

Condo Power Interchange by Virtual Synchronous Generator

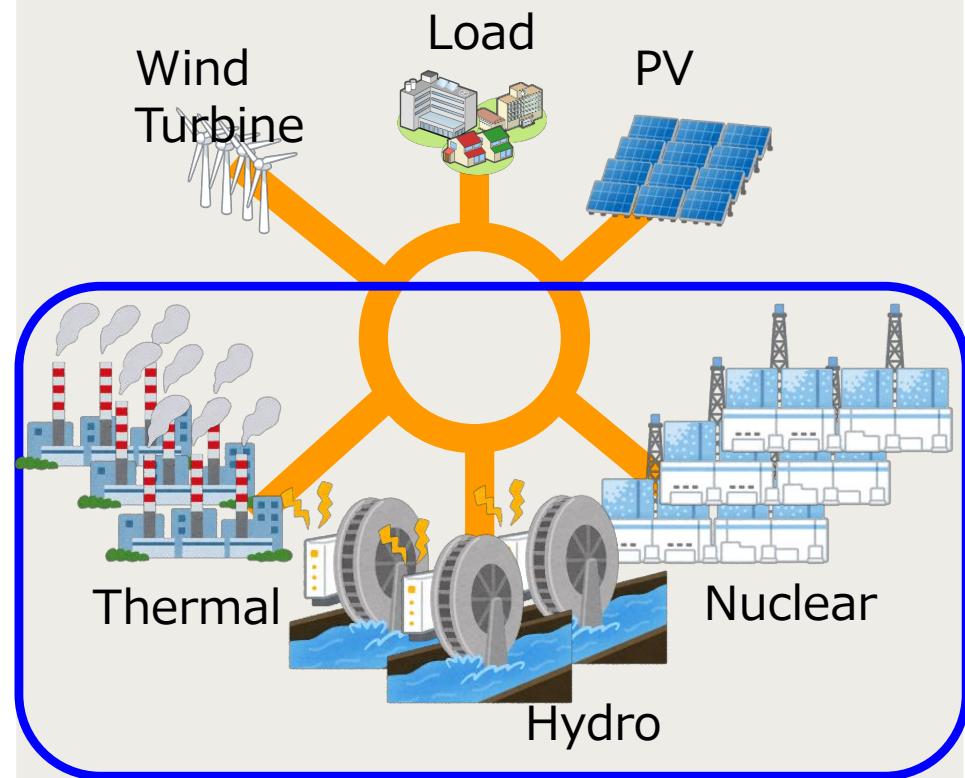
August, 2019

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(Kawasaki Heavy Industries, Ltd.)

I. Backgrounds what is “stable grid?”

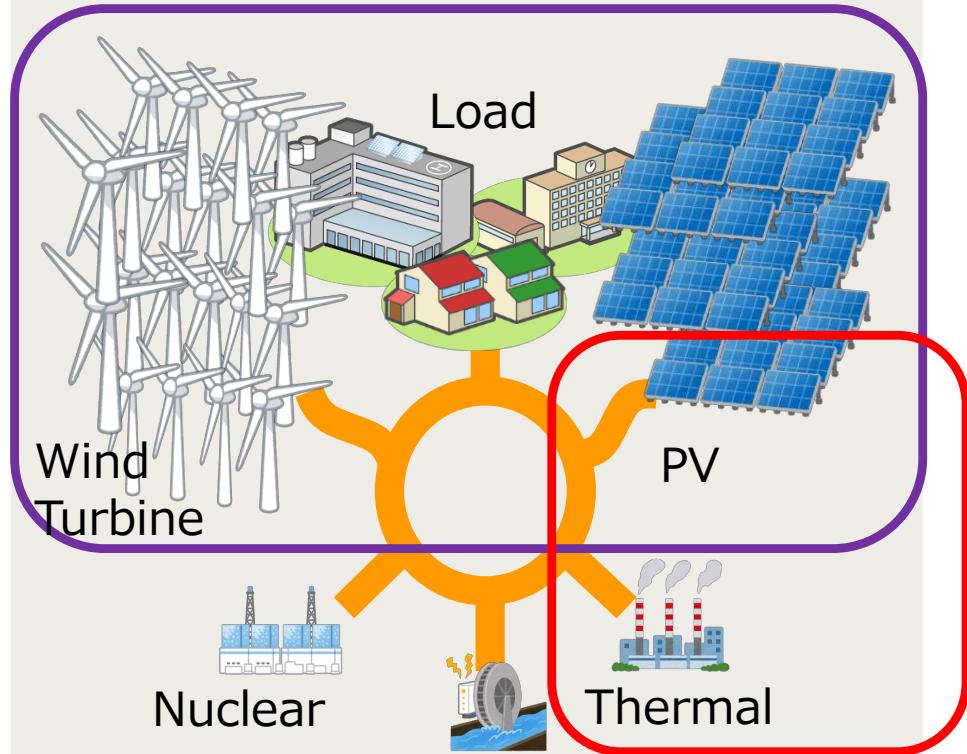
Stable Grid



Cause of stabilization (Sync. Gen.)
with inertia/Synchronization

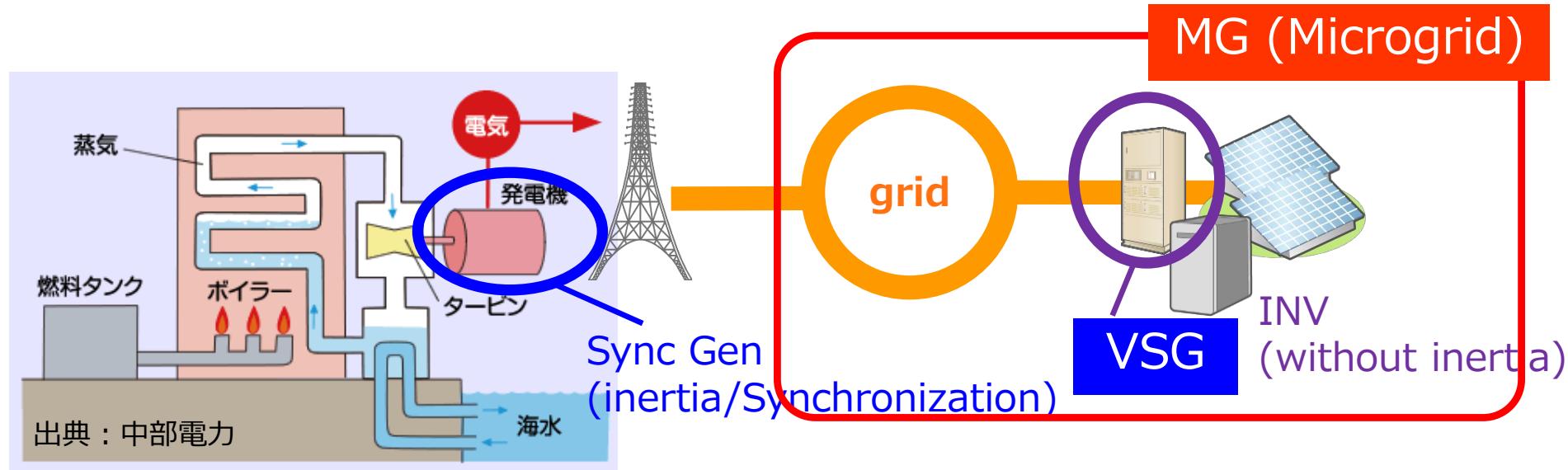
Unstable grid

Cause of Instability (Load, Renewables)
without inertia/synchronization



I. Backgrounds

VSG(Virtual Synchronous Generator)



