

# The case for financially settled contracts

Banks and hedge funds have shied away from trading electricity due to fear and ignorance of the physical nature of the market. But, as *Todd Bessemer* of Accenture points out, financially settled contracts can avoid the complexity of physical delivery and could help bring liquidity to power markets

**F**orward contracts represent an obligation to exchange an underlying product at a future date, according to pre-agreed terms. When a forward contract reaches maturity – in other words, the delivery period arrives – this obligation is discharged in one of two ways, depending on contract specification:

- **Physical delivery:** The seller must deliver the underlying product to the buyer in the agreed quantity, with the buyer making payment at the agreed price. These contracts are often referred to as ‘physicals’.
- **Financial settlement:** The seller and the buyer exchange cash payments, based on the difference between the agreed contract price and a pre-defined index price. These contracts are often referred to as swaps or ‘contracts for difference’ (CFDs).

In electricity markets, physical delivery is by far the more complicated of these two options, particularly in commodity markets such as electricity, as issues such as transmission service and real-time generation must be factored into any contract. The delivery process becomes further complicated for cleared products, with clearing houses making use of a number of specialised delivery processes, including the matching of open positions for delivery, assessment of delivery margin, verification of delivery and payment, and so on.

By contrast, financial settlement only requires the exchange of cash, which in turn depends on the existence of a reliable, independently determined index suitable for use as a reference price. For cleared products, contract settlement uses exactly the same process used for daily mark-to-market (namely,

variation margin), except the final settlement is based on an external reference price, rather than an internally derived settlement price.

All things being equal, financial settlement provides a far simpler solution than physical delivery. However, are all things equal? To address this question, we look at the specific case of Pennsylvania-New Jersey-Maryland (PJM) region electricity.

## Outcomes are unaffected

Currently most forward electricity contracts within PJM are deemed to be physicals. However, exactly the same outcomes – both physical and financial – can be achieved through the use of swaps. To understand why, it is important to examine how the current delivery process works.

## Physical delivery process

When a PJM forward contract goes to delivery, the standard procedure is for the contract counterparties to lodge an eSchedule with PJM, specifying location, date/time range and hourly quantities. This eSchedule results in a transfer of settlement obligation in the PJM spot market.

It is important to emphasise that

eSchedules are a transfer of financial obligation only, and have no direct impact on the physical scheduling of electricity. Submission of physical schedules, along with spot market bids and offers, occurs through a totally independent set of processes associated with unit commitment.

While participants may choose to submit physical schedules that are consistent with their forward contracts, they are under no obligation to do so. As a result, for a PJM forward contract the concept of physical delivery is actually a *non sequitur*, a conclusion that can be extended to any electricity market based around a reliable, underlying spot pricing mechanism.

Financially, the process of physical delivery requires the following payment flows:

- **Forward contracts:** Settled bilaterally between the buyer and the seller, at the agreed price and quantity.
- **eSchedule:** Settled through PJM, for the quantity specified in the eSchedule, in each hour, multiplied by the spot market price in that hour, at that location.
- **Spot market:** Settled through PJM, for the spot market quantity – which

Table 1: Example of physical delivery process

	A	B	C	D	PJM
Forward contract: A–B	\$4,950	-\$4,950			
Forward contract: B–D		\$1,700		-\$1,700	
Forward contract: D–A	-\$1,750			\$1,750	
eSchedule: A–B	-\$6,000	\$6,000			\$0
eSchedule: B–D		-\$2,000		\$2,000	\$0
eSchedule: D–A	\$2,000			-\$2,000	\$0
Spot sales/purchases	\$4,800	-\$4,000	-\$800		\$0
<b>Total</b>	<b>\$4,000</b>	<b>-\$3,250</b>	<b>-\$800</b>	<b>\$50</b>	<b>\$0</b>

Source: Accenture

may differ from that contracted for in the forward market – multiplied by the spot market price in that hour, at that location.

This is illustrated by table 1, for a single hour of the contract period, where:

- A is a net seller in the forward market and is also selling additional energy into the spot market.
- B is a fully hedged purchaser with matching forward and spot positions.
- C is purchasing only in the spot market.
- D is an arbitrageur participating only in the forward market.

For the sake of simplicity, the differences between outcomes in the PJM real-time and day-ahead hourly markets are not addressed.

