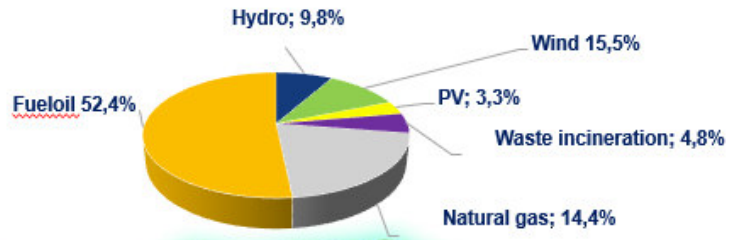
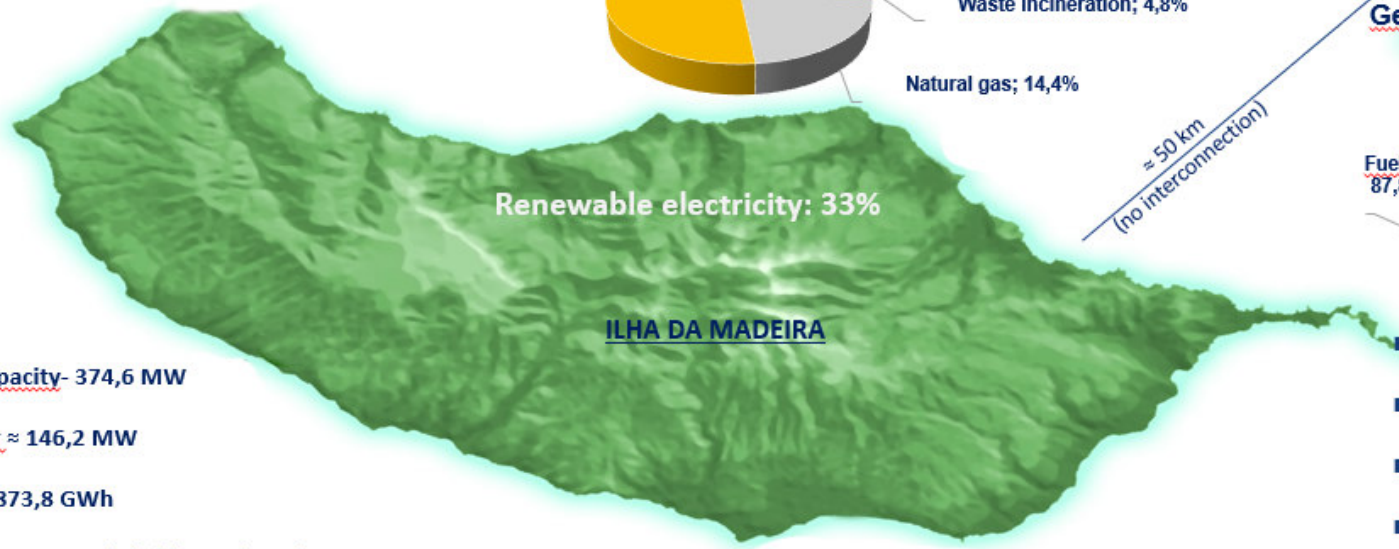
Electricity of Madeira - Portugal

Electricidade da Madeira

■AUTONOMOUS REGION OF MADEIRA

Generation Mix– 2022 – Madeira island





■Installed capacity- 374,6 MW

■Peak power ≈ 146,2 MW

■Emission ≈ 873,8 GWh

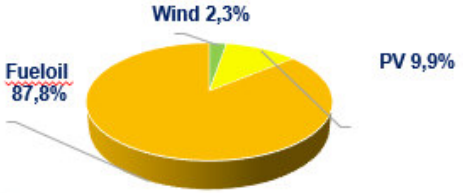
■Population ≈ 246 000 inhabitants (2021)

■Area: 741 km2

≈ 50 km
(no interconnection)

≈ 900 km
(no interconnection)

Generation Mix – 2022
Porto Santo



■Installed capacity - 20,56 MW

■Peak Power ≈ 7,7 MW

■Emission ≈ 36,6 GWh

■Population ≈ 5 151 inhabitants (2021)

■Area: 42,48 km2

RES Requirements and rights

- Reactive power capability for voltage control

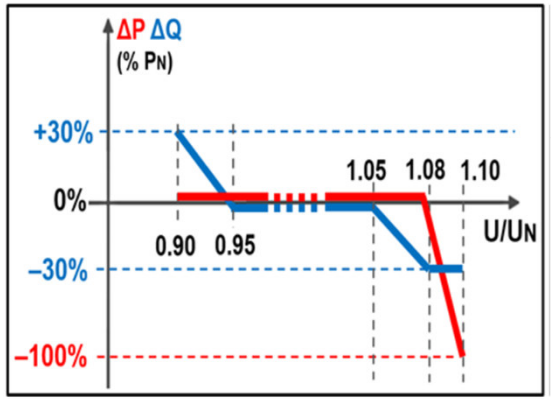
Categoria	Gama de potência instalada *grid code* Madeira
A especial	P_N < 2.5 kW
A	2.5 kW < P_N < 100 kW
B	100 kW < P_N < 1 MW
C	1 MW < P_N < 5 MW
D	P_N > 5 MW

grid code Madeira	
Gama de frequência	*Período de tempo*
52 Hz ≤ f < 53 Hz	Δt ≥ 20 s
47,5 Hz < f < 52 Hz	Δt ilimitado
47 Hz < f ≤ 47,5 Hz	Δt ≥ 20 s

