The Spark Spread

A Trader's Guide to Power Plant Economics

If you walk onto a power trading floor in London, a common phrase you'll hear is: *"Where's the spark trading?"*

While most people think of energy trading as buying and selling commodities, power trading is actually a game of **conversion**. A gas-fired power plant is essentially a giant machine that "buys" gas and carbon, and "sells" electricity. The Spark Spread is the calculation that tells a trader whether that conversion is worth doing.

In trading, a **spread** is simply the difference between two prices. The Spark Spread is the gap between what you earn selling power and what you pay for fuel and carbon—your profit margin, in other words.

1. The Concept

In the UK, natural gas is the **marginal fuel**—the fuel that sets the price when the grid needs one more unit of power. Here's why: the grid dispatches power plants from cheapest to most expensive. The last plant needed to meet demand—the **marginal plant**—sets the price for everyone. For most hours of the day, when the wind isn't blowing hard enough, that marginal plant is a gas-fired CCGT (Combined Cycle Gas Turbine).

The Spark Spread represents the **gross margin** of that plant:

- **Positive spread:** The power you sell is worth more than the gas you burned. You turn the plant on ("dispatch").
- **Negative spread:** You are burning money. You turn the plant off and buy power from the market instead.

2. The Spark Spread Formula

To understand the formula, we need to look at how a plant converts fuel to power.

Step A: Efficiency (Heat Rate)

Not all plants are equal. Some are brand new and efficient; others are old "gas guzzlers." We measure this using the **Heat Rate**.

In the UK, the market benchmark efficiency is **49.13%**. This means that to produce 1 MWh of electricity, you need roughly 2.035 MWh of gas:

$$\frac{1}{0.4913} \approx 2.035$$

Why 49.13%? This specific number is a **market convention**, not a physical law. Price reporting agencies (ICIS, Platts) and exchanges (ICE) adopted it so traders can buy and sell standardised "Spark Spread" contracts without arguing about plant specs. Real plants vary: modern CCGTs can reach 55–60% efficiency, while older units sit around 45–48%. Plant owners adjust their trading around the benchmark based on their actual performance.

Step B: The Simple Spark Spread

$$\boxed{\text{Spark Spread} = P_{\text{power}} - (P_{\text{gas}} \times 2.035)} \tag{1}$$

where P_{power} is the power price (£/MWh) and P_{gas} is the gas price (£/MWh).

Note: This formula assumes both prices are in the same units (£/MWh). In practice, you'll often need to convert—UK gas is quoted in pence/therm, so you'll see this conversion in the worked example below.

Step C: The Clean Spark Spread (CSS)

In the UK and Europe, you can't just burn gas—you have to pay for the pollution. The **Clean** Spark Spread accounts for this carbon cost (it's "clean" because it includes the price of cleaning up the emissions). Traders subtract the cost of carbon credits (UKAs or EUAs):

$$\boxed{\text{CSS} = P_{\text{power}} - (P_{\text{gas}} \times H) - (P_{\text{carbon}} \times E)} \tag{2}$$

where:

- H = Heat rate = **2.035** (the number we derived above)
- E = Emissions factor = **0.394** tCO_2/MWh (explained below)
- P_{carbon} = Carbon price (£/tonne)

Where does 0.394 come from? This is based on combustion chemistry. Burning natural gas releases about 0.184 tonnes of CO_2 per MWh of thermal energy. But our benchmark plant is only 49.13% efficient, so it burns 2.035 MWh of gas to produce 1 MWh of electricity. Multiply these together: $0.184 \times 2.035 \approx 0.394$ tonnes per MWh of power output.

A Note on US vs European Conventions

In Europe (including the UK), traders quote the **Spark Spread** as a difference in £/MWh—the absolute margin after fuel costs. In the US, traders typically quote the **implied Heat Rate** directly as a ratio (Power Price / Gas Price), measured in MMBtu/MWh.

