Energy portfolio hedging

Sustainable Smart Energy Business – Lecture 7
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Topics

1. The basics of hedging

    - Forwards

    - Financial position modeling

    - Risk and Hedging

    - Mark-to-market

    - Market price evolutions

2. Portfolio Management Game

Forwards

- A forward contract is a an agreement in which the buyer agrees to buy from the seller a fixed quantity of commodity (e.g. electricity or gas) for a fixed price for delivery in the future (delivery period).

  ➢ There is no payment at the conclusion of the forward contract.

  ➢ There is a payment at the actual delivery of the commodity

2015 FWD baseload

€/MWh
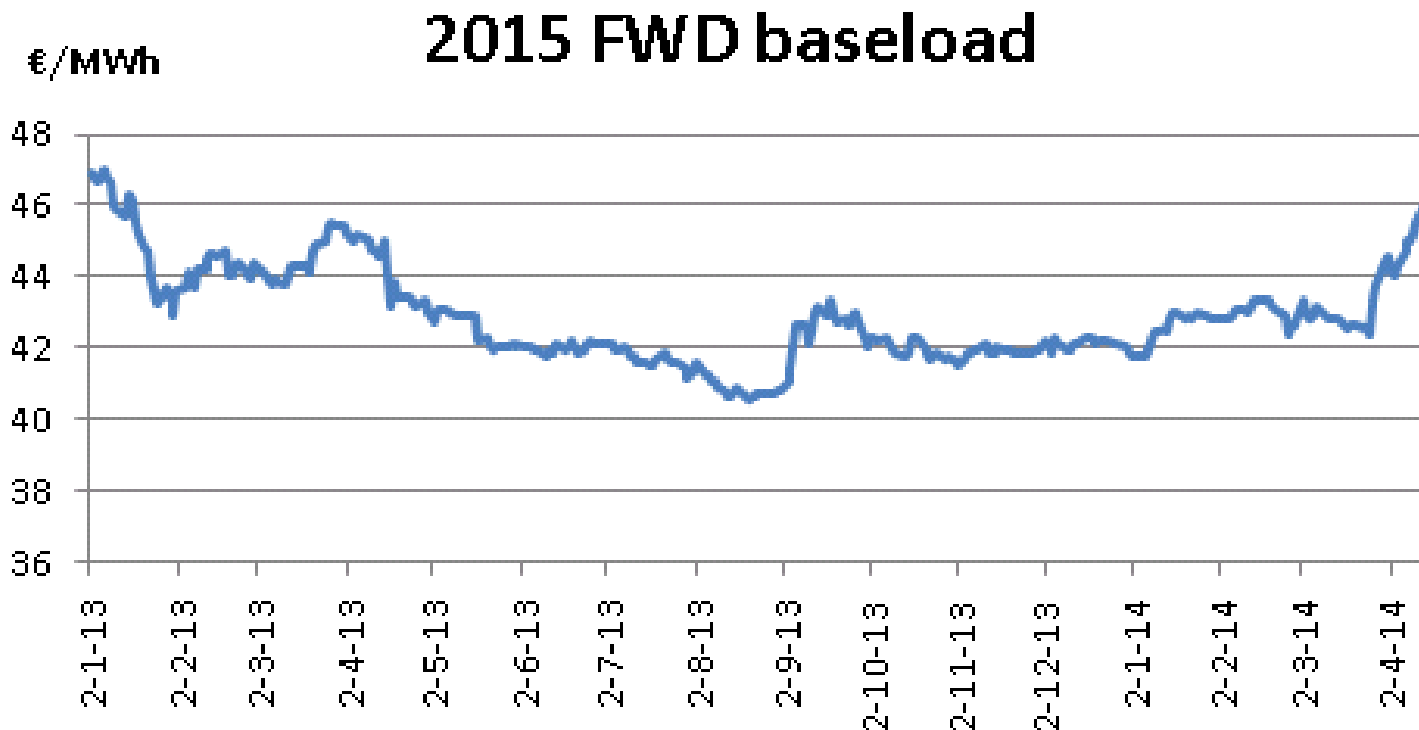
Price is driven by supply/demand
Increase of ~4 €/MWh mainly due to Doel/Tihange outage

Financial Position Modeling

- Positions can be long or short

- Long positions gains value when underlying price increases

- Short position gains value when underlying price decrease

Underlying index	Portfolio value		long-short
up	up		long
up	down		short
down	up		short
down	down		long

