



PV-COOLING

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The Goal

Produce cooling effect using thermodynamic system coupled to PhotoVoltaic (PV) plant for driving, monitoring and supervision.

Justification (1)

Energy efficiency:

matching of need and resource

Environmental efficiency :

self consumption
energy storage.

Justification (2)

- Self-consumption
- Energy storage
- Smart Energy management
- Peak Shaving

Economic justification

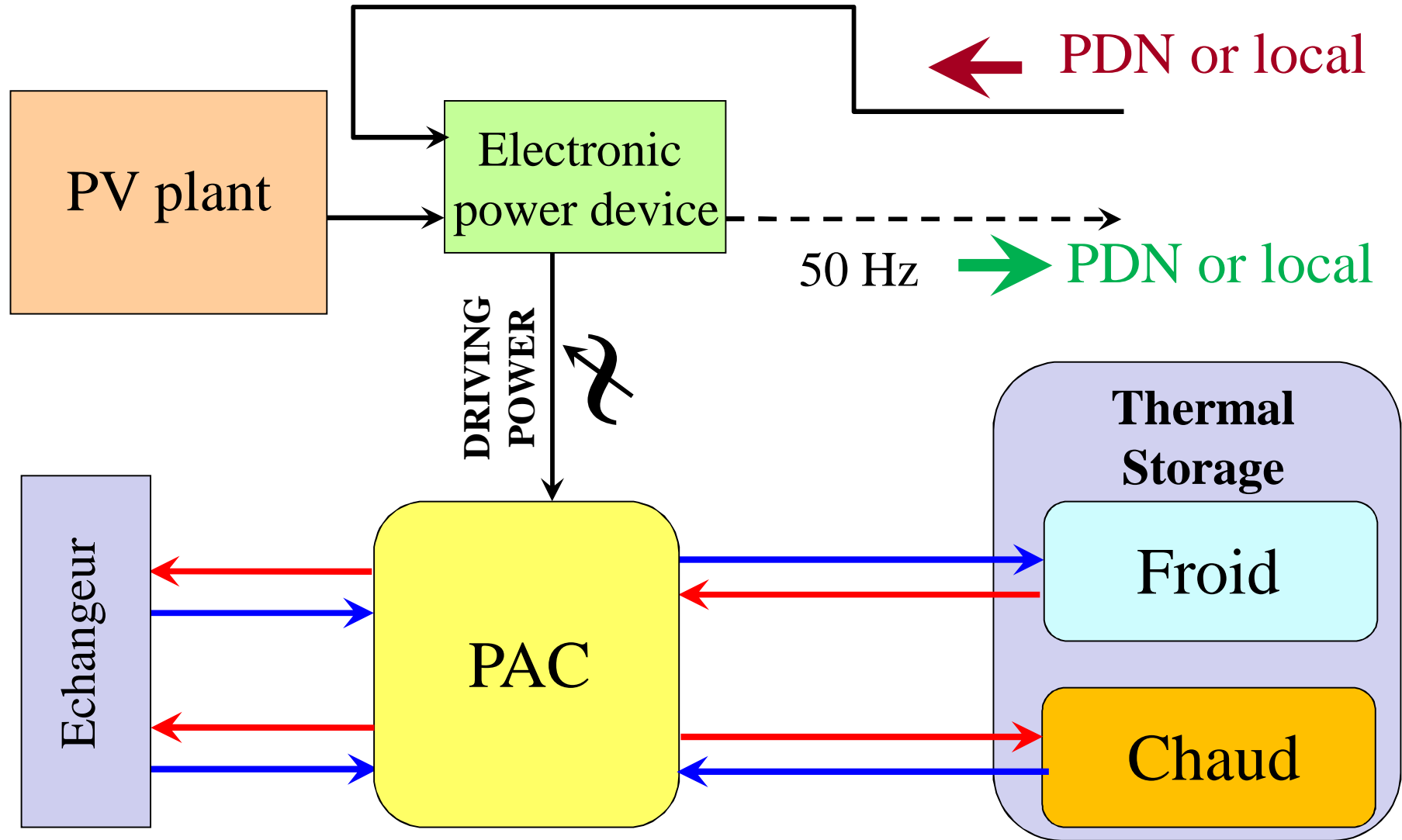
geographic areas

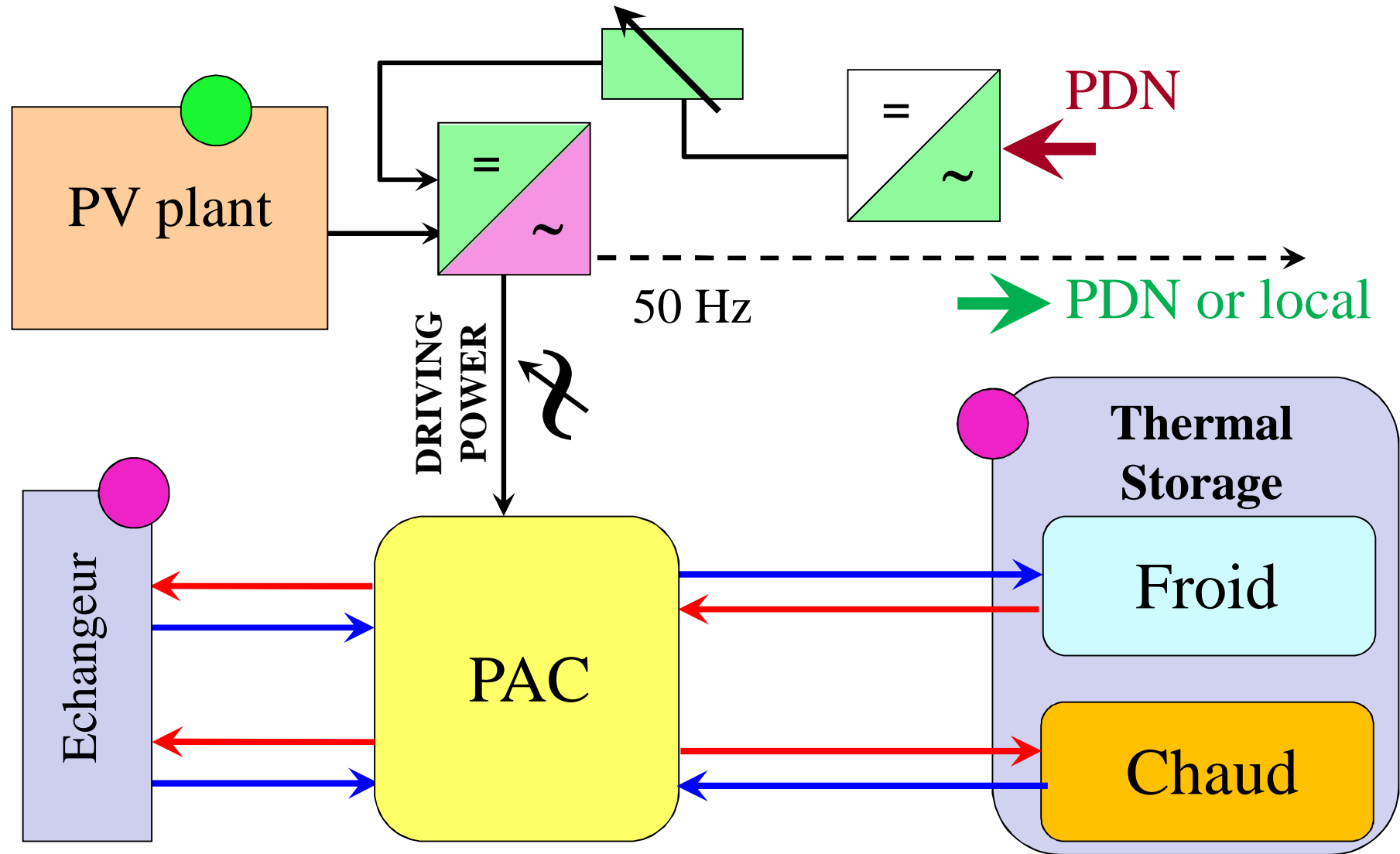
- DOM/TOM
- Maghreb, Middle East
- Southern Europe
- Australia, USA
- Southern France (Riviera, Corsica...)

