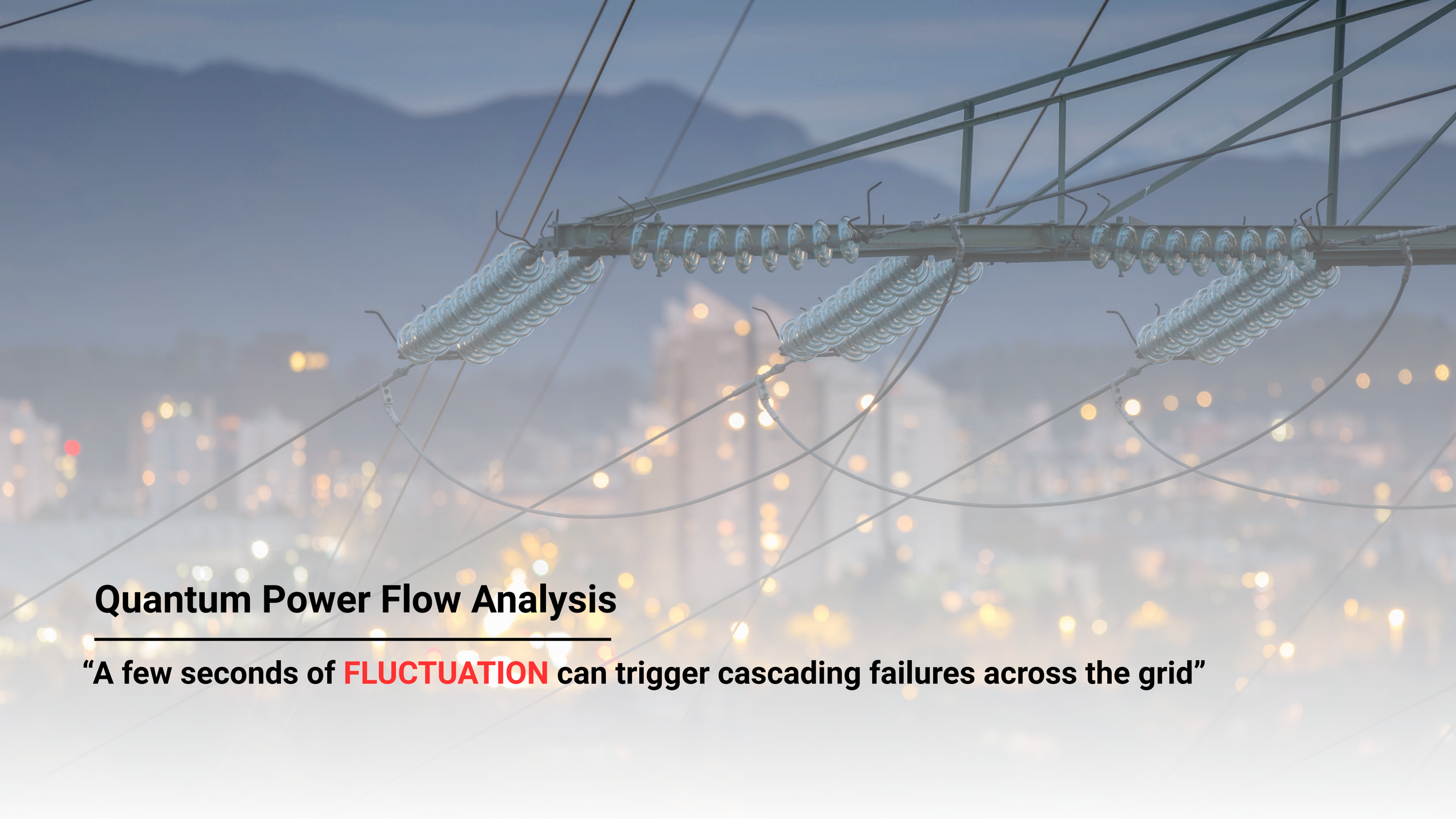
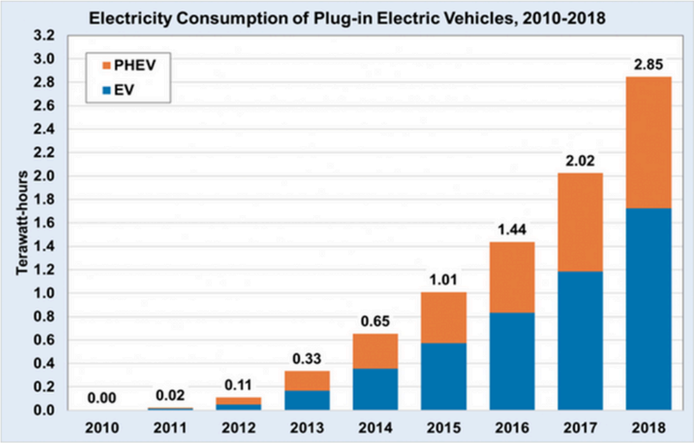


