Global Gateway

Funded by the European Union

INTERNATIONAL CONFERENCE

Sustainable Energy – the Energy of the Future: International Experience in Advancing and Implementing Innovative Energy Efficiency and Renewable Energy Technologies in Residential and Public Buildings

02 September 2025 (hybrid format)

State Energy Institute of Turkmenistan, Mary

Life Cycle Energy Efficiency of Buildings and Energy Management

Agris Kamenders

International Consultant, SECCA (online)

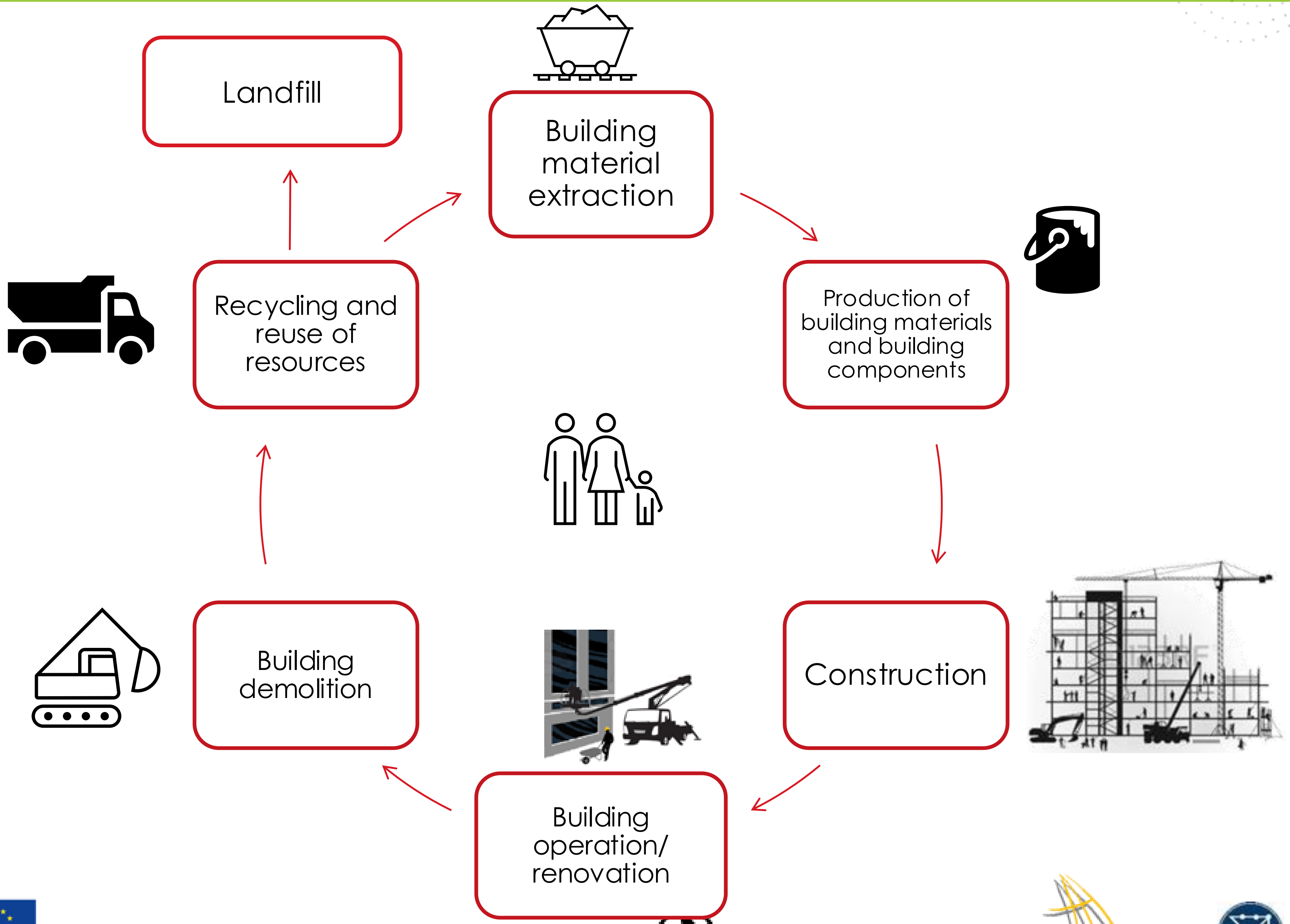
SECCA Sustainable Energy Connectivity in Central Asia

Stantec GOPA Tech ACTED EUI FLORENCE SCHOOL OF REGULATION

Content

- Life Cycle Analyses and Energy Efficiency
- Energy Management System

In which life cycle stage energy consumption the highest?



