# LOAD SHIFTING POTENTIALS IN SMALL AND MEDIUM-SIZED BUSINESSES AND SUCCESS FACTORS FOR LEVERAGING THEM

Findings of qualified studies and an analysis of 30 enterprises in the Smart Grids Model Region Salzburg

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# Short summary

- **Findings:** business enterprises have a high exploitable load shifting potential – one third of the daily peak load can be shifted for 15 min once a day
- **Success Factors:** Existing communication technologies and energy management systems should be used for development by an energy suppliers, DSO sales or aggregators
- **Benefits:** business flexibility becomes comprehensively available and, therefore, suitable for grid services on a local level *and* market activities in general
- **Preconditions:** Appropriate framework conditions have to be provided in time for market introduction. These conditions have to enable grid-oriented business models, which are flexible in terms of time and location
- **Need for research:** Cost-benefit analyses for econ. evaluation of effects regarding unburdening the grid and integration of renewables. (Merit Order of different flexibility options from grid reinforcement to DSR to DER and storage in a space and time pattern -> "traffic light" model)

# Study & structure

1. Results from existing studies
2. Analysis of enterprises in Salzburg
3. Approaches concerning business models
4. Résumé and recommendations

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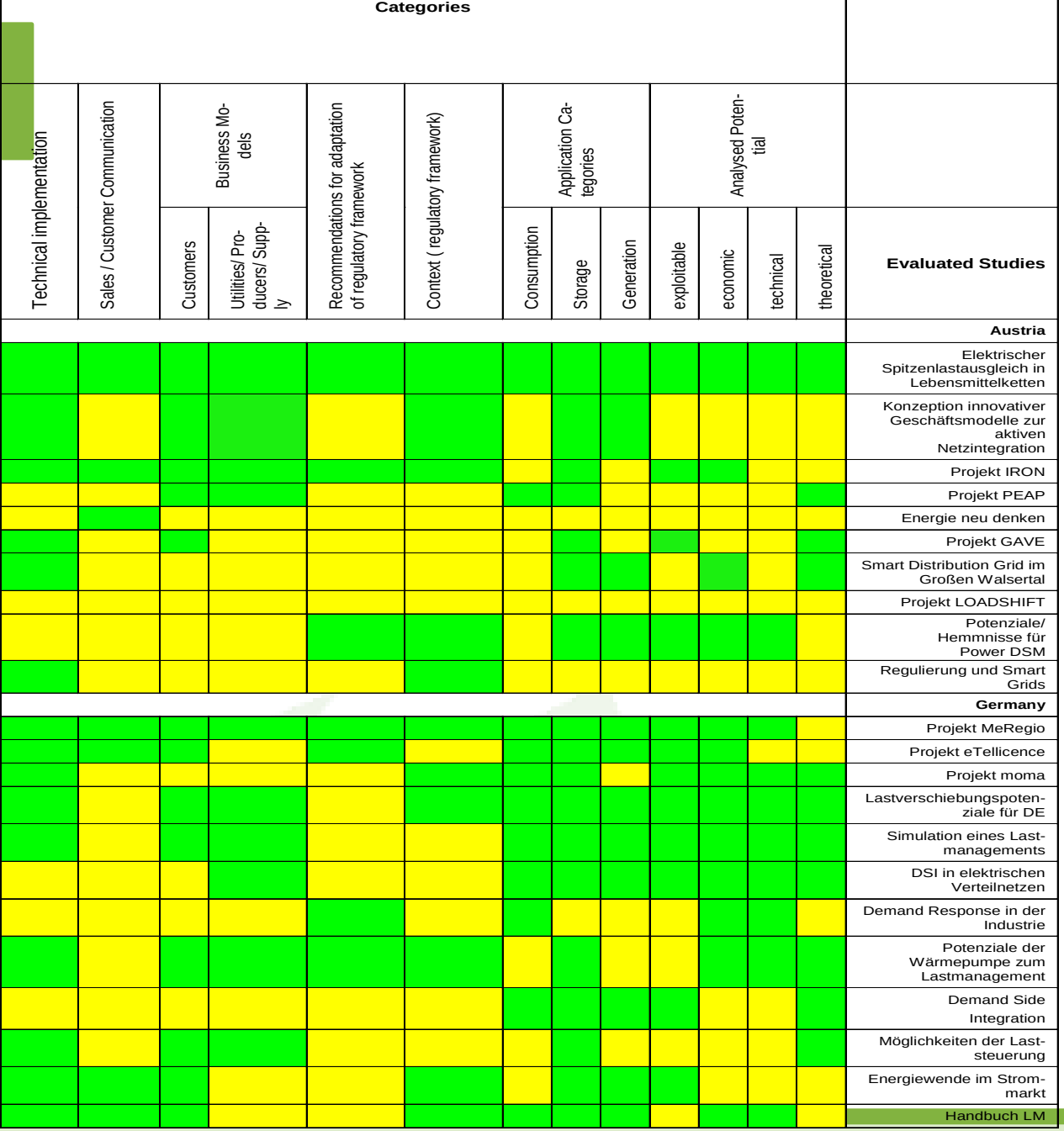



Salzburg AG B.A.U.M.

