CfDs to support renewables: the devil is in the details

Lena Kitzing

26 June 2024

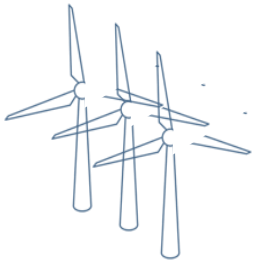
- How to properly design CfD contracts?
  - Context-specific functionality, based on a (good-enough) understanding of technology & market situation, and of design options and their implications
  - Trade-offs are inevitable
  - Tailor-made, but based on best-practice principles and harmonisation where possible
- How will their massive use impact the functioning of electricity markets?
  - Possible to design production-based CfDs that are non-distortive in the day-ahead markets – intraday issues exist (same as for almost all existing support schemes)
  - Need more analysis on exact effects
  - Production-independent ideas are compelling but face open implementation questions
  - Unresolved issues remain for all suggestions

Co-funded by the Erasmus+ Programme of the European Union

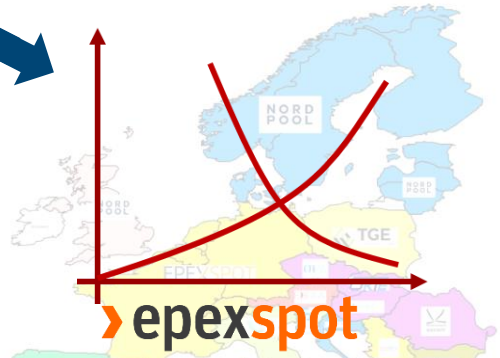
What are CfDs?

Financial hedge

Financial Derivative



Sell power



Source: EU4Energy and Energy Community, March 2020, Electricity market functions – short overview and description Online capacity-building material

Fixed-for floating swap

Swap Buyer (fixed-rate-payer)

Swap Seller (floating-rate-payer)

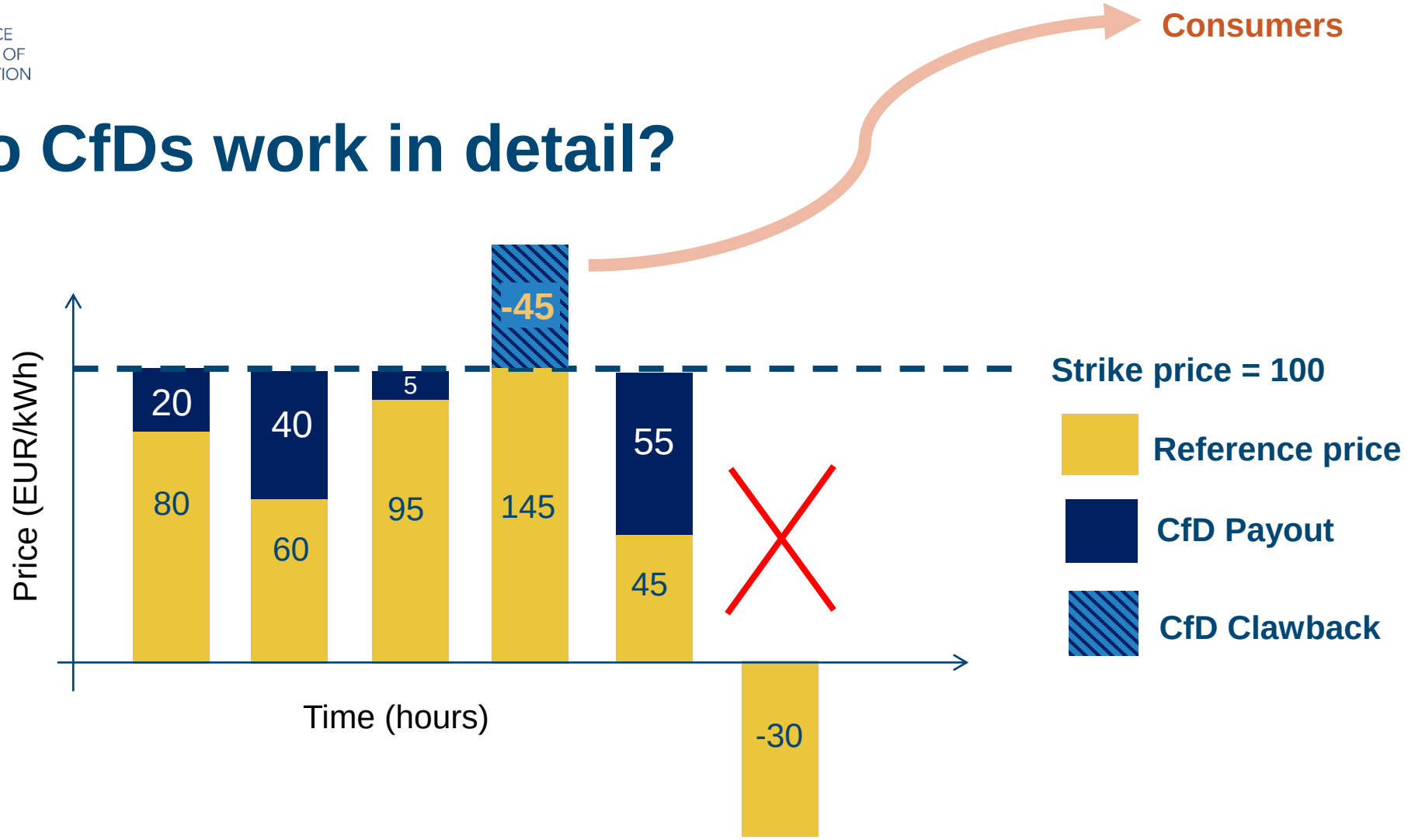
>> not invented specifically for electricity

