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Unlocking System Savings With Flexible EV Charging: Lessons From Colorado

Webinar

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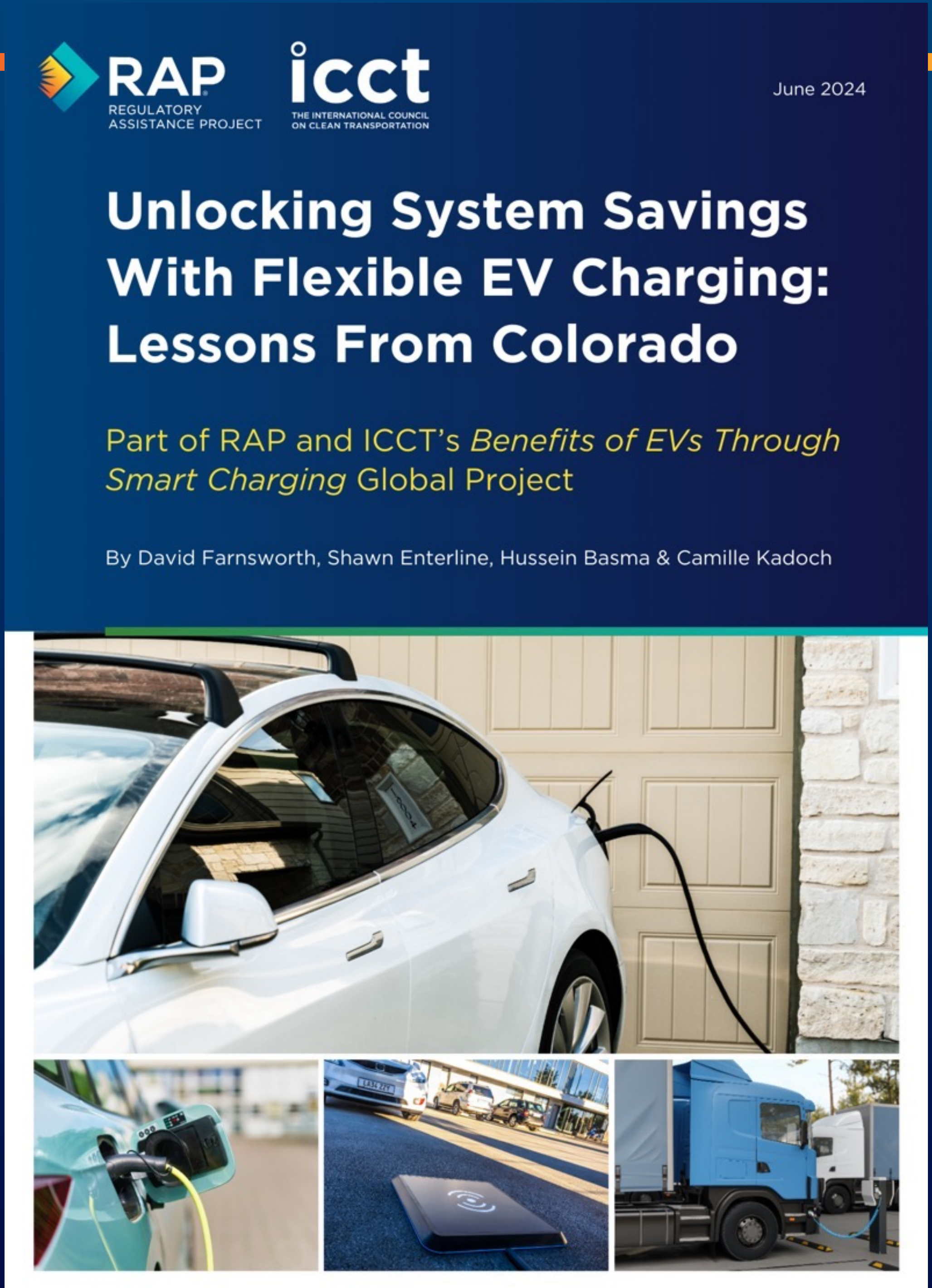

https://www.raponline.org/knowledge-center/unlocking-system-savings-with-flexible-ev-charging-lessons-from-colorado/

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Our Experts

- **Camille Kadoch**, Principal and General Counsel, Regulatory Assistance Project
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- Moderator: **Hussein Basma**, Researcher, International Council on Clean Transportation

