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Réseau québécois sur l'énergie intelligente

Artificial Intelligence Applied to Power Electronic Converters Connected to Smart Grids

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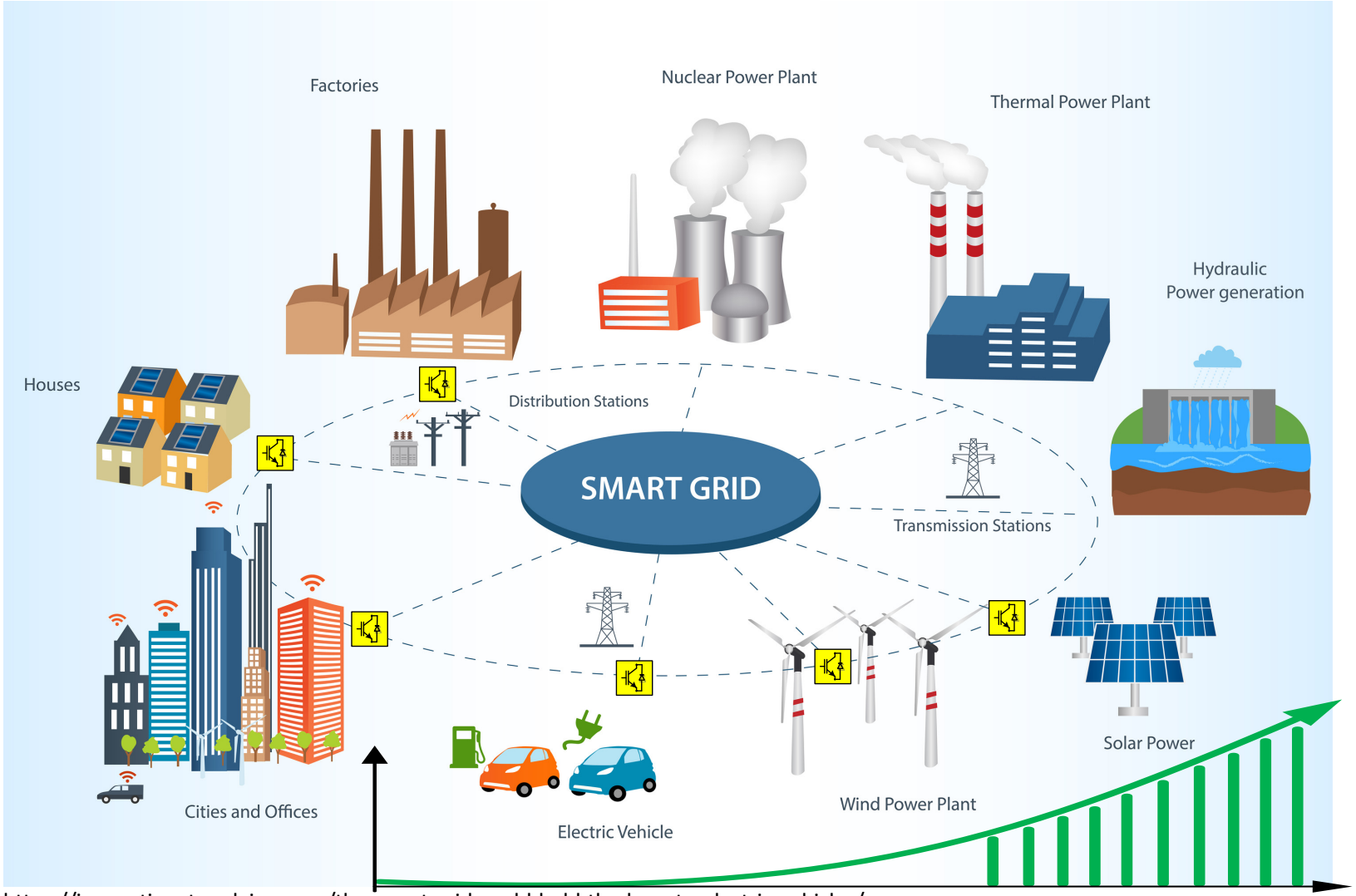
Agenda

