A Grid Connected Photovoltaic System Based on Current Conditioning

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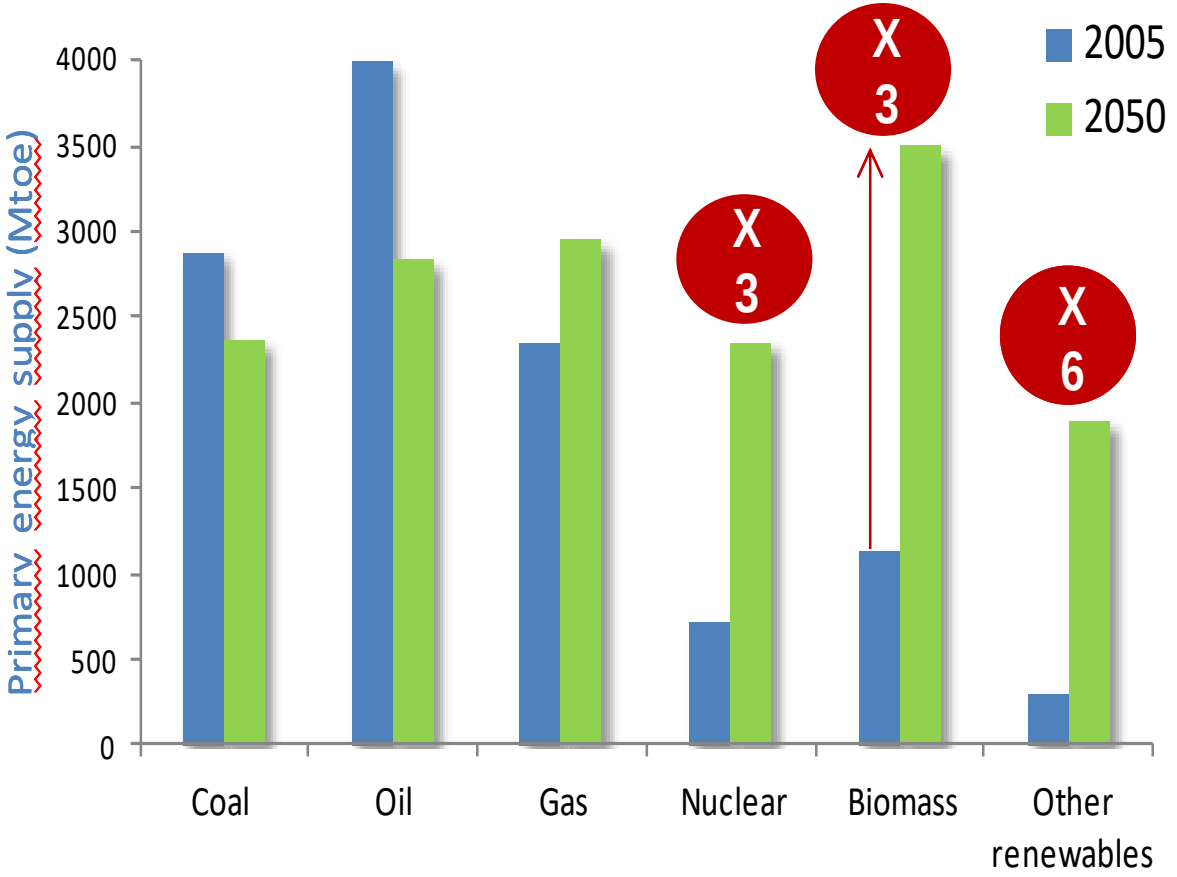
Agenda

- Motivation and Rationale
- Conventional Way of Interconnection
- Proposed Idea of Interconnection
- Control Strategy
- Performance
- Conclusions

