European electricity market : evolutions and challenges

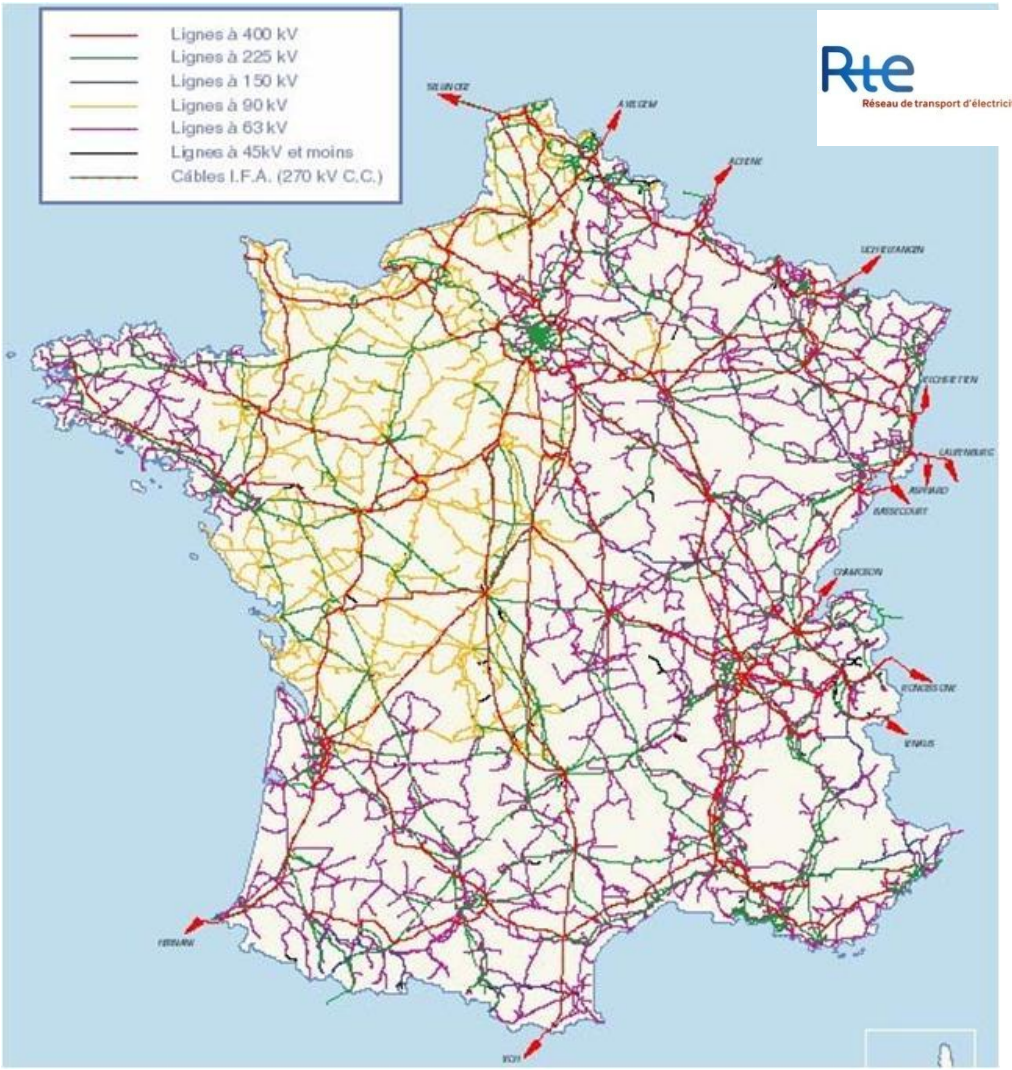
summary

1. Brief presentation of RTE / RTE-International
2. EU policies and market reform
3. The french market design
4. Current challenges after 15 years of competiton

01

Brief presentation of RTE

RTE : a few figures



- More than 500 TWh delivered
- International exchanges : 95 TWh
- Staff : 8400
- Length of circuits : 105 000 kms
- Substations : 2600
- Turnover : 4,7 Mds€
- Investments : 1,4 Mds€

Rte International

Players connected to the French network

- **Generators:**

628 power plants owned by EDF, ENDESA France, Suez - Gaz de France and other generators (co-generation, household waste, wind farms, etc.)

- **Distributors:**

27 distribution companies, including ERDF (Electricité Réseau Distribution France) which is the major one, and other LDCs (Local ones)

- **Industrial sites:**

534 sites directly connected to the transmission network

With **175** trading or supplying companies, who buy and sell energy on the wholesale market or supply consumers directly, these are RTE's customers

A strong experience recognized worldwide

- **A wide involvment in international bodies**

VLPGO
VERY LARGE POWER GRID OPERATORS

cigré

entsoe

- **Many cooperation agreements**

ICEPCO KOREA ELECTRIC POWER CORPORATION
Transelectrica
CHINA SOUTHERN POWER GRID CO., LTD.
国家电网 STATE GRID CORPORATION OF CHINA
THE KANSAI ELECTRIC POWER CO.,INC.
TRANSNET BW
Office National de l'Electricité
TENAGA NASIONAL BERHAD
PJM Interconnection
KYUSHU ELECTRIC POWER CO.,INC.
GRTE Société Algérienne de Gestion du Réseau de Transport de l'Electricité
e-latvenergo
TEPCO 東京電力

