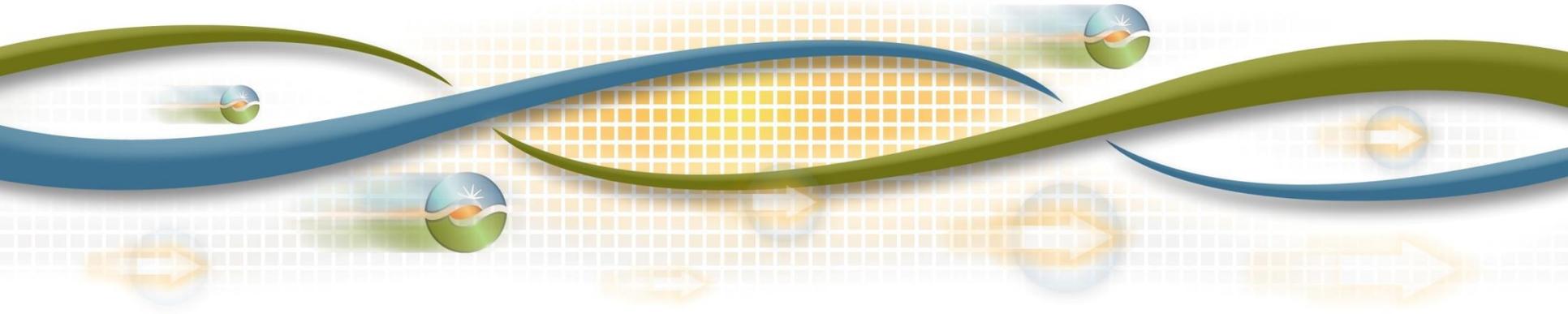


Clean Energy and Pollution Reduction Act Senate Bill 350 Study: *Summary of Preliminary Results*

May 23, 2016



Scope of the SB 350 Study

Legislative Requirement:

- 359.5. (a) It is the intent of the Legislature to provide for the transformation of the Independent System Operator into a regional organization..., and that the transformation should only occur where it is in the best interests of California and its ratepayers.

- The ISO will conduct studies of the impacts of a regional market, including:
 1. Overall benefits to California ratepayers
 2. Emissions of greenhouse gases and other air pollutants
 3. Creation or retention of jobs and other benefits to the California economy
 4. Environmental impacts in California and elsewhere
 5. Impacts in disadvantaged communities
 6. Reliability and integration of renewable energy resources

- The modeling, including all assumptions underlying the modeling, shall be made available for public review.

Transformation of the ISO to a regional organization entails a number of changes

- Combines the Balancing Areas currently operated by California and utilities in other states
- Expands the footprint of the ISO market operation
- Provides access to the larger footprint under a single, regional transmission tariff
- Transforms the current governance structure into a regional entity

Several scenarios were studied to span a range of potential outcomes

For 2020:

- Operations over current ISO footprint
- Operations over combined ISO-PacifiCorp footprint

For 2030:

1. Current Practice Scenario
 - Renewable energy procurement is largely from in-state resources
 - Current ISO market footprint
2. Regional market operations with 'Current Practice' renewable energy procurement policies
 - Renewable energy procurement is largely from in-state resources
 - ISO market footprint is expanded to most of the Western Interconnection
3. Regional market and renewable energy procurement
 - Renewable energy procurement from most of the Western Interconnection
 - ISO market footprint is expanded to most of the Western Interconnection

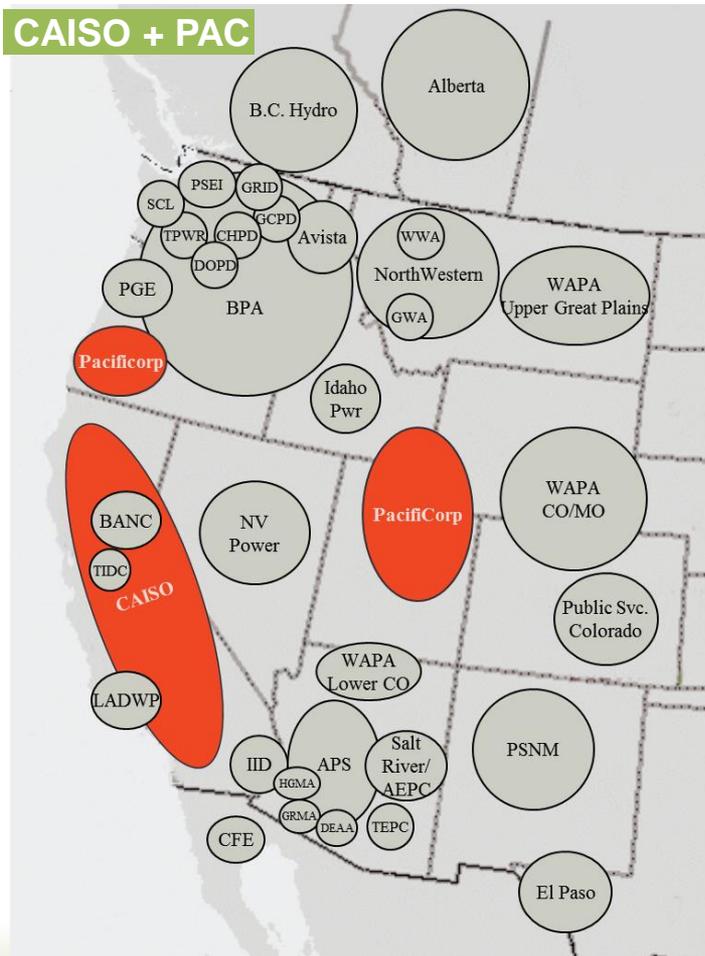
Study compares a non-regional market case (1a) against two regional market cases (2,3) in 2030

Incremental CA 50% RPS Buildout by 2030 (MW)			
Portfolio Composition	Current Practice 1a	Regional Case 2	Regional Case 3
California Solar	7,601	7,804	3,440
California Wind	3,000	1,900	1,900
California Geothermal	500	500	500
Out of State Solar	1,000	1,500	1,500
Out of State Wind	4,551	3,666	6,194
Total California New Capacity	11,101	10,204	5,840
Total Out of State New Capacity	5,551	5,166	7,694
Total New Renewable Capacity	16,652	15,370	13,534
Major Out of State Transmission Additions for California?	No	No	Yes

** Regional market cases were developed through consultation with stakeholders for the sole purpose of assessing the benefits of a regional market over a range of plausible renewable procurement scenarios. This study is not promoting or advocating for a particular procurement scenario.*

