Decarbonization Pathways for South Asia

South Asia Group for Energy (SAGE)

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Agenda

- What is SAGE?
- Decarbonization
  - Electric power grid
  - Industry and buildings
  - Transportation

South Asia Group for Energy (SAGE)

Objectives

- Implement research, analysis, and capacity building activities focused on the South Asia energy sector
- Equip USAID partner governments with critical information and consultation, enabling strategic investments along South Asia's path to self-reliance
- Facilitating access to technical expertise within U.S. DOE Labs, U.S. Government and private sector partners.

Mechanisms for activities

- Direct technical assistance to public institutions
- Enabling engagement with U.S. public and private sector
- Direct research collaborations

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Decarbonization Overview (Simple view)

Energy Efficiency

+

Electrification

+

Decarbonization the grid

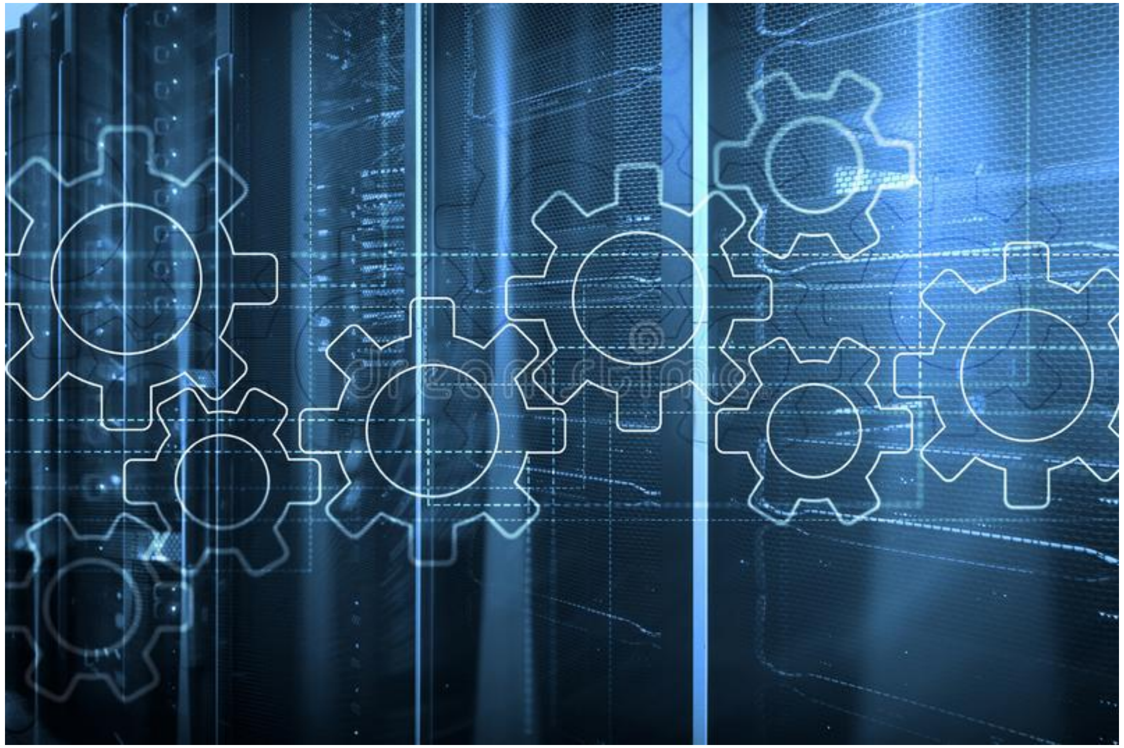
+

Hydrogen?, Biofuels?, Synthetic fuels?, Other technologies?

=

Deep decarbonization +

Co-benefits like clean air



Decarbonization of the Grid

What we know about decarbonization of energy systems

1. Likely pathways to decarbonized energy systems include increased reliance on the grid through electrification.
2. If the grid isn’t green, neither are the sectors that plug into it.
3. Variable renewable energy (wind and solar) and hydro is playing a large role in transitioning grids to lower-carbon in South Asia.
4. Distributed energy resources (rooftop solar, energy storage, demand response, electric vehicles, etc.), digitalization, utility-scale energy storage, and energy efficiency are poised to grow and likely change the supply-demand dynamics.

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Decarbonization of South Asia's Electric Power Systems

Country	Power sector targets
Bangladesh	Draft Solar Action Plan – 40 GW "ambitious scenario" by 2041
India	450 GW RE by 2030
Nepal	Expand clean energy generation from 1.4 GW existing to15 GW by 2030, 40 GW by 2040
Sri Lanka	Remain at 20% RE through 2037
Bhutan	20 MW RE by 2035

Integrating renewable energy onto South Asia's power grids will very likely be an integral part of the region's decarbonization

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Priority considerations (technical)

1) The transition to very high levels of clean energy will include existing system assets
   - Continuous studies and planning are needed to **maintain system reliability** and maximize assets through this transition (e.g., increasing flexibility of thermal plants, sharing resources through the transmission system)
2) Resource sharing can help in managing variability and climate change impacts
   - Fully utilizing the transmission system to access resources **across the whole region** could help to integrate RE. Big grids are typically more cost-effective. And some parts of South Asia have great hydro resources.
3) Demand is very likely to change in profound ways through sector electrification, DERs, and energy storage
   - Combining detailed sector-level planning exercises will be critical so that the grid can evolve appropriately
   - Distribution network characteristics will grow in importance with a more dynamic demand
4) Reaching a 100% decarbonized grid may not be all RE and hydro – will be important to continually evaluate alternatives

