Design & implement programs that support implementation of energy management systems to encourage 'continuous' energy efficiency improvement.

How can energy management programmes create a foundation for industrial energy efficiency in your country?

Marco Matteini

Energy Systems and Infrastructure Division

Department of Energy

IEA Energy Efficiency in Emerging Economies Training Week

Energy Efficiency in Industry

22 May 2019

Paris, France

Content

1. Introduction
2. Why energy management systems (EnMS) as foundation for energy efficiency in industry
3. What EnMS can achieve
4. Policies and programmes to promote and support EnMS-ISO 50001
5. Lessons learnt
6. Success factors and Challenges

UNIDO *at a glance*

The United Nations Industrial Development Organization (UNIDO) is the specialized agency of the United Nations that promotes industrial development for poverty reduction, inclusive globalization and environmental sustainability.

UNIDO's mission is to promote and accelerate inclusive and sustainable industrial development (ISID) in developing countries and economies in transition

UNIDO programmatic focus is structured in four strategic priorities:

Creating shared prosperity

Advancing economic competitiveness

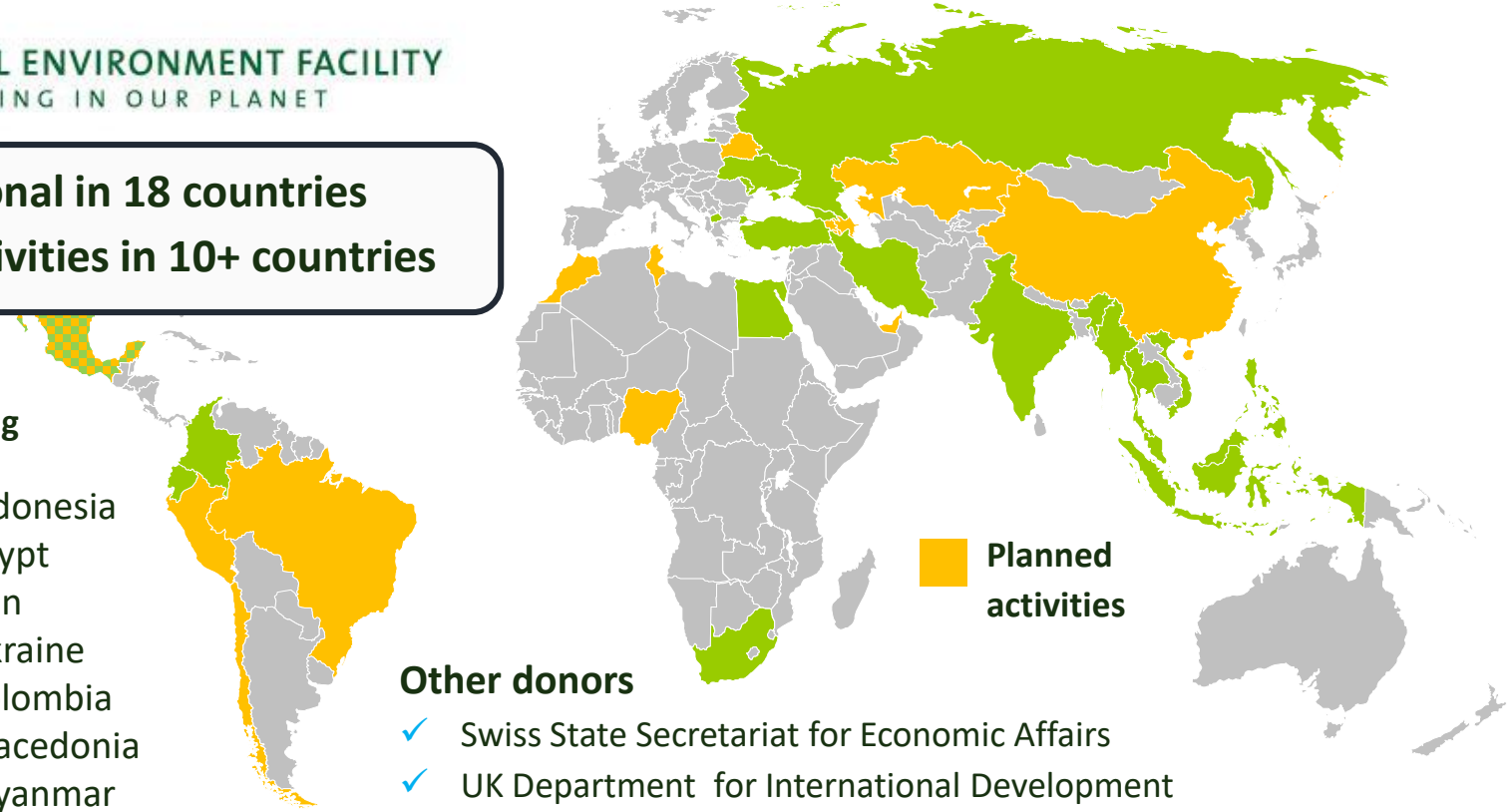
Safeguarding the environment

Strengthening knowledge and institutions

UNIDO Global EnMS-ISO50001 Programme – Dec 2018

gef GLOBAL ENVIRONMENT FACILITY
INVESTING IN OUR PLANET

Operational in 18 countries
Planned activities in 10+ countries



Projects ongoing

South Africa
Moldova
Russia
Turkey
Ecuador
Malaysia
Thailand
Viet Nam
Philippines
Indonesia
Egypt
Iran
Ukraine
Colombia
Macedonia
Myanmar
India
Georgia

Planned activities

Other donors

- ✓ Swiss State Secretariat for Economic Affairs
- ✓ UK Department for International Development
- ✓ Government of South Africa
- ✓ Government of Italy
- ✓ Government of Austria

UNIDO Global EnMS-ISO 50001-ESO Programme

- Operational in 18 countries (as of Dec 2018)
  - 12 Countries at the end of 2012

Enterprises with EnMS

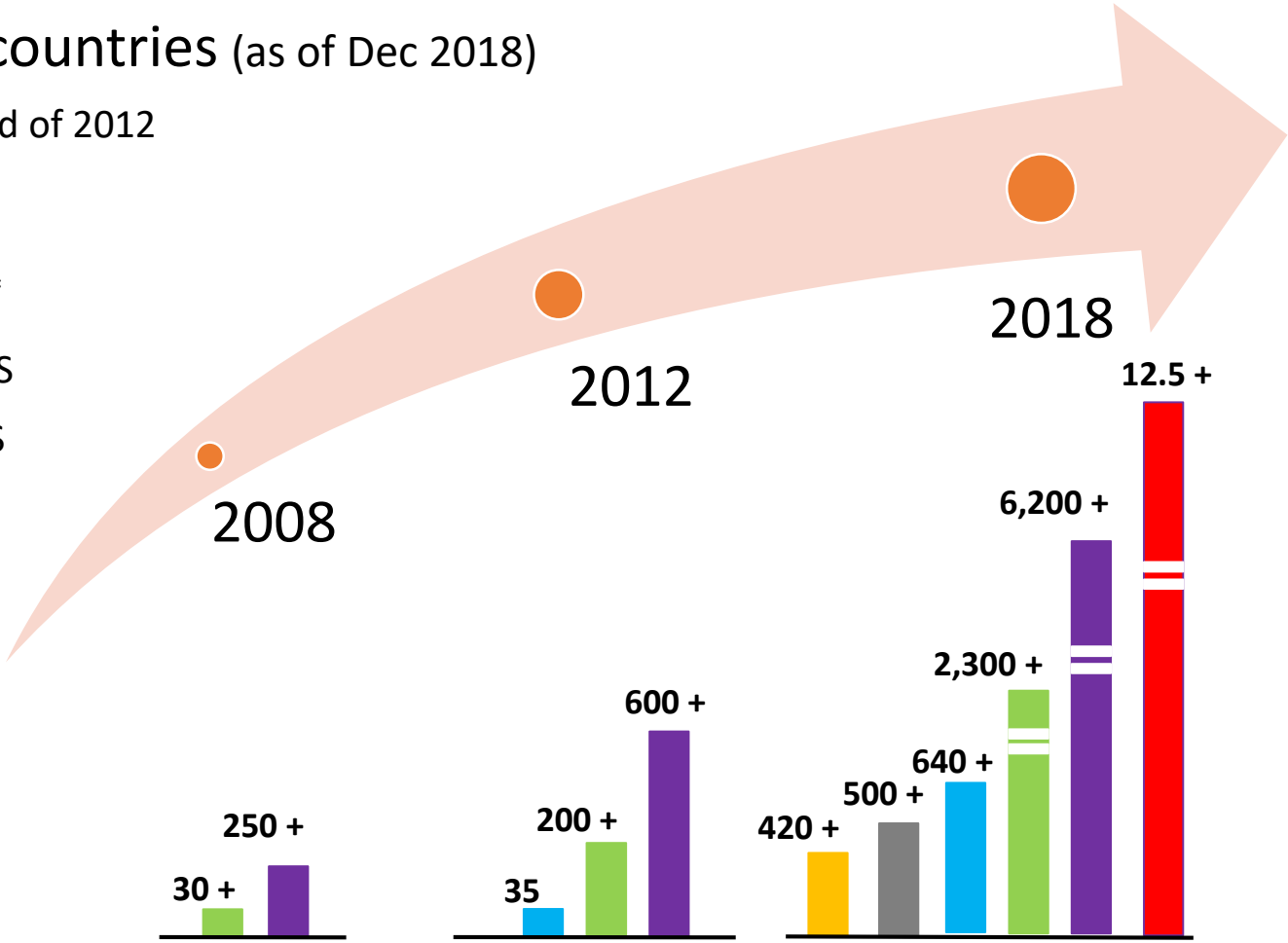
Consultants trained in ESO*

Consultants trained in EnMS

Enterprises trained in EnMS

Decision-makers reached

Cumulative direct final energy savings (TWh)



* ESO = Energy System Optimization

ISO 50001:2018

Aim of ISO 50001 (0.1)

"..to enable organizations to establish the systems and processes necessary **to continually improve energy performance**, including energy efficiency, energy use and energy consumption. .."

