CALTRAIN

ENERGY PROCUREMENT STRATEGY

FINAL REPORT UPDATE

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WSP USA

425 Market Street
Suite 17
San Francisco, California 94105
wsp.com

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GLOSSARY OF TERMS

AC	Alternating Current
AES	Advanced Energy Storage
BEB	Battery Electric Bus
BESS	Battery Energy Storage System
BEV	Battery Electric Vehicle
CA	California
CA HSR	California High Speed Rail
CAISO	California Independent System Operator
CARB	California Air Resources Board
CCA	Community Choice Aggregator
CCE	Community Choice Energy
CEC	California Energy Commission
CO_2	Carbon dioxide
COA	Comprehensive Operational Analysis
COD	Commercial Operation Date
CPSF	CleanPowerSF
CSP	Curtailment Service Provider
CPUC	California Public Utilities Commission
CUB	Contract Bus Fleet
DA	Direct Access
DC	Direct Current
DER(s)	Distributed Energy Resources
DRAM	Demand Response Auction Mechanism
EIR	Environmental Impact Report
EMU	Electric Multiple-Unit
ESP	Electric Service Provider
GHG	Greenhouse Gas
GRC	General Rate Case
HFTZ	High Fire Threat Zone
IOU	Investor Owned Utility(ies)
IRR	Internal rate of return
ITC	Investment Tax Credit
kW	Kilowatt
kWh	Kilowatt-hour

LCFS	Low Carbon Fuel Standard
LSE	Load Serving Entity
MACRS	Modified Accelerated Cost- Recovery System
MBTA	Massachusetts Bay Transportation Authority
MOU	Municipal Owned Utility
MW	Megawatt
MWh	Megawatt-hour
NCPA	Northern California Power Agency
NEM	Net energy metering
NFPA	National Fire Protection Association
NGOM	Net generation output meter
OCS	Overhead Control System
PCE	Peninsula Clean Energy
PCIA	Power Charge Indifference Adjustment
PG&E	Pacific Gas & Electric
PPA	Power Purchase Agreement
PSPS	Public Safety Power Shutoff
PV	Photovoltaic
REC	Renewable Energy Credit
RES-BCT	Renewable Energy Self-Generation Bill Credit Transfer
RFP	Request for Proposals
RPS	Renewable Portfolio Standard
SAID	Service Agreement ID
SGIP	Self-Generation Incentive Program
SJCE	San Jose Clean Energy
SOP	Super-Off-Peak
SVCE	Silicon Valley Clean Energy
TOU	Time of Use
UEDM	Utility expense data management
VPP	Virtual Power Plant
(v)PPA	(Virtual) Power Purchase Agreement
W	Watt
WREGIS	Western Renewable Energy Generation Information System

DEFINITIONS

Community Choice Aggregation/Energy (CCA/CCE)	CCA/CCE) are programs that allow local governments to procure power (including lower carbon power) on behalf of their residents, businesses, and municipal accounts from an alternative supplier while still receiving electricity delivery (called transmission and distribution) service from their existing utility provider (PG&E). Caltrain is currently served by a CCA/CCE providers.
Demand Reduction	Decreased demand for peak power.
Direct Access Power	Direct Access (DA) is an option available to non-residential customers that would allow Caltrain to purchase its electricity directly from a third-party supplier, including products that are exposed to wholesale market pricing. Under this option, Caltrain would be granted the ability to contract directly with any Electric Service Provider (ESP).
Distributed Energy Resources (DER(s))	DERs are decentralized, electricity-producing infrastructure located close to the consumer they supply energy to, and are connected to a local distribution system or host facility. DERs can include solar panels and battery storage systems, and can be integrated into a microgrid.
Electric Service Provider (ESP)	A non-utility entity that offers electric service to customers within the service territory of an electric utility.
Eligible Renewable Energy Resource	Energy sources that are eligible to meet the State of California's Renewable Energy Portfolio Standard (RPS). The RPS is a law that sets the minimum level of renewables utilities are required to procure. Eligible renewable resources include solar and solar thermal electric; wind; certain biomass resources; geothermal electric; certain hydroelectric facilities (energy from dams); ocean wave, thermal and tidal energy; fuel cells using renewable fuels; landfill gas; and municipal solid waste conversion, not the direct combustion of municipal solid waste. Large hydroelectric generation (e.g., Hetch Hetchy) and nuclear are excluded.
Greenhouse Gas (GHG) Emissions	Gases that trap heat in the atmosphere, including carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and fluorinated gases.
GHG-Free Energy	Electricity that does not emit carbon or other greenhouse gases. In California, GHG-free energy includes all eligible renewable energy sources plus large hydroelectric and nuclear energy.

