

Overview

Background

- A paradigm shift from centralized to distributed control in power system
- Distributed energy management algorithms to determine the optimal operational point for microgrids
- Vulnerable to malicious cyber attacks, which might lead to economic losses or even system breakdowns.

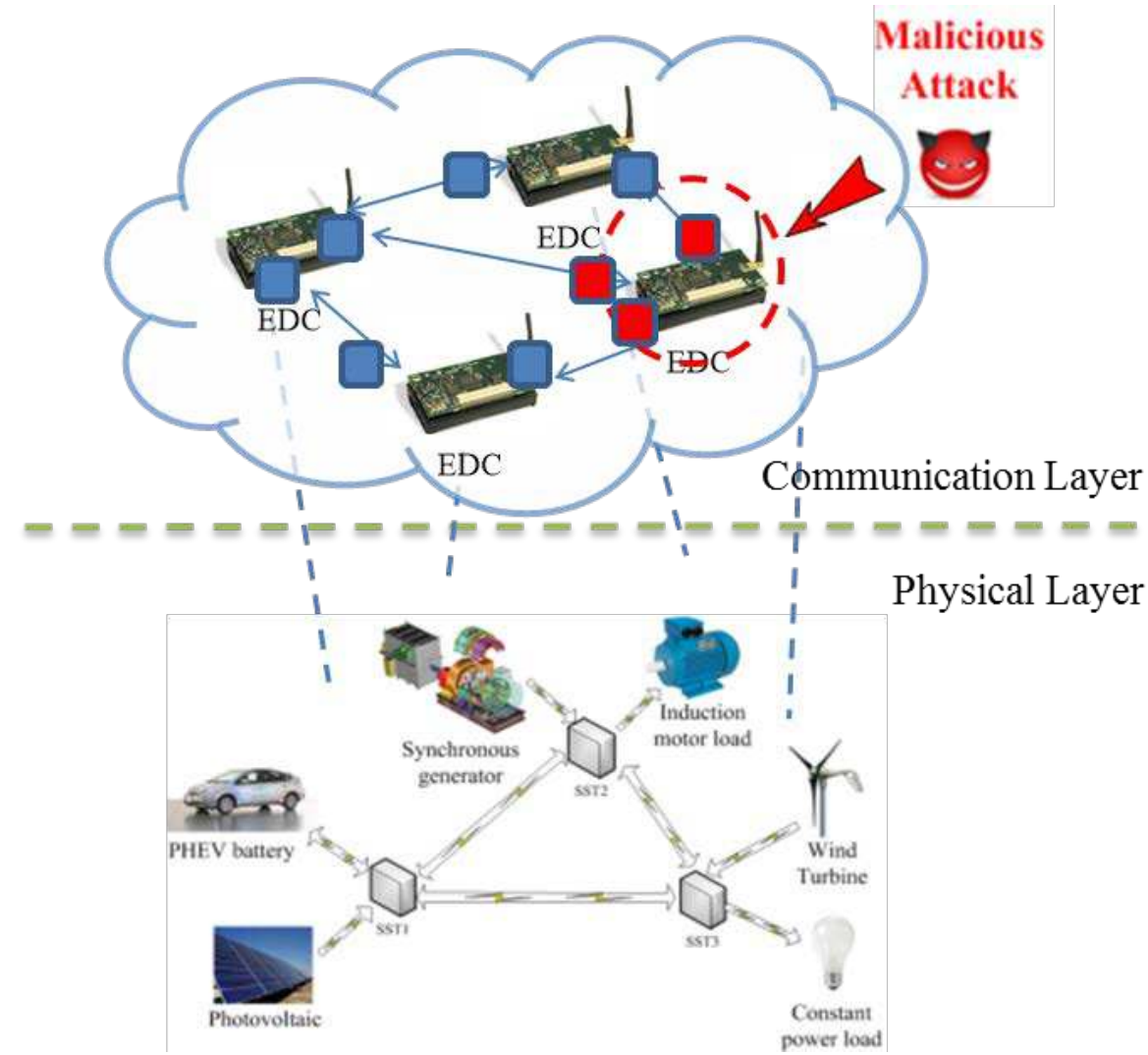


Fig.1 Malicious attacks on distributed control framework

Problem statement

- Design a resilient distributed control strategy to secure the distributed energy management algorithm:
 - Detect and respond to potential cyber attacks
 - Maintain the optimal operational point in the adversary environment
- Implement the resilient control strategy in DGI 2.0

