Study the ability of distributed power electronics in the PV system to increase the energy output

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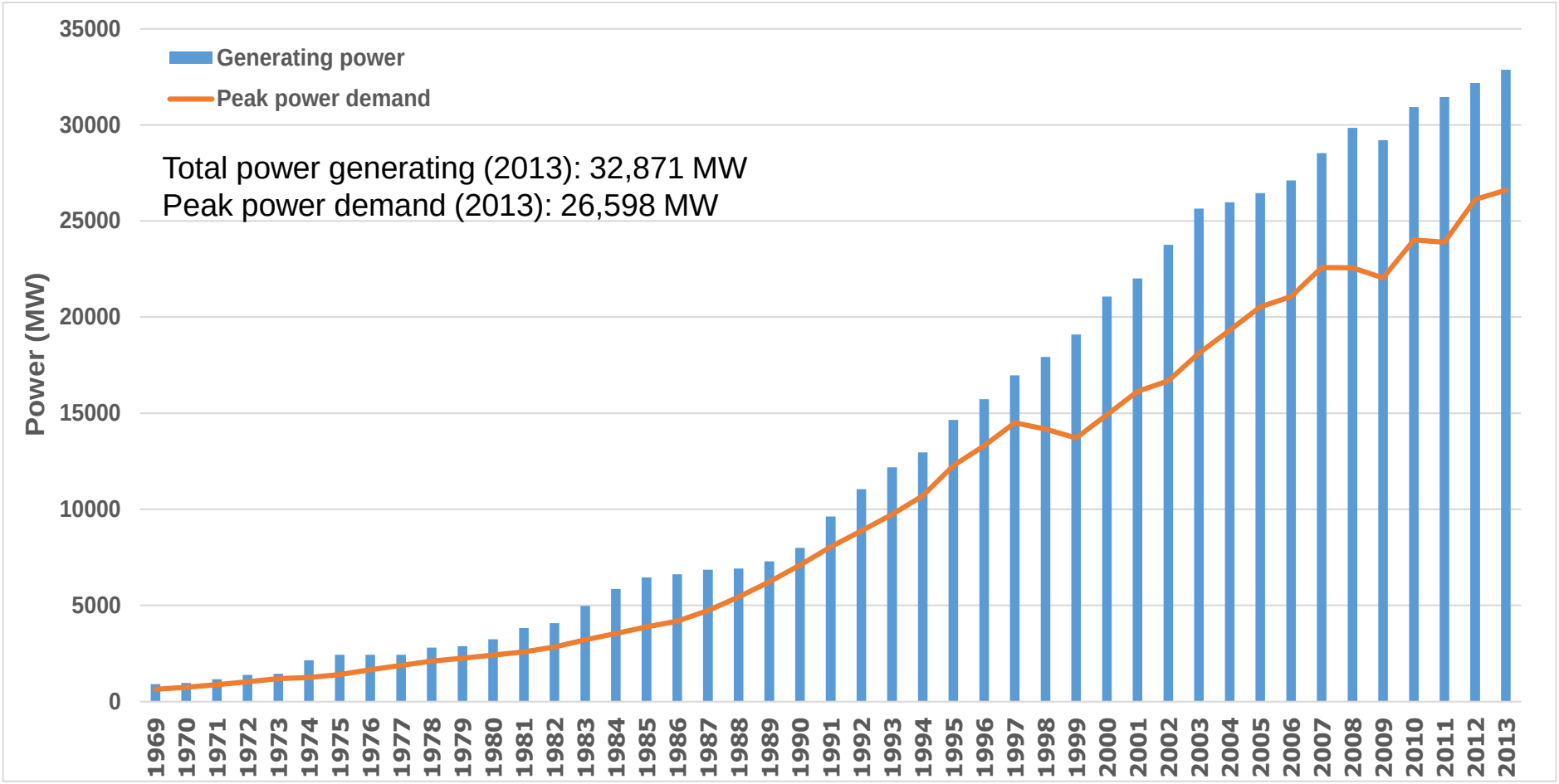
2. The problems and solution of power generation in Thailand
3. The losses in PV system
4. Distributed power electronics in the PV system
5. Simulation of the distributed power electronic ability
6. Conclusion

1. Power generation situation in Thailand



Source: EGAT

Comment

1. The electrical demand growth is usually relating with economic growth in the same way.
2. During 1997-1999 and 2007-2009, the electrical demand is not growing that result of economic crisis

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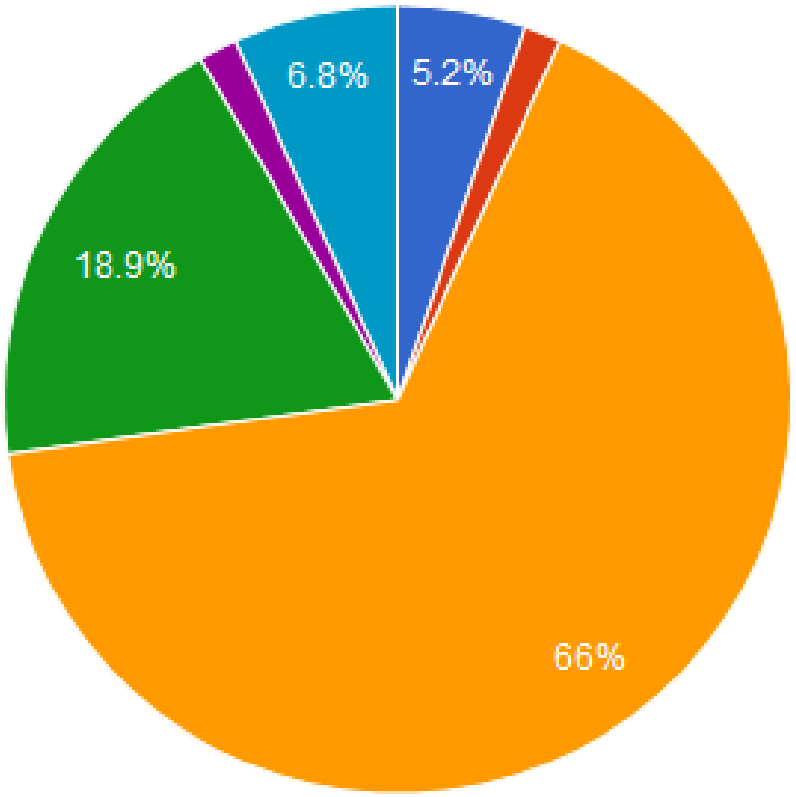
1. Power generation situation in Thailand

Energy source fraction for power generation in Thailand (2012)



Source: EGAT

- **Hydropower**
- **Diesel**
- **Natural gas**
- **Coal**
- **Renewable energy**
- **Purchase**

Comment

1. Natural gas dominates the power generation in Thailand that result to energy security risk.
2. Increasing power generation from coal and hydropower is difficult because people protest.
3. Increasing power purchase is increasing energy security risk.
4. Renewable energy fraction is still low and possible to increase power generation

