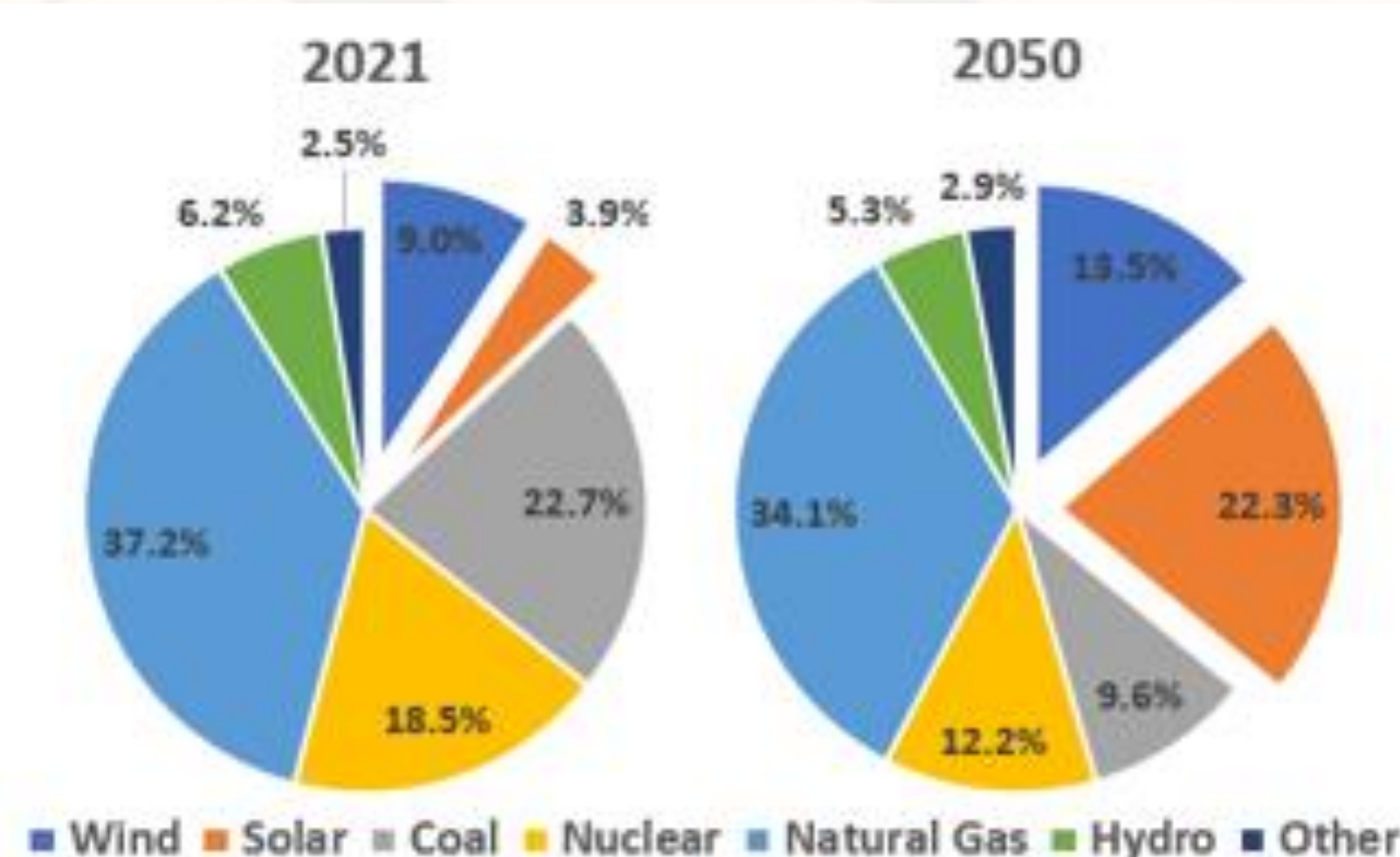


Roberto Ignacio da Silva - Cargill - US

Davide Marzotto - Westrafo - Italy

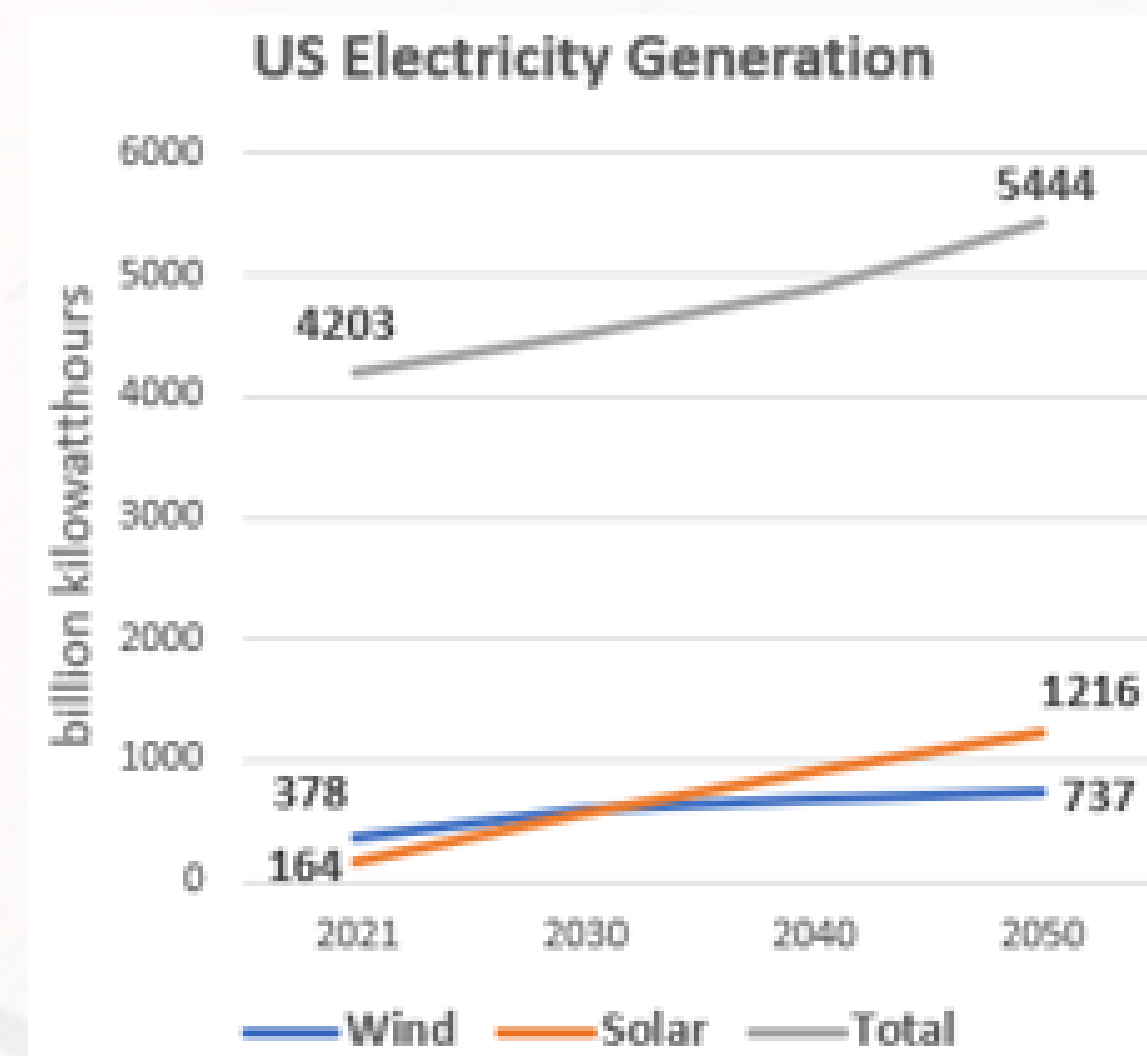
US Electricity Generation 2021 to 2050

- Generation will grow 30%
- Wind power will grow 95%
- Solar power will grow 640%