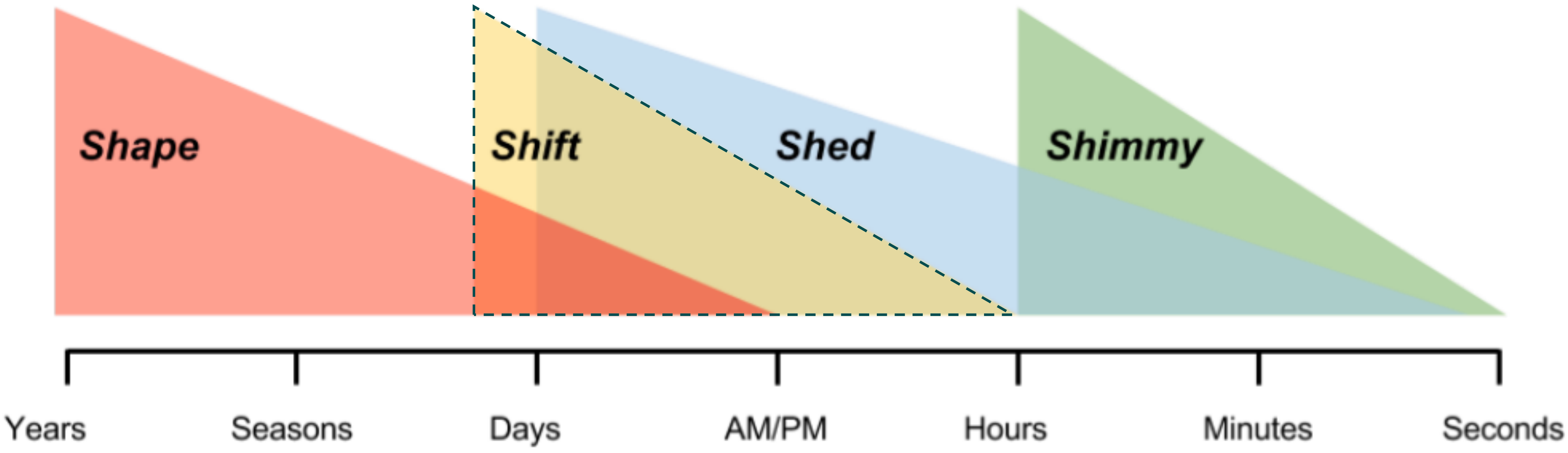
Agenda

1. Purpose & Definition
2. Methods, Assumptions, & Scenarios
3. Findings
4. Conclusions & Recommendations

1

Purpose & Definition

EV Charging Flexibility is a Load *Shift (Hours)*



Incentivize EE and Behavior Change

Mitigate Ramps and Capture Surplus Renewables

Manage contingency events and coarse net load following

Fast DR to smooth net load and support frequency

Study Purpose and the Definition of Flexibility

- Purpose: Quantify the dollar value of flexible charging to the electricity sector.
- Definition: Charging flexibility is a function of three variables.

1. The % of the (total) charging load that can be shifted in time;
2. The # of hours the charging load may be delayed; and
3. The customer's cost ($) of shifting that load.

2

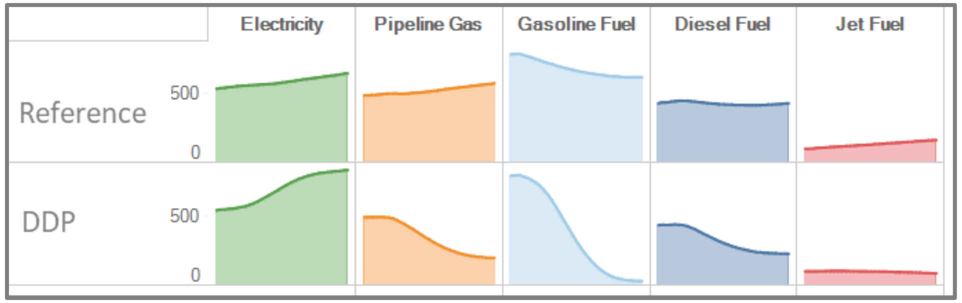
Methods, Assumptions & Scenarios

EER Analytical Tools Used in This Study

EnergyPATHWAYS (EP) is our demand-side stock-rollover accounting model that produces scenarios based on exogenous service-demand and sale shares

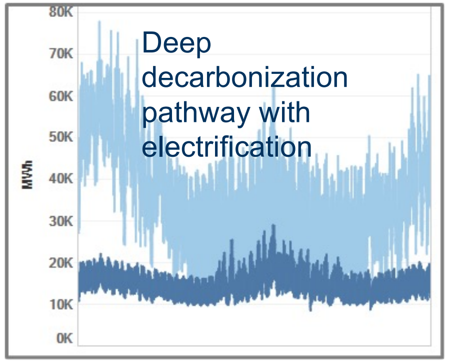
RIO is a supply-side macro-energy model that finds the lowest cost investment and operations plan with best-in-class temporal and spatial granularity

Annual End-Use Energy Demand

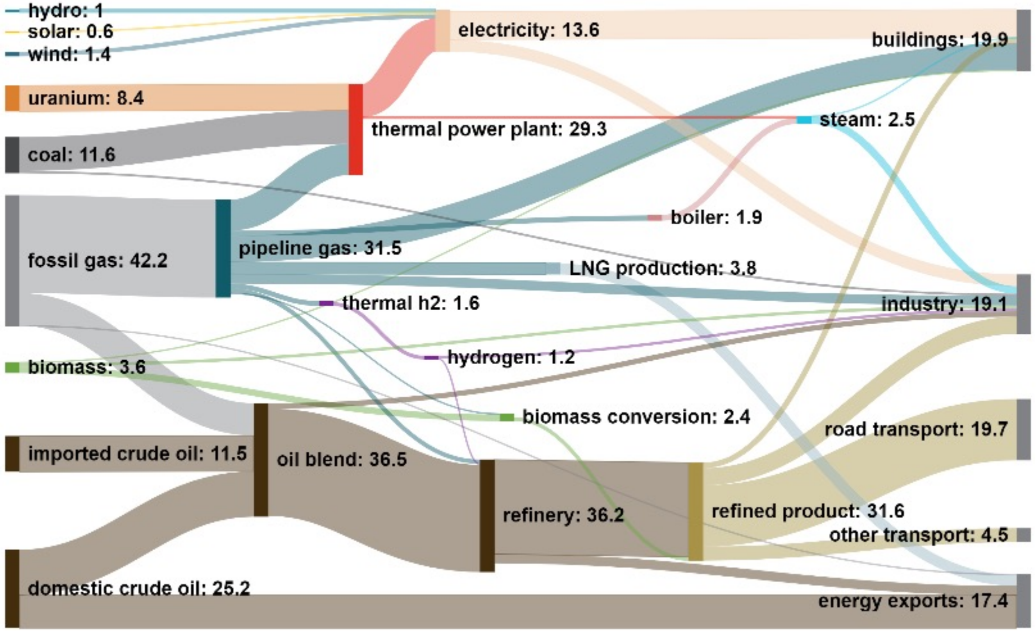


Hourly Load Shape

For this study, EER replaced our EV transport assumptions in EP with ICCT's CO specific demand projections for LDV and MHDV



