# Demand Response in the EU

## Basic Implementation Guide

to the EU package *Clean Energy for all Europeans*

14 April 2020

# A common approach for Europe

How to implement the Clean energy package regarding DR

Analysis by stakeholders involved in over 20 countries in the EU

# *Executive Summary*: Key provisions set by EU legislation and how to implement them effectively in Member States

- CEP provides for demand response to participate in all electricity markets, hence as balancing services to TSOs, but, much more important, in the wholesale market (e.g. day ahead and intra-day markets for MWh).
- Selling demand reduction (DR) in a market as an alternative to (expensive) generation lowers market prices and thus benefits all suppliers.
- However, DR comes at a cost for suppliers: they pay for it via the market where DR is sold.
- Providing their benefits are greater than the cost, suppliers overall capture a net benefit, which they may eventually transfer to overall consumers.
- No 'compensation' should be paid by DR to suppliers on top of such net benefits.
- However, some suppliers may receive a 'compensation' for costs incurred during DR activation.
- It is a major achievement of the CEP to distinguish between the compensation paid to these suppliers, and who pays for it. As it stands:
    - while a Member State may choose to set a 'compensation' to suppliers, this should not create a barrier to DR.
    - hence the burden of the compensation should be shared among market parties, not bluntly charged to DR.
    - the 'net benefit' principle is set forth as a guideline to calculate compensation sharing and limit the part paid by DR.
- Subject to the above principles, Member States may choose any 'model' regarding BRP rules, whether 'uncorrected' or with 'perimeter correction'.

# Contents

- DR in the market and aggregation: need and principles
- Economics and how to solve the ‘compensation’ issue
- Technical provisions

- Appendix
  - Examples of national experiences
  - Reference texts

# 1.1. DR in the market and aggregation: Needed for the energy transition

- Demand response, or Demand Side Management, or Load Flexibility
  - Monitoring and changing consumption … on demand, including in real time
  - Committing to deliver as part of the system/market
  - Aggregators to ensure reliability, provide technologies, bear these commitments
- Contributing to an efficient and climate-friendly power system
  - Avoid consuming when energy is scarce: alternative to expensive generation from fossil fuels – cheaper, and avoiding $CO_2$ emissions
  - Balance system (real time) + alleviate grids facing congestion (DR = long term reliability)
  - Monitor consumption to save energy and consume when available
- Large potential very useful for the energy transition
  - Up to 160 GW in the EU(1), majority in buildings and residential sector – yet to engage
  - Easier integration and better use of renewable energies, by matching intermittency
  - Improve reliability and reduce costs for all, by involving demand flexibility from volunteers
  - Social cohesion: reward participating consumers, and share benefits with all

(1) Clean energy package, Evaluation report, Annex 7 (https://ec.europa.eu/energy/sites/ener/files/documents/2_en_autre_document_travail_service_part2_v2_412.pdf )

# 1.2. DR in the market and aggregation:
## Key principles as set by the Clean Energy Package

- Member States to allow and foster participation of DR through aggregation
- As an alternative to generation, no discrimination

- Aggregators to bear balance responsibility, similar to generators': cf. allocated volume
- No prior consent from third parties, incl. supplier, no undue payments/restrictions
- Access to data: non discrimination, yet fully protecting commercial and personal data

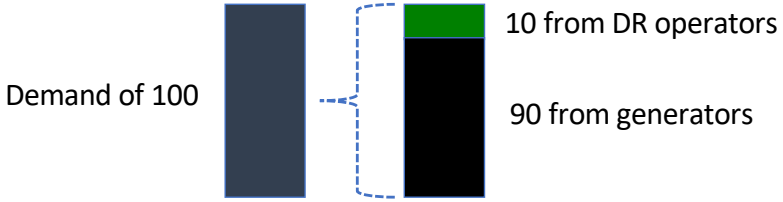
- Member States may establish compensation to suppliers/BRPs, but no barrier to DR
  - Exclude any over-compensation
  - No barrier to DR, hence may share the burden of this payment
  - Allowed to take account of benefits of DR to all suppliers and consumers

- Technical requirements based on capabilities of DR and market/system/grid needs, technology-neutral way / no discrimination