## Financial settlement process

PJM Interconnection calculates and publishes hourly prices, on both a real-time and day-ahead basis, for an extensive number of individual and aggregate points within the PJM market.

As well as being used by PJM for settlement of the spot market, these prices also represent a reliable, independently determined reference which may be used to derive indexes for financially settled forward contracts. US regulator the Federal Energy Regulatory Commission obliges all electricity spot markets in the US – PJM included – to make this data available free of charge.

By their very nature, financially settled derivatives have no direct impact on the physical scheduling process. Financially, the use of swaps involves the following payment flows:

- *Forward Contracts:* Settled bilaterally between the buyer and the seller, for the agreed quantity, multiplied by the difference between the agreed price and the reference price.
- *Spot Market:* Settled through PJM, for the spot market quantity – which may differ from that contracted for in

the forward market – multiplied by the spot market price in that hour, at that location.

As is clear from table 2, this produces different payment flows, but the same net financial outcomes.

If physical and financial outcomes are the same, why move to financial settlement? In addition to being a simpler process, financial settlement also provides a number of other benefits compared with physical delivery:

- *Extends trading expiry date:* Physically delivered contracts often

and not to trade as the delivery period approaches. In a financially settled market, however, the trader can choose to go through to financial settlement. This encourages non-physical players to stay in longer, knowing that in the worst-case scenario they can still cash out through the financial settlement process. The resultant increase in the participation of non-physical players can aid liquidity as the contract develops maturity.

- *More conducive to shorter-term markets:* The trading cut-off required for physical delivery – normally around three business days prior to

## The key unresolved issue regarding the design of a financially settled PJM contract is whether final settlement should be based on real-time or day-ahead hourly prices

require trading to terminate around three business days prior to commencement of the delivery period, so that delivery arrangements can be finalised. Financially settled products allow trading to occur right through until commencement of delivery. In fact, for contracts based on a monthly average, such as electricity, trading could continue right into the delivery month.

- *Encourages liquidity from non-physical traders:* One of the key fears of non-physical players, such as speculators and market locals, is that as the expiration of trading approaches, they will be stuck with open positions in a contract that they have no ability to deliver. This is of particular concern in thinly liquid markets such as electricity, where reversing a position in a short timeframe can be extremely difficult and expensive. To avoid this situation, many of these potential liquidity providers choose to get out of their positions well ahead of time,

commencement of delivery – is not conducive to the trading of instruments less than a month in duration. By dispensing with this constraint, financially settled contracts can be offered in smaller time blocks, such as daily, weekly and rest-of-month. These products are very important for fine-tuning risk exposure in commodities like electricity, where price and demand are heavily dependent on near-term factors like weather.

## Time for a new PJM contract

It is possible to develop financially settled instruments for PJM Electricity that achieve exactly the same physical and financial outcomes as the physically delivered contracts currently in common use, while providing significant additional advantages. What, therefore, should a redesigned PJM contract look like?

The monthly contract is the basic building block of exchange-traded derivatives. Risk exposure in the cash market, however, occurs on a far shorter timeframe. The key to creating a successful forward market in electricity is bridging this hedging gap, through the availability of shorter duration contracts. But these instruments must still relate back to the more common monthly contracts.

One effective way of achieving this is to define a financially settled monthly contract which, as the delivery period approaches, converts into a strip of daily contracts. Rather than the original

Table 2: Example of financial settlement process

	A	B	C	D	PJM
Forward contract: A-B	-\$1,050	\$1,050			
Forward contract: B-D		-\$300		\$300	
Spot contract: D-A	\$250			-\$250	
Spot sales/purchases	\$4,800	-\$4,000	-\$800		\$0
<b>Total</b>	<b>\$4,000</b>	<b>-\$3,250</b>	<b>-\$800</b>	<b>\$50</b>	<b>\$0</b>

Source: Accenture

monthly contract settling against the cash market index, each of the daily contracts would cash out separately. These dailies would also continue to trade into the delivery month, right up until the day-ahead hourly market commenced for that day. Daily contracts could trade both individually and as strips, allowing short-term and rest-of-month exposure to be hedged.

