Economic Aspects of the Development of Decentralized Energetics:

Grid Tariffs and Economic Incentives

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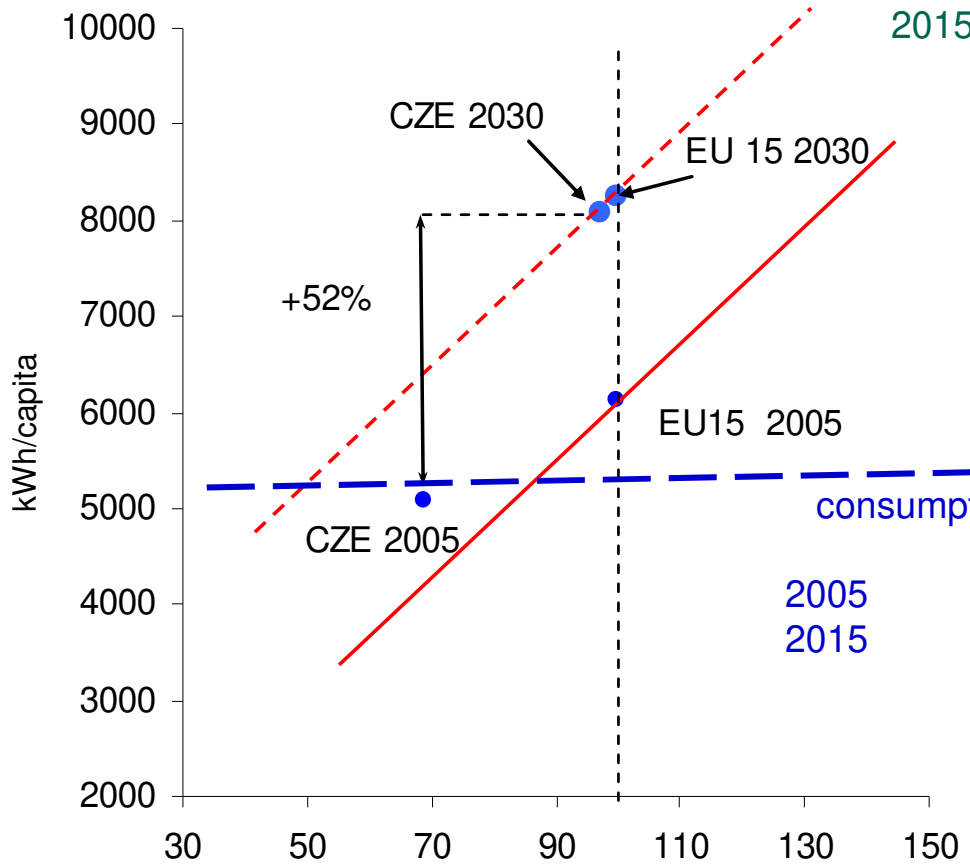
Real economic convergence of the Czech Republic



CZ economic convergence
[%EU Avg, in PPP]