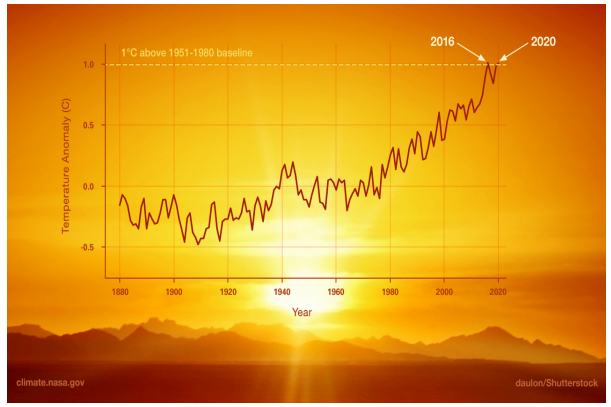
- Power electronic converters in smart grids
- Intelligent power electronic converters
- Outcomes and challenges

Power electronic converters in smart grids



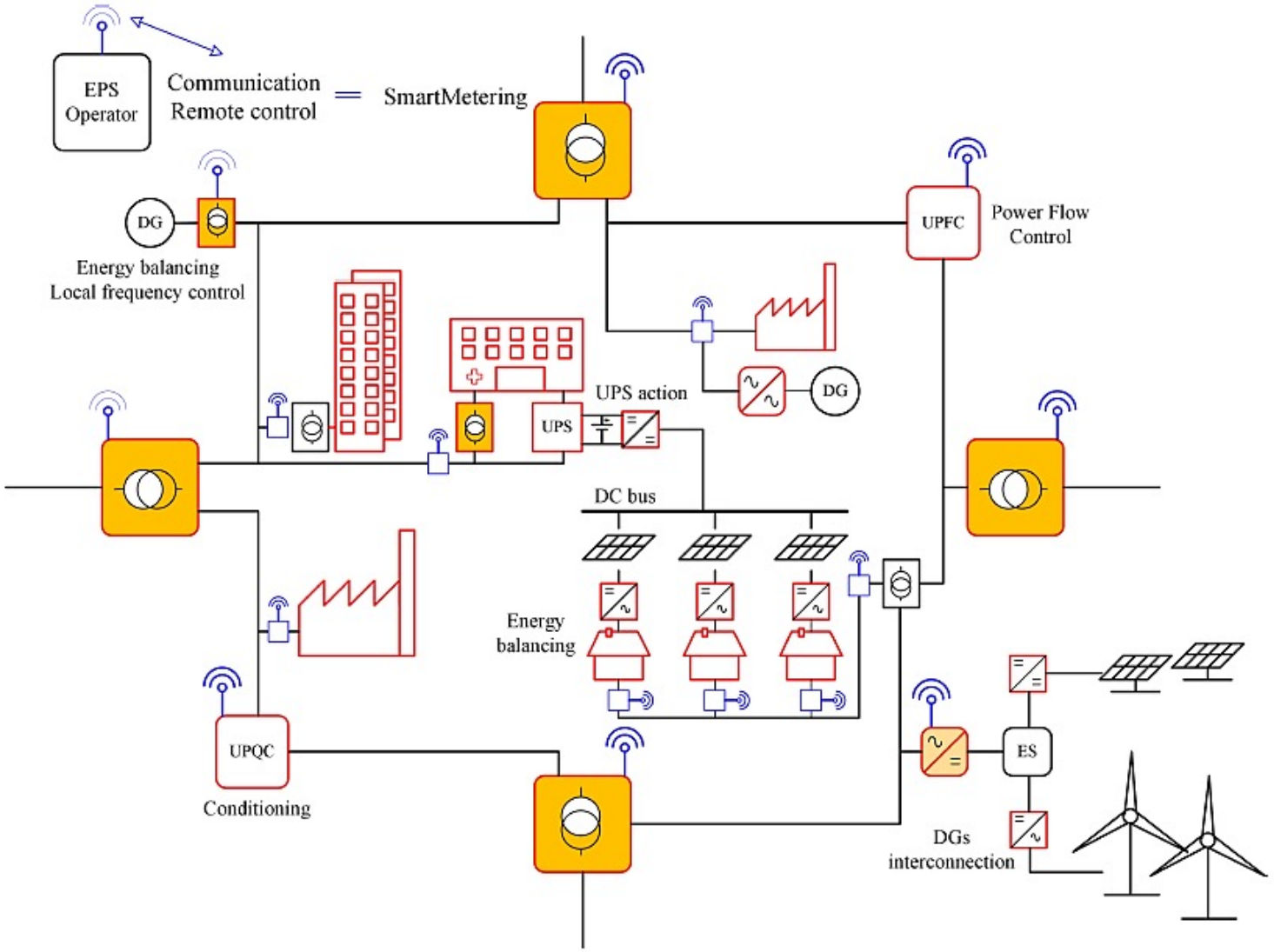
https://innovationatwork.ieee.org/the-smart-grid-could-hold-the-keys-to-electric-vehicles/