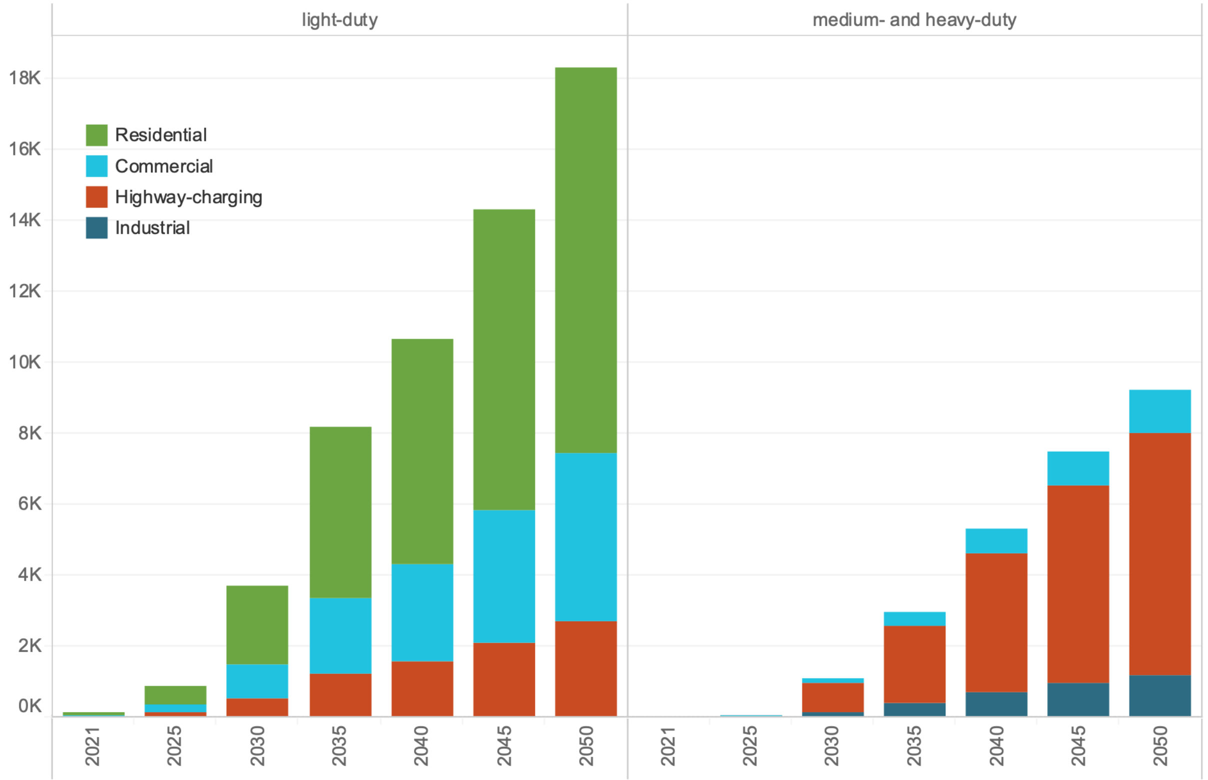
2021 Energy System



Vehicle Load Outlook

- Colorado has about 4.7 million light duty vehicles (LDVs) registered in the state.
- About 60,000 of these are electric vehicles. This represents about 1.3% of all LDV registrations.
- The state has a goal of 940,000 EVs registrations by 2030.
- Evolved modeled 4 archetypal feeders – Residential, Commercial, Industrial and Highway – to better understand the potential for load flexibility. The incremental vehicle loads by feeder type appears is shown in the figure.

Vehicle Loads in GWh (Adapted from ICCT)



Allocation of Vehicle Loads to Feeder Types

	All Scenarios			
	RES	COM	IND	HWY
LDV	61%	25%	0%	14%
MDV	0%	25%	25%	50%
HDV Long Haul	0%	0%	25%	75%
HDV Short Haul	0%	0%	100%	0%

Scenarios

Scenario	Description
Zero Flexibility	• Estimates system costs without any load shifting benefits.
Low Flexibility	• LDV RES: 50% are able to shift by 4 hours. • LDV COM: 0% are able to shift.
	• MHDV C&I: Assumes no flexibility. • MHDV HWY: Assumes no flexibility.
Mid Flexibility	• LDV RES: 75% are able to shift by 8 hours. • LDV COM: 25% are able to shift by 2 hours.
	• MHDV C&I: 50% are able to shift by 4 hours. • MHDV HWY: 50% are able to shift by 2 hours.
High Flexibility	• LDV RES: 75% are able to shift by 24 hours. • LDV COM: 50% are able to shift by 4 hours.
	• MHDV C&I: 50% are able to shift by 8 hours. • MHDV HWY: 50% are able to shift by 4 hours.

