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The extended product approach

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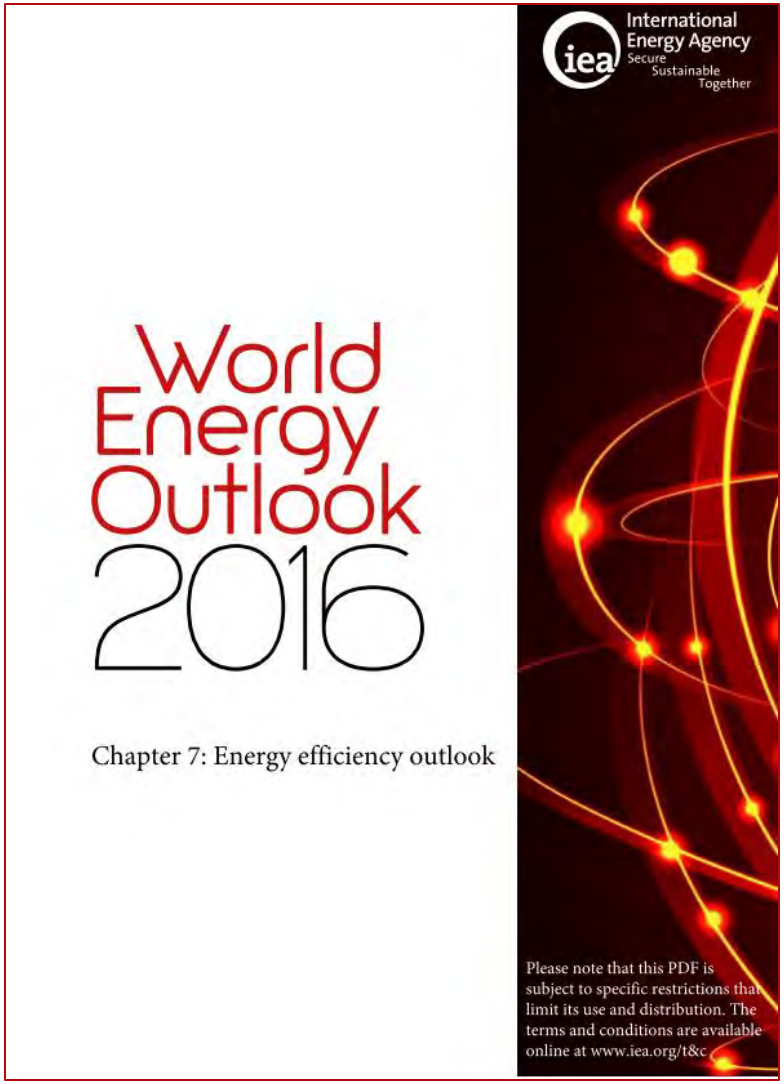
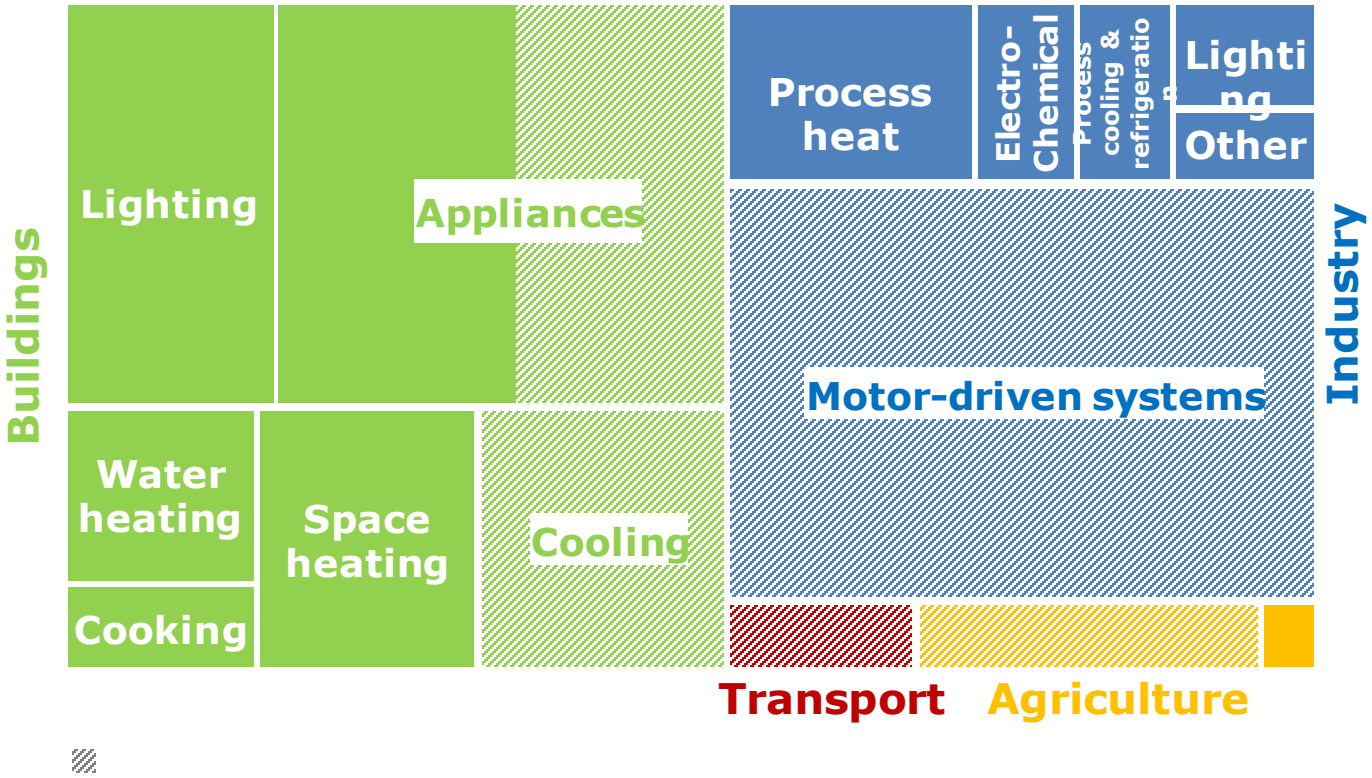
IEA published recommendations in their 2016 World Energy Outlook

