



TradeRES

New Markets Design & Models for
100% Renewable Power Systems

AMIRIS

Agent-based Market model for the Investigation of Renewable and Integrated energy Systems



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Content

Basic concepts of AMIRIS

Questions

Please wait until the end of the presentation

Presenter

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Method

agent-based simulation of day-ahead electricity market & its bidding agents

Purpose

Assess electricity market designs & regulations in future energy scenarios considering the strategies and behavior of market actors under competition and dealing with short- and long-term uncertainties.

	Temporal resolution	Spatial resolution	Time Horizon
Typical (possible)	1 h (1 s)	Market zone (any)	1 a (any)

Inputs

- *Power plants:* capacity, efficiency, OPEX, availability
- *Profiles:* demand, RE feed-in, fuel & CO₂ price
- *Flexibilities:* storage capacity & power, (dis-) charge efficiency, planning strategy
- *Policy:* support scheme(s) parameterisations

Outputs

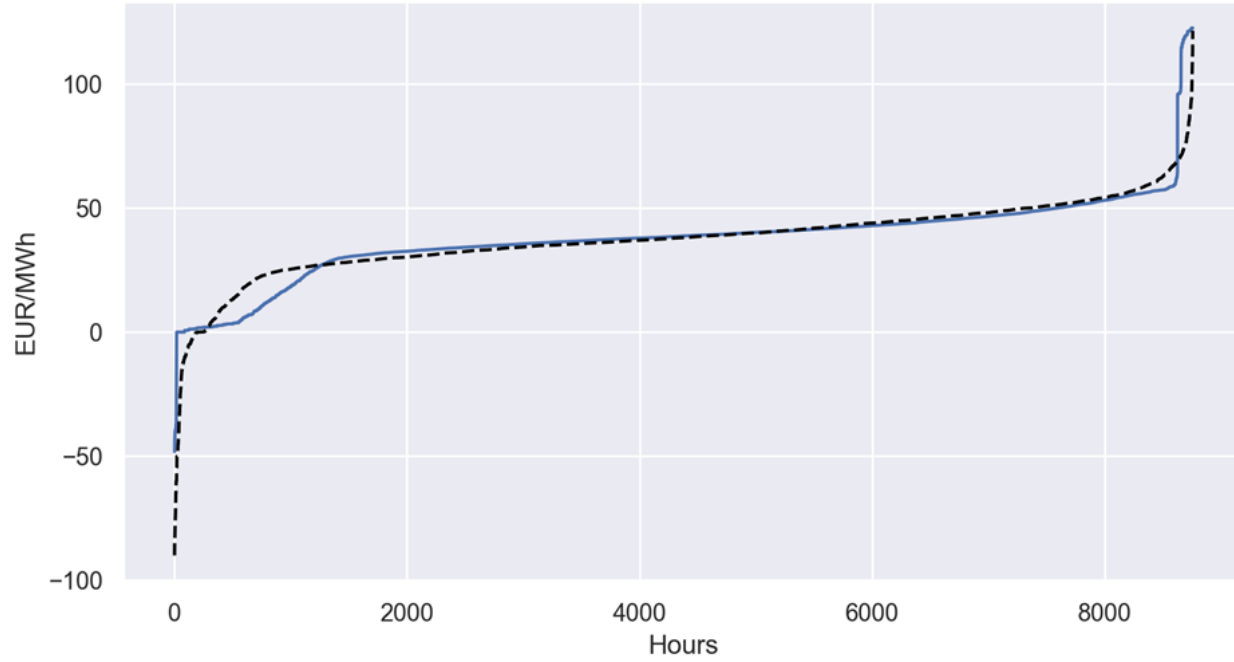
- Electricity prices
- Dispatch of generation plants & flexibilities
- Operator profits
- Support cost
- CO₂ emissions