Quantum Power Flow Analysis

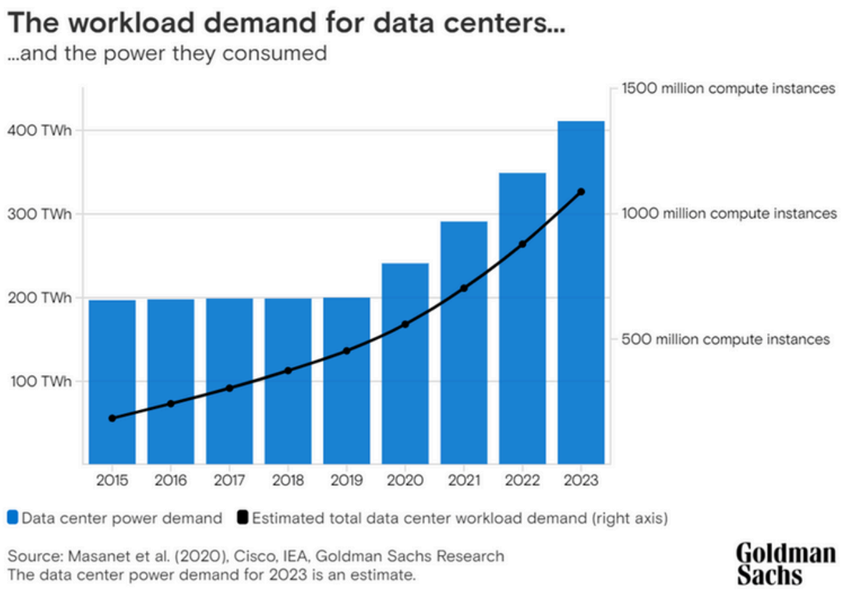
“A few seconds of FLUCTUATION can trigger cascading failures across the grid”

