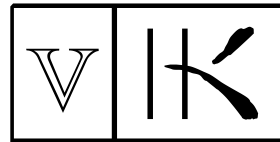


Motor Summit 2016, Zurich Switzerland



The proposed ecodesign measure for **standard air compressor packages**

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Compressed air, where to find it

- 4th Utility after electricity, gas and water
- High power-to-weight, no sparks, easy storage & distribution, clean & dry (if treated)
- It's everywhere:
 - general manufacturing
 - food & beverage
 - pharmaceutical & medical (e.g. dental tools)
 - paper & pulp, textile, electronics, chemical, oil & gas, waste water treatment, etc.

Compressed air, how to produce it

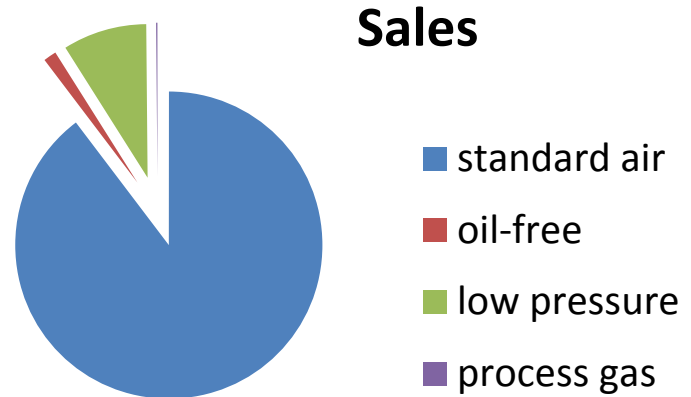
- Air (not forget: inert / hazardous gases)
- Positive displacement / dynamic
- Lubricated / oil-free
- Discharge pressure, pressure ratio
- Volume flow rate
- Flow control

Application ranges

- Standard air: lubricated, 7-15 bar(a)
- Oil-free air: no oil, 7-15 bar(a)
- Low pressure air: < 5 bar(a), usually no oil
- Process air / other gases: higher pressures, higher flows, safety

Choice for standard air

- Highest sales volume (+ 120.000 per year)
- Highest energy consumption (est.)
- Limited spread in technologies + controls:
 - positive displacement, oil lubricated
 - rotary: fixed + variable speed
 - piston: on/off
 - basic package



Environmental / economic impacts

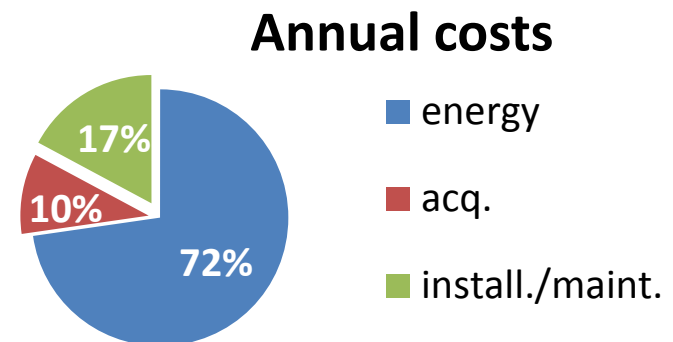
- Annual EU28 electricity consumption: 60 TWh/a
 - compare: Greece, Finland
 - 2% of EU overall electricity (3000 TWh/a)
 - 6% of EU industrial electricity (1000 TWh/a)
- 24 mton/a greenhouse gases (0.5% of EU, 2010)
- 4 billion euro energy costs

Fans: 149 TWh/a (0.125 kW and larger)