- **A company dedicated to International services**

to promote RTE experience and know-how

Rte international

02

EU policies and market reform

European Electricity Sector

32 interconnected countries

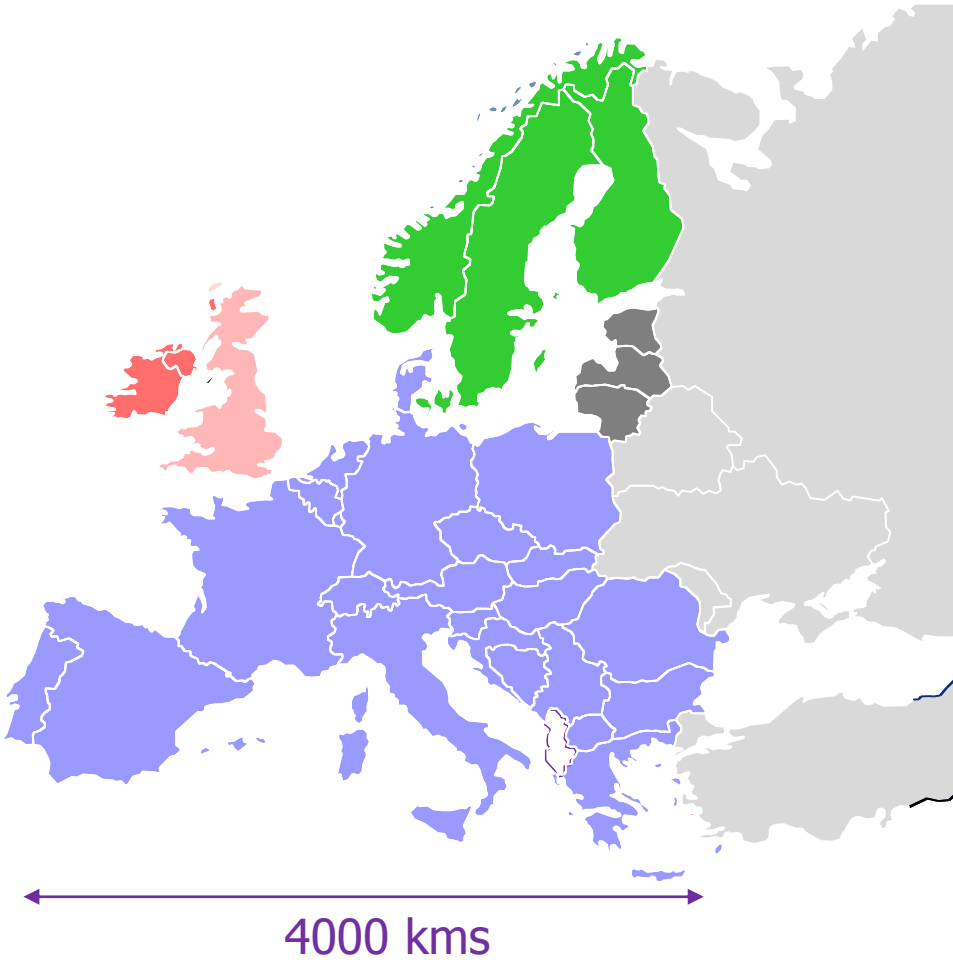
Installed capacity : **850 GW**

Consumption : **3,400 TWh/year**

Peak Load : **500 GW**

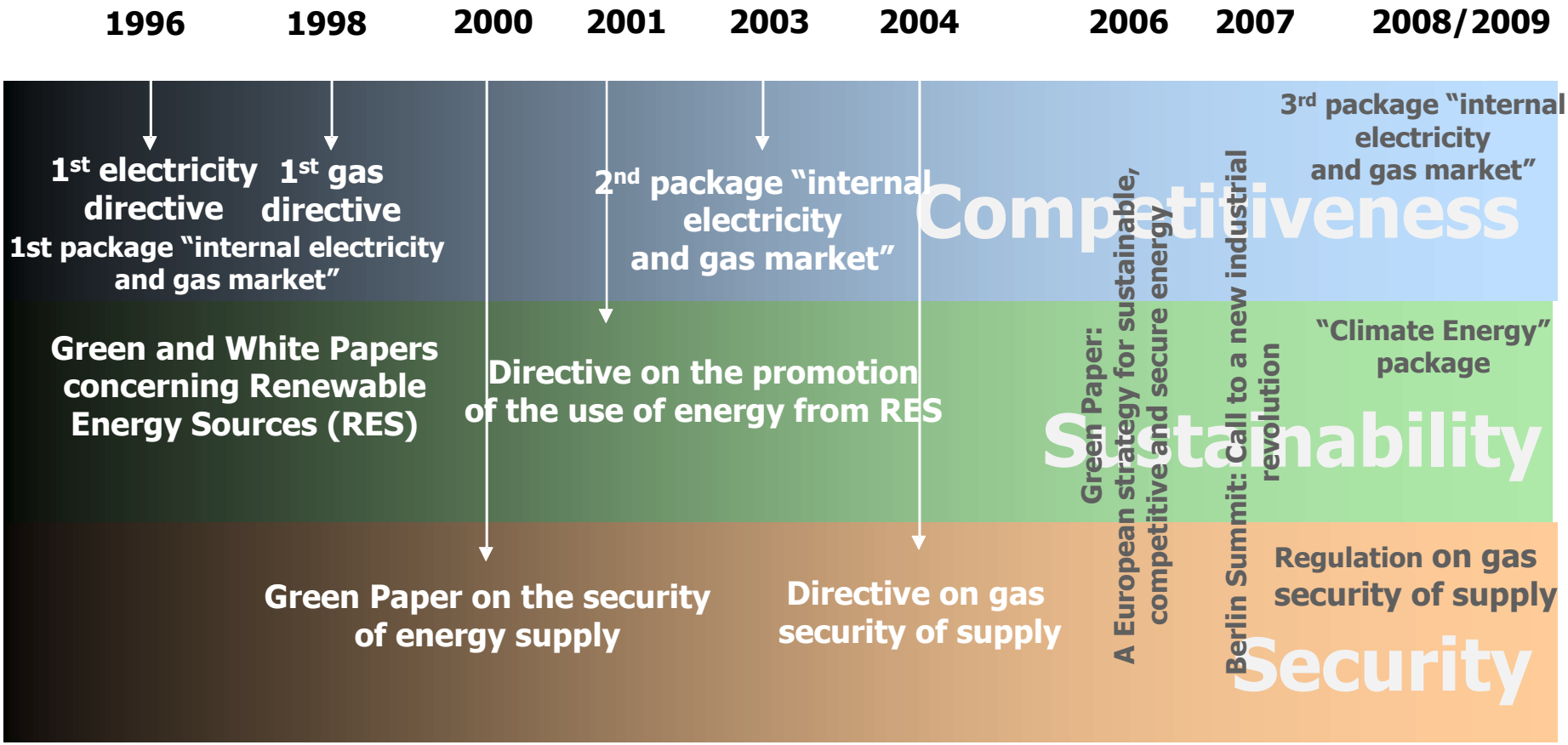
Physical exchanges : **400 TWh/year**

Population : **500 Million**



EU regulatory framework for energy

Towards more competition and harmonization

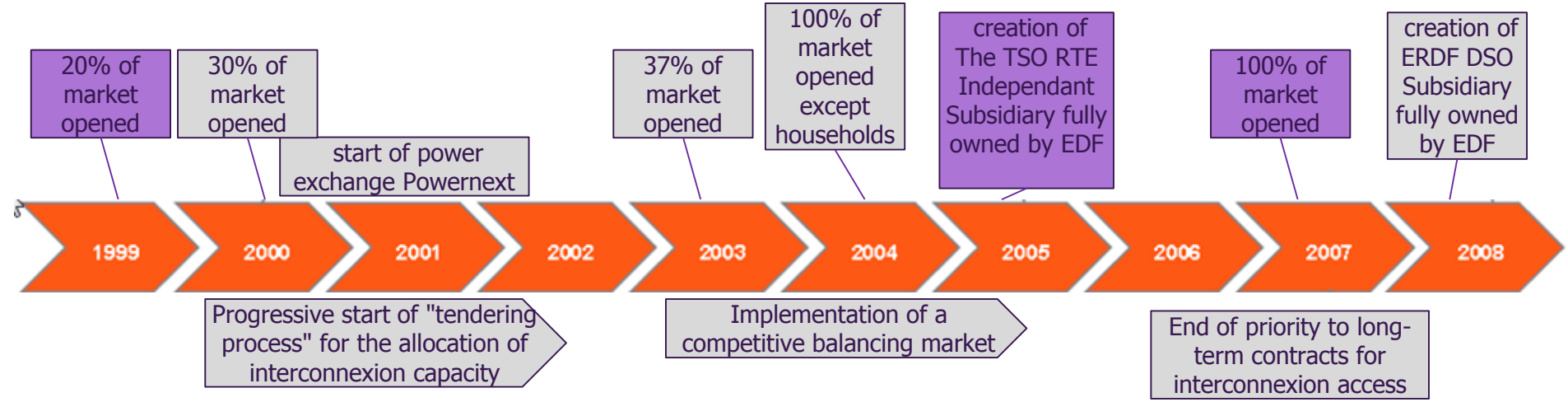


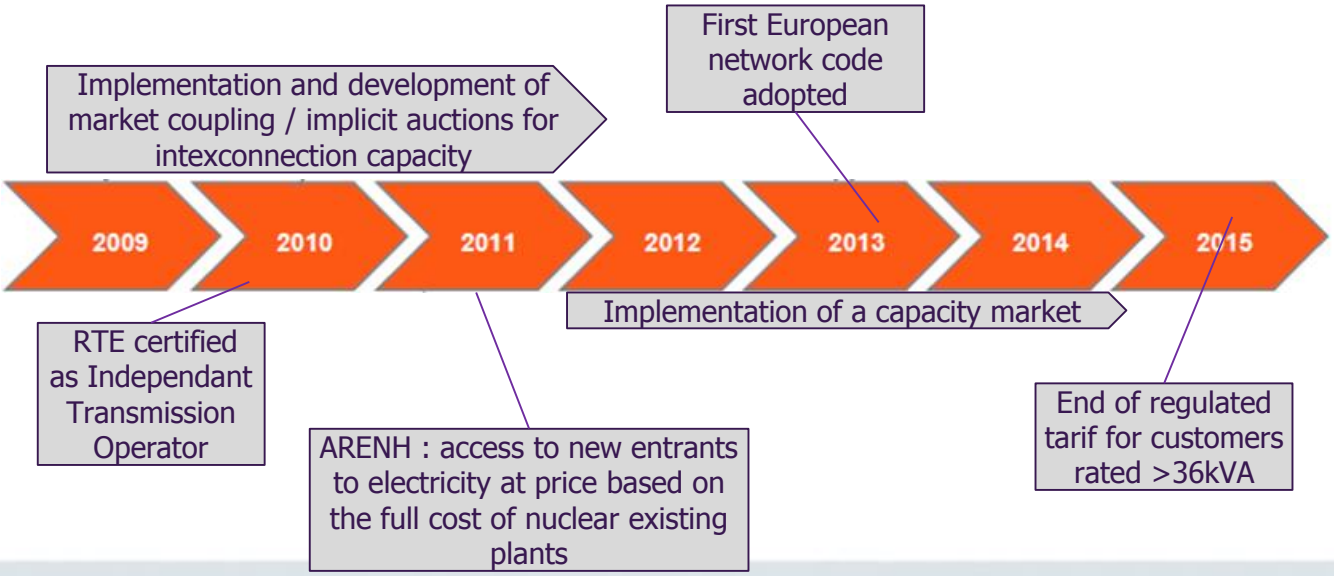
The steps of opening of electricity sector

Before 2000 :	Monopoly situation
2000 :	séparation between transmission/dispatching and generation activities
June 2000 :	sites > 16 GWh become eligible
Nov. 2001:	Powernext Spot maket go live
Feb. 2003 :	sites > 7 GWh become eligible
2003 :	implementation of a balancing market
June 2004 :	Powernext Futures maket go live
July 2004 :	all professionnal customer become eligible
July 2007 :	Market open to all customers

Market reform… A never ending story

- Progressive steps towards the full opening of the market:





- Improvements still required in 2014 such as capacity market implementation…

The implementation of competition

Market mechanisms & contracts

- Balance perimeters to do all energy accounting
- Purchase of losses
- Cross border capacity allocation mechanisms
- Balancing market for real time supply demand

Adjustment and congestion management

- household half hourly consumption estimation
- Capacity market
- Connexion to the grid contracts and procedures…

