Lessons learnt from 10 years of industry energy efficiency program management

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Abstract

Enova SF manages a program which draws from a government fund, granting investment aid for custom industry energy efficiency projects. In this paper we compare ex post impact assessments with ex ante expectations using data from our bottom-up impact evaluation scheme. We also report overall program results, and estimate cancellation rates. During ten years, a total of 337 Industry projects have been supported, averaging 16 GWh of annual energy savings with an average project support of EUR 600 000, or EUR 160 million in total. We currently hold 110 active projects, 76 cancelled projects and 151 completed projects in this project portfolio.

We have collected impact assessments from 24 completed projects that have been operating for at least three years after project completion. Ex post assessments exceed ex ante estimates by 15 %. Two thirds of the projects have reached or exceeded their expected annual results. The findings show that industry projects deliver sound and lasting energy savings also in the long run.

Energy efficiency projects take time to complete, and some projects are cancelled before completion. We estimate cancellation rates based on 76 cancelled projects. These rates may be utilized for predicting the extent of cancellations on active projects. We evaluate whether intermediate project completion assessments are more accurate than initial (ex ante) estimates, which are provided in the applications. Furthermore, the amounts of energy saved in individual projects will fluctuate from year to year. Each project has quantified this inherent uncertainty by assessing the expected impacts in a worst case and a best case scenario. The uncertainty is approximately +/- 10 %. Finally, we compare results from Industry projects with projects from other sectors.

Introduction

The focus of this article is on ex post assessments versus ex ante estimates on energy efficiency projects in industry. Enova SF is managing the Norwegian Energy Fund on behalf of its owner, the Norwegian Ministry of Petroleum and Energy. Our purpose is to promote sustainable energy use and renewable energy production. By promoting efficient and sustainable energy solutions, we restructure the energy market in order to improve energy security and reduce emissions of greenhouse gases. Our main instruments are investment aid and advisory services. Enova SF was established in 2001, and since 2002 a programme for investment aid to energy efficiency projects in industry has been running. The objective of the programme is to increase energy efficiency in industry, and the main measure is investment aid covering parts of the extra investment costs caused by the energy saving or production technologies.

Norwegian Industry has a total energy consumption of 80 TWh per year (SSB, 2011). The energy intensive industry share of this is about 80 % and this is shared by approximately 100 production facilities. The rest of the industry comprises around 15,000 companies. The energy consumption in the Norwegian industry has been stable through the last ten years, even though production has grown. Thus specific energy consumption has been reduced.

The text is organized the following way: In the next section background about potentials and barriers for energy efficiency savings in the Norwegian Industry are presented. Then we describe the development of the industry program and the ex ante results since the start. The analysis section presents ex post versus ex ante results, and the last section discuss the findings and lessons learnt.

Background – potentials and barriers

In order to develop accurate programmes, Enova has done several studies on potentials for energy saving measures and barriers. The knowledge from these studies, close cooperation with industry businesses and the state aid regulations have been the basis for development of the current running program. First, in 2002 Enova and the energy intensive industry in Norway made a study of energy consumption and potential energy investments that could be implemented in order to increase energy efficiency in Norwegian Industry (Enova, 2002). The study concluded with a large technical potential and a somewhat smaller economical potential. Some measures were profitable, but many turned out with a rate of return lower than the industry expectations. Second, in 2007 the food industry was studied separately (Enova, 2007), concluding with a saving potential of 30 % (1,3 TWh) where most measures were profitable (payback less than 2 years). Third, in 2009 an even more thorough study was done and this time not only covering energy intensive industry but also the rest of the industry (Enova, 2009). The study concluded with an energy saving potential of 27 TWh/year by 2020 (one third of the total industry consumption), and listed 260 measures – some general and some specific for each industry (see Figure 1).

The figure provides an overview and a ranking of possibilities for energy savings. If we assume energy prices around 30 EUR/MWh (indicated with a dotted line in Figure 1), 78 % of the potential has less investment cost per kWh than the energy price and should be profitable (unless there are other additional costs that have not been considered in the study). It is a generally recognized problem that actors in society often do not perform the energy behaviours that would be the most desirable from society's point of view, even if these would be rational behaviours from the actor's point of view. This discrepancy between desired and actual behaviour is often referred to as the *energy paradox* (Jaffe and Stavins, 1994, Van Soest and Bulte, 2001).

The identified causes of such lack of behaviour are usually referred to as barriers. The third study (Enova, 2009) analysed which barriers prevented profitable investments from being implemented. The five identified barriers were:

1. Lack of external infrastructure (for distribution of low temperature waste heat to nearby facilities and energy users) – these are shown in darker blue in the figure.
2. Lack of, or unproven, technology.
3. Lack of economic interest.
4. Limited funding.
5. Lack of consciousness and expertise.

The potential can be pushed through the barriers one by one – like through a funnel (see Figure 2). First, we see that about 30 % of the potential is dependent on external infrastructure. The lack of infrastructure prevents industry from investing in heat recovery. Having removed all measures depending on infrastructure, the second barrier is immature technology. The

