The scope for energy savings from Energy Management

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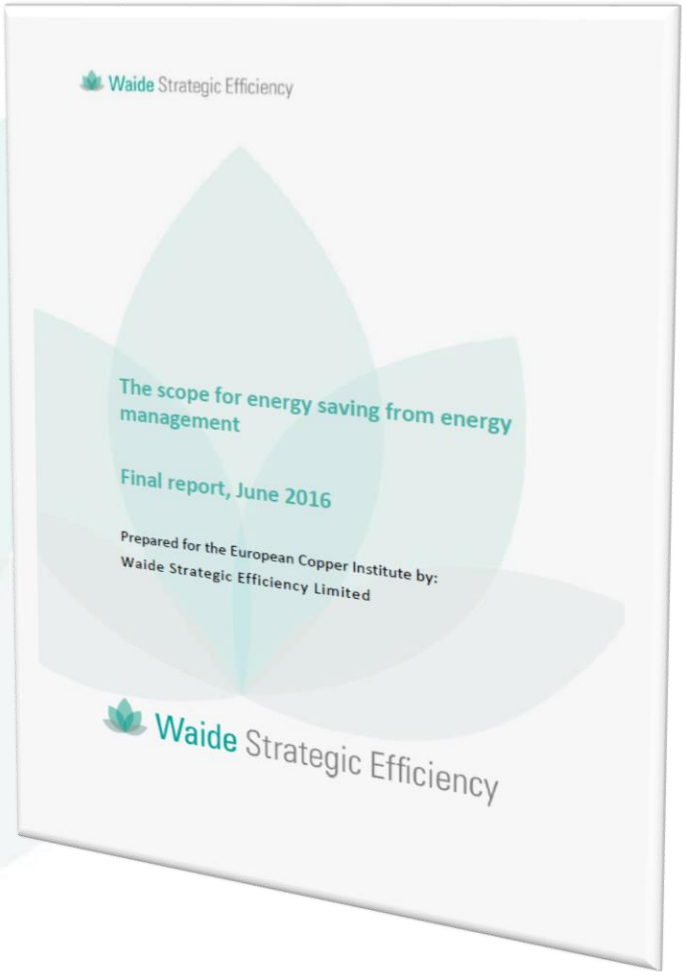
Findings from a recent study published on Leonardo Energy

Assesses the state of EM in the EU covering:

- industry and building sectors
- adoption levels and current practice
- drivers and barriers
- impacts, costs and savings potentials
- policy experiences
- recommendations



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What is energy management?

- no single definition but can be said to entail the proactive, organised and systematic coordination of procurement, conversion, distribution and use of energy to meet an organisation's requirements, taking into account environmental and economic objectives
- in the tertiary and industrial sectors its operation addresses facility management, logistics, procurement, production, planning and control, maintenance and IT
- its implementation requires an organisation to develop an energy management strategy as the key tool to implement its energy policy

Five key steps in energy management

- ENERGY POLICY - Established by senior management and defines the overall guidelines for the efforts to achieve greater energy efficiency and other energy policy objectives
- PLANNING - Identify the significant sources of energy consumption and savings potentials. Determine the order of priority of the energy saving efforts, set targets and elaborate action plans in line with policy
- IMPLEMENTATION AND OPERATION - Involve employees in the implementation of the objectives and ensure better use of energy becomes a part of daily routines including within purchasing, operation and maintenance, energy efficient design activities etc.
- CHECKING AND CORRECTIVE ACTIONS - Monitoring all significant energy consumption flows and activities. Take corrective and preventive actions
- MANAGEMENT REVIEW - Management periodically evaluates the implementation of the plan, objectives and operational control to ensure its continuing suitability in the light of the commitment to continual improvement

Techniques and tools

Energy management implementation is facilitated by specific techniques and tools

The key techniques are: energy audits, monitoring and benchmarking

The key tools are energy management and related standards:

- EN ISO 50001: 2011 *Energy management systems -- Requirements with guidance for use*
- EN 16247 series (1-6) and ISO 50002 on energy audits
- ISO 50004:2014 on implementation of energy management systems
- ISO 50006:2014 *Energy management systems -- Measuring energy performance using energy baselines (EnB) and energy performance indicators (EnPI)*
- ISO 50015:2014 Energy management systems -- Measurement and verification of energy performance of organizations
- EN 16231:2012 Energy efficiency benchmarking methodology
- EN 16212:2012 Energy Efficiency and Savings Calculation, Top-down and Bottom-up Methods

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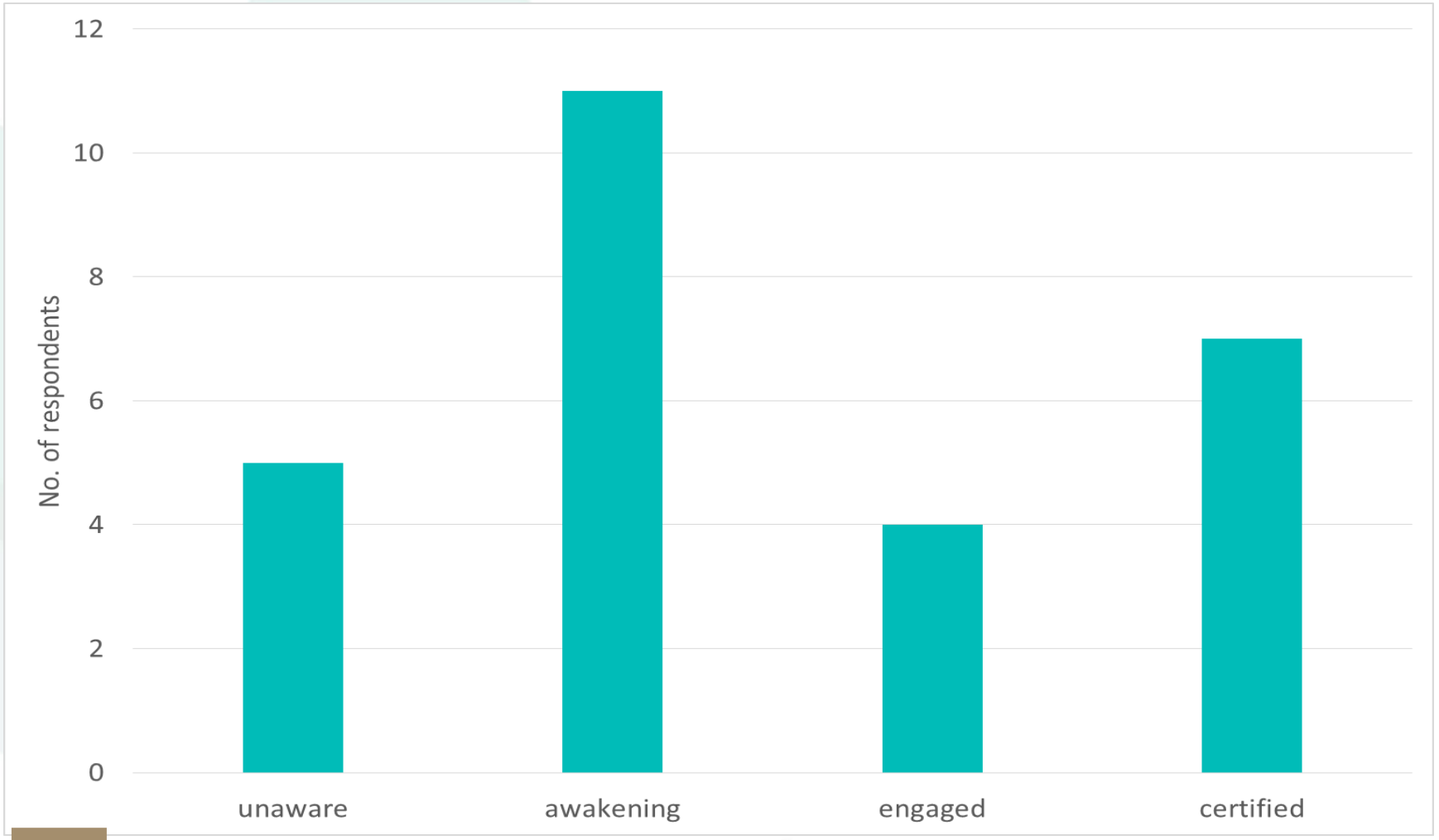
Degrees of energy management

EM strategies and practices can be grouped into the following categories ranked from least to most proactive approaches:

- no systematic planning; where an organisation only deals with the most essential issues and has no dedicated management process for energy
- short-term profit maximisation: where management is focused exclusively on measures that have a relatively short payback period and a high return
- longer-term profit maximisation: where measures with a longer term payback are also implemented
- realisation of all financially attractive energy measures: where all measures are implemented that have a positive return on investment
- climate optimisation strategy: where the organisation is willing to invest in all measures that meet a climate impact mitigation strategy and may go beyond purely cost-effective measures

