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Deep Retrofit – Economic Analysis

SERVE Deliverable D6.9

CONCERTO INITIATIVE
SERVE

Sustainable Energy for the Rural Village Environment

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Executive Summary

The main objective of this report is to evaluate the financial benefits from the implementation of selected energy retrofitting measures which were an integral part of the SERVE project. The financial analysis was performed as part of the activities aimed to assess the impact of the SERVE project on the region and its citizens from a socio-economic viewpoint.

In order to thoroughly assess the analysis, a general overview of the region was given in Chapter 3 with information on the state of the housing stock, population changes, type of fuel used for heating purposes and price fluctuations of most common fuel types used in the region. Results were compared to national averages for better understanding of the specific characteristics of the SERVE region.

Chapter 4 gives an insight on different phases of SERVE grant schemes and difficulties which were encountered after the introduction of the SEAI Home Energy Saving Scheme. An overview of supported measures was given with all the relevant data regarding investment costs, energy savings and grants issued to owners of buildings which underwent the retrofitting process. The information was retrieved from the energy audits, project partners and surveys and data available from the Irish CSO web site.

The main part of the report, economic analysis of retrofitting measures performed in the SERVE region, is presented in Chapter 5. Economic analysis assessed all the key financial parameters such as financial savings, discounted payback periods, net present values, and internal rates of return of the investments. Since there were only a small number of mandatory measures which had to be performed in order to receive grant funding, an impressive number of different combinations of RES/RUE measures was implemented. The results were generally very good since most of the buildings were quite energy inefficient and therefore large energy savings were achieved. The real question was, however, to determine how effective these investments were with and without the EU and State financial aid. Sensitivity analysis was also performed since fuel price oscillations could not be ignored and their level played a key role in the cost-effectiveness of the investments.

The analysis of local money flow in Chapter 6 was represented by the five-sector circular flow model which describes the operation of the economy and the linkages between the main sectors in the economy. This analysis was conducted in order to analyse the involvement of local companies in the whole project which clearly shows whether the local economy had any tangible benefits from the SERVE project. Sources of non-grant investment were also examined to determine the level of participation from the financial institutions.

The final chapter provides conclusions based on the results from the economic analysis and circular flow model with recommendations regarding the use of grant funding as a way of supporting local economic activity and national energy targets.

1 Introduction

The SERVE project is funded under the EU CONCERTO Programme and aims to develop a sustainable region in North Tipperary, Ireland, through the implementation of actions in the field of sustainable energy. Actions include energy upgrades for existing dwellings, installation of renewable energy heating systems, development of an eco-village in Cloughjordan and the development of a district heating system.

In addition to the technical and environmental benefits which will be brought about by the SERVE project, the objectives also include the assessment of the impact of the project on the SERVE region and its citizens from a socio-economic viewpoint. The work in this area is organized through a separate Work Package, namely WP6: Socio-Economic Analysis and Research, with the following tasks:

- Provide a detailed analysis of the impact on job creation and service supply.
- Provide a coherent overview and prepare (scenario based) forecasts for replication both within North Tipperary and beyond.
- Identify opportunities for the development of Energy Supply Companies (ESCO's) within Ireland
- Perform an analysis of local funding and money flows from proposed action
- Perform an evaluation of the different externalities of the above-mentioned chains compared to key alternatives for the different timeframes envisaged; applicable to regional conditions in the SERVE project.
- Perform an analysis of payback time for proposed SERVE project measures in buildings sector as well as other cost-benefit analysis as appropriate.
- Study the effects on health, involvement of citizens, attitudes of building owners and consumers, acceptance and effects of job growth for concrete cases included in this project.

As part of the activities within WP6 a baseline socio-economic study of the SERVE region was performed, which included the economic analysis of all implemented measures. The baseline study was carried out with the following main objectives:

- to obtain the current status of renewable energy sources (RES) utilization and rational use of energy (RUE) measures carried out within the region.
- to perform economic analysis on all implemented RES/RUE measures.
- to determine sources of funding.
- to analyze impact of the project on local economy by observing local money flow.

Information was obtained from project partners, direct questions/answers and meetings with stakeholders. Results of the analysis will contribute to prepare scenario for replication of similar projects at a wider scale and possibly in other regions in Ireland and Europe.

2 Project overview

The European Commission, under its Concerto Programme, aimed to create several Sustainable Energy Areas throughout Europe. An area of North Tipperary has been approved funding as part of this Concerto Programme. The SERVE project aims to implement a major share of sustainability into more than 500 new and existing buildings and their energy infrastructure in order to demonstrate the possibility, feasibility and most importantly a healthy, clean environment.

The SERVE project focuses on implementing a wide range of energy efficiency actions in buildings and renewable energy measures. The activities which will be completed in relation to buildings include the design, building and retrofitting of various types of buildings throughout the region.

There are two focuses of actions related to buildings:

- Retrofitting/Upgrading of existing buildings within the entire SERVE Region to improve their energy performance.
- Design and construction of new buildings within the Eco-Village in Cloughjordan.

The key objectives were:

- Upgrading/retrofitting 400 existing buildings to improve energy performance as set in the CONCERTO Programme.
- Construction of 50 new residential units with energy performance which is 40% below 2006 Irish building regulations.

Existing buildings within the SERVE region are predominantly rural dwellings, public buildings and small commercial buildings. Analyses of existing data as well as surveys have indicated that the energy performance of these buildings is poor.

Given the current profile of energy consumption (94% fossil fuel use) and the range of buildings types, energy profile and ownership the upgrading and retrofitting actions will address the following areas:

- Upgrading of building fabric by addressing building fabric energy performance;
- Installation of high energy efficiency heating systems and controls;
- Integration of controls with new renewable energy systems as appropriate.

The SERVE Project focused on the design and provision of suitable renewable energy supplies for both the retrofitted existing buildings in the Region and new buildings in the Eco-Village. It comprised of the following activities:

- Retrofitting of renewable energy systems in existing dwellings;
- Development of Wood-Biomass/Solar District Heating system in the Eco-village; and the SERVE Region
- Installation of renewable energy heating systems in existing buildings and commercial/public buildings

The new installations would result in the renewable energy supply in the targeted buildings increasing from 660 MWh per annum to 3,000 MWh per annum. Combined with the proposed Eco-Building actions this would increase the contribution of RES in these buildings from 6% to 20%.

3 About SERVE region

SERVE region is located in the province of North Tipperary with total area of 605 square kilometers. North Tipperary is an inland county located in the Mid-West Region of Ireland. The region has a strong agricultural base and its village and town structures are typical of rural Ireland. Almost two-thirds of people in North Tipperary live in the open countryside and in small towns and villages. Therefore, rural development is integral to the sustainable development of the County, as well as the SERVE region. Based on the preliminary results of the 2011 Census SERVE region has a population of approximately 10,243 people. Population distribution shows that the region is predominantly consisted of very small settlements with only Nenagh and Borrisokane division having more than 1,000 inhabitants.

In comparison to year 2006, North Tipperary region has recorded an increase of 4,196 persons or 6.4%, which is in line with the national average. Although predominantly a rural county, parts of North Tipperary are experiencing intensive urbanization and suburbanization. The town of Nenagh in particular has seen quite notable population growth and is now the most populous town in the county with 7,995 persons.

People in SERVE region are more likely to live in owner-occupied homes (79.9%) than people elsewhere in Ireland (74.7%). Households in SERVE region are more likely to own their houses outright than the national average. A total of 41.6% of permanent private households own their homes outright compared to 34.1% nationally. Within the SERVE region more owner occupiers own their homes outright than hold mortgages on their homes. Homeowners are more prone than tenants to invest in energy-saving equipment and renewable energy technologies. This is largely because they are able to recover the costs of their investment in the long term.

The age of occupied houses in the SERVE region generally reflects the age of houses in the country. The exception to this is pre-1919 housing (see Figure 3.1). SERVE region has significantly more pre-1919 housing stock than the national average (15.2% vs. 9.1%). Generally, older houses are less energy efficient and are good candidates for making large energy savings with implementation of basic measures such as investment in better insulation.

