EPEX SPOT
Power for Today. Power for Tomorrow.

17 October 2018
Howard Wright, Norbert Anhalt
The organised market: principles

- Access to an anonymous market
- Level playing field between members
- Financial guarantees through the Clearing House
- Calculation and publication of transparent and fair price references
Ways of commercialising power

- **Wholesale Market**
  - **Organised Market:** Exchange
  - **Over-The-Counter (OTC)**

- **System Services**
  - **Power commercialisation**

- **Derivatives Market**
  - Futures/Options
  - Mainly financial fulfilment

- **Spot Market**
  - Physical fulfilment

- **Day-Ahead market**
  - Auction

- **Intraday Market**
  - Continuous trading

- **Balancing**

- **Other system services (e.g. losses)**
How to trade power?

**Exchange**
- Electronic platform
- Anonymous trading
- Market rules
- Market surveillance
- Transparency
- Safe payment and delivery

Power trades comply with market rules. The Clearing House ensures market participants against counterpart risk.

**Over-the-counter trading**
- Via telephone or trading screens

Bilateral trades are not public. Market participants need to have their own guarantees against counterpart risk.
The role of the Exchange in the timeline of the market

<table>
<thead>
<tr>
<th>Derivatives</th>
<th>DAY-AHEAD MARKET</th>
<th>INTRADAY MARKET</th>
<th>Balancing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long and middle-term (Years/months/weeks)</td>
<td>Short-term (One day before delivery)</td>
<td>Very short-term (several hours before delivery)</td>
<td>Real-time (minutes)</td>
</tr>
<tr>
<td>Anticipated covering of need of supply, optimisation of production means</td>
<td>Balance of production and consumption</td>
<td>Balance of production and consumption</td>
<td>System security</td>
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</tbody>
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**DAY-AHEAD AUCTION**
- Optimisation of liquidity via an auction
- Market areas: Germany/Austria/Luxembourg, France, Great Britain, the Netherlands, Switzerland and Belgium

**CONTINUOUS INTRADAY**
- Flexibility through continuous trading
- Market areas: Germany/Luxemburg, France, Great Britain, the Netherlands, Switzerland, Belgium and Austria
Shareholder structure

EEX Group

- eex
- powernext

51%

HGRT

- amprion
- APG
- elia
- Rte
- swissgrid
- TenneT

49%

epexspot

100%

epexspot Belgium

Clearing activities

Part of EEX Group
EEX Power Derivatives

18 October 2018
The European Energy Exchange (EEX) is the leading energy exchange in Europe.

It develops, operates and connects secure, liquid and transparent markets for energy and commodity products.

At EEX, contracts on Power, Coal and Emission Allowances as well as Freight and Agricultural Products are traded or registered for clearing.

EPEX SPOT, Powernext, Cleartrade Exchange (CLTX), Gaspoint Nordic, Power Exchange Central Europe (PXE) and Nodal Exchange are also part of EEX Group.

Clearing and settlement is conducted by the clearing house ECC and by Nodal Clear in the United States.

EEX is part of Group Deutsche Börse.
EEX Group – Growing Together

- Powernext, EPEX SPOT and Gaspoint Nordic are part of EEX Group since 2015, PXE joined in 2016, Nodal Exchange in 2017
- Increase of office locations, employees, trading participants and of course advantages for all EEX Group clients

<table>
<thead>
<tr>
<th>Locations</th>
<th>Participants</th>
<th>Employees</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016: 14</td>
<td>2016: 555</td>
<td>2016: 450</td>
</tr>
</tbody>
</table>

+ 14%  
+ 6%   
+ 25%
Trading participants of EEX

EEX connects **262** trading participants from **27** countries:

- 8 Austria
- 1 Bulgaria
- 1 Croatia
- 17 Czech Republic
- 9 Denmark
- 1 Finland
- 13 France
- 55 Germany
- 3 Greece
- 3 Hungary
- 2 Ireland
- 33 Italy
- 1 Liechtenstein
- 1 Luxembourg
- 12 Netherlands
- 6 Norway
- 11 Poland
- 1 Portugal
- 3 Romania
- 4 Slovakia
- 4 Slovenia
- 15 Spain
- 3 Sweden
- 18 Switzerland
- 34 United Kingdom
- 2 N.N.

