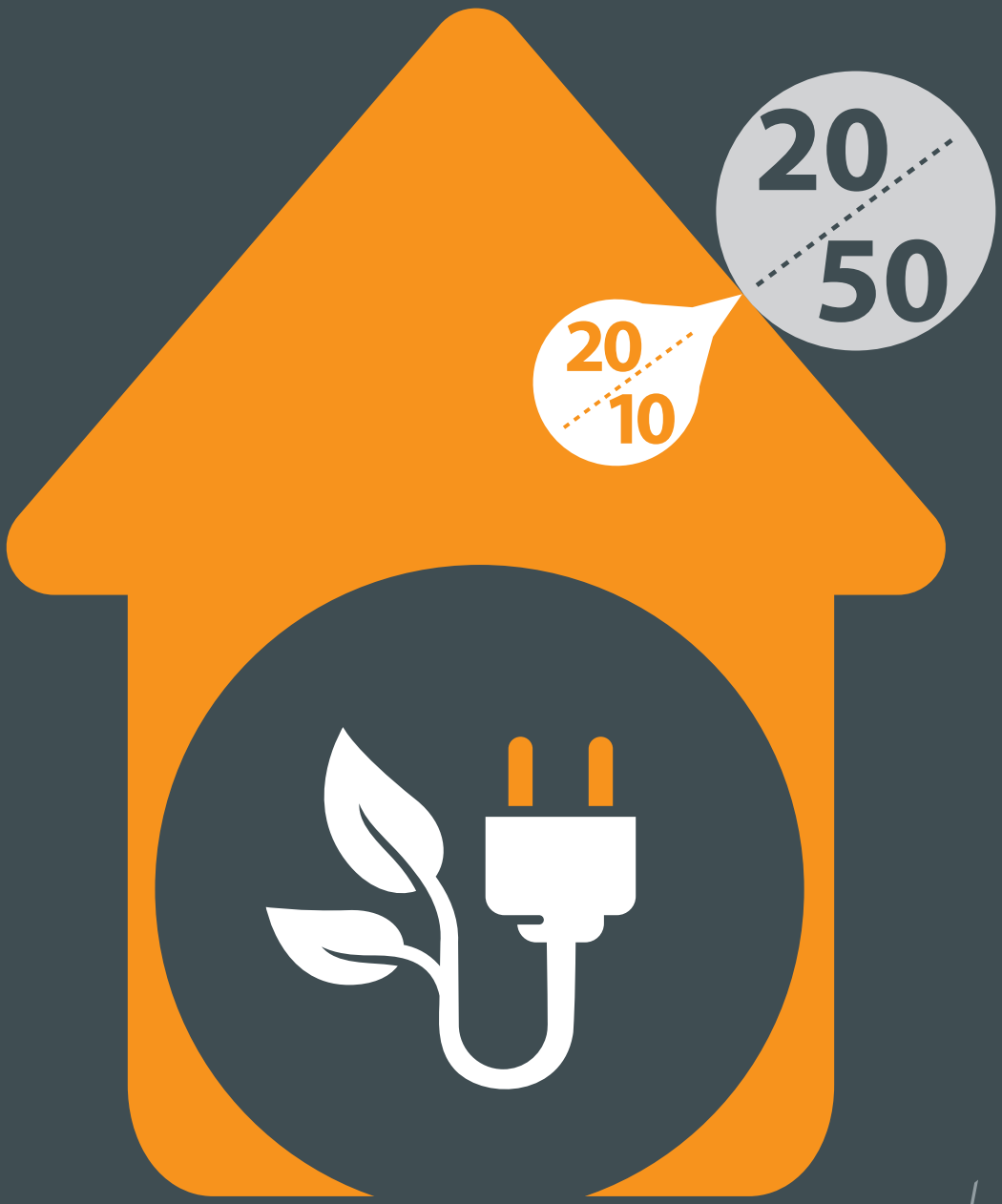
seai SUSTAINABLE ENERGY AUTHORITY OF IRELAND

RESIDENTIAL ENERGY
Roadmap



Introduction to the residential roadmap to 2050

Our homes account for more than a quarter of Irish energy-related carbon emissions. How we use energy in our dwelling is for most of us the most tangible and direct impact we have on Ireland's greenhouse gas emissions.