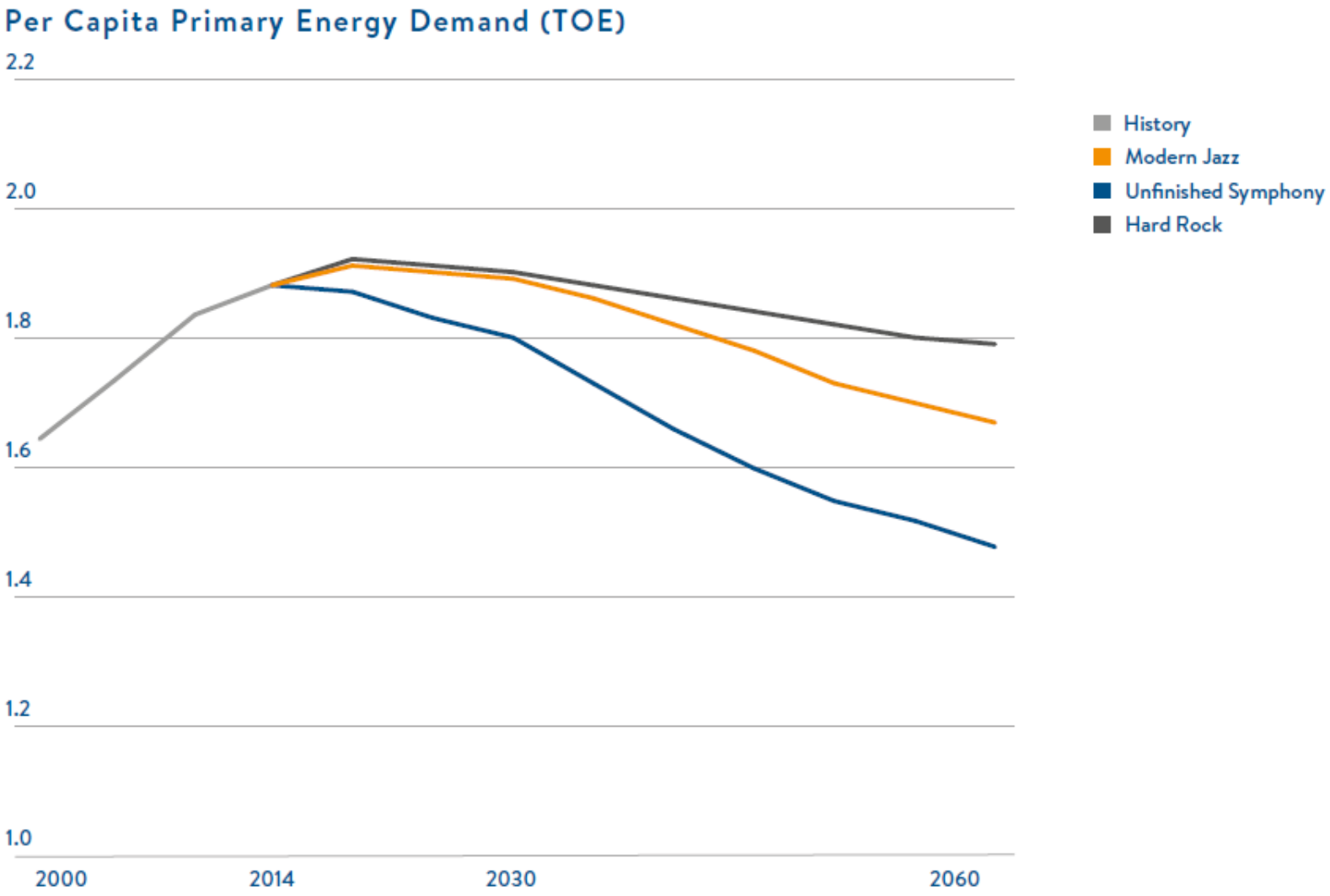
2005	74
2015	80

consumption/dom.supply/production
[TWh]