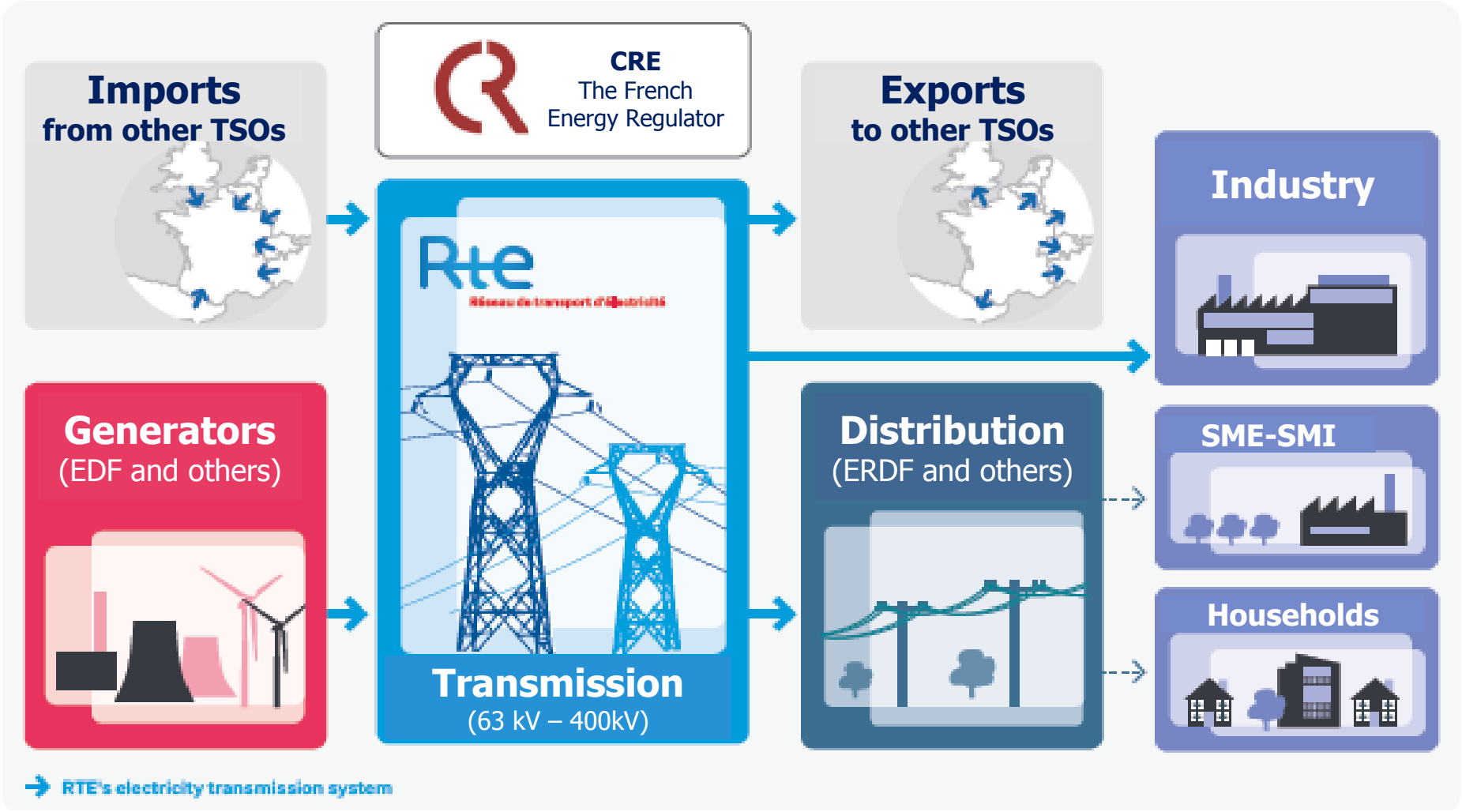
03

French electricity market design

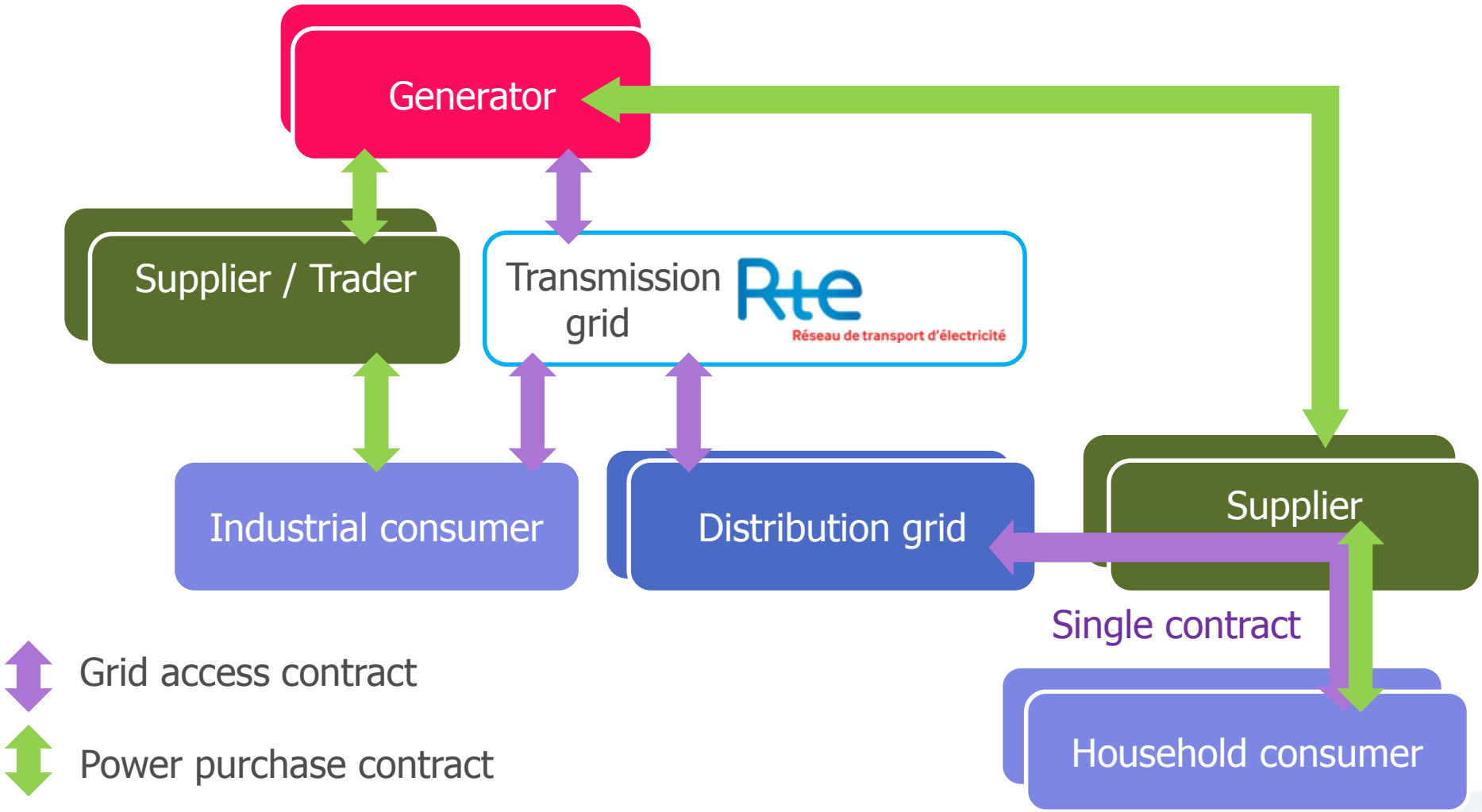
The French Electricity Market Design

- Hub/Portfolio model: clear separation between the physical dimension and the trading dimension
  - A widely accepted European standard, open to OTC and exchanges trades
  - Forward, day-ahead end intra-day markets
- RTE handles the physical issues, providing a smooth playing field to the market participants
- The market rules are set up in contracts between the Users and RTE
  - discussed in various users-group and subject to the approval of CRE ("Commision de Régulation de l'Energie" = regulator)

Organisation of the Market



Power purchase and grid access contracts are separated



Rte International

Overview of contracts with TSO

Grid access contract :

Right to inject/extract physical energy at a connecting point

Participation contract to interconnection access rules :

Right to import/export

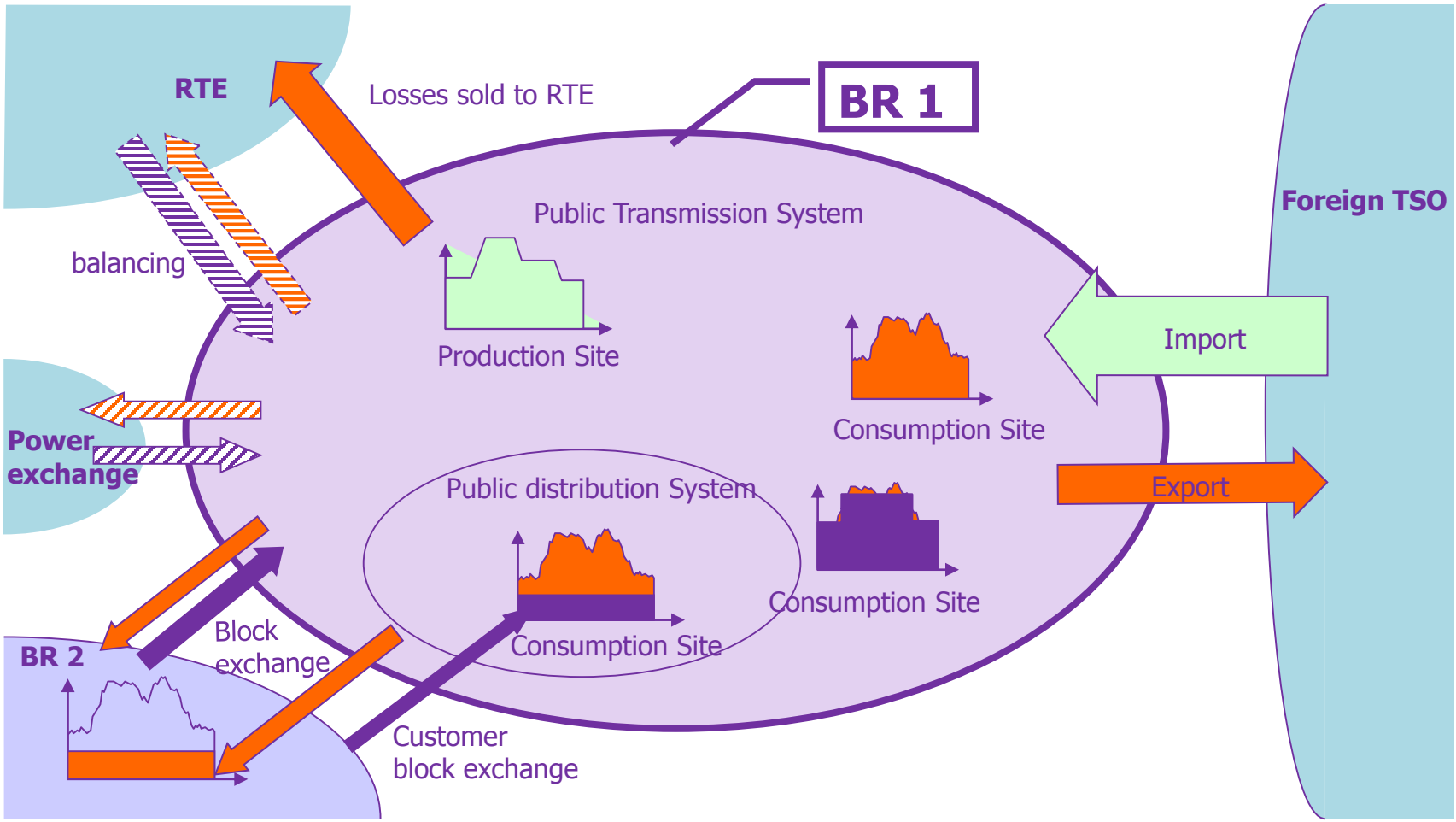
Participation contract to day-ahead/intra-day scheduling and to balancing Market rules :

Right to make offers on the Balancing Market

Participation contract to balance responsible rules :

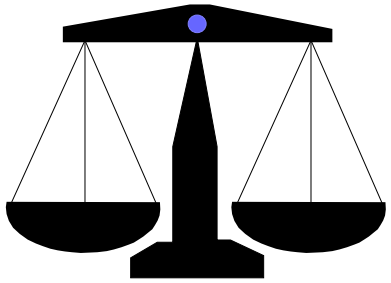
- Right to merge in a "perimeter" a set of connecting points and contractual delivery subject to imbalance settlement price
- Right to exchange energy blocks between balance perimeters

A Balancing Responsible Perimeter



Imbalance calculation on a BR perimeter

for every ½ hour period



+ Energy injection	Energy extraction -
+ Generation + Imports accepted by RTE + Purchases from another BR perimeter + Purchases from EPEX SPOT + Downward balancing energy (Balancing Market)	- Adjusted consumption - Exports accepted by RTE - Sales to others BR perimeter - Sales to sites in another perimeter - Power sold to RTE for losses - BR's sales on EPEX SPOT - Upward balancing energy (BM)

= Imbalance

The balancing market

The Balancing Market (BM) enables RTE to activate power reserves of generation plants, in order to restore the system supply demand balance and solve network congestions. It is based on a **permanent, transparent and open call for tender process**

Balancing offers

- are submitted by participants at gate closures taking place every hour
- are an upward or downward power flexibility that goes with technical conditions and a price

