in 2015 was operating for a full year.

Colorado's Emissions Gap



Colorado's Emissions Gap



Colorado's Emissions Gap



Conclusions

- As a result of recent and forthcoming retirements of fossil-steam units and additions of both renewable and natural gas combined cycle units, CO's power sector emissions are on a downward trend
- These changes put Colorado on a path towards compliance, yet additional measures may be needed to achieve compliance with the final targets
- Capacity expansion modeling could be used to identify alternative pathways towards compliance and their associated costs and benefits

Thank you!

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