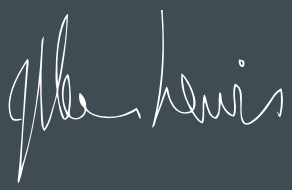
Over recent years, there have been competing pressures on the trends of energy use in homes. We have built many more homes, but these new homes are much more efficient than older ones. A house built today uses one third the heating energy compared with the average existing home, but at the same time average home size is rising. Our appliances and lights are becoming much more efficient, but we have many more devices in use. During the next decades we must seek to significantly reduce the energy demand of the existing stock and continue to push the envelope towards cutting edge building standards for new homes.

Given the poor energy performance of existing buildings, compared to that of new builds, I believe it is particularly important to look at improving the existing building stock, and such retrofitting will soon become a major component of our construction sector. Retrofitting buildings to high energy standards offers the cheapest, most readily available source of carbon and energy savings in Ireland. In fact, the upgrades can quickly pay for themselves in energy cost reductions. The reduction in energy demand that is possible will reduce our dependence on imported fuels, reduce everyone's energy costs, and deliver major reductions in Ireland's emissions. All while supporting employment.

There is already considerable activity in retrofitting homes, stimulated by Government's grant schemes, but this is merely the tip of the iceberg. We need to reach many more homes, and somehow encourage deep, future-proof upgrades.

Much can change between now and 2050, but most homes in Ireland today will still be standing and occupied in 2050. So decisions we make now have long term impacts. Hence the long-term perspective of this Roadmap. We are attempting to assess the potential CO_2 abatement opportunities within the residential sector, determine appropriate technology mixes and interrogate the impact of all of this in economic terms. To do this, we make a number of working assumptions. These are not predictions of the future nor statements of policy, but rather they represent an attempt to illustrate certain possible scenarios for our energy use in homes in 2050. These scenarios allow us to explore the key issues and should inform action and policy now.

The analysis in this Roadmap uses in-depth modelling of the Irish residential stock based on SEAI data built up over many years. This gives us the opportunity to examine the energy issues in considerable detail. But it is no more than a starting point. My hope is that this publication will stimulate a wide debate about energy in homes, what we want to achieve and how we achieve it. This Roadmap is just the beginning. We intend to engage in further debate and discussion, and I would welcome all views submitted to us at roadmaps@seai.ie



Prof. J Owen Lewis
Chief Executive Officer, SEAI

Roadmap Methodology

This roadmap sets out a number of possible trajectories for energy consumption and CO_2 emissions for Ireland's existing and future housing stock.

Energy use in the Irish housing stock is modelled between now and 2050. Developments in building fabric standards, retrofitting of existing homes, energy use in water heating, appliances and lighting are all considered. The Roadmap sets out scenarios that show what level of carbon reductions are possible through greater efficiencies and penetration of renewable energy technologies.

EXPLANATION OF THE SCENARIOS

- The "Baseline measures" trajectory reflects the expected impact of current national and EU regulations to improve the efficiency of lighting by phasing out inefficient incandescent light bulbs, as well as minimum efficiency standards (86%) for boilers being replaced in the existing housing stock. All new homes in this scenario are built to the 2008 Building Regulations and the carbon intensity of electricity reduces to 200gCO_2 per kWh by 2050 from current levels of 580 gCO_2 per kWh.
- The "Improved Building Regulations" trends include the expected impact of revised building regulations in 2010 and 2013 requiring increasing standards of energy efficiency and increased renewable energy technology deployment in new dwellings. The carbon intensity of the grid gradually declines to near 0g CO_2 per kWh by 2050.
- In the 'Low scenario', 1 million existing homes are retrofitted with a basic package of energy efficiency measures by 2020; technologies include attic and cavity wall insulation, basic air sealing and heating system controls. There is a slow uptake of renewable energy technologies.
- The 'Medium scenario' is the same as the Low scenario, except that all existing dwellings receive a further deeper package of energy efficiency retrofit measures between 2020 and 2050; technologies include internal and external wall insulation, high efficiency windows and ventilation measures with heat recovery.
- In the High scenarios; High E (electrification) and High F (fuel); 1 million homes receive both the basic and deeper retrofit measures by 2020.
- In the High E scenario, the uptake of electrically powered renewable technologies accelerate rapidly after 2020, so that by 2050 more than 95% of existing dwellings have received some form of electric renewable energy technology or are directly heated with electricity. Solutions include solar thermal and solar PV, electric storage heating and ground and air source heat pumps.
- In the High F scenario, the uptake of non-electrically powered renewable technologies accelerate rapidly after 2020, so that by 2050 more than 95% of existing dwellings have received some form of chemically fuelled renewable energy technology. Solutions include micro and community scale CHP (including biomass) and biomass boilers.