- Motors and motor driven systems use more than half of the electrical energy produced in the world => optimizing the energy efficiency of motor driven systems is a key to achieving energy savings and CO_2 abatement goals



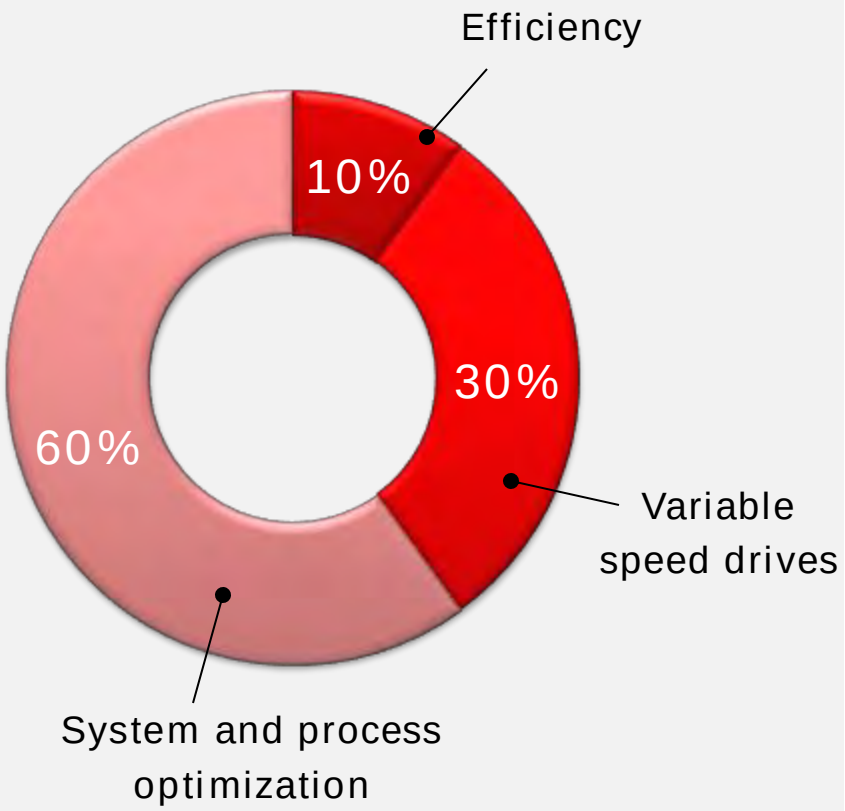
Efficiency: motors matter!