Terminology note: "Heat Rate" has two related meanings. In the formula above, it's the *conversion factor* (2.035 MWh of gas per MWh of electricity). In US markets, "Heat Rate" also refers to the *price ratio* (power price divided by gas price). Both stem from plant efficiency, but they're used differently. We'll stick with the European convention (difference, not ratio) throughout this guide.

3. Practical Example

Let's make this concrete. UK gas is traded in **pence per therm**, but power is quoted in **£ per MWh**, so we need to convert units.

Where does 0.3412 come from? One MWh equals 34.12 therms. To convert pence/therm to £/MWh, we multiply by 34.12 and divide by 100. That gives us $34.12 \div 100 = 0.3412$.

Worked Calculation

Using typical UK winter prices (late 2025):

- Power: £80/MWh (day-ahead baseload)
- Gas: 70 p/therm (NBP spot)
- Carbon: £50/tonne (UKA)

Step 1: Convert gas to £/MWh

$$70 \times 0.3412 = \pounds 23.88/\text{MWh}$$

Step 2: Calculate fuel cost (apply heat rate)

$$\pounds 23.88 \times 2.035 = \pounds 48.60/\text{MWh}$$

Step 3: Calculate carbon cost

$$\pounds 50 \times 0.394 = \pounds 19.70/\text{MWh}$$

Step 4: Calculate the Clean Spark Spread

$$\pounds 80 - \pounds 48.60 - \pounds 19.70 = \boxed{\pounds 11.70/\text{MWh}}$$

A margin of £11.70/MWh is positive but tight—the plant runs, but there's not much cushion if gas prices spike or the plant underperforms.

Python Implementation

Here's how you'd automate this calculation:

```python
def calculate_uk_clean_spark_spread(pwr_price, gas_price_therm, carbon_price):
    """
    Calculate the Clean Spark Spread for a UK CCGT plant.

    Args:
        pwr_price: Power price in GBP/MWh
        gas_price_therm: Gas price in pence/therm
        carbon_price: UKA carbon price in GBP/tonne
```

```python

    Returns:
        Clean Spark Spread in GBP/MWh
    """
    # 1. Convert gas from pence/therm to GBP/MWh
    gas_price_mwh = gas_price_therm * 0.3412

    # 2. Apply heat rate (49.13% efficiency = 2.035)
    fuel_cost = gas_price_mwh * 2.035

    # 3. Carbon cost (0.394 tCO2 per MWh of power)
    carbon_cost = carbon_price * 0.394

    # 4. Calculate the spread
    return round(pwr_price - fuel_cost - carbon_cost, 2)


# Winter 2025 prices
css = calculate_uk_clean_spark_spread(
    pwr_price=80,          # GBP/MWh
    gas_price_therm=70,    # p/therm
    carbon_price=50        # GBP/tonne
)
print(f"Clean Spark Spread: GBP {css} per MWh")  # Output: 11.70
```

Try It Yourself

Before moving on, try answering these:

1. What happens if gas rises to 85 p/therm? (Hint: recalculate Step 1 and 2)
2. At what gas price does the spread go negative? (Hint: set CSS = 0 and solve for gas)
3. If carbon doubles to £100/tonne, how much does it eat into the margin?

These are the kinds of "what-if" scenarios traders run constantly.

4. How UK Traders Use It in Practice

Price Discovery

Because natural gas is more liquid than power—with deeper markets, tighter bid-ask spreads, and faster price discovery—traders often use the Spark Spread in reverse. When gas prices move, they estimate how much power *should* move to maintain the same margin. For example, if NBP gas jumps by the equivalent of £5/MWh (in energy terms) and you assume a 2.035 heat rate, power should rise roughly £10/MWh to keep the spread intact. This gives traders a quick sanity check: if power hasn't moved yet, is it lagging or is something else going on (wind forecast changed, demand dropped)?

Asset Dispatch

At 11:00 every day, the **Day-Ahead auction** happens—this is where power is bought and sold for delivery tomorrow. A trader at a company like SSE or Centrica looks at the Spark Spread. If it's £10/MWh, they bid their power plant into the auction. If it's −£5/MWh, they keep the plant idle.

