

# **Different types of Energy Assessments and some Experiences**

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# What exactly is an Energy Audit?

# Energy Auditing has many names

- the activity has different names in different countries
- in Europe mainly term Energy Audit is used
- in the US Energy Assessments
- other names: energy surveys, energy scans...
- but we all mean the same thing: identifying energy saving possibilities and reporting them to the building owner

# What is an Energy Audit?

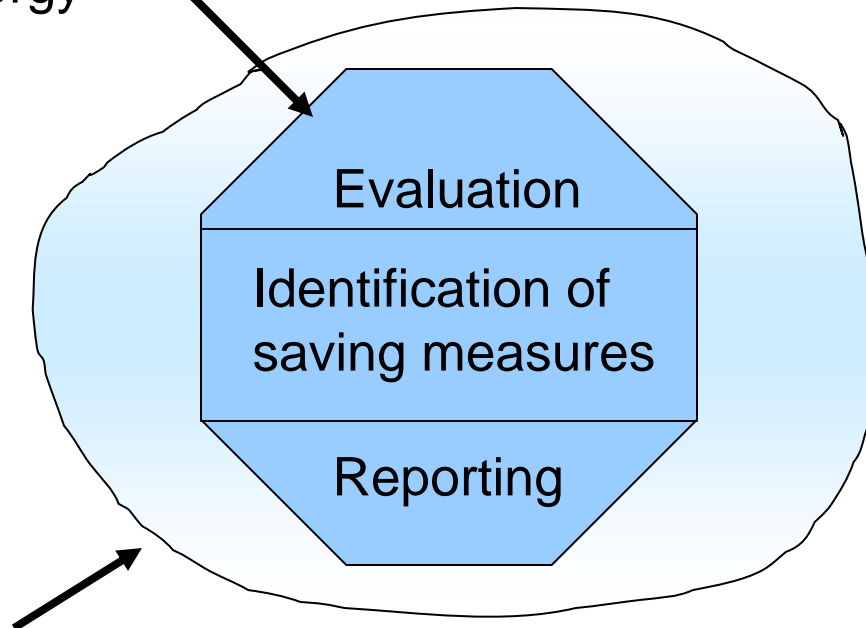
Energy audit is a systematic procedure where the purpose is to

- evaluate the existing energy consumption
- identify of the saving measures
- report the findings

in existing buildings/sites/objects...

# Energy Audit Model Theory

This is the heart  
of the energy  
audit



The "topping" is how it is done in practice in  
different countries / sites / levels of audits

# **Energy audits / assessments - some background and history**

# Energy Auditing is a good tool

- energy auditing since 1980's in many countries
- audits are essential for finding the most effective measures to improve energy efficiency
- energy auditing is a useful tool for reducing energy costs and CO<sub>2</sub>-emissions
- energy auditing is often used as the practical tool in energy efficiency agreements, environmental management, facility management long term planning, etc

# EU-level targets

- Greenhouse gas emissions
  - Reduction of by 20% from 1990 level by 2020
  - Reduction target 30% if other industrialized countries take similar action
  - Reduction of 60-80% by 2050 in industrialized countries
- Renewable energy:
  - Increase the share of renewables to 20% in the EU by 2020
  - In the transport sector increase renewable fuels to 10% by 2020
- Energy efficiency improvement 20% by 2020 from baseline of 2005
- EU stands in front line against climate change



# EU Energy-efficiency Policies / Energy Audits

Energy Auditing has a key role in the EU-level directives:

- energy performance of buildings -directive
  - energy certification of buildings is mandatory
  - the certificate includes a list of energy saving measures
- energy end-use efficiency and energy services -directive
  - energy audit schemes must be available in EU member states
  - national audit programmes are being developed

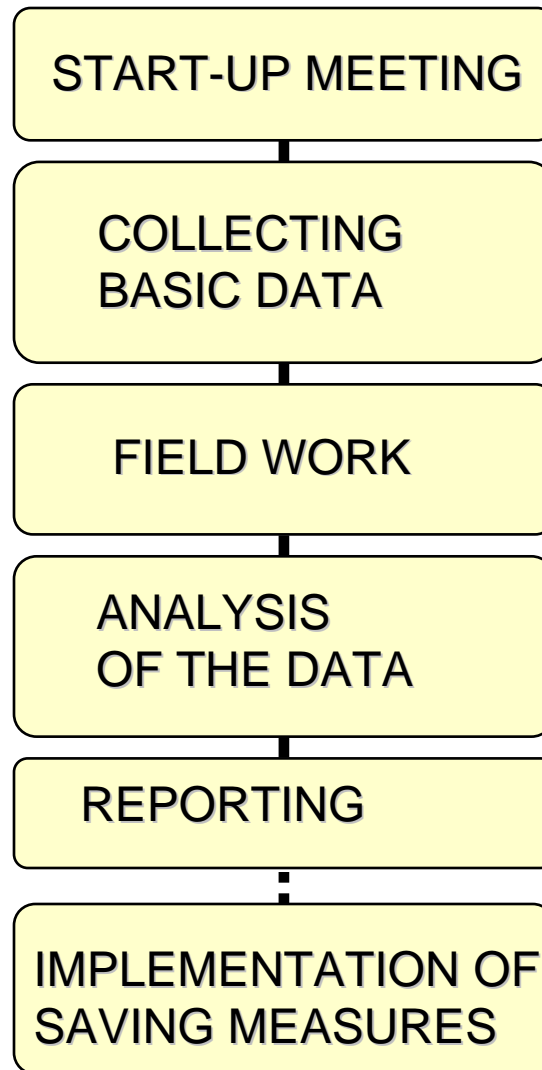
# The AUDIT-projects

The material in this slideshow is partly based on the material from 2 international projects that created energy auditing theory:

- SAVE-project AUDIT I 1998-2000
  - comprehensive study on energy auditing in EU countries
  - developing definitions on energy auditing
  - developing state-of-the-art approaches to energy auditing
- SAVE-project AUDIT II 2001-2003
  - Finland (Motiva), Norway (IFE), Austria (EVA), France (ADEME), Greece (CRES), Portugal (Adene)
  - The main aim is to start EU-level co-operation
  - Country reports on Energy Auditing (EU)
  - Topic reports on Audit Program Elements

# What are the different options for doing an audit?

# Energy Audit Procedure in general



...but there are many different ways to do it

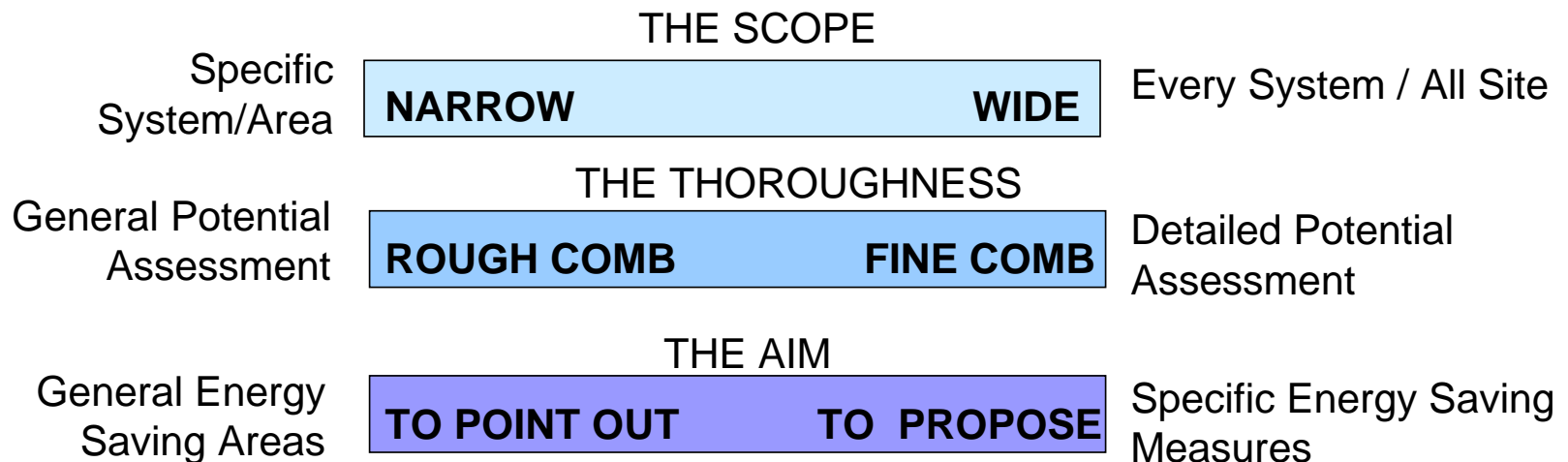
# Why different Audit Models?

