

A Supply Reliability Management Method for Provincial Region with Multiple Municipal Distribution Networks

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Introduction

In China, a provincial power grid company with multiple municipal distribution networks has to conduct power supply reliability management. Traditional approach does not satisfy the new management requirements of precision and effectiveness. This paper proposes a hierarchical management of supply reliability planning.

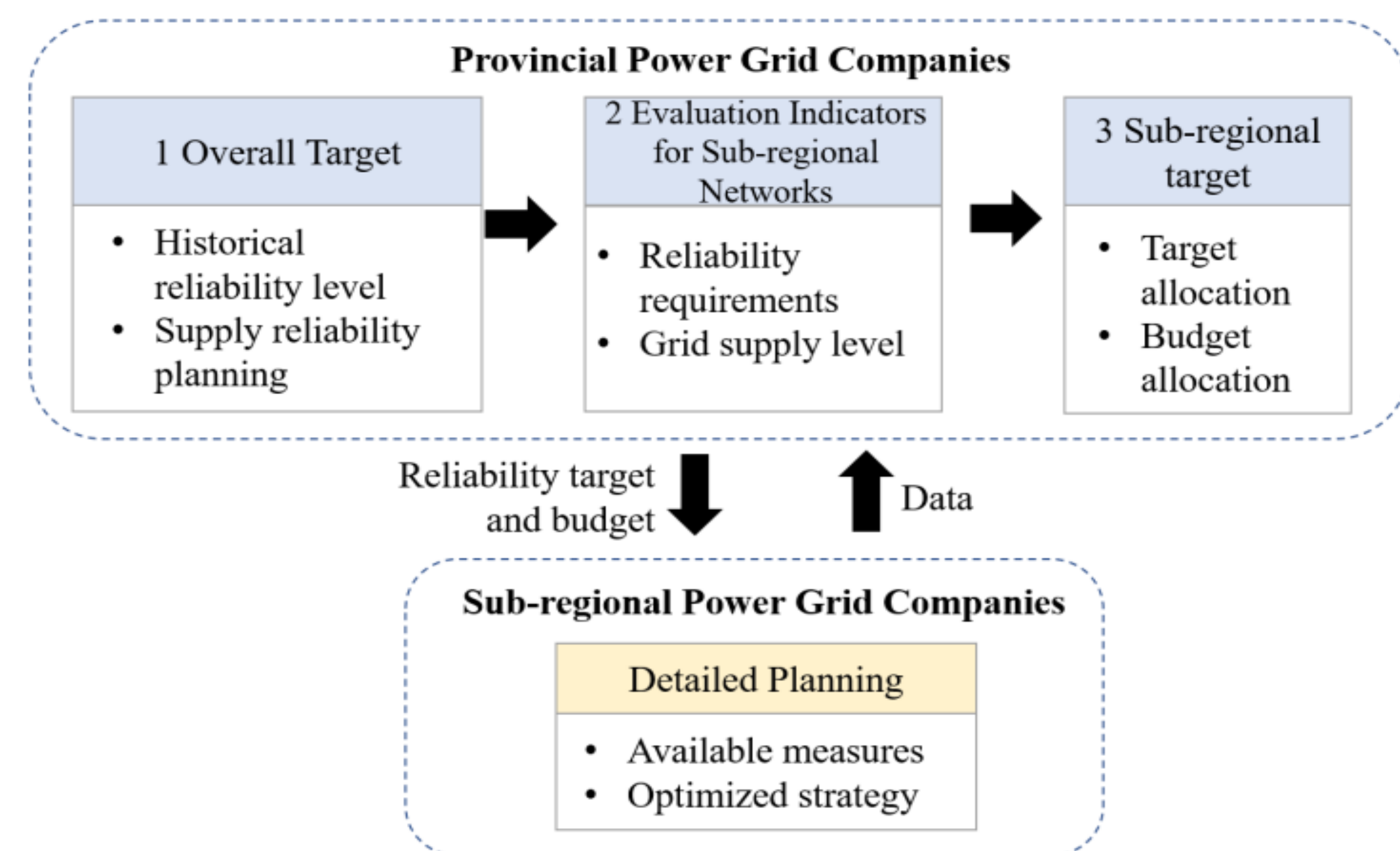


Fig. 1 Hierarchical framework for reliability management

Methods

➤ Regional reliability target

The overall supply reliability target is determined by historical reliability level and future supply reliability improvement requirements.