Pumps: 126 TWh/a

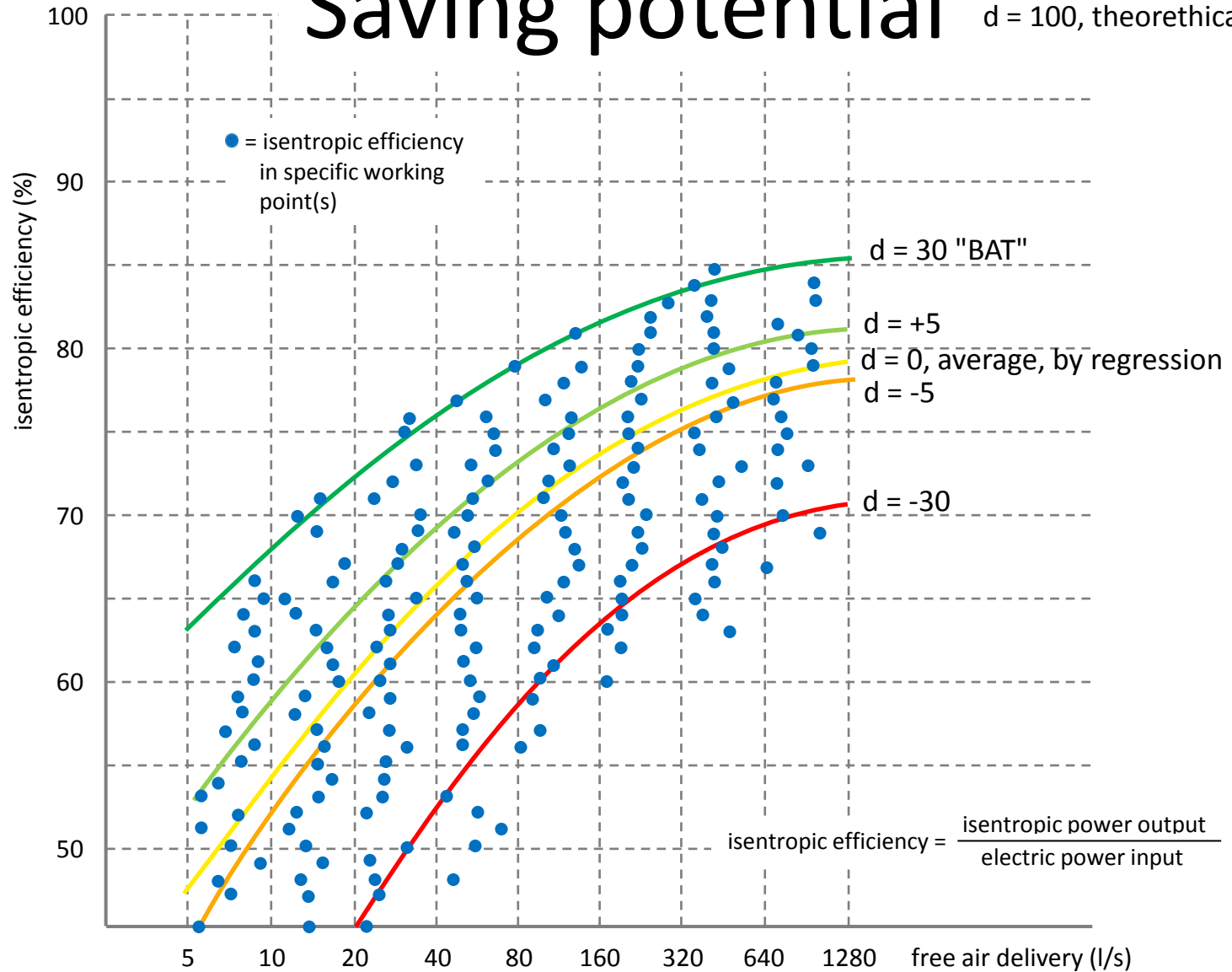
Electric motors: 1146 TWh/a (incl. double counting)

[Source: VHK, Ecodesign Impact Accounting, Jan 2016]