Levels of adoption of EM – findings from an ECI survey



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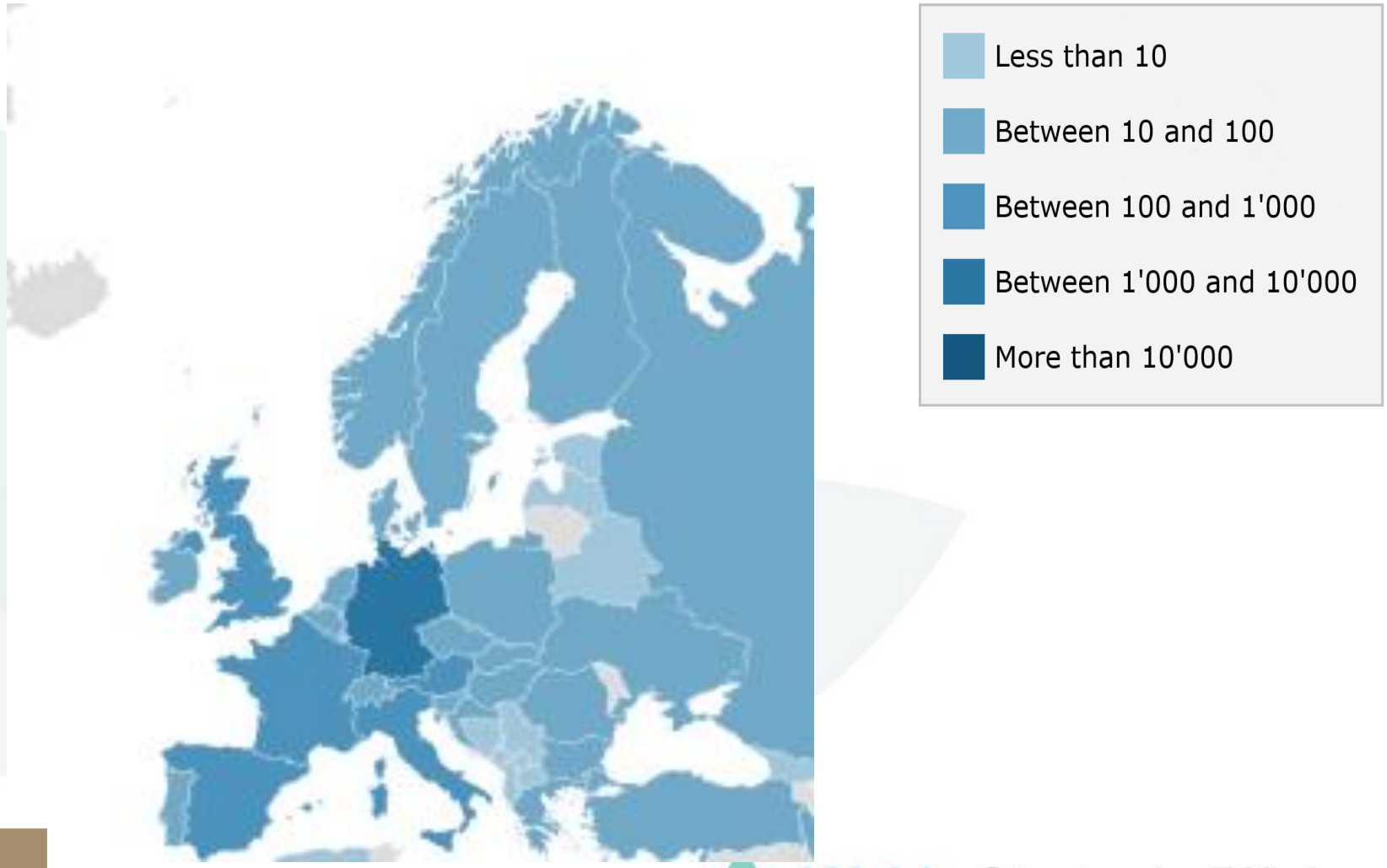
Distribution of EN ISO 50001 certification by European country in 2014



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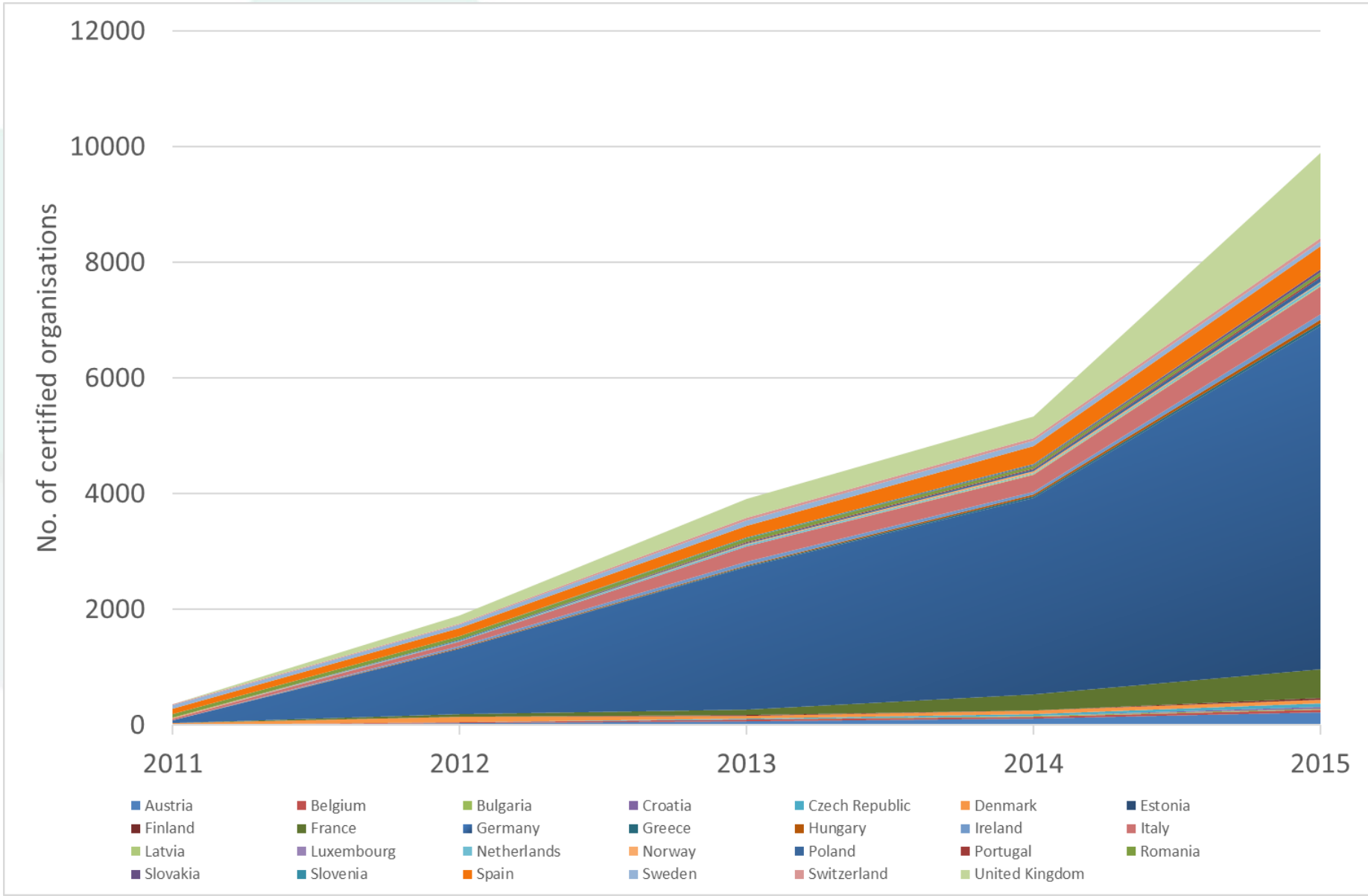
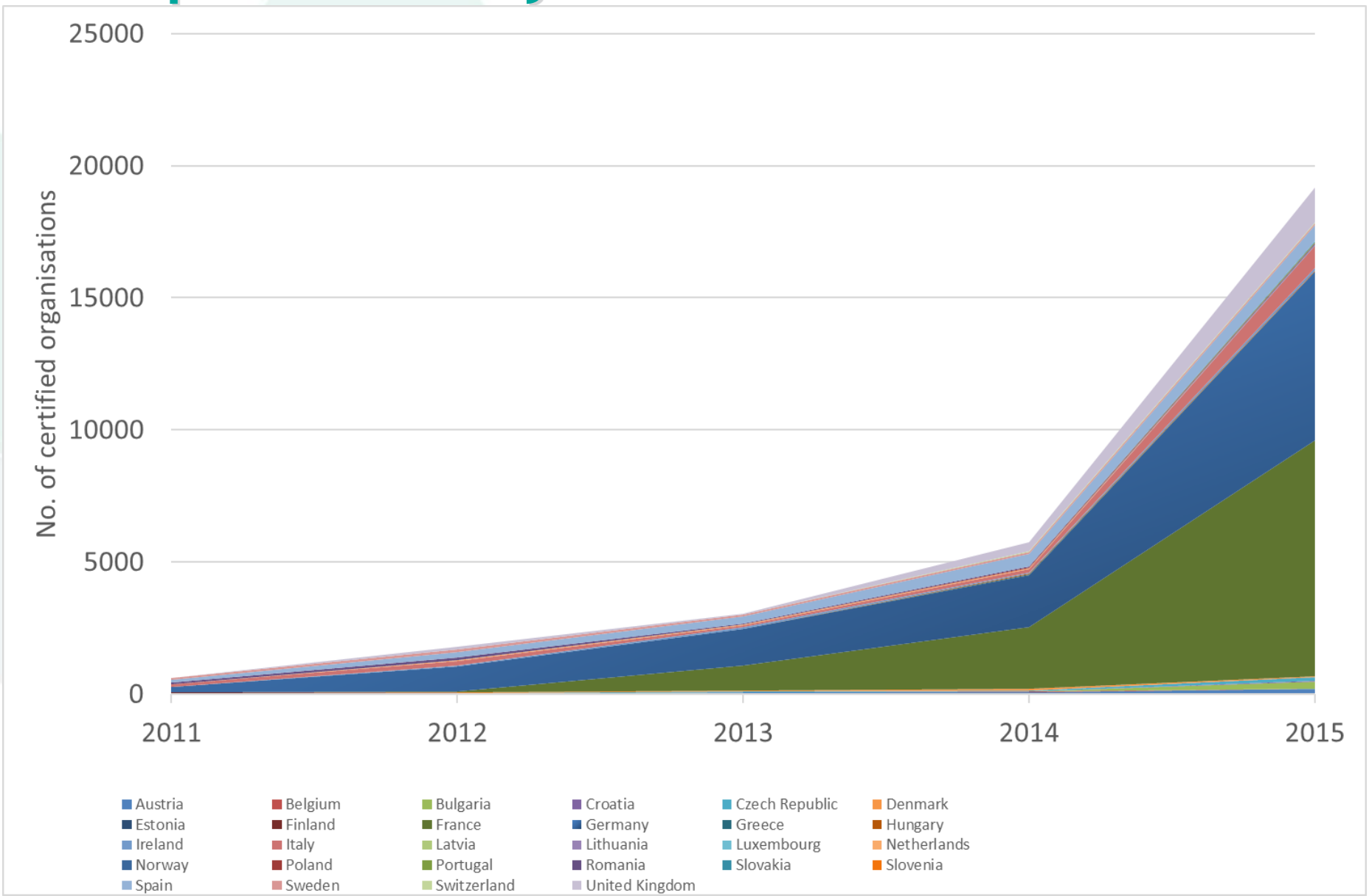
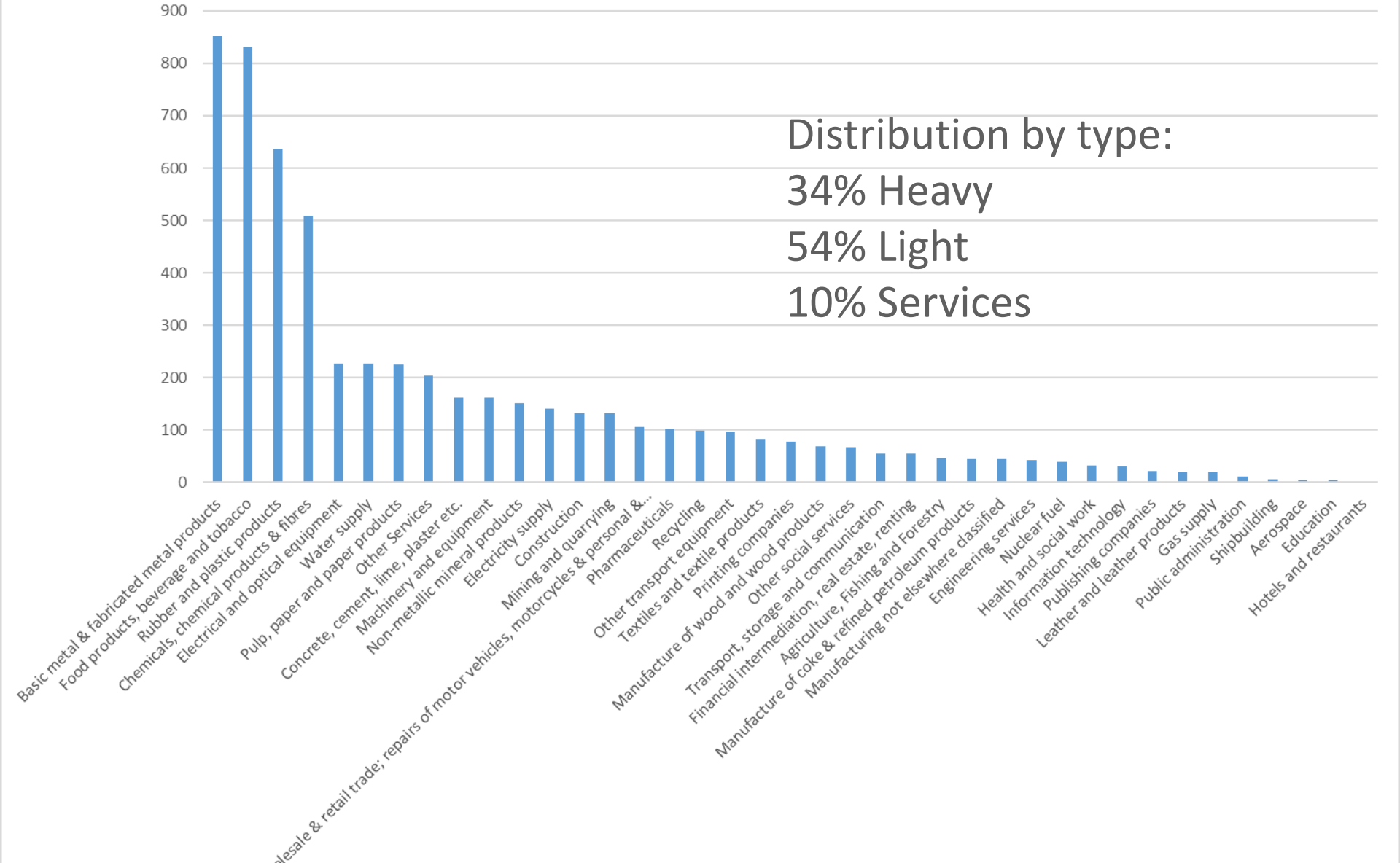
Distribution of EN ISO 50001 certification by European country from 2011 to 2015



