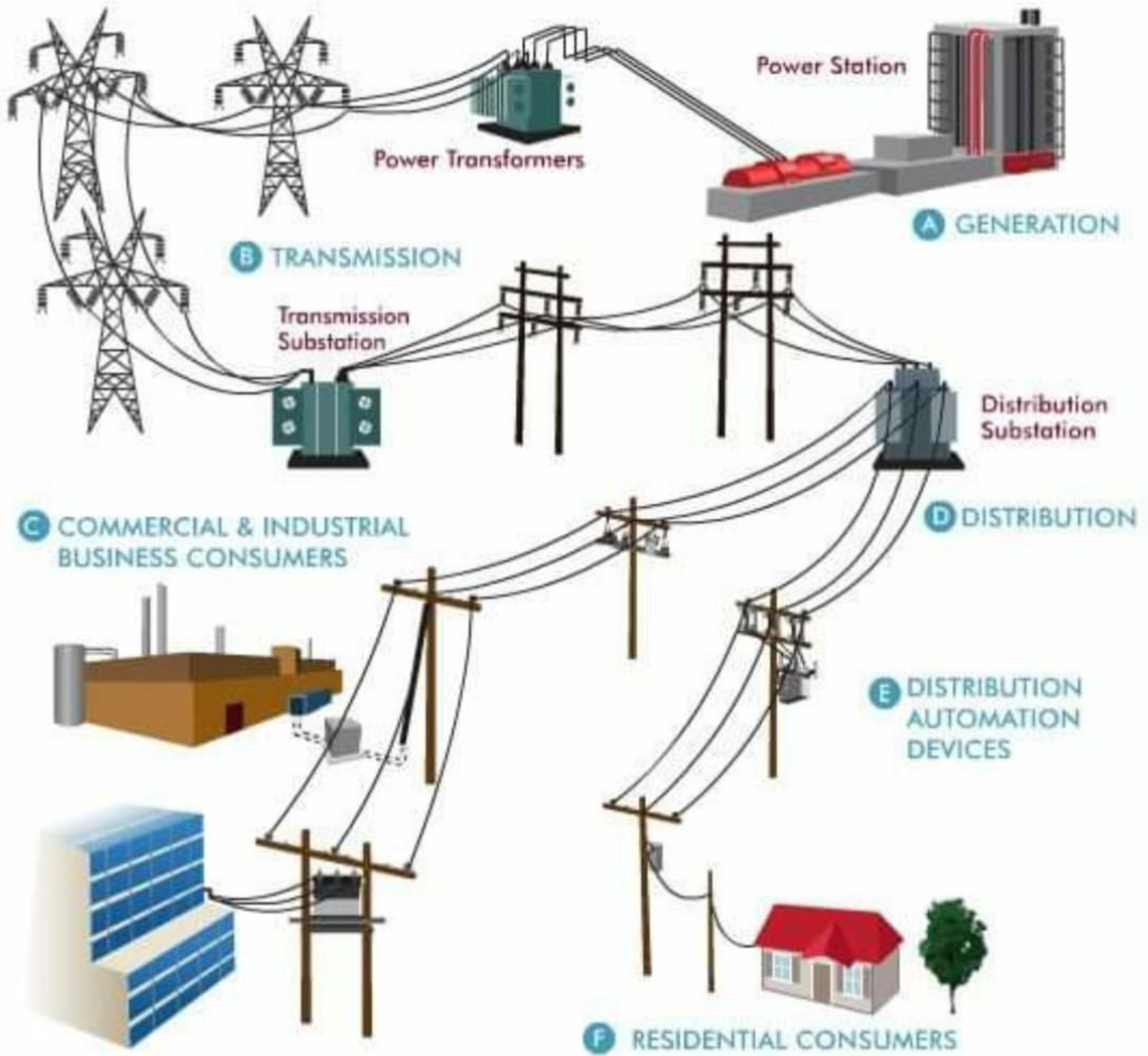
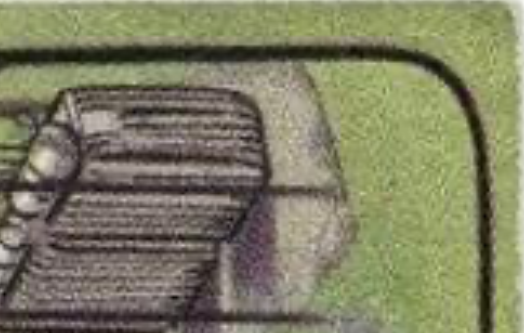
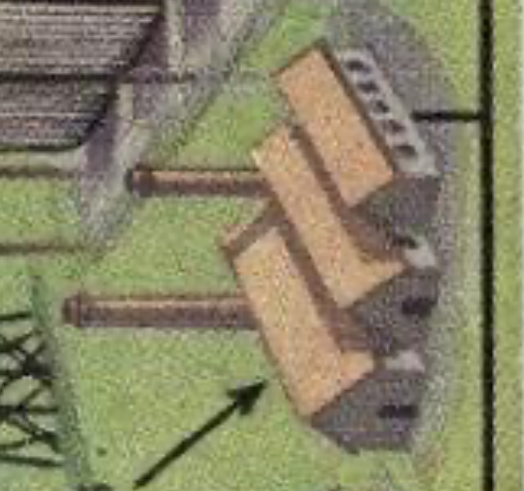
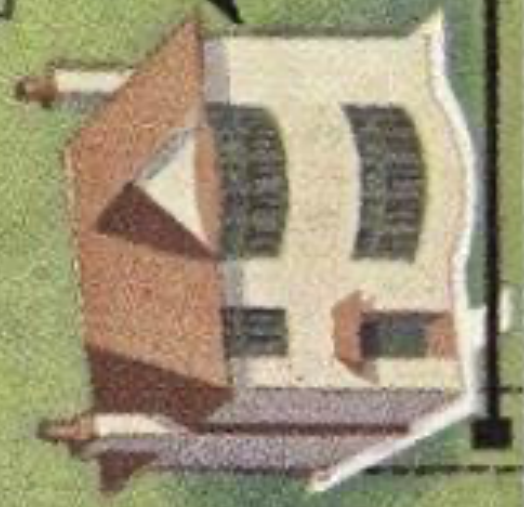
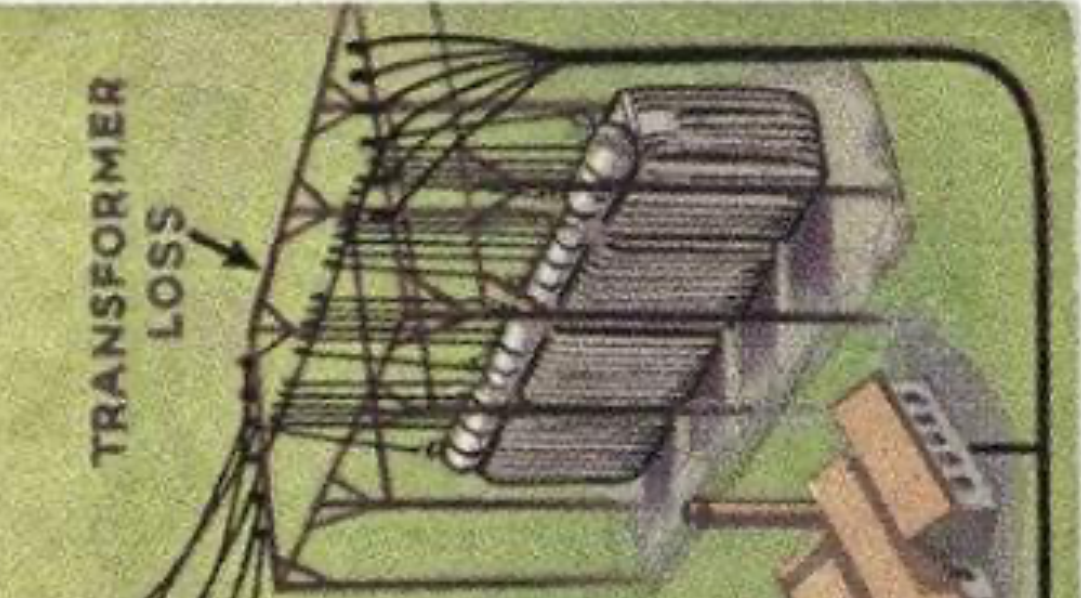
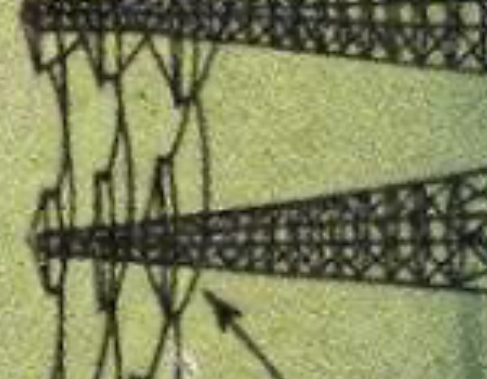
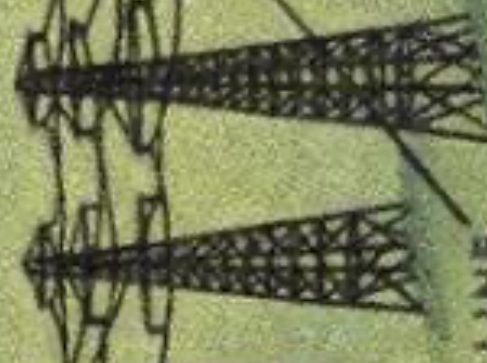


