CHAIRE EUROPEAN ELECTRICITY MARKETS
Fondation Paris-Dauphine

DAUPHINE UNIVERSITÉ PARIS

Perspectives on CRMs from an Academic Point of View

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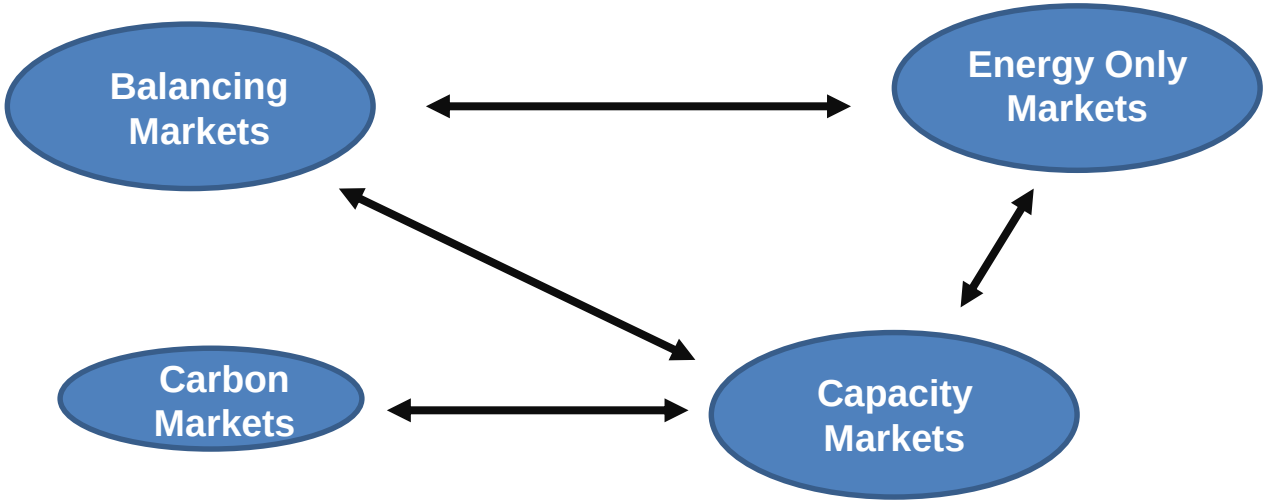
Capacity Remuneration Mechanisms (CRMs)

a) No Theoretical Foundation in Simple Model but Strong Practical Pressures
b) Three Theoretical Reasons for CRMs to Expand Simple Model
c) The Dynamic Nature of CRMs and In-built Obsolescence
d) Different Capacity Mechanisms Need to Address Specific Needs
e) Cross-border Participation Welcome in Principle but Needs Closer Cooperation between Transport system Operators (TSOs)

No Theoretical Foundation but Strong Practical Pressures

a) In theory VOLL pricing in energy-only markets takes care of any missing money
b) CRMs thus necessarily introduce inefficiencies
c) These inefficiencies concern not subsidizing capacity *per se* but cross-subsidizing peak load consumption at the expense of off-peak consumption
d) VaREN with energy > capacity have exacerbated problem; EU in difficult transition; theoretical model still holds but at the price of large number of VOLL hours.

