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Distribution tariff setting methodologies in Portugal

Course on Gas and Electricity Distribution Tariffs - Theory and Practice

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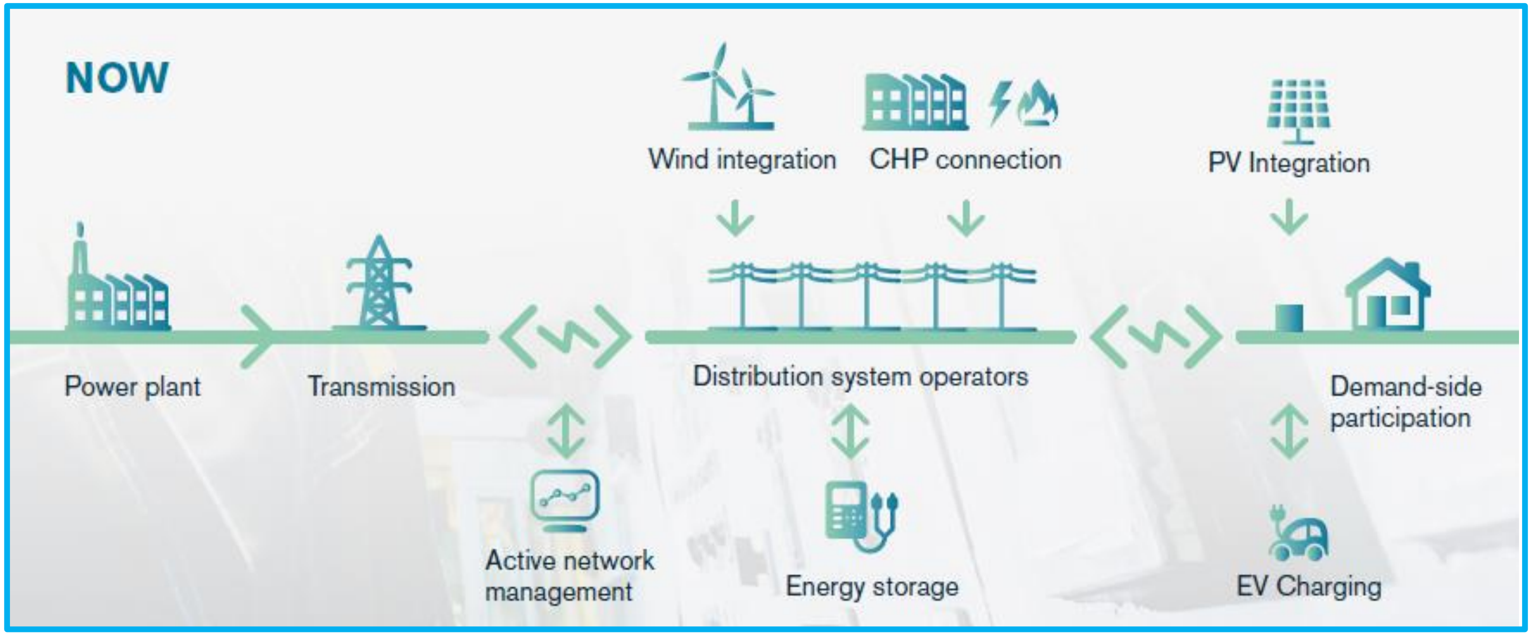
17 October 2019

Agenda

1. Distribution today
2. Electricity
   2.1 Allowed revenues
   2.2 Tariff structure
3. Natural gas
   3.1 Allowed revenues
   3.2 Tariff structure
4. Next challenges

1. Distribution today

Electricity sector



Source: Figures from the E.DSO brochure.

1. Distribution today

Use of distribution grid is changing (and will continue to change)

New technologies

- Smart meters (+ Load Control)
- Electric Vehicles (Vehicle-to-Grid charging?)
- Self-consumption
- Storage

New system use

- Intermittent generation, flexible demand
- New system peaks (EVs, electric heating, ...) that are more volatile
- Inverted power flows (LV → MV/HV)

1. Distribution today

Distribution tariffs (D-Tariffs) are getting a lot of attention

Academia

- FSR (2018) : Traditional tariffs may be unfit for solar PV and batteries

Network operators

- EURELECTRIC (2016) : Network tariffs should be more capacity-based

Consumer associations

- BEUC (2018) : Fairness; tariff options to migrate to new tariff regimes

NRAs

- CEER (2017) : Good practices on D-Tariffs
- ECRB (2018, 2019) : Policy guidelines and survey on D-Tariffs

EU

- EU (2015) : Characterization of D-Tariffs in gas and power across EU
- EU (2016) : Impact assessment on changes to D-Tariffs