AMIRIS

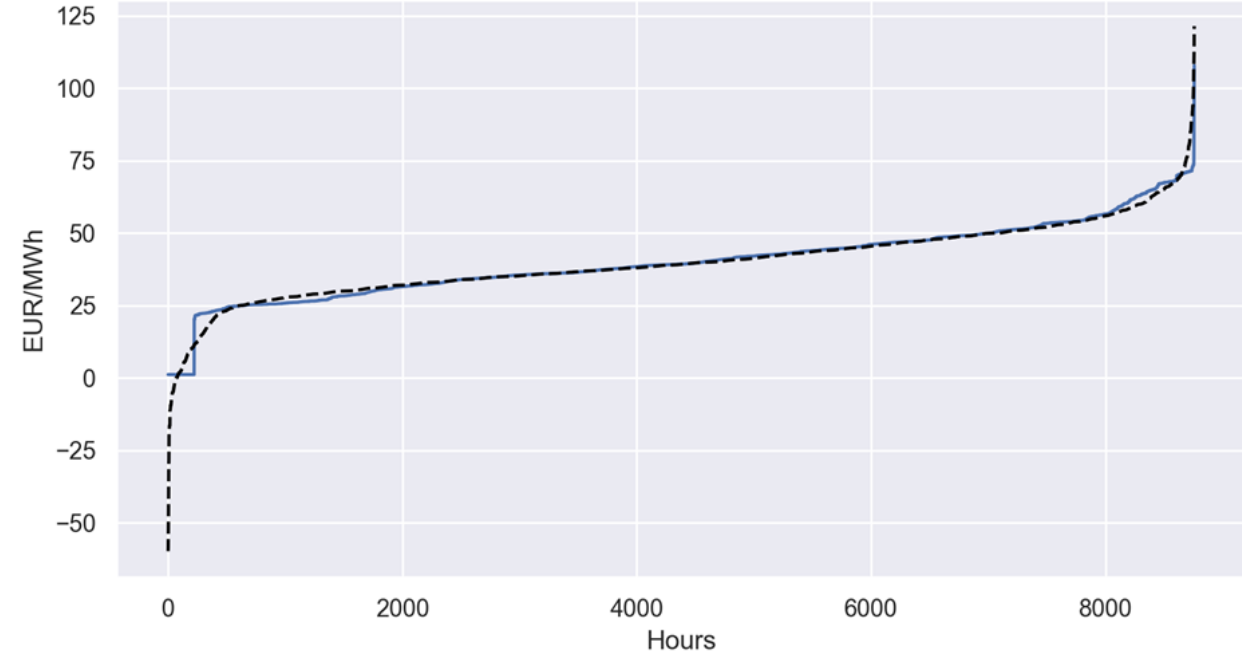
Application Example

2019



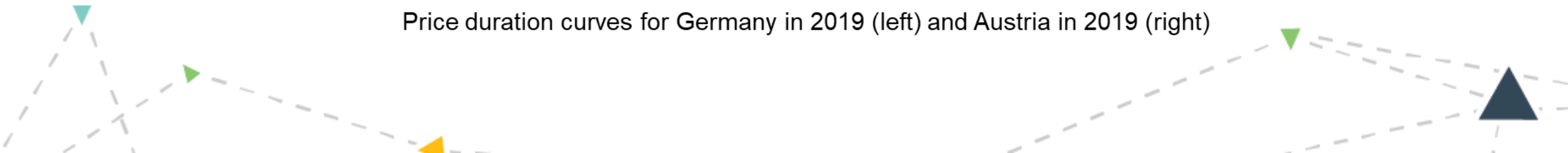
— Simulated prices - - - Historical prices

2019



— Simulated prices - - - Historical prices

Price duration curves for Germany in 2019 (left) and Austria in 2019 (right)





AMIRIS Agents Types

Markets

- Determine prices

Plant operators

- Control power plants

Traders

- Fulfil marketing strategies

Flexibility providers

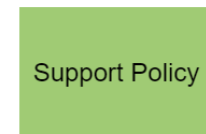
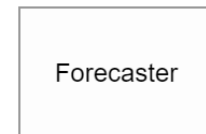
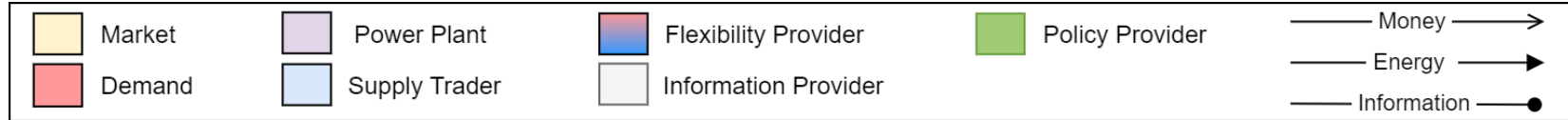
- Optimise dispatch

Information provider

- Create forecasts

Policy

- Provide support



Power Plant Holder

- Set up plant portfolio

Power Plant Operator

- Dispatch power plants
- Calculate marginal cost

CO₂ Market

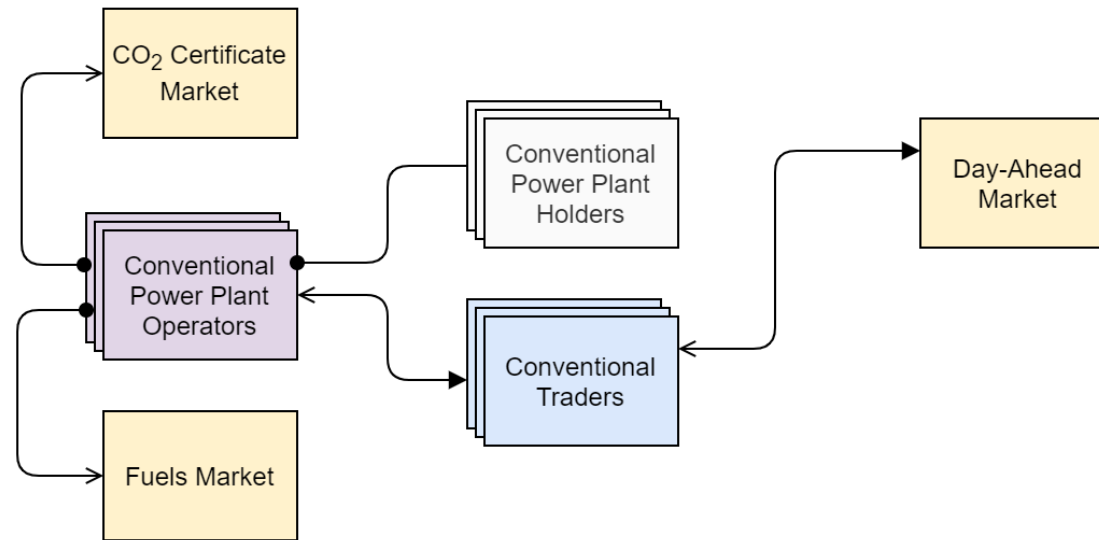
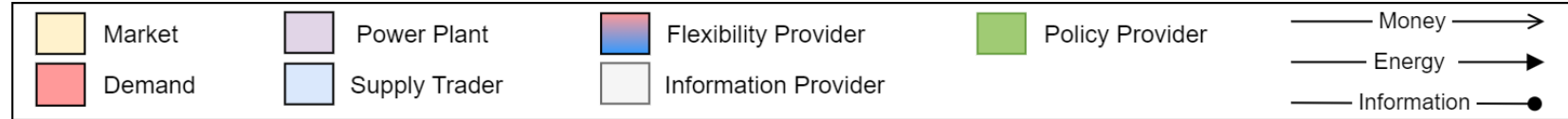
- Define certificate prices