Two regional market footprint cases considered

2020 Case

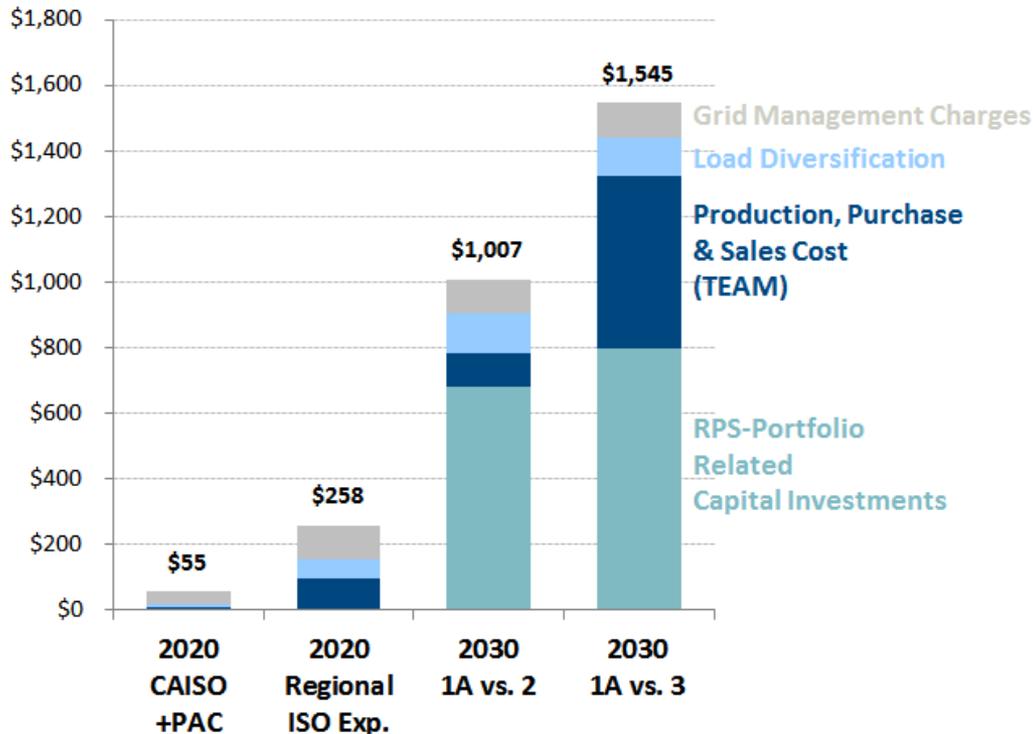


2030 Case & 2020 Sensitivity Case



Regional market provides significant savings to California Ratepayers

Annual California Ratepayer Benefits in 2020 & 2030



Overall benefits likely larger, consistent with findings in other regional market studies

- Estimates based on conservative assumptions
- Value of additional regional market benefits was not quantified

- California ratepayer impact analysis of an expanded regional market results in estimated annual savings of:

- **\$55 million/year in 2020** (0.1% of retail rates) based on limited scope of CAISO-PAC region.
 - Would be \$258 million/year for expanded regional footprint (U.S. WECC without PMAs)
- **\$1 billion to \$1.5 billion/year in 2030** (2–3% of retail rates) depending on approach to procure renewable resources to meet 50% RPS
- 2030 sensitivities show range from **\$767 million to \$1.75 billion/year**

Renewable portfolios and investment cost

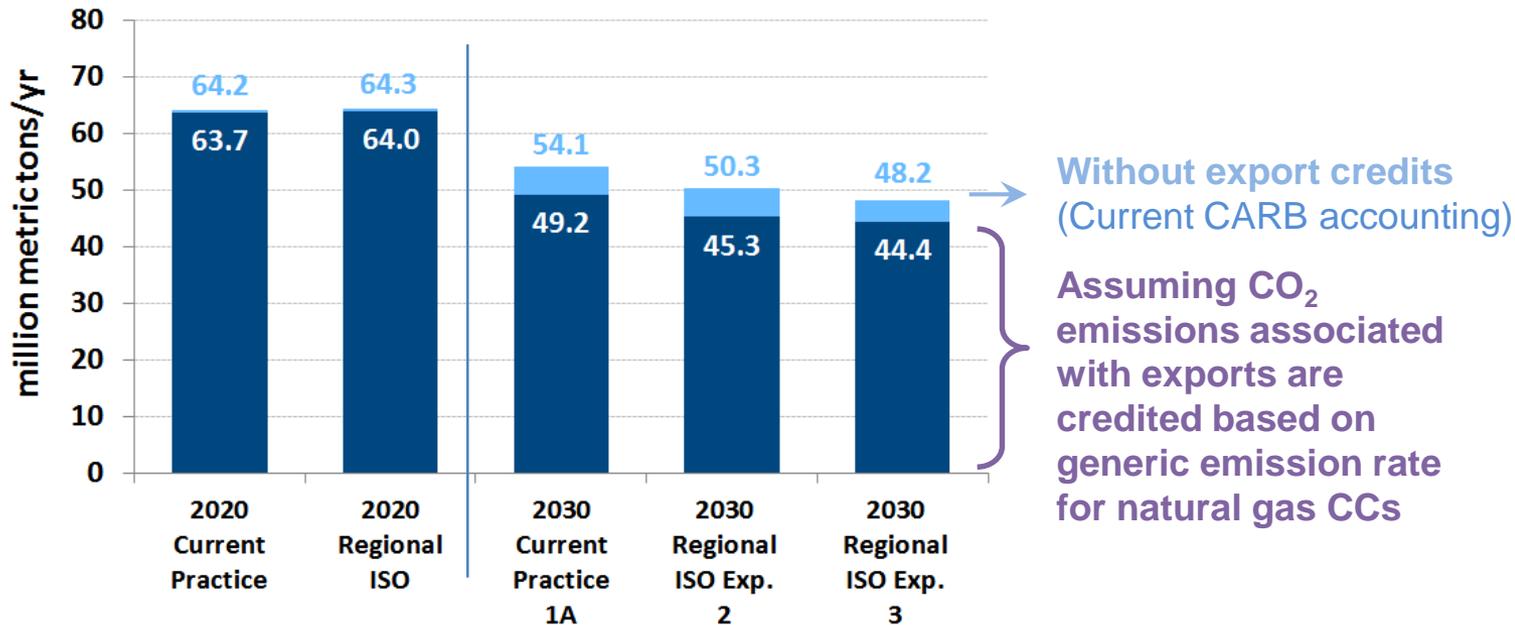
- E3 developed optimal 50% RPS portfolios under three scenarios
 - (1) Current practice,
 - (2) Regional markets with current procurement,
 - (3) Regional markets with regional procurement
- Regional markets result in lower renewable procurement costs (a portion of ratepayer impact) for California across all scenarios and sensitivities
 - Savings are **\$680 million/year** in 2030 under regional markets with current practices in renewable procurement (Regional 2)
 - Savings are **\$799 million/year** in 2030 under regional markets with regional renewable procurement (Regional 3)
 - Savings range from **\$391 - \$1,004 million/year** in 2030 under a wide range of sensitivities
- The renewable procurement benefits of regional markets increase as the RPS increases
 - Savings are **\$1.2-1.3 billion/year** in 2030 under a 55% RPS