The state of energy consumption

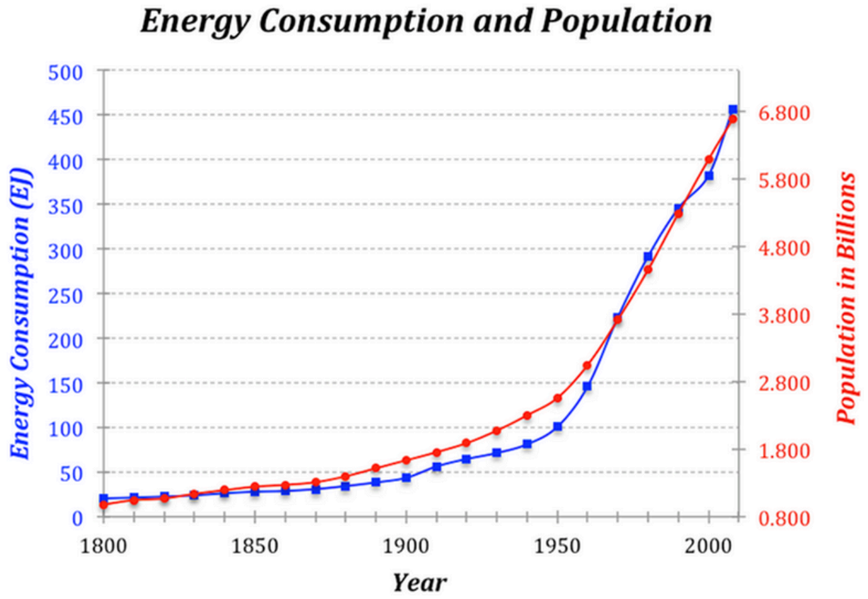
Electric vehicles



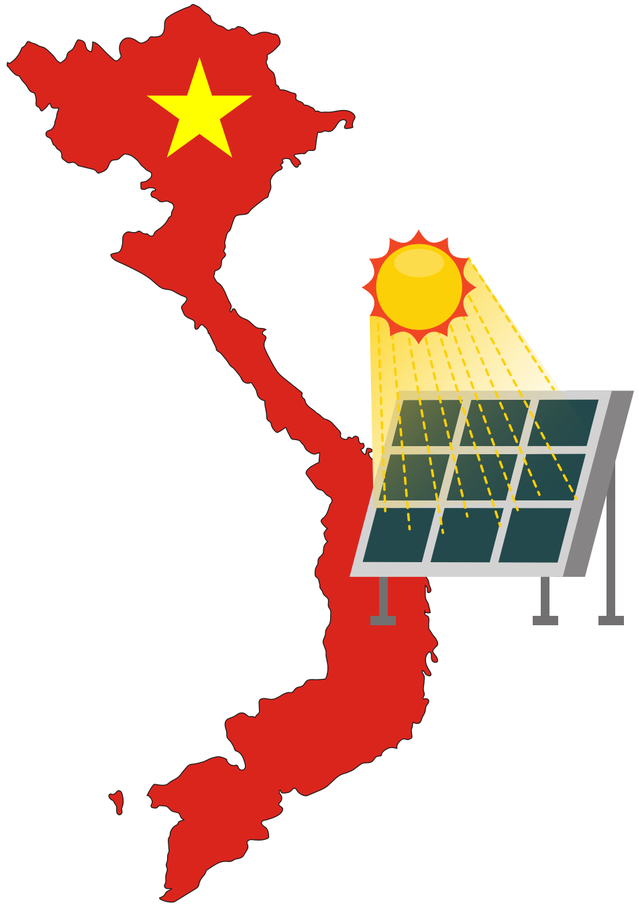
DATA CENTER



Population



ASEAN Case Example



Vietnam

- Solar Farms (16-19 GW)
- 13.7% of Generation Mix
- Grid Stability $33 billion

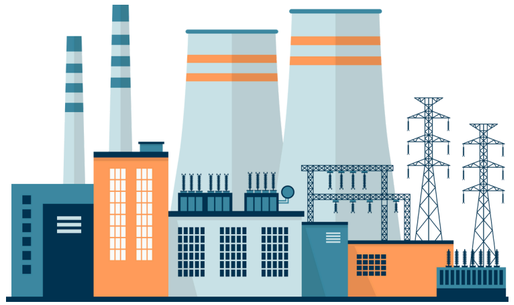
Reducing peak-time fluctuations can cut transmission losses by up to

20%

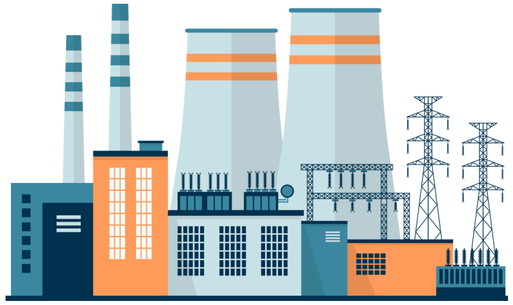
boosting grid efficiency and reliability.*

*Reduce Losses in the Transmission and Distribution System.