increase INVs decrease Sync Gen \Rightarrow decrease total inertia \Rightarrow unstable grid

Challenge : realize both **the introduction of renewables** and **the grid stabilization**



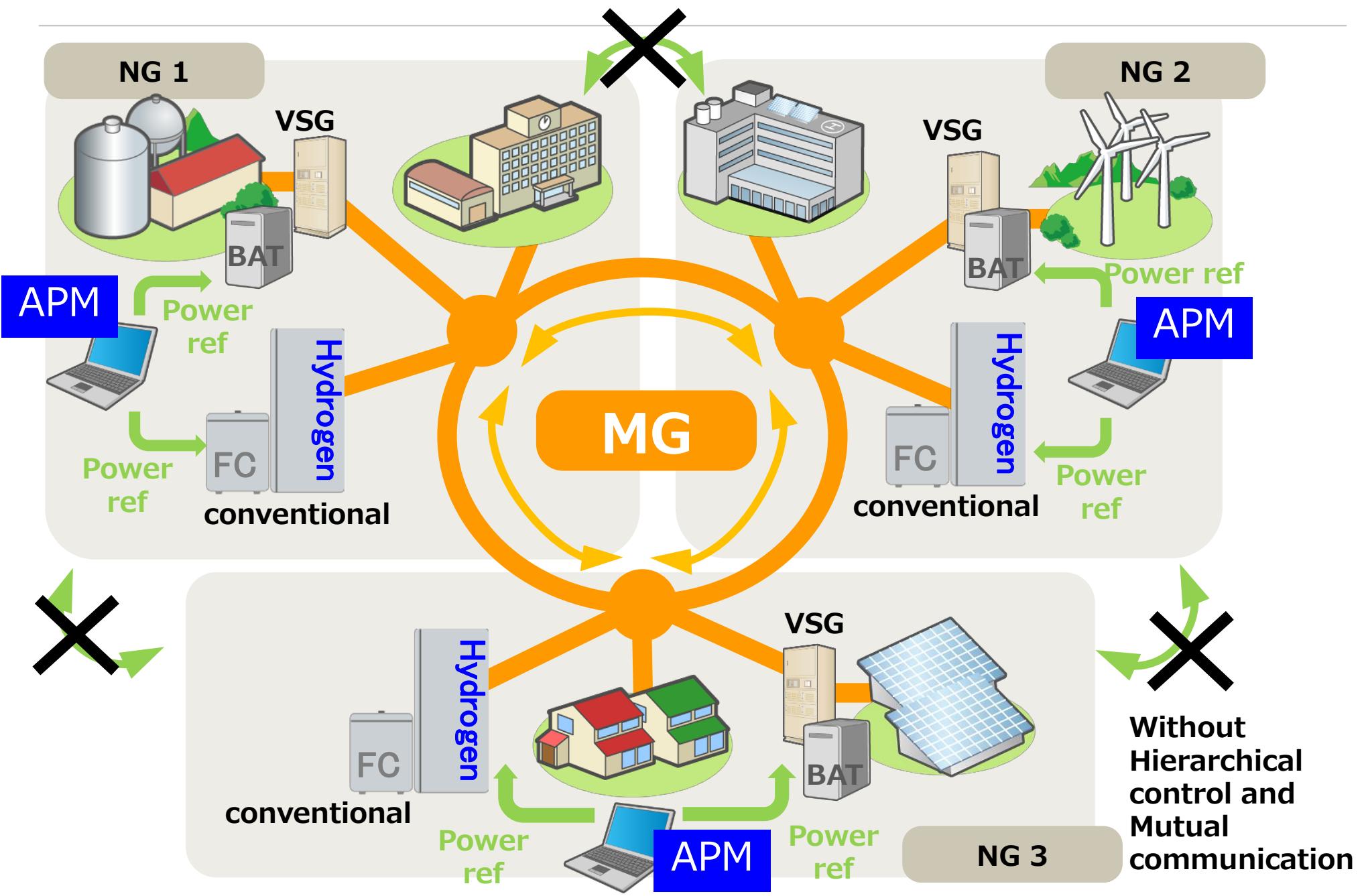
inertial/synchronization forces are mimicked by INVs

Increase INVs with virtual inertia \Rightarrow increase total inertia \Rightarrow stable grid