Potential additional benefits not quantified

- **Increased system reliability** due to expanding ISO operations to a larger regional footprint that improves pricing, congestion management, generation commitment, real-time operations, and system visibility/monitoring
- **Improved use of the physical capabilities of the existing grid** both on constrained WECC transmission paths and within the existing WECC balancing areas
- **Improved regional and inter-regional system planning** to increase efficiency in transmission buildout across the West
- **Improved risk mitigation** from a more diverse resource mix and larger integrated market that can better manage the economic impacts of transmission and major generation outages and better diversify weather, hydro, and renewable generation uncertainties
- **Long-term benefits** from stronger generation efficiency incentives and better long-term investment signals across a larger regional footprint

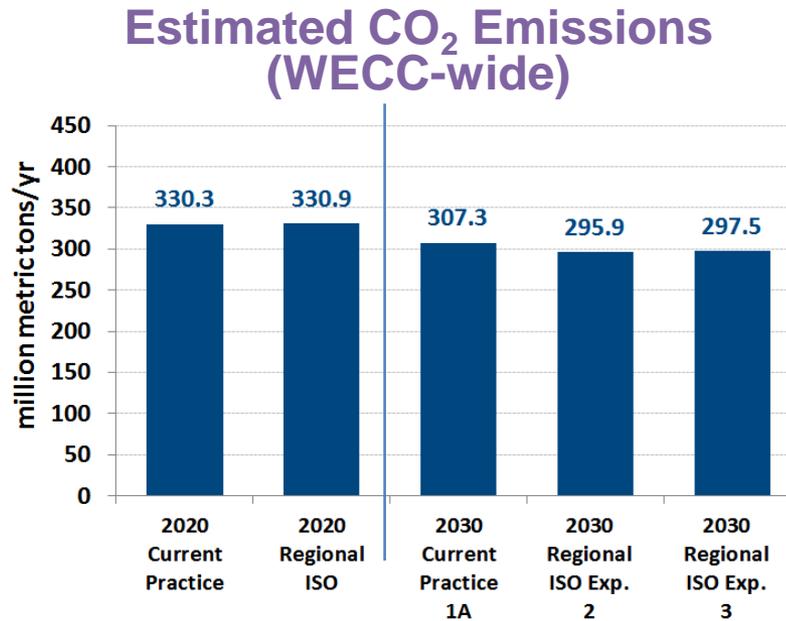
Regional market lowers California CO₂ emissions

Estimated CO₂ Emissions in California



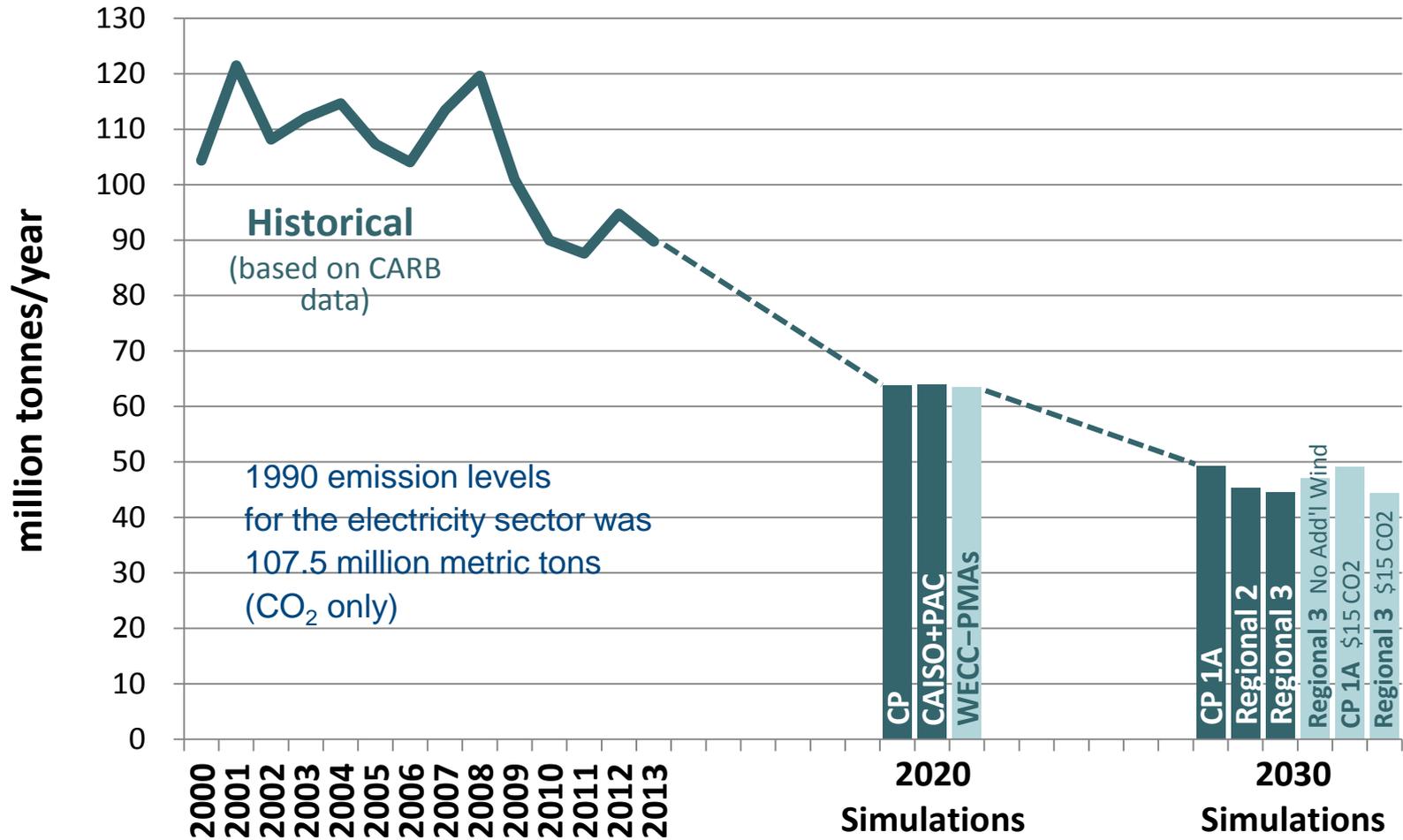
- Significant electricity sector emissions reductions between 2020 and 2030, with **2030 emissions 55–60% below 1990 levels and below EPA’s CPP requirements for California**
- Regional market reduces CO₂ emissions associated with serving California load
 - Little/no change in 2020
 - **Decrease of 4–5 million tonnes (8–10% of total) of CO₂ emissions level** in 2030
- By 2030, CA exports of surplus renewable energy displaces 4-5 million tonnes of CO₂ in rest of WECC; export credits not currently considered in CARB accounting