Grid Services Programs	Distributed Energy Resources, such as batteries can participate in relatively new grid services programs such as the Demand Response Auction Mechanism (DRAM). Similar to traditional demand response programs (where customers are compensated for allowing the utility to turn off some of certain loads during certain high energy usage events), the DRAM program (as well as others) enable behind-the-meter resources to earn revenue by reducing or shifting a facility's load at specified times.
Investor Owned Utility (IOU)	Utilities owned privately by shareholders. Other types of non-IOU utilities include municipally owned utilities and community choice aggregators.
Load Serving Entity (LSE)	An organization that serves end users and has been granted authority by the state to sell electric energy to end users. Legislation would be required to allow SamTrans to become an LSE.
Low Carbon Fuel Standard (LCFS)	Designed to encourage the use of cleaner low-carbon transportation fuels in California, encourage the production of those fuels, and therefore, reduce GHG emissions and decrease petroleum dependence in the transportation sector. SamTrans will generate LCFS credits by switching from diesel fuel to electricity in proportion to the percentage of the fleet that is operated using electricity instead of diesel. The benefits provided by the alternative fuel source (e.g., grid electricity) are compared to the standard fuel source (e.g., gasoline or diesel) and the GHG emissions associated with the complete life-cycle of each fuel is compared in order to determine the reduction in GHG emissions due to the use of the alternative fuel source. The agencies can increase the value of the LCFS credits by achieving zero-carbon electricity by either (1) using DER onsite to charge the vehicles; or (2) retiring renewable energy credits (RECs).
Microgrid	A local energy grid that can be disconnected from the traditional grid and operate autonomously, which provides resilience during a power outage. A solar-battery storage system could be designed as a microgrid.
Oversubscribed	Demand for power that exceeds supply, especially in regard to a program that has capped its participation in terms of capacity.
Peak Power	In reference to electric power, the maximum power output a load serving entity can supply to load within a defined period of time.
Peak Shaving	Strategies used to proactively reduce peak power demand.
Power Purchase Agreement (PPA)	A long-term electricity supply agreement between two parties: the power producer and the power consumer. The power producer funds, constructs, owns and operates the energy generation source (e.g., solar) and charges the consumer and agreed upon rate per kWh. The energy generation source can be located either on or off the consumer's property.

Retail Electricity	Retail providers (e.g., IOUs like PG&E and CCAs like PCE) that sell power directly to end-use consumers. In California, end-use customers need legislative authority to bypass a retail provider and procure electricity directly on the wholesale market.
Renewable Energy	Electricity from a source that is not depleted when used, and that is not derived from fossil or nuclear fuel. In California, the term "eligible renewable" is used to indicate which renewable sources qualify for the Renewable Energy Portfolio Standard (RPS). The RPS is a law that sets the minimum level of renewable energy utilities are required to procure. Large hydroelectric sources are not eligible renewable sources because they result in other negative environmental impacts (e.g., to fish and aquatic communities). Low-impact hydroelectric sources have fewer negative environmental impacts and are considered to be eligible renewable energy resources. A power content label identifies the percentage of eligible renewable energy resources used by an energy provider.
Renewable Energy Credit (REC)	Credits “created” by a renewable energy generator, like a solar array, when it produces renewable energy. A REC allows the holder to claim the environmental benefits of one unit of energy generated from a renewable source. RECs can be monetized and have financial value.
Renewable Portfolio Standard (RPS)	A law mandating a minimum level of eligible renewable energy resource use by investor owned utilities (IOUs). The law is implemented at the state level. In this study the law will refer to California’s RPS; however, other states have also adopted RPS legislation.
Tariff	The rates utilities charge customers, typically differentiated by customer type and level of electricity consumption.
Time-of-Use (TOU)	A rate plan in which rates vary according to the time of day, season and day of the week. Higher rates are charged during periods of higher electricity demand, or “peak” hours, and lower rates during low demand hours (called off-peak). PG&E’s new TOU rates, which go into effect in 2021, shift the peak period, the higher cost period, to 4 to 7 PM year-round.
Wholesale Power	The wholesale electricity market is typically a market for generators and resellers (e.g., PG&E, CCAs, and ESPs), but there are some instances where large energy users are granted access to the market (e.g., BART).

EXECUTIVE SUMMARY

As Caltrain transitions from diesel- to electric-powered locomotives, electricity – and the procurement thereof – will become an increasingly important component of the agency's fuel spend, environmental impacts, and participation in revenue-generating opportunities such as the Low Carbon Fuel Standard (LCFS) market. It is also critical to consider options for power resilience in the event of a sustained power outage.