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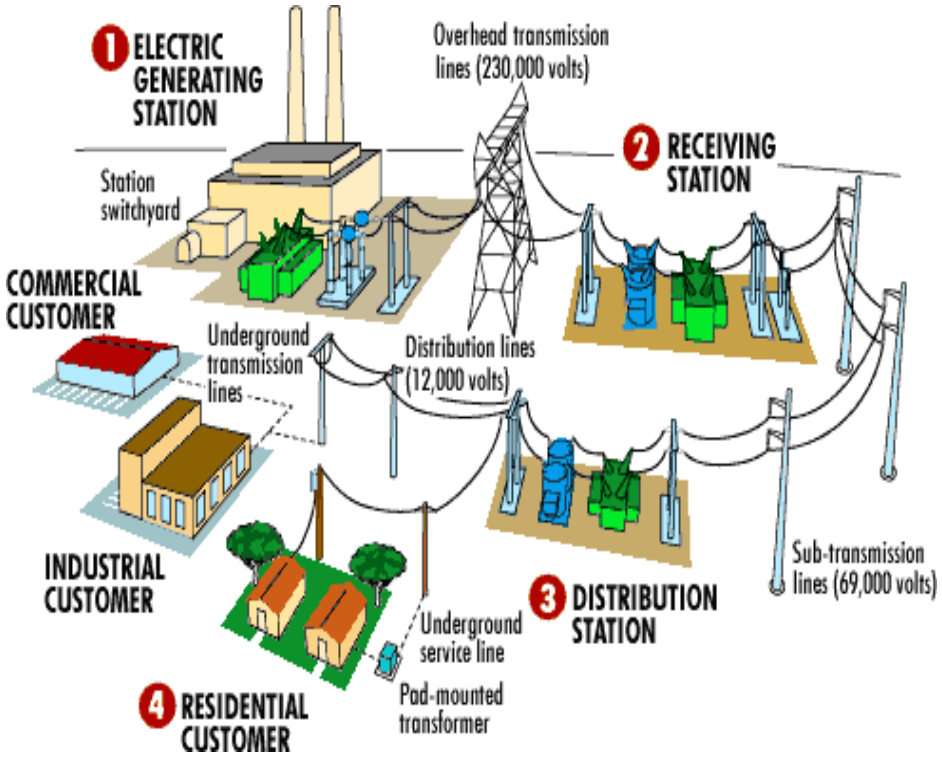
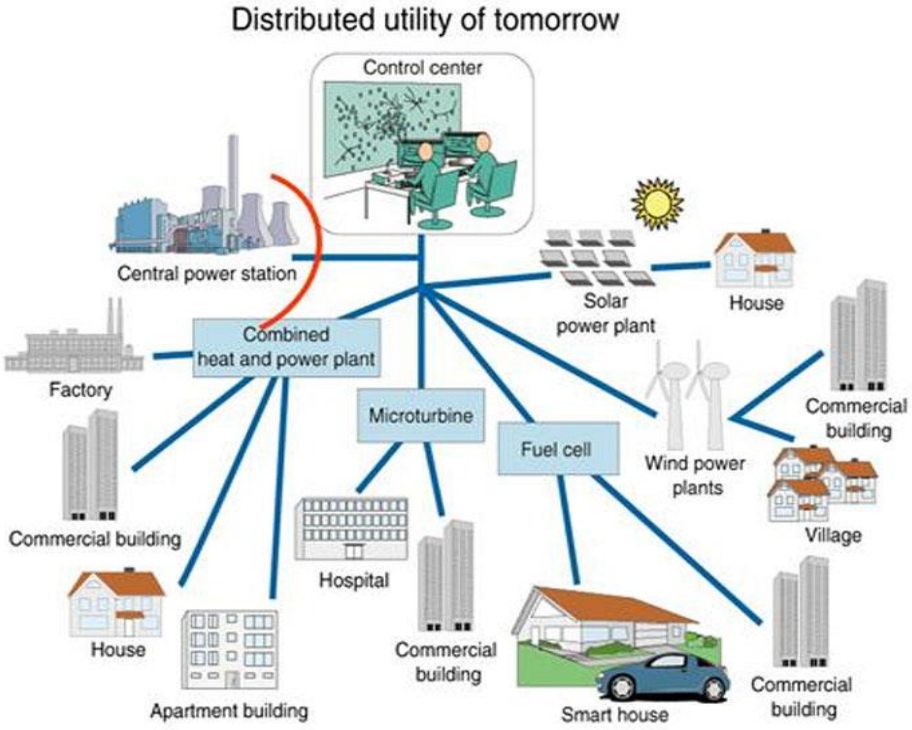
2. The problems and solution of power system in Thailand



Source: http://portlandwiki.org/Green_industry



Source: Energy DGP

Problems

1. Highly depend on natural gas
2. Base on traditional centralized power generation
3. Import energy resource and power from other countries

Solution

1. Develop distributed power generation with automatic control and IT (Smart grid)
2. Develop power generation from renewable energy
3. Use the local renewable energy resource

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2. The problems and solution of power system in Thailand

