IRISH ACADEMY OF ENGINEERING

Energy Policy and Economic Recovery 2010 – 2015

Technical Annex

February 2011

Annexes

Annex 1

Price Comparisons

1.1 Introduction

Electricity price comparisons for the EU 27 countries are produced twice per year by Eurostat. Price comparisons for the first semester of 2010 were published in November 2010.

Statisticians advise that the first question to be asked in any statistical enquiry is "what is the purpose of this analysis?" The purpose of the Irish Academy of Engineering (IAE) is to compare the overall efficiencies of the electricity industries of EU countries using price as a metric.

This leads to some specific methodological assumptions described below.

1.2 Taxes

Many EU countries apply non-refundable taxes to electricity (VAT is a refundable tax for industry). The IAE believes that such taxes say nothing about the underlying efficiency of the industries in question and in fact distort comparisons.

If the German government, for example, taxes electricity (as it does) and the Irish government doesn't (it doesn't), this makes Irish electricity production appear relatively more efficient when in fact it plainly is not.

The IAE price comparisons therefore exclude all taxes.

1.3 Affordability

Analyses of domestic (or household) electricity prices often focus on affordability. This means that the analysis adjusts the basic prices depending on the incomes of the purchasers. This type of analysis applies what economists refer to as a Purchasing Power Parity (PPP) correction. Again this says absolutely nothing about the underlying industry efficiency.

Because Irish average incomes are high by EU standards this type of correction makes the Irish electricity industry look more efficient than it actually is.

The IAE does not apply PPP corrections in its comparisons.

1.4 Consumption bands

Electricity prices vary depending on consumption. Large consumers for various reasons will benefit from lower prices. It is important therefore to compare like with like and to understand the type of consumer in each band.

Domestic consumers are classified as follows by Eurostat:

Band	Consumption	Typical consumer	Proportion of total national consumption[1]
DA	<1000kWh	Holiday home	0.9%
DB	1,000kWhr – 2,500kWh	Small house	6.8%
DC	2,500kWhr – 5,000kWh	Medium house	30.1%
DD	5000kWhr - 15,000kWh	Large Premises	53.6%
DE	>15,000kWh	Extra-large Premises	8.7%

Industrial consumers are classified as follows:

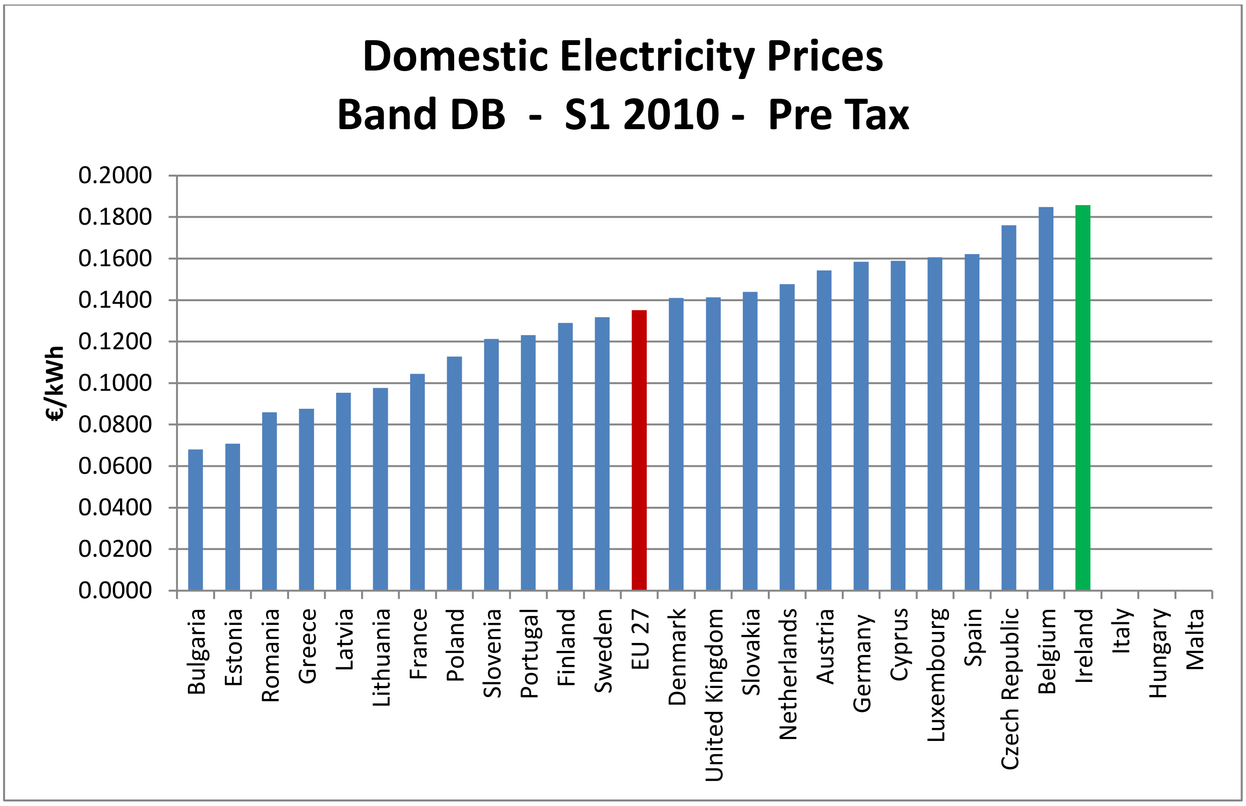
Band	Consumption	Typical consumer	Proportion of total national consumption
IA	<20MWh	Small Industry	5.8%
IB	20MWhr – 500MWh	Small - Medium Industry	28.2%
IC	500MWhr – 2,000MWh	Medium Industry	15.9%
ID	2,000MWhr – 20,000MWh	Medium – Large Industry	30.4%
IE	20,000MWhr – 70,000MWh	Large Industry	12.6%