MOTIVATION AND RATIONALE

Global Primary Energy Demand



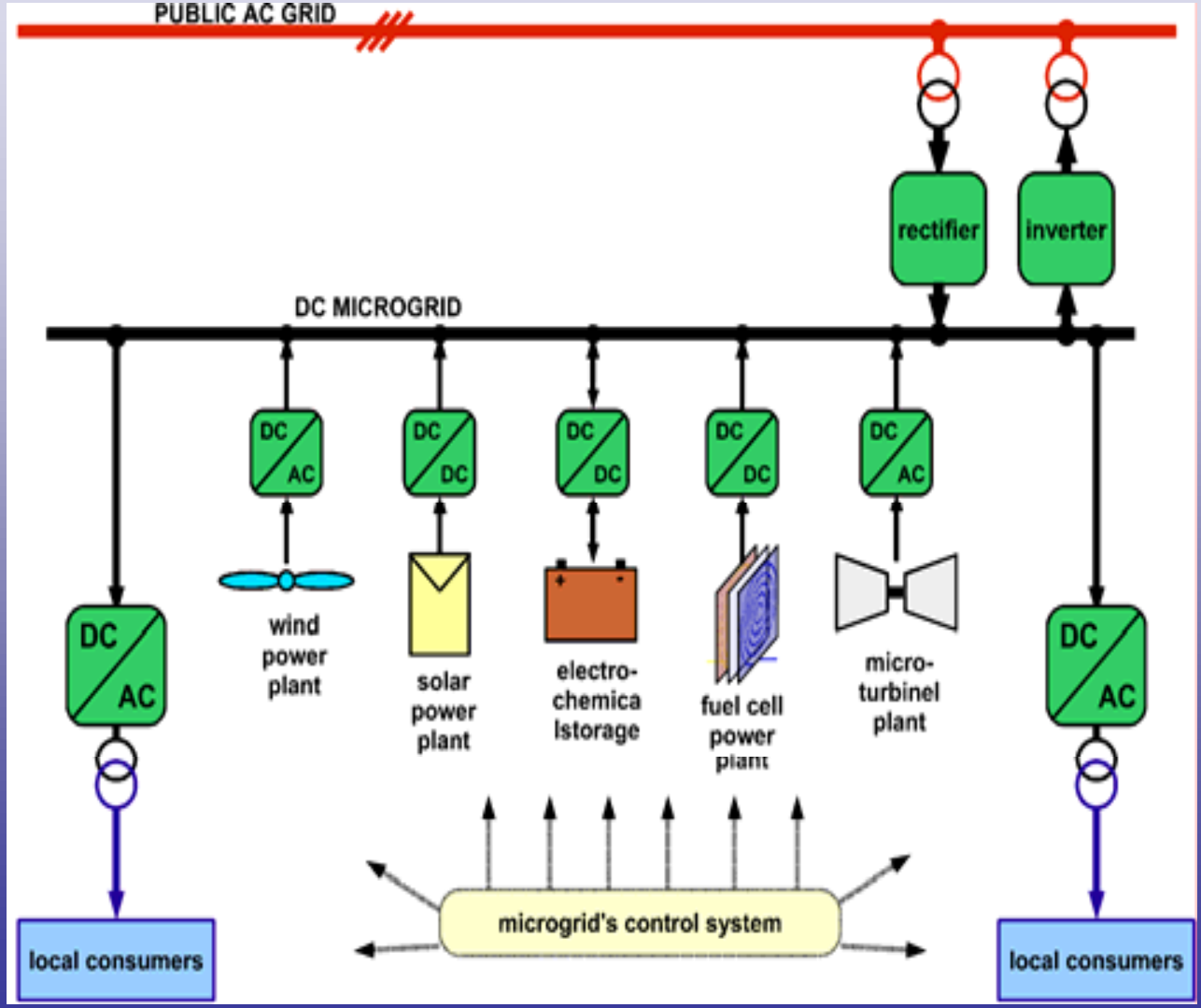
Fuente: IEA *Energy Technology Perspectives 2008*

BLUE Map scenary: reducción global emisiones de CO2 en un 50% en 2050/2005

- **US … 20% Wind by 2030**
- **EU … 20% Renewable Energy by 2020**
- **China … 30 GW Wind by 2020**
- **India … 12 GW Wind by 2012**

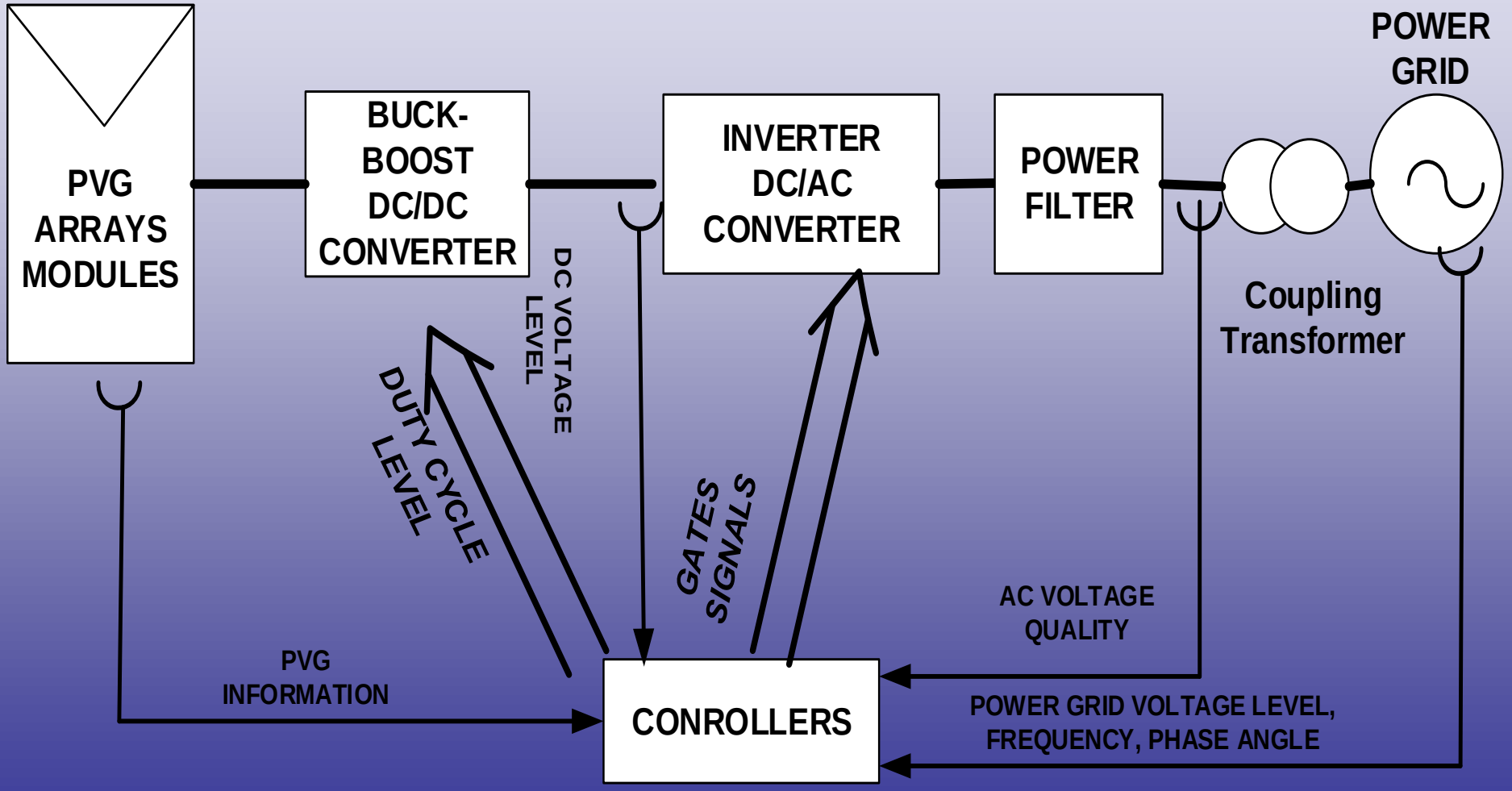
- **Bahrain 5% by 2025 and 10% by 2035**

