

Demand Side Management in Industry

DIW Workshop
Berlin, 21.09.2015

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Projects concerning Demand Response in Industry

Agora-Study (with Fraunhofer)

Potential in Southern Germany



Developing standards for entering DSM markets



DSM Bavaria

MOS & MONA

DSM in competition with other flexibility options



Experiences of DSM market participants



EU-Project ADVANCED



Main Methodologies

Data from efficiency consultancy

Around 80 profound data collections within the energy efficiency networks – including on-site inspection

Focus: cross-section technologies

Getting a good impression of decision routines and priorities of the energy manager

Identifying barriers

Face to face interviews

Interviews with „interested“ companies and companies already participating in the DSM markets

Focus: cost of implementation

In the Agora-Study more than 200 companies took part in the online survey

Focus: the ad-hoc potential seen by the companies

The logo consists of the letters 'F', 'F', and 'E' in a bold, red, 3D block font. The letters are slightly offset from each other, creating a sense of depth and movement. The 'F's are on the left and the 'E' is on the right.

Regular Workshops with energy manager

Online surveys

Some results for the discussion

- Technologies
- Potential as function of time
- Regional distribution
- Costs

Technologies – Cross-section technologies

Cross-section technologies are those used not in just one economic sector, but across all industries. Examples include pumps, compressors, and ventilators.

Main cross-section technologies for DSM

- Pumps
- Ventilation
- Cooling
- Lighting
- Compressed air

Interesting:

- Interestingly, a lot of the firms indicated in the online survey that they see potential for load shifting in the field of compressed air. BUT a closer inspection shows that the practical potential is much lower.
- Interestingly, lighting is also often indicated. Actually illuminance can be dimmed over an extended period if it is above what is required for the workplace.

Technologies – Industrial processes for load shifting

Individual energy-intensive industrial processes were analyzed.

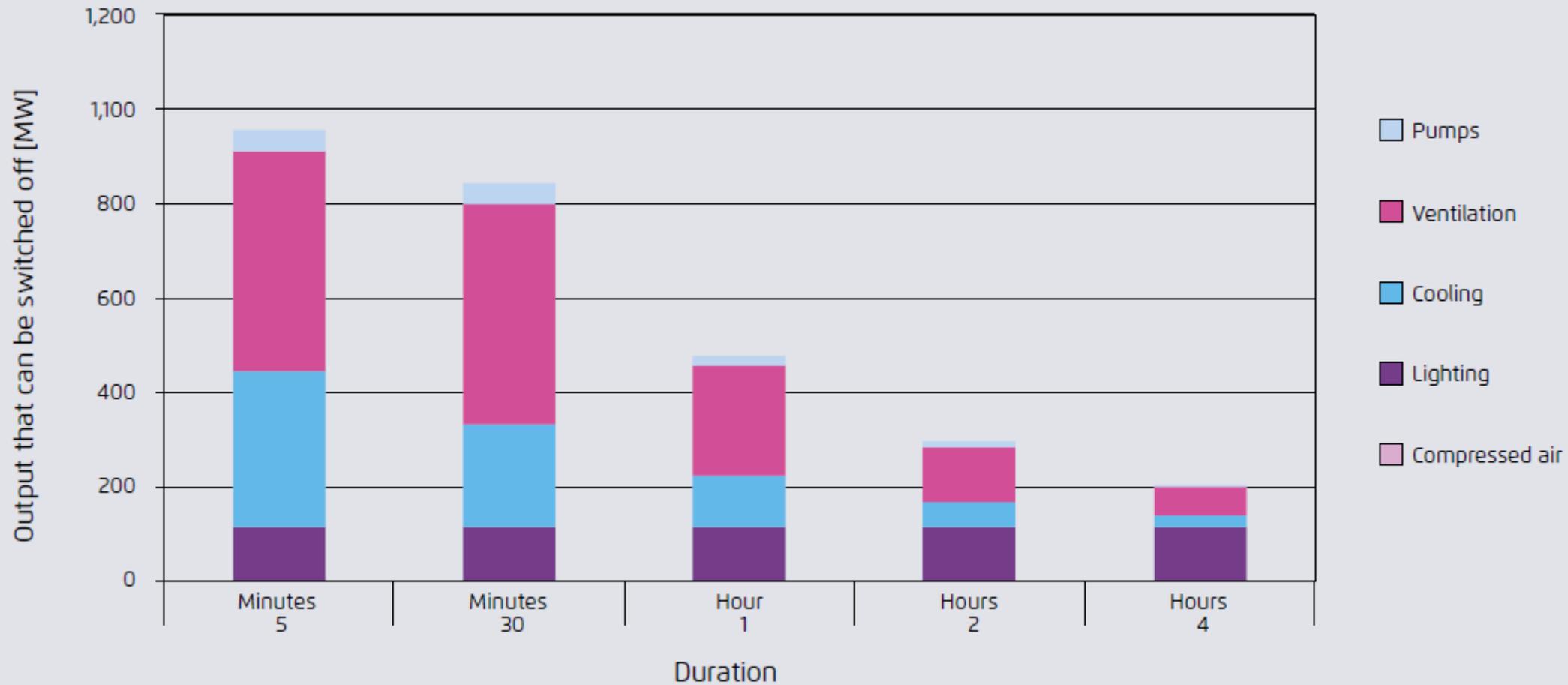
Main industrial processes for DSM

- Cement
- Paper
- Chemical industries and chlorine production
- Aluminium
- Electric steel industry