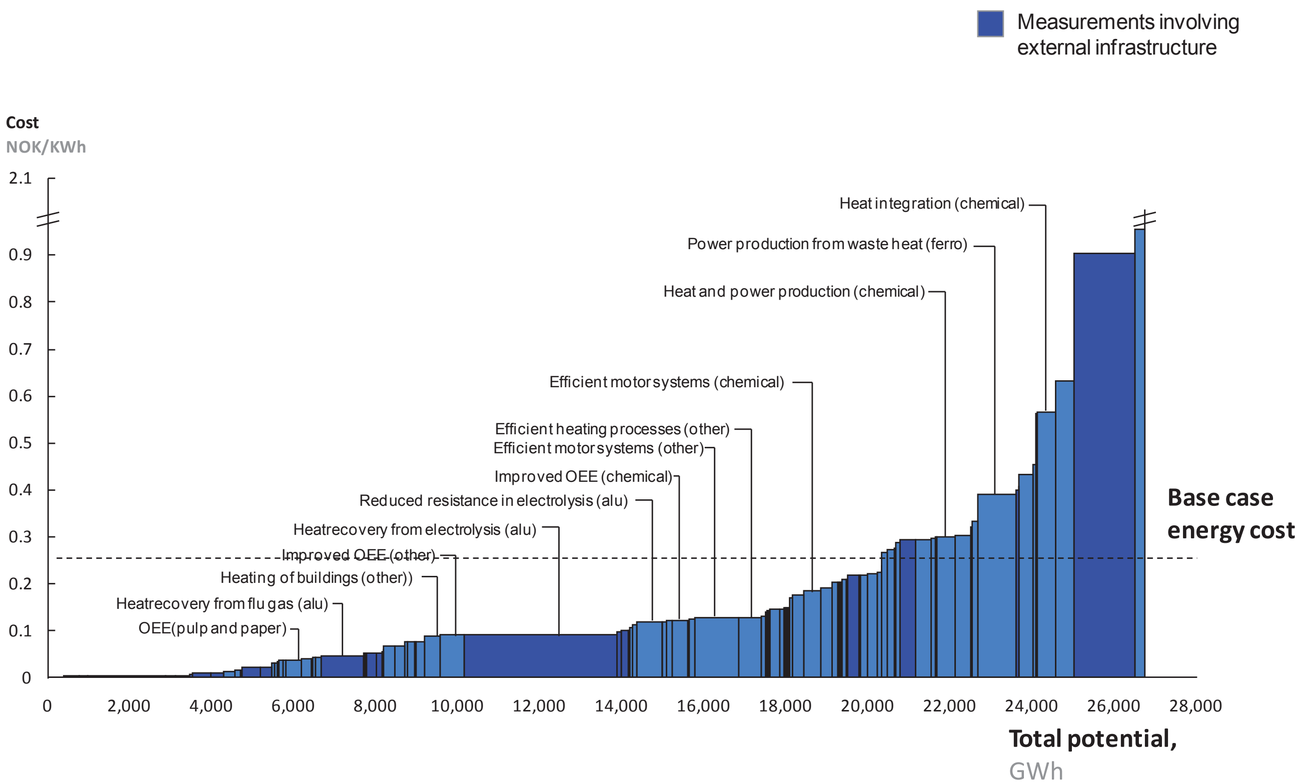

Figure 1. Energy saving measures and costs (Enova, 2009).

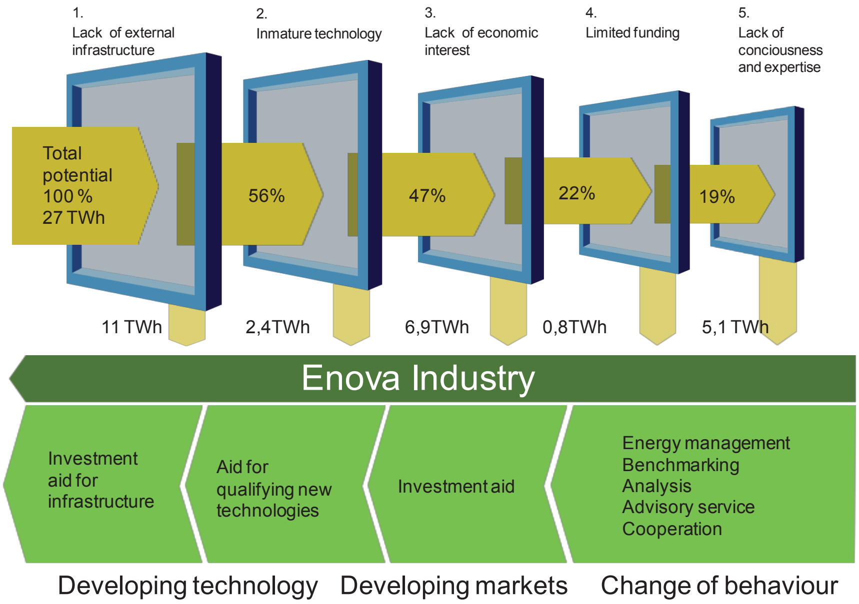

Figure 2. Energy Efficiency potential in Norwegian industry, and Enova's measures to overcome barriers.

technology needed does not exist or needs to be proven. Then there are two economic barriers – the project is not profitable enough (given the internal competition between projects) or the company has too limited funding for these projects. The fifth barrier is lack of consciousness and expertise.

Three of the barriers have characteristics that can be met by financial instruments: (1) The risk involved with testing immature technology can be relieved by partial funding from Enova. (2) Enova can raise the profitability of unprofitable projects to a level that makes them interesting for industry. (3) Enova can also provide partial funding that releases the rest of the funding from the organisation itself. Enova has developed a series of measures – from advisory activities to partial funding which as a whole address all barriers preventing industry from action. This can be presented as shown in the figure above together with the barriers. Activities related to "Change of behaviour" will primarily be advisory activities whereas "Developing markets" and "Developing Technology" both can be triggered by investment aid.

The legal basis for Enova SF to provide grants for energy saving and renewable energy production is an approved notification to the Efta Surveillance Agency (ESA 2006, ESA 2011), based on guidelines on State Aid for environmental protection (Guidelines, 2008). The grant is linked to an obligation to save energy by increasing energy efficiency. Enova SF and the applicant sign a contract where the rights and the obligations of both parties are presented.