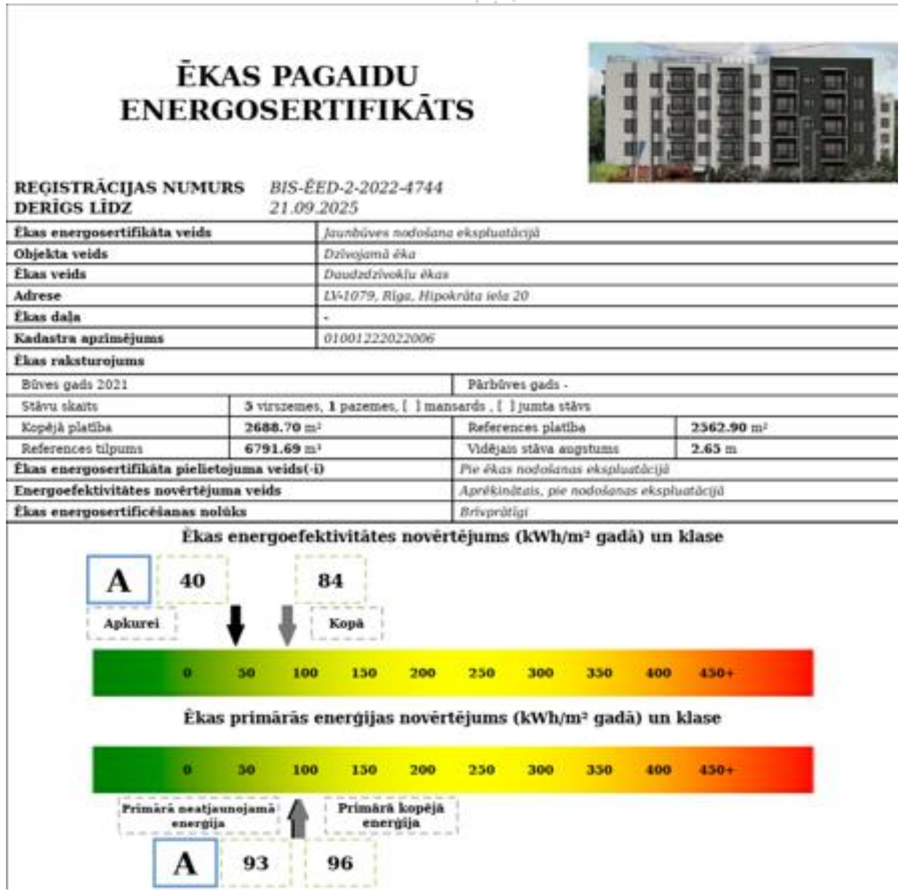
Example of building complex analyses from Riga

Perform a comprehensive energy and CO_2 assessment of the building using Life Cycle Assessment (LCA)

- Identify the greatest impacts from different stages of building construction and use, as well as from materials
- Evaluate the results obtained and compare them with other buildings/standards

Building maintenance and end-of-life scenario

- **B2 Building maintenance and cleaning** – includes water and cleaning agent consumption for building cleaning
- **B4 Replacement activities** – includes replacement of floor laminate and elevators
- **B5 Refurbishment activities** – includes repainting of all façade walls
- **B6 Building energy consumption** – covers heat, domestic hot water, and electricity consumption. Data are based on building energy performance certificates
- **C End-of-life stage** – based on the average Latvian waste recycling and disposal scenario



ĒKAS PAGAIDU ENERGOSERTIFIKĀTS

REĢISTRĀCIJAS NUMURS BIS-ĒED-2-2022-4744
DERĪGS LĪDZ 21.09.2025

Ēkas energosertifikāta veids	Jaunbūves nodošana ekspluatācijā
Objekta veids	Dzīvojamā ēka
Ēkas veids	Daudzdzīvokļu ēkas
Adrese	LV-1079, Rīga, Hipokrāta iela 20
Ēkas daļa	-
Kadastra apzīmējums	01001222022006
Ēkas raksturojums	

Būves gads 2021		Pārbūves gads -	
Stāvu skaits	5 virszemes, 1 pazemes, [ ] mansards , [ ] jumta stāvs		
Kopējā platība	2688.70 m²	References platība	2562.90 m²
References tilpums	6791.69 m³	Vidējais stāva augstums	2.65 m

Ēkas energosertifikāta pielietojuma veids(-i)	Pie ēkas nodošanas ekspluatācijā
Energoefektivitātes novērtējuma veids	Aprēķinātais, pie nodošanas ekspluatācijā
Ēkas energosertificēšanas nolūks	Brīvprātīgi

Ēkas energoefektivitātes novērtējums (kWh/m² gadā) un klase

A 40 Apkurei 84 Kopā

0 50 100 150 200 250 300 350 400 450+

Ēkas primārās enerģijas novērtējums (kWh/m² gadā) un klase

0 50 100 150 200 250 300 350 400 450+

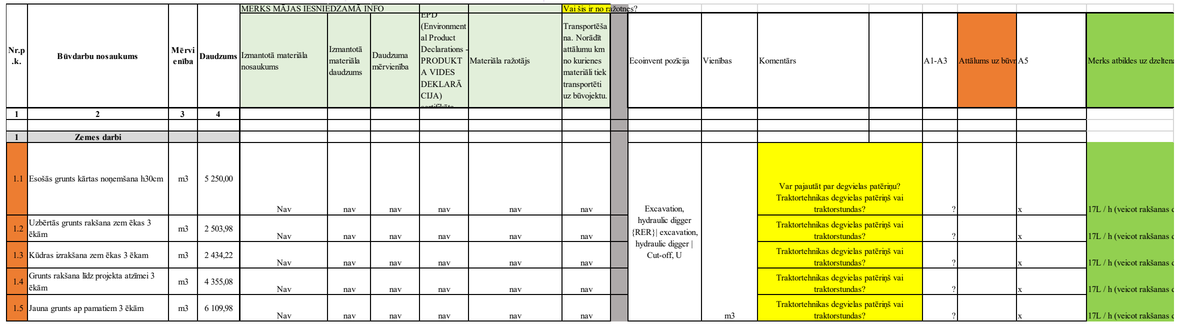
Primārā neatjaunojamā enerģija Primārā kopējā enerģija