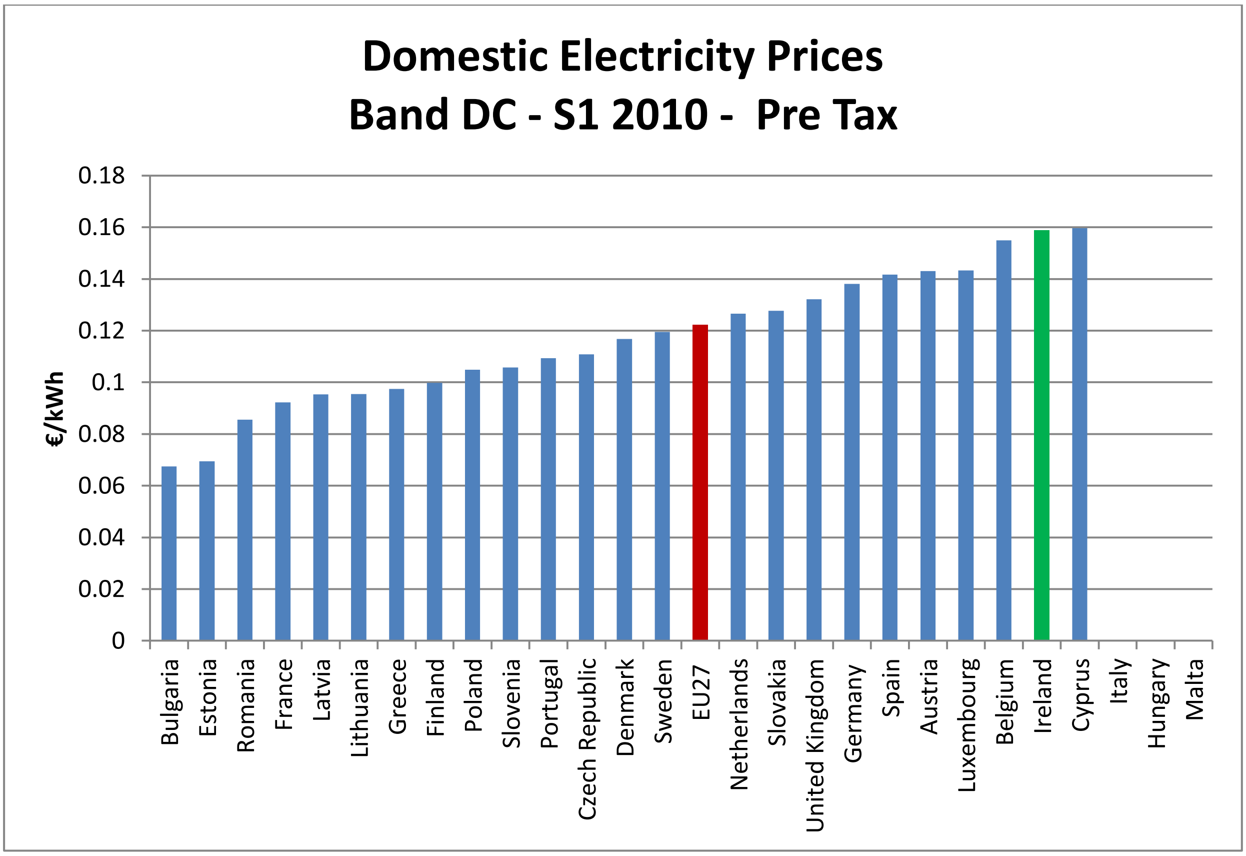
The charts setting out Ireland's position against its EU competitors are shown in 1.5 below. These show the position of Ireland in the eight most important bands as classified above. The premiums paid by Irish consumers (pre-tax and no PPP correction) are shown in the following table:

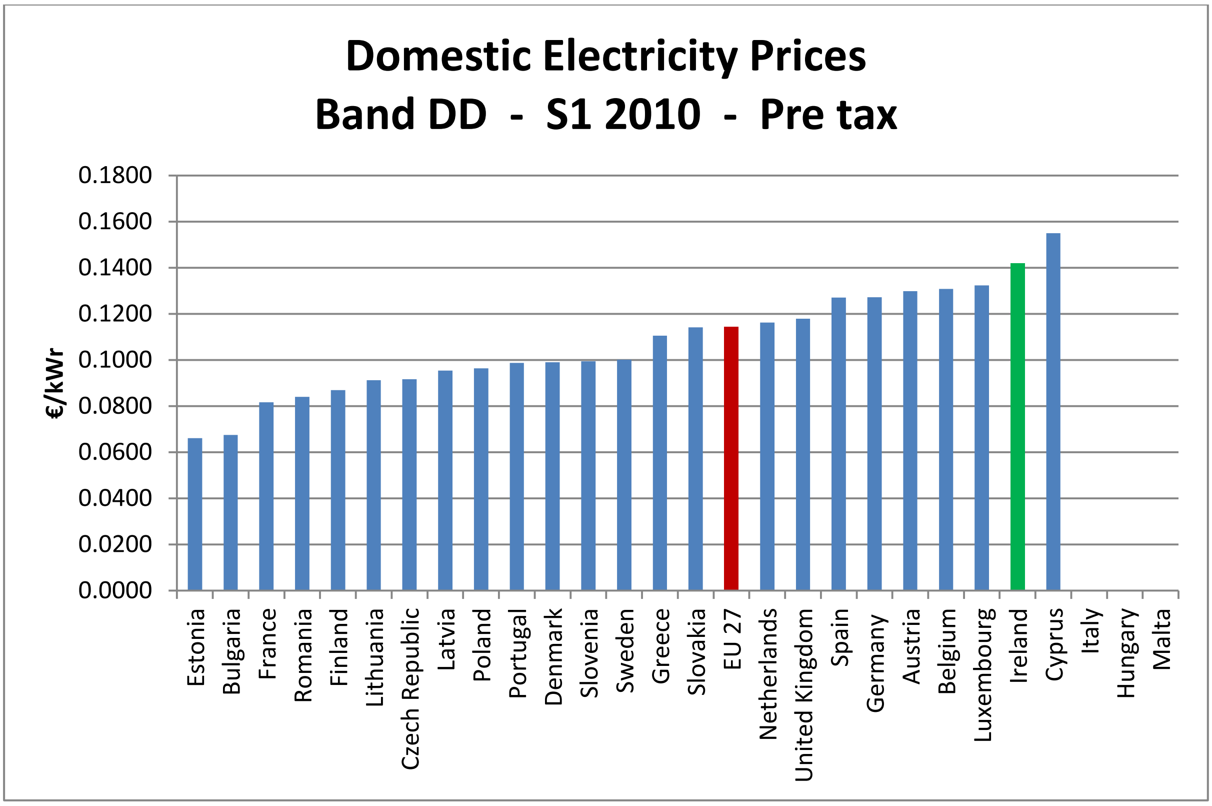
Domestic			Industrial	
Band	Premium[2]		Band	Premium
DB	37%		IA	10%
DC	30%		IB	26%
DD	24%		IC	22%
DE	11%		ID	3%
			IE	1%

[1] http://www.seai.ie/Publications/Statistics_Publications/EPSSU_Publications/Electricity_and_Gas_Prices/Electricity_and_Gas_Prices_in_Ireland_january_to_june.pdf
[2] This is the percentage over EU average paid by Irish electricity consumers.

