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*What local- and whole-system considerations shall be applied to optimise the design and mitigate any potential side-effects when using synchronous condensers, grid-forming inverters, or a combination to address emerging system stability issues?*

According to the grid forming (GFM) definition proposed in the WP3 of the OSMOSE H2020 project, this capability refers to a set of technical requirements such that: *a grid forming unit shall, within its rated power and current, be capable of self-synchronise, stand-alone and provide specific synchronisation services depending on the technology*. These new services are defined as a set of responses required to ensure the reachability of a new stable equilibrium point, which often implies the injection of active and reactive power, within the unit's capabilities, until electrical transients vanish (during the transient and sub-transient regimes).

In practice, synchronisation services allow for grid-connected devices to remain synchronised to the power system even after being submitted to large disturbances; hence, they can be seen as a subset of the new stability services, the ones related to the synchronisation of generating units, with a direct impact on the angle stability. As a consequence, they are meant to fill the gap between time 0 and the time when traditional (frequency and steady state voltage regulation), new ancillary services (for instance enhanced frequency response), or any other flexibility levers relying on the observation of the system (measurement-based), are deployed.

Synchronisation services include: synchronising power (eg. response to phase jump), system strength (eg. response to a voltage amplitude variation within current limits), fault current and inertial response (eg. limitation of the initial rate of change of the frequency, not to be confuse with the "synthetic inertia" provided by grid following sources). Depending on the subset of synchronisation services that a given unit can provide, we propose to classify them in 4 types (see Fig. 1), such that a synchronous machine is, by construction, a type 4 GFM unit while energy storage systems (ESS) would fall in the type 3 category. Wind Power Plants (WPP) could provide type 2 or 3 GFM capability depending on the operating point and the specific sustained time required for the inertial response provision while PV PP, HVDC systems (at both side simultaneously) or STATCOM could be designed to provide type 1 GFM capability.

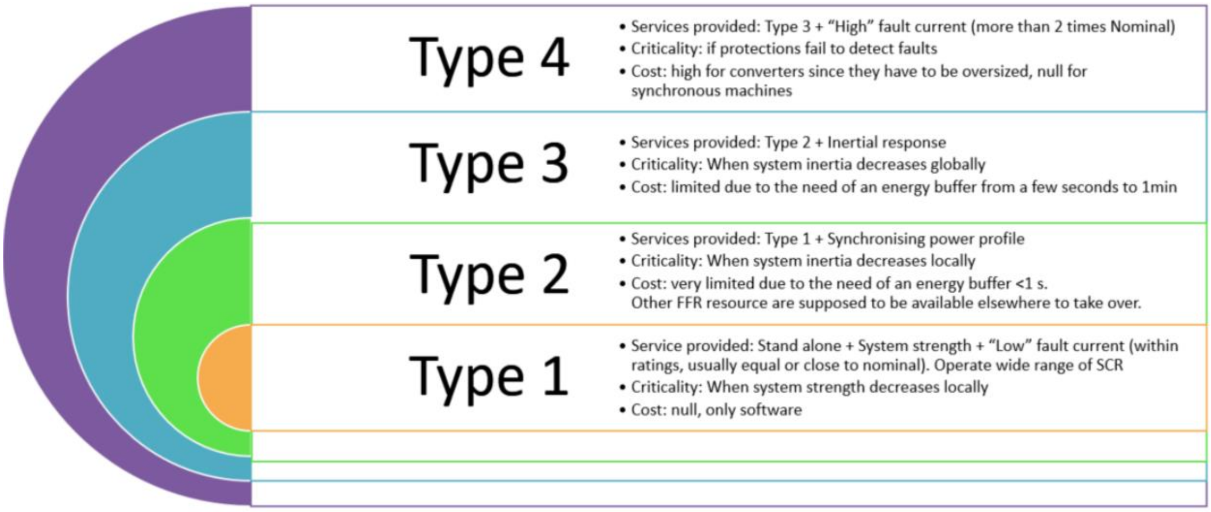


*Figure 1. Types of GFM capability as a function of the synchronisation services they are able to provide*