VSG

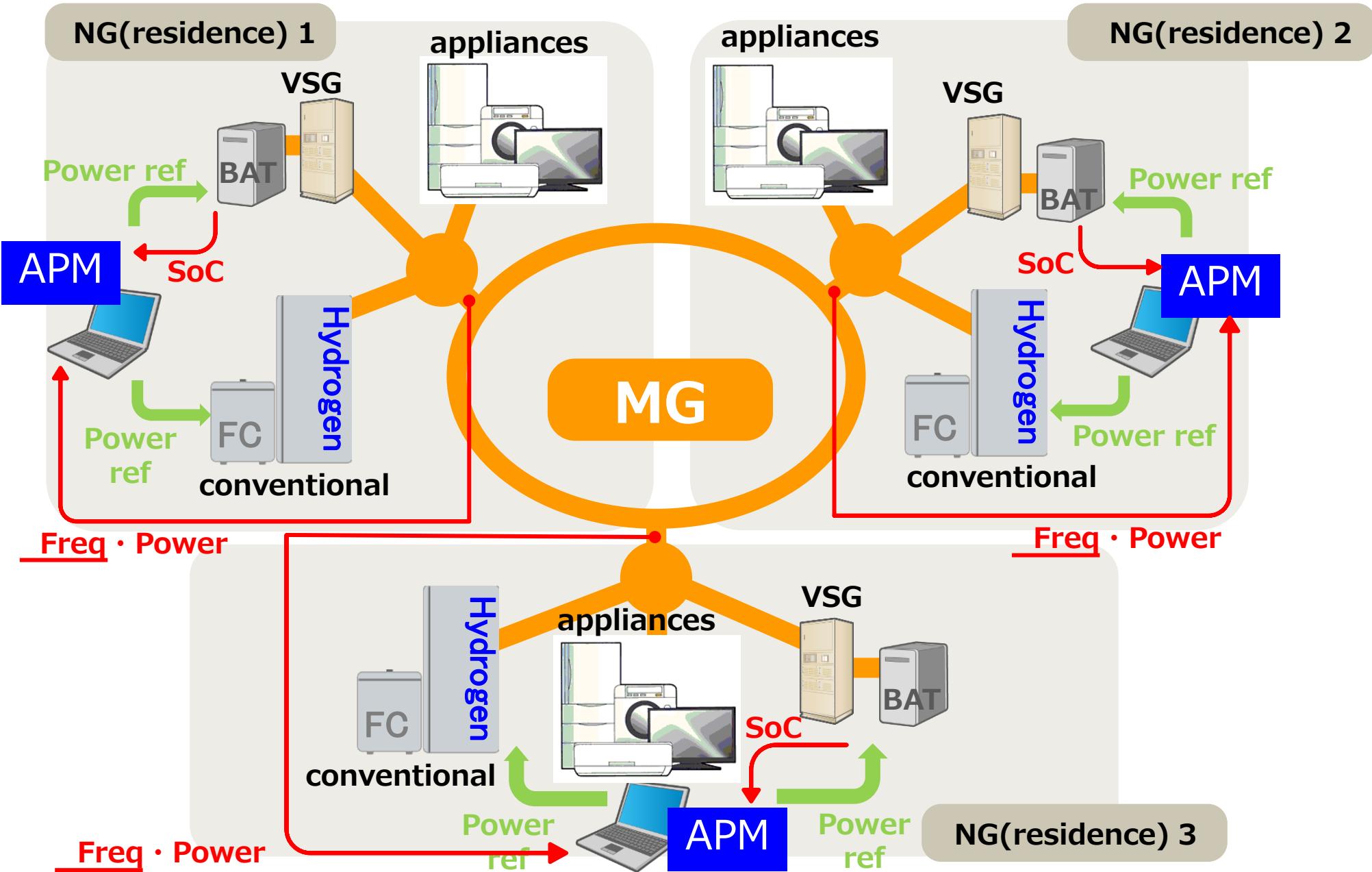
I. Backgrounds

APM (autonomous Power Management)