*In fact, a trillion EUR business for interest rates and currency exchange rates **

** Fixed-for-floating interest rate swaps in the EU traded at $1.8 trillion in Jan 2022 alone https://www.isda.org/a/yQPgE/Interest-Rate-Derivatives-Trading-Activity-Reported-in-EU-UK-and-US-Markets-January-2022.pdf*

Co-funded by the Erasmus+ Programme of the European Union

How do CfDs work in detail?



Co-funded by the Erasmus+ Programme of the European Union

Key impact areas of CfDs

- Closing the profitability gap
- Capping of revenues and redistribution to end-consumers
- Enabling market integration and fostering a cost-efficient system
- Allocating risks
- Addressing ‘missing’ long-term markets

Co-funded by the Erasmus+ Programme of the European Union

When to use CfDs?

WHEN

(1) the market does not provide sufficient investment incentive

- Sufficiently large and liquid long-term markets are missing
- Not only when assets are unprofitable – also when not bankable

(2) Government wishes to directly collect revenues at high prices

FOR ASSETS that

- have high upfront investment cost
- benefit greatly from reduced exposure to volatile prices
- Need stabilisation of price (or revenue) to achieve:
  - bankability
  - low cost of capital for financing

Co-funded by the Erasmus+ Programme of the European Union

Dimensions of CfD design

DIMENSION	Category	Discussed design options
Reference volume	Reference volume	▪ Generation-based ▪ Capacity-based ▪ Generation-potential-based
Reference price design	Reference market	▪ Day-ahead only ▪ Mixed price index (e.g. incl. intraday and balancing)
	Reference period	▪ No aggregation (hourly / half hourly) ▪ Monthly ▪ Quarterly, Seasonal, Annual
	Referencing method	▪ No averaging ▪ Technology-specific ▪ Technology-uniform RE ▪ Flat average (baseload price)
Further design elements	Strike price design	▪ Cap-and-floor system (rubberband, bufferzone) ▪ Indexation ▪ Add-ons / Deductions
	Market integration safeguards	▪ Payout limitations at negative prices ▪ Clawback limitations at low prices
	Contract design	▪ Duration ▪ Administrative payment settlement rules ▪ Timing of referencing and payouts (ex-post, ex-ante) ▪ Exit option(s) for producer