$$SAIDI_j = SAIDI_{j-1} - \alpha_j(SAIDI_{Y-PY} - SAIDI_Y)$$

➤ AHP model for reliability allocation priority

AHP model is applied to determine the priority of reliability improvement among sub-regions. The model is shown as follows:

Target layer	Criterion layer		
	First layer	Second layer	Third layer
Prioritization of reliability improvement	A Supply reliability demands	A1 GDP per capita
		A2 Load density	
		A3 Urbanization rate	
	B Power grid construction level	B1 Line construction level	
		B2 Equipment level	
	C Reliability management status	C1 Outage rate	
C2 Average duration of outages			

➤ Sub-regional planning targets

$$\Delta SAIDI_i \% = \frac{\Delta SAIDI_{oa} \times R_i \times \sum_{i=1}^N h_i}{\sum_{i=1}^N SAIDI_i \times R_i \times h_i}$$

$$Budgt_i = \frac{Budgt_{oa} \times \Delta SAIDI_i \times h_i}{\sum_{i=1}^N \Delta SAIDI_i \times h_i}$$

Case Study

We verify the proposed method with a reliability improvement allocation problem of Province A in China. Province A has 15 sub-regions.

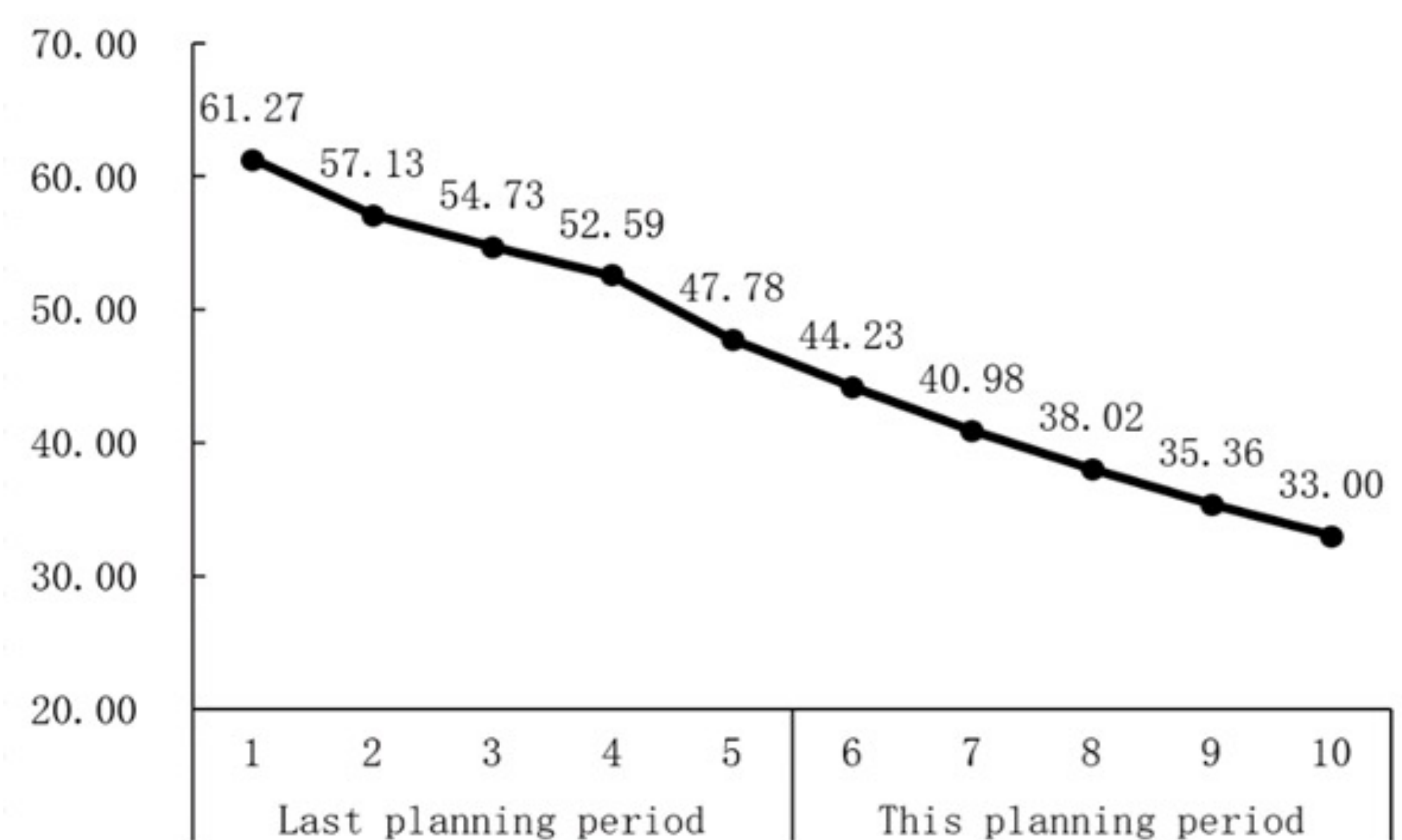


Fig.2 The overall reliability reduction of this planning period

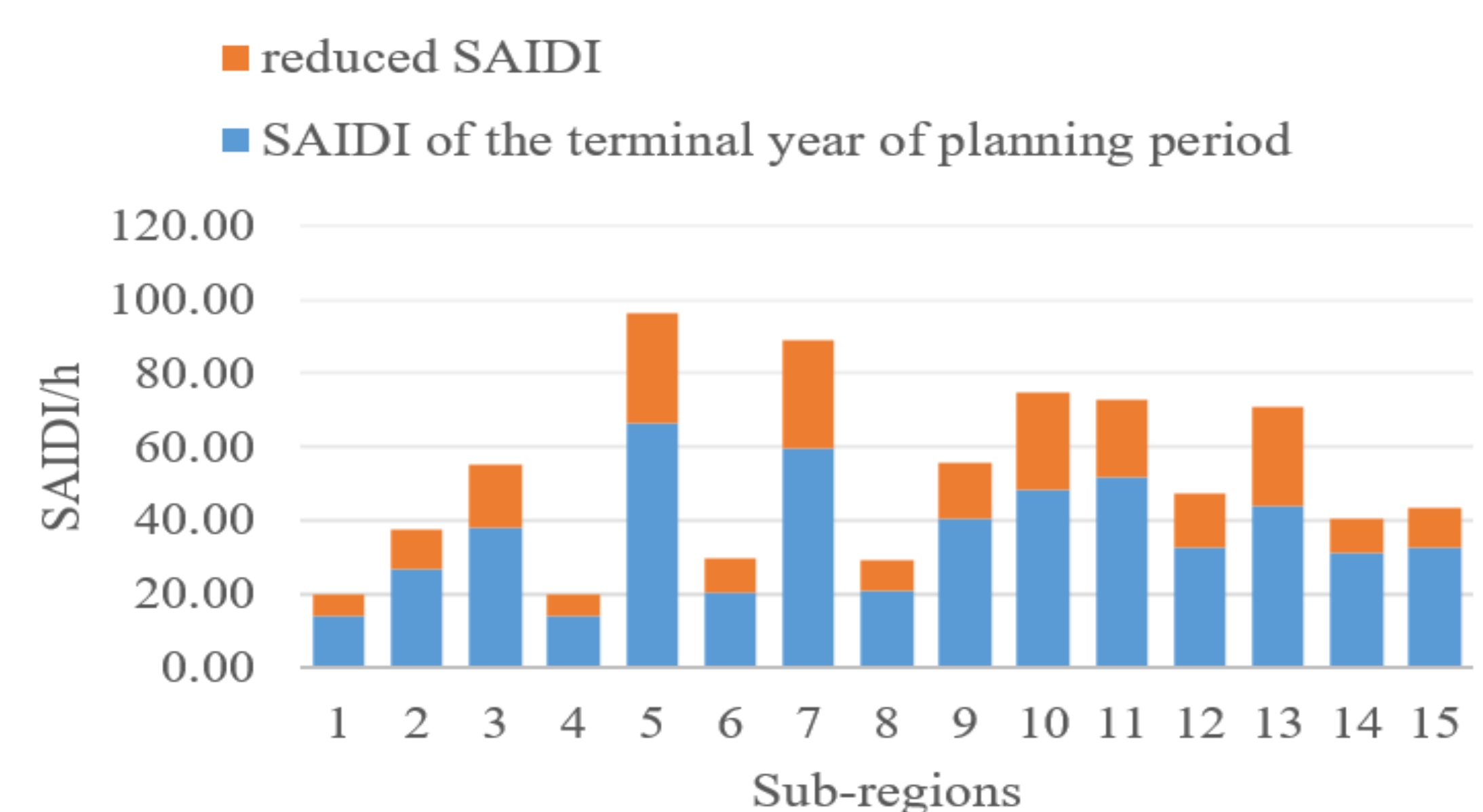


Fig.3 Reliability improvement of all sub-regions

Conclusions

This paper proposes a quantitative reliability management method for provincial power grids oriented to multiple sub-regional power grids. This method is universal to the reliability management of multiple distribution areas.