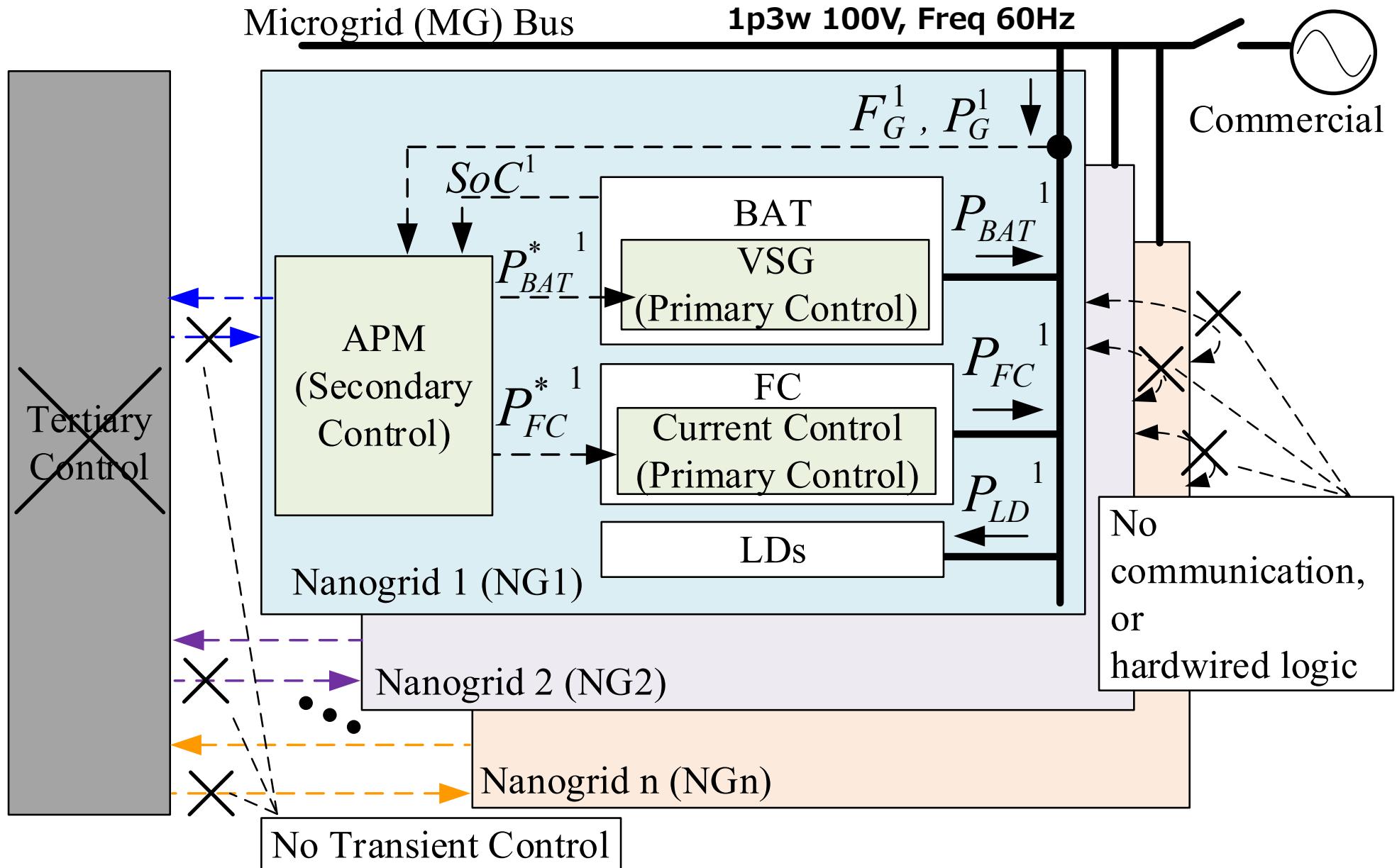


I. Backgrounds

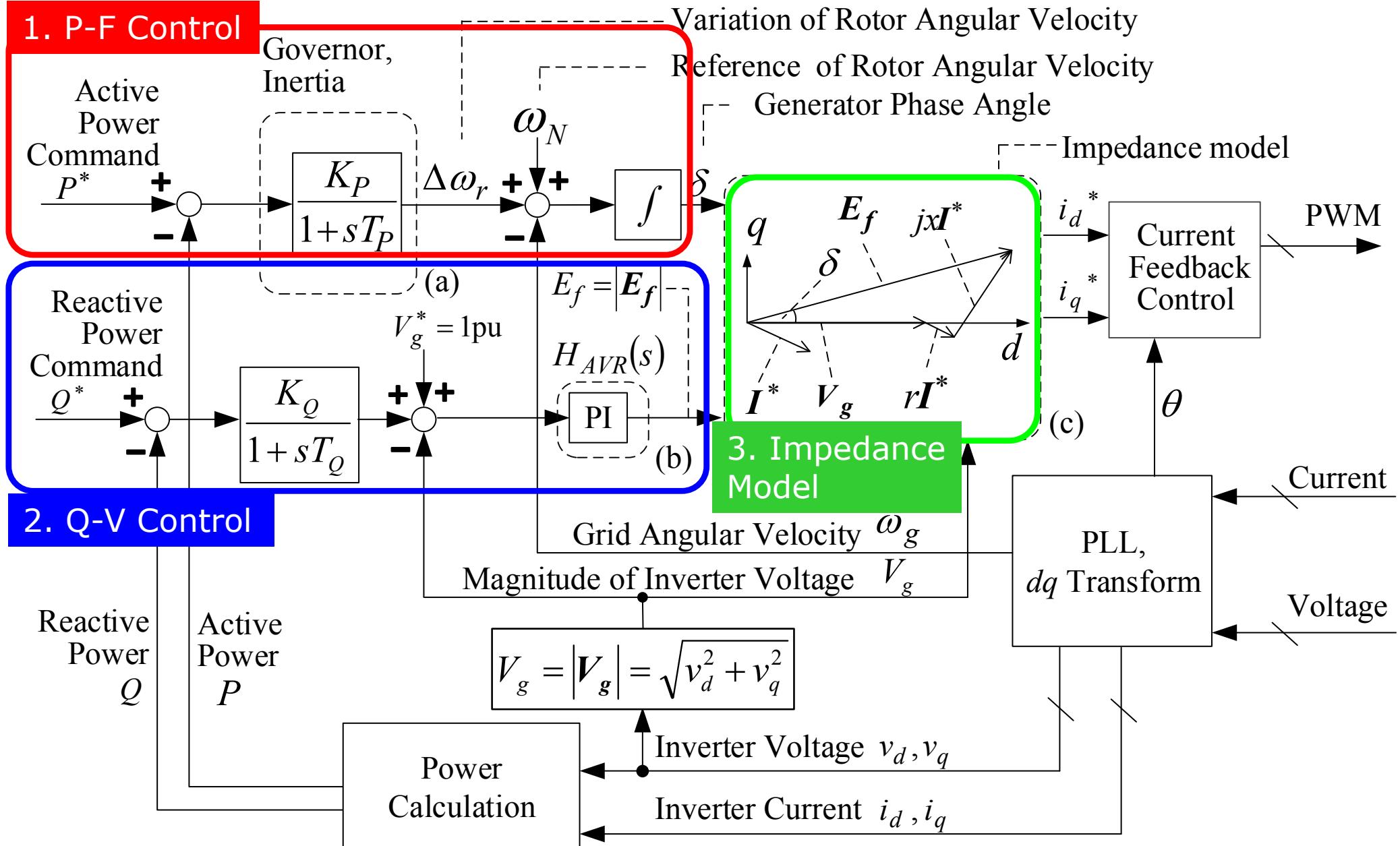
APM (autonomous Power Management)