1 **non-European participants**

Cayman Islands

- Exchange traded EEX Power Futures
- EEX Trade Registration Services for Power Futures
- ECC Clearing for Partner Exchanges
Trading volume on the Power Spot and Derivatives Market

TWh

- Spot Market
- Derivatives Market
Market share of EEX’s core Power Derivatives Markets

The calculation of EEX’s market share is based on the figures published by the exchanges and the London Brokers’ Association (LEBA) every month.
The EEX group develops, operates and connects secure, liquid and transparent markets for energy and commodity products. Standardized contracts are traded or registered for clearing. Clearing and settlement of all trading transactions are provided by the clearing house European Commodity Clearing (ECC).
UK Power Market
UK Power Market

Volume UK Futures (Exchange + TR)

Number of traded contracts for UK Products (Exchange + TR)
• Norbert Anhalt
• Senior Sales Manager
• norbert.anhalt@eex.com
• Phone DE: +49 341 2156 247
• Phone UK: +44 207 862 7549
• Mobile: +49 172 369 0088
• EIKON: norbert.anhalt@eex.com
Liberalization of the European power market

1990: Creation of the UK Pool
1992: Creation of Nord Pool in Norway
1996: European Directive on energy market liberalization
2000: Creation of the two Power Exchanges in Germany. **UK’s first independent power exchange, established**
2001: Creation of Powernext in France. 2003: **UKPX integrated into APX**
2006: Launch of the first Market Coupling in continental Europe
2008 / 2009: Creation of EPEX SPOT SE, merger of power markets in DE, FR, CH, AT & LU
2010: Launch of Market Coupling in Central West Europe (CWE)
2011: European Commission announces target date 2014 for the Internal Energy Market;
2014: **Launch of Price Coupling in North-Western Europe;**
2015: **Merger of EPEX and APX**
2018: Launch of XBID

**THE CREATION OF EPEX SPOT AND THE DEVELOPMENT OF POWER TRADING IS ONE OF THE MOST VISIBLE RESULTS OF THE LIBERALIZATION OF THE EUROPEAN POWER MARKET**
Overall governance

**SUPERVISORY BOARD**
(12 MEMBERS)
- Elects and controls
- Reports to

**MANAGEMENT BOARD**
(3 MEMBERS)
- Manages the Exchange
- Reports to

**COMPETENT AUTHORITIES**
- Regular reports
- Reports on demand
- Transmission of data
- Alerts

**MARKET SURVEILLANCE**
- Monitors the markets

**EXCHANGE COUNCIL**
(ELECTED BY MEMBERS)
- Approves Rules & Regulation
- Reports to

**epexspot**
- Organizes Trading
- Admits new members
- Elaborates market rules
- Defines products

**11/7/2018**
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Trading on the Exchange

EXCHANGE MEMBERS

Scheduling

Sending of trades

Settlement

CLEARING MEMBER (BANK WITH AGREEMENT AT ECC)

Balance Responsible Agreement

TRANSMISSION SYSTEM OPERATORS

Source: EPEX SPOT
Clearing at ECC
Who are sellers and buyers on EPEX SPOT?

- **Trading companies and banks**: have an essential role in providing additional liquidity on the wholesale power market. They do not necessarily own power assets but are active on the market and also trade cross-border.

- **Municipal and regional suppliers**: specialize in supplying end consumers. They do not always own power producing assets, and thus often buy energy on the wholesale market.

- **Utilities**: buy and sell electricity to adjust imbalances between the production of their power plants and the supply of their customers.

- **TSOs**: intervene on the spot markets in order to compensate their grid losses. In Germany, they are also in charge of marketing green electricity provided by the feed-in tariff regulatory scheme.

- **Some energy intensive industries**: are also involved in the wholesale market in order to purchase power at the best price.