Hedging

A trader might see that the Spark Spread for "Winter 26" is currently very high. ("Winter 26" is a standard contract covering October 2026 to March 2027—roughly 4,380 hours. "Month" contracts cover individual calendar months.) They will sell power futures and buy gas futures simultaneously. This "locks in" the margin today, even if the plant doesn't run for another year.

Fuel Switching

Traders also watch the **Dark Spread** (coal) versus the Spark Spread. If gas becomes too expensive, the market "switches" to coal. We'll cover other spread types in detail later.

5. The Shape: Hourly Variation

The Spark Spread is not constant throughout the day. In the UK, power settles in **half-hourly periods** (48 per day), while gas is typically traded in daily or seasonal blocks.

The Twin-Peak Pattern

The spread typically follows a predictable daily shape:

- **Overnight (11 PM–6 AM):** Low or negative—demand is minimal
- **Morning peak (7 AM–9 AM):** Spikes as homes and businesses wake up
- **Afternoon (12 PM–4 PM):** Moderate—steady industrial demand
- **Evening peak (4 PM–7 PM):** Maximum—cooking, heating, lighting all at once

Because gas prices are relatively stable within a single day, the **power price** drives most of the hourly variation. This creates **shape risk**—the risk that your plant is only profitable for 4 hours instead of 24.

Quick Check

If the spread is positive only during morning and evening peaks (say, 6 hours total), but you've hedged a "Baseload" contract (24 hours), what's your exposure?
Answer: You're committed to deliver power during 18 hours when you'd lose money on each MWh.

Extension

Try modifying our Python function to take an array of 24 hourly power prices and return an array of 24 hourly spreads. Which hours would you run?

6. Renewables and Negative Spreads

Renewables have fundamentally changed the old model where "gas always sets the price."

The Merit Order Effect

Power plants are dispatched from cheapest to most expensive—this ranking is called the **merit order**. Wind and solar have a marginal cost of zero (the fuel is free). When the wind blows hard, renewables flood the bottom of the merit order, pushing gas plants out.

Going Negative

If renewable generation is high enough to meet almost all demand, the power price can drop below the cost of gas. The spark spread goes deeply negative.

Who loses money?

- **Unhedged gas plants** that must run for grid stability lose money on every MWh.
- **Wind farms on CfDs:** Under UK "Contracts for Difference," if the price stays negative long enough, they stop receiving their subsidy. This is why you sometimes see turbines standing still on very windy days—it's more profitable to be off than to pay the grid to take your power.

Who wins?

- **Battery storage:** Gets paid to absorb excess power, then sells it back during the evening peak.
- **Demand response:** Large factories get paid to turn *on* and consume the surplus.

Quick Check

On a very windy winter afternoon, power prices drop to £30/MWh. Using our formula with gas at 70 p/therm and carbon at £50/tonne, what's the Clean Spark Spread?
Answer: $30 - 48.60 - 19.70 = -£38.30$/MWh. Deeply negative—the plant should be off.

7. Why Plants Run at a Loss

It seems counter-intuitive to burn money, but physical assets have constraints that purely financial models don't capture.

Ancillary Services

The National Grid needs more than just energy—it needs **frequency response** (instant power adjustments to keep the grid at 50 Hz), **inertia** (spinning mass that resists sudden frequency changes), and **voltage control** (reactive power to maintain voltage levels). A plant might be losing £2/MWh on the spark spread but getting paid £10/MWh by the Grid to stay synchronised and provide stability.

Startup Costs

It is expensive to "cold start" a CCGT—typically £20k–£100k in extra fuel and mechanical wear. If the spread is negative for only 2 hours but positive for the 10 hours after, it's cheaper to run at a loss than to shut down and restart.

Take-or-Pay Contracts

A plant may have a gas contract where they must pay for a certain volume whether they use it or not. In that case, the marginal cost of that gas is effectively zero—you've already paid for it.

