WISSEN ▪ TECHNIK ▪ LEIDENSCHAFT

Demand Response: Potentials in Industry

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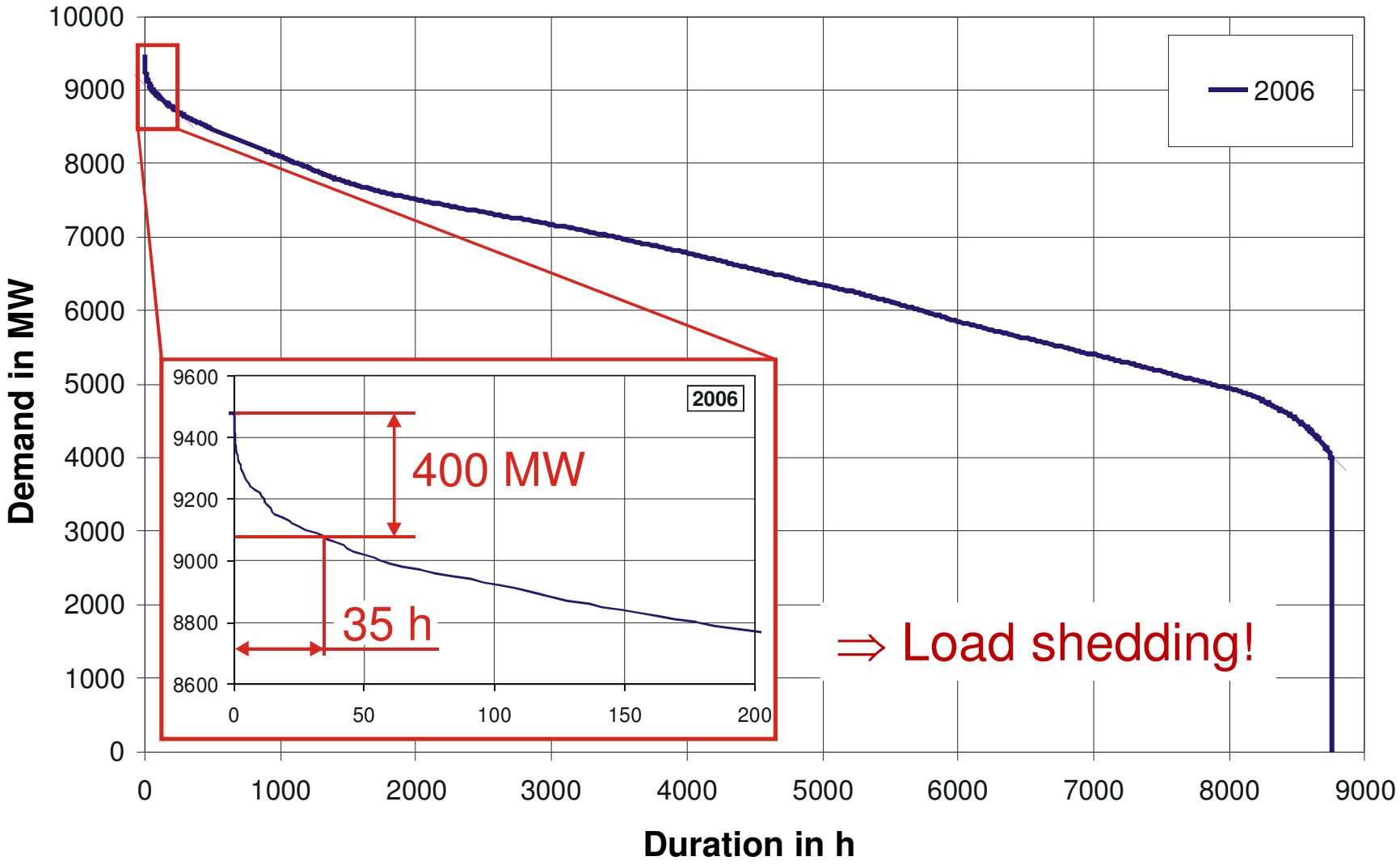
Why should DR be taken into account?