Key Findings

There remains significant potential to retrofit homes in Ireland with basic energy efficiency measures which are generally low cost with a short payback period.

Residential CO_2 emissions can be reduced by 90% through a sustained programme of dwelling retrofits and regulation improvements

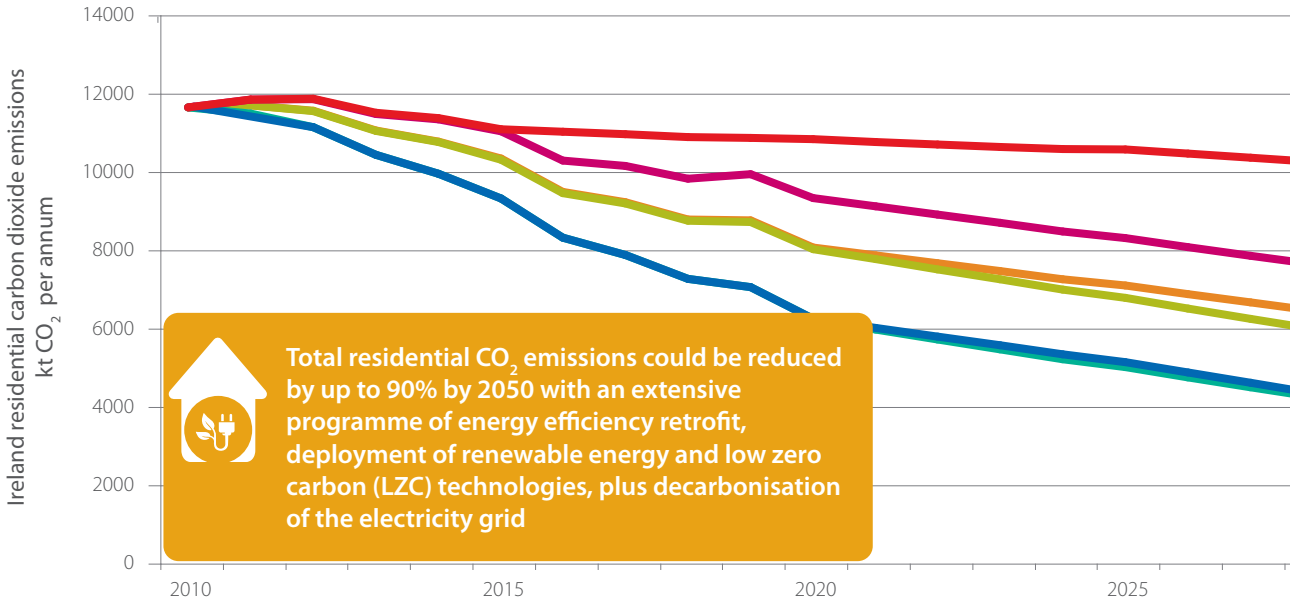
Delivery of a deep level of retrofit measures to 2020 will support up to 10,000 installer jobs in Ireland

- The deepest decarbonisation of Ireland's residential sector (circa. 90% of current levels by 2050) could be achieved with very high levels of energy efficiency retro-fit, deployment of renewable energy technologies and low and zero carbon (LZC) technologies, high levels of electrification and decarbonisation of the grid.
- Given their cost-effectiveness, the widespread deployment of energy efficiency technologies should occur as a matter of priority.
- Large scale roll-out of LZC technologies will enable a shift from fossil based energy sources to a sector based largely on renewable energy sources and highly efficient micro-generation technologies.
- Delivery of a deep level of retrofit measures to 2020 will increase the number of installer jobs in Ireland to as many as 10000 per annum. Ongoing energy efficiency improvements and broad scale roll-out of LZC technologies to 2050 could sustain high levels of employment over the period.
- Continual revision to building regulations will have a significant influence in reducing average energy demand out to 2050.
- Significant investment will be required to realise the full potential available, however over the lifetime of technologies installed, substantial net financial benefits flowing from energy savings can be realised.
- Beyond energy savings, improvements made will make Ireland's building stock warmer, more comfortable and provide a healthier environment for many citizens.
- Actions that reduce Ireland's reliance on imported fossil fuels will have significant security of supply benefits and help to insulate the economy from the negative effects of fossil fuel price volatility.