CRMs Are Indispensable but Will Create Issues of their Own

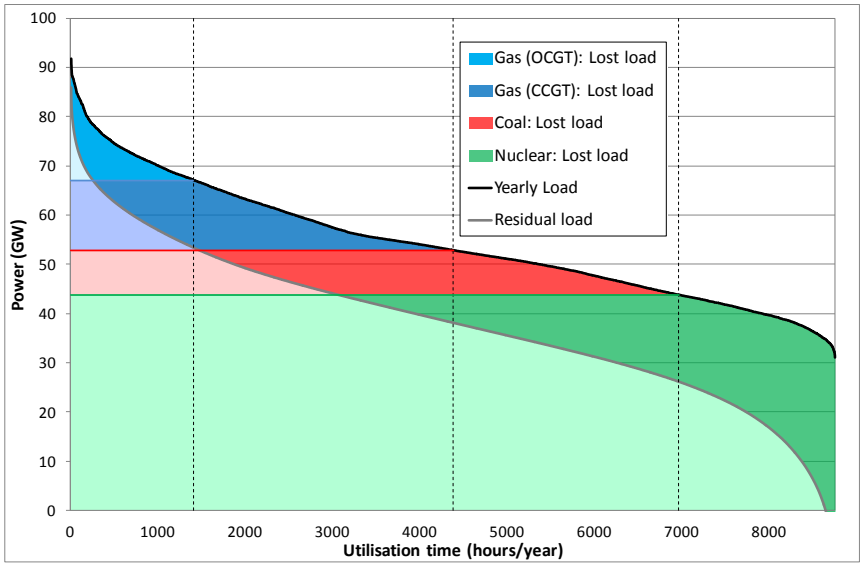


- Prices in day-ahead energy-only, balancing market and other short-term (Intraday) markets will fall with increased capacity;
- **CRMs are no substitute for short-term flexibility markets, as ramping and balancing continue to require specific products.**
- *Vice versa*, flexibility markets do not give required visibility to investors.

Prices Declines and Load Losses Modelling Results

VaREN with zero marginal costs replace conventional technologies with higher marginal costs (gas, coal and nuclear):

- Lower load factors of dispatchable plants (*compression effect*);
- In the absence of **plant closures**, reductions in the average electricity price (*merit order effect*).



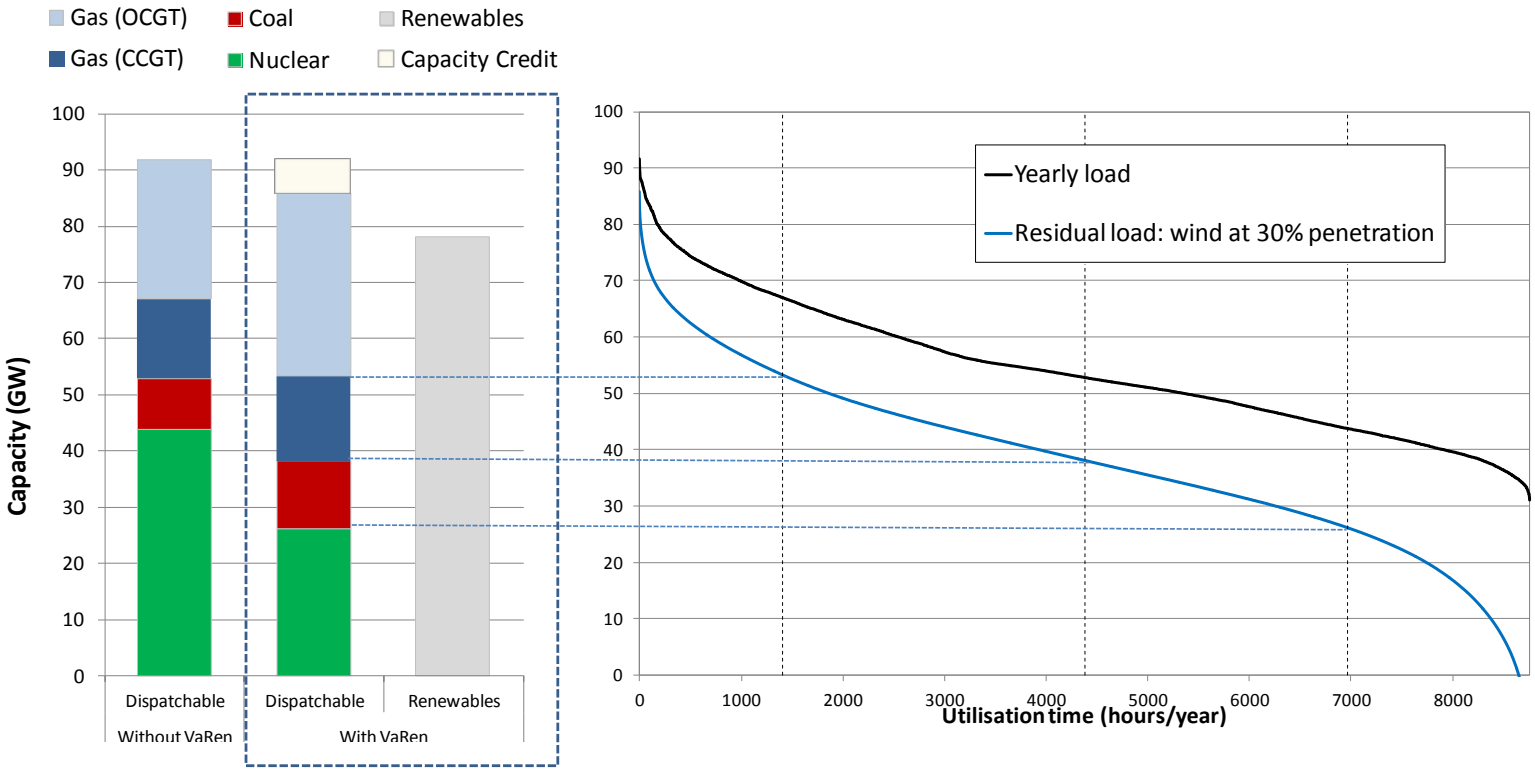
		10% Penetration level		*30% Penetration level*	
		Wind	*Solar*	*Wind*	*Solar*
Load losses	*Gas Turbine (OCGT)*	-54%	-40%	-87%	-51%
	Gas Turbine (CCGT)	-34%	-26%	-71%	-43%
	Coal	-27%	-28%	-62%	-44%
	Nuclear	-4%	-5%	-20%	-23%
Profitability losses	*Gas Turbine (OCGT)*	-54%	-40%	-87%	-51%
	Gas Turbine (CCGT)	-42%	-31%	-79%	-46%
	Coal	-35%	-30%	-69%	-46%
	Nuclear	-24%	-23%	-55%	-39%
Electricity price variation		-14%	-13%	-33%	-23%