Energy performance approach (0.2)

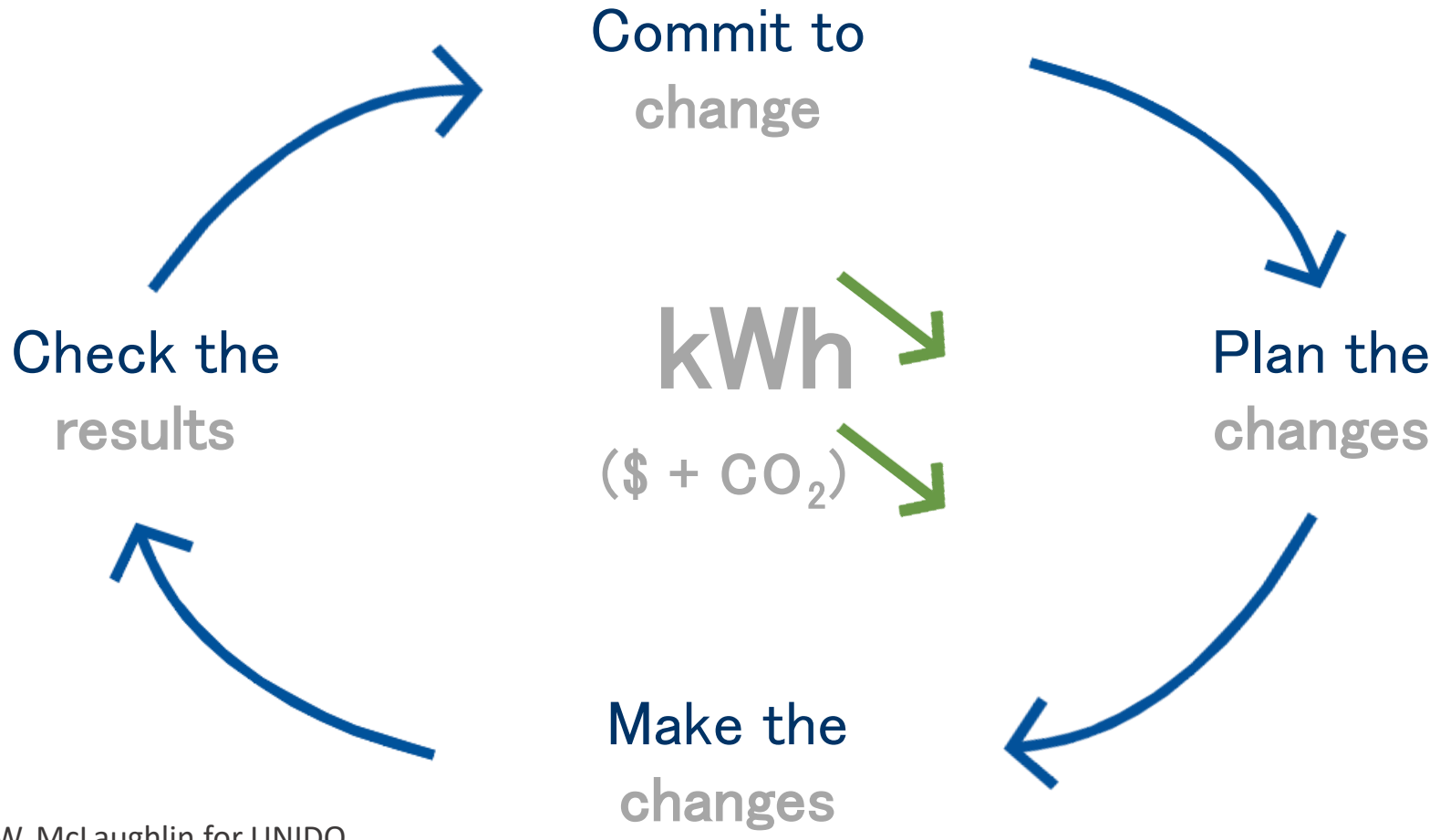
"..document provides requirements for a systematic, data-driven and fact-based process, focused on **continually improving energy performance**.

Energy performance is a key element integrated within the concepts introduced in this document in order to ensure effective and measurable results over time."

Figure 1 — Plan-Do-Check-Act Cycle

Source: ISO 50001:2018

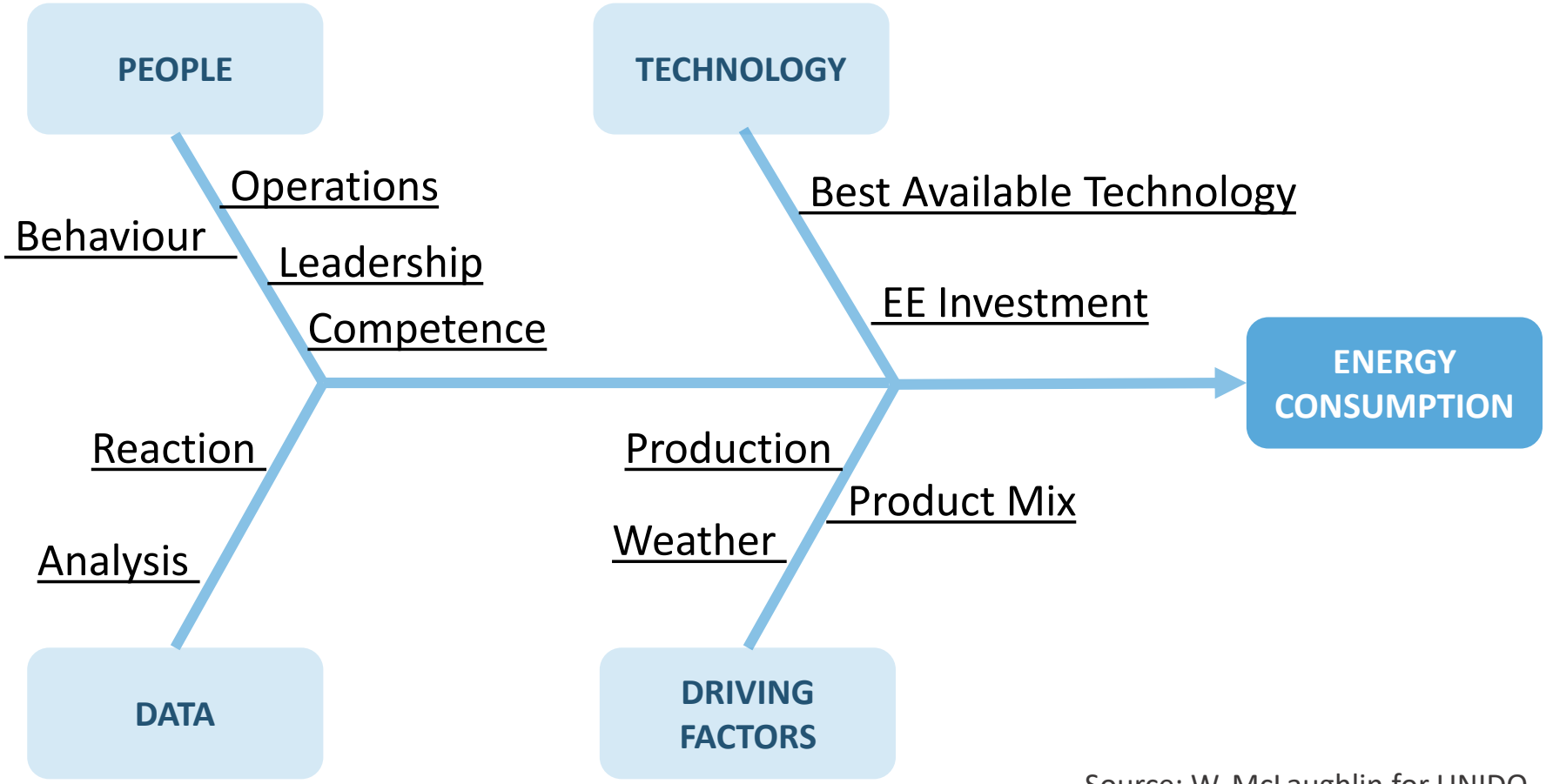
EnMS – ISO 50001 Simplified



Source: W. McLaughlin for UNIDO

Why energy management systems (EnMS) as foundation for energy efficiency in industry?

Energy consumption in Industry



Source: W. McLaughlin for UNIDO

BARRIERS to Energy Efficiency in Industry

- M • Management focus is on production, volumes and compliance , not EE
- K • Lack of information and understanding of own energy performance
- K • Lack of adequate competencies and skills for identifying, assessing, developing and implementing EE measures and projects
- K • Poor or misused monitoring systems and data
- M • Lack of communication for energy perform. between business units
- M • First costs more important than recurring costs → disconnection between capital and operating budgets
- M • Staff behavior and attitude
- F • Financing constraints

✓ *Production, technological, operational and staff changes over time*

M **Management/organizational barrier** K **Knowledge/competency barrier** F **Financial barrier**

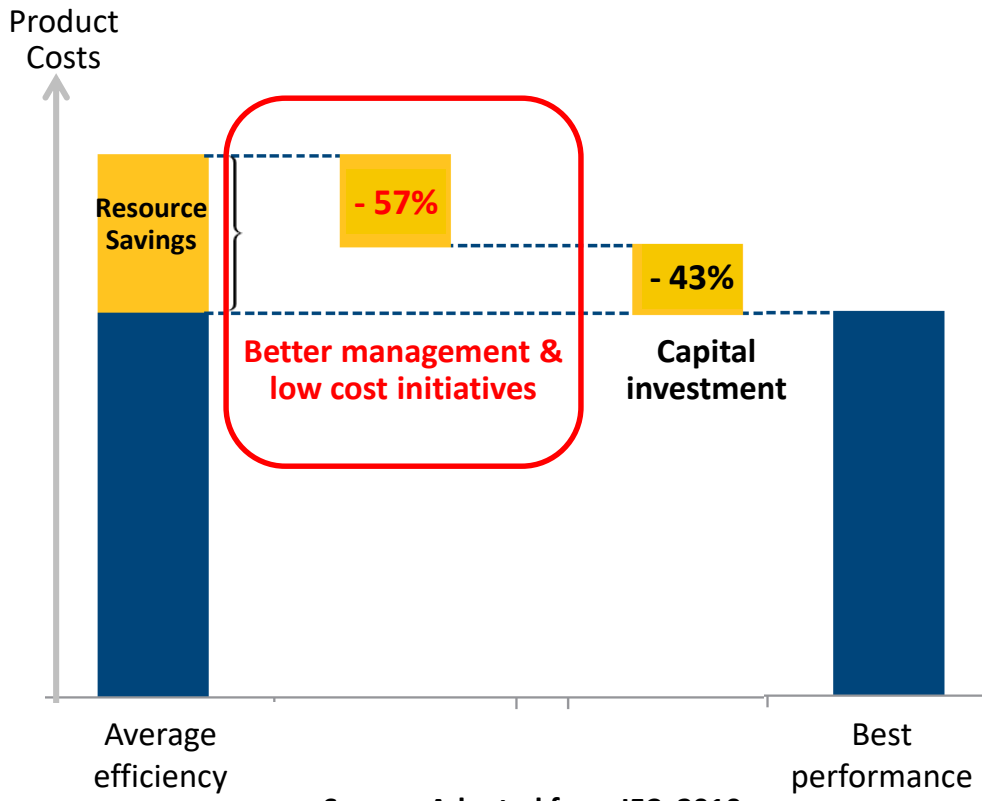
Where are opportunities for improvement?

