UK PACT
GREEN RECOVERY CHALLENGE FUND

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Session 1: PT Electrification Strategy for Ahmedabad

Power Flow Analysis and Grid Strategy

Chun Sing Lai and Jital Jhaveri

CRDF CEPT RESEARCH AND DEVELOPMENT FOUNDATION

UNIVERSITY OF LEEDS

Brunel University London

GERMI
GUJARAT ENERGY RESEARCH AND MANAGEMENT INSTITUTE

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Introduction

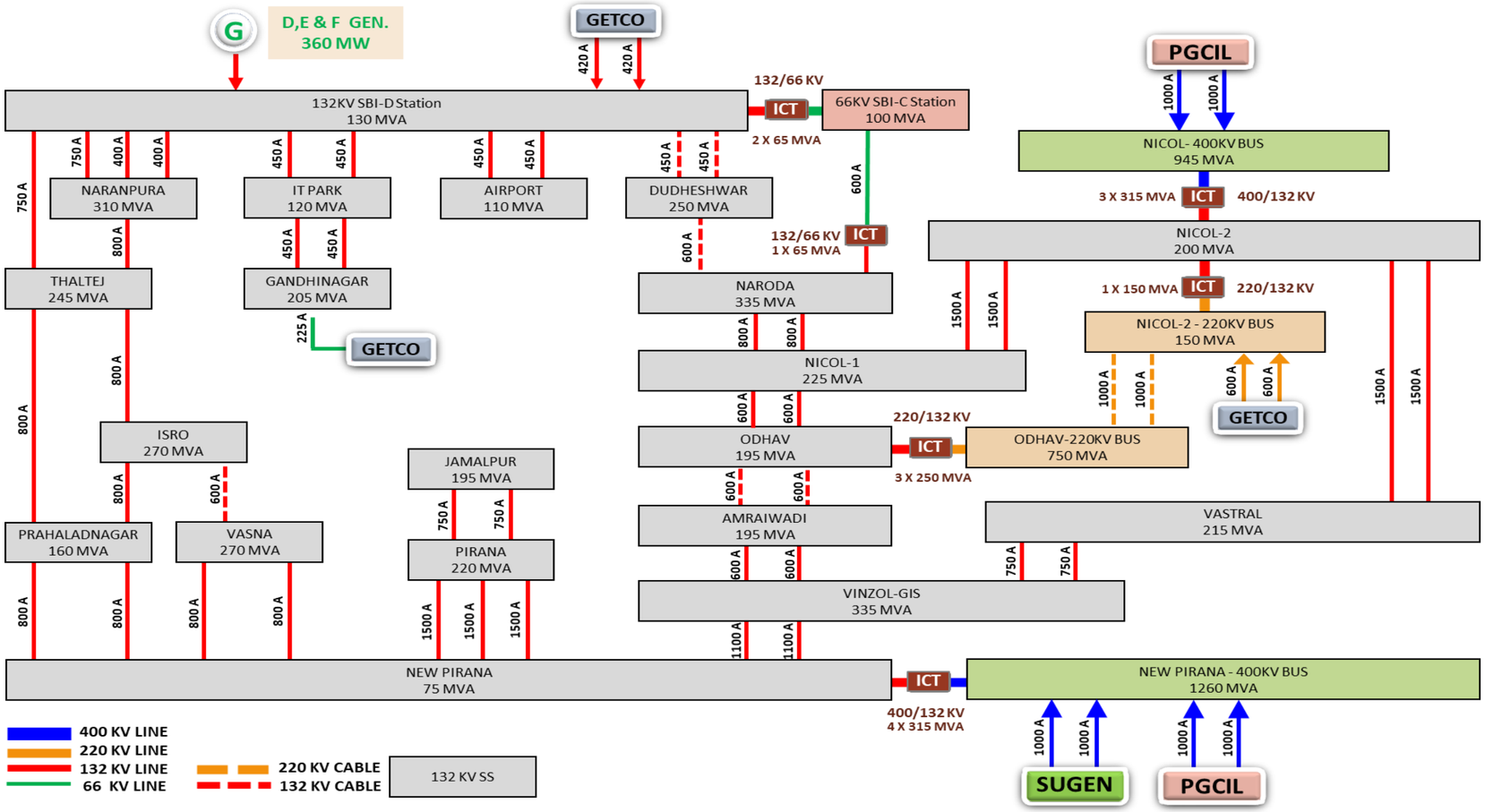
- The automotive industry in Indian is the 5th largest in the world and is expected to become the 3rd largest by 2030
- The long-term market share of EVs in India is expected to reach nearly 40% of the total passenger vehicles (Bloomberg New Energy Finance 2020)
- However, with the rapid growth of EVs in India, the power grid will face the risk of large EV loads