Co-funded by the Erasmus+ Programme of the European Union

Dimensions of CfD design

ROBERT SCHUMAN CENTRE

Contract design

- Duration
- Payment settlements
- Exit option

Strike price design

- Indexation
- Add-ons / Deductions

CfD Implementation

- context specific
- evolving

Market integration safeguards

- Payout limits at negative prices
- Dynamic clawback design

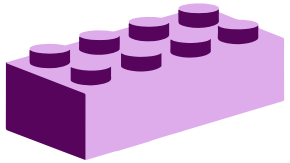
Reference price design

- Reference market
- Reference period
- Referencing method
- Timing of referencing

Reference Volume

- Generation-based
- Capacity-based
- Generation-potential-based

Co-funded by the Erasmus+ Programme of the European Union

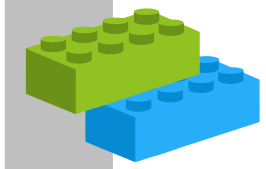


Generation-based

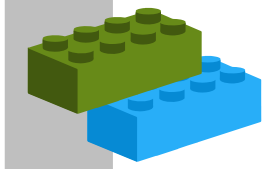
"produce-and-forget"

MARKET INTEGRATION

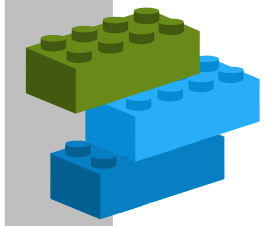
Hourly reference period



Hourly reference period &
Payout paused < 0 prices



Quarterly reference period &
Payout paused < 0 prices



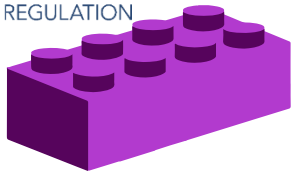
Quarterly reference period &
Payout paused < 0 prices &
Dynamic clawback design

Some market distortions remain

Table 1: CfD schemes implemented in European countries

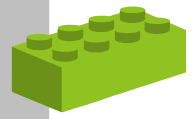
Country	Duration (Years)	Reference period	Referencing method	Other features
DK	20	Annual	Uniform	Limited clawback / net payment cap
FR	20	Monthly	Volume-weighted	Premium for curtailment during negative prices
GR	20	Monthly	Technology-specific	-
HU	up to 25	Monthly	Technology-specific	-
IE	20	Hourly	n/a	Compensation for unrealised available energy
IT	up to 30	Hourly	n/a	-
PL	15	Daily	Volume-weighted	-
PO	15	Hourly	n/a	-
ES	up to 20	Hourly	n/a	Adjustment factor for remuneration at market price / Electricity market is regarded
UK	15	Hourly	n/a	-

Co-funded by the Erasmus+ Programme of the European Union

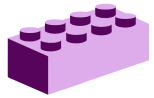


Generation-independent

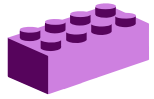
DEVIATION FROM PRODUCTION



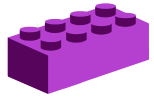
Hourly reference period



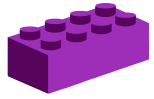
Producer's forecasted production



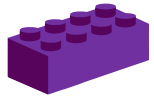
Mathematical model based on weather data



