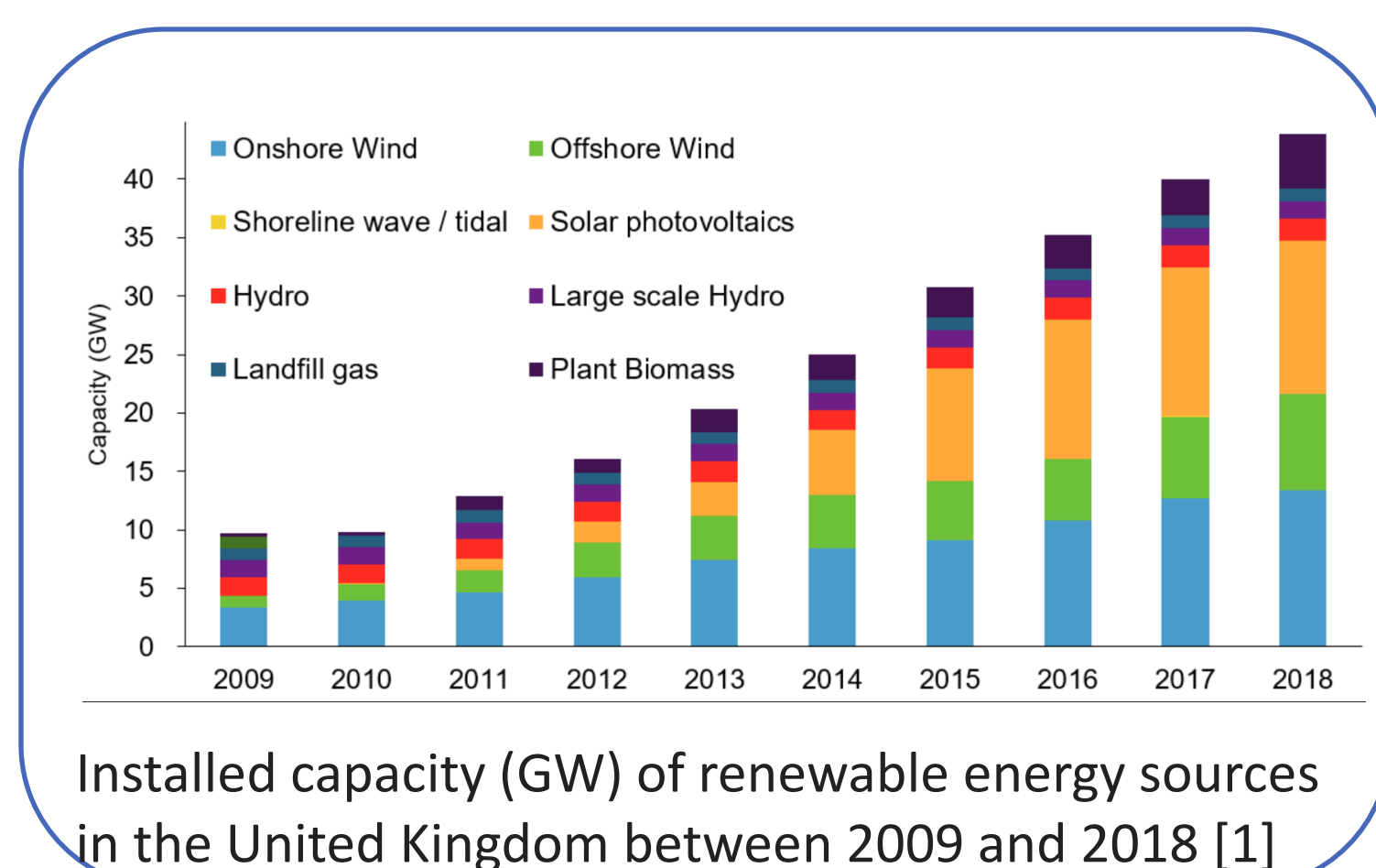


# Contribution of hybrid, spatially widely distributed, RES plant to voltage and transient stability of transmission network

