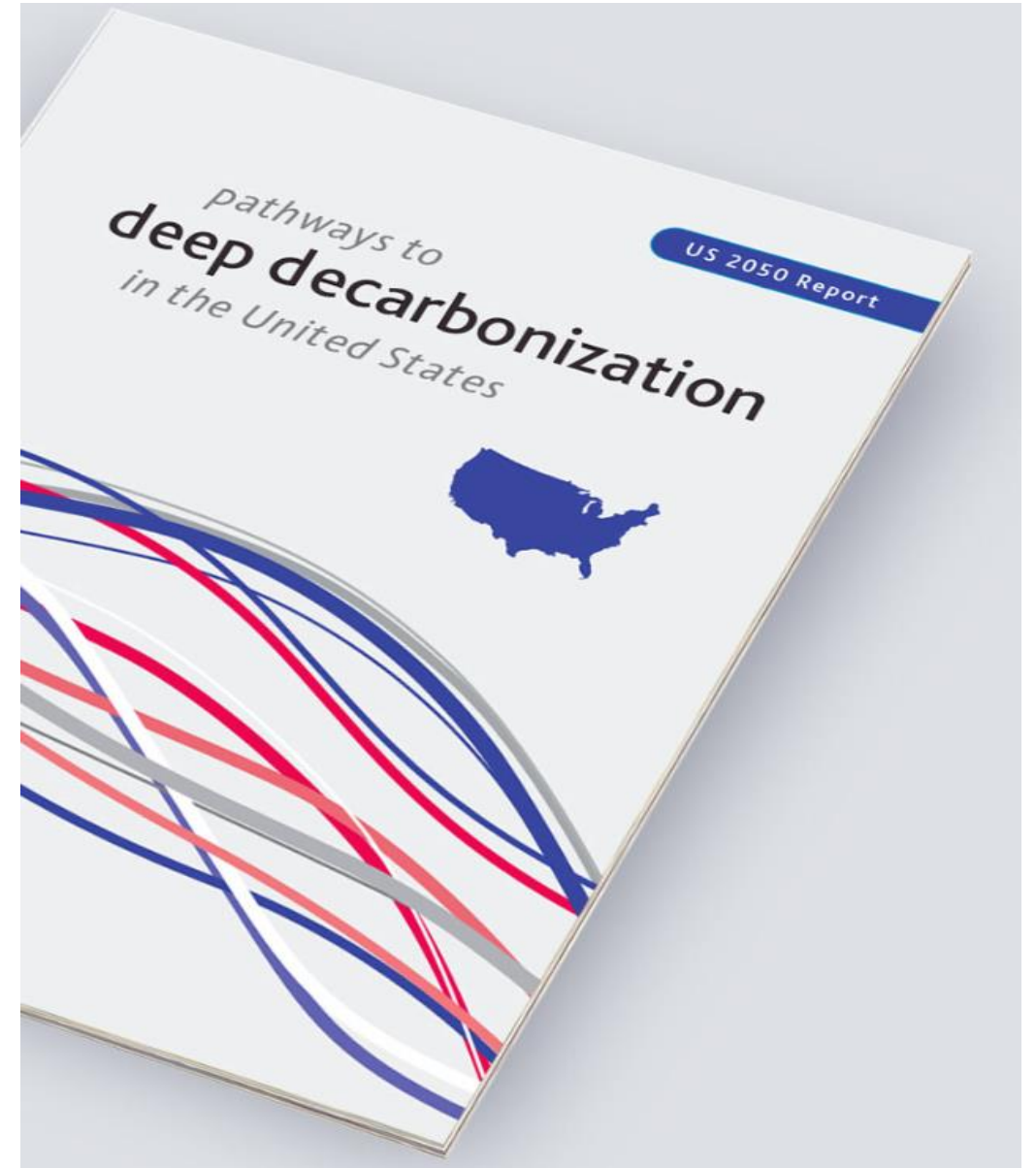


DEEP DECARBONIZATION CITY OF PALO ALTO ELECTRIFICATION CASE STUDY

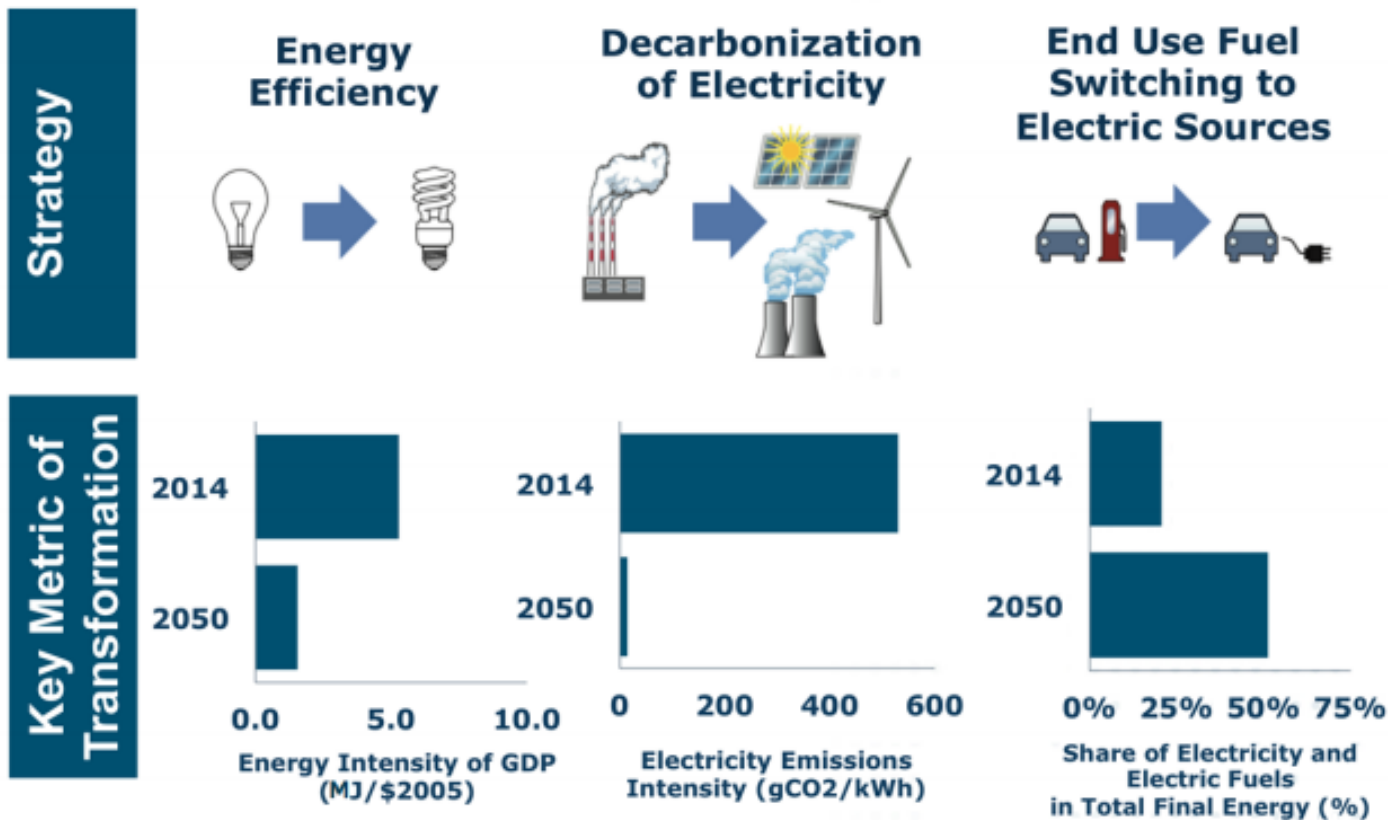
FANNY YANG | CIVICSPARK CLIMATE FELLOW 2016-2017

CITY OF ALBANY | SUSTAINABILITY COMMITTEE MEETING



MARCH 2017

DEEP DECARBONIZATION (US CONTEXT)