Regional market lowers WECC-wide CO₂ emissions



- 2020 simulations of regional market (CAISO+PAC) show almost no change in CO₂ emissions relative to Current Practice
- In 2030 (and despite load growth in rest of WECC), the expanded regional market (U.S. WECC without PMAs) is estimated to **decrease CO₂ emissions levels by about 10–11 million tonnes (3.2–3.7% of total)** depending on the Scenario
- Achieving CPP compliance would require additional measures

Simulated vs. Historical California CO2 Emissions



* Simulation results assume CO₂ emissions associated with imports are charged and exports are credited based on a generic CO₂ emission rate for natural gas CCs.

Regional market reduces emissions of other air pollutants

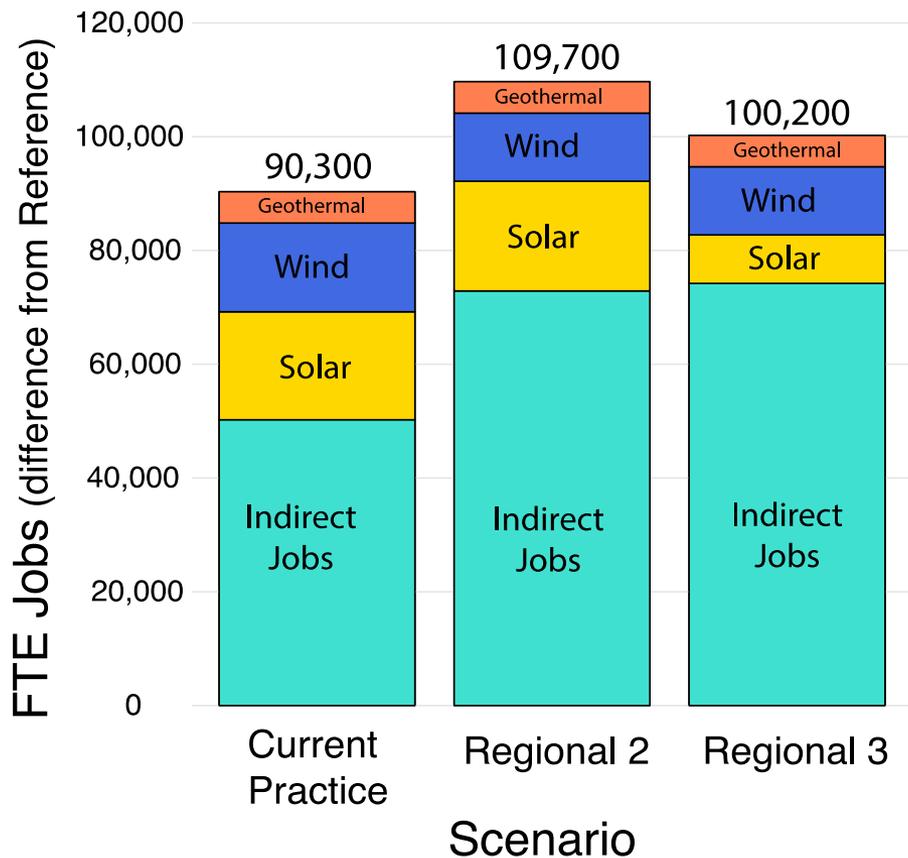
- Expanded regionalization (by 2030) decreases electric sector NO_x, SO₂, and PM_{2.5} emissions WECC-wide and within California

Study Topic	2020 Regional ISO Relative to CP	2030 Regional 2 Relative to CP1A	2030 Regional 3 Relative to CP1A
Air Emissions Changes in California	<ul style="list-style-type: none"> Slight decrease in emissions 	<ul style="list-style-type: none"> Lower emissions of NO_x (-6.5%) Lower emissions of PM_{2.5} and SO₂ (-4.0%) 	<ul style="list-style-type: none"> Lowest emissions of NO_x (-10.2%) Lowest emissions of PM_{2.5} and SO₂ (-6.8%)
Air Emissions Changes Outside California	<ul style="list-style-type: none"> Slight increase in emissions 	<ul style="list-style-type: none"> Least emissions of NO_x (-1.9%) Least emissions of SO₂ (-0.9%) 	<ul style="list-style-type: none"> Lower emissions of NO_x (-1.3%) Lower emissions of SO₂ (-0.2%)
Disadvantaged Communities in California	<ul style="list-style-type: none"> No change 	<ul style="list-style-type: none"> Lower emissions from California power plants in air basins of greatest concern 	<ul style="list-style-type: none"> Lowest emissions from California power plants in air basins of greatest concern