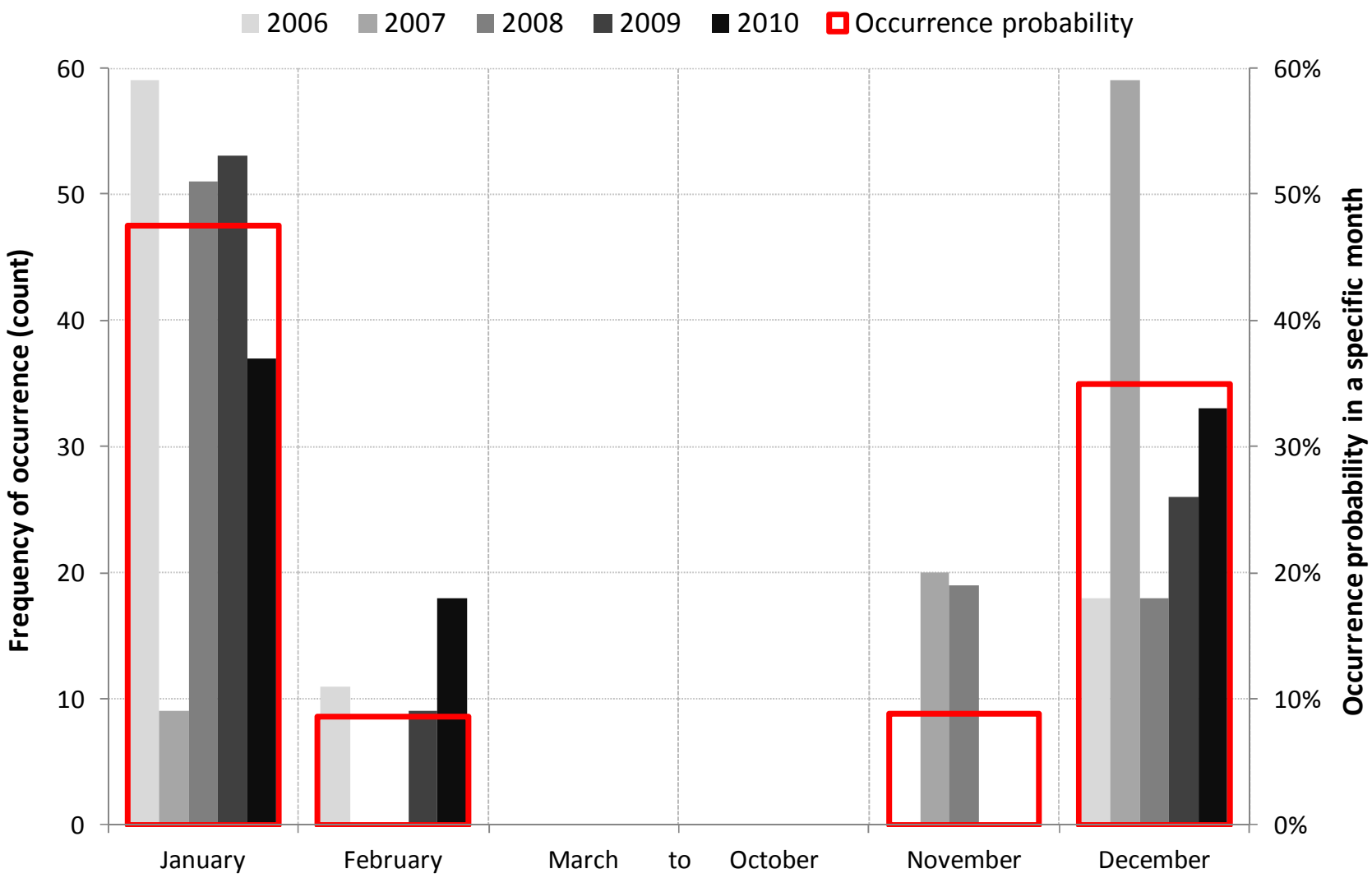
- Peak load problem ⇒ high peak prices
  - Establishment of capacity markets is on the way
- Renewable generation ⇒ storage problem
- High prices in markets for control power
  - DR can increase liquidity of markets for system services
- Emergency situations
  - Adequacy or frequency problems
  - Congestions or voltage problems in distribution grids

- Why DR in industrial plants?
  - \+ Professional energy management
  - \+ Switching, metering and communication devices already exist
  - \+ 1 cement mill = 1.000 refrigerator