- Declining profitability especially for OCGTs and CCGTs;
- Insufficient incentives for new investment;
- Gas plants close, 30 GW during last two years.

OECD NEA (2012)

Plant Retirements not an Option: Disconnect between Socially and Privately Optimal Levels of Capacity

DESSOUKY (2012)



- Logical response to price, load factor and profit declines are plant retirements.
- Limits as VaREN have low capacity credits (10% wind energy → -14% price → -40% profit (CCGT) but only 2% capacity credit).

Three Theoretical Reasons for CRMs to Expand Simple Model

a) Security supply externalities during *involuntary and unanticipated* supply cuts due to VOLL-pricing justify higher capacity margins than those delivered by the market.
b) Lumpy investments and inelastic short-term demand will incite operators to err on the side of caution, CAP < CAP*.
c) Risk aversion will also incite operators to err on the side of caution, CAP < CAP*.

Capacity mechanisms consist in "smoothing" the missing money over a larger number of hours thus providing higher levels of remuneration than delivered by the market (< predicted by theory) with greater certainty.

The Dynamic Nature of CRMs and In-built Obsolescence

a) Capacity mechanisms will affect the technological and behavioral *parameters* of the actors in the system;
b) More flexible, low capacity cost and DSM resources will be forthcoming;
c) Demand response ≠ VOLL as lack of supply is voluntary and (statistically) anticipated; this eliminates externalities;
d) With time these parameter changes will be come engrained in the system ("ratchet effect");
e) Due to parameter changes, CRMs need to be permanently adjusted;
f) Defining procedural rules for adjustment is vital;
g) With time CRMs may become obsolescent, systems with significant demand response resources do need CRMs.