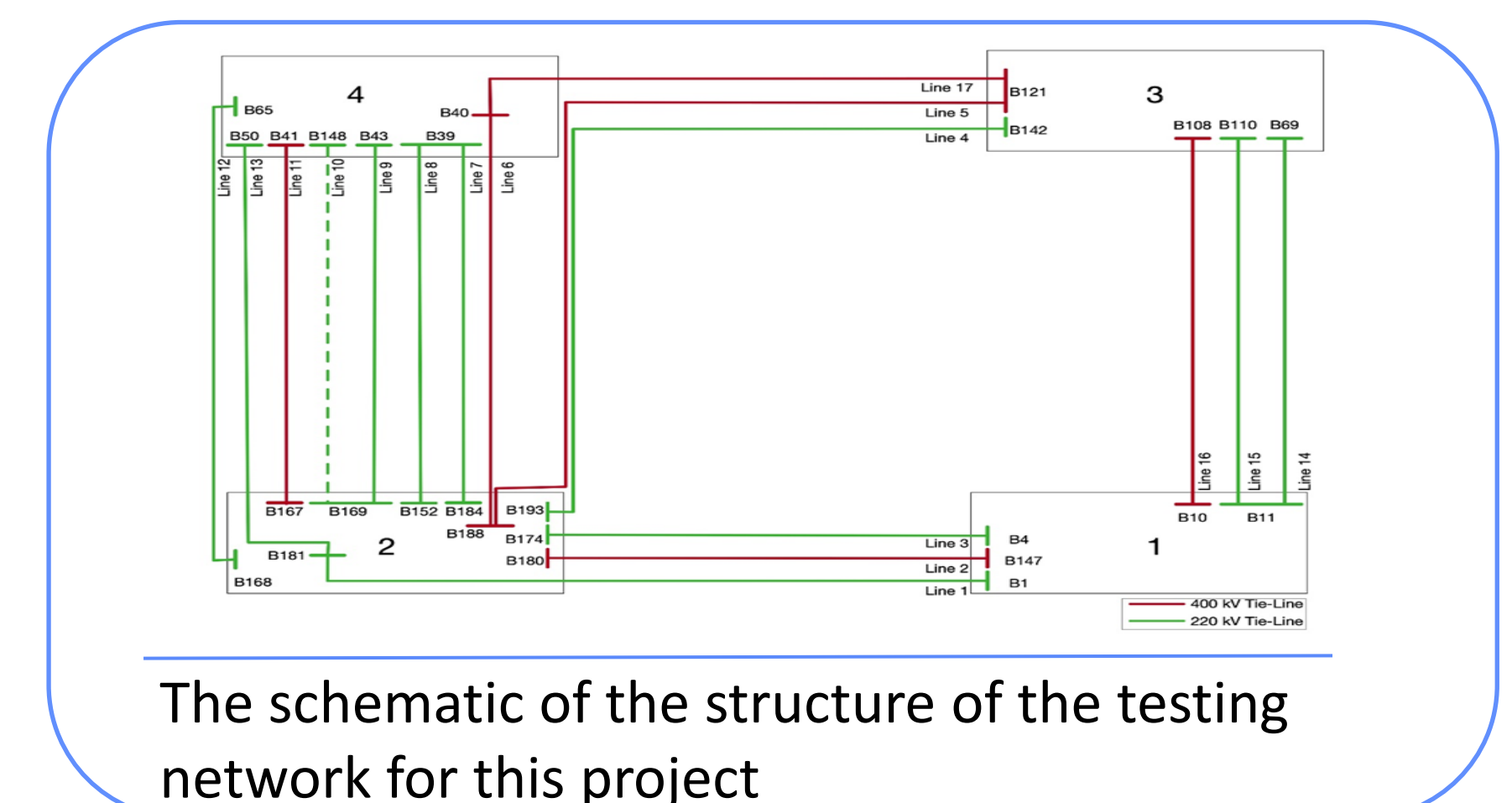
## INTRODUCTION

Recent years, **renewable energy source (RES)** as the cleaner energy alternatives has received considerable attention in electrical industries because of the climate warming. Accordingly, the **hybrid renewable energy system plant (HRESP)** has formed in many countries.



However, with the increasing penetration of RES, **the impact of the change of generation configurations on the system stability has not been determined.** This project focus on the **dynamic stability assessment** for the system.