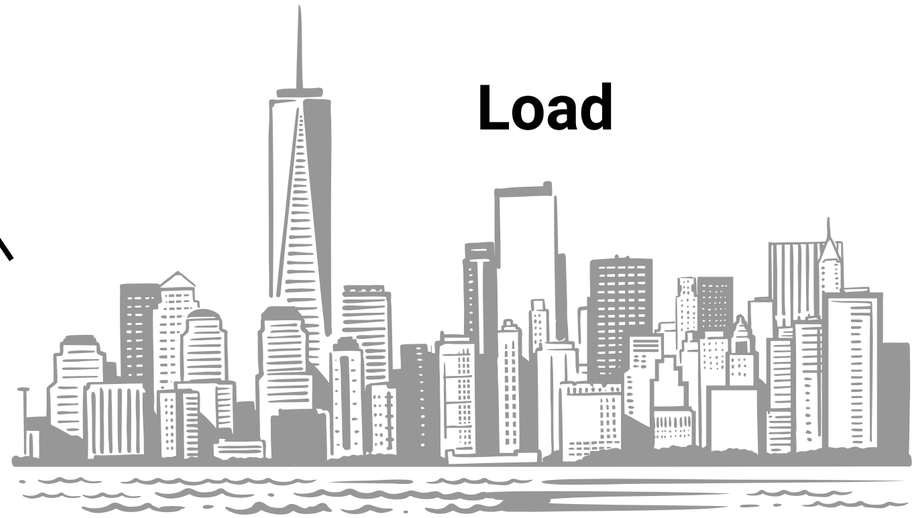
Energy system



Generator with Renewable resources



Generator (Swing)



Load

To meet ASEAN's 23% renewable energy goal by 2030, we need to make the energy grid more efficient through quantum-based power flow solutions

Existing Power Flow solutions vs Quantum-based

Limitations of Classical computer-based solutions

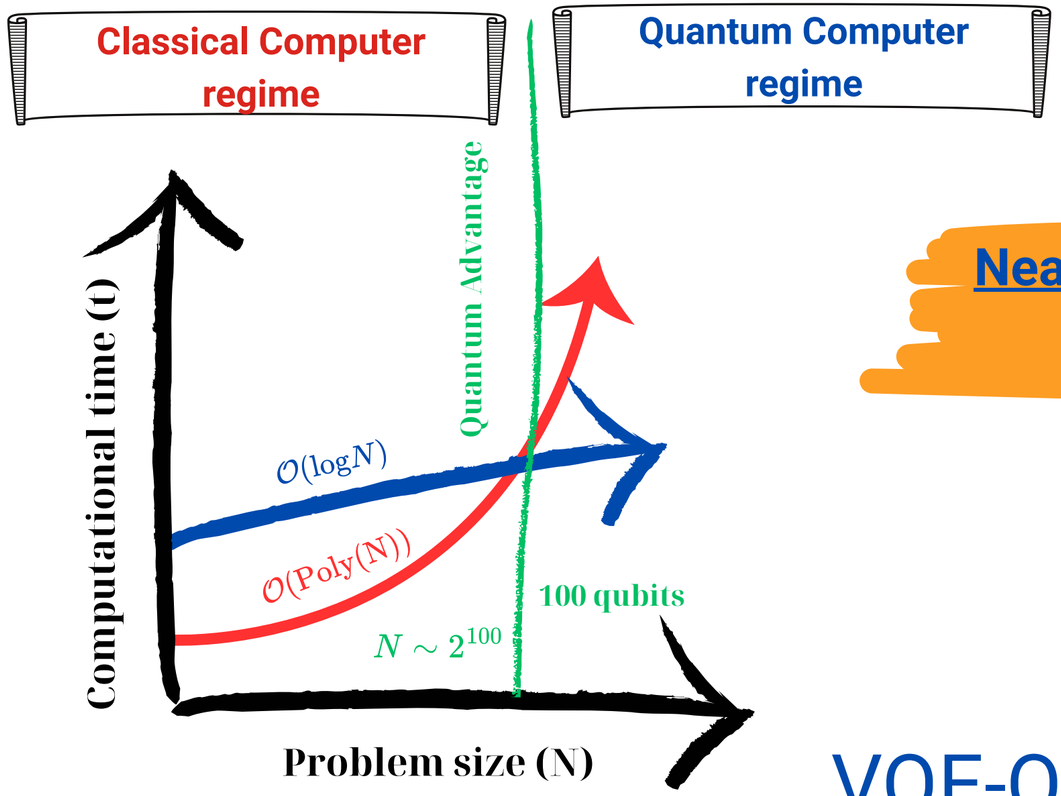
- Slow response to dynamic grid conditions
- Poor accuracy under RE variability (solar/wind)
- Limited scalability in large smart grids