# 2.1. DR in the market: ‘alternative’ MWh-s to

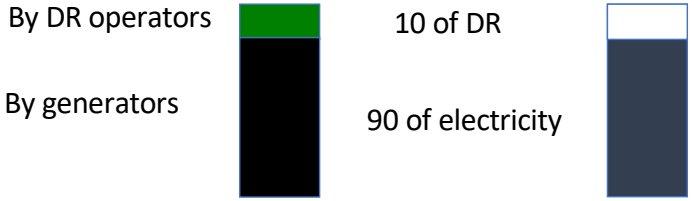
## Ensure system balance and reduce sourcing costs for suppliers

Wholesale markets
(in advance)




*Via* wholesale markets (i.e. in advance)
consumption forecast is balanced by purchases

Physical delivery
(in real time)




Actual consumption (90) *(as reduced by DR)*
is balanced
by actual electricity generation (90)

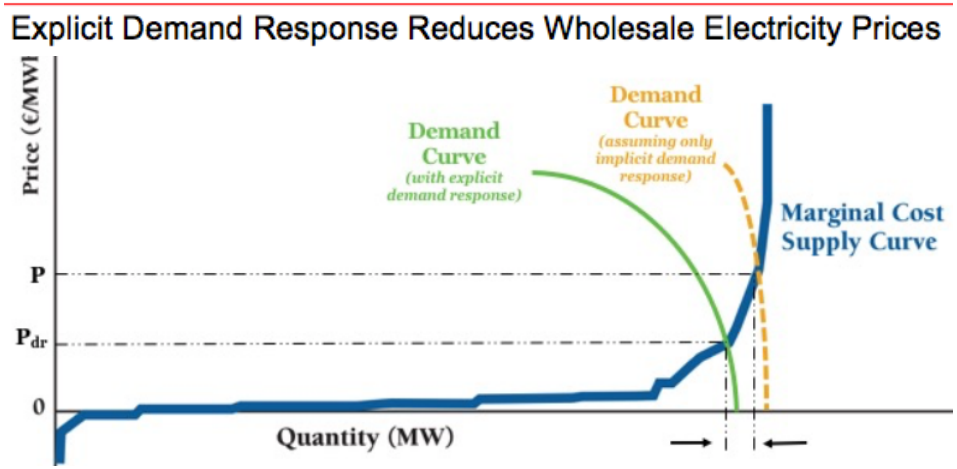
- DR ensures energy is neither generated nor consumed, in two steps
  - **DR avoids generation via the market**
  - **DR reduces consumption physically**
- DR ensures balance *instead of* generation
  - ➢ DR avoids expensive generation

*Save energy and $CO_2$*
*Save money for all*

# 2.2. Economics

# Benefits for all suppliers via the market

- By providing an alternative to traditional generation, DR ensures highest prices are avoided / reduced
- Suppliers capture benefits because market settles at lower price: suppliers save on their sourcing costs
- Calculations are easy to run using the merit order curve drawn as shown by market prices
  - Benefits result from difference of price achieved in the market with versus without DR bids
  - Counterfactual price can be calculated ex post, to show the benefits achieved.
  - Calculation of counterfactual price = call more generation bids as an alternative to DR volumes delivered in the market
- Calculated or not, benefits are captured by suppliers on their sourcing costs; calculations will only confirm that choice of developing DR benefits consumers.
- Ultimately these market-driven benefits reflect the costs avoided on generation turning useless as DR provides an alternative, both cheaper and more climate-friendly (not to mention grid costs avoided).




