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Sustainability benefits of smart EV charging – global lessons & focus solar truck charging in India

Global MoU summit / Arnhem

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Global study on smart charging benefits

Europe
Essone - south of Paris City | France

Artelys
OPTIMIZATION SOLUTIONS



India
Delhi City & Delhi-Jaipur Corridor

MP ENSYSTEMS



China
Zhejiang Province



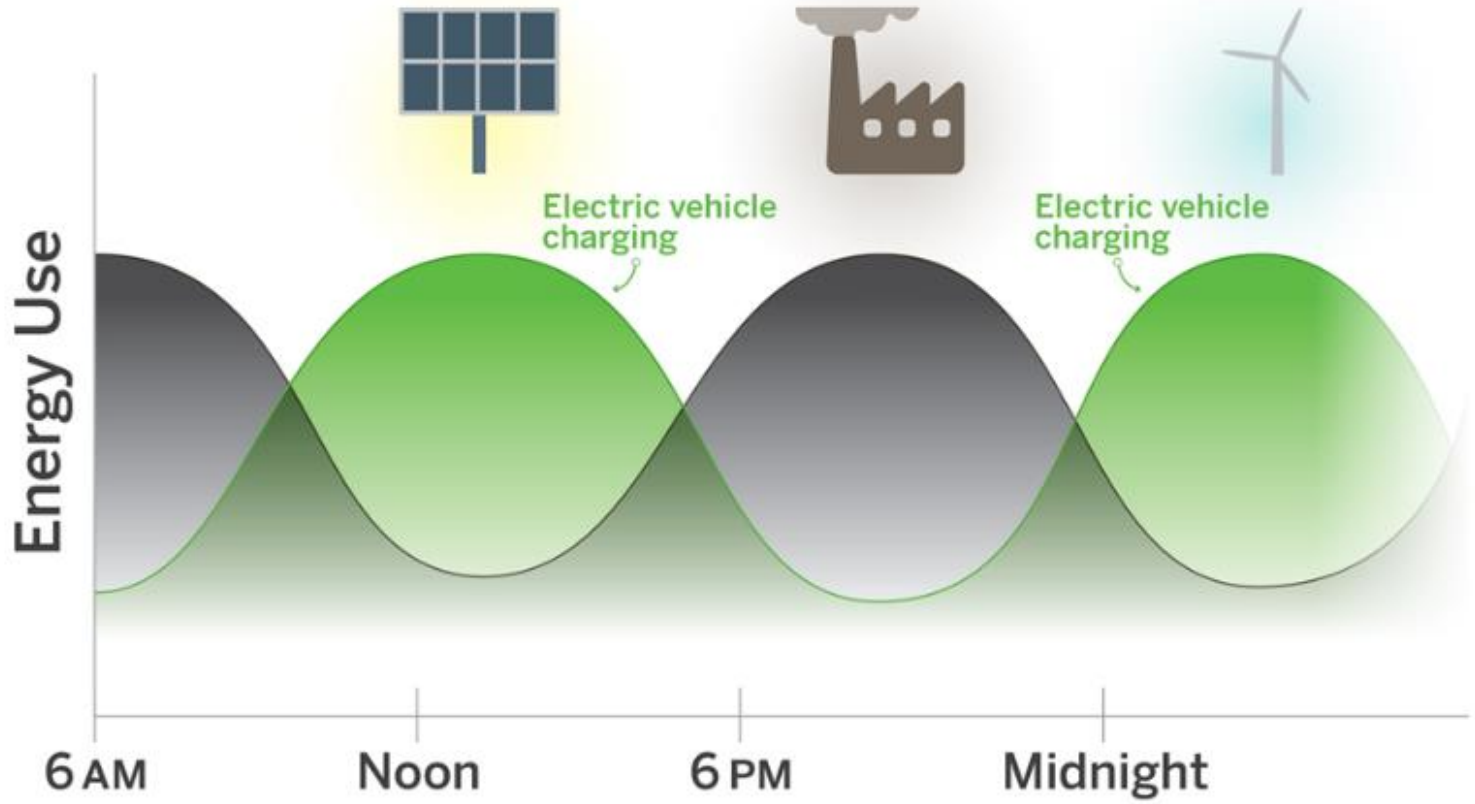
DERC 卓尔德环境研究与咨询中心
Draworld Environment Research Center