Conventional Way of Interconnection

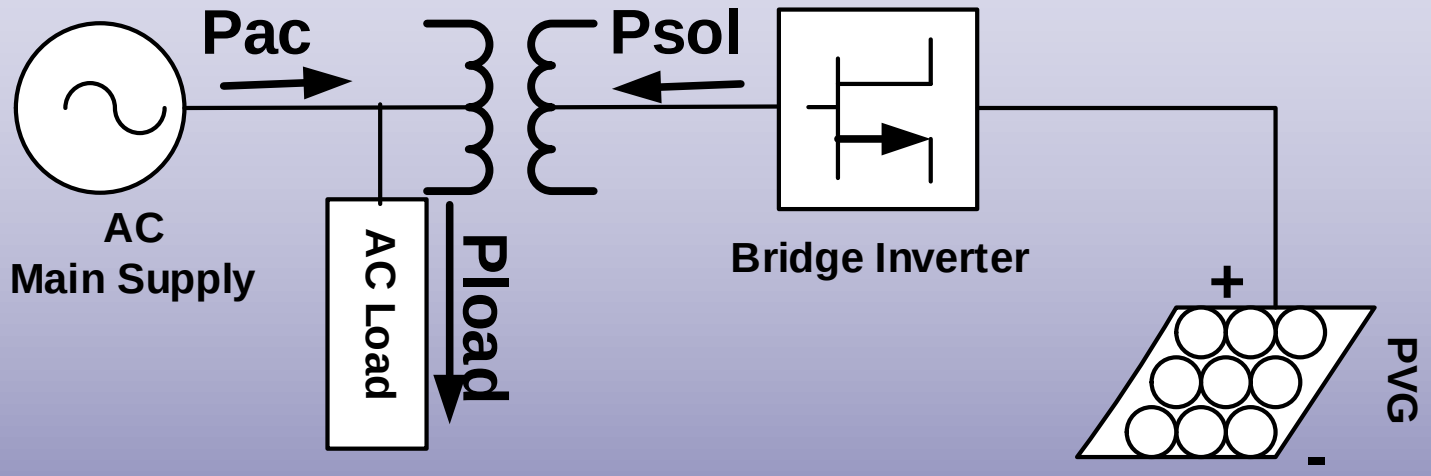


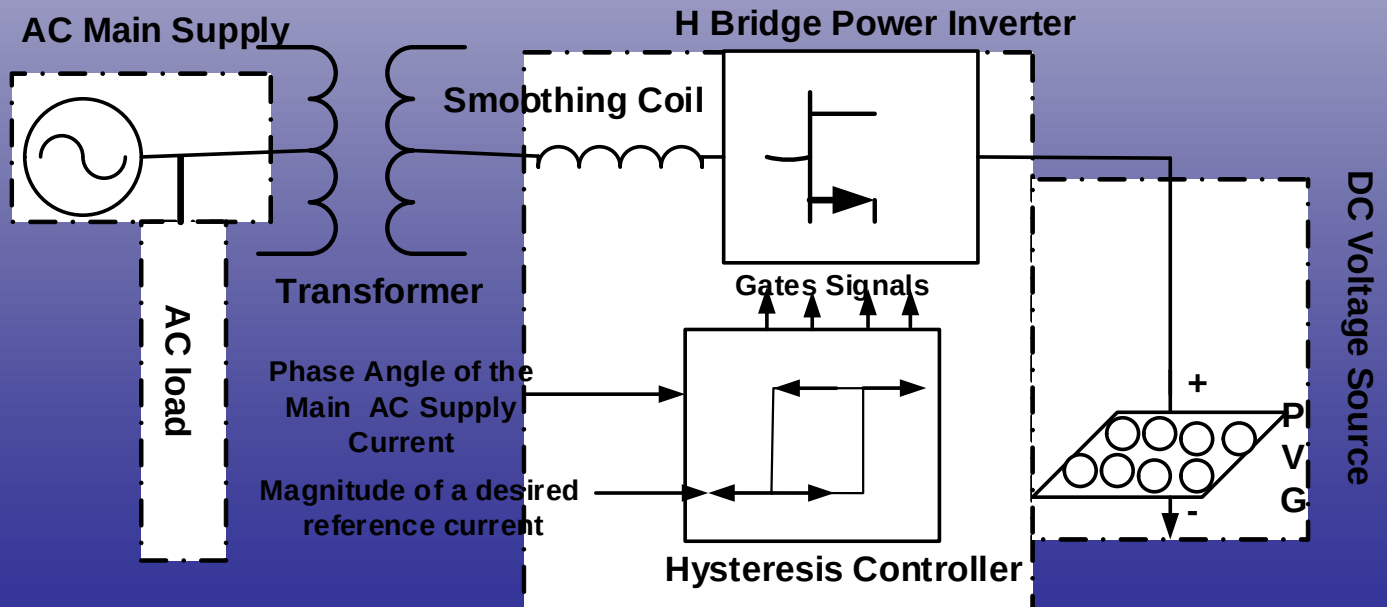