1. Distribution today

Regulators and policy-makers are responding to that attention

- NRAs are sharing their practices (workshops, publications in English)

- Some NRAs are reviewing their D-Tariffs
  - **UK**: Significant Code Review on network charges (transmission/distribution)
  - **Norway**: contracted power (ex-ante) + surcharge (ex-post, >contracted)

- EU level
  - Network code for gas transmission tariffs (transparency, ACER analysis)
  - Clean Energy Package requires ACER analysis of transmission/distribution tariffs

Distribution tariffs in Portugal – Key figures

	Electricity	Gas
Number of DSOs	1 (HV/MV/LV in mainland) 10 (local LV in mainland) 2 (islands)	11 (only mainland)
Network length	82 558 km	18 245 km
Start of regulation	1999	2008
Regulatory period Tariff period	3 years 1 year	4 years 1 year
Type of regulation	HV/MV: Price-cap(OPEX) + RoR(CAPEX) LV: Price-cap (TOTEX)	Price-cap(OPEX) + RoR(CAPEX)
Incentive schemes	Smart grids, Losses, Continuity of supply	-
Investment plans	Every 2 years (5-year horizon)	Every 2 years (5-year horizon)
Tariff design	Cost cascading, TOU	Cost cascading
Price signal	Average LT Incremental Costs	Average LT Incremental Costs

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2.1 Electricity – Allowed revenues

Economic regulation *(regulatory period 2018-2020)*

HV/MV Distribution

- Price cap (OPEX) + Rate of return (CAPEX)
  - Efficiency target for controllable OPEX (RPI – X)
  - CAPEX scrutinized in advance through Network Development Plans (NDPs)

LV Distribution

- Price cap on TOTEX
  - CAPEX is very granular (LV is not part of NDPs)
  - DSO in better position to decide whether to invest in assets (CAPEX) or efficiency (OPEX)

2.1 Electricity – Allowed revenues

Cost drivers for 'price cap' regulation *(regulatory period 2018-2020)*

Determined based on econometric analysis and benchmarking.

HV/MV OPEX

- Number of clients (40%)
- Network length (40%)
- Fixed component (20%)

LV TOTEX

- Number of clients (57.5%)
- Financial conditions (18.5%)
- Network length (12%)
- Installed power at transformation sub-stations (12%)

2.1 Electricity – Allowed revenues

Return on assets

- Pre-tax nominal WACC
- WACC indexed to 10-year public debt (with cap and floor)

Depreciation

- Straight line depreciation (5 – 40 years)
- Included in annual CAPEX

Quantities

- DSOs submit quantity forecasts subject to NRA analysis
- Quantity forecast for tariff determination scrutinized by tariff council

Losses

- Suppliers must buy network losses in wholesale market
- Loss profiles (15 minutes) published by NRA

Incentive schemes

Investment in smart grids *(since 2012)*

- **Objective**: Promote integration of new assets/services (vRES, EVs, DR)
- **Previous scheme**: complex approval, short projects (3 years), low return, CBA of projects viewed in isolation, minimum scale for projects
- **Changes**: longer implementation (6 years), system-analysis for CBA, clear up-front selection criteria

Reduction of distribution losses *(since 1999)*

- **Objective**: reduce losses below a reference value
- **Symmetric**: reward/penalty for losses below/above a reference value
- **Limitations**: scheme has a cap and a floor for the reward/penalty
- **Evolution**: introduction of ‘dead’ band (no return/penalty)

Incentive schemes (cont.)

Continuity of supply (CoS) *(since 2003)*

- **Double objective**: improve CoS (1) globally, (2) worst-served customers
- **Scheme**: reward/penalty scheme with 'dead' band and cap/floor
- **Scheme (1)**: Non-served energy in MV
- **Scheme (2)**: SAIDI in MV for 5% of worst-served delivery points (since 2015)
- **Exclusions**: cases of security, *force majeur* or events caused in transmission
- **Results**: (1) CoS improved, DSO obtained mostly a reward, parameters constant since 2011; (2) CoS improved (inverting the previous trend), more demanding parameters for 2018-2020

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2.2 Electricity – Tariff structure

General aspects

- Uniform D-tariffs
- Differentiated by voltage level: HV, MV and LV
- Cost cascading principle
  - MV consumers pay D-tariffs for HV and MV (but not LV)
- Investments divided into central and peripheral assets
- Price signal results from average long term incremental costs
- Billing variables
  - contracted power, peak power, active energy, reactive energy

2.2 Electricity – Tariff structure

Central vs Peripheral network assets

- Incremental cost approach divides investments into central and peripheral assets

