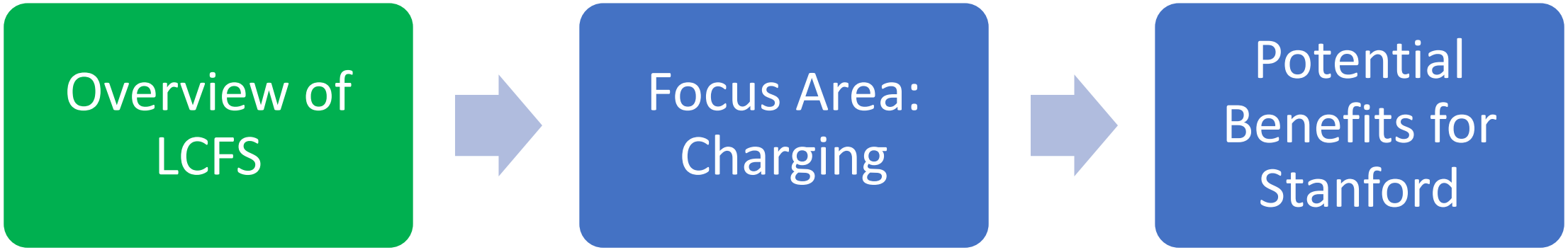
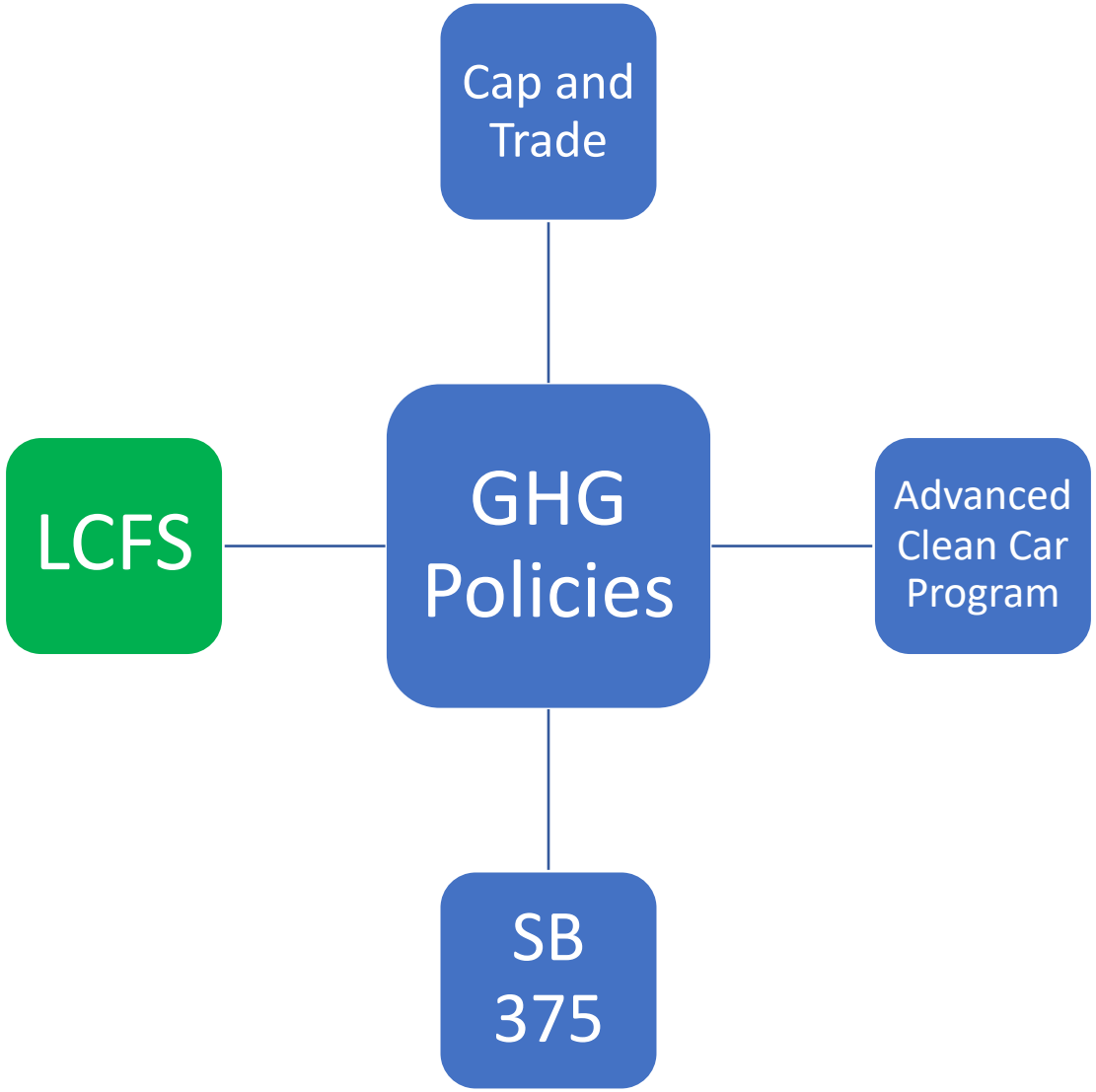
Low Carbon Fuel Standards (LCFS)