Regional market improves the California economy

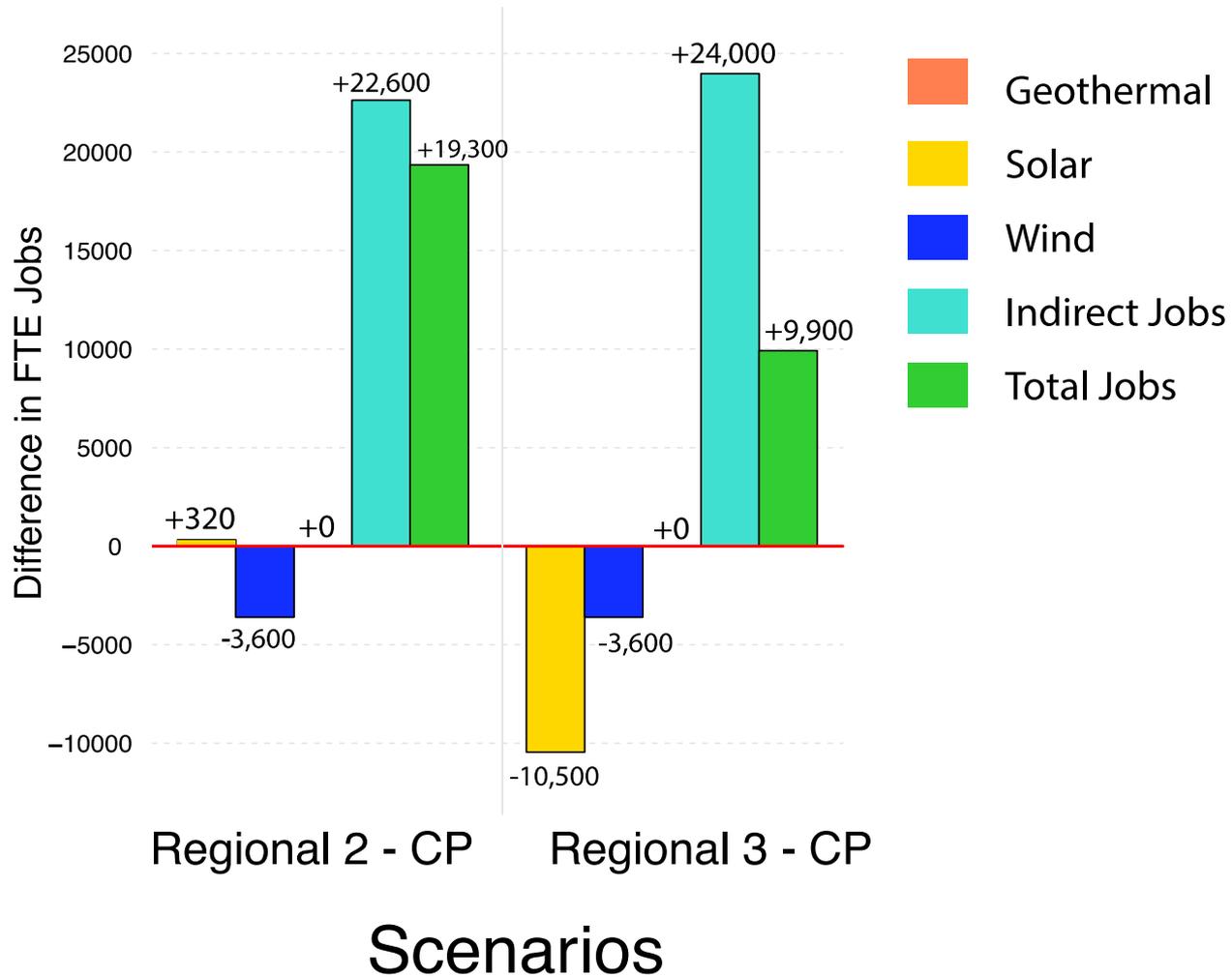
- Regionalization (Scenarios 2 and 3) can create **9,900–19,400 more jobs** than Current Practice (Scenario 1A) in California, primarily by making electricity more affordable
 - Higher statewide household real disposable income due to more affordable energy
 - **\$300–\$550 more disposable income per household** in 2030 due to regional market
 - Higher statewide Gross State Product, real output, state revenue, and employment
- Regional market with California-focused procurement can help California balance ratepayer savings with job creation from renewable resource buildout
 - Highest impact on statewide output and employment
 - But higher environmental impacts
- Disadvantaged communities benefit from the stimulus effect in all scenarios, both in terms of new jobs and higher real incomes

Statewide jobs created by 2030



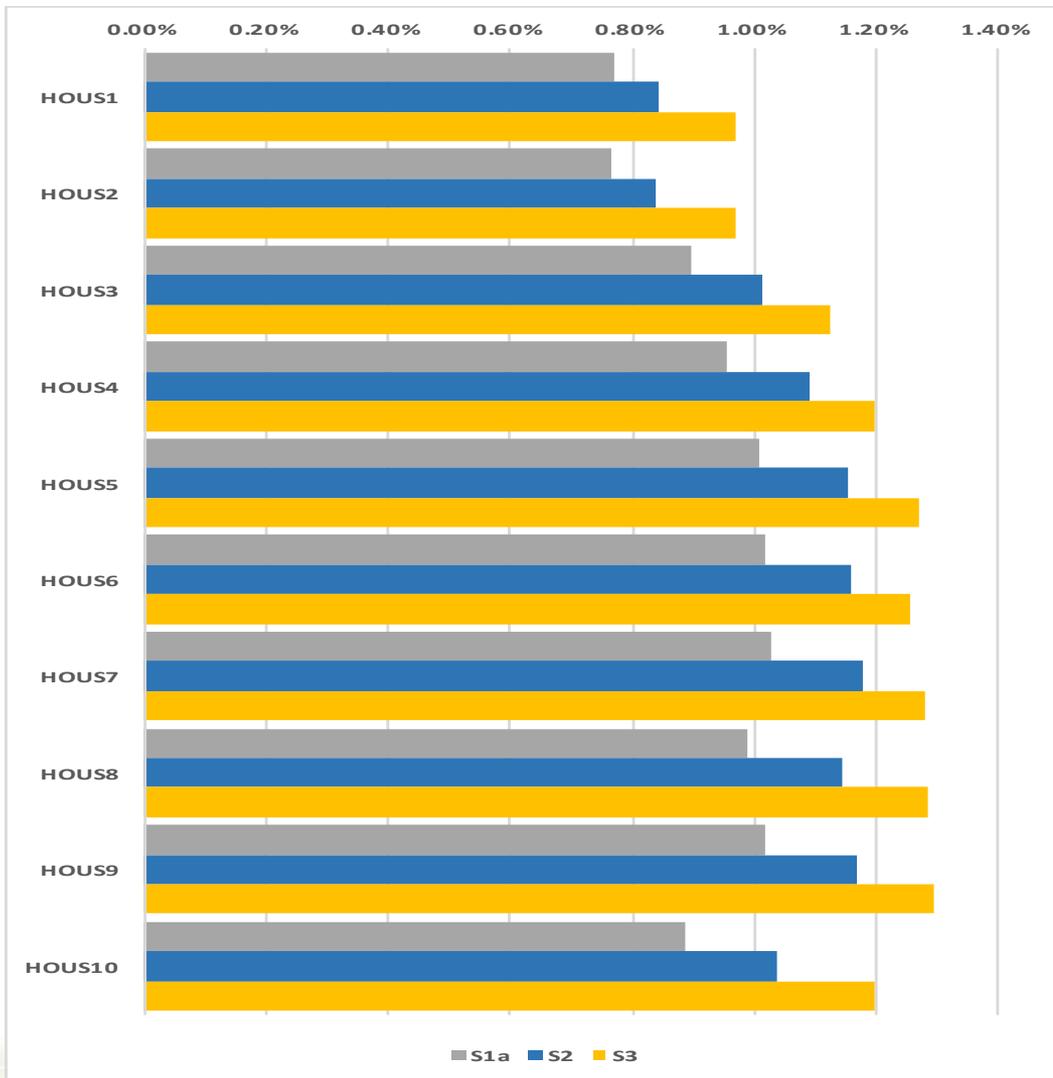
- Direct jobs contain both estimates short-term construction jobs and long-term operations
- Job estimates calculated using data from:
 - Solar – Phillips (2014)
 - Wind and geothermal – Kaman & El Alami (2015)

Difference in statewide jobs created by 2030



Household real income impact by decile

(percent change from Reference in 2030)



- Household income rises for every scenario and every decile.
- Households benefit most from more affordable energy.