Interesting:

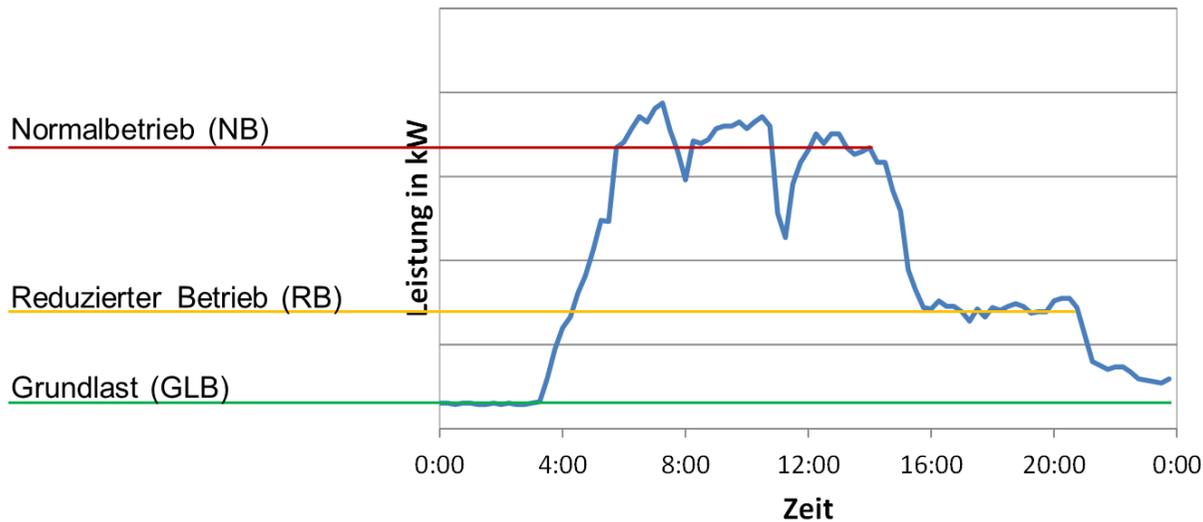
- A significant part of this potential is already used for optimized procurement, so the contribution from energy-intensive processes towards reducing peak power loads would be lower.

Potential capacity as function of the activation duration

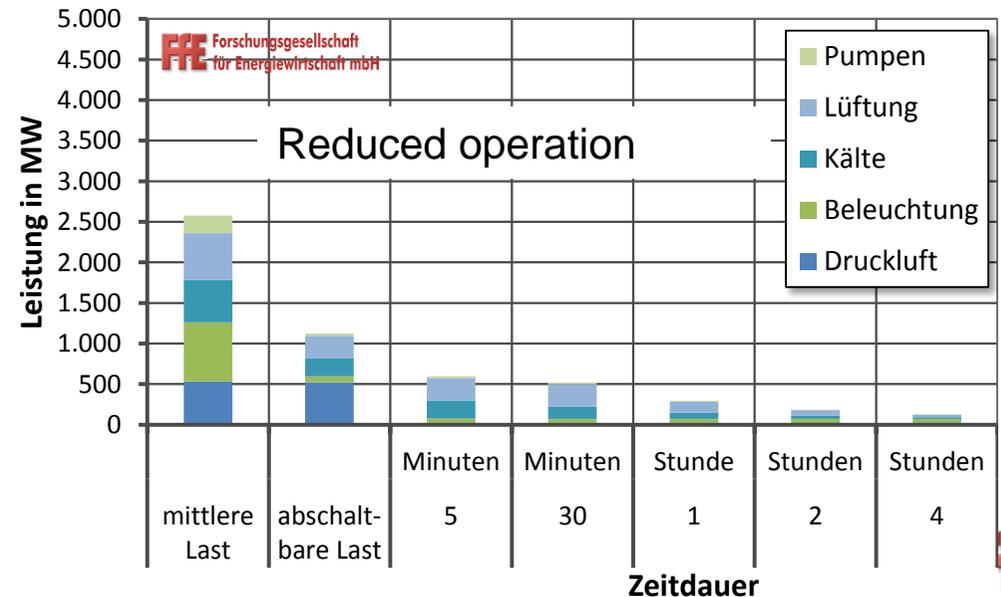
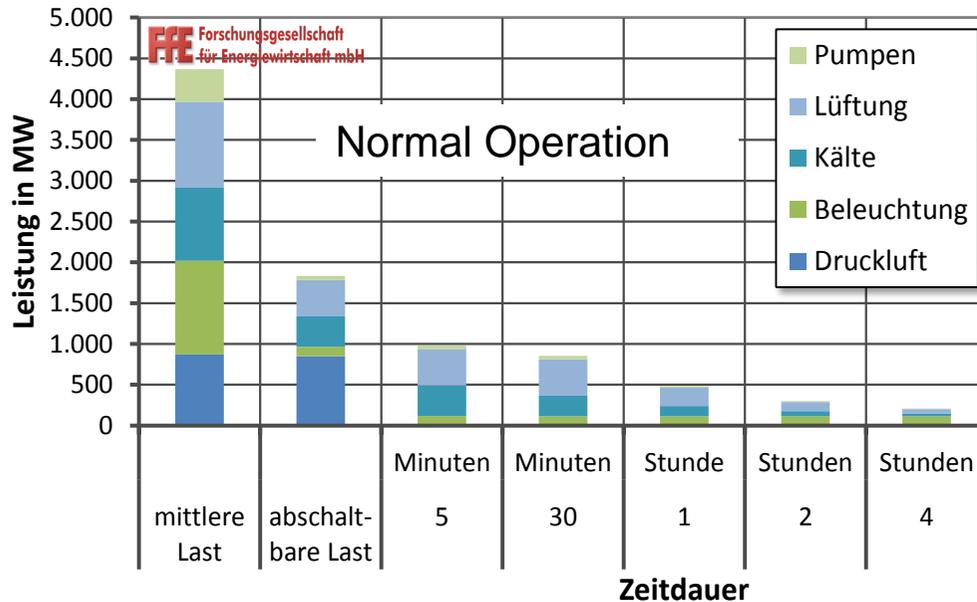