Application in the 24/7 carbon-free charging project

Topics Covered



LCFS is part of a portfolio of GHG Policies



Sets carbon intensity (CI) standards – g CO_2e/MJ – for transportation fuels

CI based on Life Cycle – production, distribution and consumption

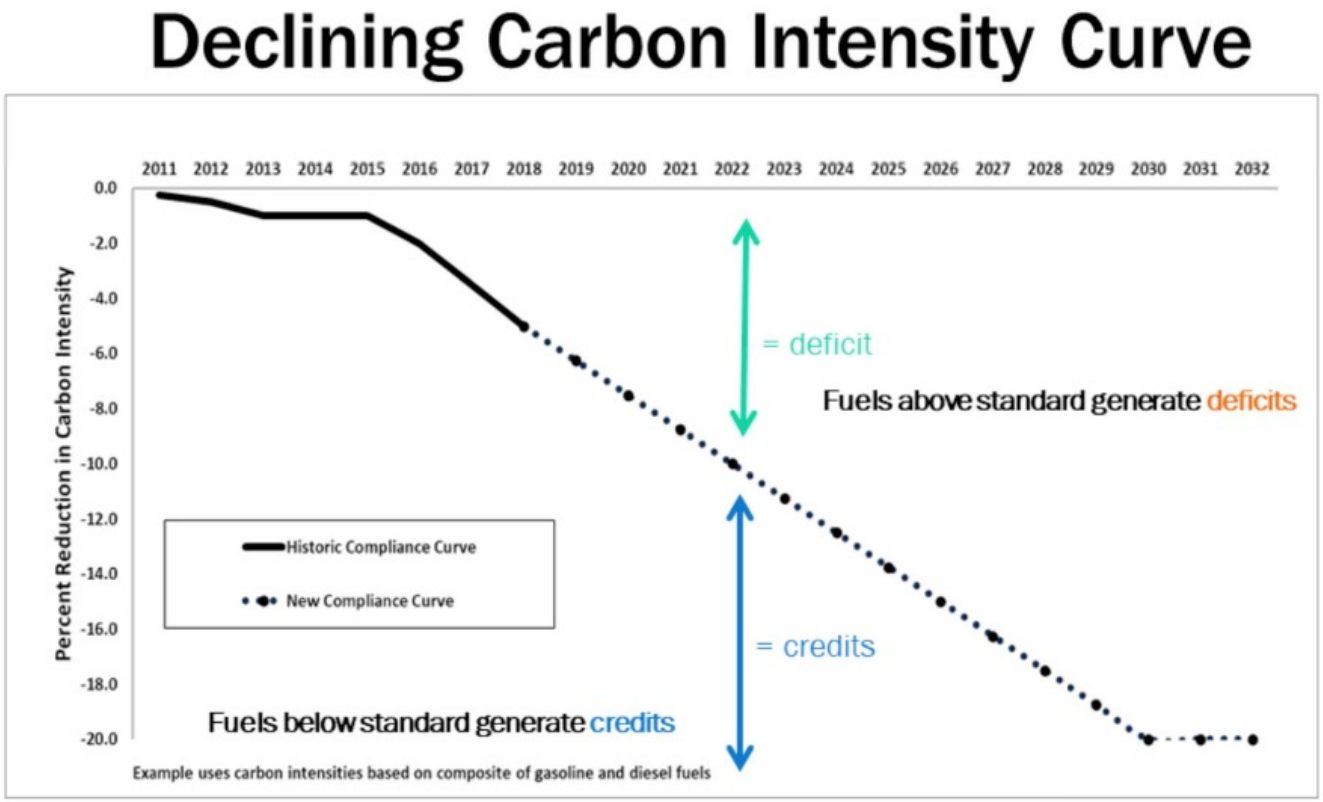
