

Stand-alone versus integrated energy audit programmes A comparison of Flemish programmes Paper 1-016-16 Barbara GOVAERT- Björn DE GRANDE -Joachim CASTELAIN – Erwin CORNELIS eceee Industrial Summer Study Berlin – 12-14 Sept 2016

#### Context of this paper

# Subject of this paper \* ENERGY AUDIT

#### ► Definition

EED 2012/27/EC: "a systematic procedure with the purpose of obtaining adequate knowledge of the existing energy consumption profile of a building or group of buildings, an industrial or commercial operation or installation or a private or public service, identifying and quantifying costeffective energy savings opportunities, and reporting the findings"

#### Sector Purpose

To bridge the knowledge gap on the energy consumption and the possible actions to save energy

#### Context of this paper

#### Types (Standard ISO 50002:2014)

#### \* Walk-Through Audit

- aiming at identifying maintenance, operational or deficient equipment issues
- results in an identification and a qualitative assessment of energy saving opportunities.

#### Energy Diagnosis

- includes economic calculations
- results in an energy balance of the facility and a financial analysis of each of the identified energy efficiency measures

#### Investment Grade Audit

includes a detailed account of energy use and a quantitative study of the implementation

#### Context of this paper

#### Policy measures

- **\*** ENERGY AUDIT PROGRAMMES
- 🛰 Types (Price & Lu, 2005)
  - Stand-alone energy audit programmes
    - focuses mainly on the execution of as many energy audits as possible

#### Integrated energy audit programmes

- combines energy audits with other supporting policy measures, to increase the implementation rate of the suggested energy saving measures in the energy audit report
  - energy efficiency targets (includes voluntary agreements)
  - guidance on the implementation of the identified energy efficiency measures
  - knowledge exchange between companies (includes learning networks)

### Aim of this paper

#### Research questions

- Does have the type of energy audit an impact on the type of the energy efficiency measures identified?
- Do have stand-alone and integrated energy audit programme different implementation rates of the identified energy efficiency measures?

#### 🛰 Test cases (Flanders, BE)

- Auditing Covenant: voluntary agreement (integrated programme)
- \* A stand-alone energy audit programme by Enterprise Flanders
- \* A local more integrated energy audit programme in Ghent
- \* A learning network on energy efficiency in Limburg

#### Method of this paper

#### Method to describe the energy audit programmes

\* Based on Price & Lu (2011), own research: list of key elements

	Start of the programme	Conducting energy audits	Follow-up of energy audit results
rities	<ul> <li>Motivation to start project?</li> <li>Scope of the programme?</li> <li>Targets for the programme?</li> </ul>	<ul> <li>Manuals, tools?</li> </ul>	<ul> <li>Support to implementation?</li> <li>Monitoring, verification proced</li> <li>Databases, showcases?</li> <li>Knowledge sharing?</li> </ul>
pants	<ul> <li>Obligation to participate?</li> <li>Targets for the participants?</li> <li>Obligation to conduct an energy audit?</li> <li>Obligation to implement EE measures?</li> <li>Incentives?</li> </ul>	• Type of audit?	<ul> <li>Obligation to implement energy management scheme?</li> </ul>
, rs		<ul><li>Training?</li><li>Certification?</li></ul>	
	• Outreach?	<ul> <li>Identified energy saving potential?</li> </ul>	• Actual implementation rate?

#### Method of this paper

- Method to describe the energy efficiency measures
  - + Inspired by schemes proposed by Fleiter et al. (2012) and Trianni et al (201

	Procedures	Optimisation	Technology add-on	Technology replace
al	Monitoring en. data			
city system		VSD	$\cos \phi$ correction	Replacing engines
ig envelop			Insulation	Replacing windows
		Room temperature 凶		
g		Motion detectors		Relighting – relampi
essed air	Leak detection	Pressure 🏼		
		Pressure 🏼		
al oil			Insulation	
g systems	Regular de-icing			
ction processes			Heat recovery	