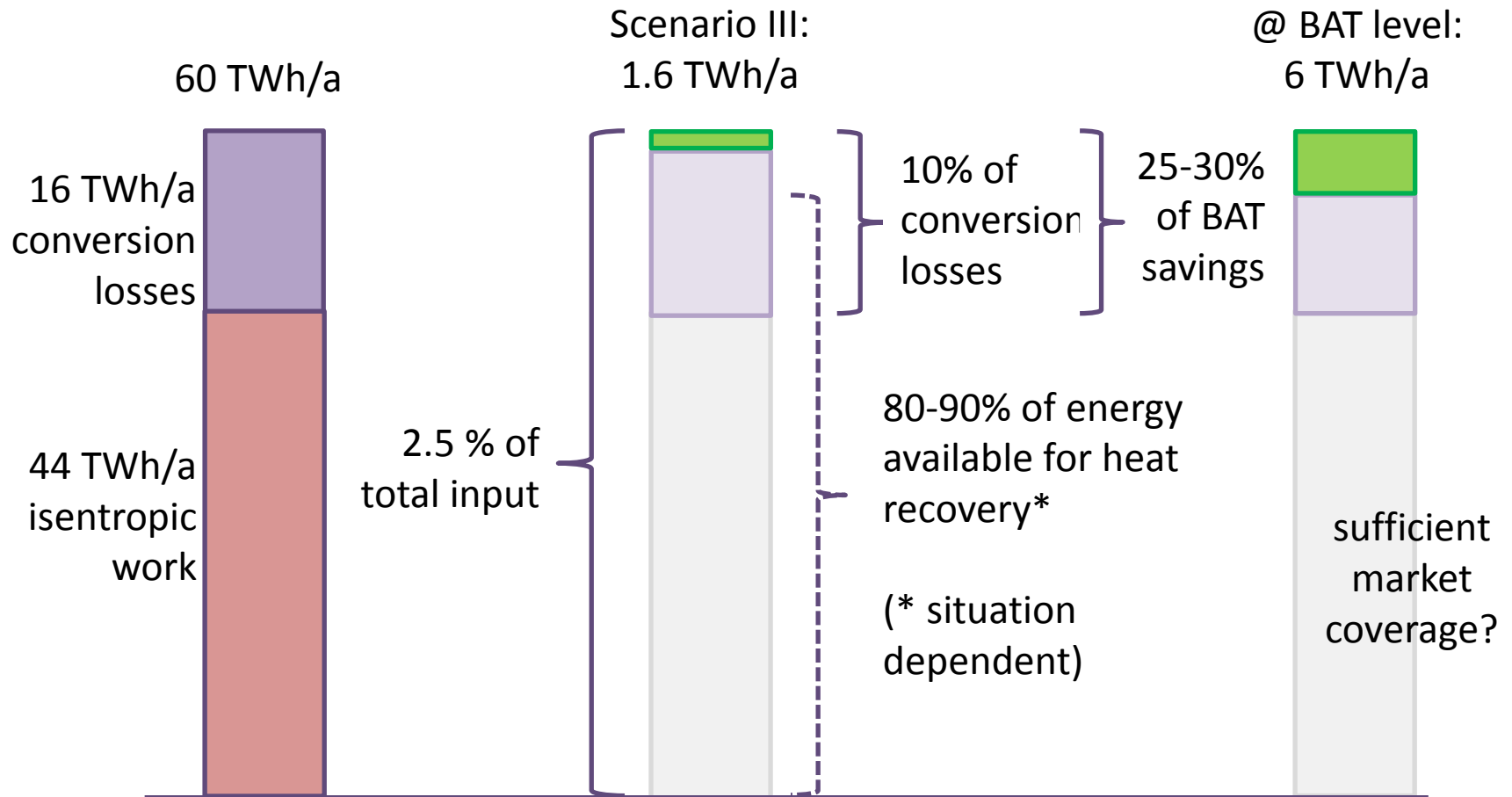


Saving potential

d = 100, theoretical max



Savings 2030

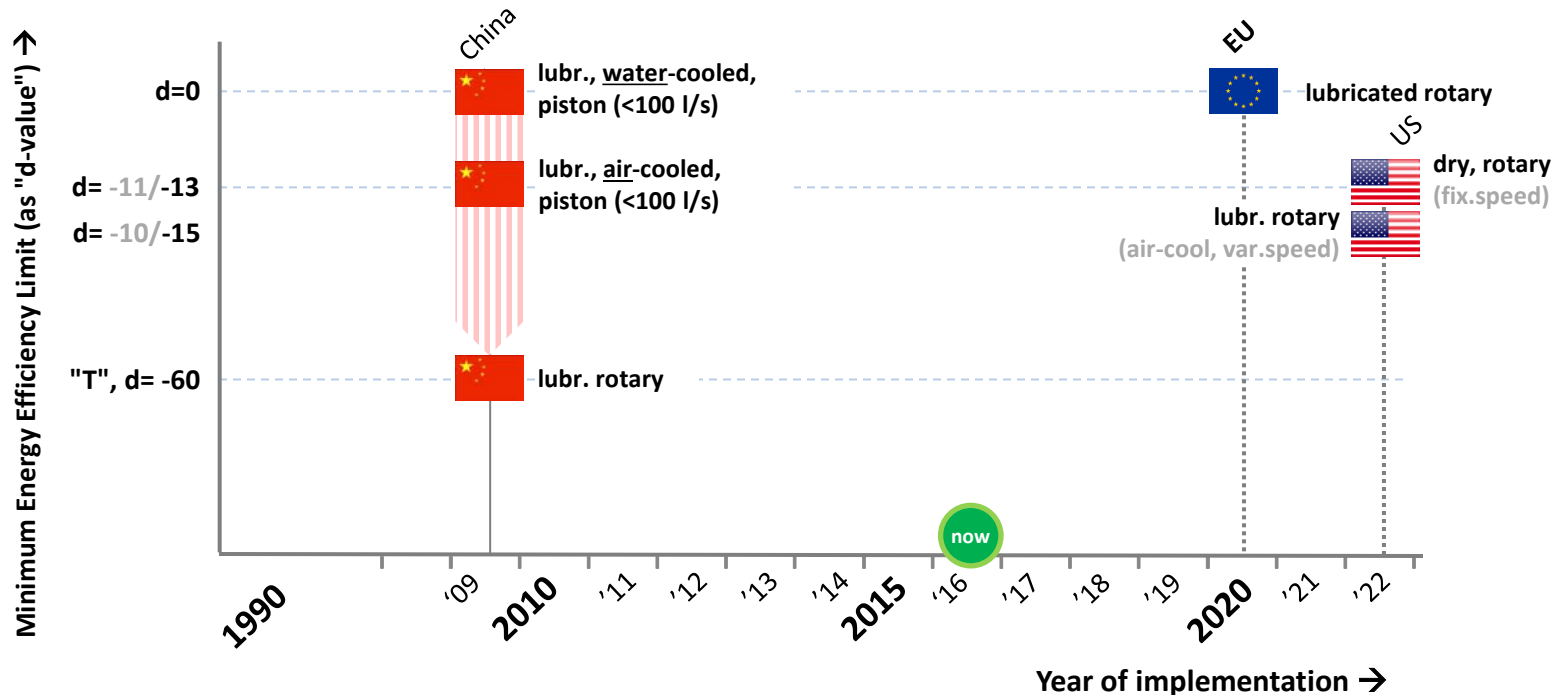


EU reasons to regulate compressed air

- Reduces energy consumption and Greenhouse Gas (GHG) emissions
- Reduces energy spending (costs)
- Promotes awareness (customer) & innovation (manufacturer)
- International developments
 - China 2009
 - USA 2016
 - EU dumping ground?