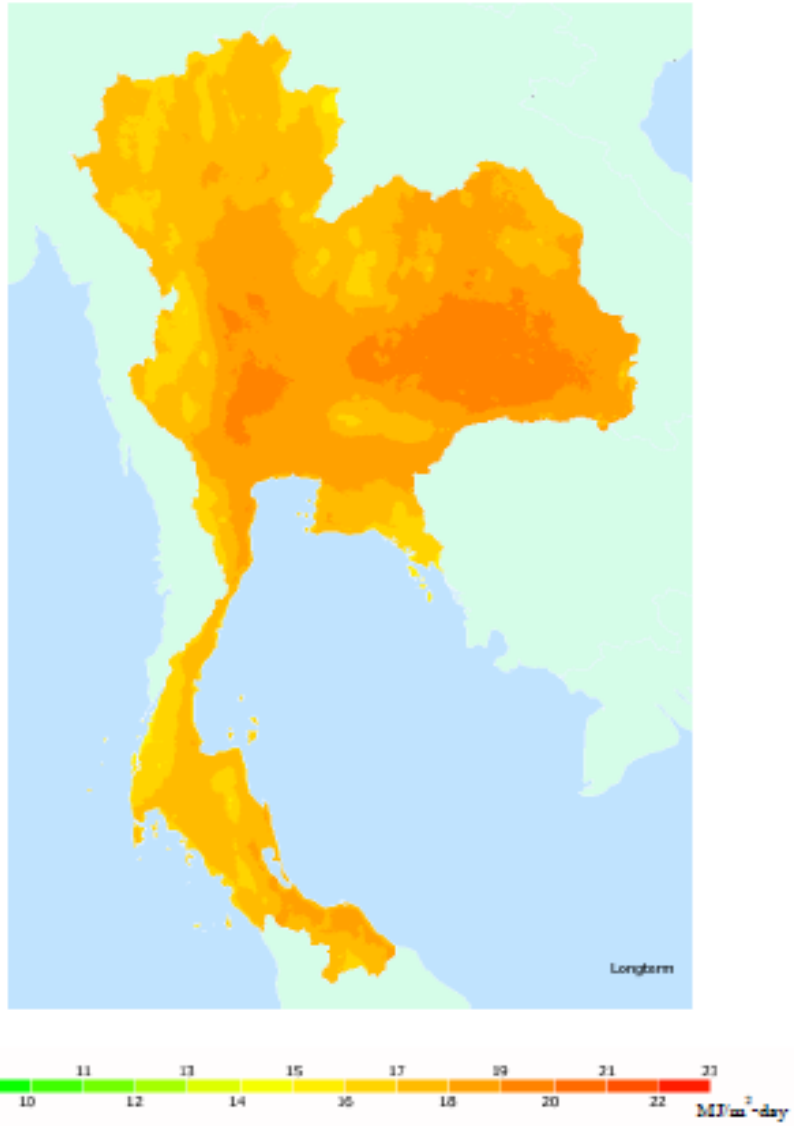
Renewable energy potential in Thailand

ประเภทพลังงาน	ศักยภาพ
ไฟฟ้า	เมกะวัตต์
แสงอาทิตย์	50,000
พลังงานลม	1,600
ไฟฟ้าพลังน้ำ	700
ชีวมวล	4,400
ก๊าซชีวภาพ	190
พลังงานขยะ	400
ไฮโดรเจน	
รวม	

Source: DEDE

Comment

1. Solar energy in Thailand is double of power peak demand.
2. Solar energy is scattering in every part of Thailand.



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2. The problems and solution of power system in Thailand

Energy sources	Power generation cost (Bath/kWh)
Natural gas	3
Natural gas (LNG)	5 - 6
Coal	2 - 2.25
Hydropower	2
Nuclear	2
Diesel	11 - 12
Biomass	3 - 3.5
Wind	6
Solar	8
Solar (German Fit)	4.3

Source: Thairath

Comment

1. The solar energy of 1 kWp PV system in Thailand is 1400 – 1500 kWh/year and Germany is 900 – 1000 kWh/year.
2. Why solar power generation is Thailand is more expensive than Germany?

2. The problems and solution of power system in Thailand

The advantage of PV system

1. Flexible size (From about 0.1 kW to 500 MW).
2. Flexible installation (Install in the same place with load or a way from load)
3. Cut the peak power demand during daytime (For roof top and BIPV)
4. Do not need to install the new transmit ion line.
5. Environmental friendly
6. Stable generation cost
7. Easier to installation and commission
8. Lower operating and mentaiance cost

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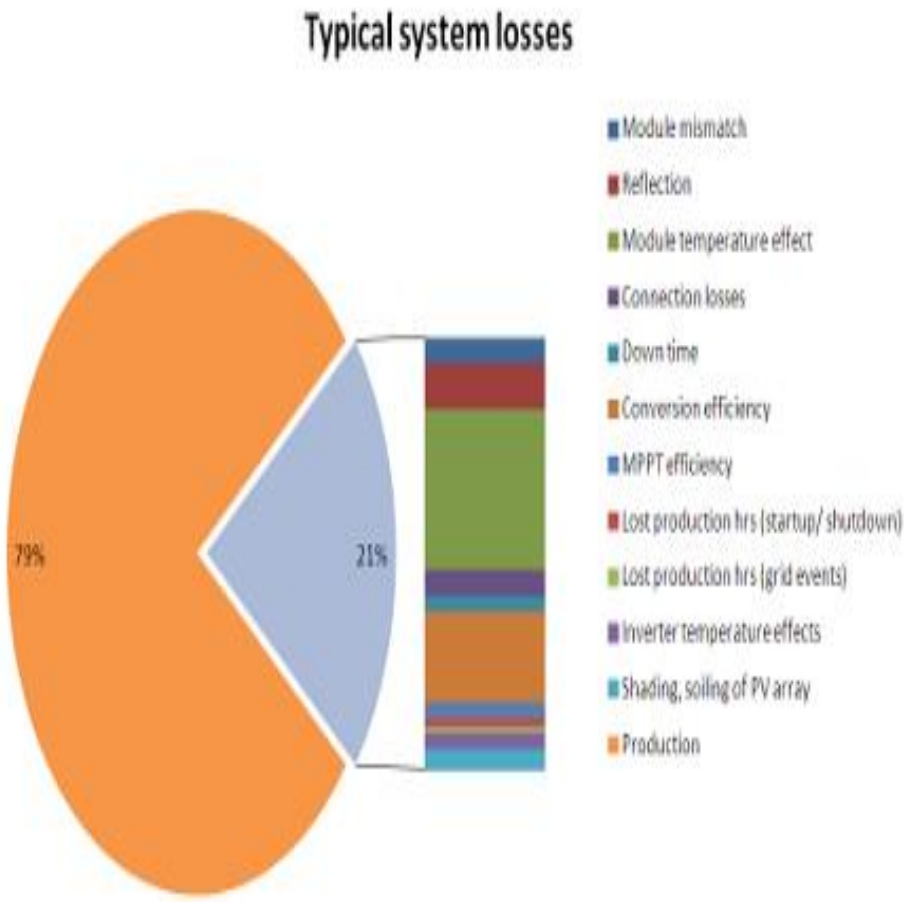
3. The losses in PV system

Cause of energy loss	Influenced by	Annual loss of energy
Module mismatch	Solar module	1 – 2%
Reflection	Solar module	2 – 3%
Module temperature	Solar module	7 – 11%
Connection losses	Cable, connectors and inverter (system voltage)	1 – 2%
Downtime	All system-components	0 – 2%
Conversion efficiency	Inverter	3 – 6%
MPPT efficiency	Inverter	0.2 – 2%
Late startup / early shutdown	Inverter	0 – 4%
Production hours lost due to grid events	Inverter, grid	0 – 4%
Inverter temperature effects	Inverter, installation location	0.5 – 1.5%
Shading, soiling of PV array	Inverter, environment, maintenance	0 – 6%
Total system losses (*)		Min. 15% - typ. 25%