Advantages of Quantum-based power flow analysis

- Real-time simulations for fast contingency planning
- Probabilistic modeling handles uncertainty effectively
- Scales efficiently with more nodes and grid complexity

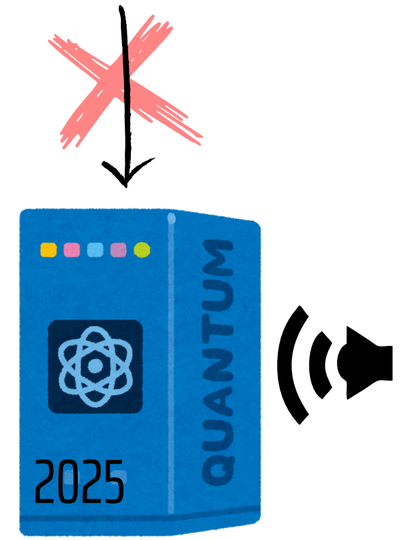
Quantum Power Flow Algorithm

Quantum Power Flow (QPF)



Near-term applications on current devices!!

HHL algo.

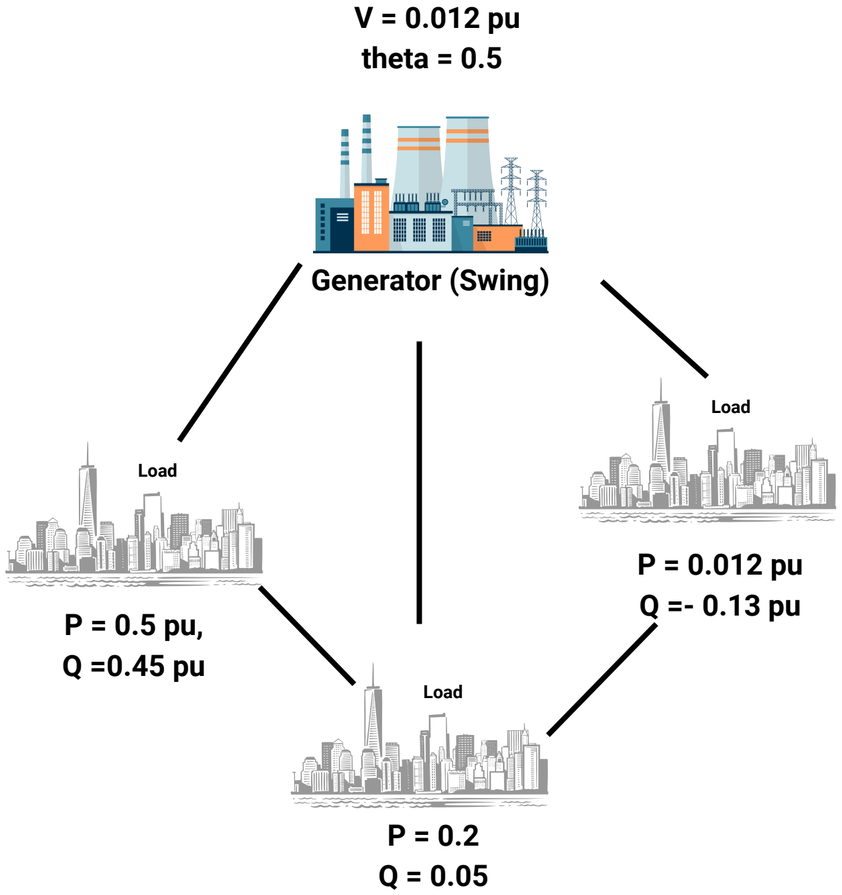


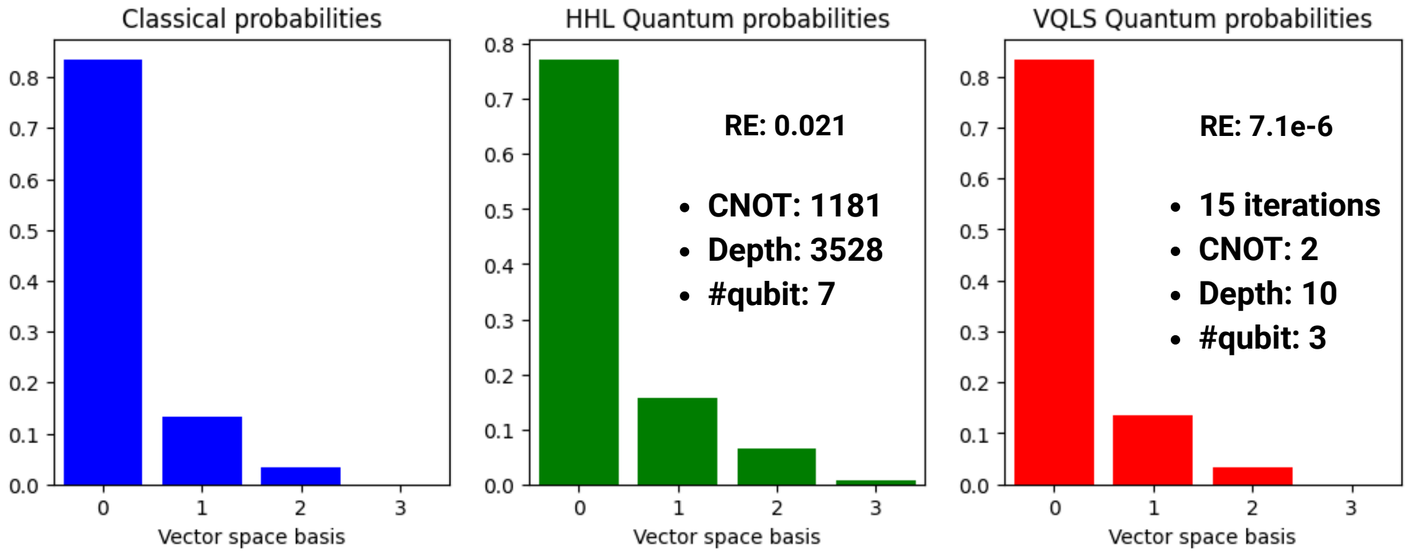
VQLS algo.

Reduce quantum resources by half

VQE-QLS algo.

Quantum Power Flow Algorithm





- Comparable accuracy with the classical method
- Better than HHL (3000 times)
- Considerably reduce the quantum resources against HHL (~99%)

Market Size

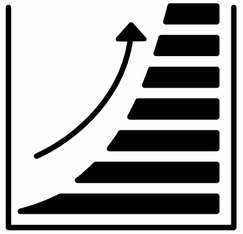
ASEAN Energy transition market
$597.8 billion (2022)

⇣

$1,383 billion (2032)
at **8.80%** compounded annual
growth rate (CAGR)

ASEAN Energy Transition Market

Our Roadmap



1

2

3

Phase 1: Foundation & Local Partnership (Years 1-2)

- Focus on a single, high-renewable-energy town in Vietnam.
- Partner with a leading Vietnamese university and the local power utility to build trust.
- Deliver a successful proof-of-concept on a real-world grid problem.
- Demonstrate a clear technological advantage.

Phase 2: Pilot Deployment & Value Demonstration (Years 3-4)

- Deploy user-friendly software in within the local utility's control center.
- Allow operators to see benefits firsthand without risk.
- Create a powerful business case that quantifies the value delivered in improved stability and financial savings.