A 93 96

Energy consumption date based on EPCs

Metodoloģija

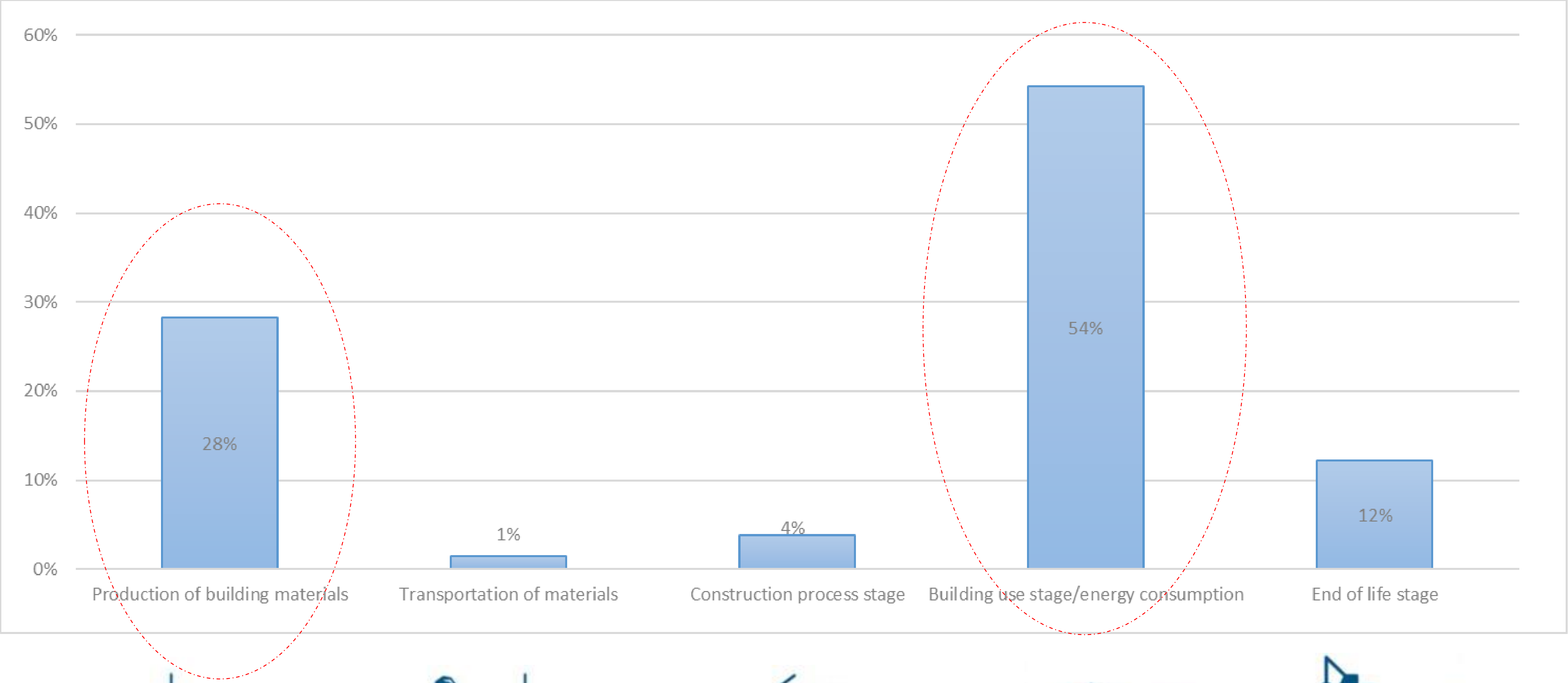
- **Energy consumption calculation** – energy use modeling
- Input data in Excel: quantities of materials used and energy consumed, based on the **construction bill of quantities**
- Where possible, Environmental Product Declarations (**EPDs**) for materials were used
- Reference values from the **Ecoinvent 3.9 (Swiss Centre for Life Cycle Inventories) database and SimaPro 9.5 software**