Conductive charging modes for EVs– a comparison

Charging modes	Infrastructure	Charging power
Mode 1	Common household sockets and cables; ordinary household socket, which can get AC power from the grid.	2.3 kW
Mode 2	Special charging cable and dedicated charging station are used to obtain greater charging power.	About 10 kW
Mode 3	Special plug socket and a dedicated circuit; Use circuits and plugs that can carry more power to obtain more charging power.	About 20 kW
Mode 4	Off-board fast charging; DC quick charging pile with three-phase rectifier.	Higher than 50 kW Direct current

Power Flow Analysis -- Ahmedabad electricity transmission and distribution system

- The power flow study is a numerical analysis of the flow of electric power in an interconnected system

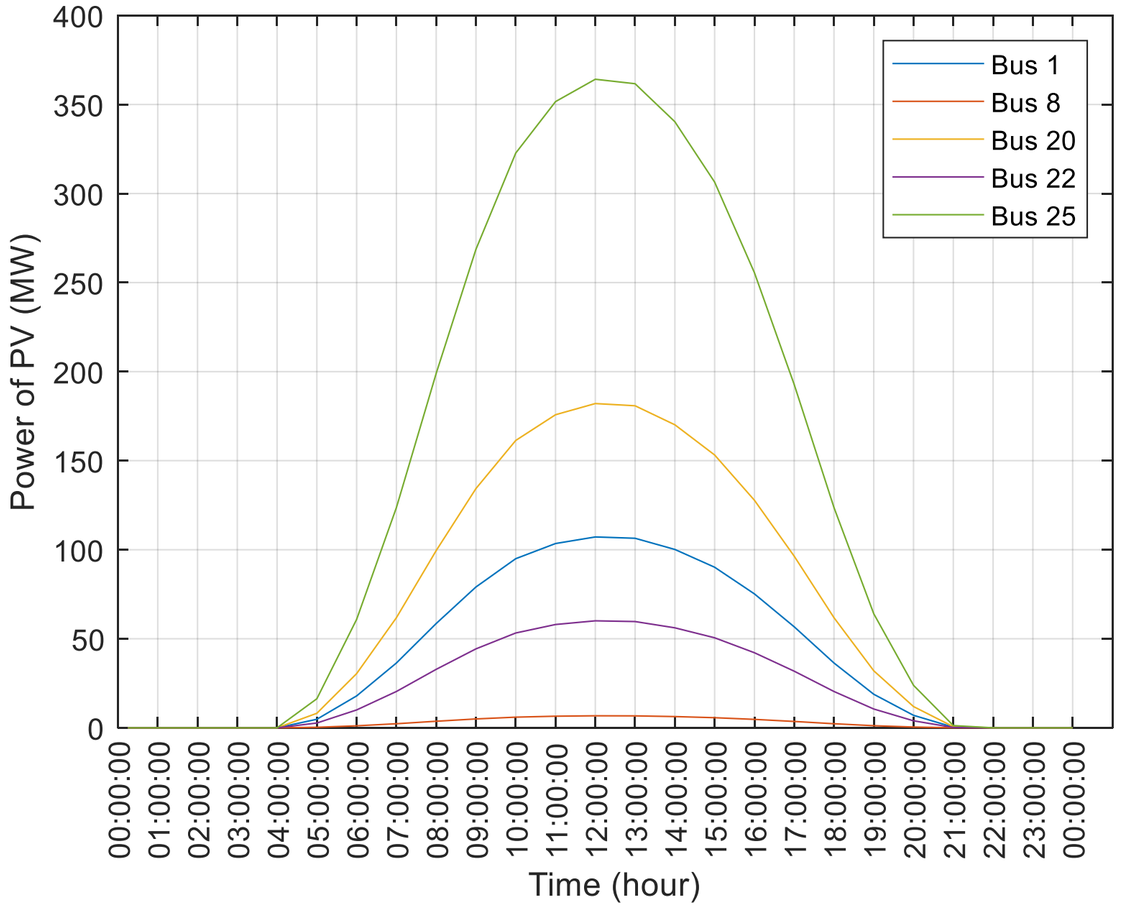


Modelling Assumptions

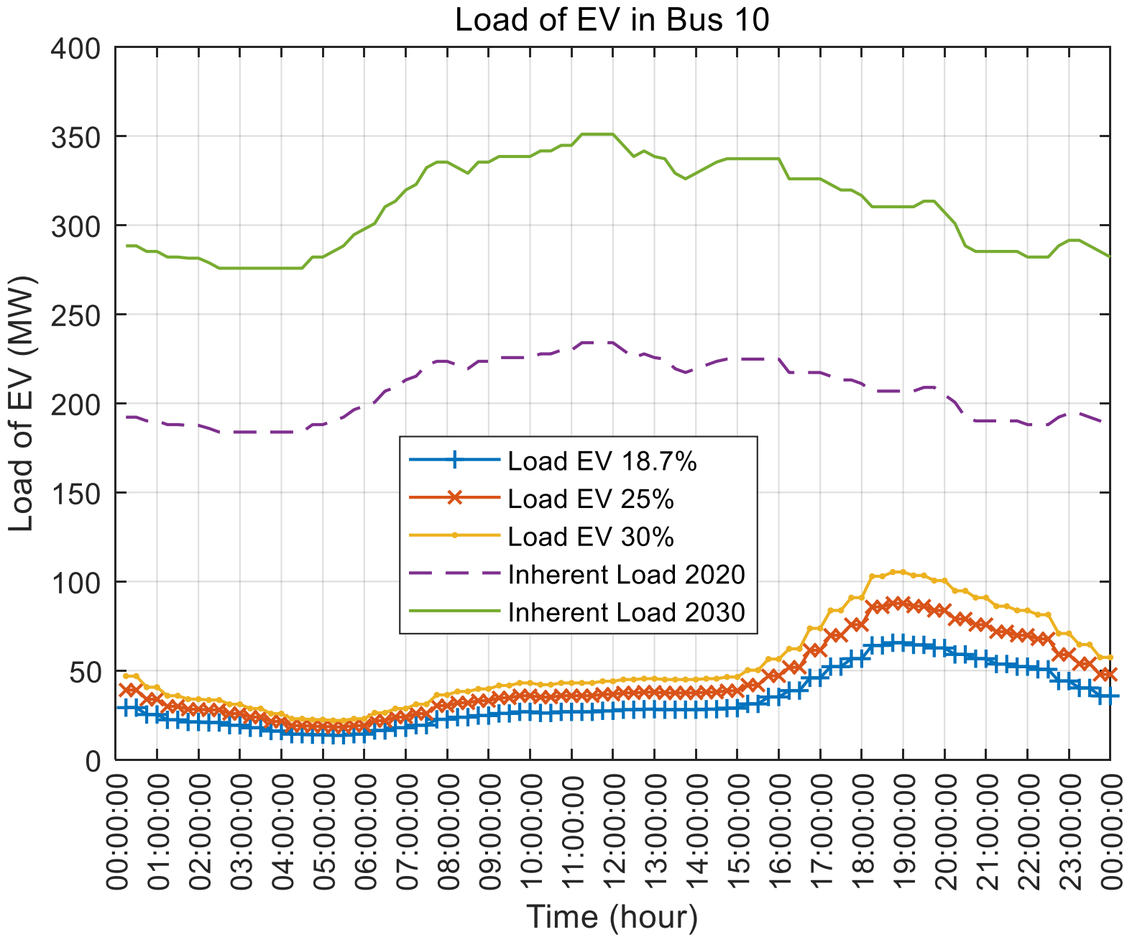
- PV generation penetration is assumed to reach 22.76% according to the national level
- A charging power of 7 kW for 4W EVs, 150 kW for electric buses, 0.21 kW for 3W EVs, and 0.18 kW for 2W EVs
- EVs can reach 18.7% of electricity demand penetration in 2031