Savings potential from EE (%)

Sector or Product	Developed countries	Developing countries
Petroleum refineries	10-15	70
Steam cracking	20-25	25-30
Ammonia	11	25
Alumina production	35	50
Iron and Steel	10	30
Cement	20	25
Glass	30-35	40
Pulp and Paper	25	20
Food and beverage	25	40
Other sectors	10-15	25-30

Source: UNIDO, 2011

Benchmarking study



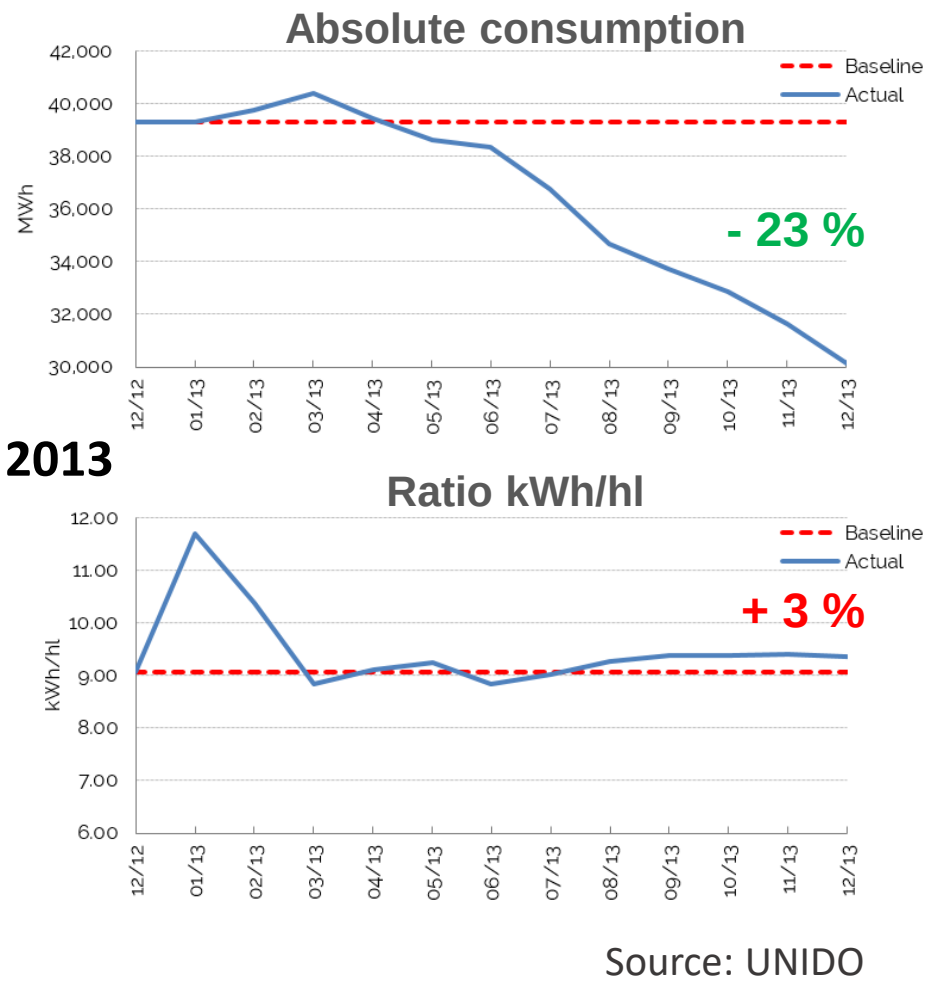
Source: Adapted from IFC, 2010

Energy performance in industry

Brewery Case Study

- ✓ Large brewing company with 8 production and packaging plants
- ✓ In 2012 top management hired a new Energy Manager in one of the plants to increase work on energy efficiency
- ✓ In 2012 top management approved allocation of about 500,000 Euro for 2013 for EE projects and investments in the plant
- ✓ The plant was/is a modern facility in term of technologies, and pretty advanced, by EU standards, with regard to metering and monitoring systems.

Energy performance in industry: "View" 1



Source: UNIDO

If you would be the top management of this company, what would you decide with regard to the following?

1. Would you retain the new energy manager?

YES ☐ NO ☐

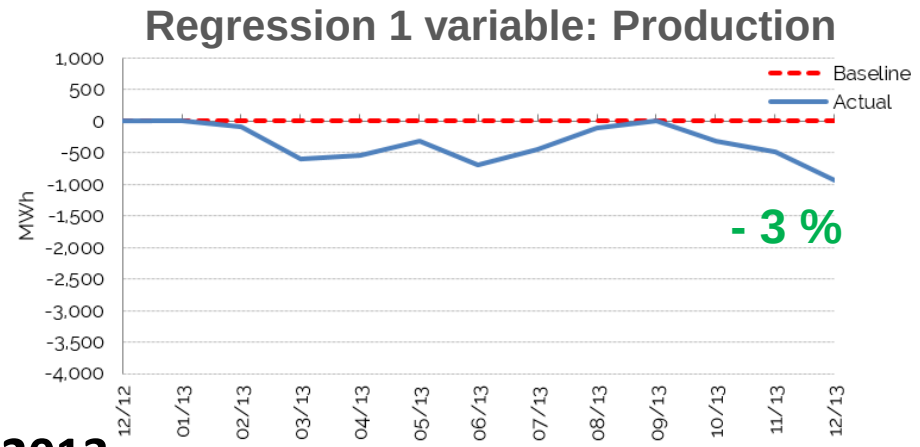
2. Would you approve additional 500k Euro for EE in 2014?

YES ☐ NO ☐

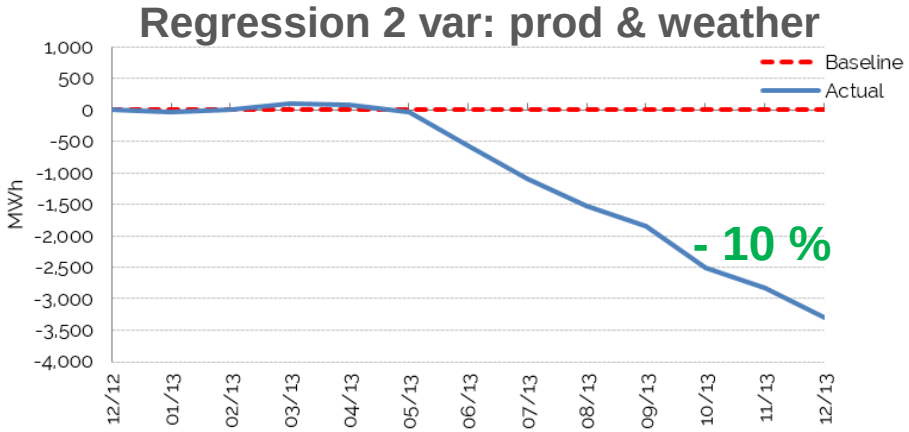
3. Would you consider a cash bonus for your energy team staff?

YES ☐ NO ☐

Energy performance in industry: "View" 2



2013



If you would be the top management of this company, what would you decide with regard to the following?

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YES ☐ NO ☐

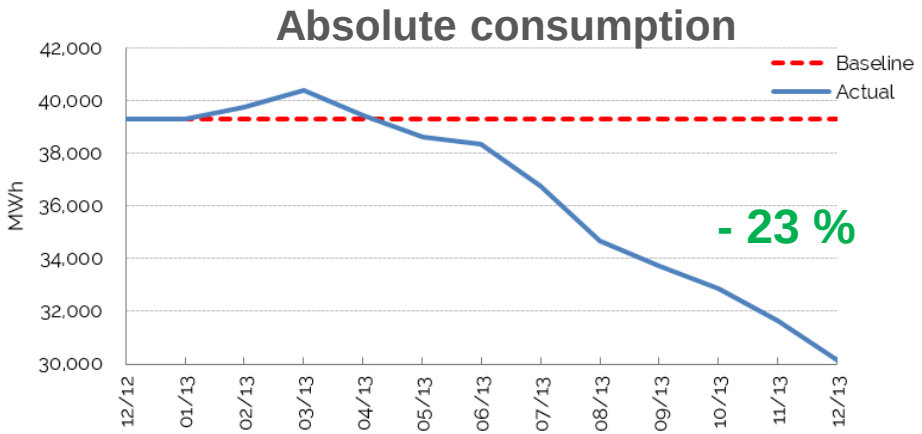
2. Would you approve additional 500k Euro for EE in 2014?

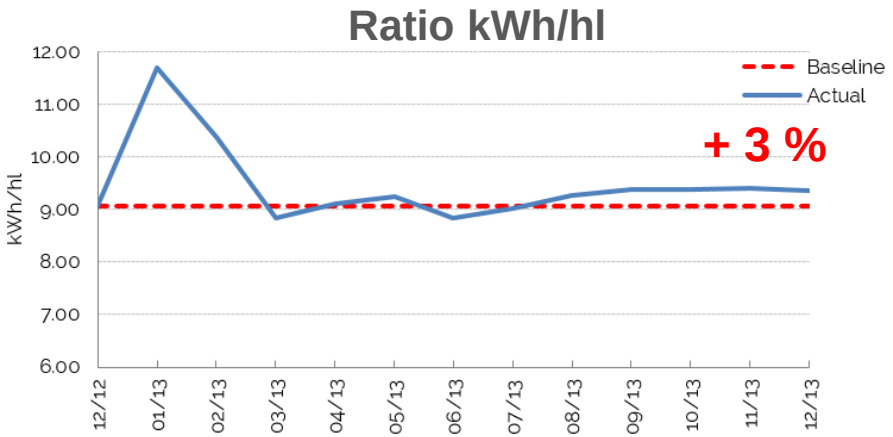
YES ☐ NO ☐

3. Would you consider a cash bonus for your energy team staff?

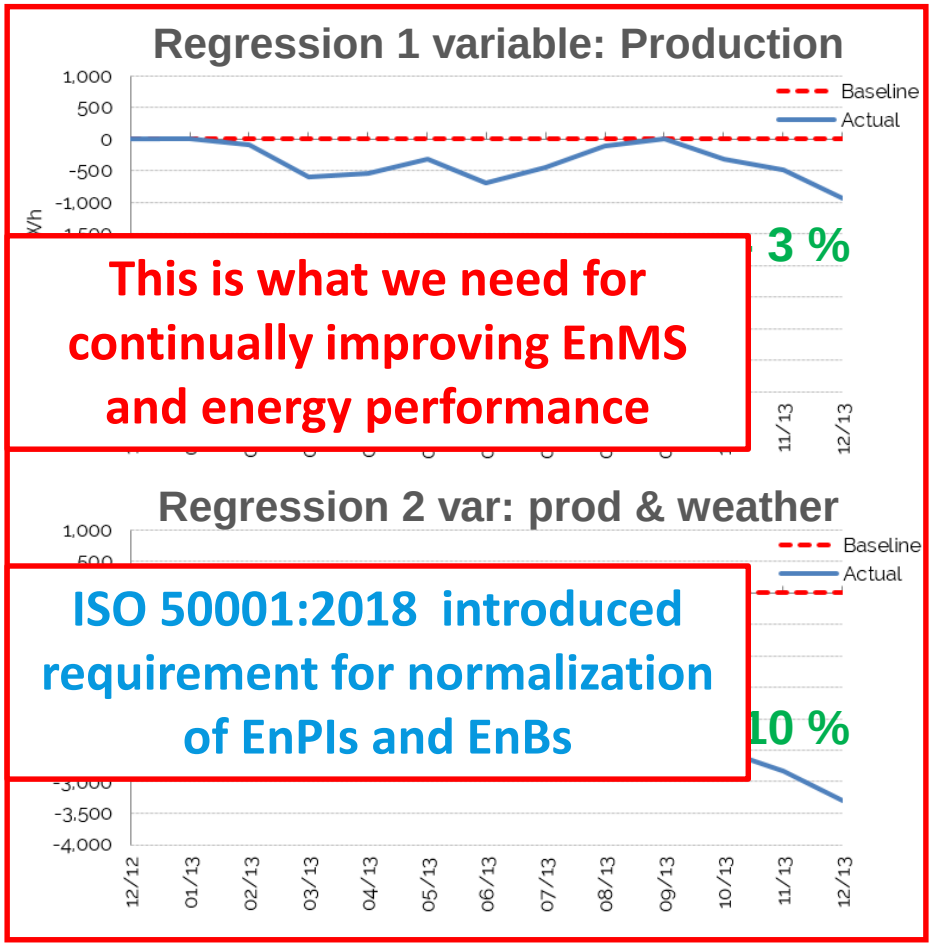
YES ☐ NO ☐

Energy performance in Industry – Which is right?