The 5-Way Race to Provide Flexibility

- Charging Flexibility
- Utility Scale Batteries
- H2 Electrolysers
- Gas-Fired Gen. with CCS
- Transmission

3

Findings

Summary of Findings

Total value ranges from $100-$300M/year in 2035 and $200-$900M/year by 2050

1. Flexibility Value Increases as the Amount of Variable Renewable Energy Increases
2. The Majority of Flexibility Value Stems from LDVs in the Residential Sector
3. The Highway Sector Produces the Least Value of the Four Sectors
4. Flexibility Mitigates the Cost of Reducing Emissions
5. Residential Savings Pays for 1.3 Million Level 2 Chargers (100%)
6. Flexibility Flattens the Net Load Curve

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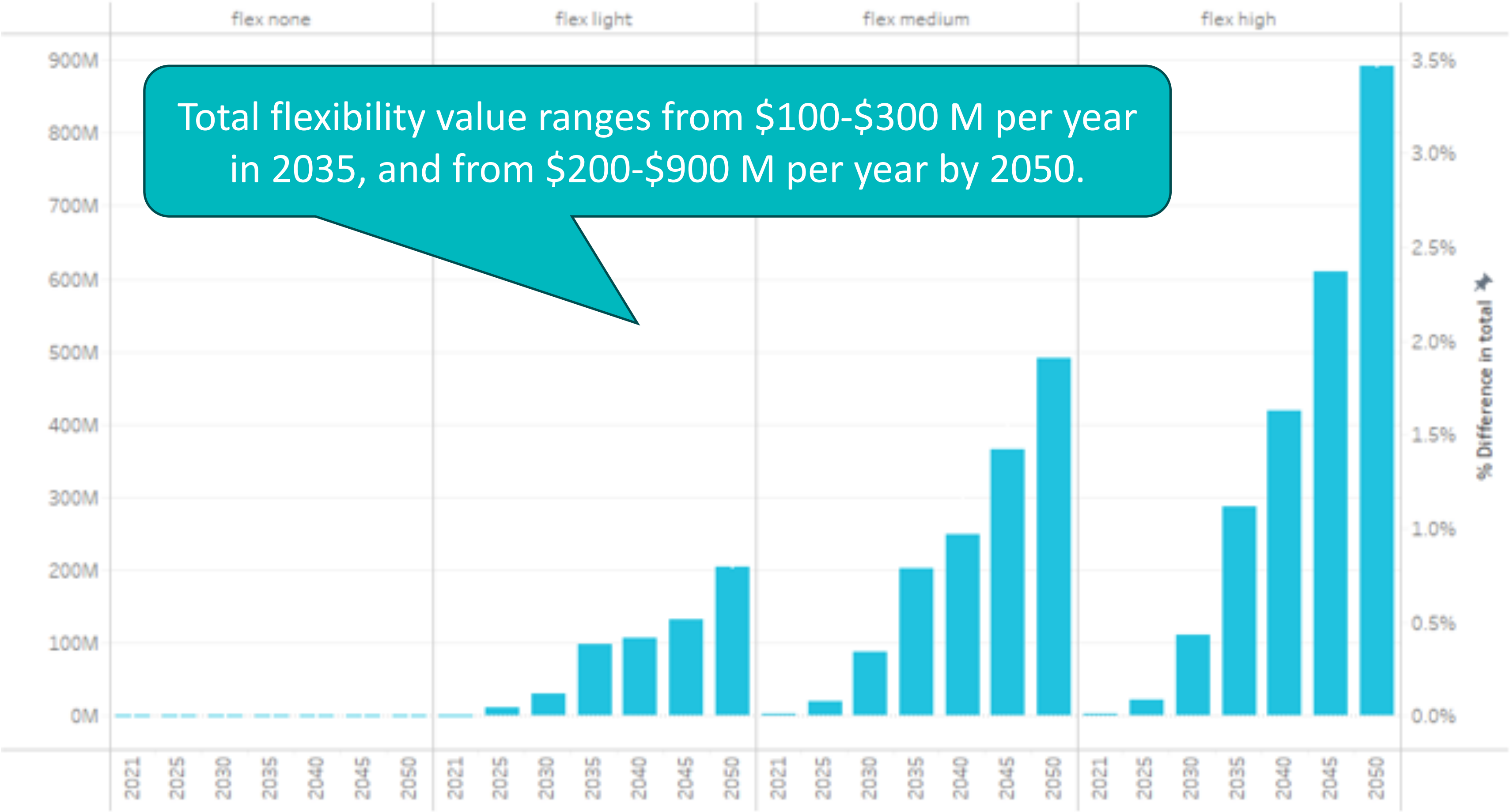