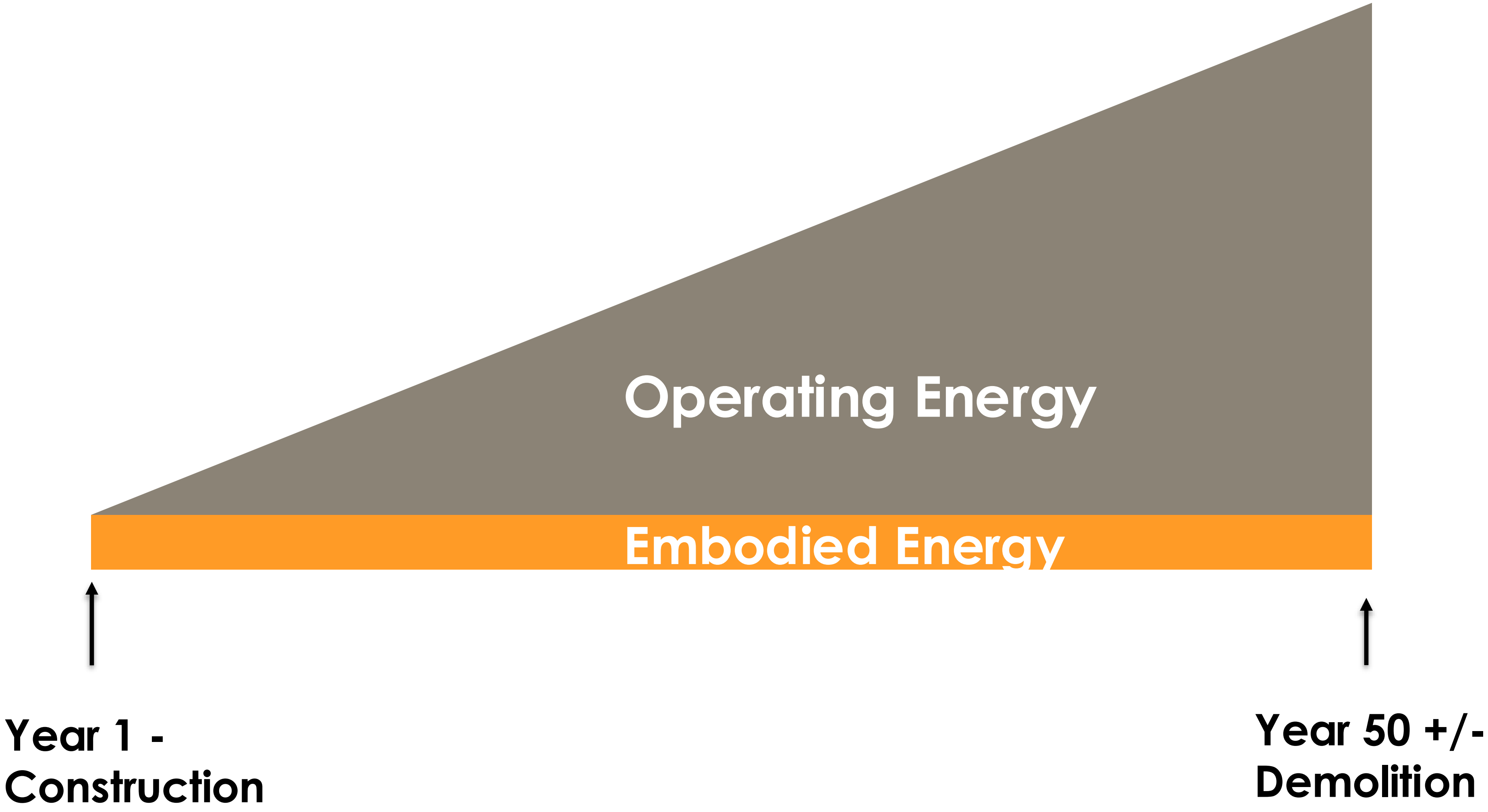
Nr.p.k.	Būvdarbu nosaukums	Mērvienība	Daudzums	Izmantotā materiāla nosaukums	Izmantotā materiāla daudzums	Daudzuma mērvienība	EPD (Environmental Product Declarations - PRODUKTA VIDES DEKLARĀCIJA) sertifikāts	Materiāla ražotājs	Transportēšana. Norādīt attālumu km no kurienes materiāli tiek transportēti uz būvojektu.	Ecoinvent pozīcija	Vienības	Komentārs		A1-A3	Attālums uz būvr	A5	Merks atbildes uz dzeltena
				MERKS MĀJAS IESNIEDZAMĀ INFO					Vai šis ir no ražotnes?								
1	2	3	4														
1	Zemes darbi																
1.1	Esošās grunts kārtas noņemšana h30cm	m3	5 250,00	Nav	nav	nav	nav	nav	nav	Excavation, hydraulic digger {RER}| excavation, hydraulic digger | Cut-off, U	m3	Var pajautāt par degvielas patēriņu? Traktortehnikas degvielas patēriņš vai traktorstundas?		?		x	17L / h (veicot rakšanas
1.2	Uzbērtās grunts rakšana zem ēkas 3 ēkām	m3	2 503,98	Nav	nav	nav	nav	nav	nav			Traktortehnikas degvielas patēriņš vai traktorstundas?		?		x	17L / h (veicot rakšanas
1.3	Kūdras izrakšana zem ēkas 3 ēkam	m3	2 434,22	Nav	nav	nav	nav	nav	nav			Traktortehnikas degvielas patēriņš vai traktorstundas?		?		x	17L / h (veicot rakšanas
1.4	Grunts rakšana līdz projekta atzīmei 3 ēkām	m3	4 355,08	Nav	nav	nav	nav	nav	nav			Traktortehnikas degvielas patēriņš vai traktorstundas?		?		x	17L / h (veicot rakšanas
1.5	Jauna grunts ap pamatiem 3 ēkām	m3	6 109,98	Nav	nav	nav	nav	nav	nav			Traktortehnikas degvielas patēriņš vai traktorstundas?		?		x	17L / h (veicot rakšanas

Global Gateway

CO_2 (embodied energy) emissions over the building's life cycle



Building Energy Consumption during building life cycle



- **Majority of energy use in buildings**
  – heating, cooling, ventilation, lighting, hot water, and other systems

- **Post-construction focus:**
  Monitor **energy efficiency** and ensure **proper operation and maintenance** of all systems

Costs and energy consumption over the entire life cycle of the building

Building Life Cycle Information																Supplymentary information
A 1–3 Product stage			A 4–5 Construction process stage		B 1–7 Use stage							C 1–4 End of life stage				Supplementary environmental info
A1 – Raw material supply	A2 – Transport	A3 – Manufacturing	A4 – Transport	A5 – Construction-installation process	B1 – Use	B2 – Maintenance	B3 – Repair	B4 – Replacement	B5 – Refurbishment	B6 – Operational energy use	B7 – Operational water use	C1 – De-construction, demolition	C2 – Transport	C3 – Waste processing	C4 – Disposal	Biogenic carbon storage Net exports of locally produced electricity

The building life cycle stages are defined in accordance with LVS EN 15804 *Sustainability of construction works – Environmental product declarations*