LCFS Basics

Fuel CI > benchmark – deficit

Fuel CI < benchmark – credit

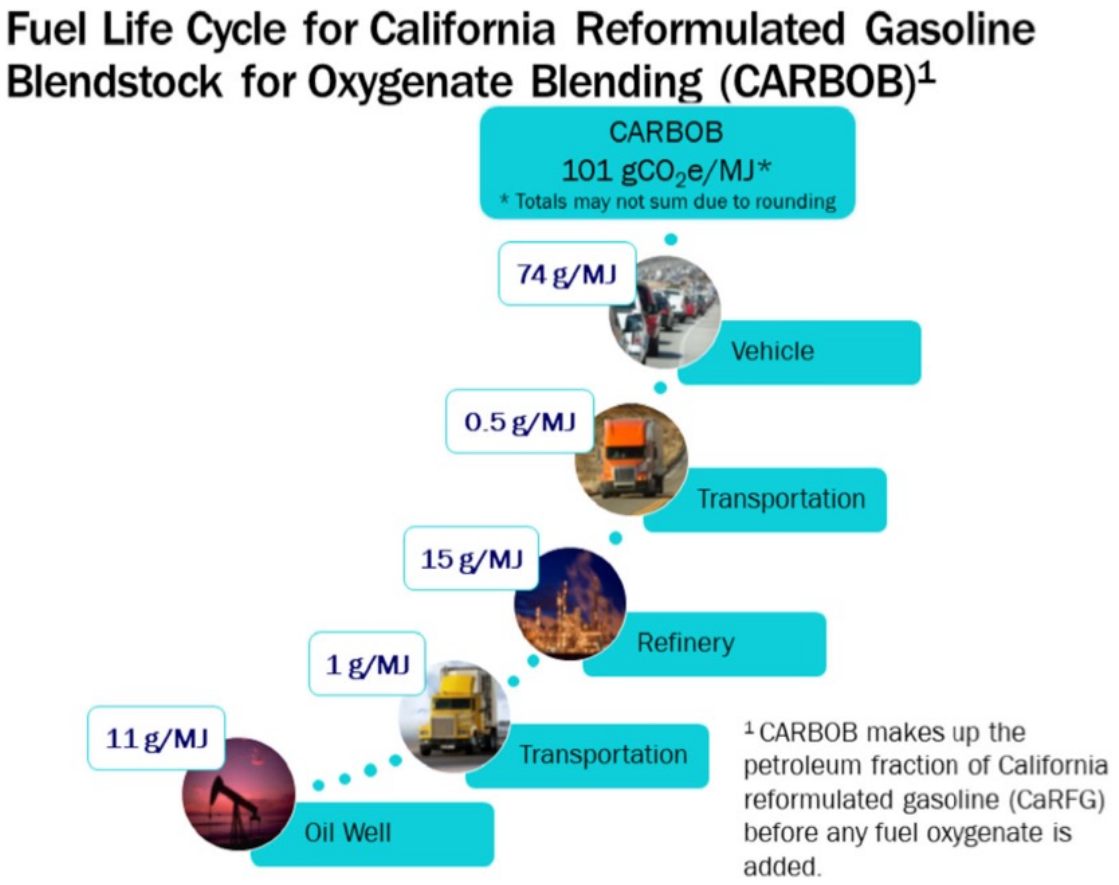
Market decides mix of fuels needed

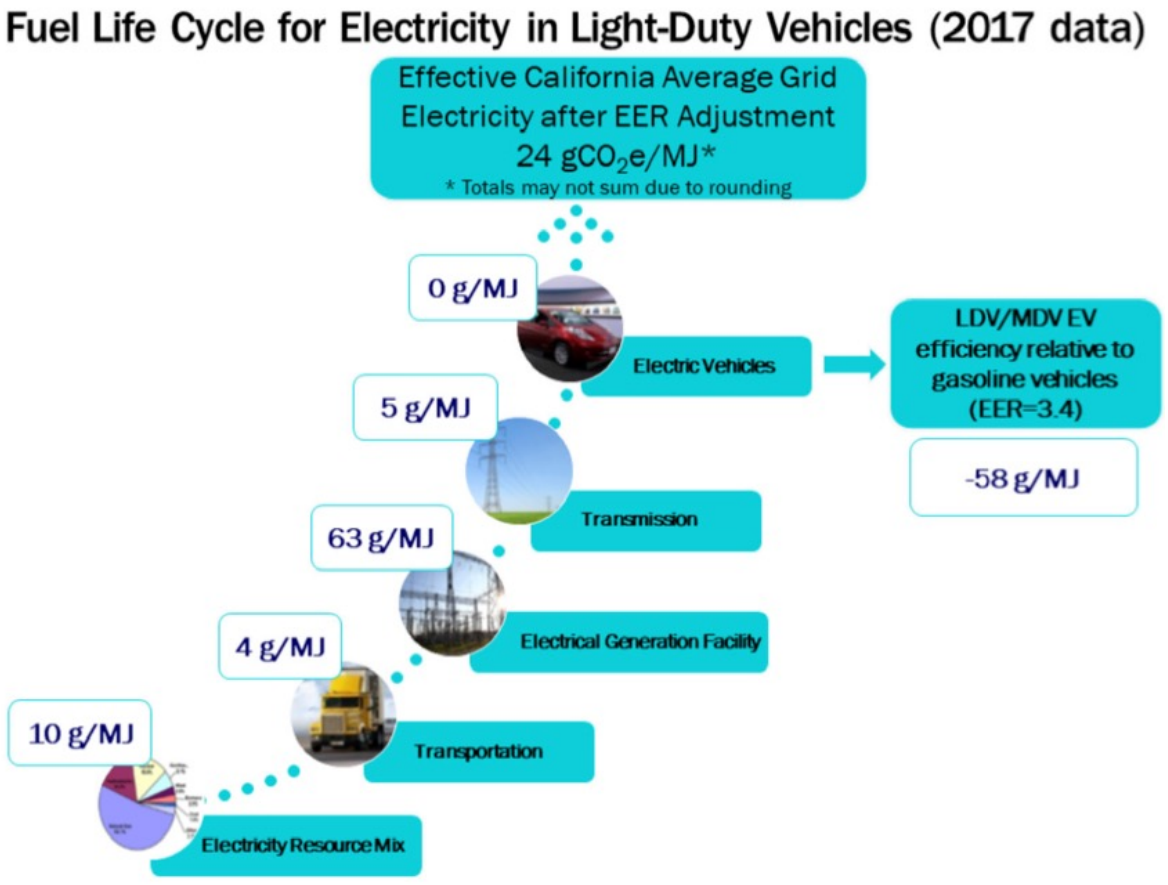
Goal: Reduce carbon intensity of transportation 20% from 2010 levels by 2030