Potential capacity as function of the time period of activation

Tageslastgang

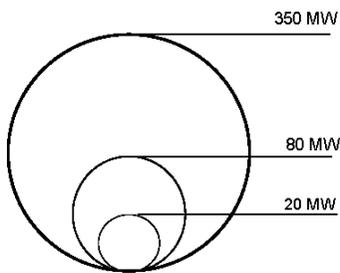


- Normal operation: Production in all areas
- Reduced operation: e.g. 3. shift, in which only one area is working
- Base load: no production



Maximal abschaltbare Leistung Querschnittstechnologien nach Branchen in Deutschland und Österreich

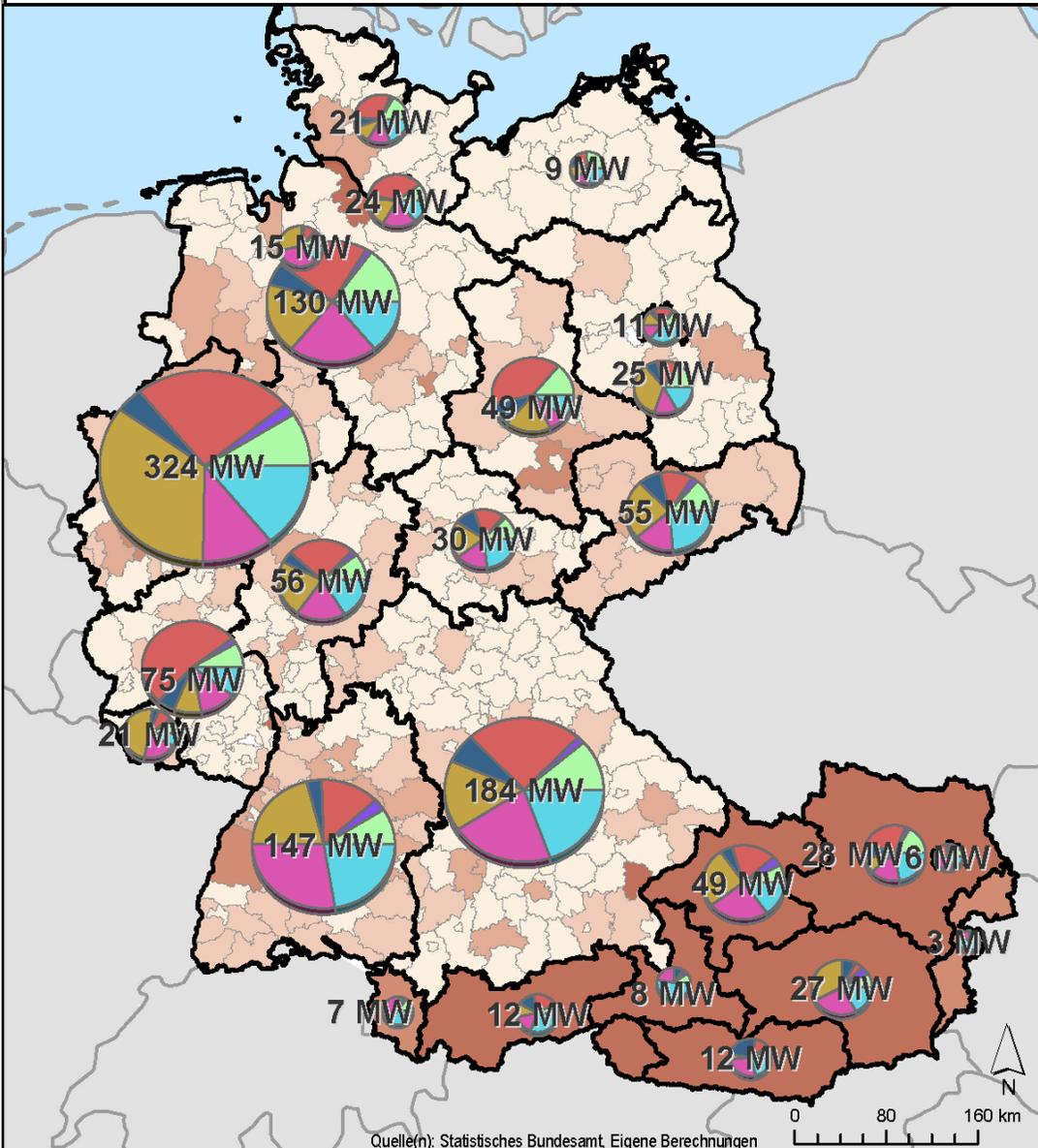
- Branchen
- Ernährung und Tabak
 - Papier
 - Chemie
 - Glas, Keramik, Steine und Erden
 - (NE-) Metallerzeugung/-bearbeitung
 - Maschinenbau, Fahrzeugbau
 - Sonstige