Taxa de variação máxima a suportar**	até ±4 Hz/s Δt: 250 ms

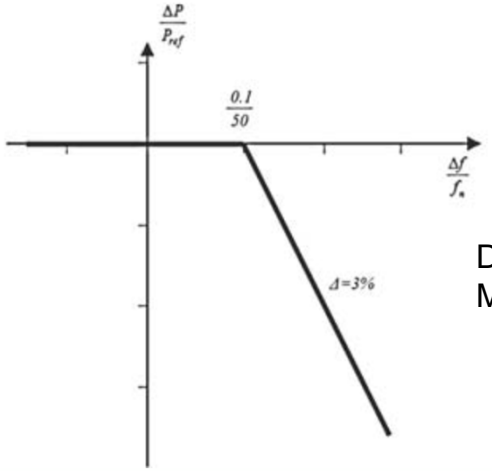
** exceto A especial

(A, B, C, D)
P>2,5 kW (stationary regime)



P/Q modulation as f (Voltage)

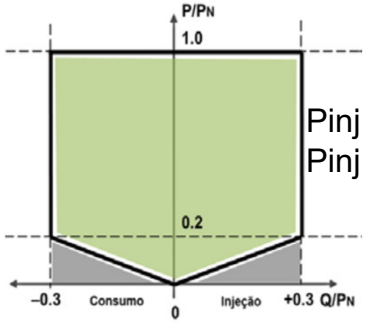
Voltage range:
0,9 p.u. ≤ U/Un ≤ 1,1 p.u.: unlimited time
U/Un< 0,9 p.u.: (A) not applicable
U/Un< 0,9 p.u.: (B, C, D): Fault ride through capability



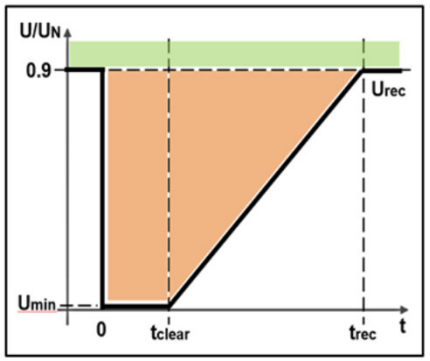
Sensivity to high frequency

Deadband of +0,3 Hz
Maximum response time
PV: 1 s
Wind: 5 s (ΔP operation ≤ -50%)
Wind: 2 s (-50%≤ ΔP operation ≤ 0%)

(B, C, D)
P>100 kW (stationary and dynamic regime)



Pinj > 20% Pn; Qmax=30% Pn
Pinj ≤ 20% Pn; Qmax=150% Pinj

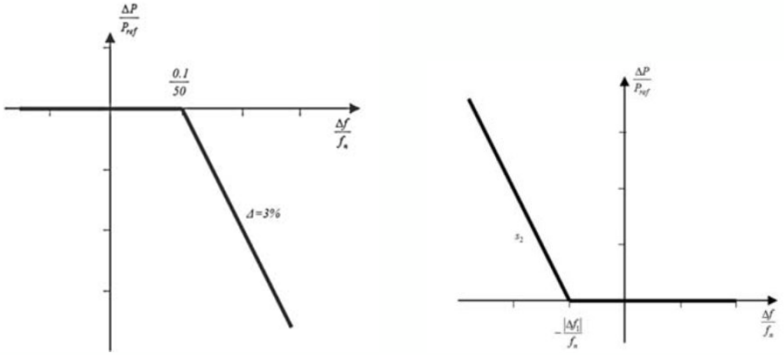


t_{clear}	500 ms		U_{min}	0 p.u.
t_{rec}	3 s		U_{rec}	0,9 p.u.

Remote control by Disptach Center

(C, D)
P>1000 kW

Frequency sensitivity mode (overfrequencies and underfrequencies)



Deadband of + 0,3 Hz
Maximum response time
PV: 2 s (ΔP operation ≤ 50%)
Wind: 5 s (ΔP operation ≤ -50%)
Wind: 2 s (-50%≤ ΔP operation ≤ 0%)

Deadband of - 0,3 Hz
Maximum response time
PV: 1 s (0% ≤ ΔP operation ≤ 10%)
PV: 2 s (ΔP operation ≥ 10%)
Wind: 5 s (0% ≤ ΔP operation ≤ 20%)
Wind: 7,5 s (If P operation ≤ 50% Pn)