- An energy audit analyses the present energy use and points out profitable saving measures, but
  - energy is used for different purposes (e.g. heating or process)
  - the scale of energy consumption varies (e.g. school or power plant)
  - the site can be at various stages of its life cycle (e.g. new, updated, completely renovated)
  - the size of the site varies (e.g. petrol station or city hospital)
  - the scope of the energy audit varies (walk-through / thorough analysis, system-specific / wide scope...)
- Different needs for
  - amount of work
  - audit phases
  - reporting

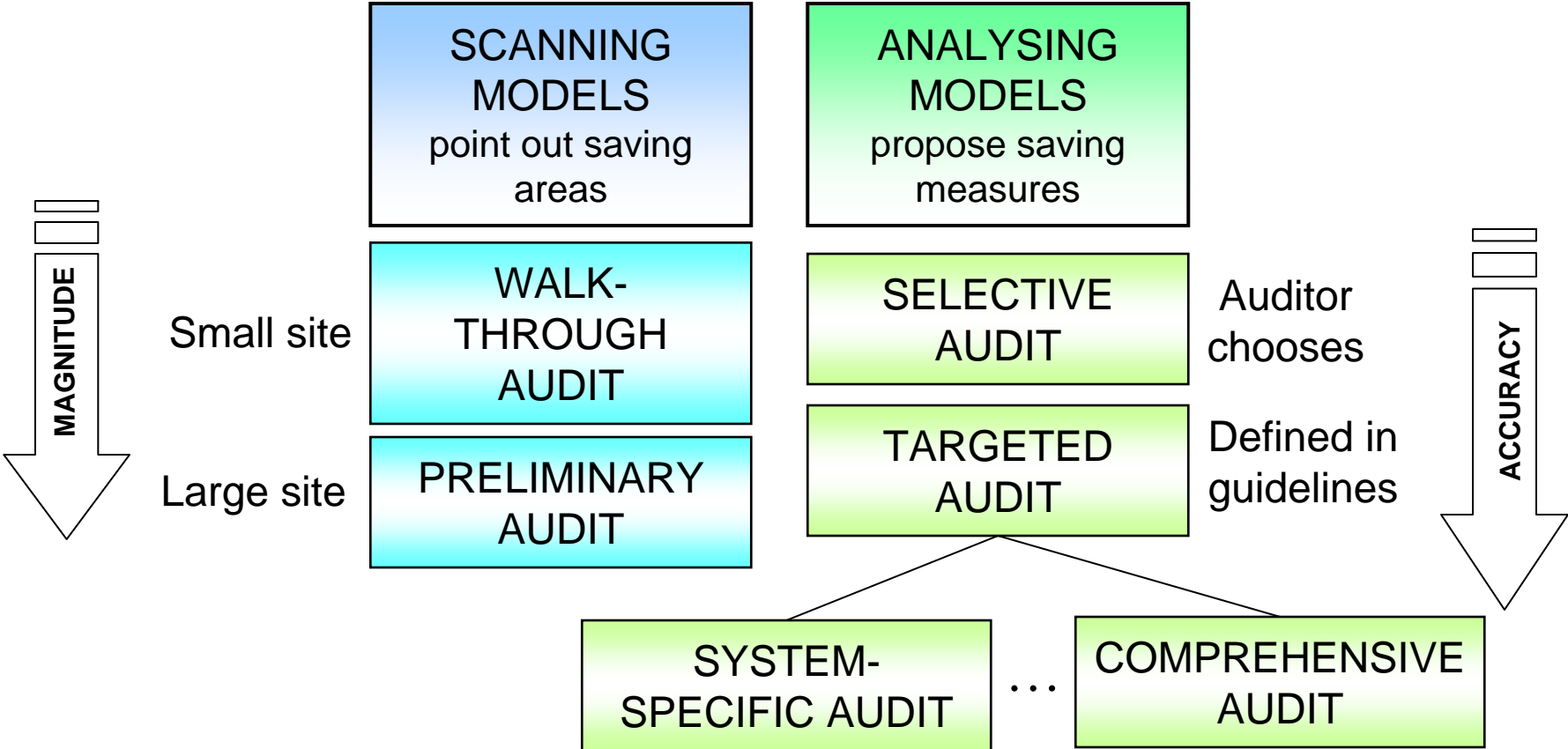
# What kind of audit?

- **what is the aim:**
  - to find easy savings (“cream skimming”)
  - to define all saving possibilities (comprehensive audit)
  - to identify possible areas for further assessments (first step)
  - to identify possibilities for ESCO /EPC
- **what is the scope:**
  - whole building or site
  - a specific area of energy use
- **what does the audit work include:**
  - quick walk-through
  - more detailed assessment with measuring

# Energy Audit Scope and Aim



# Different targets for audits





# Scanning Energy Audits

“The main aim is to point out areas, where energy saving potentials exist or may exist and also the obvious, normally “good housekeeping” and no-cost measures. Do not go deeply into the profitability of the measures”

## THE WALK THROUGH ENERGY AUDIT

### Area of application:

- small tertiary sector, industrial
- buildings with standard systems in general

### Content of work:

- overview of site’s energy use
- rough consumption breakdown
- points out the obvious savings
- rough estimates of potentials
- may have simple calculations
- simple & brief documentation
- suggestions for the next steps

### Working time:

- from a few hours to a day or two

## THE PRELIMINARY ENERGY AUDIT

### Area of application:

- energy intensive process industry

### Content of work:

- detailed consumption analysis
- defining of areas where energy consumption is significant and where the Analysing Models are needed as a second step
- listing the obvious savings
- complete reporting on breakdown but brief on measures

### Working time:

- typically 3 to 6 weeks

# Analysing Energy Audits

“The aim is to cover the whole site, locate all profitable energy saving opportunities and propose concrete measures with adequate data for decision making ”

## THE SELECTIVE ENERGY AUDIT

### Area of application:

- all buildings, all sectors
- for good and target-oriented energy auditors

### Content of work:

- only general guidelines
- auditor has freedom to choose what to do on site
- concentrates on majors,
- ignores the minors,
- points out the obvious
- can be very cost-effective
- but also cream-skimming
- detailed report on “findings”

### Working time:

- few days to 1...2 weeks

## THE TARGETED ENERGY AUDIT

### Area of application:

- all “standard” buildings
- no special requirements for the auditors

### Content of work:

- detail guidelines
- all systems audited and work is in balance
- systems to be audited are known in advance
- consumption breakdown
- detail calculations on savings and investments
- detailed standard reporting

### Working time:

- 1,2...1,5 x Selective

## THE COMPREHENSIVE ENERGY AUDIT

### Area of application:

- medium & large industry

### Content of work:

- covers everything “inside the fence”, work balance based on the breakdown
- detail calculations on savings and investments
- detailed standard reporting

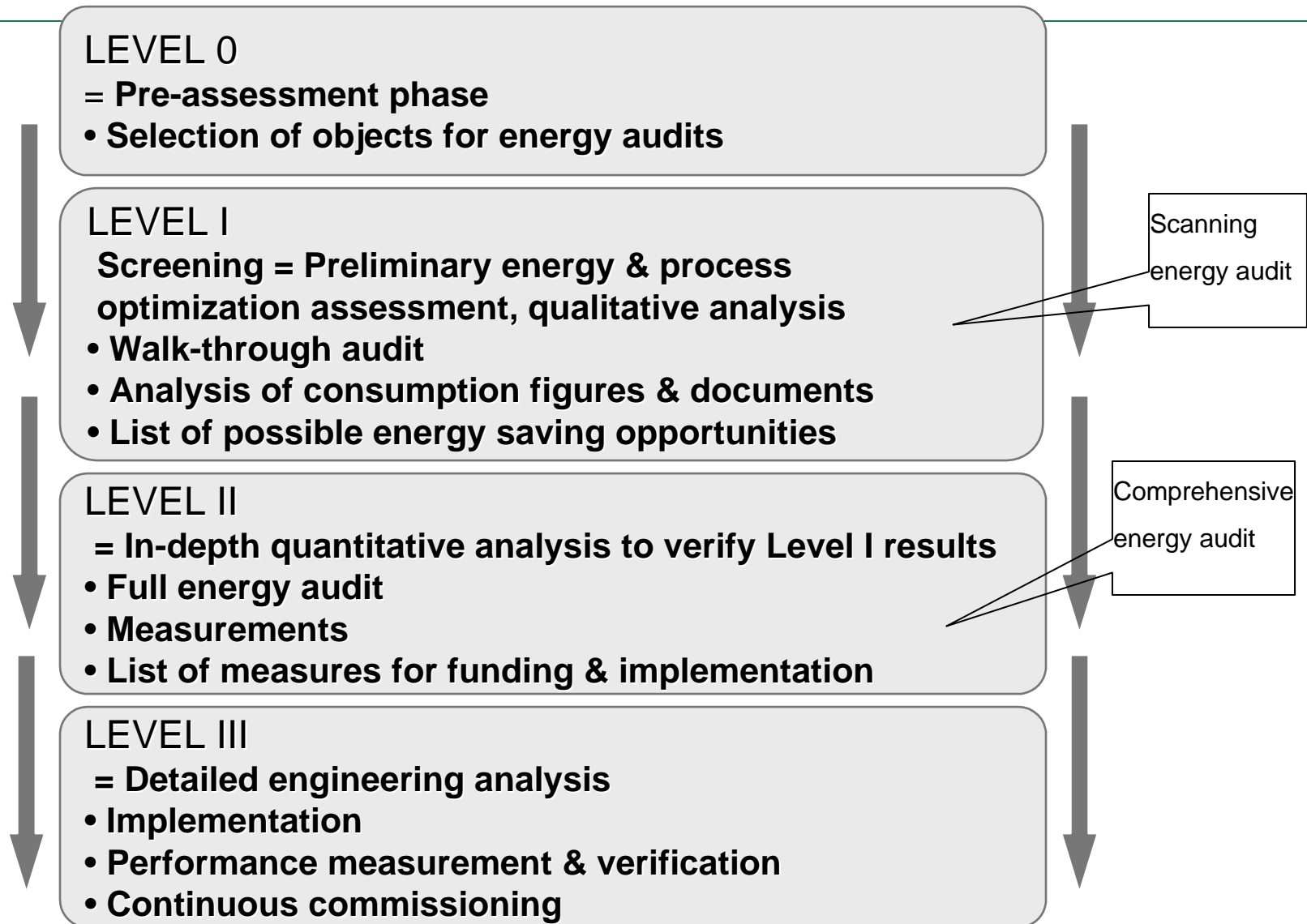
### Working time:

- 3...5+ weeks

## THE SYSTEM SPECIFIC ENERGY AUDIT

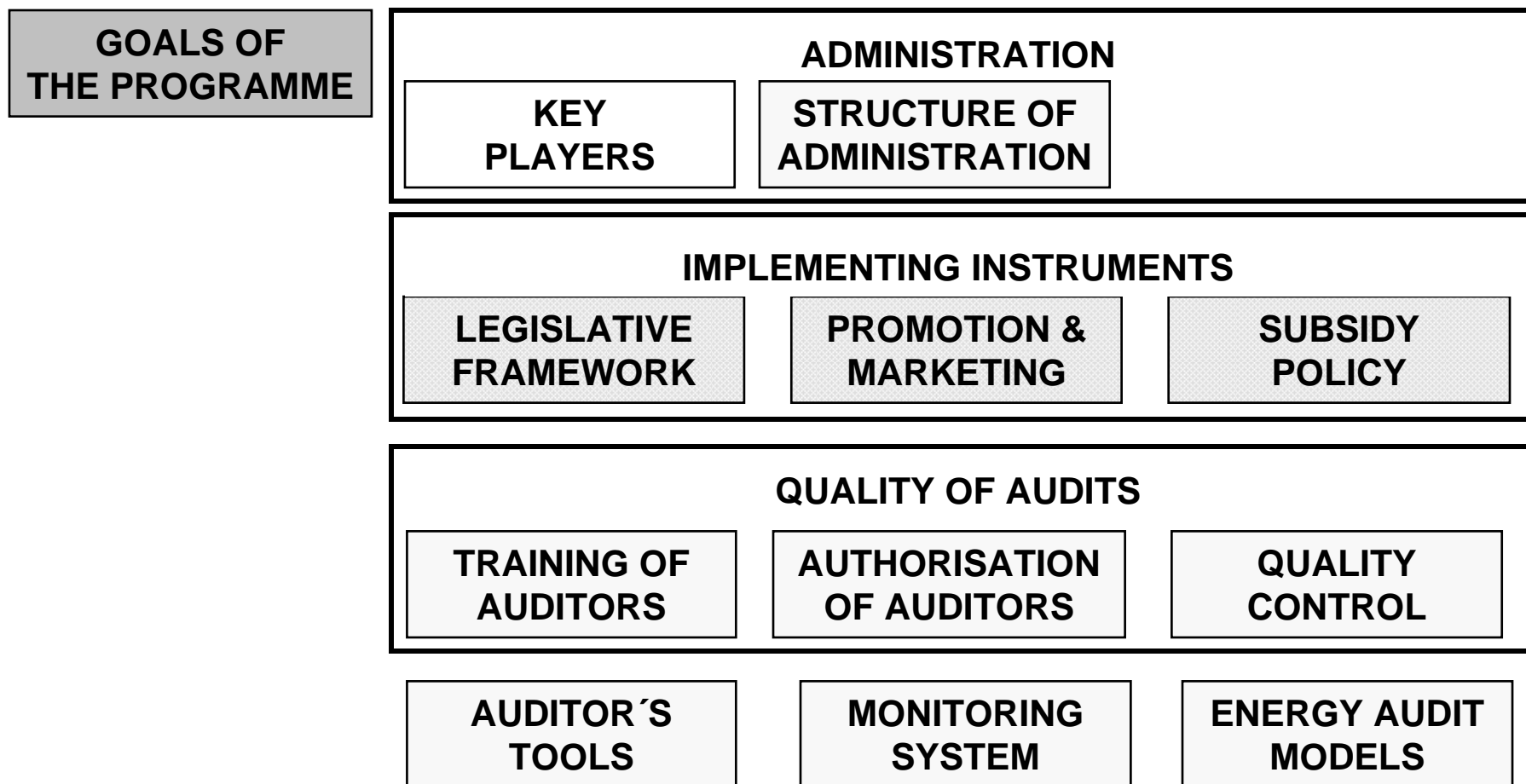
- requires “special auditors”
- very compact procedure
- detailed standard reporting