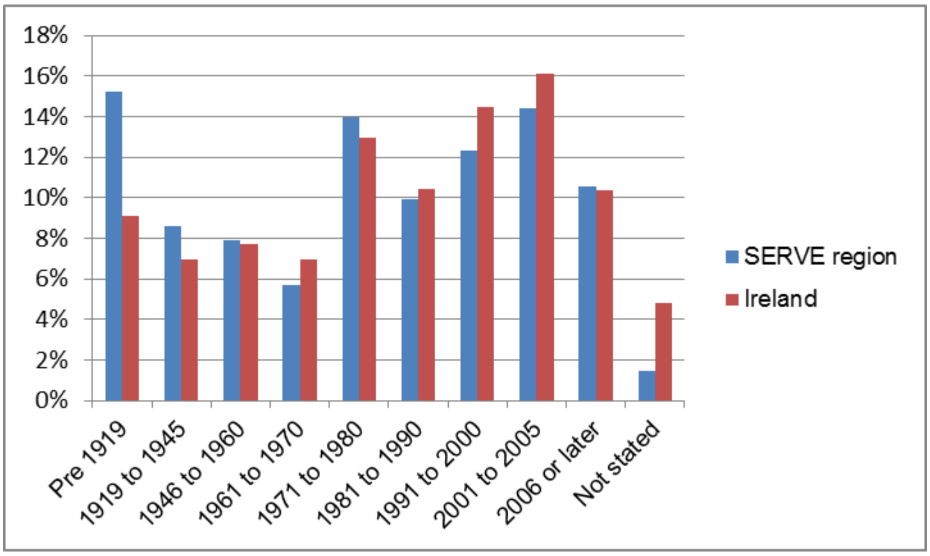

Figure 3.1 Permanent private households by year built
Source: CSO 2011

Low-income households also tend to occupy more inefficient, older buildings. Fuel poverty is a massive problem for those on low incomes; inefficient buildings only exacerbate this problem and further waste their scarce resources.

Ireland is fairly unique in the EU when it comes to fuel sources used for domestic heating purposes. Rather than the gas oil which is utilized more commonly across Europe, fuel oil (kerosene) is still the major fuel source for primary heating purposes in households (see Figure 3.2)

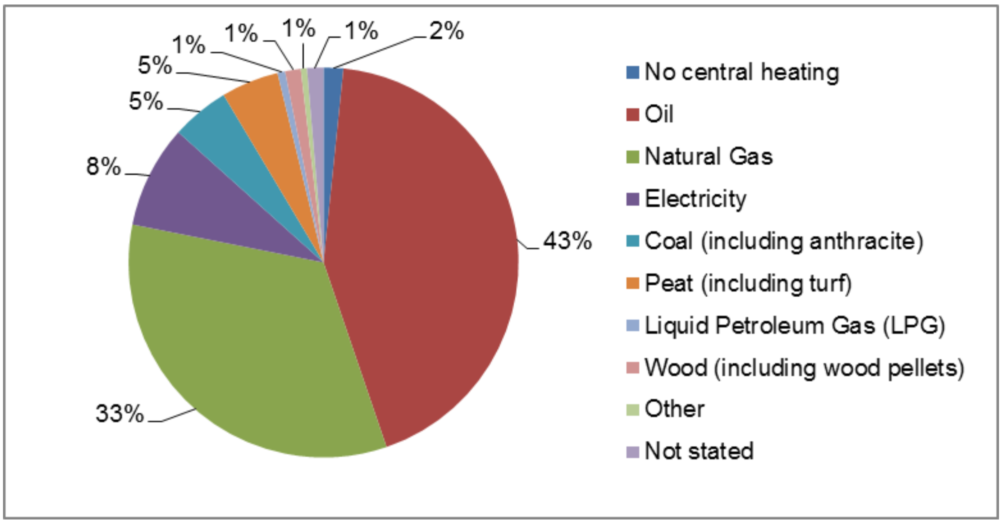

Figure 3.2 Permanent private households by central heating – Ireland
Source: CSO 2011

In Ireland, the main reason kerosene is so commonly used as a heating fuel is the lack of connection to gas pipeline network. Many properties in remote parts of Ireland cannot be connected to the main, nationwide gas supply without considerable cost implications. Such is the case with the SERVE region which can be seen at Figure 3.3.

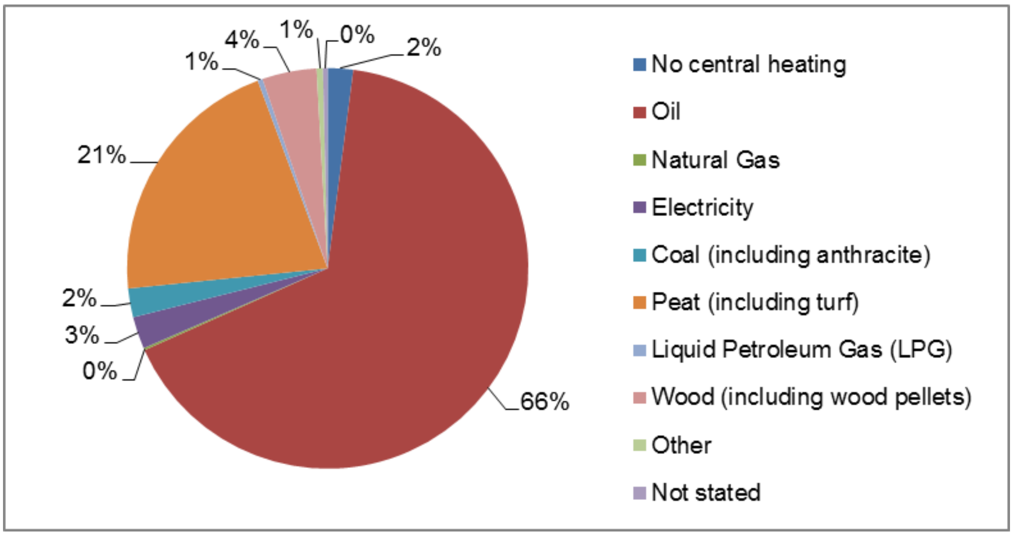

Figure 3.3 Permanent private households by central heating – SERVE region
Source: CSO 2011

Given this situation, it's likely that the use of kerosene will persist in the foreseeable future. However, the lack of gas availability and the inevitable rise of the fossil fuel prices could be beneficial to the development of the renewable energy heating sources in rural areas such as SERVE region.

Oil heating has historically been the most common fuel for heating a home and remains the only available choice for some. But with oil prices being market driven, this type of heating is becoming more expensive and while natural gas is not available in rural areas, renewable energy sources (primarily wood and solar) should be viewed as a viable alternative.

Concerning energy prices, during the economic boom in Ireland (2000-2008), electricity prices for households doubled, while the price of kerosene rose by 78% and natural gas prices increased by 87%. From January 2006, when SEAI began with data collecting, to January 2008 the price of bagged wood pellets increased by 12%. SERVE project was conducted during the major financial crisis which saw a general drop of fuel prices (see Figure 3.4).

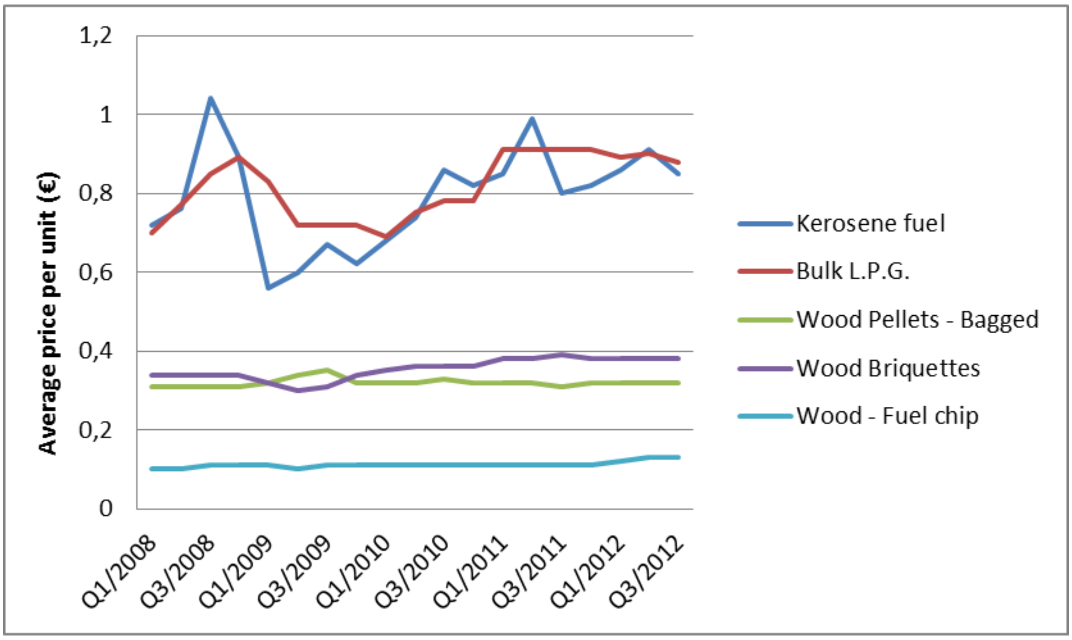

Figure 3.4 Archived Domestic Fuel Costs (2008-2012)
Source: SEAI

Prices of wood pellets and briquettes as well as wood chip did not vary significantly due to increased domestic production while the price of kerosene and LPG fluctuated extremely. The biomass market in Ireland is still relatively undeveloped, although there has been a rapid expansion in the number of biomass consumers since 2006, with the launch of separate grant programmes (HESS, ReHeat and SERVE). The grant support programmes are still considered necessary due to the high prices of pellet/briquette boilers and stoves (when compared to oil or gas boilers). Their biggest potential for expansion remains in regions such as SERVE which are not connected to the national gas pipeline network.