1.5 Price Charts






Domestic Electricity Prices
Band DD - S1 2010 - Pre tax
€/kWr
0.1800
0.1600
0.1400
0.1200
0.1000
0.0800
0.0600
0.0400
0.0200
0.0000
Estonia
Bulgaria
France
Romania
Finland
Lithuania
Czech Republic
Latvia
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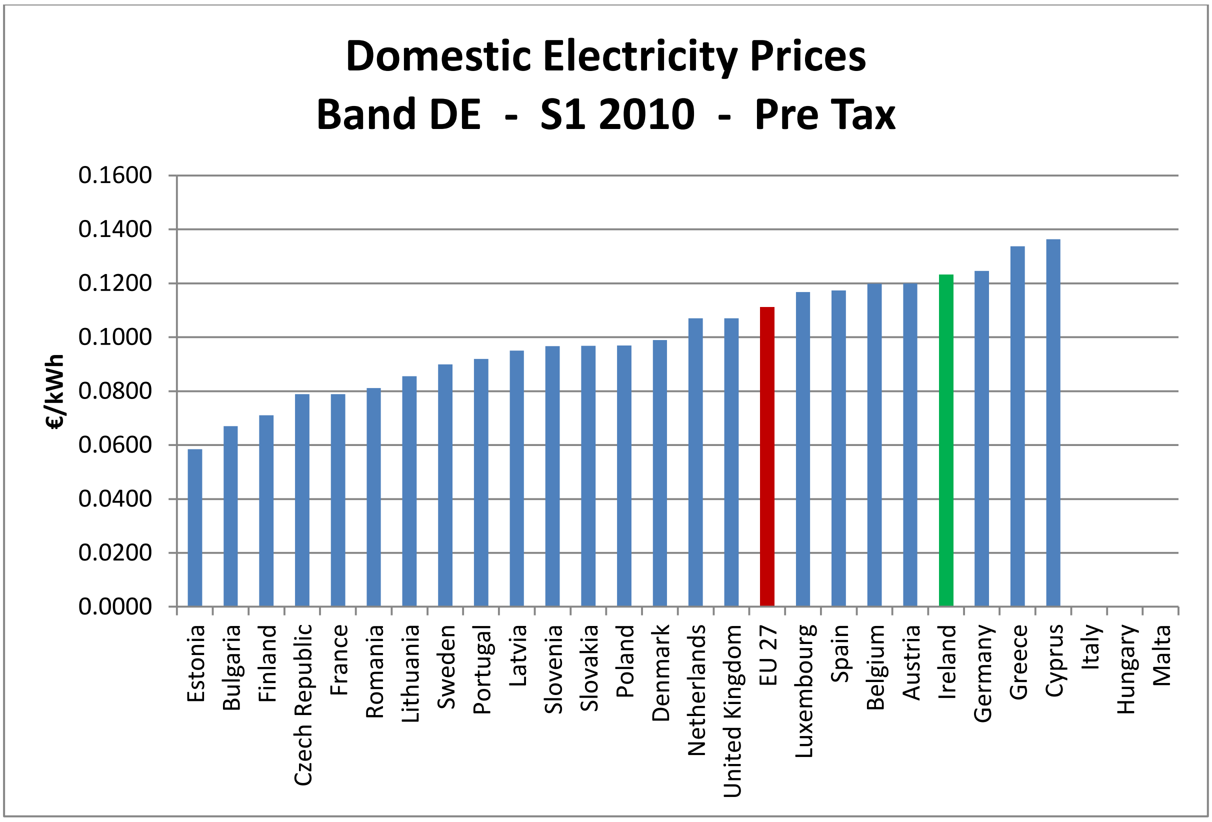
Domestic Electricity Prices
Band DE - S1 2010 - Pre Tax
€/kWh
0.1600
0.1400
0.1200
0.1000
0.0800
0.0600
0.0400
0.0200
0.0000
Estonia
Bulgaria
Finland
Czech Republic
France
Romania
Lithuania
Sweden
Portugal
Latvia
Slovenia
Slovakia
Poland
Denmark
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United Kingdom
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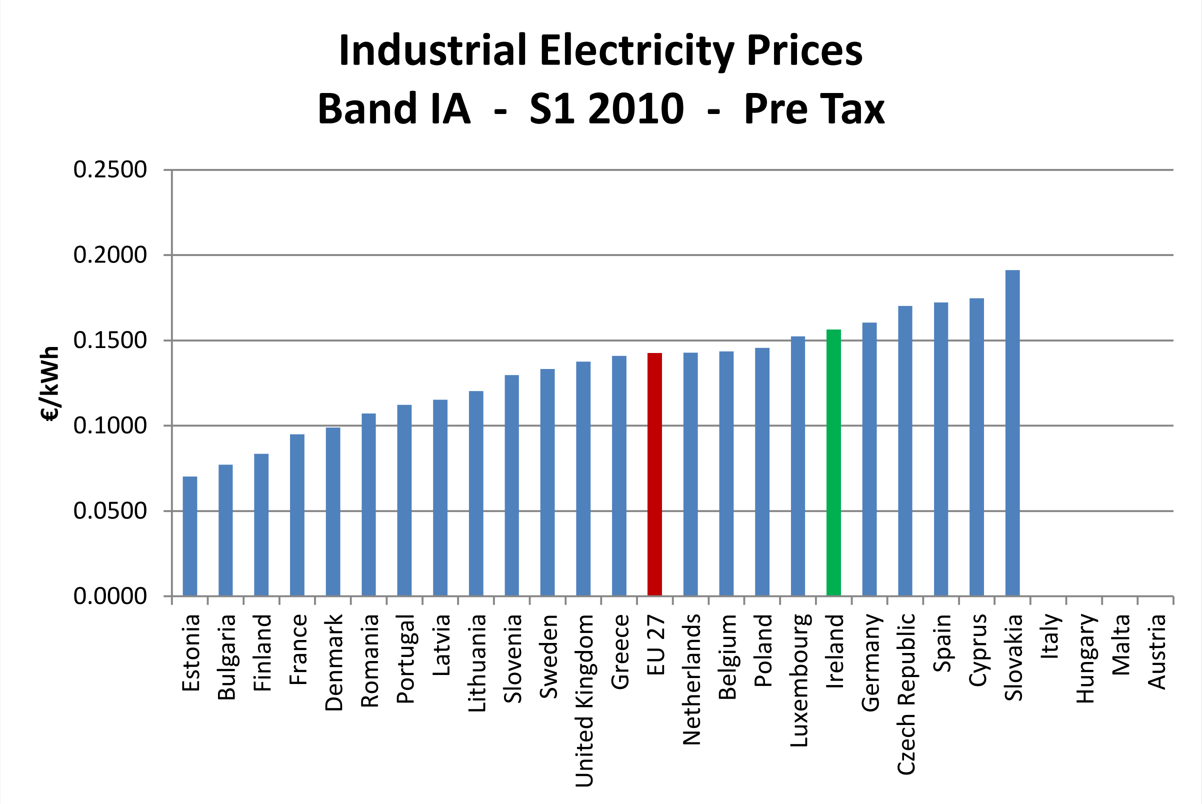
Industrial Electricity Prices
Band IA - S1 2010 - Pre Tax
€/kWh
0.2500
0.2000
0.1500
0.1000
0.0500
0.0000
Estonia
Bulgaria
Finland
France
Denmark
Romania
Portugal
Latvia
Lithuania
Slovenia
Sweden
United Kingdom
Greece
EU 27
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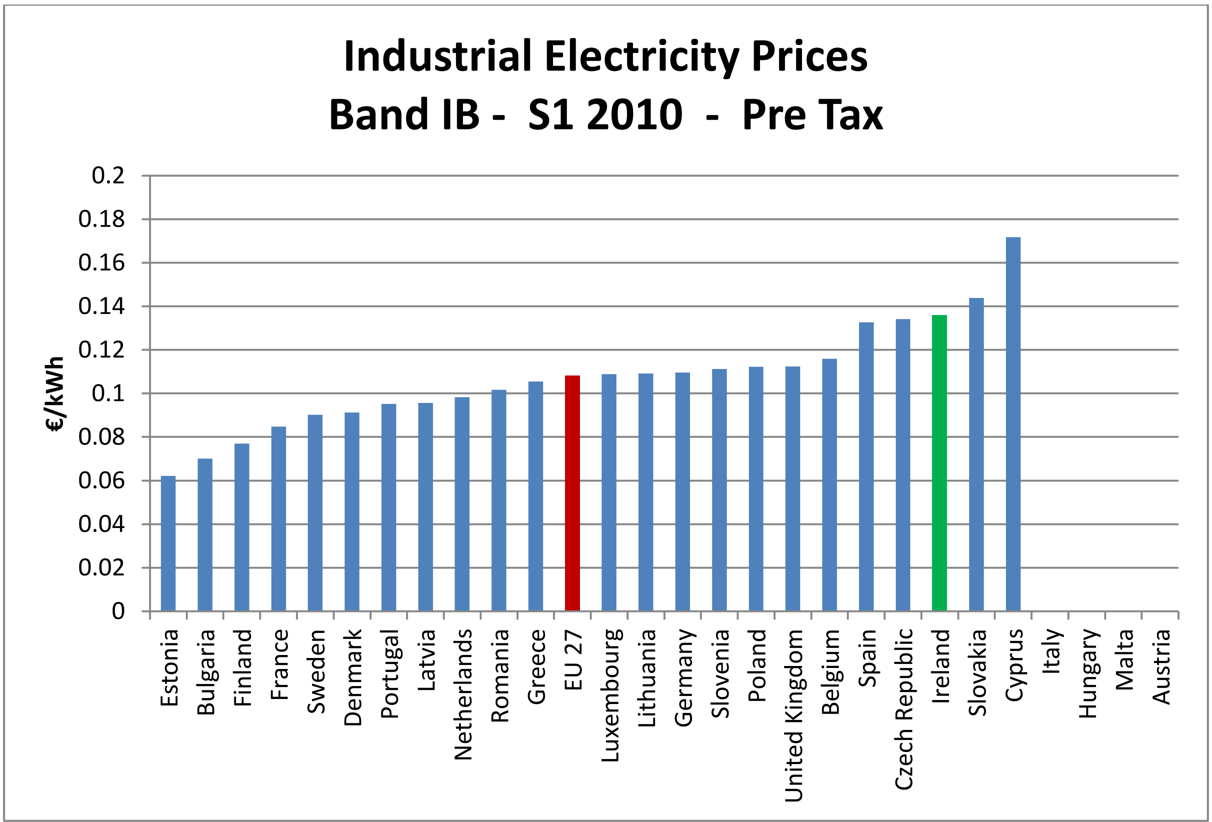
Industrial Electricity Prices
Band IB - S1 2010 - Pre Tax