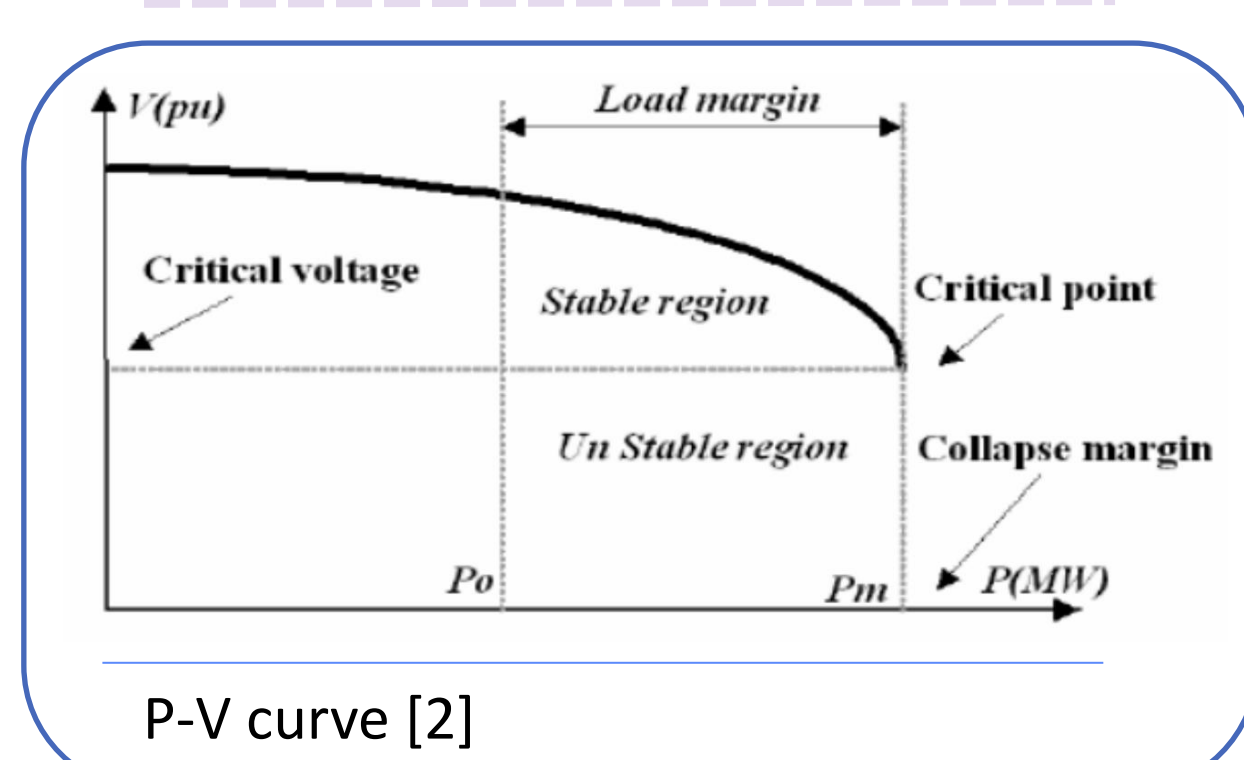
## SCOPE OF THE STUDY



To investigate the impact of HRESP consisting of **different generation technologies** on **transient stability** and **voltage stability** of large interconnected transmission network.

## METHODOLOGY

### PV CURVES (block {5})



### LOAD MARGINS (block {7})

$$P_{margin} = P_{max} - P_0$$

### TSI (block {8})

$$TSI = 100 \times \frac{360 - \delta_{max}}{360 + \delta_{max}}$$

Import an equivalent model in DigSILENT/PowerFactory and Set the parameters for the test cases {1}