4 Supported retrofitting measures

A key part of the SERVE project is the upgrading of around 500 existing homes and buildings from an energy efficiency point of view. In order to make this a reality North Tipperary County Council, with its partner Tipperary Energy Agency, delivered a Grant Scheme to residential and non-residential building owners to upgrade their properties. The scheme ran in three phases which all had a different set of conditions and were divided into Energy Efficiency Grants and Renewable Energy Grants.

A total of 318 households were included in this analysis which does not represent all buildings that have gone through retrofitting process. Seventeen buildings had to be excluded from the analysis due to the incomplete or faulty data.

4.1 Energy efficiency and renewable energy grant schemes

In 2008 the SERVE Project team worked with Sustainable Energy Authority of Ireland (SEAI) on their Home Energy Saving Scheme Pilot. As a result Phase 1 grant support was developed which ran from Month 6 to Month 14. The scheme was simple and had no mandatory actions that had to be implemented in order to receive grant funding. During Phase 1, TEA worked with SEAI on launching of the Phase 2 of the SERVE Grant Scheme once the Phase 1 was completed. In addition, the TEA was involved in the assessment of the impact of the Pilot HESS and the TEA and SERVE project provided feedback to SEAI and the relevant Government Departments on potential future operations of such a scheme. Based on the assessment of the pilot, the Government proposed a National Home Energy Saving Scheme (HESS). The design of this national HES Scheme roll out mirrored the measures planned for Phase 2 of the SERVE Scheme. This presented a challenge and risk to the SERVE project as there was potentially considerable duplication of resources and effort. To manage this risk a period of discussion and negotiation was required to find a solution that allowed both schemes to co-exist.

4.1.1 Residential sector

The SERVE Residential Energy Efficiency Grants were available to house owners during three project phases which had different set of conditions. Homeowners could also apply for grants under the Home Energy Saving scheme being administered by Sustainable Energy Authority Ireland. However, if a homeowner had already begun works under the Home Energy Saving scheme, they were ineligible for the SERVE Energy Efficiency Grant. General eligibility criteria and grant requirements were as follows:

- The building must be in the SERVE Region;
- The building must have been built pre 2006;

Additional criteria applied for non-residential buildings including:

- The building must be at least 100m^2 and have an annual heating spend of €1,000 (minimum);
- Upgrading works identified had to result in a 40% reduction in energy use;
- Buildings and proposed works had to have a planning permission, especially in cases of protected structures and houses in Architectural Conservation areas.

Additionally, a BER (Building Energy Rating) was required before and after the upgrades were carried out. The SERVE Energy Efficiency Grant was made up of €1,000 for mandatory measures (attic insulation, wall insulation & heating controls) and additional payments for further energy efficiency measures (windows & external wall insulation, novel low carbon insulation, flat roof/room in roof insulation, advanced heating controls, high efficiency boilers and cylinders, lighting controls and LEDS). At least 2 of these additional measures had to be completed. Homeowners could apply to both the SERVE Project Energy Grant and Sustainable Energy Authority Ireland's Home Energy Saving Scheme (HESS). The basis for same was that SERVE grantees were required to achieve a higher energy efficiency standard than HES only grantees.

The SERVE Residential Energy Efficiency Grant in Phase 1 was a pilot scheme during which 37 residential buildings were retrofitted. There were no mandatory measures which had to be implemented so the owners were able choose which specific energy efficiency or renewable energy investment they wanted to make. SERVE grants were limited to 35% of eligible costs (without VAT) which were calculated based on the buildings' heated floor area (€48 per m^2). SEAI grants were also available and all of the 37 investors applied and received the HESS grant as well. Table 3.1 shows the number and type of investments made during the Phase 1 period.

Table 4.1 Retrofitted buildings in Phase 1

Measures	Number of applicants	Total investment costs with VAT (€)	Total grants: CONCERTO + SEAI (€)	% Grant Support (CONCERTO + SEAI)
Insulation, heating controls, biomass boiler and solar	1	9,535.00	3,455.00	36%
Insulation, heating controls, windows, solar	1	15,035.00	4,040.00	27%
Insulation, heating controls, solar	1	9,008.00	1,165.00	13%
Insulation, heating controls, biomass boiler	2	10,201.00	1,973.00	19%
Insulation and windows	5	33,979.00	9,404.00	28%
Insulation and biomass boiler	1	4,720.00	1,050.00	22%
Insulation and heating controls	14	67,659.00	19,212.00	28%
Insulation	7	21,672.00	6,502.00	30%
Windows	1	2,375.00	713.00	30%
Heating controls	4	9,271.00	4,373.00	47%
Total	**37**	**183,455.00**	**51,886.00**	**28%**

Almost all (32) of the building owners went for the insulation measures while all seven buildings which were having windows replaced also invested in upgrade of attic and wall insulation. Renewable energy sources (solar and biomass boilers) were a less common investment since there was no specific RES grant scheme like in phases 2 and 3.

Phase 2 and 3 grant scheme were made up of a payment of €1,000 for 3 mandatory energy efficiency measures and additional payments for further energy efficiency measures. The payment of €1,000 was for the mandatory measures outlined in Table 4.2. The additional energy efficiency measures are detailed in Table 4.3 and at least two of these measures had to be implemented.

Table 4.2 Mandatory measures in phases 2 and 3

<table>
<tr><th>Mandatory measures</th><th>Grant (€)</th><th>Number of applicants</th></tr>
<tr><td>Attic Insulation</td><td rowspan="3">1,000</td><td rowspan="3">302</td></tr>
<tr><td>Wall insulation:
- Cavity Fill
- Internal
- External</td></tr>
<tr><td>Heating Controls (with or without boilers)</td></tr>
</table>

Table 4.3 Additional measures in phases 2 and 3

Additional Measures	Grant (€)
Windows	2,000
External Wall Insulation	4,000
Novel Low Carbon Insulation	250
Flat Roof/Room in Roof	750
Advanced Heating Controls	500
High Efficiency Boiler	300
High Efficiency Cylinder	100
Lighting	30% or up to €150

Based on the data collected until June 2012, 302 applications have been positively reviewed and received grant funding. Beside the energy efficiency measures households were allowed to file a joint application for renewable energy measures grant funding as well.

In October 2008 (Month 12) the WP3 team began discussions with Sustainable Energy Authority Ireland on how it can work with the National Greener Homes Scheme, a grant scheme for domestic renewable energy systems, to facilitate uptake of renewable energy, in particular boilers. The links between the SERVE measures and Greener Homes Scheme are outlined in the table below.

Table 4.4 Available RES grant schemes

RES Technology	Supported by SERVE	Supported by SEAI
Wood Stoves	Yes	No
Solar Panels	Yes	Yes
Biomass Boilers	Yes	Yes

The SERVE WP3 team aimed to work with SEAI to maximize the grant support levels that building owners could access in order to increase the implementation of measures. The SERVE Residential Renewable Energy Grants were available to homeowners who had an existing C1 rating on their home. Grants were available for solar panels (flat plate and evacuated tubes), wood stoves/inserts, wood heating systems and wind/PV demonstration systems.