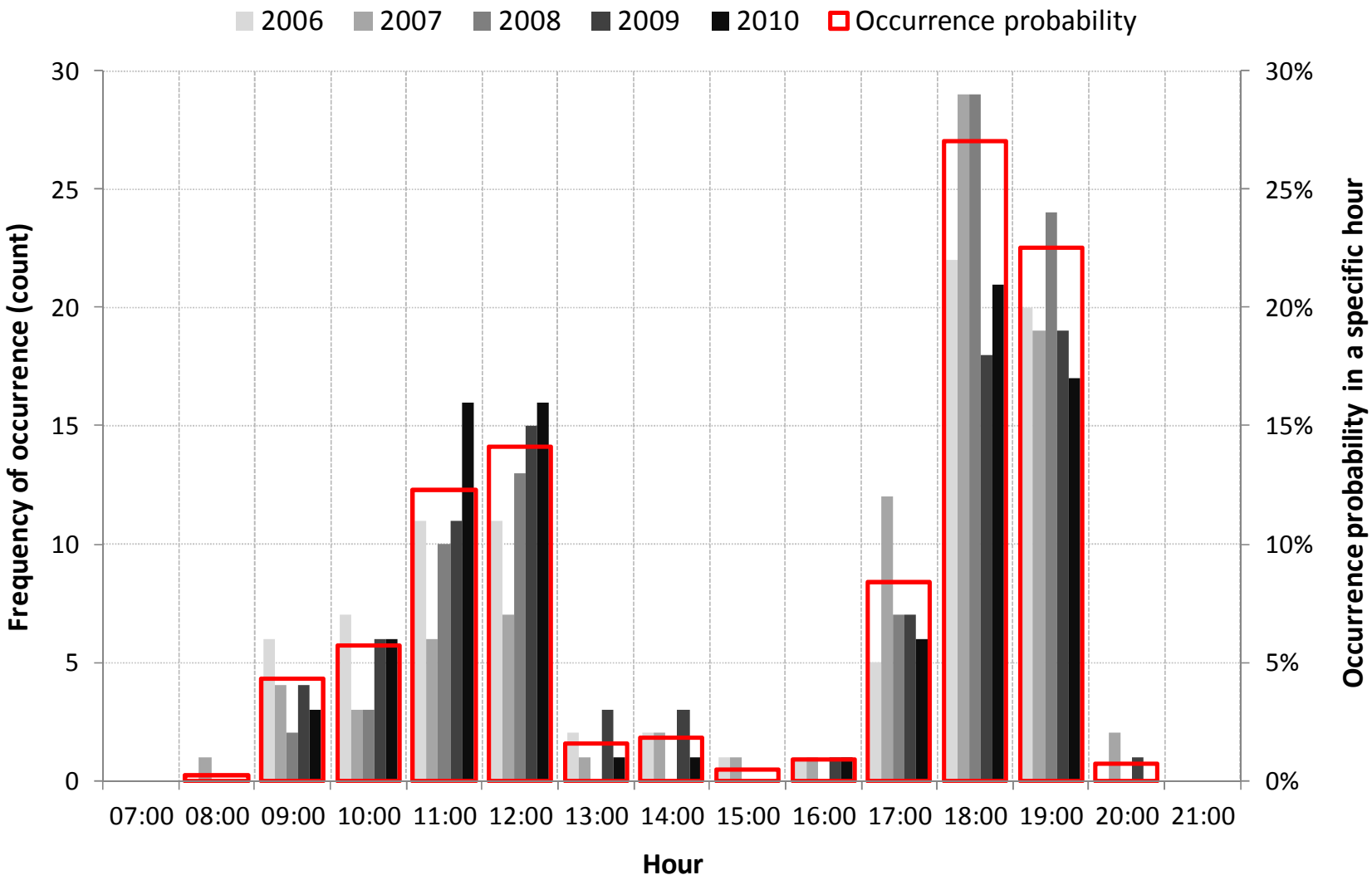
Duration Curve of Electrictiy Demand



The highest 1% of demand (1)