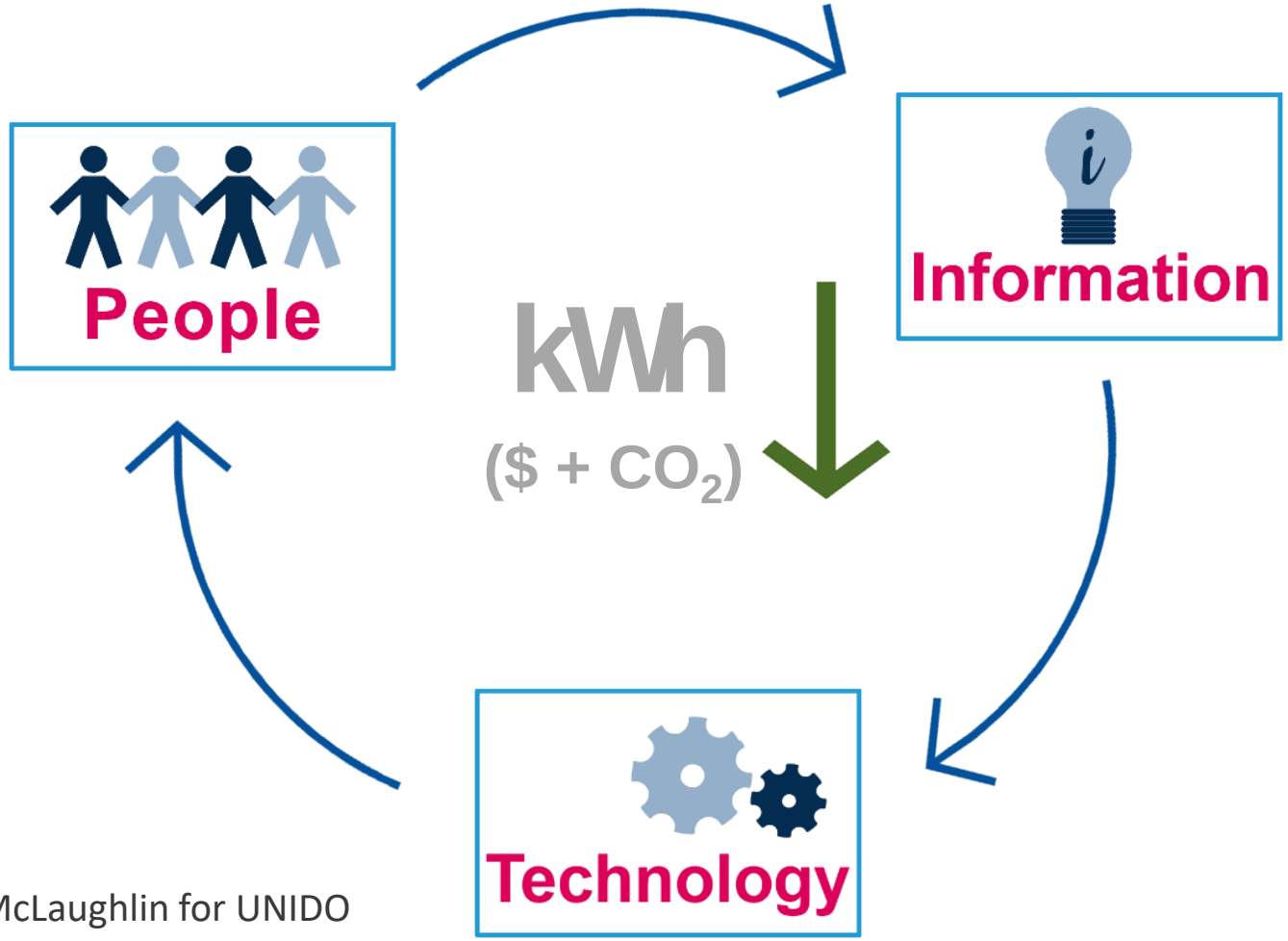


Source: UNIDO



Brewing industry

EnMS – Managing and improving 3 pillars

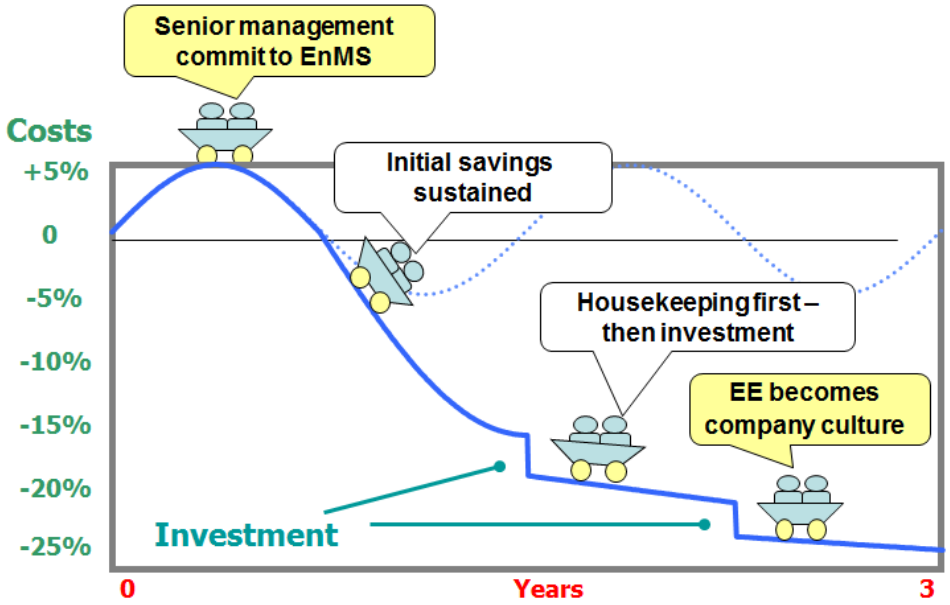


Source: W. McLaughlin for UNIDO

EnMS - Productive Change & Continual Improvement

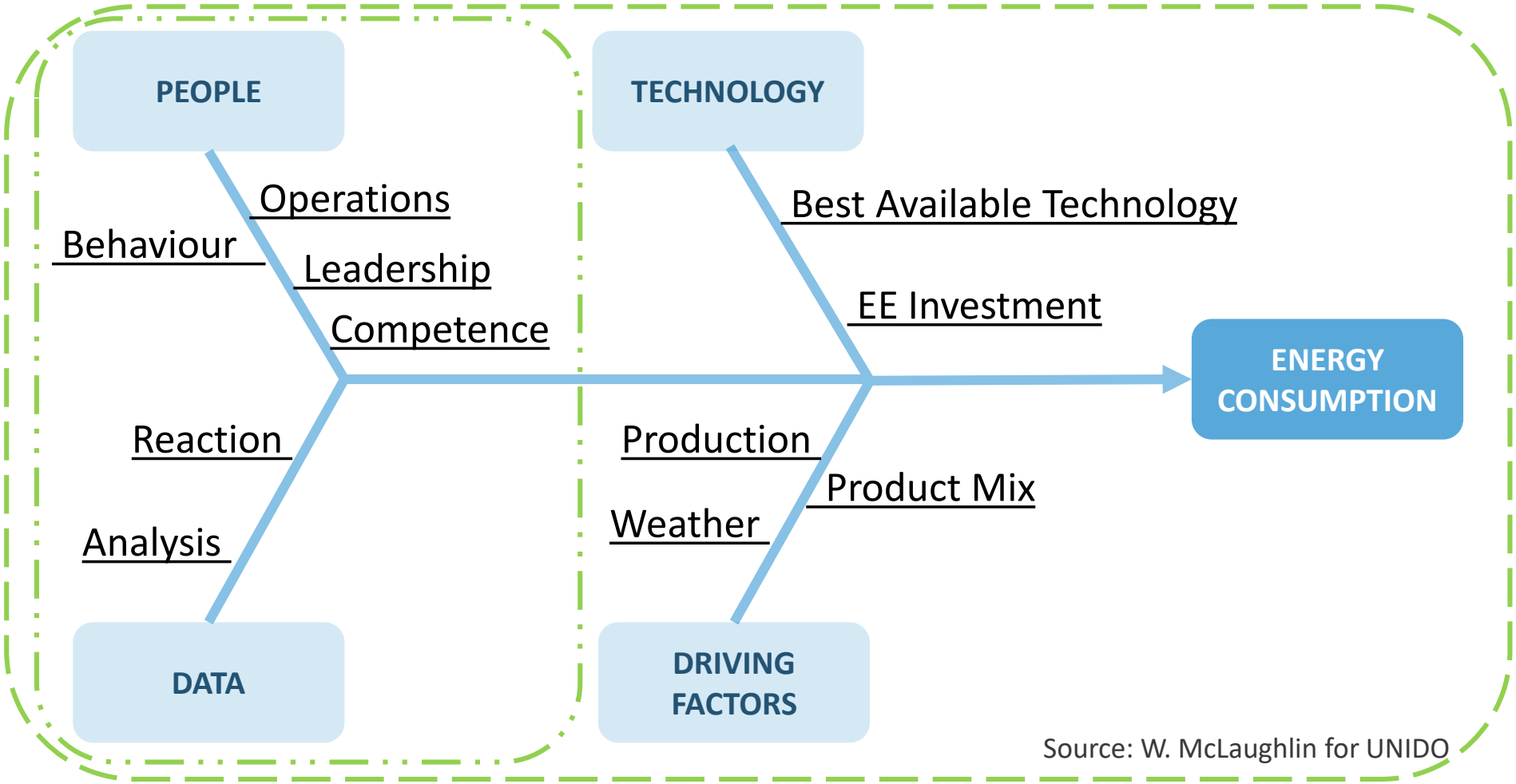
- ✓ Top management engage in EE
- ✓ Challenge operations and established practices
- ✓ Build internal technical skills
- ✓ Data and analysis discipline
- ✓ Focus on no/low-cost measures
- ✓ Continual improvement

EE INTEGRATED



SUSTAINED ENERGY SAVINGS & INVESTMENTS!

Energy Management System – ISO 50001



Source: W. McLaughlin for UNIDO

What can EnMS achieve?

Example 1 : Iron and Steel – South Africa

Arcelormittal Saldanha Works

ArcelorMittal

- ✓ Electricity demand : 160 MW
- ✓ Manpower: 548 permanent employees
- ✓ Sales output: 1,2 million ton HRC/annum

Adjustments/optimization of production operations, energy systems optimization, fuels switching, etc..... driven by EnMS!