Sample of wind/PV plants



Aggregated wind/PV production in a region



Technology-neutral base profile

New basis risk related to volume reference

Practical implementation questions

Disruptive to existing support landscape

Co-funded by the Erasmus+ Programme of the European Union

	Addressing risk exposure for RE producers		Exposing RE producers to basis risk (reference deviation)		Enabling market integration	Challenges and remaining issues / Implementation issues
	Price	Volume	Price	Volume		
CfD with hourly reference period	No exposure	Normal production risk exposure	No exposure	No exposure	"Produce-and-forget" incentives, hardly incentivises market integration, intraday distortions	Lacking variable short-term price signals hinder market integration
CfD with hourly reference period, payout paused during negative day-ahead prices		*			"Produce-and-forget" incentives for positive DA prices, improved market integration for negative DA prices, distortions on intraday and balancing markets	Lacking variable short-term price signals hinder market integration
CfD with monthly, quarterly or annual reference period		*	**		Provides short-term/seasonal price signals, creates bidding and production distortions on day-ahead, intraday and balancing market	Design in times of clawback, remaining DA-ID distortions
CfD with monthly/quarterly/ annual ref. period and dynamic clawback design		*	**		Provides short-term/seasonal price signals, DA-distortions are addressed, intraday distortions persist	Determination and implementation of dynamic clawback design, remaining DA-ID distortions
CfD with a cap-and-floor system (and market integration safeguards as above)		*	***		Price signals depend on ref. period similar to above, price signals passed through within corridor, ID and DA distortions similar to CfDs above.	Determination of Cap /floor parameters; Fewer issues with "drying up" of forward markets; Lower pay-back to consumers than in other CfD variants
Capability-based CfD	***		***		Short-, medium-, and long-term market integration ensured No DA and ID distortions	Potential measurement and manipulation possibilities (or their prevention).
Financial CfD	***	No exposure to negative prices, additionally removes weather risk	(***)	****	Short-, medium-, and long-term market integration ensured No DA and ID distortions In case of aggregated reference: incentive to optimise plant location	Complexity and implementation issues, dealing with "collateral", possibly implications of classification as financial derivative and consequences for small players.
Yardstick CfD		Potentially removes weather risk	***		Short-, medium-, and long-term market integration is ensured Locational distortions are addressed	Design details not specified

Co-funded by the Erasmus+ Programme of the European Union

Risk exposure is key to understanding CfD design

- Price risk
  - not directly related to the choice between generation-based or generation-independent
- Volume risk
  - risk of revenue losses from negative prices mainly in generation-based, due to dynamic designs
  - weather risk exposure addressed in generation-independent (should it?)
- Basis risk (= risk of deviating from the reference)
  - Mostly dependent on the choice of referencing method and period
  - volume basis risk introduced by generation-independent

Co-funded by the Erasmus+ Programme of the European Union

Open discussion on CfDs

- **Benefits from the two-sided CfD:**
  - More stable revenues for bankability
  - Avoids strike price erosion, as seen under one-sided CfD (sliding premiums)
  - Avoids emergency revenue-collection interventions by policy makers

- **Interaction between markets:**
  - Potential distortions regarding intraday, balancing market & forward markets
  - Quantification of effects, ***more research needed***
  - Much can be handled through ‘smarter’ designs, schemes are continuously improved

- **Interactions with PPA and forward markets:**
  - It is still a vastly growing segment / many countries do not yet provide access to adequate long-term hedging at all
  - The volumes that can be offered by PPA market will likely not be sufficient for massive scale-up
  - CfDs will influence the attractiveness and scope of PPA and forward markets, ***more research needed***