| | Market | Year | Average decrease in spot price on application of DR (€/MWh) | Whole market retailer benefit [M€] | Compensation payment to retailers (based on French compensation model) [M€] | DR sales [M€] | Retailer market benefit/ (Cost = DR sales) |
|---|---|---|---|---|---|---|---|
| 400b/1GW | FRA | 2013/14 | 13.01 | 379.27 | 28.06 | 24.68 | 15.37 |
| | | 2014/15 | 11.81 | 344.57 | 27.93 | 20.77 | 16.59 |
| | | 2015/16 | 18.99 | 515.54 | 21.42 | 15.72 | 32.80 |
| | GER-AUT | 2013/14 | 20 | 635.83 | 24.44 | 19.13 | 33.24 |
| | | 2014/15 | 13.83 | 458.89 | 22.66 | 17.9 | 25.64 |
| | | 2015/16 | 11.29 | 355.13 | 18.4 | 15.58 | 22.79 |
| | NORDIC | 2013/14 | 7.71 | 186.32 | 19.69 | 14.26 | 13.07 |
| | | 2014/15 | 5.49 | 135.12 | 18.08 | 13.47 | 10.03 |
| | | 2015/16 | 10.21 | 272.75 | 14.75 | 13.98 | 19.51 |

*Source: report by The Regulatory Assistance Project*

# 2.3. Economics

## Benefits for all suppliers >> costs

- On the one side: benefits

  Suppliers buy cheaper => save on sourcing costs

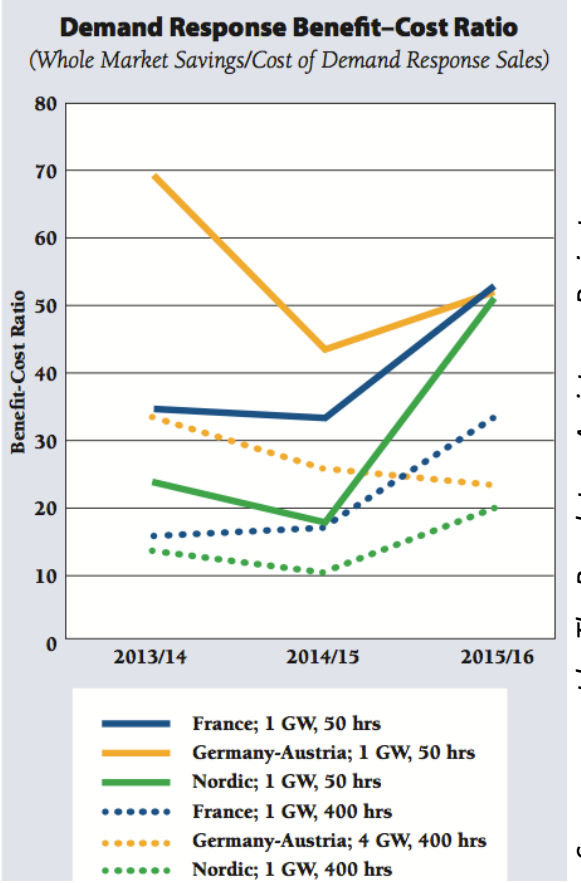
- On the other side: costs

  Suppliers buy same volumes incl. DR, but sell less to consumers (who reduce their consumption)

- Overall: shared benefits
  - Each participating consumer reduces his bill
  - All suppliers reduce their sourcing costs more than the new cost they face collectively => net benefits
  - ➢ DR entails net benefits for all suppliers together….
  - ➢ … who can pass them on to their customers, i.e. to all consumers

- Net benefit principle: avoid globally over-compensating suppliers
  - While DR is providing greater benefits than costs, i.e. a net benefit, DR should not be requested to give away additional money on top of this net benefit

- Impact on individual supplier/BRP: depends on "model", as detailed on next page



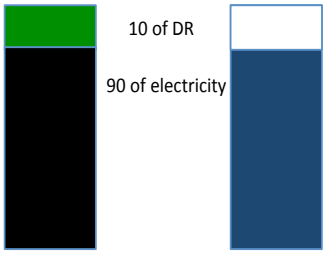

*Source: report by The Regulatory Assistance Project*

450 GWh/mkt = 1.6 G€/y benefits for retailers

# 2.4. Economics

## From physical balance and market wide benefits to accounting rules tackling accounting imbalances for suppliers and their BRPs

Physical balance thanks to DR




Generation (90) = Consumption (90)

- *DR offered in the market alongside generation*
- *DR selected by market if offered cheaper*
  - *DR sold rather than (expensive) generation*
  - *Market settles at lower price*
- *DR delivered, i.e. aggregator reduces demand*

- *Aggregators target high prices, i.e. help the system*
- *Generation is avoided (… and $CO_2$)*
  - *Lower sourcing costs for all*
- *Consumption is avoided*
  - *Less retail sales*

DR sold in the market ensures physical balance, at lower level (generation = consumption).