Conventional Way of Interconnection

continued

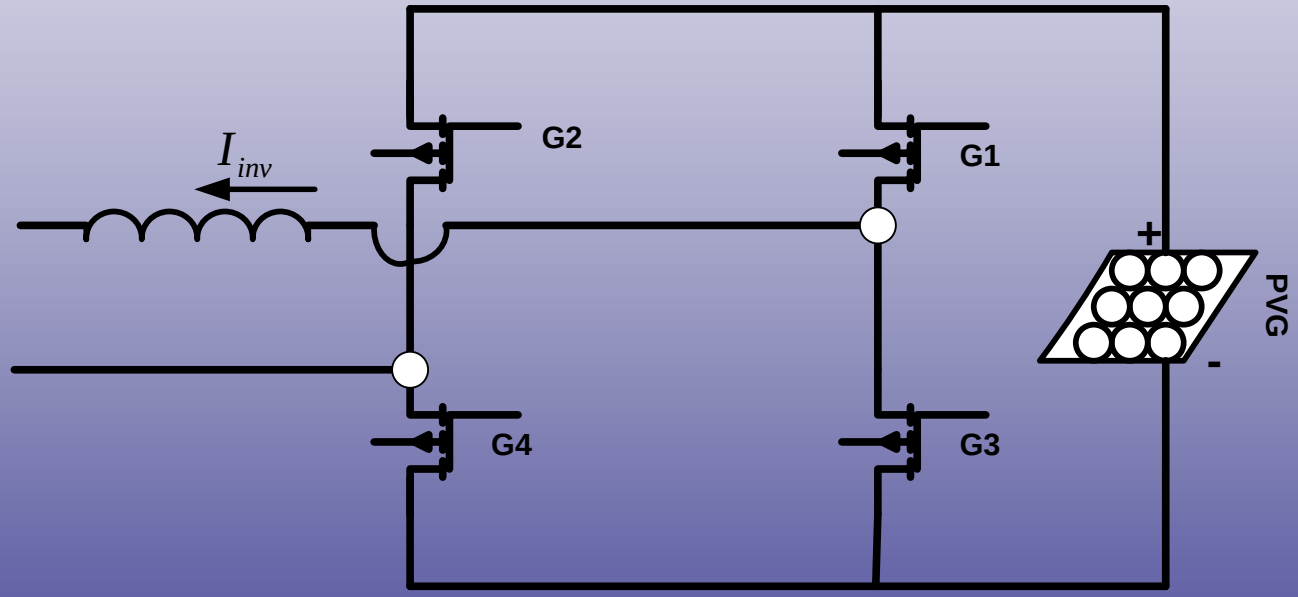


Proposed Idea of Interconnection