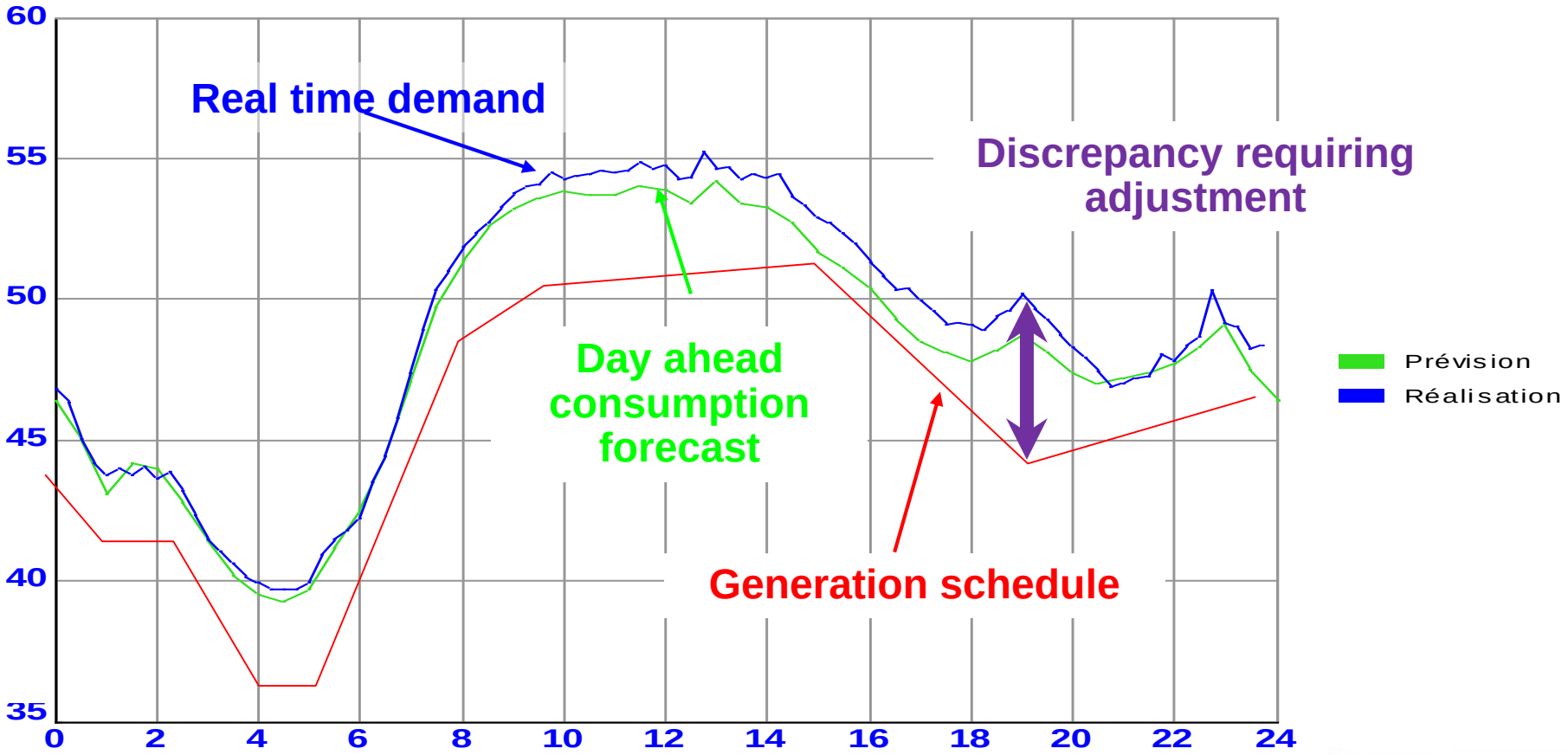
Players

- Generators connected on the transmission network **must** offer their unused capacity upwards and downwards.
- Consumers able to reduce (or increase) their consumption **can** offer also their capacity
- Foreign players with flexibility can also offer to the balancing market through interconnexions

Around 40 players, and a balancing volume of 8 TWh (50% upward)

Almost 2/3 of the players are from foreign countries (mainly Switzerland and Germany)

Basic Principles of the Balancing Market



Link between Balancing market and Balance Reponsible Entities : Settlement of imbalances

A pricing mechanism shall incitate the Balancing Responsible party to reach equilibrium

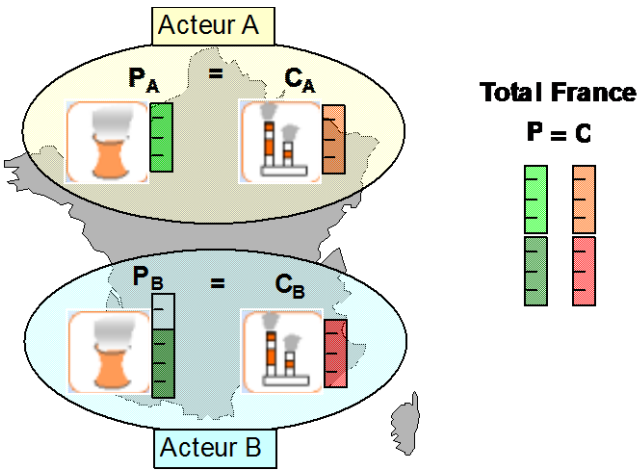
	System short	*System long*
Positive imbalance (RTE pays the BRP)	Power spot price	Min [PMPb/(1+K), PWX]
Negative imbalance (BRP pays RTE)	Max [PMPh(1+K), PWX]	Power spot price

PMPb : weighted average price of downward offers (system selling)
PMPh : weighted average price of upward offers (system buying)

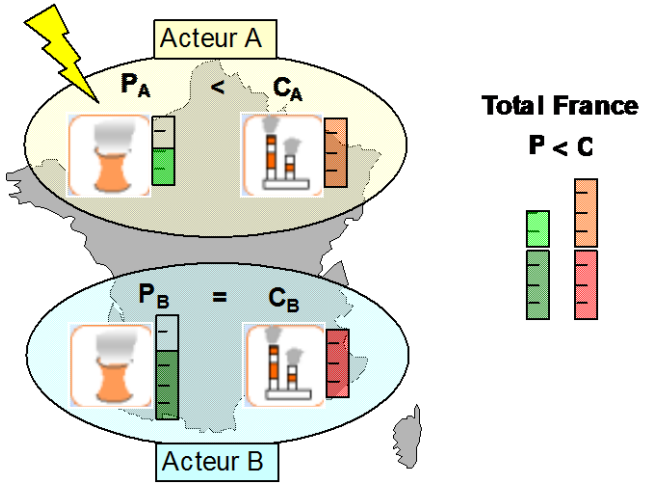
A pricing mechanism which incitates the BR to reach equilibrium
buying of lacking energy >= Power spot price
selling of excess energy to the system <= Power spot price

Imbalance pricing and balancing market

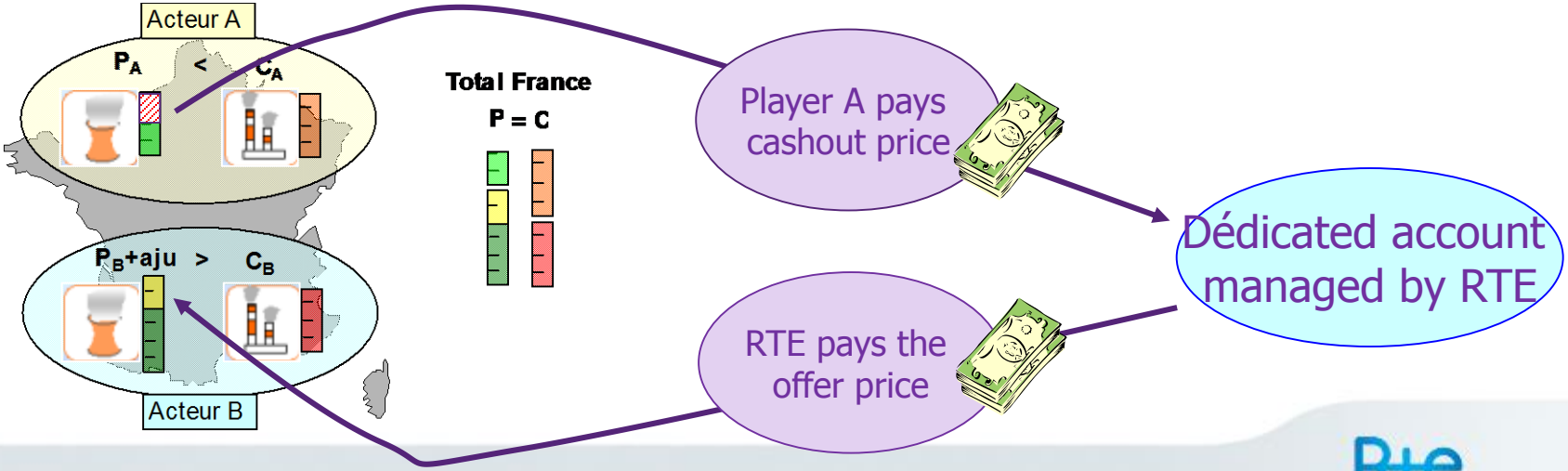
1. Initial situation



2. Failure generation player A



3. Action of the Balancing Market and link with imbalance cashout price

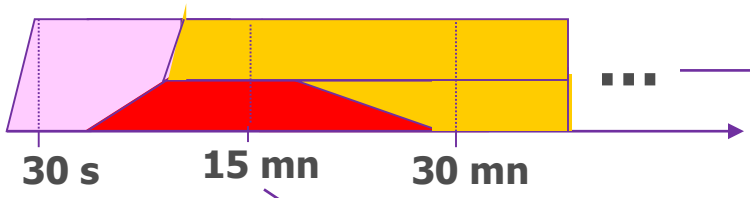


Overview of operational reserves in France

Contracted with producers, regulated price for capacity and energy

~ 600 MW	~700 MW (min. 500 MW)	1000 MW in 15 mn + 500 MW in 30 mn
Primary control	Secondary control	Tertiary control

Contracted with producers (long-term call for tenders), rest offered by producers on the Balancing Market (legally binding)



Long-lasting imbalances are dealt with by other tertiary reserve (non contracted)

« Complementary tertiary reserve » takes over if necessary – it must be activated in 30 mn

Primary control must be activated in 30 s

Secondary control (completed by « fast tertiary reserve » if necessary) must be activated in 15 mn

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Automatic frequency (and voltage) control

Related services

Primary and secondary frequency control

Primary and secondary voltage control

These services are mandatory

In order to have access to the grid, plants are legally bound to be technically able to provide such services

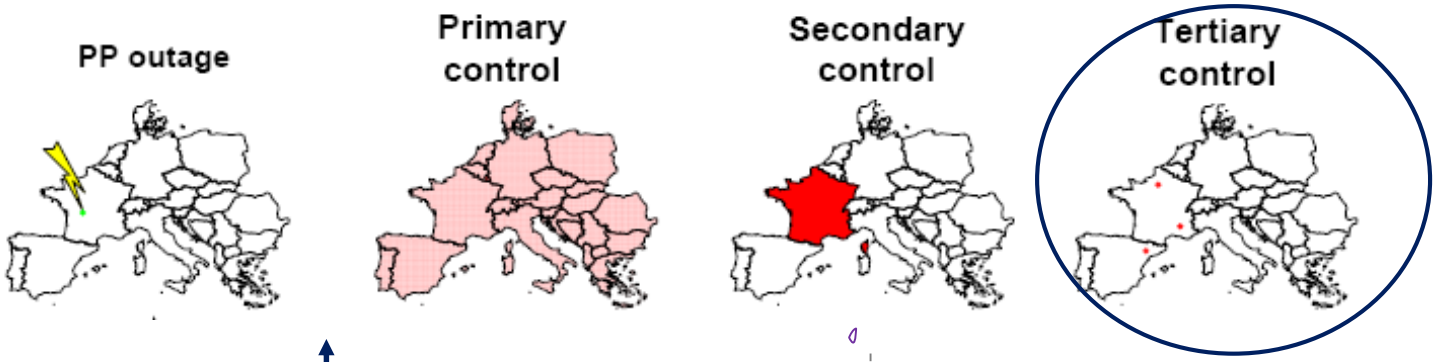
Producers must sign a standard contract with RTE (3 years) – the conditions of this contract are identical for all producers, and negociated collectively between RTE and all producers