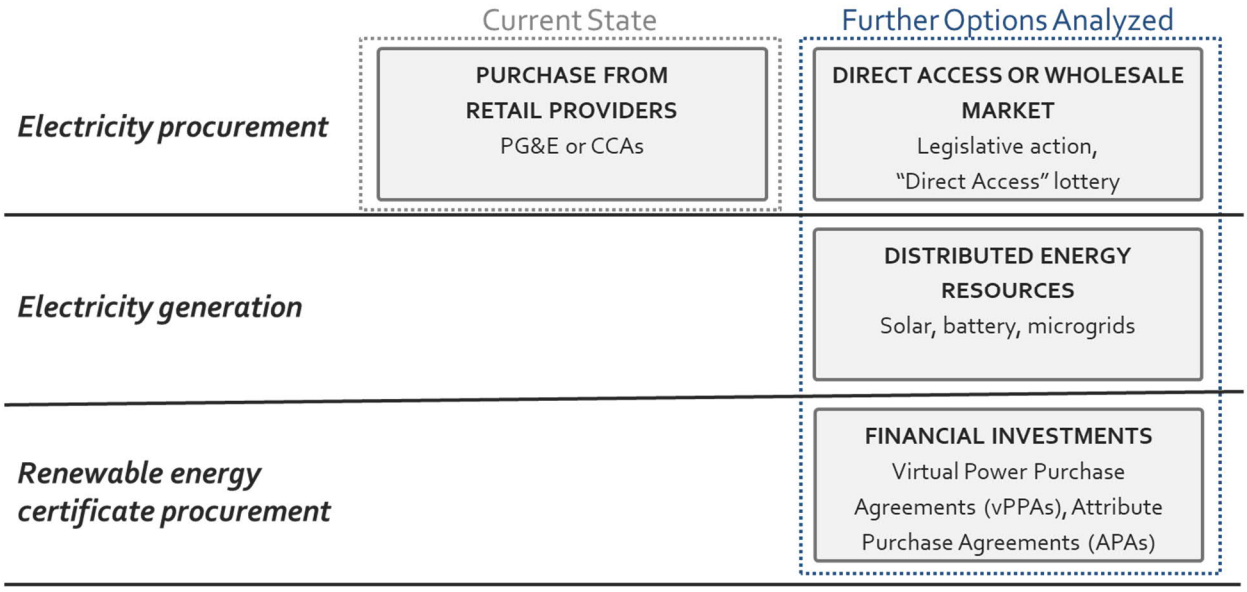
WSP and TerraVerde Energy (TerraVerde) (the Project Team) were retained to conduct a comprehensive energy procurement study to evaluate Caltrain's short- and medium-term energy procurement options. This report provides an analysis of the electricity and technology procurement options available to Caltrain, including evaluation of the associated environmental impacts, risks, trade-offs, operational impacts and financial considerations of each option. This report also includes discussion of the potential benefits associated with jointly procuring electricity with SamTrans.

Caltrain currently procures 100% greenhouse gas (GHG)-free and renewable electricity through Community Choice Aggregators (CCAs) and two municipal owned utilities (MOUs).[1] The CCA electricity is still delivered to Caltrain through Pacific Gas & Electric's (PG&E's) transmission and distribution network. Over the short-term (1 to 4 years), Caltrain has the option to choose from two types of retail electricity providers to serve its growing load: (1) an investor-owned utility (IOU) (in this case, PG&E); or (2) CCA providers available in Caltrain's jurisdiction. Caltrain also has the option to install onsite distributed energy resource (DER) systems (a solar photovoltaic system and/or battery energy storage system [BESS]) to reduce electricity procurement needs and costs.

Over the medium to long-term (4+ years), Caltrain can continue to remain a retail electricity customer and choose between currently available providers, or it could pursue expanded retailer choice through Direct Access (DA) or work to have access to the wholesale electricity market, provided DA capacity is available or Caltrain is granted legislative authority to purchase through the wholesale market. DER systems could also be installed over the medium-term as additional technology options become available or existing options become more affordable. The energy procurement and technology options evaluated in this study are summarized in Figure ES-1.

[1] Where Caltrain procures from an MOU, the agency does not have the option to switch to a CCA provider. For this reason and because the future traction load studied will be located in PG&E territory, the MOU electricity consumption is excluded from this analysis.

Figure ES-1. Energy Procurement and Technology Options



Key findings and suggestions from the study are presented below by project phase.

PHASE 1: SHORT-TERM ENERGY PROCUREMENT STRATEGY SUMMARY

Both the CCA providers and PG&E offer default rates and greener rates that have higher percentages of GHG-free and/or renewable energy. The short-term energy procurement strategy analysis demonstrates that the CCA providers have more favorable rates compared to PG&E for Caltrain's existing and future electric load under both the default and greener rates.