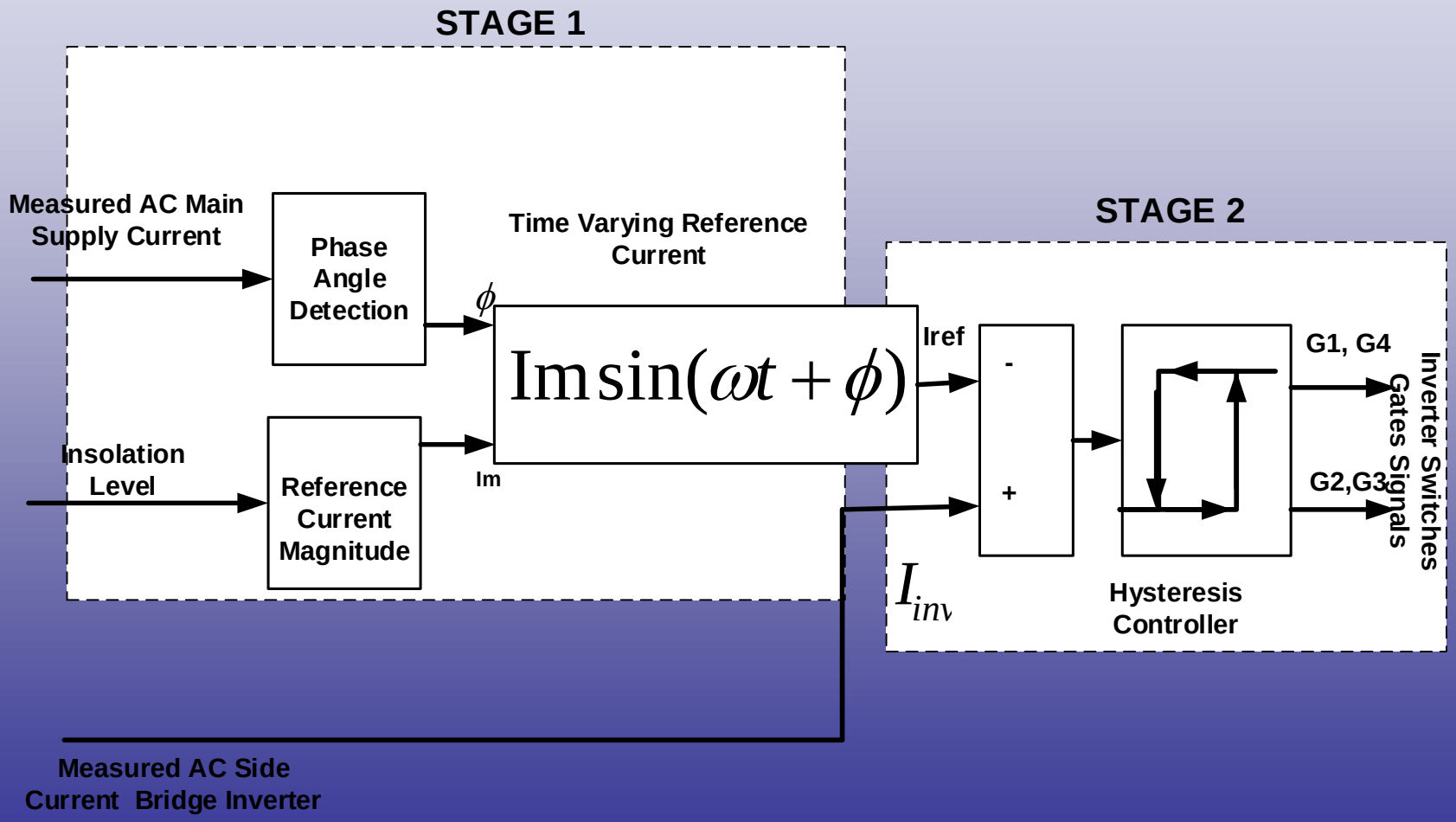




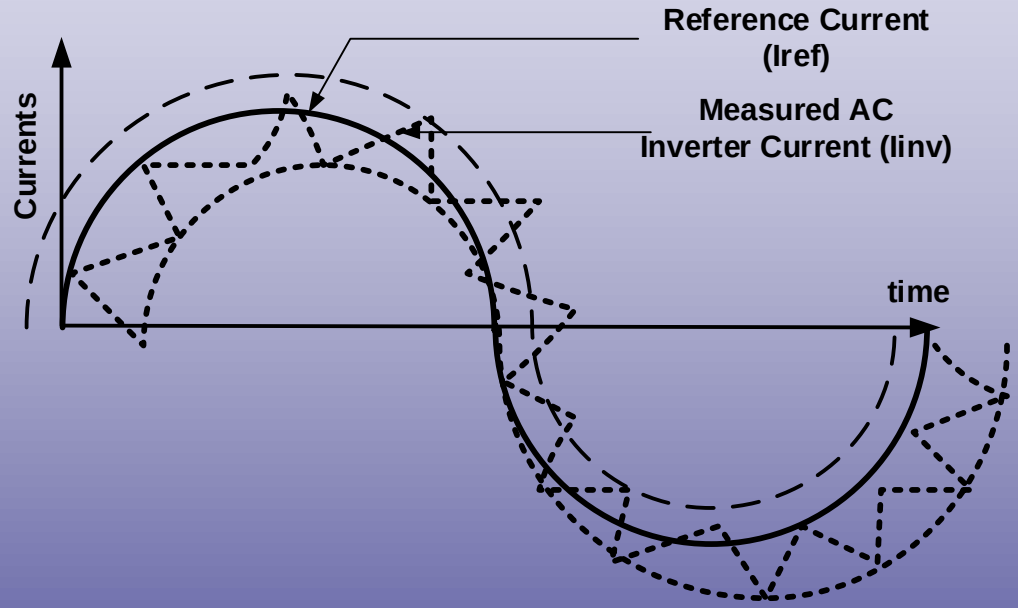
Proposed Way of Interconnection (*continued*)