USA
Colorado State

EVOLVED ENERGY RESEARCH



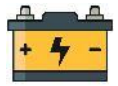
As EVs grow, smart charging is key to avoid costs for consumers, grids and environment



For illustration purposes only. Source: RAP

Methodology

Quantify Electric Vehicle Stocks

- Number of EV passenger cars and trucks 
- EV battery size needs (kWh) 
- Expected fleet growth overtime 

Quantify Infrastructure Needs

- Number of charging stations 
- Station power demand (MW) 
- Station charging load over the day 

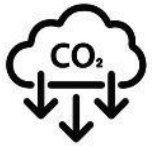
Locate Charging Stations

- Traffic flow data and driving patterns 
- Local electric grid capacity 
- Local site space and logistics constraints 

Deploy Smart Charging Techniques

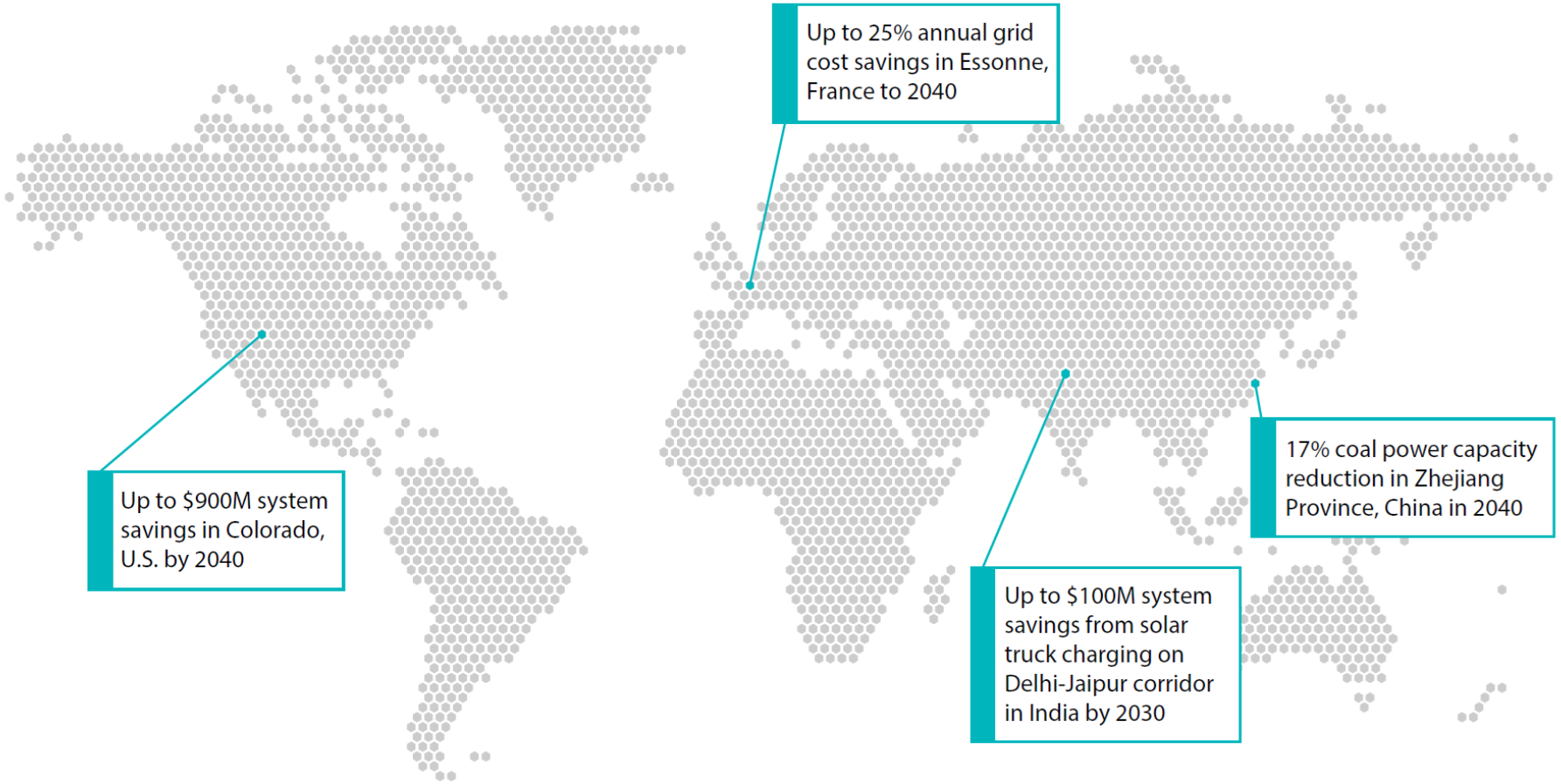
- Availability of time-of-use electricity rates 
- Availability of renewable energy 
- Assess the potential for shifting the charging load 