2005	55 / 70 / 83
2015	54 / 71 / 84

Additional source: IEA, www.iea.org

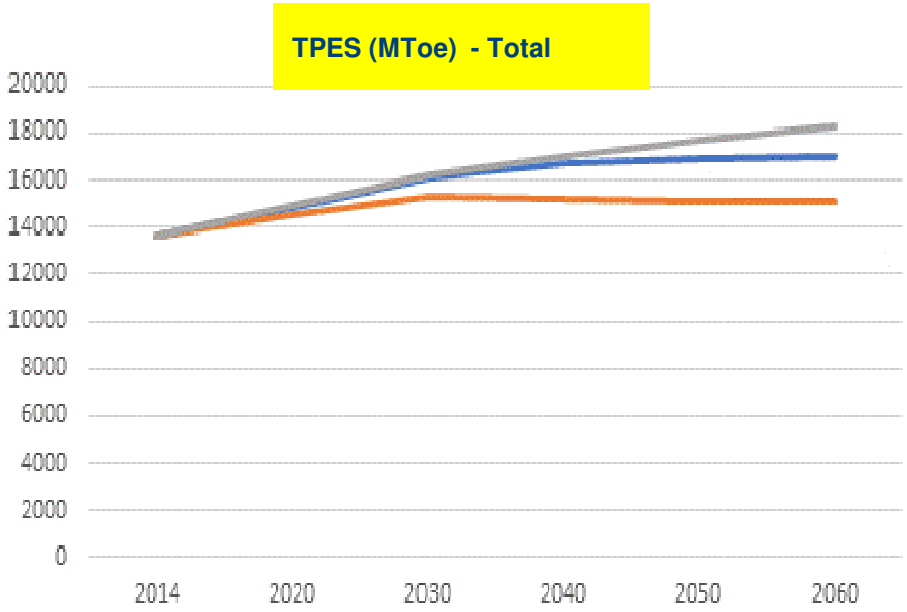
WEC Energy Outlook

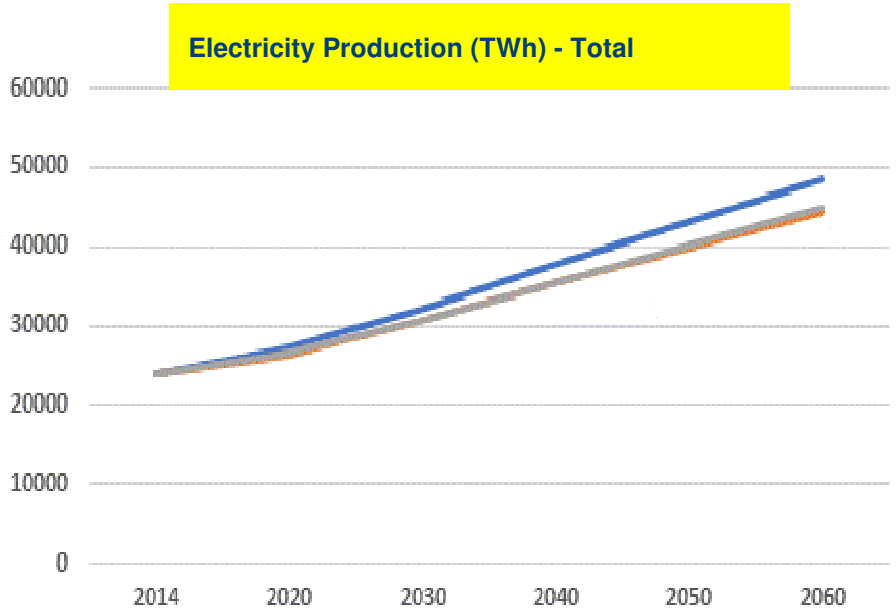


Source: World Energy Council, Paul Scherrer Institute, Accenture Strategy

WEC Electric Energy World Outlook

- Different patterns of Electricity
  - Continuously rising production (and needs)