Electric problem

Secure compressor energy supply: provide necessary complement to PV power (PDN, battery storage, ...):

- Possible energy complement provided by external supply (PDN, battery)
- Working conditions of compressor is constraint within the « acceptable domain » (variable power).
- PV power excedent is injected to PND or local network

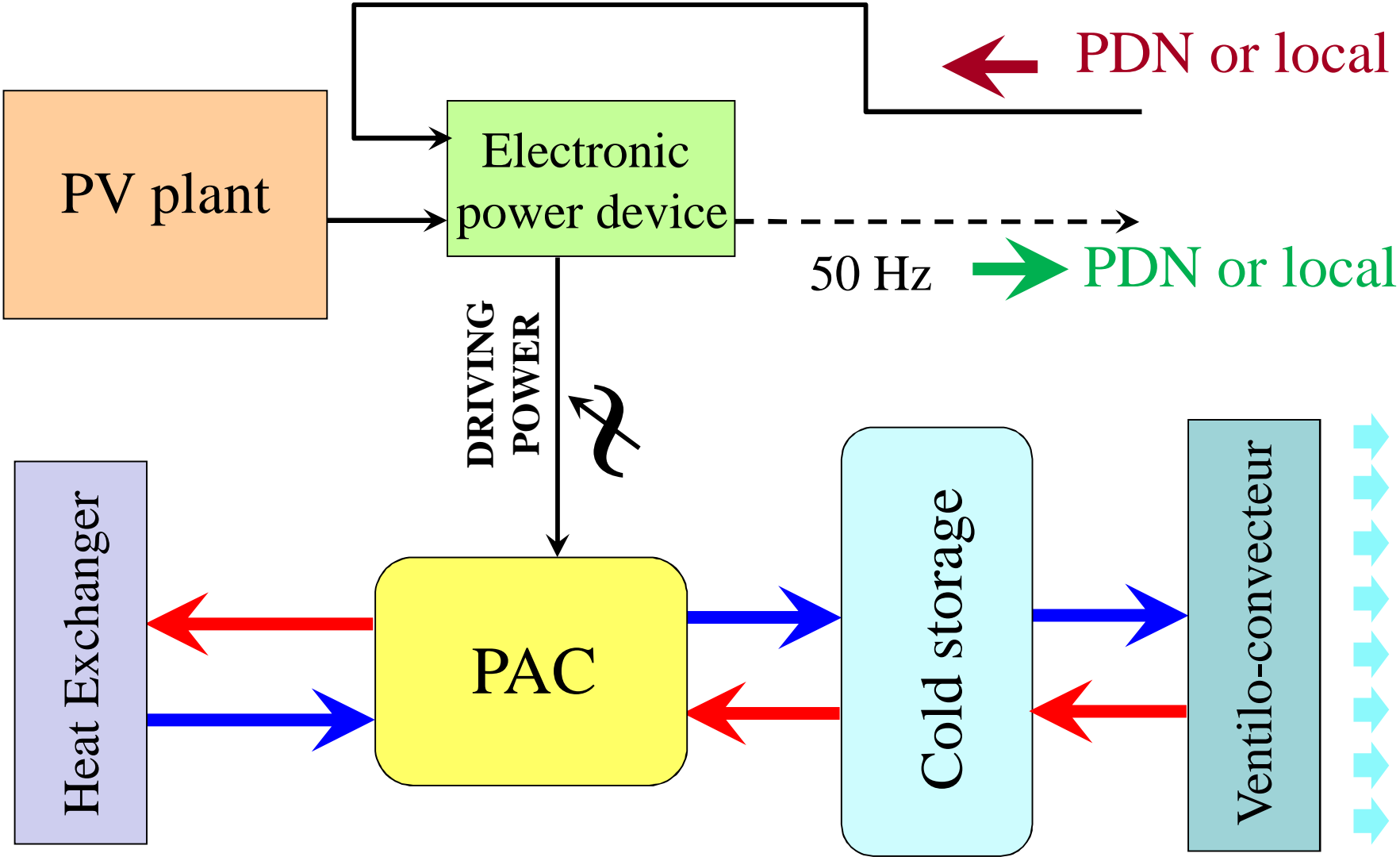