Central assets

- Shared by many users
- Designed for the system peak, not based on individual peaks

➢ Cost driver: Peak power (*average power in peak period during last month*)

Peripheral assets

- Close to end-users
- Designed to withstand peak of individual end-users

➢ Cost driver: Contracted power (*max. power in 15-min during last 12 months*)

2.2 Electricity – Tariff structure

Selection of billing variables

- Must be compatible with other regulated tariffs (transmission, energy, …)
- Should be cost drivers of the regulated activity

Billing variables for distribution

Billing variable	Unit	Rationale
Contracted power	€ / kW per month	▪ Relevant for use of assets close to individual end-users ▪ Recovers cost of peripheral assets (close to end-users)
Peak power	€ / kW per month	▪ Relevant for use of assets used by a large number of users ▪ Recovers cost of central assets (shared by many end-users)
Active energy	€ / kWh	▪ Reflects that DSOs take into account the potential to reduce network losses when developing networks ▪ Includes time-of-use schedule
Reactive energy	€ / kVArh	▪ Price signal to reduce reactive energy at customer premises (not applied to SMEs and households)

Incremental cost approach

- Average Long Term Incremental Cost (IC), per cost driver D

$$IC_D = \frac{\mathrm{NPV}(\Delta\mathrm{INV}_D)}{\mathrm{NPV}(\Delta\mathrm{D})}$$

NPV : net present value (discounted at average WACC)

$\Delta\mathrm{INV}_D$: investments (CAPEX + related OPEX) due to increments in cost driver D

$\Delta\mathrm{D}$: increments in the cost driver (peak power, contracted power)

Computed for two cost drivers

- Peak power (central assets)
- Contracted power (peripheral assets)

Pilot-project for a dynamic network tariff for industrial consumers

2011: 1st reference in the tariff code to dynamic network tariffs.

2016: DSO commissioned a CBA analysis, indicating a net benefit from introducing dynamic network tariffs for a demand response of 5%.

2018: after a public consultation in 2017, the design for a dynamic network tariff was presented (Pilot 1). In addition, a second pilot-project was also designed, representing a review of the static TOU design (Pilot 2).

- Target samples of 100 consumers per pilot were not reached.
  - 20 candidates for Pilot 1; 82 candidates for Pilot 2.
- ERSE decided to implement only Pilot 2 (started in June 2018).

Pilot-project for a dynamic network tariff for industrial consumers (cont.)

Pilot 1 (dynamic network tariff)

- **Target sample**: 100 consumers in VHV, HV, MV
- **Critical Peak Pricing**: 80 to 100 hours/year (≈ 20 critical days * 5 hours)
- **Locational**: Critical days/hours could be different across 6 grid areas
- **TSO-DSO cooperation**: DSO triggers critical period, but consults with TSO
- **Notification**: ≥ 48 hours in advance
- **Bill benefit**: cap (maximum gain of 10%) and floor (opt-out)

Pilot-project for a dynamic network tariff for industrial consumers (cont.)

Pilot 2 (reviewed TOU)

- Target sample: 100 consumers in VHV, HV, MV
- Time-of-use: Break-down of current peak period (≈ 1000 h/year) into a super peak (≈ 333 h/year) and a normal peak (≈ 667 h/year)
- Locational: TOU schedules different across 6 grid areas
- Bill benefit: cap (maximum gain of 10%) and floor (opt-out)

Currently

- Pilot ended in May 2019.
- Results are being analyzed to decide about the net benefit (CBA, KPIs).

2.2 Electricity – Tariff structure

How were the tariffs for the pilot-projects determined?

- **4-year data set**: 15-min consumption/generation for years 2013-2016
- **Power flows**: power flows per voltage level were computed (bottom-up)
- **Scarcity signal**: Allocation of costs with central assets to 154 peak hours/year
- **New TOU**: Based on power flows, new TOU schedules per grid area
- **Prices in Pilot 1**: Average cost per period of the new TOU schedule, simulating the activation of critical days/hours
  - Critical peak (100h), Non-critical peak (900h)
- **Prices in Pilot 2**: Average cost per period of the new TOU schedule
  - Super peak (333), Normal peak (667h)

2.2 Electricity – Tariff structure

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2.2 Electricity – Tariff structure

Time-of-use schedule by grid area, working days (Pilot 2)

Lisbon

	00:00	00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30	05:00	05:30	06:00	06:30	07:00	07:30	08:00	08:30	09:00	09:30	10:00	10:30	11:00	11:30	12:00	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30	18:00	18:30	19:00	19:30	20:00	20:30	21:00	21:30	22:00	22:30	23:00	23:30
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South