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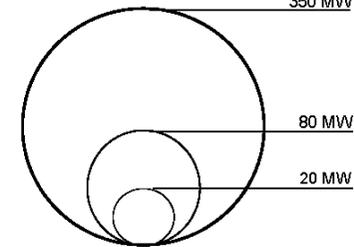
Für eine Stunde werktags -
Summe pro Landkreis bzw.
Bundesland in MW

- < 2 MW
- 2 - 5 MW
- 5 - 10 MW
- 10 - 20 MW
- > 20 MW



Maximal zuschaltbare Leistung Querschnittstechnologien nach Branchen in Deutschland und Österreich

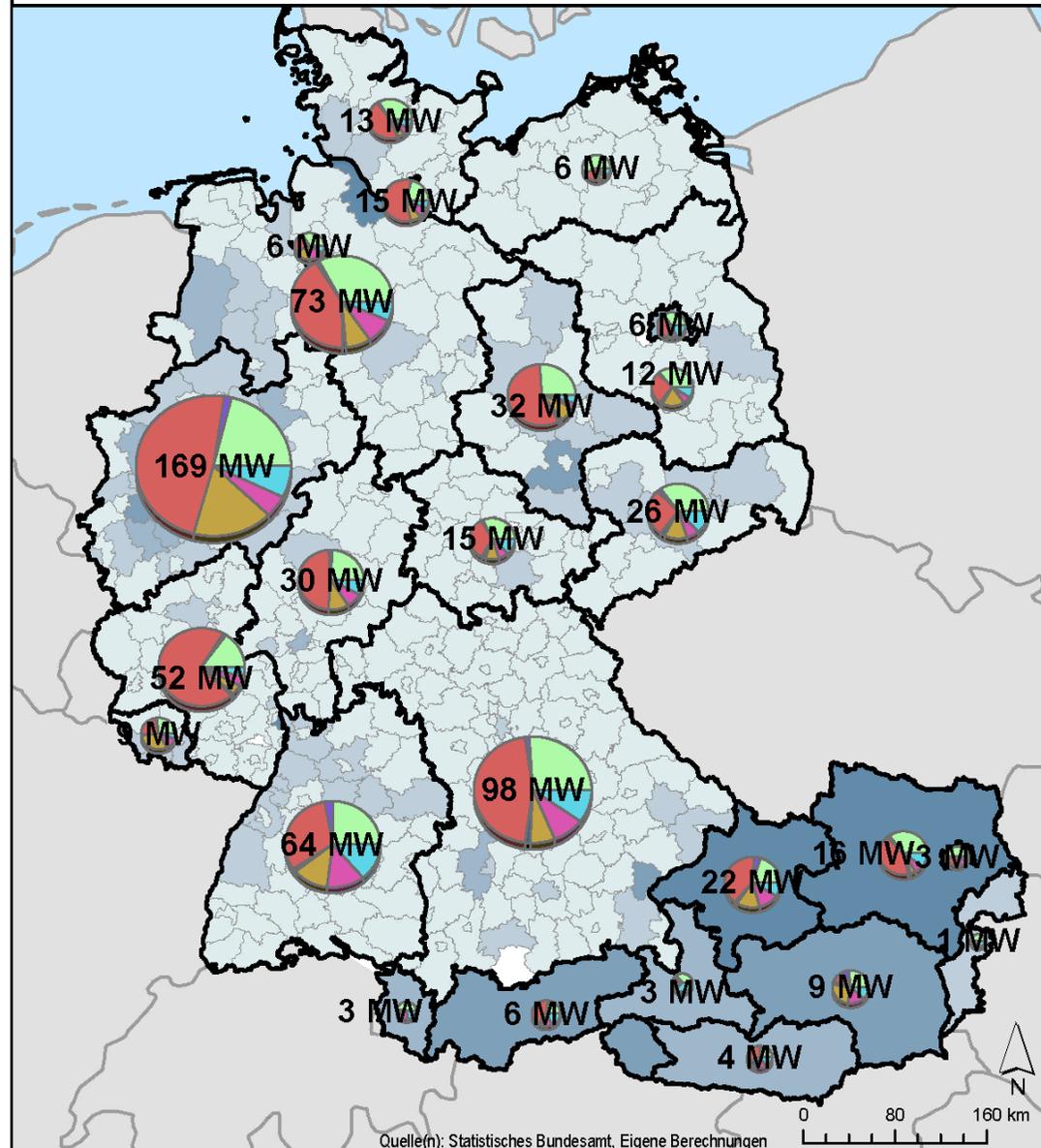
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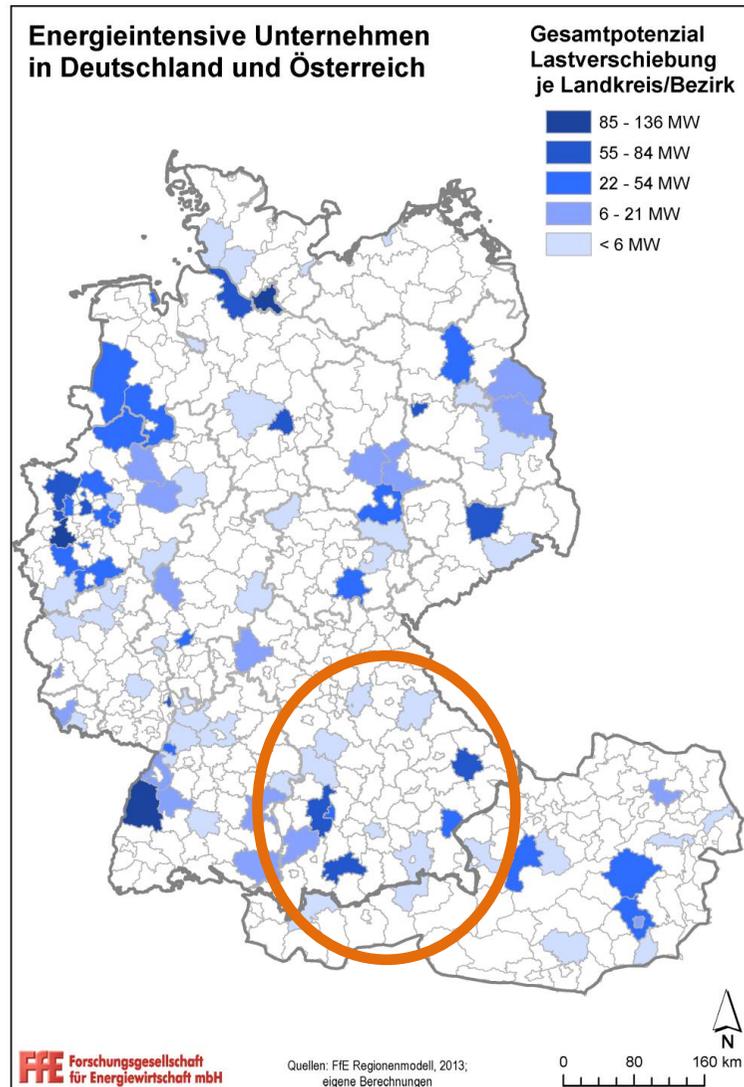
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Für eine Stunde sonntags -
Summe pro Landkreis bzw.
Bundesland in MW