€/kWh
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Estonia
Bulgaria
Finland
France
Sweden
Denmark
Portugal
Latvia
Netherlands
Romania
Greece
EU 27
Luxembourg
Lithuania
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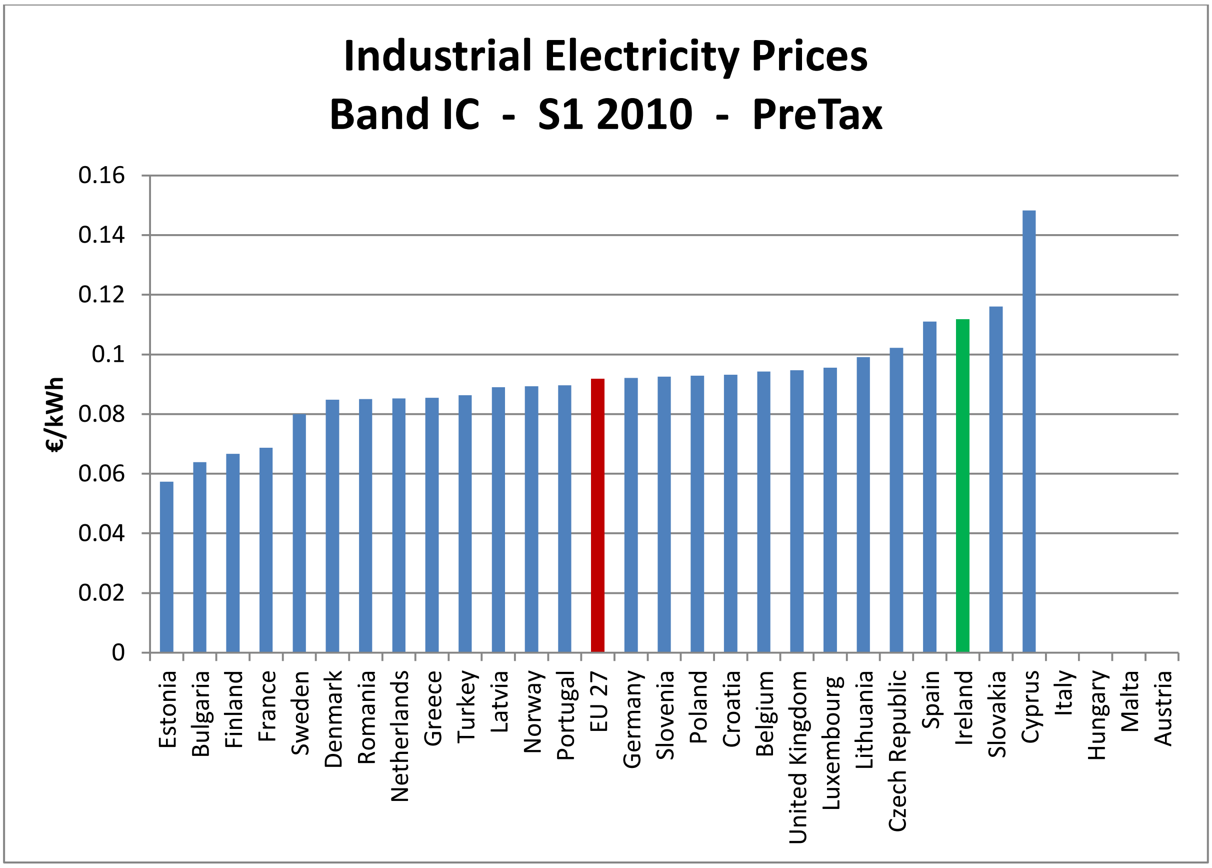
Industrial Electricity Prices
Band IC - S1 2010 - PreTax
€/kWh
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Estonia
Bulgaria
Finland
France
Sweden
Denmark
Romania
Netherlands
Greece
Turkey
Latvia
Norway
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Slovenia
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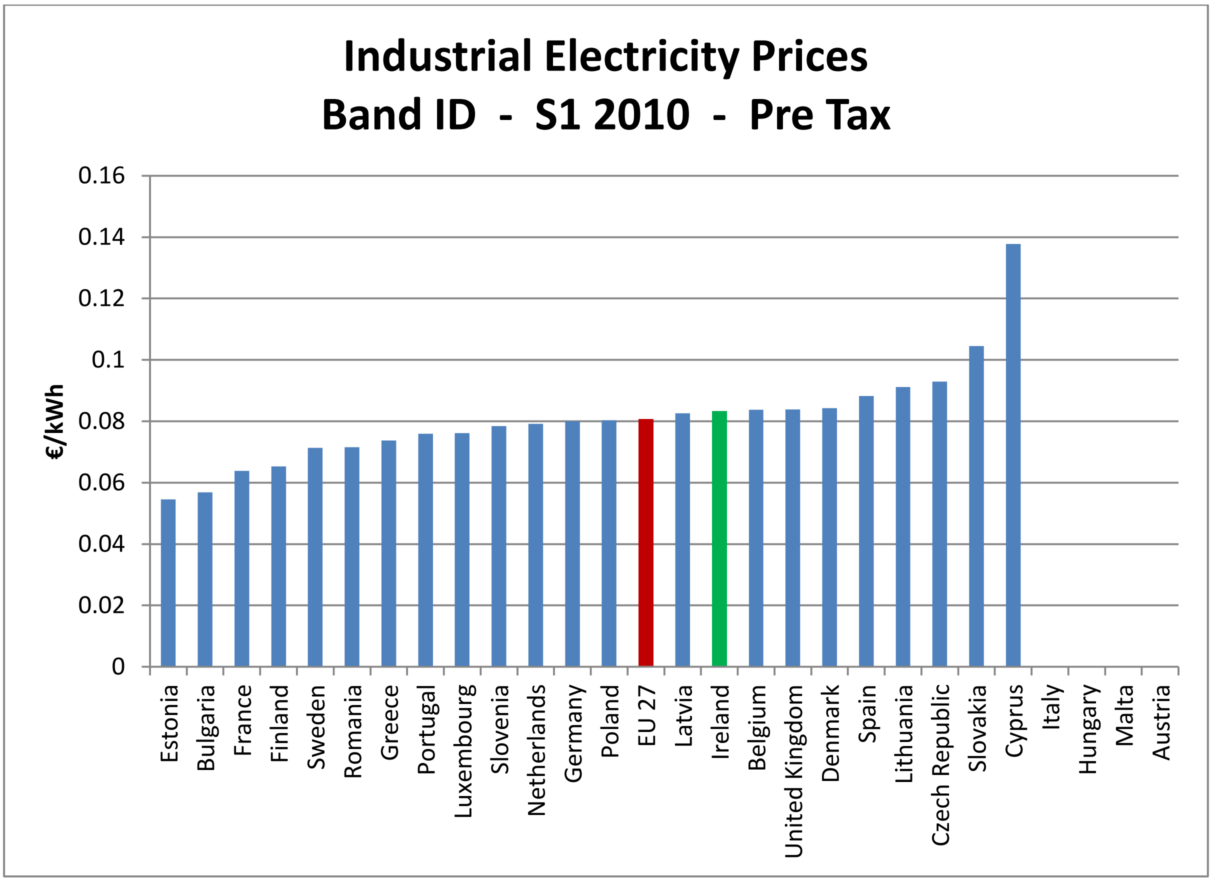
Industrial Electricity Prices
Band ID - S1 2010 - Pre Tax
€/kWh
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Estonia
Bulgaria
France
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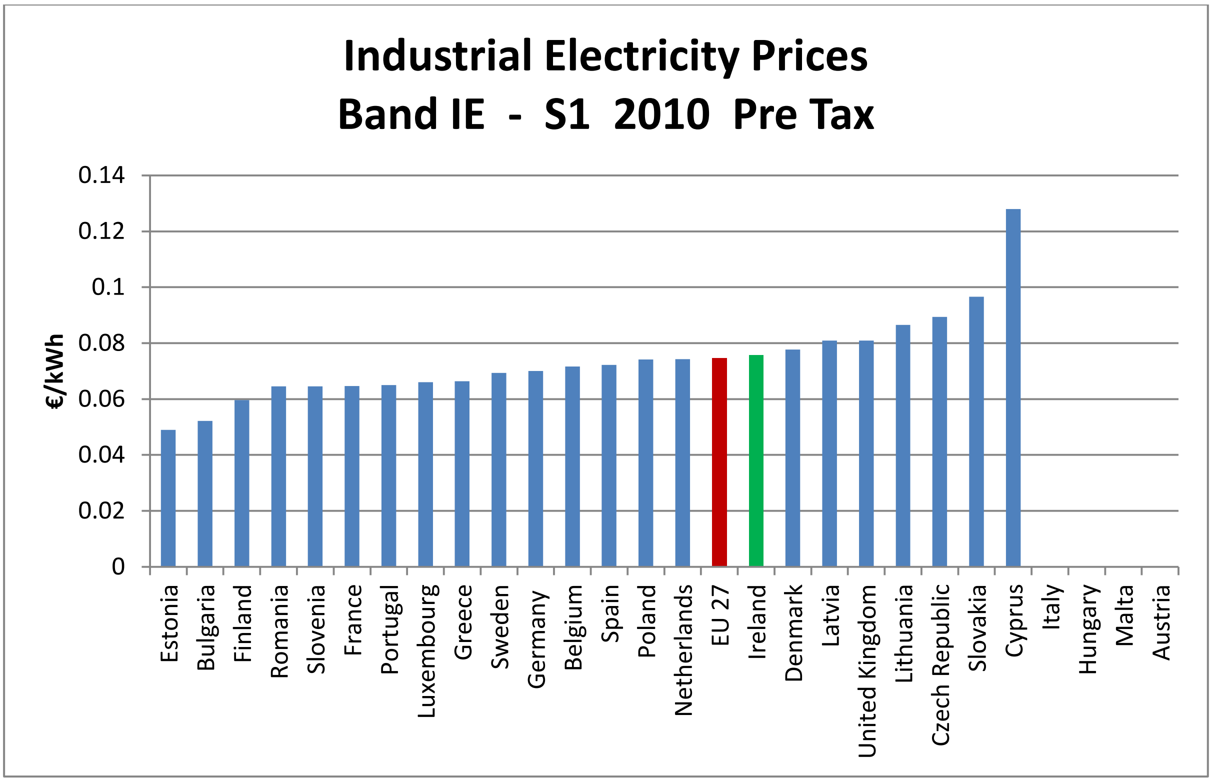
Industrial Electricity Prices
Band IE - S1 2010 Pre Tax
€/kWh
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Estonia
Bulgaria
Finland
Romania
Slovenia
France
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Annex 2