Different CRMs Need to Address Specific Needs – One Size Does Not Fit All

a) **No-ideal-type! CRMs must address different issues in different contexts. The key parameter are the no of annual hours, which define the technology, which the defines the capital intensity, which defines the risk, which defines the system:**

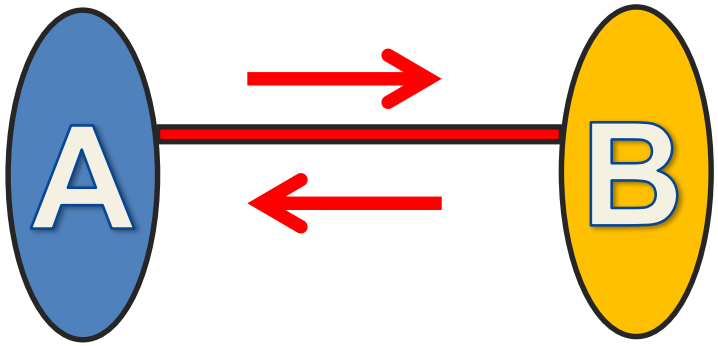
1. Flexibility provision at extreme peak hours (< 500 h/a, example France w/ thermosensitivity): **Capacity obligations enabling DSM**
2. Back-up for intermittent renewables (500 h/a < 3000 h/a, example Germany with large-scale intermittency): **Centralised auctions for gas capacity**
3. Generalised support for capital-intensive investments (> 3000 h/a, example UK with looming lack of baseload capacity): **Capacity payments for baseload capacity and low carbon investments, FITs and CFDs are capacity instruments as they remunerate average instead of marginal costs!**

b) **Two further remarks:**

Strategic reserves are easy to implement, politically sellable, attractive to investors and have low transaction costs. They also have a big drawback: no increase in total capacity due to added private investment retention.

In capacity markets, physical trading should be favoured over financial claims. “Quality” and diversity of capacity is an issue. Paper claims for DSM not always a substitute for production capacity (see US experience during “polar vortex”).

Cross-Border Cooperation in Capacity Mechanisms?