The applicants will have incentives to overstate their goals and costs in order to maximize the financial support, but the contractual requirements also introduce risk elements to the project owner (Enge, Holmen and Sandbakk 2007). If the obligation (the energy savings) is not met, the grant might be reduced, or in extreme cases withdrawn. The grant is also linked to the investment costs – it is approved as a percentage of the (extra) investment. If the investment turns out to be less than anticipated, the grant is reduced proportionally. This paper investigates whether projects fall short of meeting their contractual obligations, such as the incentives to overstate goals and costs would lead to.

Programme development, applications and ex ante energy results

Enova was established in 2001 and the first investment aid programmes were put into action in 2002. The investment aid programme for industry was established late in 2002 and was based on the results from the first potential study (Enova, 2002). From 2002 only energy intensive industry could apply for investment aid, while smaller industry companies were offered aid for energy analysis only. The initial programme included only energy savings measures. From 2005, conversion from fossil to renewable fuels was also included. From 2005 smaller energy users could apply for investment aid as well. The historical development of the programme is presented in Table 1.[1, 2]

THE APPLICATION PROCESS

The application process usually starts with discussions and meetings, before the applicant sends an application for aid to Enova. Applications are processed by Enova staff members through up to four stages – depending on the size of the aid. When the project aid exceeds certain thresholds, it has to be approved by the aid committee, the management group, the board – and the largest projects are also approved by the EFTA Surveillance Authority (ESA). Some applications are withdrawn during this process – usually because of internal conditions in the company.

The project is then approved or denied. Denial is usually a result of too profitable projects, too immature projects or

1. From 2002 to February 2011 an investment had to give an energy result of at least 0,5 GWh, this limit was reduced to 0,1 GWh in 2011.

2. From 2002 to 2009 the investment aid was limited to 20% of the extra costs and kept substantially lower than allowed by the State Aid Guidelines in order to avoid overcompensation. Since 2009 the State Aid Guidelines has been the upper limit.

Table 1. Historical development of the Industry programme.

	Large energy users (> 50 GWh energy consumption)			Smaller Energy users (< 50 GWh energy consumption)		
	Investment Aid		Energy analysis aid	Investment Aid		Energy analysis aid
	Energy saving	Conversion to renewable energy		Energy saving	Conversion to renewable energy	
2002	x		x			x
2003	x		x			x
2004	x		x			x
2005	x	x		x	x	x
2006	x	x		x	x	x
2007	x	x		x	x	x
2008	x	x		x	x	
2009	x	x		x	x	
2010	x	x		x	x	
2011	x	x		x	x	
2012	x	x		x	x	

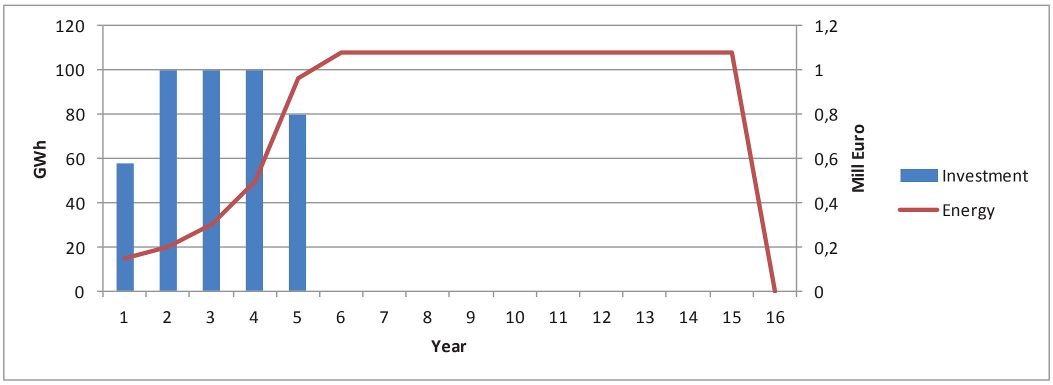

Figure 3. A hypothetical project profile, with a 5 year project period and 10 years operational lifetime.

projects that cannot compete in cost-effectiveness compared to other projects. The objective for Enova is to maximize the energy savings (or renewable production) subject to a yearly budget constraint, hence minimizing the aid intensity in each project. The major criterion for making priorities is cost per unit of energy saving (EUR/MWh). Projects with a lower EUR/MWh are given priority.

Approved projects sign a contract with Enova and will then be active for a number of years – the largest industry projects can be planned for as long as 4–5 years, and in some cases last for an even longer period of time. Figure 3 shows a hypothetical project profile. The energy efficiency project takes 5 years to complete, and results are assumed to evolve after completion during a project specific lifetime (10 years in the figure).

Some of the projects are cancelled after signing the contract, and will never be finished. Usually these projects have never started investing due to internal priorities: Too low profitability compared to other investments (even with Enova aid), unstable market conditions, lack of funding, etc. The rate of cancellations gives an indication of Enova's ability to read the market and avoid free riders. If all projects get implemented, this may indicate that Enova is overcompensating and attracting free-riders. If many projects are cancelled, this may indicate that Enova is too risk averse and needs to improve the support available.

Completed projects report their completed activities in order to get the last share of the support paid, and they also submit an updated estimate of the energy results they expect from the project. Sometimes this updated estimate is based on measurements, otherwise it is based on expectations. After 10 years of running the investment aid program, Enova in 2011 for the first time assessed ex post results by contacting the project owners and collecting both textual experiences and new calculations of the achieved project results. These results are discussed in the analysis section – but first we look at the ex ante results.

EX ANTE ENERGY RESULTS

During the 10 years since 2002 until the end of 2011 we have granted investment aid to 337 industry projects. 96 of these projects were active at the end of 2011, 162 were completed and 79 have been cancelled. Figure 4 shows the number of supported projects per year. The activity level has been quite steady during the programme lifetime. The number of projects per year has varied from 22 to 59, and has been slightly decreasing during the period. On average, we have supported about 30 industry projects per year. Figure 4 also shows that about 30 percent of the number of supported projects up to 2008 has been cancelled. We discuss the dynamics of cancellations in the analysis section.