II. Control method MG configuration

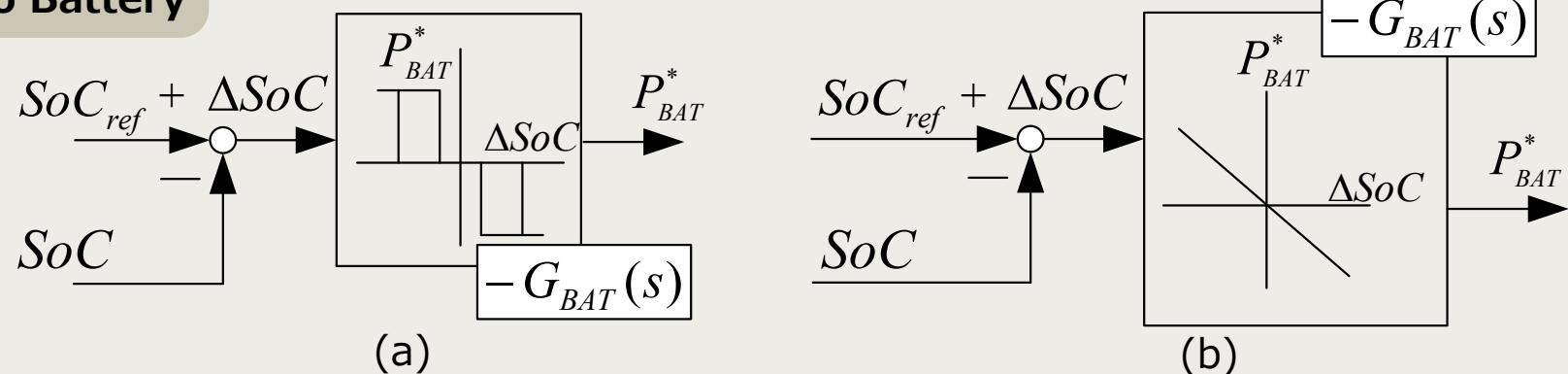


II. Control method VSG control

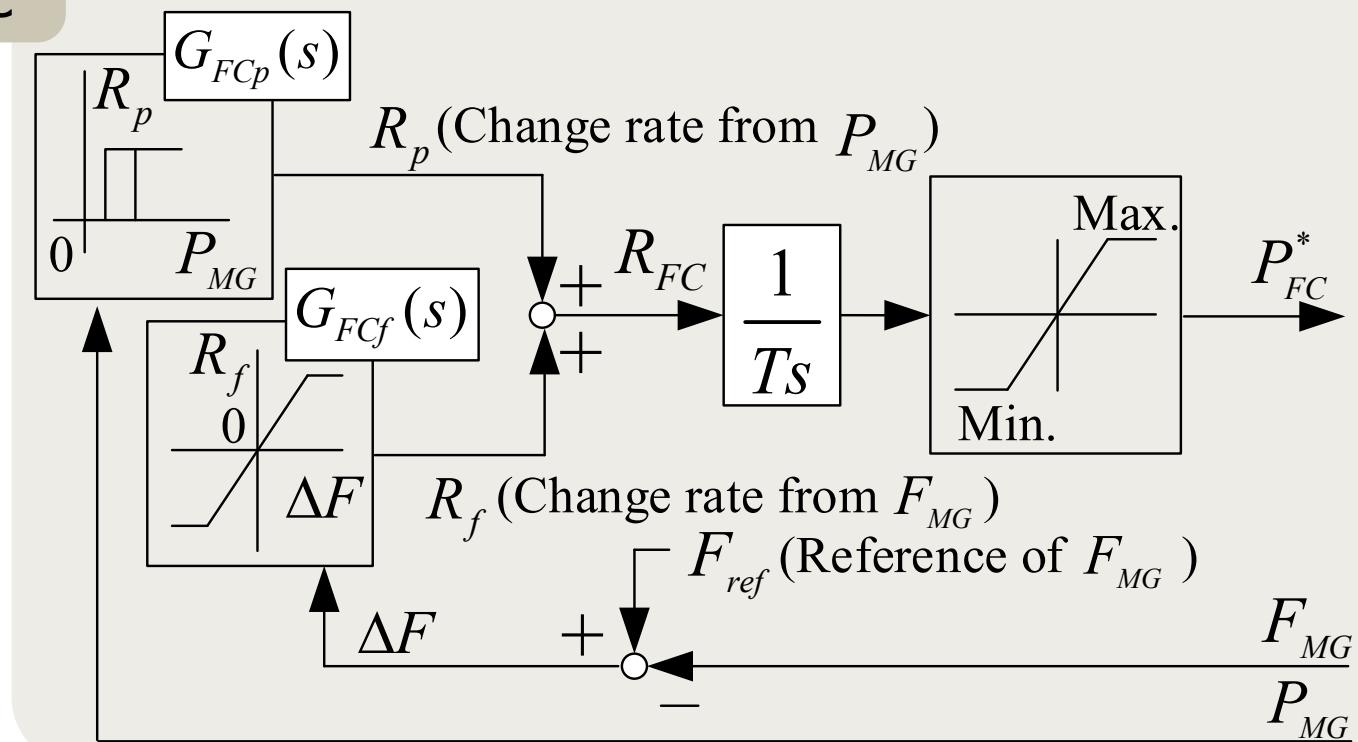


II. Control method Battery/FC outputs control in APM

Cmd to Battery



Cmd to FC



II. Experimental condominiums

Experiment on SOFC in condominiums

Osaka Gas conducts experiments on introducing SOFC in actual homes at the NEXT21, an experimental residential complex built by Osaka Gas.

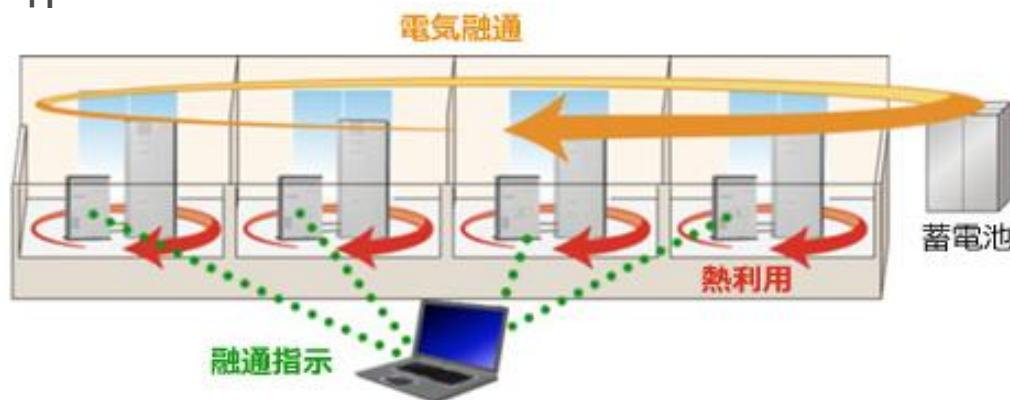


Experiment on SOFC at the NEXT21, an experimental residential complex built by Osaka Gas

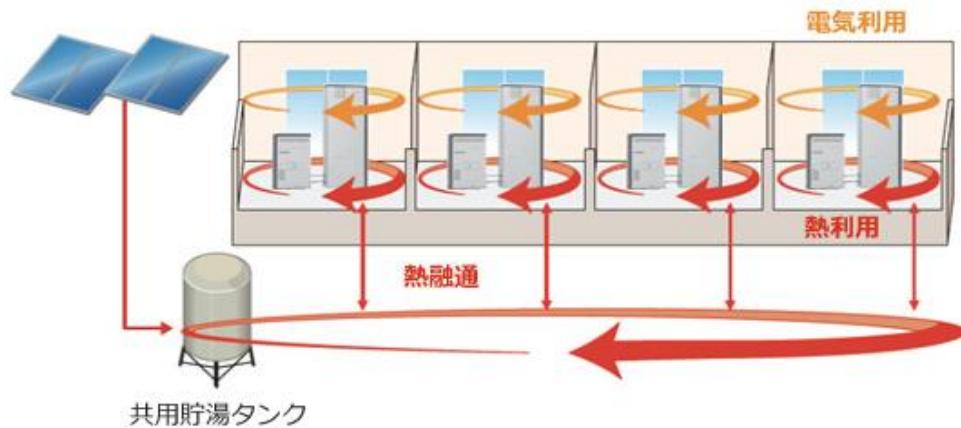
http://www.osakagas.co.jp/en/rd/fuelcell/sofc/sofc_report/index.html