# Different levels of audits

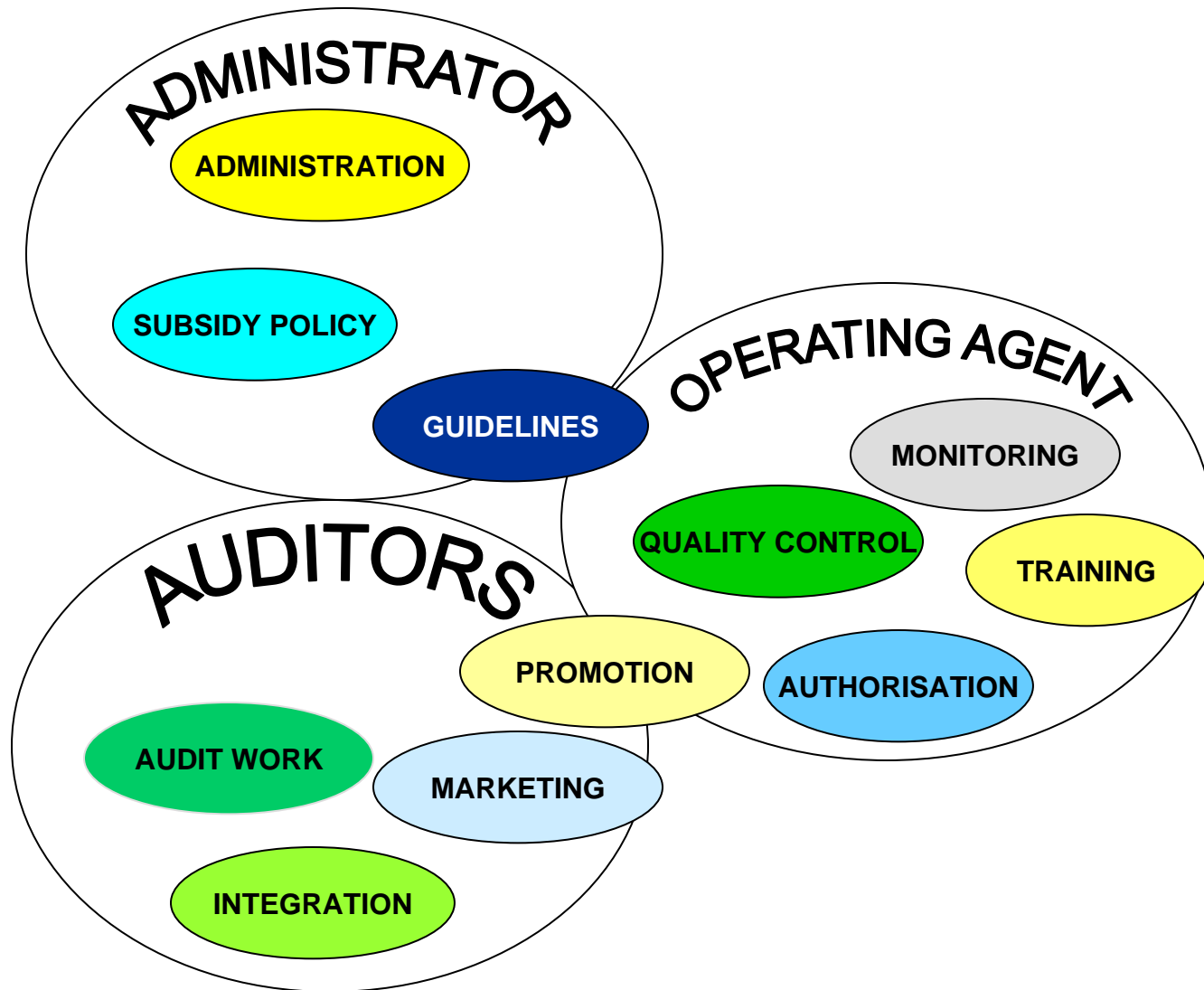


**Energy audits -  
yes,  
but how to run the show?**

# The Elements of an Energy Audit Scheme



# Key Players and their Roles



# Why Monitoring?

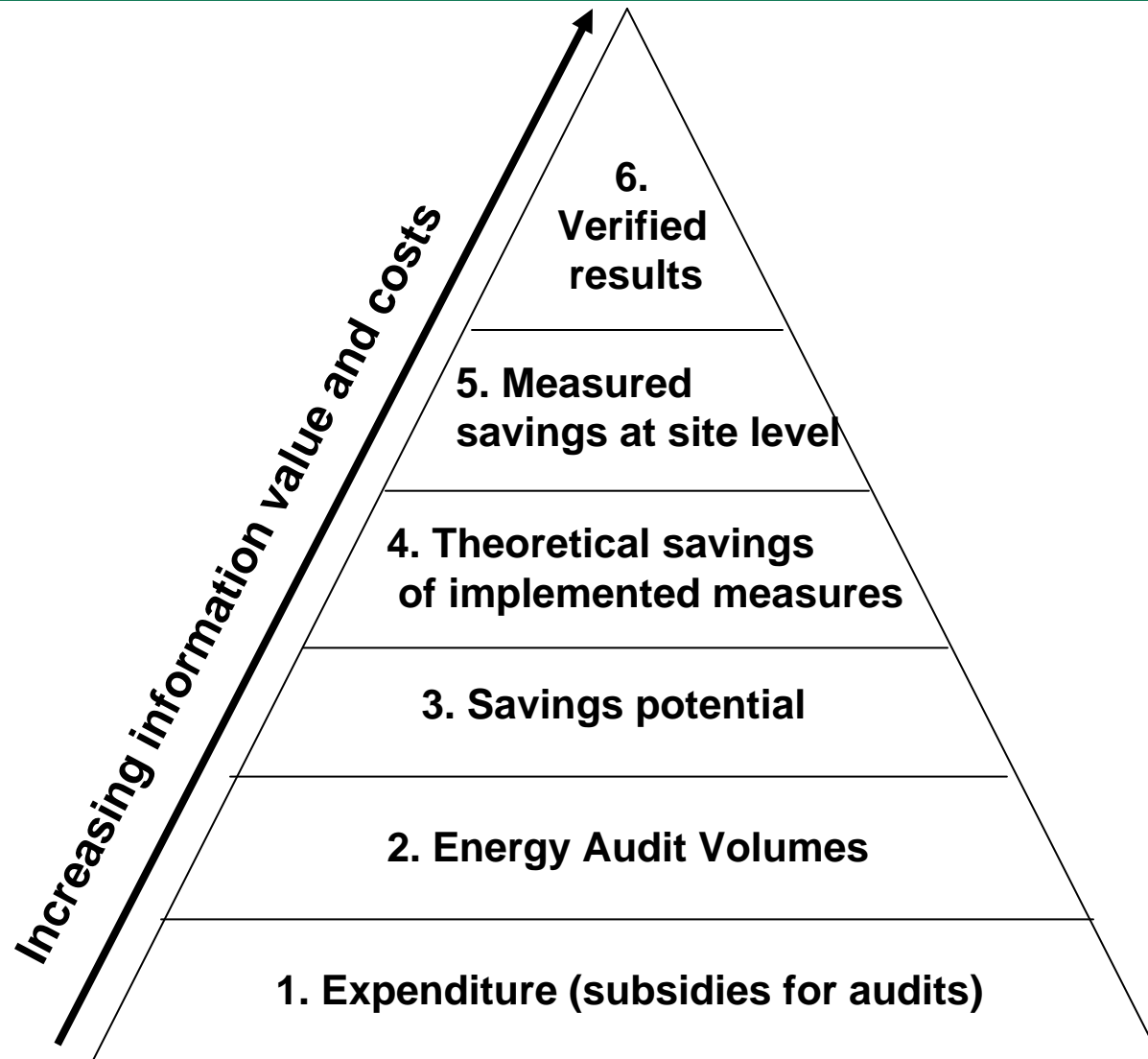
To be able to prove it has been effective.

Monitoring and evaluation are essential elements in an energy auditing activity to provide information on the impact of the activity.

The financier will want to know exactly what comes out of the money and resources they allocate to the activity.

In addition, monitoring and evaluation are of interest for the clients and auditors, since it will give them feedback on the results and the quality of the work.

# Different levels of Monitoring





# Data available from a Monitoring System

- Data for clients, auditors, administrator, media
- Annual reports on the Energy Audit Programme
  - subsidies, audit volumes, saving potentials
  - implemented savings
  - typical savings
- Sample studies
  - number of audits in sample
  - specific consumption data (kWh/m<sup>3</sup>...)
  - total energy use, total cost
  - total saving potential, typical saving measures
- Connection to Voluntary Agreements monitoring

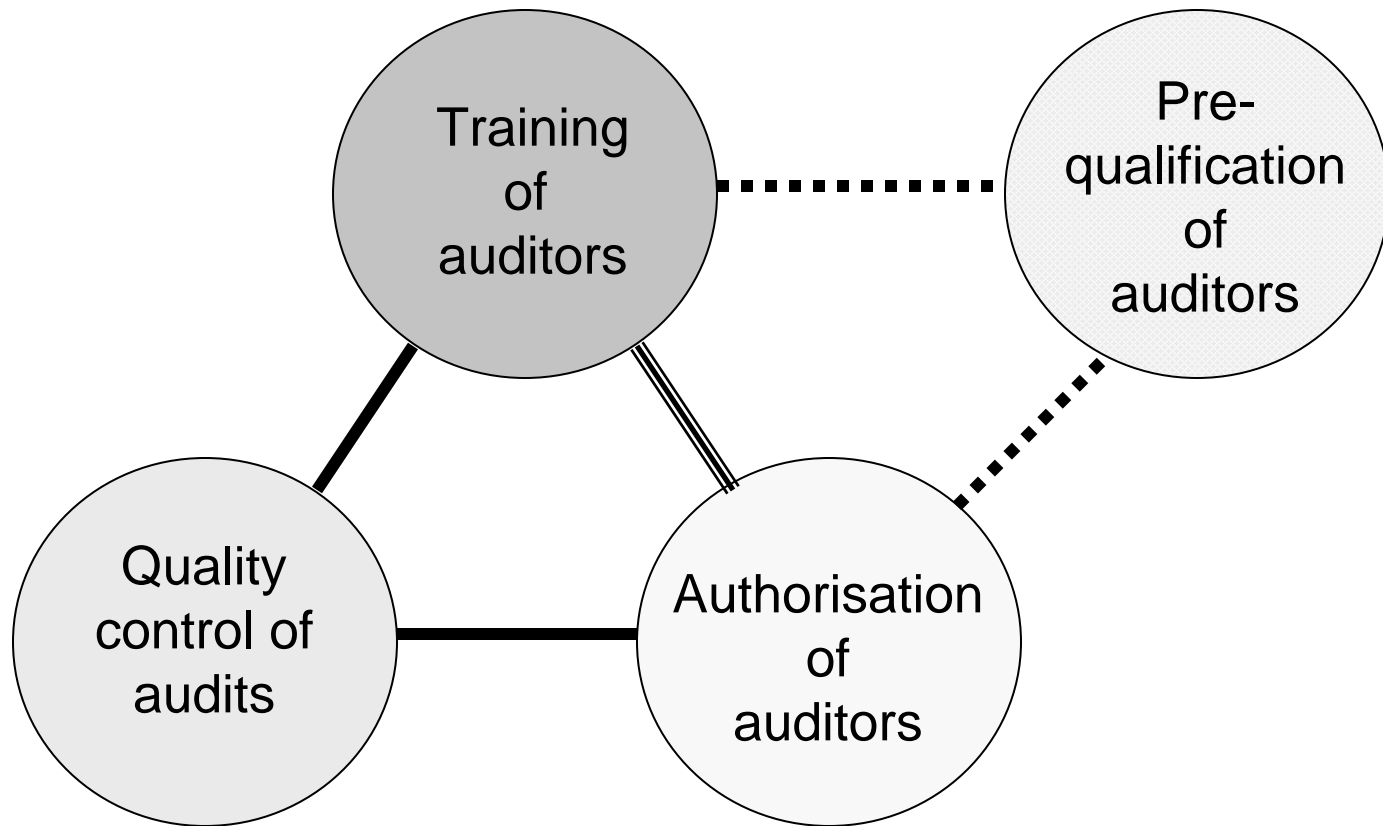
# Why Training and Quality Control?

It is all about quality.

The final aim of an energy auditing activity is to save money and reduce greenhouse gas emissions.

To make this happen, the auditors must be able to do good energy audits and produce reports, which provide the client adequate information for the implementation of the measures.