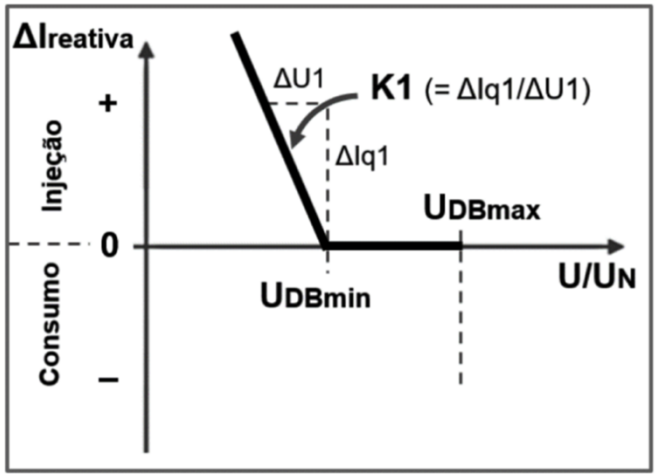
Dynamic control capability of active and reactive current during voltage dips

$$I_{aparente} = \sqrt{I_{ativa}{}^2 + I_{reativa}{}^2} \leq I_N$$

I act, fault ≥ I act (pre-fault)

I react, fault: Proportional to ΔU

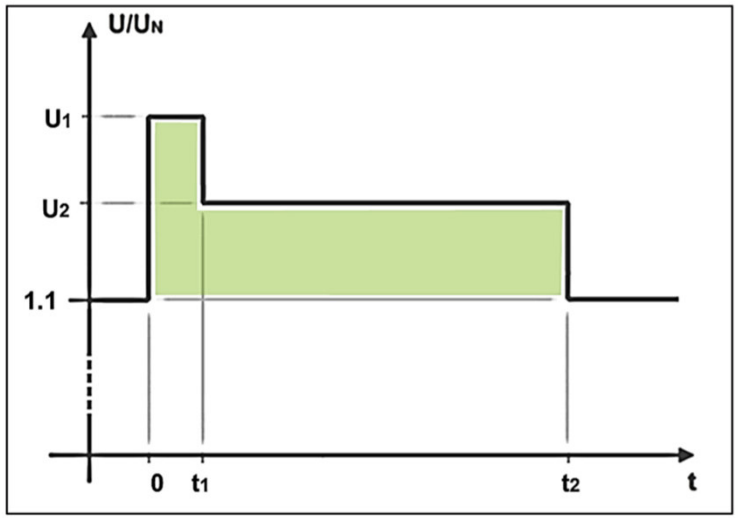
Priority to active current;



U_{DBmin}	0,9 p.u.
U_{DBmax}	1,1 p.u.
K_1	[-5; -2]

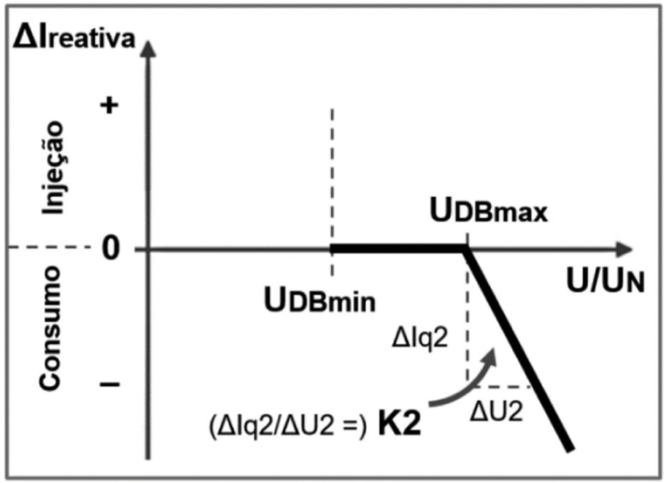
(C, D)
P>1000 kW

Overvoltage survival



t_1	100 ms
t_2	1000 ms
U_1	1,2 p.u.
U_2	1,15 p.u.

Dynamic control of reactive current during overvoltages



U_{DBmin}	0,9 p.u.
U_{DBmax}	1,1 p.u.
K_2	[-5; -2]

Maximum permissible increase power ramps for PV installations

For this purpose, the installations may also be equipped with energy storage systems that ensure the technical feasibility of the established requirements, and in this case may also ensure descending ramps.

To be defined by the Regional Government

C1: Adjustable between 10%-100%/min ?
C2: Fixed: 20%/min???

Requirements	Installation type				
	A Esp. < 2.5 kW	A < 100 kW	B < 1 MW	C < 5 MW	D > 5 MW
Steady-state operation requirements					
1-Acceptable frequency range	X	X	X	X	X
2-Acceptable voltage range	X	X	X	X	X
3-Range of injection and reactive power consumption			X	X	X
4-Voltage control		X	X	X	X
5-Remote control of the operating point			X	X	X
Dynamic regime operation requirements					
6-Survival of frequency gradients (Δf up to 4 Hz/s)	X	X	X	X	X
7-Frequency variation sensitivity mode – overfrequency (LFSM–O)		X	X	X	X
8-Frequency Variation Sensitivity Mode (LFSM)				X	X
9-Ride through capability			X	X	X
10-Active power recovery after voltage dips			X	X	X
11-Capacity for dynamic control of reactive current during overvoltages			X	X	X
12-Capacity for dynamic control of active and reactive current during voltage dips				X	X
13-Active power recovery ramps				X	X