Key Disruptive Technology Regulatory Design Overview: Focus on Electric Vehicles (EV)

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Agenda

- Introduction to USAID Clean Power Asia Program
- Overview of 5 Key Regulatory Designs: Focus on EVs
- Possible Regulatory Implications for Thailand Case
- EV Regulatory Considerations for Thailand
USAID Clean Power Asia

Program introduction and current activities on fostering renewable energy policies and regulations
USAID Clean Power Asia program

- 5 years: June 2016 – June 2021
- Aims to increase deployment in ‘grid-connected’ renewable energy in Asia
- Focus on Cambodia, Lao PDR, Thailand, and Vietnam
- Goals:
  - 15 laws/policies/regulations
  - $750 M USD investment mobilization
  - 500 MW of installed RE
  - 3.5 M tCO2e reduction
- Implemented by Abt Associates and partners
- Funded by United States Agency for International Development (USAID)

Our website: http://www.usaidcleanpowerasia.org/
Activities on fostering RE policies and regulations

- Competitive Procurement
  - Solar pilot auction
  - Green Energy Auction and Pricing

- Distributed Photovoltaics
  - Utility revenue and rate impact of DPV
  - Department Circular on Net Metering

- Energy Storage
  - Technical standards for battery energy storage

- Disruptive Technologies
  - Energy transition with disruptive technologies (e.g., DPV, storage, EV)

Regulations for RE integration (grid interconnection, technical standards, permitting)
- Lay regulatory foundations for grid interconnection, technical standards and guidelines for conducting feasibility studies for solar, wind and biomass in Laos

Regional Dialogue and Knowledge Exchange on RE Policy in Southeast Asia
- Competitive Procurement (Asia EDGE workshop in Bangkok)
- Distributed PV (Workshop and webinars)
- Energy Storage (Regional workshop in Bangkok)
- Outreach through co-organized DDW at regional events (ACEF)

Partners: 
- Government counterpart:

Our website: http://www.usaidcleanpowerasia.org/
Draft report on disruptive technologies

- Report provides overview of key regulatory designs that fostered deployment of disruptive technologies (i.e., DPV, battery energy storage, EV) in U.S. and draws implications for design of regulations to support disruptive technologies in Thailand (Expected publication Jan 2021).

- **Key Regulatory Design Topics**

  1. Develop and prioritize regulatory objectives
  2. Technical and metering configurations
  3. Retail tariff design and compensation mechanisms
  4. Technical standards and grid codes
  5. Enabling new business models for P2P electricity trading
Grid edge transformation: Future trends with disruptive technologies

**ELECTRIFICATION**
Critical to long-term carbon goals and will be a relevant distributed resource

**DECENTRALIZATION**
Makes customers active elements of the system, though requires significant coordination

**DIGITALIZATION**
Allows for open, real-time, automated communication and operation of the system

Source: Illustration by World Economic Forum (2017)
Overview of Key Regulatory Designs: Focus on EVs

Five elements of regulations to support disruptive technologies
I. Develop and prioritize regulatory objectives

How can regulatory objectives affect DER regulatory choices?

<table>
<thead>
<tr>
<th>Regulatory Objectives</th>
<th>Design Choice</th>
<th>Regulatory measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase share of renewable electricity in EV charging</td>
<td>Encourage charging with renewable electricity</td>
<td>• Enable smart charging and signal for EVs to charge during solar generation hours</td>
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<tr>
<td></td>
<td></td>
<td>• Enable additional income for charging stations that enable green charging, e.g., California’s Low Carbon Fuel Standard (LCFS) program</td>
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<tr>
<td>Capture network benefits of P2P energy trading</td>
<td>Increase network asset visibility</td>
<td>• Pilot testing and studying various scenarios of how network benefits can be captured and allocated to various parties.</td>
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<tr>
<td></td>
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<td>• Implement rules to increase data sharing and analysis of data in order to analyze how network benefits can be captured.</td>
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2. Technical and metering configurations

Technical configurations for electric vehicle (EV) charging infrastructure

- Determining right charging infrastructure mix tied to local context and customers’ needs.

- State of California’s Vehicle-Grid Integration Roadmap recommends **smart charging** as one of the strategies to ensure that EV charging responds to grid conditions, does not increase peak load, and do not require additional generation or capacity expansions (CAISO, 2014).

Source: Francis (2020)

Source: Shalan (2019)
3. Retail tariff design and compensation mechanisms

Rates can be designed to encourage EV charging with renewables

<table>
<thead>
<tr>
<th>Customer side</th>
<th>System/Utility side</th>
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<tbody>
<tr>
<td>EVs can charge electricity at prevailing tariffs or EV-specific tariffs, resulting in different costs for EV owners.</td>
<td>EVs can be encouraged to charge during times when there is excess renewable generation on the grid (e.g., solar generation hours to avoid overloading grid).</td>
</tr>
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### Examples

<table>
<thead>
<tr>
<th>Utility, State</th>
<th>TOU rates for EVs</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCE, California</td>
<td>TOU-D-PRIME Rate: Encourage customers to charge on weekdays and weekends during off-peak hours when solar power is abundant and then again at night when wind power can be abundant.</td>
</tr>
<tr>
<td>HECO, Hawaii</td>
<td>TOU-RI Rate: A separate meter rate for EV charging only. Rates are lowest during the midday period, when solar and other RE is most abundant and at an excess on the grid.</td>
</tr>
</tbody>
</table>
### 3. Retail tariff design and compensation mechanisms