Figure 5 shows ex ante energy results per year. The energy results fluctuate much more than the number of projects in Figure 4, because the sizes of the individual projects vary a lot. The average project size has been increasing throughout the period, but declined in 2010 and 2011. The total contractual commitments amount to more than 4 TWh yearly – more than 5 % of the yearly energy consumption in Norwegian industry. The commitments are divided between energy efficiency, energy recovery and conversion to renewable energy.

Figure 6 shows the amount of investment aid that has been allocated for each year. The total investment aid amounts to

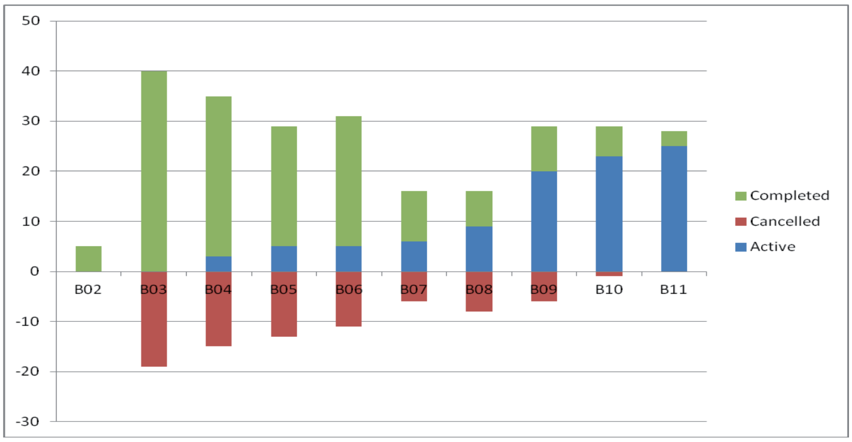

Figure 4. Number of projects by year and state.

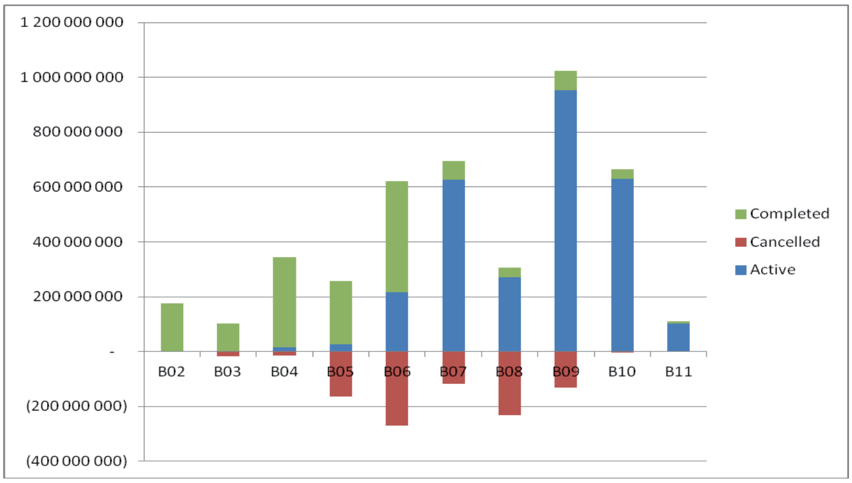

Figure 5. Ex ante energy results by year and state [kWh].

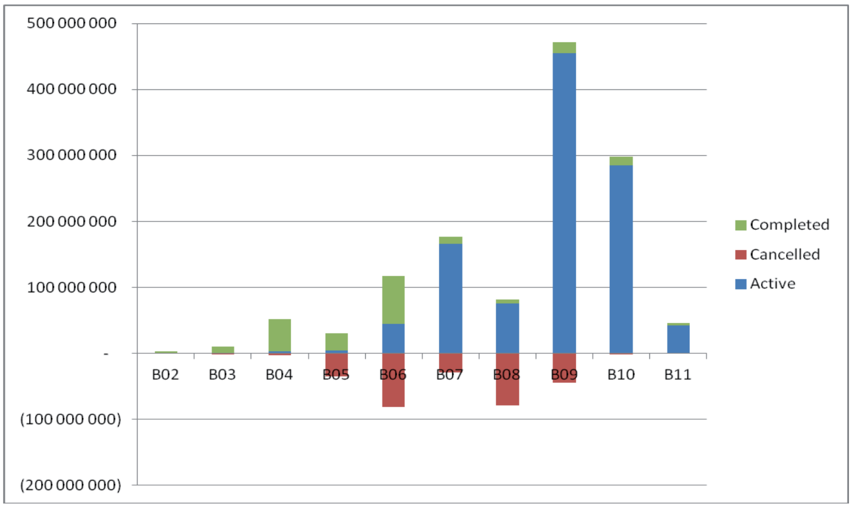

Figure 6. Investment aid by year and state [M NOK].

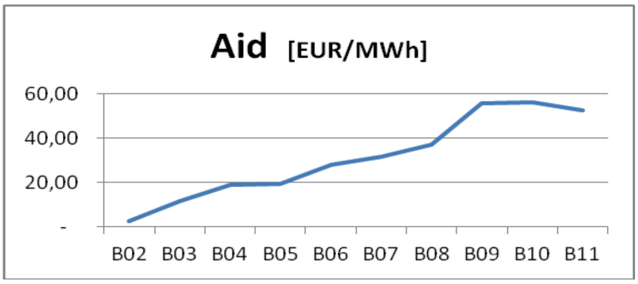

Figure 7. Aid per MWh.

more than EUR 160 million. Enova has experienced increasing budgets, and has been able to support larger projects. The largest projects constitute a larger and larger proportion of the total. This also leads to larger fluctuations from year to year. Some years we do not have large projects in the pipeline, depending on the general economic growth and cycles in the industry. Thus we expect such fluctuations to continue.