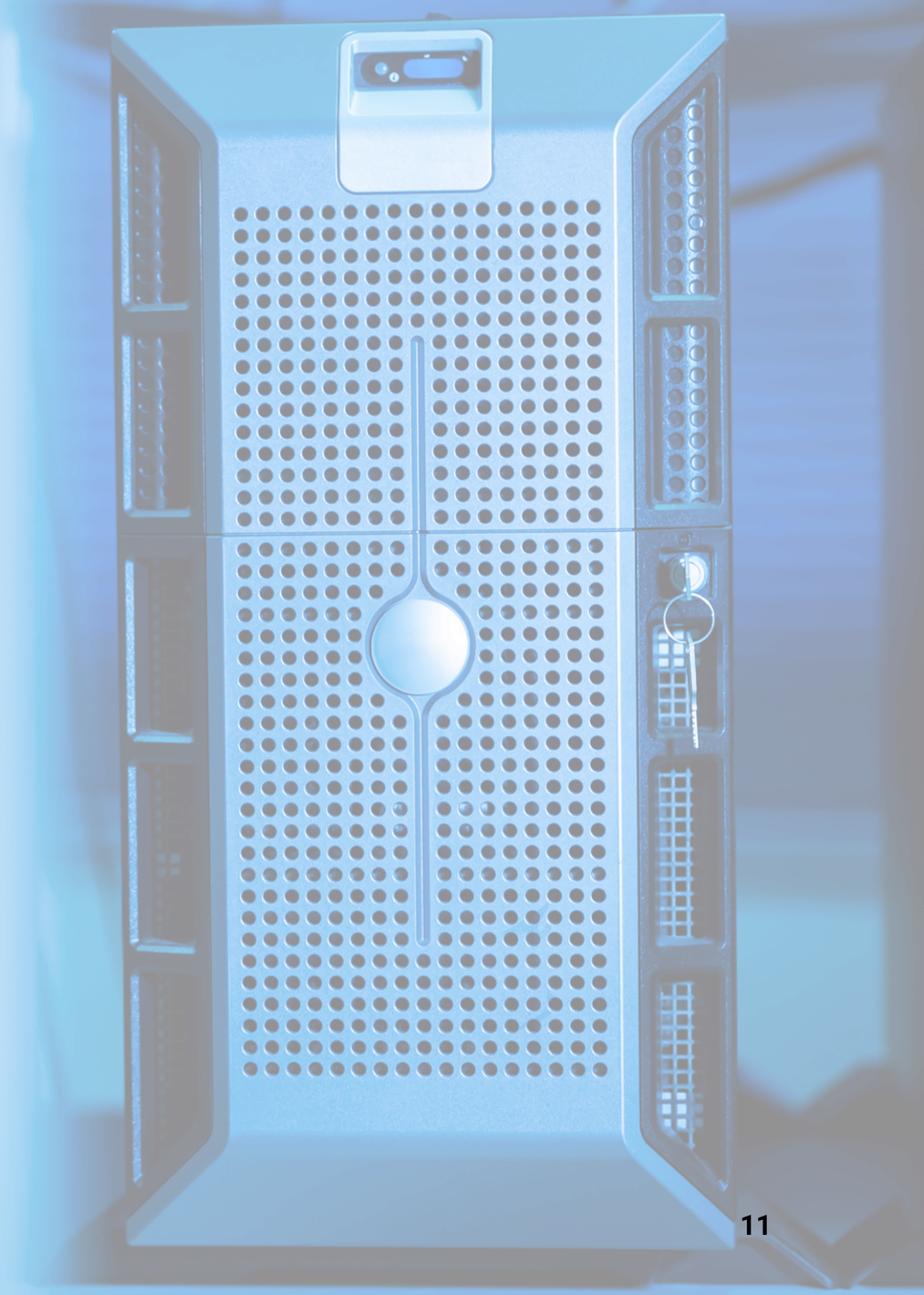
Phase 3: Commercial Rollout & National Scaling (Years 5+)

- Convert the successful pilot into the first commercial contract.
- Use this initial success as a powerful case study.
- Create a blueprint to systematically expand to power corporations across all of Vietnam.

Quantum Revolution

It's not necessarily the strongest or most intelligent that survives, but the most adaptable to change.

Charles Darwin

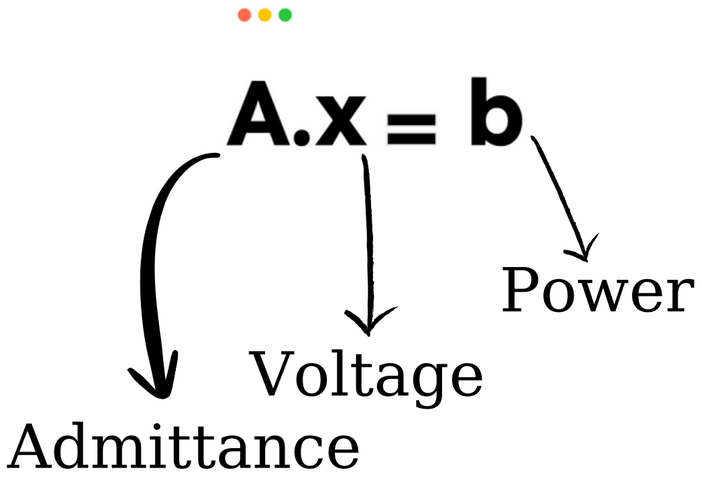


Backup Slide

QUANTUM POWER FLOW ALGORITHM

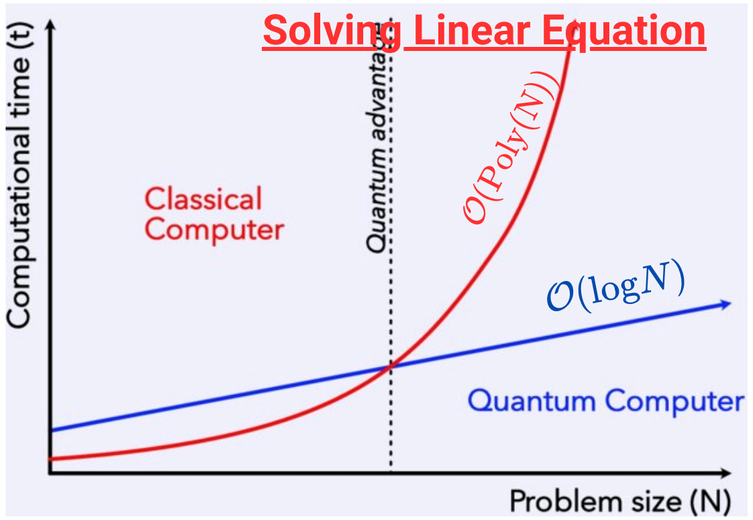
Fast Decoupled Load Flow (FDLF)

Solving Linear Equation



Quantum Power Flow (QPF)