2012 Energy Savings (Norm.) > 100 GWh

Energy Efficiency Achievements 2011	
Energy Management System Implemented	
No. of Projects/Measures	11
Total Capital Investment (USD)	**0**
2011 Gross Financial Savings (USD)	**9,076,000**
Overall Payback Period (in years)	0
2011 Energy Savings Norm. (GWh)	**79.95**
2011 GHG Reductions (tons CO_2)	77,000

Example 2 : Refractory Material – Macedonia

Vardar Dolomit

- ✓ Production of fire resistant materials based on sintered dolomite
- ✓ 85 employees
- ✓ 29.3 GWh consumption of oil & mazut in 2015
- ✓ 3.3 GWh consumption of electricity in 2015
- ✓ EnMS scope in 2016 only electricity
- 19,655€ from electricity savings (7.5%), normalized
- 70,000 € of money savings from power purchase contract renegotiation

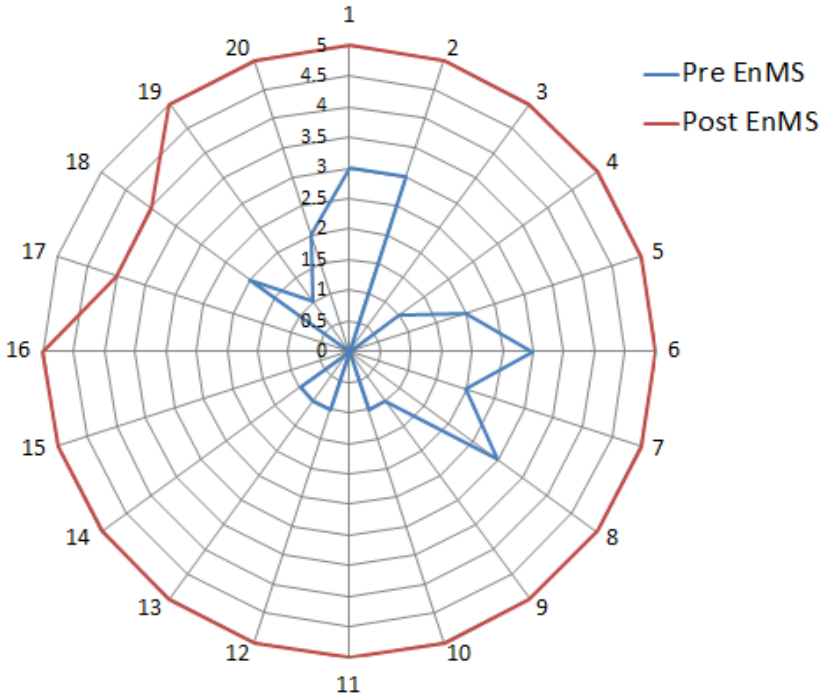
Payback time of EnMS implementation considering all experts and staff costs = 3 months

Vardar Dolomit improvements 2016	
Energy Management System Implemented	
No. of Measures/Projects	**21**
Total Capital Investment (EUR)	**5,600**
Gross Monetary Savings (EUR)	**89,655**
Overall Payback Period (in years)	**0.06**
2016 Electricity Savings Nor. (MWh)	**248**
2016 GHG Reductions (tons CO_2)	**320.7**

Example 2 : Refractory Material – Macedonia

Vardar Dolomit

- EnMS scope in 2017 electricity + oil + mazut
- 174 MWh of normalized energy savings in first 4 months of 2017, against 2016 baseline, with NO investments
- Identified a furnace malfunctioning thanks to UNIDO energy performance measurement methodology and prevented a possible explosion

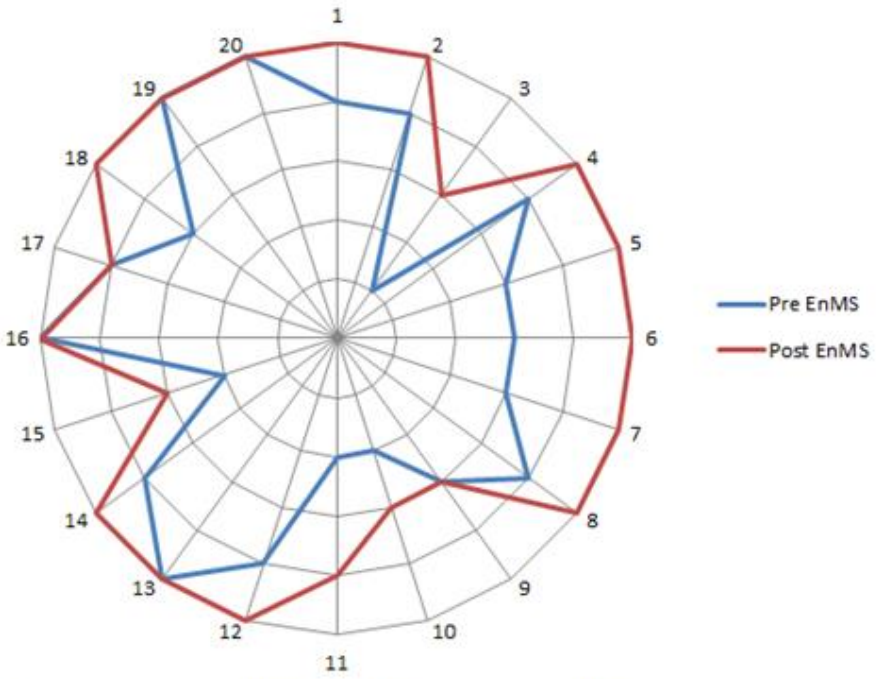


Improvement of Energy Management Practices

Example 3 : Power Generation – Macedonia

REK BITOLA

- ✓ Mining and Energy Combine (REK) Bitola meets over 70% of country's demand for electricity
- ✓ Coal-lignite thermal power plant, total installed generating capacity of 700 MW and annual generation of 4,000 GWh
- ✓ Production in 2016 was 2,685 GWh; own consumption was 286.2 GWh
- ✓ In 2016, EnMS limited to power generation facilities
- **8,700 MWh** normalized savings as of 7 Oct 2017
- Started EnMS implementation in other branches of ELEM, the national largest power utility