Initialize the simulation with optimal power flow calculation (OPF) {2}

Perform voltage stability simulation {3}

Record the PV curves {5}

Load margins are calculated and analyzed {7}

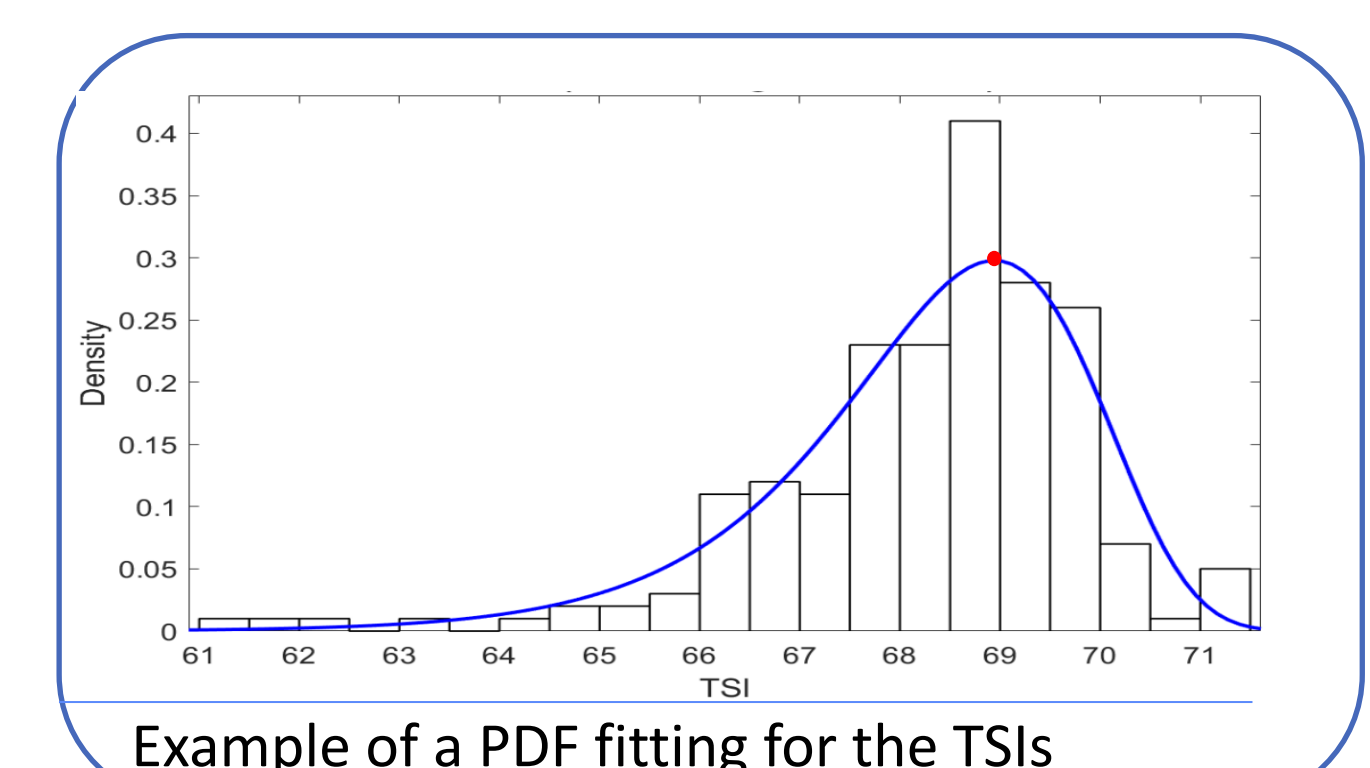
Perform transient stability simulation with DPL script {4}