Year	2W/number	3W/number	4W/number	EB/number
2031	1053515	13929	50650	302

Input Data

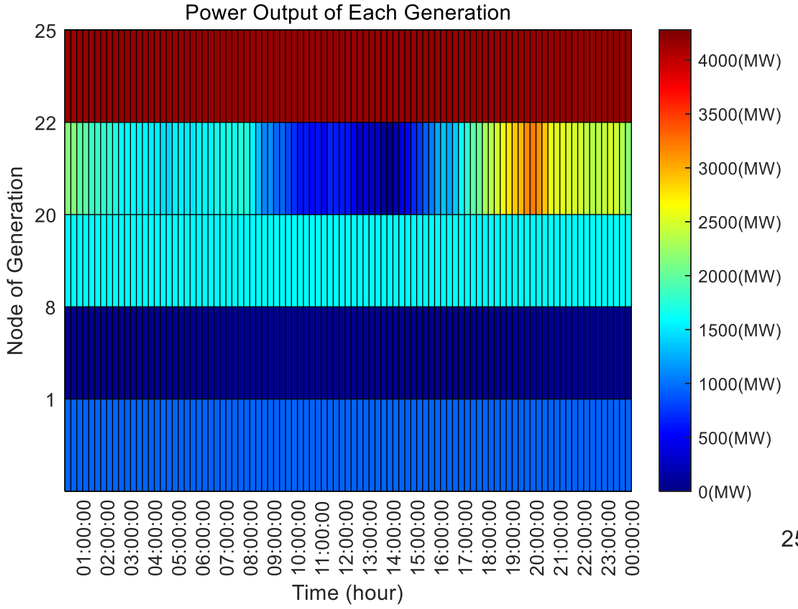


PV generation curve for buses with generators

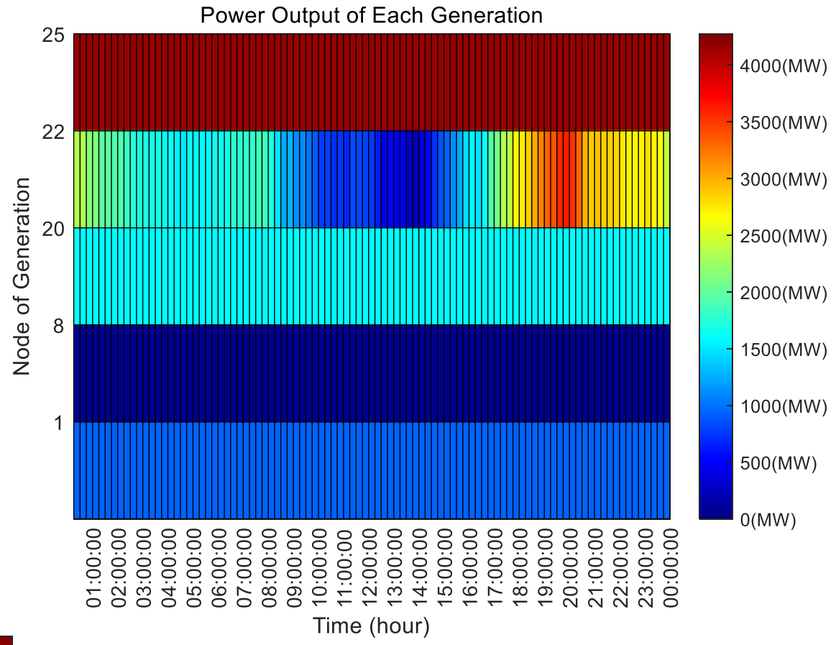


Typical load of EV in Bus 10

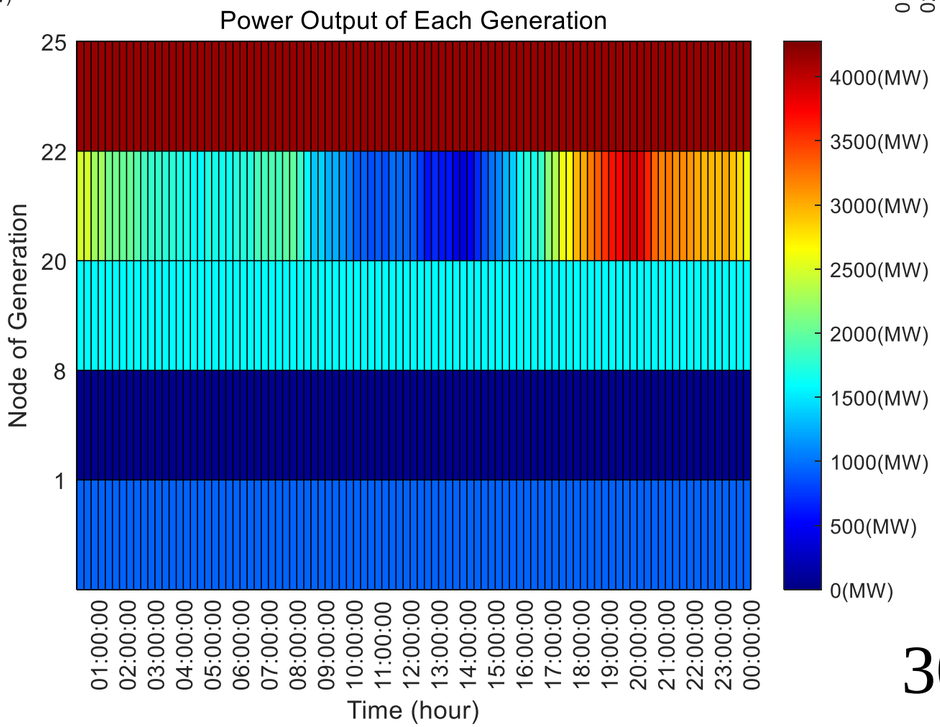
Results: Power demand of each generator node with various EV load penetration