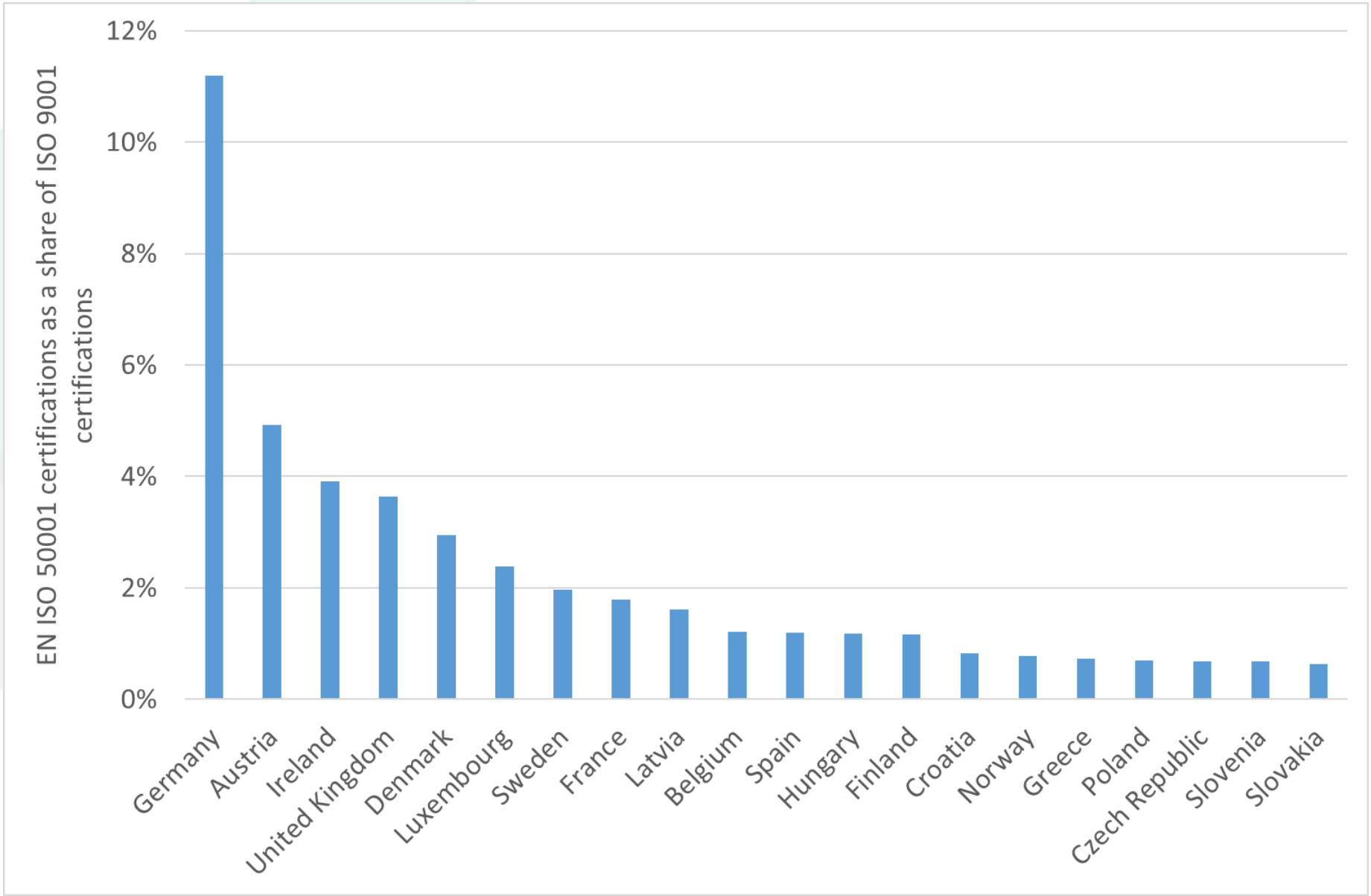
EN ISO 50001 site certifications by European country from 2011 to 2015



Distribution of EN ISO 50001 certification by European industry sector in 2015



EN ISO 50001 certifications as a share of ISO 9001 certifications by country in 2015



Levels of adoption of EM

Just 2.8% of medium to large European companies had adopted EN ISO 50001 in 2015

- there is a broad spectrum of behaviours currently seen but on average EM adoption is well below economically rational levels
- energy intensive and larger organisations are much more likely to have adopted proactive energy management strategies
- very few organisations adopt strategies to realise all financially attractive measures and even less to optimise their climate impact
- the case of no systematic planning predominates in SMEs
- short term profit maximisation is most common in other commercial enterprises such that measures with payback periods of beyond 2 years are seldom considered.