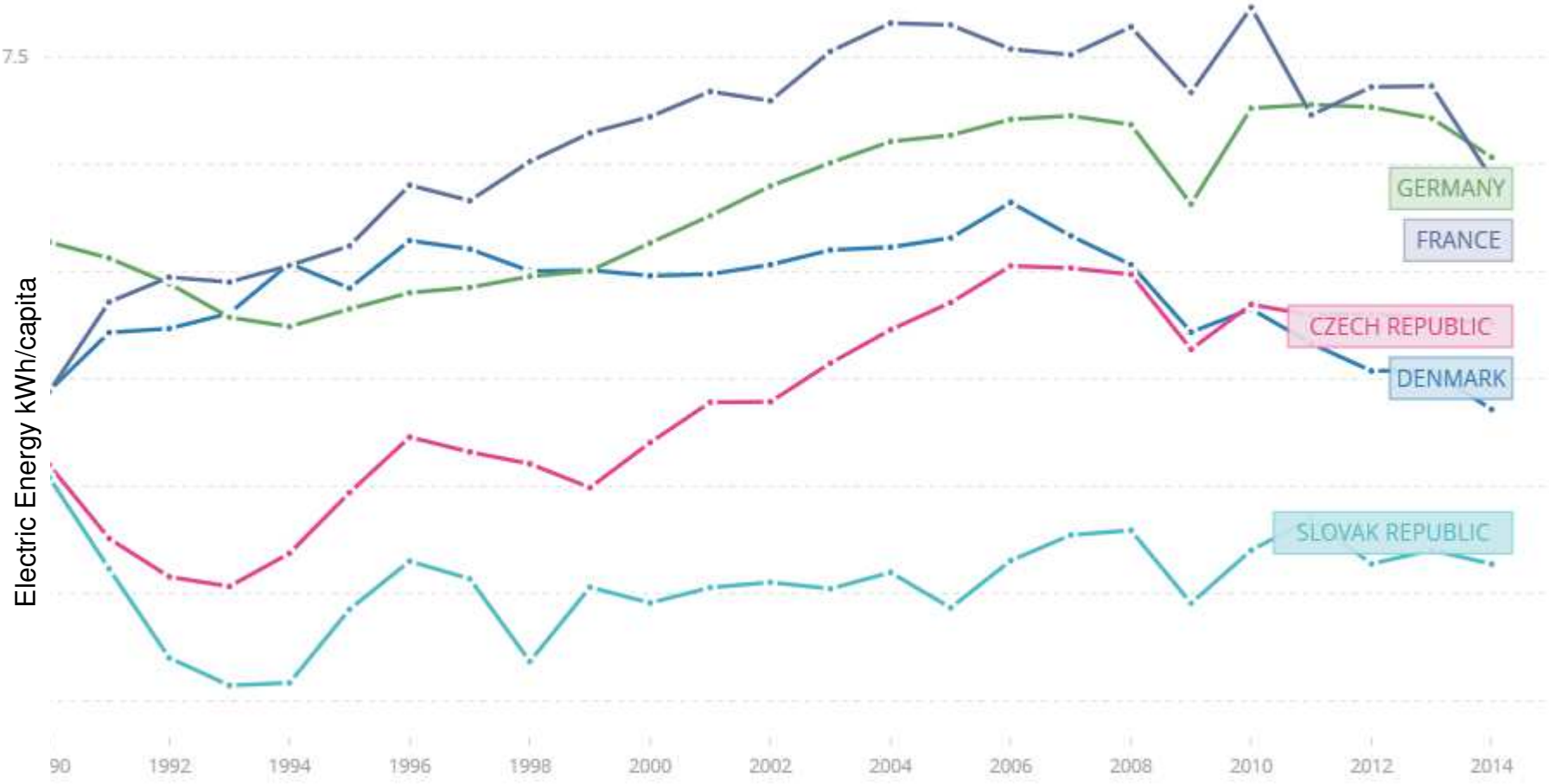




Three scenarios called Modern Jazz, Unfinished Symphony, and Hard Rock

Testing the predictions

Electric power consumption (kWh per capita)



Time

Source: WB, data.worldbank.org

Quick-check results

- After 10 years
  - Despite the long economic downturn
  - Despite massive political pressures (standards, limits, fees etc.) in favor of energy savings
  - Despite the subsidies on energy savings
  - The absolute electric energy consumption has not decreased but rather stagnated
    - Limited relative convergence of CZ is a question for future
      - Stagnation vs. increase of consumption
      - Decrease unlikely