	00:00	00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30	05:00	05:30	06:00	06:30	07:00	07:30	08:00	08:30	09:00	09:30	10:00	10:30	11:00	11:30	12:00	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30	18:00	18:30	19:00	19:30	20:00	20:30	21:00	21:30	22:00	22:30	23:00	23:30
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ago	V	V	S	S	S	S	S	S	S	S	V	V	V	V	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	P1	P1	P1	P1	P1	P1	P1	P1	P1	P1	C	C
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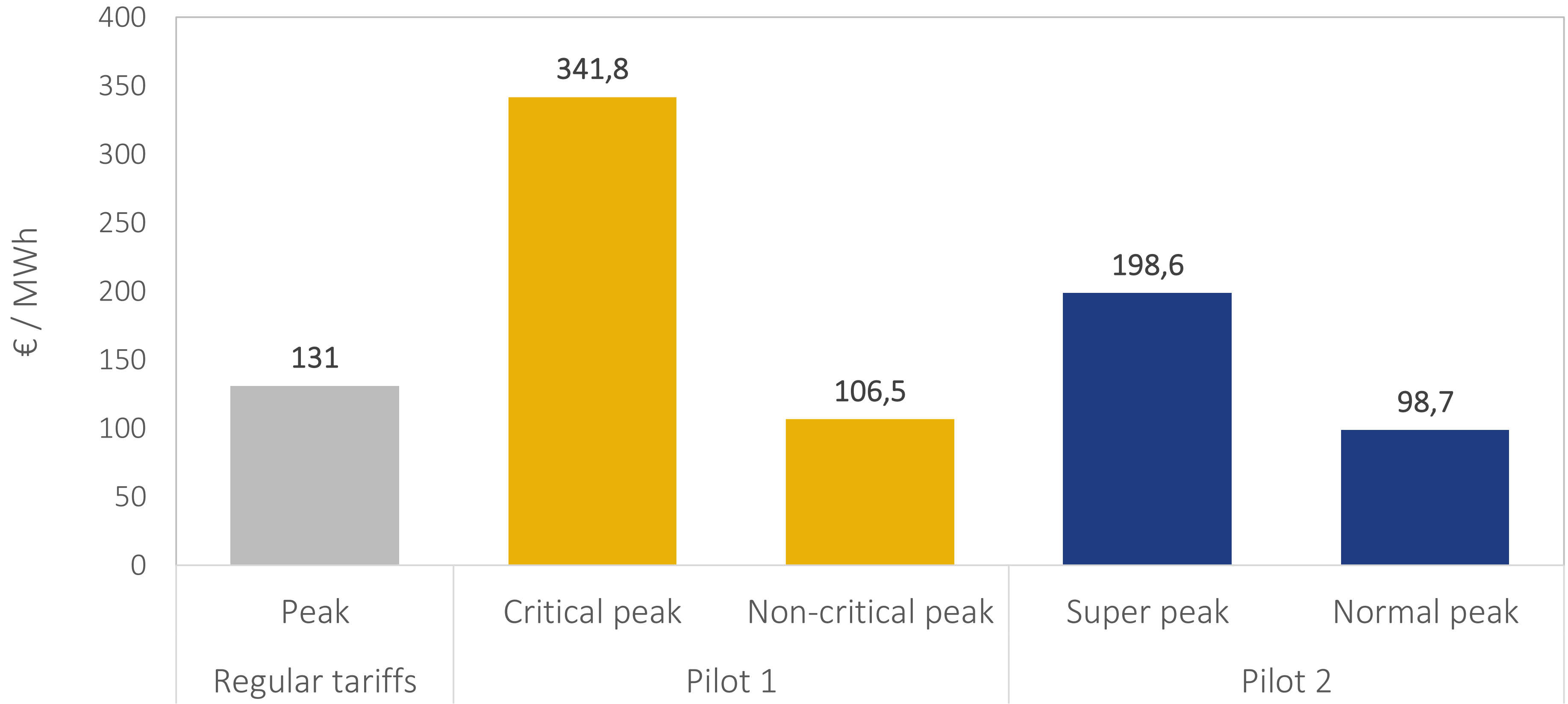
dez	V	V	S	S	S	S	S	S	S	S	V	V	V	V	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	P2	P2	P2	P2	P2	P2	C	C	C	C

- Different patterns (summer tourism in South, with peak at the end of day)

P1 - Super peak, P2 - Normal peak, C - Shoulders, V - Normal valley, S - Super valley

2.2 Electricity – Tariff structure

Price signal in the peak period of the network access tariff* in MV, year 2018



Note: A consumer with a flat consumption profile is indifferent between the 3 cases (Pilot 1 seems more penalizing than Pilot 2 due to different durations of the 2 sub-periods)

* Includes transmission, distribution and system use.