**Traders** can buy and sell on the Power Exchange (multilateral organized market).
Markets and services of the European Power Exchange EPEX SPOT

- Current EPEX markets
- Market Expansion
- Market operation services and 25% shares
- Market operation services
- Market coupling services

- 21 borders
- Area of 1600 TWh consumption
- Over 285 Exchange Members
- 535 TWh of traded volume in 2017
### Market review 2017: Volumes and delivery zones

#### DE/AT/LU: 280 TWh
- thereof intraday: 47 TWh
- share in consumption: 50%
- delivery zones: 50Hertz, Amprion, APG, TenneT, TransnetBW

#### FR: 110 TWh
- thereof intraday: 4 TWh
- share in consumption: 23%
- delivery zone: RTE

#### NL: 35 TWh
- thereof intraday: 1.5 TWh
- share in consumption: 31%
- delivery zone: TenneT

#### UK: 66 TWh
- thereof intraday: 15 TWh
- share in consumption: 22%
- delivery zone: National Grid

#### BE: 19 TWh
- thereof intraday: 1 TWh
- share in consumption: 22%
- delivery zone: Elia

#### CH: 25 TWh
- thereof intraday: 2 TWh
- share in consumption: 42%
- delivery zone: Swissgrid
Day-Ahead markets: Traded volumes

EPEX SPOT YEARLY DAY-AHEAD VOLUMES

TWh

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Intraday markets are very active both locally and cross-border.

Cross-border trades represent on average 20% of total traded volume.
Multiple market segments to answer all market participants’ needs

- **Day-ahead**
  - FR: 12AM Hourly Auction
  - CH: 11AM Hourly Auction
  - DE/AT: 12AM Hourly Auction
  - NL: 12AM Hourly Auction
  - BE: 12AM Hourly Auction
  - UK: 12AM Hourly Auction

- **Intraday**
  - FR: Hourly Continuous
    - 30min Continuous
    - 15 min Continuous
  - CH: Hourly Continuous
    - 30min Continuous
    - 15 min Continuous
  - DE: 15PM 15min Auction
    - Hourly Continuous
    - 30min Continuous
    - 15 min Continuous
  - AT: Hourly Continuous
    - 30min Continuous
    - 15 min Continuous
  - NL: Hourly Continuous
  - BE: Hourly Continuous
  - UK: Hourly Continuous
    - 30min Continuous
    - Blocks Continuous

- **Capacity Market**
  - FR: FCM auctions
Products – how Day-Ahead and Intraday complement each other

**DAY-AHEAD MARKET**

**Hourly auction (all markets)**
- Auction at noon, 7 days a week, year-round
- 24 hours of the following day are traded
- Hourly and block contracts available for trading
- Integrated in Multi-Regional Coupling which encompasses Germany/Austria/Luxemburg, France, Belgium, the Netherlands, Great Britain, the Nordics and Baltics, Spain, Portugal, Italy and Slovenia
- Reliable and robust trading platform through the EPEX Trading System (ETS) using the Euphemia algorithm for European coupling

**Half-Hour Day-Ahead 15:30 auction (UK)**
- Auction at 3:30 pm, 7 days a week, year-round
- 48 half hours of the following day are traded

**INTRADAY MARKET**

**Continuous trading (all markets)**
- Continuous trading and price formation, 24 hours a day, 7 days a week, year-round
- Hourly and block contracts available for trading
- In the NL, BE and DE contracts can be traded until 5 minutes before the delivery; in AT, FR and UK 30 minutes and in CH 60 minutes before the beginning of delivery
- 15-minute contracts on German, Swiss and Austrian markets and 30-minute contracts on UK, DE, FR, CH market allow flexible balancing of portfolio
- Cross-border trading between DE, FR, AT & CH on the one hand and between NL, BE & NO
- Trading on the M7 trading system

**15-minute opening auction (Germany)**
- Auction at 3 pm, 7 days a week, year-round
- 96 quarters of the following day are traded
- Reliable and robust trading platform through the EPEX Trading System (ETS) using the Euphemia algorithm

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Day Ahead market
A Short History of European Market Coupling Initiatives
Two « Target Models » for market integration, now set in the EU Law

Day-Ahead Market Coupling

Intraday Market Coupling

CACM Regulation (EU) 2015/1222
Roles and Functions of the stakeholders

Transmission system Operators (TSOs)

Power Exchanges (EPEX SPOT)

Clearing House
Market Coupling initiatives since 2006

2006

TLC: Trilateral Coupling
Market Coupling initiatives since 2006

- 2006: TLC: Trilateral Coupling
- 2010: CWE Market Coupling: Central Western Europe
Market Coupling initiatives since 2006

- 2006: TLC: Trilateral Coupling

- 2010: CWE Market Coupling: Central Western Europe

- 2014: February: NWE Market Coupling: North-West Europe
Market Coupling initiatives since 2006