## Profile of 22 studies from Austria and Germany focusing on load shifting:

- Potentials (theoretical, technical, economical, exploitable),
- types of devices (generators, storages, loads),
- framework conditions (legal framework),
- recommendations concerning legal regulation,
- business models (utility/producer/ operator, customer),
- customer communication/ sales
- technical implementation.

# Potentials in Germany

## Technical potential

| sectors | Techn. shiftable power | Shiftable Energy |
|---|---|---|
| Household | 2010: ca. 2,6 GW<br>2020: ca. 3,8 GW<br>2030: ca. 6,0 GW | 2010: ca. 8,0 TWh per year<br>2020: ca. 12,4 TWh per year<br>2030: ca. 32,3 TWh per year |
| Tertiary sector | 2010: ca. 1,4 GW<br>2020: ca. 1,7 GW<br>2030: ca. 1,8 GW | 2010: ca. 5,0 TWh per year<br>2020: ca. 5,6 TWh per year<br>2030: ca. 9,7 TWh per year |
| Industry | 2010, 2020, 2030 load shift potential of 2,8 GW to 4,5 GW | |

9GW PSW, 40-70 GW load

7-15% total electricity consumption

**1,5 GW load shifting potential in Germany especially through thermal applications**

# Excerpt of findings „sectors and appliances“

*Studies identified attractive load shifting potentials in the economy (incl. municipalities) – especially thermal systems are suitable due to relatively low storage costs and ever-present availability.*

<u>sectors:</u>

- Food retail sector (cooling, freezing)
- Baths (hot water)
- Sewage treatment plants
- Hospitals

<u>appliances:</u>

- Thermal storages (HP, night storage heater)
- Thermal storage (cooling- freezing appliances)
- Air conditioning, white goods
- Compressed air energy storage, pumped storage
- Battery, e-mobility
- Emergency power, CHP

# Variable generation needs a more flexible system

Energy transition – flexibility – load shift – industry

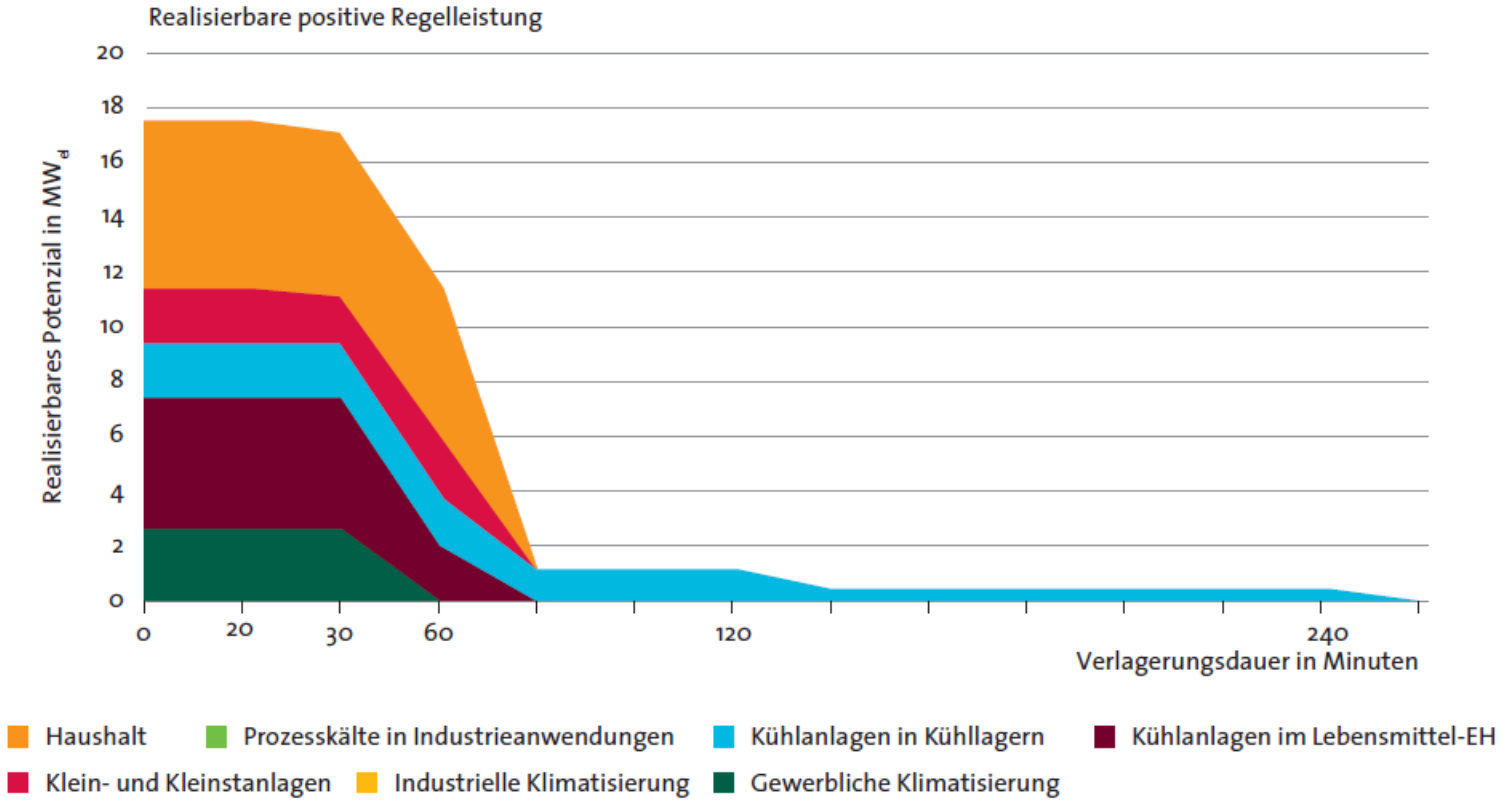
| Flexible generation | Storage | Demand-Side Management | Import-/ Export | Hybrid systems |
|---|---|---|---|---|
| **central** (controllable gas power plants) **decentralized** (control of self-consumption) | **Long-term storage** (days - seasonal) **Short-term storage** (seconds - hours) | **Incentive based control** (Variable tariffs) **Direct control** (VPP, grid control) | **Cellular grids** (European wide area - micro grids) **Regional market** (local balancing, capacities) | **Power to gas** (combined power plant, gas grids) **Thermal control** (CHP, heat grid) |