#### Case 1: the Auditing Covenant

	Start of the programme	Conducting energy audits	Follow-up of energy audit results
ities	<ul> <li>Part of 1<sup>st</sup> Flemish Climate Action Plan</li> <li>2005 - 2014</li> <li>Energy consumption: 0.1 - 0.5 PJ<sub>prim</sub>/a, no ETS-obligation</li> <li>Indicative target to save 10%</li> </ul>	<ul> <li>Manuals, tools</li> <li>Verified by a dedicated office</li> </ul>	<ul> <li>Monitoring, verification proced in line with Voluntary Agreeme (Monitoring tool)</li> <li>Databases, showcases</li> <li>Knowledge sharing</li> </ul>
oants	<ul> <li>Voluntary program</li> <li>Targets for the participants:         <ul> <li>Obligation to conduct an energy audit</li> <li>Obligation to implement EE measures</li> </ul> </li> <li>Incentives: energy tax reduction</li> </ul>	• Type of audit: <b>energy diagnosis</b>	<ul> <li>Obligation to implement all EE with an IRR of &gt;15%</li> </ul>
rs		<ul> <li>Training</li> <li>Approval by Verification Office</li> </ul>	
	<ul> <li>229 participants in 2005</li> <li>Total annual primary energy consumption: 44 PJ</li> <li>Average: 194 TJ p / participant</li> </ul>	<ul> <li>First round:</li> <li>2,324 EEMs (4.7 PJ)</li> <li>Half are mandatory</li> </ul>	<ul> <li>First round:</li> <li>1,785 EEMs implemented</li> <li>2.5 PJ primary / annum sate</li> </ul>

#### Case 1: the Auditing Covenant

#### Distribution of the energy saving measures (2,324 EEMs – 4.66 PJ/a)

rimary Energy Savings (TJp)	Procedures	Optimisation	Technology add-on	Technology replacement
ieneral	125		A	
lectricity		309	393	1
uilding	19	63	77	4
ighting	1	32	2	8
compressed air	120	105	87	4
team	59	84	577	5
hermal oil		1	46	
cooling installations	12	156	234	5
rocess	34	430	968	41

# Case 2a: Regional Energy Audit Programme – 1<sup>st</sup> phase INNOVEREN & ONDERNEMEN

AGENTSCHAP

	Start of the programme	Conducting energy audits	Follow-up of energy audit results
rities	<ul> <li>Enterprise Flanders:         <ul> <li>expansion of services to industry</li> </ul> </li> <li>Nov 2008 – Oct 2013</li> <li>Supported by ERDF</li> <li>Scope         <ul> <li>Electricity: &gt; 20 MWh/a</li> <li>Fuel &gt; 50 MWh/a</li> </ul> </li> </ul>	• Manuals, tools	<ul> <li>Support to implementation</li> <li>Monitoring, verification process</li> <li>Databases, showcases</li> <li>Knowledge sharing</li> </ul>
pants	<ul> <li>Free to make use of the programme</li> <li>Incentives: <ul> <li>Audit: offered free of charge</li> <li>Thematic advice: subsidy</li> </ul> </li> </ul>	<ul> <li>Type of audit: walk-through energy audits</li> <li>Thematic advice: energy diagnosis</li> </ul>	Obligation to implement EEMs
, rs		<ul> <li>Only for thematic advice         <ul> <li>Training</li> <li>Selected by public tendering</li> </ul> </li> </ul>	
	<ul> <li>520 participants</li> <li>Total annual primary energy consumption: 4.4 PJ</li> <li>Average: 8.4 TJ p / participant</li> </ul>	<ul> <li>1,715 EEMs <ul> <li>Elec: 1,173 EEMs (4.72%)</li> <li>Fuel: 542 EEMs (9.46%)</li> </ul> </li> <li>106 thematic advices <ul> <li>250 EEMs</li> </ul> </li> </ul>	<ul> <li>72% of the EEMs from audits</li> <li>~80% of EEMs for thematic adv</li> </ul>

#### AGENTSCHAP Case 2b: Regional Energy Audit Programme – 2<sup>nd</sup> phase INNOVEREN & ONDERNEMEN

	Start of the programme	Conducting energy audits	Follow-up of energy audit results
rities	<ul> <li>Enterprise Flanders:         <ul> <li>Continuation of programme</li> </ul> </li> <li>Nov 2013 – Dec 2015</li> <li>Supported by ERDF</li> <li>Scope         <ul> <li>Electricity: &gt; 20 MWh/a</li> <li>Fuel &gt; 50 MWh/a</li> </ul> </li> </ul>	• Manuals, tools	<ul> <li>Support to implementation</li> <li>Monitoring, verification process</li> <li>Databases, showcases</li> <li>Knowledge sharing</li> </ul>
pants	<ul> <li>Free to make use of the programme</li> <li>Incentives: <ul> <li>Audit: offered free of charge</li> </ul> </li> </ul>	<ul> <li>Type of audit: walk-through energy audits</li> <li>Thematic advice: energy diagnosis</li> </ul>	Obligation to implement EEMs
, rs		<ul> <li>For the energy audits</li> <li>Training</li> <li>Selected by public tendering</li> </ul>	
	<ul> <li>400 participants</li> <li>Total annual primary energy consumption: 5.1 PJ</li> <li>Average: 13 TJ p / participant</li> </ul>	<ul> <li>2,812 EEMs</li> <li>Elec: 20% savings</li> <li>Fuel: 16.8% saving s</li> </ul>	<ul> <li>49% of the EEMs from audits</li> <li>47% of the savings</li> </ul>