More efficient RPS buildout reduces environmental impacts

- 2020 Regional ISO scenario includes no incremental renewable energy development (33% RPS portfolio fixed):
 - No impacts to land use or biological resources
 - Slight changes in water use and emissions due to dispatch
- By 2030, the change from Current Practice 1a into Regional 2:
 - Less acreage required in California **by at least 42,000 acres** and fewer impacts due to wind in California
 - Less water use and lower emissions of NO_x, PM_{2.5} and SO₂ in California
 - Least water use and lowest emissions of NO_x, PM_{2.5} and SO₂ outside California
- By 2030, the change from Current Practice 1a into Regional 3:
 - Least overall renewable buildout for RPS, in MW capacity
 - Least acreage required in California and fewer impacts due to wind in California
 - Includes impacts due to Out of State wind resources for California to access (Wyoming and New Mexico) and major Out of State transmission for California RPS
 - Least water use and lowest emissions of NO_x, PM_{2.5} and SO₂ in California
 - Less water use and lower emissions of NO_x, PM_{2.5} and SO₂ outside California

Regional market offers benefits to disadvantaged communities in California

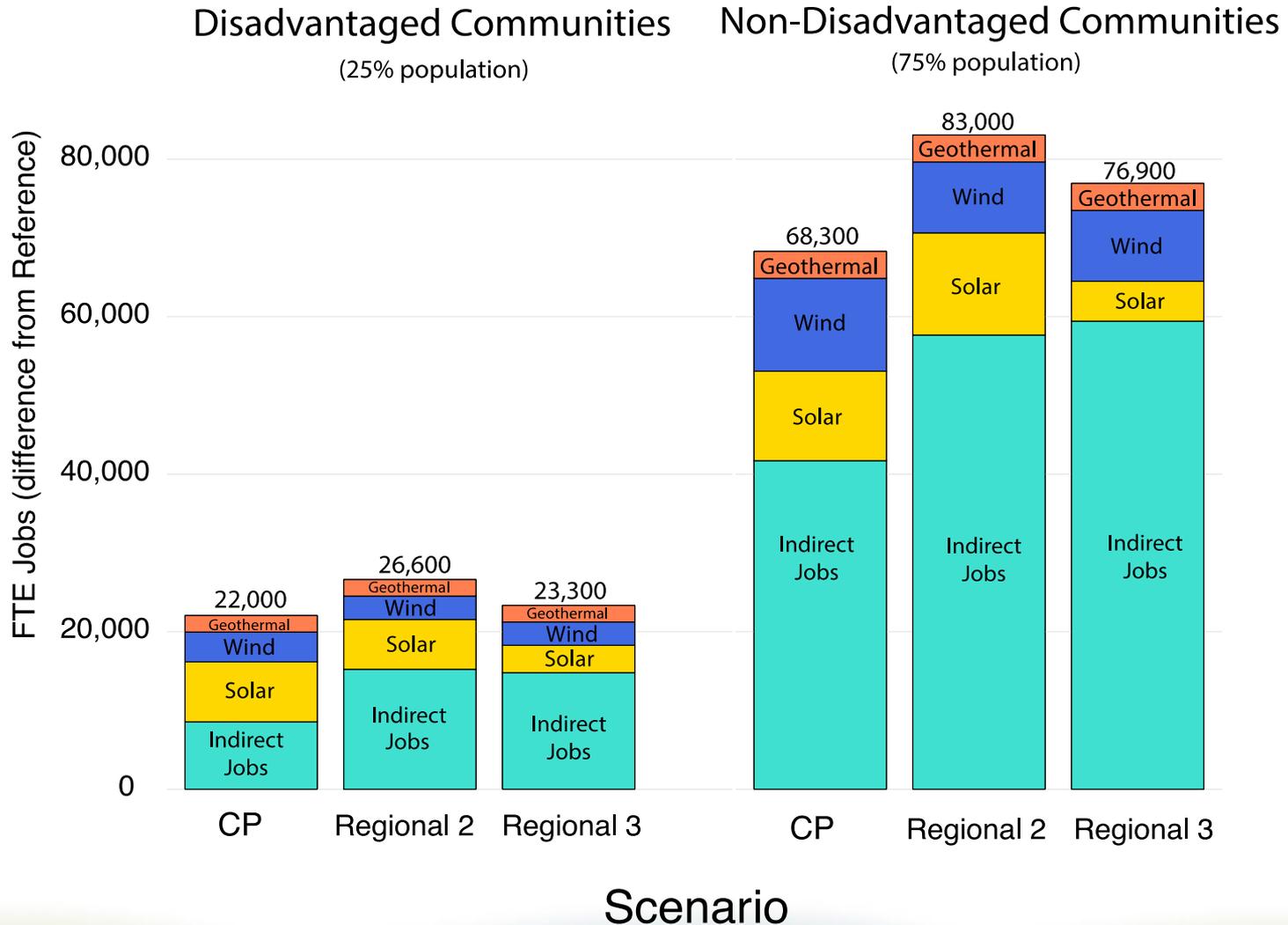
■ Economic Benefits

- Increases real income and jobs in several disadvantaged communities (DC), particularly in Inland Valley, Greater Los Angeles, and Central Valley
 - **1,300 – 4,600 more jobs over 2020 – 2030 period**
 - **Real income increased by \$180 – 330 per household per year**