Table 4.5 Retrofitted buildings in phases 2 and 3

Measures	Number of applicants	Total investment costs with VAT (€)	Total grants: CONCERTO + SEAI (€)	% Grant Support (CONCERTO + SEAI)
Insulation, heating investments	83	522,367	250,461	48%
Insulation, heating investments, biomass stove/boiler	54	462,473	187,010	40%
Insulation, heating investments, lighting	42	205,399	109,924	54%
Insulation, heating investments, lighting, biomass boiler/stove	18	88,722	49,046	55%
Insulation, windows, heating investments	14	208,622	62,085	30%
Insulation, windows, heating investments, biomass boiler/stove	11	150,337	56,400	38%
Insulation, heating investments, lighting, solar	9	77,375	35,502	46%
Heating investments	9	51,790	26,377	51%
Insulation, heating investments, biomass boiler/stove, solar	8	98,601	39,367	40%
Insulation, heating investments, solar	8	90,666	35,222	39%
Insulation, room in roof insulation, heating investments	5	54,107	22,000	41%
Insulation, windows, heating investments, biomass boiler/stove, solar	4	91,600	25,959	28%
Insulation, novel insulation, heating investments, lighting	3	11,755	7,384	63%
Insulation, heating investments, lighting, biomass boiler/stove, solar	3	34,903	14,042	40%
Insulation, room in roof, heating investments, biomass boiler/stove	2	22,990	8,100	35%
Insulation, novel insulation, heating investments	2	13,305	5,300	40%
Insulation, windows, biomass boiler/stove	1	13,850	4,350	31%
Insulation, windows, heating investments, lighting	1	8,955	4,237	47%
Insulation, windows, heating investments, lighting, biomass boiler/stove	1	18,483	5,377	29%
Insulation, novel insulation, heating investments, lighting, biomass boiler/stove	1	5,224	1,938	37%
Windows, heating investments, biomass boiler/stove	1	11,085	6,400	58%
Heating investments, biomass boiler/stove, solar	1	9,774	4,200	43%
Total	**281**	**2,252,385**	**960,679**	**43%**

The homeowner had to have a BER completed before and after the energy upgrades. The homeowner had to use a BER Assessor from Tipperary Energy Agency's BER Assessor Panel. These assessors had been trained and educated on the SERVE Project and were in a position to help the homeowner with any queries and advise on the options available to them. These BER Assessors also meet the National requirements in relation to standards of training, codes of conduct and quality assurance. The BER provides an indication of the energy performance of a building in kWh/m^2/year. It was based on the characteristics of the major components of the building (wall, roof and floor dimensions) as well as the construction type and levels of insulation, ventilation and air tightness features, systems for heat supply (including renewable energy), distribution and control, and the type of lighting. It covered annual energy use for space heating, water heating, ventilation, lighting and associated pumps and fans, calculated on the basis of a notional standard family with a standard pattern of occupancy. Overall grant payment was dependent on both the before and after BERs being completed. All grant payments were paid after the Post BER had been completed and were only paid if the required works had been implemented to the required standard.

4.1.2 Non-residential sector

The SERVE project also tried to provide support for the upgrading of 10,000m^2 of non-residential buildings within the SERVE region. The aim was to reduce energy consumption by at least 40% within these buildings and to bring them in line with the 2006 building regulations.

The SERVE Non Residential Grant Scheme was available to buildings that were at least 100m^2 and had an annual heating spend of at least €1,000. Grants were available for attic and wall insulation, heating controls and boiler upgrades. The energy efficiency measures that were grant aided were based on the results of an energy audit of the building carried out by Tipperary Energy Agency.

5 Economic analysis

Economic analysis is a critical component of a comprehensive project evaluation methodology that considers all key quantitative and qualitative impacts of the project. It allows stakeholders to identify, quantify, and value the economic benefits and costs of the projects over a multiyear timeframe. EU Cohesion Policy regulations require a cost-benefit analysis of all major investment projects applying for assistance from the Funds.

Economic analysis of the SERVE project will assess the following financial parameters:

- Initial investment costs for RES/RUE measures;
- Annual energy and financial savings;
- Sources of funding;
- Financial return on the investment costs;
- Sensitivity analysis.

In order to analyze the cost effectiveness of SERVE project measures a Cost-Benefit Analysis (CBA) tool will be used in the following chapter.

Additionally, economic appraisal of a RES/RUE project requires some assumption in critical parameters to be made, which can be seen in the table 5.1.

Table 5.1 General parameters

Parameters	Values
Project lifetime	20 years
Inflation rate	4.7%
Financial discount rate	6.7%

The parameter values and assumptions of any economic model need to be elaborated and backed up by concrete figures and policy recommendations. Therefore the complete explanation of all parameters is given below:

- Project lifetime: is the duration over which the financial feasibility of the project is evaluated. Depending on circumstances, it can correspond to the life expectancy of the renewable energy equipment, the term of the debt, or the duration of a power/heat purchase agreement. The project lifetime is used to calculate the yearly cash flows, the internal rate of return, the annual life cycle savings and the present values of annual costs and savings. In this analysis, a 20 year period has been chosen due to the long term nature of the investments and volatile macroeconomic circumstances.

- Inflation: projected annual average rate of inflation over the life of the project. This factor is used to calculate the yearly cash flows and the present values of annual costs and savings. According to the Ireland's Department of Public Expenditure and Reform the appropriate figure for inflation to be used in Public Sector Benchmark (PSB) modeling is 2% over the medium to longer term. This represents the Harmonized Index of Consumer Prices or HICP. During the past five year period (2007-2011) Ireland has experienced the first sustained period of deflation in over sixty years. In 2009 the CPI fell by 4.5 per cent relative to 2008 which has caused the average HICP in this period to drop below 1% (0.77%). However, energy prices show a high level of volatility and are difficult to predict even in the medium term. Since kerosene is the most common energy carrier used for heating in households in the SERVE region, its average price change during the past two years was used for estimating future energy prices. Based on the SEAI statistics the average kerosene prices increased 4.7% per year during the past two years. The initial energy savings were calculated based on the fuel prices from second quarter of 2012.

- Financial discount rate: is used in order to reduce future costs and benefits by a chosen percentage, to represent a preference rate for present gains and losses compared to those realized in the future. Therefore, the discount rate which will be used in the analysis (as a discount factor in NPV and as a target factor in IRR) must reflect the rate at which the people immediately involved or the society as a whole are willing to exchange present for future costs and benefits. The National Development Finance Agency (NDFA) of Ireland advises that for medium term (more than 5 (five) years & less than 20 (twenty) years) Design, Build & Operate projects, it is recommended that a financial discount rate of 6.70% be used for discounting project cash flows. The financial discount rates are nominal rates and are applied to nominal cash flows (i.e. including projected inflation).

5.1 Financial analysis of implemented RES/RUE measures

The criteria that were used in the evaluation, for the assessment of the impacts which can be expressed in monetary terms, are:

- The Net Present Value (NPV): defined as the sum of the discounted flows (discounted inflows minus discounted outflows for each one of the years of the evaluation period). The evaluation period for the financial evaluation is selected to be 20 years.

- The Internal Rate of Return (IRR): defined as the rate of discount for which the sum of the discounted annual cash inflows and outflows within the evaluation period will become equal, therefore representing in some respects a financial return on capital.

- The Pay-Back Period (simple and discounted): considered as the most comprehensive criterion as it defines the time period in which the monetary expressed benefits of the project will outweigh its costs (investment and operational ones).

The financial results show great variation depending on the type of implemented measures, but also, on the level of grant funding. Therefore, two versions were provided in order to determine how effective these investments are with and without the EU and State financial aid. A summarized version of all implemented measures including total and average investment costs, share of grant funding, energy and financial savings is shown in Table 5.1.1.

Table 5.2 Summarized investment results

<table>
<tr><th></th><th>Total investment costs with VAT (€)</th><th>Total grants: CONCERTO + SEAI (€)</th><th>Percentage of CONCERTO grant (%)</th><th>Energy savings (kWh per year)</th><th>Energy savings (€ per year)</th><th>Energy savings (%)</th></tr>
<tr><td>Total figures</td><td>2,435,840</td><td>1,012,565</td><td rowspan="2">55.6</td><td>2,651,883</td><td>231,250</td><td rowspan="2">42.5</td></tr>
<tr><td>Per household</td><td>7,660</td><td>3,184</td><td>8,339</td><td>727</td></tr>
</table>

The financial results of Phase 1 investments are generally better than those of Phase 2 and 3. This can be attributed to the fact that the energy savings achieved in this phase were better than those in later phases. Also, there were no mandatory measures that had to be implemented in order to receive grant funding so the households could freely choose energy efficiency measures they wanted to invest in. As shown in Figure 3.1 housing stock in the SERVE region is significantly older compared to national level and old buildings are rarely in good condition, energy efficiency wise. Therefore rather high energy savings were achieved even with only basic retrofitting measures such as installation of heating controls and wall insulation. The switch from kerosene to biomass boilers/stoves was also a very cost effective measure considering the high and unstable price of kerosene. Grant support from both SERVE and SEAI programme proved to be the key to success of the whole project by cutting investment payback periods almost in half and thus making the investments more attractive to citizens.

Complete financial results of the investments can be seen in the following tables.

