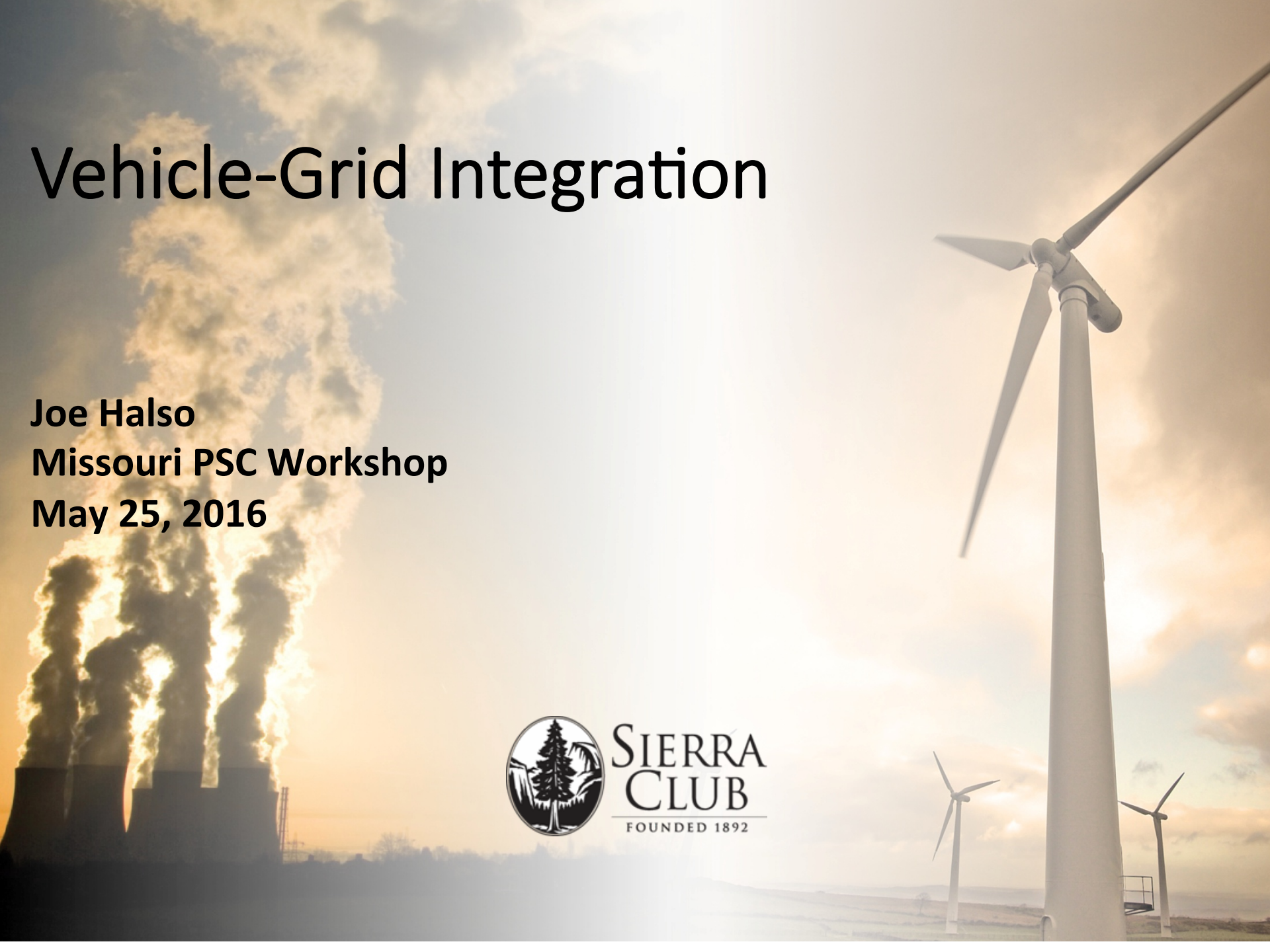


Vehicle-Grid Integration

Joe Halso
Missouri PSC Workshop
May 25, 2016

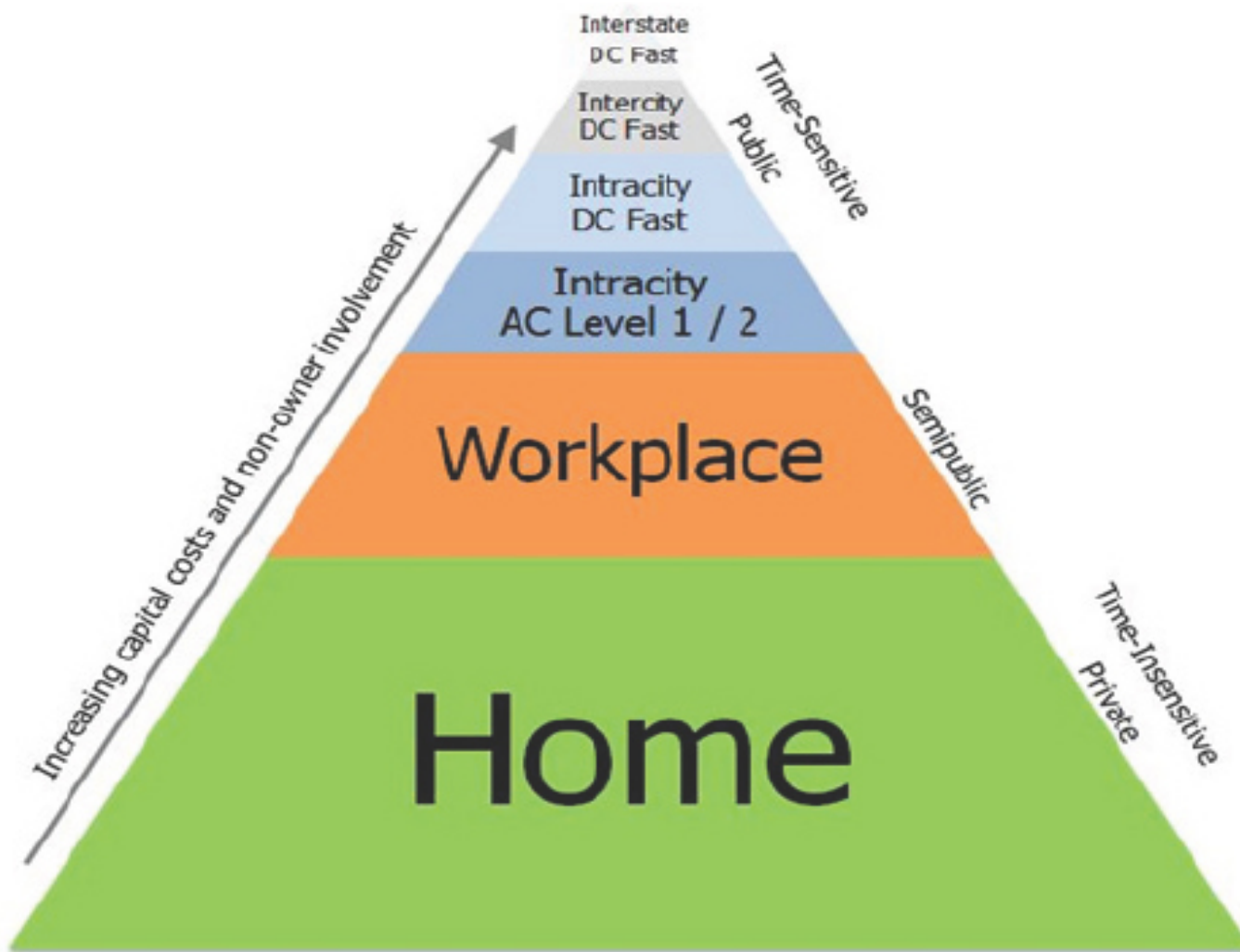


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- **Vehicle-Grid Integration:** Scheduling, planning, or varying EV charging reduce impact or provide benefits.
 - **Rate Design:** special rates for EV charging (TOU, dynamic, etc.)
 - **V1G:** Using VGI communications to effect **unidirectional** demand response at peak demand periods.
 - **V2G:** Using VGI communications and **bidirectional** charging technologies to provide DR and ancillary services.