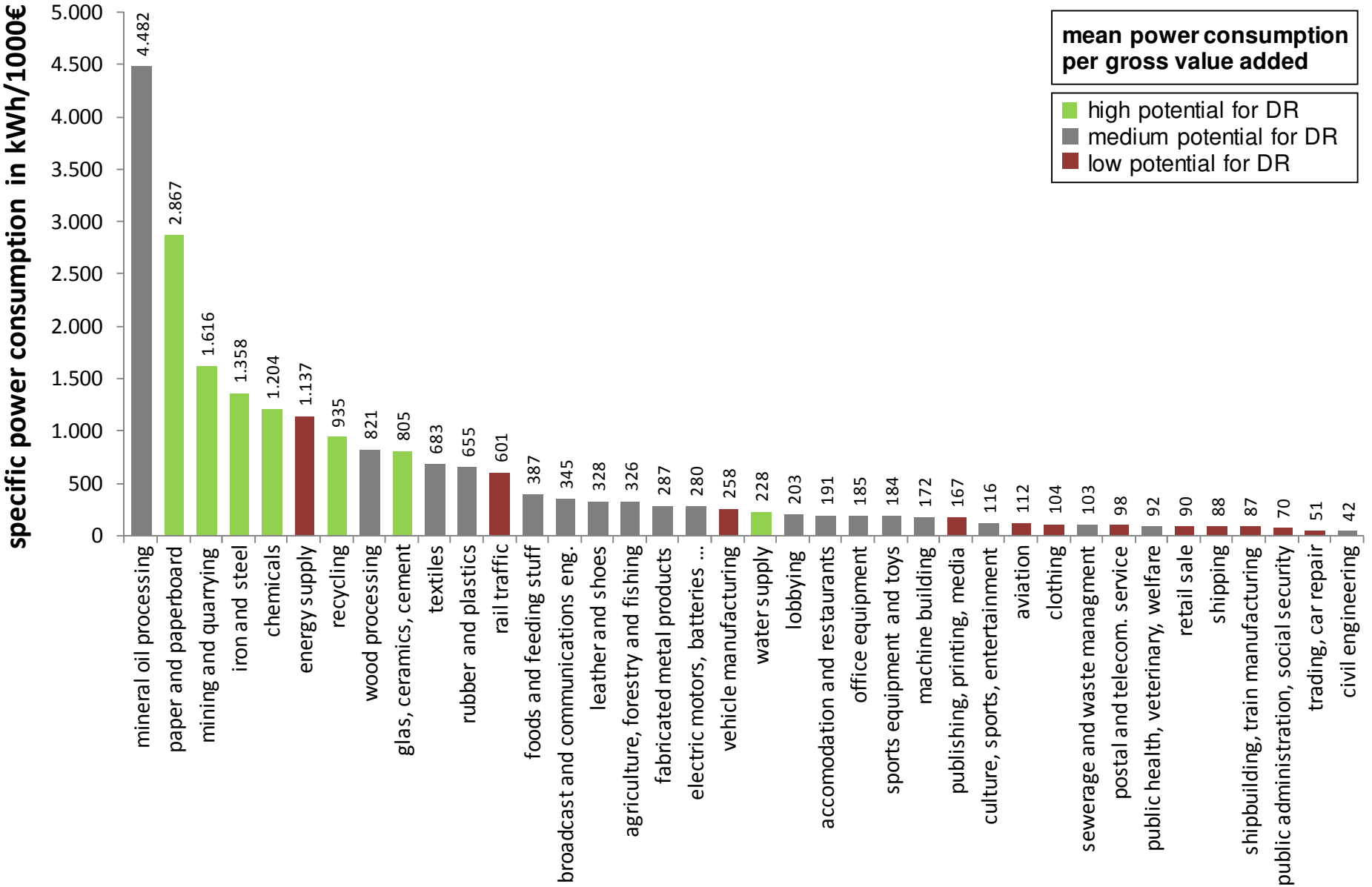
The highest 1% of demand (2)