Contractual conditions

Prescriptions are allocated pro-rata of the production

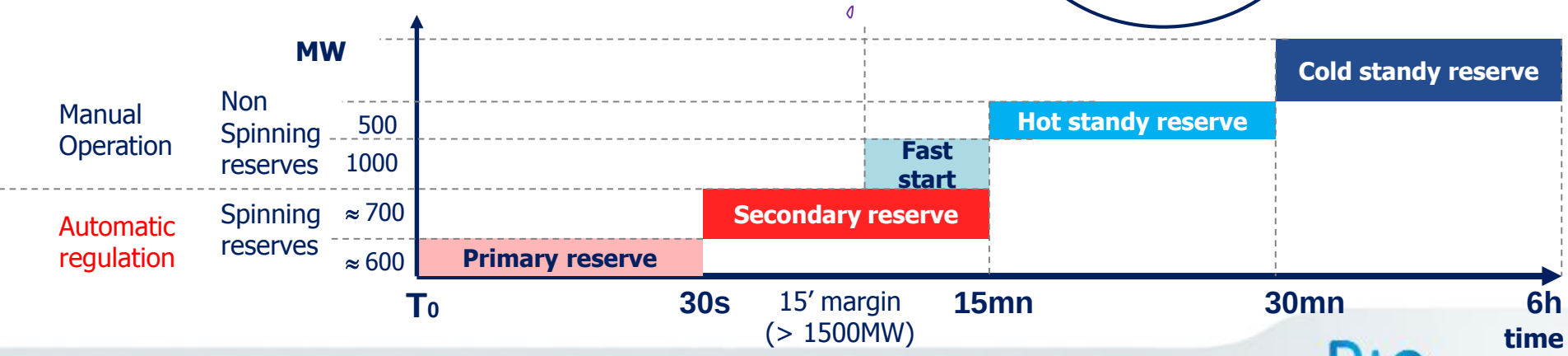
The service is compensated for at a regulated price, recovered in the grid tariff

Services are paid if provided (performance of service is monitored)



Balancing Mechanism

Tertiary reserves



04

Current challenges after 15 years of competition

RTE current challenges

Main issues :

1- Generation from RES to confirm its take-off…

2- Electricity demand slows down, but …

3- Higher cross border capacities are needed…

4- Developing grids is increasingly difficult…

RTE strategy :

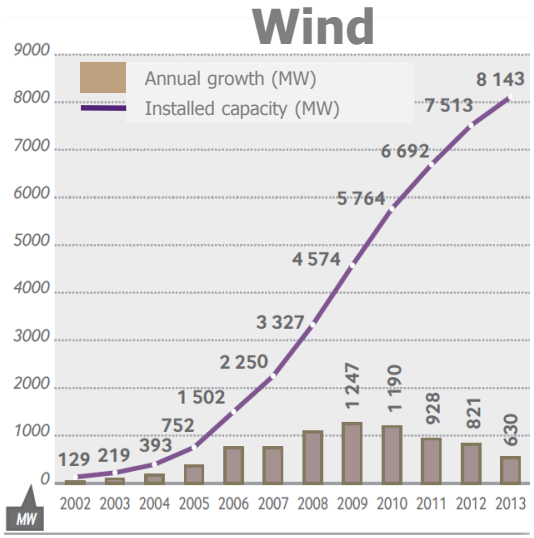
A- Improving Market Design

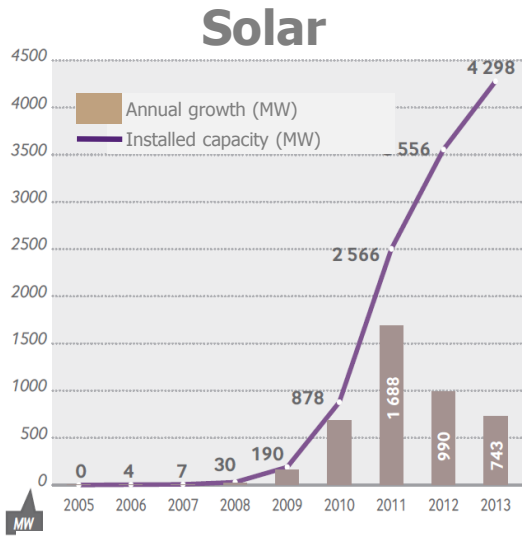
B- Developing infrastructures

C- Promoting European coordination

D- Innovating with smart grids

1- Generation from RES to confirm its take-off…





Wind energy :

- **8.1 GW installed** (6% of total capacity)
- **+ 0.6 GW last year**
- **Target : 25 GW by 2020** (incl. 6 GW offshore)
- **Thanks to feed in tariffs** : 82 €/MWh for 10 years, then between 28 and 82 €/MWh for 5 years according to efficiency

Solar energy :

- **4.3 GW installed** (3% of total capacity)
- **+ 0.7 GW last year**
- **Target : 5.4 GW by 2020**
- **Thanks to feed in tariffs :** between 105 €/MWh (Ground Farm) and 354 €/MWh (Households)

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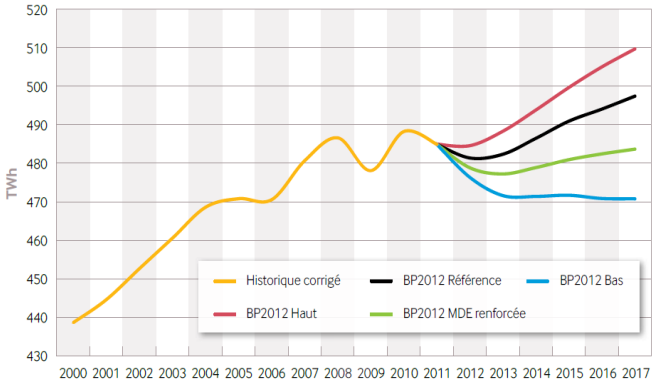
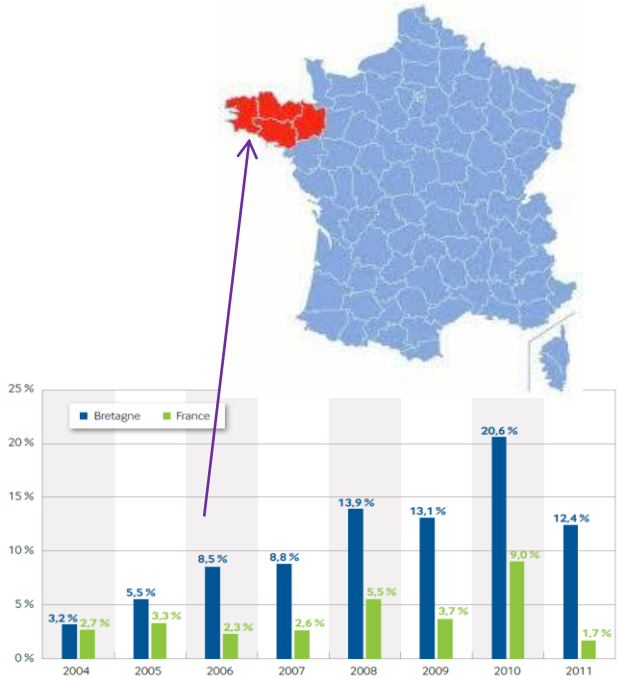
2- Electricity demand slows down, but …





Demand slows down : +0.7%/year

- Economic activity in the short term (GDP Growth)
- New thermal standards for building
- Energy savings and efficiency measures
- Incertainties on how switching of energy demand from fossil fuels to electricity may accelerate under new energy policy (price of electricity quite low, taxation on CO2, Electric vehicules and transportations)

=> affects the revenues growth

But :

- Electricity demand **sensitivity to temperature** remain very high (2400 MW/°C) because of electric heating
- **Consumption in some areas** is growing much faster than the average (Brittany/ French Riviera). Production is not sufficient in these areas…

=> Still need to develop grid

RTE International

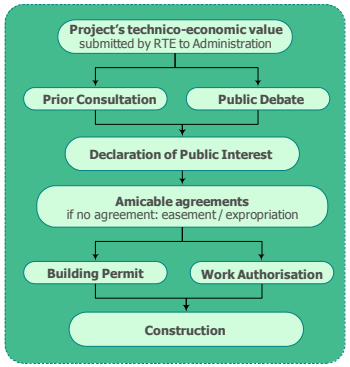
3- New cross border capacities are needed

- **Congestion revenues are about 2Bn€** each year in Europe (around 300M€ for RTE alone) because of un-sufficient market integration
- **Energy mix and demand are changing**
  - Fast development of Generation from RES (Wind, Solar…)
  - Decision of some countries to stop nuclear
  - Or/and to close polluting plants
  - Various changes in demand (depending on economic situation and energy savings)

Higher cross border capacities are needed

- Optimisation of ressources in a large scale
- European Market integration
- Security of supply and system reliability

4- Developing grids is increasingly difficult



Up to 7 years of consultation before having a chance to get necessary permits! (and then build…)

Local opposition and permitting issues

- **NIMBY** → transmission infrastructure no longer seen as positive, and highly resisted by locals
- **NOCEBO** → despite all evidence, fear that long term exposure to low frequency EMF could generate health trouble is on the rise
- **A multi-layer administrative and regulatory framework** → permits increasingly difficult to obtain

=> Developing grids like in the old good days is no longer an option

Economical and funding issues

- **A pressure to keep tariffs under control**, to preserve the purchasing power and the competitiveness of enterprises (and slow growth of volumes doesn't help…)
- **A need to keep a good financial profile**
  With the financial crisis, Capital providers and stakeholders are very cautious and challenging

A- Improving Market Design

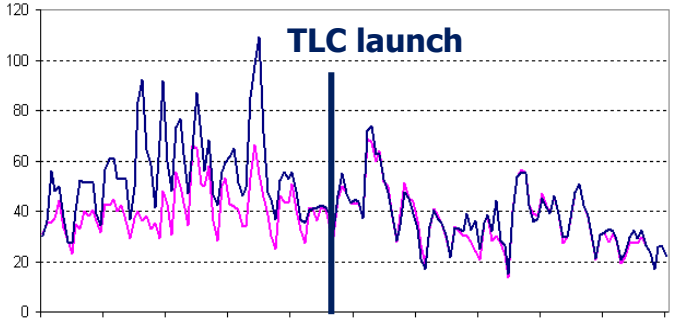
Clever market designs can spare the need for additional physical infrastructure :