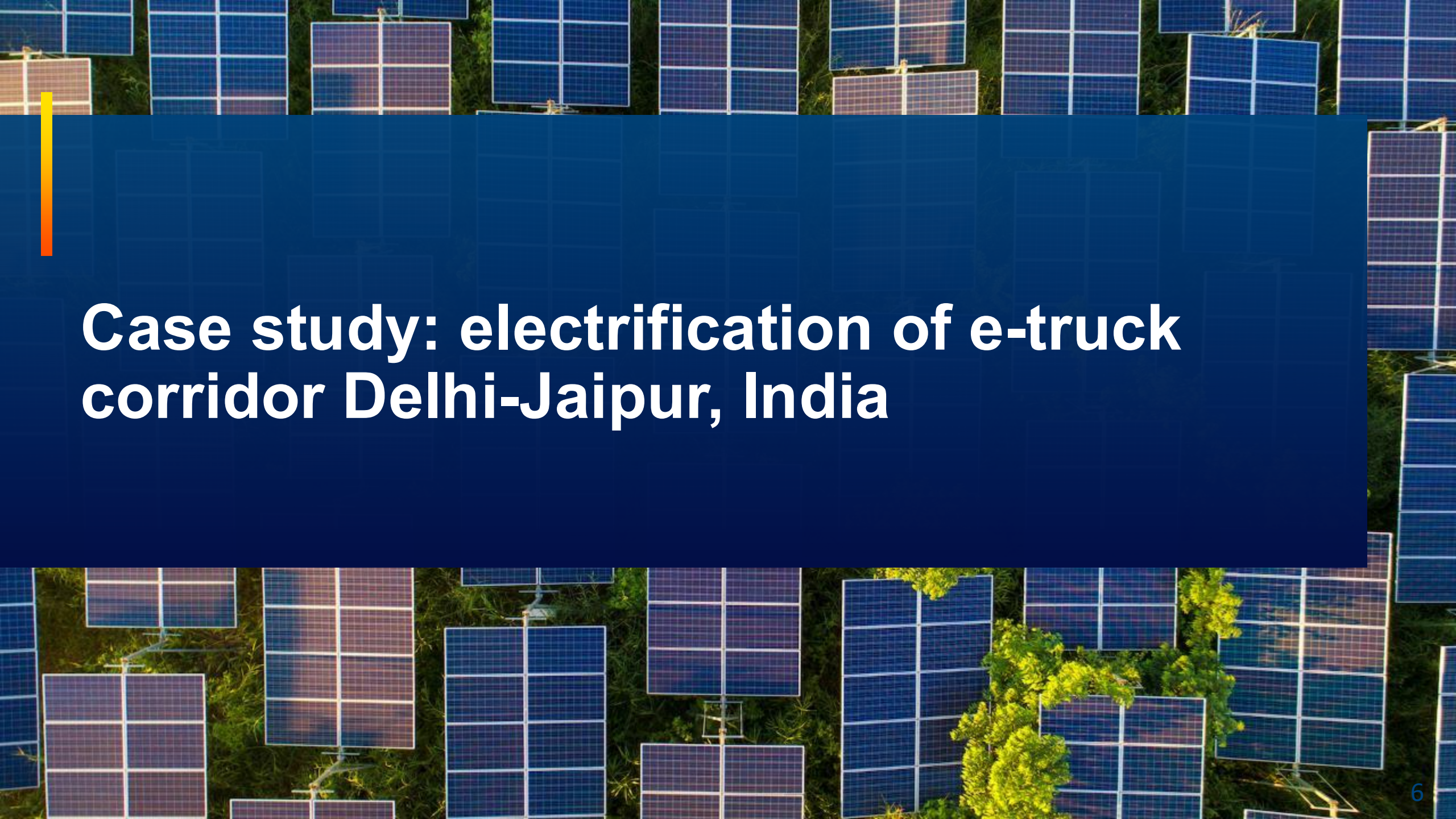
Quantify Smart Charging Benefits

- Avoided GHG emissions (system and vehicle levels) 