Fuels Market

- Define fuel prices

Trader

- Assign bid markups

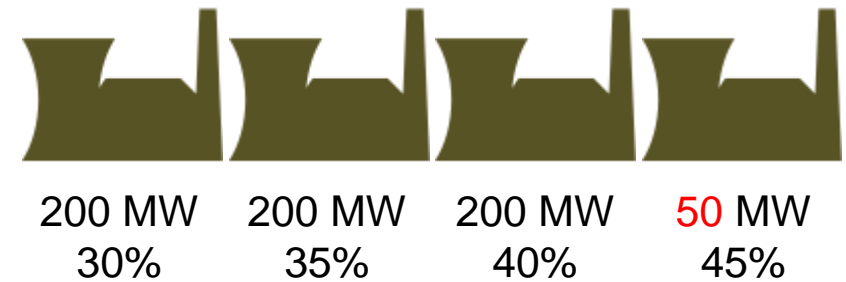


Actions

- 1) *Set up power plant portfolio*
- 2) *Send Portfolio*

Input parameter	Value
Prototype.FuelType	LIGNITE
InstalledPowerInMW	650
BlockSizeInMW	200
Efficiency.Minimal	.30
Efficiency.Maximal	.45

Portfolio



↓
Plant Operator



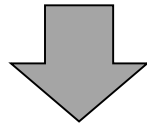
Conventionals

Power Plant Operator

Actions

- 1) *Receive portfolio*
- 2) *Get Fuel / Emission prices*
- 3) *Calculate marginal costs*
- 4) *Send marginals to Trader*
- 5) *Receive dispatch assignment*
- 6) *Dispatch plants*

Plant Holder



50 MW
45%



. . . .

200 MW
30%



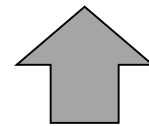
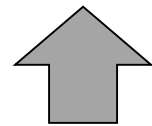
MW	€/MWh
50	32
200	37
200	44
200	50



Trader

CO₂ price

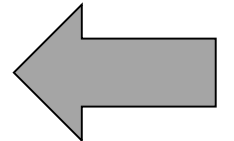
Fuel price



CO₂ Market

Fuels Market

20 MW

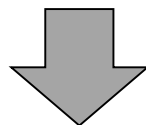


Trader

Actions

- 1) *Receive marginal costs*
- 2) *Interpolate markups*
- 3) *Send bids to Exchange*
- 4) *Receive awards*
- 5) *Forward power to operator*