Co-funded by the Erasmus+ Programme of the European Union

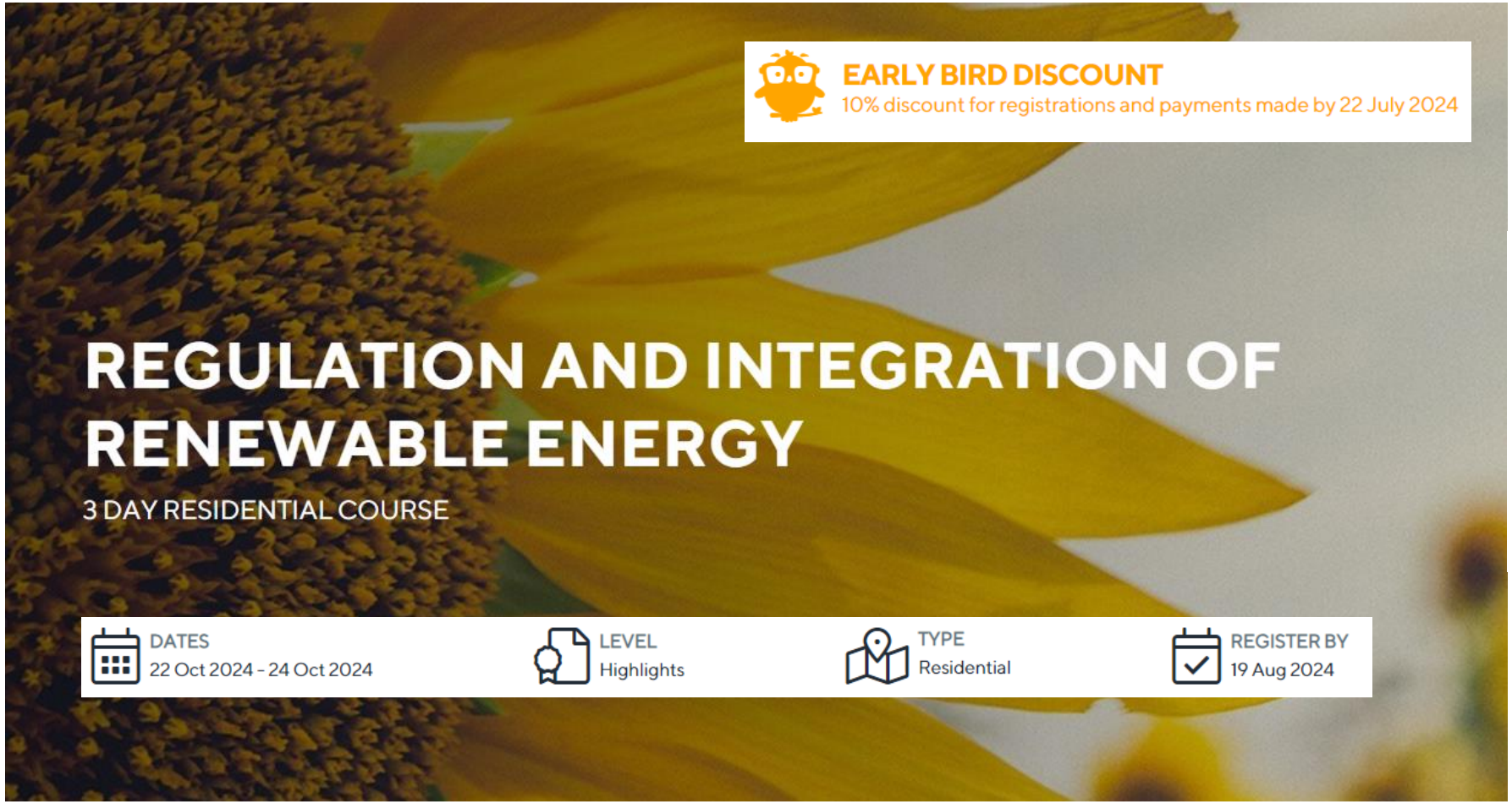
Conclusions

- **Contract-for-Difference are highly diverse in implementation**
- **Many design options available for the informed policy maker – possible advantage to experiment and create positive learning feedback loops**
- **We can design & implement production-based CfDs that are non-distortive on the day-ahead market & provide investment certainty**
- **We can conceptualise the design of functional generation-independent CfDs, but lack experience & compatibility**
- **Some unresolved issues remain with all suggestions**

> what really matters is to create adequate designs that ensure context-specific functionality & implementability

Co-funded by the Erasmus+ Programme of the European Union

…want to learn more? >> JOIN OUR COURSE!