Method

Technical Approach

- A novel data integrity attack on FREEDM system
 - A malicious DESD misleads the system with false information
 - The malicious DESD maximizes its economic benefit while satisfying all the system constraints

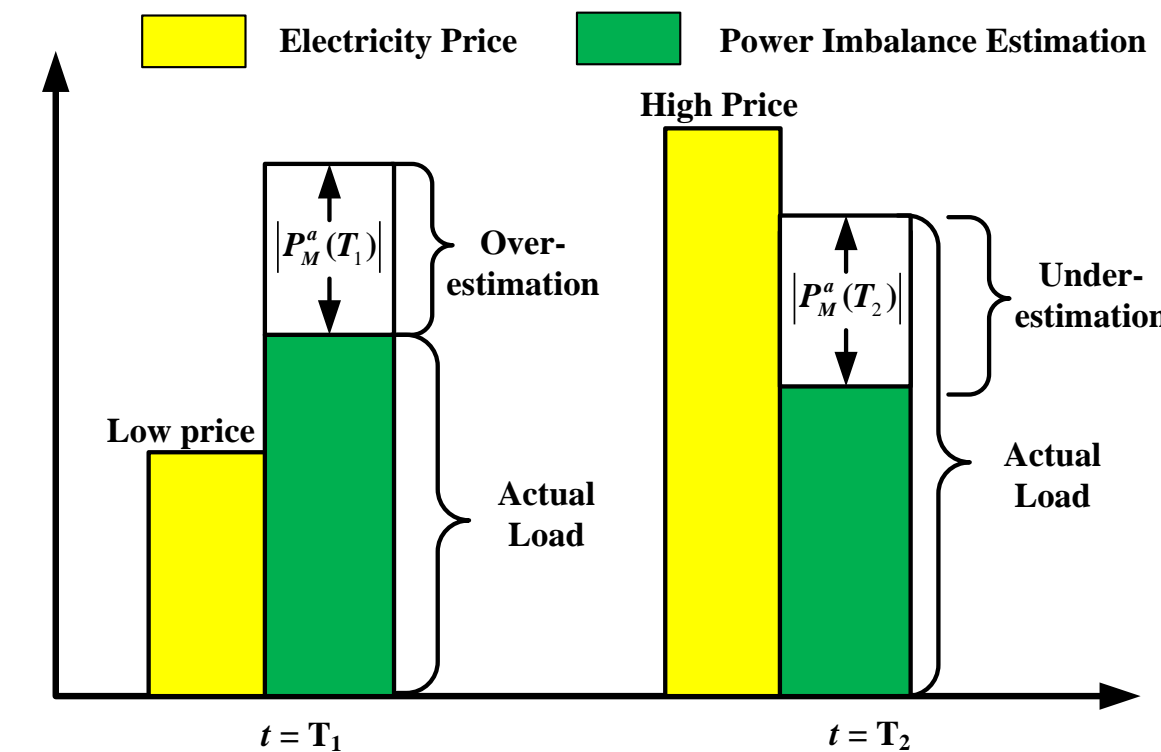


Fig.2 Attacking Strategy for the malicious DESD

- Reputation-based neighborhood watch algorithm
 - Two-hop communication neighbors collaboratively detect false information
 - A Reputation index quantifies the neighbors' behavior history