- Avoided grid investment costs 
- Reduced charging cost per vehicle 

Smart EV Charging saves cost everywhere





Case study: electrification of e-truck corridor Delhi-Jaipur, India

Case study

- Electrification of highway corridor (Delhi-Jaipur – 300 kms)
- Traffic measured per segment
- E-truck growth projected based on policy scenarios
- Charging demand for depot and highway charging projected

Map of corridor and corresponding grid areas

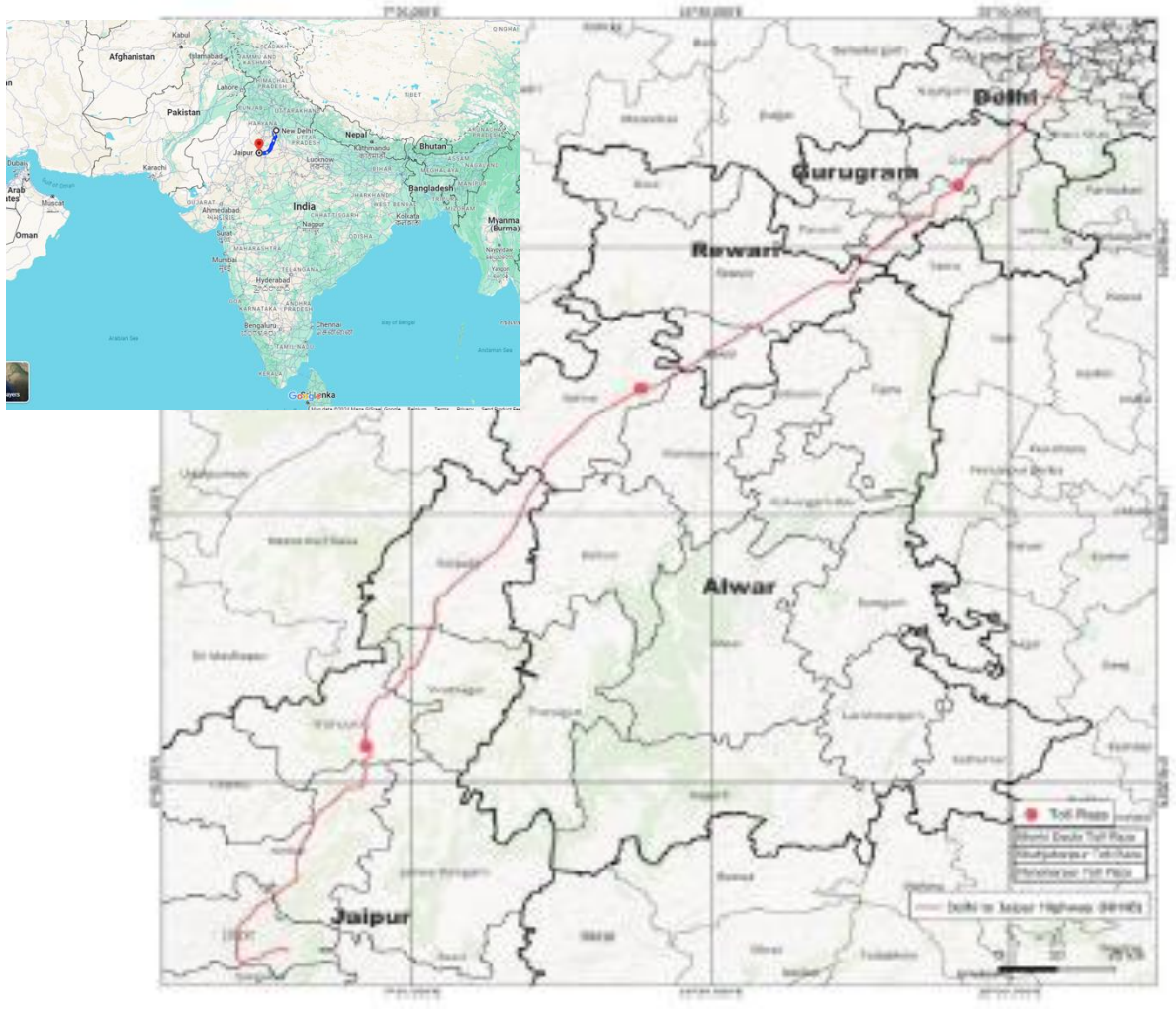
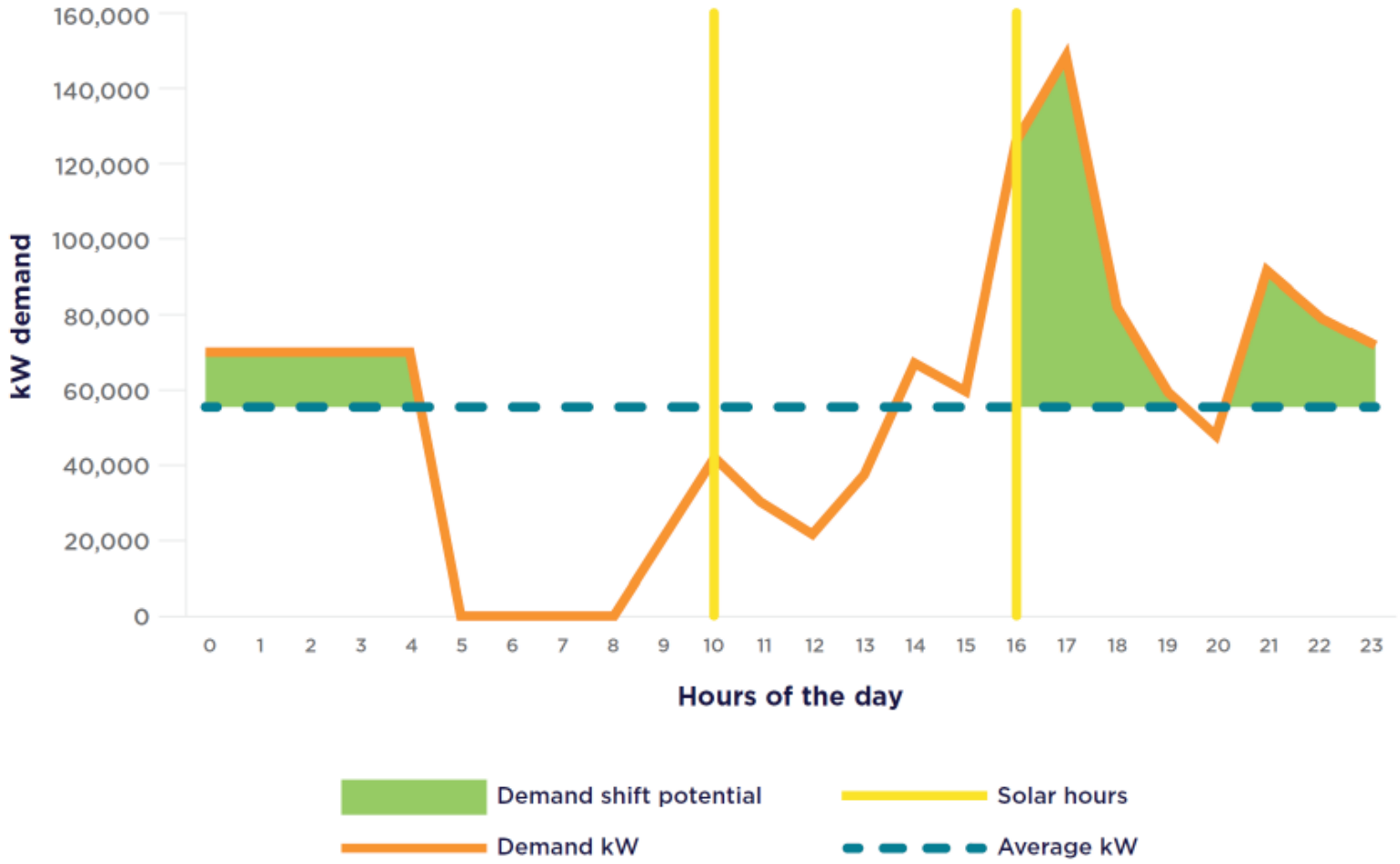
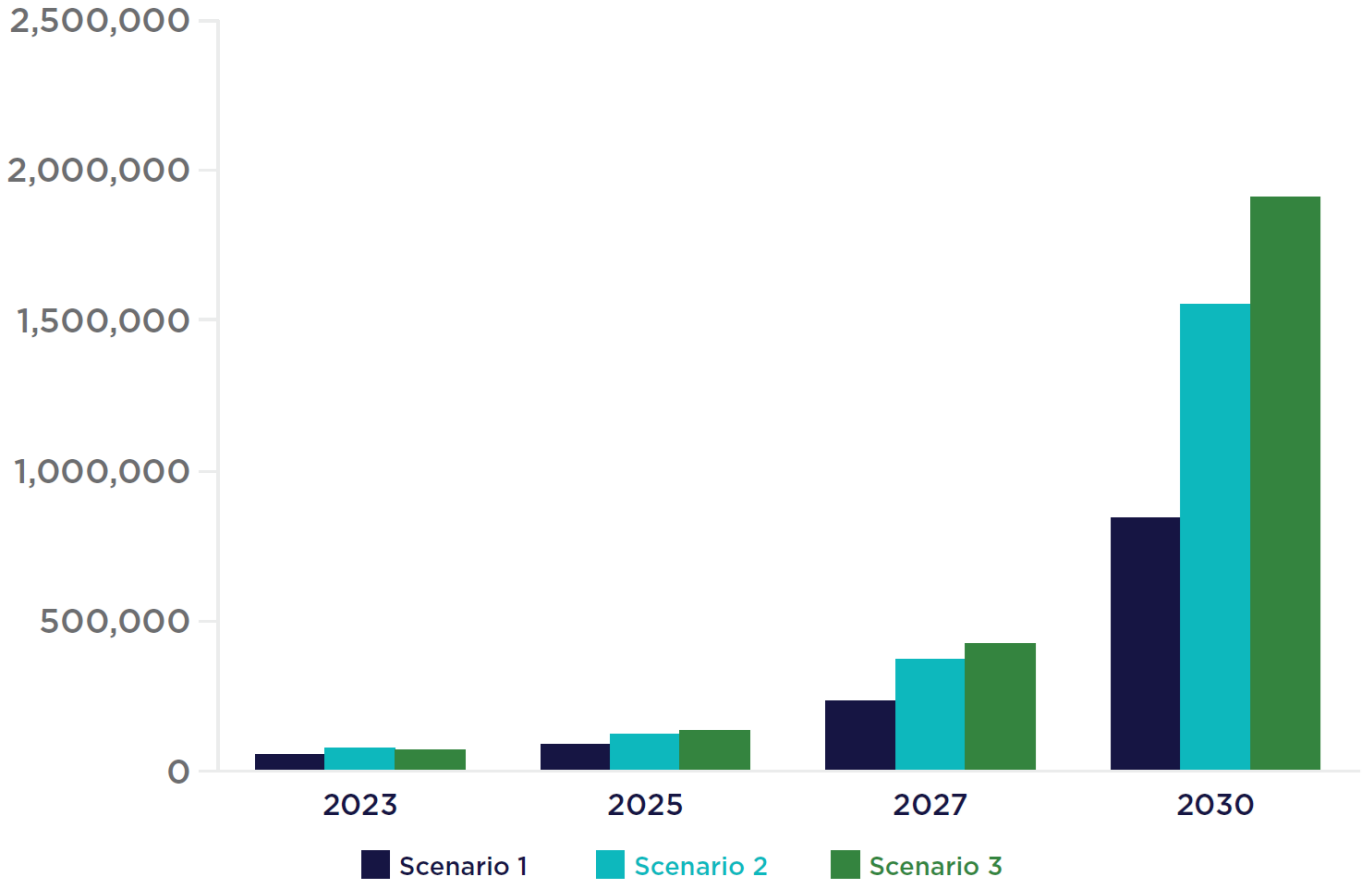