Only ICT can leverage all necessary flexibility options, which are necessary for a stable power or energy supply.

Source: moma

**Integration of distributed generation through local control (voltage range, reversed load flow, grid frequency)**
**System efficiency = optimal utilization RES -> minimized usage of fossil resources**

# Who can for how long?



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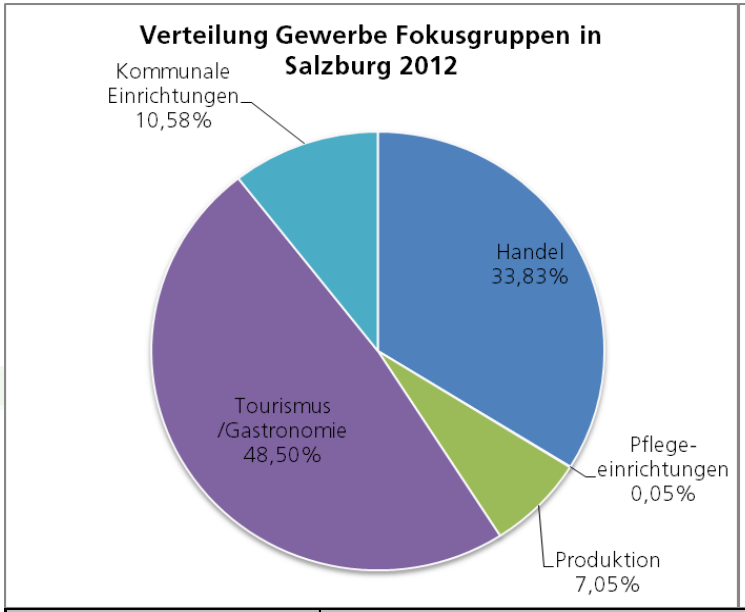
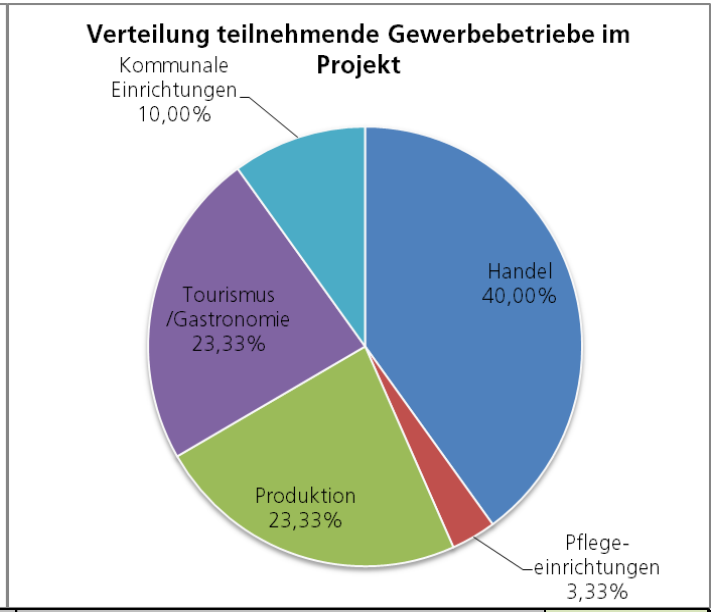
# 30 enterprises studied in Salzburg