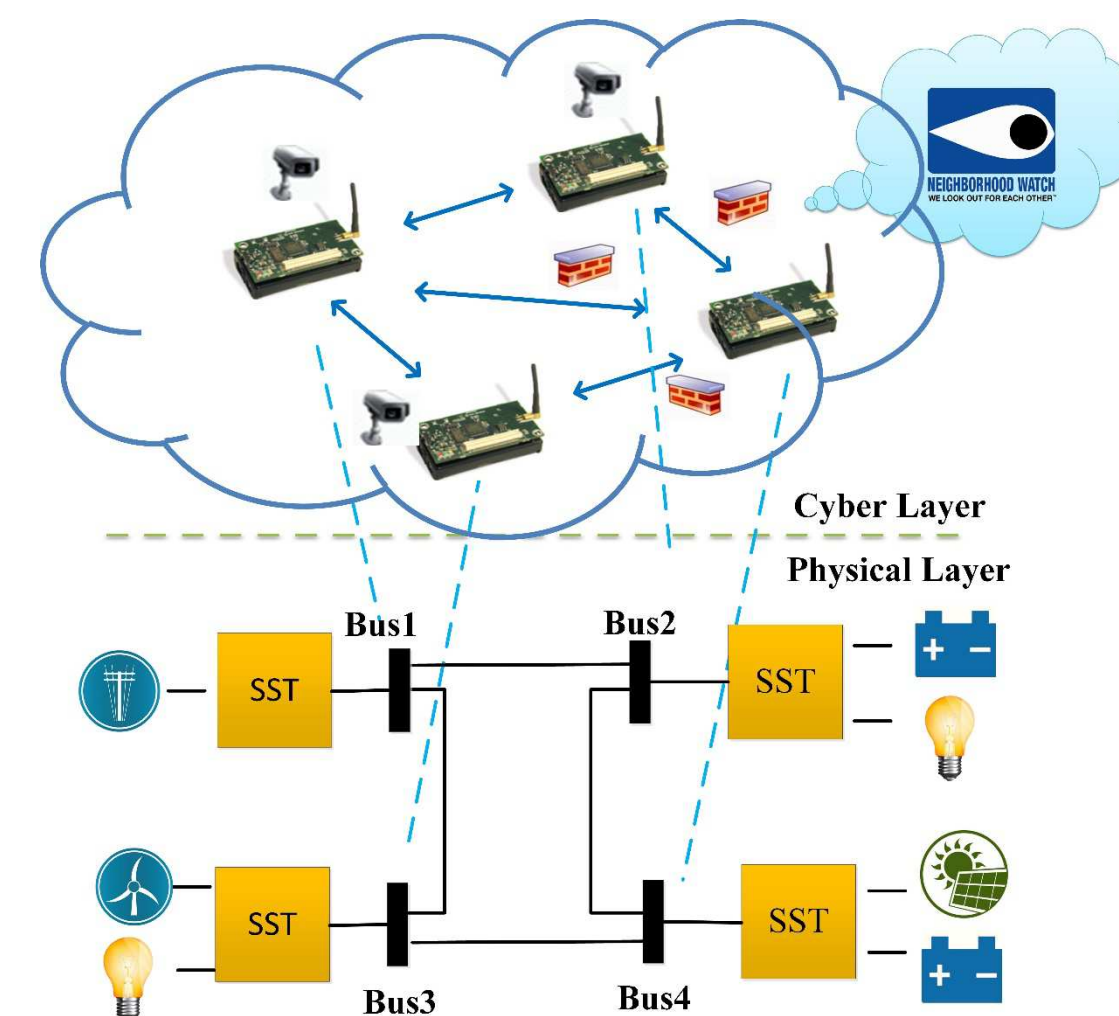


Fig.3 Reputation-based neighborhood-watch algorithm

Results

Case Study

- 3-node GEH system, DESD 1 is malicious with the objective to maximize its own profit