Record the angular response {6}

TSIs are calculated and analyzed with probabilistic method {8}

Identify the optimal operating condition {9}

### PROBABILISTIC STABILITY METHOD (block {8})



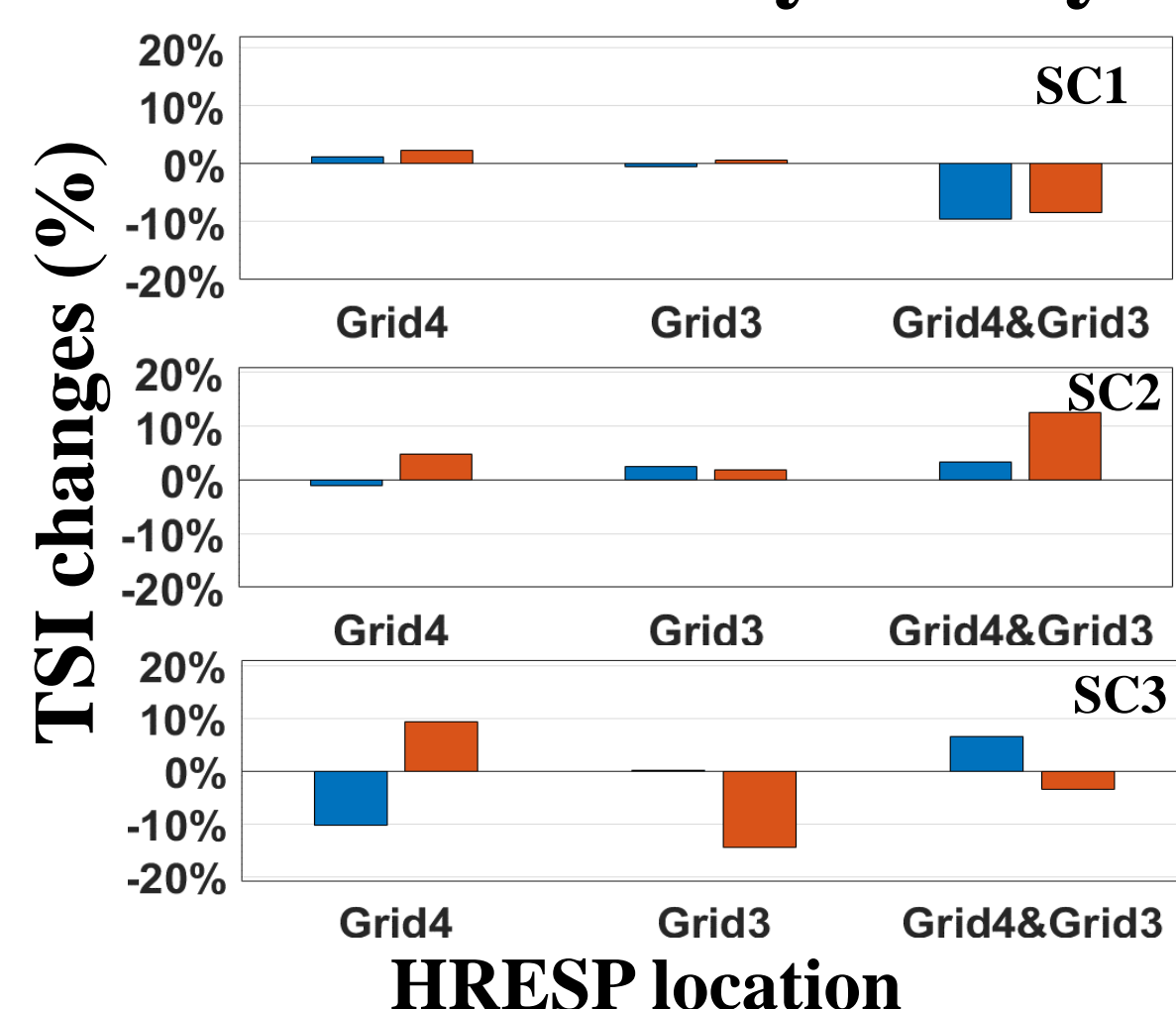
1 Plot the histograms of TSIs calculated