#### Demand Charge Alternatives for EV Charging Stations

<table>
<thead>
<tr>
<th>Utilities, State</th>
<th>Demand Charge Alternatives</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nevada Energy, Nevada</strong></td>
<td>5-year payment from Governor’s Office of Energy to qualified charging station owner to offset demand charge costs (GOE, 2019).</td>
</tr>
<tr>
<td><strong>Pacific Power and Light Company (Washington)</strong></td>
<td>Discount for demand charges for owners of DC Fast Charging stations. Discount started at 100% in 2018, declined to 90% in 2021, and declines by 10% every year until 2030 (Pacific Power and Light Company, 2018).</td>
</tr>
<tr>
<td><strong>PECO, Pennsylvania</strong></td>
<td>EV station owners can apply for demand credit for 5 years (PECO Energy Company, 2019).</td>
</tr>
<tr>
<td><strong>PG&amp;E, California</strong></td>
<td>Eliminate demand charges and implements subscription model similar to cell phone bills, with time-of-use volumetric energy charges that encourage customers to charge off-peak (CPUC, 2019).</td>
</tr>
<tr>
<td><strong>Vermont</strong></td>
<td>Incorporate into energy rate for first three years of operation, provided that EV charging station owner allows for active and dynamic load control capabilities to host utility.</td>
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</tbody>
</table>
During rapid pace of U.S. DPV deployment, four standards and codes shown below are important for achieving safe, reliable and affordable interconnection (Horowitz, et al., 2019). These standards have a strong connection as they are typically codified in state rules for DER interconnection.
Utility best practices for EV infrastructure deployment (Bolduc, et al., 2020) provide examples of EV charging standards:

- **IEC 61851-1** (for conductive charging system for charging standard AC supply voltages up to 1,000 volts and DC voltages up to 1,500 volts)

- **IEC 61980-1** (the equipment for inductive charging from the grid to EV)

- **IEEE P1547.9** (applications of the IEEE 1547 standard for the interconnection of energy storage capable of bi-directional real and reactive power flow and EV chargers that could have power system impacts)

- **SAE J2836/1** (use cases for communication between EVs and the grid)

- **SAE J2894/1** (practice for EV chargers that enable reasonable design decisions regarding power quality)

- **SAE J3072** (interconnection requirement for a utility-interactive inverter systems, which is integrated into an EV and connects with an electric power system by the way of conductively coupled EVSE)
5. Enabling new business models for P2P electricity trading

- Emerging trends on new business models towards P2P electricity trading with EV charging and P2P EV charging network
- Example of a P2P pilot project by a distribution utility in Thailand

Source: National Energy Trading Platform (https://www.bot.or.th/Thai/PaymentSystems/FinTech/Documents/Blockchain_the_Series_3_Session_2.pdf)
5. Enabling new business models for P2P electricity trading

- Example of a P2P pilot project by the transmission utility in Thailand

Source: National Energy Trading Platform (https://www.bot.or.th/Thai/PaymentSystems/FinTech/Documents/Blockchain_the_Series_3_Session_2.pdf)
5. Enabling new business models for P2P electricity trading

- Key steps for designing P2P project
  - Identify objectives of P2P project
  - Design market incentives and trading rules around objectives
  - Design tariff structure that incentivizes consumption of local generation and fosters localized energy market
  - Test P2P model at scale in order to ascertain outcomes

Source: Illustration based on an interview of Power Ledger’s Executive Chairman and Co-Founder conducted by the Energy Research Institute of Chulalongkorn University
Regulatory Implications for Thailand

Considerations for designing regulations to foster adoption of disruptive technologies
Regulatory implications for Thailand

• Integrate plans for disruptive technology deployment into Power Development Plan (PDP) and utilities’ distribution system planning.

• Clarify roles of electric utilities and other players in disruptive technology deployment.

• Design electricity rates driven by system conditions.

• Encourage pairing of solar and BESS systems to pave way for P2P electricity trading.

• Align distribution companies’ regulated objectives with potential benefits from distributed energy resources (DER).

• Lay down the foundation for EV smart charging.

• Adopt relevant equipment standards and codes.
EV Regulatory Considerations for Thailand

Key considerations specific to promote and support EV deployment
Smart Mobility Roadmap

2021 - 2022
Motorcycles
Public/government vehicles

2025
ECO EV
Smart City Bus

2030
30% EV
Manufacturing Capacity

Source: Ministry of Industry of Thailand

Towards Zero Emissions & Future Mobility:
Autonomous, Connected, Electric and Shared Vehicles (ACES)

AUTOMOTIVE TRANSITION

GOALS 2035
Provide a direction to a sustainable automotive innovations

Ensure a smooth transition to a sustainable next-generation automotive industry

Source: Office of National Higher Education Science Research and Innovation Policy Council (NXPO)
EV regulatory considerations for Thailand

- **Infrastructure**
  - Charging stations
  - Grid readiness
  - Charging tariff

- **Demand**
  - Tax incentives
  - Reduce EV price
  - Low interest financing
  - Perks for EV users

- **Supply**
  - Reduce import duty on parts
  - Promote local manufacturing

- **Standards**
  - EV standards
  - Charging station standards
  - Testing standards and equipment certification

- **Capacity Building**
  - Improve resource capacity
  - Educational institution courses
  - Licenses/certifications

Source: Draft AEDP White Paper, Federation of Thai Industries