# Training, Authorisation, Quality Control



# Quality Control- Main points to check

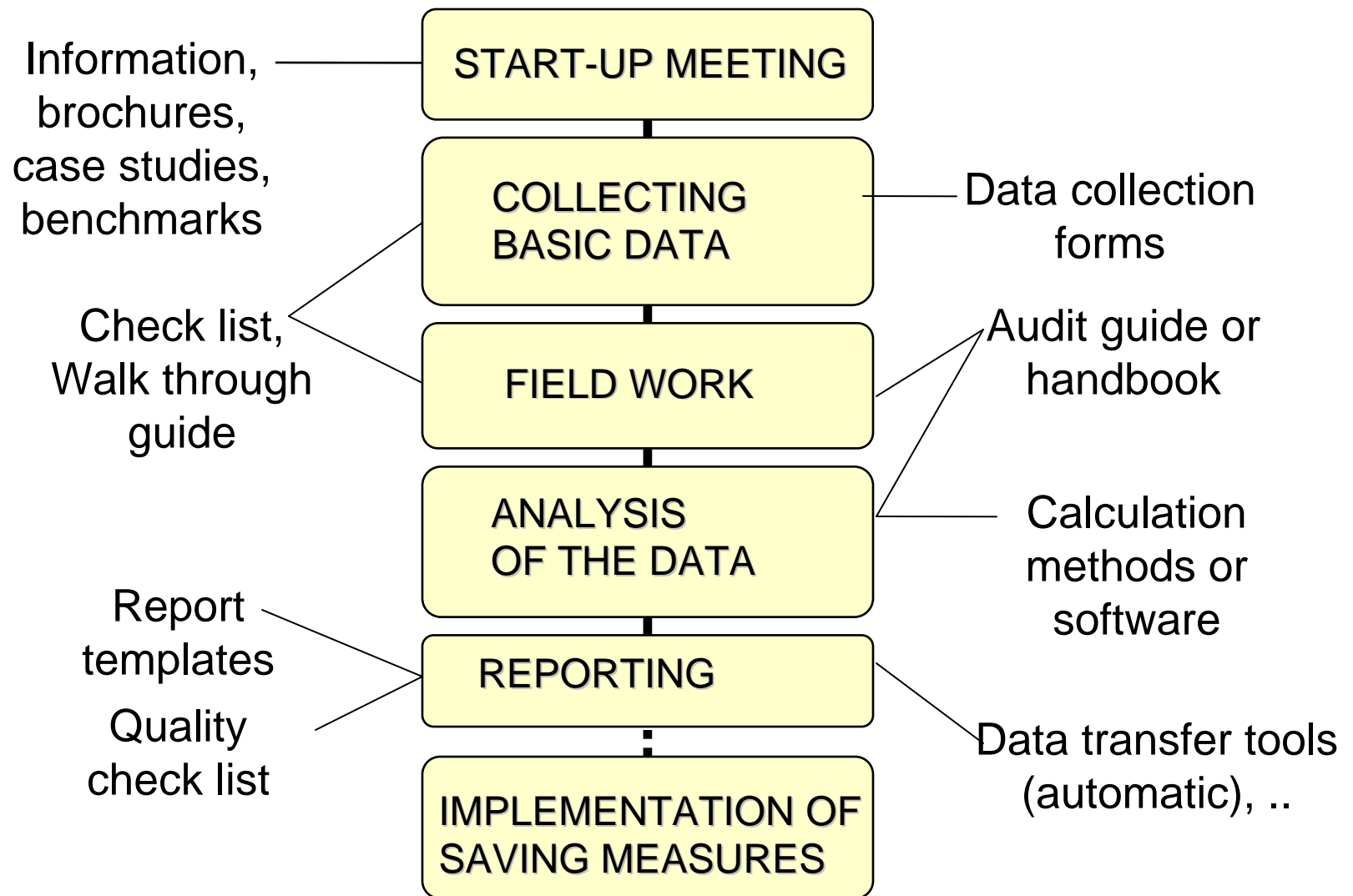
- The general guidelines have been followed
- The presented numbers are realistic
  - saving potential compared to present consumption level
  - investment costs for suggested measure
- The content of the report is technically correct
- The proposed measures are appropriate and realistic
- The report “looks ok”

# Why Tools for Auditors?

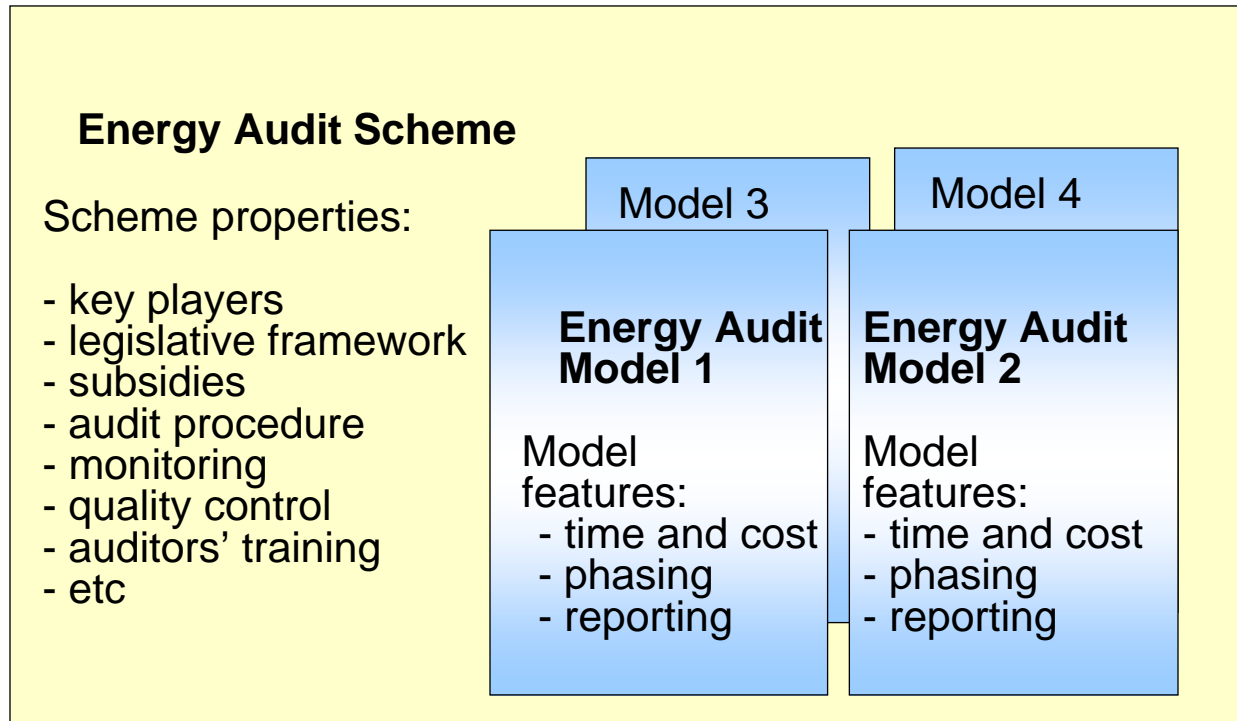
The auditors' tools include a large family of support documents and applications which are intended to facilitate the work of auditors in the view both of minimising audit costs and maximising audit quality.

The tools usually describe the Energy Audit Models but may address different stages in the audit procedure and provide help either on technical matters or on marketing aspects.