| Branche | Geschäftsfeld | geeignete Verbraucher | Anzahl Teilnehmer |
|---|---|---|---|
| Handel | Einzelhandel Lebensmittel | Kühlaggregate, Kältegeräte | 9 |
| | Großhandel Lebensmittel | Kühlaggregate, Kältegeräte | 1 |
| | Handel Baubedarf | Batterien | 1 |
| | Versandhandel | Batterien | 1 |
| Gesundheit/ Pflege | Pflegeheime | alle gesteuerten Verbraucher | 1 |
| Produktion | Bäckerei | Backöfen, Kühlanlagen | 1 |
| | Betonwarenerzeuger | alle gesteuerten Verbraucher | 1 |
| | Glasverarbeitung | alle gesteuerten Verbraucher | 1 |
| | Kunststofferzeugung | alle gesteuerten Verbraucher | 1 |
| | Gießerei | alle gesteuerten Verbraucher | 1 |
| | Brauerei | Kühlaggregate, Batterien | 1 |
| | Sägewerk | alle gesteuerten Verbraucher | 1 |
| Tourismus/ Gastronomie | Hotels, Gasthöfe, Pensionen | Kühlaggregate, alle gesteuerten Verbraucher | 7 |
| Kommunale Einrichtungen | Abwasserentsorgung (Kläranlagen) | Belebungsbecken, Faulturm, Rührwerke | 2 |
| | Schule | alle gesteuerten Verbraucher | 1 |
| | | | 30 |

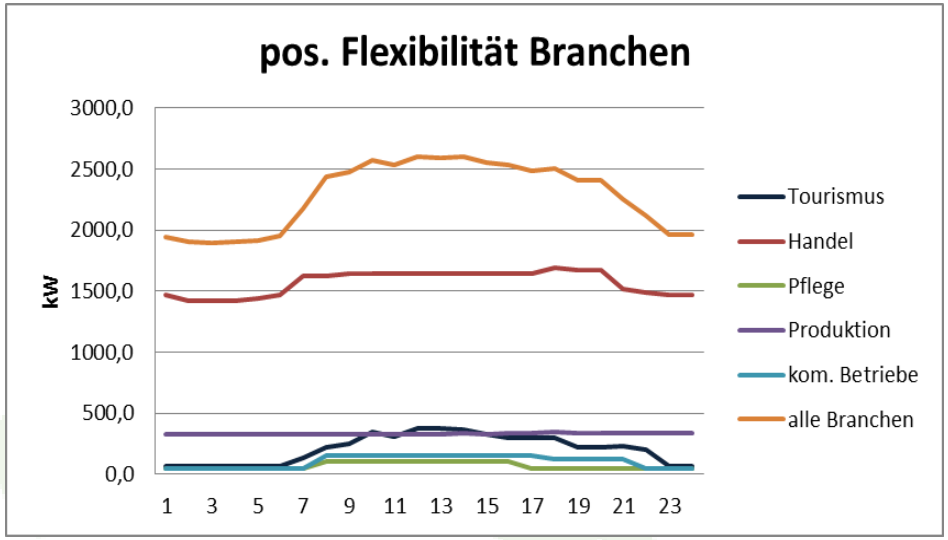
# Excerpts of the findings

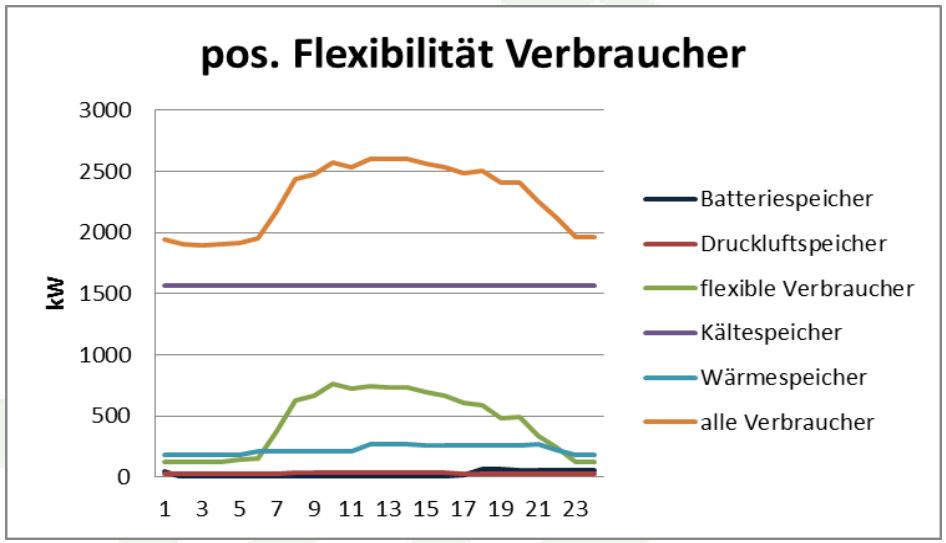
- flexibility: once per day unscheduled 15-min. switch-on/off
- 21 enterprises analyzed
- 2-2.5 MW loadshifting potential (neg./pos.) identified (=third of daily peak load)
- Extrapolated to focus groups Salzburg (2GW -> 600MW)
- Emphasis pos. Flex. because of familiarity with peak shaving
- Suitability of enterprises depends on internal processes, compatibility with existing energy management systems and assessment from managers; labor costs, not energy costs are driving forces
- Thermal storage, esp. cold storages (groceries, supermarkets), are suitable and available
- Duration of disconnection <= 15 Min.; flexible power decreases with increasing duration of activation and increasing requirements concerning short-term availability and reliability