Plant Operator



MW	€/MWh
50	32
200	37
200	44
200	50

Input parameter	Value
minMarkup	-20
maxMarkup	40

Markup

€/MWh
-20
+0
+20
+40

Bid price

€/MWh
12
37
64
90



Exchange

20 MW



Exchange

Power Plant Operator

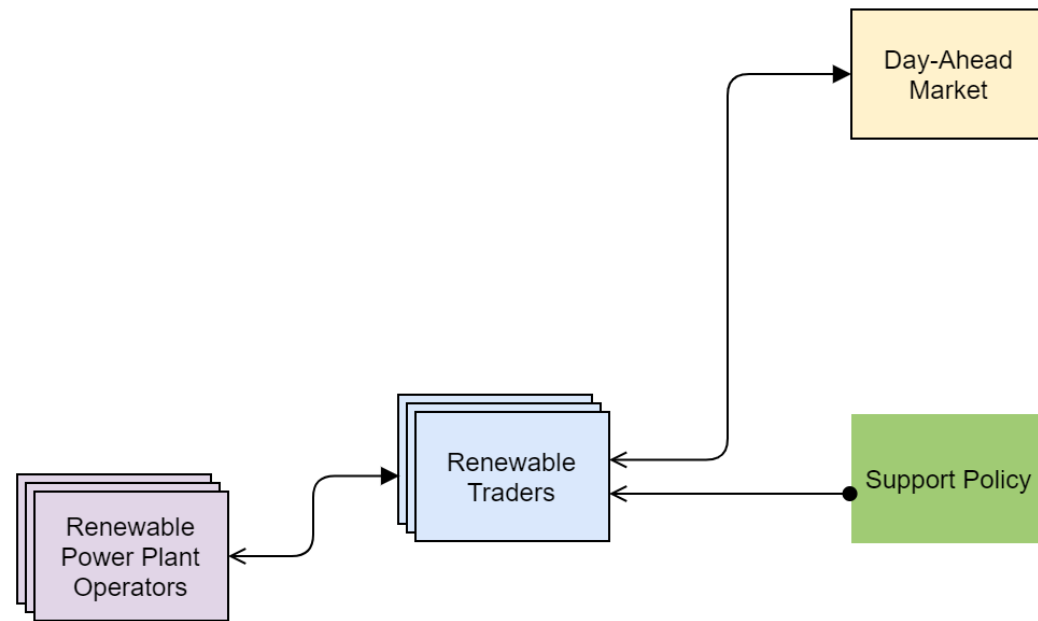
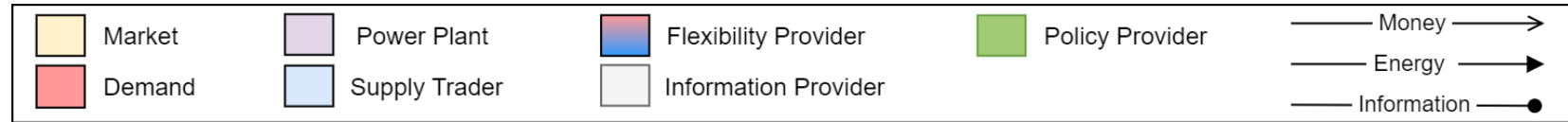
- Calculate marginal cost
- Dispatch power plants

Renewable Trader

- Create bid
- Request support

Support Policy

- Calculate support tariffs
- Provide support funding

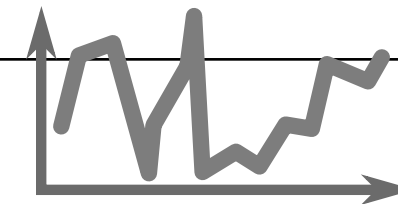


Actions

- 1) Calculate power potential
- 2) Calculate marginal costs
- 3) Send marginals to Trader
- 4) Receive assignment
- 5) Dispatch plants



Input parameter	Value
EnergyCarrier	WindOn
InstalledPowerInMW	1000
OpexVarInEURperMWh	10
YieldProfile	