Financial Position Modeling

- You sold 100 000 MWh/month at fixed price for Y+1

- You will need to source this profile from the market

  - ➤ Increasing forward power prices for Y+1 will reduce the value of the contract: You are "short power"

  - ➤ E.g.: if power prices increase with 1€/MWh in M1, you will have a value decrease of 100 000 € in this contract in M1

- You bought 200 000 MWh/month gas at fixed price for Y+1
- You will need to sell this gas back in the market
  - o Increasing forward gas prices for Y+1 increase the value of the contract:

you are "LONG GAS"

  - o E.g: if gas prices increase with 1 EUR/MWh over the year, you will have a value increase of 200 000 x 12 x 1 = 2 400 000 EUR on this contract

Financial Position Modeling

- A coal fired power plant will generate 200 GWh power per month by burning 75 000 ton of coal per month
- You will need to sell the power in the market and buy the coal in the market:
  - Increasing forward power prices increase the value of the power plant
  - Increasing forward coal prices reduce the value of the power plant
- Power prices staying stable and coal prices rising with 1 EUR/ton in M1 decreases the value of the plant by: 75 000 EUR in M1
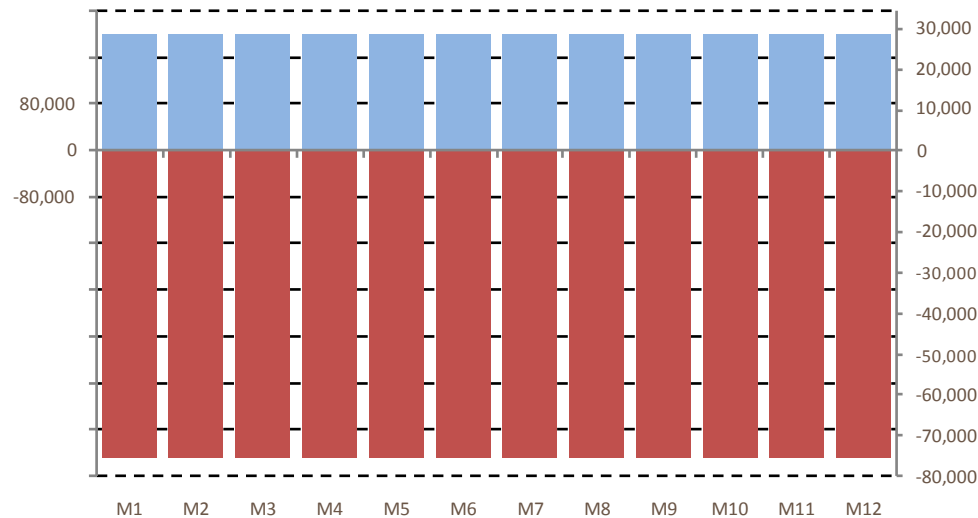
Risks and hedging

- Risk = profit is not known in advance with absolute certainty

- Holding long or short posiions is risky

- Hedging: reducing the positions, thus reducing the risks

Mark-to-market

Calculation

- The MtM of your position is the profit or loss you would make if you would liquidate (sell or buy) your complete position today on the market at current forward market prices

- For a long position:

  - o MtM = (forward market price – contract price) * volume

- For a short position:

  - o MtM = - (forward market price – contract price) * volume

Mark-to-market

Some examples

- You sold 100 000 MWh power in the market for Y+1 at 60 EUR/MWh. You are SHORT power

The forward market price for Y+1 today is at 55 EUR/MWh

MtM = - (55 – 60) * 100 000 = + 500 000 EUR

- You bought 200 000 MWh gas in the market for Y+1 at 25 EUR/MWh. You are LONG gas

The forward market price is today at 22 EUR/MWh

MtM = (22 – 25) * 200 000 = - 600 000 EUR

Mark-to-market

Some examples

• You have a nuclear power plant that will generate 1 TWh.
  You are LONG power

Today, power is quoted at 60 EUR/MWh
MtM plant = (60 – 0) * 1 000 000 = + 60 MEUR

• You have a gas fired power plant that will generate 200 GWh power and
  will consume 400 GWh gas
  You are LONG power and SHORT gas

Today, power is quoted at 60 EUR/MWh and gas quoted at 20EUR/MWh
  MtM power = (60 – 0) * 200 000 = + 12 MEUR
  MtM gas = - (20 – 0) * 400 000 = - 8 MEUR
  MtM plant = MtM power + MtM gas = + 4 MEUR