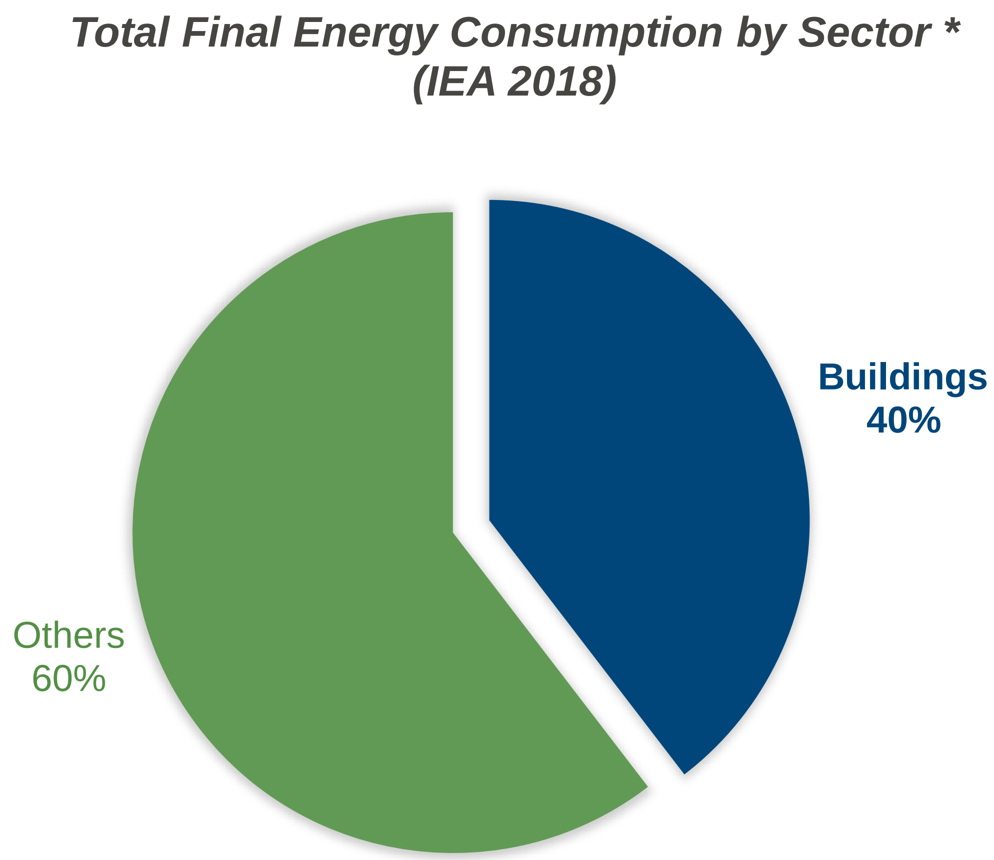
Enabling Decarbonization through a Low-Carbon Grid

Priority considerations (policy and regulatory environment)

1) The transition to very high levels of clean energy will include existing system assets
   - New rules may be needed for older assets because their utility to the grid may evolve (e.g., flexibility is a highly valued quality on today's grid, tomorrow it may be something different)
2) Resource sharing can help in managing variability and climate change impacts
   - Coordinated planning and operations and jointly managing system reliability of the grid (among other topics) between countries would require substantial investment in bilateral cooperation
3) Demand is very likely to change in profound ways through sector electrification, DERs, and energy storage
   - Demand or DER (e.g., rooftop solar) participation in balancing supply and demand could require new regulations, such as allowing third-party aggregators, etc.
4) Reaching a 100% decarbonized grid may not be all RE and hydro – will be important to continually evaluate alternatives
   - Low cost RE can help drive the transition to a decarbonized grid, although accelerating the transition will require targeted measures. Especially when transitioning from 80-100%.

Decarbonizing Buildings and Industry

Building Energy Consumption in South Asia



- Building energy demand in South Asia increased by 40% between 2000 and 2018.
- Building electricity demand in South Asia increased by over 300% between 2000 and 2018.