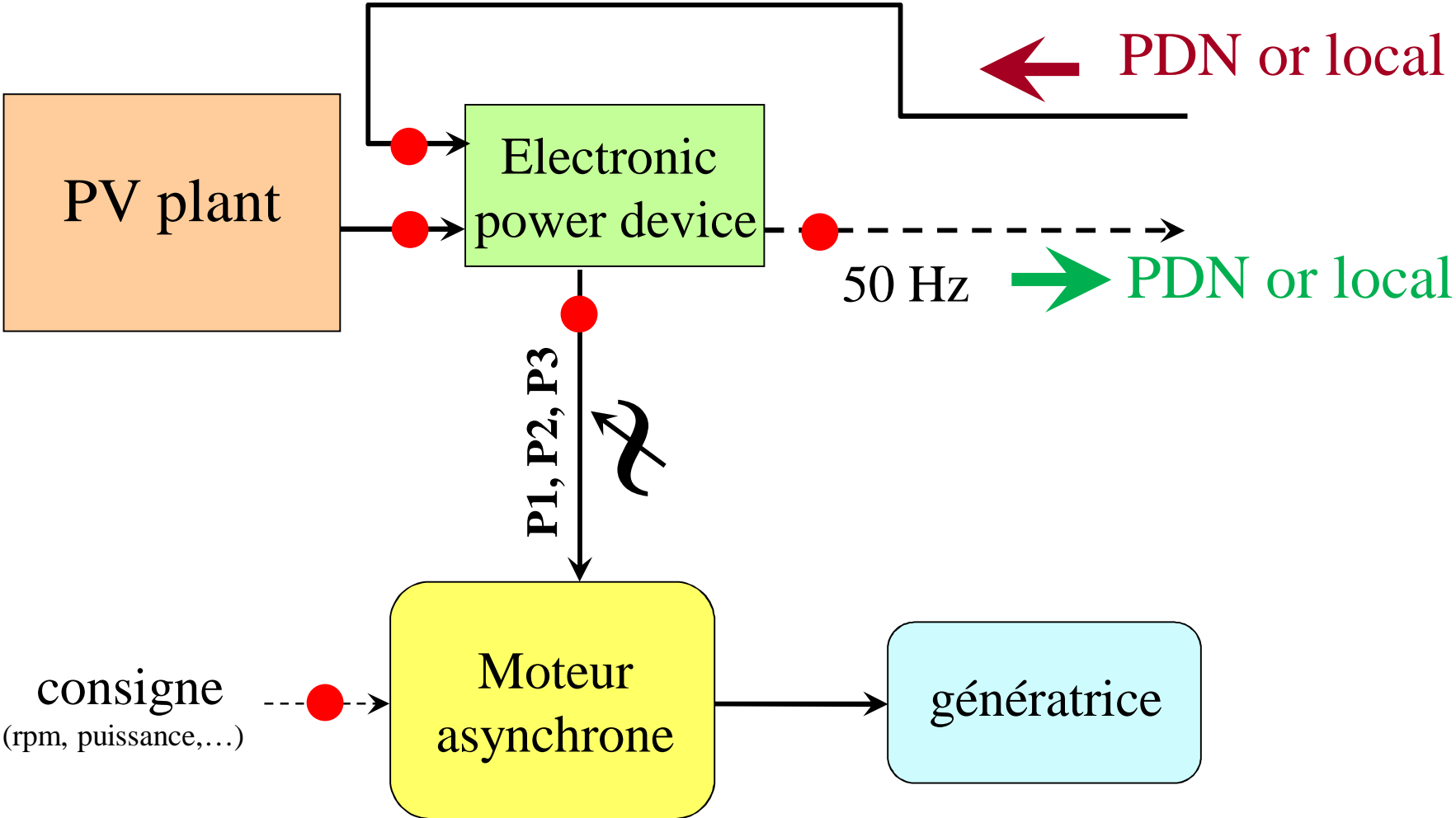
The thermal problem

- Define acceptable COP compressor working domain (variable power)
- Analysis of storage modes (sensible, latent)
- Storage and distribution management
- Dimensioning whole system

Prototype set-up



Preliminary set-up



Primary experiment

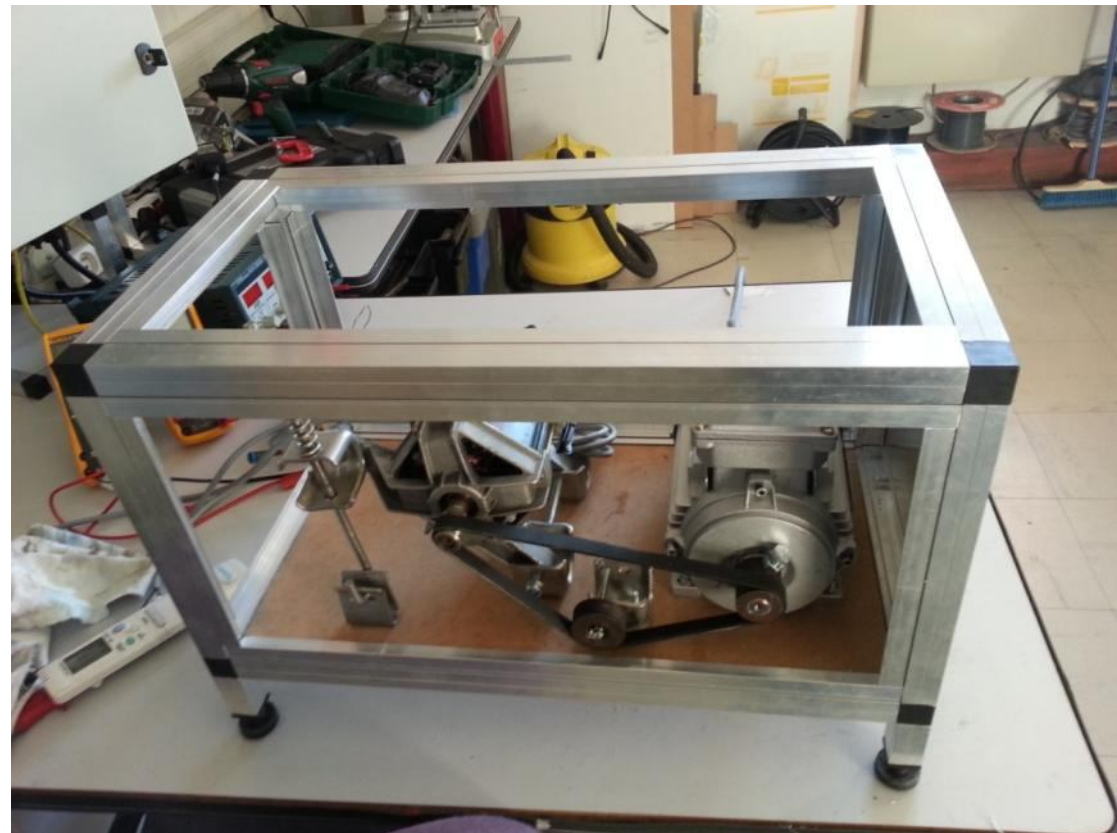


PV power (500 W) feeds an asynchronous triple phase Motor which drives a generator