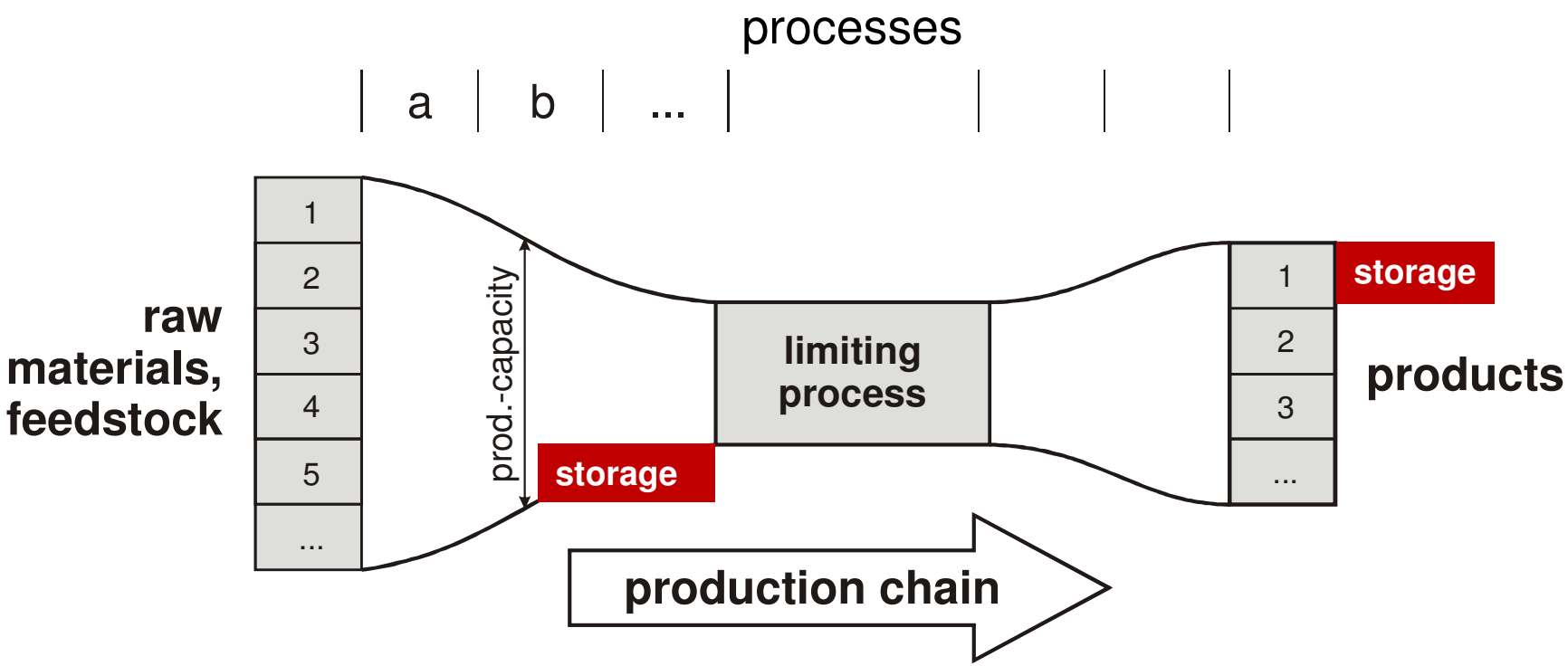
Which industries are fitting to DR?

+ Power intensive production process
+ Storable products or intermediate goods
+ Possibility for cheap product storage
+ Discontinuous (batch) production processes
+ 2/3 shift and weekend production
+ Plant with certain overcapacities
+ Robust machines and plants
+ Immediate/fast switch-off or short interruption is possible
+ Industrial sector with overcapacities (or recession period)
– just-in-time production, high deadline pressure
– Long start-up duration
+ **Innovative management or energy manager!**