Analyzed regions include India, Bangladesh, Sri Lanka, and Nepal

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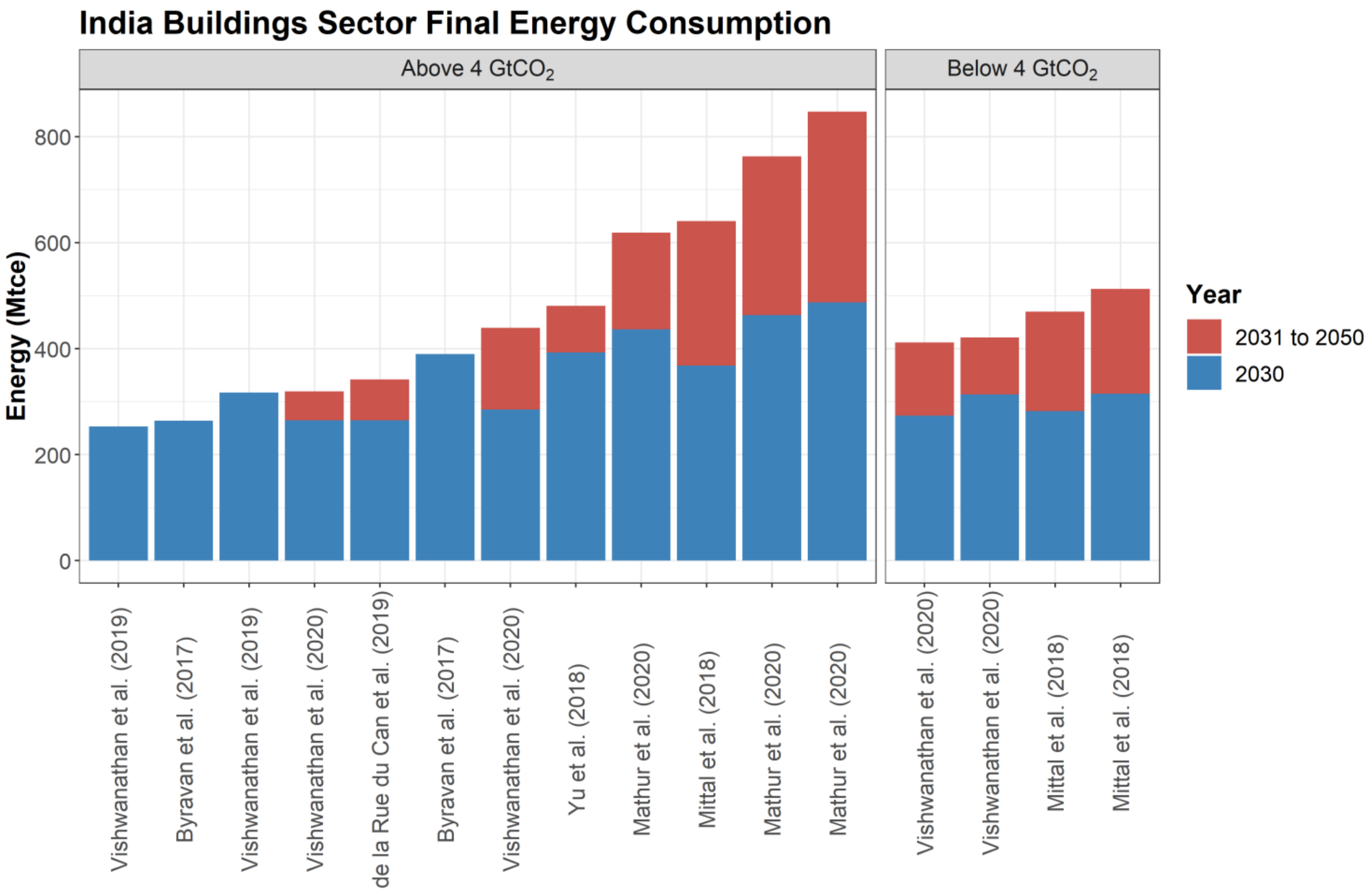
What We Learn from Existing Studies



Source: Durga, Siddarth. et al. "Developing New Pathways for Energy and Environmental Decision-making in India." *Environmental Research Letters*. (Forthcoming)

- Phasing out traditional biomass and increasing energy efficiency of cooling, lighting, and appliances are common trends identified across studies.
- None of the studies evaluated long-term deep decarbonization pathways for the buildings sector.

Pathways to Decarbonize Buildings

Key strategies

- Sustainable design
- Advanced energy efficiency improvement
- Electrification
- Renewable energy integration

Co-benefits

- Energy access
- Air pollution reduction
- Improved health outcomes
- Cost reduction

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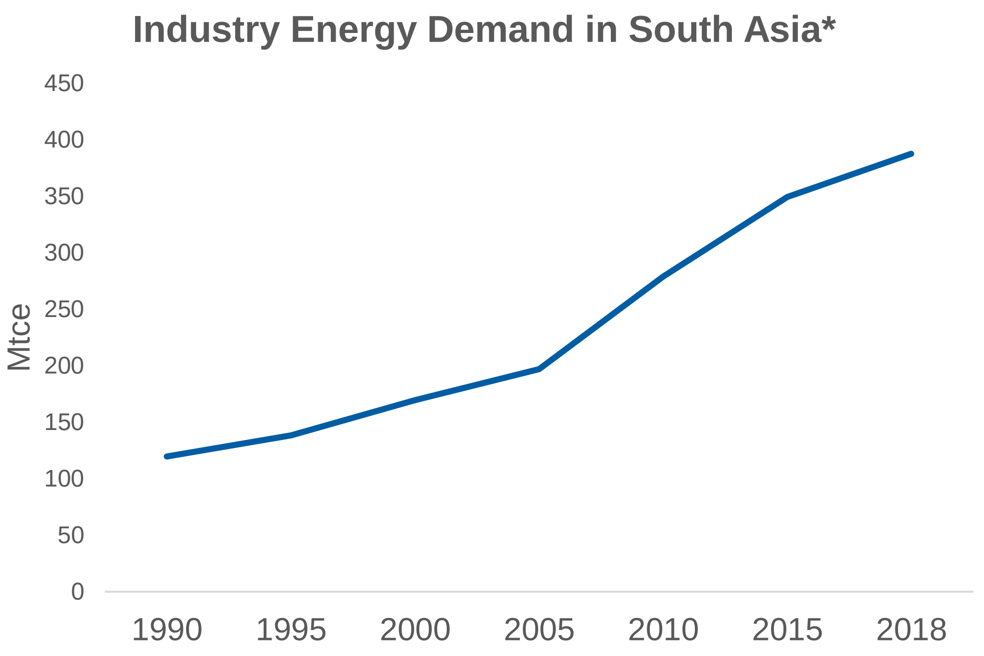
Industry Energy Consumption in South Asia