District Heating

Some plants provide heat to local towns via steam or hot water. If the town is freezing, the plant must run regardless of the power price.

8. Hedging: The Products

In the UK, the Clean Spark Spread is a **composite trade**. You aren't buying a single "Spark Product"—you execute three separate legs.

The Gas Leg

Traders use **NBP (National Balancing Point)** futures. This is the UK's virtual trading hub—a notional delivery point for all UK gas contracts. Common products include Seasons (Winter, Summer) and Months. Even though gas is eventually delivered to a physical plant, traders hedge using the NBP financial index.

The Power Leg

Traders sell **Baseload** power (flat 24/7) or **Peak** power (typically 7 AM–7 PM) depending on when the plant expects to run. In the UK, these trade on ICE (Intercontinental Exchange).

The Carbon Leg

Traders buy **UKAs (UK Allowances)** to cover emissions. Post-Brexit, UK plants use UKAs rather than EU EUAs.

The "Click" Trade

To lock in the margin, a trader matches volumes across all three legs. The key is understanding the **ratios**:

For every **1 MWh of power** you commit to deliver:

- You need **2.035 MWh of gas** (because of the heat rate)
- You need **0.394 tonnes of carbon allowances** (because of the emissions factor)

MW vs MWh: Power contracts are quoted in MW (a rate), but you're actually delivering MWh (energy over time). A "10 MW Baseload Winter" contract means delivering 10 MW continuously for the entire winter season—roughly 4,380 hours. So the total volumes are:

- Power delivered: $10 \times 4{,}380 = 43{,}800$ MWh
- Gas needed: $43{,}800 \times 2.035 \approx 89{,}000$ MWh of NBP gas
- Carbon needed: $43{,}800 \times 0.394 \approx 17{,}000$ tonnes of UKAs

This is why a "small" efficiency error compounds into a massive financial hole over a season. If your plant actually runs at 45% efficiency instead of the benchmark 49.13%, you'll burn roughly 10% more gas than you hedged—try plugging different efficiencies into our Python function to see the impact.

9. Basis Risk

(This section is more advanced—feel free to skip on first read.)

Basis risk is the risk that the price at the virtual hub doesn't match your physical reality.

Gas Basis (Location)

Your hedge is at NBP (a virtual hub), but your plant is at a physical location. If there's a pipeline constraint—say, limited capacity from terminals in the North to your plant in the South—your actual gas cost might exceed the NBP price. You're "hedged" on paper, but paying more in reality.

Power Basis (Transmission)

UK power prices are generally **postage stamp**—the same price everywhere, like a postal stamp costs the same regardless of destination. But the Grid uses the **Balancing Mechanism** to manage congestion. If you're in Scotland with too much wind and the wires to London are full, the Grid might pay you to turn *off*. Your hedge assumed you'd be running.

Operational Basis (Efficiency)

Your hedge assumes the standard 49.13% efficiency. If your plant has a technical problem and efficiency drops from 49.13% to 45%, you're under-hedged on gas. You'll need to buy more gas at spot prices to meet your power delivery obligation.

Exercise

Modify the Python function to accept efficiency as a parameter instead of using the hardcoded 49.13%. Calculate the spread at 45%, 49.13%, and 55% efficiency. How much does each percentage point of efficiency affect the margin?

Risk Type	Paper Hedge	Physical Reality	Danger
Location	NBP (virtual)	Your plant's pipe	Regional price spikes
Efficiency	49.13%	Actual heat rate	Using more gas than hedged
Volume	Fixed (10 MW)	Forced outage	Buying back power at penalty

10. Other Spreads

The Spark Spread has cousins for different fuel types.