Global total final electricity consumption by end-uses, 2014



Motors account for about 53% of today's electricity consumption

Savings potential

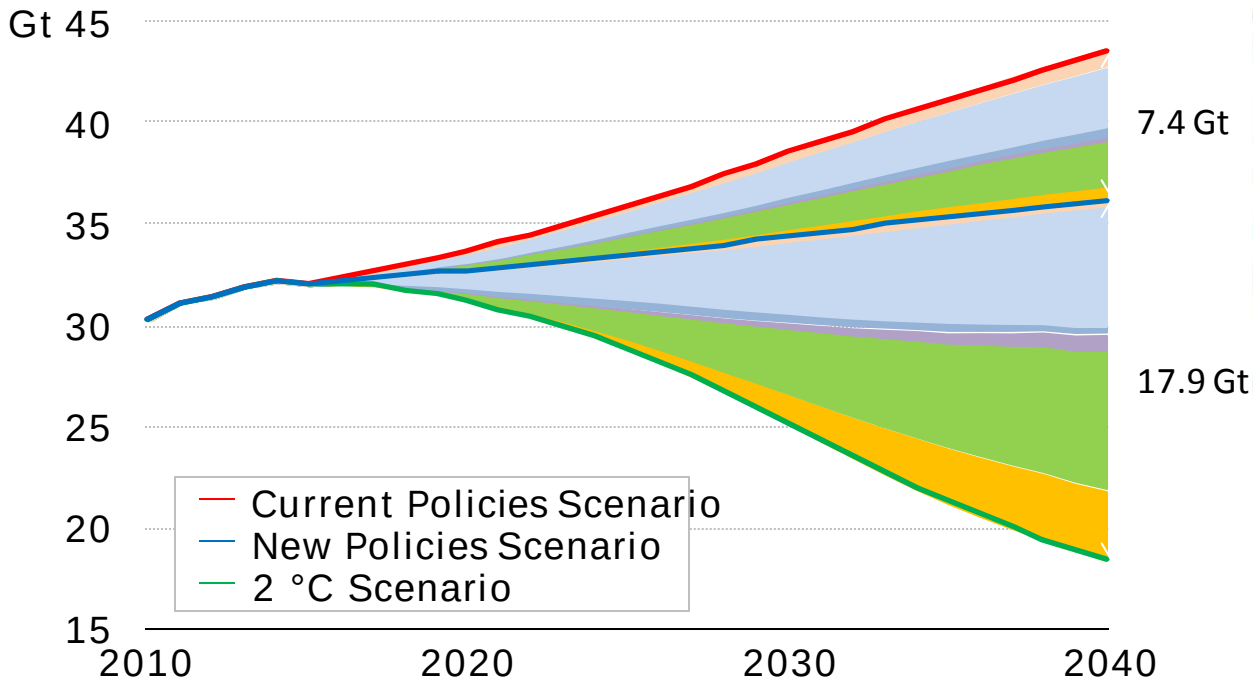


Source: SAVE Report of EU & ZVEI

- 10% - Increase component efficiency
- 30% - Use variable speed drives
- 60% - System and process optimization
- Recent years' political initiatives to improve the efficiency of motor systems focused mainly on component level efficiency
- 90% of the total savings potential remains insufficiently addressed