- Largest end-use sector in terms of greenhouse gas emissions in South Asia
- Significant sources of air pollutant emissions
- Potential for rapid growth in future
- Critical to economic and technology development
- Heterogeneity in nature
- Emissions from both combustion and industrial processes
- Energy used as both fuel and feedstocks

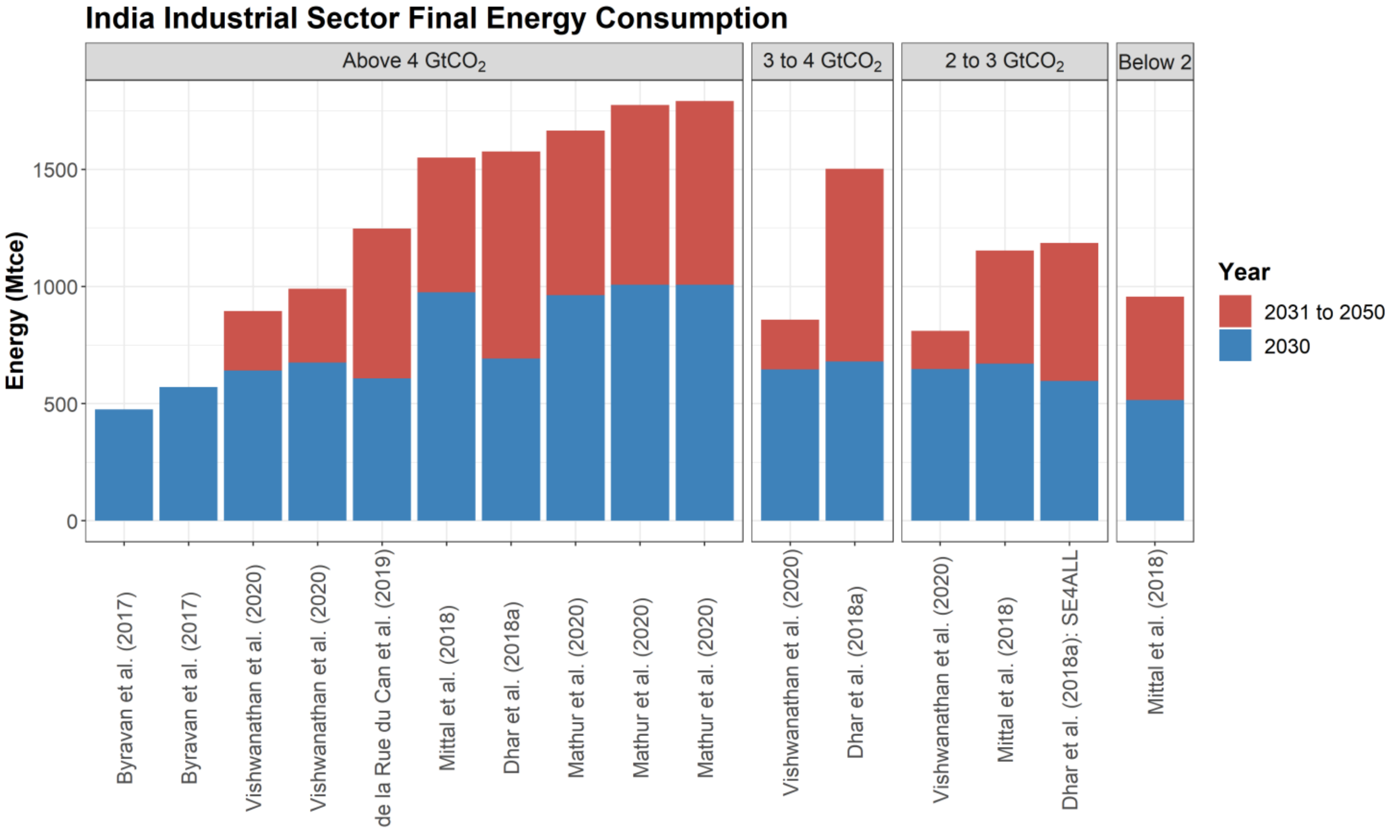


Industry energy demand in South Asia* doubles between 2005 and 2018.