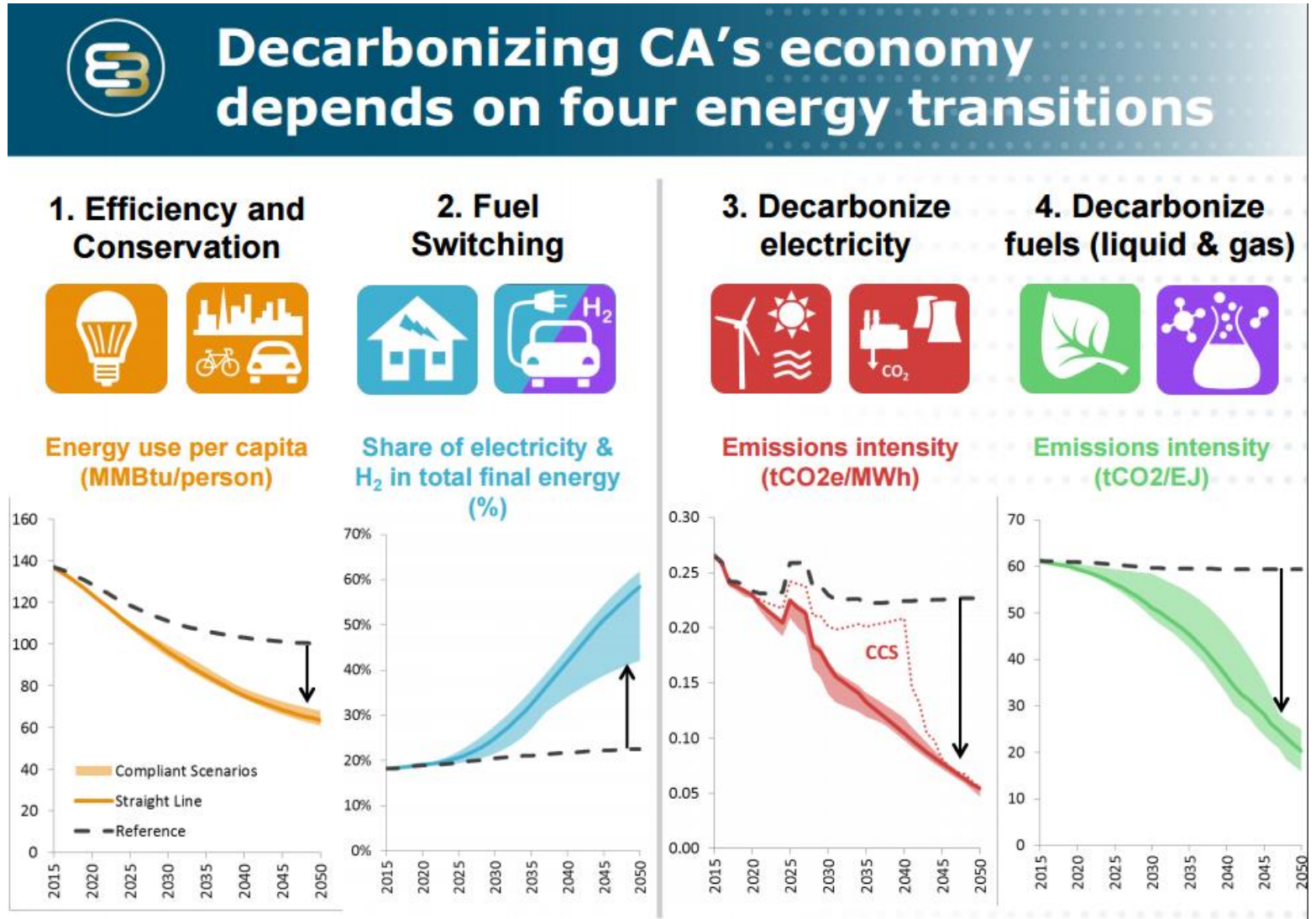
Three Pillars

1. Energy Efficiency
 - Energy intensity of GDP must decline by 70% to 2050
2. Decarbonization of Electricity
 - Near complete decarbonization of electricity
3. Fuel Switching
 - Electrification where possible

DEEP DECARBONIZATION (STATE LEVEL)

CA goal for GHG emission reduction

- 1990 levels by 2020
- 80% below 1990 levels by 2050



CITY OF PALO ALTO TIMELINE

2013

2014

2015

2016

2017

Achieving 100 % carbon neutral

March 2013

Introduction of a Carbon Neutral Plan to achieve carbon neutrality

December 2014

City Manager instructed to prepare report outlining CAP implementation strategies reducing natural gas and gasoline usage