II. Experimental condominiums

4F

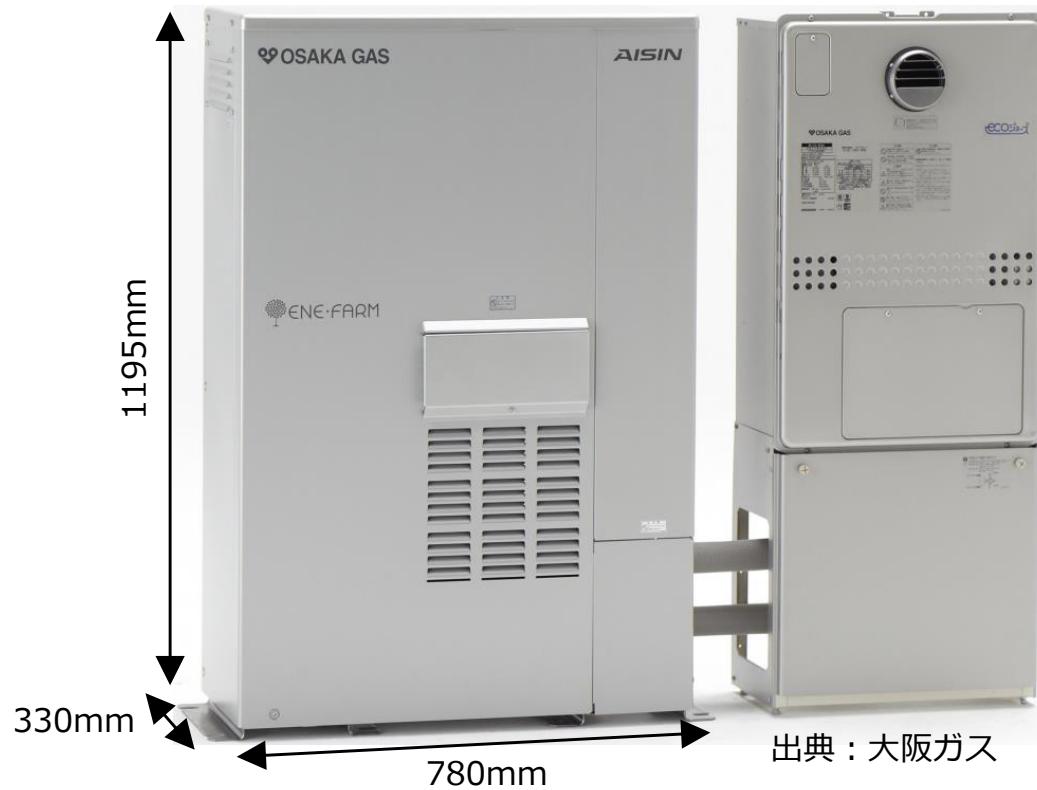


5F



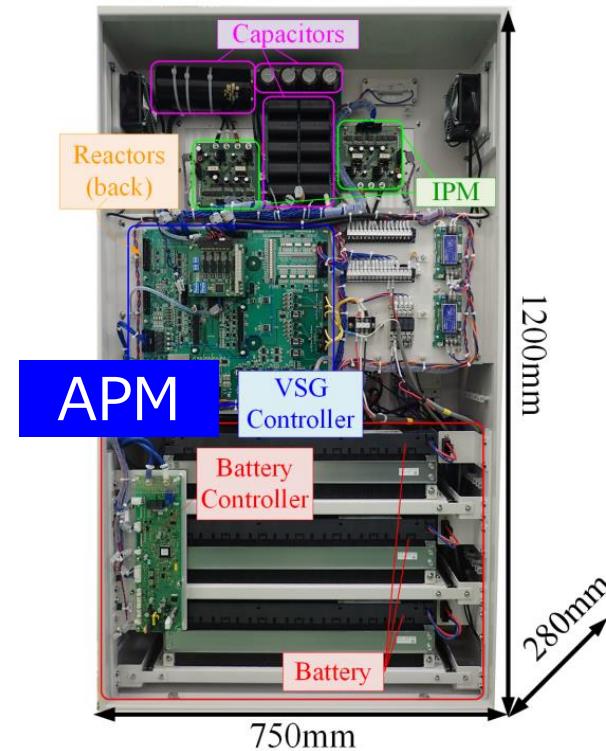
<http://www.osakagas.co.jp/company/efforts/next21/system/system2.html> (in Japanese)

II. Results Equipment (FC and VSG INV)



ENE · FARM type S

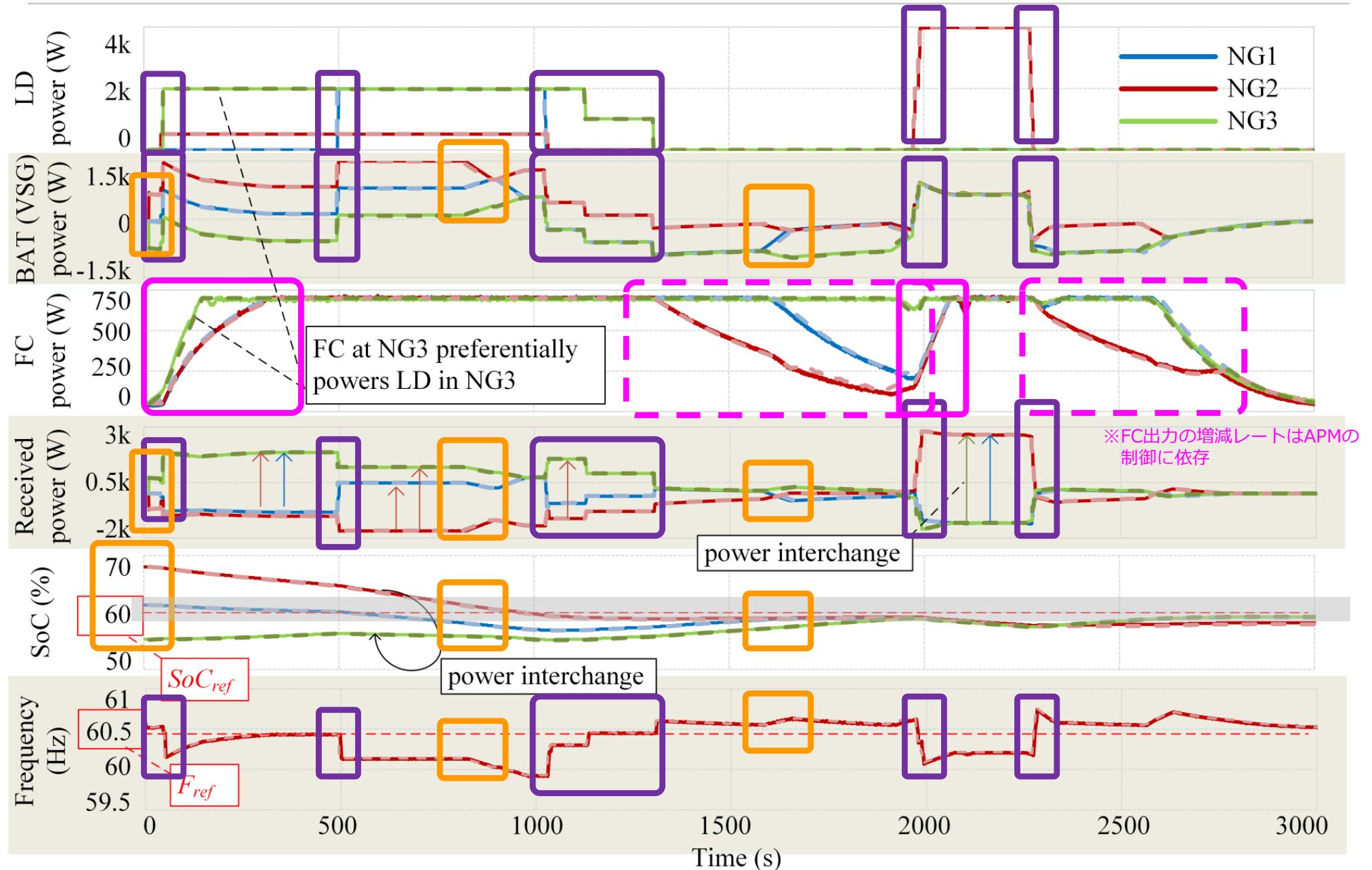
- 200V 1p3w
- generate power 50~700W
- grid connected (conventional current control)
- stand-alone is OK (use designated outlet) ←unused



