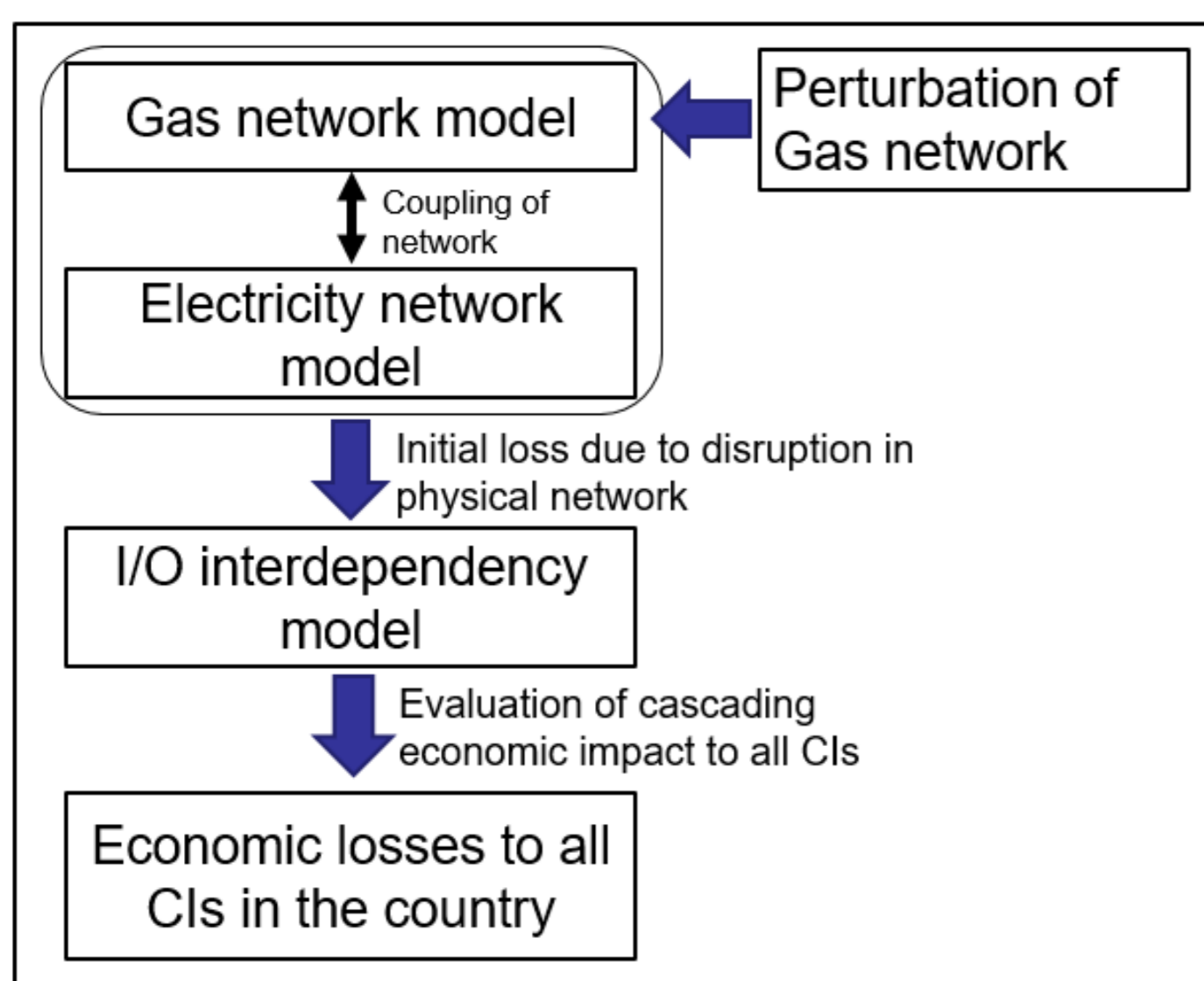


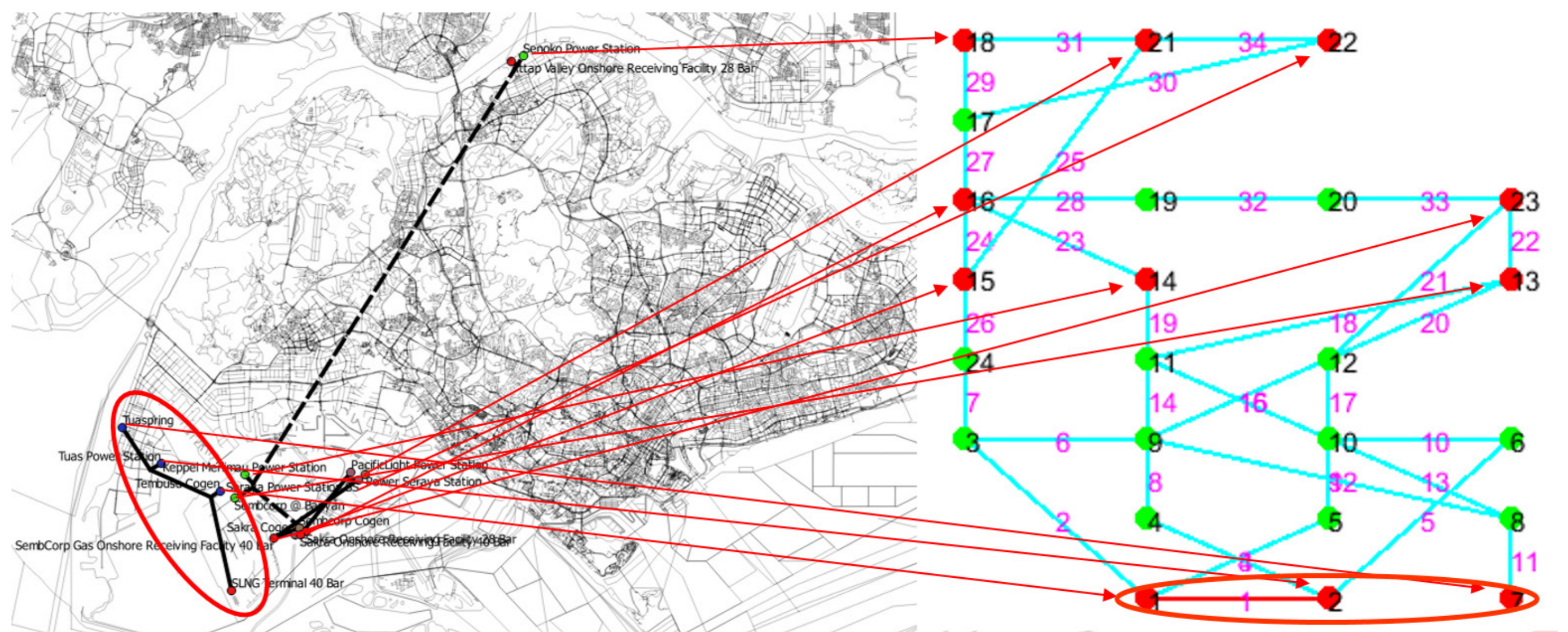
Modelling of Multi-Sectoral Critical Infrastructure Interdependencies for Vulnerability Analysis

- Critical infrastructures (CIs) are increasingly closely linked and interdependent on one another.
- With increasing investment and coupling complexity, limitations and vulnerabilities of coupled networks are becoming increasingly vital in their operational planning, with a prime example being that of coupled gas and electricity networks.
- The objectives of this work are (1) model the coupling of realistic multi-sectoral physical infrastructures, specifically gas and electricity physical infrastructure networks with open-source data, and (2) simulate the cascading failure of the two infrastructure networks with a further evaluation of cascading national economic impact using a recently developed CI interdependency input-output (I/O) model based on national-level I/O tables[1,2].

Dr Lin Jiwei, Research Fellow
Prof. Pan Tso-Chien, ED-ICRM
A/Prof. Edmond Y.M. Lo, DD-ICRM



Flow of cascading failure analysis



Simulating disruption on Singapore gas network with IEEE 24 bus network (as model of Singapore's electricity grid)

Methodology:

- An integrated formulation for the steady-state analysis of the gas (general flow model) and electricity (DC power flow model) infrastructure systems, coupled as based on a power rating ranking of the power stations is developed towards the quantifying the effect of disruptions (e.g. gas source failure in the gas network) to both networks.
- The CI I/O interdependency model evaluates the overall economic losses to all CIs based on the initial loss due to disruption in the coupled infrastructure systems.

Results and Summary:

- This developed framework allows the evaluation of the cascading impact of the known multiple critical infrastructure sectors in a country.
- The I/O interdependency model provides insight on the economic impact on a country when a disruption on CI(s) happens, taking into account the interdependency of CIs as based on data from national I/O tables.
- Right figure show typical results from the I/O interdependency model, providing stakeholders with the amount of cascading losses (SGD) and ranking of the economic sectors due to a prescribed disruption in the gas network.