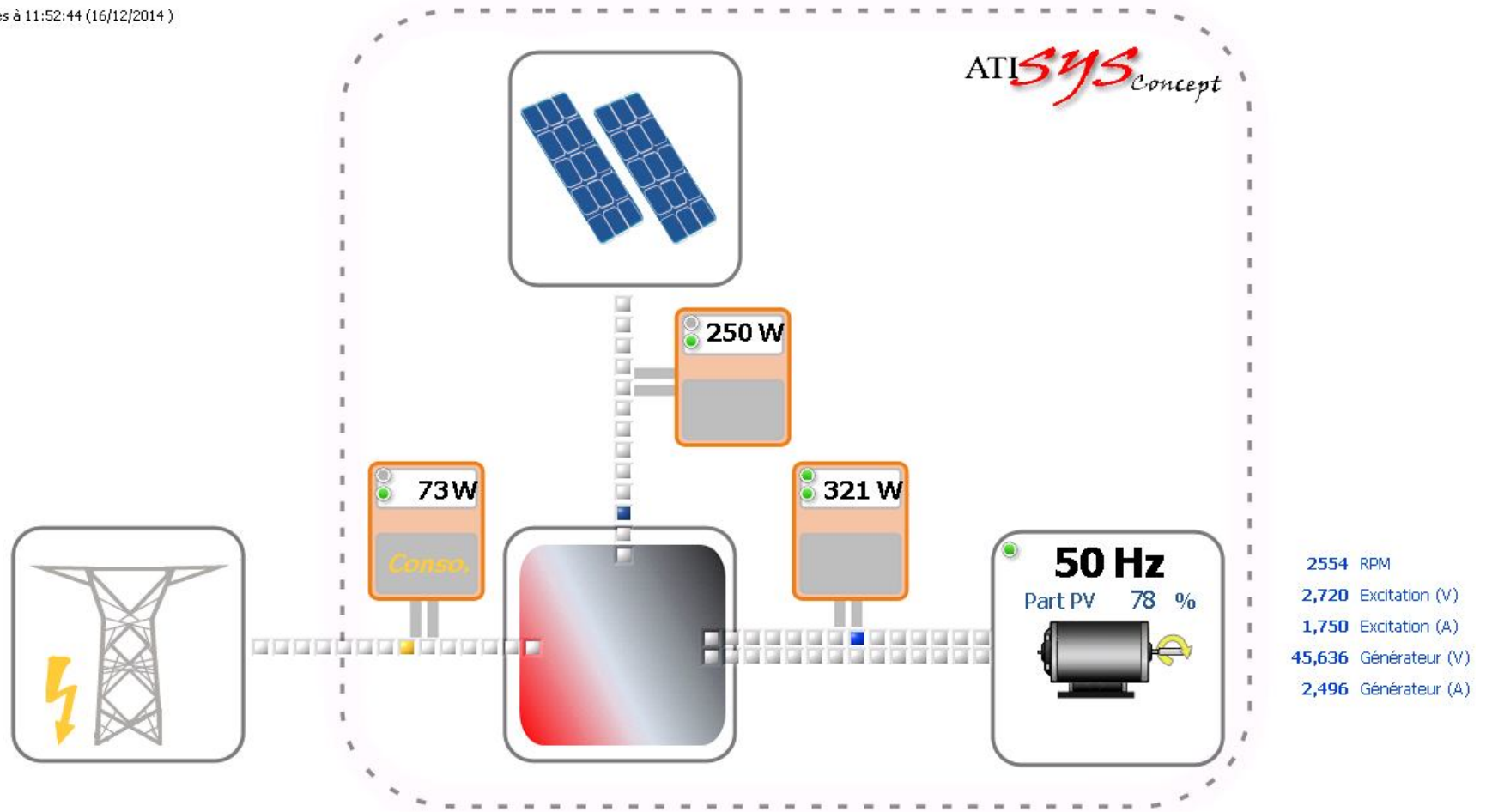


Controlled load:

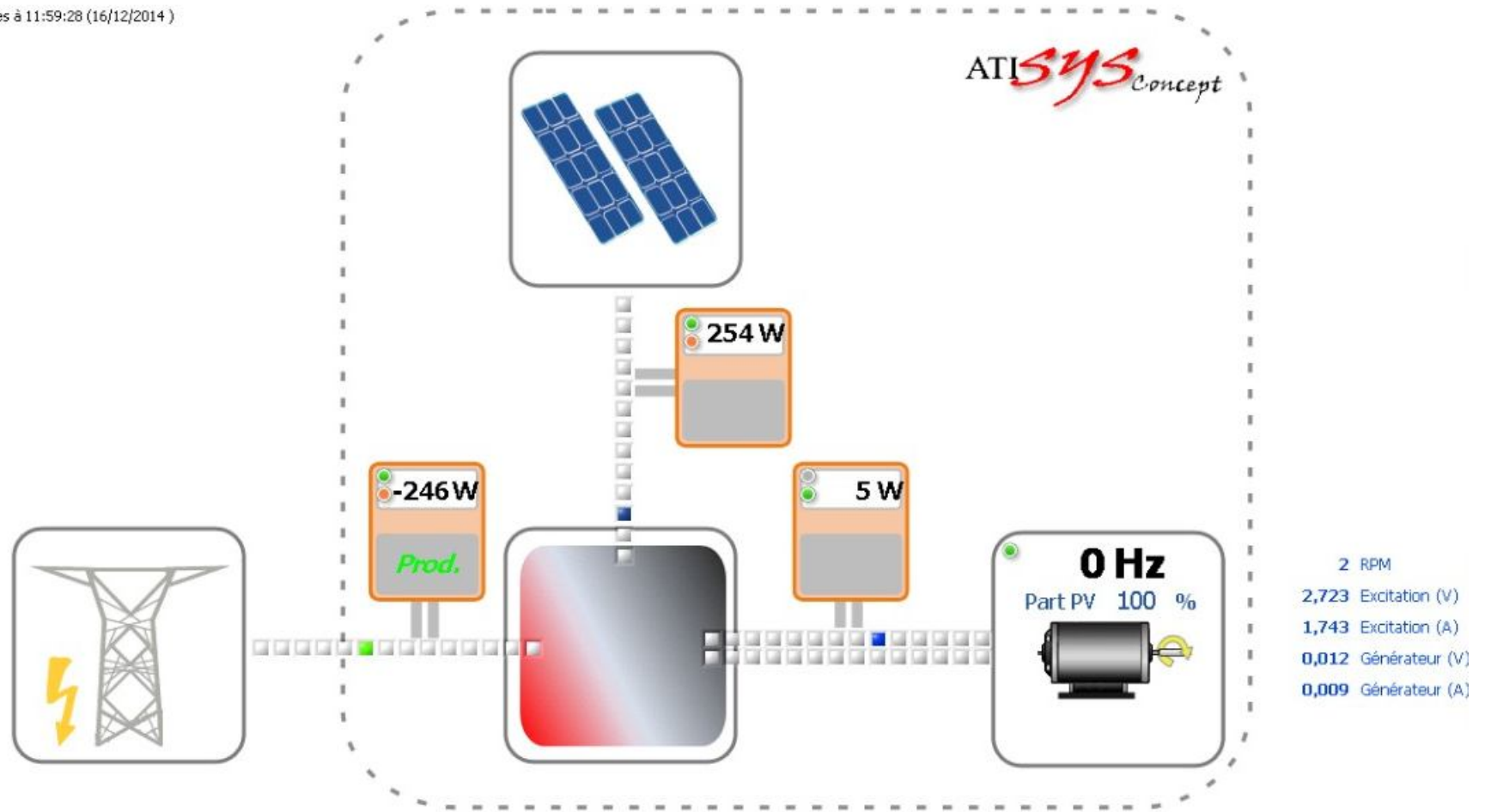
- inductor current
- output resistor



Dernières données reçues à 11:52:44 (16/12/2014)







Dernières données reçues à 11:59:28 (16/12/2014)



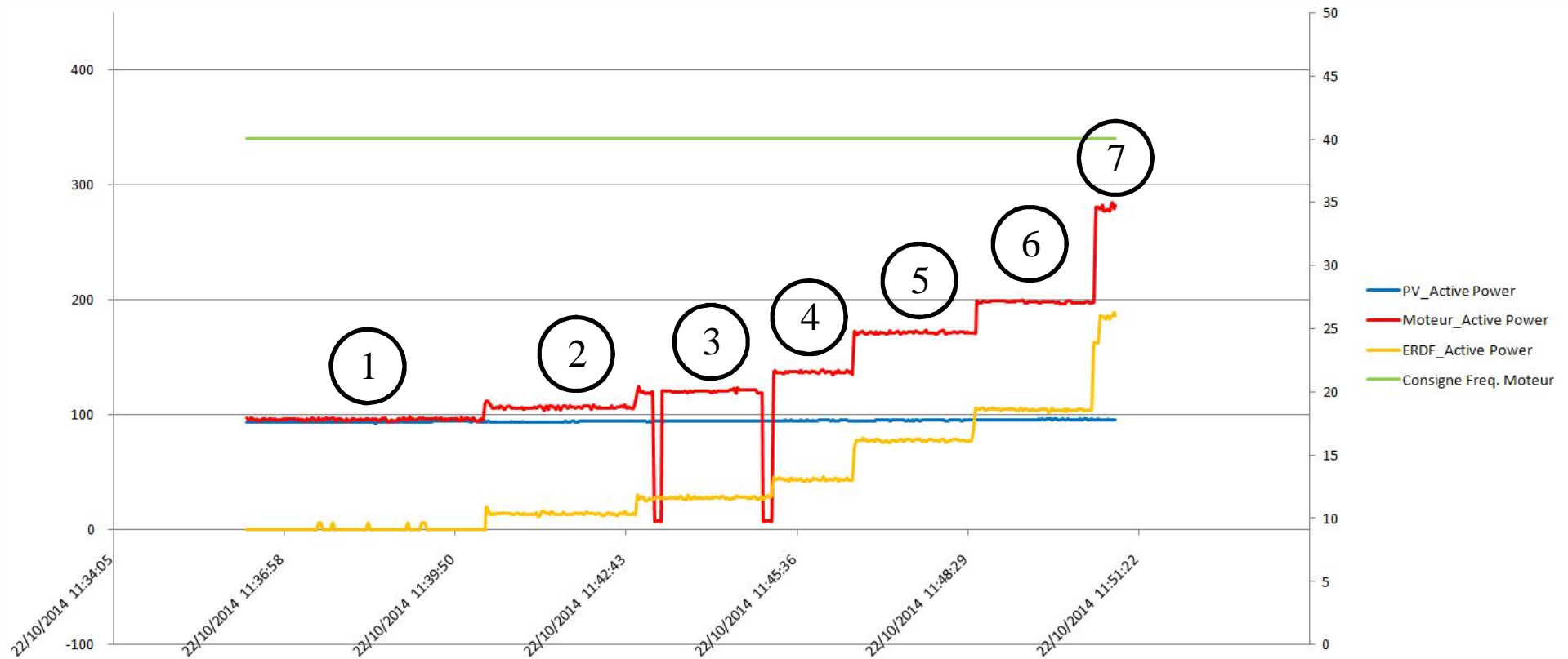
Several regulation scheme :

1. at **constant speed** (and constant PV power) and **variable load** (system uses PDN complement);
2. at constant PV power, one **vary speed instruction**, step by step, and then one **vary the load**;
3. at **constant motor power instruction** (and constant PV power), one **vary the load** : motor speed adapts automatically (in real conditions, such an adaptation is to be managed according to compressor builder instructions);
4. Example of **adjustment with PV power**.