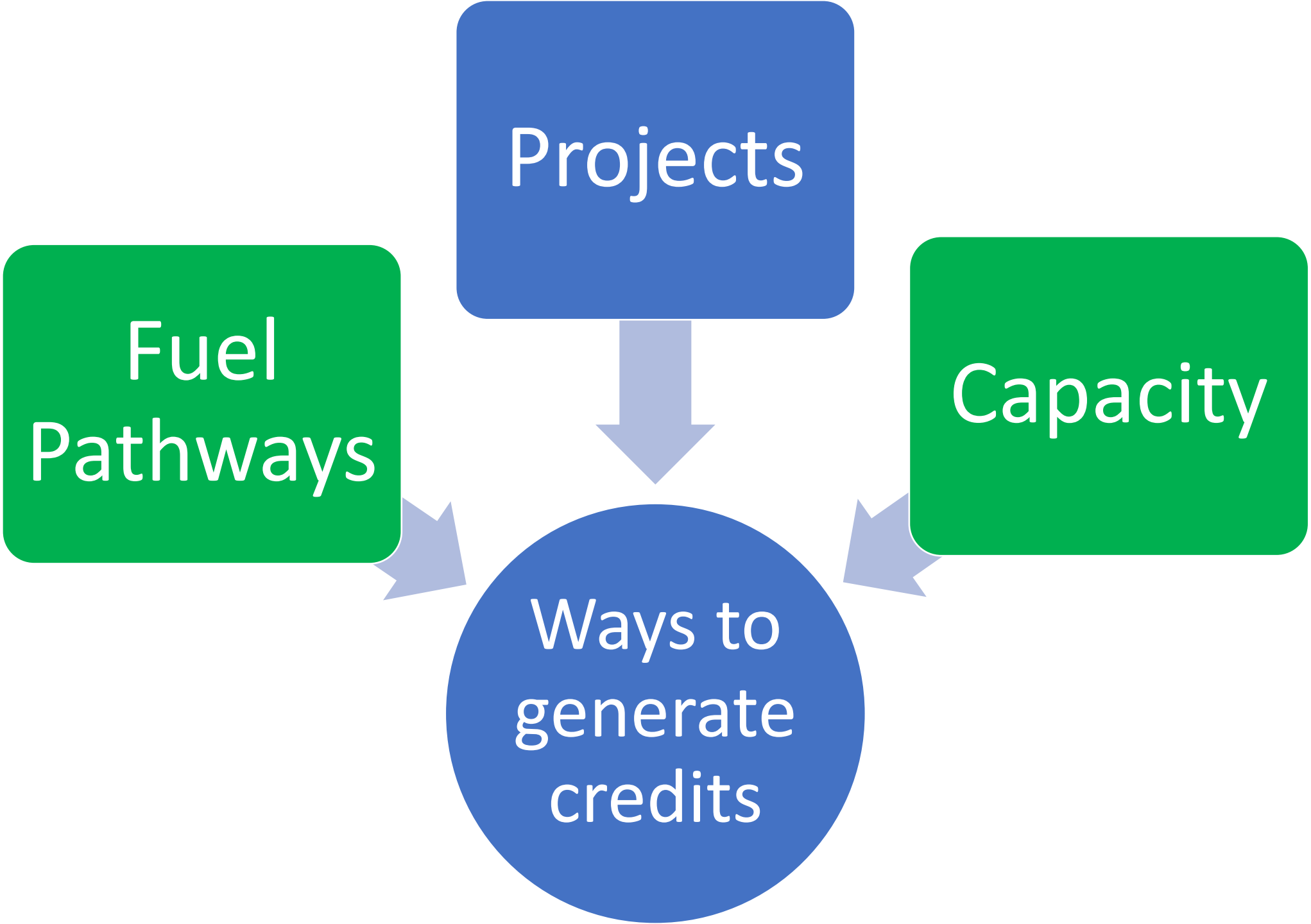


Program continues with a 20% CI target post 2030

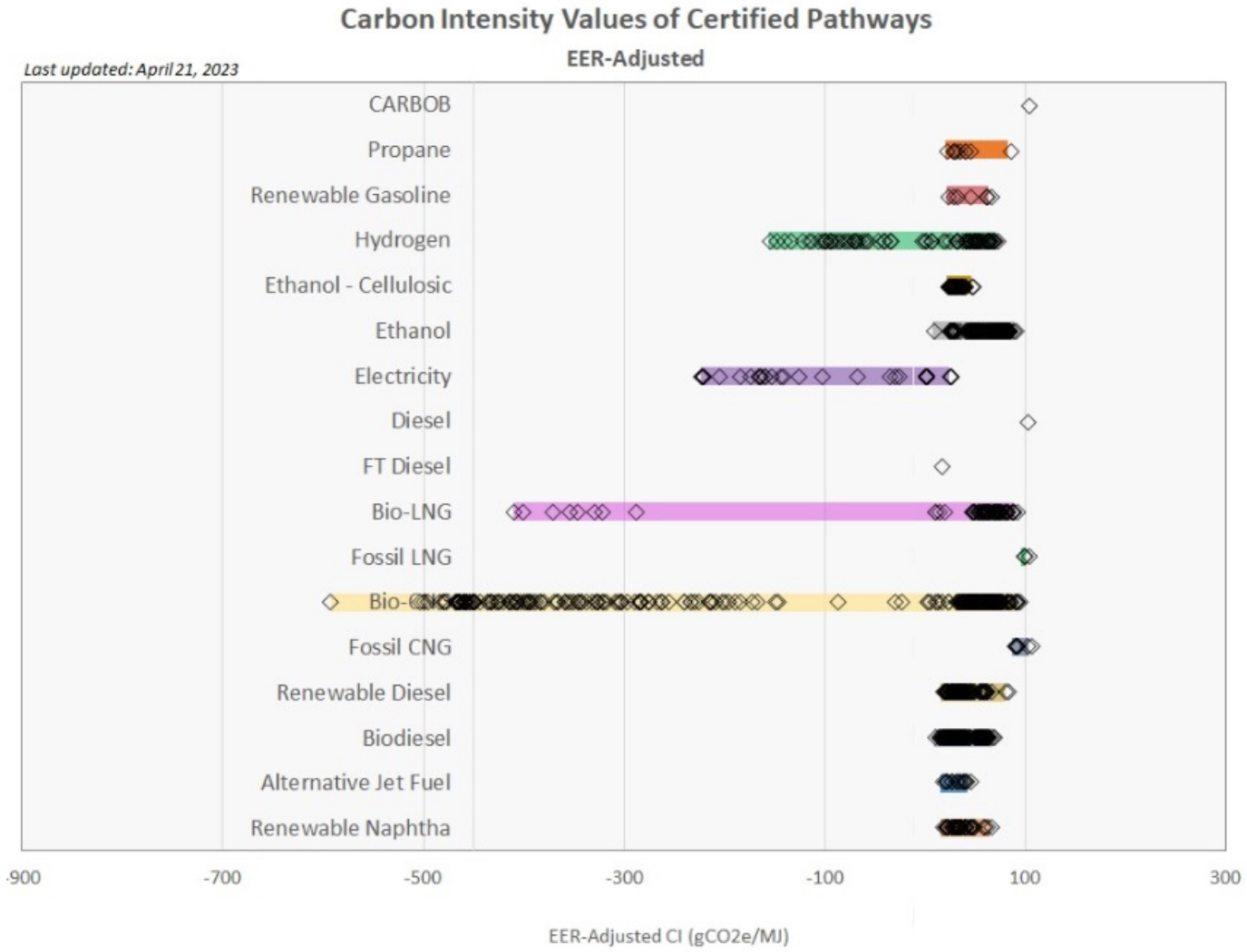
Life Cycle Assessment to calculate Carbon Intensity (CI)