- **Market coupling** implemented from Nov. 2006 between France, Belgium and the Netherlands, extended to Germany in 2010 and to be extended to Spain, UK and Italy
- **Flow based market coupling** to be implemented in 2013 on CWE to improve handling of network constraints
- **Intra day exchanges mechanisms** to react to uncertainties
- **Coordination of TSO's balancing mechanisms**

  …. **which paves the way for a progressive integration of market areas…**

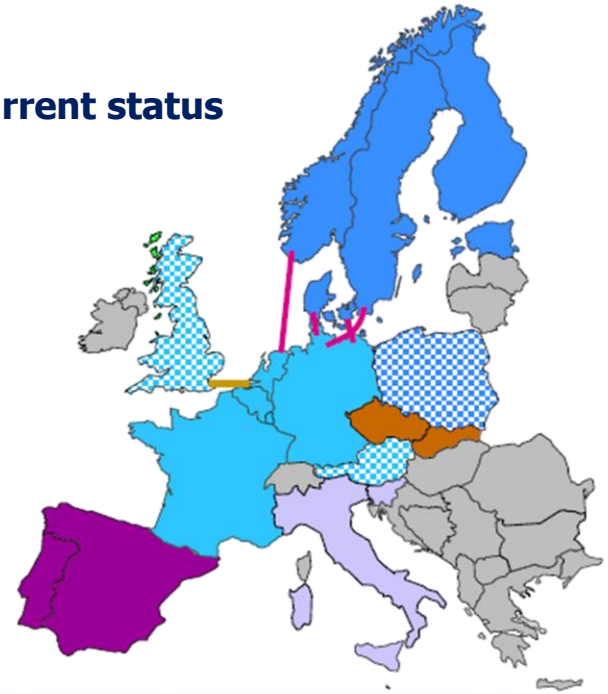
Other Market Design improvements are in study : Capacity mechanism, Incentives on generation location, Demand Respond framework, better RES integration in market design…

Market Coupling



impressive results as regards price convergence – and use of interconnectors…

Current status



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B- Developing infrastructures

1st : Optimising the existing grid

- **Extending grid's working life :** pushing the limits (assets management rehabilitation, supervision and conditional maintenance)
- **Using the existing grid to its full potential** (upgrades with high performance conductors, PST, Phase-Shifters, FACTS, capacitors…)
- **Adopting advanced techniques** (Live working, airborne work…)

Increasing the use of underground cables

- **2012 : 75% of new circuits from 63 to 225kV** underground
- **HVDC as an alternative to new 400 kV overhead** (in tunnels : France-Spain, France-Italy …)

Improving social acceptability and environmental insertion

- Promoting shared solutions with **regional and local stakeholders**
- Improving the **integration into the landscape**
- Improving the integration into the **social environment** (compensating inconvenience, accompanying local economic development)

C- Promoting European coordination

RTE is fully involved in ENTSO-E, the European TSO association

Development planning

- Coordinated **Ten-Year Network Development Plan** (ENTSO-E)
- European Commission aims at using this plan as planning tools
- New EC legislation : **Infrastructure Package** (permiting and funding)

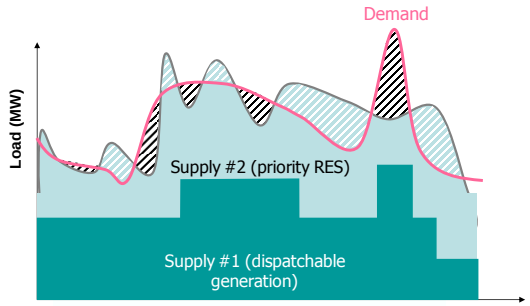
Coordination for secure operation

- **CORESO** operational since 2009 - NGET, Terna, Elia, 50 Hz and RTE
- **Relaying information** between TSOs, pro-active **assessment of the security level** of the network & **proposing coordinated actions**
- **Now implementing Regional Security Coordination Initiatives**

Harmonisation with Network codes

- **Network codes will be binding for the states** when adopted
- **Developed by ENTSO-E, ACER and market actors. 7 topics** :
  Capacity allocation & congestion management, balancing, generator connection, on DSO & industrial load connection, operational security, operational planning & scheduling, load frequency control & reserves

D- Innovating with smart grids



Turn Smart Grids into a means to relaunch investments and increase grid security

Smart grids matter of course at the local level for distribution (smart meters, etc.)…but also **for transmission grid**

Developing demand side management

Many initiatives implemented - Emergence of demand side management agregators- volontary schemes

Tools for forecasting and integrating renewables

New system operating since November 2009 (for wind power), and then extended to PV-solar (IPES, Safewind)

Real-time flows monitoring in power grids

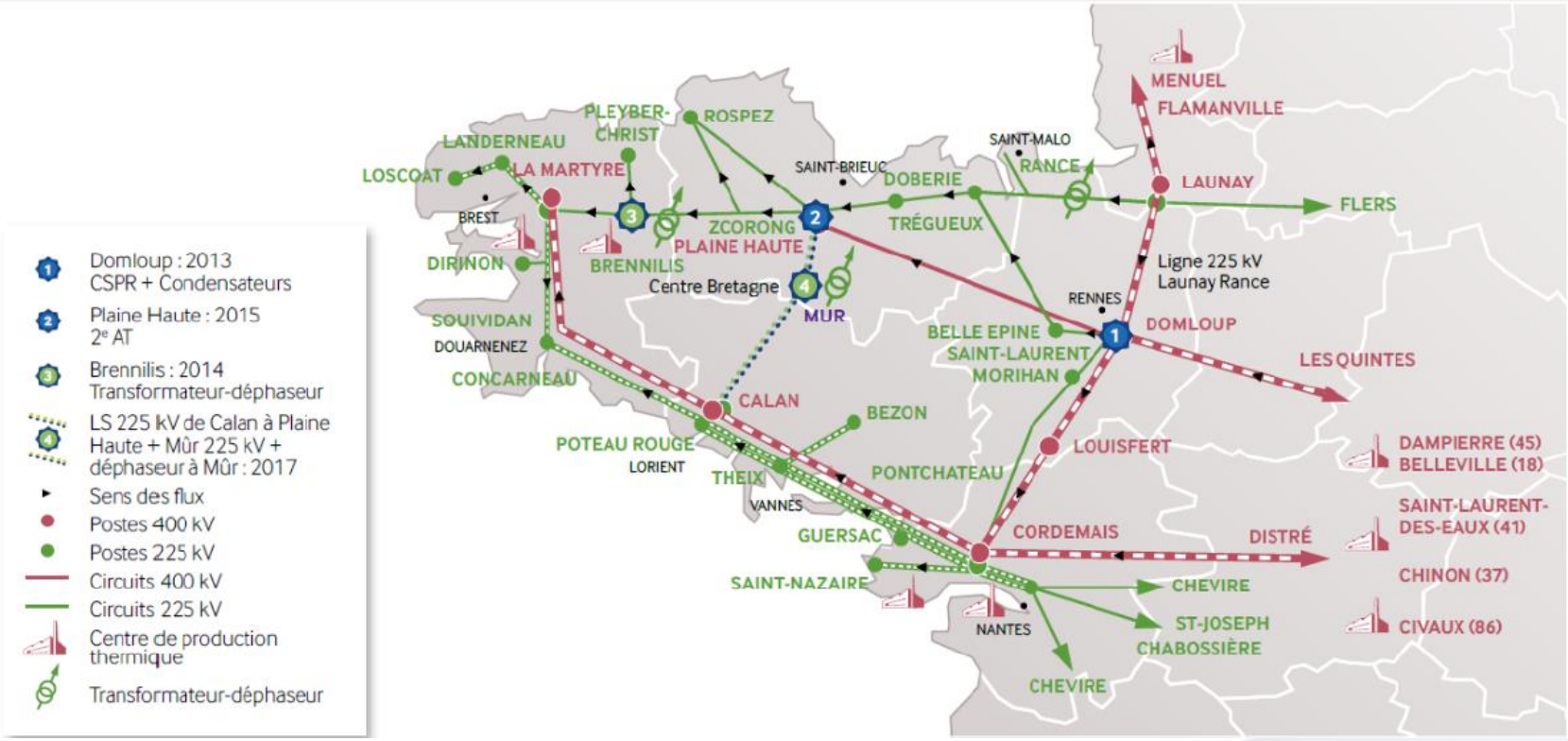
New technologies for infrastructure and control

European R&D projects on relative topics

PEGASE : Large scale, multicountries network calculation models
TWENTIES : new technologies to welcome more RES safely in the grid
OPTIMATE : market design optimization for RES integration
…and others

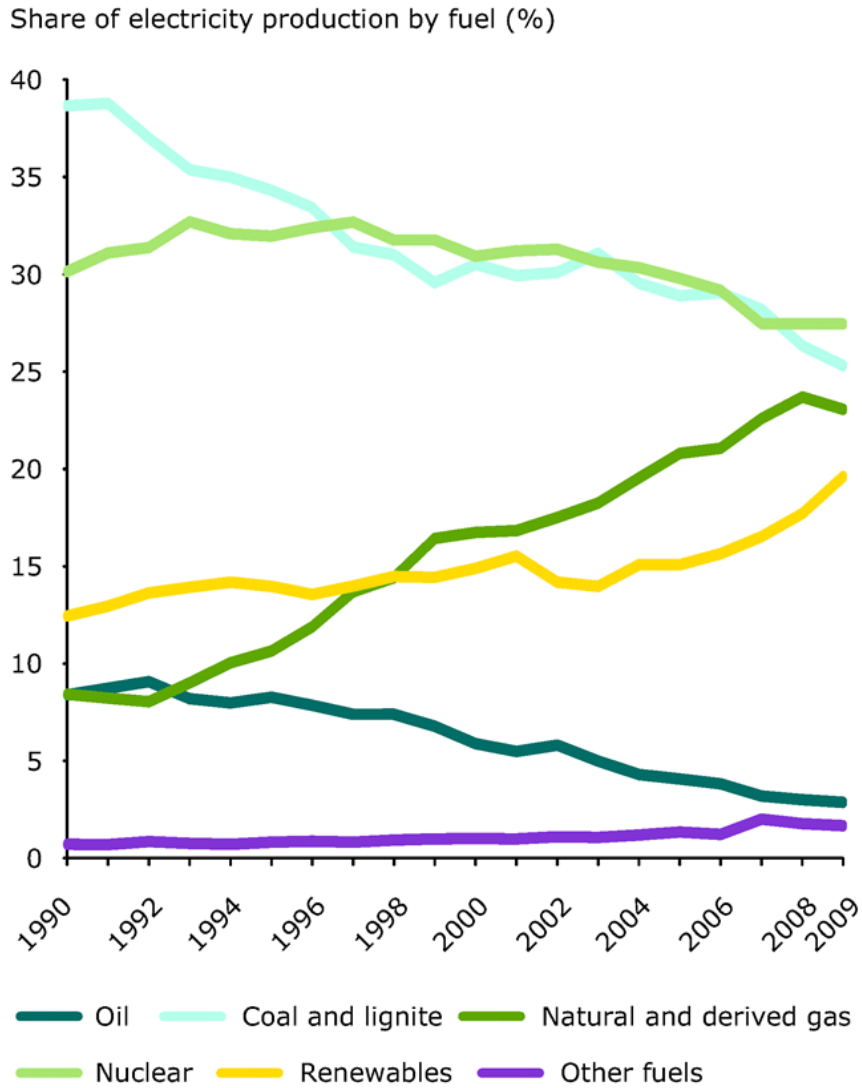
Brittany example

This French peninsula, with only volatile RES generation, has been secured thanks to a mix of FACTS, targeted demand response initiatives and network investment



Thank you for your attention !!