Sourcing volumes remain the same (100), but 90 come from generation and 10 from DR (cheaper than generation). Thus, sourcing costs are reduced => **benefits for all suppliers**.

Consumed volumes are less than expected by suppliers (reduced to 90 versus 100 expected), i.e. retail sales reduced. Impact for supplier/BRP of participating consumers depends on "model" chosen:
**either accounted for a positive imbalance, or not, when "model" with "perimeter correction" imposed to BRP.**

# 2.5. A choice of 'models' for BRP rules

## With or without 'perimeter correction'?

*TSO acting in its role as imbalance clearing and settlement agency*

### Without perimeter correction… BRP is compensated via TSO

- With DR, physical balance: 90=90
- Yet accounting imbalance:
  - Volumes bought (generation + DR) = 100
  - Volumes sold (actual consumption) = 90
  - Total: positive imbalance 100 - 90 = + 10
- Under existing BRP rules (before any DR), positive imbalances are paid by TSO: income for BRP
- Supplier/BRP is happy with such payment, same as usually paid
- TSO pays BRP: who will compensate the TSO? Currently: TSO charges all BRPs. Keep as is?

### With perimeter correction, and compensation to supplier/BRP… via TSO

- Same physical balance: 90=90
- Change of accounting rule: BRP's position is corrected, i.e. calculated "as if" no DR
  - Counterfactual consumption: 90+10=100
  - No positive imbalance
- BRP/Supplier unhappy
  - Has bought more than sold: 100 > 90
  - Yet not paid for positive imbalance because of correction
- Often considered fair: TSO when correcting perimeter should compensate BRP/supplier
- TSO pays compensation to BRP/Supplier: who will compensate the TSO? How to share?

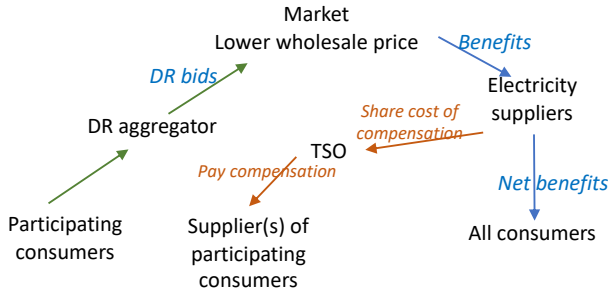
Whatever the model, very similar: no costs for any individual supplier/BRP, TSO to pay, then share among all parties.

Directive leaves choice of model to Member State,

but sets a common frame for sharing cost if specific compensation is established (cf. Directive Art.17-4)

# 2.6. Economics: CEP principles to comply with.
# No barrier for DR, no overcompensation for suppliers

- Member State may decide whether suppliers receive compensation (or not)
- Cannot be a barrier for aggregation nor for flexibility, hence need to share fairly
  - Charging full compensation to DR would mean depriving DR of revenues
  - Confirmed by French experience: after 10 years, only 27 GWh in the market from 23 aggregators with over 2 GW
- How to share
  - Directive allows to involve wide array of market parties
  - Take into account benefits for all suppliers and customers
  - **Net benefit principle: no overcompensation of suppliers globally**
    - Costs are taken into account but also benefits entailed by DR
    - If benefits for all suppliers are greater than costs, then no contribution from DR
    - If benefits are small (i.e. small decrease in market price thanks to DR), then DR to contribute to compensation so as to offset any net cost born by all suppliers




- Solutions (if Member State to establish 'compensation payments')
  - ➢ Either uncorrected model and BRPs are compensated for the positive imbalances
  - ➢ Or with corrected model
    - Payment to corrected BRP/Supplier by TSO at spot price
    - Payments to TSO by all suppliers, e.g. shared on the basis of their current market share
    - Regular assessment of overall net benefits of DR to confirm design (e.g. monthly or yearly)