Proposed Controller For The Interconnection



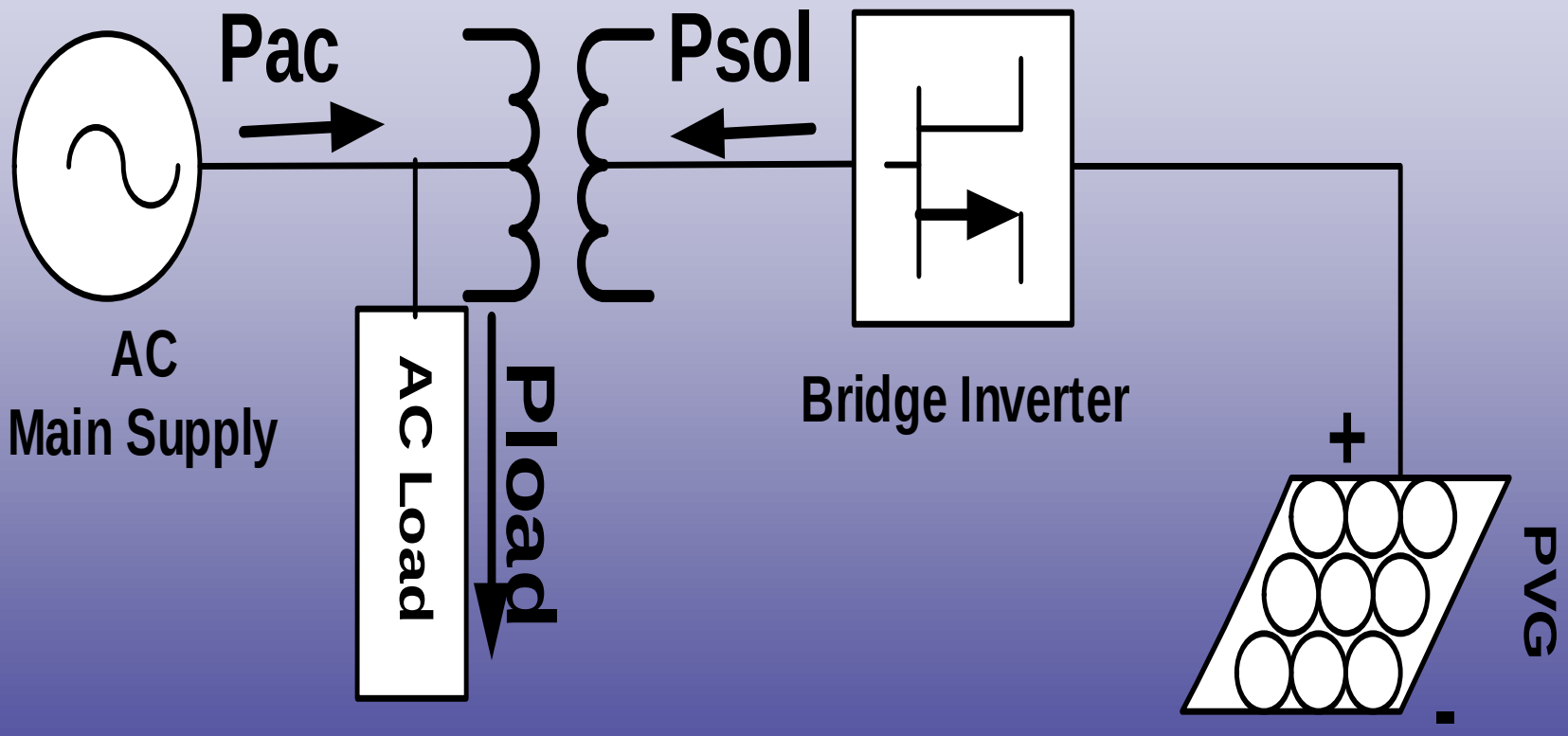
Anticipated Currents



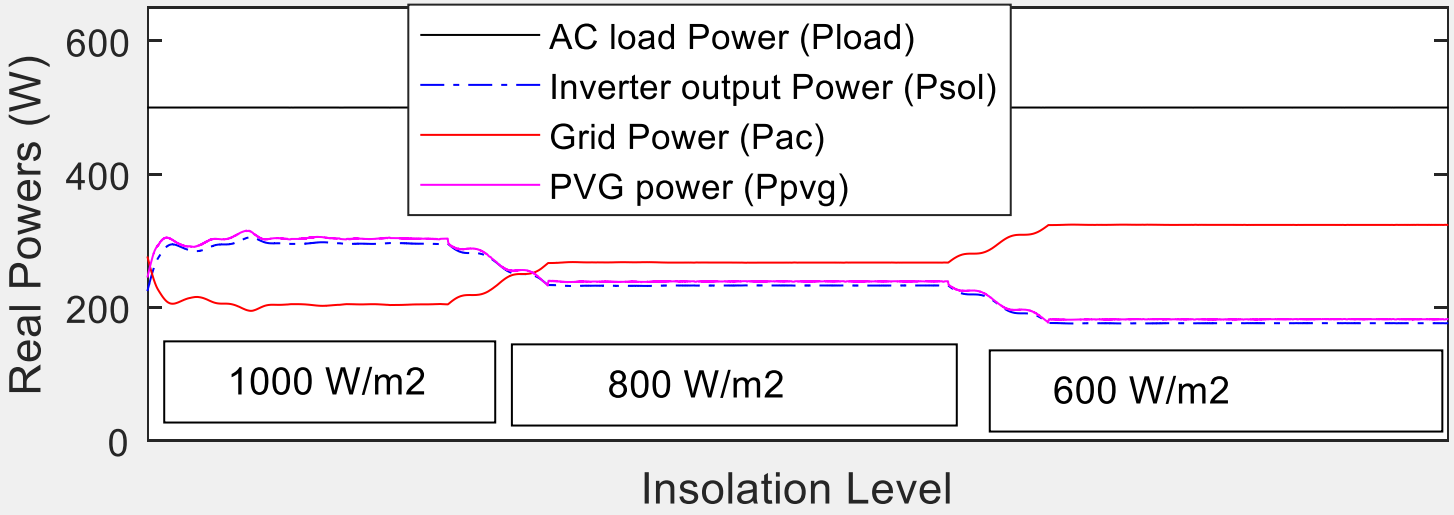
Merits of the Proposed Interconnection

- Prevents the penetration of the harmonics into the power grid
- Avoids the requirement of having controllable at the DC side of the power inverter