Table ES-1 summarizes the future annual costs associated with the new electrical services for train electrification at the Caltrain North and South substations. Caltrain will also earn LCFS credits for switching from diesel-powered trains to electric-powered trains, which will offset a large portion of Caltrain's electricity costs.[2] The potential financial benefits from the LCFS program are factored into the table, based on using grid electricity. As shown in Table ES-1, the CCA default option provides savings of approximately $267,580 over the PG&E standard rates and the CCA 100% green option provides approximately $468,146 of savings over the PG&E 100% Solar Choice rates.

Table ES-1. Future Rate Analysis Summary

Costs/Savings	Annual Electricity Cost	Total Electricity Costs with Grid Electricity LCFS Credit ($/YR)
PG&E Default Costs	$15,565,068	$1,835,959

[2] Caltrain must register with the LCFS program to participate.

Costs/Savings	Annual Electricity Cost	Total Electricity Costs with Grid Electricity LCFS Credit ($/YR)
PG&E Solar Choice Costs	$16,879,890	$3,150,781
CCA Default Costs	$15,297,488	$1,568,379
CCA 100% Green Costs	$16,411,744	$2,682,634
CCA Savings (standard)	**$267,580**	
CCA Savings (100% Green)	**$468,146**	

Caltrain can increase the value of its LCFS credits by procuring zero-carbon electricity. There are two pathways to achieving zero-carbon electricity for LCFS: (1) through onsite renewable energy sources used to directly power the vehicles; or (2) retiring qualifying renewable energy credits (RECs) from zero-carbon sources such as solar photovoltaic (PV), wind, renewable portfolio standard (RPS)-eligible hydroelectric generation, ocean wave, ocean thermal or tidal current sources. Table ES-2 summarizes the estimated difference in the value of LCFS credits generated through grid electricity versus zero-carbon electricity. Achieving zero-carbon electricity provides a projected additional LCFS credit benefit of approximately $2,952,487.

Table ES-2. Low Carbon Fuel Standard Benefits Summary[3]

Transformer	Consumption (kWh/ YR)	LCFS Using Grid Electricity ($/kWh)	LCFS Using Zero Carbon Electricity ($/kWh)	LCFS Using Grid Electricity ($/YR)	LCFS Using Zero Carbon Electricity ($/YR)
TPS-1: T1	28,536,892	$0.1232	$0.1497	$3,516,124	$4,272,277
TPS-1: T2	30,172,819			$3,717,692	$4,517,193
TPS-2: T1	30,907,744			$3,808,245	$4,627,219
TPS-2: T2	21,808,104			$2,687,048	$3,264,906
TOTALS:	**111,425,559**			**$13,729,109**	**$16,681,596**

The Project Team analyzed the feasibility of installing solar PV and/or battery energy storage (BESS) DER systems adjacent to the future Caltrain North and South traction power substations and at Caltrain stations. Based on the analysis, a solar and/or BESS system does not appear to be

[3] Assumes the LCFS credit price is $100 per ton CO^2 equivalent. The LCFS credit price varies over time. The value used is conservative based on the past two years of history showing that the lowest LCFS credit price was $150 per ton CO^2 equivalent in April of 2018 and the highest LCFS credit price was $218 per ton CO^2 equivalent in February of 2020. The LCFS value shown uses projected carbon content values from CARB for 2022 grid electricity, solar electricity and diesel. Assumes the cost per REC is $20.

viable at the South and North substations due to space limitations. Therefore, Caltrain would need to purchase RECs to realize the zero-carbon electricity LCFS value. Onsite DER systems are potentially feasible at three Caltrain stations – San Francisco, San Jose and Gilroy. However, based on future land use plans, only one of the Caltrain stations (Gilroy) is potentially feasible for a DER system in the short-term.

Short-term energy procurement findings and suggestions include:

- **Remain on the current time-of-use (TOU) rate tariffs.** PG&E introduced new TOU rate tariffs that are available now, but are not mandatory until March 2021. Staying on the current TOU rate tariffs until it becomes mandatory to switch to the new TOU rate tariffs is the best financial option.
- **Adjust select electric meters to different rate tariffs.** Caltrain can realize approximately $27,635 in annual savings by switching 40 meters to more ideal rates as described in Section 3.2.
- **Consider setting up future electric accounts that will serve large loads as primary voltage service.** Receiving service on primary voltages generally provides additional bill savings. However, the physical changes to the electric service required to achieve the annual bill savings alone do not justify the cost to complete the transition from secondary voltage service to primary voltage service for existing meters. Therefore, this should only be evaluated when infrastructure changes are already being considered for a specific site. It would be beneficial for Caltrain to review the option of setting up future electric accounts that have large loads on the highest voltage level service that makes sense, as is the case for the new electric services being installed at transmission level for the purposes of rail electrification.
- **Continue to procure electricity through CCA providers.** The CCA providers provide more cost effective rates compared to the PG&E equivalent rates. The CCA default rate is the most cost effective based on our analysis.
- **Consider purchasing RECs to increase the value of Caltrain's LCFS credits.** Achieving zero-carbon electricity provides a projected additional LCFS credit benefit of approximately $2,952,487, assuming a price of $20 per REC. Based on the estimated value of the LCSF benefits and the costs for procuring energy, Caltrain has the potential to cover a significant portion of the costs of their utility bills for the portion of the fleet that is electrified.
- **Monitor changes in the federal ITC program and state SGIP program related to incentives for stand-alone battery energy storage projects.** Without the SGIP incentives, the stand-alone battery energy storage projects explored for the San Francisco and Gilroy station sites are not anticipated to provide sufficient financial benefit to warrant proceeding with projects at these sites. Depending on the outcome of the ITC legislation for stand-alone battery energy storage systems, a third-party ownership model may be an option that

Caltrain wants to explore in the future. Caltrain could also consider financing the Gilroy onsite BESS through federal, state or local incentive programs or by issuing green bonds. As discussed in Section 4.2.3, the U.S. Department of Energy and the California Energy Commission each offer different financing and loan programs for renewable energy projects. Caltrain could also consider issuing a green bond to finance the Gilroy BESS. Green bonds are discussed in more detail in Section 4.2.3.

- **Pairing a BESS with onsite solar yields additional financial and resilience benefits.** When paired with an onsite solar PV system, a BESS can further reduce demand and provide savings value that is not available to a stand-alone BESS or solar PV system. Integrating energy storage systems with solar PV systems provides a holistic approach to renewable energy generation and financial savings. A solar PV system by itself provides per-kWh utility bill savings and some peak demand reduction but is subject to intermittency based on weather conditions and therefore plays an unreliable role in ensuring that demand charges can be effectively managed. In cases where the customer has high demand charges, solar PV and energy storage can be controlled together to provide the optimal overall bill and peak demand savings through charge/discharge management software capable of making decisions that allow for optimized financial savings based on the actual operating profile on a real time basis. This includes the ability to decide when to charge the battery system with energy provided by the solar PV system, ensuring that the battery is always charged and available for use to make up for a period of low production from the PV system. Batteries charged by solar PV also have the potential of providing "energy arbitrage," i.e., charging the batteries from the solar PV during low bill credit periods and exporting energy from the batteries during high bill credit periods. In addition, a combined solar PV and energy storage system can be configured to have the added benefit of providing an alternative source of power and resiliency in times when the grid is either unreliable or not available. Although this study did not identify any viable solar PV opportunities, any future solar PV opportunities should also consider installing a BESS system.
- **Investing in a utility expense data management (UEDM) solution will streamline electricity data collection and payment and reduce costs.** UEDM offers companies an end-to-end solution that centralizes utility information (cost and consumption), improves data accuracy, reduces costs (direct and indirect expenses), and provides for timely and insightful reporting all within a single cloud-based platform.

PHASE 2: MEDIUM-TERM ENERGY PROCUREMENT STRATEGY SUMMARY

The medium-term energy procurement strategy analysis demonstrated that there are potential financial and sustainability benefits to procuring electricity through DA or wholesale markets. Neither option is currently available to Caltrain, but the agency can take steps now to position for future opportunities. Table ES-3 summarizes the estimated savings associated with DA or wholesale procurement.

Table ES-3: Estimated annual savings from DA or wholesale procurement versus retail

Estimated Electricity Consumption When Fully Electrified (MWh)	119,000
Percent Electrified at Plan	75%
Year Plan is Met	2023
Average Blended Rate from Task 3 Report ($/MWh)	$221
Estimated Annual Spend in Year Plan is Met (2020 dollars and rates)	$26,300,000
Estimated 10% Annual Savings Wholesale v. Retail Electricity	$2,630,000

The emergency power review conducted as part of Phase 2 concluded that the traction power system designed for Caltrain is quite robust and meets all industry best practices. However, it is still vulnerable to a regional large power outage, such as one associated with a sudden and intense earthquake.