Interconnection

The Academy is pleased to note that EirGrid has produced a number of techno economic reports on important power system issues over the past year and thus assisted in bringing clarity in a number of areas. EirGrid has also actively cooperated with the Academy in presenting and explaining a number of its reports. The Academy wishes to express its thanks to EirGrid for this assistance.

Following a discussion on the East – West interconnector the Academy feels that the economic analysis supporting the €600m (Net €500m) investment is weak and that the project is possibly being commissioned a number of years too early. Unusually in the case of an interconnector project, Ireland is the sole financial contributor to the East West Interconnector (EWIC). It is therefore important to distinguish the economic case for such a project from the investment case as they are distinctly different

The Academy is concerned to note that in the absence of a properly coordinated set of trading arrangements between the two jurisdictions the investment is unlikely to achieve an acceptable return. Such trading arrangements, it would appear, are not yet in place despite the fact that the project is proceeding.

There is no economic analysis available supporting increased interconnection in order to export excess renewable generation.

Interconnections are highly capital intensive pieces of infrastructure. The East – West interconnector is already almost unique in that it is being financed entirely by one side (the UK authorities are not contributing to it). In such cases it is essential that the financial (as against the economic) justification is well researched and definitive. It is perfectly possible that the Irish electricity consumer who is solely paying for this infrastructure may ultimately confer a substantial benefit on the UK consumer for free.

The Academy is not in any way opposed to interconnections and is well aware of the benefits which they may bring. Given the capital intensity of the projects however it is imperative that the investment decision be better grounded particularly with respect to the overall risk.