- Controls the power factor level at the point of interconnection with the grid
- Relaxes the constraint of synchronizing the inverter output voltage with the power grid voltage
- Extracts (*if possible*) maximum power from PVG panels.

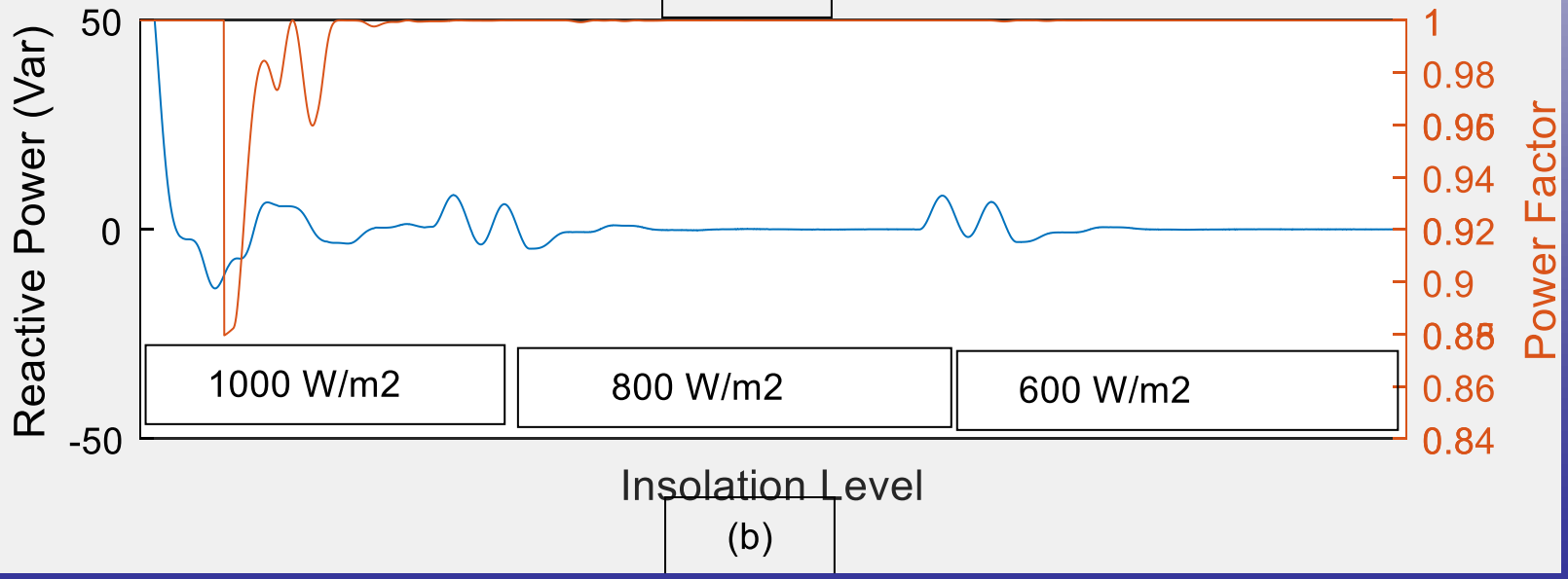
System Performance



System Performance *(Continued)*



(a)