July 2015

Cost-effectiveness evaluation presented to Utilities Advisory's Commission

August 2015

Cost-effectiveness evaluation of fuel switching in single family residential homes presented to Council

April 2016

Sustainability /Climate Action Plan 2.0 update

August 2016

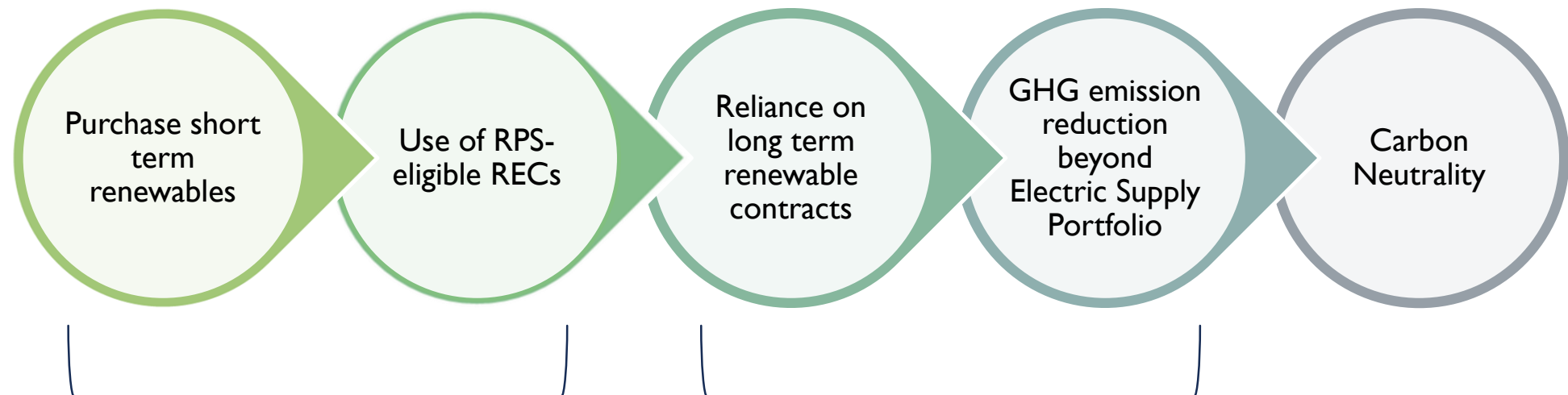
City Council approved Electrification Workplan

November 2016

Palo Alto Electrification Final Report completed by TRC

CARBON NEUTRAL PLAN

Objective: Reduce the City of Palo Alto's overall community GHG emissions by achieving carbon neutrality for the Electric Supply Portfolio starting in calendar year 2013 within an annual rate impact not to exceed 0.15 cents per kilowatt-hour



Phase I

Phase II



CITY OF PALO ALTO SUSTAINABILITY
CLIMATE ACTION PLAN (SCAP)
UPDATE 2.0 OF PALO ALTO
SUSTAINABILITY

- Approved in April 2016
- Goal: 80% GHG emission reduction by 2080
- “a few core moves”
- SCAP initiatives would contribute additional 28% reduction



CITY OF
PALO ALTO

SUSTAINABILITY
AND CLIMATE
ACTION PLAN

Draft – April 2016



REDUCE



SHIFT



TRANSFORM

PALO ALTO ELECTRIFICATION FINAL REPORT

BARRIERS + FEASIBILITY RESULTS

Code Barriers	Technical Barriers	Operational Barriers	
<ul style="list-style-type: none">▪ TDV as a compliance metric in Title 24▪ DOE regulates min. efficiencies required for all appliances▪ Lack of building department experience	<ul style="list-style-type: none">▪ Lack of contractor experience▪ Additional electrical upgrades to properly serve heat pump equipment	HPWH <ul style="list-style-type: none">▪ Improper location installation▪ Requires frequent filter cleaning and occasional replacement	HPSH <ul style="list-style-type: none">▪ Refrigerant discharge risk▪ Lower supply air temperature

PALO ALTO ELECTRIFICATION FINAL REPORT COST EFFECTIVENESS RESULTS

- HPWH and HPSH package results using both societal and customer service perspective were generally consistent
 - Exception of Heat Pump Package in new single family home construction