- **2006**: TLC: Trilateral Coupling
- **2010**: CWE Market Coupling: Central Western Europe
- **2014**: February: NWE Market Coupling: North-West Europe
- **2014**: May: SWE Market Coupling: South-West Europe
Market Coupling initiatives since 2006

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- **2010**: CWE Market Coupling: Central Western Europe
- **2014**: February: NWE Market Coupling: North-West Europe
- **2014**: May: SWE Market Coupling: South-West Europe
- **2014**: End of the year: 4MMC Coupling
Market Coupling initiatives since 2006

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- 2010: CWE Market Coupling: Central Western Europe
- 2014: February: NWE Market Coupling: North-West Europe
- 2014: May: SWE Market Coupling: South-West Europe
- 2014: End of the year: 4MMC Coupling
- 2015: February: Italy and Slovenia

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Market Coupling initiatives since 2006

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- **2010**: CWE Market Coupling: Central Western Europe
- **2014**: February: NWE Market Coupling: North-West Europe
- **2014**: May: SWE Market Coupling: South-West Europe
- **2014**: End of the year: 4MMC Coupling
- **2015**: February: Italy and Slovenia
- **2016**: July: Austria-Slovenia
European Market Coupling Benefits

1. Optimal use of interconnectors facilitating congestion management
2. Price convergence of market areas in case of sufficient border capacity
3. Smoothing effect on negative or positive price spikes
4. Attenuation of extreme weather conditions (i.e. cold wave, storm front) on other market areas
5. Higher security of supply through market integration and no longer depending on the individual country
Day-Ahead Market

DAY-AHEAD AUCTIONS

Market Areas:
Belgium, France, Germany/Austria/Luxembourg, UK, The Netherlands, Switzerland

- Auction, 7 days a week, year-round
- 24 hours of the following day are traded
- Hourly and block contracts available for trading
- Integrated in Multi-Regional Coupling which encompasses EPEX markets, the Nordics and Baltics, Spain, Portugal, Italy and Slovenia
- Reliable and robust trading platform through the EPEX Trading System (ETS) and using the Euphemia algorithm

Closing of order books (CET):
All coupled markets: 12:00
CH: 11:00
Publication of market results:
All coupled markets: 12:55
CH: 11:10

- During the auction, all orders in the order book will be matched to trades at a specific moment.
- The buy entries are aggregated to form a demand curve, and the sell entries are aggregated to form an offer curve.
- The Market Clearing Price (MCP) and the Market Clearing Volume (MCV) are determined at the intersection point of the two curves.
## Day-Ahead markets: Price evolution

![Graph showing price evolution of various markets from 2009 to 2017]()

**Source:** EPEX SPOT

### Market Prices

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<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>DE/AT/LU (Phelix)</td>
<td>38.85</td>
<td>44.49</td>
<td>51.12</td>
<td>42.60</td>
<td>37.78</td>
<td>32.76</td>
<td>31.63</td>
<td>28.98</td>
<td>34.19</td>
</tr>
<tr>
<td>FR</td>
<td>43.01</td>
<td>47.50</td>
<td>48.89</td>
<td>46.94</td>
<td>43.24</td>
<td>34.63</td>
<td>38.48</td>
<td>36.75</td>
<td>44.97</td>
</tr>
<tr>
<td>CH (Swissix)</td>
<td>47.92</td>
<td>51.02</td>
<td>56.18</td>
<td>49.52</td>
<td>44.73</td>
<td>36.79</td>
<td>40.30</td>
<td>37.88</td>
<td>46.00</td>
</tr>
<tr>
<td>NL</td>
<td>39.16</td>
<td>45.38</td>
<td>52.03</td>
<td>48.00</td>
<td>51.95</td>
<td>41.18</td>
<td>40.05</td>
<td>32.24</td>
<td>39.31</td>
</tr>
<tr>
<td>BE</td>
<td>39.36</td>
<td>46.30</td>
<td>49.37</td>
<td>46.98</td>
<td>47.45</td>
<td>40.79</td>
<td>44.68</td>
<td>36.61</td>
<td>44.58</td>
</tr>
<tr>
<td>UK (in £)</td>
<td>-</td>
<td>-</td>
<td>47.18</td>
<td>44.51</td>
<td>49.68</td>
<td>42.02</td>
<td>40.43</td>
<td>40.43</td>
<td>45.32</td>
</tr>
</tbody>
</table>
Intraday market: integrating renewables
Reasons for trading on the Intraday market