# 2.7. Economics for electricity suppliers

## Every supplier will benefit from DR
## + Every supplier may wish to become a DR aggregator

- Neutral for supplier of participating consumers, as he receives compensation from TSO
  - With 'uncorrected model': supplier's BRP is paid by TSO for positive imbalance
  - With 'corrected model', compensation for correction is paid by TSO, hence neutral for BRP & supplier
- Benefits for all suppliers (including supplier of participating consumer)
  - Benefits from reduced sourcing costs
  - Direct costs (/foregone revenues) offset by compensation
  - Overall cost = cost of paying TSO
  - If benefits > costs, net benefit for all suppliers, fairly shared
  - If ever costs of DR > benefits, then DR would pay the difference
  - ➢ Every supplier benefits from DR in all cases
  - ➢ Hence all consumers get their share of the net benefits of DR

✓ Electricity suppliers should be strong supporters of this market design for DR

✓ Innovative suppliers wish to become (or partner with) DR aggregators

# 3. Technical provisions & key enablers

## 3.1. How to measure DR volumes

- Use most appropriate data
  - Smart meters
  - Submetering
  - Collecting and adding
- Calculate the baseline (= counterfactual consumption, as if without DR)
  - Various methodologies depending on kinds of DR and market/service delivered
    - Ex.1: Basic rectangle
    - Ex.2: Real-time individually-determined baseline
    - Ex.3: Forecast based on historical load curve
  - Each methodology to be proposed by aggregator(s), discussed with TSO, approved by TSO/NRA
- Measure the DR volumes
  - Calculations performed by aggregator, under control by TSO/NRA => full auditing rights
  - Operational on-going process, close to real time, results made available to TSO (/DSOs)
  - Settlement ex-post data possibly more detailed (e.g. per BRP), provided by TSO, aggregated

# 3. Technical provisions & key enablers
## 3.2. Consumers' rights and data protection

- Protect consumers
  - Data: GDPR + protection of commercially sensitive information
  - Consent and contract
- Protect data from undue transmission or use
  - Avoid anti-competitive provisions such as informing (competing) BRPs
- Taking care of DSOs' situations
  - Only TSOs need aggregated data, because in charge of settlement, and access to details when auditing
  - DSO only if buying DR: DR is delivered as a service to a DSO, should receive data confirming delivery

# 3. Technical provisions & key enablers
## 3.3. Allocated volumes and Balance Responsibility

- DR aggregator should bear balance responsibility for his operations (only)
  - Responsible for delivering DR volumes as sold
  - Be or have a BRP
  - Allocated volumes* = DR actually performed/delivered is counted as 'injections' of Aggregator's BRP
  - Offtakes = sales to other parties
  - DR Aggregator not responsible for consumption taking place, but for reducing as sold
  - Consumption as actually occurs is in the supplier's BRP's perimeter (subject to perimeter correction if any)
- When DR fails to deliver, penalties via his BRP's position, paid to TSO
  - Same as a generator: can be all included in a perimeter, off-setting consumptions and sales ('off takes')
- Balance responsibility may not be needed when operating as a BSP
  - Same as a generator providing balancing services
  - Depending on national model, subject to network code on Balancing

➢ All similar to a generator's

** The Electricity Regulation establishes balance responsibility (art.5) and also defines the allocated volume for DR (cf. recital 15).*

# 4. Rebound, shifting and increasing loads

## 4.1. Rebound, if any, has small impact, hence should not delay DR framework

- Technically, rebound can be managed: load monitoring after DR event to avoid peaks
  - Rebound from industrial DR is standard consumption: process delayed days or weeks, still under control
  - Rebound from residential DR is a minor share of DR volume, spread over more than 20 hours (cf France*)
- Economically, rebound has a direct impact for supplier of second or third order of magnitude
  - Consumers pay for energy used during rebound/shift
  - Hence, economic impact for supplier/BRP is not energy price but only imbalance price spread
  - And spread depends on whether system is long or short during rebound period, hence will average
- Rebound shall not be taken into account, when calculating compensation to suppliers/BRPs, which is limited to "covering costs incurred **during** the activation of DR" (as per art.17-4**).
- Rebound could be taken into account when assessing the net benefit
  - During rebound, more energy is needed, hence market prices increase
  - Rebound likely to be during periods when prices are low, i.e. in the flat part of the merit order curve, hence small impact on market prices then
  - This small impact could be taken into account when assessing overall net benefit, but this is likely not to change overall situation with very high net benefits