Medium-term energy procurement findings and suggestions include:

- **Caltrain should engage its CCA providers relative to any products that would provide electricity and LCFS-compliant RECs**. The CCA providers do not currently offer a product that meets the California Air Resource Board's (CARB's) requirements for zero-carbon fuel sources (which increase the value of LCFS credits). However, CCA providers could provide bundled product (i.e., electricity plus the associated RECs) that would be compliant in the LCFS program thereby leading to increased LCFS revenue.
- **Caltrain should continue to monitor the Direct Access market and consider participation.** The DA market is a market in California that allows energy buyers to have expanded choice in their service provider. For example, if a buyer is granted the ability to enter the DA market, it can choose a different Electric Service Provider (ESP) than their current options of PG&E and CCAs, the current electricity retail providers for the agencies. DA procurement is likely to result in savings for Caltrain, regardless of whether or not it pursues jointly with SamTrans. DA is only available via a lottery system and the program is currently at capacity. Additional capacity may become available in 2024, but the amount, timing, and process to apply for capacity are all in question. If sufficient capacity is added that could serve Caltrain's anticipated load, it may be worth applying.
- **Caltrain should partner with other California transit agencies (such as California High Speed Rail) to pursue legislation that would enable access to the wholesale market and conjunctive billing.** Though BART was able to gain access to the wholesale market through legislation, the process was very specific to BART's unique circumstances and took many years to finalize. Other California transit agencies have interest in gaining access to the wholesale market as well and have taken steps towards this goal. It will be important to ensure that the legislation is inclusive of (1) existing modes of transit and (2) non-rail transit (for SamTrans). By pursuing legislation, Caltrain will have the option to switch to wholesale procurement in the future if desired.

- **Caltrain should participate in CPUC, CAISO and PG&E regulatory processes that would affect future electric vehicle rates and access to Direct Access and wholesale energy markets.** The California energy market is complex and dynamic. Caltrain would benefit by actively engaging in the rulemaking process. This is another opportunity to partner with other California transit agencies, particularly those in the Bay Area, who may have similar goals.
- **Caltrain should not pursue wholesale market participation without addressing its significant risks.** Wholesale electricity prices are subject to greater variability over time as the market reacts to real-time supply and demand needs, but on the whole are lower than retail electricity prices since they are also competitive. The estimated savings from wholesale procurement will be somewhat offset by the need to engage an entity that will effectively operate as your ESP or to take management of the wholesale market electricity efforts in-house. Either management route will have both real costs, likely including consulting, legal fees, and ESP management fees or additional staff headcount plus it will have a material impact on internal staff time regardless of whether or not the management is out- or in-sourced. It is important to weigh the benefits of access to the wholesale market with these costs.
- **Caltrain would benefit from jointly procuring energy with SamTrans.** If Caltrain elects to pursue onsite DER, unique CCA products, DA or wholesale market strategies, it would benefit from procuring energy together to reduce costs and streamline management.
- **Caltrain should evaluate the feasibility of wayside power storage systems.** Wayside power storage systems, including batteries and flywheel technologies, have the potential to increase the use of regenerative braking power, operate the system more effectively (less voltage swings, faster acceleration, etc.), while earning revenue for Caltrain. In addition, they will reduce the needs for large scale back up power from other sources.
- **Caltrain stations, other facilities and systems should follow the recommendations for power reliability in National Fire Protection Association (NFPA) 130.** This includes stations, signals, communications, and more. WSP recommends Caltrain perform an evaluation of the other systems to make sure that they are prepared for large scale power outages.

OPPORTUNITIES, RISKS AND TRADEOFFS

Each energy procurement decision is associated with different opportunities and risks and may have implications on other decisions. Tables ES-4 and ES-5 present the primary risks, trade-offs and other considerations for each of the options evaluated in this study. Figure ES-2 illustrates the energy procurement options in a decision tree format and Figure ES-3 provides a high-level timeline of near-term decisions.

Table ES-4. Energy Procurement Opportunity Matrix

OPPORTUNITY	TIME HORIZON	LEVEL OF EFFORT	FINANCIAL IMPACTS	ENVIRONMENTAL BENEFIT	LOCAL ECONOMIC BENEFIT	EMERGENCY POWER POTENTIAL
Retail Electricity Options						
PG&E Default	Near-term	Low	$$	🍃		
PG&E 100% Renewable	Near-term	Low	$$$	🍃🍃🍃		
CCA Default	Near-term	Low	$	🍃🍃	✓	
CCA 100% Renewable	Near-term	Low	$$$	🍃🍃🍃	✓	
Direct Access	Medium-term	High	$-$	🍃🍃🍃	✓	
Purchasing Wholesale Electricity						
Procuring Power on the Wholesale Market	Long-term	High	$-$	🍃🍃		
Wholesale Power Purchase Agreements	Long-term	High	$-$	🍃🍃🍃		
On-Site Energy Resources						
Solar PV	Medium-term	Medium	$$$	🍃🍃🍃🍃	✓	✓
Battery Energy Storage	Medium-term	Medium	$$	🍃🍃🍃	✓	✓
Hydrogen	Long-term	High	$$$$	🍃🍃	✓	✓
Other Opportunities						
Renewable Energy Credits	Near-term	Medium	$	🍃		
Low Carbon Fuel Standard Credits	Near-term	Medium	$$$$	🍃🍃		
Grid Services Programs	Medium-term	Medium	$	🍃		

