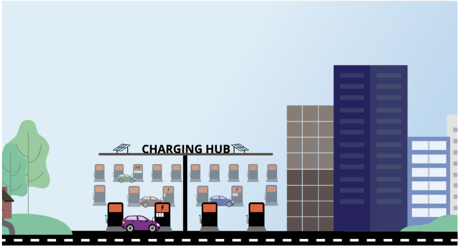
Quantum City Challenge: Smart Charging of EVs

Applying Quantum Technology in Alberta's Energy Industry

Quantum City

December 18, 2023



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- Maximum daily energy requirement: 7,000 EVs x 50 kWh = 350,000 kWh or 350 MWh.

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- Consistent Voltage 240V with current varying between 0 and 64A

Objective

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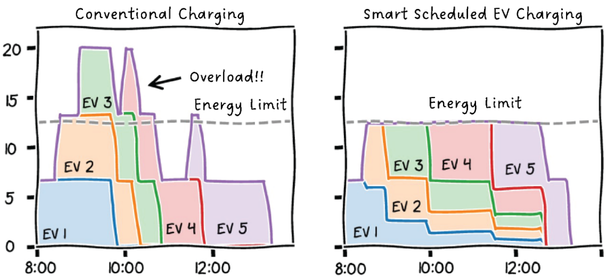
We must adjust the current of each charging port to ensure that every plugged-in EV is served within the available charging time, while minimizing energy spending and without exceeding the charging limits



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$$e_i(t_k) = e_i - \sum_{j=0}^{k} r_i(t_j) * V * \Delta t$$

- v_{t_k} is a set that denotes the active EVs plugged-in at given t_k (needs to be update in every time step)

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$$\sum_{j=0}^{k} r_i(t_j) \cdot V \cdot \Delta t \leq e_i(t_k) \quad \forall i \in v_{t_k}$$

Cost Function

$$U^{QC}(\hat{r}) := \sum_k \frac{T - t_k}{T - t_1} \sum_{i \in v_{t_k}} r_i(t_k)$$

$$U^{NC}(\hat{r}) := -\sqrt[p]{\sum_{i \in v_t} \left| \sum_k^{\tau^i_{end}} r_i(t_k) \cdot V \cdot \Delta - e_i \right|^p}$$

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$$U(\hat{r}) = \alpha U(\hat{r}) + \beta U^{NC}(\hat{r}) + \gamma U^{LV}(\hat{r})$$