Figure 7. Example of demand-shift potential, Scenario 1, 2030



Data source: ICCT. (2024). [Unpublished raw data projecting potential demand shift to solar hours in 2030]

Scenarios for shifting truck charging



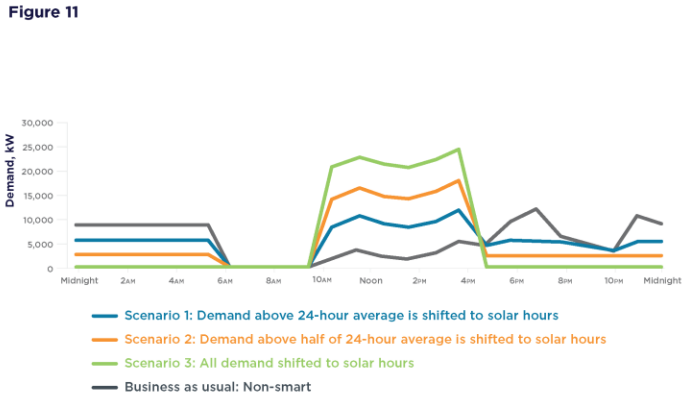


Figure: societal benefits from solar smart charging (proxied by change in total profit of utility), in INR/day

Savings from “solar truck charging”

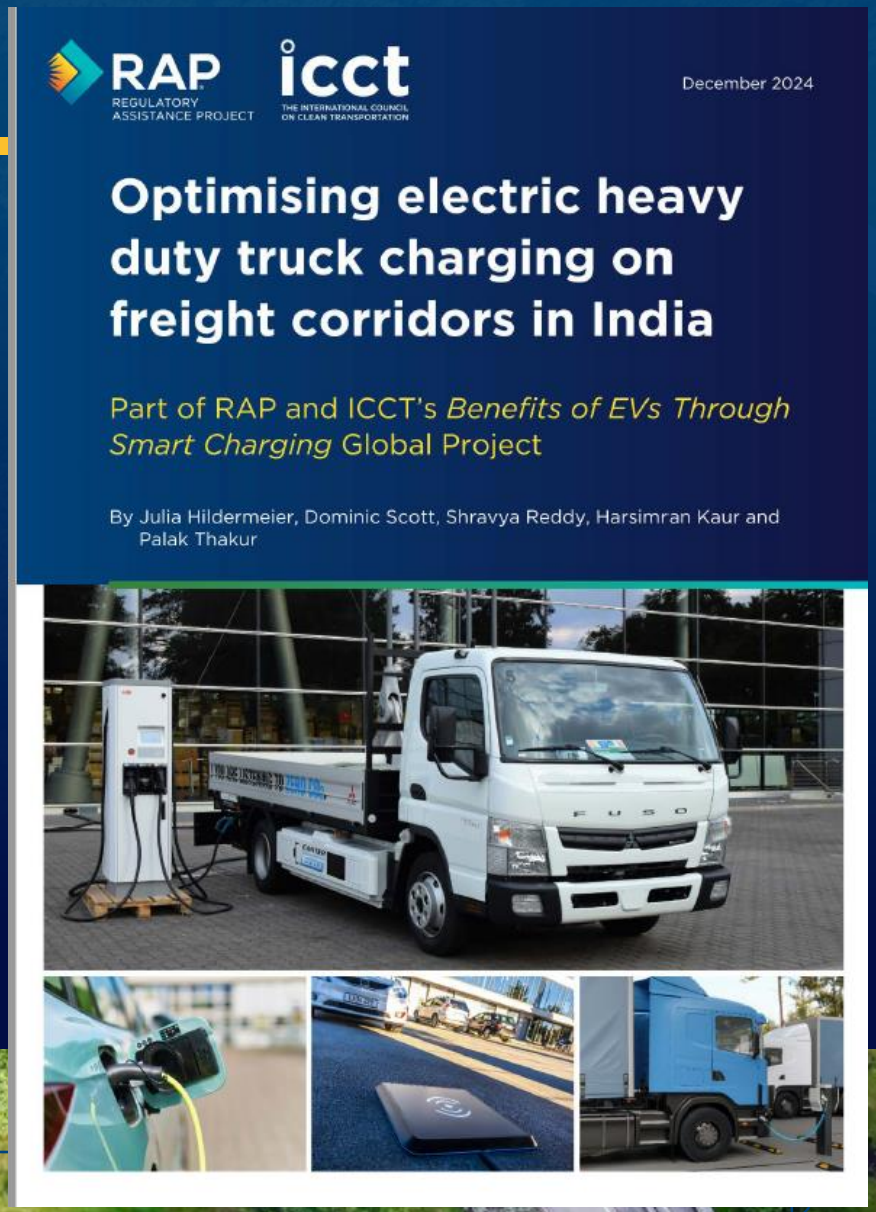
- annual savings in the range of 3.6 million to 8.4 million US$ by 2030.
- Over 12 corridors, 45 million to 100 million US$.
- Greenhouse gas reductions from increased solar power across 12 corridors btw. 1 million to 3.5 million metric tons

Conclusions

- High potential savings on system costs !
- High emission savings potential on one freight corridor only – electrifying more corridors can multiply savings!
- Truck charging can be optimized by move opportunity charging to daytime – with a solar rebate - and keep depot charging at night
- Time-varying tariffs, or solar rebate tariffs, can incentivize solar charging for e-HDVs and save system costs
- When electrifying freight corridors, seek a balanced roll-out of depot charging and highway charging.