MW	€/MWh
497	10

497 MW



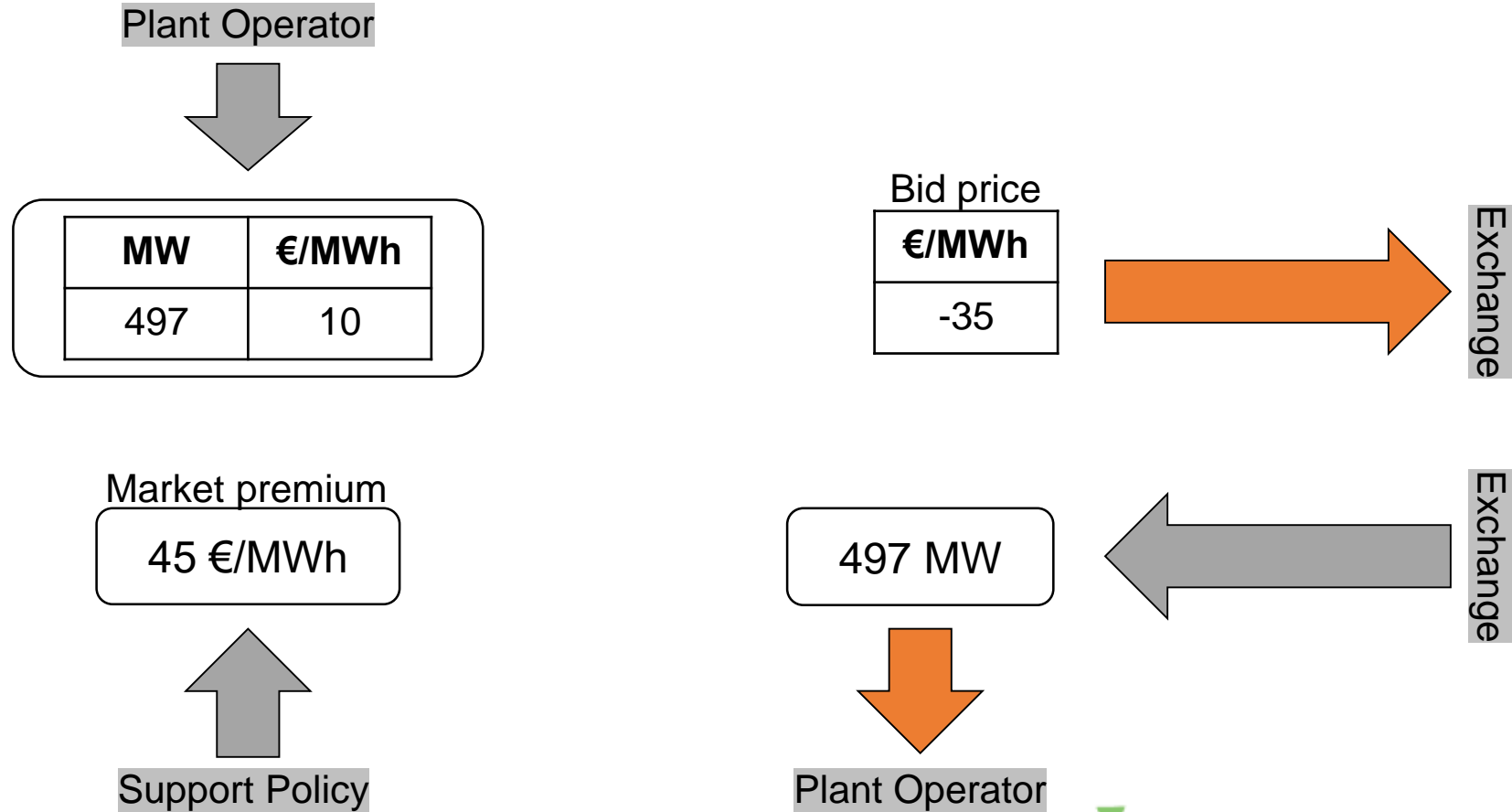
Trader



Trader

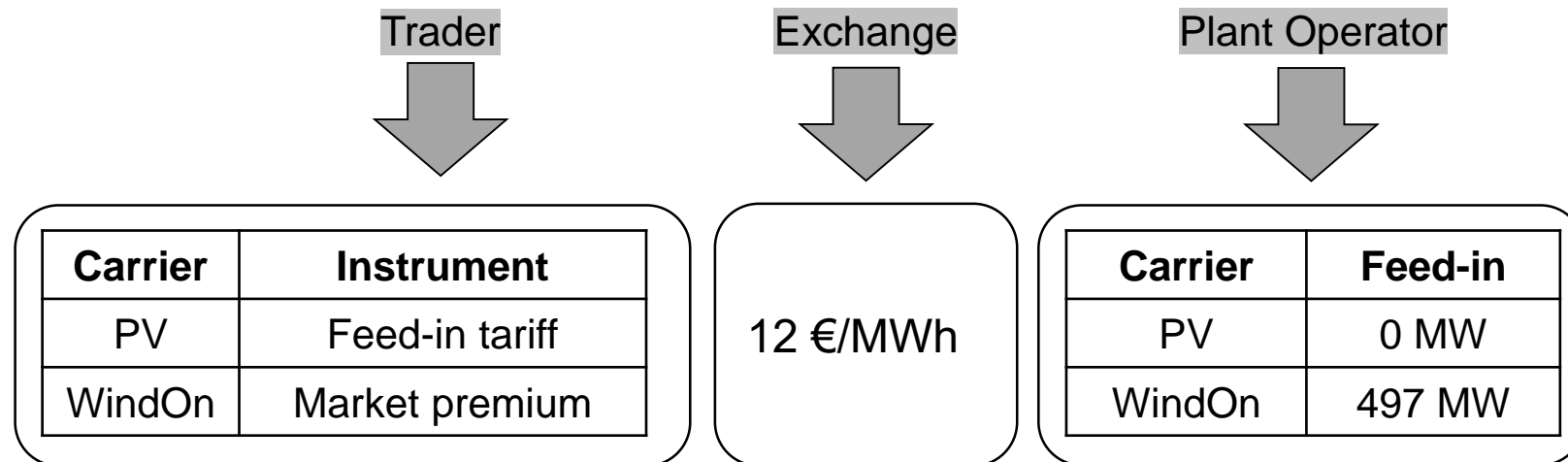
Actions

- 1) *Receive marginal costs*
- 2) *Check support instrument*
- 3) *Derive bid*
- 4) *Send bids to Exchange*
- 5) *Receive awards*
- 6) *Forward power to operator*

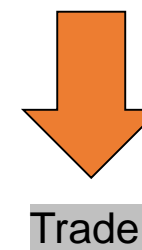


Actions

- 1) Register clients
- 2) Track power prices
- 3) Track feed-in potentials
- 4) Calculate variable tariffs
- 5) Provide support



Carrier	Instrument	Support
PV	Feed-in tariff	90 €/MWh
WindOn	Market premium	45 €/MWh