Proposals for a connection to France are currently being discussed. The Academy is of the view that extreme care needs to be exercised before any financial commitment is made to such a project.

Annex 3

New generation technologies

New generation technologies are being developed in many parts of the world. In particular investors see potential in:

- Solar
  - Thermal
  - Photovoltaic

- Marine
  - Tidal
  - Wave

None of these technologies is currently commercial and, even under the best circumstances; some will not reach that stage for a further decade.

Table 30 Technology maturity assumptions

Technology	2010	2015	2020	2025	2030
CCGT	Mature	Mature	Mature	Mature	Mature
Gas - CCGT with CCS	Emerging	Emerging	Emerging	Emerging	Established
Coal - IGCC with CCS	Emerging	Emerging	Emerging	Emerging	Established
Coal - ASC with FGD & CCS	Emerging	Emerging	Emerging	Emerging	Established
Nuclear	Emerging	Emerging	Established	Established	Mature
Wind - Onshore (High)	Mature	Mature	Mature	Mature	Mature
Wind - Onshore (Medium)	Mature	Mature	Mature	Mature	Mature
Wind - Onshore (Low)	Mature	Mature	Mature	Mature	Mature
Wind - Offshore	Established	Established	Mature	Mature	Mature
Wind - Offshore R3	Emerging	Emerging	Established	Established	Mature
Small biomass power only	Emerging	Emerging	Established	Established	Mature
Large biomass power only	Emerging	Emerging	Established	Established	Mature
Large biomass CHP	Emerging	Emerging	Established	Established	Mature
Wave	Emerging	Emerging	Emerging	Emerging	Established
Tidal Stream	Emerging	Emerging	Emerging	Emerging	Established
Hydro	Mature	Mature	Mature	Mature	Mature
Energy from Waste	Established	Established	Established	Mature	Mature
AD on wastes	Emerging	Emerging	Emerging	Established	Mature
OCGT	Mature	Mature	Mature	Mature	Mature

Excerpt from the Redpoint report supporting UK policy development[3]

[3] http://www.decc.gov.uk/assets/decc/Consultations/emr/1043-emr-analysis-policy-options.pdf

In terms of the short and medium term issues facing the Irish energy industry these technologies are not relevant to *energy* policy.

They may well however have relevance to *industry* policy where the Government feels that Ireland might gain an industry advantage by encouraging the development of such technologies. As long as these decisions are made intelligently from an industrial development standpoint the Academy is supportive of the Government's efforts while cautioning that Governments generally have a pretty poor record of "picking winners" in the technology game.

There are significant potential marine energy resources around Ireland for example and the Government has made a determined effort to support the development of relevant tidal and wave technologies. As long as the efforts are reasonably proportionate, limited to demonstration and pre-commercial plants and do not impose a significant burden on the electricity consumer the Academy is supportive of the Government's efforts to foster industrial policy in these areas.

Offshore wind generation is also being promoted, particularly in the UK, at present. The capital costs are currently very high and it is notable that initial efforts on the Arklow Banks have not been followed up. Given that there are many available onshore sites for wind generation in Ireland it would not seem to make sense for the country to pursue an offshore wind policy until the costs radically decrease.

Finally in respect of nuclear power which is not a new technology in the sense mentioned above, the Academy acknowledges that this technology is not relevant to Ireland's short to medium term energy policy. However, from the point of view of decarbonising the Irish energy sector from 2025 onwards, nuclear energy is likely to be an essential component and the existing legal prohibition of the technology makes no sense and should be revoked.

During the next five years the opportunity to remove barriers (particularly legislative barriers) to nuclear technology should be availed of in order to permit the country to rationally consider the use of the technology post 2020 In the future nuclear power will play an increasingly important role in decarbonising global energy supplies. Legislation which prevents the consideration of such an established and proven technology has no place in a modern economy.

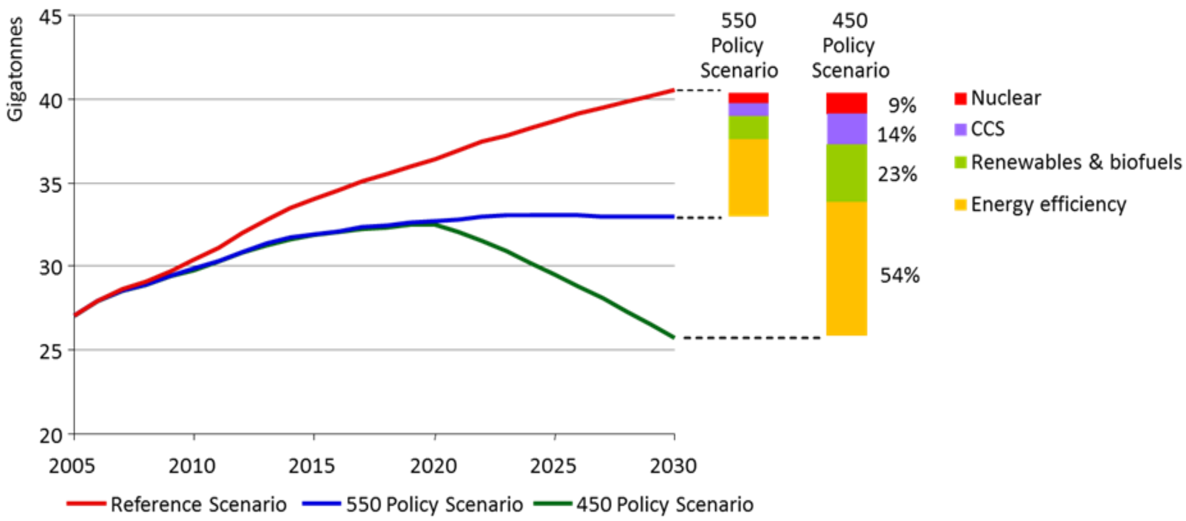
Annex 4

Energy Conservation

4.1 Introduction

The International Energy Agency (IEA) has long recognised that more than 50% of the CO_2 savings necessary to ameliorate climate change should come from conservation measures. Fig 4.1 shows the so-called "450 Policy Scenario" which illustrates the contribution that different energy technologies can make to stabilising the concentration of CO_2 in the atmosphere at 450 ppm which would limit global temperature rise to 2° C.

Fig 4.1 450 Policy Scenario - CO_2 savings by policy measure (IEA)



Various studies including McKinsey reports (see Fig 4.2 below) show clearly that conservation measures are the most cost effective way to meet environmental targets and are well ahead of renewables, nuclear, biofuels and others in payback terms.

Ireland's immediate target is to achieve a 20% reduction in energy use by 2020. The Academy in its 2006 Energy Policy report dealt comprehensively with energy conservation and, in particular, the insulation of buildings. This report pointed out that conservation in Ireland had been a stop/go process and that the programmes were not keeping pace with energy use.