18.7%

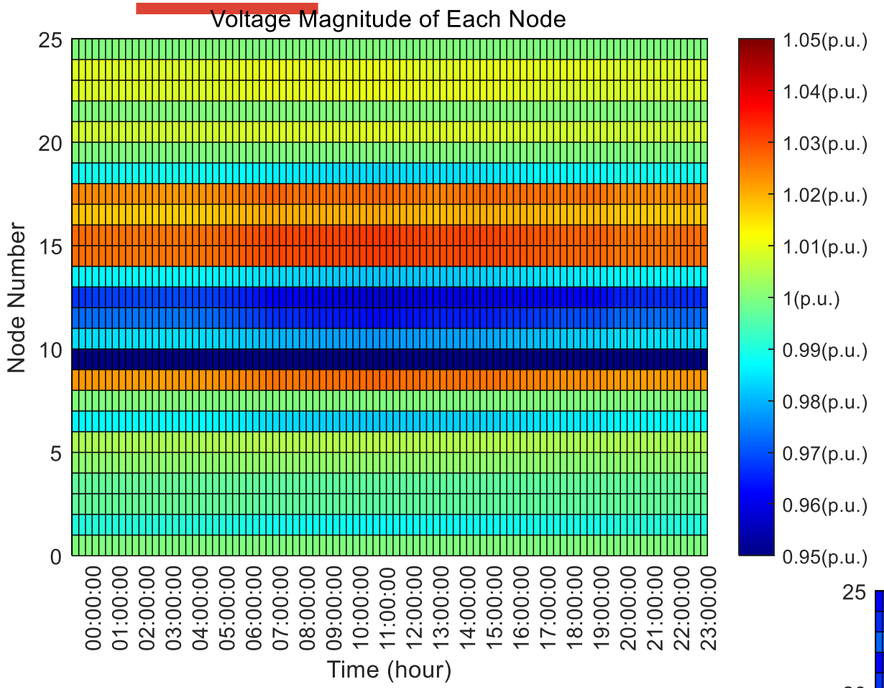


25%

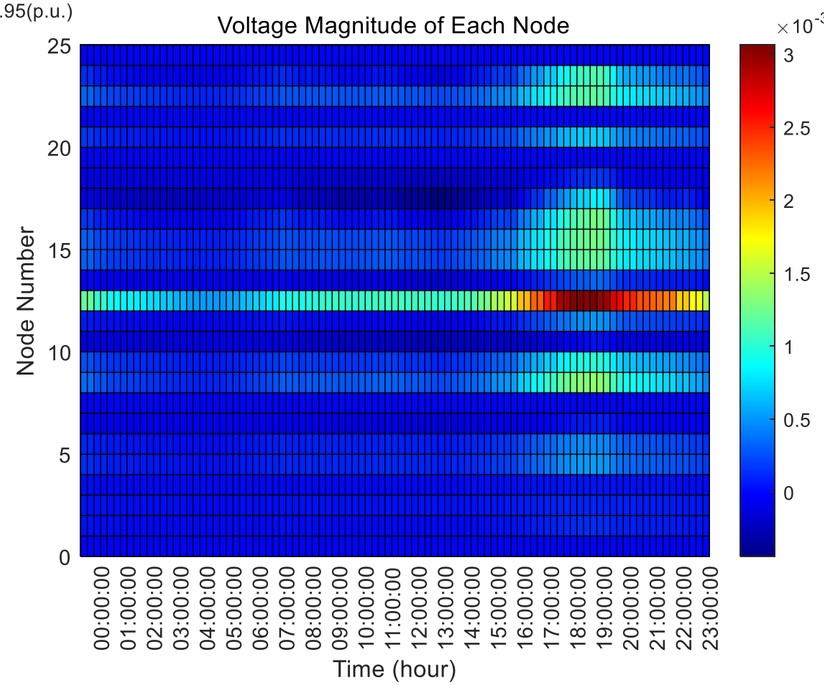


30%

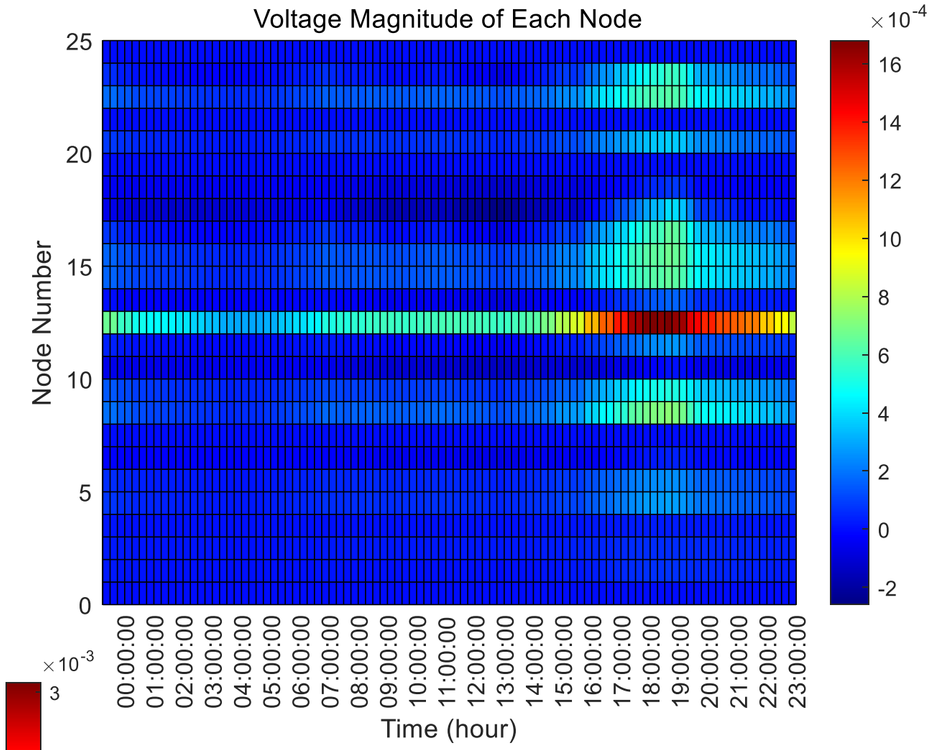
Results: Voltage magnitude of each node with various EV load penetration



18.7%



18.7%-30%



18.7%-25%

Recommendations

- Higher EV load penetration will contribute to higher peak power demands in the evening and requires additional conventional generation to maintain the grid operation
- Adopt smart charging strategies or demand response programmes by providing incentives for charging vehicles
- Install large-scale energy storage devices to accommodate surplus solar energy and to be used in the later hours of the day
- Diverse energy mix: wind power can still operate at night