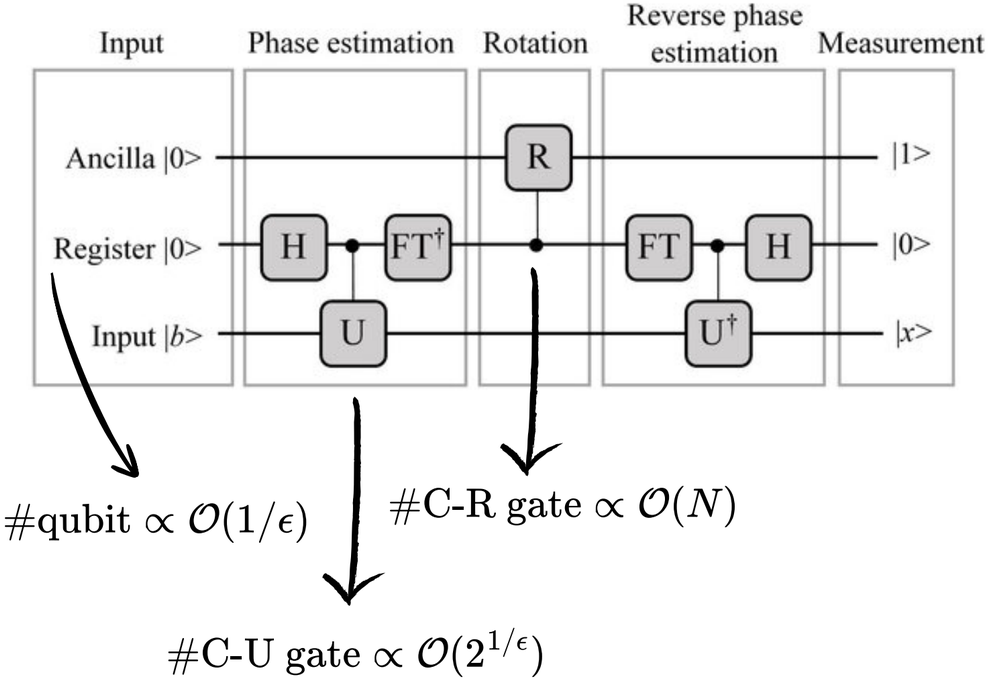
Solving Linear Equation



Cre: 10.48550/arXiv.2504.03866

	3 bus	5 bus	9 bus	17 bus
$B^{'}$ matrix size	2x2	4x4	8x8	16x16
Circuit Width	5	7	9	11
Circuit Depth	336	3528	76876	802737
CNOT Gates	108	1181	28956	298594

Cre: 10.48550/arXiv.2010.02442



QUANTUM POWER FLOW ALGORITHM

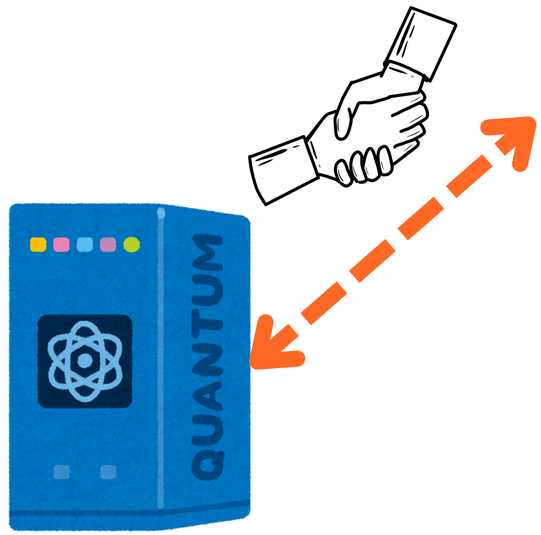
Fast Decoupled Load Flow (FDLF)

Solving Linear Equation

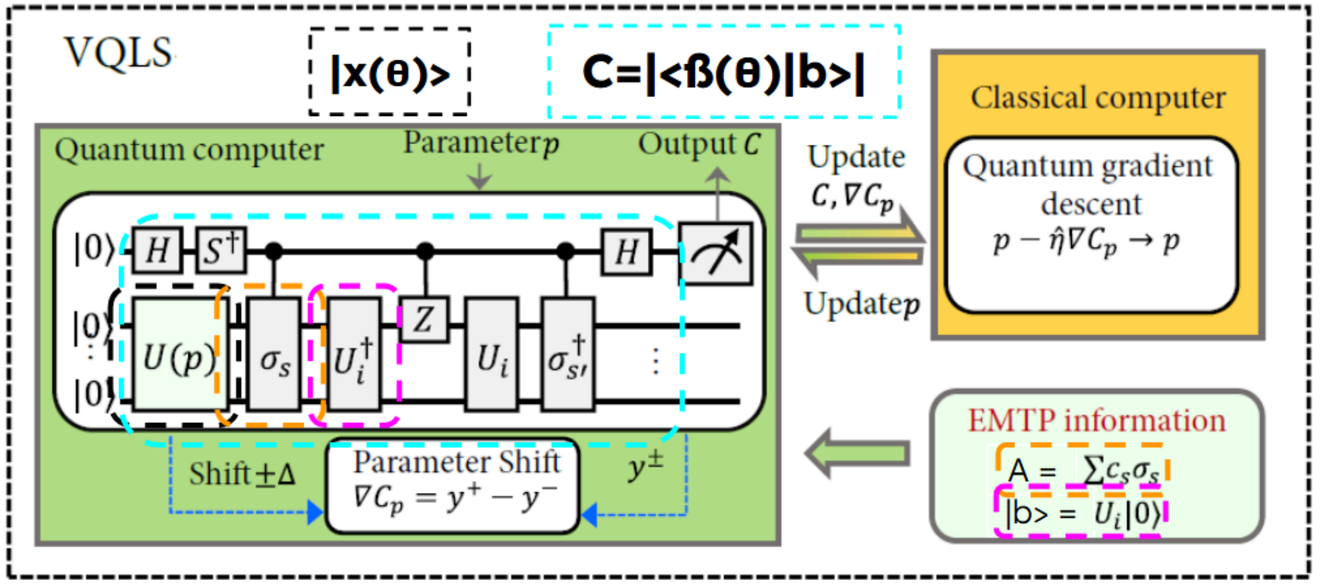
$$A.|x(\theta)\rangle = |\beta(\theta)\rangle$$