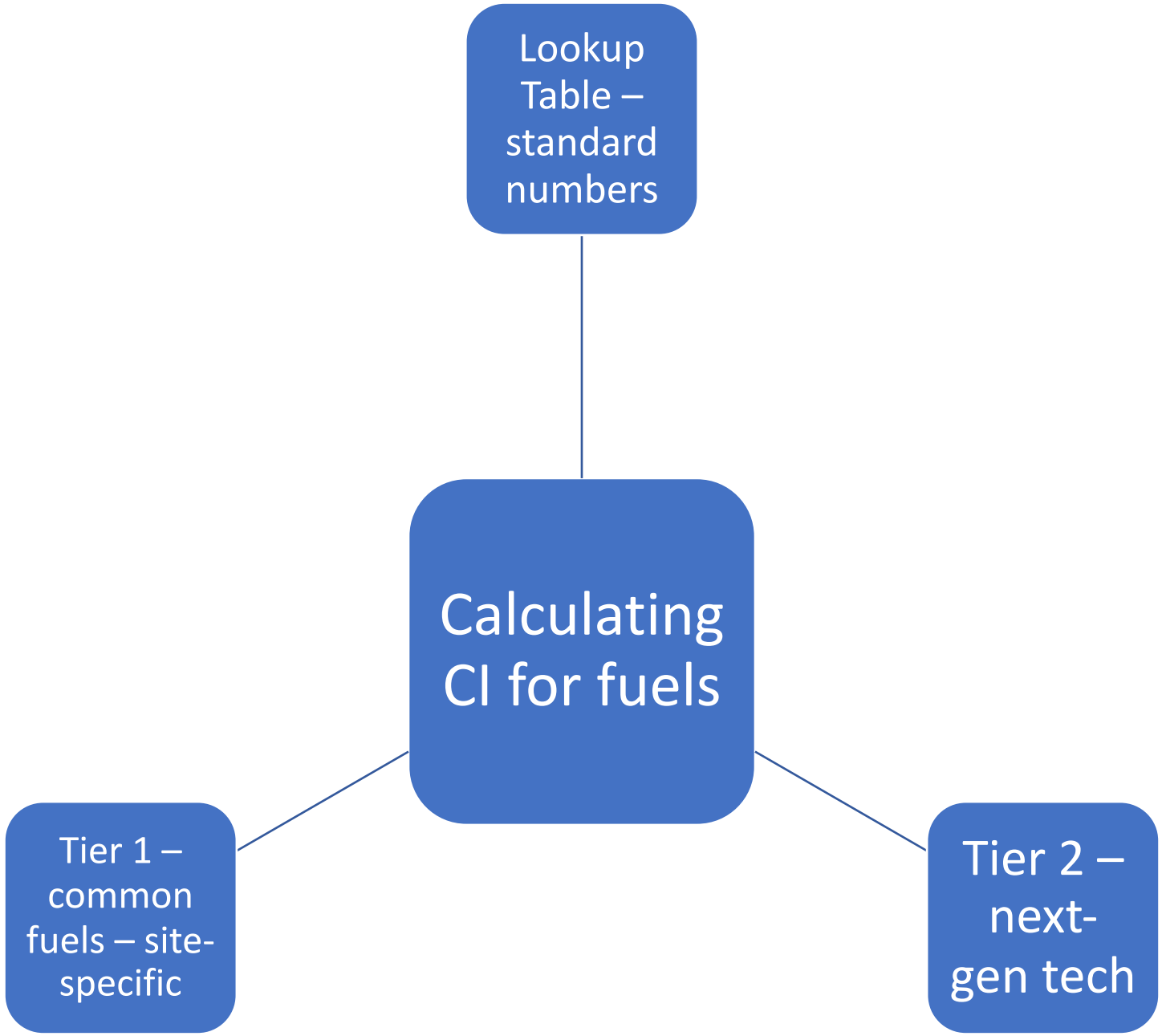




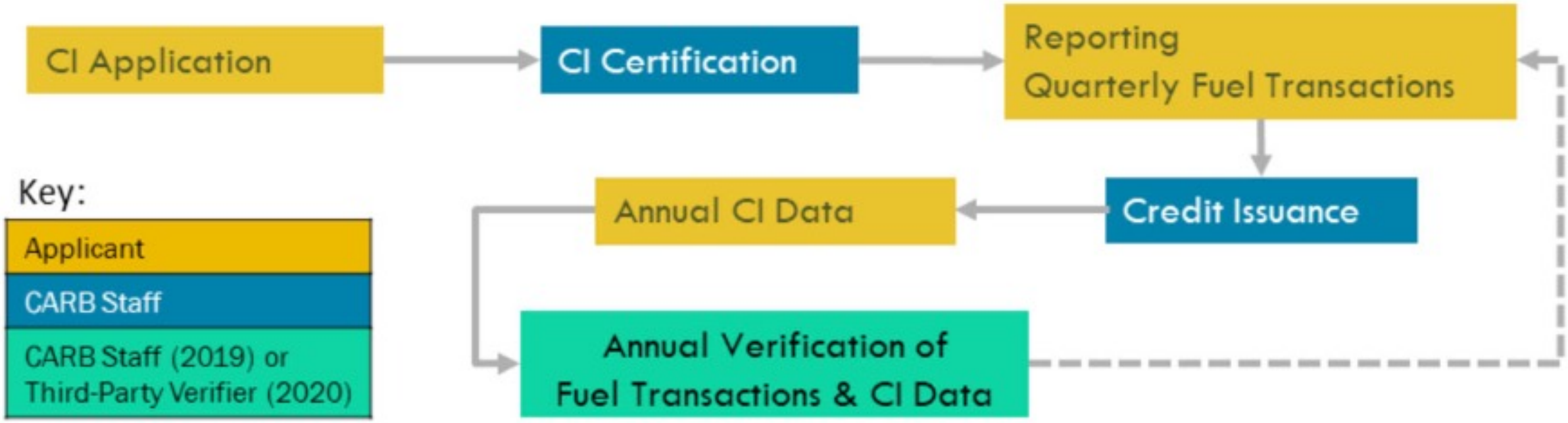

Projects
Fuel Pathways
Capacity
Ways to generate credits

Fuel Pathways




Lookup Table – standard numbers
Calculating CI for fuels
Tier 1 – common fuels – site-specific
Tier 2 – next-gen tech