International comparison

Chinese requirements are in kW/(m³/min) for multiple categories (discharge pressure, cooling, lubr./dry)
not simple to express in d-value



Differences EU / USA



(WD 23 Oct 2014)



(NOPR 19 May 2016)

rotary (5-1280 l/s) + piston (2-64 l/s)
dynamic: under study

3-phase only

pressure: 7-15 bar(a)
low pressure: under study

lubricated only

no cooling categories

test: basic package, no features

3 categories

d=-5/0

rotary only (1-500 HP)
piston: excluded (but studied)
dynamic: excluded

1+3-phase

pressure: ~ 3-16 bar(a)
no low pressure specific approach

lubricated + oil-free

air- / water-cooled

test: features (e.g. drying) included

8 categories

d=-15/-10

Spec.energy kW/(m³/min) @ pressure 'x'

Drive Motor Input Power Rating kW	Energy Efficiency Grade	Rated Discharge Pressure											
		MPa											
		0.7		0.8		1.0		1.25					
18.5	75	3	6.09	6.62	7.21	6.50	7.06	7.26	7.88	8.59	8.12	8.82	9.60
		T	6.03	6.55	7.14	6.44	6.99	7.17	7.80	8.50	8.04	8.73	9.50
		1	5.40	5.71	6.09	5.76	6.10	6.41	6.72	7.24	6.86	7.29	7.88
	90	2	5.93	6.28	6.69	6.33	6.70	7.04	7.39	7.96	7.54	8.01	8.66
		3	6.08	6.61	7.20	6.49	7.05	7.25	7.87	8.58	8.11	8.81	9.59
		T	6.02	6.54	7.13	6.43	6.80	7.18	7.79	8.49	8.03	8.72	9.50
	110	1	5.31	5.61		5.67	5.98	6.34	6.66		6.80	7.22	
		2	5.84	6.16		6.23	6.57	6.97	7.32		7.47	7.93	
		T	6.02	6.55		6.42	6.99	7.17	7.79		8.02	8.72	
	132	1	5.96	6.49		6.36	6.92	7.10	7.71		7.94	8.63	
		2	5.27	5.51		5.61	5.87	6.27	6.55		6.69	7.12	
		T	5.79	6.05		6.17	6.45	6.89	7.20		7.35	7.82	
160	1	5.94	6.37		6.34	6.79	7.07	7.58		7.91	8.48		
	2	5.25	5.48		5.60	5.84	6.24	6.52		6.66	7.09		
	3	5.77	6.02		6.15	6.42	6.86	7.17		7.32	7.79		
200	1	5.94	6.34		6.34	6.76	7.04	7.54		7.88	8.45		
	2	5.25	5.44		5.60	5.81	6.21	6.49		6.62	7.04		
	T	5.77	5.98		6.15	6.38	6.82	7.13		7.28	7.74		
250	1	5.94	6.31		6.34	6.72	7.00	7.51		7.83	8.40		
	2	5.25	5.42		5.60	5.79	6.19	6.38		6.60	6.93		
	3	5.77	5.96		6.15	6.36	6.80	7.01		7.25	7.61		
315	1	5.93	6.31		6.33	6.72	7.00	7.46		7.83	8.35		
	2	5.93	6.23		6.33	6.65	7.07	7.45		7.91	8.33		
	T	5.87	6.17		6.27	6.58	7.00	7.38		7.83	8.25		
355	1	5.20	5.36		5.55	5.71							
	2	5.71	5.89		6.10	6.28							
	T	5.89	6.16		6.28	6.57							
400	1	5.83	6.10		6.22	6.50							
	2	5.20	5.35		5.55	5.71							
	T	5.71	5.88		6.10	6.27							
450	1	5.88	6.15		6.27	6.56							
	2	5.82	6.09		6.21	6.49							
	3	5.19	5.34		5.53	5.70							
500	1	5.70	5.87		6.08	6.26							
	2	5.87	6.14		6.26	6.55							
	T	5.81	6.08		6.20	6.48							

Note: for 55 kW compressors, values marked with an asterisk (*) denote single-acting air compressors, whereas unmarked values denote dual-acting air compressors.