Current situation in the EU

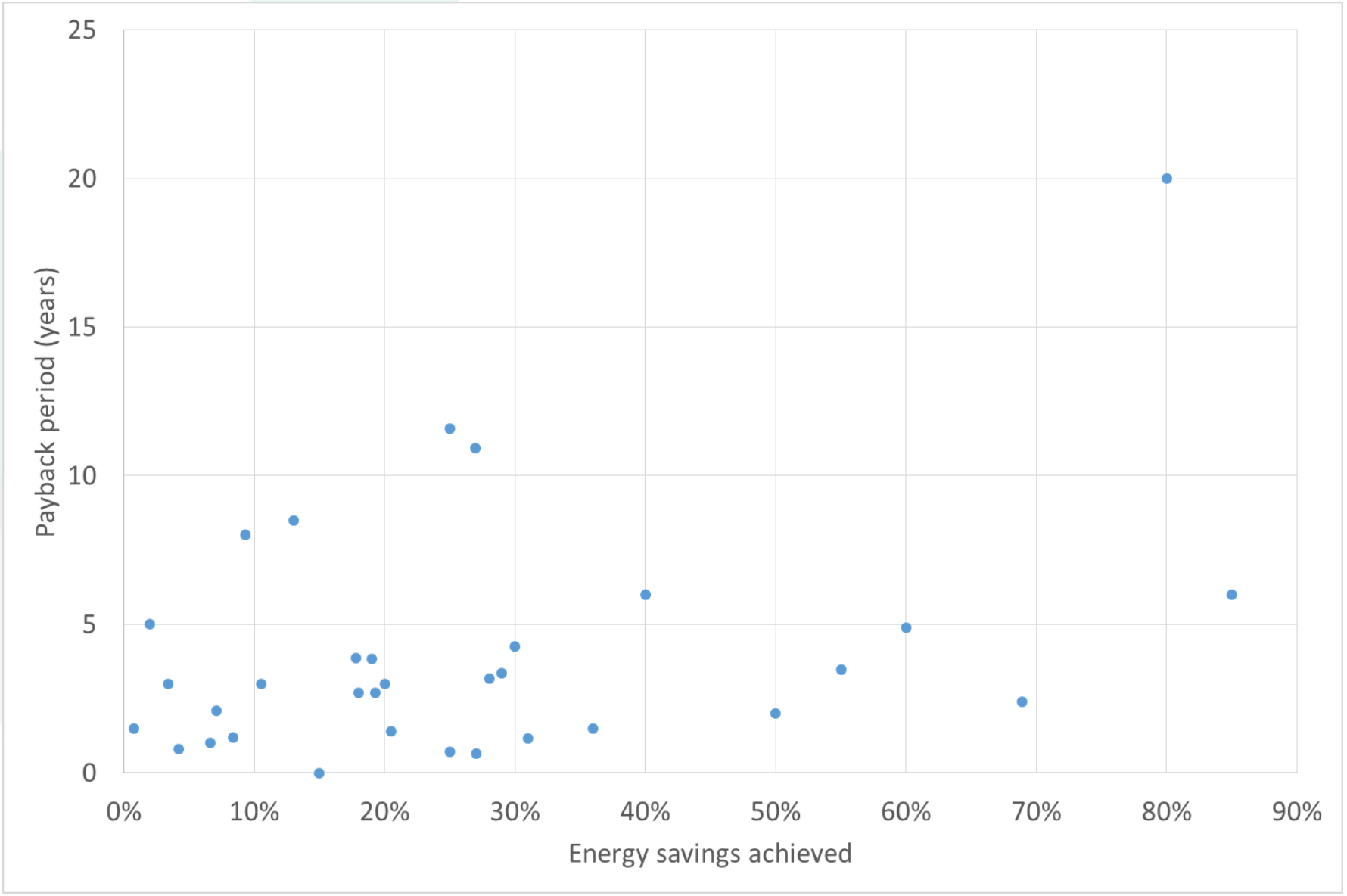
- certification to EN ISO 50001 is growing quite rapidly from a low base
- motivation to be certified is driven by economic incentives (stimulated by public policy) resulting in a major asymmetry in the level of certification by EU Member State
- awareness of energy management and its significance is increasing yet most organisations are struggling to implement it effectively
- they tend to operate conservative, risk-averse strategies that avoid deflecting time and effort from core business activities
- given this situation there remains a considerable scope to develop more sophisticated EM strategies that mine the cost effective savings potentials more fully

Energy savings potential analysis

- partially based on a meta-analysis of several energy savings potentials studies across the EU
- for the industrial sector it is combined with an analysis of 53 case studies across a wide range of industrial sectors from FR, DE, UK
- integrated into separate stock models for EU industry and EU service sector buildings (note other uses, such as data centres were not assessed)
- the buildings stock model is the same one used to provide the detailed assessment of savings potentials from building automation and control systems (BACS) in WSE 2013 study[1]
- base case scenarios aligned with IEA World Energy Outlook

[1] http://www.leonardo-energy.org/white-paper/building-automation-scope-energy-and-co2-savings-eu

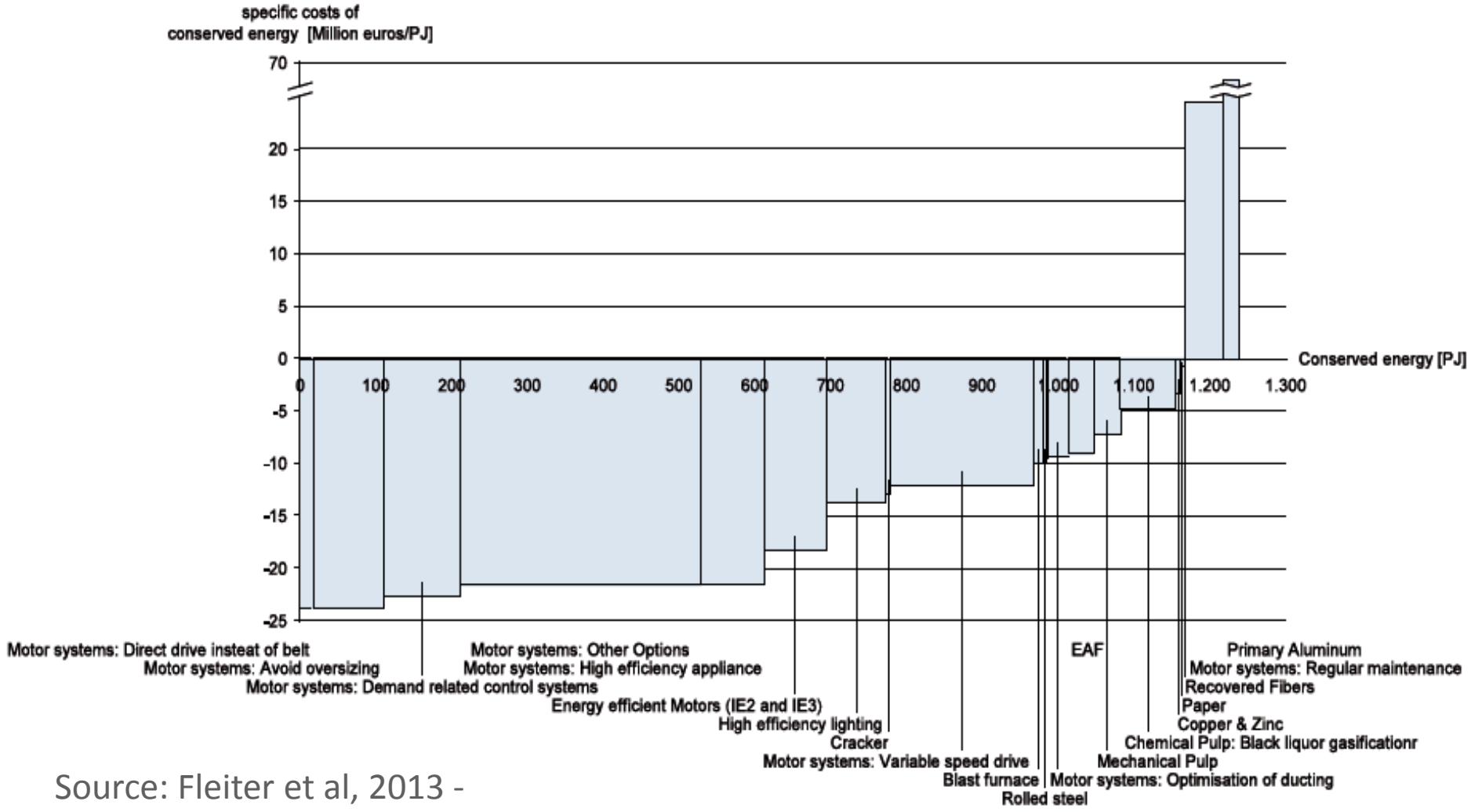
Payback period versus savings from 53 EM industrial case studies in DE, FR, UK