Energy efficiency performance gap

Operation & Maintenance Impact

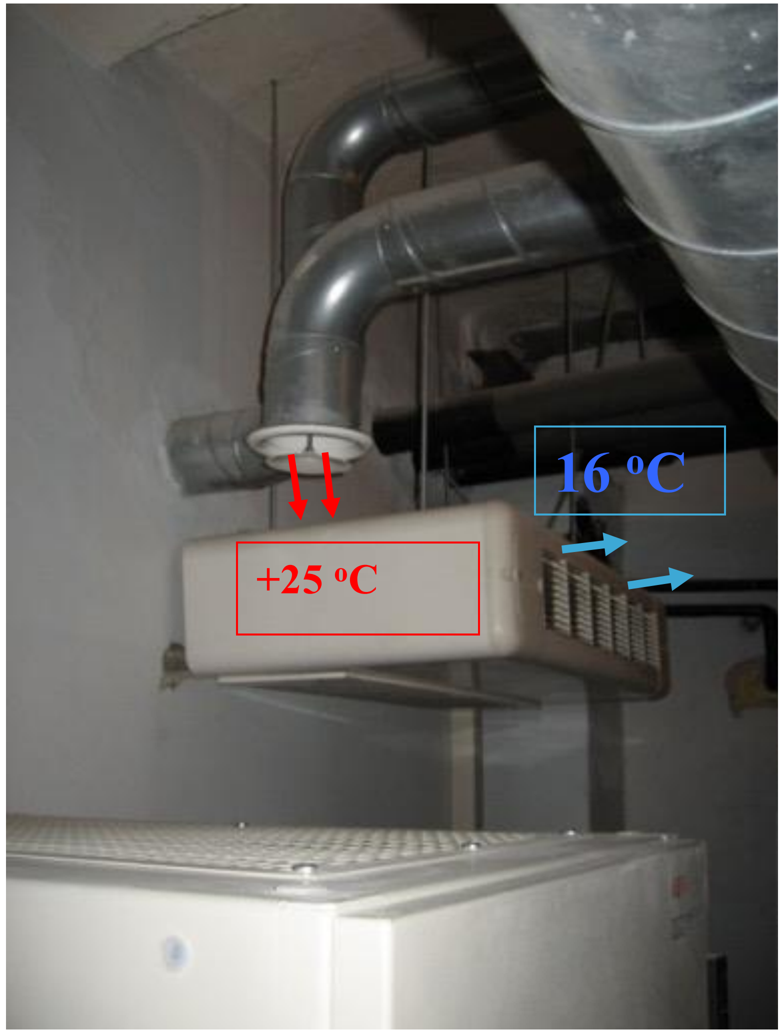
- Poor O&M can cause **10–30% performance gaps**
- Smart control & monitoring (e.g. predictive control, fault detection) can cut energy use by **up to 20–25%** — *without major retrofits*

Sources of performance gaps:

- **Design & simulation:** model limitations, inaccuracies, assumptions
- **Construction & commissioning:** workmanship issues, material/system differences
- **Operation:** poorly functioning systems, mismatch with actual use

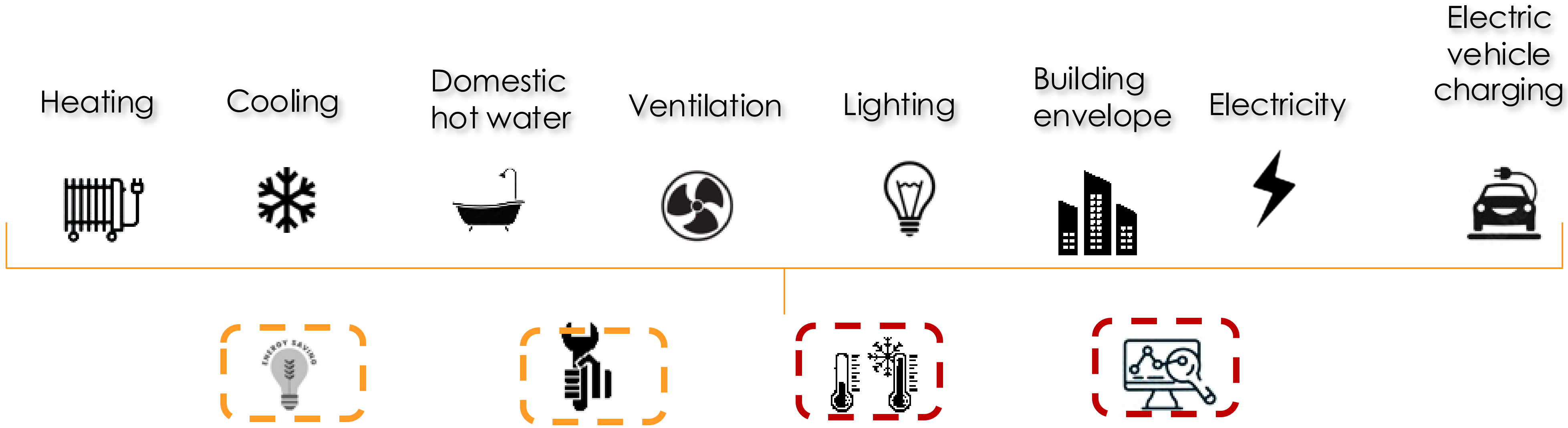
Common issue in large buildings:

- Poor control of HVAC & lighting systems
- Problems with equipment scheduling, temperature setpoints
- Simultaneous heating & cooling causing energy waste
- **Solution:** better commissioning for new/renovated buildings or retro-commissioning for existing ones



How to ensure building energy efficiency performance

Maintenance Targets & Actions – Technical Systems



- **Systematic and scheduled maintenance** – Regular inspections and servicing of HVAC, lighting, and control systems to prevent efficiency losses
- **Continuous energy monitoring & analysis** – Use of smart meters, IoT sensors, and Building Management Systems (BMS) for real-time data, fault detection, and benchmarking against expected performance
- **Setpoint management & control strategies** – Regularly verify and adjust temperature, ventilation, and lighting setpoints; implement demand-controlled ventilation and adaptive control algorithms