| Verbraucher | Verbraucher-kategorie | Leistung gesamt (kW) | Status | Betrieb | Dauer |
|---|---|---|---|---|---|
| Verbundkühlung | Kältespeicher | 4,50 | ok | Intervall | 15 min |
| Kühlpult | Kältespeicher | 2,00 | ok | Intervall | 15 min |
| Gemüsekühlzelle | Kältespeicher | 2,00 | ok | Intervall | 15 min |
| Fleischkühlzelle | Kältespeicher | 2,00 | ok | Intervall | 15 min |
| Tiefkühlzelle | Kältespeicher | 3,00 | ok | Intervall | 15 min |
| **Summe Kältespeicher** | | | | | |
| Wäscherei - Waschmaschine | flex. Verbraucher | 9,35 | krit. | Bedarf | 15 min. |
| Wäscherei - Trockner | flex. Verbraucher | 9,35 | krit. | Bedarf | 15 min. |
| Wäscherei - Bügelmaschine | flex. Verbraucher | 11,90 | krit. | Bedarf | 15 min. |
| **Summe flexible Verbraucher** | | | | | |
| Wärmeschrank | Wärmespeicher | 3,20 | ok | Intervall | 15 min. |
| Wärmebrücke | Wärmespeicher | 3,80 | ok | Intervall | 15 min. |
| Bainmarie | Wärmespeicher | 2,00 | ok | Intervall | 15 min. |
| Gästesaunen | Wärmespeicher | 30,00 | ok | Intervall | 15 min. |
| **Summe Wärmespeicher** | | | | | |
| **Summe alle** | | | | | |

# Results in Salzburger Land

## 30 enterprises analyzed - retail food industry, tourism




- Business enterprises show surprisingly high willingness for load shifting: One third of the daily peak load can be shifted once for 15 minutes, especially thermal flexibilities.
- The retail (food) industry can offer the highest flexibilities due to its cooling appliances.
- The load shifting potentials of these enterprises are available area-wide; and are therefore available where fluctuating generation will have to be compensated.
- The top 5 enterprises account for approx. 60%-70% of this effect.

# REWE-Group: an extrapolation for Austria

Energy management of many chain stores can be controlled centrally ⇨large leverage

| Department | Quantity | Peak load | Flexible load (minimum available) | Total |
|---|---|---|---|---|
| subsidiary Merkur | 122 | 400 kW | 100 kW | 12 MW |
| subsidiary Billa | 1000 | 70 kW | 20 kW | 20 MW |
| logistics, production | | | | 2 MW |
| Total | | | | 34 MW |

# Businesses are flexible, if…

- … the activation happens via existing communication lines (network sales, suppliers, „product requiring explanation“)
- … existing energy management systems can be used for exploitation (easy, error-free integration through plug&play solutions)
- … the load shift does not interfere with the enterprises’ core processes (system security “emergency shutdown”, and legal certainty -> certification?) and does not increase personnel expenditure (shift operation)
- … attractive conditions are being offered by energy suppliers, network sales or aggregators (low-threshold investments (standards, p.r.n. prosumer management or pooling of subsidiaries)
- … the benefit is clearly visible (energy cost savings, improved image)

# Results concerning customer approach I

- Enterprises rate **investments in load management** similarly to **investments in energy efficiency** (ROI in 3-5 years)
  –> Offers made by aggregator sshould account for that, I**nvestment barriers** should be designed accordingly **low**
- **Core processes** of enterprises must **not be interfered** with
  -> emphasis should be put on appropriate security **(„Off“-Switch)**
- **Internal load management** is being conducted (partially) **very** professionally, the **supply of** flexibilities as a service for external subjects will initially be perceived as a disturbance and **competition**.
  -> thus, the supply of flexibilities has to be introduced within an **intensive consultation** and **“bit by bity”**, beginning with the non-critical processes.
- Many business customers brought up the topic of **PV subsidies**
  -> **combined business model** possible

# Results concerning customer approach II

- **Labor costs** are usually considerably **larger than energy costs**
  therefore, processes, which **influence the staff planning the least**, should be used in the beginning. Exception: sustainable changes of procedures, for permanently achieving beneficial load profiles
- **Multiplier effects** are a **key for success** concerning distribution
  branches, purchasing associations, producers of EMS systems and locally successful electricians have to be taken into account for future distribution strategies
- "Efficiency" and "cost savings" have been named the most important benefits. In experience, those are not the benefits, which are most important in the course of the implementation of these measures. **The companies most interested in the pilot phase have been either very idealistic or desired a green image.**
  -> focus on benefits, which make people take action.