Payback period versus savings from 53 EM industrial case studies in DE, FR, UK

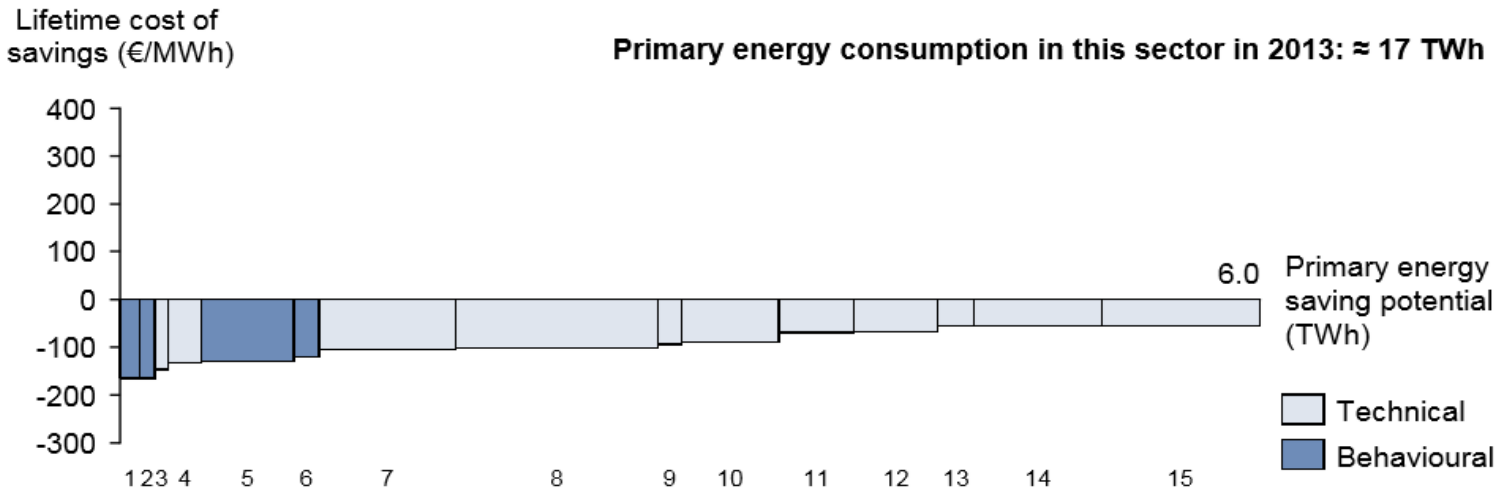
- the payback periods ranged from 0 to 20 years with an average of 4.4 years
- the savings potentials ranged from less than 1% to 85% with an average of 26%
- most commonly the EM projects produced savings between 11 and 30% of total energy consumption but much larger savings potentials were also delivered in some instances
- there is no correlation between the payback period and the savings potentials

Energy efficiency cost curve analysis e.g. EU industrial sector



Source: Fleiter et al, 2013 - Fraunhofer Institute

Energy efficiency cost curve analysis e.g. commercial buildings in Ireland



Measure	PE saving (TWh)	Measure	PE saving (TWh)
Total technical measures	**5.15**	14. Energy efficient glazing	0.67
3. Energy efficient appliances - Refrigeration	0.07	15. Heat pump	0.82
4. Draught proofing	0.17		
7. Roof insulation	0.71	**Total behavioural measures**	**0.80**
8. Energy efficient lighting with lighting control	1.11	1. Turn off lights for extra hours	0.10
9. Cavity wall insulation	0.12	2. Enable standby features on all PCs and monitors	0.08
10. More efficient air conditioning	0.51	5. Reducing room temperature	0.49
11. More efficient boiler with heating control	0.39	6. Reducing hot water use	0.13
12. Solid wall insulation	0.44		
13. Energy efficient appliances - Office equipment	0.19	**Total**	**5.95**

Source: J. Scheer (2015)
Sustainable Energy Authority Ireland

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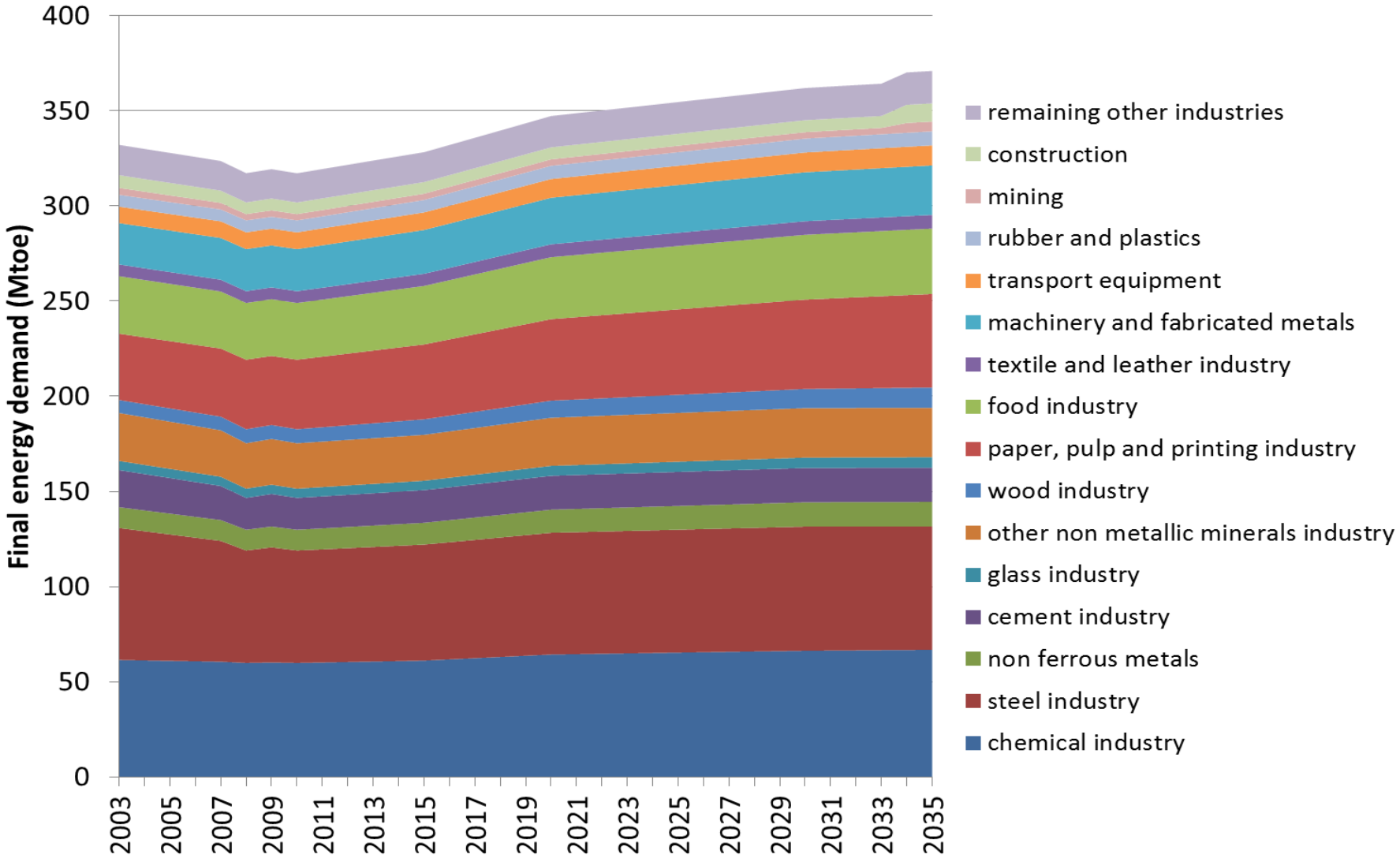
Energy scenarios considered