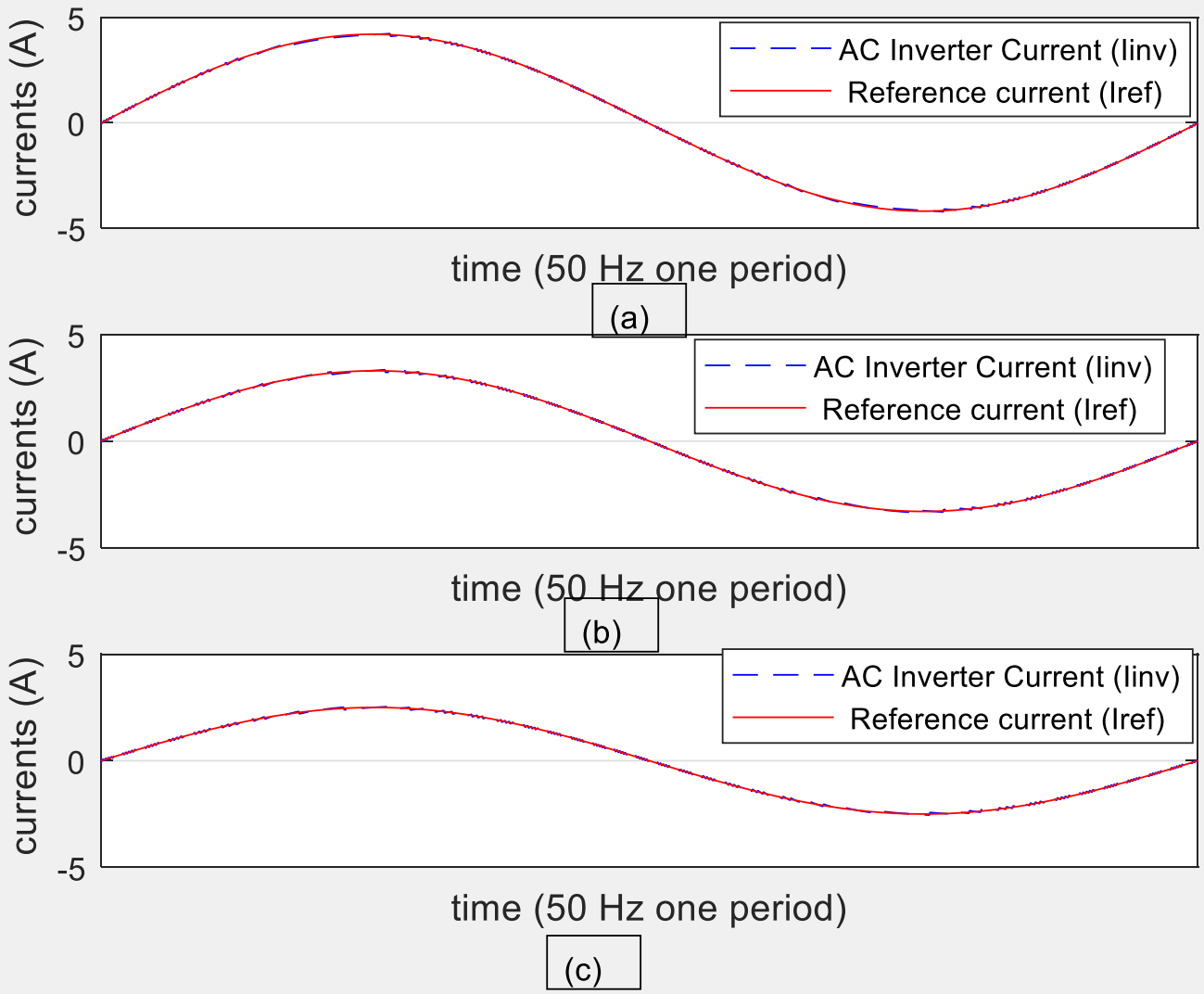


(b)

System Performance *(Continued)*

Insolation Level at T=25 ^{0}C	1000 W/m^2	800 W/m^2	600 W/m^2
AC Load Power Pload (W)	500	500	500
Inverter AC Power PSol (W)	295.5685	232.8918	176.2920
Contribution to the AC load	*59.11 %*	*46.58 %*	*35.25 %*
Grid Power Pac (W)	204.5214	267.2120	323.7820
Contribution to the AC load	*40.89 %*	*53.42 %*	*64.75 %*
Extracted PVG Power P_{PVG} (W)	303.2830	239.2475	181.8783
Percentage of the PVG Power to the Maximum PVG power	46.80 %	49.43 %	49.16 %

System Performance
(Continued)



THD

1.1246 (%)

1.1650 (%)

1.5941 (%)

Conclusions

An alternative strategy of interconnecting a PVG source with the AC power grid through the H-bridge inverter was investigated. The proposed alternative used a hysteresis controller responsible of controlling the operation of the H-bridge switches.

The hysteresis controller serves at conditioning the inverter AC current. The conditioning offered the following features:

the inverter AC current is sinusoidal and is forced to flow into the AC side of the network regardless the level of the intermittency of the PVG source

the inverter AC current is synchronized with the AC main supply and consequently a controllable power factor is anticipated at the AC supply side

Limitations

- The proposed interconnection was found to be limited by the fact that not all possible maximum power of the PVG source can be extracted.

- Extracting more power from the PVG source resulted in the deterioration and the distortion of the AC inverter current Waveforms.


Thank you for your attention..