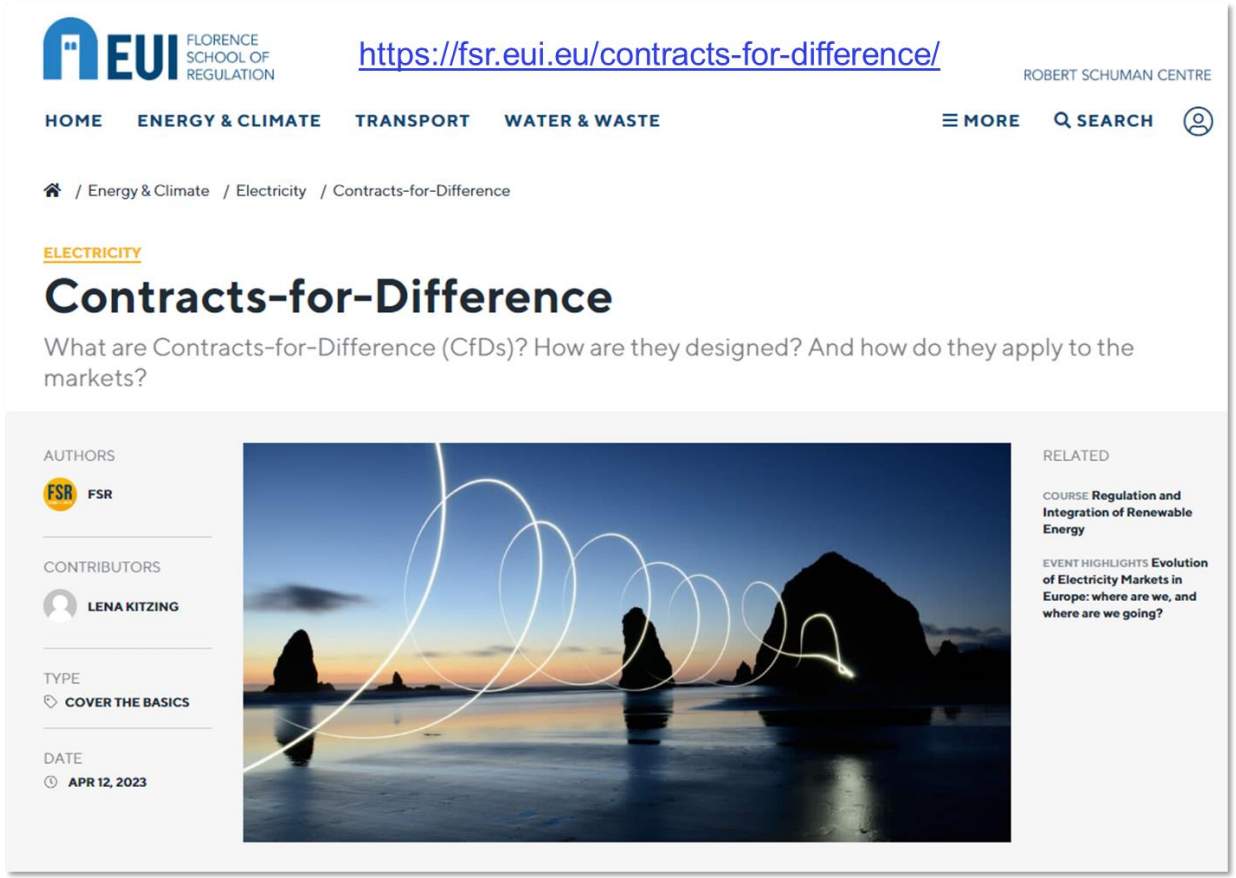
Course Director
Lena Kitzing

Course Director
Mario Ragwitz

REGISTER HERE

https://fsr.eui.eu/course/regulation-and-integration-of-renewable-energy/
https://apps.eui.eu/EventRegistration/?eventId=564883

Co-funded by the Erasmus+ Programme of the European Union



https://fsr.eui.eu/publications/?handle=1814/76700

Co-funded by the Erasmus+ Programme of the European Union

		Period 1	Period 2	Period 3	Period 4	Period 5	TOTAL
Design 1: no averaging	Own production volume [MWh]	50	90	25	80	110	
	Production of technology group [GWh]	400	950	250	700	1250	
	Strike price [EUR/MWh]	120	120	120	120	120	
	Market price [EUR/MWh]	110	50	130	20	20	
	CfD payout [EUR/MWh]	10	70	-10	100	100	
	Achieved price in period [EUR/MWh]	120	120	120	120	120	
	Revenues [EUR]	6,000	10,800	3,000	9,600	13,200	42,600
Design 2: volume weighted averaging	CfD payout [EUR/MWh]	74	74	74	74	74	
	Achieved price in period [EUR/MWh]	184	124	204	94	94	
	Revenues [EUR]	9,200	11,170	5,100	7,520	10,350	43,340
Design 3: flat averaging	CfD payout [EUR/MWh]	54	54	54	54	54	
	Achieved price in period [EUR/MWh]	164	104	184	74	74	
	Revenues [EUR]	8,200	9,360	4,600	5,920	8,140	36,220

Co-funded by the Erasmus+ Programme of the European Union