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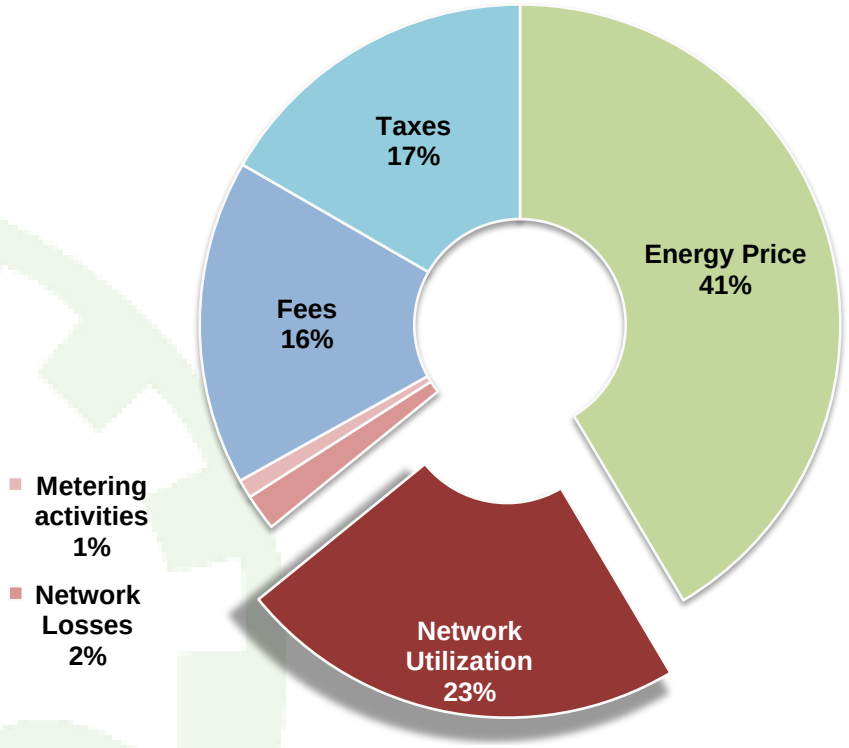
# 8 remuneration system

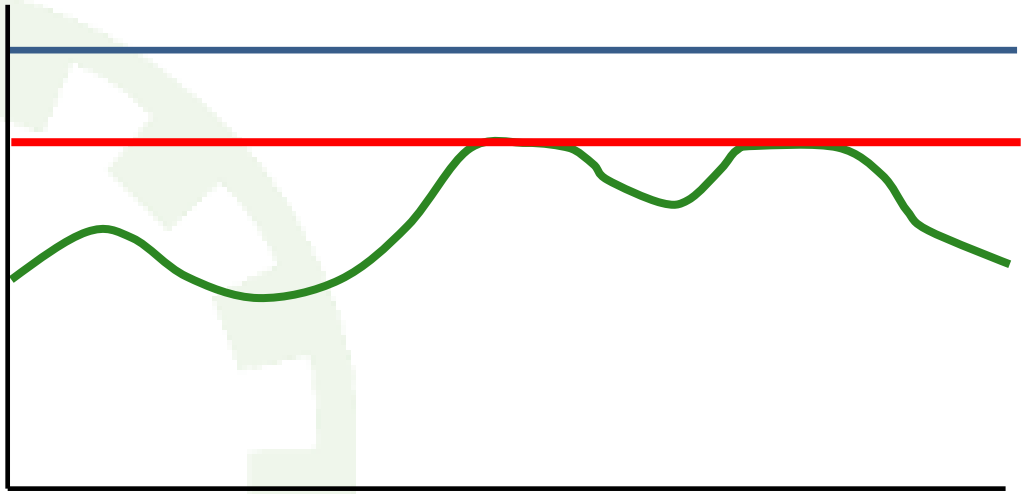
- Goodwill
- Non-monetary  (badge „Energy Transition Business“)
- Subsidies for additional effort
- Compensation (free energy audit)
- Cooperation (help for installing PV systems)
- Separate grid tariff (indiv. arrangements for dis-/connection)
- Multi-step tariffs (fixed times with different costs)
- Dynamic grid fees (short-term changeable fees, nodal prices)

➢ respect local conditions and non-discrimination!