Mark-to-market

Some examples

- You have a nuclear power plant that will generate 1 TWh. You have hedged the risk by selling forward 1 TWh at 60 EUR/MWh -> Power plant makes you LONG power; hedge makes you SHORT power
- Today, power is quoted at 55 EUR/MWh
  MtM plant $(55 - 0) * 1\ 000\ 000 = 55$ MEUR
  MtM hedge $- (55 - 60) * 1\ 000\ 000 = 5$ MEUR
  MtM total 60 MEUR
- Today, power is quoted at 70 EUR/MWh
  MtM plant $(70 - 0) * 1\ 000\ 000 = 70$ MEUR
  MtM hedge $- (70 - 60) * 1\ 000\ 000 = -10$ MEUR
  MtM total 60 MEUR
- Price fluctuations do no longer affect the portfolio value
  Being 100% hedged = no more price risks

Mark-to-market

• To compute the MtM of an asset, you need to estimate or forecast how much that plant will generate and how much that plant will consume

•	These estimations can be influenced by forward power and fuel prices and is for a gas and coal asset depending on the level of Carbon Clean Spark Spread and Dark Spread

$$CCSS = \text{power revenues} - \text{gas costs} - CO_2 \text{ costs}$$
$$CCDS = \text{power revenues} - \text{coal costs} - CO_2 \text{ costs}$$

•	Hedging: reducing the positions, thus reducing the risks

Market price evolutions

Some major drivers for commodities

BRENT
Supply/demand GDP
USD/EUR
…

POWER
Underlying fuels Reserve margin
  Merit order
Cross border capacity
…

COAL
Supply/demand
USD/EUR
Freight
…

CO2
Gas/coal consumption
NAP's
Regulatory
…

GAS
Supply/demand
Brent
LNG
Storages
Weather
conditions
…

SPREADS
Underlying fuels
Power prices
Technology, efficiency
…

Portfolio Management Game

Portfolio presentation

You will own 4 power plants

PV:
- Capacity: 290 MW
- Production: 1 TWh/yr
- Built in 2014
- Thin film panels (CdS/CdTe)

Wind:
- Capacity: 630 MW
- Production: 4 TWh/yr
- Built in 2012
- Offshore (R2)

Coal:
- Capacity: 500MW
- Production: 5 TWh/yr
- Built in 1994
- efficiency 38%, consuming 2 Mton coal

Gas:
- Capacity: 500MW
- Production: 5 TWh/yr
- Built in 2011
- CGGT, efficiency 50%, consuming 10 TWh gas

The different steps

Step 1:
Evaluate
market input

Step 2:
Forecast the
production

Step3:
Evaluate
market view

Step 4:
Define hedging
strategy

Forecasting

Each period (T1 to T6), you will need to forecast how much power your assets will generate and how much fuel they will consume based on the current market prices

- Evaluate the market input   **①**
- Forecast the production. The plant is on/off!   **②**

FORECASTING				T0	T1	T2	T3	T4	T5	T6
Plant A	nuclear	power	MWh	10.000.000	10.000.000					
Plant B	coal	power	MWh	5.000.000	5.000.000					
		coal	ton	-2.000.000	-2.000.000	0	0	0	0	0
Plant C	gas	power	MWh	5.000.000	5.000.000					
		gas	MWh	-10.000.000	-10.000.000	0	0	0	0	0
ASSETS	TOTAL	power	MWh	20.000.000	20.000.000	0	0	0	0	0
		coal	ton	-2.000.000	-2.000.000	0	0	0	0	0
		gas	MWh	-10.000.000	-10.000.000	0	0	0	0	0
Market		power	€/MWh	72	70					
		coal	€/ton	52	52					
		gas	€/MWh	30	31					
Spark Spread = power - 2 * gas			€/MWh	12,0	8,0					
Dark Spread = power - 0,4 * coal			€/MWh	51,2	49,2					

Hedging

- **You will need to hedge the 2015 risks**
- **At 6 different times in 2014 (T1 -> T6)**
- **At T6 at the latest, total exposures need to be hedged**
- **Hedging volumes per T (for buys and sells) (= Clip sizes)**
  - Power: multiples of 0,2 TWh, maximally 10 TWh
  - COAL: multiples of 400 000 ton, maximally 1.2 Mton
  - GAS: multiples of 1 TWh, maximally 6 TWh