Improvement of Energy Management Practices

2.97% of total consumption

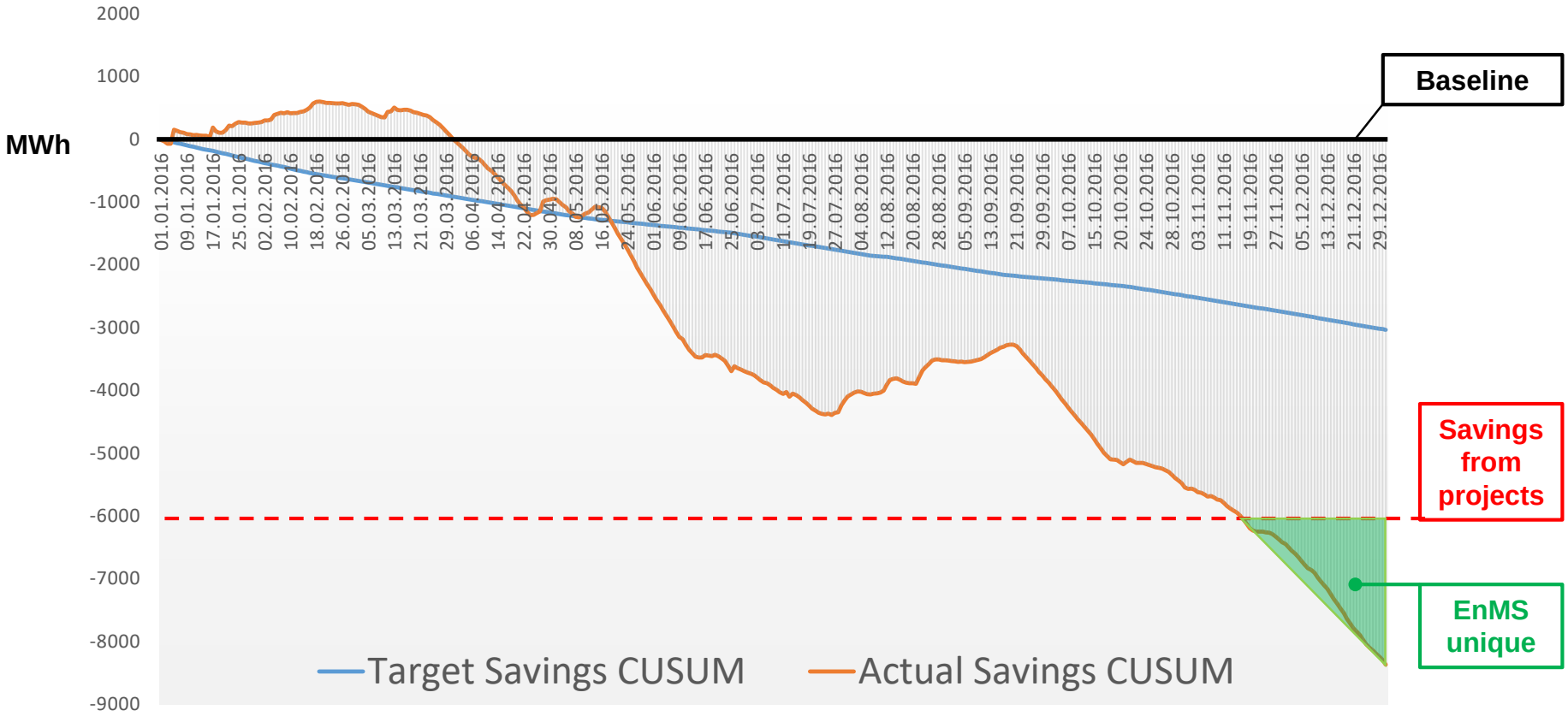
Payback time: 22-24 days

2016 Energy Savings Norm. (MWh)	**8,502**
2016 GHG Reductions (tons CO_2)	**10,528**

Example 3 : Power Generation – Macedonia

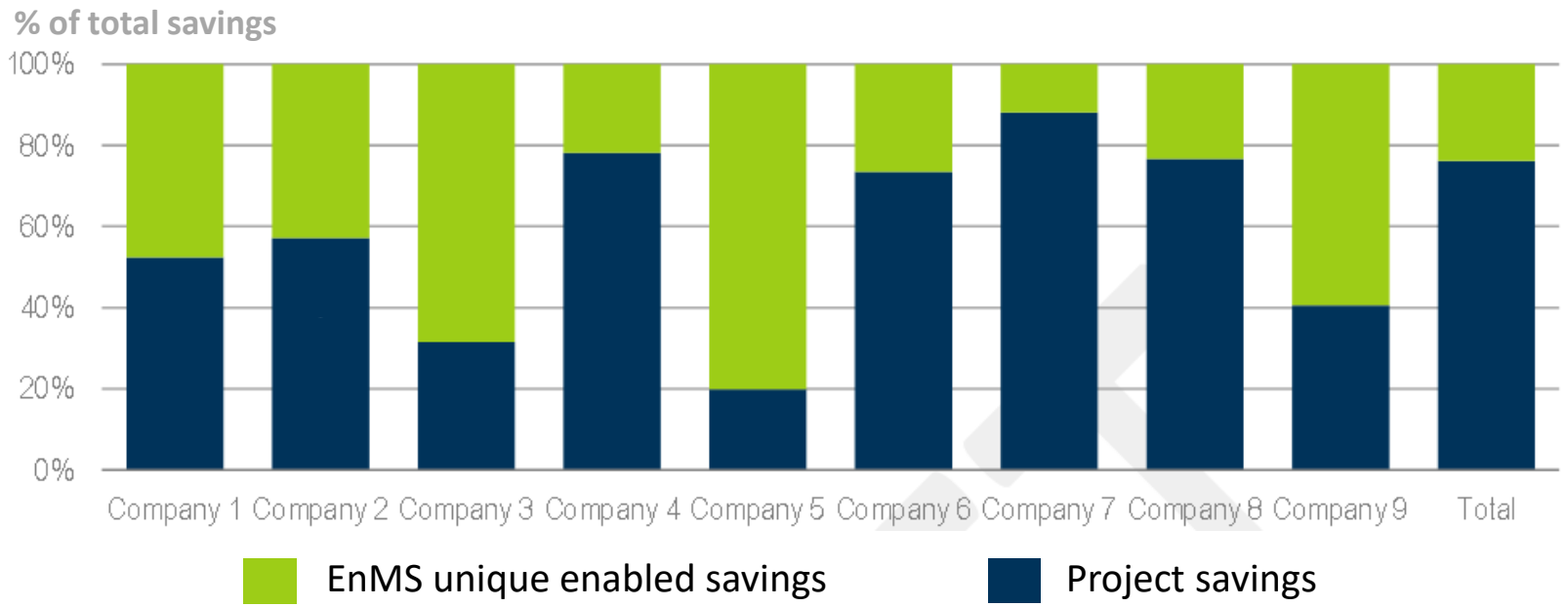
REK BITOLA

Actual savings vs Target & vs Projects - 2016



The unique nature of EnMS-ISO 50001

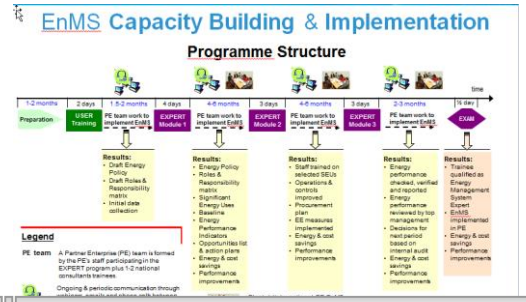
Comparison of project savings and EnMS unique enabled savings



There is evidence that energy management systems unlock energy savings beyond those from technology replacement or process upgrades

Note: Companies 1-9 are medium-sized and large companies from metal processing, chemicals, automotive, construction material and power generation sectors in Egypt, North Macedonia, South Africa and Turkey

Example 4 : EnMS in Cities – Russian Federation

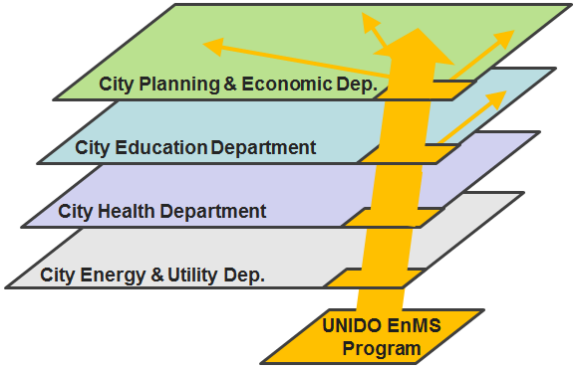


Participants

9 companies from industry

3 companies from housing and utilities sector

Track 1



Participants

City Executive Committee

10 municipal dept./comp.

2 industrial companies

Track 2

EnMS Achievements - Qualitative

- Management focus for energy efficiency
- Systematic and structured activities, including internal communication
- Staff at all levels within the organization are engaged in the management of energy
- Better informed decision making
- Improved control of production operations and energy/power demand
- Staff competencies development
- Behavioral/cultural change for energy efficiency and continual performance improvement
- Continuity of performance through changes of personnel, products and processes
- Improved quality of production
- Positive company/corporate image (operational excellence, environmental stewardship, social responsibility, etc.)

EnMS Achievements - Quantitative

- Energy savings
- Energy cost savings
- Non-energy benefits (water savings, material savings, maintenance costs reduction, etc.)
- GHG and other pollutants emission reductions
- Resources for EE
- Reduced response time to dev.
- ……

- Most industrial enterprises that implemented EnMS achieved average annual energy intensity reductions of 2-3% against 1% reduction of business as usual (IRL, NET, DEN, SWE, USA)
- For companies new to energy management, savings during the first 2 years are 10-20%
- **UNIDO experience**: organization-wide energy savings in first 1-2 years range from 4% to 15%, with little or no capital investments

Impact of UNIDO EnMS-ISO 50001-ESO Programme

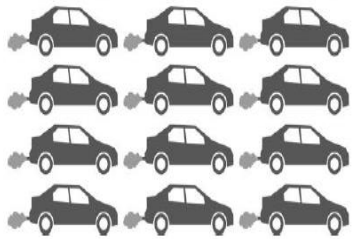
12.5 TWh of final energy savings **=**

Annual energy consumption of 2,000,000 EU households

OR

5 years energy production of 800 MW wind power

OR



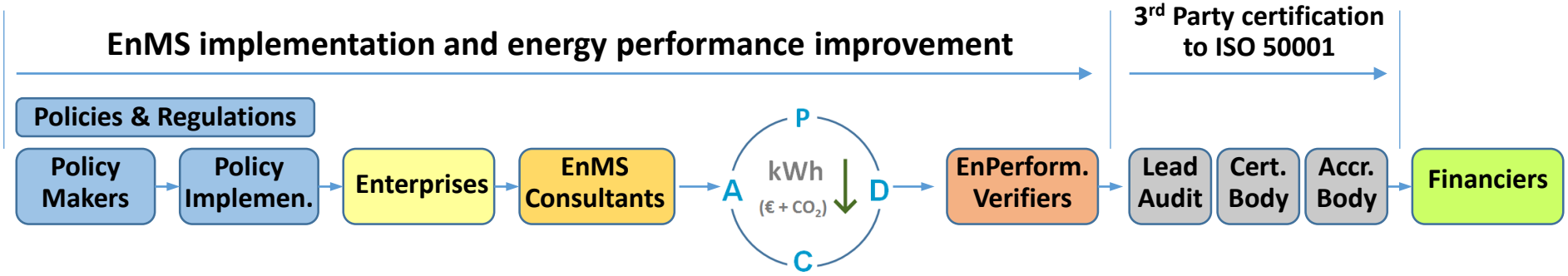
CO2 emissions of 3,000,000 middle class cars (running 12,500 km per year)

- Organization-wide energy savings in first 1-2 years range from 4% to 15%, with little or no capital investments
- Cumulative cost savings of beneficiaries companies estimated to exceed ***USD 350 mio*** without considering non-energy benefits
- GHG emission reductions of more than ***7 million*** **tCO2**
- Sustainable pipeline of IEE investments generated

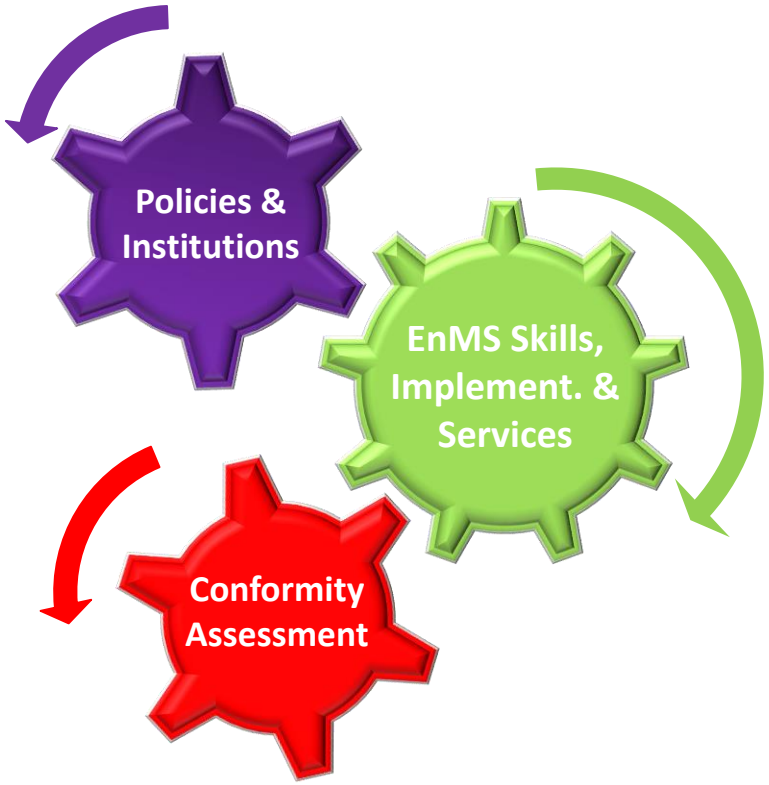
Policies and Programmes to promote EnMS-ISO 50001

Supply and value chain for EnMS-ISO 50001

Structure and Stakeholders



Success Factors for EnMS-ISO 50001 Deployment



- ✓ Level and quality of policy support, including regulation, for promotion & implementation of EnMS/ISO50001

+

- ✓ Availability of competent EnMS workforce on the "Supply" and the "Demand" sides

+

- ✓ Credible demonstration to organizations and the market of EnMS/ISO50001 tangible benefits

Policies that can support EnMS-ISO 50001

Sticks

- Energy or Carbon taxes
- Environmental legislation
- Mandatory implementation
- Energy Saving Obligation Schemes and White Certificates
- Mandatory competencies/professional requirements

Carrots

- Tax avoidance and rebates
- Cost-free or subsidized EnMS expert assistance and/or energy audits
- Funding schemes for energy management systems
- Long-term voluntary agreements
- Training and qualification programmes

Tambourine

- Peer-to-peer networks
- Award and recognition programmes

Adapted from Clemens Rohde

The importance of a Programmatic Approach

	Voluntary or Mandatory Standard	Financial incentives for Compliance	Technical Assist. Available	Penalties for Non-Compliance	Recognition Program	Linked to Voluntary Agreement	Training Avail. on Standard Compliance	Reporting to Public Entity Required	Industrial Systems Training Available	Market Penetration by Industrial Energy Use
Denmark	Vol	Yes*	Yes	Yes*	Yes	Yes	Yes	Yes	Lim	60%
Ireland	Vol	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	25%
Sweden	Vol	Yes**	Yes	Yes**	Yes	Yes	No	Yes	No	50%e
United States	Vol	No	Yes	No	Yes	No	Yes	No	Yes	<5%

Source: 2007, A. McKane for UNIDO

Examples of Policies Frameworks for EnMS-ISO 50001

Germany

- Energy taxes
- Mandatory energy audits for non-SME
- Funding schemes for energy management systems
- Energy efficiency networks