# Tools for Auditors



# Energy Audit Model Features

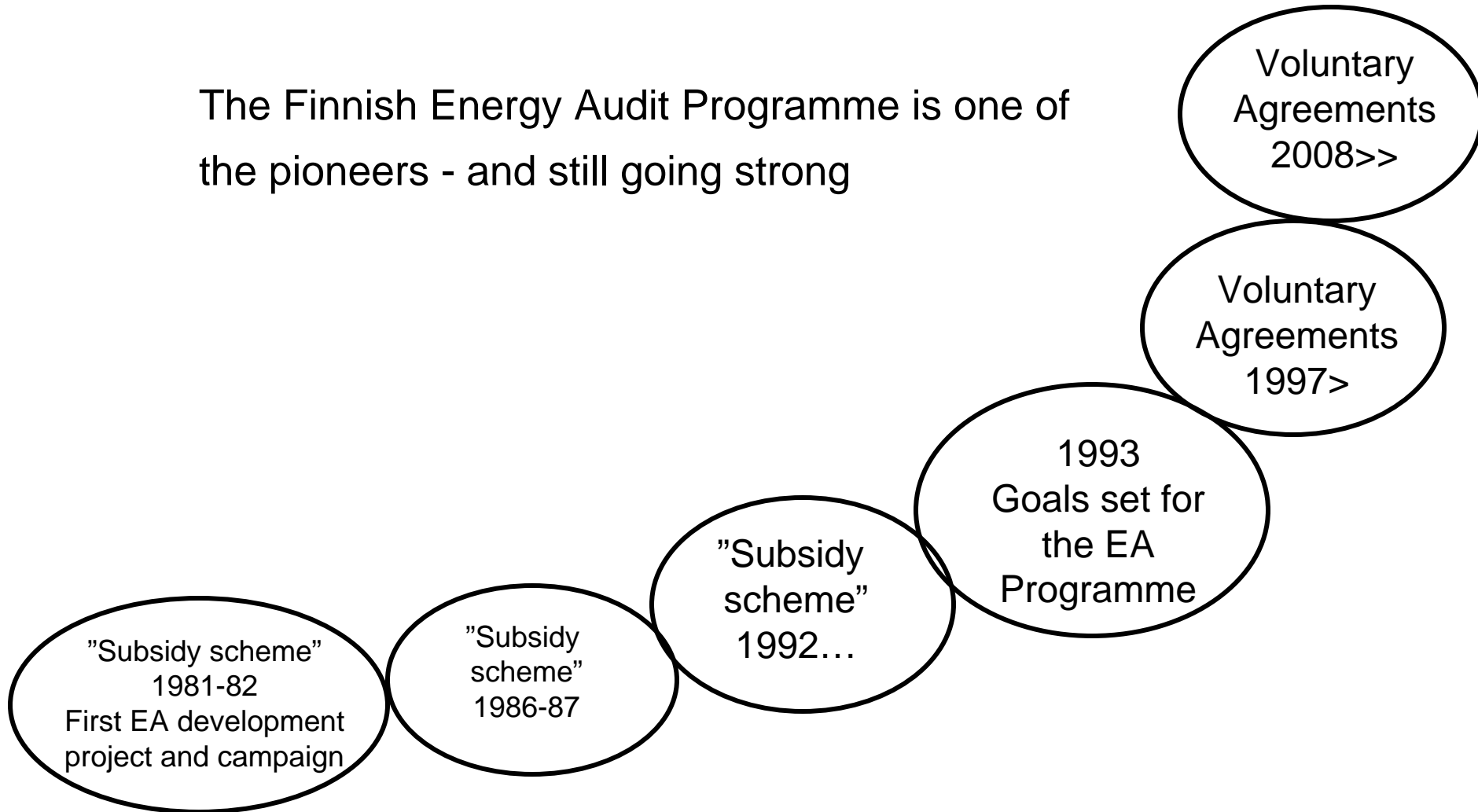


# Some Experiences & Results from Finland



# Long history of Energy Auditing

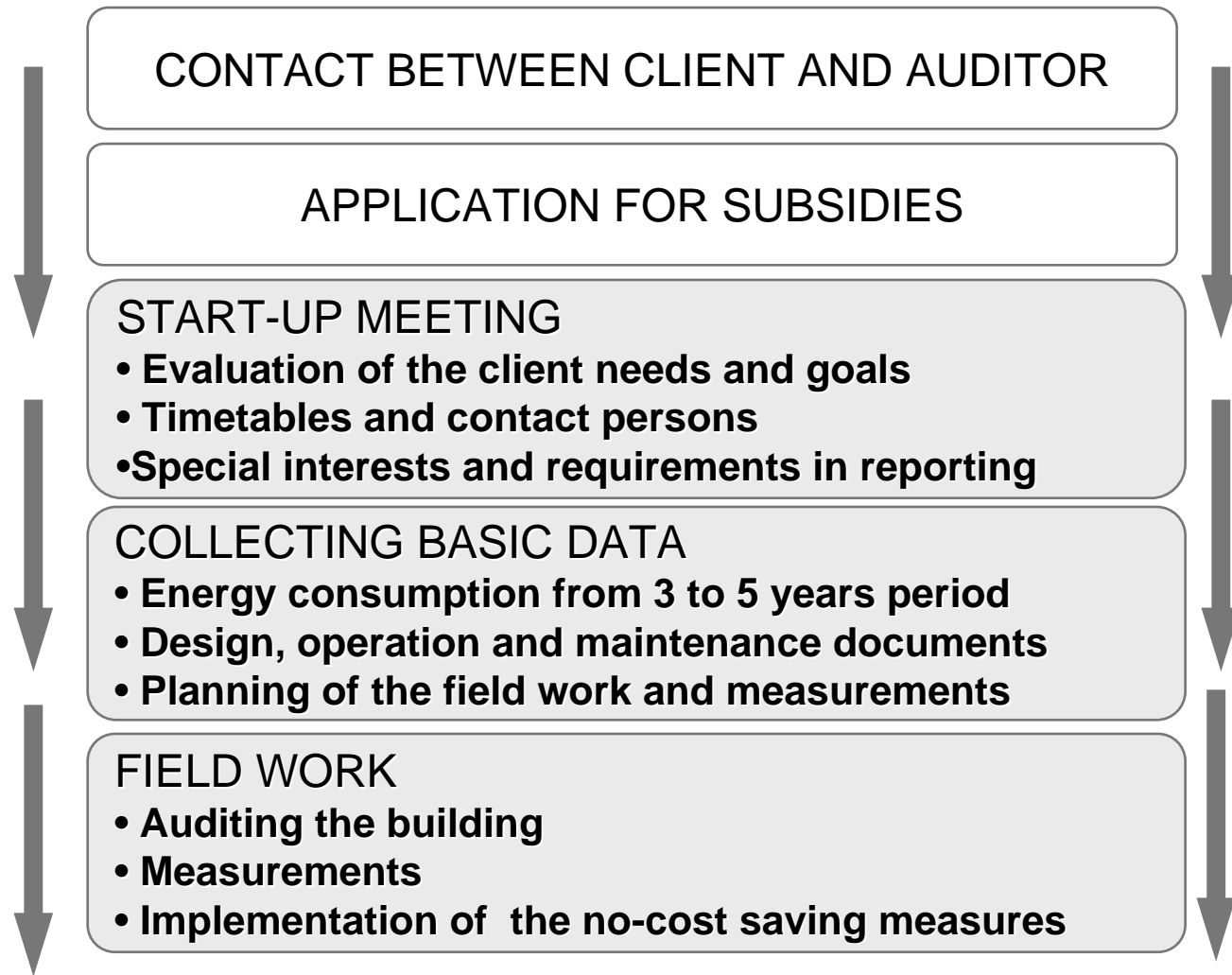
The Finnish Energy Audit Programme is one of the pioneers - and still going strong



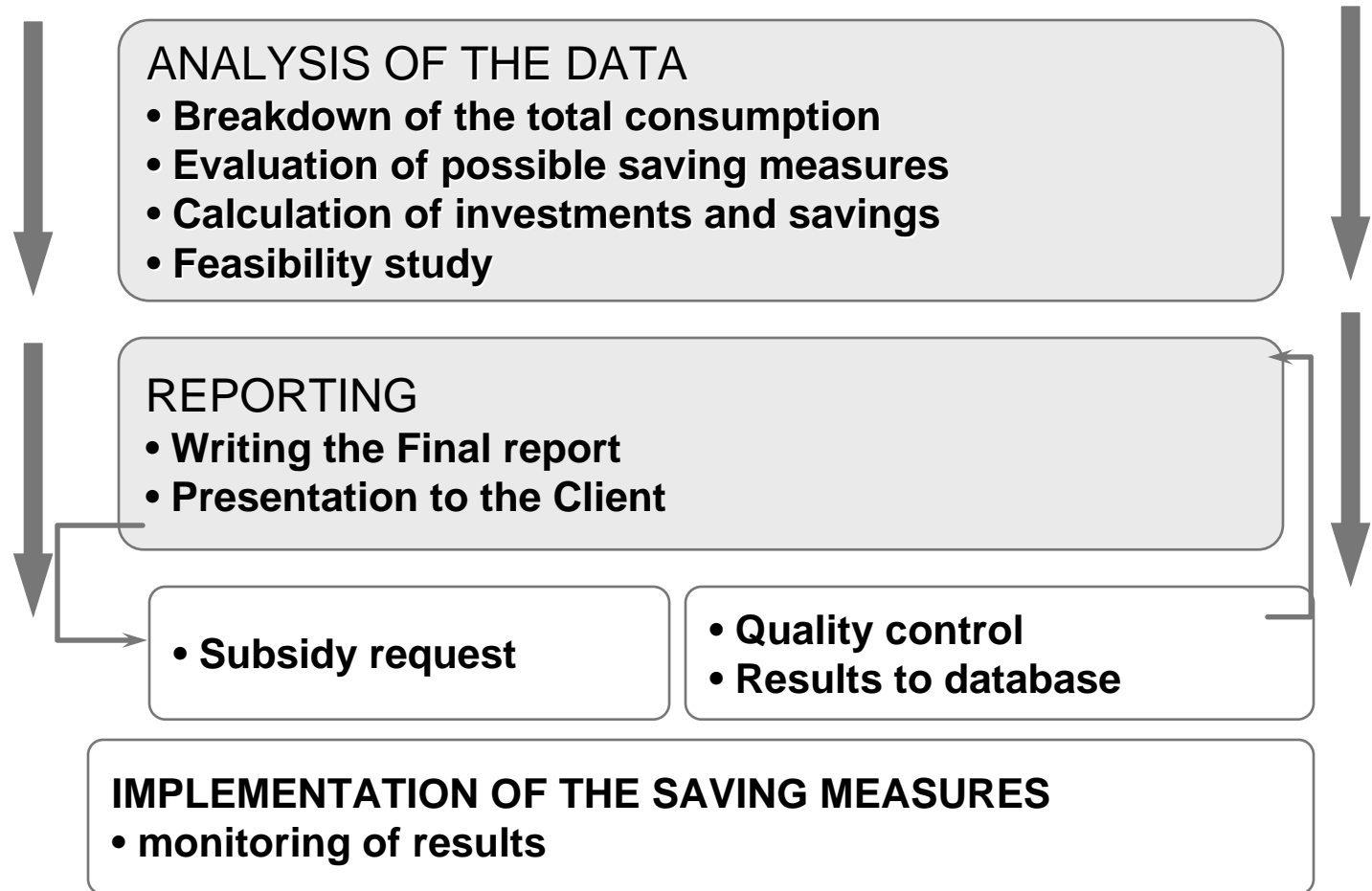
# And why has it been successful?