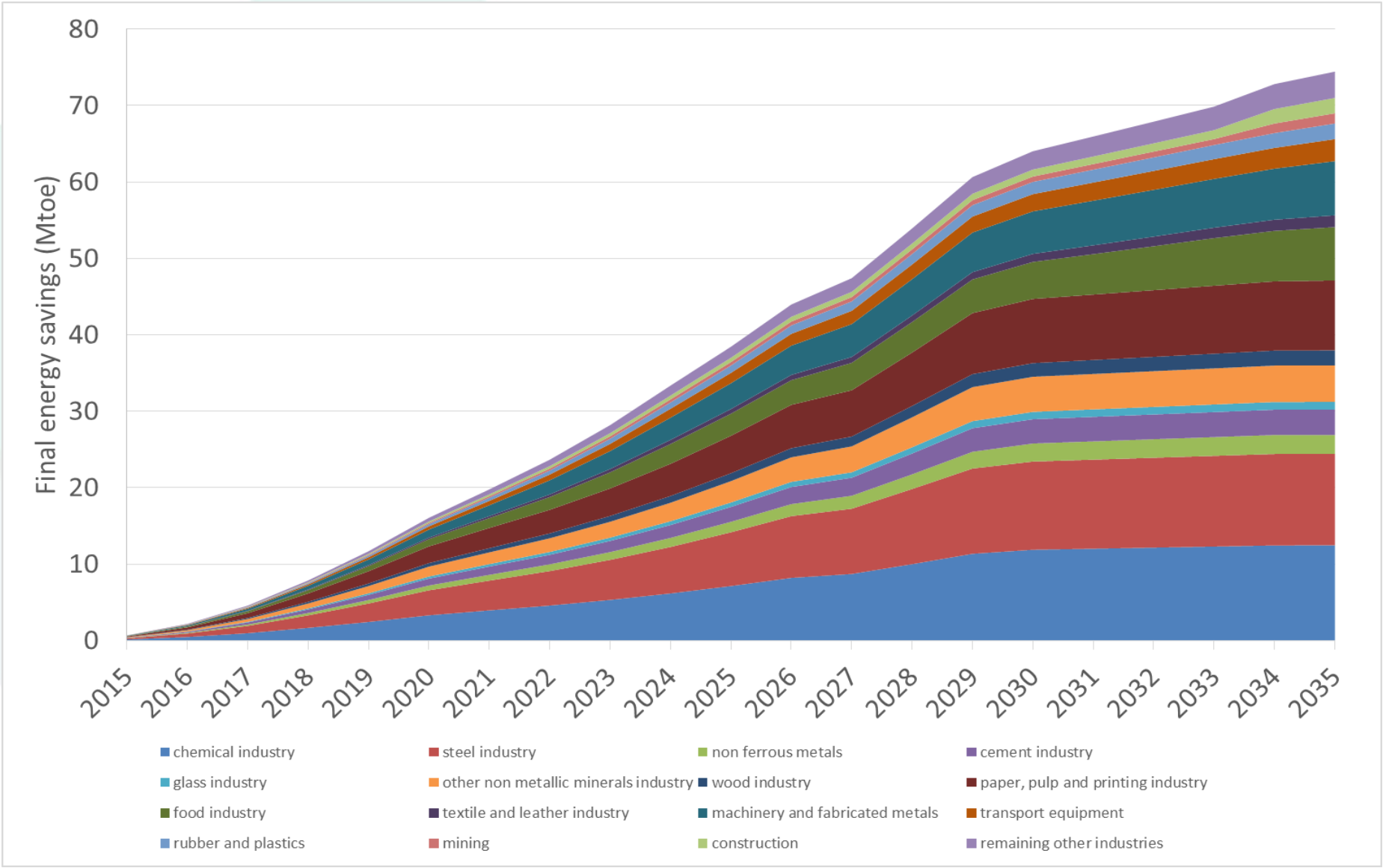
To clarify the value proposition from broader adoption of effective energy management a set of scenarios were developed as follows:

- A *Reference Scenario* that considers the energy use by sector that is anticipated with a continuation of current trends
- A techno-economic *Optimal Scenario* that considers the energy use by sector that would be expected were all cost-effective energy management options to be adopted as rapidly as is realistically technically feasible
- A *Recommended Action Scenario* that explores what savings from energy management would be expected to be achieved were the specific recommendations in the study to be implemented across the EU

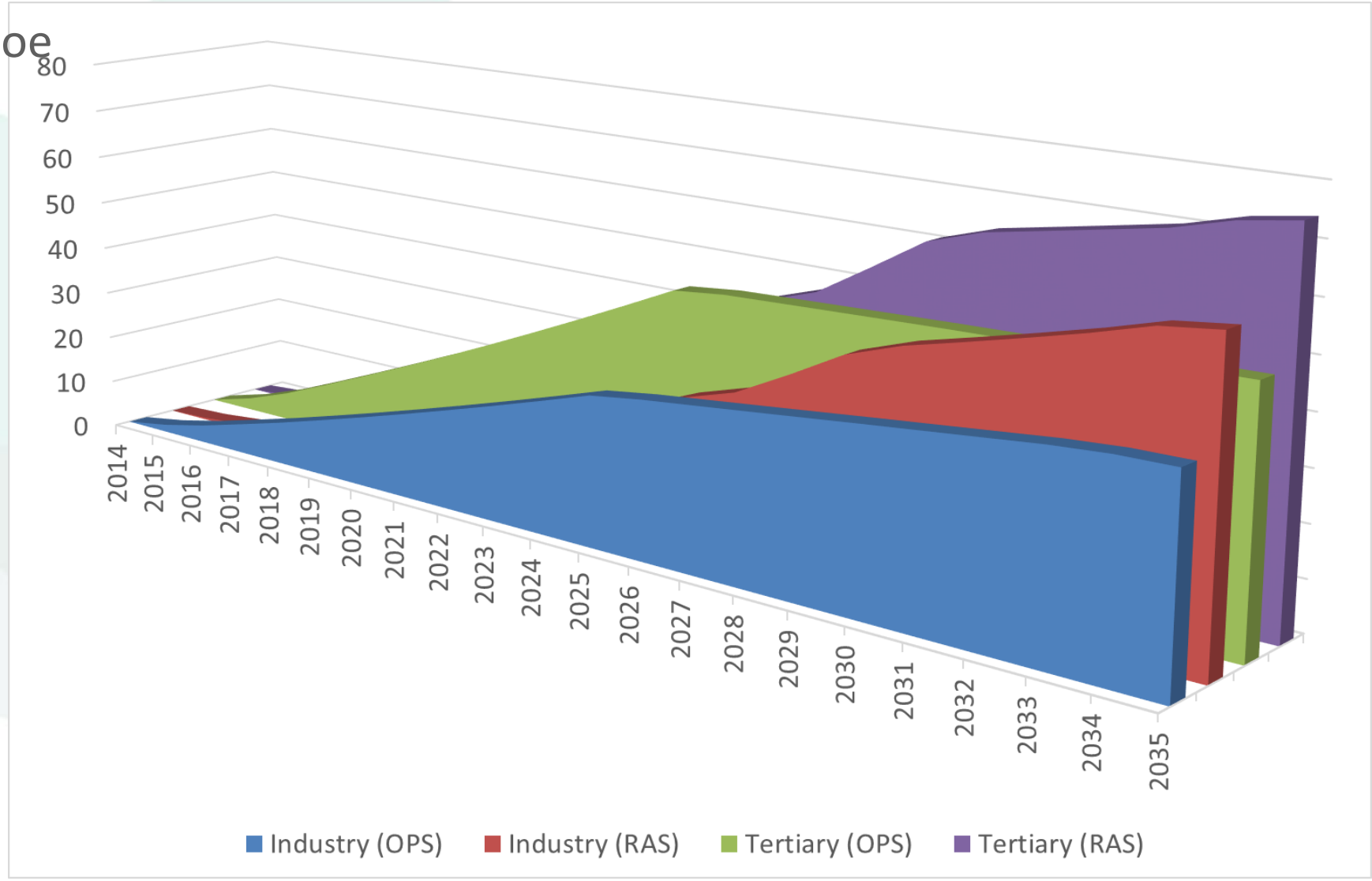
Final energy consumption for industry in the EU under the Reference Scenario



Industrial sector savings under the Optimal Scenario compared with the Reference Scenario



Final energy savings from EM under the Recommended Action and Optimal Scenarios



Optimal Scenario - summary

- The *Optimal Scenario*, which assumes economically-optimised EM, leads to some 1 728 Mtoe of cumulative energy savings from 2016 to 2035 of which:
- 807 Mtoe of savings are in industry and 931 Mtoe of savings are in the tertiary sector
- This equates to estimated cumulative CO_2 savings of 4.8 gigatonnes over the same period with annual savings of 383 million tonnes of CO_2 in 2035
- Extra investments of €119 billion in equipment and related services are needed at an average of €6.0 billion per year to deliver these savings
- These are over fourteen times less than the value of the energy bill savings, which total €1 684 billion over the period, at an average of €84 billion per year

Recommended Action Scenario - summary

- The *Recommended Action Scenario*, which assumes policy recommendations are followed, leads to some 1 184 Mtoe of cumulative energy savings from 2016 to 2035 ow which:
- 560 Mtoe of savings are in industry and 624 Mtoe of savings are in the tertiary sector
- This equates to estimated cumulative CO_2 savings of 3.3 gigatonnes with annual savings of 295 million tonnes of CO_2 in 2035
- Extra investments of €91 billion in equipment and related services are needed at an average of €4.6 billion per year to deliver these savings
- These are over twelve times less than the value of the energy bill savings, which total €1 154 billion over the period, at an average of €58 billion per year

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Generic barriers to energy savings

	Barrier	Effect	Remedial policy tools
VISIBILITY	EE is not measured	EE is invisible and ignored	Test procedures/measurement protocols/efficiency metrics
	EE is not visible to end users & service procurers	EE is invisible and ignored	Ratings/labels/disclosure/benchmarking/audits/real-time measurement and reporting
PRIORITY	Low awareness of the value proposition among service procurers	EE is undervalued	Awareness-raising and communication efforts
	Energy expenditure is a low priority	EE is bundled-in with more important capital decision factors	Regulation, mechanisms to decouple EE actions from other concerns
ECONOMY	Split incentives	EE is undervalued	Regulation, mechanisms to create EE financing incentives for those not paying all or any of the energy bill
	Scarce investment capital or competing capital needs	Underinvestment in EE	Stimulation of capital supply for EE investments, incubation and support of new EE business and financing models, incentives
	Energy consumption and supply subsidies	Unfavourable market conditions for EE	Removal of subsidies
	Unfavourable perception and treatment of risk	EE project financing cost is inflated, energy price risk under-estimated	Mechanisms to underwrite EE project risk, raise awareness of energy volatility risk, inform/train financial profession
CAPACITY	Limited know-how on implementing energy-saving measures	EE implementation is constrained	Capacity-building programmes
	Limited government resources to support implementation	Barriers addressed more slowly	
FRAGMENTATION	EE is more difficult to implement collectively	Energy consumption is split among many diverse end uses and users	Targeted regulations and other EE enhancement policies and measures
	Separation of energy supply and demand business models	Energy supply favoured over energy service	Favourable regulatory frameworks that reward energy service provision over supply
	Fragmented and under-developed supply chains	Availability of EE is limited and it is more difficult to implement	Market transformation programmes

Abbreviation: EE = energy efficiency.