Table ES-5. Risk Analysis and Trade-off Matrix

Option	Primary Risks	Trade-offs	Impact on Other Options: how decisions effect acting on other options	Additional Considerations
Current State	Overpaying relative to other options, not maximizing LCFS revenue.	Ease; minimal effort to maintain current contracting.	DA, legislative action, and current state are all relatively mutually exclusive options.	Potential new products that create more LCFS revenue; would need comparative cost analysis.
DER: Solar PV, Batteries, & Microgrids	Regulatory changes and/or changes in energy usage at project locations could impact the savings performance from these systems.	Cost savings from avoided electricity costs and avoided costs from REC purchases, revenues earned through emerging grid services programs.	Distributed projects would pair well with each of these additional options.	With the step-down of the ITC and the fast-paced incentive funding draw down for SGIP, procurement of these projects should be prioritized.
Direct Access	Transactional costs with minimal payback; difficult negotiating for LCFS-qualifying RECs.	Ability to potentially spur new renewable energy generation; cost savings v. retail; potentially more lucrative LCFS credit generation.	DA, legislative action, and current state are all relatively mutually exclusive options.	The program is at capacity; seeking capacity at this stage may not be worth the effort; wait until it reopens.
Wholesale market	Significant effort with no guarantee of success; risks associated with being exposed to wholesale trading.	Potential cost savings.	DA, legislative action, and current state are all relatively mutually exclusive options.	This process and the results for BART are complex; encourage a debrief with BART before exploring deeply.
Financial investment: vPPA	Expensive and risk financial position relative to only receiving RECs.	Long term REC position with potentially more lucrative LCFS credit generation.	All other options, specifically relative to their REC generation impact this option.	Only should be implemented if other sources of potential LCFS revenue are unsuccessful.
Financial investment: APA	Overpaying for RECs in the long term.	Long term REC position with potentially more lucrative LCFS credit generation.	All other options, specifically relative to their REC generation impact this option.	This is a potentially good alternative to buying spot-market RECs for use in the LCFS program.