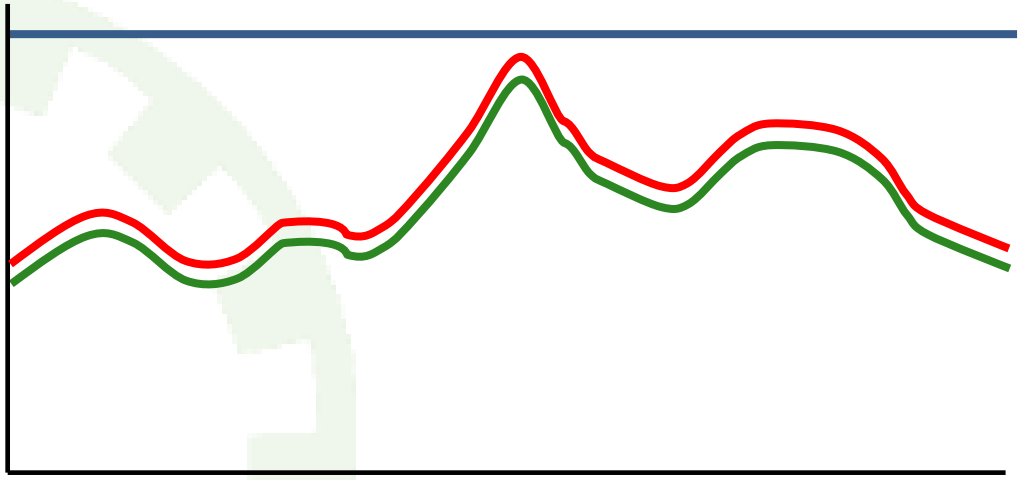
# Electricity price business clients (SAG)