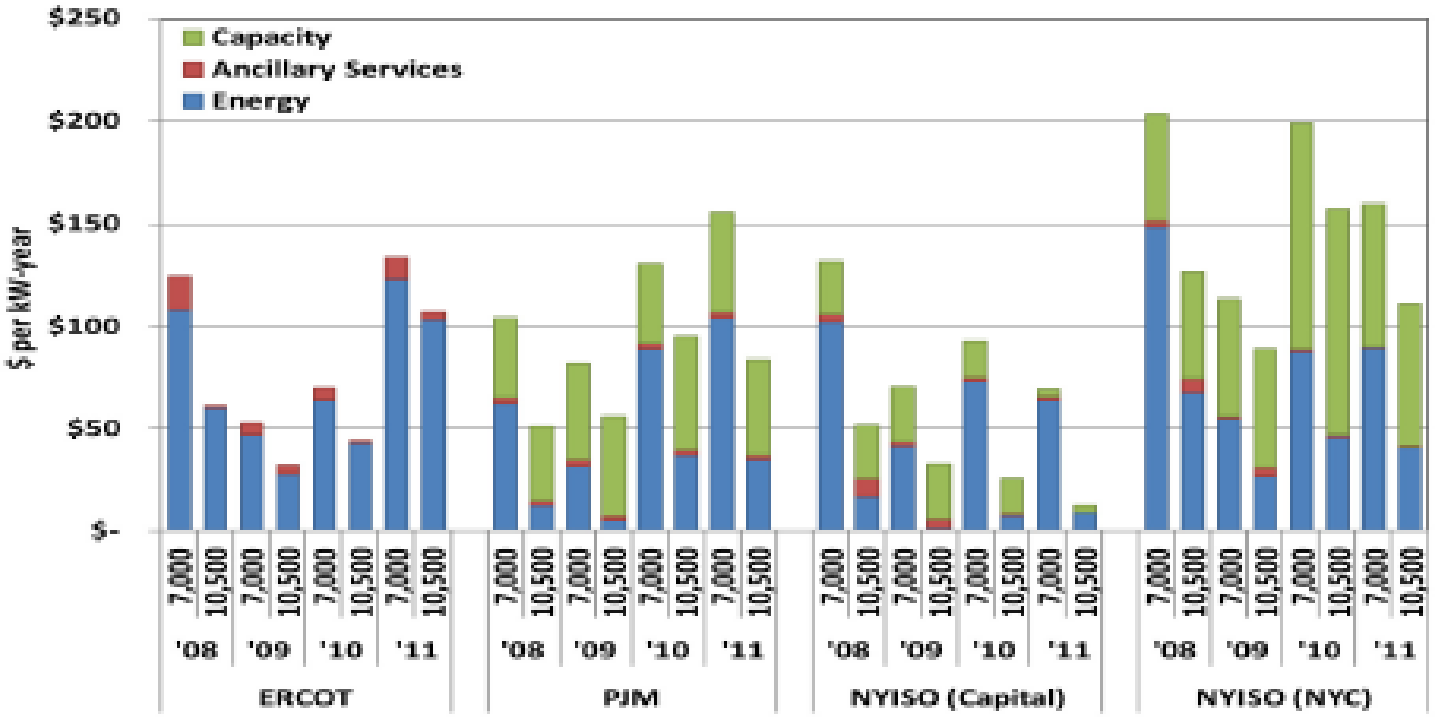


- Why not? However, with a scarcity situation in country A (B) and no scarcity situation in country B (A), then interconnections from B to A (A to B) will already be saturated in the right direction due to “normal” exports with a working market. Cross-border capacities in country B (A) will add nothing to security of supply in country A (B).
- Thus cross-border participation only can make a useful contribution if there is a scarcity situation in both countries. This however raises difficult legal and operational issues to be resolved between TSOs with national security of supply obligations.
- Two absolutely indispensable pre-requisites for cross-border participation:
  - Common understanding of security of supply criteria among national TSOs;
  - Coordination of operational procedures in bi-national scarcity situations.

Back-up Slides

CRMs May or May not Increase and Stabilise Revenues for Generators

Figure 37 • Comparison of net revenues of gas-fired generation between markets



Source: Potomac Economics (2012) cited in IEA (2012), technologies are differentiated by efficiency, 7 000 MMBtu/MWh CCGT and 10 500 MMBtu/MWh OGT.