Application and Credit Generation Process

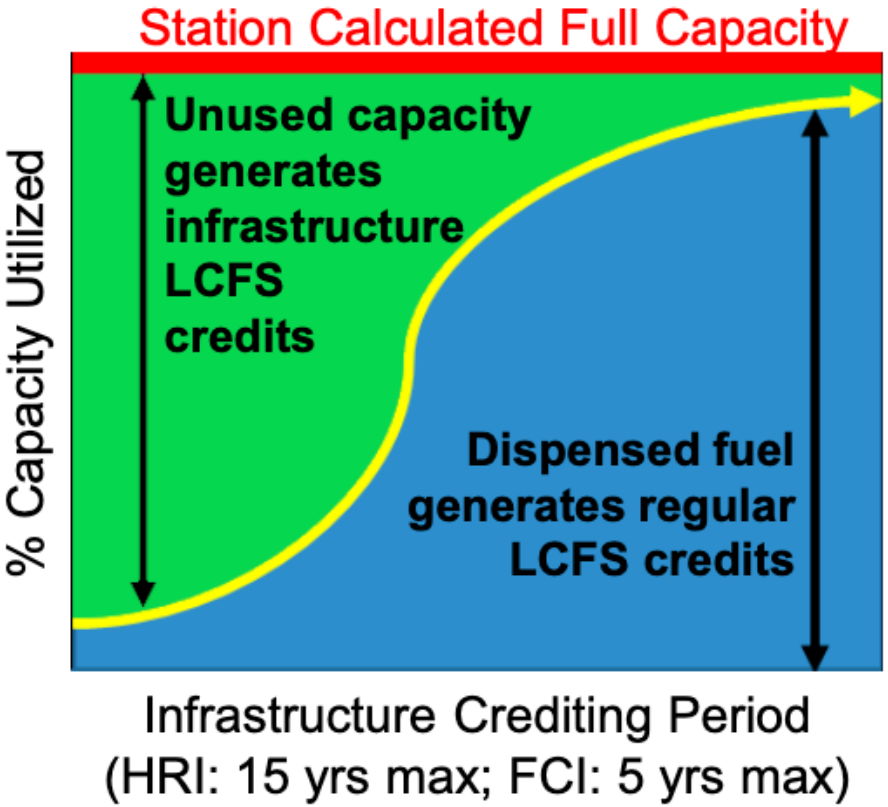


Solve chicken-and-egg problem

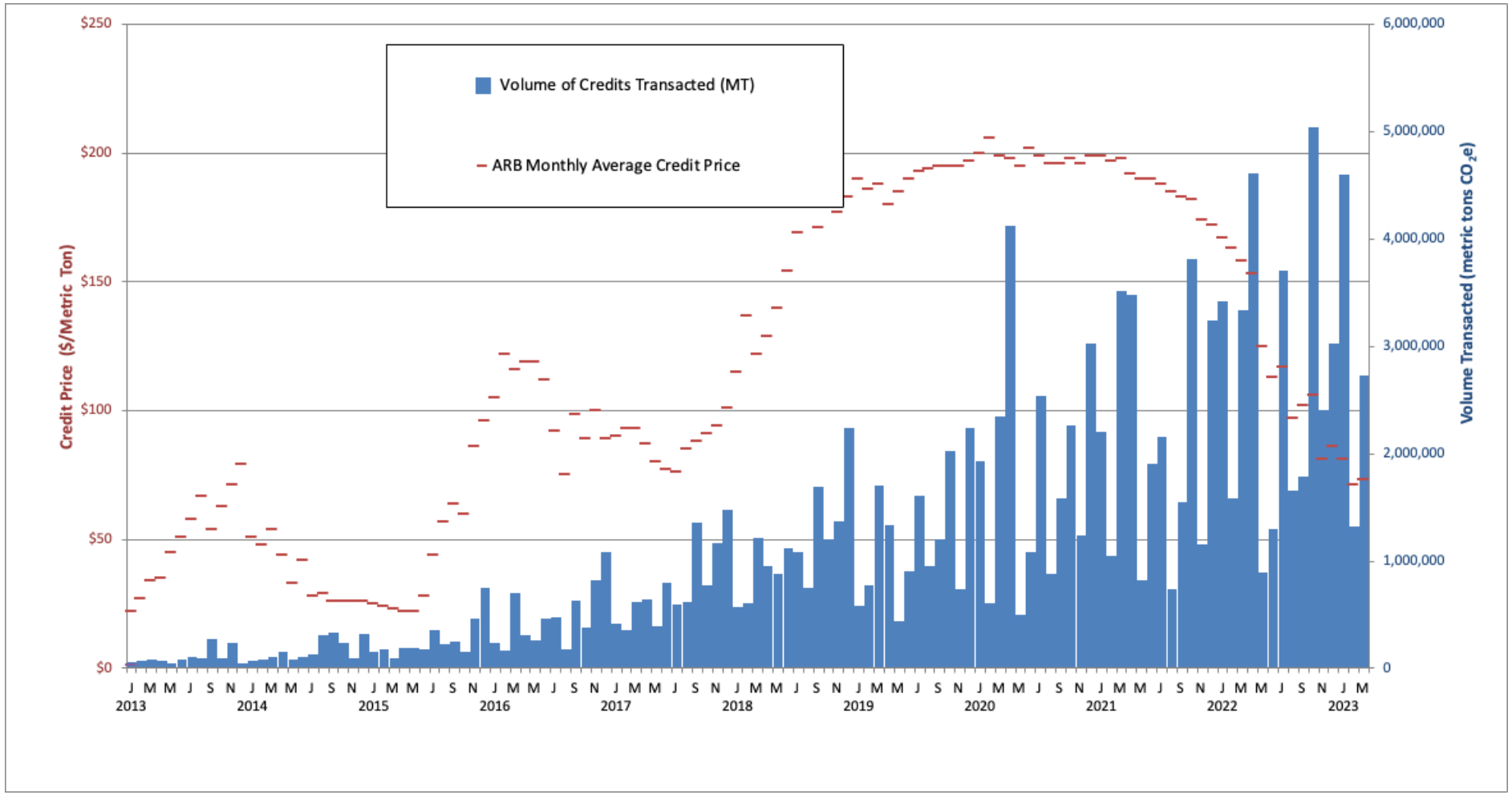
Capacity Credits

Must have started operating after 1/1/2019

2500 kW max, each charger 50 kW minimum



Credit Price History (1 credit = 1 MT CO_2e)