- < 2 MW
- 2 - 5 MW
- 5 - 10 MW
- 10 - 20 MW
- > 20 MW



Regional distribution – energy intensive processes

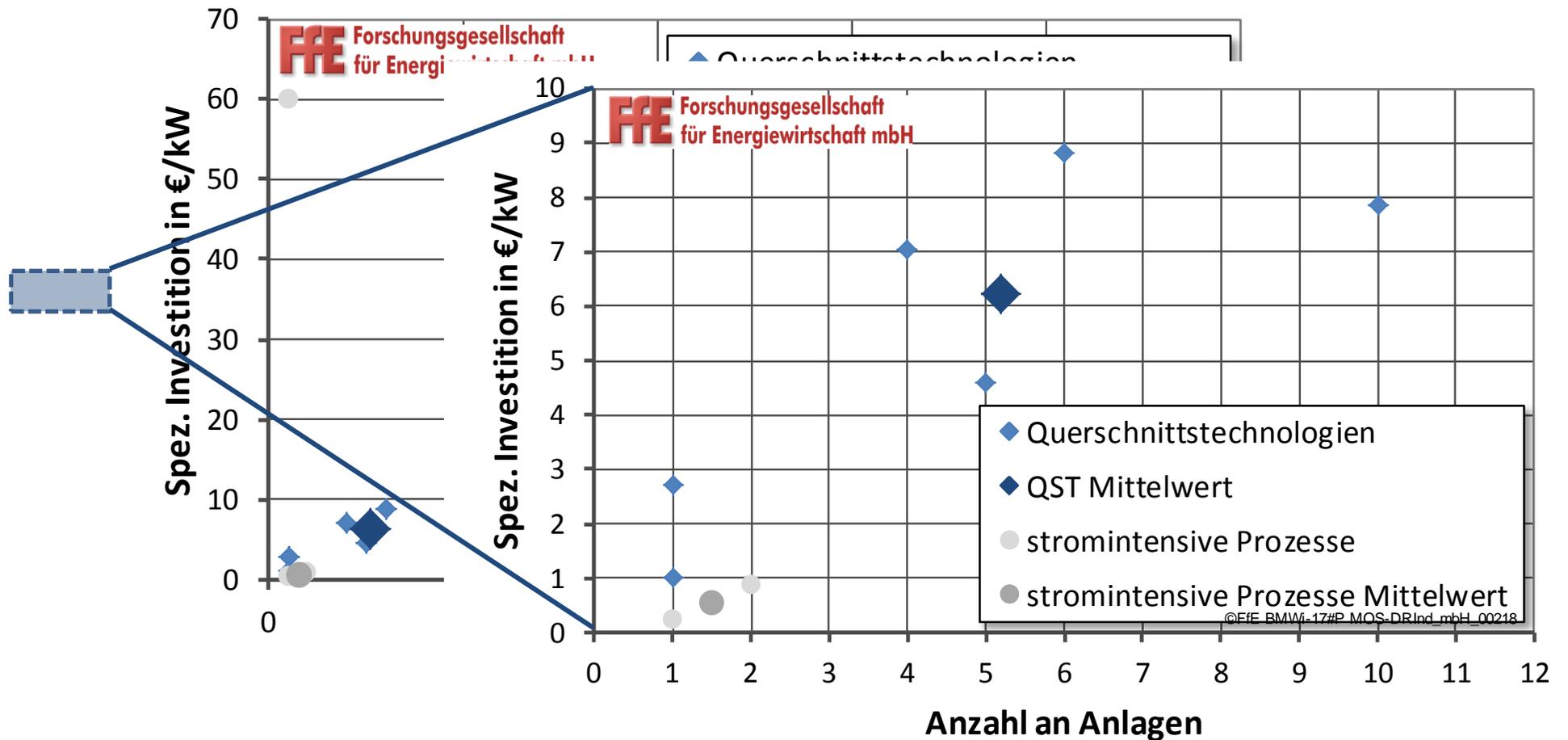


Branche	LMM-Potenzial		
	Österreich	Deutschland	
Papier	109	313	MW
Zement	21	152	MW
Aluminium	0	267	MW
Chlor	10	593	MW
Stahl	35	718	MW
Summe	175	2.042	MW

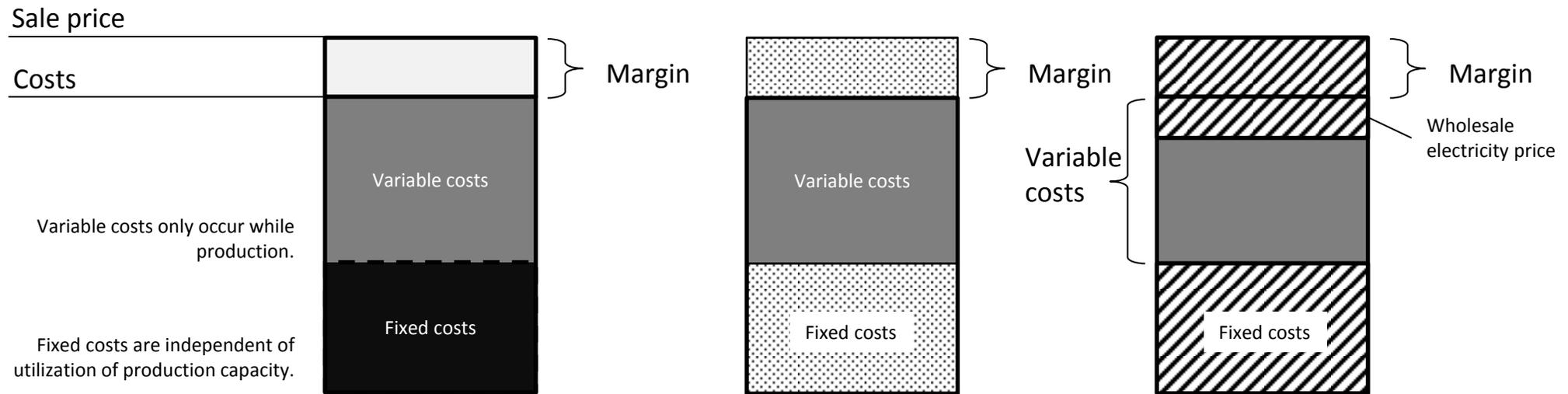
Branche	LMM-Potenzial	
Papier	421	MW
Zement	173	MW
Aluminium	267	MW
Chlor	603	MW
Stahl	753	MW
Summe D und AT	2.217	MW