T1   T2   T3   T4   T5   T6

2014

2015
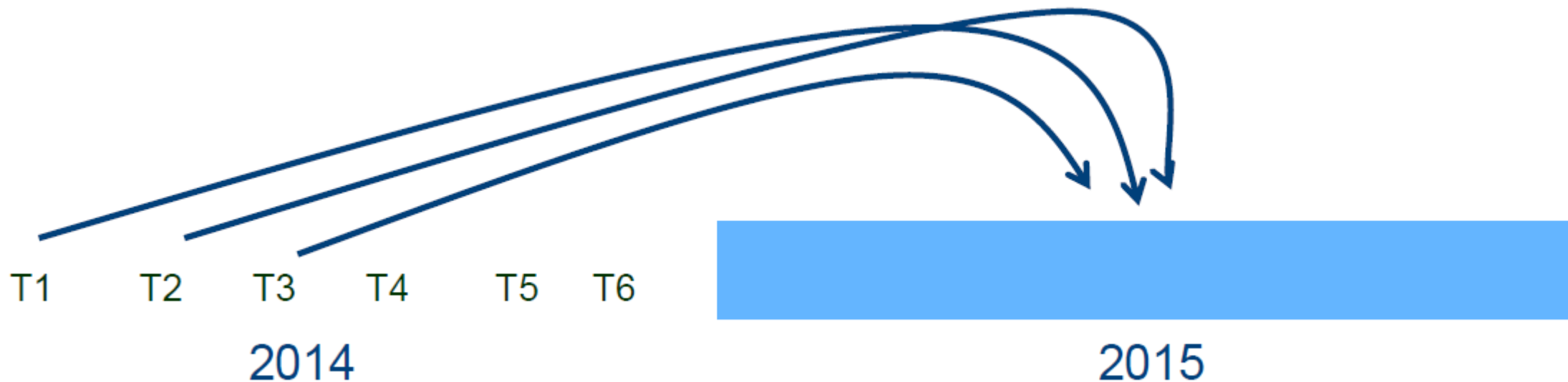
Hedging

Forecast				T0	T1	T2	T3	T4	T5	T6
Plant A	power	MWh		10.000.000	10.000.000					
Plant B	power	MWh		5.000.000	5.000.000					
	coal	ton		-2.000.000	-2.000.000					
Plant C	power	MWh		5.000.000	5.000.000					
	gas	MWh		-10.000.000	-10.000.000					
ASSETS TOTAL	power	MWh		20.000.000	20.000.000	0	0	0	0	0
	coal	ton		-2.000.000	-2.000.000	0	0	0	0	0
	gas	MWh		-10.000.000	-10.000.000	0	0	0	0	0

Hedging											
Plant A	power	MWh		0	-3.000.000						
Plant B	power	MWh		0	-2.000.000						
	coal	ton		0	800.000						
Plant C	power	MWh		0	-1.000.000						
	gas	MWh		0	2.000.000						
TOTAL	power	MWh		0	-6.000.000	0	0	0	0	0

When you want to sell: -

When you want to buy: +

Market			T0						
	power	€/MWh	72						
	coal	€/ton	52						
	gas	€/MWh	30						
Spark Spread = power - 2 * gas		€/MWh	12,0						
Dark Spread = power - 0,4 * coal		€/MWh	51,2						

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Positions

cumm hedges	Plant A	power	MWh	0	-3.000.000
	Plant B	power	MWh	0	-2.000.000
		coal	ton	0	800.000
	Plant C	power	MWh	0	-1.000.000
		gas	MWh	0	2.000.000
	TOTAL	power	MWh	0	-6.000.000
		coal	ton	0	800.000
		gas	MWh	0	2.000.000
Net position	Plant A	power	MW	10.000.000	7.000.000
	Plant B	power	MW	5.000.000	3.000.000
		coal	ton	-2.000.000	-1.200.000
	Plant C	power	MW	5.000.000	4.000.000
		gas	MWh	-10.000.000	-8.000.000
	TOTAL	power	MW	20.000.000	14.000.000
		coal	ton	-2.000.000	-1.200.000
		gas	MWh	-10.000.000	-8.000.000

0

- Cumulatieve hedges show the sum of all hedges executed
- Nett position show the remaining positions per plant for power and fuels
- At T6 your remaining position should be 0!

MtM impact

MtM										
	Plant A	Asset	M€	720	680					
		hedges	M€	0	0					
		TOTAL	M€	720	680					
	Plant B	Asset	M€	256	230					
		hedges	M€	0	0					
		TOTAL	M€	256	230					
	Plant C	Asset	M€	60	20					
		hedges	M€	0	0					
		TOTAL	M€	60	20					
	TOTAL	Asset	M€	1.036	930					
		hedges	M€	0	0					
		TOTAL	M€	1.036	930					

- After every step you can see the impact of your actions on the MtM!

- The team with the highest MtM at T6 will be the winner

Market outlook