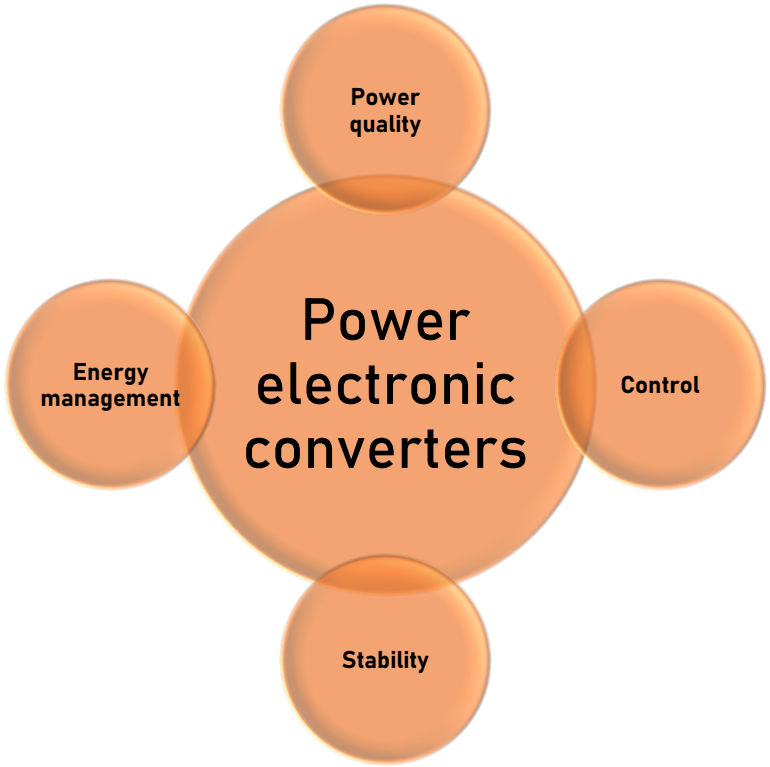
- DC-AC inventer
- AC-DC rectifier
- Power quality regulator
- Uninterruptible power supply



- Global warming
- Natural resources depletion
- Energy self-sufficiency

Power electronic converters in smart grids





Benysek, G., et al. "Power electronic systems as a crucial part of Smart Grid infrastructure-a survey." *Bulletin of the Polish Academy of Sciences: Technical sciences* (2011): 455-473.