Analyzed regions include India, Bangladesh, Sri Lanka, and Nepal

Decarbonizing Industry: Current Studies

- Limited studies on industrial deep decarbonization in South Asia
- Energy efficiency is the main strategy discussed in literature
- Need better sectoral granularity and innovative technologies
- Linkages between industry and other sectors
  - Buildings/material efficiency and implications for steel and cement demand
  - Transportation and implications for steel and aluminum demand
  - Industry decarbonization and implications for power grid
  - Industrial use of hydrogen

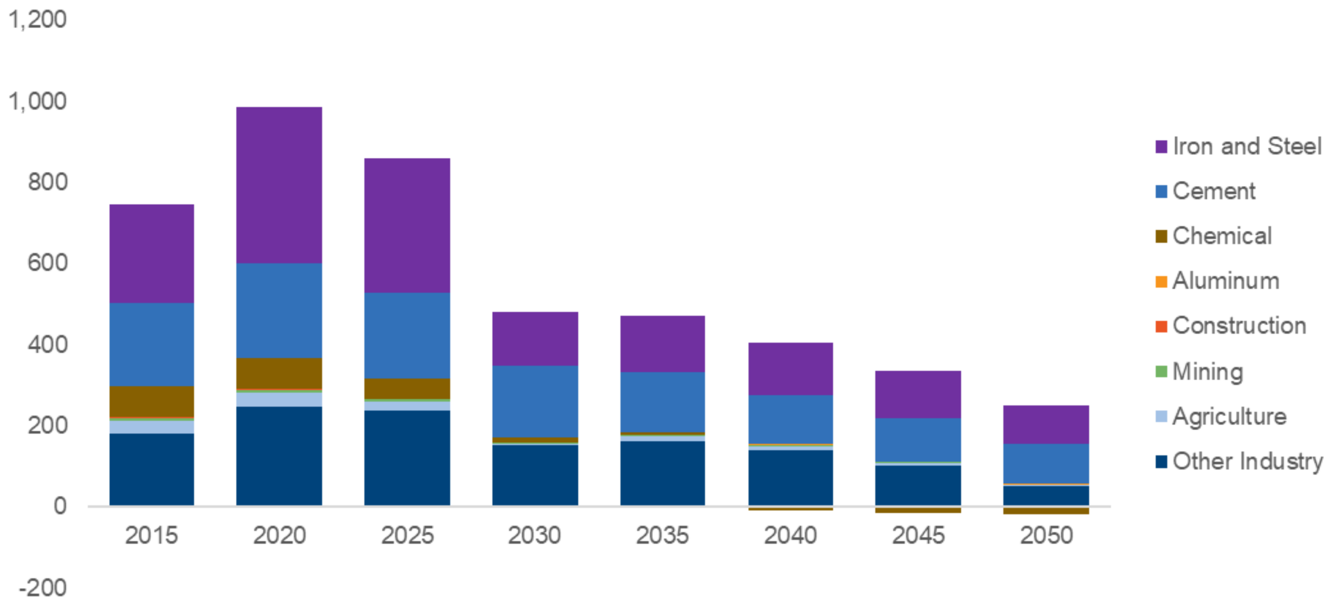


Source: Durga, Siddarth. et al. “Developing New Pathways for Energy and Environmental Decision-making in India.” *Environmental Research Letters*. (Forthcoming)

Comprehensive Strategies to Decarbonize Industry

- Efficiency improvement
- Recycled materials use
- Materials substitution
- Electrification
- CCUS
- Hydrogen
- Biomass

Industrial Sector CO_2 Emissions in South Asia ($MtCO_2$)



Source: Liu, Y. et al. "Rapid industrial transformation needed for a 1.5°C future." *Energy and Climate Change*. (Forthcoming)

Policy Support Needed for Deep Decarbonization

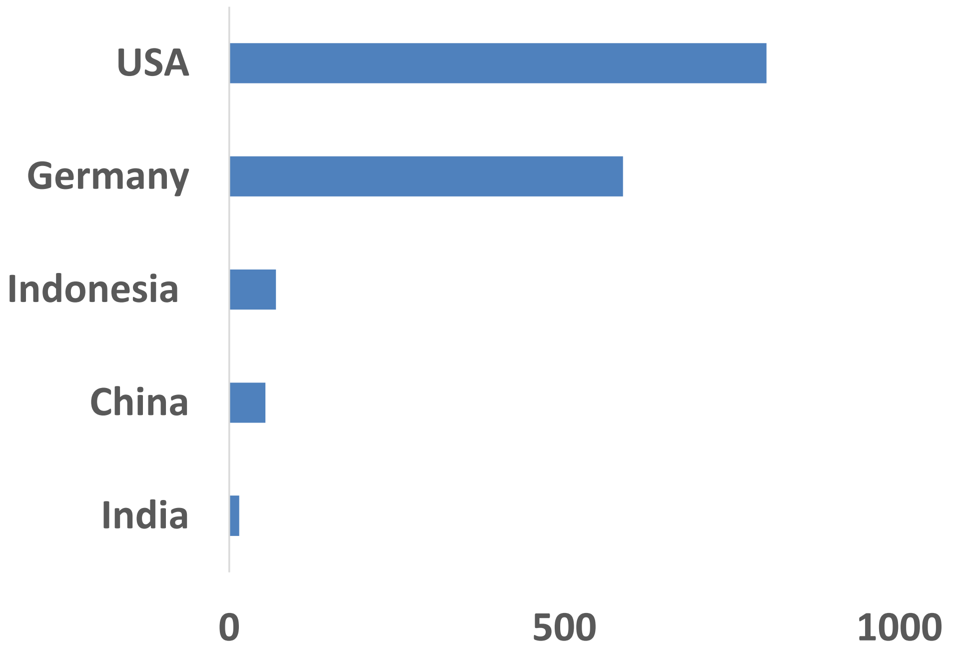
- **Comprehensive decarbonization policies**
  - Consider interactions across sectors
  - Cover all GHGs (e.g. HFCs in buildings and F-gases from aluminum production)