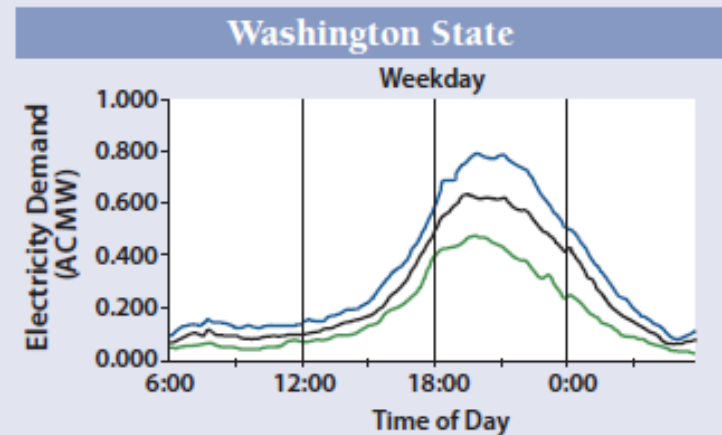
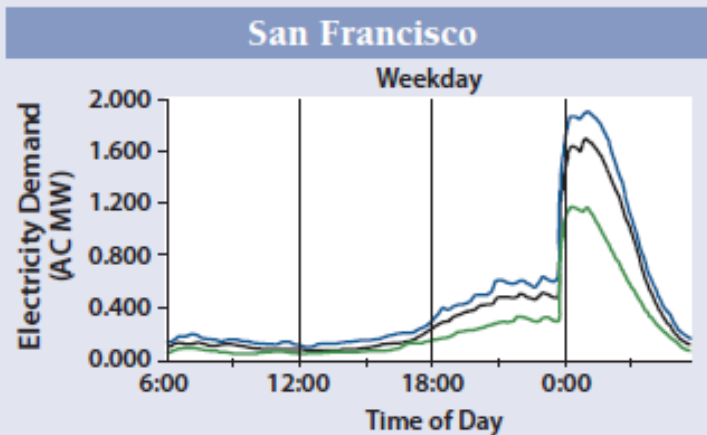
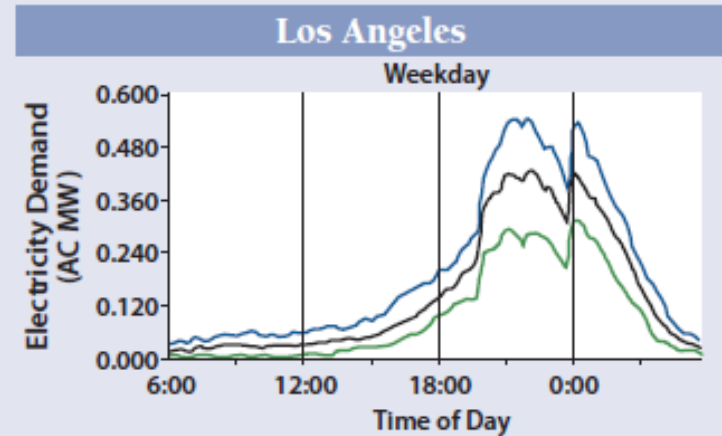
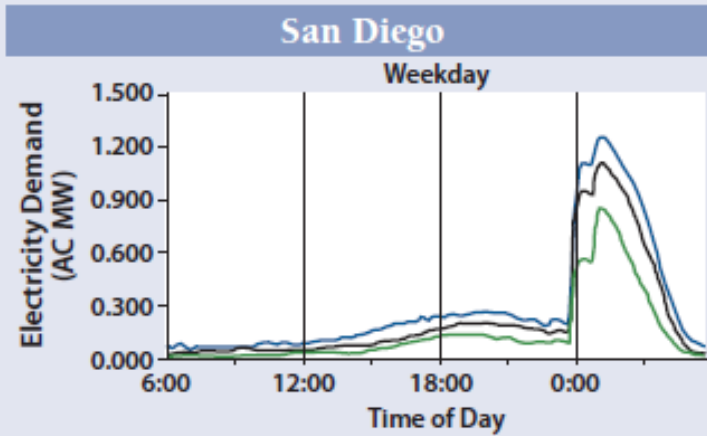
Siting Charging to Optimize Grid Benefits