Current energy efficiency policies leave large potentials untapped

World energy-related CO_2 emissions abatement by scenario

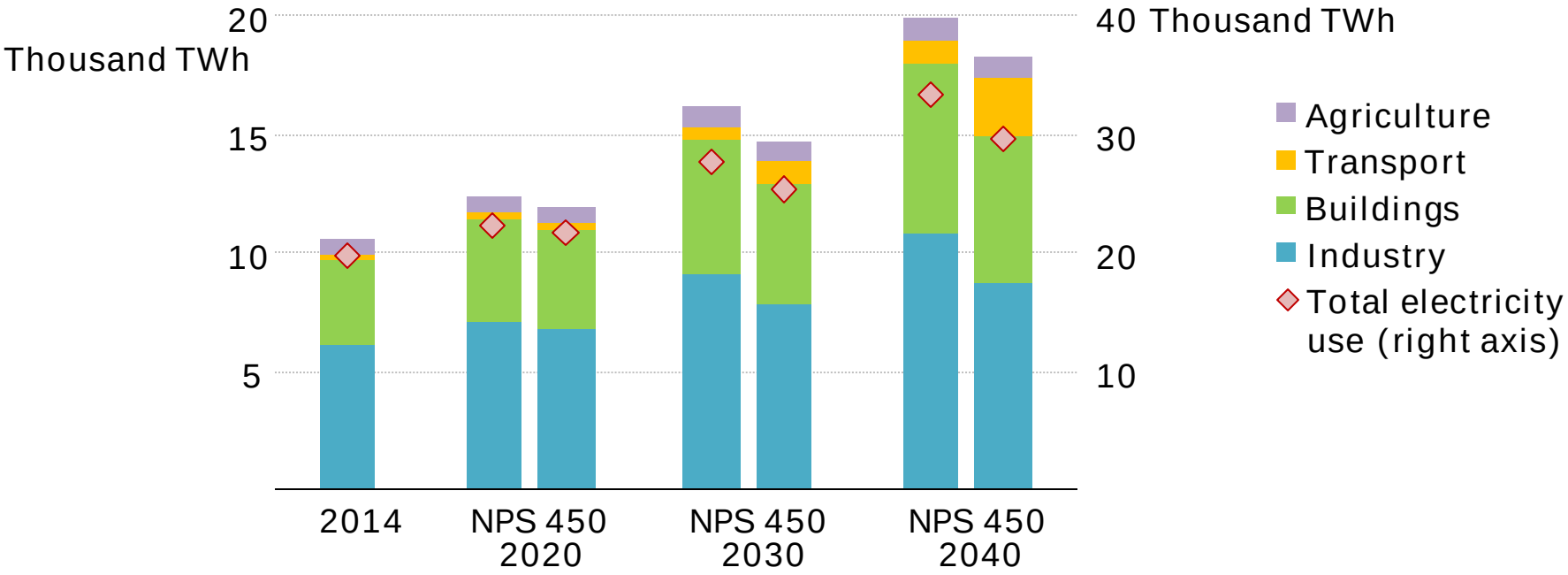


CO_2 abatement in 2040	CPS to NPS	NPS to 450
Activity effect	12%	2%
End-use efficiency	39%	35%
Supply efficiency	6%	3%
Fuel and technology switching in end-uses	3%	7%
Renewables	32%	38%
Nuclear and CCS	9%	15%
Total (Gt CO_2)	**7.4**	**17.9**

Energy efficiency is a key abatement measure in our main scenario & 2 °C Scenario