- Potential policies to consider
  - Enhance the stringency and implementation of energy efficiency policies
  - Improve resource efficiency
  - Accelerate electrification and understand implications for the power system
  - Promote R&D of new technologies, such as CCUS and hydrogen

Decarbonizing Transport

Emerging economies lag ~2 trillion in energy infrastructure

Cars per 1000 people (2017)



As transport demand builds, several decarbonization pathways exist:

- Modal shift (freight and passenger) – very long term
- Engine efficiency / fuel switching – does not move the needle much
- Hydrogen / fuel cells – high cost + challenging infra
- Electric vehicles – ➔ *focus of this talk*

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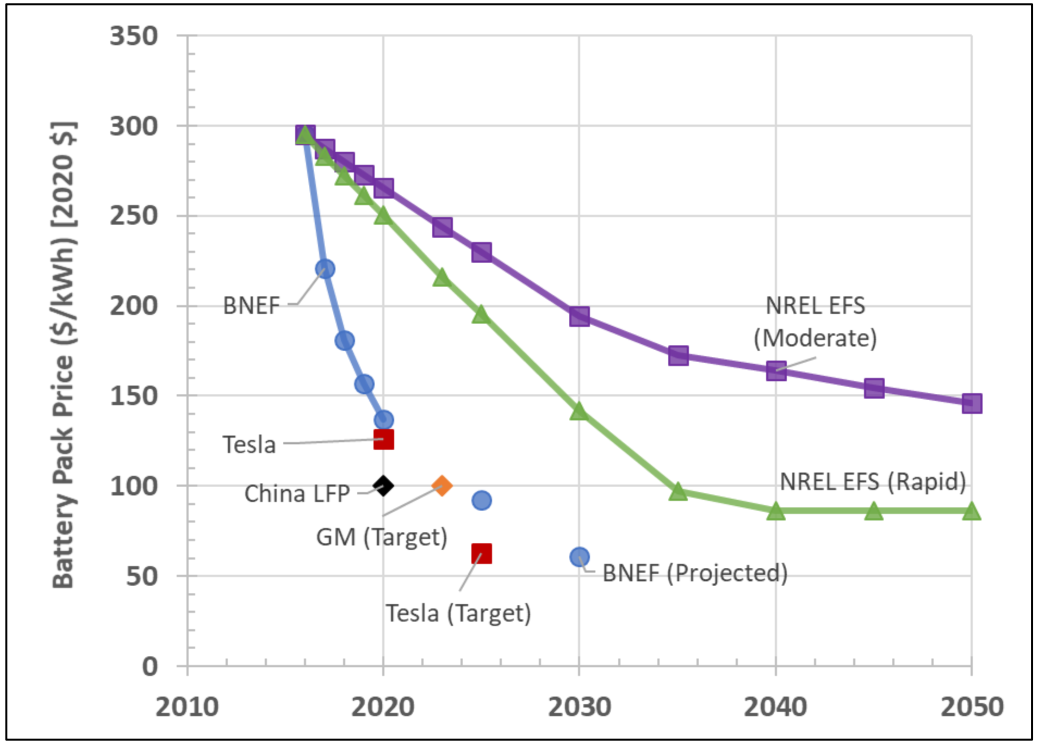
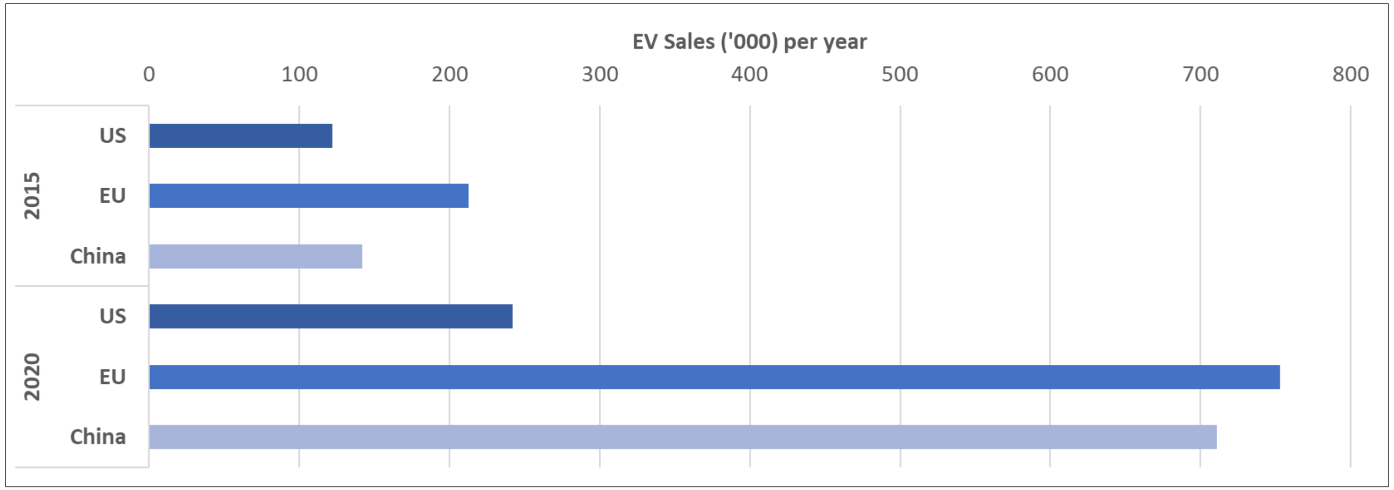
Battery technology improvement has been unprecedented