Preventive maintenance & retro-commissioning – Early detection of faults, calibration of controls, and periodic retro-commissioning to restore performance and address system drift over time

Optimization through digital tools – Use predictive control, AI-based optimization, and Digital Twins to balance comfort, energy efficiency, and indoor climate quality

Integration of renewable energy & storage – Maximise on-site renewable energy production and apply storage solutions to reduce primary energy demand

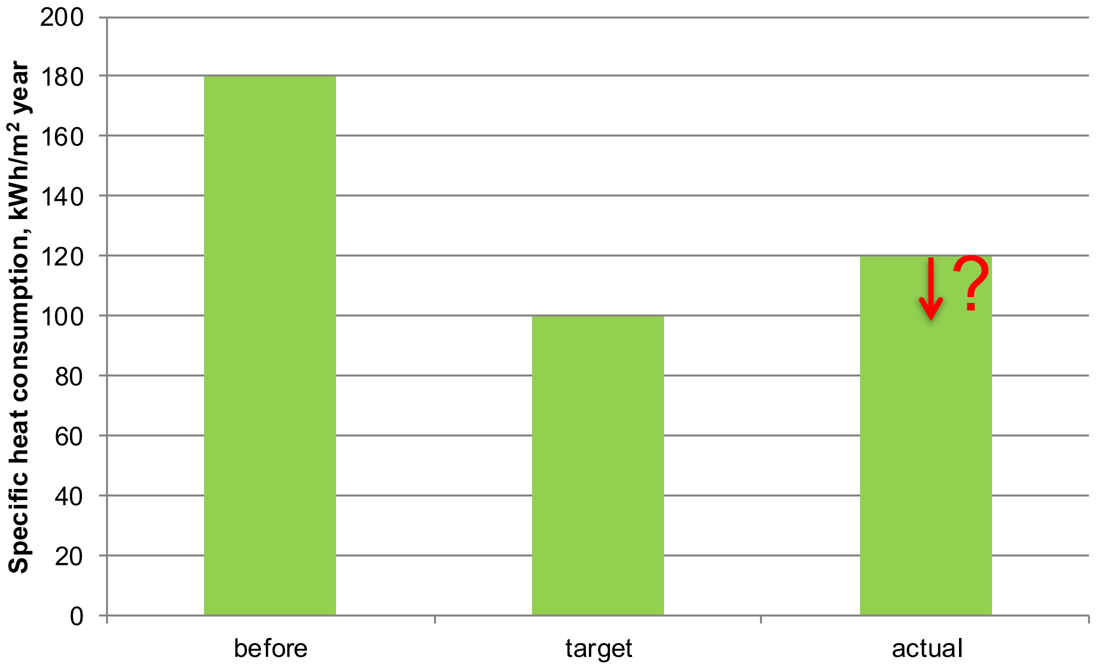
User engagement & training – Ensure building operators and occupants understand system functions, fostering energy-conscious behaviour

What was and still is the Starting point (motivation) towards energy management in different organization?

One of the reasons: Failure to reach targeted heat consumption

Grant for renovation of a public building - target values are set (kWh/m^2 year)

1 year later



Every big organization (municipality, university) should have an energy management system in place

1. Energy management system ensures rational use of energy and reduction of energy costs
2. Energy management system defines clear roles and responsibilities
3. Certified energy management system ensures continuity

The challenges

At the building level:

- Is the building maintained as well as possible?
- Is heat consumption known? We consume a lot or average?
- Is electricity consumption known?
- Is air quality good?
- Are rooms well ventilated?
- Is lighting appropriate?
- Is system regulated so that there is less heating ensured during the weekends (if building is not used)?

Etc.

At the municipal/organization level:

- Are all buildings maintained as well as possible?
- Do we know heat consumption in each building and how it changes?
- Is electricity consumption known for each building?
- Do we know how much we pay monthly/annually for energy?
- Is air quality good in all schools and kindergartens? Are rooms well ventilated?
- Is lighting appropriate?
- Is system regulated so that there is less heating ensured during the weekends (if building is not used)?
- Etc.

Global Gateway

What often happens at the building level...

- Kindergarten built in 1970-ies
- Renovated in 2015
- 120 children
- 1566 m^2
- Heat consumption before renovation – 206 kWh/m^2 year
- Heat consumption after renovation (from energy audit) – 99 kWh/m^2 year
- Real consumption 4 years after renovation – 180 kWh/m^2 year
- Building is overheated and ventilation is ensured through open windows
- Automatisation of the heating system was not connected
- Annually lost around 5000 EUR

The role of International standard MN ISO 50001:2019: why it was made?

The ISO 50001 was designed to allow any organisation to pursue, following a systematic approach, the **continuous improvement of its own energy performance**, including:

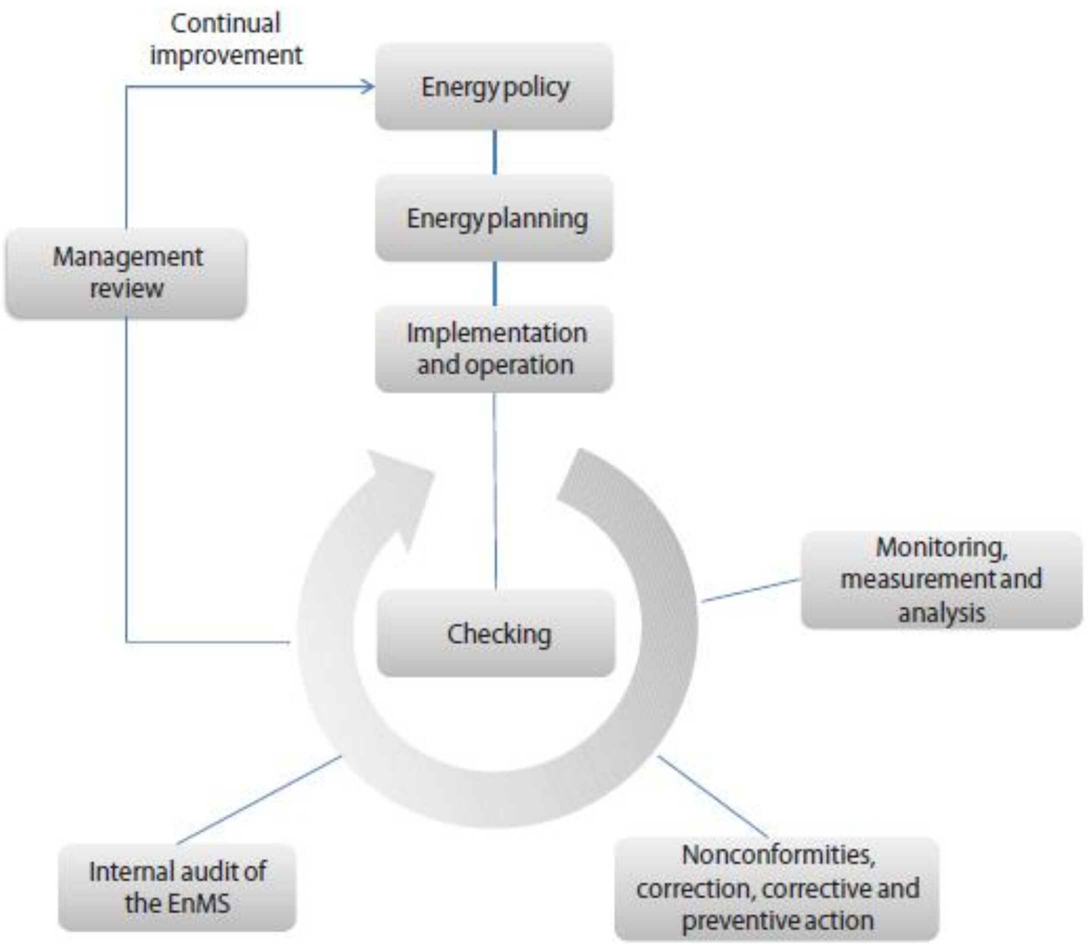
- *More efficient energy use and better use of the organisation's energy consuming assets*
- *Energy efficiency*
- *Reduction of energy costs*

- Based on the core concept of continuously improving energy performance, the **ISO 50001 standard defines and addresses the most important requirements towards energy use and consumption**, including
  - measurement
  - procurement
  - documentation
  - design
  - equipment
  - processes and personnel
- All these issues can affect the energy performance of any organisation