Total residential CO_2 emissions

2010 — 2020

2010 : 1.6 million occupied homes
2020 : 1.8 million occupied homes
2050 : 2.8 million occupied homes



Total residential CO_2 emissions could be reduced by up to 90% by 2050 with an extensive programme of energy efficiency retrofit, deployment of renewable energy and low zero carbon (LZC) technologies, plus decarbonisation of the electricity grid

POLICY & MEASURES

- One million homes retrofitted via the National Retrofit Programme
- Additional schemes to promote further retrofitting (2020-2030) and
- Improvements to building regulations to limit energy consumption in new dwellings to realize the potential of zero carbon and net energy positive homes
- Development of incentive schemes to increase uptake of energy efficiency measures & LZC technologies via national retrofit program
- Further analysis of housing stock to determine technical potential and sector potential
- Further technical analysis of energy efficiency measures and retrofit packages
- Analysis of the current planning regime for potential to asses maximum potential to support LZCs
- Continued monitoring, re-assessment, and reporting of programmes
- Development of planning system to ensure that LZCs are supported through the planning system to maximise
- Long term support of electricity generating LZCs through net metering

TECHNOLOGY

- Development of construction and design techniques for achieving future building regulations for new and existing buildings
- Continued research and development of renewable CHP technologies including biomass CHP and digestion technologies
- Research into biogas generation technologies and the potential for injection into the natural gas network
- Support R&D to bring about a step change in product costs, performance, and installation time
- Assessment of potential for new businesses in Ireland developing LZC technologies

KNOWLEDGE & SKILLS

- Use existing skills and increase capacity to enable widespread deployment of energy efficiency upgrades
- Development of training schemes and installation standards for installers, and assessors of energy efficiency and LZC measures
- Marketing and education of the long term vision to residents by suppliers and new schemes
- Promote further education and jobs in the energy sector