1. ✓ Adjust purchase and sale based on the results of the day-ahead auction
2. ✓ Run and plan power generation closer to delivery
3. ✓ Manage unforeseen events such as power plant outage
4. ✓ Enable arbitrage between neighboring countries, provides opportunities for cross-border trading
Flexibility to adjust to RES production

- Forecast deviations:
  Wind & Solar forecasts can vary significantly from day-ahead forecast to last intraday-forecast.
- Intraday continuous volumes are correlated to the forecast errors on wind and solar generation.
Continuous Intraday Market Principles

• The system matches compatible orders in real time according to the priority rules: price and time priority in serial processing
• The offers are entered in real time and can be viewed anonymously by all participants
• The offers are classified in the order book according to: - their position (purchase or sale) - the price limit - the time of submission
• The best offers from the order book are matched. An offer is executed against a corresponding offer at the same price (or at a better price).
• Orders are executed in real time, either entirely or partially, at the best price available in the system according to the priority rules. Different types of orders can be submitted (FOK, IOC, Iceberg, AoN,…)
• Orders entered in one of the order books of the continuous intraday market (DE, FR, AT, CH, BE, NL) may be matched to orders from other order books, provided that:
  - Cross-border schedules are possible,
  - Availability of XB capacity.
• Where cross-border allocations are not possible, only local trading is open.
Automated trading applications spread across the market

• Automated trading apps are developed either in-house or by ISVs and automate power trading on the basis of algorithms. The apps are connected through EPEX SPOT open API.
• More than 60 applications (read/write) and 12 certified ISVs connected to the exchange
• This enables market participants to react quickly to fluctuations in power production / demand. Renewable energy has direct impacts on the intraday market. Its volatility is several times higher than that of financial markets.
• Open customer positions can be covered according to MP specifications/risk profiles.
• Pre-defined and customized strategies.
• Trade outside of regular business hours
• Helps traders achieve better prices.
• Limit management for transactions at extreme price settings or large quantity variations.
• Stop losses in case of unexpected market developments.
New challenges to the power market

The current power system is expected to be facing significant challenges in the future, regarding the integration of much more decentralized intermittent energy resources.

• How to make the power system more efficient and able to deal with foreseen challenges?

Current wholesale market

• Considering very large price zones
• Intra-zonal grid topology not considered at the moment (study on zone splitting carried out at Entsoe level)

Future challenges

• Adapt the power system to the integration of much more decentralized intermittent energy (wind and solar power)
  • Find a way to handle congestions

New paradigm for the future power system

• Design a new way of functioning for the power system that will overcome the foreseen challenges
• The use of new technologies will need to be integrated and organized such that the whole system remains efficient

New technologies

• The development of new technologies (Internet of Energy, smart grids, demand response, blockchain, smart metering, etc.) has the potential to meet our future challenges.
High-level objectives

The concept in a few words:
Implementation of a market-based congestion management platform efficiently centralizing local flexibility offers to allow System Operators to reliably and economically relieve physical congestions and bottlenecks from the grid.

A clear and transparent market mechanism
- **Clear and transparent market rules** for actors participating in the market-based congestion management
  - Asset Certification by the SOs, Verification of the physical impact, Strict Compliance
- Definition as an addition to all existing wholesale markets to solve specific local issues.

Development of distributed flexibility
- **Unveil the potential of distributed flexibility**
  - Provide transparent locational flexibility prices and foster the development of distributed flexibility (demand-side management, renewables, aggregators, batteries...).
- The platform can become the **short-term activation mechanism of long-term local flexibility contracts** if there are any, but also be open to any other flexibility provider.

Coordination between System Operators
- **Clear guidelines and communication protocols to increase and develop the cooperation between TSOs and DSOs.** It is a key element to reach optimality in the congestion management solution and avoid inefficiencies.
- **EPEX SPOT is a neutral and objective third party** that will be able to efficiently run the platform, adapt to current System Operator processes and Grid management rules, and ensure compatibility with the current European zonal markets.
Local flexibility markets: what is the rationale?

- In recent years, Germany have seen significant increases of wind and solar capacity. Installed capacity of wind and solar in Germany has reached almost 100GW in 2017.