Forecaster

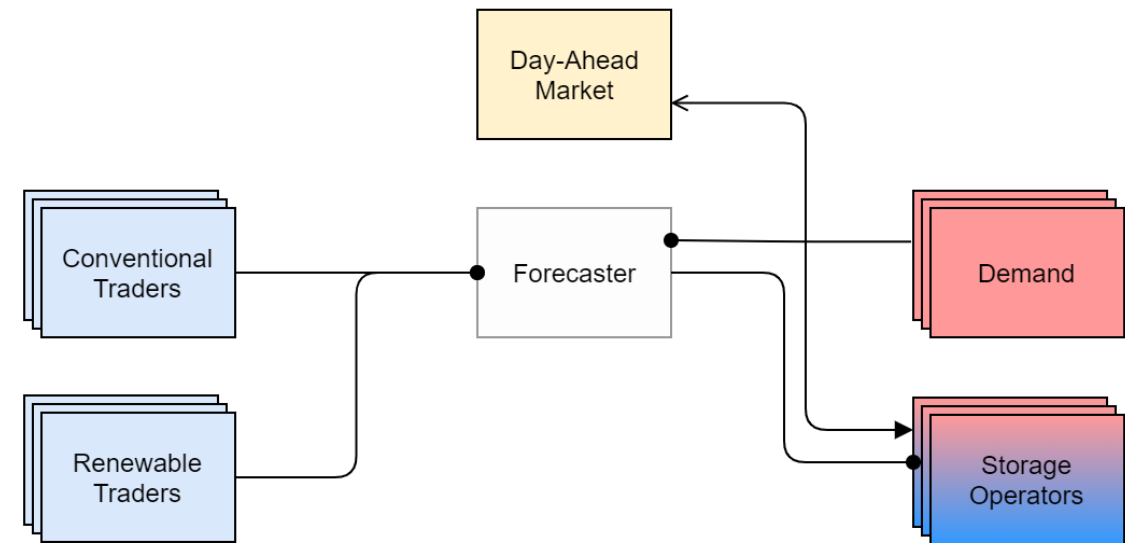
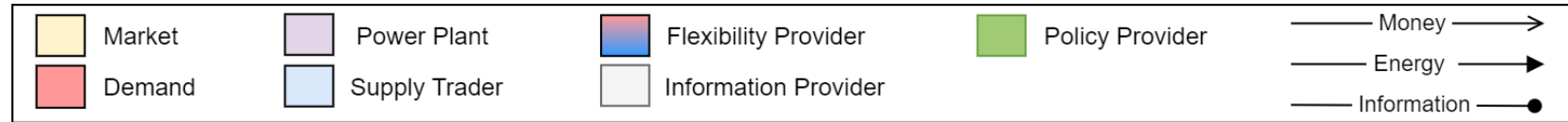
- Calculate forecasted merit order

Storage Operator

- Evaluate forecasts
- Optimise dispatch
- Consider own impact on prices

Other Traders

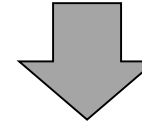
- Assumed “inflexible”
- Provide forecasted bids



Actions

- 1) *Get (inflexible) forecasted bids*
- 2) *Clear forecasted market*
- 3) *Send forecasted clearing data*

Trader



Forecasted

- (inflexible) demand bids
- (inflexible) supply bids

Forecasted Price: 37 €/MWh



Storage



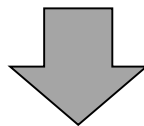
Flexibilities

Storage Operator

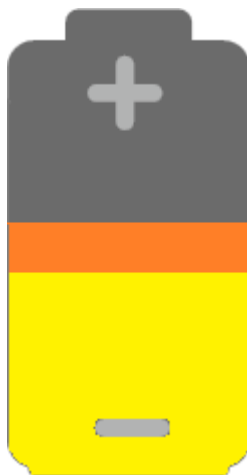
Actions

- 1) *Get forecast clearing data*
- 2) *Optimise bidding*
- 3) *Send bids to Exchange*
- 4) *Receive awards*
- 5) *Operate storage device*

Forecaster



Forecast:
37 €/MWh



Input parameter

Value

InstalledPowerInMW

1000

EnergyToPowerRatio

5

(Dis-)ChargingEfficiency

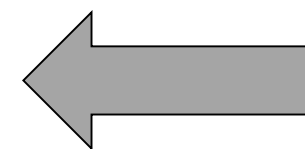
.90

MW	€/MWh
500	11



Exchange

Discharge
500 MWh



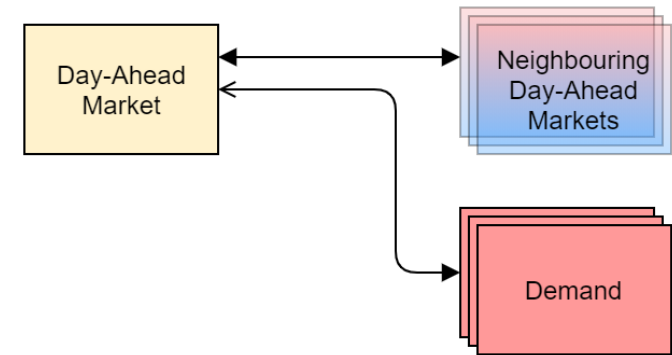
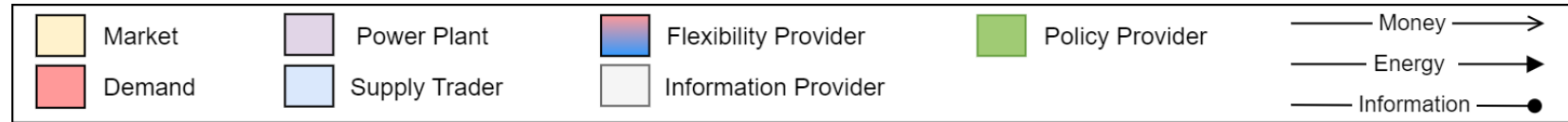
Exchange