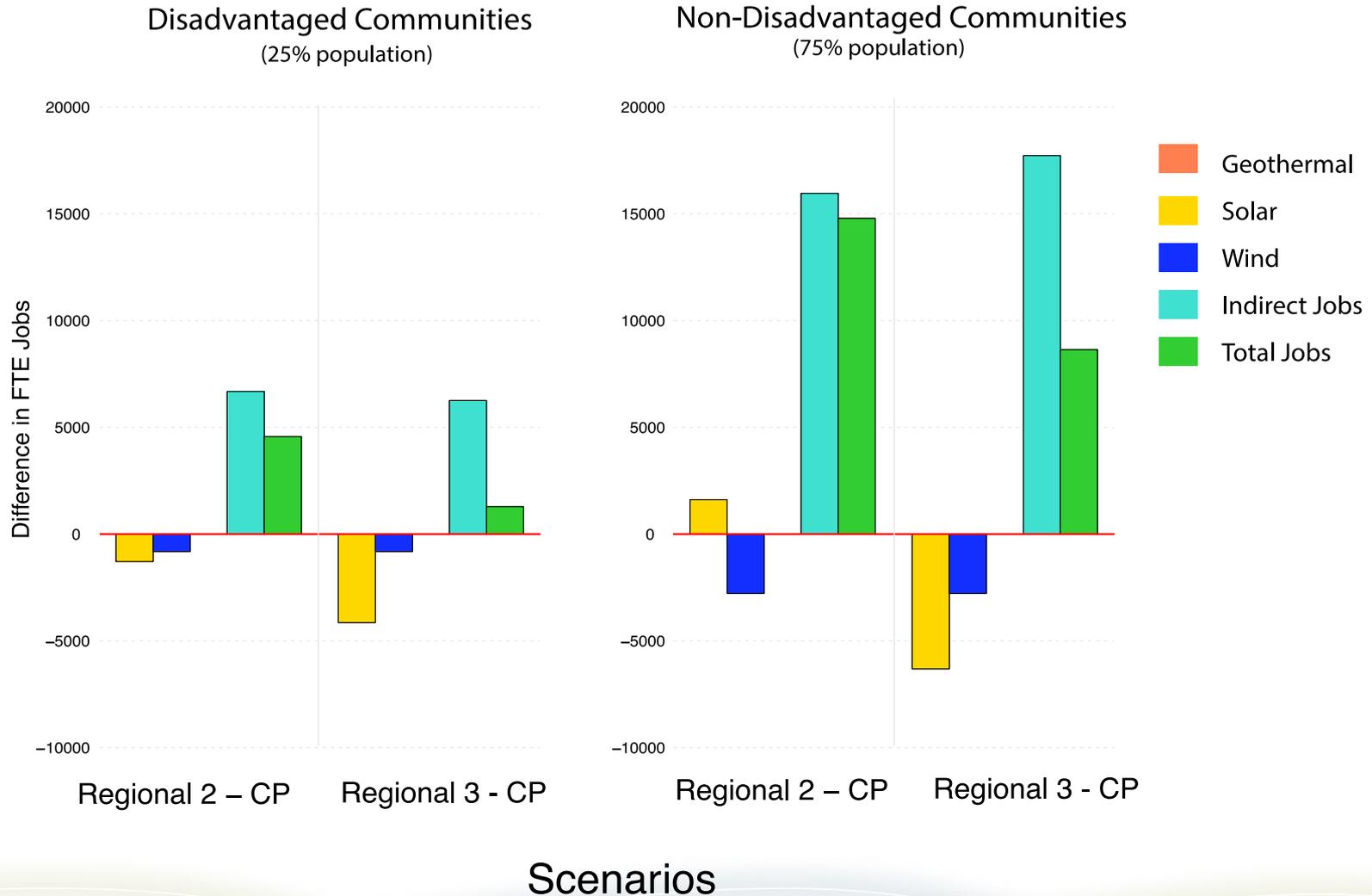
■ Environmental Benefits

- Decreases community-scale construction-related environmental impacts from decreasing renewable resource development in California, particularly in Westlands where a significant amount of new solar would be built in the Current Practice Scenario
- Lower output from natural gas-fired generators in California decreases the amount of water used during power production and decreases power plant emissions in the San Joaquin Valley and South Coast air basins

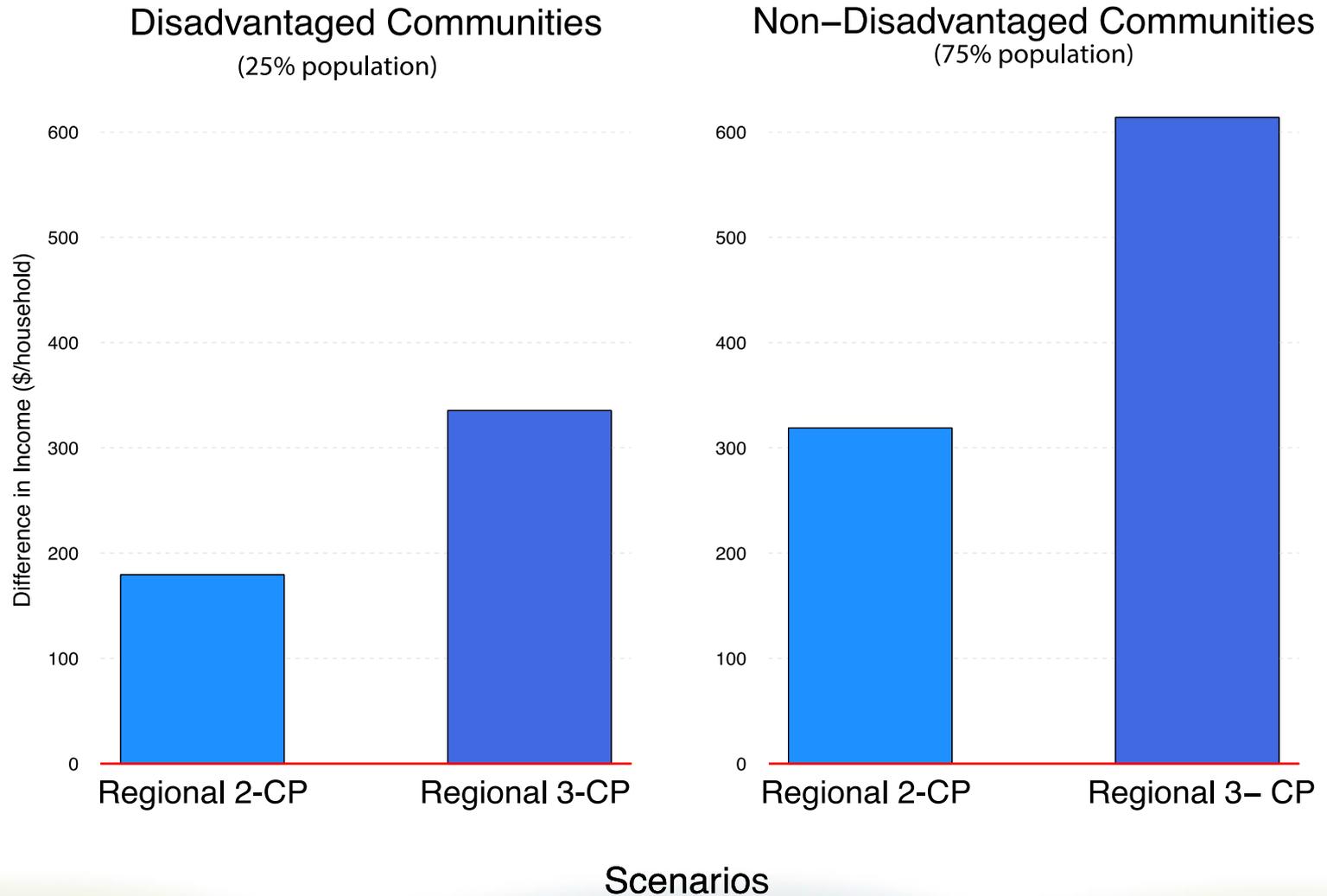
Job creation across scenarios in DCs vs Non-DCs