RES generation increase in Europe



Source european environment agency

Sharp changes of fuel mix

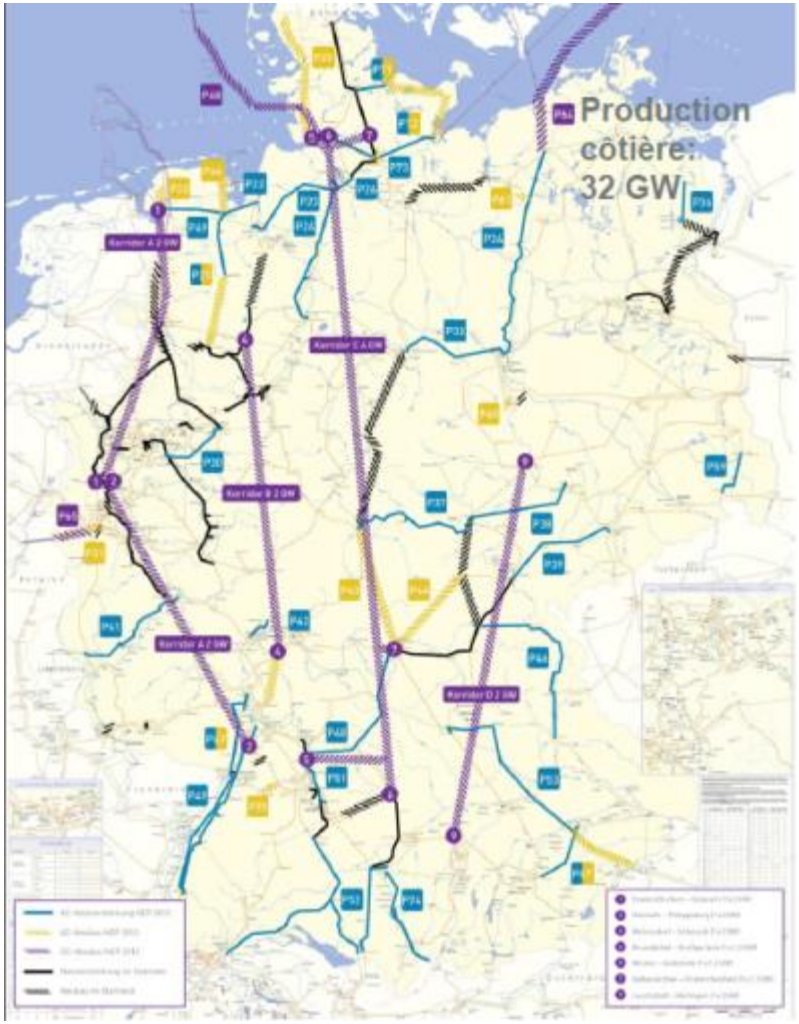
- Increase of RES
- Increase of Gas
- Decrease of oil and coal

Consequences :

- Different flow patterns
- Volatile supply demand

Increase of RES and network investment

- Network development is required to increase RES
- German example : wind generation in the north, industries in the south
- But building new lines is not an easy matter : NIMBY / BANANA
- Innovative solutions required to relieve congestions



Network projects in Germany

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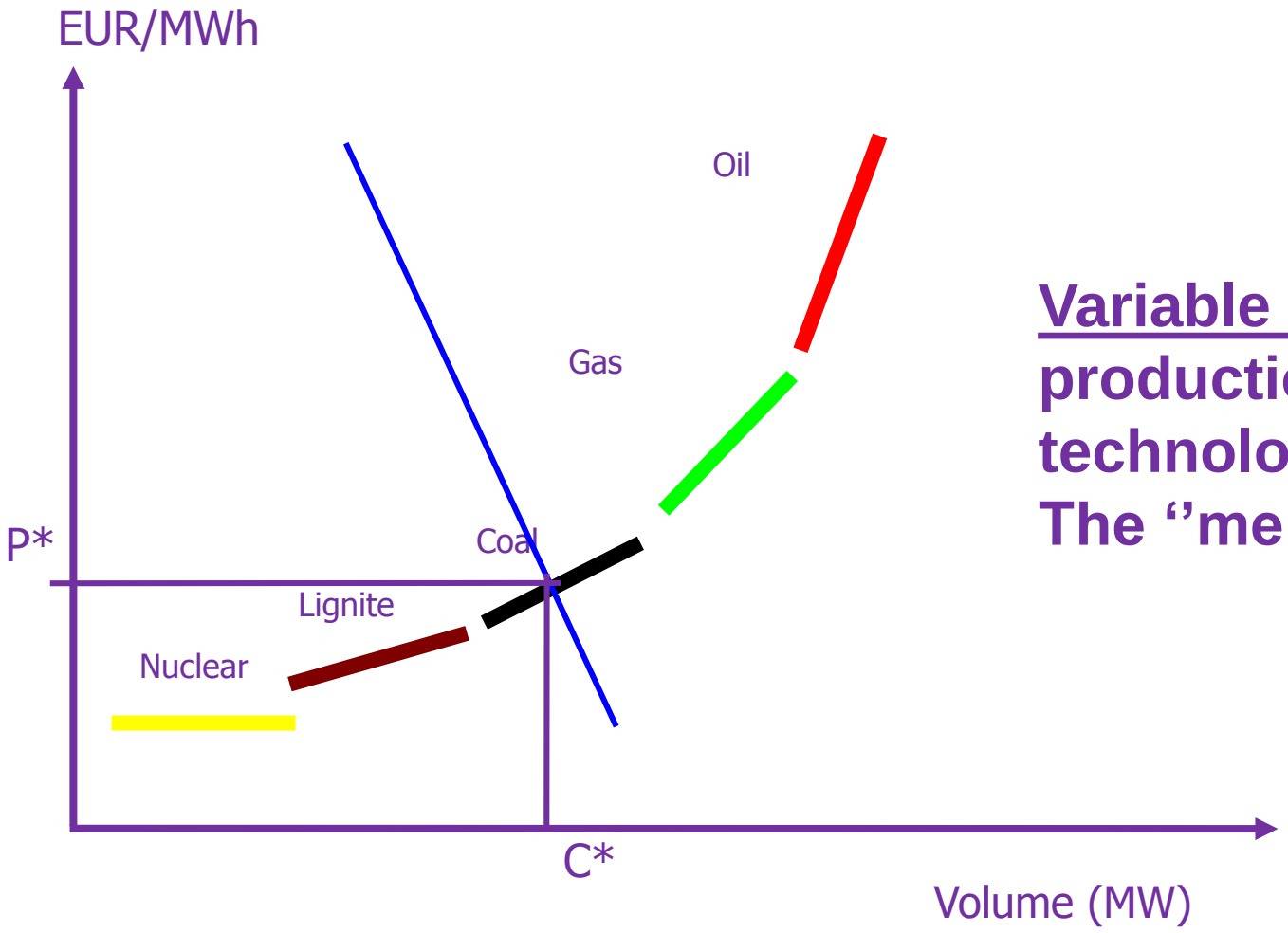
Increase of RES and supply demand (1)

1 : merit order and load curve



Variable costs of production technology: The ''merit order''

Increase of RES and supply demand (1)

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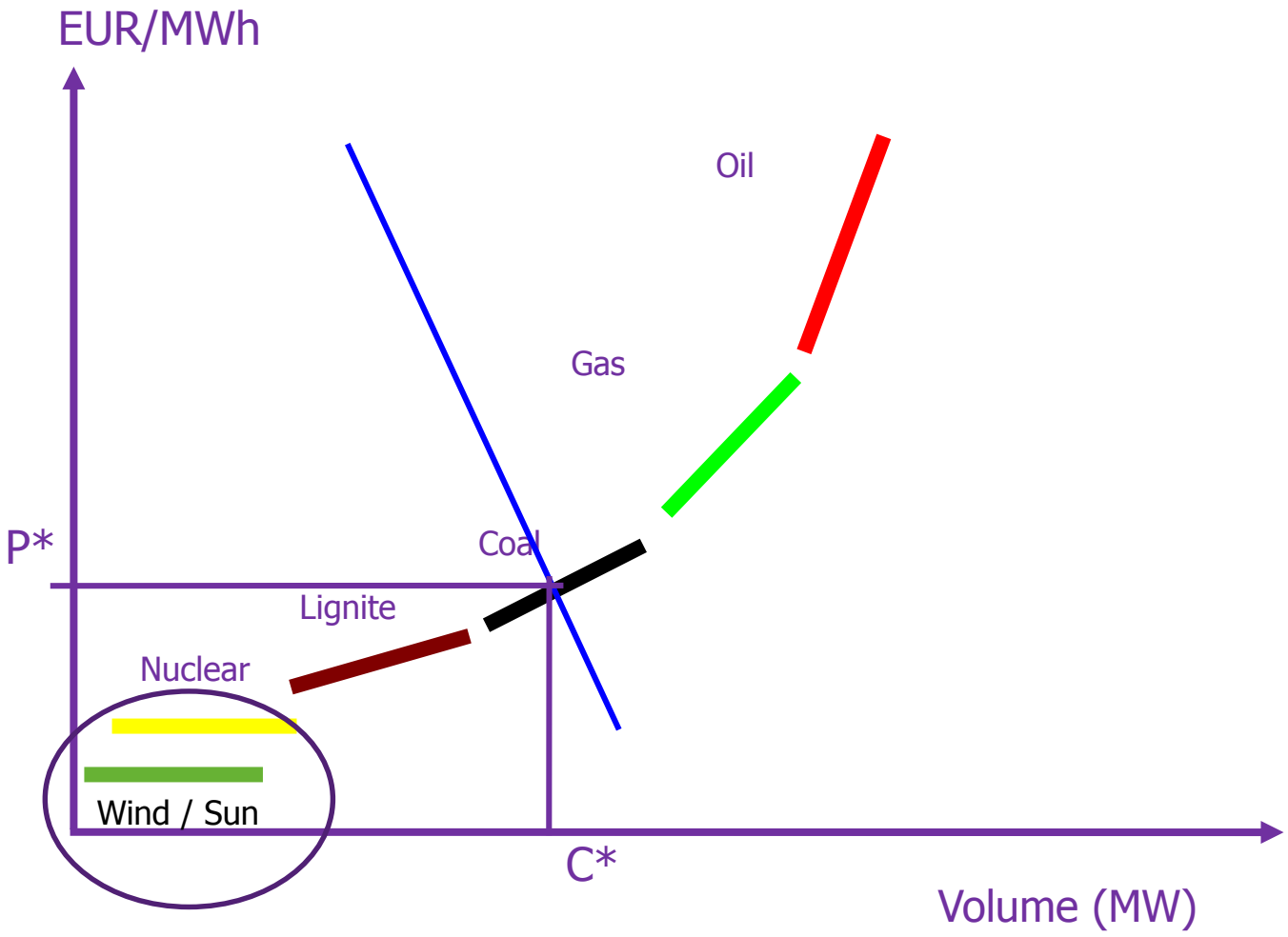