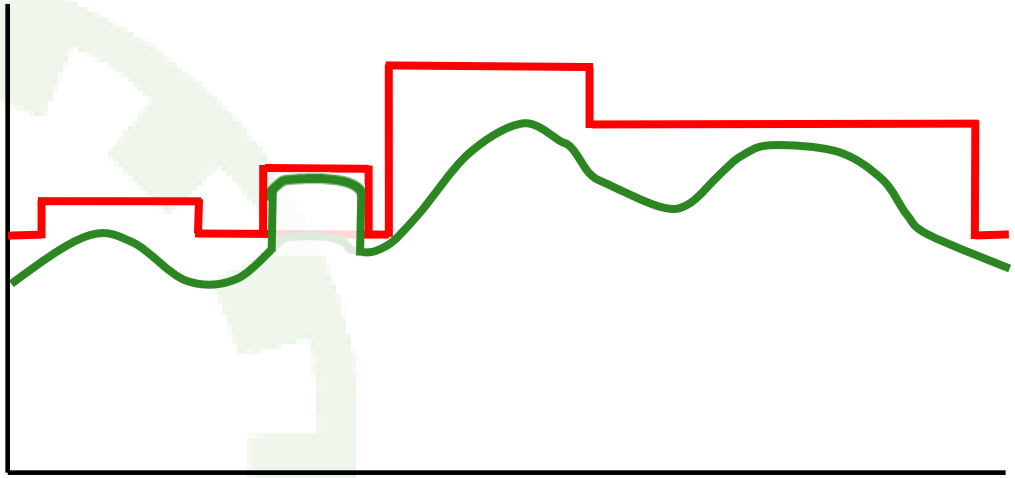
# Peak shaving



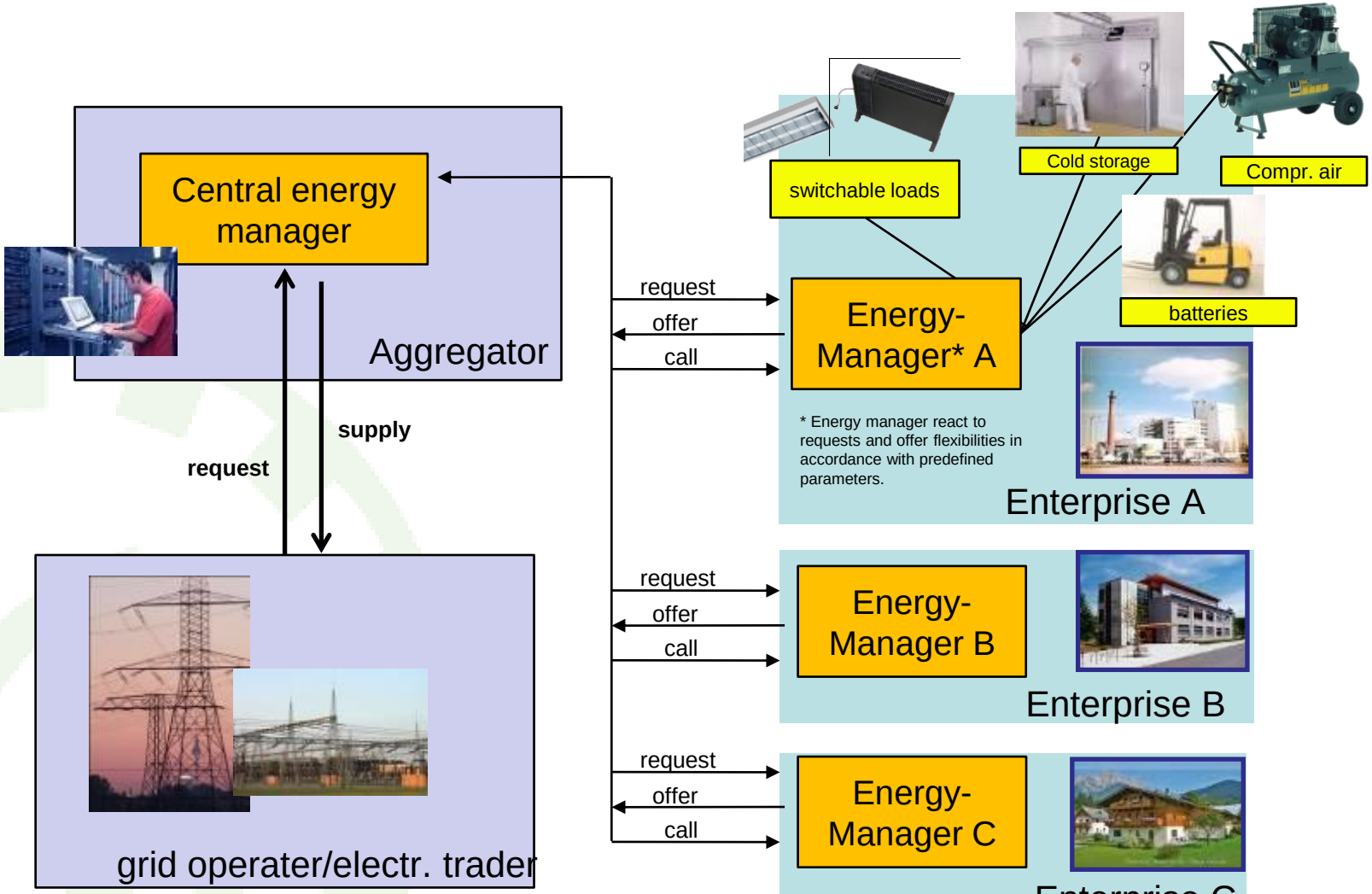
# Comsumption by schedules



# Options for intervention



# Connection of flexibilities for grid and market (via IEC 61850)



# 10 business cases

a) Limitation of peak load (classic DSM use case)

b) Schedules for loads and feed-in (agreed upon well in advance)

c) Options for direct control (contracted near-term available for switch-on/off, space- and location-specific)

d) Day-ahead adjustment of feed-in/load curve

e) Neartime / Realtime adjustment of the load curve

X) Prosumer-Models

- x1: schedule oriented prosumer (direct marketing)
- x2: optimized self-consumption (unpredictable, esp. with storage)
- x3: system-guided prosumer (supply-side storage management)

Y) Group models (heterogeneous aggregation of small loads, p.r.n. locally)

Z) Branch model (decentralised control of homogenous enterprises , chains)

# Business cases

| **Model and its effects** (o=neutral, +=advantage, -=disadvantage, §!=not backed by regulation) | **grid** | **customer** | **supplier** | **aggregator** | **regulator** |
|---|---|---|---|---|---|
| A limitation of peak load (classic DSM use case) | + | + | 0 | 0 | ok |
| B schedules for loads (agreed upon well in advance) | + | + | + | + | §! |
| C direct control options (contracted near-term available, switch-on/off, time- and location-specific) | + | + | - | + | §! |
| D day-ahead adjustment of feed-in /load curve | + | + | 0 | 0 | §! |
| E near time / real-time adjustment of the load curve | + | + | - | + | §! |
| X1 schedule oriented prosumer (direct marketing) | + | + | + | + | §! |
| X2 optimized self-consumption (unpredictable, esp. with storage) | - | + | 0 | 0 | Ok |
| X3 system-guided prosumer (supply-side storage management) | + | 0 | - | 0 | §! |
| Y group models (heterogeneous aggregation of small loads , p.r.n. locally) | + | + | + | + | §! |
| Z branch model (decentralised control of homogenous enterprises, chains) | 0 | + | + | + | §! |

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# Résumé

- Load shifts can be leveraged in the commercial sector via ICT and have a market potential, if the framework conditions will be adapted.
- Flex-readiness is available in enterprises, (via known channels, without interference of production processes, based on existing systems, noiseless, comfortable, lucrative)
- Several MW can be exploited from a technical point of view in different qualities (space, time, reliability), <-> communication infrastructure (area coverage, standards, speed)
- Especially attractive potential based on thermal storages (cold and heat). One third of the installed power can be used for flexibility considerations (switching once per day for 15-30 minutes). The occurring potential accounts for up to 200 MW in the case of Salzburger Land alone.
- Barriers are trending towards self-consumption, shortage of specific offers, no possibility of aggregation, lacking communication connection and legal uncertainty

-> cost-benefit-analyses are missing (costs for integration, system benefits, system needs, „price tags“ nodal, temporary)

# Thank you for your attention

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