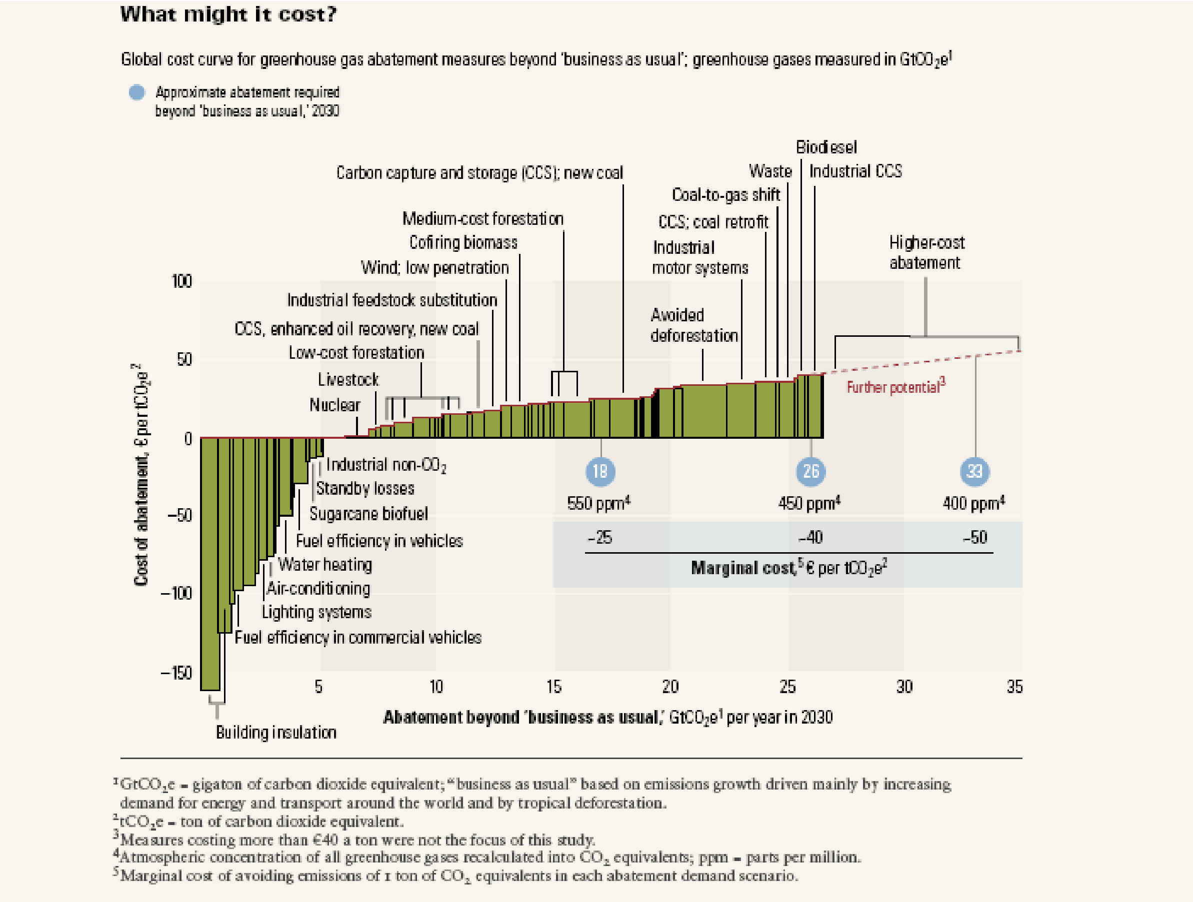


Fig 4.2 (Source: McKinsey)

Despite recent new initiatives it is most unlikely that the 2020 target will be achieved in the absence of a series of major new initiatives. These are:

- Structural/organisational/rationalisation
- Regulatory
- Funding
- Incentives
- Technological innovation

The key to conservation is technology (for example, improved appliances, new forms of construction, more efficient engines, better controls and so on). Behavioural change is also required, but of itself will not yield significant results. There is considerable scope for conservation in three main areas:

- Industrial processes
- Commercial buildings
- Housing

More than 50% of all energy is used in buildings and this is a critical area in achieving reductions. It is also the most difficult due, for example, to the large stock of poorly insulated houses in Ireland.

Solutions are available, but specialised funding or relief is necessary in view of the relatively long pay-back periods.

Given the state of public finances other forms of funding are required and the experience of other European countries is detailed below.

Energy conservation/efficiency programmes are a good fit with the structure of the Irish economy. There is no tradition of heavy engineering manufacturing for power equipment, but there is considerable strength in light engineering, IT and contracting. There is plenty of evidence of innovation in areas of new energy technology in Ireland. Energy conservation activity is labour intensive and will fit well with job creation objectives.

Conservation policy involves three Government departments (Environment, Energy and Transport). Effective coordination is vital. SEAI embodies essential knowledge and data relating to energy conservation and solutions. However, it is not resourced to deliver the type of major programmes that will be required to meet the 2020 target of 20% reduction in energy use.

The array of instruments available to tackle energy conservation include financial incentives, taxation, regulations, research and development, training, institutional and promotional instruments. These need to be coordinated within a national policy and implementation plan.

To achieve the 20% conservation target all sectors need to be addressed simultaneously (for example, industrial, commercial, domestic (housing), transport, efficiency of power generation). All have considerable scope for improvement using available technology. However, the array of instruments listed above needs to be deployed in a manner that makes achievement of the 20% target feasible and cost effective.

There is a requirement for an updated National policy framework with associated regulations and financial measures that can form the basis of a detailed implementation plan. It is essential that this plan clearly defines responsibility for meeting the 20% target over a 10 year period and incorporates objective measurement of results.

In its review document of June 2009 the Academy`s recommendations were as follows:

1. Promote further energy efficiency improvement in Ireland`s building stock bearing in mind that such investment will provide significant stimulus to the economy and encourage job creation.
2. Divert capital from energy production/transmission projects to conservation programmes and use it to fund a major new national energy efficiency programme.
3. Establish proper standards, control measures and output targets and ensure that they are professionally managed by a specialist coordinating agency to ensure that programmes with predictably high rates of return are prioritised and completed.

4.2 Commercial Energy Efficiency Example

The Corrib Oil case study is typical of what can be achieved using readily available technologies directed by skilled technical personnel. The company operates eighteen oil distribution centres and fifteen service stations mainly in the West of Ireland. By upgrading its lighting, refrigeration and air conditioning the company, with the assistance of specialised third party services, achieved:

- A 15% reduction in group energy use
- A 30% reduction in refrigeration operating costs
- A payback of less than 18 months.

The project was grant aided by SEAI.

4.3 Retrofit Programme

The Institute for European Affairs produced its excellent report `*Greenprint for a National Energy Efficiency Retrofit Programme'* (Oct. 2009), which reviews in depth the whole area with a particular focus on housing. The Sustainable Energy Authority of Ireland (SEAI) has, in many reports, recommended similar policies. It also operates the grant aid schemes devised by government (based on SEAI policy advice) in this area.

The experiences and policies of three different countries - the UK, Germany and the Netherlands - were outlined at a recent conference organised by the IEA. The following is a brief summary.

UK
The `*Green Deal*` first mooted by the outgoing Labour government has been adopted by the new coalition government and is currently in draft process. Assuming that issues (particularly in respect of property rights) can be overcome, the legislation is expected to pass in 2011 and to roll out in 2012.

It aims at a comprehensive deep retrofit with energy suppliers being principally responsible for achievement of the targets. The view is that the payback on deep retrofit (particularly external wall insulation) is too long for most householders, who will need upfront capital and the perceived benefits are too uncertain for the majority.