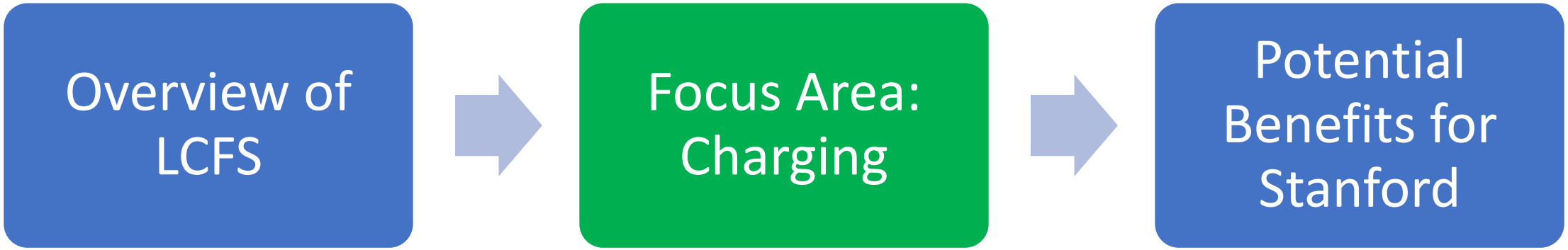
Current Price:

$82/credit

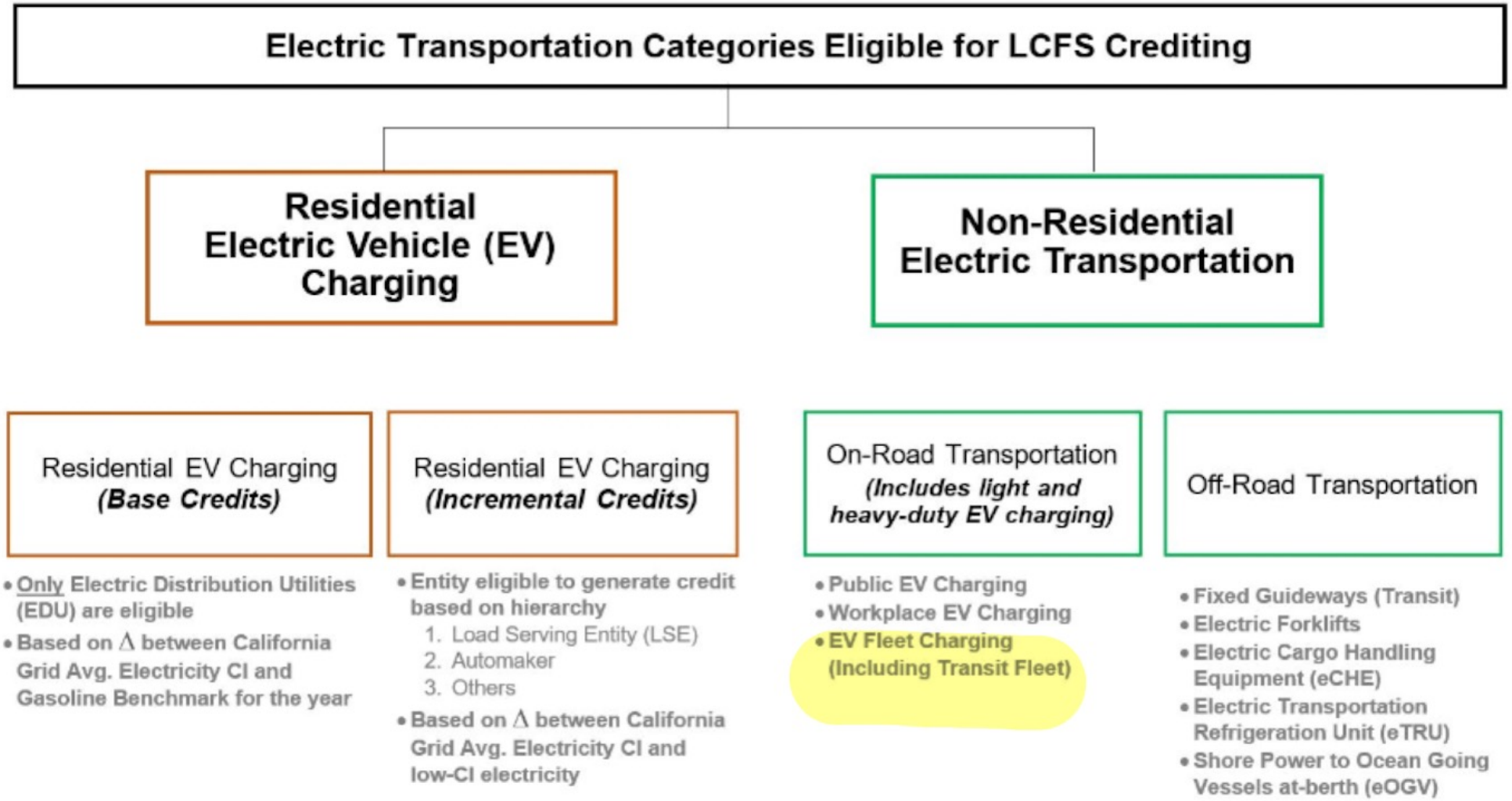
(or)

$82/MT CO_2

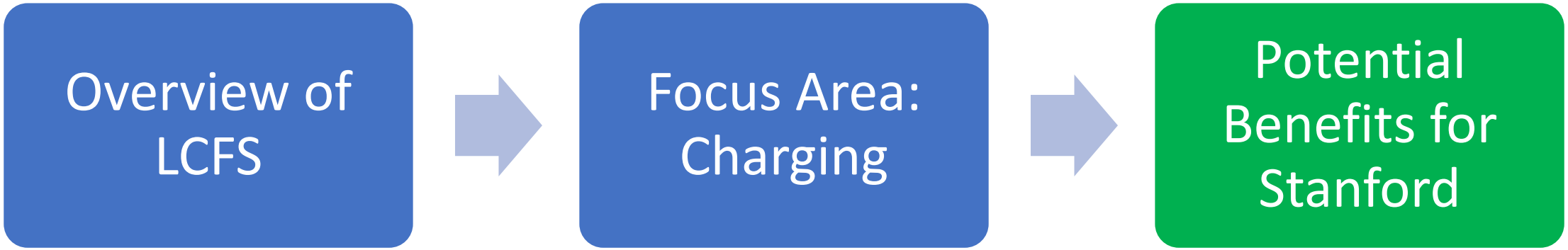
Topics Covered



Which category does Stanford fall in?