Costs for the implementation of DSM

- Results of a survey



Methodology – Structure of Costs and Earnings and Opportunity Costs



 Profit contribution = sale price – variable costs
= margin + fixed costs

 Opportunity costs = profit contribution + wholesale electricity price
= sale price – variable costs + wholesale electricity price

Quantification of the Opportunity Costs

$$OC = \frac{(1 + r) - vc_{ma,e} - vc_{el} * \left(\frac{(VC_{el,eex} + VC_{el,a}) - VC_{el,eex}}{(VC_{el,eex} + VC_{el,a})} \right)}{\frac{vc_{el}}{(VC_{el,eex} + VC_{el,a})}}$$

OC – opportunity costs [€/MWh]

VC – variable costs [€/MWh]

r – percentage of margin [%]

vc – share of costs [%]

ma – materials

e – energy (without electricity)

el – electricity

eex – wholesale electricity market

a – additional cost components for electricity

Opportunity Costs Matrix

		electricity price for industrial clients [€/MWh]							
		155	129	103	77	51	51	51	51
		VC _{el}							
		2.5 %	5.0 %	7.5 %	10.0 %	12.5 %	15.0 %	17.5 %	20.0 %
VC _{ma,e}	2.5 %	7175	2948	1556	873	473	394	336	294
	5.0 %	7020	2883	1521	854	463	385	329	287
	7.5 %	6865	2819	1487	834	453	377	322	281
	10.0 %	6710	2754	1453	815	443	368	315	275
	12.5 %	6555	2690	1418	796	433	360	308	269
	15.0 %	6400	2625	1384	777	422	352	300	262
	17.5 %	6245	2561	1350	757	412	344	292	256
	20.0 %	6090	2496	1315	738	402	336	284	249
	22.5 %	5935	2432	1281	719	392	328	276	243
	25.0 %	5780	2367	1247	700	382	320	268	236
	27.5 %	5625	2303	1212	680	371	312	260	230
	30.0 %	5470	2238	1178	661	361	304	252	223
	32.5 %	5315	2174	1144	642	351	296	244	217
	35.0 %	5160	2109	1110	623	341	288	236	210
	37.5 %	5005	2045	1075	603	331	280	228	204
	40.0 %	4850	1980	1041	584	320	272	220	198
	42.5 %	4695	1916	1006	565	310	264	212	191
	45.0 %	4540	1851	972	546	300	256	204	185
	47.5 %	4385	1787	938	526	290	248	196	178
50.0 %	4230	1722	903	507	280	240	188	172	
52.5 %	4075	1658	869	488	269	232	180	165	
55.0 %	3920	1593	835	469	259	224	172	159	
57.5 %	3765	1529	800	449	249	216	164	152	
60.0 %	3610	1464	766	430	239	208	156	146	
62.5 %	3455	1400	732	411	229	200	148	140	
65.0 %	3300	1335	697	392	218	192	140	133	
67.5 %	3145	1271	663	372	208	184	132	127	
70.0 %	2990	1206	629	353	198	176	124	120	
72.5 %	2835	1142	594	334	188	168	116	114	
75.0 %	2680	1077	560	315	178	160	108	107	