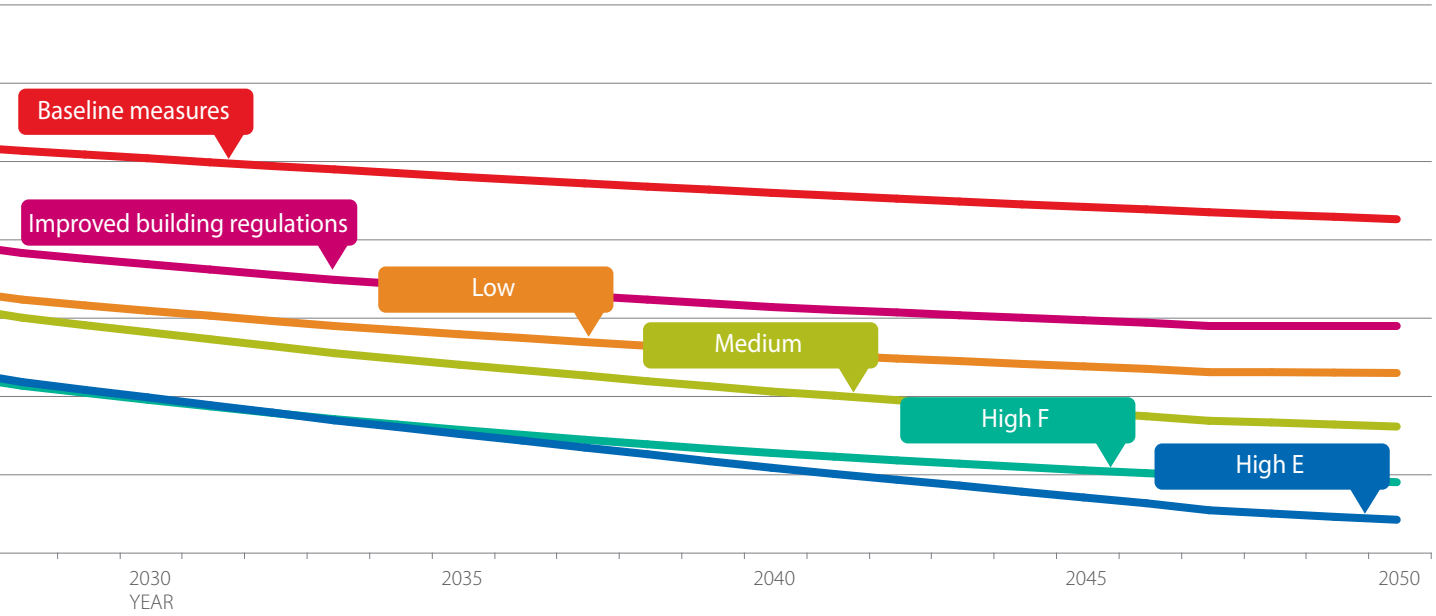
Glossary

LZC	Low and Zero carbon
ktoe	Kilotonnes of oil equivalent
kt CO_2	Kilotonnes of carbon dioxide
g CO_2	Grams of carbon dioxide
kWh	KiloWatt - hour

KEY

Government & governing bodies — Industry — Power systems & regulators

2030 2040 2050

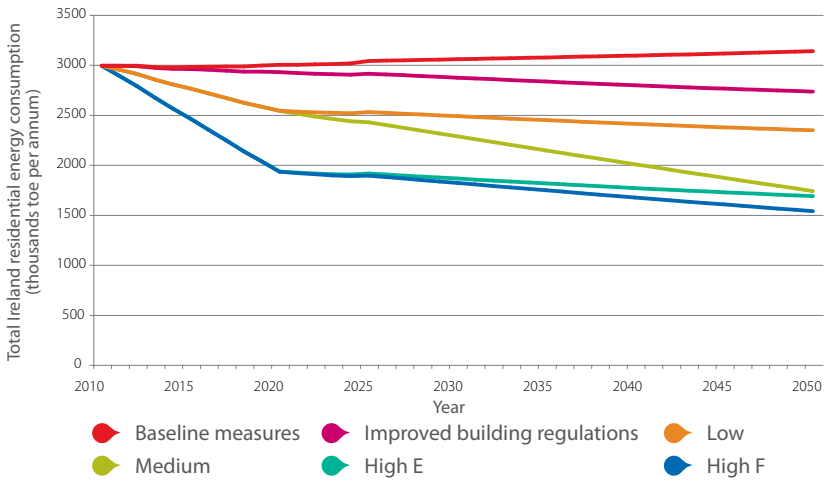


installation of low and zero carbon (LZC) technologies

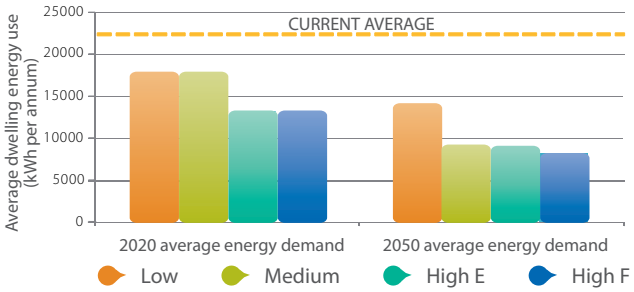
potential. Includes ongoing monitoring and assessment

Total energy demand for the residential sector could be reduced by as much as 50% by 2050. This would require comprehensive retrofit for energy efficiency improvements; together with the construction of new low and net zero energy dwellings post 2020. Net Positive Energy (NPE) homes that result in excess net annual energy returned to the grid (via renewable generated electricity on site) are already under development in some countries and their potential should be considered in the Irish context.

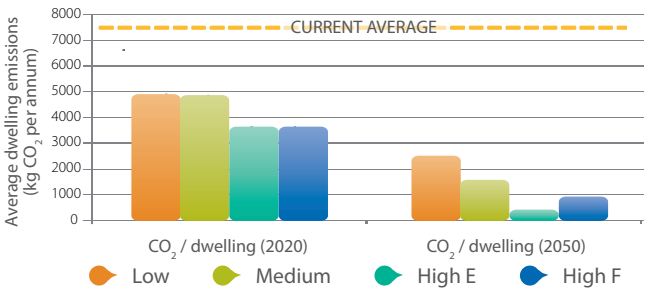
Total Ireland residential energy demand by scenario