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3.1 Natural gas – Allowed revenues

Economic regulation *(regulatory period 2020-2023)*

Price cap (OPEX) + Rate of return (CAPEX)

- Efficiency target for controllable OPEX (RPI – X)
- CAPEX scrutinized in advance through Network Development Plans (NDPs)

Cost drivers for 'price cap' on OPEX

Determined based on econometric analysis and benchmarking.

- Number of clients (45% - 48.75%)
- Distributed energy (15% - 16.25%)
- Fixed component (35% - 40%)

3.1 Natural gas – Allowed revenues

Return on assets

- Pre-tax nominal WACC
- WACC indexed to 10-year public debt (with cap and floor)

Depreciation

- Straight line depreciation (5 – 45 years)
- Included in annual CAPEX

Quantities

- DSOs submit quantity forecasts subject to NRA analysis
- Quantity forecast for tariff determination scrutinized by tariff council

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   - **3.2 Tariff structure**
4. Next challenges

3.2 Natural gas – Tariff structure

General

- Uniform D-tariffs (inter-DSO compensations)
- Differentiated by pressure level: MP, LP> and LP<
- Cost cascading principle
- Investments divided into central and peripheral assets
- Price signal results from average long term incremental costs
- Billing variables:
  - Used Capacity, energy, fixed term

3.2 Natural gas – Tariff structure

Selection of billing variables

- Compatible with other regulated tariffs (transmission, system use, energy, …)
- Should be cost drivers of the regulated activity

Billing variables for distribution

Billing variable	Unit	Rationale
Max. used daily capacity	$€/kWh/d/month$	▪ Relevant for use of assets close to individual end-users ▪ Recovers CAPEX on peripheral assets (close to end-users)
Energy (Off-Peak)	$\frac{€}{kWh}$	▪ Relevant for costs that are proportional to distributed energy in off-peak periods (off-peak = August)
Energy (Peak)	$\frac{€}{kWh}$	▪ Relevant for use of assets used by a large number of users ▪ Recovers CAPEX on central assets (shared by a large number of end-users)
Fixed Term	$\frac{€}{day}$	▪ Recovers administrative costs and costs on peripheral assets that depend on the number of delivery points

3.2 Natural gas – Tariff structure

Incremental cost approach

- Average Long Term Incremental Cost (IC), per cost driver D

$$IC_D = \frac{\mathrm{NPV}(\Delta\mathrm{INV}_D)}{\mathrm{NPV}(\Delta\mathrm{D})}$$

NPV : net present value (discounted at average WACC)

$\Delta\mathrm{INV}_D$: investments (CAPEX + related OPEX) due to increments in cost driver D

$\Delta\mathrm{D}$: increments in the cost driver (peak power, contracted power)

Computed for 3 cost drivers

- Peak energy (central assets)
- Used capacity (75% of peripheral assets)
- # clients/fixed term (25% of peripheral assets)

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4. Future challenges

Design a pilot project for dynamic network tariffs for households

Context

- Smart-meter roll-out, EVs, Energy boxes
- Clean Energy Package: Dynamic price contracts (i.e. spot-based energy)
- Network Access weights 45% of power bill (D-Tariff in LV: 14%)
- LV represents ≈ 50% of total consumption

Challenges

- Easy tariff structure (dynamic prices or dynamic periods?)
- Compatible with dynamic price contracts
- Bring suppliers on board

4. Future challenges

Network tariffs for self-consumption

- Government promoted public consultation on self-consumption in 2019

Tariff-related responses to consultation

- Uncertainty about value of network tariffs (payback of projects?)
- Request that tariffs are only paid if public network is used
- Doubts about who must pay tariffs (consumer or producer?)
- Special cases? Bilateral sale of excess energy, energy communities, …
- Lack of time plan for implementation

NRA position

- If public (distribution) network is used, tariffs must be paid.
- Tariffs must reflect system use: if there are no power flow inversions, only LV tariffs; otherwise, at least a partial contribution for upper voltage levels.

4. Future challenges

Smart grid services

- Regulation for smart grids approved by ERSE in 2019
- Supports development of smart grids in LV
- DSOs must provide data access do 3rd parties (w/ consumer permission)

New incentive scheme for DSOs

- Reward for the integration of smart meters into smart grids
    - Depends on the number of smart meters successfully integrated
- "Integration" = smart meters provide specified services
    - Daily metering, data notifications, remote control of parameters (e.g. contracted power, power supply), temporary reduction of contracted power, …

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Thank you

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