Netherland

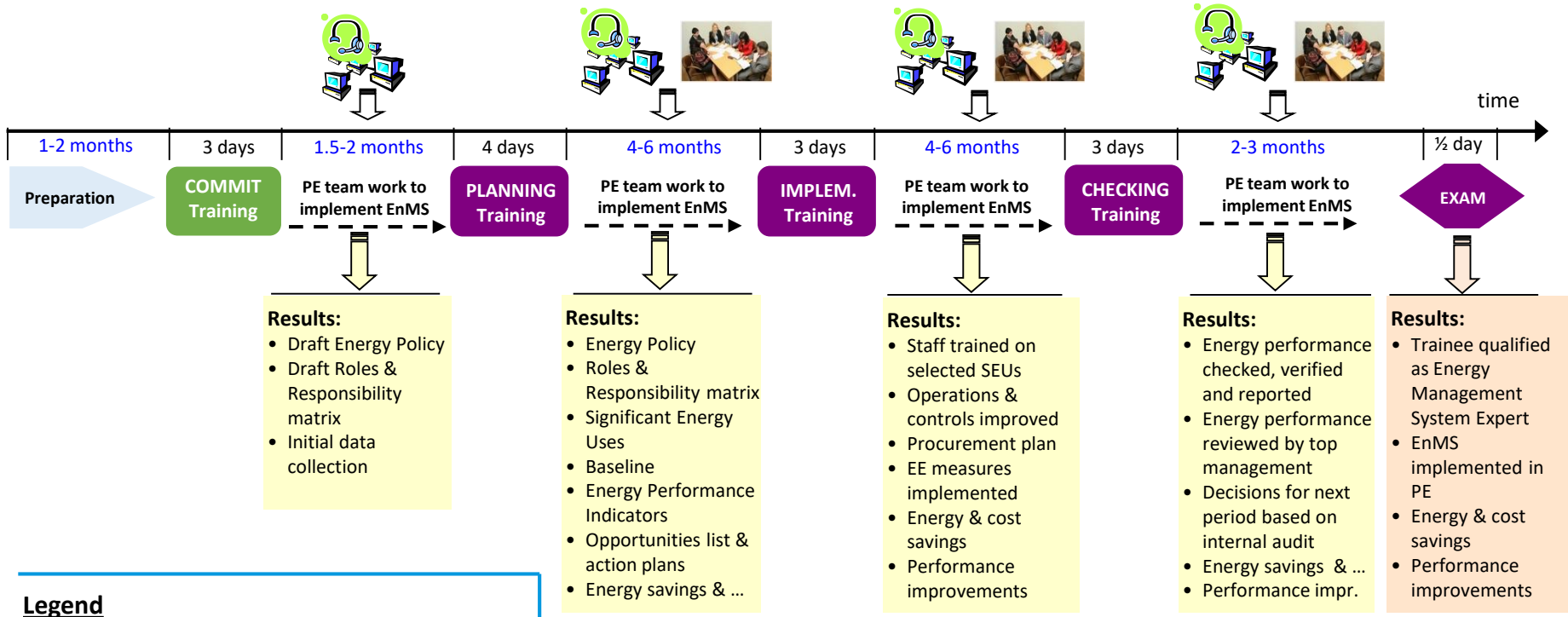
- Environmental law obligation to make IEE investments
- Long-Term Agreements including
  - ✓ TA for EnMS
  - ✓ Subsidies for audits
  - ✓ Financial incentives

Ireland

- Energy Agreements Programme including
  - ✓ Training
  - ✓ Financial support
  - ✓ Expert advice and assistance for EnMS implementation

Combining Skills Development and Results

The UNIDO EnMS Capacity Building and Implementation Programme



Legend

PE team A Partner Enterprise (PE) team is formed by the PE's staff participating in the EXPERT program plus 1-2 national consultants trainees.

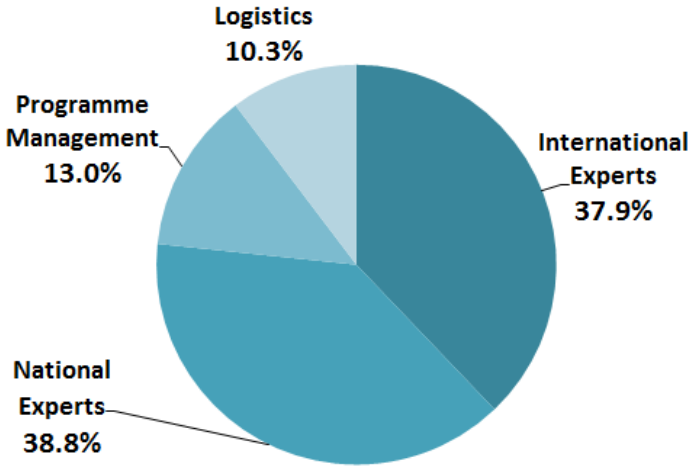
Ongoing and periodic communication through webinars, emails and phone calls between international trainers and PE teams to review progress, discuss issues and provide guidance.

Plant visits by national EE consultants trainees

Capacity Building and Implementation Programme

Costs and Benefits Analysis - FYR of Macedonia Pilot

- 12 Partner enterprises (70% success rate)
- 23 Nat. Consultants/Expert Trainees
- Full cost/value of Nat. Consultants
- Include Progr. develop. and implementation
- No inclusion of UNIDO staff & support costs
- 1 Yr: 13.19 GWh (67% no cost)
- **Cost-Benefit Ratio (1Yr) = 0.337**
- **Cost-Benefit Ratio (5Yr) = 0.026**
- **Money savings 5 Yr: 10,7**
- **Without considering non-energy benefits!**



UNIDO Implementation	COST
Category	[USD]
International Experts	110,000
National Experts	112,700
EnMS CBI Programme Management	37,800
Logistics	30,000
TOTAL	**290,500**

Scaling-up – Utility Programmes

FYR of Macedonia

- Partnership UNIDO IEE Project and EVN Macedonia (Power Utility)
- 6+2 new companies implementing EnMS, including EVN Macedonia
- 6 UNIDO Qualified National EnMS Experts providing support
- 7 new EnMS Expert Trainees, 2 from EVN Macedonia
- Cost-sharing of Qualified National EnMS Experts
  - 1/3 UNIDO project; 1/3 EVN Macedonia; 1/3 Beneficiary company
- 75% National Trainers – 25% International Trainers
- EVN Macedonia's Goals → Start providing EnMS-EE Services to Clients

Estimated (Replication) Cost to UNIDO ~ 10% of Pilot Program (i.e. <30,000 USD)

Scaling-up – Corporate Programmes

Ural Mining and Metallurgical Company (UMMC Holding)

9 companies in EnMS Program in 2015

1. AK Serov Metallurgical Plant
2. Coal Mining Company “Kuzbassrazrezugol” (Kedrovsky Open Surface Mine)
3. Branch Of “UMMC-Steel” - Electrostal Tyumen Metallurgical Plant
4. Joint Venture Company “Katur-invest”
5. Kirov Non-ferrous Metals Processing Plant
6. Revda Non-ferrous Metals Processing Works
7. "UMMC-Agro" - Teplichnoe
8. Shadrinsky Automobile Units Plant
9. Sukhoi Log Secondary Non-ferrous Metals Plant

Costs of energy resources in 2015 > **17 billion rubles;**

Energy resources account for **11.6%** in production costs;

Due to tariff increase, energy costs expected to account for **21,5 billion rubles in 2018.**

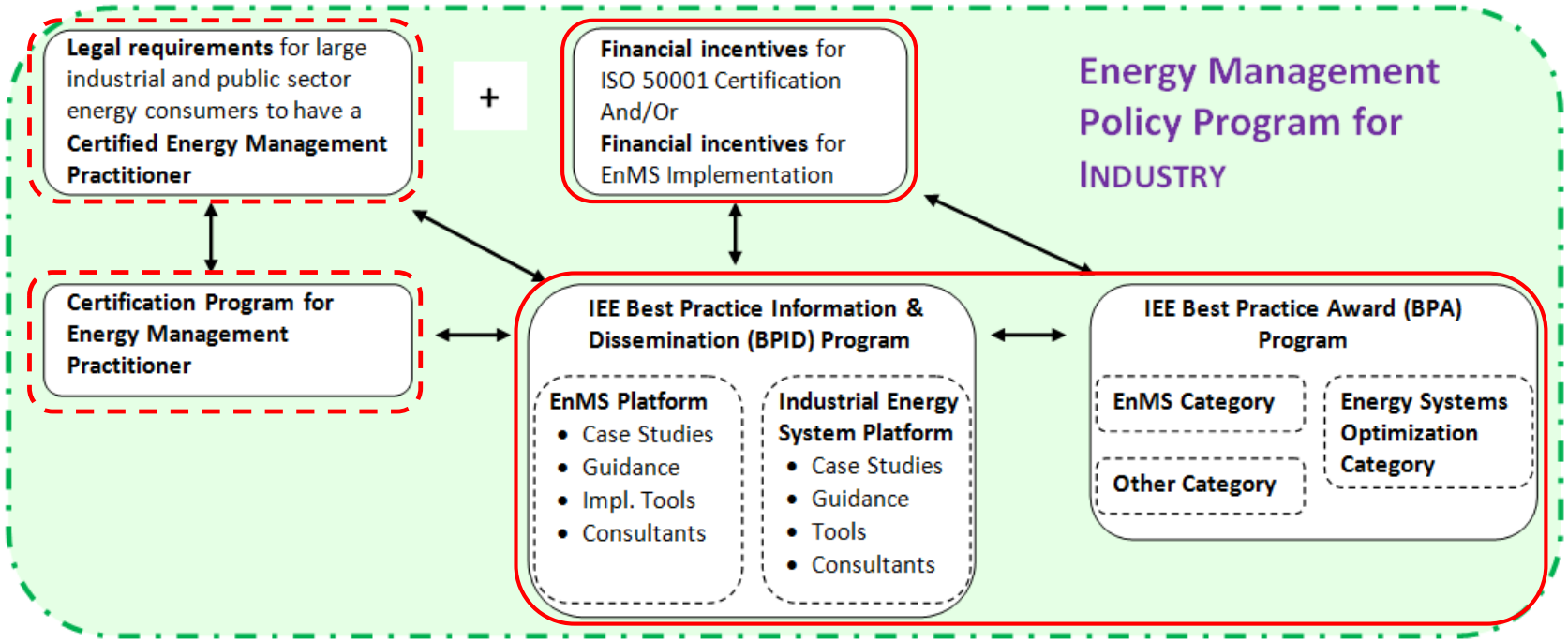
Energy consumption: 1054.3 GWh of Electricity
(9 companies) : 269.1 thou. m3 of Natural Gas

2015 Final Energy savings: 78.1 GWh (7.3%)
2015 Cost savings: 86.4 mln. rub.
2015 GHG emissions avoided: 32 361 tons CO2

EnMS implemented in 10 new companies in 2016-2017. UMMC holding counts more than 70 companies.