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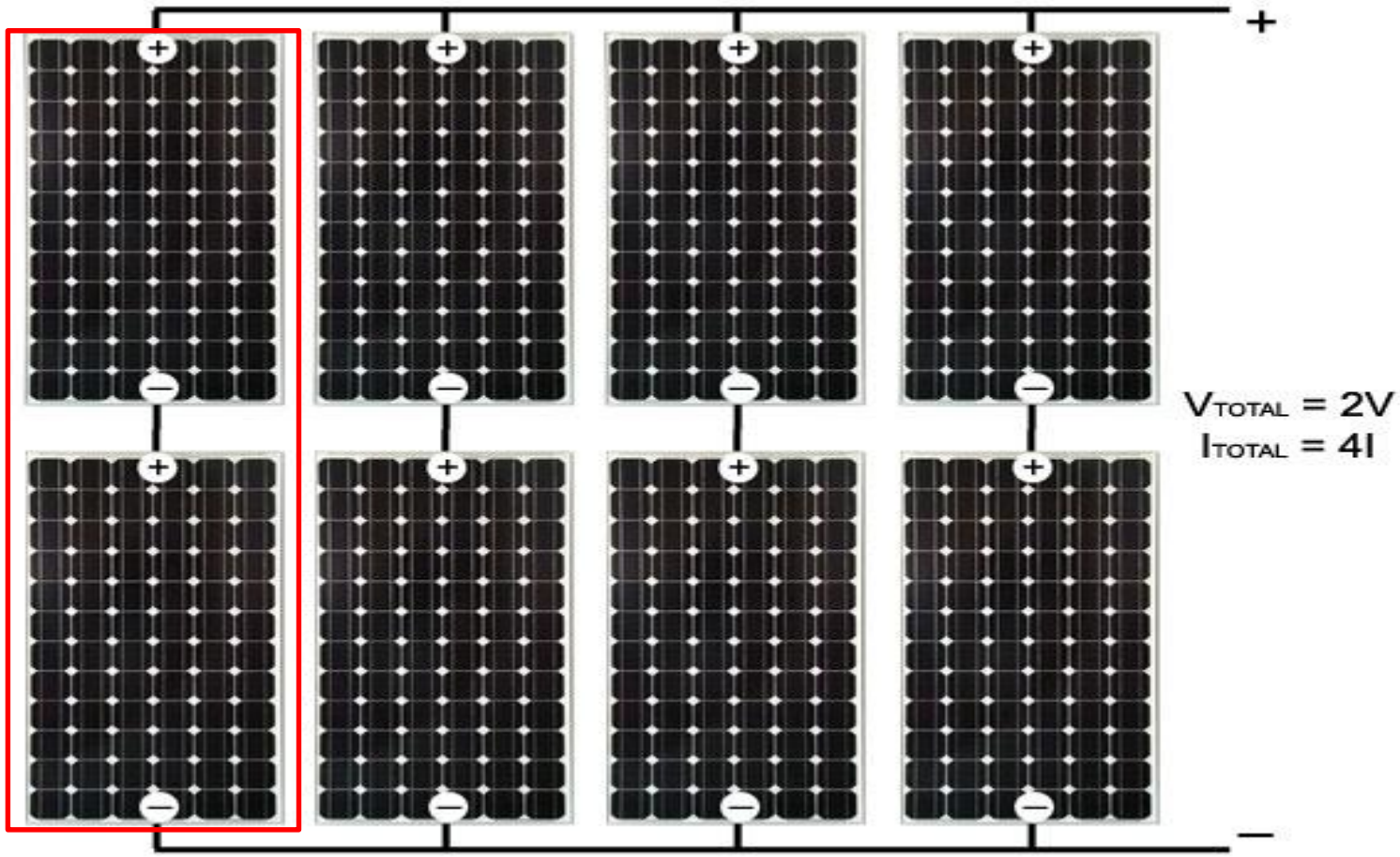
3. The losses in PV system



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4. Distributed power electronics in the PV system