Effects of Rate Design



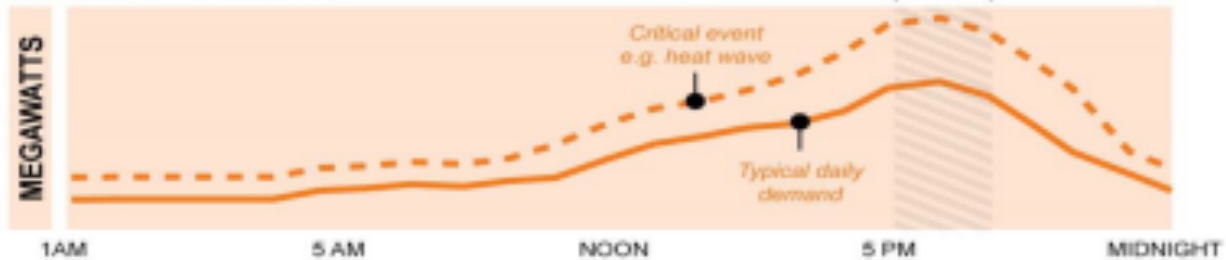
EV Project EV Charging Patterns With and Without TOU Rates¹²



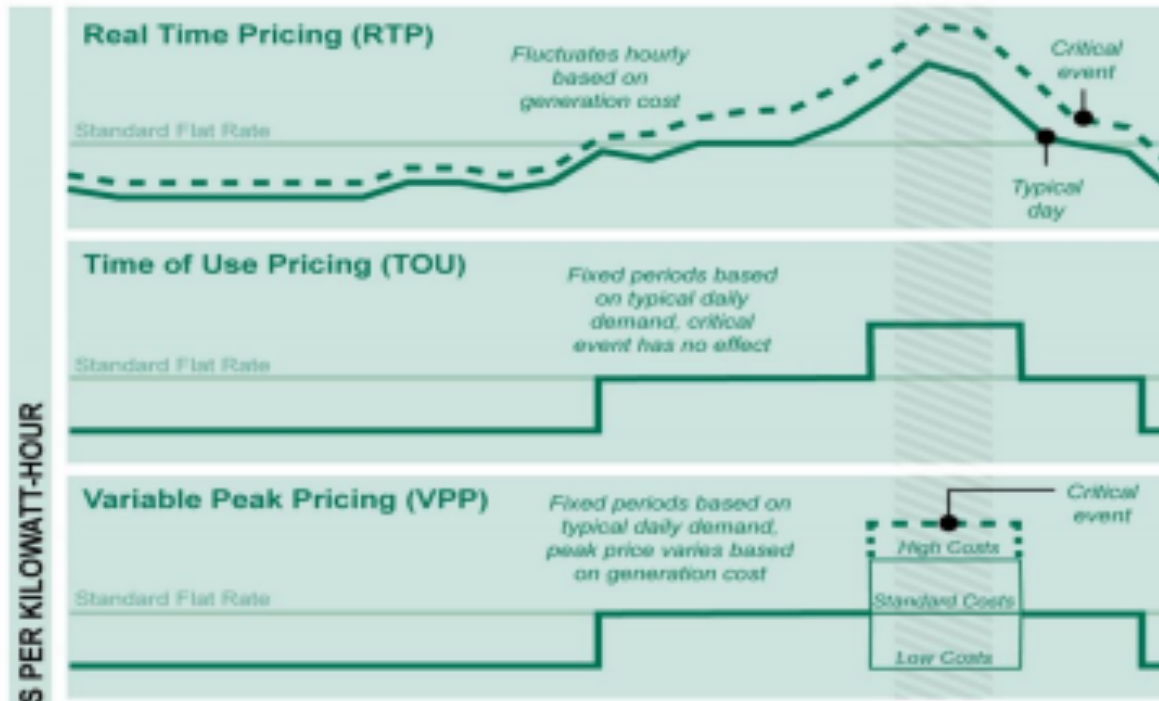
Examples of Time-Variant Rate Design



ENERGY DEMAND



PRICING OPTIONS

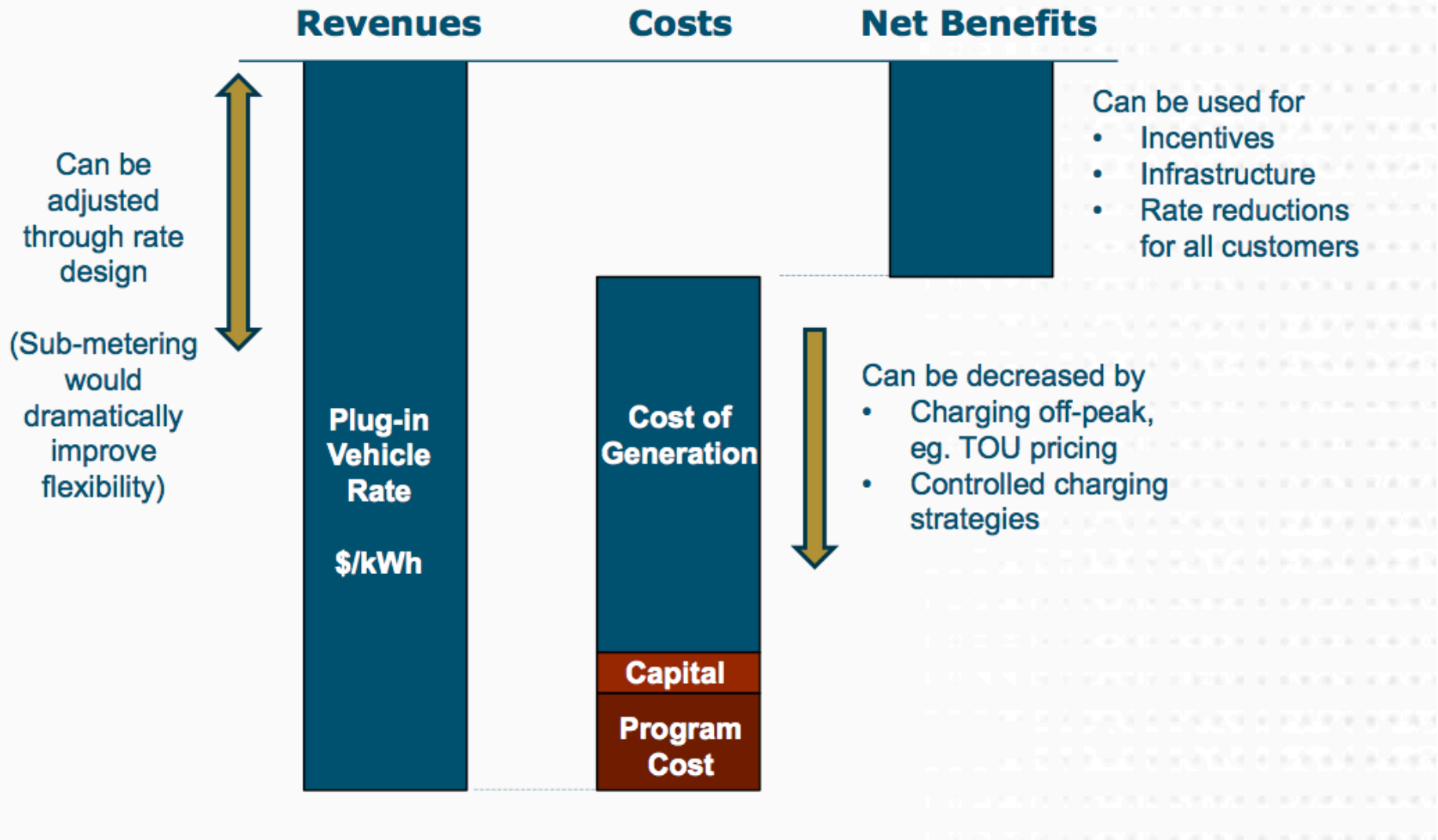


- DR historically relied on large commercial customers, but the times they are a-changin'
- EV owner/operator contracts with utility or third party
- EV owner/operator cedes level of control over charging in exchange for \$
- Utility/3rd party can modulate or curtail charging
- SCE & PG&E commitment to EV-specific DR programs

V2G: Vehicle-to-Grid



Ratepayer Impacts



PSC should proactively support growth of and access to EV charging, including utility cost recovery, **so long as utilities can demonstrate** benefits to the electricity grid, EV drivers and **the body of utility customers**

Thank You



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