➢ Because impact of rebound is not easy to prove but small, it shoud not slow down DR participation

** Comprehensive study on 45,000 homes published by French TSO (RTE)* https://clients.rte-france.com/htm/fr/mediatheque/telecharge/20160401_Rapport_report_complet.pdf

*** The electricity directive (art.17-4) states that « the financial compensation shall be strictly limited to covering the resulting costs incurred by the suppliers of participating customers or the suppliers' balance responsible parties during the activation of demand response. »*

# 4. Rebound, shifting and increasing loads

## 4.2. Increasing or shifting load as a way to reduce it during periods of high prices

- DSM in the market to trigger loads: when should consumption be increased?
  - In principle, increasing consumption as such does not contribute to the energy transition policies, and therefore should not be incentivised
  - However, with more renewable energy made available, load shifting will be valuable, i.e. load increase triggered to consume electricity when abundant and cheap, with the aim to avoid consuming when prices are high.
  - This is similar to a rebound (whether after or anticipated), with the added feature that the increase is precisely monitored in order to ensure it takes place when prices are low
  - It shall be considered as a demand reduction (DR), as far as the reduction can be monitored and proved.
    - As usual for DR, proving delivery requires using an appropriate baseline methodology.
    - Hence the aggregator can sell the demand reduction (DR) volume in wholesale markets* at times with high prices.
  - Net benefit principle to apply: provided this shift entails overall net benefits for all suppliers, they should not receive any money from aggregator
  - In other words, demand increase is valuable insofar as it comes with demand reduction, which is beneficial to all (suppliers and) consumers.

- DSM as a balancing service
  - Increasing load may also be useful to balance the grid, as an alternative to reducing generation
  - Balancing services provided to the TSO should be treated equally, without discrimination, as per art 17-2 of the electricity directive.

** Otherwise, it is simply 'implicit DSM' operated by supplier, i.e. transactions on retail side, not wholesale markets.*

# Appendix

- National experiences, pros and cons
- Reference texts

# *Appendix 1*
# Examples from existing or new frameworks built in the EU and abroad

- Austria
- Estonia
- Finland
- France
- Spain

- USA
- Singapore

# *Feedback from:* Austria

*Good*

- DR accepted by TSO with same rules as for generators.
- Min. bid size of 1 MW in balancing markets, aggregation is allowed.
- Power industry players agreed for d+1 schedule correction to avoid any impact on the supplier.
- Voluntary participation in automated system for exchange of metering data and schedules between all relevant partners (BRPs, supplier, DSOs, TSO, market operator)

*To avoid*

- Voluntary agreements instead of binding rules set by the regulator
- Uncertainty about costs for schedule correction by the supplier or BRP, usually no costs at the moment; but binding legal rule would be appreciated
- Small BRPs/suppliers without automated systems may have some effort for schedule correction. Same if correction schedules are submitted via email (automated system is voluntary)
- Online data exchange with BRPs&DSOs increase effort for first time implementation of aggregator (market entry barrier)

# *Feedback from: Estonia*

*Good*

- DR allowed in balancing market. 1MW minimum amount to enter the market.

*To avoid*

- Compensation rules not set. Some BRPs/suppliers are billing consumers for DR events.

# *Feedback from:* Finland

*Good*

- TSO supportive to, step by step, accept DR in all ancillary services
- Prior consent from supplier not required

*To avoid*

- Very slow changes, DR limited to small pilots
- Markets not open to DR (day ahead etc.)