- Energy Audits are connected to Voluntary Energy Conservation Agreements (industry, service sector, energy production) - large volumes
- Monitoring system proves that it has been efficient
- Client feedback is positive
- Energy auditors do audits as a part of their regular business
- Implementation tools have been developed to help clients

# Energy Audit Procedure 1



# Energy Audit Procedure 2



# Energy Audit Models in Finland 1

- **Service sector**
  - **Building Energy Audit** - the basic model for service sector buildings, includes two categories of buildings: simple (schools, offices, etc) and complicated (swimming halls, ice arenas, etc)
  - **Energy Inspection** - the model for small buildings, light reporting
  - **Post-acceptance Energy Audit** - the model for new and renovated buildings, “tuning” the energy use to optimal level
  - **Follow-up Energy Audit** - the model to update the previous energy audit
- **In these models the audit cost (and subsidy) are related to the building volume**

# Energy Audit Models in Finland 2

- **Industry**
  - **Energy Inspection** - can be applied for extra-small SME's
  - **Industrial Energy Audit** - the model for sites with low energy intensive production process, looks at the energy use of the building and the process supply systems
  - **Industrial Energy Analysis** - the heavier model for sites with medium energy intensive production process, includes the process analysis
  - **Process Industry Energy Analysis** - the two-phase model for energy intensive process industry, the first step scans the needs for following Industrial Energy Audits and Analyses
  - These models can be used as Follow-up Audits also
- **In these models the audit cost (and subsidy) are related to yearly energy and water cost**

# Energy Audit Models in Finland 3

- **Energy sector**
  - District Heating Audit - the model for district heating plants and heat distribution networks
  - Power Plant Energy Analysis - the model for power plants
- **System specific audits:**
  - Compressed air system energy audit
  - Refrigeration plant energy audit
- **Transport chain energy audit**

# Energy Audit Results 1 / Motiva database

Total consumption, costs, saving potential, investments of 1 164 energy audits in the service sectors (37 milj. m<sup>3</sup>) reported 2002-2007

Present consumption	SERVICE SECTOR		
1164	Saving potential 2002-2007		
Heat			
1 181 076 MWh/a	173 382 MWh/a	14,7 %	
39 405 161 €/a	5 596 519 €/a	14,2 %	
Electricity			
1 023 810 MWh/a	66 456 MWh/a	6,5 %	
57 909 814 €/a	4 080 196 €/a	7,0 %	
Water			
3 547 825 m <sup>3</sup> /a	213 873 m <sup>3</sup> /a	6,0 %	
7 777 341 €/a	449 799 €/a	5,8 %	
<b>Total consumptions</b>	<b>Total savings</b>		<b>Investments</b>
105 092 316 €/a	10 126 515 €/a	9,6 %	16 142 906 €



# Energy Audit Results 2 / Motiva database

Total consumption, costs, saving potential, investments of 177 energy audits in the industrial sector with total energy consumption of less than 70 GWh/a during the period 2002-2007

Present consumption	INDUSTRY, Energy consumption < 70 GWh/a		
177	Saving potential 2002-2007		
Heat			
1 199 462 MWh/a	257 815 MWh/a	21,5 %	
35 296 540 €/a	7 599 559 €/a	21,5 %	
Electricity			
1 019 827 MWh/a	61 452 MWh/a	6,0 %	
45 969 711 €/a	3 361 503 €/a	7,3 %	
Water			
6 219 977 m <sup>3</sup> /a	657 969 m <sup>3</sup> /a	10,6 %	
7 050 586 €/a	778 167 €/a	11, %	
<b>Total consumptions</b>	<b>Total savings</b>		<b>Investments</b>
88 316 837 €/a	11 739 229 €/a	13,3 %	32 743 365 €

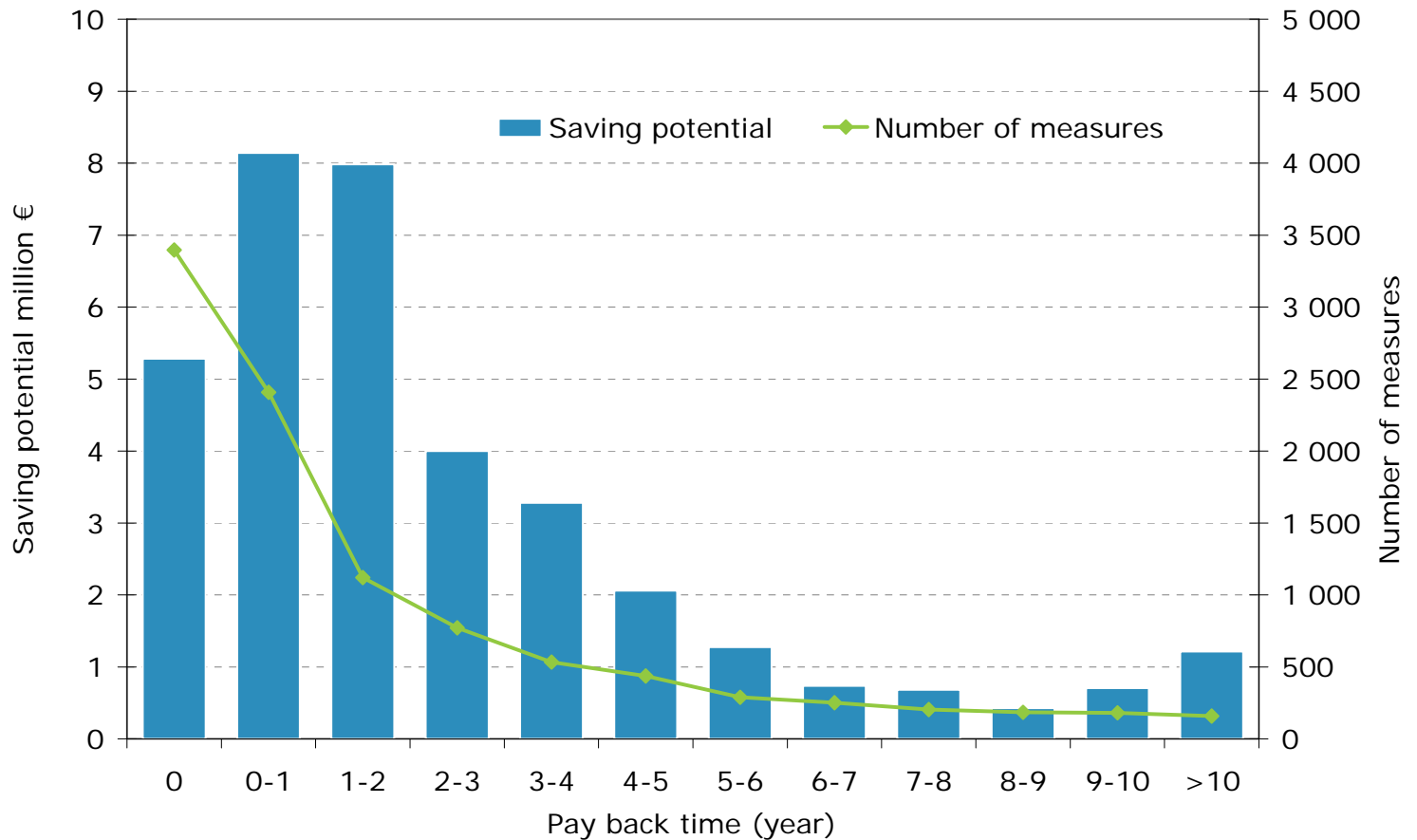
# Energy Audit Results 3 / Motiva database

Sector-specific saving potential in the 5 228 energy audits reported in 1997-2007

REPORTED BUILDINGS 1992-2007 (5228 BUILDINGS)													
SECTOR	BUILDINGS	SAVINGS-POTENTIAL TOTAL	PBT	INVESTMENT	SAVING POTENTIAL								
					HEAT			ELECTRICITY			WATER		
					energy	costs		energy	costs		water	costs	
					GWh/a	energy	power	GWh/a	energy	power	km <sup>3</sup> /a	milj. €/a	
	pcs	milj. €/a	a	milj.€	GWh/a	milj. €/a	milj. €/a	GWh/a	milj. €/a	milj. €/a	km <sup>3</sup> /a	milj. €/a	
PJ	Public services	3124	17,6	1,9	33,4	397,1	9,5	1,0	74,8	3,9	1,7	743,2	1,4
PY	Private services	1338	17,7	1,7	30,0	339,6	8,5	0,7	122,4	6,3	1,4	458,9	0,9
TE	Industry, Energy consumption < 500 GW	738	41,1	2,2	89,2	1 184,5	24,0	1,6	239,8	9,7	2,6	3 718,2	3,2
TE	Industry, Energy consumption > 500 GW	8	21,6	3,7	79,9	1 202,1	14,5	0,1	197,0	5,1	1,7	6 872,8	0,2
EA	Heat and power	20	0,2	1,4	0,2	6,2	0,1	0,0	1,5	0,1	0,0	21,9	0,0
	<b>TOTAL</b>	<b>5228</b>	<b>98,1</b>	<b>2,4</b>	<b>232,8</b>	<b>3 129</b>	<b>56,5</b>	<b>3,3</b>	<b>636</b>	<b>25,1</b>	<b>7,5</b>	<b>11 815</b>	<b>5,7</b>