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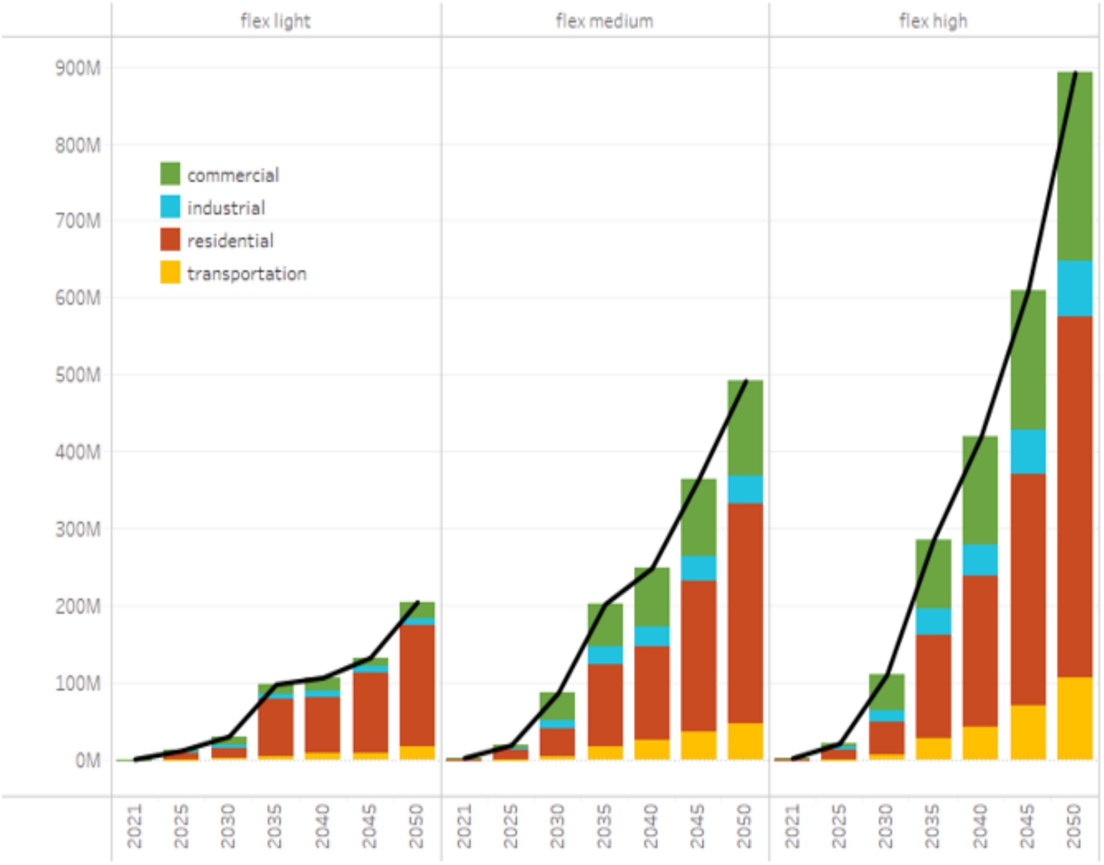
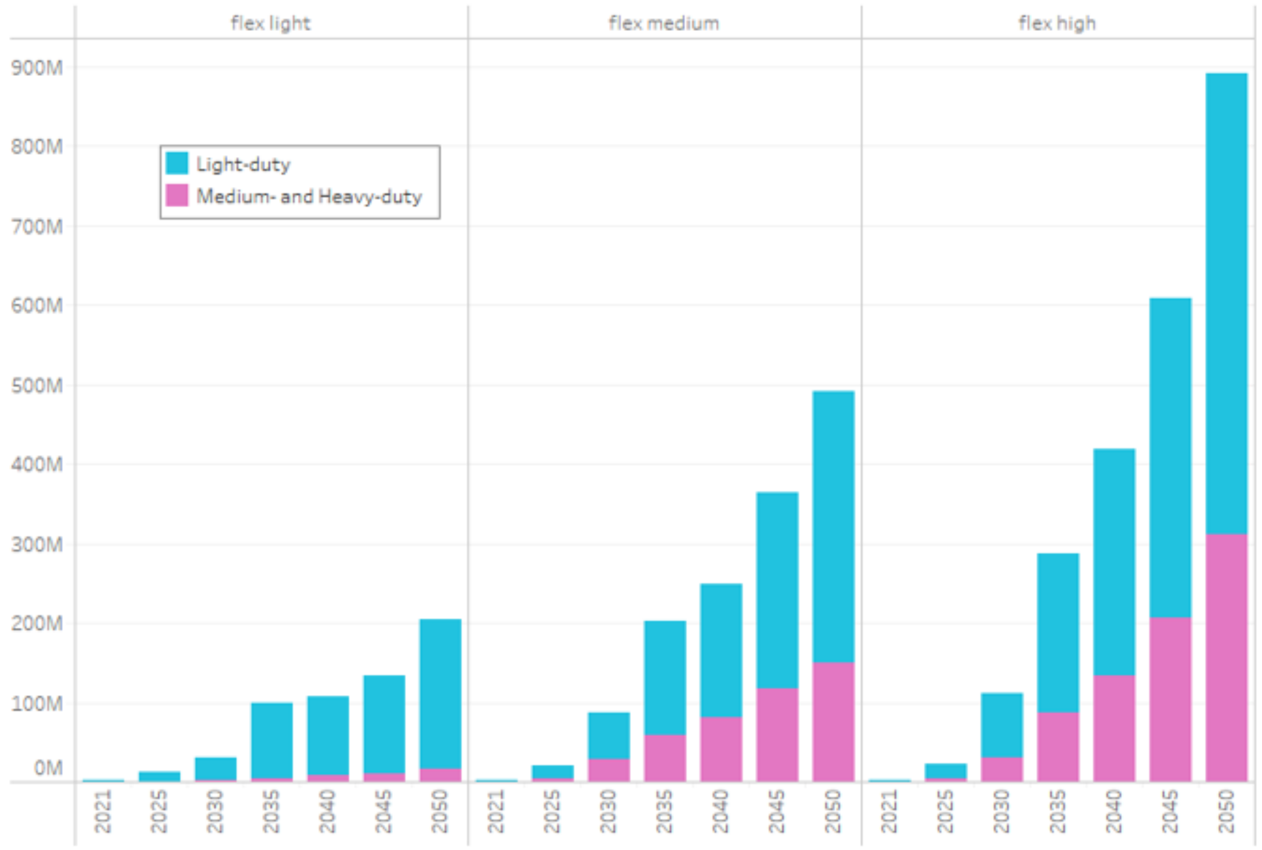