- Is reliable power supply possible using 100% renewables?

- Network congestions are likely to increase in the future. The copper plate could be challenged in the coming years.

- The usage of flexibility in supply & demand in transmission and distribution grids is necessary to guarantee a sustainable and reliable energy system.

- Local markets are seen as a market-based “software” solution to many problems currently occurring because of the growing share of renewable energies and distributed generation. A complement to grid expansion (i.e. “Hardware” solutions).

- Integration of new resources: DSM, Storage at locational level could be achieved more efficiently with Locational Price signals.

![Solar and Wind Installed Capacity](chart.png)
The cost of balancing the grid likely to increase in the future

- Congestions are becoming more frequent and the energy called for re-dispatching is increasing significantly. As of today, most power management interventions are resulting in cutting RES (i.e. Eisman rule)

- The re-dispatch remuneration has so far been regulated based on the marginal/fuel costs costs. According to a recent court decision in Germany, opportunity costs will have to be remunerated by the TSOs.

- A market-based solution that will allow locational price signals to emerge and flexibility options to be developed further.

- In all designs the issue of market power needs to be carefully taken into account. Some locations are likely to have very limited competition. Although a voluntary design does not force the network operators to either open a local OBK or purchase flexibility from the local OBK once it is operational, flawed incentives (i.e INC/DEC) can hamper the efficiency of the mechanism.

- Beyond the usual regulation/monitoring by authorities there is a multitude of solutions that can help mitigate local market power.
The concept of flexibility market / platform

- All active flexibility participants: consumers, producers and storage operators are possible flexibility providers.

- Flexibility is provided, when the participant adapts his production / consumption pattern by an external signal.

- The grid oriented allocation of flexibility can be used for a capacity management in the grid. Thereby flexibility becomes an economical option to defer or even substitute grid expansion.

- Flexibility traffic light concepts enable system operators to allocate available flexibility in order to comply with grid restrictions.

The Flexibility Triangle

- **Market oriented use** portfolio optimization of demand and supply
- **System oriented use** balancing independent of location
- **Flexibility adaption of generation or demand behavior by external signals**
- **Customer oriented use** self-consumption
- **Grid oriented use** avoid grid constraints

Source: Based on S. Ohrem, D. Telöken (2016)
Portfolio of projects and initiatives

EPEX SPOT is involved in several initiatives aiming at the creation of a design and pilot-projects for market-based congestion management.

• SINTEG (DE) gives us access to a wide range of stakeholders incl. TSOs, DSOs, traders, software providers, manufacturers,… and financing from the BMWi + exemptions from regulatory framework.
  - ENERA (w/ EWE, Tennet DE): EPEX is an associate partner to develop a pilot in EWE area (Bremen/Hamburg)
  - WindNODE (w/ 50Hz): EPEX is an observer.
• USEF (NL):
  - EPEX SPOT could start implementation of a pilot in Nijmegen, NL
  - ENERA could also become the pilot for the USEF framework (NL). Discussions between ENERA and USEF have started.
  - EPEX SPOT will be a USEF board member
• SMILE (FR):
  - Initiative to make use of recent smart technologies in order to develop distributed flexibility (Brittany region)
  - EPEX SPOT will join the SMILE association and collaborate with RTE and Enedis to build local flexibility markets
• Romande Energie / Swiss Grid:
  - Apply the concepts we have developed in Switzerland, to solve current congestion and redispatch issues efficiently.
• Lazarettgarten (Luxemburg) with LO3 and Enovos.
Thank you for your attention!

EPEX SPOT Paris
5 boulevard Montmartre
75002 Paris
France
Tel +33 1 73 03 96 00
info@epexspot.com

EPEX SPOT London
11 Westferry Circus
Canary Wharf
London E14 4HE
United Kingdom

EPEX SPOT Bern
Marktgasse 20
3011 Bern
Switzerland

EPEX SPOT Amsterdam
Atlas Arena Amsterdam – Australia Building
Hoogoorddreef 7
1101 BA Amsterdam
The Netherlands
Tel +31 20 305 4000

EPEX SPOT Leipzig
Augustusplatz 9
04109 Leipzig
Germany

EPEX SPOT Brussels
Boulevard de l’Impératrice 66
1000 Bruxelles
Belgium

EPEX SPOT Wien
Mayerhofgasse 1/19
1040 Wien
Austria