Drive Motor Input Power Rating kW	Energy Efficiency Grade	Rated Discharge Pressure										
		MPa										
		0.7		0.8		1.0		1.25				
2.2	22	T	8.3	8.9	8.8	9.4	10.2	10.7	11.5	12.1		
		1	6.2	6.8	6.6	7.2	7.8	8.1	8.7	9.1		
		2	7.0	7.6	7.4	8.1	8.8	9.1	9.8	10.2		
	30	3	T	7.1	7.5	7.5	8.0	9.0	9.5	10.0	10.6	
		1	1	5.6	6.0	6.0	6.3	7.2	7.4	8.1	8.4	
		2	2	6.3	6.7	6.7	7.1	8.1	8.3	9.1	9.4	
	37	3	3	7.2	7.6	7.6	8.1	9.1	9.6	10.1	10.7	
		1	T	7.1	7.5	7.5	8.0	9.0	9.5	10.0	10.6	
		2	1	5.3	5.5	5.7	5.9	7.0	7.2	7.8	8.2	
	45	3	2	6.0	6.2	6.4	6.6	7.9	8.1	8.8	9.2	
		1	3	6.8	7.2	7.5	7.9	8.9	9.4	9.8	10.5	
		T	T	6.7	7.1	7.4	7.8	8.8	9.3	9.7	10.4	
55	1	1	5.3	5.5	5.7	5.9	7.0	7.2	7.8	8.2		
	2	2	6.0	6.2	6.4	6.6	7.9	8.1	8.8	9.2		
	3	3	6.8	7.2	7.5	7.9	8.9	9.4	9.8	10.5		
63	1	T	6.7	7.1	7.4	7.8	8.8	9.3	9.7	10.4		
	2	1	5.2		5.4		6.7		7.4			
	3	2	5.8		6.1		7.5		8.3			
75	1	3	6.4		7.1		8.5		9.4			
	2	T	6.3		7.0		8.4		9.3			
	3	1	5.2		5.4		6.7		7.4			
90	1	2	5.8		6.1		7.5		8.3			
	2	3	6.4		7.1		8.5		9.4			
	T	T	6.3		7.0		8.4		9.3			
110	1	1	5.2		5.4		6.7		7.4			
	2	2	5.8		6.1		7.5		8.3			
	3	3	6.4		7.1		8.5		9.4			
132	1	T	6.3		7.0		8.4		9.3			
	2	1	5.2		5.4		6.7		7.4			
	3	2	5.8		6.1		7.5		8.3			
150	1	3	6.4		7.1		8.5		9.4			
	2	T	6.3		7.0		8.4		9.3			
	3	1	5.2		5.4		6.7		7.4			
18.5	1	2	5.8		6.1		7.5		8.3			
	2	3	6.4		7.1		8.5		9.4			
	T	T	6.3		7.0		8.4		9.3			
22	1	1	5.2		5.4		6.7		7.4			
	2	2	5.8		6.1		7.5		8.3			
	3	3	6.4		7.1		8.5		9.4			

Concluding

- EU regulators: relatively simple measure to unlock significant savings in largest market segment:
 - Saving 1.6 TWh/a compensates 1 day residential electricity use for each EU household (assuming 3000 kWh/hh.a, 210 mio hh.) → "annual compressor day"
- Manufacturers: creates level playing field for minimum package efficiency
 - need innovation for heat recovery: heat-to-energy within package?
- Customers: lower Total Cost of Ownership (TCO), higher awareness of efficiency
- Local authorities: link measure to system audits, site permits; improve system efficiency (lot to gain there!)

What's next

- EU:
 - Finalise Impact Assessment phase 'standard air'
 - Finalise 2nd Lot 31 'low pressure + oil-free' (March '17)
 - See: www.eco-compressors.eu
- USA:
 - Final rule still this year?
 - See: <https://www.regulations.gov/docket?D=EERE-2013-BT-STD-0040>

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