Quick-check of conditions

- After 10 years
  - Energiewende
    - Closure of nuclear power plants in Germany
    - Faster phase-out/closures of coal plants
  - Yet no new economically viable technologies of storage
  - Cheaper technologies for unstable generations
    - Photovoltaic, wind
  - Almost all new investments are based on
    - **Subvention schemes**
  - Crowding out any private investment
    - Economic reasons
    - **Political uncertainty** (e.g., BAT, tariffs, other legal changes)
  - **Only distorted market/price signals**

Starting Points

- Current grid tariff structures either based on
  - volume consumed
  - or on the capacity (exceptionally)
- Future needs of final customers, (decentralized) generators, distribution system operators (DSOs) have to be reflected.
- European policy on energy efficiency (Energy Efficiency Directive) should (ideally) lead to
  - lower consumption
  - lower volumes of electricity (gas etc.) transported on the grid

Consequence of Low Volumes

- However that implies **no direct cost-reducing effect for network operators:**
- Costs
  - are predominantly INDEPENDENT on volume
  - determined by (past and future) investments in network capacity (i.e., fixed costs)
  - based on current and expected connection capacity

- However, structure of grid tariffs determines behavior of players (assuming they cover networks costs) and can help or worsen the transformation process

Higher distribution costs

- The opposite regarding future costs is true:
  - an increasing amount of distributed generation will require higher investments DSOs networks
  - New components and IT grid monitoring, automation and procurement of flexibility services will lead to **higher distribution costs per unit**.
- The in-feed of renewable energies (sun or wind) are not controllable (only shut-downs) and to overcome the challenge we need for more flexibility
  - on the demand side
  - on the supply side
  - for services that can facilitate the flexible arrangements

Policy objectives

- Policy objectives of distribution and security
- Tariffs should:
  - ensure well-functioning of the electricity markets
  - encourage energy efficiency
  - encourage the development of distributed generation
  - contribute to system flexibility through supply/demand response
    - Long-term (correct signals whether to build new generating resources or adopt new technologies on the demand side)
    - Short-term (adjust required demand/supply patterns)
    - Immediate (shift demand, provide active stability support)

Economic Principles of Grid Tariffs

- General and specific economic principles should be met:
- **Cost reflectiveness**
  - should reflect the costs incurred by serving each user
- **Infrastructure cost efficiency**
  - reduce infrastructure costs by reducing/shifting peak demand
- **Operational cost efficiency**
  - low operational, administrative and monitoring costs
- **Revenue adequacy**
  - ensure full recovery of network cost and return on capital
- **Transparency**
  - transparent, auditable, and (time) consistent

- Combining together: Conflicts

	Volume [CZK/kWh]	Capacity [CZK/kW, CZK/kVA]
Economic Principles of Grid Tariffs		
Cost reflectiveness	--	++
Infrastructure cost efficiency	--	++
Operational cost efficiency	--	++
Revenue adequacy	--	++
Transparency	-	++
Policy Objectives		
Market functioning	-	-
Distributed generation	++	--
System flexibility	++	--
Energy efficiency	++	--

No Easy Way Out

- **Multiple component tariffs for distribution (DSOs):**
- fixed tariff per customer
  - covers fixed costs (e.g., metering, mailing, billing)
- capacity tariff
  - covers capacity related costs
- volume tariff
  - covers volume related costs

Tariffs and Complexity

- Shifting consumption to off peak period
  - higher tariffs at peak times
- Varying grid tariffs deliver economic incentives for the efficient use of the network
- Complex time tariffs require **SMART (time-dependent)** metering
- Tariffs can allow an adequate response but:
  - High number of time periods lead to complexity and less transparency
  - Real time (dynamic) complex grid tariffs require automation operated by service providers and is opaque
  - Regular end-customers can not deal with complexity
    - **HI-LO is enough**

Hybrid Tariffs

- Combining volume and capacity elements
  - Flat component
    - fixed payment per customer
  - Power component
    - per kW (measured capacity) or per kVA (connection capacity)
  - Energy component
    - per kWh
      - Proportionate
      - Progressive
      - Degressive
      - Differential