Demand

- Provide static demand bids
- Load shedding

Neighbouring markets

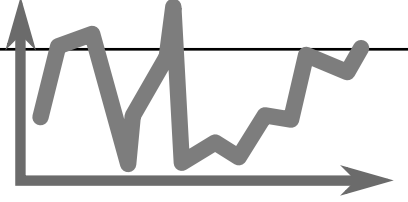
- Not (yet) a dedicated agent
- Emulate with Demand / Supply



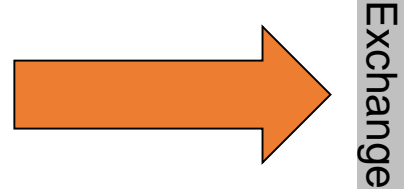


Actions

- 1) *Create bid*
- 2) *Send bid(s) to Exchange*

Input parameter	Value
ValueOfLostLoad	3000
DemandSeries	

MW	€/MWh
1017	3000

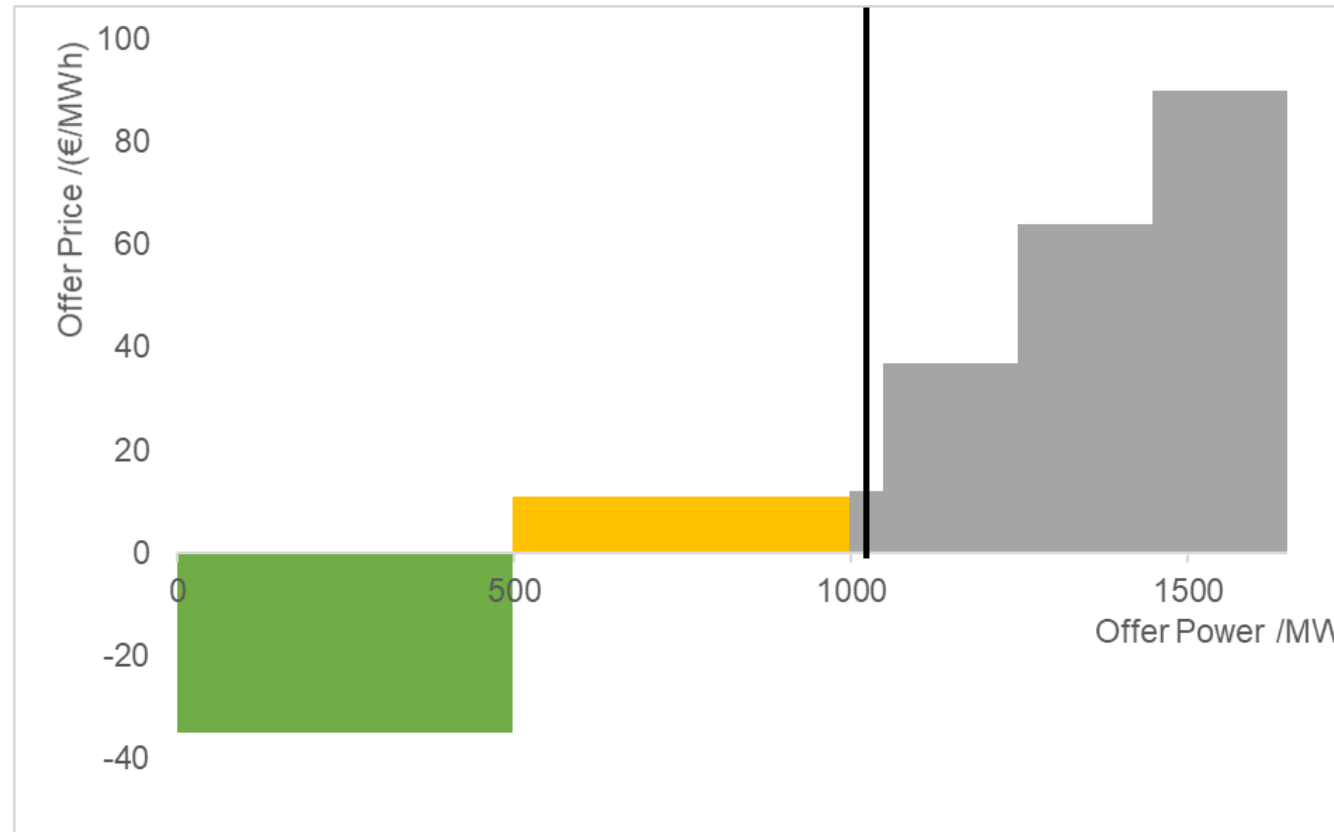




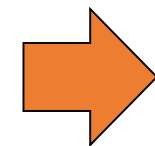
Energy Exchange

Actions

- 1) *Receive bids*
- 2) *Clear market*
- 3) *Send awards*



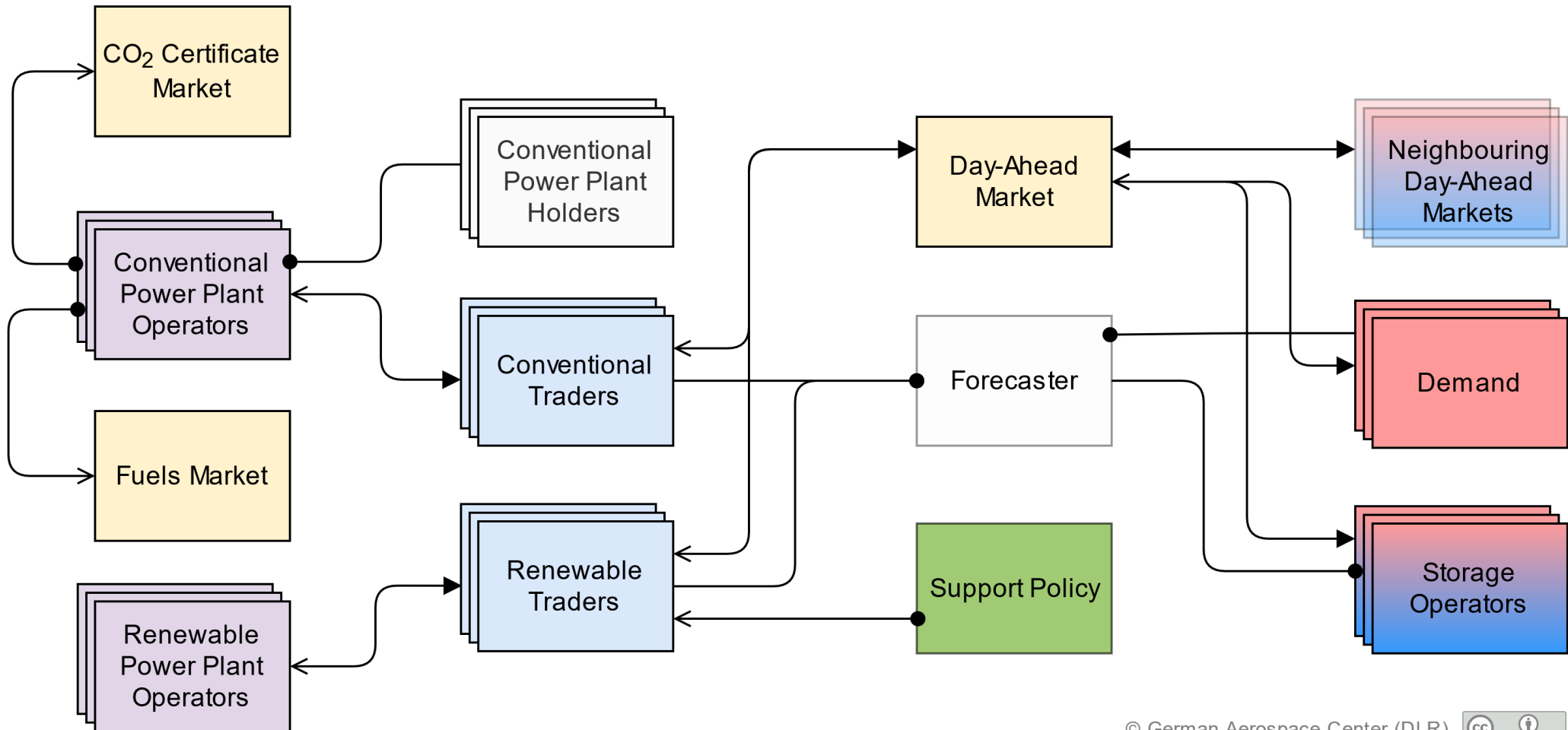