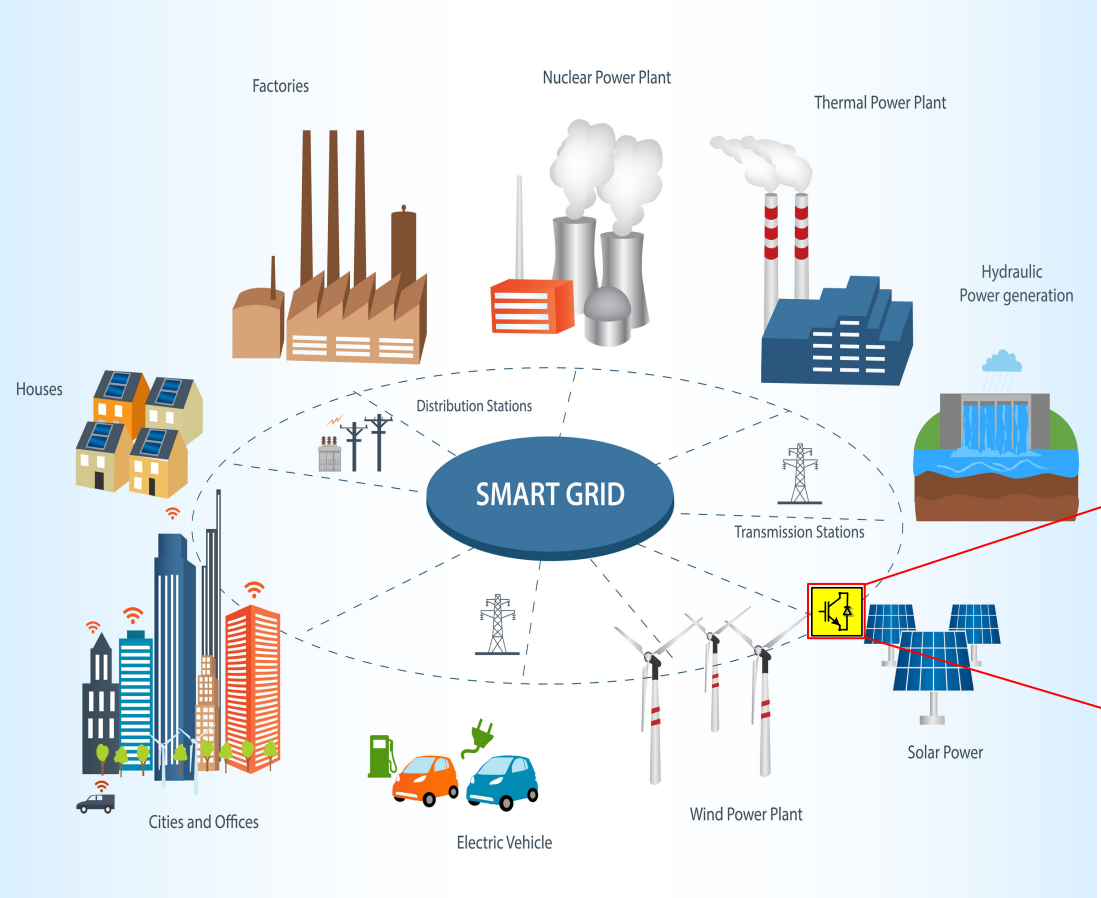
Intelligent power electronic converters

- Artificial intelligence as an emerging technology contributes to enhancing the robustness, reliability, and efficiency of the power electronic converters in smart grids.