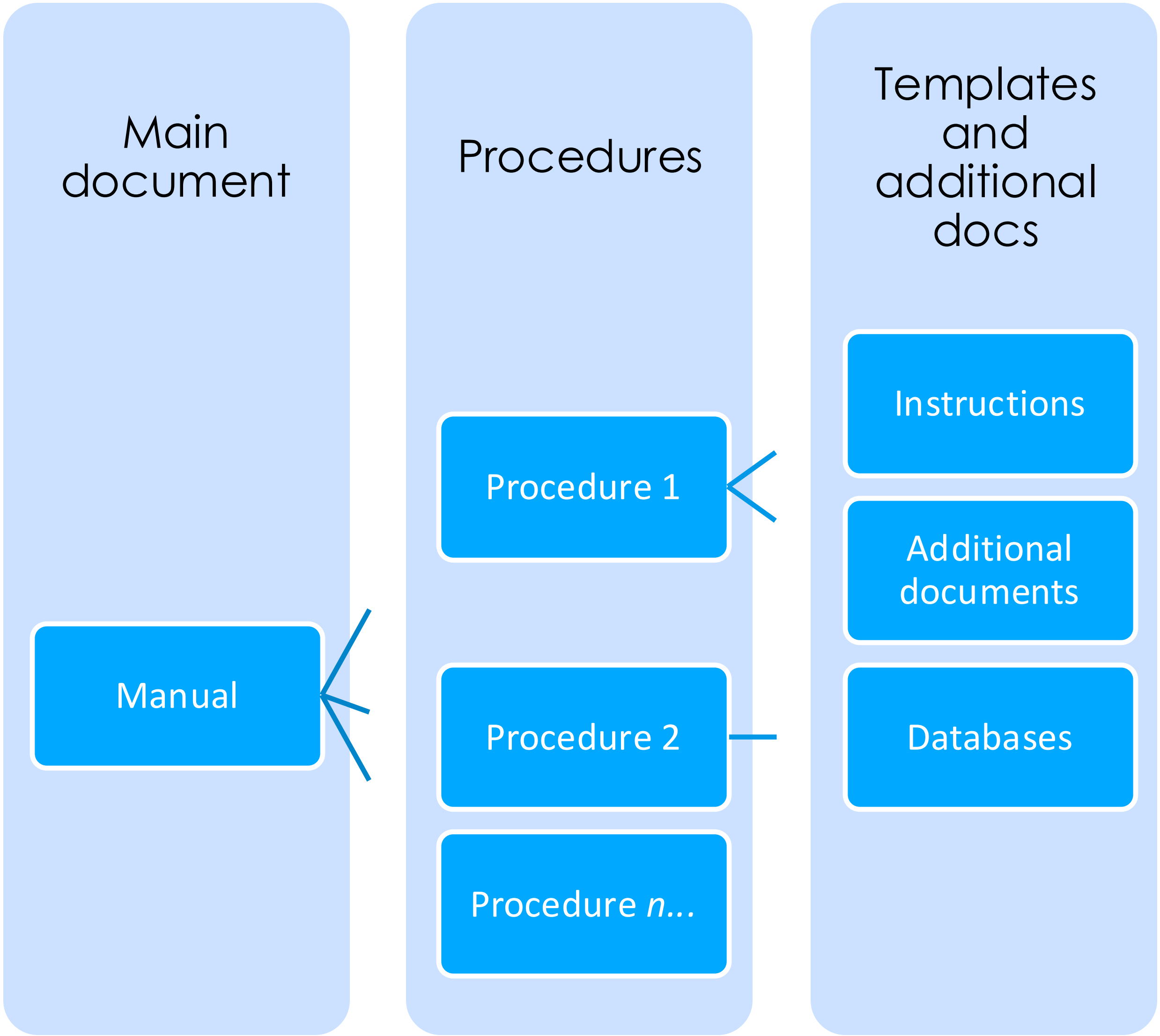
Plan-Do-Check-Act (PDCA) approach

The ISO 50001 standard is structured according to the general Plan-Do-Check-Act (PDCA) approach

- **Plan:** establish energy balances of the LA's assets, as well as define necessary objectives, targets and action plans that will improve energy performance
- **Do:** implement an effective energy management action plan
- **Check:** provide a methodological and operational approach for monitoring and analysing the energy performance of the LA
- **Act:** continually improve the LA's energy performance with the aim that the EnMS becomes not just a niche tool, but rather actually an integral part of the administration's Energy Policy and day-to-day operations



What does the EnMS look like?



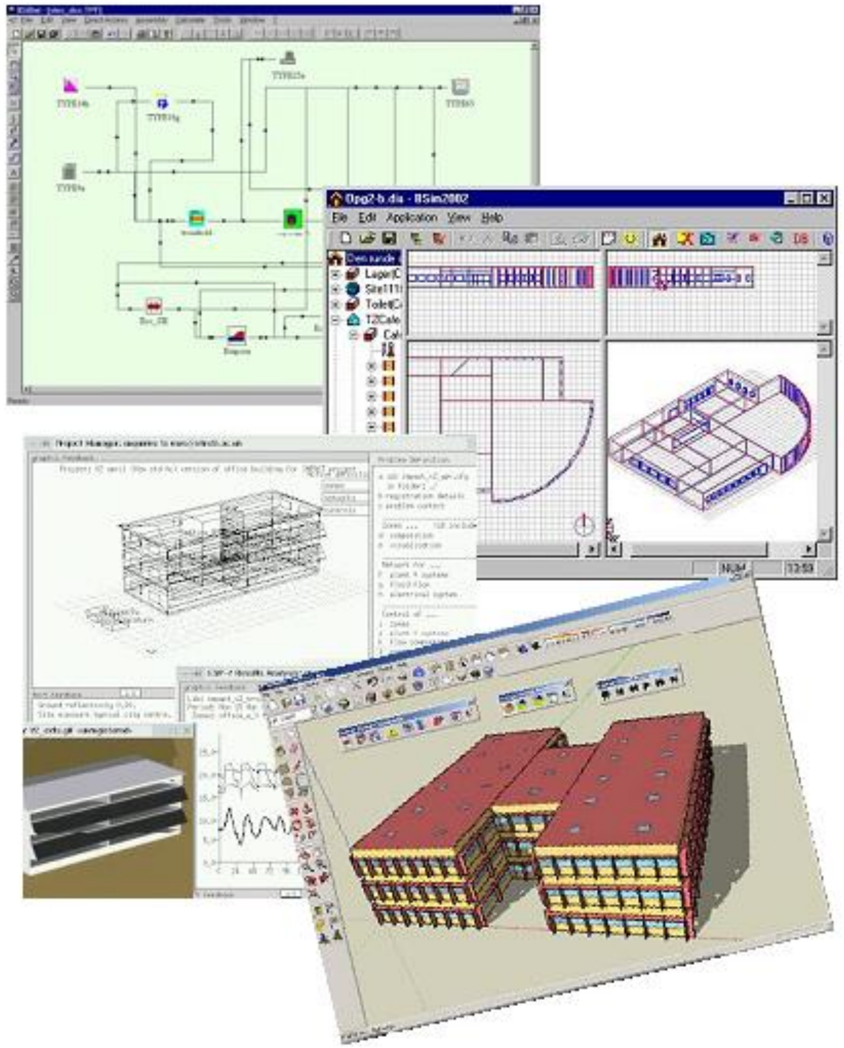
Documentation of an EnMS

- Common elements found in many other ISO management system standards
- Organisation is given some degree of flexibility in how it actually implements the EnMS
- This flexibility helps make EnMS to be a so-called “organic system” made up of documents, processes, people, physical and organisational boundaries, energy objectives and targets

How to operate energy management system?

Operating an Energy Management System (EnMS) in a bigger organization

- **Governance:** assign energy manager/team, set clear roles
- **Targets:** define savings & CO_2 reduction goals (ISO 50001)
- **Monitoring:** sub-metering, BMS, real-time data
- **Optimization:** adjust HVAC & lighting schedules, lab systems
- **Maintenance:** regular & predictive servicing
- **Engagement:** train staff, involve students, awareness actions
- **Improvement:** audits, retro-commissioning, integrate renewables



Global Gateway

Thank you!

SECCA
Sustainable Energy Connectivity in Central Asia

Funded by the European Union

Stantec

GOPA Tech

ACTED

EUI FLORENCE SCHOOL OF REGULATION