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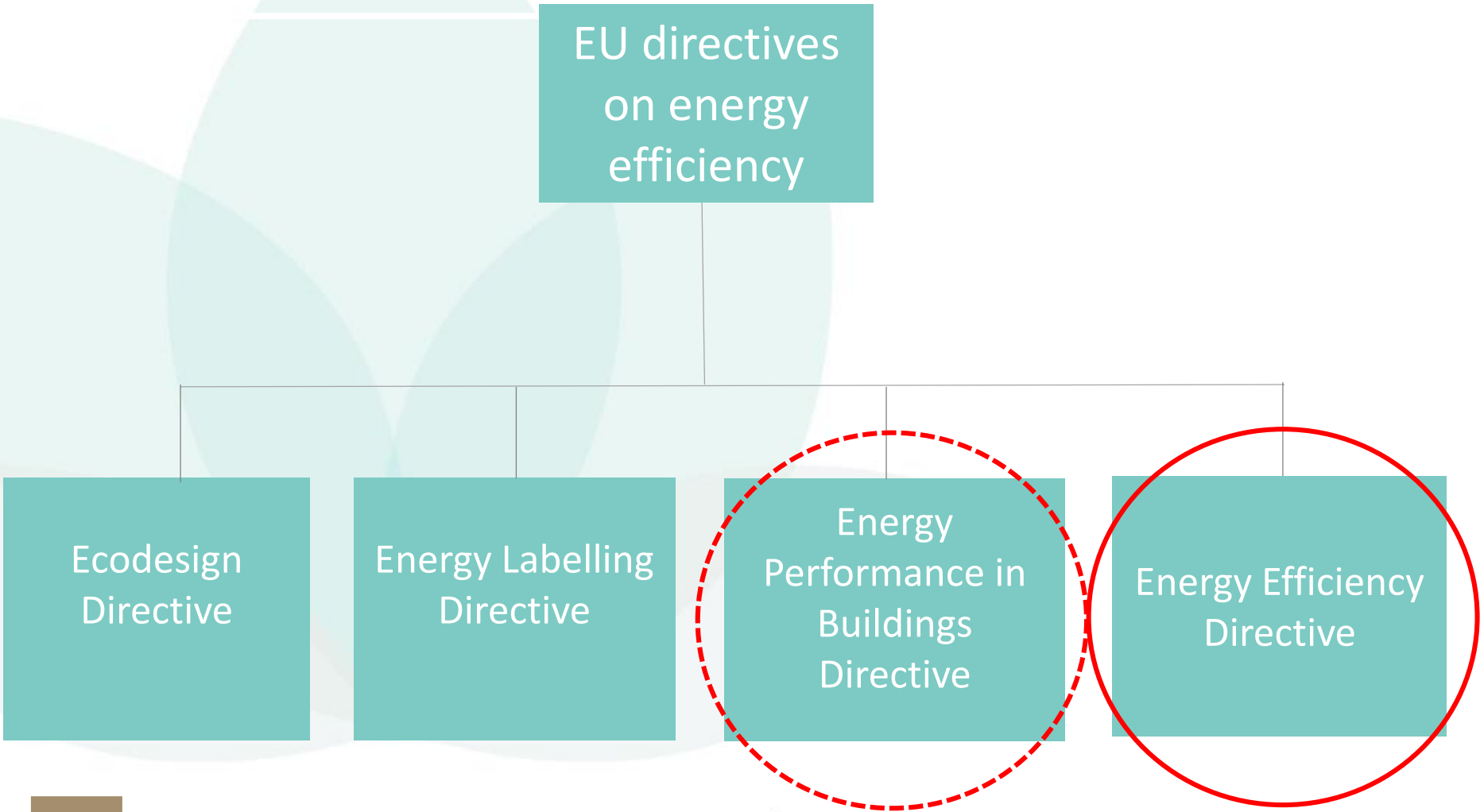
Policy - The four principal EE Directives



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Energy Efficiency Directive - 2012/27/EU

Includes:

- NEEAPS (National Energy Efficiency Action Plans)
- Energy efficiency obligations – Article 7
- Building renovations and public sector buildings – Article 4
- Energy audits and SMEs – Article 8
- Public procurement – Article 6
- Metering/Billing and information
- Heating and cooling (DHC, CHP/cogeneration, microgeneration)
- Energy services
- Transformation, transmission and distribution
- Training, accreditation, certification – Article 16
- Funding and financing – Article 20

EED Article 8 and audits

Audits are great but fall short of energy management…

The EED requires Member States to make energy audits mandatory for large enterprises and gives the possibility for enterprises that have implemented broader energy management schemes such as ISO 50001 to be exempt.

Nonetheless it leaves several important gaps:

a) it does not oblige or encourage affected enterprises to implement an energy management system (just to conduct audits)

b) it does not oblige or encourage affected enterprises to implement cost effective measures identified in the audits

c) it does not create a system to support the adoption and implementation of energy management systems

d) mandatory audits only apply to large enterprises

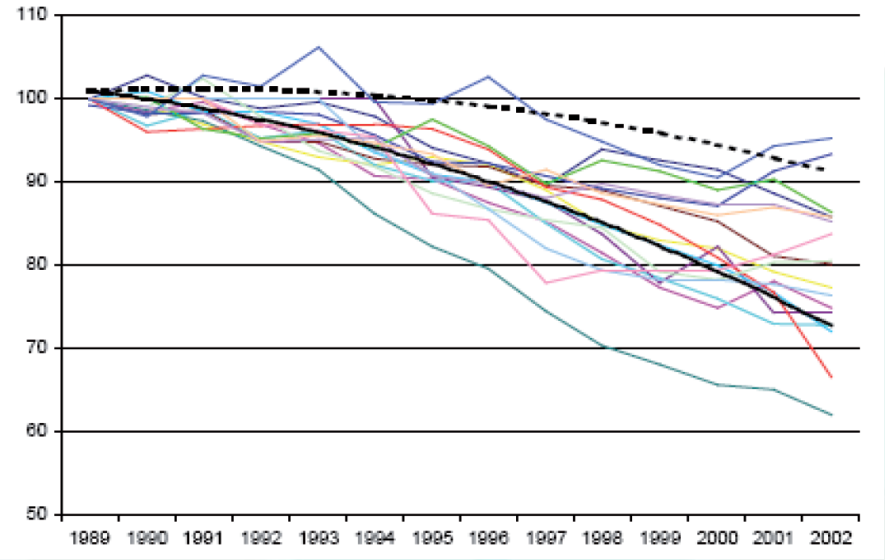
What policies are implemented at MS level?

Incentives and obligations feature in the most visibly effective programmes

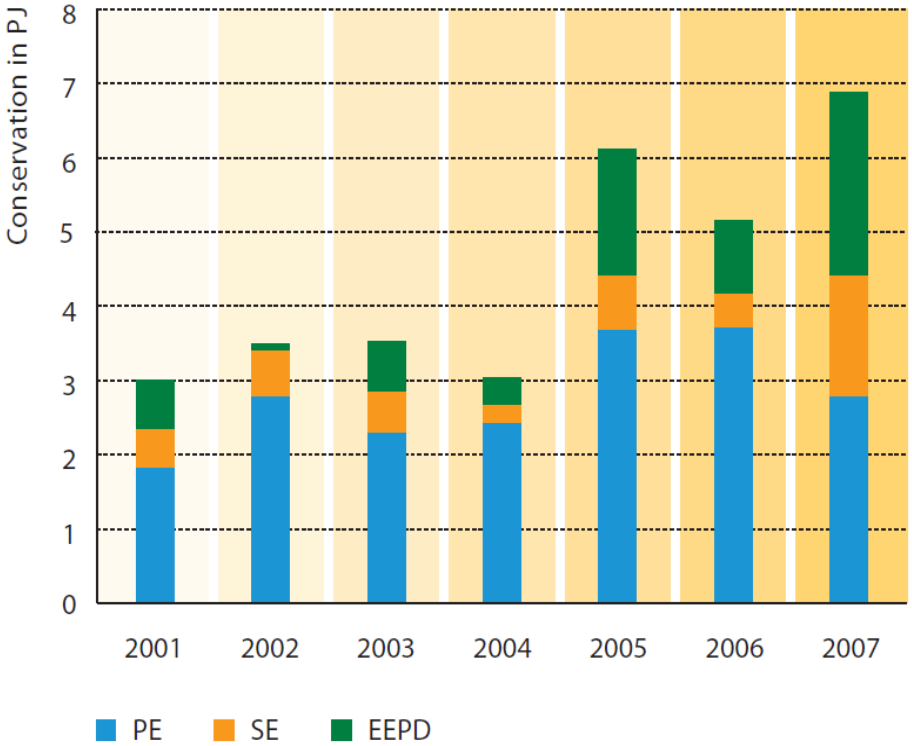
- long term voluntary agreement (LTAs) schemes operated by Denmark, Finland, Flanders, Ireland, Netherlands, Sweden and UK, wherein participating enterprises agree to reduce their energy intensity or CO_2 emissions by pre-agreed amounts over a certain period
- In each case the authorities have created an incentive to participate in these schemes through access to more favourable tax regimes; often via lower energy or carbon taxes