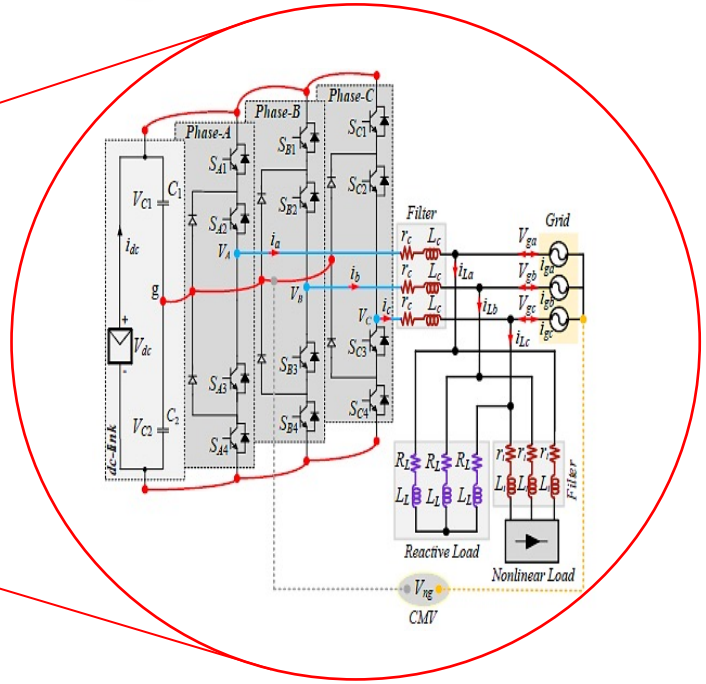
- Artificial Intelligence
  - Artificial Neural Networks (ANN)
  - Fuzzy systems
  - ANFIS
  - Metaheuristic algorithms
- Applications
  - Modeling (Digital twin)
  - Control
  - Cybersecurity
  - Estimation
- Advantages
  - Model-free
  - Robustness
  - Flexibility
  - Learning and interpolation
  - Tolerance of incorrect data

Intelligent power electronic converters

- **Case study:** Intelligent predictive control for grid-tied transformerless multilevel converters



- **Control objectives**
  - Reactive power compensation
  - Harmonic mitigation
  - Common mode voltage suppression
  - Switching regulation



M. Babaie, and K. Al-Haddad, "Intelligent Predictive Control for Grid-Tied Transformerless Multilevel Converters: Novel Strategies to Train ANNs and Mitigate Harmonics," in IEEE Transactions on Power Electronics, 2022.

Intelligent power electronic converters

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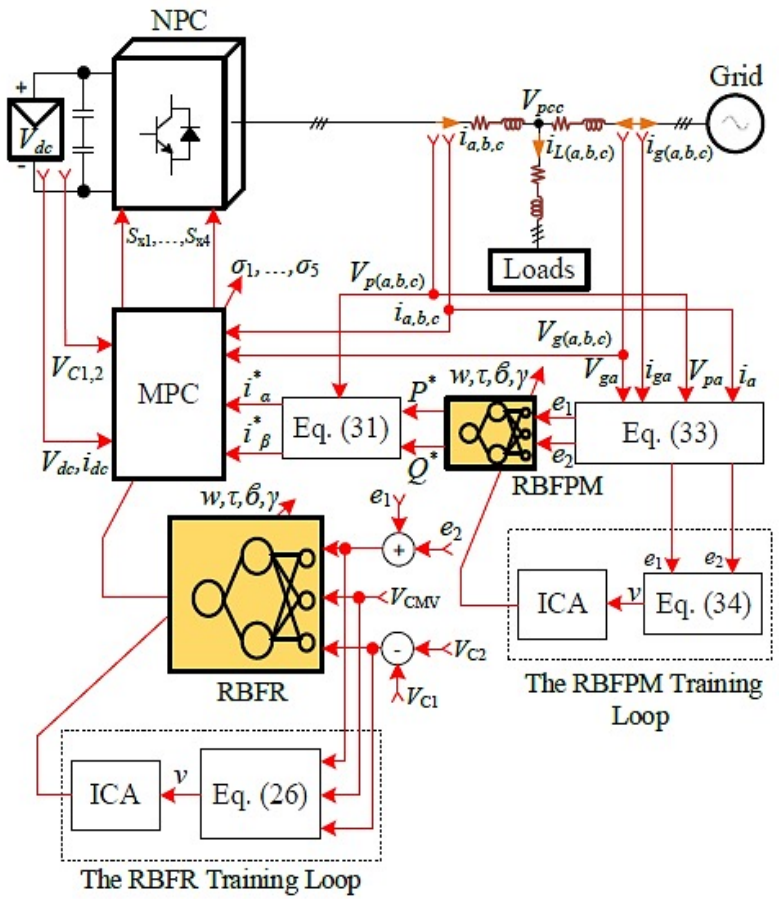