Topics Covered

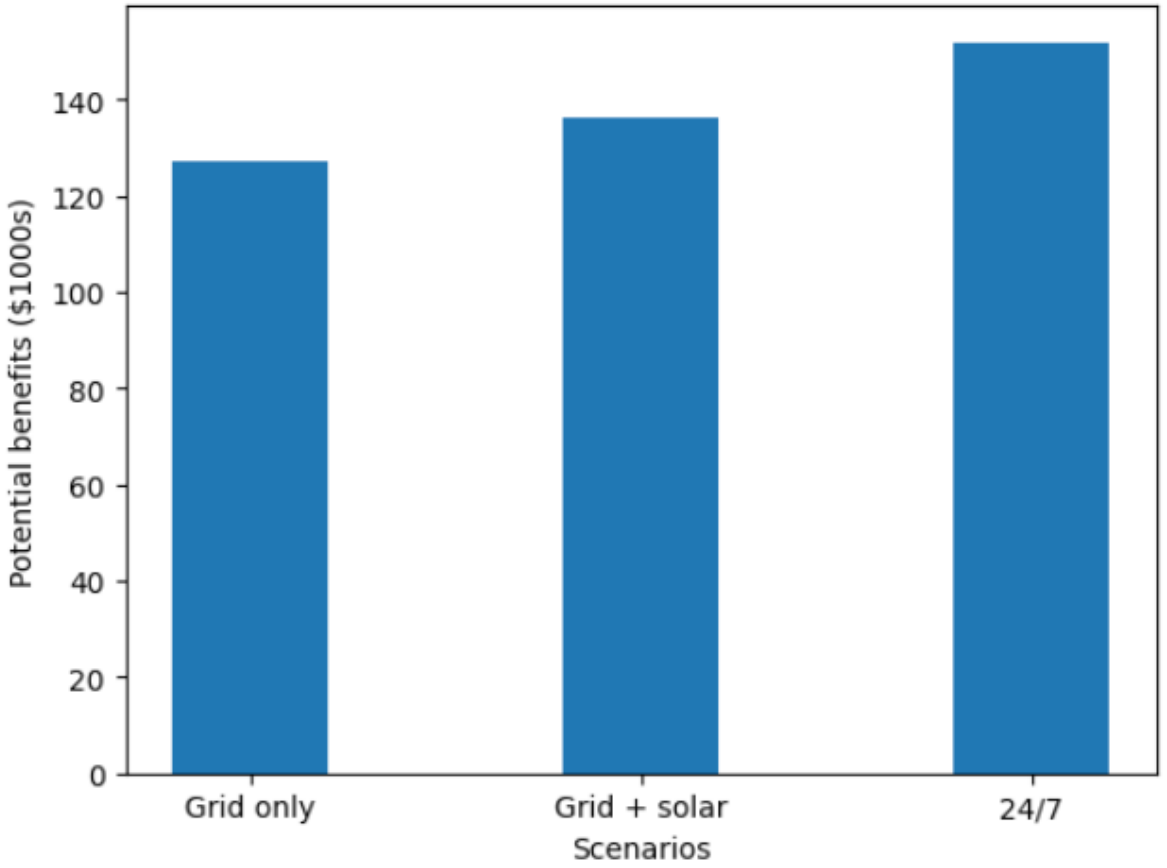


Calculation Sample – Grid Electricity – Fuel Pathways

- CARB Standard = 100.82 g CO_2/MJ
- California grid electricity – CI = 81.49 g CO_2/MJ
- EER = 5 (electric bus, relative to diesel-powered bus)
- EER adjusted CI = 81.49/5 = 16.3 g CO_2/MJ
- Credit = Difference = 100.82 – 16.3 = 84.52 g CO_2/MJ
- Converting MJ to kWh and multiplying by current price ($82/ton), we get benefit = $ 0.025 / kWh
- Annual energy displaced (2022) = 1021057.5 kWh * 5 = 5.11e6 kWh/year
- Potential benefits for Stanford = 5.11e6 kWh/year * $ 0.025/kWh =
- $ 128k/year!

$$LCFS\ Revenue = \left[\left(CI_{Diesel} - \left[\frac{CI_{Electricity}}{EER_{BEV}}\right]\right) \times E \times EER_{BEV} \times C\right] \times Credit\ Price$$

Repeating similar calculations for grid + solar and 24/7 carbon-free….



Note: For grid + solar, 35% electricity from solar and rest from grid

Calculation Sample – Grid Electricity - Capacity

- CARB Standard = 100.82 g CO_2/MJ
- California grid electricity – CI = 81.49 g CO_2/MJ
- EER = 5 (electric bus, relative to diesel-powered bus)
- EER adjusted CI = 81.49/5 = 16.3 g CO_2/MJ
- Credit = Difference = 100.82 – 16.3 = 84.52 g CO_2/MJ
- Converting MJ to kWh and multiplying by current price ($82/ton), we get benefit = $ 0.025 / kWh
- Annual charging capacity = 80 kW * 8760 h/year * 23 = 1.61e7 kWh/year
- Annual charging = 5.11e6 kWh/year
- Potential benefits for Stanford

= (1.61e7 - 5.11e6) kWh/year * 5 * $ 0.025/kWh

- = $ 1.37 million /year!

$$Credits_{FCI} = \left(CI^{XD}_{standard} \times EER - CI_{FCI}\right) \times C_{Elec} \times \left(Cap^{i}_{FCI} \times N \times UT - Elec_{disp}\right) \times C$$