Table 5.3 Financial results with grant funding – Phase 1

Measures	Number of applicants	Energy savings (kWh per year)	Energy savings (€ per year)	Energy savings (%)	Simple payback period (years)	Discounted payback period (years)	NPV (€)	IRR (%)
Insulation, heating controls, biomass boiler and solar	1	9,110	783	43.1%	8.7	12.3	4,173	11.63
Insulation, heating controls, windows, solar	1	13,676	1,176	40.1%	10.9	15.6	7,533	13.12
Insulation, heating controls, solar	1	4,293	369	22.6%	15.1	29.1	-2,026	3.66
Insulation, heating controls, biomass boiler	2	15,840	1,362	30.1%	8.7	12.5	4,115	11.53
Insulation and windows	5	34,618	2,977	22.1%	7.2	9.5	22,325	14.94
Insulation and biomass boiler	1	7,012	603	24.0%	5.5	6.8	5,830	20.07
Insulation and heating controls	14	189,687	16,313	33.1%	2.8	3.2	208,542	38.24
Insulation	7	61,787	5,314	25.2%	2.8	3.1	65,538	39.62
Windows	1	10,373	892	28.1%	1.8	2	12,391	28.1
Heating controls	4	33,302	2,864	27.1%	1.7	1.9	40,219	63.15
Total	**37**	**379,697**	**32,654**		**3.9**	**4.5**	**380,759**	**28.74**

Table 5.4 Financial results without grant funding – Phase 1

Measures	Number of applicants	Energy savings (kWh per year)	Energy savings (€ per year)	Energy savings (%)	Simple payback period (years)	Discounted payback period (years)	NPV (€)	IRR (%)
Insulation, heating controls, biomass boiler and solar	1	9,110	783	43.1%	9.8	14.9	2,807	9.66
Insulation, heating controls, windows, solar	1	13,676	1,176	40.1%	10.3	15.6	3,493	9.07
Insulation, heating controls, solar	1	4,293	369	22.6%	16.7	40.2	-3,191	2.37
Insulation, heating controls, biomass boiler	2	15,840	1,362	30.1%	10.3	15.9	2,141	8.85
Insulation and windows	5	34,618	2,977	22.1%	9.3	13.7	12,922	10.46
Insulation and biomass boiler	1	7,012	603	24.0%	6.9	9	4,780	15.76
Insulation and heating controls	14	189,687	16,313	33.1%	3.9	4.6	189,330	28.4
Insulation	7	61,787	5,314	25.2%	3.9	4.5	62,037	28.83
Windows	1	10,373	892	28.1%	2.5	2.9	11,679	42.18
Heating controls	4	33,302	2,864	27.1%	3.1	3.6	35,846	35.41
Total	**37**	**379,697**	**32,654**		**5.1**	**6.2**	**330,962**	**21.61**

Table 5.5 Financial results with grant funding – Phases 2 and 3

Measures	Number of applicants	Energy savings (kWh per year)	Energy savings (€ per year)	Energy savings (%)	Simple payback period (years)	Discounted payback period (years)	NPV (€)	IRR (%)
Insulation, heating investments	83	674,128	50,560	42.0%	5.4	6.1	524,589	22.49
Insulation, heating investments, biomass stove/boiler	54	344,231	30,783	34.7%	8.9	10.3	209,476	13.74
Insulation, heating investments, lighting	42	307,344	23,051	36.4%	4.1	4.5	267,657	28.44
Insulation, heating investments, lighting, biomass boiler/stove	18	105,789	9,980	33.0%	4.0	4.3	117,545	29.5
Insulation, windows, heating investments	14	231,221	17,342	53.8%	8.5	9.8	126,655	14.59
Insulation, windows, heating investments, biomass boiler/stove	11	141,066	11,885	48.1%	7.9	9.0	93,288	15.61
Insulation, heating investments, lighting, solar	9	69,220	10,289	33.9%	4.1	4.5	120,216	28.89
Heating investments	9	40,772	3,058	35.6%	8.3	9.7	22,760	14.84
Insulation, heating investments, biomass boiler/stove, solar	8	76,057	7,798	46.0%	7.6	8.8	63,620	16.24
Insulation, heating investments, solar	8	82,404	11,427	57.9%	4.9	5.5	124,567	24.68
Insulation, room in roof insulation, heating investments	5	33,443	2,508	35.9%	12.8	15.9	7,406	9.05
Insulation, windows, heating investments, biomass boiler/stove, solar	4	61,024	9,582	54.9%	6.9	7.8	85,312	17.95
Insulation, novel insulation, heating investments, lighting	3	9,903	743	31.7%	5.9	6.5	7,329	20.7
Insulation, heating investments, lighting, biomass boiler/stove, solar	3	29,747	3,616	39.0%	5.8	6.5	36,103	21.09
Insulation, room in roof, heating investments, biomass boiler/stove	2	16,221	1,583	36.2%	9.4	11.0	10,040	13.03
Insulation, novel insulation, heating investments	2	10,501	788	28.2%	10.2	12.0	8,005	11.97
Insulation, windows, biomass boiler/stove	1	4,571	343	24.1%	27.7	50.4	-4,099	1.24
Insulation, windows, heating investments, lighting	1	8,283	621	29.4%	7.6	8.9	5,068	16.24
Insulation, windows, heating investments, lighting, biomass boiler/stove	1	6,957	565	33.4%	23.2	35.7	-4,199	2.84
Insulation, novel insulation, heating investments, lighting, biomass boiler/stove	1	3,537	421	27.8%	7.8	8.9	3,340	15.79
Windows, heating investments, biomass boiler/stove	1	11,162	980	64.5%	4.8	5.3	10,752	25.01
Heating investments, biomass boiler/stove, solar	1	4,607	676	29.8%	8.2	9.6	5,072	14.95
Total	**281**	**2,272,186**	**198,596**		**6.5**	**7.5**	**1,836,898**	**18.86**

Table 5.6 Financial results without grant funding – Phases 2 and 3

Measures	Number of applicants	Energy savings (kWh per year)	Energy savings (€ per year)	Energy savings (%)	Simple payback period (years)	Discounted payback period (years)	NPV (€)	IRR (%)
Insulation, heating investments	83	674,128	50,560	42.0%	10.3	12.2	274,128	11.75
Insulation, heating investments, biomass stove/boiler	54	344,231	30,783	34.7%	15.0	18.9	22,466	7.22
Insulation, heating investments, lighting	42	307,344	23,051	36.4%	8.9	10.2	157,734	13.81
Insulation, heating investments, lighting, biomass boiler/stove	18	105,789	9,980	33.0%	8.9	10.1	68,500	13.84
Insulation, windows, heating investments	14	231,221	17,342	53.8%	12.0	14.6	64,569	9.8
Insulation, windows, heating investments, biomass boiler/stove	11	141,066	11,885	48.1%	12.6	15.5	36,888	9.19
Insulation, heating investments, lighting, solar	9	69,220	10,289	33.9%	7.5	8.7	84,714	16.4
Heating investments	9	40,772	3,058	35.6%	16.9	21.7	-3,617	5.93
Insulation, heating investments, biomass boiler/stove, solar	8	76,057	7,798	46.0%	12.6	15.5	24,253	9.2
Insulation, heating investments, solar	8	82,404	11,427	57.9%	7.9	9.1	89,345	15.55
Insulation, room in roof insulation, heating investments	5	33,443	2,508	35.9%	21.6	29.7	-14,594	3.52
Insulation, windows, heating investments, biomass boiler/stove, solar	4	61,024	9,582	54.9%	9.6	11.2	59,353	12.81
Insulation, novel insulation, heating investments, lighting	3	9,903	743	31.7%	15.8	20.0	-55	6.65
Insulation, heating investments, lighting, biomass boiler/stove, solar	3	29,747	3,616	39.0%	9.7	11.2	22,061	12.67
Insulation, room in roof, heating investments, biomass boiler/stove	2	16,221	1,583	36.2%	14.5	18.0	1,940	7.59
Insulation, novel insulation, heating investments	2	10,501	788	28.2%	16.9	21.9	-898	5.96
Insulation, windows, biomass boiler/stove	1	4,571	343	24.1%	40.4	65.7	-8,449	-1.87
Insulation, windows, heating investments, lighting	1	8,283	621	29.4%	14.4	17.9	831	7.68
Insulation, windows, heating investments, lighting, biomass boiler/stove	1	6,957	565	33.4%	32.7	51.2	-9,576	-0.17
Insulation, novel insulation, heating investments, lighting, biomass boiler/stove	1	3,537	421	27.8%	12.4	15.1	1,402	9.42
Windows, heating investments, biomass boiler/stove	1	11,162	980	64.5%	11.3	13.5	4,352	10.57
Heating investments, biomass boiler/stove, solar	1	4,607	676	29.8%	14.5	18.0	872	7.64
Total	**281**	**2,272,186**	**198,596**		**11.3**	**13.4**	**876,218**	**10.54**

5.2 Sensitivity analysis

Risk is an integral part of every project, therefore risk analysis helps to identify potential problems and estimate expenses to minimize the risks. There are some risks that can significantly affect the economic results of a project and these should be considered. Market fluctuations, such as demand or energy prices, dispersion of the economic assumptions initially made, technical problems and legislative changes are issues that can occur and need to be addressed if found necessary.