Energy use per existing dwelling

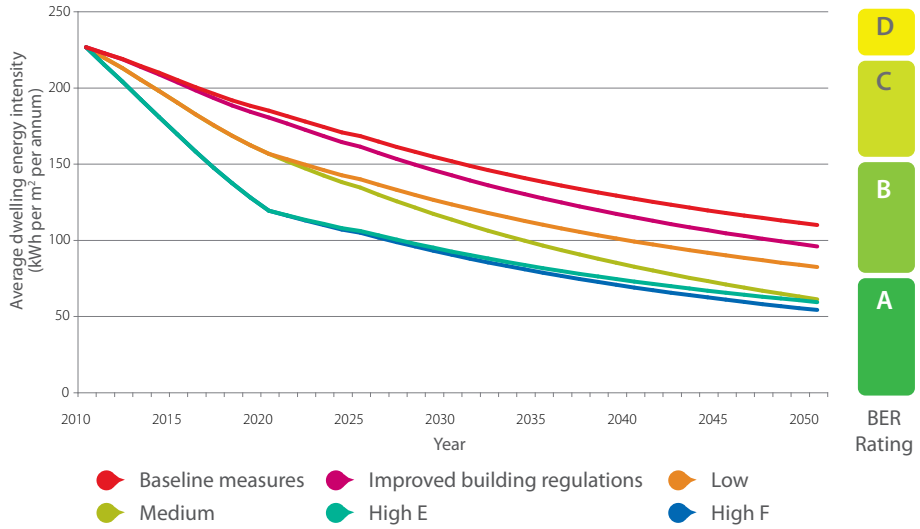


CO_2 emissions per existing dwelling



In 2010, the average existing dwelling uses around 22,500 kWh and emits around 7.5 tonnes CO_2.
By 2050, the average energy demand per dwelling could be reduced by 60% to 65% (to 8000 - 9000 kWh) due to energy efficiency improvements for space and water heating, reductions in lighting and appliance electricity consumption and the application of LZC technologies.
The impact on average dwelling CO_2 is greater, due to both the decarbonisation of the electricity grid and a switch to cleaner fuels.

Average dwelling energy intensity

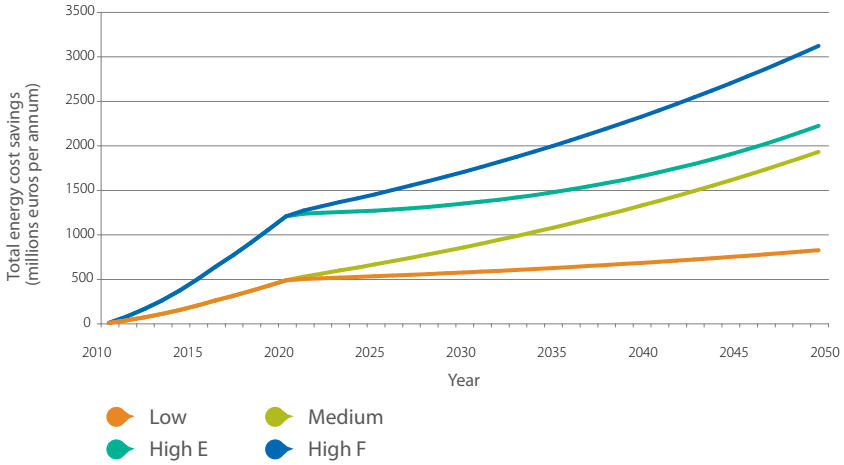


The current average energy intensity per dwelling is approximately equivalent to a D rating on the Building Energy Rating (BER) scale. The stock average could be shifted to within the A band with broad scale roll out of renewable energy and LZC technologies, deep energy efficiency upgrades to existing dwellings and future improvements to building regulations.