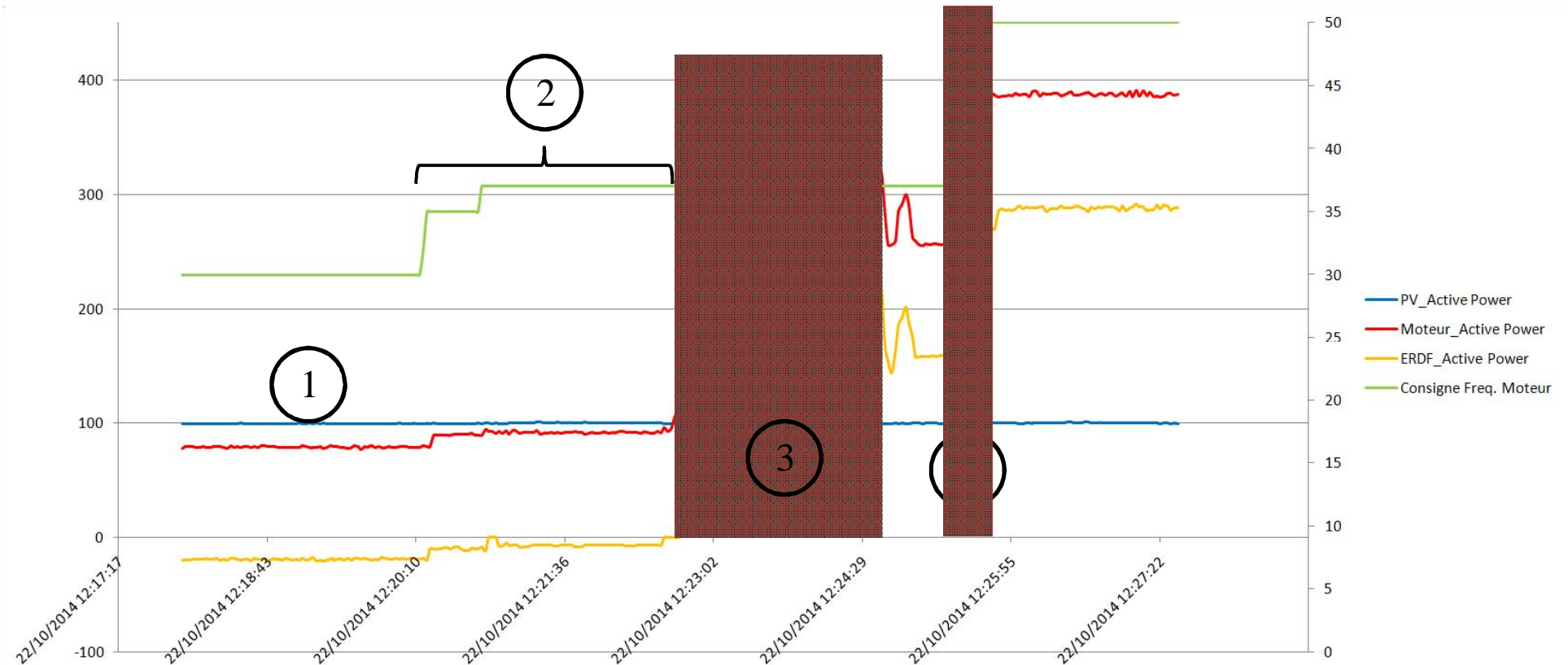
For understanding next graphes:

	PV power (W)
	Motor active power (W)
	PDN active power (W)
	motor speed (rpm)