Targeting efficiency of electric motor systems is key to limit demand growth

Global final electricity consumption in motor-driven systems in the New Policies (NPS) & 2 °C Scenarios (450)

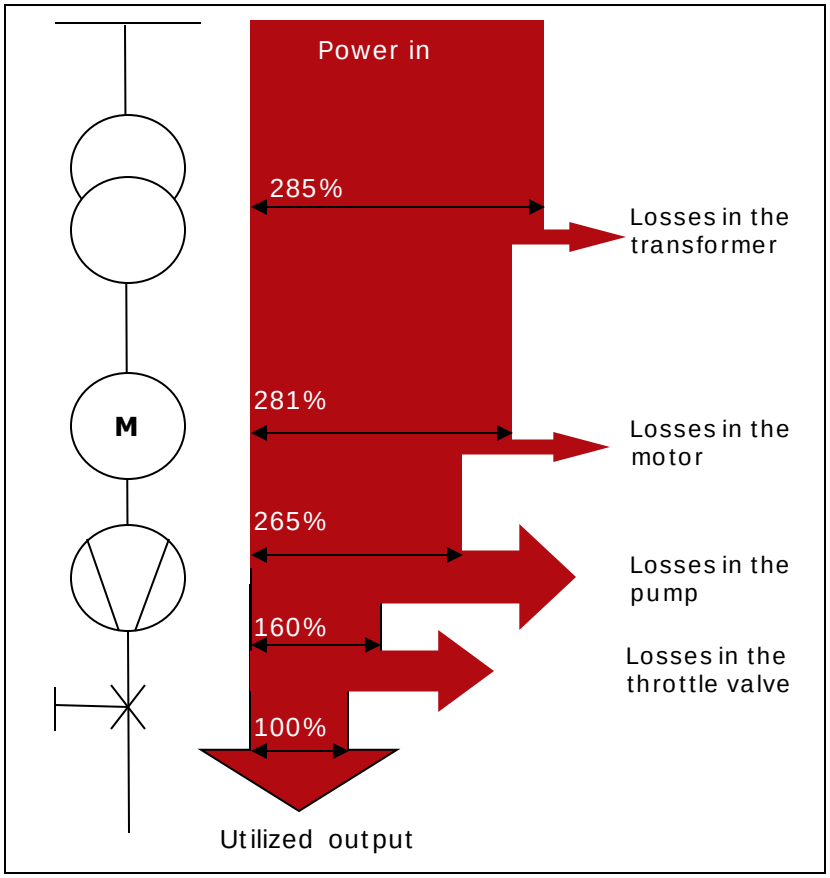


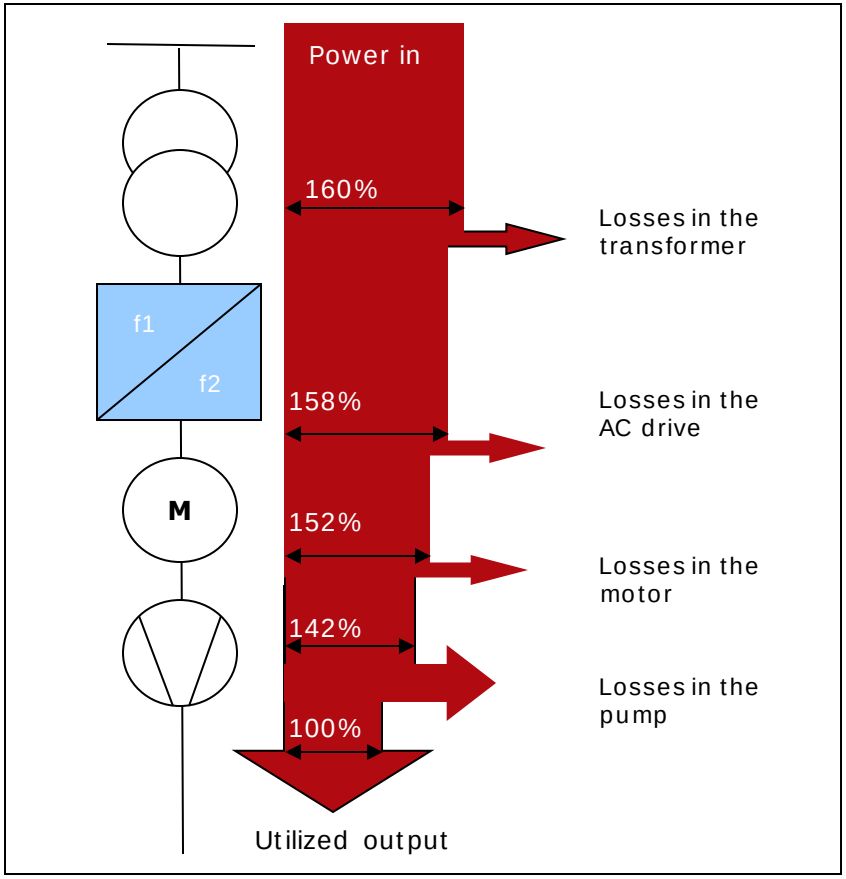
Electricity consumption almost doubles to 2040 in our main scenario with significant savings untapped

Conclusions – WEO 2016 by IEA

- Today electric motors consume 53% of global electricity. 30% of global electricity (6000TWh) is used in industry
- By 2040, increased industrial activity would double global electricity use for motors, but today's efficiency policies constrain that growth to 80%
- A system-wide energy efficiency approach – as in the 450 Scenario – would reduce global electric motor consumption by 8% in 2040 (1600TWh ~ 250 large coal powerplants or half EU 28)
- In industry the system wide approach potentially can reduce electric motor consumption on average by 40%
- Additional investment in industrial systems of around $300 billion is outweighed by avoided investment in power supply of $450 billion