Hybrid Tariffs: Progressive Capacity Element

- Hybrid tariffs with progressive capacity element
- Advantages:
  - Facilitates the transition from volume to capacity
  - Reduces the financial impact of the transition for the final customer
  - Better orientation of customer choice to the most suitable connection capacity level
  - Can function without SMART meters in connection capacity
- Requirements:
  - connection capacity of every individual customers is known
    - This is not equivalent to the distribution circuit-breaker
  - for the measured capacity smart meters needed anyway

Dynamic pricing

- Adverse effects of dynamic retail pricing
- Price signals should promote active change of consumer behavior in return for financial benefits
  - price signals: time-differentiated pricing systems, time-of-use pricing (e.g. peak and off-peak prices) or real-time pricing
- Low energy prices due to abundant supply
  - => create a peak on the network due excessive increase in consumers' consumption simultaneously
  - => consequently the network tariff should be high
- Dynamic network tariffs can create unstable behavior
  - Proper weighting necessary

SMART Grids

- Neutral market – the DSO – and the tariff structure
- all flexibility resources (e.g. generation, storage and demand) **compete on a level playing field**
- Needed:
- improvement of infrastructure (strengthening the grids);
- addition of the digital layer
- business process models to allow the economic benefits of the SMART elements materialize

SMART Grids

- Key features of the smart grid:
- IT / data communication
  - Cyber-security
- SMART meters
  - an essential part
  - increased data granularity with time-based metering used either by the DSO or by the market parties.
- Control and monitoring of the grid enabling:
  - Flexibility in network topology (photo-voltaic (PV) installation, EVs, Flexible storage facilities, etc.)
  - Load adjustment / Load balancing
  - Peak curtailment
  - Improved reliability

Cars and public budgets

- Electric vehicles are often exempt from taxes and other regulations (e.g., parking…)
- Creates **distorted incentives** with potential problem in the future (e.g., excessive PV compensation case in CZ)
  - Excise tax proceeds in CZ ~ 80mld. CZK (plus 16ml. VAT)
  - Total about ~100mld CZK
  - The more EV the higher pressure to on tax proceeds
  - Tax on EV will be levied => structural change inevitable

DSO Tariffs

- Network tariff structures should really reflect the cost incurred by the behavior of the connected customer.
  - The one who is inducing extra costs should pay more
    - and more than the one who does not induce these
- Proper incentives
  - increases the value of flexibility
  - stimulate the development of devices and services
- A well-designed tariff is the accelerator of the development of flexibility.

Incentives and DSO Tariffs

- Multiple elements:
- Tariff basis
  - Capacity: reflects better the cost for the network
  - Consumption: stimulation to energy saving measures.
- Timing
  - Fixed timing (e.g. discount at off-peak hours)
  - Dynamic (real-time depending on the current state of the local/global network)
- Direction
  - Consumption
  - Production
- Location
  - tariff structure per DSO area
  - locational tariff

Combined DSO Tariffs

- Combined tariff structure
  - the simpler a tariff structure is, the easier it is to understand
  - the more effective usually is
- Network tariff based on consumption no longer correctly reflects the network costs
  - The real costs depends on required peak capacity.
- Example 1 (good)
  - symmetrical capacity bandwidth
  - exceeds of the bandwidth automatically charged with an extra fee. Incentive to stay as much as possible within the bandwidth
    - e.g. to charge an EV smoothly during night hours

Net metering

- A well-designed tariff structure stimulates the development of flexibility instead of blocking it.
- Example 2 (bad)
    - **net metering**
        - Right use that electricity at any time
        - No control when electricity is generated
        - applied daily/monthly/quarterly/annually
    - The longer the period the lesser it stimulates own management
- Net metering puts the burden of stabilizing the production and consumption at DSO and other market parties
- Does not stimulate the further development of flexibility.

Thank you for your attention

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