The key unresolved issue regarding the design of a financially settled PJM contract is whether final settlement should be based on real-time or day-ahead hourly prices. Strong arguments exist for both points of view:

### Real-time prices

The real-time market is the true spot market, with prices based on the actual

physical dispatch. As a result, forward contracts based on real-time prices provide a better hedge against actual physical exposures. Day-ahead prices do not take account of on-the-day demand fluctuations or any operator recommitment of units for reliability reasons.

### Day-ahead prices

The bulk of physical electricity in PJM is currently scheduled through the day-ahead market. While not providing a perfect hedge against physical outcomes, day-ahead prices provide a better indication of the actual prices paid for most physical/cash market purchases.

Financial Transmission Rights (FTRs), PJM's in-built instruments for managing locational basis risk, are based around prices in the day-ahead market.

There is no consensus amongst industry players regarding the better approach to take. Current practice for physically delivered contracts, however, is to lodge eSchedules based on real-time prices. The minimalist solution, therefore, would be to replace the existing physical contract with an analogous financially settled instrument based on real-time prices. Another potential solution that has been suggested is to list two separate contracts, based on real-time and day-ahead prices respectively. The market could then make its own decision, through uptake. [EPRM](#)

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## Financial flows for cleared products

The physical and financial outcomes for cleared products are identical to those for non-cleared, though there are some differences in financial flows – a result of clearing house processes such as variation margining and final settlement/delivery. The financial flows for both physically delivered and financially settled cleared products are shown below.

### Physical delivery process

The process of physical delivery for cleared forward contracts requires the following payment flows:

- **Forward contracts (variation margin):** Settled between each counterparty and the clearing house on a daily basis, based on mark-to-market against that day's settlement price for all open positions.
- **Forward contracts (delivery payment):** Settled bilaterally between the counterparties matched for delivery by the clearing house, based on the delivery quantity (that is, net open position) multiplied by the last-day settlement price (that is, the price on the final day of trading).
- **eSchedule:** Settled through the Pennsylvania-New Jersey-Maryland (PJM) operator, for the quantity specified in the eSchedule in each hour, multiplied by the spot market price in that hour, at that location. We should note that, for cleared contracts, the eSchedule quantity equals the net position for delivery – whereas uncleared trading requires an eSchedule for each trade.
- **Spot market:** Settled through PJM, for the spot market quantity – which may differ from that contracted for in the forward

market – multiplied by the spot market price in that hour, at that location.

The physical delivery process is shown in table 3, for a single hour of the contract period. In this particular case, it is assumed that Nymex is the clearing house for all contracts. A and B are matched for delivery, as they are the only parties with net open positions at the expiry of trading.

### Financial settlement process

Financial settlement for cleared forward contracts requires the following payment flows:

- **Forward contract (prior to delivery):** Settled between each counterparty and the clearing

house on a daily basis, based on mark-to-market against that day's settlement price for all open positions.

- **Forward contract (final settle):** Settled between each counterparty and the clearing house, based on a final mark-to-market of all open positions against the contract's external index price.
- **Spot market:** Settled through PJM, for the spot market quantity – which may differ from that contracted for in the forward market – multiplied by the spot market price in that hour, at that location.

Table 4 uses the same example as table 3. This produces different payment flows but the same net financial outcomes as physical delivery.

**Table 3: Example of physical delivery process for cleared products**

	A	B	C	D	PJM	Nymex
Forward contracts (variation margin)	-\$200	\$150		\$50		\$0
Forward contracts (delivery payment)	\$3,400	-\$3,400				
eSchedule	-\$4,000	\$4,000			\$0	
Spot sales/purchases	\$4,800	-\$4,000	-\$800		\$0	
<b>Total</b>	<b>\$4,000</b>	<b>-\$3,250</b>	<b>-\$800</b>	<b>\$50</b>	<b>\$0</b>	<b>\$0</b>

Source: Accenture

**Table 4: Example of financial settlement process for cleared products**

	A	B	C	D	PJM	Nymex
Forward contracts (prior to delivery)	-\$200	\$150		\$50		\$0
Forward contracts (final settle)	-\$600	\$600				\$0
Spot sales/purchases	\$4,800	-\$4,000	-\$800		\$0	
<b>Total</b>	<b>\$4,000</b>	<b>-\$3,250</b>	<b>-\$800</b>	<b>\$50</b>	<b>\$0</b>	<b>\$0</b>

Source: Accenture