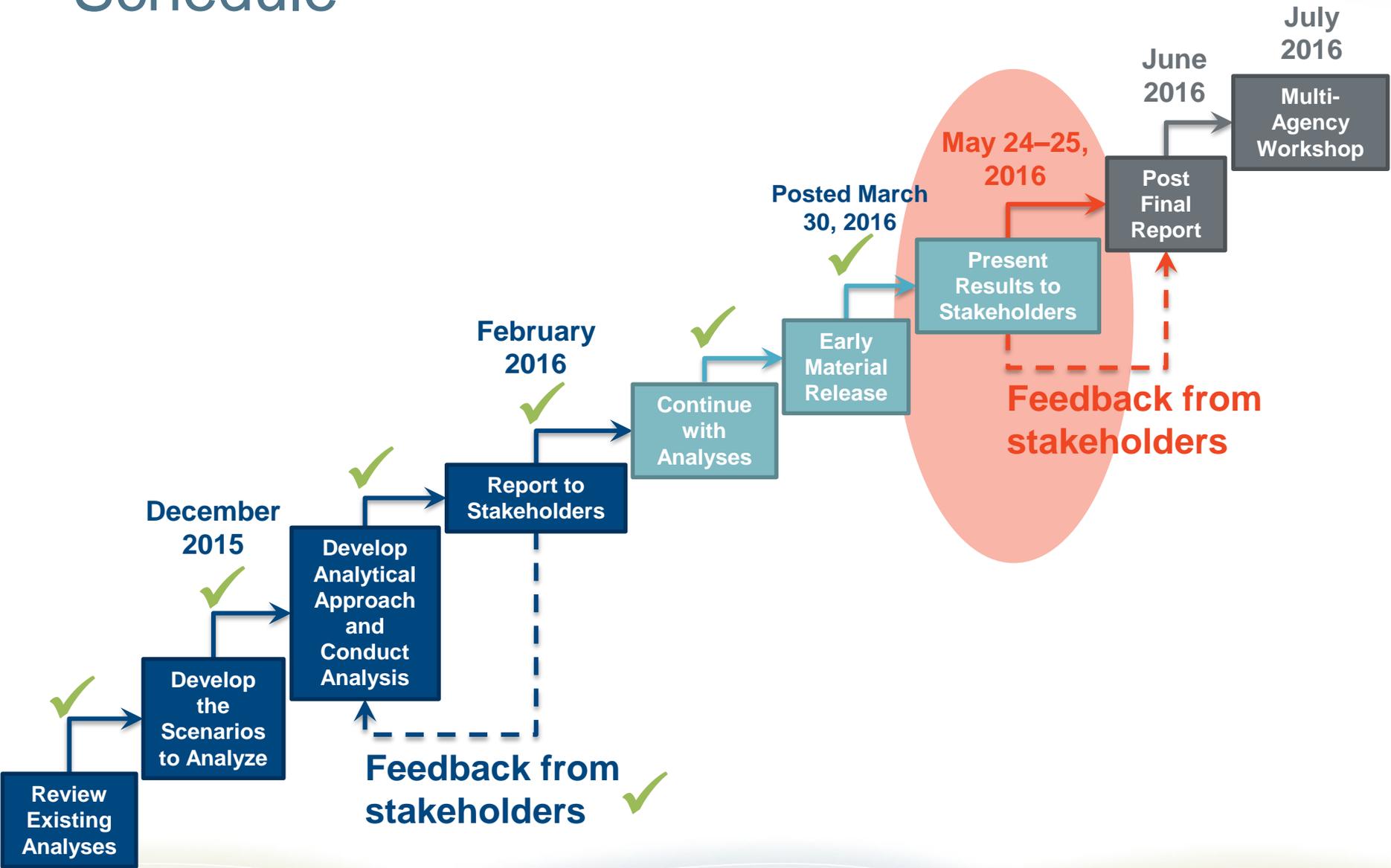
Difference in job creation across scenarios in DCs versus Non-DCs



Difference in real income across scenarios in DCs versus Non-DCs



Schedule



Next Steps



Milestone	Date
Comments due on presentation materials and meeting discussion – Please use comments template available at http://www.caiso.com/Documents/CommentsTemplate-SB350CleanEnergy-PollutionReductionAct-Presentation-Discussion.doc	June 8
Post final report	Target – Mid-June
Joint agency workshop	Target – July

Additional questions or comments can be directed to:
regionalintegration@caiso.com

SB350 Study Reference Material

The May 24 – 25, 2016 stakeholder meetings will be recorded in their entirety. The recording will be available to stakeholders on the regional energy markets webpage at:

<http://www.caiso.com/informed/Pages/RegionalEnergyMarket/BenefitsofaRegionalEnergyMarket.aspx>.

This is a service to stakeholders who couldn't join us, or would like to review the proceedings. Materials related to the SB350 study and other regional integration efforts are also available at the link provided above.

Additional reference materials:

Senate Bill No. 350 - Clean Energy and Pollution Reduction Act of 2015

https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160SB350

Fast Facts – Benefits of a regional energy market

<http://www.caiso.com/Documents/2015RegionalBenefitsFactSheet.pdf>

Early release material

<http://www.caiso.com/informed/Pages/RegionalEnergyMarket/BenefitsofaRegionalEnergyMarket.aspx>