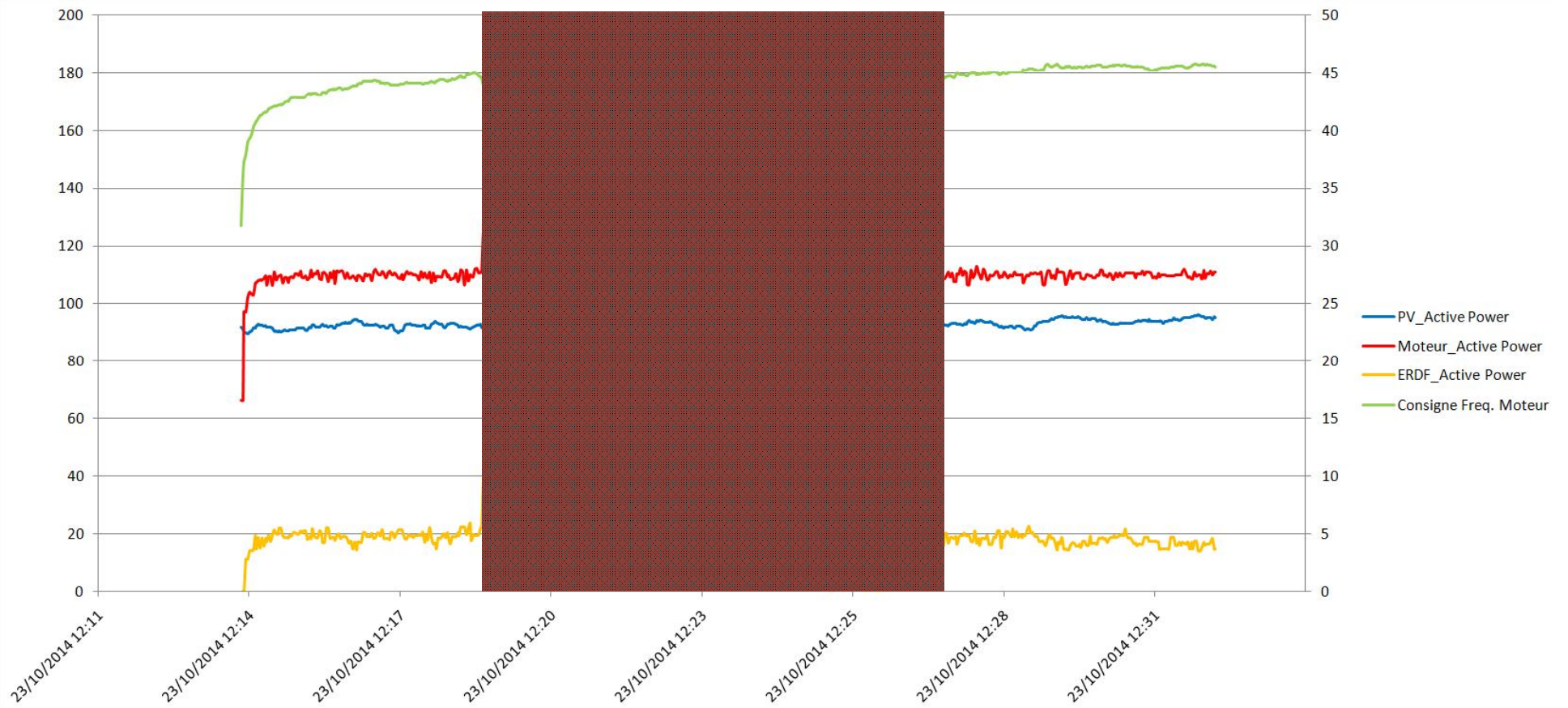
Constant speed (rpm), variable load



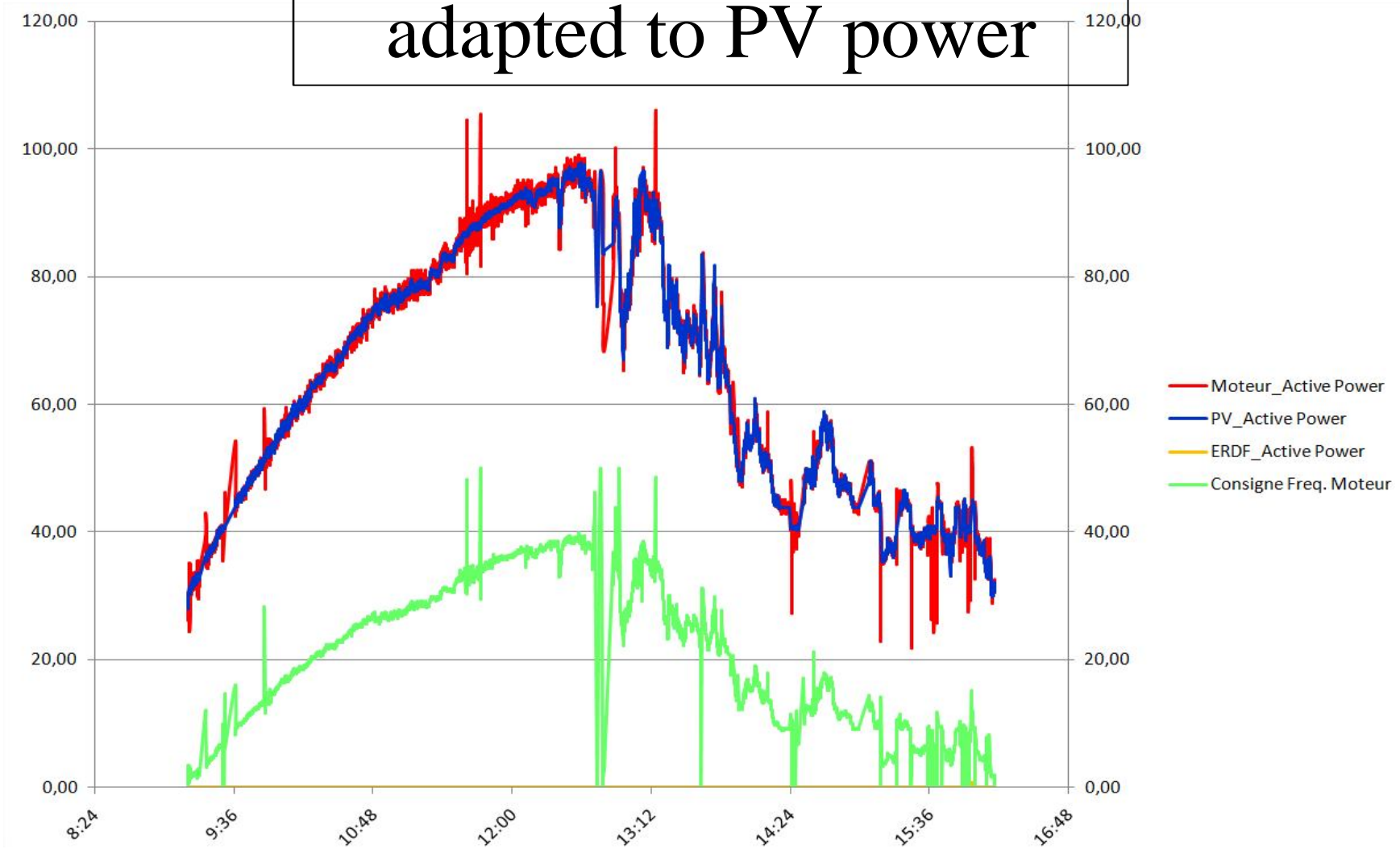
Constant speed (step by step) variable load