Sensitivity analysis is a tool used to determine the level of impact a particular variable will have on project's NPV, payback period, and IRR results if it differs from what was assumed in the initial planning phase. Sensitivity analysis was performed by varying single input parameter at a time, while keeping all other variables fixed at their typical values. The parameter that has by far the highest impact on the performance and economics of the project is the price of fuel used for heating. All other key parameters that could influence the cost effectiveness of the investments are already known and measured such as total investment costs and energy savings. Therefore the sensitivity analysis performed in this study will focus solely on oscillations of fuel price. As seen in Figure 3.4, during 2008-2009 period the price fluctuated between 0.56 €/l and 1.04 €/l which is a difference of almost 85%. Considering that these were specific macroeconomic circumstances, a price fluctuation of 50% will be used in the sensitivity analysis. The sensitivity analysis was performed on one specific package of retrofitting measures from Phase 2 and 3 which included application of building insulation and heating investments. This package was chosen considering it was the most popular type of investment: a total of 83 households or 23% have made this specific investment. Effect of fuel price change on payback period, net present value and internal rate of return can be seen in the following graphs.

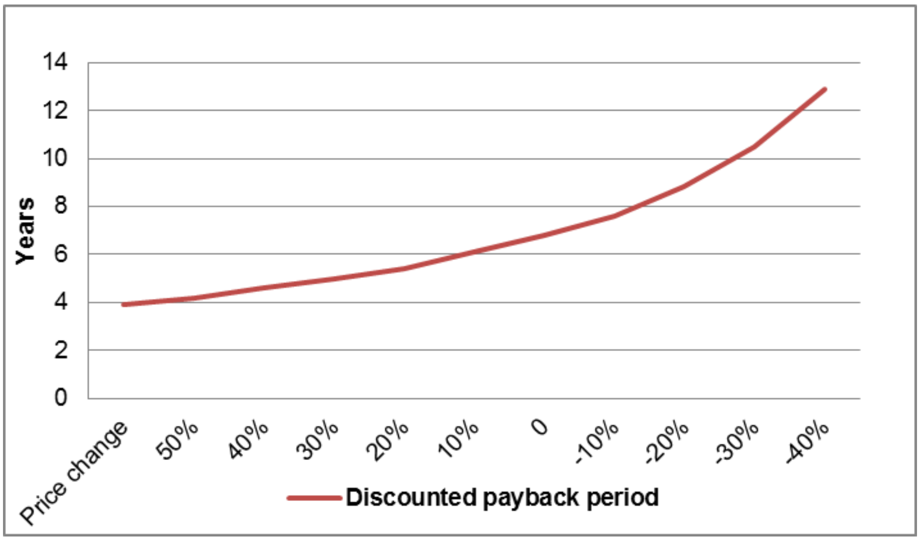

Figure 5.1 Sensitivity analysis – effect on discounted payback period

With standard fuel prices the discounted payback period of this package of retrofitting measures was 6.1 years. This very good result can be attributed to high amount of SERVE and SEAI grants which were available for this investment. Without grant funding the payback period would exceed 12 years. The change of fuel price significantly affects the cost-effectiveness of the investment, making it less viable with drop of kerosene prices. However, significant drop of fuel prices comparable to one in 2009 is considered an anomaly and unlikely to happen in the future.

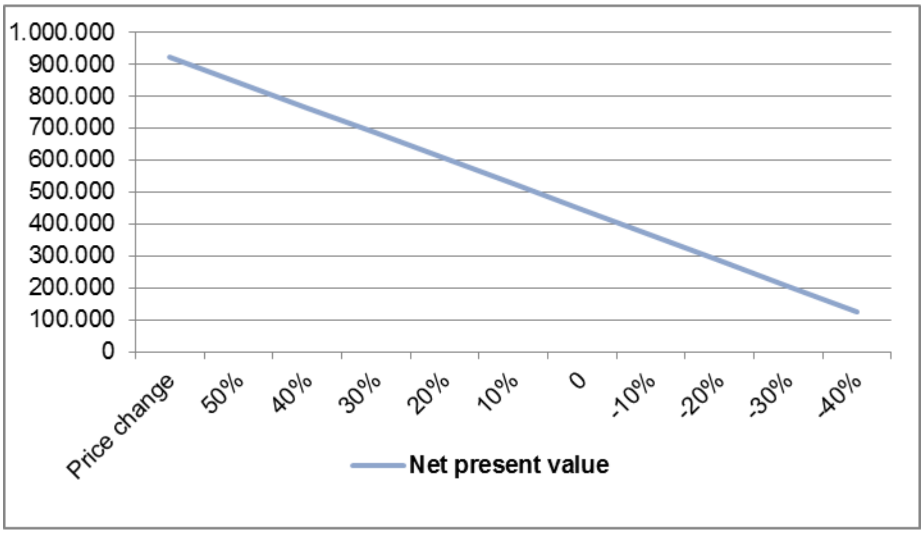

Figure 5.2 Sensitivity analysis – effect on net present value of the investment

Net present value shows moderate sensitivity to fuel price change. The project remains viable in all projections as the net present value remains positive even with the highest projected drop of prices (50%). Grant funding can be considered the difference maker in this case since projections without the grant support show negative values with fuel price decreasing more than 20%.

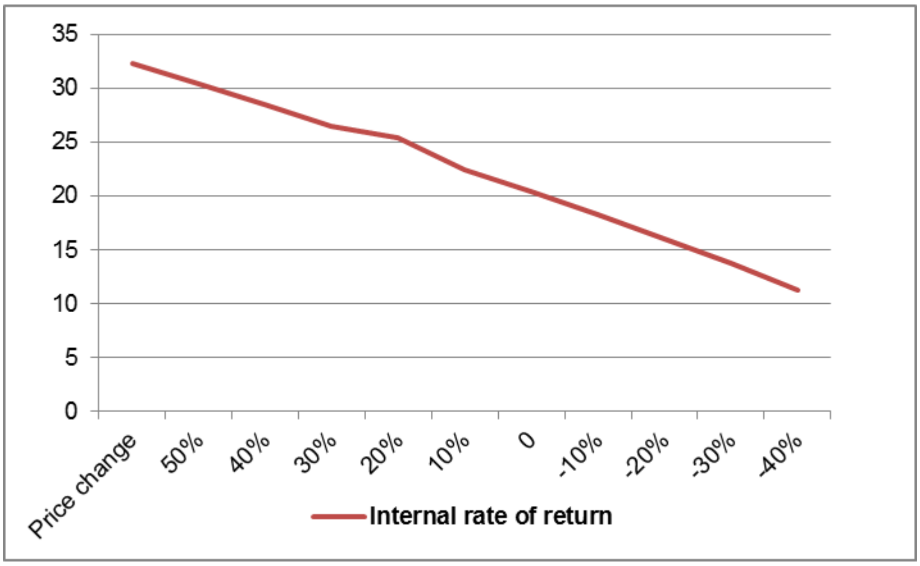

Figure 5.3 Sensitivity analysis – effect on internal rate of return

The internal rate of return with standard fuel prices was quite high and has remained high even with the fuel price decreasing by 50%. The investment is generally considered viable when the internal rate of return is higher than the used discount rate and this was the case with all fuel price changes used in this projection.

Overall, the conclusion of the sensitivity analysis performed on this specific retrofitting package of RES/RUE measures is that the investment is only moderately sensitive to fuel price changes. The high amount of grant support has helped the investment remain viable and attractive even with the highest drop of fuel prices. Realistically, the dramatic decrease of fuel prices which happened in 2009 can be seen as an anomaly and the fossil fuel prices are only expected to rise in the foreseeable future, making RES/RUE investments even more cost-effective.

6 Analysis of local money flow

The circular flow of income is a neoclassical economic model depicting how money flows through the economy. In the simplest version, the economy is modeled as consisting only of households and firms. However, actual money flows through the economy are far more complicated. Economists have expanded on the ideas of the circular flow of income model to better depict the complexity of modern economies. Therefore, the economists have expanded the initial two model economy to a five-sector circular flow model to explain the interaction between all five sectors.