Figure 1. Cost Effectiveness Summary – Societal Net Savings using Time Dependent Valuation of Energy

Building Type	Construction Type	Heat Pump Water Heater	Heat Pump Space Heater	Heat Pump Package (Gas Connection Remains)	All-Electric Package (No Gas Connection)
Single Family	New	\$(2,459)	\$5,180	\$2,639 ⁱⁱ	\$9,051
	Alteration	\$(8,424)	\$3,866	\$(3,737)	\$(5,170)
Low-rise Multifamily	New	\$(21,982)	\$18,023	\$(5,665)	\$12,041
	Alteration	\$(54,324)	\$16,537	\$(36,627)	\$(38,060)
Small Office	New	\$(777)	\$(5,620)	\$(6,397)	\$5,941
	Alteration	\$(3,187)	\$(9,844)	\$(12,904)	\$(14,337)
Medium Office	New	\$(777)	\$(169,234)	\$(170,011)	\$(159,533)
	Alteration ⁱ	\$(3,344)	-	-	-

ⁱ HPSH alterations, and packages with HPSH alterations, will be less cost effective than new construction due to baseline system design. Detailed calculations have not been performed.

ⁱⁱ The single family new construction Heat Pump Package is not cost effective when using the customer perspective methodology.

PALO ALTO ELECTRIFICATION FINAL REPORT CONCLUSION + RECOMMENDATIONS

Conclusions

Code barriers are associated with Title 24 compliance software modeling.

Residential technical barriers relate to lack of experience.

Commercial building industry is more familiar with heat pump systems.

Current codes and retail rate assumptions does not provide cost effective HPWH and HPSH scenarios.

Recommendations

Introduce training program

Reduce code barriers

Incentive heat pumps

Carbon tax on natural gas

Expanding the scope of all electrification packages



Mix and match combinations of assumptions for a variety of solutions that can be cost effective.





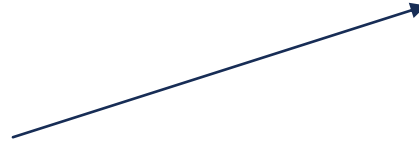
THANK YOU

FANNY YANG | CIVICSPARK CLIMATE FELLOW 2016-2017 | CITY OF ALBANY SUSTAINABILITY COMMITTEE MEETING

“ELECTRIFICATION”

(FUEL SWITCHING)

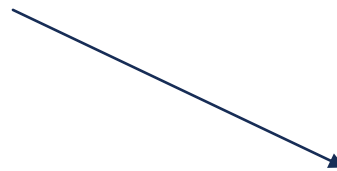
- The conversion/replacement of all natural gas appliances and gasoline-powered vehicles to electrical appliances and electric vehicles
- Renewable energy fuel growth occurring in electricity generation sector
- Recent examples : Caltrain



Electric Vehicles



Electric Trains



Electric Stovetops

CITY OF PALO ALTO SUSTAINABILITY CLIMATE ACTION PLAN (SCAP) UPDATE 2.0

“BUILDING AN EFFICIENT ELECTRIC CITY”

- Goal I: Efficiency and electrification
- Goal II: Reduce natural gas usage in existing business
- Goal III: Reduce natural gas usage in existing home
- Goal IV: Reduce natural gas in new buildings
- Goal V: Reduce the carbon intensity of natural gas



ELECTRIFICATION WORKPLAN

1. Promote HPWH and HPSH in existing homes
2. Convert existing homes to all-electric homes
3. Retail electric rate schedule for homes that electrify
4. Residential and commercial building code changes
5. Analyze utility connection fees and permitting fees
6. EVSE for public use and at multi-family homes
7. Time of Use (TOU) electric rate options
8. Electrify existing and new City buildings
9. New financing sources to expedite electrification
10. Options for district heating for building

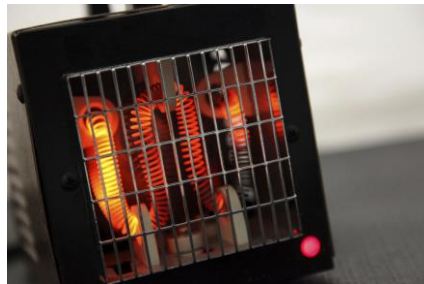


Image Credit: Michael Movchin