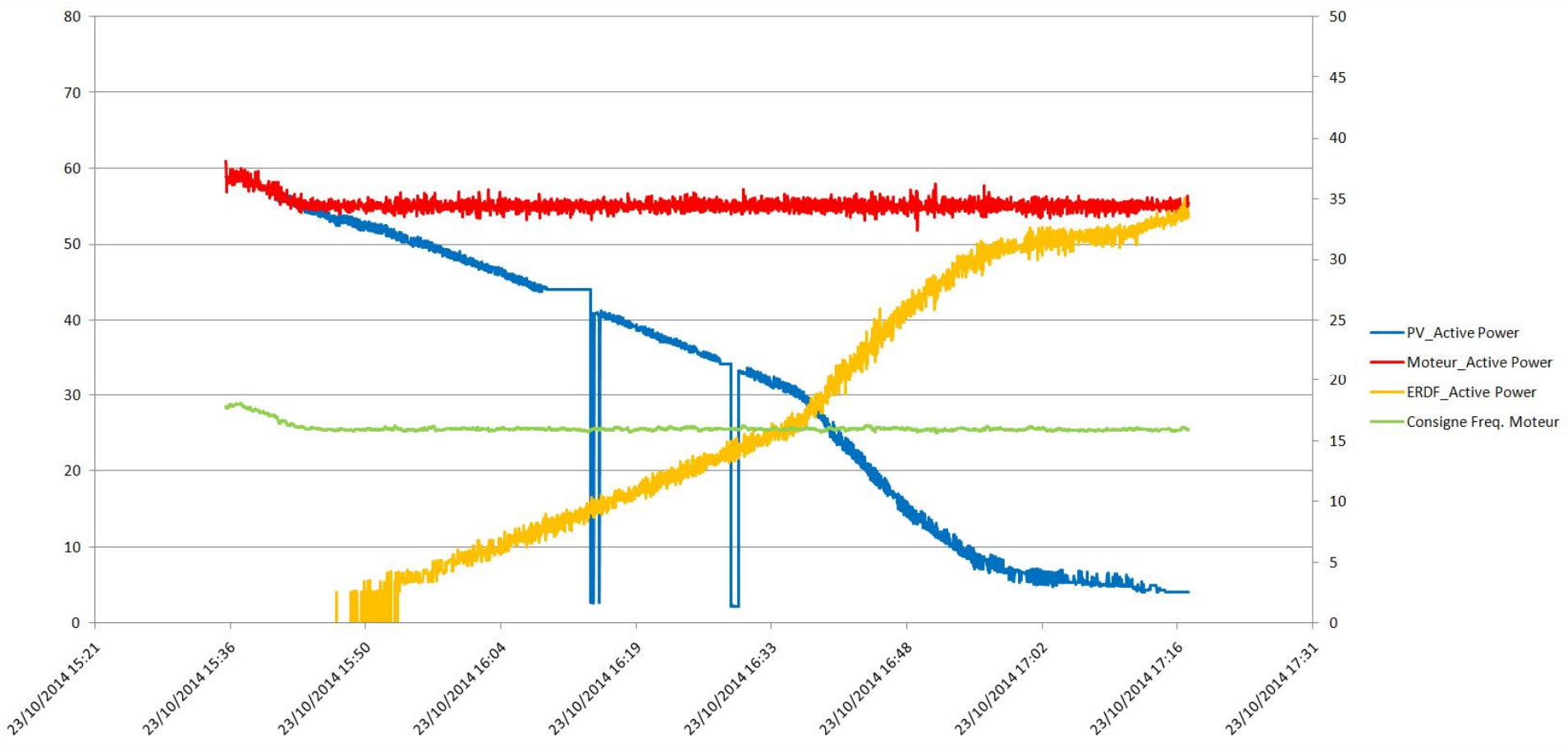
Constant motor power variable load



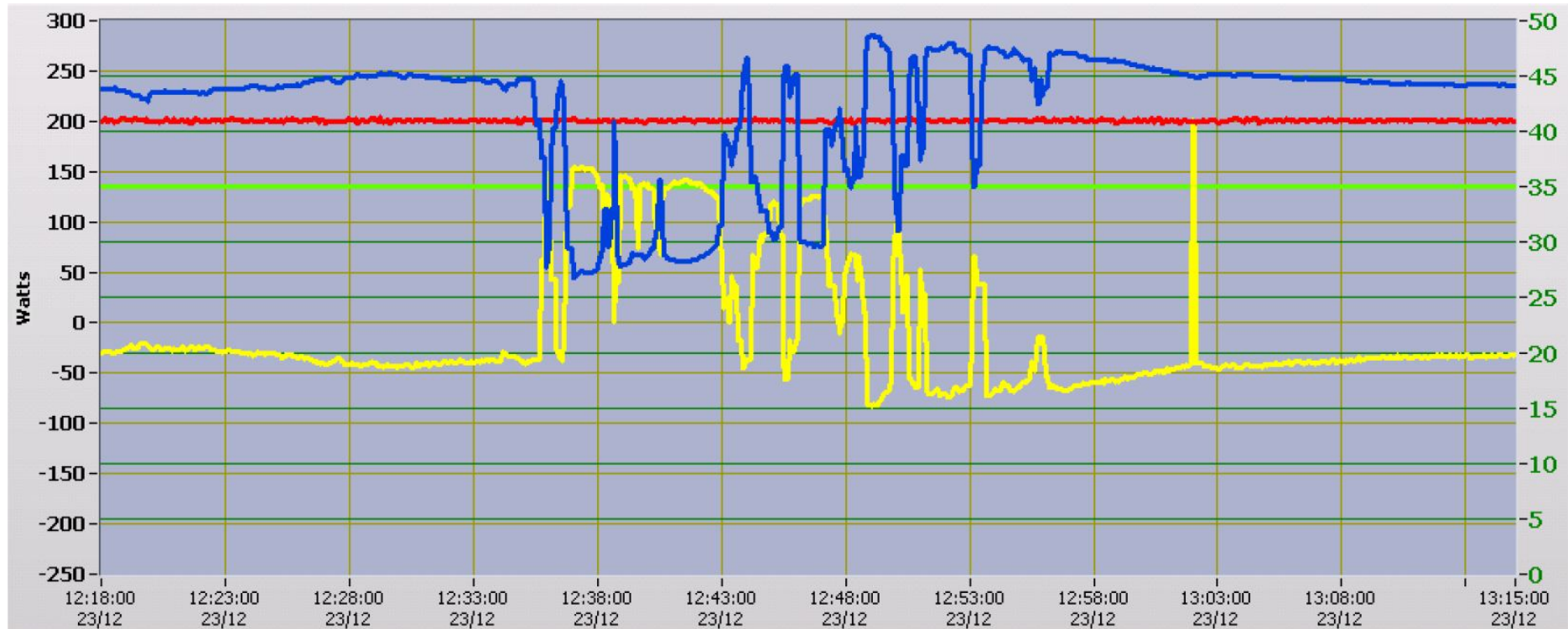
Motor speed adapted to PV power



solar extinction Constant power request



Automatic regulation (cloud obstruction)



puissance PV
puissance active moteur
puissance active réseau (<0 : injectée ; >0 : consommée)
vitesse moteur (Hz) échelle de droite

Conclusion

- Evidence has been given that electric coupling of power consuming machine and PV plant is possible
- Adaptive coupling has been demonstrated
- No reason for not working with thermodynamic system
- Application to realistic set-up is on its way