1. µ inverter

PV module

DC

µ inverter

AC

2. Parallel optimizer

PV module

DC

Parallel optimizer

DC

String inverter

AC

3. Serial optimizer

PV module

DC

Serial optimizer

DC

String inverter

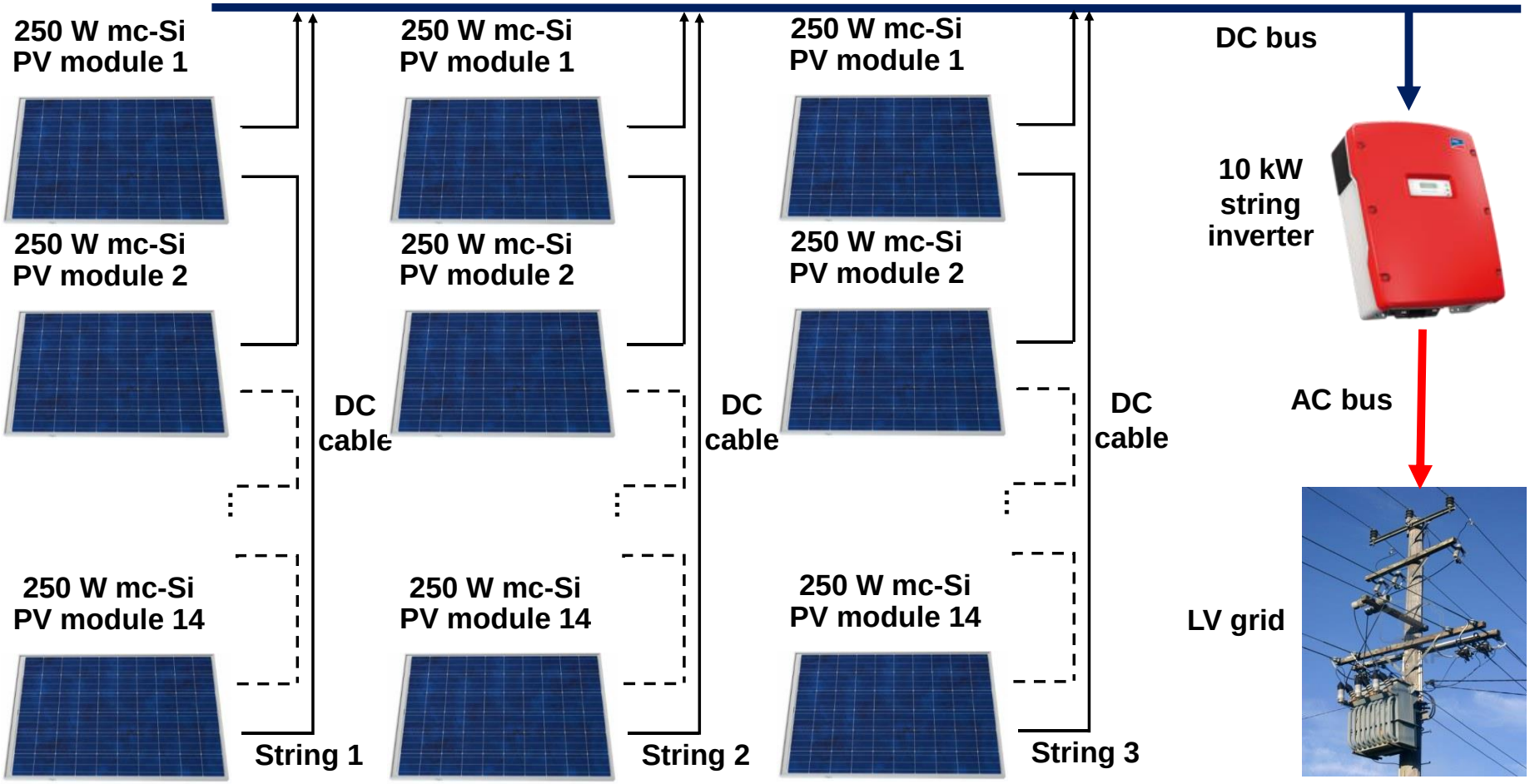
AC

LV grid

AC bus

5. Simulation of the distributed power electronic ability

(A) String inverter configuration



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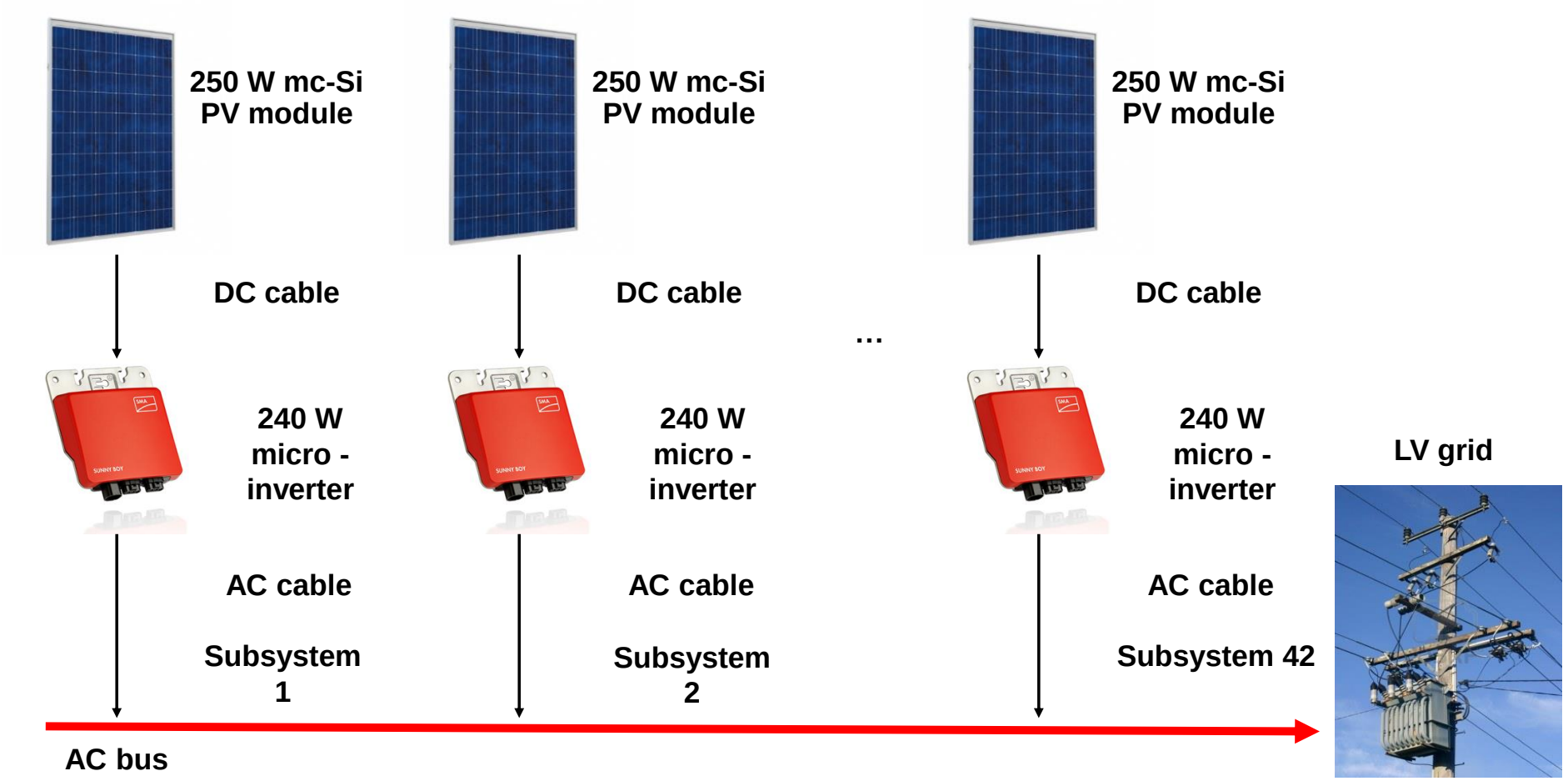
5. Simulation of the distributed power electronic ability

(B) μ inverter configuration



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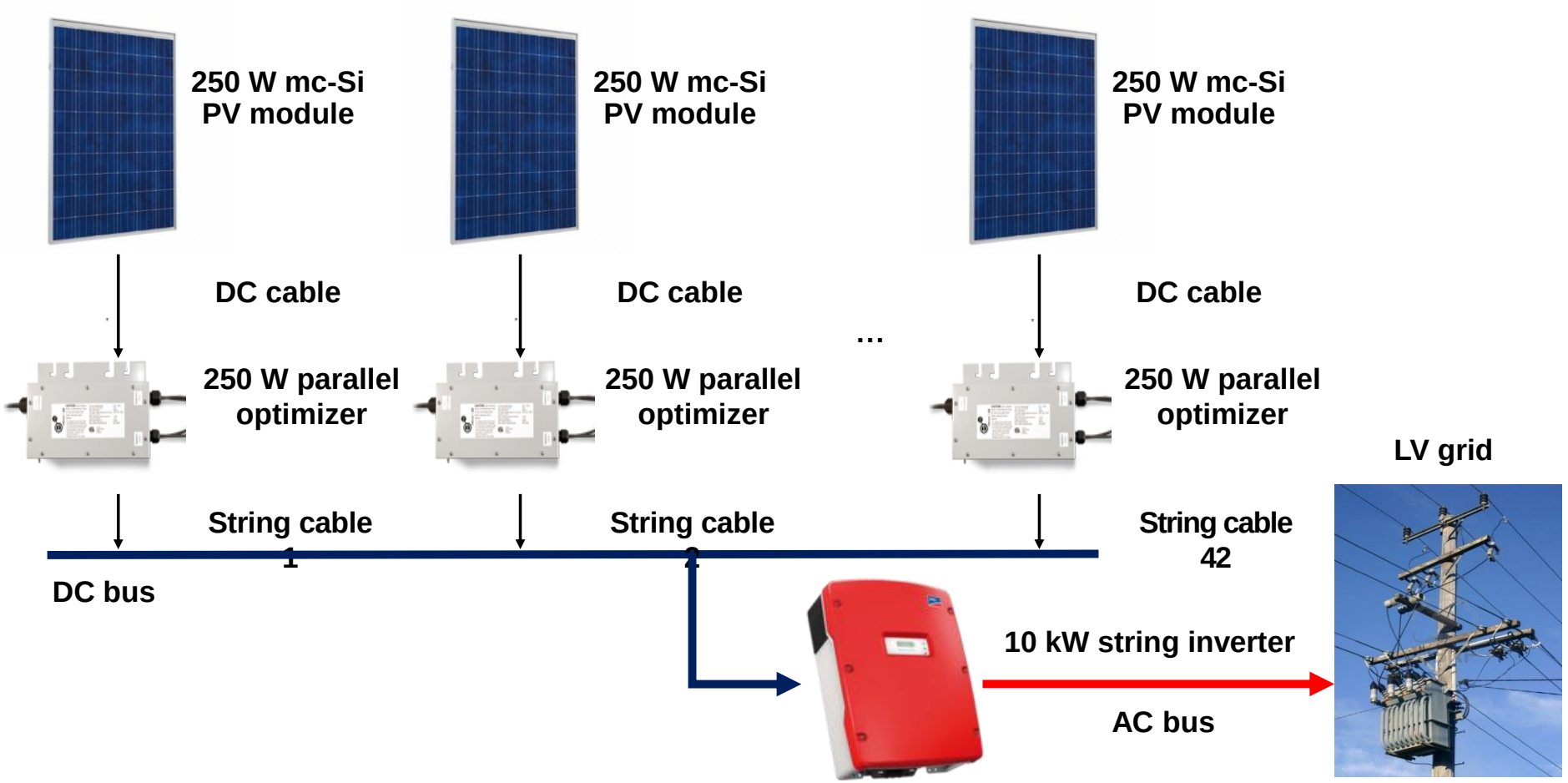
5. Simulation of the distributed power electronic ability