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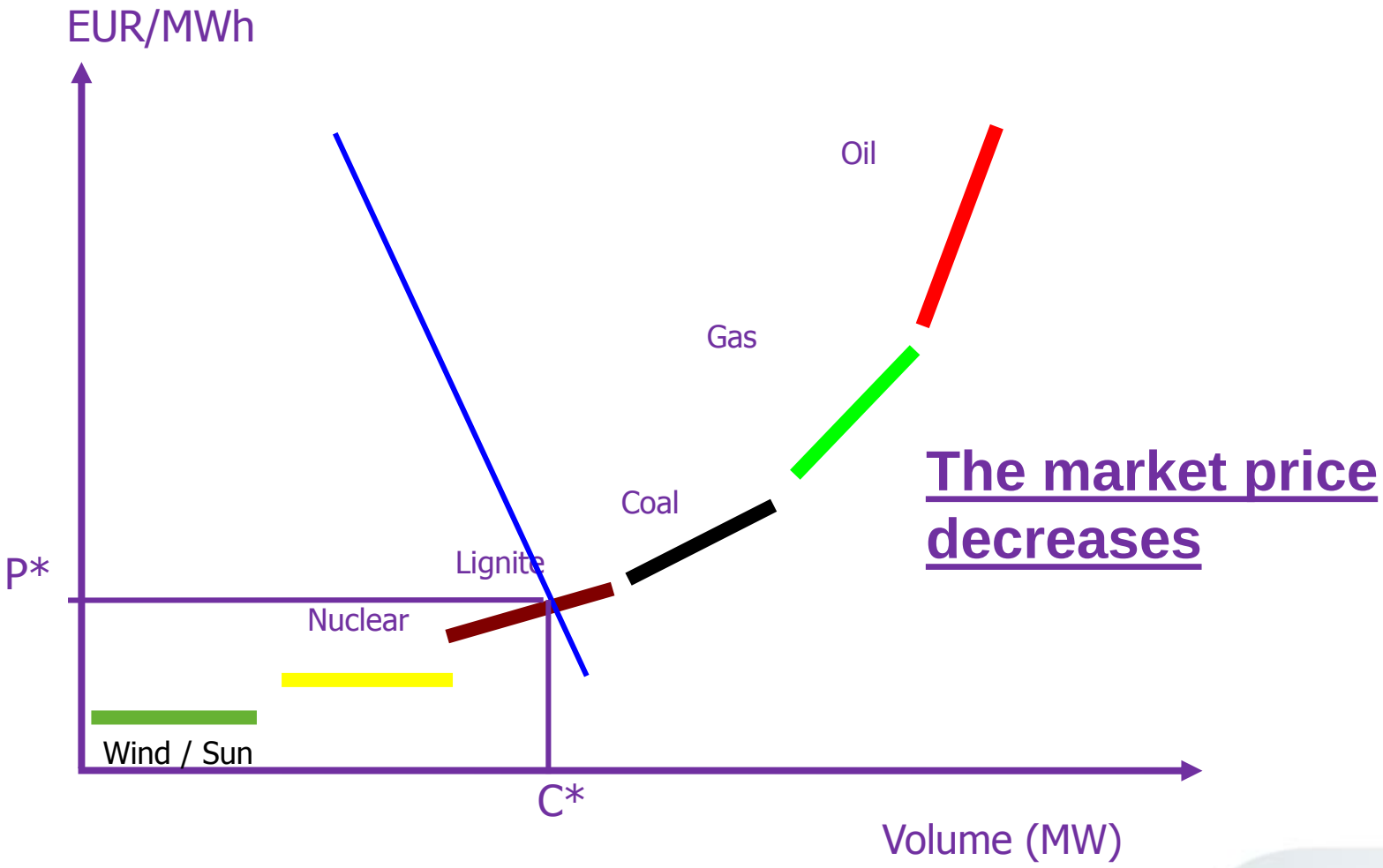


Increase of RES and supply demand (1)

The weekend of June 15 and 16 2013, France has experienced 14 hours of negative prices on the spot market with a low at -200 €/MWh during 3 hours, which is four times more than the average spot price in absolute value.

This calls for new means of fexibility in supply demand balance and for well designed RES incentive schemes.

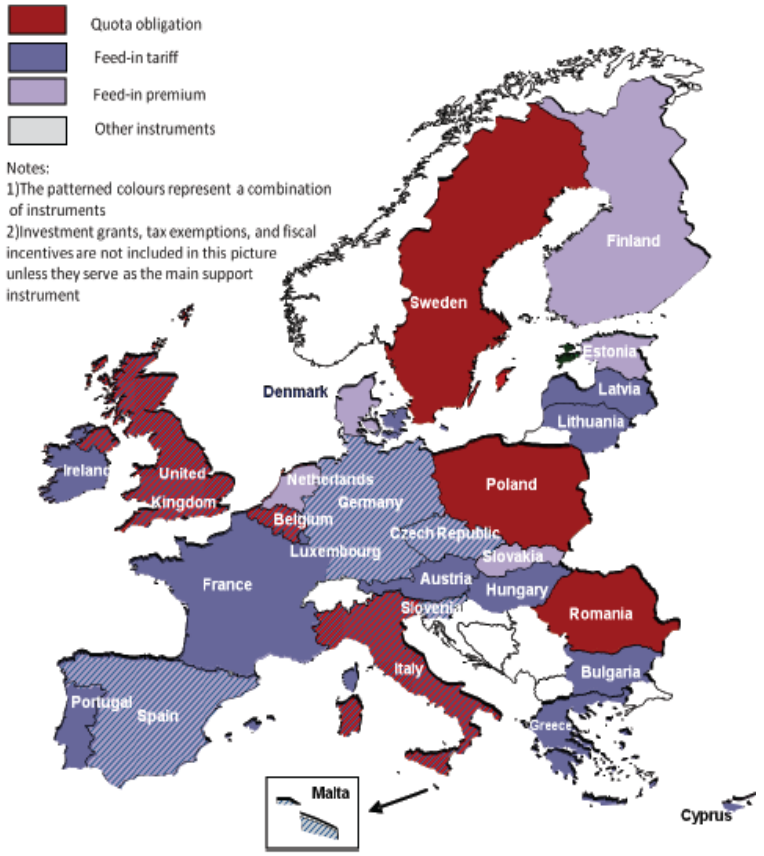
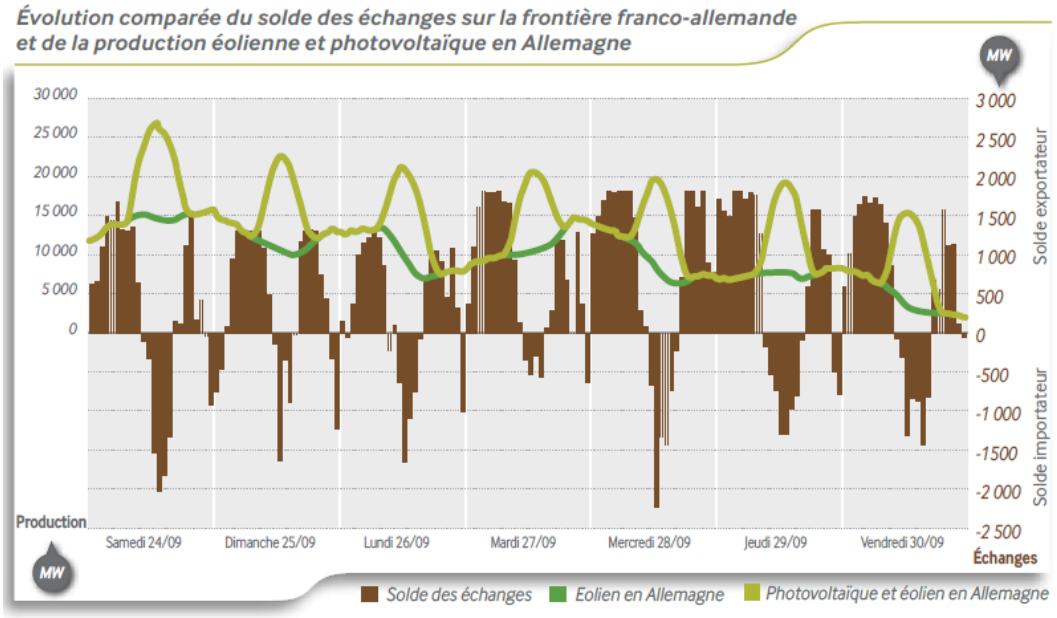


Figure 1 Map of EU countries according to their support mechanisms for RES-E

New interconnection capacities required

Not only increase in interconnexions capacities but also design of new mechanisms to optimise the usage of capacity.

the greater the possibilities for exchange, the grater the mitigation between the supply demand constraints of different zones.

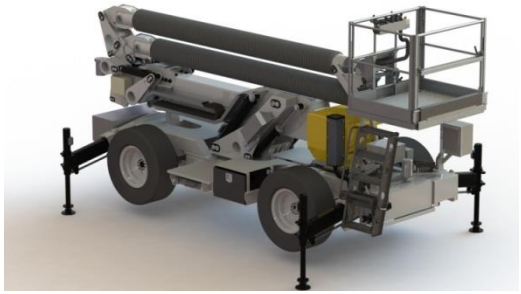


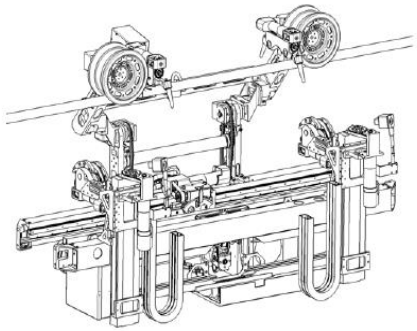
Correlation between french German border flows in brown and renewable generation in Germany in green

Call for new solutions

Maximise the availability of the network

1. Develop live maintenance
2. Robots or drones for inspection





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