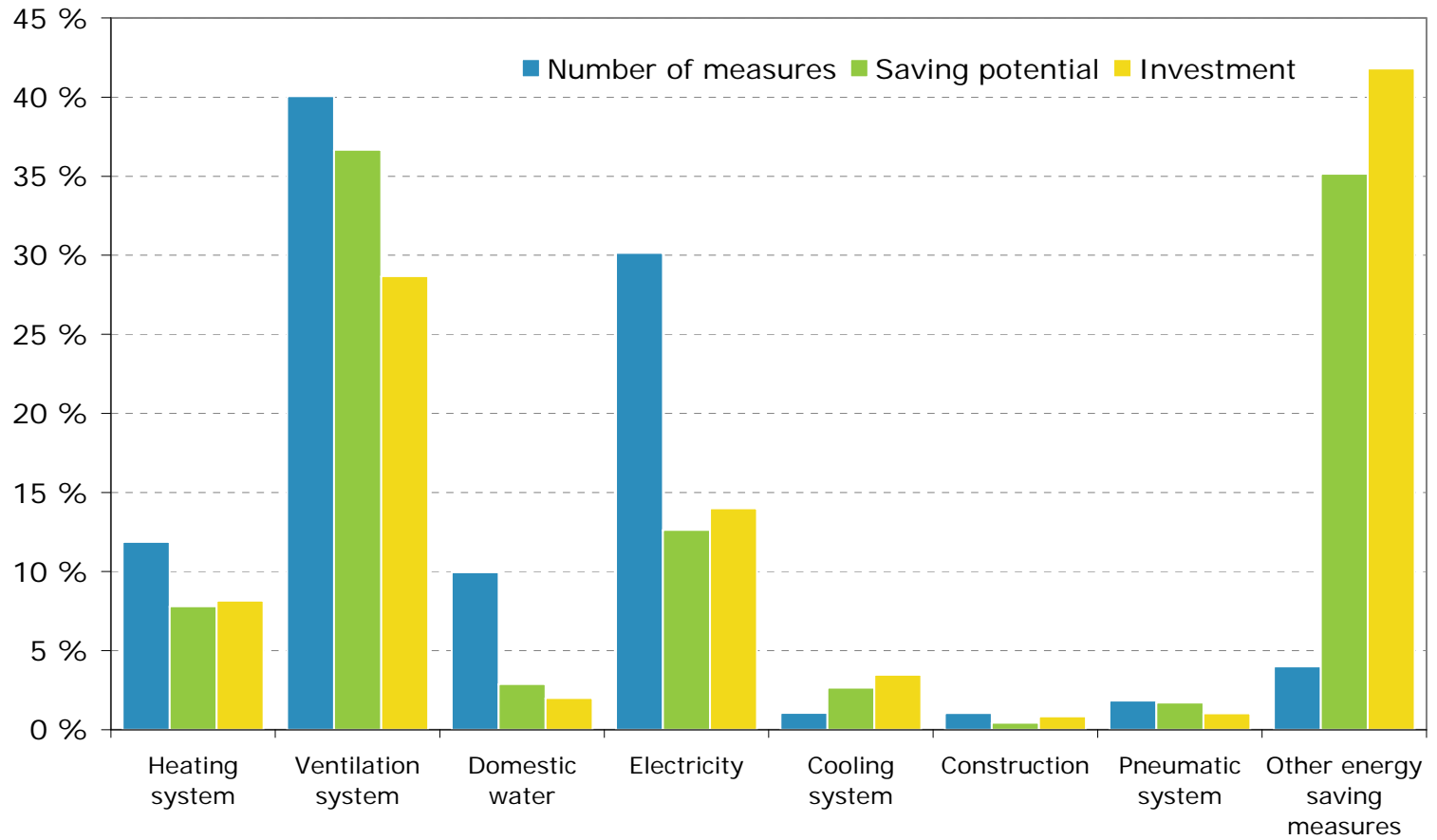
# Energy Audit Results 4 / Motiva database

The saving potential of the 1 368 energy audits (reported 2002-2007) divided according to pay back time



# Energy Audit Results 5 / Motiva database

The saving potential, required investment and number of measures according to measure classification (9 972 measures reported years 2002-2007)



# Top 7 saving measures in the service sector

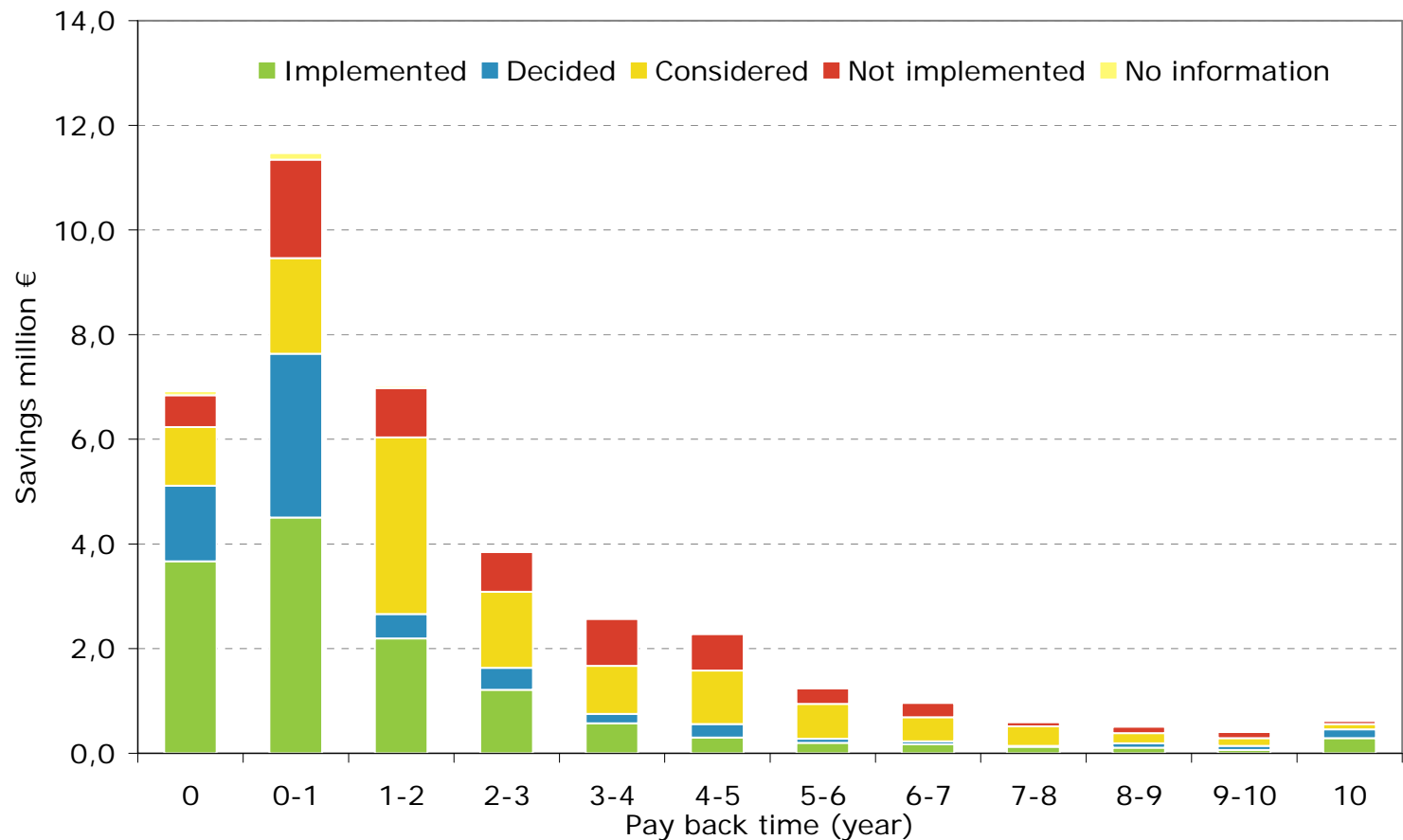
- Reduction of ventilation running hours
- Changes in lighting (low energy bulbs, schedules, controls, etc)
- Adjustment of temperature settings (heating and ventilation)
- Reduction of water flows in faucets and toilets
- Changes in tariffs = cost savings
- Adjustments in electrical heating (freezing protection, car heating, etc)
- Improvement of heat recovery system (existing or new)

# Experiences: savings

- saving potential in old and new buildings is about the same
- top 7 measures apply to most buildings
- no-cost measures are the majority
- in industry process-related savings = high potential + cost
- simple is beautiful, high-tech solutions considered expensive and unreliable
- clear suggestions are appreciated in report
- savings must not be over-estimated
- pay-back time requirements: 2-3 years
- maintenance staff training useful during audit

# Energy Audit Results 6 / Motiva database

Implementation rate of saving potential by pay back time (1 957 energy audits, 14 868 savings measures)



# Why are not all measures implemented?

- **why saving measures are not implemented?**
  - No risks taken (indoor air quality, process, etc)
  - No resources (good idea, but no staff for implementation)
  - No money for investment
  - Energy is not an important cost factor
  - Audit report does not convince the client



# More information about Energy Audits

- [www.motiva.fi](http://www.motiva.fi) > choose English website >
  - **Areas of operation > Energy auditing in Finland**
  - **Projects and Campaigns > SAVE II -projects > Audit I and Audit II**
  - **Projects and Campaigns > IEE-projects > Audit '06 conference material**
  
-