Electrical Power System ⚡⚡



LOSSES OF ELECTRIC POWER IN TRANSIT



1 BENEFITS

Batteries can provide services for system operation and for solar PV and wind generators, defer investments in peak generation and grid reinforcements.

RENEWABLE GENERATORS

- Reduced renewable curtailment
- Renewable capacity firming

SYSTEM OPERATION

- Frequency regulation
- Flexible ramping
- Black start services

INVESTMENT DEFERRAL

- Transmission and distribution congestion relief
- Energy shifting and capacity investment deferral



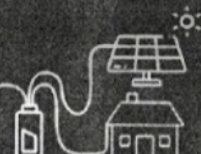
Renewable generators



Transmission networks



Distribution network



2 KEY ENABLING FACTORS



Reduced upfront costs



Conducive regulatory framework



Pilot projects and knowledge dissemination

3 SNAPSHOT

- 10 GW of battery storage is deployed globally (2017)
- Batteries with a total annual production of 27 MWh are providing 1/4 of total enhanced frequency regulation capacity in UK.
- A demonstration project in US showed that a 4 MW/40 MWh battery can save USD 2 million in fuel costs and 400 hours of grid congestion.

WHAT ARE UTILITY-SCALE BATTERIES?

Stationary batteries can be connected to distribution/transmission networks or power-generation assets. Utility-scale storage capacity ranges from several megawatt-hours to hundreds. Lithium-ion batteries are the most prevalent and mature type.

UTILITY-SCALE BATTERIES

Battery storage increases flexibility in power systems, enabling optimal use of variable electricity sources like solar photovoltaic (PV) and wind energy.