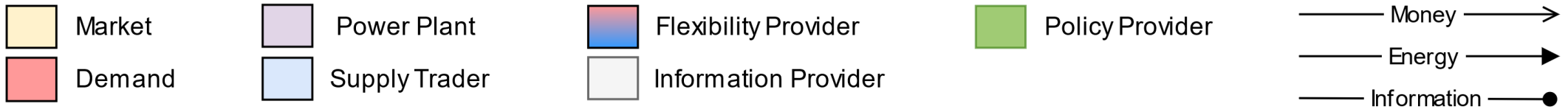
MW	€/MWh
497	12
500	12
20	12



Trader



AMIRIS Agents Overview

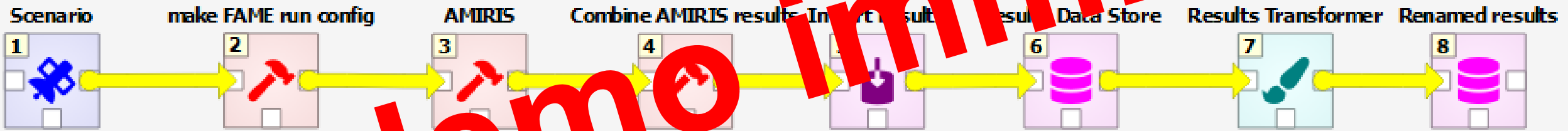




AMIRIS

Spine-Toolbox workflow

Run AMIRIS in one Go



Life demo imminent

Check it out!

<https://github.com/TradeRES/toolbox-amiris-demo>

Watch tutorial videos and learn how to

- Install & Execute AMIRIS
- Modify its Inputs
- Inspect and Interpret its Outputs

Publications



Landing Page



Gitlab Project



FAME



Open mod Forum



Wiki



Javadoc



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