“Power intensity” of products

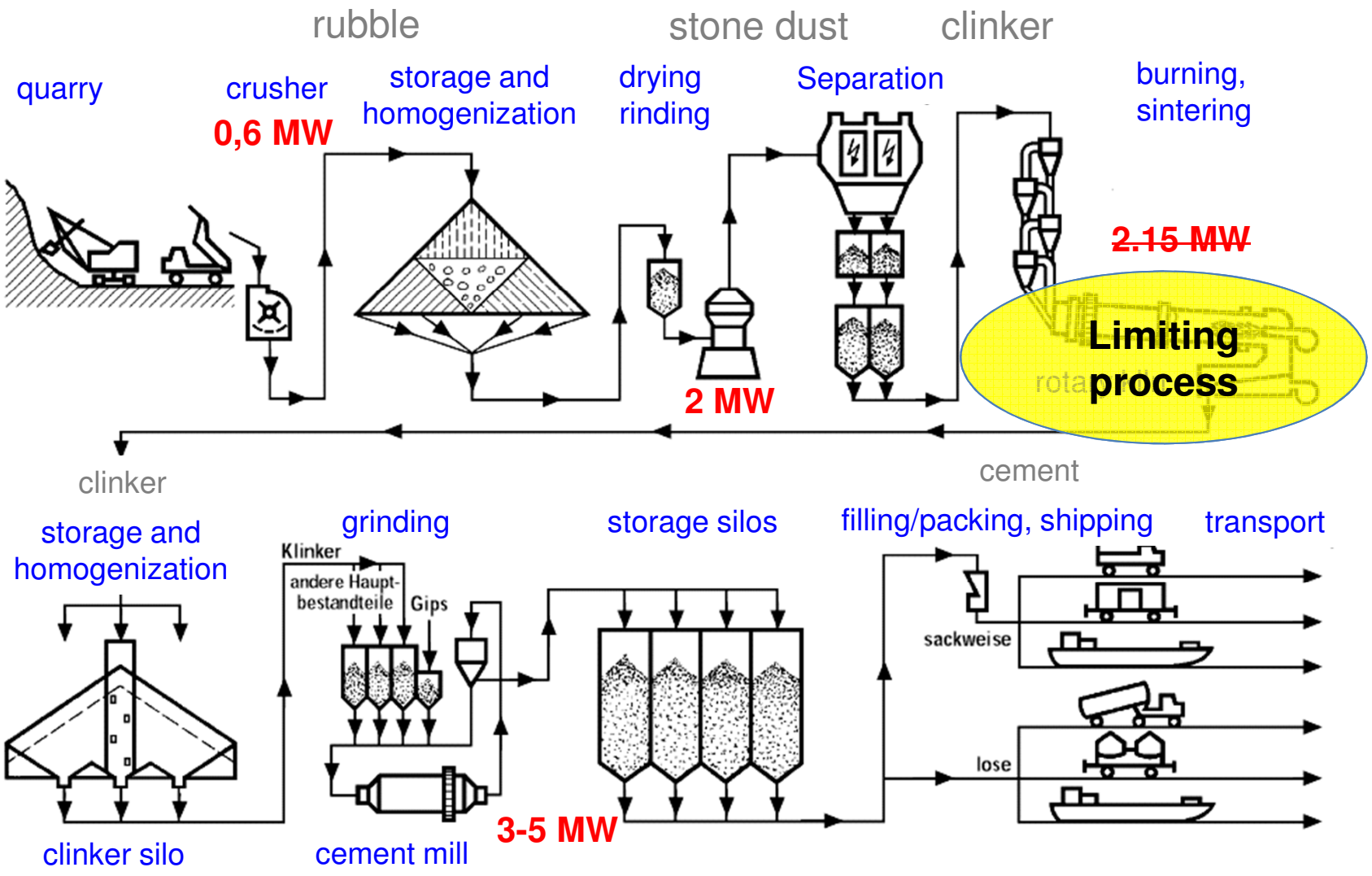


How can DR become *smart*?



- Stopping pre-processes and post-processes for a short period of time does not decrease product output.
- **Never switch of the limiting process!**
- **"Energy service battery": Store the product instead of electricity!**