(C) Parallel optimizer configuration



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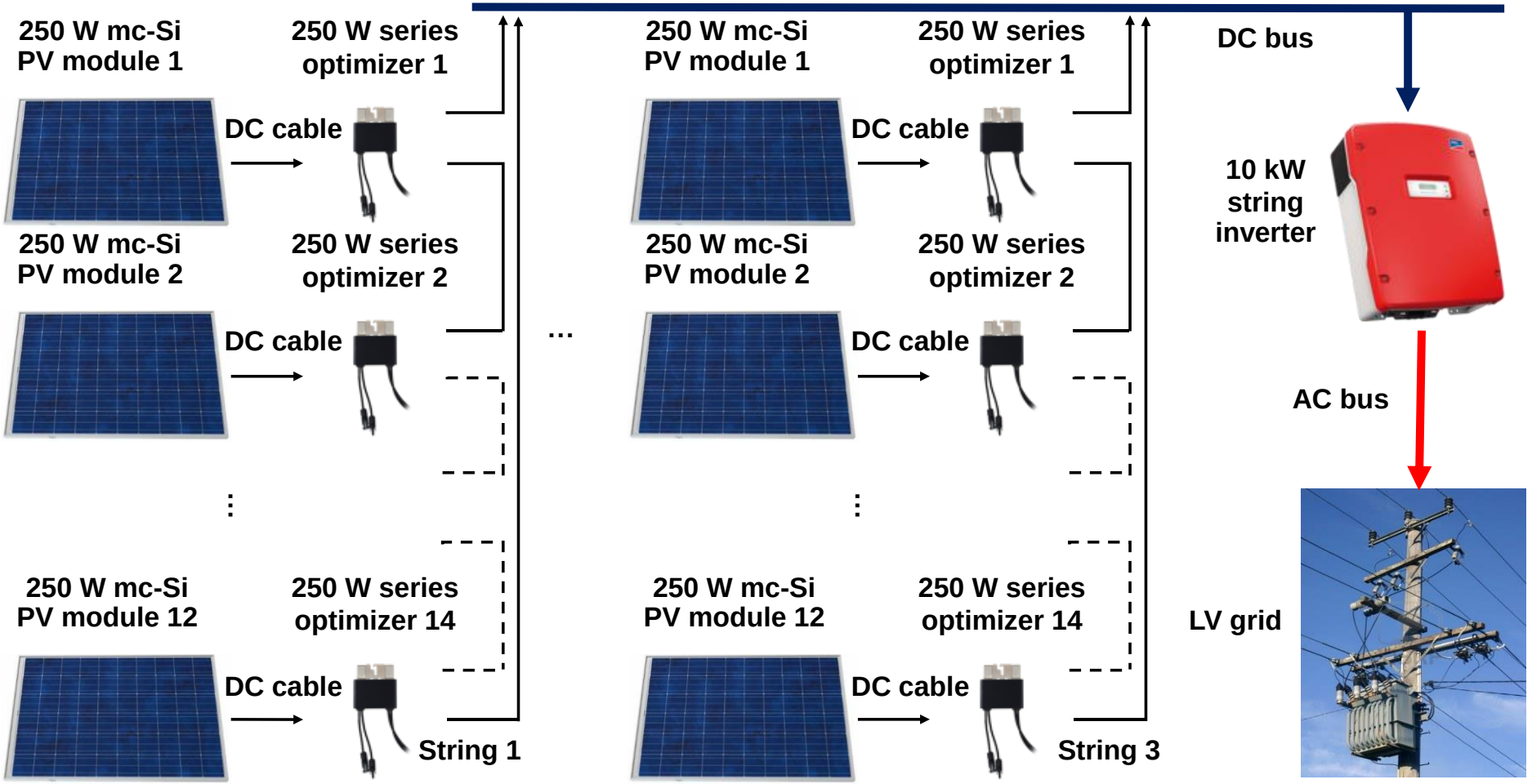
5. Simulation of the distributed power electronic ability

(D) Serial optimizer configuration



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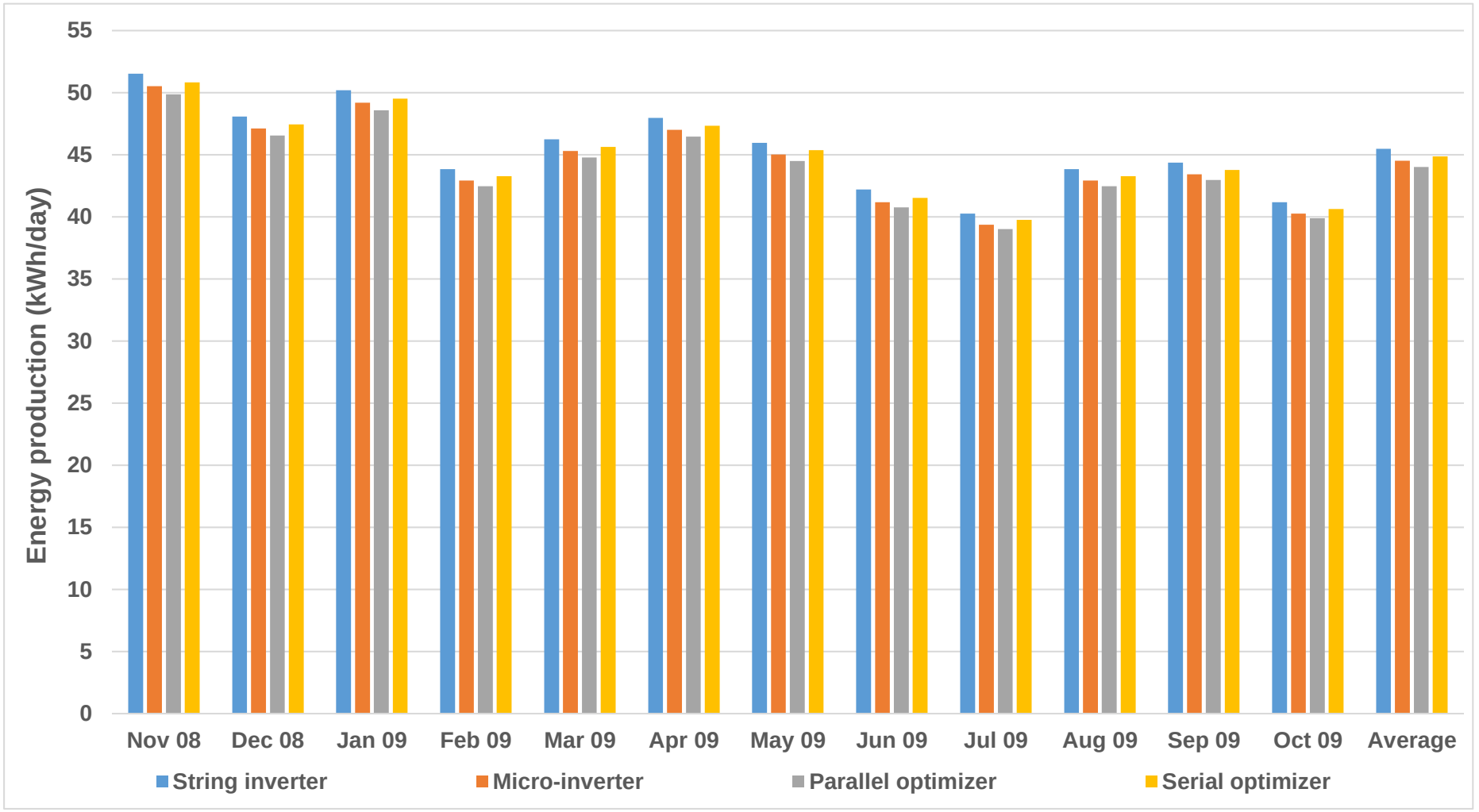
5. Simulation of the distributed power electronic ability