2 Generate a **probability density function (PDF)** to fit the histograms

3 Chose the TSI of the PDF peak point to represent the stability of the test cases

## PRELIMINARY RESULTS

### Transient Stability Studying



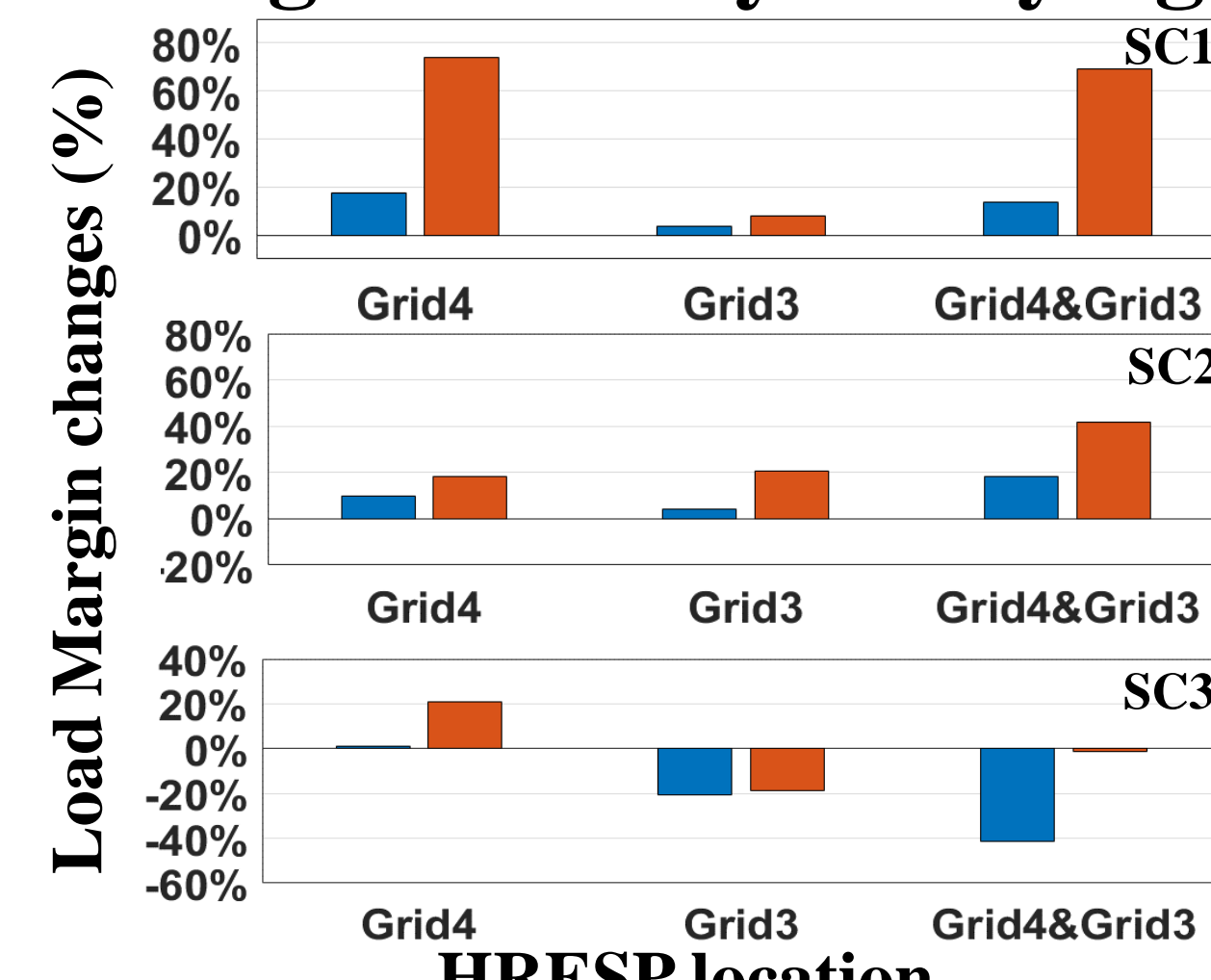
HRESP location

SC1: Max loading + Current RES

SC2: Min loading + Current RES

SC3: Min loading + Future RES

### Voltage Stability Studying



HRESP location

Impacts of RES

Impacts of the local SGs

### Conclusions

- The impact of RES and the local SGs on transient stability varies with different HRESP location and operating scenarios.
- The involvement of RES and the local SGs would improve voltage stability in SC1 and SC2, but the effect in SC3 depends HRESP location.

## REFERENCE

- [1] "Energy Trends: renewables" 2018
- [2] "Online voltage instability detection of distribution systems for smart-grid applications", 2012
- [3] "Identification of Critical Parameters Affecting Voltage and Angular Stability Considering Load-Renewable Generation Correlations," July 2019
- [4] "The Effect of the Type and Composition of Demand on the Influence of DSM on Power System Angular and Frequency Stability", Mengxuan Wang, 2019
- [5] "Contribution of Aggregated Renewable Generation To Flexible Control and Operation of Transmission Network", Yitian Dai, 2018