Installation and operation jobs in Ireland by scenario

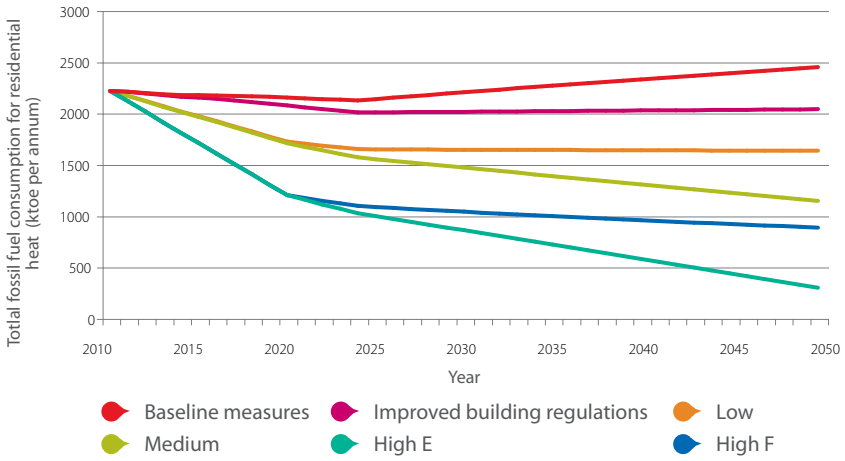
Scenario	Short term (up to 2020)	Long term (2020 – 2050)
Low	Around 5000 additional installers required to install basic energy efficiency measures in 1 million homes by 2020.	New jobs will be created in the expanding low carbon economy, including the construction of high efficiency homes and non-domestic buildings required under new regulations.
Med	Around 5000 additional installers required to install basic energy efficiency measures in 1 million homes by 2020.	Some installers continue to install advanced energy efficiency measures whilst others support other areas of the low carbon economy such as renewable energy technology deployment.
High E	Up to 10,000 new jobs created for the installation of advanced energy efficiency and electrification measures prior to 2020.	Partial transfer of jobs to the installation and maintenance of LZC technologies. Significant expansion and modification of the electricity grid and an increase in generation capacity providing many new jobs in the renewable energy sector.
High F	Up to 10,000 new jobs created for the installation of advanced energy efficiency measures prior to 2020.	Partial transfer of jobs to the installation and maintenance of LZC technologies. New businesses and supply chains developed in the construction sector for decentralised energy infrastructure and fuel supply chains such as biomass.

Annual energy cost savings



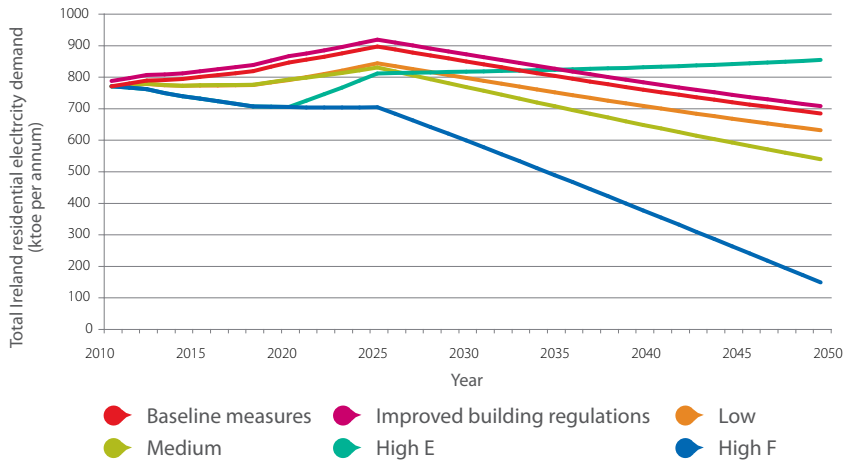
Ireland's residential energy bill could be reduced by between €500 million and €1.2 billion per annum depending on the scenario followed. This potential increases to between €2.2 billion to over €3 billion by 2050 from a combination of energy efficiency and LZC deployment.

Total fossil fuel consumption for residential heat in Ireland



Currently, space and water heating demand represents three quarters of overall residential energy demand and is highly dependent on imported fossil fuels. Total current demand could be reduced by as much as 60% for the High F and over 85% for the High E scenario.

Total Ireland residential net electricity demand



The level of residential electricity demand on the grid could vary radically depending on the technology path chosen post 2020. Under the High E scenario, electricity demand from the grid would increase due to increased electrification of the sector, whilst under the High F scenario, net demand from the grid falls due to decentralised generation of electricity. Ongoing grid development will be required in both scenarios to deal with potential intermittency and distributed generation.

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Ireland's EU Structural Funds Programmes 2007 - 2013
Co-funded by the Irish Government and the European Union

EUROPEAN UNION STRUCTURAL FUNDS

The Sustainable Energy Authority of Ireland is financed by Ireland's EU Structural Funds Programme co-funded by the Irish Government and the European Union.

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