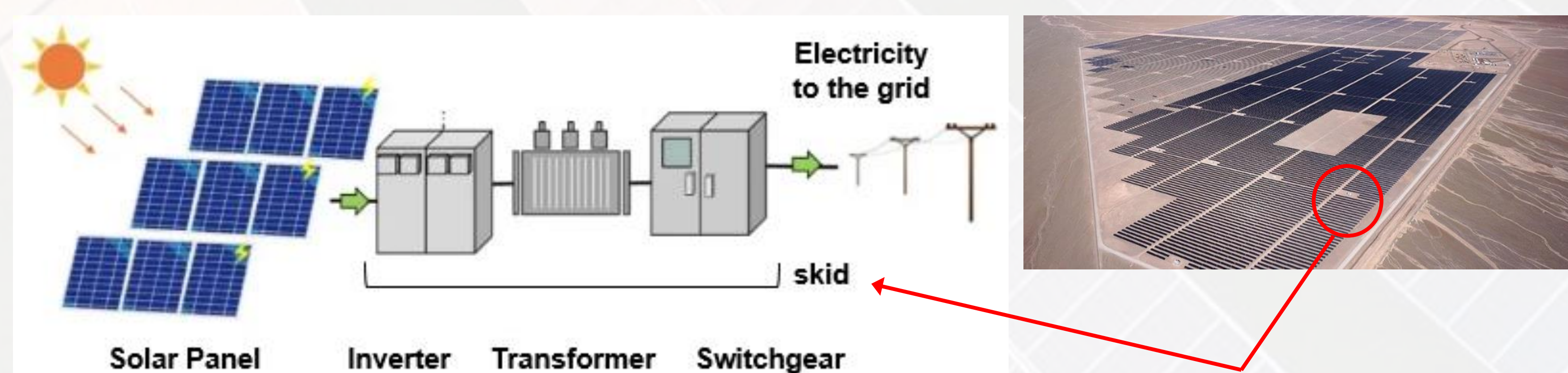


US Electricity Generation Matrix 2021 to 2050

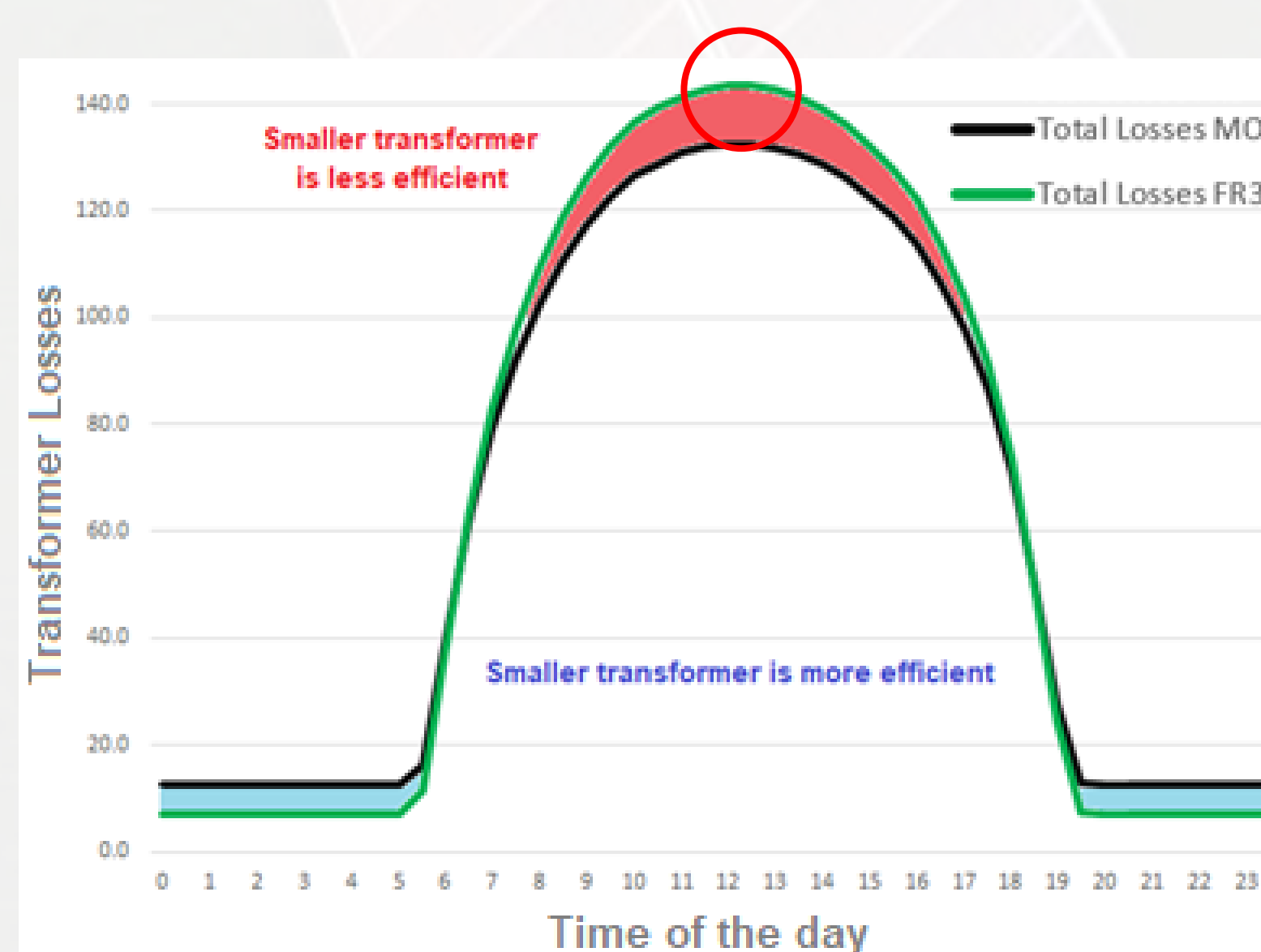
- Wind power → 9% to 13.5%
- Solar power → 3.9% to 22.3%