Rapid battery price reduction and performance improvement changes the feasibility of EVs



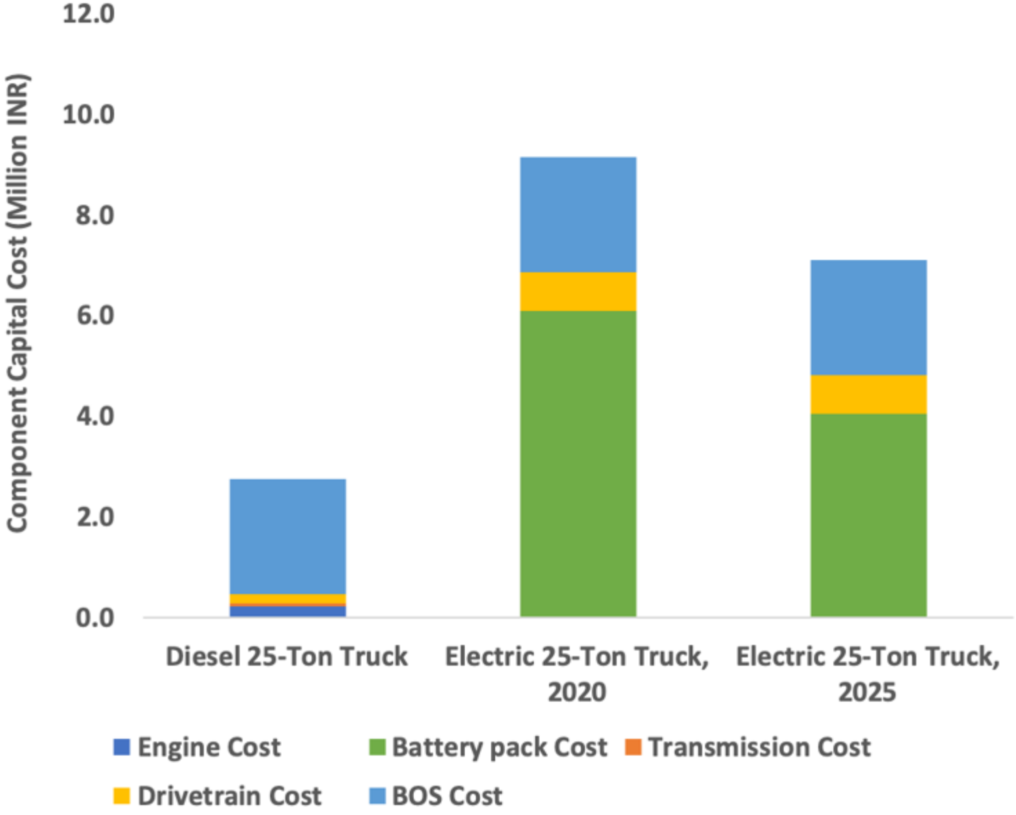
Major OEMs are committing to 100% new EV sales

Key economies are aggressively expanding the EB deployment and infrastructure buildout