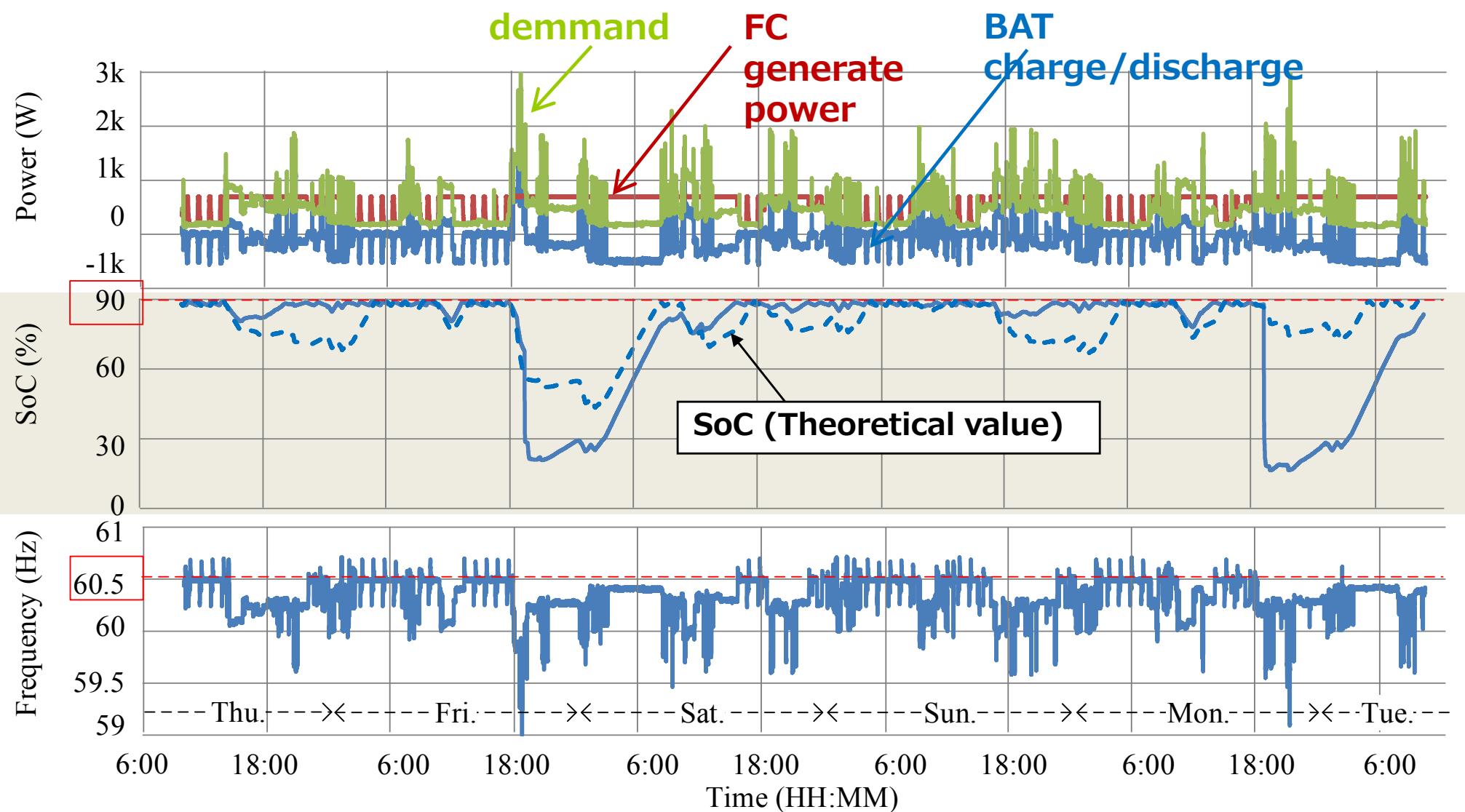
VSG INV + Battery

- 1p3w(100V/200V)
- rated output 4kW
- Built-in **Li-ion battery(4.2kWh)**
- VSG control by INV
- stand-alone and parallel run are OK