Figure 6 is quite similar to Figure 5. There is a close link between the investment grants and the energy results. We notice that the aid that is necessary to trigger new projects has increased substantially during the period (measured as granted EUR per yearly MWh of energy saved). This trend is shown in Figure 7.

Analysis of ex post results

CANCELLATION AND COMPLETION RATES – HOW MANY PROJECTS DO WE LOSE?

Even though an application is granted support, some of the projects are cancelled. Both internal and external factors may change before the investment decision is taken by the applicant. Projects are usually cancelled because of:

- Lower profitability than expected: Energy prices are particularly important elements in the calculations of the project. If energy prices drop and expected future energy prices are low, the expected project profitability drops and the company will postpone or cancel the investment.
- Lack of rooting in the organization: The project is not rooted in the management of the organization and the investment aid is not enough to trigger any interest.

Even though a project is cancelled, this does not necessarily mean that any monetary support has been lost. Support is paid in arrears based on project progress. Our experience is that when a project has started to receive any payments, it is rarely cancelled. Cancelled projects have rarely received any payment, and thus the agreed funding can be fully recycled into new projects.

We assume that the probability for a project to be cancelled or to be completed depends on the project age (i.e. the time from the approval of the support). Based on these aggregated project data we calculate cancellation and completion rates based on project age. Table 2 summarizes each year's energy results and records how shares of the results are cancelled before the projects complete.

Using these rates of cancellation and completion, we can calculate an expected development for Industry projects that get support. This is shown in Figure 8.

The cancellation and completion rates[3] produce an expected cancellation of 25 % of the energy results from Enova's supported Industry projects. Out of 100 GWh supported, we would expect 25 GWh to be cancelled – most likely during year 4.

We can compare cancellation and completion rates from industrial energy efficiency projects against Enova's portfolios in other market sectors. The building sector comprises primarily energy efficiency projects (like the industry projects). The heating sector consists primarily of projects for renewable energy production. Both the Buildings and Heating sectors have higher number of projects than the industry sector.

Industry projects have similar cancellations as Renewable heating projects. Cancellations in the Buildings area tend to be distributed over a longer time period. As to the completion rates, the industry projects have a higher completion rate from year 6 and all Industry projects have been completed 9 years after support was granted. The other areas still have some active projects 9 years after the support was granted. It may be that these projects need more time in general, but another contributing factor is that a larger number of projects have been supported in these areas and that some of the projects are not on track with the reporting.

Table 3 shows how much of the ex ante estimates that are lost because the projects are cancelled.

Both Industry and Buildings projects lose about 25 % of the ex ante estimates due to cancellations, while the cancelled Heating projects account for 31 % of the ex ante estimates.

EX POST IMPACT ASSESSMENTS – DO THE PROJECTS REACH THEIR COMMITMENTS?

We have looked at the projects that are cancelled. Now we will discuss the projects that are completed. Figure 11 shows the stacked energy results for 24 completed industrial energy efficiency projects that received support from the Norwegian energy fund.

As we can see, the ex post assessments exceed the ex ante estimates. The 24 ex ante estimates sum up to 386 GWh, while the ex post assessments total is 446 GWh. Thus the average industry project achieves 15 % better results than the ex ante assessments indicate.

A paired sample one-tailed T-test rejects the hypothesis that ex post impact assessments equals ex ante estimates on the 6 % significance level, and supports the conclusion that ex post impacts assessments exceed ex ante estimates ($p=0.0592$)[4].

Details for the single projects are shown in Figure 12. We see that a few large projects make up a large proportion of the total energy results. We still see that most of the projects exceed their ex ante estimates. Two thirds are above or equal to the ex ante estimate, one third is below. In two cases operations have been shut down, in which case the reported ex post results are zero.

Four of the five largest projects are from pulp and paper, and aim to reduce thermal energy consumption and recover energy.

3. These are interrelated, and both rates must be used in projections.

4. We consider this as a satisfactory level of significance with only 24 observations.

Table 2. Cancellation and completion rates for Industrial energy efficiency projects supported by the Norwegian energy fund.