Figure ES-2. Energy Procurement Decision Tree

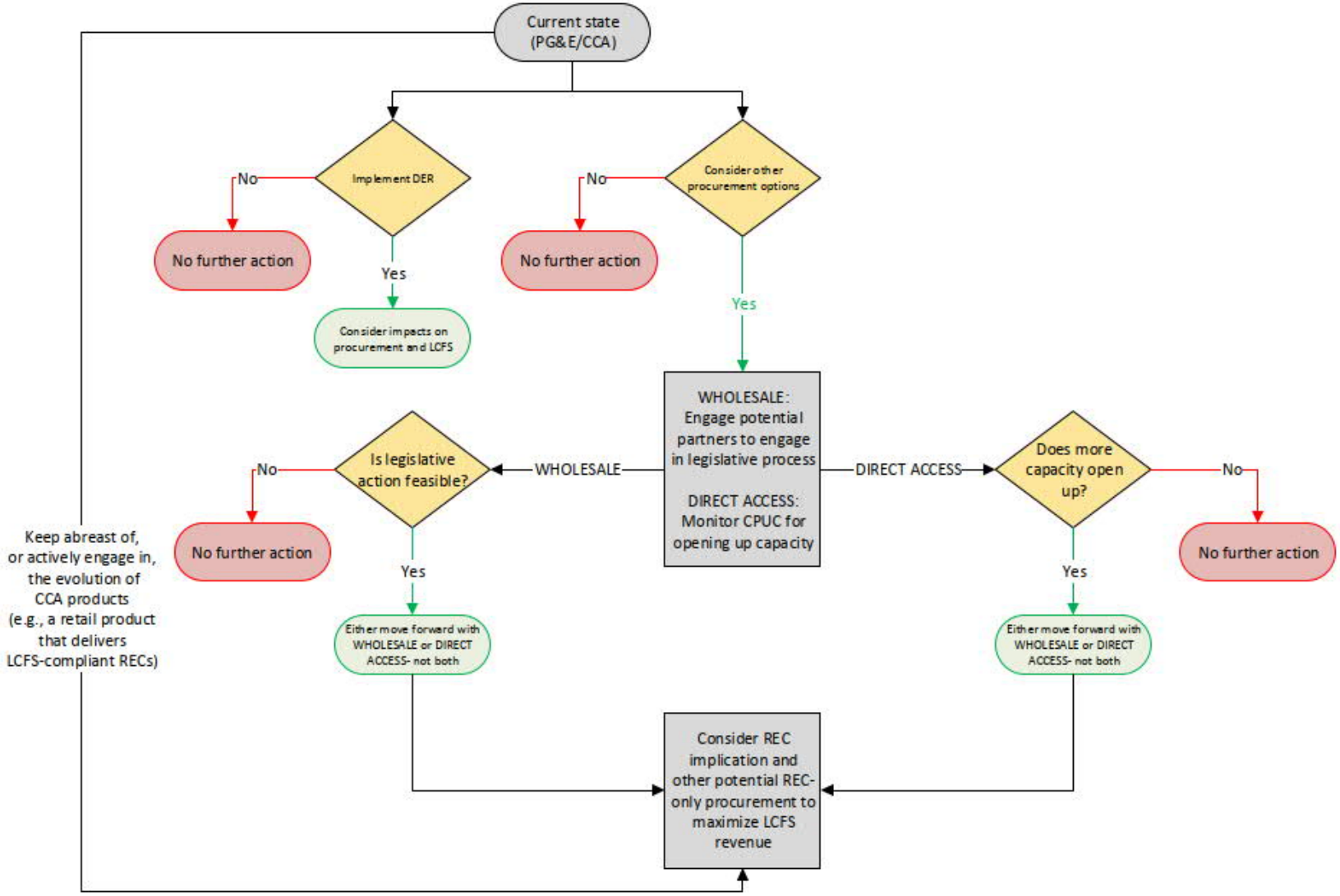
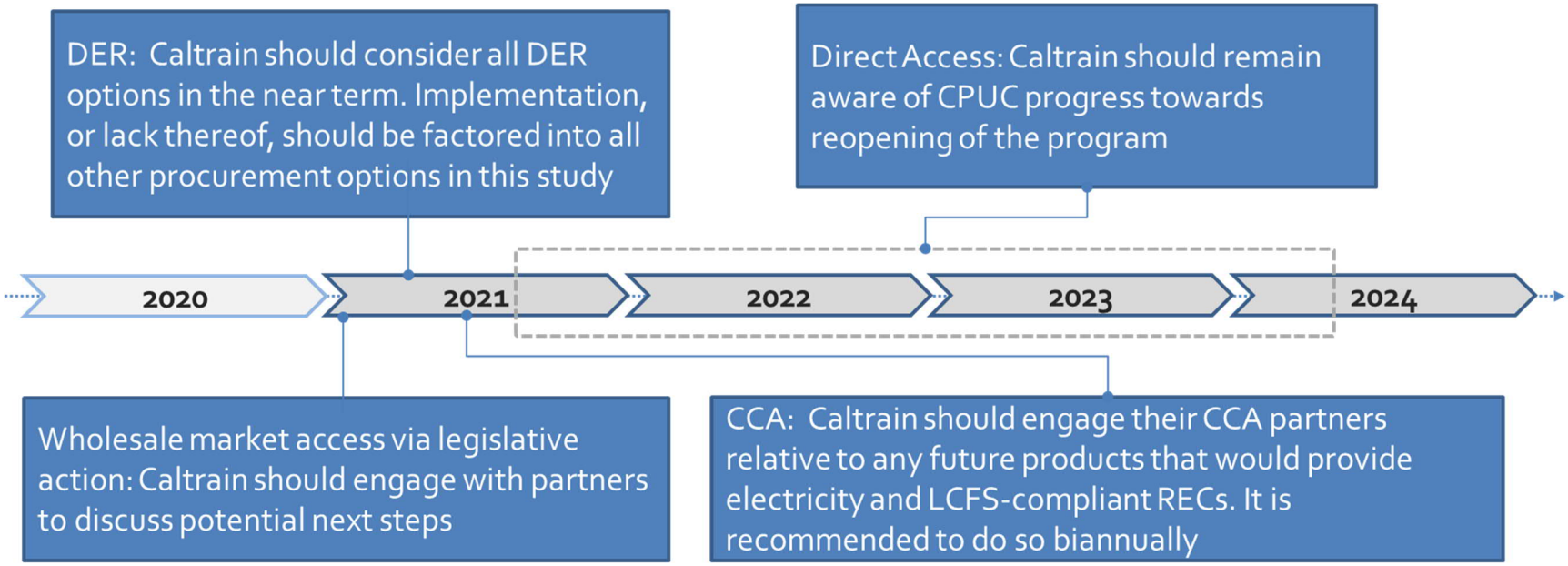


Figure ES-3. Time Horizon



** Consideration of renewable energy certificate procurement should be considered throughout in relation to electricity procurement decisions*