# *Feedback from:* France

*Longest and largest experience in the EU: France got many things right, but ruined all with compensation payment and subsidies, then chose compensation cost sharing, and finally supported net benefit solution in the Directive*

*Good*

- DR accepted in all markets, in principle, competing with generation day ahead & balancing, capacity, etc.
- DR participation and activation without consent from supplier(s)
- Data provided by aggregator may be used for DR delivery check, subject to initial qualification and regular audits by TSO

*To avoid*

- Compensation cost charged 100% to DR, total barrier to DR (only 27 GWh delivered in 2018) – new approach of cost sharing to be implemented
- Information delivered to supplier/BRP of participating consumers

# *Feedback from:* Spain

*Good*

- Terms and conditions to implement the Electricity balancing guideline approved and published in the BOE
  - DR allowed to participate in balancing services
  - Minimum capacity to participate (aFRR, mFRR, RR) reduced to 1 MW (versus 10 MW before) and 200 MW per zone for secondary regulation

*To avoid*

- …yet lack of operational procedures (PO) to allow the participation of DR
  - Consultation by TSO to be launched in 2020
- Bids on balancing markets to be made in separate categories, hence not allowing aggregation of various resources (DR, generation, storage)
- No process or consultation neither started nor announced on the transposition of the CEP regarding DR participation in wholesale markets

# *Outside Europe*
# *Feedback from:* USA

*Good*

- DR to participate in ancillary services (FERC order, 2008) and all organized electricity markets (2012)
- DR participation in day ahead market competing with generation, paid same price, no compensation
- Participation subject to net benefits test, i.e. only when market price above a threshold published monthly by ISO/TSO
- Order based on net benefits for retailers, hence for consumers, later backed by Supreme Court (2015)

*To avoid*

- Weaknesses in compliance check and baselines

# *Outside Europe*
# *Feedback from:* Singapore

*Good*

- DR to participate in ancillary services ('IL market') and day ahead wholesale markets ('DR')
- DR is paid 1/3 of the benefits, as calculated by market operator (EMC)

*To avoid*

- Participation was initially limited to large consumers ('contestable')
- Data provided by others than DSO (Singapore Power) not used

# *Appendix 2*
# References (European framework)

- Clean energy package
  - Directive
    - Art 17
    - Recital 39 (including choice of ’models’)
    - Art. 12 & 13 (including aggregation independent from supplier)
  - Regulation
    - Recital 15
  - Working documents
- Network codes
  - Electricity balancing
  - Future delegated act on procurement/provision of flexibility ?

# Directive – art.17 on DR aggregation

| Directive (art.17) - Demand response through aggregation | Consequences when implementing the directive |
|---|---|
| 1. Member States shall allow and foster participation of demand response through aggregation. Member States shall allow final customers, including those offering demand response through aggregation, to participate alongside electricity generators in a non-discriminatory manner in **all** electricity markets. | All markets open to DR |
| 2. Member States shall ensure that transmission system operators and distribution system operators when procuring **ancillary services**, treat market participants engaged in the aggregation of demand response, in a non-discriminatory manner alongside producers on the basis of their technical capabilities. | Including ancillary services (balancing, reserves, …) |
| 4. Member States may require electricity undertakings or participating final customers to pay financial compensation … | Any electricity company or consumer<br>(not specifically those involved in DR) may be required to pay. |
| to other market participants or to the market participants' balance responsible parties, if those market participants or balance responsible parties are directly affected by demand response activation. | May receive money only those parties directly affected by DR. |
| **Such financial compensation shall not create a barrier to market entry for market participants engaged in aggregation or a barrier for flexibility.** | Payment by DR should not be a barrier, *hence only a small part if any.* |
| In such cases the financial compensation shall be strictly limited to covering the resulting costs incurred by the suppliers of participating customers or the suppliers' balance responsible parties during the activation of demand response. | Payment only to suppliers/BRPs, limited to their costs<br>*Note: Demand reduction means no cost for BRPs, be it in a 'corrected' model ('correction' ensures neutrality for BRP), as well as an 'uncorrected' model (his positive imbalance is paid by TSO).* |
| The method for calculating compensation may take account of the benefits brought about by the independent aggregators to other market participants and, where it does so, the aggregators or participating consumers may be required to contribute to such compensation but **only where and to the extent that the benefits to all suppliers, customers and their balance responsible parties do not exceed the direct costs incurred.** […] | To share the cost of the compensation, taking into account benefits ensures DR does not over-compensate suppliers as a whole.<br>Hence the part of the compensation paid by DR only if ever and to the extent that DR would result in net cost for them – not if net benefit.<br>Rest of the compensation shared among suppliers, to ensure they all share fairly benefits… and costs – hence the net benefit brought to them by DR. |