Cement production process 10 MW load

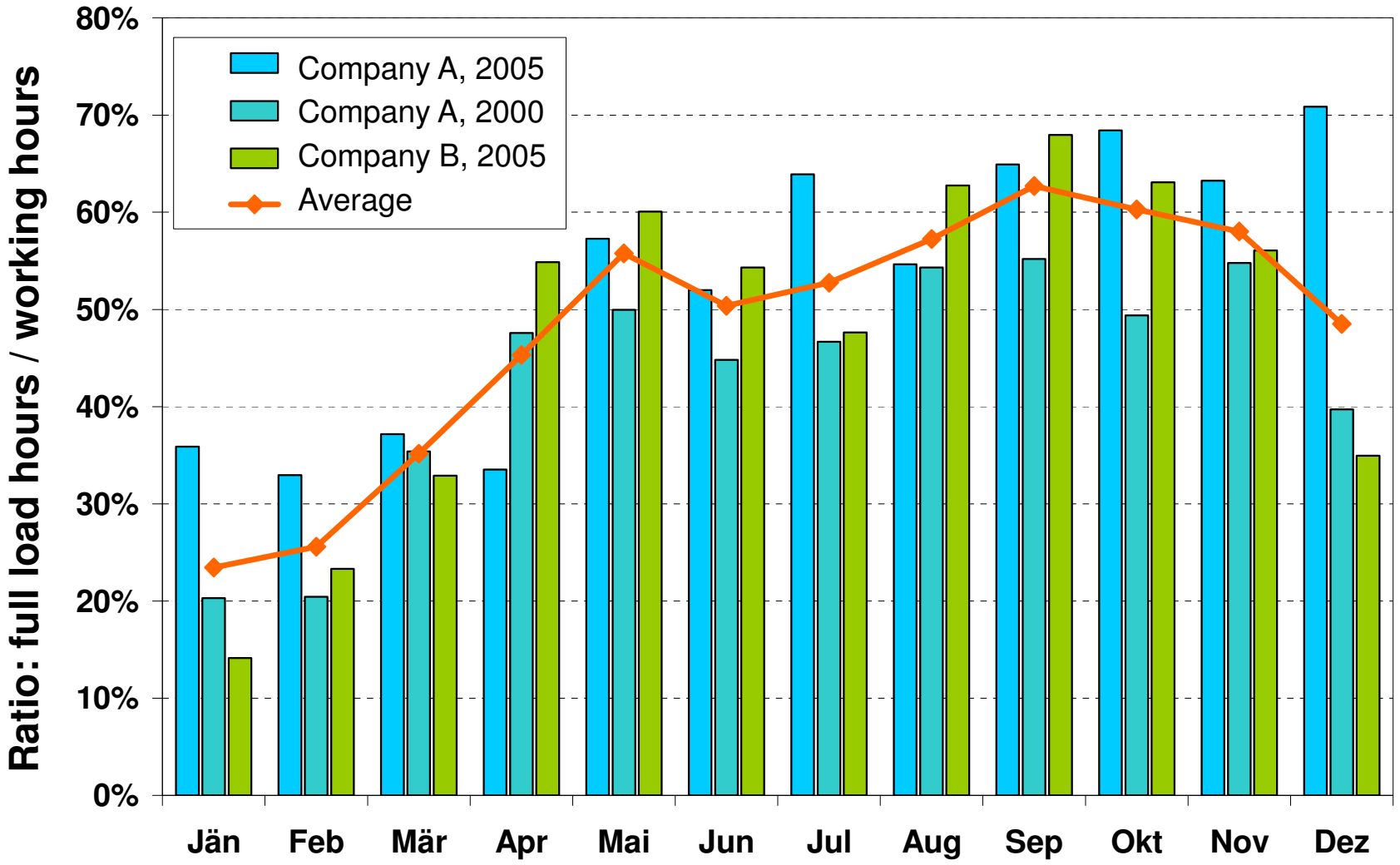


Source: VDZ

Other Potentials for DR in Industry

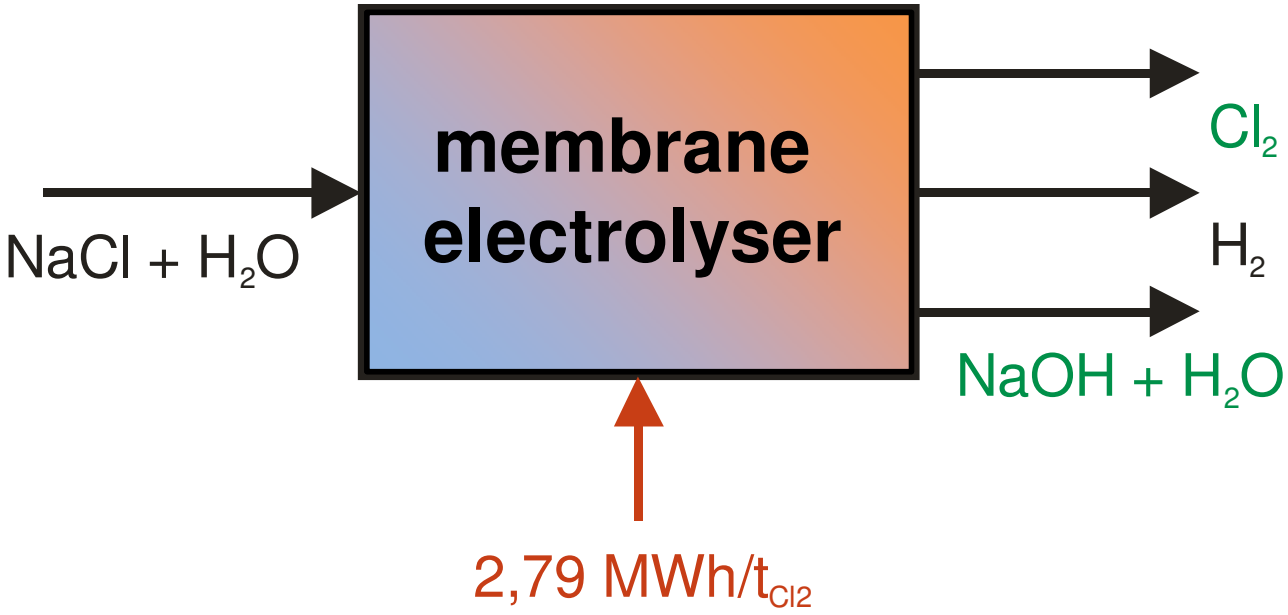
- **Paper industry:** refiners *30 – 40 MW*
- **Mining, quarries:** crushers, grinders, sieves
- **Iron and steel:** electric arc furnaces *5 – 30 MW*
  rolling mill
- **Nonferr. metals:** electric arc furnace *10 MW*
  electrolyser
- **Cooling plants:** up to *1 MW*
- **Technical gases:** liquefaction *10 – 13 MW*
- **Bulk chemicals:** Chloralkali process *10 – 20 MW*
  Calcium carbide smelter *7 MW*
- Discussion with plant operators will show additional potentials! ⇒ **Care about your clients´ needs!**

Medium-size Quarries



Low plant utilization during winter ⇒ perfectly fitting for load shedding.

Chloralkali process



$$2\ H_2O + 2\ NaCl_{(aq)} \rightarrow H_2 + Cl_2 + 2\ Na^+ + 2\ OH^-$$

typ. plant capacity: 50 – 200 kt_{Cl2}/a

$\Rightarrow$ 140 – 560 GWh/a

$\Rightarrow$ **16 – 65 MW**

Control power from electrolysers

Chloralkali electrolysers in Germany	**Mercury process**	**Diaphragm process**	**Membrane process**	**Others**	**Sum**
Number of plants	13	3	4	3	23
Capacity [kt/a]	1 762	1 446	844	230	4 282
Typical power consumption [MWh/kt]	3 560	2 970	2 790	2 790 (est)	-
Annual consumption at full load [GWh]	6 273	4 295	2 355	642	13 565
Band load (P_N) [MW], 8760h/a	716	490	269	73	1 549