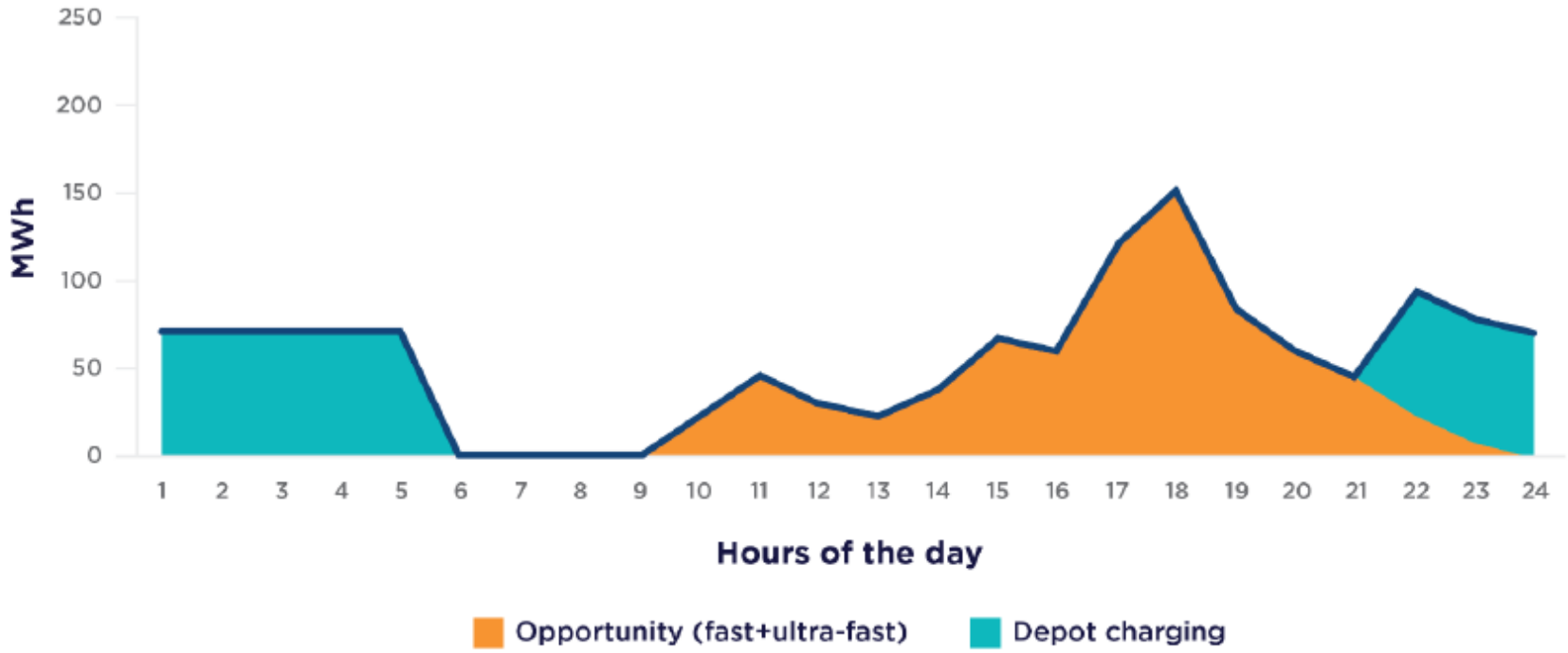
Key Findings

- **Smart EV charging is key to prepare global EV markets cost-efficiently.**
- **Anticipating charging demand, and increasing grid transparency is essential**
- **Cost-reflective electricity and network pricing are key**
- **Energy and transport stakeholders need to collaborate**



Charging demand

Figure 5. Charging demand business as usual 2030 (depot charging occurs overnight)



Data source: MP Ensystems Advisory Pvt. Ltd. (2024). *Smart Charging in India*

No smart charging, years 2023 (light green), 2025 (blue), 2027 (yellow), 2030 (dark green)

Modelling

- Key metric: average profit for utility (APU)
- Higher APU = more system value from using E