Thousands of New Generator Step-Up Transformers (GSU)



Typical GSU Transformer Capacity



- Solar duty is well known
- But transformer capacity is defined by the peak load
- Considered continuous loading

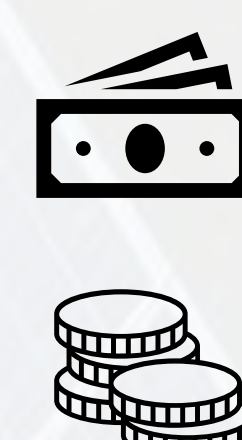
CONCEPT

Dual Nameplate Transformer

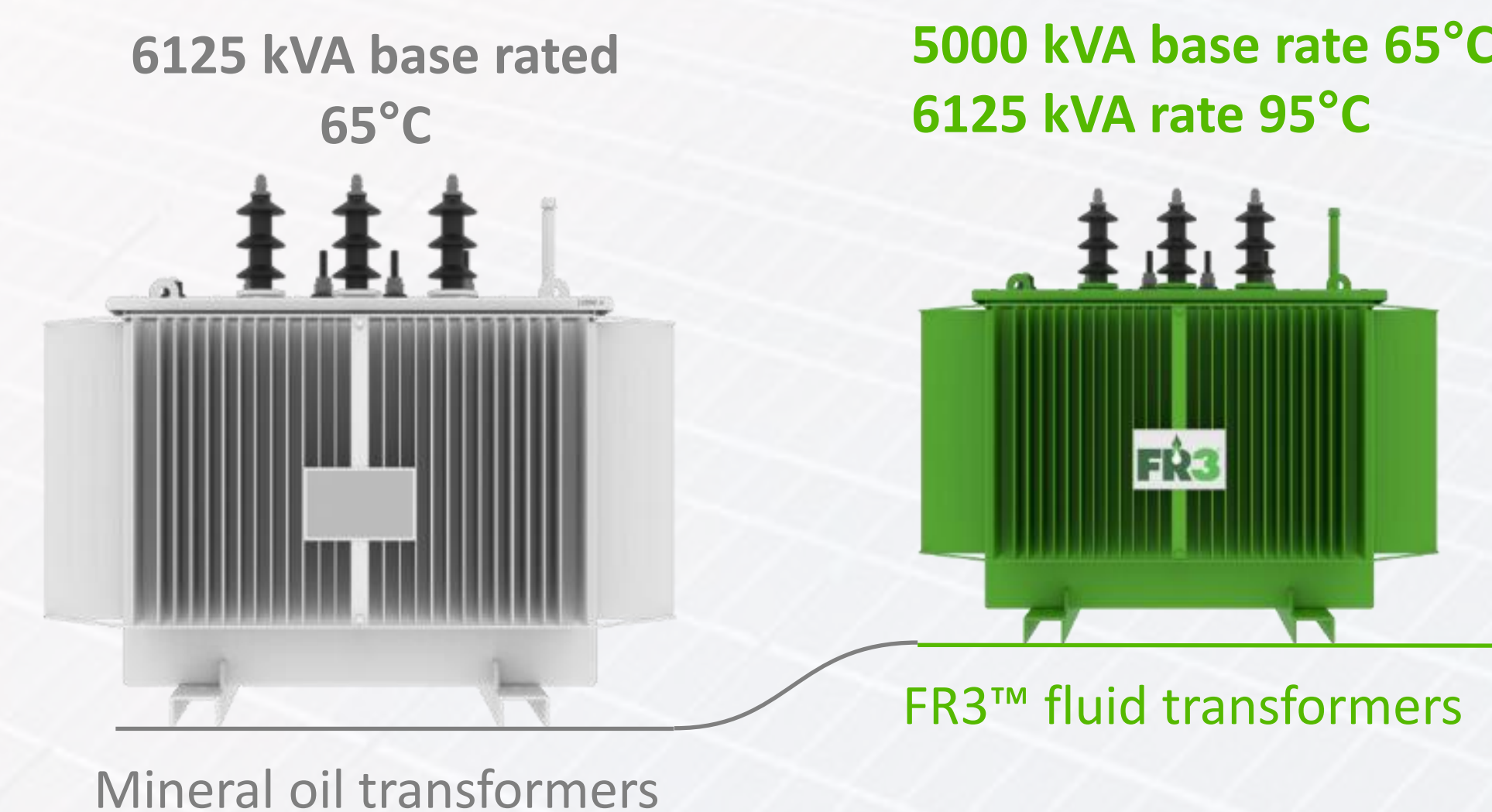
- Winding temperature rise is the reference
- Base Rating → 65°C ; Dual Nameplate → 95°C
- High Temperature Insulating Materials

- Same peak load capacity
- Reduced dimensions and weight
- Similar annual energy losses
- Similar life cycle cost

Material Savings



1 High Temperature Insulating Materials



- Thermally Upgraded Paper + Natural Ester
- Thermal Class 140
- Higher permissible hot spots
- Downsizing the active part
- Lower initial cost than the larger mineral oil unit

2 FR3 Natural Ester Insulating Liquid

Better Fire Safety:

- Fire Point = 360°C
- Zero fires reported in 28 years and +3 million installations



Better environmental properties:

- Biodegradable and non-toxic ; Carbon neutral

Extends the transformers life:

- Insulation system continuous drying ;
- Reduces paper degradation rate



Increased robustness for harmonics:

- Can operate at higher temperature
- Higher PDIV avoid the inception of discharges



FR3 CO₂ Emissions

Stage	gCO ₂ eq / unit	
	Mineral Oil	Natural Ester
Raw Material	1,048,184	-381,590
Manufacture	544,363	160,212
Transport	122,478	71,498
Use	154,124	153,450
Waste Management	30,825	30,690
Total	1,899,973	34,260

	Mineral Oil	Natural Ester
Emission of kgCO ₂ eq per liter	1.005	0.018
Total volume of insulating liquid in liters	18,271,400	
Total emissions in tCO ₂ eq	18,368	329



3 Conclusion

- Sizing the transformer per solar duty
- Frees up space for a larger inverter, increasing capacity
- More power out of same skid unit
- Equivalent losses on a yearly base (±10%)