Projects supported in	Project State	year 1	year 2	year 3	year 4	year 5	year 6	year 7	year 8	year 9	year 10
2002	Active	176 700 000	176 700 000	24 600 000	24 600 000	24 600 000	6 600 000	6 600 000	-	-	-
	Cancelled										
	Completed		152 100 000			18 000 000		6 600 000			
2003	Active	119 754 122	117 507 122	113 789 392	73 549 392	25 670 000	17 200 000	9 000 000	1 000 000	1 000 000	
	Cancelled		3 717 730	1 600 000	8 359 000	2 240 000	300 000				
	Completed	2 247 000		38 640 000	39 520 392	6 230 000	7 900 000	8 000 000	-	1 000 000	
2004	Active	356 960 566	356 660 566	352 735 566	331 452 993	66 100 000	28 500 000	19 000 000	17 500 000		
	Cancelled	300 000	300 000	1 500 000	11 280 000	250 000					
	Completed		3 625 000	19 782 573	254 072 993	37 350 000	9 500 000	1 500 000			
2005	Active	422 215 000	422 215 000	359 835 000	289 505 000	179 773 000	142 873 000	137 873 000			
	Cancelled		58 620 000	63 600 000	21 795 000	16 200 000		4 500 000			
	Completed		3 760 000	6 730 000	87 937 000	20 700 000	5 000 000	102 466 000			
2006	Active	891 365 100	891 365 100	744 099 000	714 441 000	583 106 000	579 750 000				
	Cancelled		132 138 000		115 220 000	1 100 000	21 200 000				
	Completed		15 128 100	29 658 000	16 115 000	2 256 000	342 650 000				
2007	Active	814 481 000	814 481 000	814 481 000	703 490 000	681 754 000					
	Cancelled			110 000 000	5 736 000	1 550 000					
	Completed			991 000	16 000 000	49 136 000					
2008	Active	538 131 507	536 981 507	529 829 360	413 541 300						
	Cancelled	1 150 000	3 298 147	96 000 000	129 900 000						
	Completed		3 854 000	20 288 060	6 412 000						
2009	Active	1 154 598 644	1 145 678 644	1 011 080 644							
	Cancelled	6 420 000	118 698 000								
	Completed	2 500 000	15 900 000	46 800 000							
2010	Active	664 625 451	664 625 451								
	Cancelled		620 000								
	Completed		19 740 000								
2011	Active	110 768 991									
	Cancelled										
	Completed										
Base [kWh]	(A)	5 249 600 381	5 126 214 390	3 950 449 962	2 550 579 685	1 561 003 000	774 923 000	172 473 000	18 500 000	1 000 000	-
Cancellations [kWh]	(B)	7 870 000	317 391 877	272 700 000	292 290 000	21 340 000	21 500 000	4 500 000	-	-	-
Completions [kWh]	(C)	4 747 000	214 107 100	162 889 633	420 057 385	133 672 000	365 050 000	118 566 000	-	1 000 000	-
Cancellation rate (%)	(B/A)	0,1 %	6,2 %	6,9 %	11,5 %	1,4 %	2,8 %	2,6 %	0,0 %	0,0 %	
Completion rate (%)	(C/A)	0,1 %	4,2 %	4,1 %	16,5 %	8,6 %	47,1 %	68,7 %	0,0 %	100,0 %	

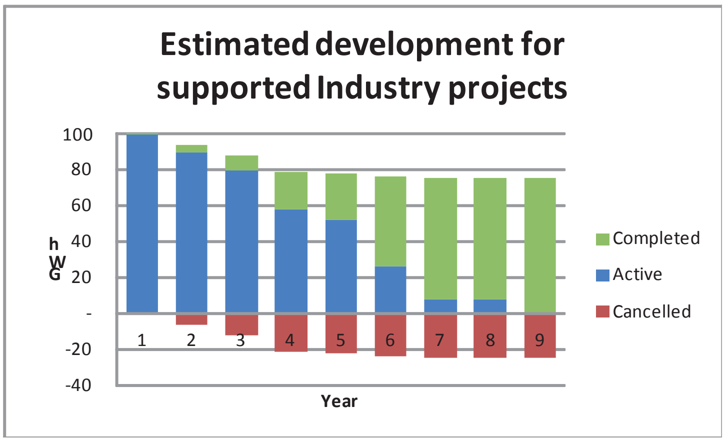

Figure 8. Estimated development for supported Industry projects.

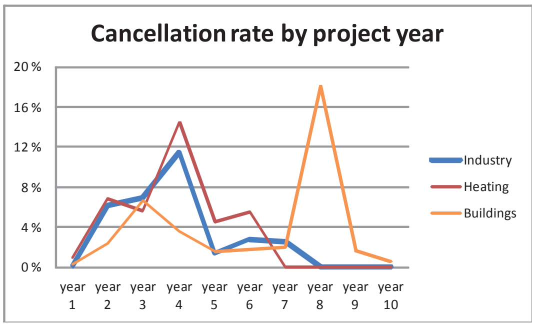

Figure 9. Cancellation rate by project year in different market areas.

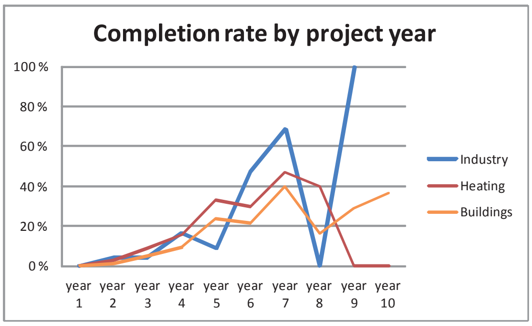

Figure 10. Completion rate by project year in different market areas.

Table 3. Share of ex ante estimates that are cancelled.

Sector	Ex ante estimates cancelled
Industry	25%
Heating	31%
Buildings	23%

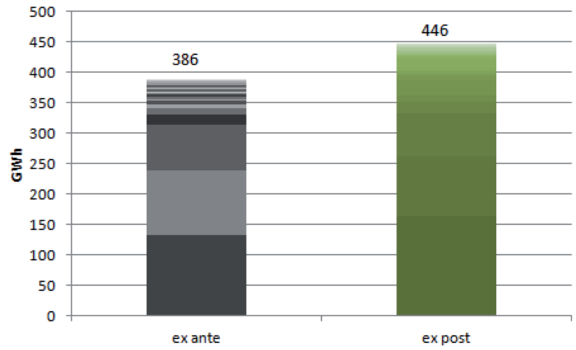

Figure 11. Industrial energy efficiency projects meet their commitments.