Simulation result in 0% tolerance of PV module



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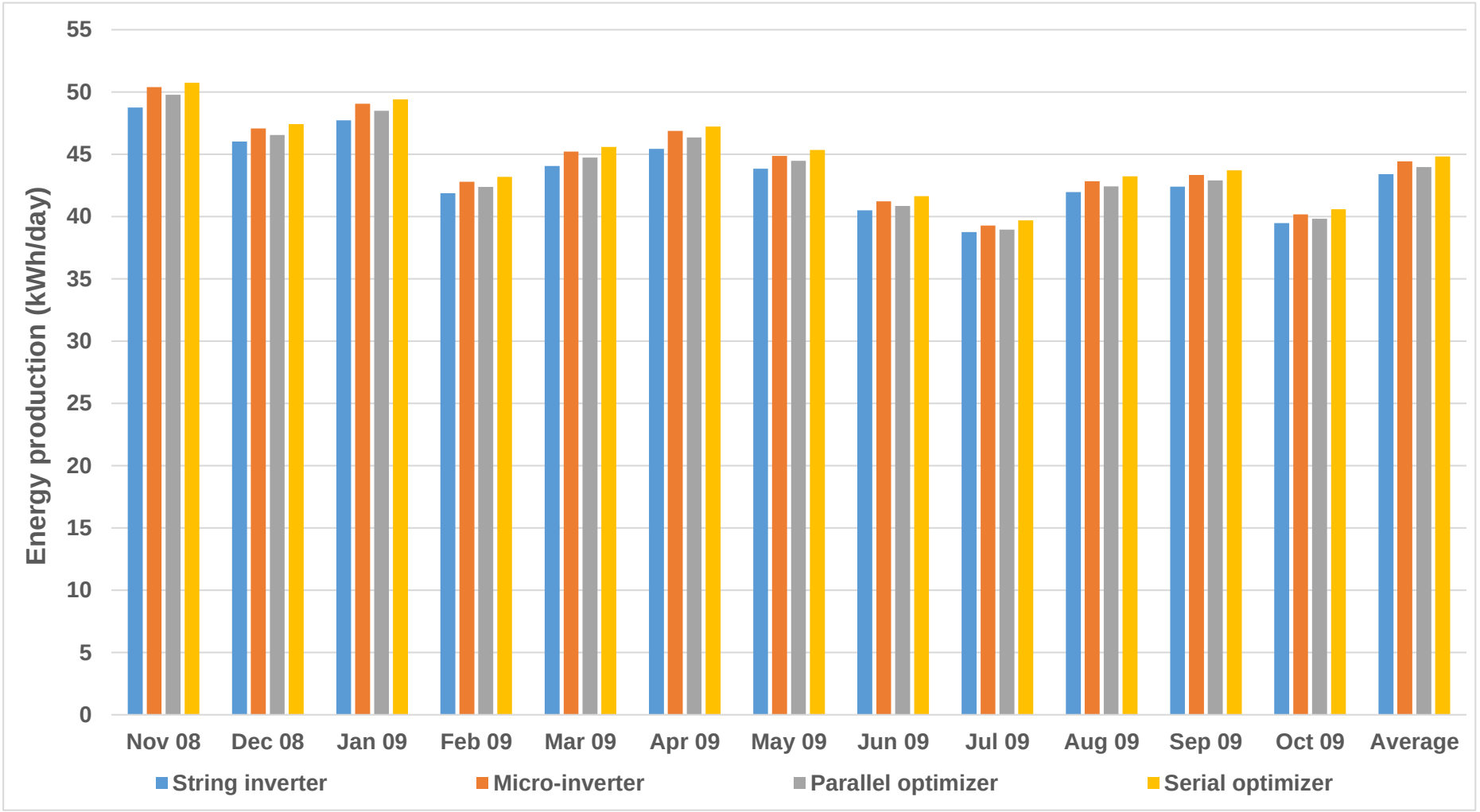
5. Simulation of the distributed power electronic ability