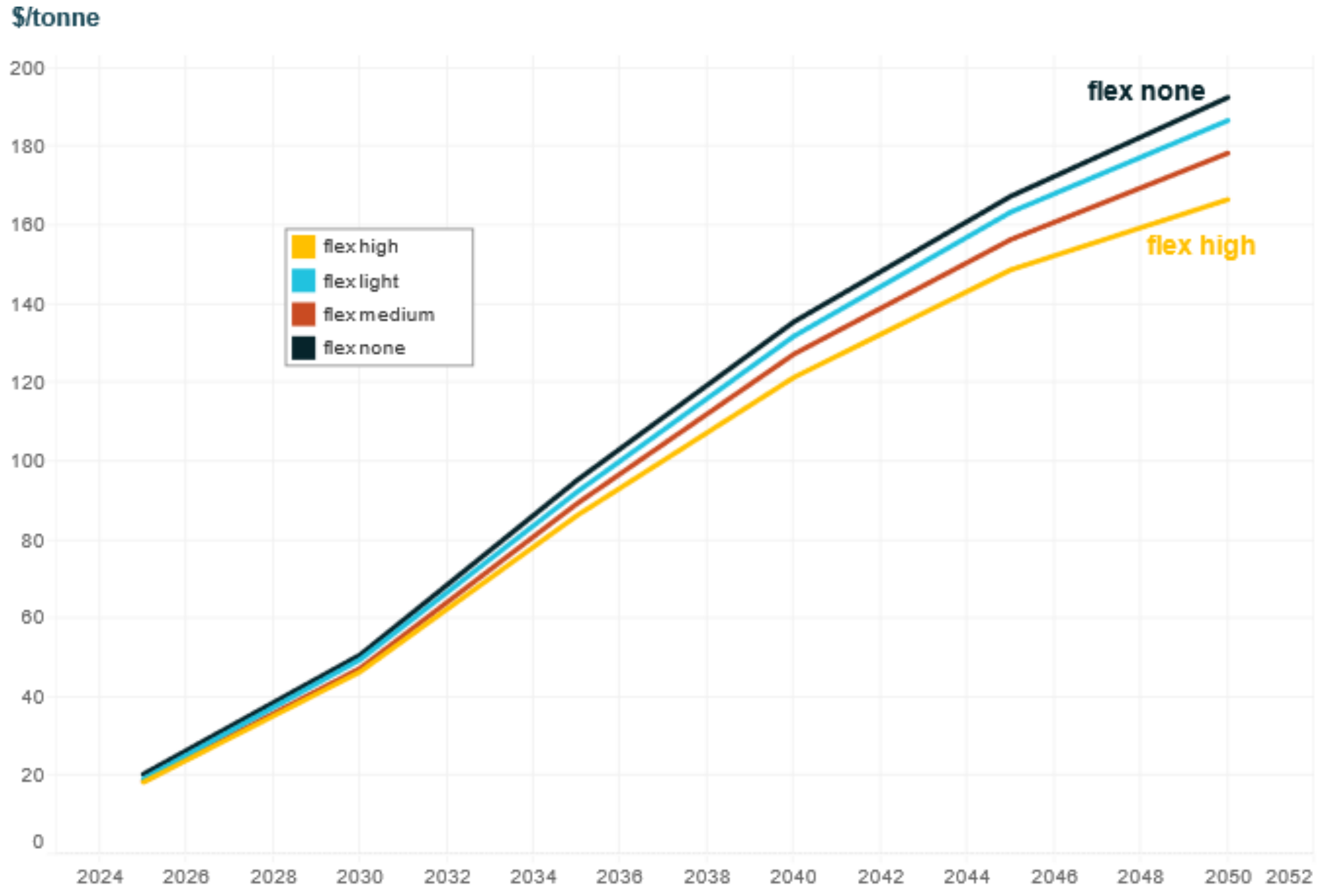


3. The Highway Sector Produces the Least Value of the Four Sectors

- The cost of delaying charging, from the customer's perspective, is higher in this sector than it is in other sectors.
- By definition, drivers who seek out DC "fast" charging have less flexibility (aka less time) to charge than drivers who are content to charge at lower, slower voltages.
- Highway charging infrastructure typically interconnects at transmission voltages. As a result, avoided costs of additional distribution level investment is limited or non-existent.
- Dispatch of H2 electrolysers effectively manages overall system loads, and there is less of a need for highway charging flexibility.
- Fast charging flexibility is not expected to have a high participation in the LDV user class given the convenience value to customers.