#### AGENTSCHAP Case 2b: Regional Energy Audit Programme – 2<sup>nd</sup> phase INNOVEREN & ONDERNEMEN

#### Distribution of the energy saving measures (2,812 EEMs – 0.930 PJ/a)

rimary Energy Savings (TJp)	Procedures	Optimisation	Technology add-on	Technology replacement
ieneral	93,2	0,9	Δ	
lectricity	35,7	39,5	206,0	1,
uilding		0,1	30,9	3,
IVAC	0,3	13,1	54,8	79,
ighting		6,2		213,
compressed air	22,2	9,0	12,4	1,
team		0,4	13,4	0,
hermal oil			1,3	
cooling installations	0,1	15,1	18,2	32,
rocess		1,1	16,4	7,
rocess		1,1	16,4	7

#### Case 3: Local Energy Audit Programme – Ghent



	Start of the programme	Conducting energy audits	Follow-up of energy audit results
ities	<ul> <li>City of Ghent: climate neutral by 2050</li> <li>Pilot: End 2012 – Jun 2014</li> <li>Supported by InterREG</li> <li>Scope <ul> <li>Industry / Tertiary</li> <li>Auditing Covenant</li> </ul> </li> </ul>	<ul> <li>Manuals</li> <li>Electronic tool for monitoring</li> </ul>	<ul> <li>Discussion of audit results with management</li> <li>Coaching on implementation o measures and refining of investantlysis</li> </ul>
ants	<ul> <li>Free to make use of the programme</li> <li>Incentives: <ul> <li>Subsidy for 90% of the cost of audit</li> </ul> </li> </ul>	<ul> <li>Type of audit: walk-through energy audits</li> </ul>	<ul> <li>Commitment to implement all with a PBT &lt; 2 years</li> </ul>
S		<ul> <li>Training</li> <li>Selected by public tendering</li> </ul>	
	<ul> <li>15 participants</li> <li>Total annual primary energy consumption: 0.577 PJ</li> <li>Average: 37 TJ p / participant</li> </ul>	<ul> <li>200 EEMs</li> <li>Savings 71 TJp/a (13%)</li> </ul>	<ul> <li>Half of the EEMs is implemented</li> <li>3 companies: ISO 15001</li> <li>Pilot project → full scale project</li> <li>2014-2019</li> </ul>

#### Case 3: Local Energy Audit Programme – Ghent



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#### Distribution of the energy saving measures (200 EEMs – 0.071 PJ/a)

rimary Energy Savings (TJp)	Procedures	Optimisation	Technology add-on	Technology replacement
ieneral	1,7			
lectricity	2,4			
uilding	0,5	1,3	0,1	
IVAC	1,2	12,7	0,3	
ighting	0,4	0,5	0,1	1,
ompressed air	5,1	0,5	10,6	
team	4,5	4,2	8,6	0,
hermal oil			1,6	
ooling installations		0,9	1,9	A
rocess		2,9	1,5	6,

Ineven distribution: 10 EEMs account for 55% of the total savings

#### Research questions

#### Question 1

Does have the type of energy audit an impact on the type of the energy efficiency measures identified?



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Conclusion: energy diagnosis type energy audits seem to be more successf in identifying more challenging EEMs, such as process related ones 016-09-15

#### Research questions

- Question 2
  - Do have stand-alone and integrated energy audit programme different implementation rates of the identified energy efficiency measures?

		Auditing Covenant – integrated	Regional programme – stand- alone	Programme of G – integrated
А	Total energy consumption (PJp)	44.5	5.11	0.577
В	Number of participants	229	400	15
С	Average energy cons. (TJp/part.) (A / B)	194	12.8	37
D	Total identified energy savings (TJp)	4.7	0.78	0.071
E	Relative energy savings (D / A)	10%	15%	13%
F	Implementation rate	56%	47%	50%
G	Relative implemented savings (E x F)	5.6%	7.1%	6.5%

Conclusion: NO firm evidence that integrated energy audit programmes hat higher implementation rates that stand-alone energy audit programmes 016-09-15

#### **Conclusions - Recommendations**

#### Method to describe energy audit programmes tested

- Many ways to integrate the energy audits
  - Need for more detail in definition of an integrated energy audit programme?
- \* Verification of the proposed EEMs is a key element
  - Collaboration between Verification Office and regional / local programmes?

Categorisation of energy efficiency measures used to test hypotheses

1: Energy diagnosis type energy audits seem to be more successful in identifying more challenging EEMs, such as process related ones

An energy audit programme should find ways to identify process related EEM

\* 2: No confirmation that integrated energy audit programmes have higher implementation rates than stand-alone ones.

## Thank you for your attention !

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