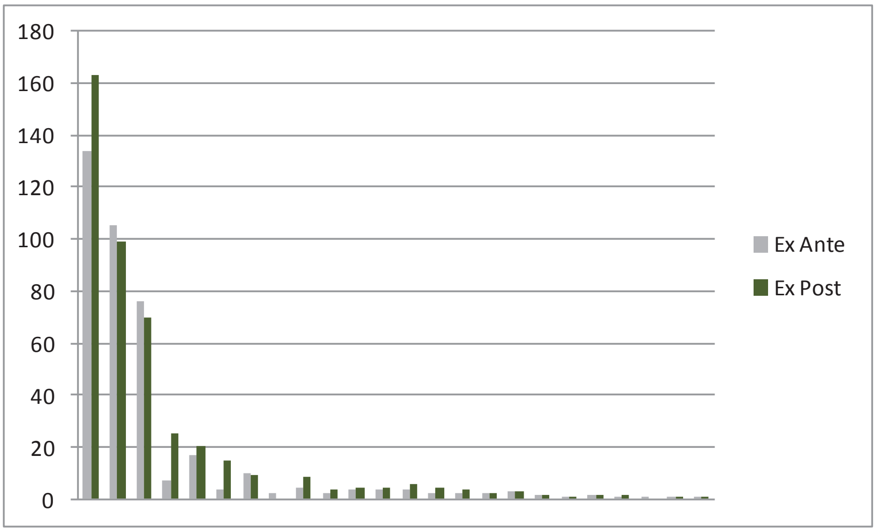

Figure 12. Ex ante estimates versus ex post assessments for 24 industrial energy efficiency projects.

All of the three largest pulp and paper producers in Norway are represented among these supported projects. The projects consist of several measures bundled together, creating a size that also increases attention and focus in the companies. Waste heat recovery in general has exceeded the expectations, and especially in the fourth largest project which is from metallurgic industry. The sixth project is from the food industry, where improved isolation and rehabilitation of evaporators have decreased energy consumption by 44 %.

ARE INTERMEDIATE PROJECT COMPLETION ESTIMATES MORE ACCURATE THAN INITIAL EX ANTE ESTIMATES?

In addition to ex ante estimate which are given within the application for support, projects also submit an updated estimate upon the project completion. Are these intermediate project completion assessments more accurate than initial estimates? Yes, they seem to be: Figure 13 shows ex ante estimates, project completion estimates and ex post assessments for 24 industrial energy efficiency projects.

Figure 13 shows that the updated estimates given on project completion in total are more accurate than ex ante estimates before the projects are started. The assessment upon completion is 10 % higher than ex ante assessments for the average industry project. This figure, however, is dominated by the larger projects, so we should also examine the individual projects. The findings per individual project are summarized in Table 4.[5]

The projects tend to submit conservative estimates. At project completion some of the projects are able to report measured results, while other projects need time to get operational experience in order to confirm impacts. The latter category tend to report in accordance with the application data. The applicants underestimate the effects from their project, in order to reduce the risk of not fulfilling the contractual obligation. The measured projects are more likely to report results that are higher than the ex ante estimates.

FLUCTUATIONS FROM YEAR TO YEAR

There are many factors that will influence the energy consumption from year to year – and thereby also the energy savings achieved. The product mix and production volumes affect economies of scales – a high production volume will typically lead to lower specific energy consumption than low production volumes. The quality of raw materials may change from year to year – a wet season will for instance lead to high water content in crops and corresponding need for energy intensive drying. Energy prices may favour different energy carriers that can be substituted and affect energy savings.

5. Operations have been shut down after project completion, so ex post assessments are zero for two projects. This leaves the completion assessment too optimistic.

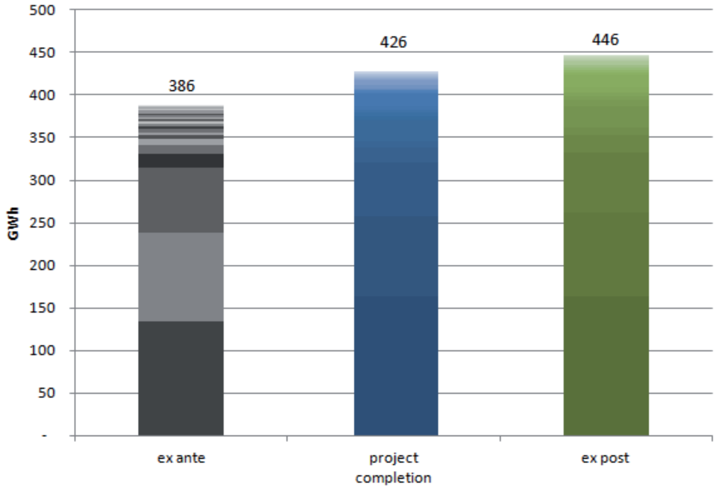

Figure 13. Project completion estimates are more accurate than ex ante estimates.

Table 4. Intermediate estimates provide improved guidance over ex ante estimates.

Guidance from completion estimates	Count	Share	Completion assessment is: too pessimistic	realistic	too optimistic
Improved	11	46%	3	7	1
No change	6	25%	5		1
Worse	7	29%	5		2
Total	24	100%	13	7	4

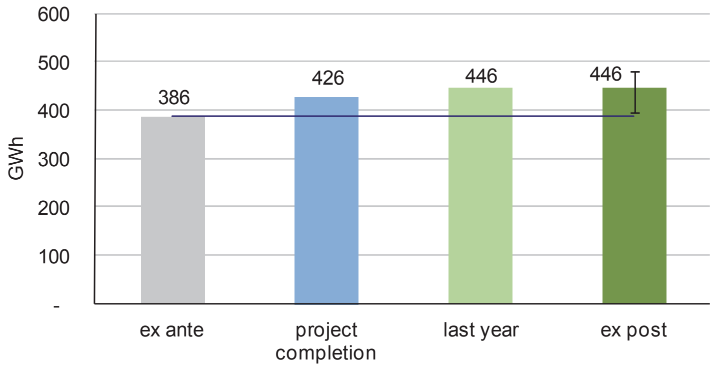

Figure 14. Yearly fluctuations are expected to be within -11 % and +8 % for the 24 industrial energy efficiency projects.