II. Results results in 3 residences (50min)

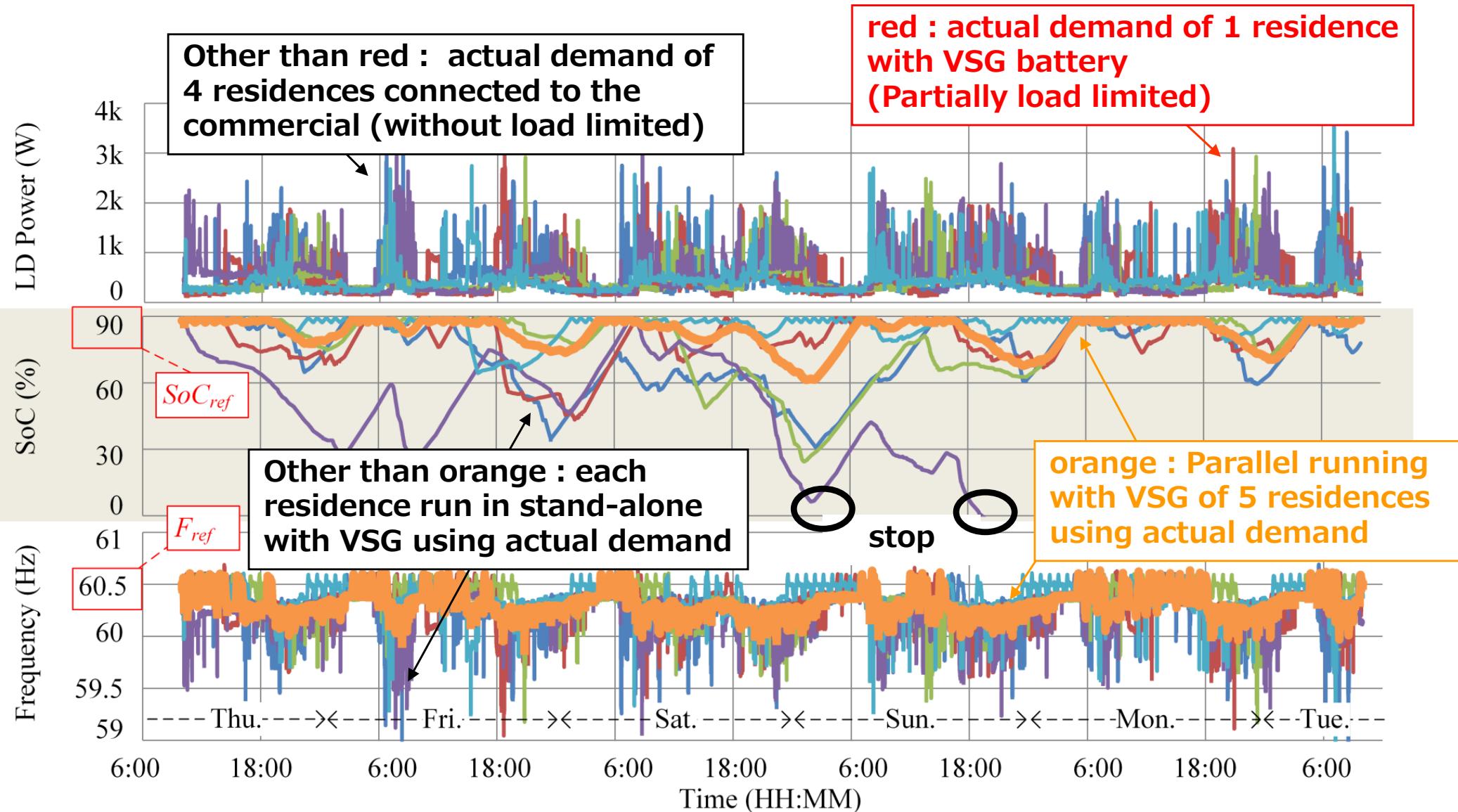


II. Results results in 1 residence (5days)



II. Results

simulation of 5 residences using actual remand data (5days)



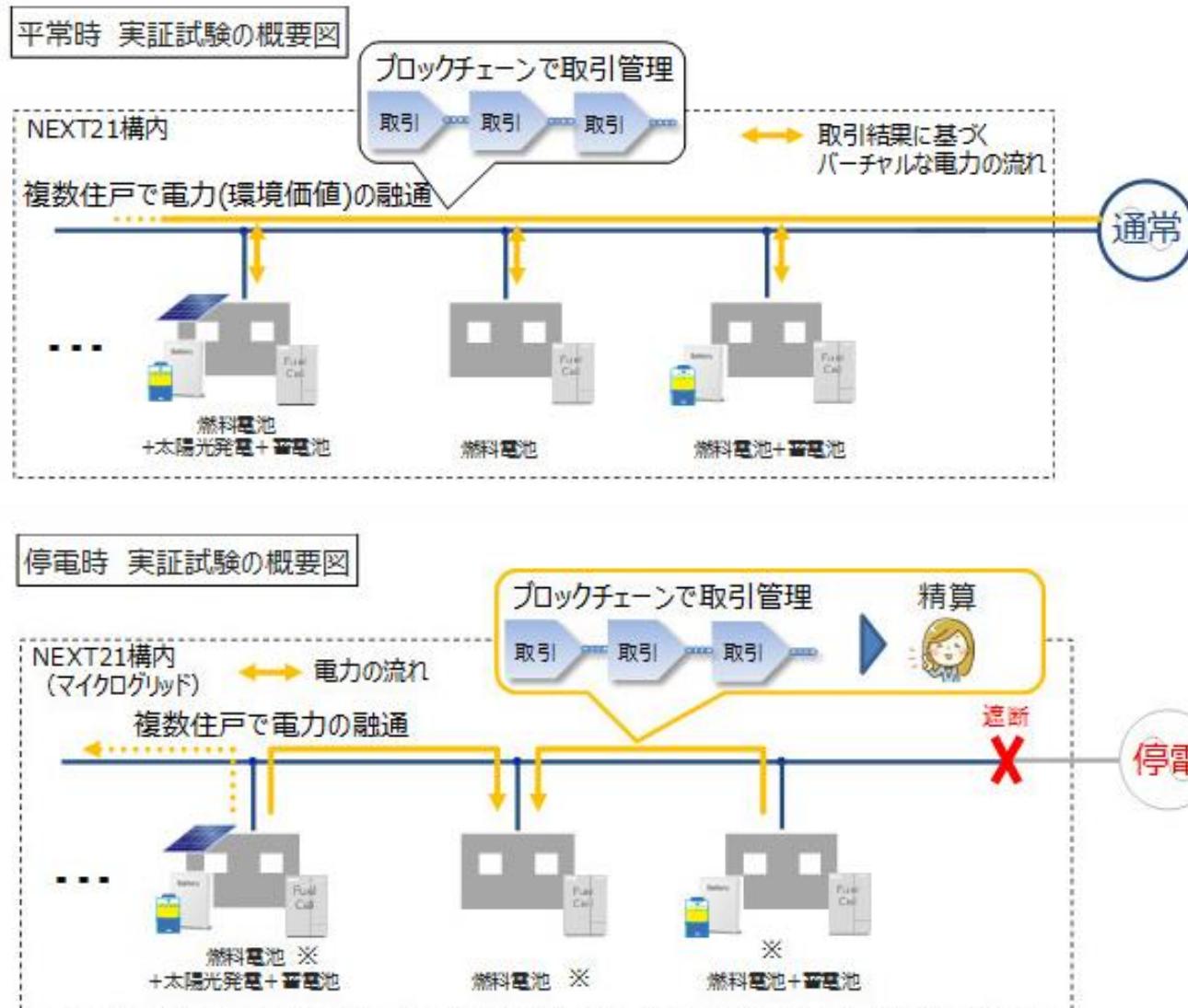
IV. Future outlook

- Press release “Improvement of energy security and power transactions”
 - surplus power generated by distributed energy systems will be able to **freely buy and sell without using power retailers.**
 - Blockchain technology is expected to be effective in managing such trading.

- Demonstration tests
 - In order to **confirm the effectiveness of blockchain technology in inter-individual power transactions**, demonstration tests are planned using the resident's real-life environment.

http://www.osakagas.co.jp/company/press/pr_2019/1278594_40360.html (in Japanese)
http://www.osakagas.co.jp/en/whatsnew/1281331_11886.html (only title)

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Thank you for your kind attention.

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