Scaling-up – Policy Programmes

FYR of Macedonia



Lessons learnt from EnMS implementation

- ✓ Top management necessary but not always sufficient
- ✓ Education, knowledge and competencies are critical
- ✓ EnMS-ISO 50001 means CHANGE .... first and foremost of organizations' processes and people's behavior rather than technologies
- ✓ EnMS-ISO 50001 brings about "paradigms shift" → save energy without spending money; energy management is not just one person's business; change of organization culture for EE; ….
- ✓ EnMS-ISO 50001 can drive and achieve long-term sustainability of EE

Some Success Factors and Challenges

SUCCESS FACTORS

- ✓ Real top management commitment
- ✓ Openness to change
- ✓ Ability to show improvements at early stage
- ✓ Rewarding commitment and performance
- ✓ Strong consultants and supporting program

CHALLENGES

- ✓ To support change management and behavior change for EE
- ✓ To manage and support transition from OLD to NEW energy performance measurement and indicators
- ✓ Small companies

Designing a Programme to support EnMS-ISO 50001

- What do you want to achieve?
  - How are you going to monitor and evaluate it?
  - Segment/select carefully your target "clients"
- Take in due account the existing country baselines for IEE-EnMS
  - Awareness, skills, market services, technology providers, etc.
- Take in due account the complexity of EnMS supply/value chain
- Strive for long-term programmatic framework perspective
  - Take into account resistance to change
  - Market creation and transformation
  - 3 years project or 10 years programme
- Who is going to pay
- Who is going to benefits

Energy Management Leadership Awards

2019 ENERGY MANAGEMENT LEADERSHIP AWARDS

www.cleanenergyministerial.org/initiative-clean-energy-ministerial/2019-energy-management-leadership-awards

THANK YOU!

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UNIDO

BACK-UP SLIDES

Examples of Policies Frameworks for EnMS-ISO 50001

Germany

Policy Instrument	Type of Instrument	Areas of Application	Description	Remarks
Eco tax cap for manufacturing industry	Financial	✓ Large enterprises ✓ SME ▪ Energy audits ▪ EnMS	Aimed to reduce electricity tax burdens on companies in the manufacturing sector. Companies need to prove that they have implemented an EnMS. For SMEs, an alternative system is enough (e.g. DIN EN 16247-1).	Energy Intensity as indicator. Assessment being conducted.
Special equalization scheme	Financial	✓ Electricity-intensive enterprises ▪ EnMS	It provides for reduction of renewable surcharge for energy intensive companies. A prerequisite to obtain the reduction is to have an operating certified energy or environmental management system (in line with ISO 50001, formerly EN 16001 or EMAS)	Companies with < 5 GWh can operate DIN EN 16247-1 or other systems for EE.
BAFA support program for EnMS	Financial	✓ Large enterprises ✓ SME ▪ EnMS	Aimed to support certification of EnMS for companies. Funding for initial certification, for purchasing metering technology and/ Or software for an EnMS; for external energy consultant; for training costs of employees. Limited to EUR 20 000 in 36 months.	
Energy efficiency networks	Information	✓ Large enterprises ✓ SME	Networks of companies with energy costs > EUR 500k from different sectors come together to enhance their energy efficiency and share their best practice - focus is on cross-cutting technologies.	EnMS piloted in Mexico in 2016.

Examples of Policies Frameworks for EnMS-ISO 50001

Denmark

Policy Instrument	Type of Instrument	Areas of Application	Description	Remarks
Voluntary agreement scheme	Voluntary agreement	✓ Large enterprises ✓ SME ▪ EnMS	Since 1996 companies were reimbursed CO2 tax if they implemented an EnMS. The new scheme (2013) reimburses part of the public service obligation (PSO) tariff. It has stricter conditions to be considered and applies to SMEs and large enterprises.	
Energy management light	Information	✓ SME ▪ EnMS	System and guideline targeted to SMEs on how to implement an EnMS in line with EN 16001 or part of it	
Energy saving obligation targeted at energy companies	Financial	✓ Large enterprises ✓ SME ▪ Energy audits	Energy companies need to ensure energy savings amounting to 12.2 PJ per year. Savings can come from agreements with end users. Energy companies may provide energy audits or grants connected to energy savings, making more attractive for SMEs and large enterprises to do EE.	Established in 1995. Denmark EEOS is the only one with top savings in Industry

Policies Frameworks for EnMS-ISO 50001

EU Energy Efficiency Directive – Article 7 & Article 8

Article 7

Energy efficiency obligation schemes

1. Each Member State shall set up an energy efficiency obligation scheme. That scheme shall ensure that energy distributors and/or retail energy sales companies that are designated as obligated parties under paragraph 4 operating in each Member State's territory achieve a cumulative end-use energy savings target by 31 December 2020, without prejudice to paragraph 2.

.....

9. As an alternative to setting up an energy efficiency obligation scheme under paragraph 1, Member States may opt to take other policy measures to achieve energy savings among final customers, provided those policy measures meet the criteria set out in paragraphs 10 and 11. The annual amount of new energy savings achieved through this approach shall be equivalent to the amount of new energy savings required by paragraphs 1, 2 and 3. Provided that equivalence is maintained, Member States may combine obligation schemes with alternative policy measures, including national energy efficiency programmes.

Article 8

Energy audits and energy management systems

1. Member States shall promote the availability to all final customers of high quality energy audits which are cost-effective and:

(a) carried out in an independent manner by qualified and/or accredited experts according to qualification criteria; or

(b) implemented and supervised by independent authorities under national legislation.

.....

6. Enterprises that are not SMEs and that are implementing an energy or environmental management system - certified by an independent body according to the relevant European or International Standards - shall be exempted from the requirements of paragraph 4, provided that Member States ensure that the management system concerned includes an energy audit on the basis of the minimum criteria based on Annex VI.

Opportunities are everywhere

MMK Iron & Steel Works, Russia

8,1 % over 3 year

$ 38 596 000 Total

3 days

ACC (Cement), Egypt

8% over 3 years

$8.74 Million total

1.3 years

Great Giant Pineapple, Indonesia

5.8 over 2 years

$ 528,070 total

5.2 months

GSK, Ireland

8.1% over 6 Years

$4,642,769 total

8 days

Nissan, USA

18% over 2 years

$4,624,000 annually

2 weeks

Catalyst Paper, Canada

5.6% over 3 years

$3,263,885 annually

>1 year

ISO 50001:2018 – Scope

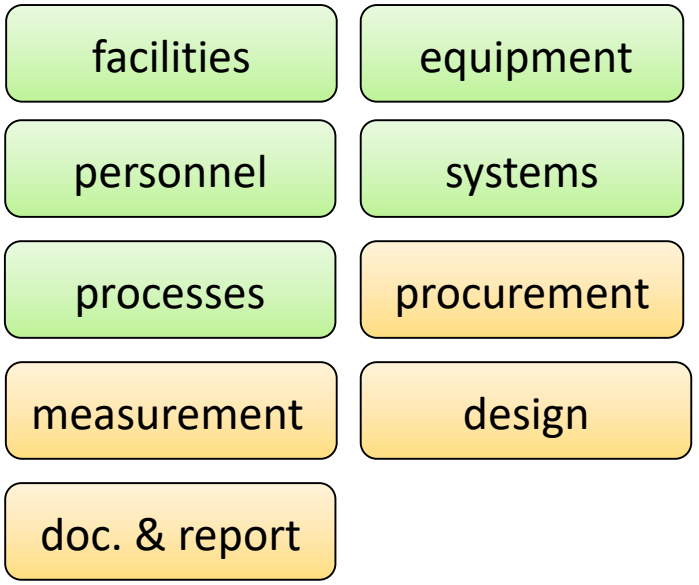
1 Scope

".. requirements for establishing, implementing, maintaining and improving an energy management system (EnMS). The intended outcome is to enable an organization to follow a systematic approach in achieving continual improvement of energy performance and the EnMS."

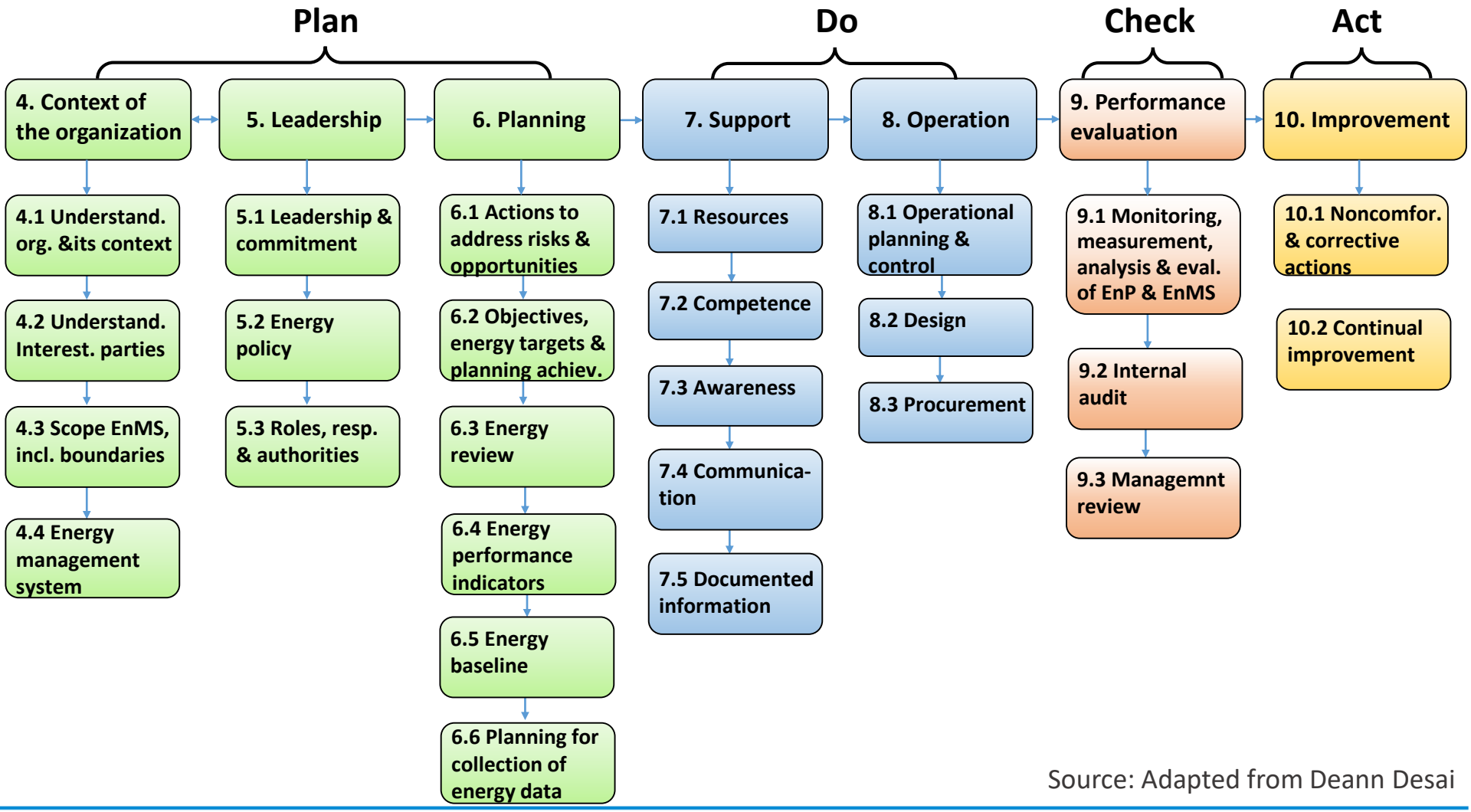
Applicable to:

- Any organization
- Activities affecting energy performance (EnP) managed and controlled by the organization
- No matter level or type of energy consumed

Demonstration of continual EnP improvement, but does NOT prescribe targets for EnP improvement



ISO 50001:2018 Basic Structure



Source: Adapted from Deann Desai