Stochastic fluctuation

Renewable Energy



Variational Quantum Linear Solver (VQLS)



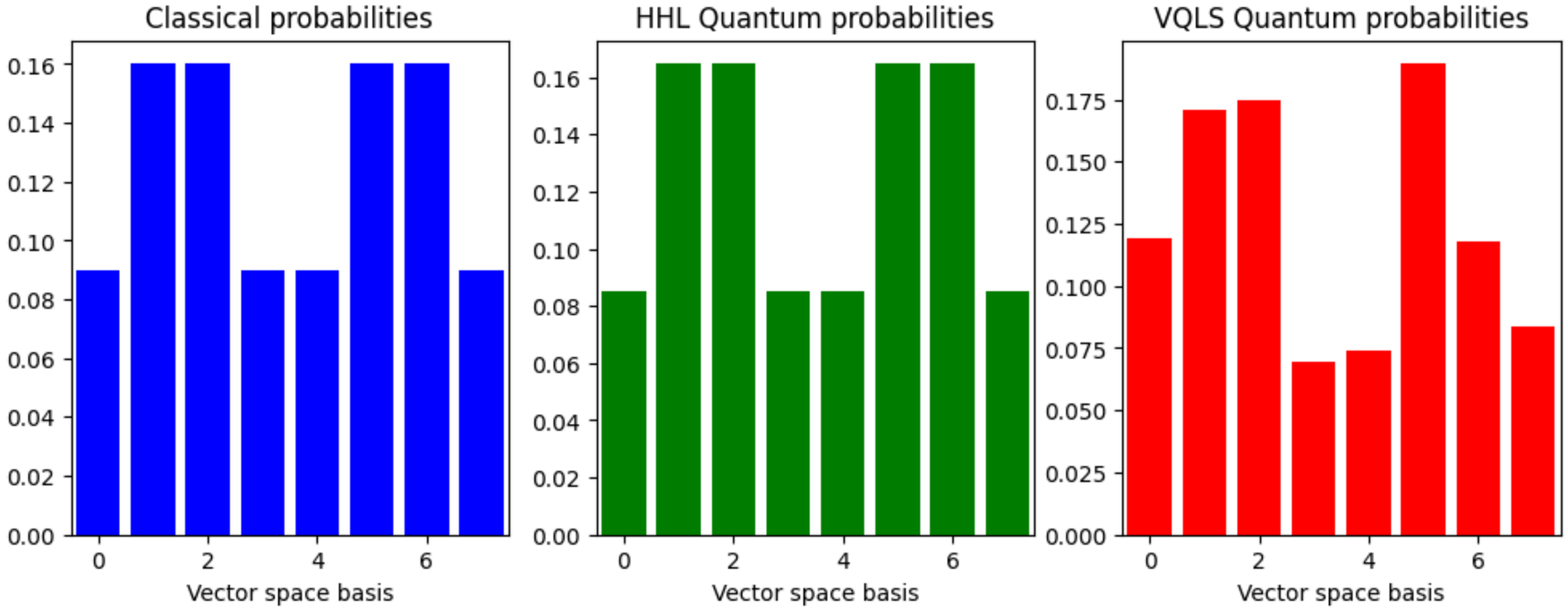
Cre: 10.23919/IEN.2022.0021

$$B'' = \begin{bmatrix} 4 & -1 & 0 & 0 & -1 & 0 & 0 & 0 \\ -1 & 4 & -1 & 0 & 0 & -1 & 0 & 0 \\ 0 & -1 & 4 & -1 & 0 & 0 & -1 & 0 \\ 0 & 0 & -1 & 4 & 0 & 0 & 0 & -1 \\ -1 & 0 & 0 & 0 & 4 & -1 & 0 & 0 \\ 0 & -1 & 0 & 0 & -1 & 4 & -1 & 0 \\ 0 & 0 & -1 & 0 & 0 & -1 & 4 & -1 \\ 0 & 0 & 0 & -1 & 0 & 0 & -1 & 4 \end{bmatrix}$$

Nine-buses system

RE: 0.00077

RE: 0.0186



- **42 iterations**
- **CNOT: 4**
- **Depth: 24**
- **#qubit: 4**

- **CNOT: 54004**
- **Depth: 151795**
- **#qubit: 8**