Simulation result in -5 to 5% tolerance of PV module



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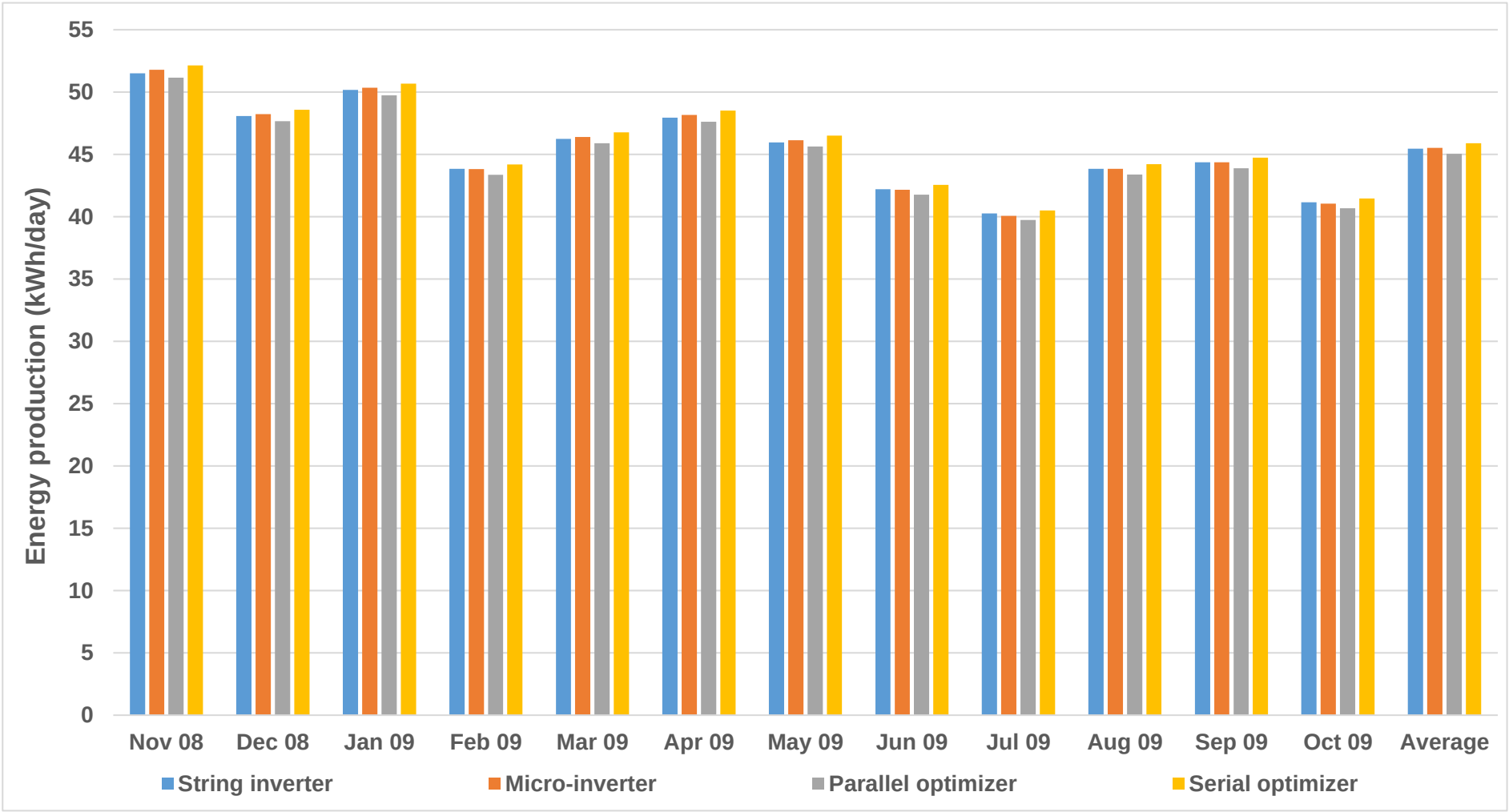
5. Simulation of the distributed power electronic ability

Simulation result in 0 to 5% tolerance of PV module



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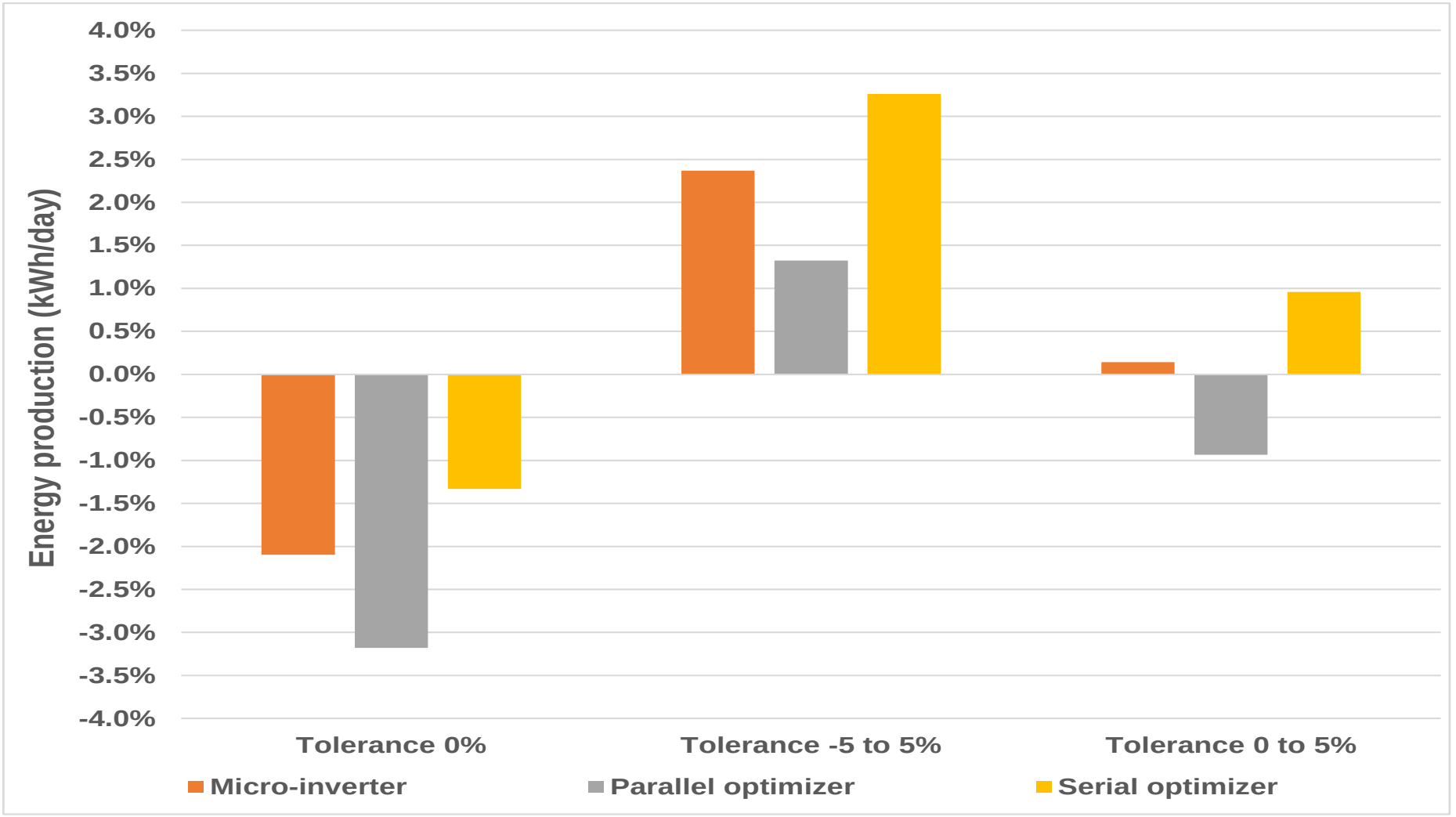
5. Simulation of the distributed power electronic ability

Simulation result in percentage of energy different when compare with string inverter



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6. Conclusion

1. The power generation and system in Thailand can not respond the power demand and security.
2. Distributed power generation with automatic control and IT (Smart grid) with renewable energy is a interesting solution.
3. PV system is a interesting solution but it is still expensive.
4. Distributed power electronics in the PV system can improve PV system performance
5. Distributed power electronics in the PV system can improve PV system performance when the mismatch is higher than 5%.

Thank you for your attention

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