Example - the Dutch Long Term Agreements

Energy efficiency improvement for various sectors under LTA1



Annual energy savings under the LTA2 by type (PE= process efficiency, SE = systems efficiency, EEPD = supply chain efficiency)



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	DK	IE	NL	Sweden	Flanders	Finland	UK
Programme name	LTA	Large Industry Energy Network (LIEN) and SEAI Energy Agreements Programme	Long-Term Agreements	Programme for improving energy efficiency, PFE	Energy policy agreements with energy-intensive companies	Energy efficiency agreements	Climate Change Agreement
Period of operation	1996-2013		1992 to now	2004-12 (repealed due to contravention of EU rules on state aid)	2012-2015	2008-now	2001-now
Incentives to participate	Rebate in Energy Savings Tax	Subsidised audits and support	Participants pay a lower Energy Tax	Five-year exemption from energy tax on electricity (SEK 0.005/kWh)	Required to attain the environmental license to operate	20% subsidy of EE related capital costs (€22.5m of subsidies in 2011)	Reduction of up to 90% on the Climate Change Levy
Other features	Implement-ation of identified cost-effective EE measures is binding for a 3 year period	Agree to work towards ISO50001 implementation	Businesses must draw up an EE plan every four years and implement cost-effective measures. Also road-maps to reduce CO2 by 50% by 2030	Must implement EM, do audits and invest in measures with payback <3 years	Participants cover 82% of industrial energy use in benchmarking agreement and 6% in the audit agreement		
Sectors covered	Industry	Industry - sites cover >50% of industrial energy use	Industry, services and agriculture. Covers 80% of Ind. energy	Industry	Industry	Industry, Services, Energy	Energy intensive industries and over thirty smaller sectors
Reported impacts		3.26 TWh in2012 from all industrial EE measures (not just LTA)	Average efficiency saving of 22.3% from 1992-2000 = 2%/year From 2009-12 average savings of 1.6%/year.	13.7 TWh from 2007-11 (electricity savings of 1.45 TWh/year)		All industrial EE measures. (Agreements + audits) produced savings of 7.5% in 2010	9,600 facilities have signed up to CCAs accounting for 268 TWh in 2010. Savings target to 2020 of 11%

Summary of mandatory energy efficiency investment programmes by MS

	DK	NL	Flanders
Mandatory EE investments linked to EM	Yes if entity has entered into the LTA	Yes	Yes
Programme name	LTA	Environmental Management Act	VLAREM
Description	Must implement all EE measures with a payback of < 3 years	Must implement all EE measures with a payback of < 5 years	Must implement all EE measures with a payback of < 3 years
Sectors covered	Industry	Companies and buildings	Industry
Other features		Entity size limits apply. Local authorities can oblige audits to be done.	Mandatory approved energy plan

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Germany's energy tax incentives

- A tax on electricity payable by firms was introduced in Germany in 2007 and set at €205/MWh
- Until 2012 companies that paid more than €1000/year for this tax were eligible to apply for a 90% reduction; however, in 2013 the exemption eligibility rules were amended such that companies are now obliged to prove that they have an energy management system certified to DIN EN 16001 or DIN EN ISO 50001 in place to be eligible to receive the tax discounts
- As of 2014 about 25000 firms were eligible to receive tax reductions that totalled 2.3 billion Euros in value, and about 3000 EN ISO 50001 certifications were undertaken in early 2014
- DE has the highest certified uptake of EN ISO 50001 in the world

Audit incentives and EE networks

- France, Finland, Germany, Norway, Sweden and the UK amongst others have provided direct financial and technical assistance to conduct energy audits and implement energy savings measures in the industrial sector and sometimes the service sector
- Germany, Ireland and Sweden operate extensive (subsidised) energy efficiency networks to provide peer to peer support in implementing EE in businesses

Energy efficiency obligations – summary by MS

	DK	FR	EE	IE	IT	LV	LT	LU	MT	ES	SI	PL	UK
EEO type	Yes	Yes - White certificate scheme	Yes	Yes	Yes - White certificate scheme	Yes	Yes	Yes	Yes	Yes	Yes	Yes - White certificate scheme	Energy Company Obligation (ECO)
Year introduced	2006	2006	2015	2014	2005	2014	2014	2015	2015	2014	2014	2013	2003/2015
Sectors where savings measures can be made	Domestic Industry Commerce	Domestic Industry Commerce		Domestic Industry Commerce	Domestic Industry Commerce			All		Industry buildings transport	All	All	Domestic
Scale of savings	3% of all non transport energy use	2.5 Mtoe per year in 2013	Target of 6.5 TWh cumulative by 2020	0.55 TWh per year	1.2 Mtoe in 2012	0.979 TWh in 2020	Target of 11.7 TWh cumulative by 2020	Target of 6 TWh in 2020	Target of 0.22 TWh in 2020	Target of 0.571 Mtoe/year	0.75% of energy supplied by 2018	0.55 Mtoe/year	
Allocations of savings by end-use sector	39% Industry, 8% services, 53% domestic	6% industry		Unspecified	53% Industry, 4% services, 43% domestic			Unspecified		54.6% Industry, 15.3% buildings/equipment, 25.3% transport, 4.8% public/agriculture	Not specified	Unspecified	

Benchmarking

- Benchmarking is one of the most important energy management tools
- Depending on its scope it allows comparison of the energy performance of whole enterprises, businesses, facilities, processes, buildings and systems on a common metric
- At its best it allows like for like comparison where the results display unequivocal differences in energy efficiency
- When this is recognised by all parties it can be a powerful motivation for improvement and means of monitoring improvement

Danish real-time benchmarking of municipal buildings power and electricity use

Arbejdssteder - individuelle oplysninger

Antal	Arbejdssted	Myndighed/firma	Arbejdssteds-type	Rapport	Areal m²	Årsforbrug kWh	Årsforbrug kWh/person	Årsforbrug kWh/m²	Graf
1	Biblioteksadministrationen	Høje Taastrup Kommune	Bibliotek		14.360	137.867		10	
1	Bornholms Centralbibliotek	Bornholms Regionskommune	Bibliotek		2.236	176.972		79	
1	Brønderslev Bibliotek	Brønderslev Kommune	Bibliotek		2.708	95.497	168	35	
1	Danmarks Blindebibliotek	Kulturministeriet	Bibliotek		6.670	291.864		44	
1	Danmarks Kunstbibliotek	Kulturministeriet	Bibliotek		4.647	57.747		12	
1	Danmarks Natur- og Lægevidenskabelige Bibliotek	Kulturministeriet	Bibliotek		10.826	510.868		47	
1	Det Kongelige Bibliotek Lergravsvej	Kulturministeriet	Bibliotek		6.732	139.928		21	
1	Det Kongelige Bibliotek Njalsgade	Kulturministeriet	Bibliotek		6.840	519.150		76	
1	Frederikshavn Bibliotek	Frederikshavn Kommune	Bibliotek		6.703	240.171	4.803	36	
1	Herlev Bibliotek	Herlev kommune	Bibliotek		2.325	222.390		96	

1 2

I alt for 17 Arbejdssteder:	95.167	5.353.312		
Gennemsnit for 17 Arbejdssteder:	5.598	314.901	593	56

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An energy action plan for Europe (1/3)

Following review of the EED the Commission and MS should consider amending the provisions which currently exclusively concern energy audits to:

- introduce MS level targets for the share of enterprises that have adopted EM and where the targets are set based on the proportion of enterprises of a given size and energy intensity within each MS
- consider amending the EED energy audit obligations to become an obligation to adopt a full energy management system for enterprises using more than a minimum prescribed energy consumption or energy intensity level and above a minimum size
- set MS targets for the number of certified energy managers, wherein the targets are proportional to the economy's size and energy intensity and increase to a plateau with time

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An energy action plan for Europe (2/3)

- support the development of EM standards and tools which are targeted to each sub-sector and which are designed to be less burdensome and more relevant for SMEs and less energy intensive enterprises
- complete the development of and promote benchmarks of energy performance in the industrial and tertiary sectors that are tailored for relevance to each specified industrial or tertiary sector activity (including SMEs) and require companies and organisations to benchmark their energy use and share the results in an anonymous format with public authorities
- develop and provide free energy management support services to SMEs targeted at those with poor benchmarked efficiency levels (note this would include but not be limited to energy audits) - consider obligating/incentivising the poorer performers to implement highly-cost effective measures

An energy action plan for Europe (3/3)

- provide incentives on energy efficiency capital expenditures for those organisations that adopt relatively advanced EM, wherein the total scale of the incentives provided by each Member State is commensurate to a proportion (say a quarter) of the value of expected energy savings to be achieved over the lifetime of the investment
- financing of these incentives could be integrated within national energy efficiency obligation schemes imposed on energy suppliers under the provisions of EED Article 7
- develop common EU methodologies to account for and evaluate energy savings produced via EM to facilitate funding through EEOs and similar market mechanisms
- develop extensive capacity building programmes to train organisations in the development and implementation of EM policies and to build and support the energy services sector

Summary of key findings

- EM accesses systemic energy savings opportunities that are very difficult to capture through other means
- Current EM adoption rates are far below cost-effective levels
- Better and more widely adopted Energy Management has the potential to save ~26% of EU combined energy use in the industrial and service sectors of which 19% could be delivered through more robust policies
- Average net cost savings of €53 billion per annum to 2035 and average CO_2 emissions savings of 165 Mt CO_2/year
- Current policy frameworks, such as the encouragement for audits in the Energy Efficiency Directive are helpful but need to be strengthened to deliver
- More robust and holistic policy approaches are required

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