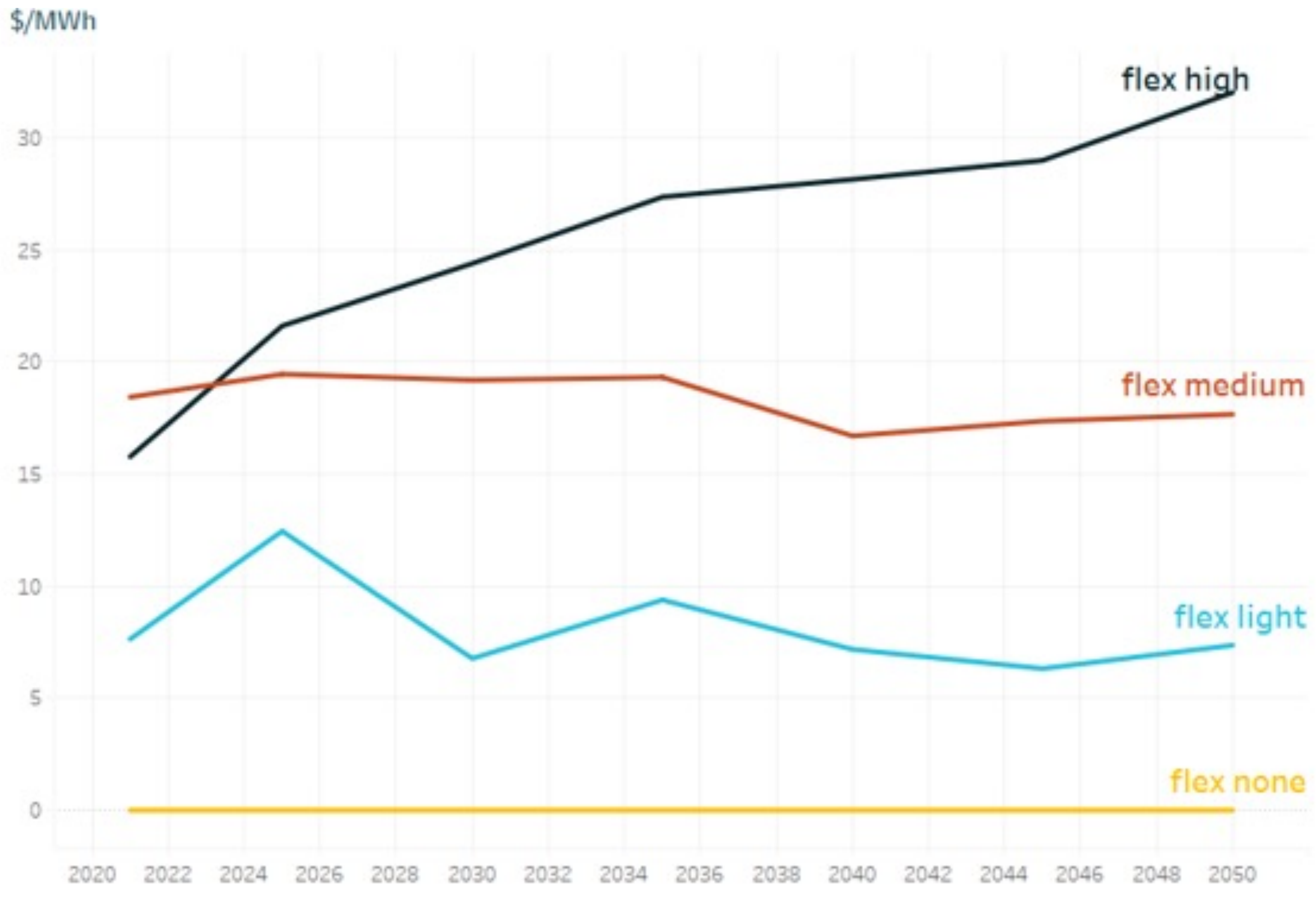
4. Flexibility Mitigates the Cost of Reducing Emissions

- All of the scenarios are constrained to reach the same clean electricity targets; higher levels of vehicle flexibility do not materially impact emission reductions.
- Savings from higher levels of vehicle flexibility translate into lower abatement costs for the electricity sector.
- For example, the flex high scenario reduces the annual dollars-per-ton cost of reducing electricity emissions by roughly 10% in each year of the analysis.