Economists often portray an economy as a circular money flow, where producers pay salaries to workers who in turn use their incomes to purchase consumption goods and services from the producers. Goods are assumed to move around the circle in the opposite direction from the money flows. While the circular flow concept has been used to describe individual economies, it is equally applicable to the more complex system of the world economy.

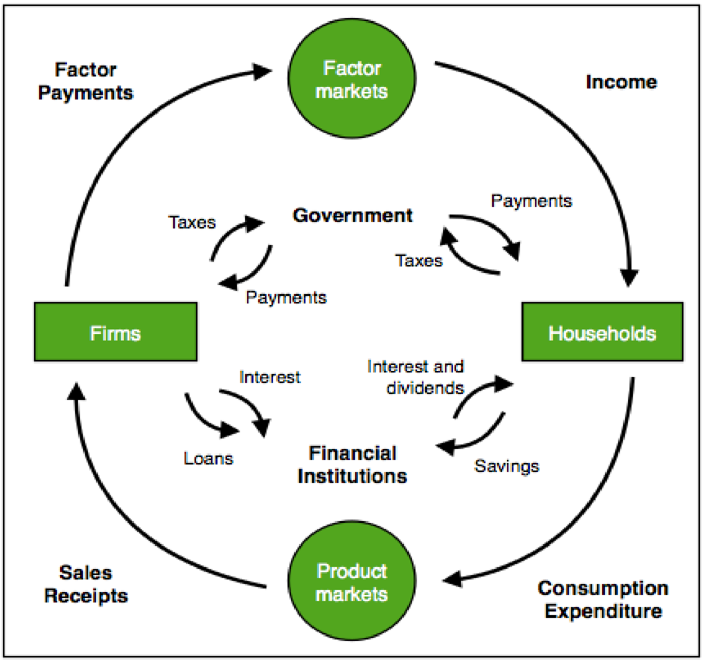

Figure 6.1 The five sector circular flow model
Source: Sciencedirect

The five-sector circular flow model describes the operation of the economy and the linkages between the main sectors in the economy. A sector may be defined as a part of the economy where the participants are engaged in a similar type of economy activity. The five sectors are the following:

1. Households - This sector consists of all individuals in the economy which are the owners of productive resources, and the consumers in the economy. Individuals supply factors of production (inputs) such as labor and enterprise to businesses, which they use to produce goods and services. As a reward for supply resources such as labor and enterprise to firms, individuals receive incomes – rent, wages, interest and profit. The households sector is the focal point of the SERVE project considering that they were the beneficiaries of the grant support as well as major investors in the retrofitting programme. In total, 318 households invested 2,435,840 Euros in energy efficiency and renewable energy measures. Of that investment, 1,010,480 Euros or 41.48% was donated by the EU and Ireland via grants from the SEAI and CONCERTO programme. Citizens were given a free choice of selecting a funding scheme to finance the investment not covered by the grant component. The results can be seen on Figure 6.2

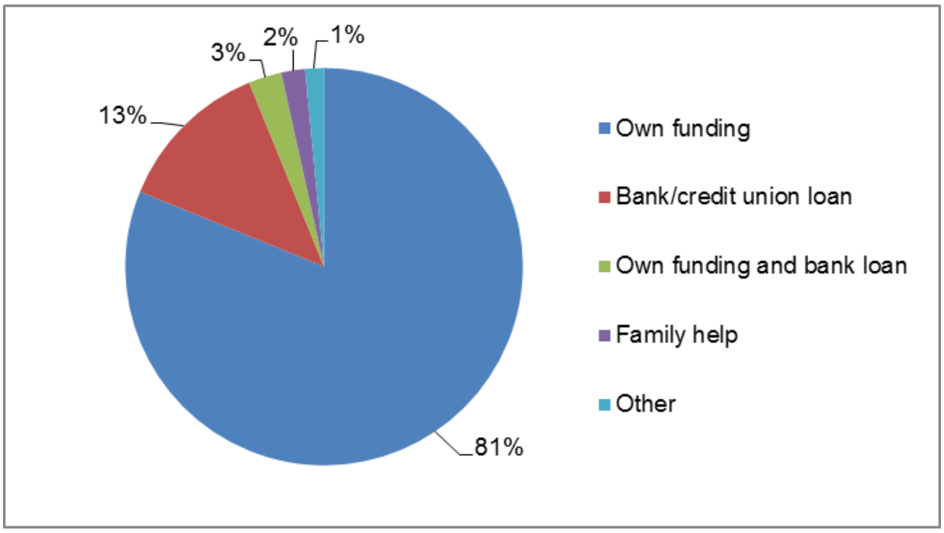

Figure 6.2 Source of non-grant investment

The results of funding scheme analysis are somewhat surprising and show that the vast majority of households have funded the investments with their own savings. The average size of retrofitting investment per household was 4,482 Euro (without grant component) which can still be considered a large investment. Only 13% of citizens have chosen bank loans as means of financing. Such low percentage for a developed financial market as Ireland's can be attributed to high interest rates that the banks charge for long term investments. However, by investing their own funds, households have kept most of the financial gains from energy savings to themselves, instead of losing them by paying high interest rates to credit institutions. With current energy prices energy savings account to 231,250 Euros per year and most of this money would otherwise leak out of the community since fossil fuels originate outside of Ireland and generate little to no local economic activity. The retrofitting activities have also unleashed the otherwise passive capital and created a whole new business cycle within the construction industry. How much these activities have actually helped the local economy can be determined by analysing the level of involvement of local companies in the retrofitting activities.

2. Businesses - This sector consists of all the business companies engaged in the production and distribution of goods and services (apart from financial services). It concerns all their activities involved with buying factors of production and using them to produce and sell goods and services. Individuals and businesses have an interdependent relationship. This is most apparent in cases where citizens which are investors in this project are also employed in one of businesses directly or indirectly related to retrofitting activities. This relation cannot be precisely determined but goes to show how interrelated these two sectors can actually be. Businesses were amongst largest recipients of the project due to their role of conducting all of the works in the project. The companies which were performing retrofitting measures have received an estimated 2.2 million Euros for their services.

It is usually mentioned that energy efficiency and renewable energy projects have a large potential to contribute to a wide variety of socioeconomic benefits by providing an opportunity to support domestic industry and create employment opportunities. As most rural regions SERVE region possesses a limited number of companies which could be an integral part of large retrofitting projects such as SERVE. Since any company outside of SERVE/Ireland would provide leakages of money, it was interesting to observe the level of involvement of local companies in the project. To get a better picture of what services were provided by local companies a breakdown by RES and RUE measures was given separately in the following charts.

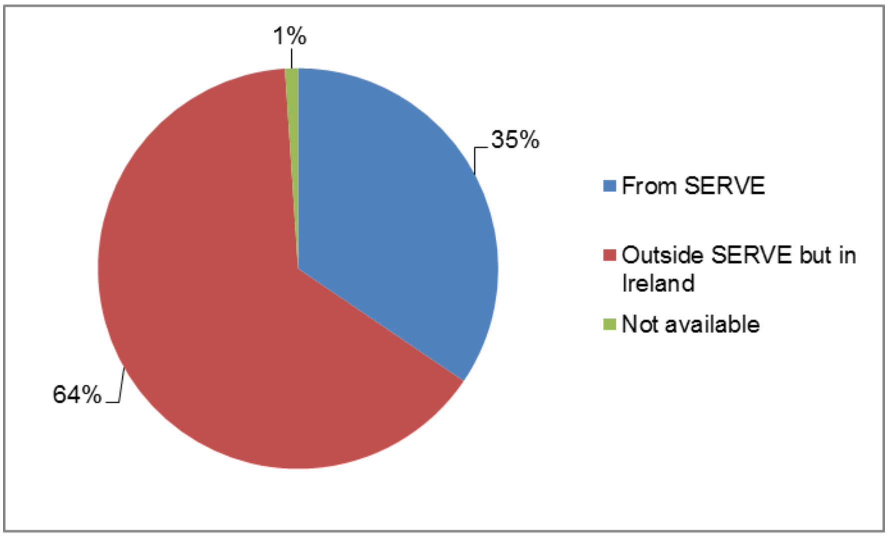

Figure 6.3 Location of companies that performed energy efficiency measures

The analysis shows that majority of companies that conducted energy efficiency works were not from the SERVE region. This was somewhat expected due to the small size of SERVE region and lack of companies offering integrated energy efficiency solutions. Homeowner's choices were further limited by the SEAI list (Register Contractor List) from which the contractors had to be chosen in order to receive grant funding. However, some specific investments had recorded above average share of local companies. Such is the case with windows (38%), heating controls (46%) and lighting (52%) installers. The more complex works like attic, wall and novel insulation were mostly performed by companies outside of the SERVE region (79%). In total, around 630,000 Euros (VAT excluded) of works were done by the local companies.