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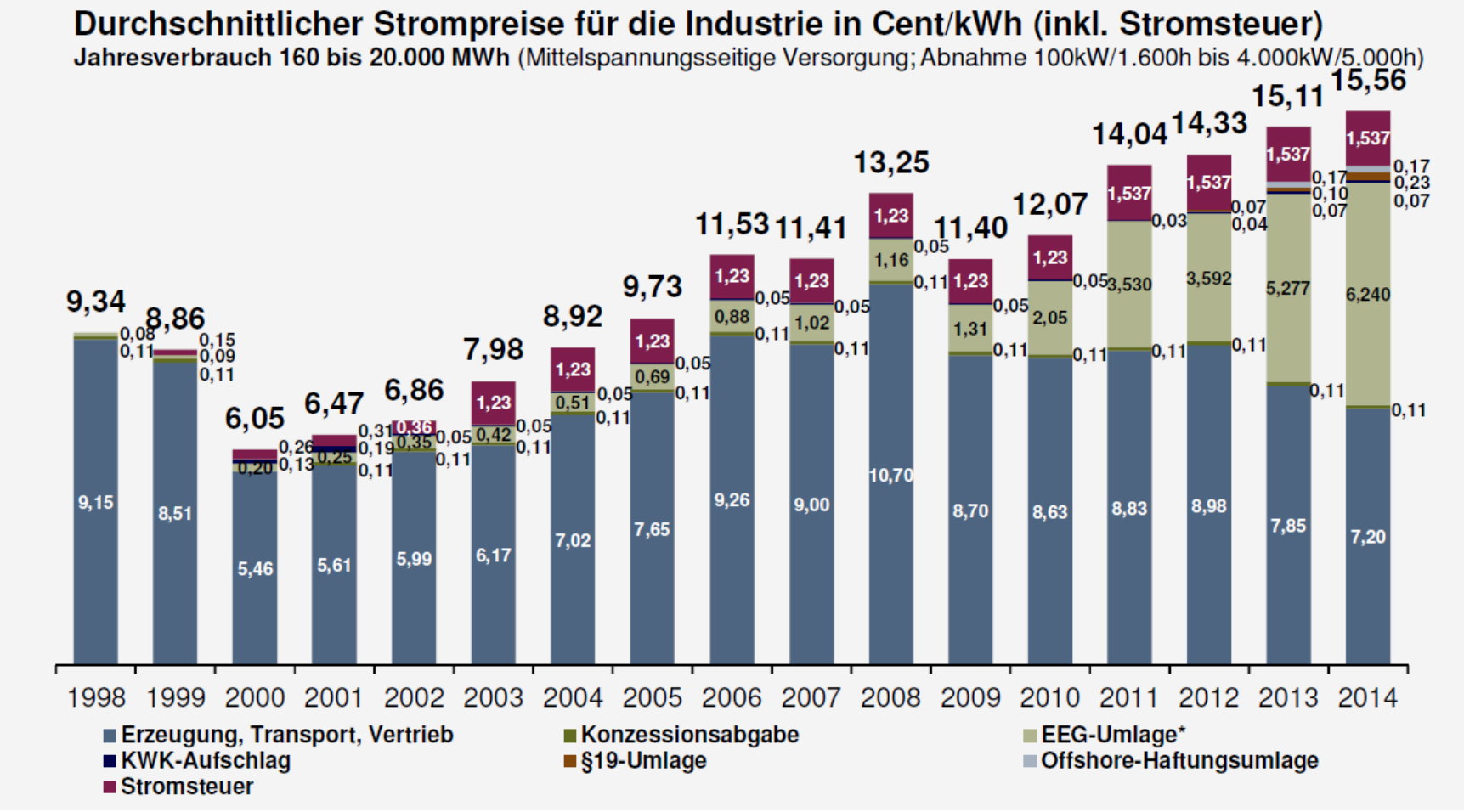
Think before You Act: Different CRMs Have Very Different Consequences

	Loss per MW Baseload	Loss per MW Extreme Peak	Hours of Scarcity	Hours of DSM	€/MWh Baseload	€/MWh Peakload	Highest Price
Hypothetical case "missing money"	-50 000	-50 000	0	0	23	60	150
Scarcity pricing	0	0	18	0	23	72	3 000
Capacity market w/ DSM	0	0	0	143	23	72	500
Cap. Payment (6 €/MWh)	0	0	0	0	29	66	156
Strategic reserve	-50 000	-29 730	0	0	23	60	150

Modelling results for a hypothetical system with 80 000 MW capacity and price cap of 3 000 €/MWh loosely built on Joskow (2006).

Strompreis für die Industrie (inkl. Stromsteuer)



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What Needs to Be Done

A. Markets and Products for Short-term Flexibility Provision in the Face of VaREN

Four options that should compete on cost (1) Dispatchable back-up capacity and load-following, (2) Electricity storage (3) Interconnections and market integration and (4) Demand side management (DSM). So far dispatchable back-up remains cheapest but DSM has promising perspectives. Appropriate products need to be developed.

B. Fairer Allocation of System Costs

Costs for balancing, grid extension and intermittency must be allocated to those who cause them. This regards also cross-border flows. Otherwise **Cost Entropy** will provide misguided incentives and lead to inefficiencies.

C. Mechanisms for the Long-term Provision of Capacity

There are always moments when the wind does not blow or the sun does not shine. Capacity mechanisms as pragmatic and possibly temporary solutions must assure profitability for dispatchable capacity where needed.

D. A Review of Infrastructure Needs

Cross-border markets require adequate interconnections to realise their full potential. Market coupling is optimising existing infrastructures but further progress will require increased interconnection capacity.