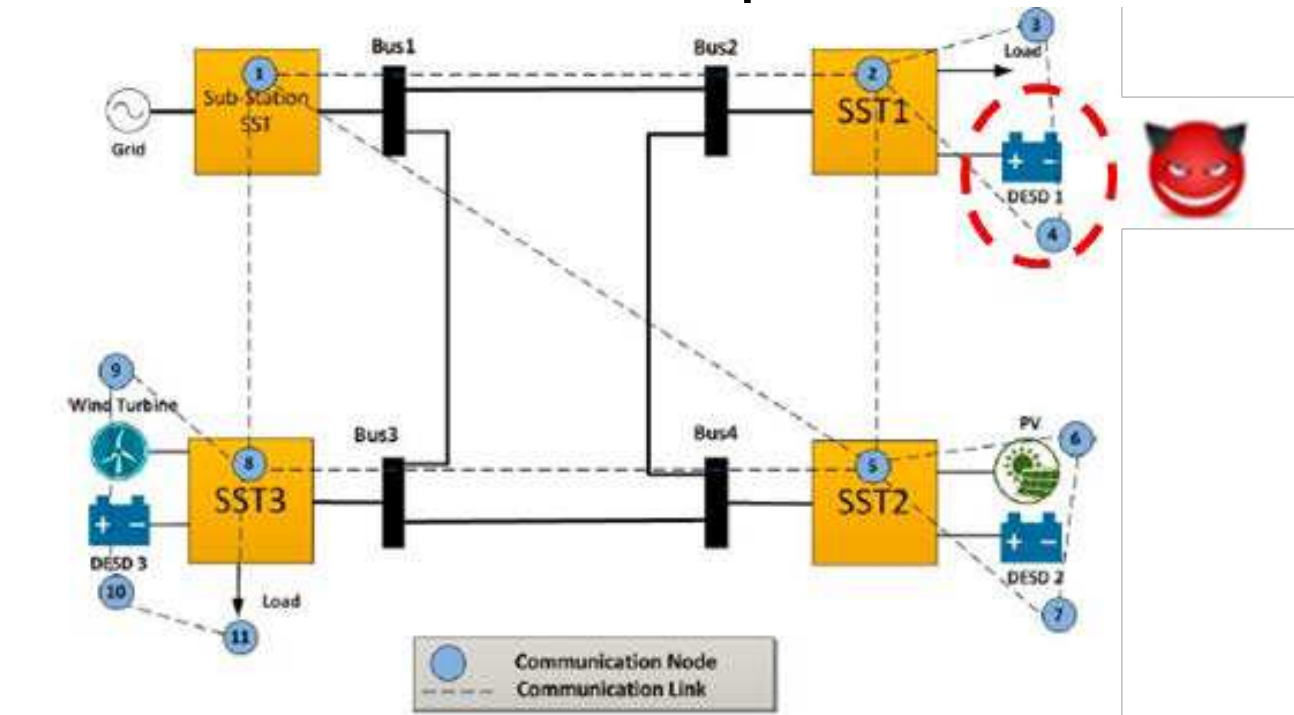


Fig.4 Data Integrity Attack on FREEDM system

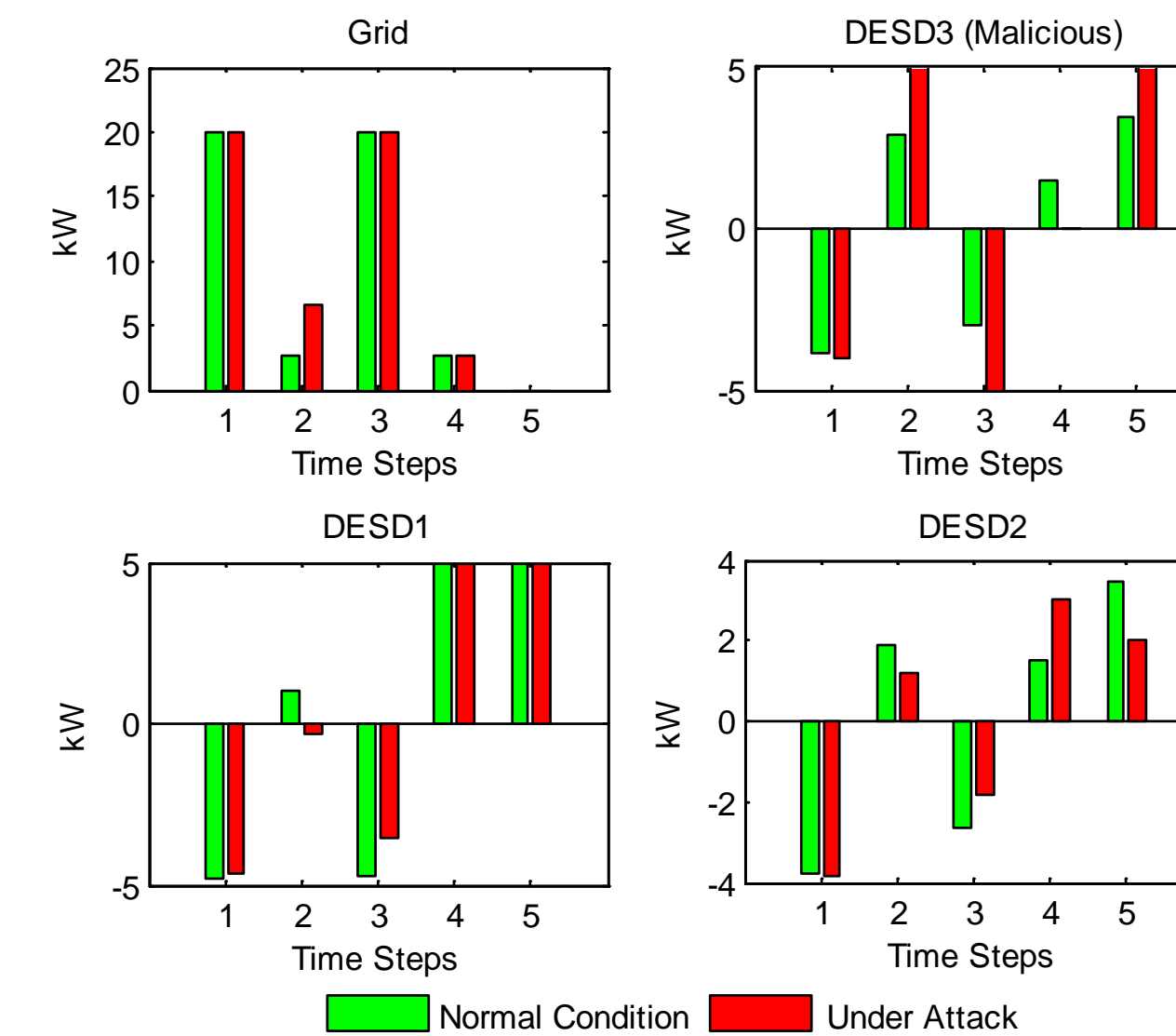


Fig.5 The power schedule with/without attack

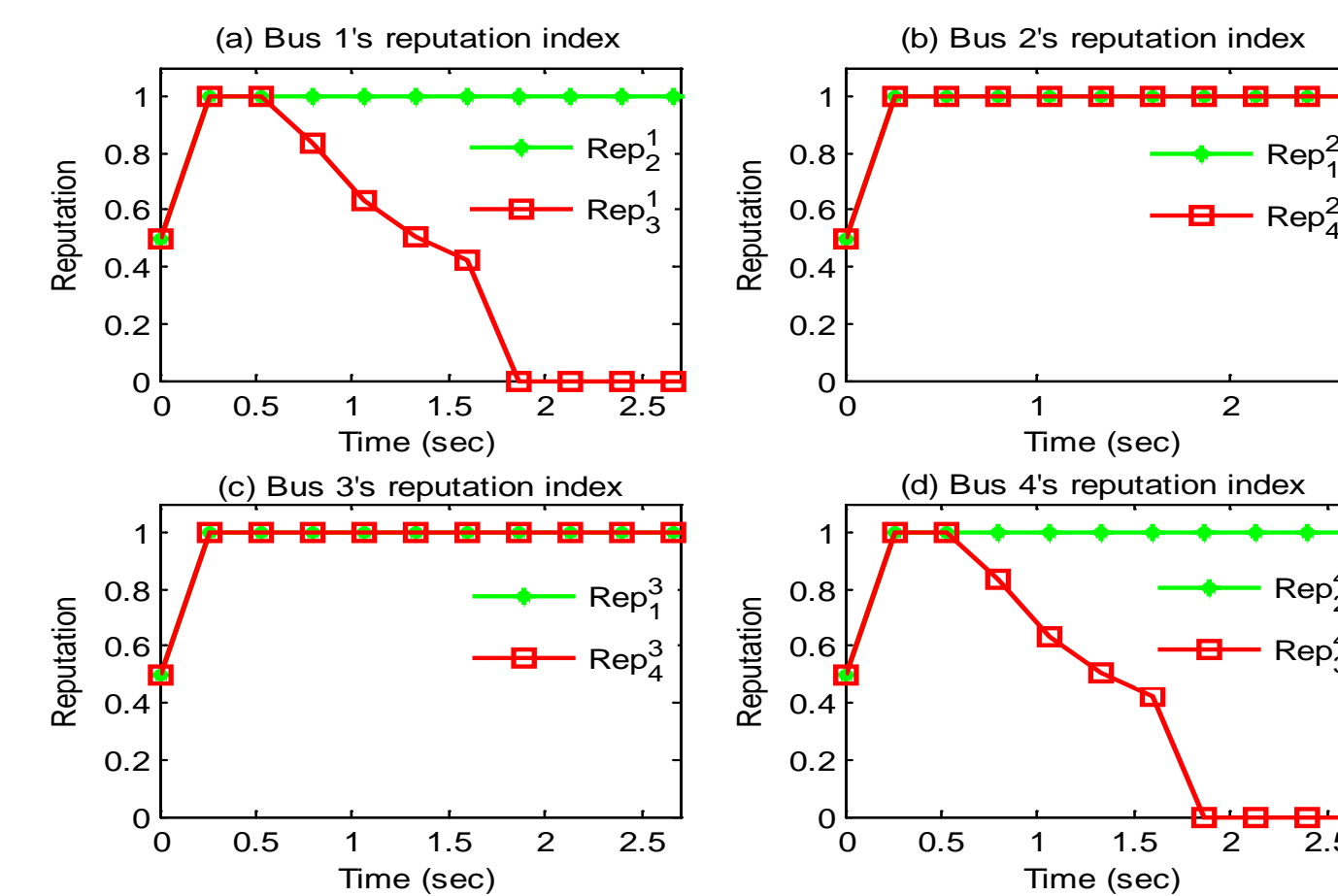


Fig.6 The change of reputation index under attack

TABLE I The economic impact of attack on FREEDM System

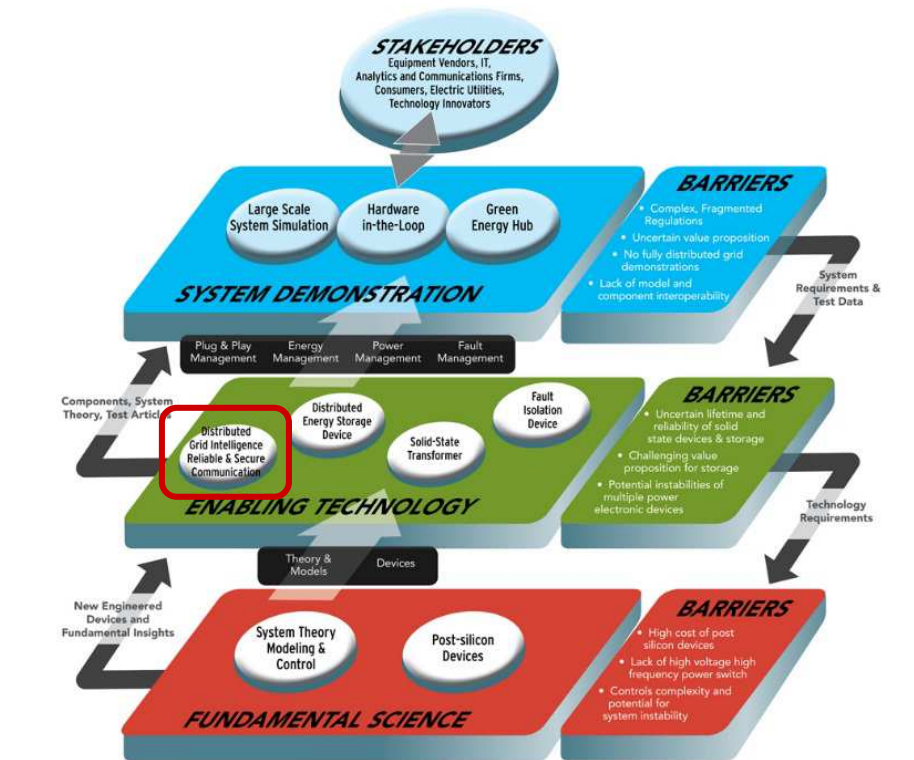
Benefit (cents)	Total Bill	DESD 3	DESD 1	DESD 2
Normal	187.02	26.08	38.56	22.35
Attacked	208.55	34.06	35.98	17.03
Difference	21.53	7.98	-2.58	-5.32
Impact (%)	+11%	+30%	-6%	-23.6%

On the Horizon

- Implement the Reputation-based resilient distributed control algorithm in DGI 2.0

References

1. J. Duan; W. Zeng; M. -Y. Chow, "Resilient Cooperative Distributed Energy Scheduling against Data Integrity Attacks," in 42nd Annual Conference of the IEEE Industrial Electronics Society, Florence, Italy, 2016.
2. J. Duan; M. -Y. Chow, "Data Integrity Attacks on Consensus-based Energy Scheduling Algorithm," in IEEE Power & Energy Society General Meeting, Chicago, MI, 2017. (Submitted)



Partners