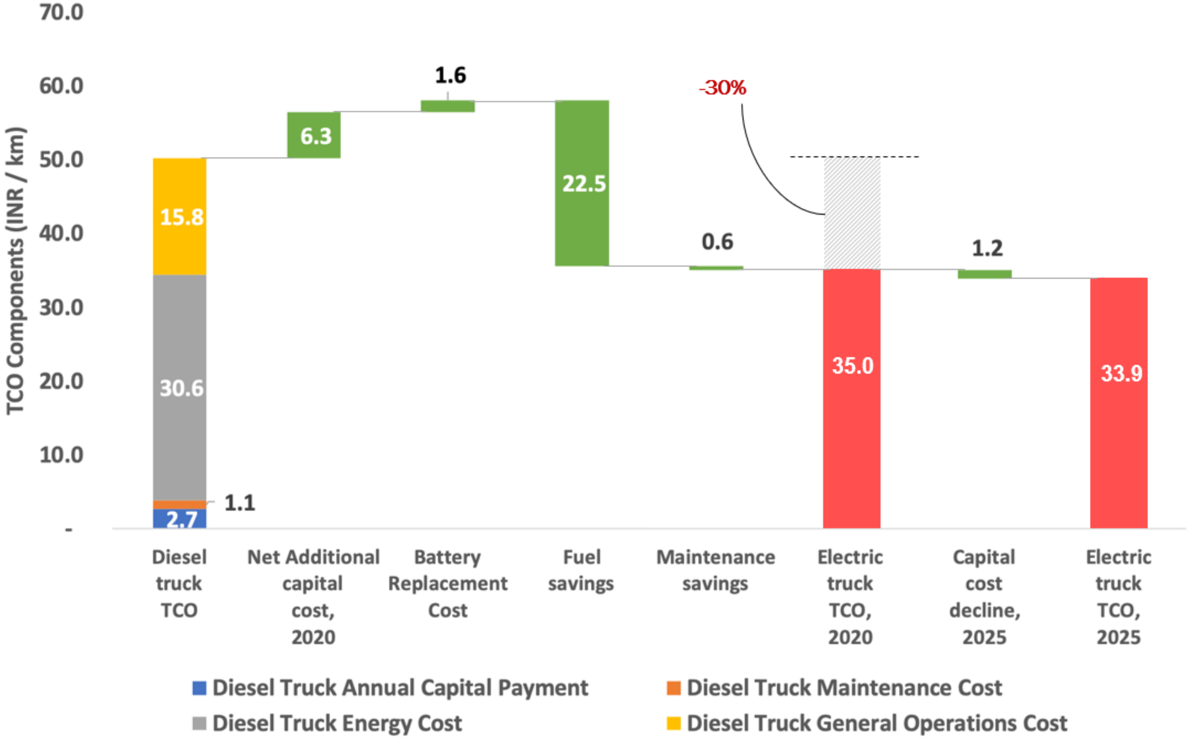


Electric vehicles have lower TCO; Battery weight impact is minimal

Electric trucks have higher upfront costs



But significantly lower operating costs; Electric Truck TCO < Diesel TCO in *2020* Payback period < 3 years



These costs are shown for a freight truck with GVW of 25-ton (the most popular truck size in India).
Battery size = 580 kWh. Range = 450 km. Payload capacity is within ~10% of a comparable diesel truck.

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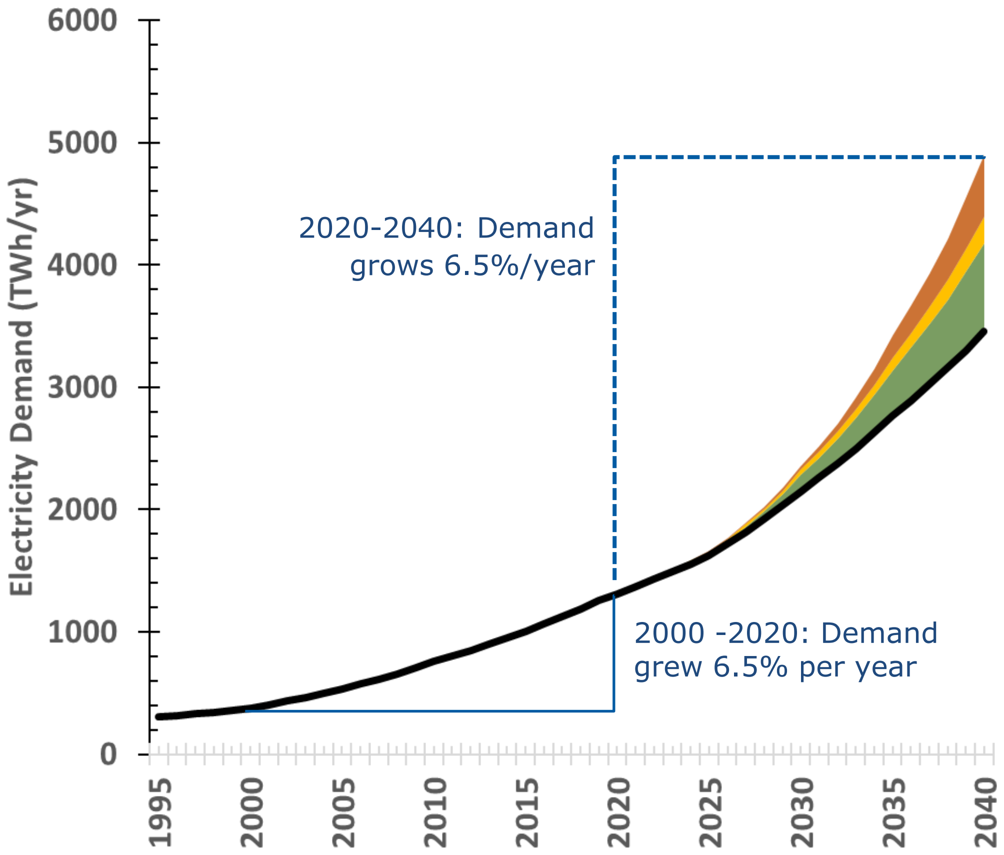
Additional electricity demand modest; Large macro-economic benefits

Annual Electricity Consumption (TWh/yr)
For Aggressive Electrification Case (~1.5 deg C consistent)



- 90% oil is imported

➔ Energy security and trade balance benefits

- Inflation proof low-cost freight transport

➔ Low industrial costs + consumer inflation

- Maintain global competitiveness of the auto sector

➔ Catch-up with other major economies

- Avoid >200,000 premature deaths/yr

➔ >$1-2 trillion of public health benefits

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Significant policy support needed for aggressive decarbonization

- Procurement / sales / fleet mandates e.g. ZEV mandate
- Incentives / rebates / low-cost financing to address the upfront cost barrier
- Accelerate public charging infrastructure buildout
- Reform electricity pricing (demand charges, time-of-use, long-term RE PPA)
- Incentivize domestic manufacturing e.g. production linked incentives, tradable domestic content requirement etc.

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