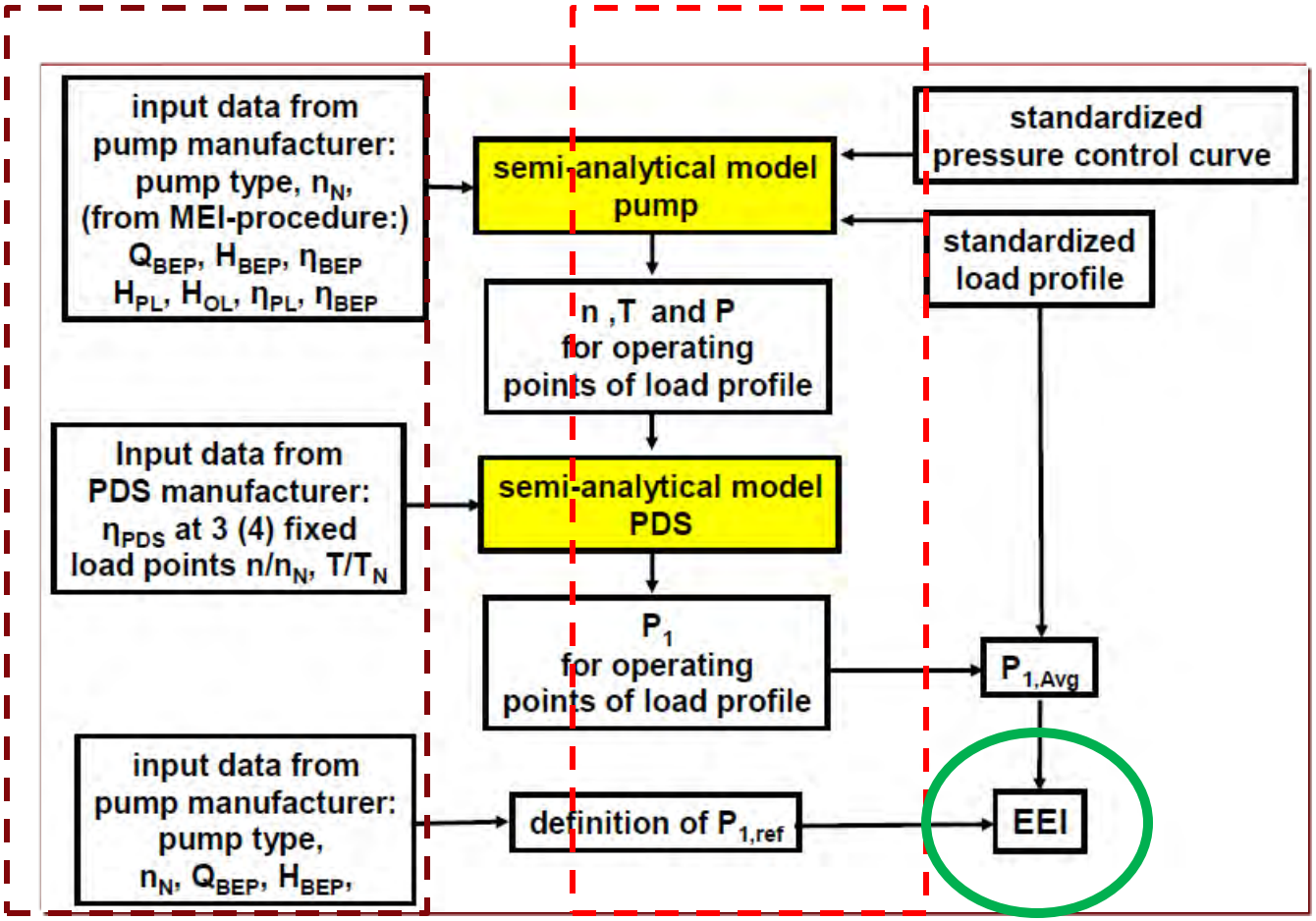
System energy efficiency is not a product of component energy efficiency





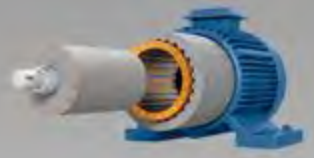
- Source ZVEI
- Energy savings 44% in this example

Scheme of determination EEI



Motor technologies

Induction motor ✓



IM with copper rotor ✓

PM motor ✓
(Surface monted magnets)

PM motor ✓
(Interior permanent magnets)

Line start PM motor ✓

Synchronous reluctance motor ✓

- Using a variable speed drive enables the use of alternative motor technologies with high efficiency levels (IE4 and superior) such as: permanent magnet motors (PMSM) and synchronous reluctance motors (SynRM)
- Example: Motor 18.5 kW, pre IE1, 4160 h/a, average electrical load 12.7 kW

	Annual energy use	Savings compared to baseline
Baseline	52.633 kWh	-
DOL IE3	49.672 kWh	2.961 kWh
VSD IE1	27.270 kWh	25.363 kWh
VSD IE3	24.433 kWh	28.200 kWh
VSD PMSM (IE4)	**23.286 kWh**	**29.347 kWh**

Conclusions

- By 2040, increased industrial activity would double global electricity use for motors, but today's efficiency policies constrain that growth to 80%
- System level optimization results in the highest energy savings, but require a shift in policy attention to a system-wide energy efficiency approach – as in the 450 Scenario (IEA)
- The regulatory challenge in promoting savings in highly diverse industrial motor systems is more difficult than in other end-use sectors => **The extended product approach to be used for all new initiatives in energy efficiency**
- Authorities and regulators are encouraged to focus less on component efficiency and more on system efficiency in legislation and regulation
- Open availability of efficiency data, also in part load conditions, to be used in optimal system design
- Use of energy optimized motor control is key to harvest the efficiency potential of electric motors

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