The Dark Spread (Coal)

$$\text{Dark Spread} = P_{\text{power}} - (P_{\text{coal}} \times H_{\text{coal}}) - (P_{\text{carbon}} \times E_{\text{coal}})$$

Coal plants are less efficient (∼35–40%) and emit more CO_2 (∼0.9 t/MWh). When carbon prices are high, coal becomes uneconomic even if the fuel is cheap. This drives **fuel switching**—the point where traders shift bets from coal to gas or vice versa.

The Quark Spread (Nuclear)

$$\text{Quark Spread} = P_{\text{power}} - P_{\text{uranium}}$$

Nuclear fuel costs are tiny (£5–10/MWh) and extremely stable. The Quark Spread is almost always positive. Nuclear plants are "price takers"—they run at maximum capacity and bank whatever the power price happens to be.

The Bark Spread (Biomass)

Relevant for plants like Drax in the UK, which burn wood pellets. Similar structure to the Dark Spread, but with biomass fuel costs.

Spread	Fuel	Volatility	UK Relevance
Spark	Gas	High	Primary price-setter
Dark	Coal	Medium	Historical/European
Quark	Nuclear	Low	Stable baseload
Bark	Biomass	Medium	Drax, subsidised generation

11. Beyond Simple Dispatch: The Plant as Optionality

The Spark Spread formula tells you whether the spread is positive or negative *right now*. But modern traders don't just check "spread > 0" and switch on the plant. They treat the plant as an asset that gives them the *right, but not the obligation*, to generate.

The Decision Every 30 Minutes

UK power settles in 30-minute periods. That means every day, a CCGT operator makes **48 separate decisions**: "Should we run this half-hour?" Each decision considers:

- Is the spark spread positive for this period?
- What about the next few periods—is it worth starting up for 1 hour, or should we wait for 4 hours of positive spreads?
- What are the startup costs (fuel to warm the turbine, mechanical wear)?
- Are there minimum runtime constraints (once started, must stay on for X hours)?

Why This is "Optionality"

In financial markets, an **option** gives you the right (but not obligation) to buy or sell something. A CCGT plant is economically similar: you have the right (but not obligation) to convert gas into power. You only "exercise" that right when it's profitable (spread > 0, after accounting for startup costs).

This framework—treating physical assets as portfolios of options—is standard in algorithmic trading desks and sophisticated asset operators. The mathematics involves volatility modeling, forward curves, and optimization under uncertainty.

Looking ahead: We won't dive into options theory here. That's for a future guide on energy derivatives and real options. For now, understand that modern dispatch is *continuous optimization*, not just "on/off" based on a snapshot spread. The Spark Spread is the starting point—but there's a layer of decision-making complexity on top of it.

12. Summary

The Spark Spread answers a simple question: is it worth turning on a gas plant right now?

What you've learned:

- **The formula:** Power price minus gas cost (adjusted for efficiency) minus carbon cost
- **The benchmark numbers:** 49.13% efficiency, 2.035 heat rate, 0.394 tCO_2/MWh
- **Why it varies:** hourly demand shapes, renewable penetration, physical constraints
- **How traders hedge it:** three-legged trades across power, gas, and carbon

When the spread rises, the grid is tight—more gas plants need to fire up. When it falls, renewables are winning or demand is weak. These signals ripple through every trading desk in the UK energy market.

About Jordan Dimov

Portfolio CTO and energy trading software specialist with over 20 years of software engineering experience and 7 years in the energy commodities sector. Based in London since 2011, working through A115 Ltd, a London-based contracting and consulting company.

Previous roles include trading platform development at Shell, Centrica Energy, and Limejump, delivering systems for front office trading, middle office risk management, and back office settlement across gas, power, and environmental markets.

Professional Services

Individual & Team Training

- Energy trading bootcamps for software engineers
- ETRM development training for technical teams

Technical Consulting

- Architectural review and validation sprints
- Code review and technical assessment
- Bespoke energy trading software development

Business Development

- Strategic advisory for energy trading technology firms
- Investor relations support in the energy trading sector

Contact

Email:	jdimov@a115.co.uk
LinkedIn:	linkedin.com/in/jdimov
Website:	a115.co.uk