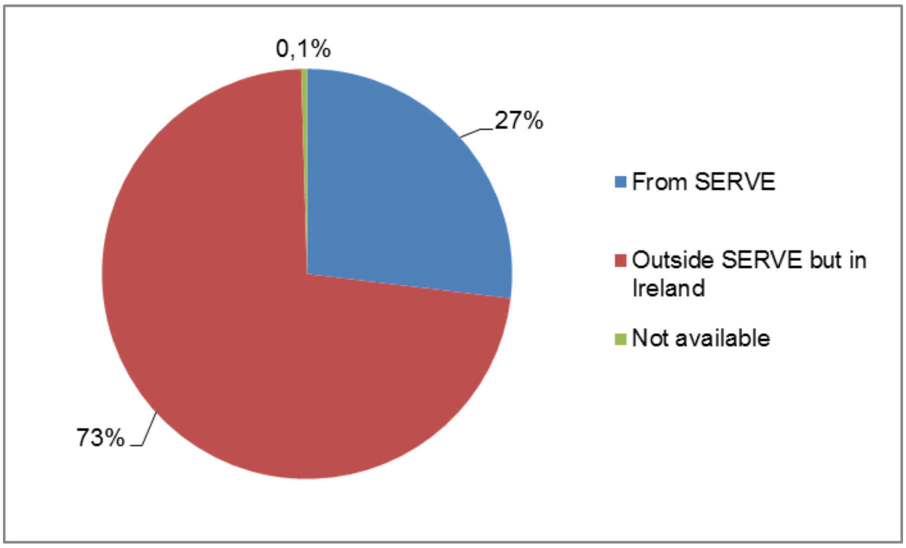

Figure 6.4 Location of companies that installed renewable energy equipment

The share of local installers of RES equipment from the SERVE region is quite smaller than the one of RUE equipment due to the complexity of works and general lack of companies which provide these services. This issue is most apparent with investments such as biomass boiler/stove installations: only 7% of total works were performed by installers from the SERVE region. In contrast, almost half (45%) of all solar system installations were done by local companies. In total, around 75,000 Euros of works were done by the companies from the SERVE region. However, to properly assess the impact made both on SERVE and Ireland's economy the origin of equipment components would have to be determined. In case that these materials and equipment were imported from outside of Ireland, there would be a significant leakage from the system.

3. Financial Institutions - This sector consists of all those institutions that are engaged in the borrowing and lending of money, acting as the intermediaries between those who save, and borrowers of money. Financial institutions are needed for individuals and firms to be able to undertake saving and investment. They perform the function of mobilizing savings for investment.

Savings are generally considered as potential leakages from the circular model but in this case, by making concrete investments they became financial injections to the system. The role of banks was minimized by the fact that most of the investments (as seen in Figure 6.2) were financed through citizen's own savings and this would actually imply that the banks were left with less money since savings were mostly kept on savings accounts and withdrawn for purposes of funding the investments. The financial institutions issued around 200,000 Euros of loans for the purpose of project while further 1.2 million Euros were invested by the citizens and most likely, withdrawn from their banking accounts.

4. Government - This sector consists of the local government, state of Ireland and the European Union. It obtains its resources through imposing taxes on the other sectors of the economy. It uses this tax revenue to undertake various government and supranational expenditures. Because payment of tax does not reduce national income, it is not a cost from the standpoint of the society as a whole. Taxes remain a part of the overall benefit stream of the project that contributes to the increase in national income.

Three main taxes in Ireland consist of: value added tax, income tax and corporate tax. All three of those taxes are revenue of the state which basically means that the increased economic activity within the region has not resulted in local government collecting more tax income. This could be seen as an issue since the taxation system can have a major influence on the fiscal outlook for local governments in areas affected by large scale development projects and thus on the welfare of area residents. Therefore, the tax effect on local community during the increased economic activities in the SERVE region can be considered as minimal. The project did however generate significant tax income for the state, mostly from the collected VAT, with almost 300,000 Euros paid for the conducted RES/RUE investments. On the other hand, the state, in conjunction with the EU provided grants which have by far exceeded the amount of taxes collected from this project. In total SERVE and SEAI initiatives have distributed around 1 million Euros of grants to households for the retrofitting measures. This huge disparity implies that the SERVE region received an injection of funding from the State and EU three times larger than the taxes which had to be paid. Retrofits generate significant operating savings that can be reinvested into the building, supporting future operations and/or capital work. These savings can also generate additional economic activity by providing an opportunity for increased spending by residents due to reduced energy expenditures. This way, a new business cycle is initiated leading to additional tax revenues and employment opportunities.

Other forms of taxes such as income and corporation tax were not measured and due to their nature mostly had little effect. Ireland's corporation tax is among the lowest in the world at 12.5% so the companies could retain most of the profits of the project to themselves. Additional state revenue from income taxes could be relevant and measured only in cases where companies had employed additional workers due to increased amount of work. However, since companies from the SERVE region had a minor level of participation, the tax effect also was minimal.

Ireland's Finance Act 2011 proposed a new scheme of tax relief for energy-efficiency works but it was decided not to proceed with this provision since the government and the EU already provided incentives for individuals in the form of grants.

5. International trade - plays an increasingly important role in shaping the performance of the national economy. The value of exports sold overseas is injected into the circular flow, while spending by Irish consumers and businesses on imported products represent a leakage from the flow. (Goods and services are coming into the economy to satisfy domestic demand, but money to pay for them is flowing out of the economy). Since all of the retrofitting works conducted in the SERVE region were performed by companies in Ireland, only two major leakages can be found: imported retrofitting equipment and fossil fuel (kerosene, gas and LPG) produced outside of Ireland. Since neither one was closely monitored it would be hard to estimate the share of local production. However, any leakage from this sector was significantly minimized by achieving large energy savings and switching to locally produced biomass fuel sources.

7 Conclusion

Energy efficiency and renewable energy projects have a potential to make positive changes in regard to sustainable development of rural territories by providing them with a wide variety of socioeconomic benefits. These benefits depend on several factors, and not only on the type of RES/RUE projects. The specific socioeconomic features of the SERVE region, including the productive structure of the area, the relationships between the stakeholders and the involvement of local actors in the project play a relevant role in this regard. The socioeconomic characteristics of the SERVE region makes them particularly suitable to benefit from RES/RUE investments, such as a relatively large share of rural, dispersed population, old housing stock, high unemployment rate and dependency on fossil fuels.

This study focuses almost solely on the financial aspects of retrofitting measures and gives a more objective perspective on the project cost-effectiveness. Key financial indicators shown in the financial analysis point to the fact that even though significant energy savings were achieved and fuel prices are among highest in Europe, a need for government and EU financial assist with RES/RUE investments still exists. This has proved to be especially beneficial during one of the toughest macroeconomic situations in Ireland's modern history. By being able to use both grant schemes (SERVE and SEAI) payback periods were cut almost in half and investments became less sensitive to potential price changes. Generally, grants and taxes can be applied in a positive sense to encourage environmental friendly and sustainable energy investments in forms of: tax exemptions, reduced level VAT, feed-in tariffs for renewable energy or tax credits. However, impact of tax policy on local economy was limited due to non-existence of local taxes which could have gained extra revenue from increased economic activity within the SERVE region.

Analysis of local money flow showed some interesting indicators regarding funding schemes and share of local companies involved in the retrofitting programme. Since grant funding significantly lowered total investment costs citizens were able to cover their share of investments from their own savings without the need to resort to financial institutions. That way they were also able to keep all the benefits of energy savings to themselves. The share of local companies performing RES/RUE investments was expectedly in minority. However, all the works were made by companies from Ireland so the impact on wider region can still be viewed as considerable. A long term effect on manufacturers and installers of RES/RUE equipment should not be underestimated since creating a demand for energy-efficient buildings can stimulate the emergence of local companies and rural economies.

SERVE project has also contributed to national and EU goals of environmental protection by reducing the overall emission of greenhouse gases and increasing the level of regional energy independence. As this study shows, sustainable energy projects can also be seen as an instrument for initiating economic activities, increasing the use of local fuel resources but also a way to fight fuel poverty by lowering energy expenses and securing stable fuel prices. Moreover, retrofits also help improve the health, safety and comfort of building residents, including improved indoor environmental quality and better tenant mental and physical health outcomes.

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