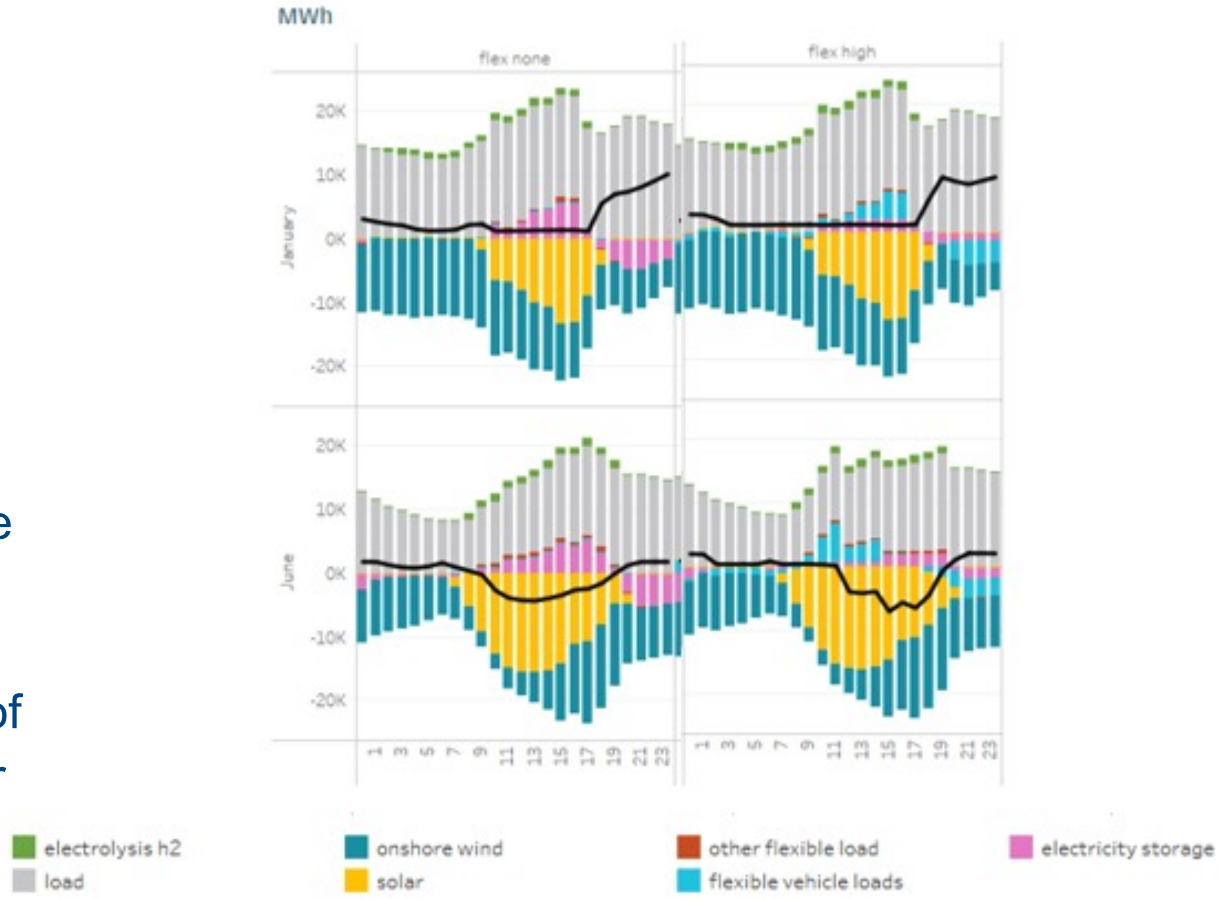
5. Consumer Savings Range from $7-$30/MWH

- These savings per MWh of shifting are relatively flat for Flex light and Flex medium.
- Once there is enough energy to move through flexible load, as shown in the Flex high slope, the scale of the needed investments changes.
- The Flex high slope moves upward in the outer years due to sufficient resources being available.



6. Flexibility Flattens the Net Load Curve

- The figure shows a typical summer and winter day in 2050 in Colorado.
- The bars show how the load and the various sources of supply and flexibility are optimally dispatched in each hour of the day.
- The bold black line shows the load, net of all of the sources of supply and flexibility. Notice that this line is flatter than the load itself.
- This flattening is one way to illustrate the benefits of flexibility. From a grid operator’s perspective, flatter net loads are easier to manage than more varied ones.



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Conclusions & Recommendations

Conclusions

1. Vehicle charging flexibility has the potential to reduce Colorado’s electric infrastructure costs by $100-$300M per year in 2035 and $200-$900M in 2050.
2. Customer programs and complementary electric rates are necessary.
3. Utility planning will be most effective where it integrates customer program plans and data.

Residential Savings Pays for 1.3M L2 Chargers

Residential sector cost savings are so large that they could pay 100% of the cost of controlled Level 2 charging in the sector.

- The net present value (NPV) of residential charging is sufficient to pay for 100% of the cost of 1.3 million Level 2 (L2) chargers.
- Increasing the availability of L2 chargers is a key to unlocking the value of charging flexibility.
- There is an opportunity to give participating customers a sizable incentive to adopt a controllable L2 charger and still have enough value left over to reduce costs for nonparticipating customers.

Residential Value Associated with Level 2 chargers

	2030	2035	2040	2045	2050
Flex Light	$ 13,893,000	$ 73,346,000	$ 73,219,000	$ 104,639,000	$ 158,418,000
Flex Medium	$ 35,259,000	$ 107,340,000	$ 122,678,000	$ 195,563,000	$ 285,396,000
Flex High	$ 43,023,055	$ 134,418,000	$ 195,777,000	$ 302,089,000	$ 467,356,000

NPV (10 year lifetime energy system value) of level 2 charger investment

	2030 NPV	L2 chargers (100% incentive)	2040 NPV	2040 L2 chargers (100% incentive)
Flex Light	$396,953,346	171,693	$788,067,498	394,034
Flex Medium	$607,433,298	262,731	$1,316,991,272	658,496
Flex High	$753,155,660	325,759	$2,014,575,905	1,007,288

❖ *These calculations use a 7% rate, 10-year life and a $2,312/L2 charger in 2030, and $2,000/L2 charger in 2040.*

Why Integrated Planning is Important

- **Distribution Planning**
  - If distribution system planners exclude or discount the impact of managed EV charging programs, then they will continue to call for investment in the system that could otherwise be avoided.

- **Load Forecasting**
  - If load forecasters or resource planners exclude or discount the impact of these programs, then they will continue to produce load forecasts that are too high and resource plans that call for more investment in generation than is necessary.

Recommendations

1. Focus first on LDVs in the residential sector, then on MDV/HDVs in the other sectors.

2. Develop customer programs that enroll customers at or near the point of sale.

3. Design customized charging rates for each sector that maximize customer retention.

4. Develop well integrated utility operating systems.

5. Develop well integrated utility planning processes.

About RAP

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