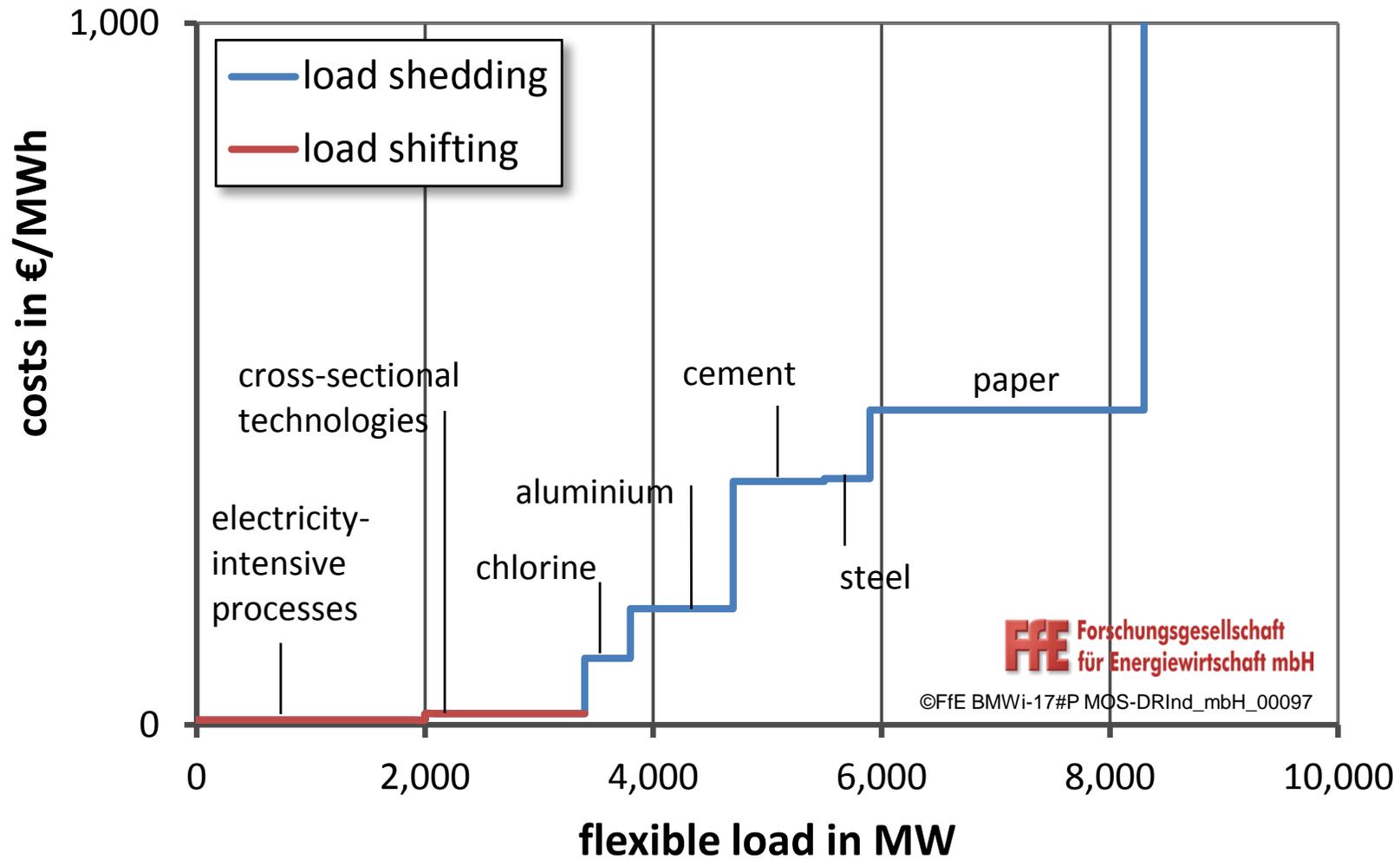


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		vc _{el}																														
		2.5%	5.0%	7.5%	10.0%	12.5%	15.0%	17.5%	20.0%	22.5%	25.0%	27.5%	30.0%	32.5%	35.0%	37.5%	40.0%	42.5%	45.0%	47.5%	50.0%	52.5%	55.0%	57.5%	60.0%	62.5%	65.0%	67.5%	70.0%	72.5%	75.0%	
VC _{ma,e}	2.5%	7175	2948	1556	873	473	394	336	294	260	234	212	194	178	165	154	144	135	127	120	114	108	103	98	94	90	86	83	80	77	74	
	5.0%	7020	2883	1521	854	463	385	329	287	255	229	207	190	174	162	150	141	132	124	117	111	106	101	96	92	88	84	81	78	75	72	
	7.5%	6865	2819	1487	834	453	377	322	281	249	224	203	185	171	158	147	137	129	122	115	109	103	98	94	90	86	82	79	76	73	71	
	10.0%	6710	2754	1453	815	443	368	315	275	243	218	198	181	167	154	144	134	126	119	112	106	101	96	92	88	84	80	77	74	71	69	
	12.5%	6555	2690	1418	796	433	360	307	268	238	213	193	177	163	151	140	131	123	116	109	104	98	94	89	85	82	78	75	72	70	67	
	15.0%	6400	2625	1384	777	423	351	300	262	232	208	189	173	159	147	137	128	120	113	107	101	96	91	87	83	80	76	73	71	68	65	
	17.5%	6245	2561	1350	757	412	343	293	255	226	203	184	168	155	143	133	125	117	110	104	99	94	89	85	81	78	74	71	69	66	64	
	20.0%	6090	2496	1315	738	402	334	285	249	221	198	179	164	151	140	130	122	114	107	101	96	91	87	83	79	76	72	70	67	64	62	
	22.5%	5935	2432	1281	719	392	326	278	243	215	193	175	160	147	136	127	118	111	105	99	94	89	84	80	77	74	71	68	65	63	60	
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ordinance for interruptible loads (AbLaV)  FFE Forschungsgesellschaft für Energiewirtschaft mbH

Merit Order of Demand Response in Industry (100 h / a)



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Vielen Dank für Ihre Aufmerksamkeit

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