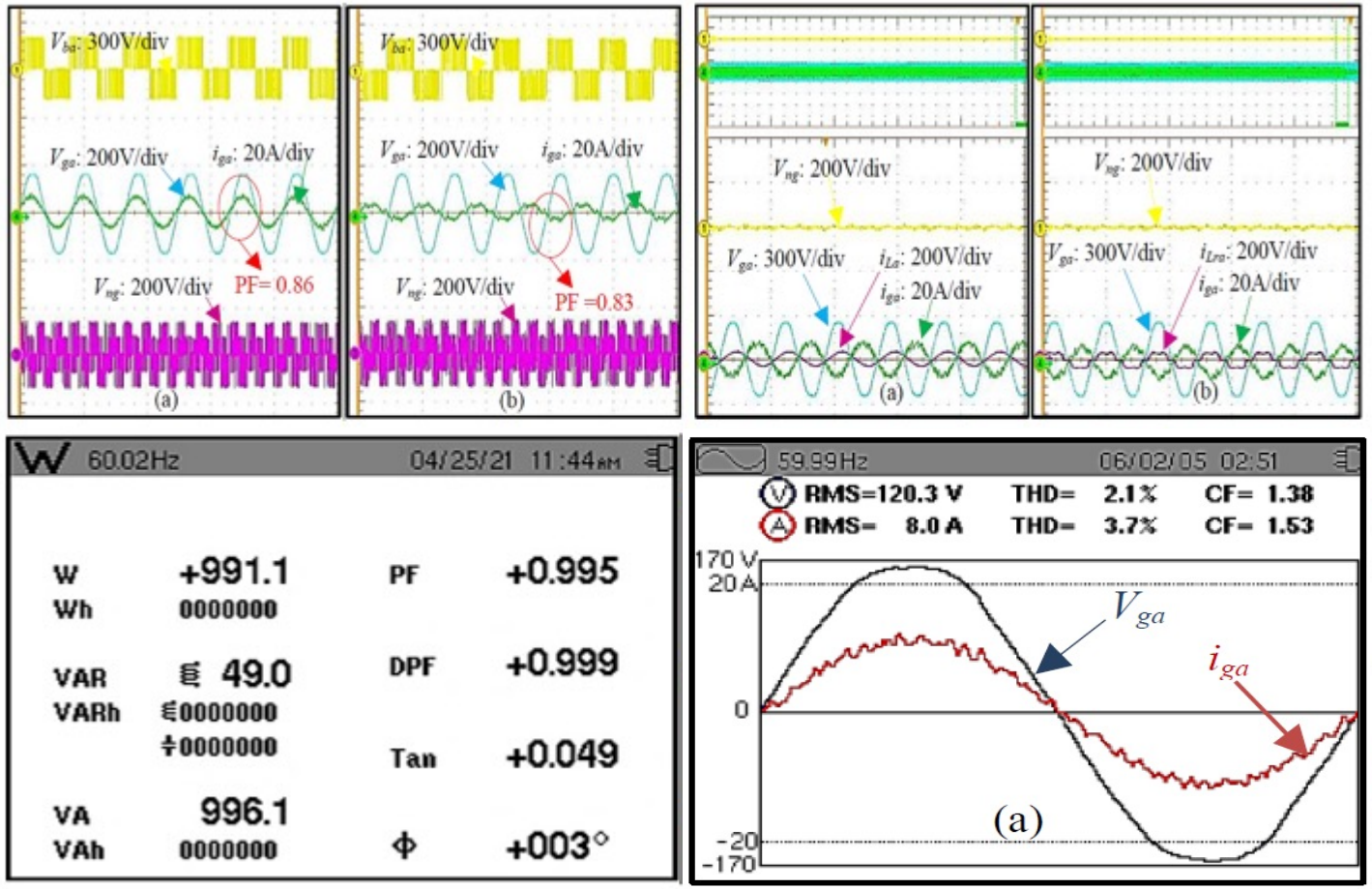

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Outcomes and Challenges

- Power quality
- Multitasking
- Energy self-management

- Exhausting training process
- Limited stability analysis tools

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THANK YOU - MERCI!

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