Each project has reported ex post assessments for a normal year, but also last year's energy result and the results they expect in a worst case and best case scenario. The two scenarios are loosely defined as:

- Best case: How good could the energy result from the supported project be next year, if the utilization of production capacity and production factors is optimal?
- Worst case: How bad could the energy result from the supported project be next year, if the utilization of production capacity and production factors is far from optimal?

The reference to "next year" is made in order to limit the range of possible outcomes in a best case or worst case scenario. These definitions do not lead to a detailed specification on how to calculate the numbers. We find that the respondents have been able to provide reasonable assessments without too many questions. Of course the assumptions will vary, but we do get data that provide a picture of the year to year uncertainty.

The worst case and best case assessments define a range from 397 to 480 GWh, which is shown in Figure 14. The range of uncertainty is substantial, but even the worst case scenario is above the ex ante estimate. This indicates that the projects are confident that they reach their commitments.

In Figure 15 we compare the fluctuation range reported from Industry projects against those from Renewable heating projects and Buildings projects.

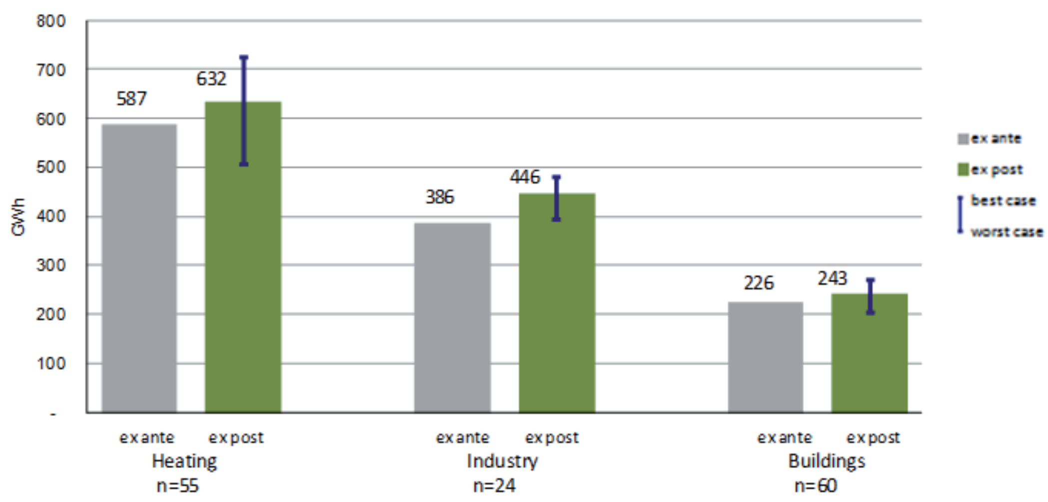

Figure 15. Range of fluctuations for projects in different sectors.

Table 5. Relative uncertainty ranges for projects in different sectors.

Sector	Worst case	Best case
Industry	-11%	8%
Heating	-20%	15%
Buildings	-16%	12%

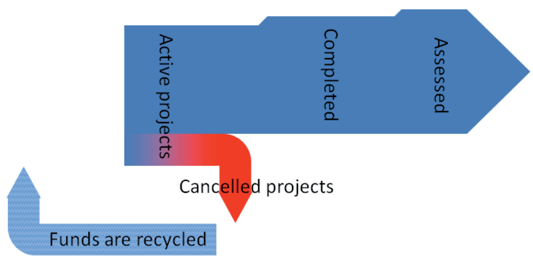

Figure 16. Energy results at different project stages.

Industry is the sector that has reported the relatively narrowest range, compared to Buildings and Renewable heating (see Table 5).

It may be easier for projects in renewable heating to quantify a range, since they can measure their production precisely and production obviously depends on the temperature through the year. Nevertheless, there are many uncertain factors for the energy efficiency projects too. Energy efficiency projects have to compare their energy consumption against a counterfactual baseline. This calculation is inherently uncertain, and to assess worst case and best case scenarios should add even more uncertainty. On the other hand, the uncertain factors would affect the counterfactual as well, so these findings could very well be reasonable.

Discussion and conclusions

Enova has been running an industry support programme for 10 years. Investment aid serves as the main instrument, and the experiences with investment aid are good. However, financial support should not be the only instrument in the tool box, it should be complemented by other measures in order to reduce the full set of barriers to implementation of energy efficiency projects. A good mixture of instruments will fortify each other, and information and advisory services are important to trigger a larger share of the potential savings.

1. We lose some of the projects due to cancellations (25 %) – but we retain the money and recycle them into new project support.
2. Few projects are cancelled after they have started to receive support.
3. The industry projects generally over perform by +15 %, compared to their ex ante estimates.
4. If we compare against the project completion estimate, ex post assessments are 5 % higher.
5. Project completion estimates are more accurate than initial ex ante estimates.
6. Actual energy results may fluctuate by as much as -11 % / +8 % from year to year.
7. We find similar or bigger fluctuations from projects in other sectors.

Figure 16 summarizes how the energy results evolve by the different projects stages.

We see that the cancelled projects constitute a substantial share of the initially active projects, but since the cancelled projects have very rarely received any payment we are able to recycle the funds into new projects. The industry energy efficiency projects are able to deliver their contractual obligations, and the hypothesis from Enge, Holmen and Sandbakk (2007) that applicants may overstate their goals in order to maximize support is not supported by the ex post results. Most of the projects exceed their goals, and both their ex ante estimates and their project completion estimates are conservative when we compare against the ex post assessments. Although the actual energy results will vary from year to year, the overall conclusion is that the projects deliver sound energy savings in the long run.

IDEAS FOR FURTHER WORK

These are the first ex post results from the project portfolio, and the data collection will be repeated for the coming generations of completed projects, providing more data for further analysis. With a broader data set, we may assess whether there are trends associated with project estimates and project types. This knowledge will then be utilized in further programme development.

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