Possible power gradient					
in 1 min (1.5% of P_N) [MW]	10.7	7.4	4.0	1.1	23.1
in 5 min (7.5% of P_N) [MW] → ***secondary control***	53.7	36.8	20.2	5.5	**116**
in 15 min (22.5% of P_N) [MW] → ***tertiary control***	161.1	110.3	60.5	16.5	**348**

Assessment of opportunity costs

Company	Band load [MW]	Specific opportunity costs in 2005 [€/(MW·h)]
Paper mill A (mechanical pulp)	95	**190**
Paper mill B (mechanical pulp)	85	**200**
Paper mill C (chemical pulp)	30	470
Paper mill D (chemical pulp)	90	400
Production of cellulose	65	550
Cement mill A	13	510
Cement mill B	10	580
Steel works A (carbon steel for structures)	35	**210**
Steel works B (stainless)	57	570
Iron and steel casting	8,5	730
Copper mill (without electrolysis!)	7,8	950
Wood processing	23	1.340
Aluminium processing	6	440
Aluminium foundry A	10	1.370
Aluminium rolling mill	16,5	2.330
Aluminium foundry B	1,6	3.970

Summary

- The demand reached the limits of the generation fleet.
- 5% of generation capacity is necessary for 1% of time!
- The DR potential in Austria is in the range of 400 MW (≈4% of peak load)
- In the near future, load shedding will be an important part of an efficient power system.
- Renewable generation leads to a storage problem!
- DR can be used as indirect electricity storage!
- **Utilities have to understand their clients needs!**

Many thanks for your attention!

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