As part of the programme all householders/occupiers are to be given a free Building Energy Efficiency (BER) rating. Energy suppliers will devise and implement the solutions through licensed energy service companies (ESCos). The costs will be recovered through meter charges. The meter user will be liable for payment to the suppliers and liability will not rest with the property or the owner/occupier. The meter charges will be uniform for all and there will, therefore, be some cross subsidisation. These meter charges will be the funding source to reward the capital. Further details have still to be agreed between a regulatory authority/government agency and the suppliers.

Germany
Responsibility for implementing the German action plan has been devolved to the KfW Bankengruppe. This Bank was founded in 1948 as the promotional bank of the then Federal Republic of Germany (owned 80% by the Republic and 20% by the constituent federal states). It has a wide array of functions including environmental and climate change protection and energy efficiency. €20bn has been committed to housing and SME buildings in 2009.

KfW acts as more than a bank - its wider role includes promotion and all technical and financial issues. Its focus is on loans (albeit subsidized loans) and not grants. The Bank funds loans to clients through local banks who deal directly with the clients according to a prescribed format. The high proportion of apartment blocks means that contracts for deep retrofit can be large and result in relatively low unit costs. As only 40% of dwellings are owner occupied, as compared to over 70% in the UK and 80% in Ireland, landlords and housing associations are the principal clients. Approximately 75% of the housing stock is pre-1979 when strict criteria were introduced for all new buildings.

Much of the work now underway is in the Eastern areas incorporated since 1991. The Government subsidises KfW to borrow on the wholesale market and lend at bearable rates to clients. Direct savings in energy supply costs fund the customer's outlay in capital and interest. However, according to some sources the scheme does not work well with individual owner occupiers. The maximum loan per unit is €75,000.

Netherlands
The first National Insulation Programme (all buildings including commercial/industrial & housing) ran from 1978 to 1990. The decision to terminate this programme was made in 1988 due to high cost and suspicions of "free riders". Four government agencies were involved. The national approach is now being resuscitated largely for housing with the four agencies now being merged into one control agency.

The assessment of the first programme was that the savings were greater than the estimates; job creation was 7,500 per annum; dwellings did not in general have deep retrofit and the average number grant aided was 180,000 per annum. Subsidies were 90% of direct costs and the organisational, research, technical and administration costs were approximately 9% of the direct costs and borne centrally. The total housing stock in the country is currently just under 7 million dwellings. A new policy aimed at significant upgrades is now being developed. The housing stock ownership profile is nearer the German model than the Irish or UK. As yet no financial policy to achieve the targets set has been agreed. A nationwide survey of actual BER ratings is well underway as a necessary first step towards this end.

4.4 Conclusions

- It is essential that one central body is given responsibility for the delivery of a national deep retrofit is programme.

- Funding options can be arranged through Green bonds or by way of supply companies' balance sheets with some comfort from State arrangements and without the State taking on the total liability.

- The total costs per annum of a central control body embracing research, Energy Services Company (ESCo) licensing, technical, inspection, certification and administration would be close to 10% of the total programme's direct costs i.e. €100m for expenditure of €1bn per annum.
- Significant employment would be created , estimated at 30,000 for a plus €1bn annual outlay. Payback in individual and national terms would be good to excellent.

- A very flexible approach both in standards, promotion and contract lettings will be essential as will particular arrangements for financing. At present virtually all options are already on trial. All that is needed is the commitment to a major programme centrally driven and controlled.

Annex 5

Alternative Scenario

The Academy believes that an alternative scenario should be based on the following principles:

- Future energy policy and demand projections should be based on conservative economic growth assumptions.
- Maximum use should be made of existing assets.
- Capital investment should be minimised.
- Employment growth in Ireland should be fostered.

This scenario involves a significant reduction in expensive renewables investment (mainly wind) but still requires some new production facilities in order to comply with Ireland's target of 16%o of total final energy to be sourced from renewables by 2020. In the short term the Academy believes that this target should be postponed until 2025. However this alternative scenario described below is based on attempting to meet the 2020 target.

Thus the Academy proposes that:

- Future energy demand projections should be based on ESRI's 'Low Growth Scenario' of July 2010.
- Energy efficiency and conservation be identified as the key strategy, rather than renewable energy development. (A policy shift from supply side to demand side management)
- Any additional renewable energy requirement be met from the technological options requiring the least capital investment and the lowest cost per tonne of CO_2 abated
- The development of apparently desirable new technologies for renewable energy production should be funded at least partly from the national R&D budget.

Specifically the Academy's analysis indicates that:

- Energy demand projections should be developed on the basis that GNP in 2020 will be 17% lower than assumed in the National Renewable Energy Action Plan.

- That a more aggressive and capital intensive energy efficiency and conservation strategy be implemented, than is provided for in current Government policy. The objective should be to achieve an improvement of 20% on the historic relationship between energy demand and economic activity, rather than the 12% assumed by SEAI at present.

- Achieving this conservation objective would meet the target of reducing energy related GHG emissions from the Non-ETS sector by 20%, from 2005 levels, when account is taken of the requirement for renewable energy to meet 10% of requirements for road and rail and the objective of increasing the use of renewable energy in the residential and commercial/services and industrial sectors from the Academy's estimate of 390ktoe at present to 690ktoe.

- Achieving the conservation target, coupled with the lower economic growth assumptions, will also reduce the renewable energy output required to meet Ireland's 16% target to 1.93 Mtoe, rather than the 2.27 Mtoe proposed in the NREAP.

- The use of biomass in existing stations was identified by the Academy as the lowest cost way of meeting the renewables target, as the incremental capital investment required in the power stations is, on the basis of our discussions with the operators, estimated to lie in the range €50-100m. But it has the potential to save €2.0bn investment in onshore wind farms, or considerably more, if offshore wind farms were deployed. There are fuel handling and ash chemistry issues which have to be resolved, but the problems are believed to be soluble and the potential scale of the capital savings involved justifies an acceleration of both the effort and investment required.

- It would also require a significant investment in the agricultural sector, to develop the required acreage of Short Rotation Forestry (SRF) to cover the projected shortfall between the availability of biomass, from conventional forestry or imported supplies and potential requirements. Teagasc estimates that an investment of €175m would be required to develop SRF plantations if half of the power stations' potential requirements were to be supplied from SRF.

- The reported level of biomass consumption in the residential sector, 33 ktoe in 2009, is a significant underestimate, based on analysis of household fuel use commissioned by Bord na Mona. These surveys, which are conducted twice each year, indicate that wood use is approximately half of total peat use, thus it is approximately 135ktoe p.a. rather than the 33 ktoe, reported by SEAI.

Appendix IV

Total Final Energy Consumption

Assuming GNP Grows at 5.5%p.a. 2011-2015 & 3.3% p.a. 2016-2020

Total CO2 Emissions / **Non-ETS CO2 Emissions**

	SEI Estimates					SEI Baseline Forecast		SEI Policy Forecast		Emissions	Total CO2 Emissions	Derived from Baseline Forecast		Derived from Policy Forecast		Non-ETS CO2 Emissions	Derived from Baseline Forecast		Derived from Policy Forecast	
	1990	**1995**	**2000**	**2005**	**2008**	**2012**	**2020**	**2012**	**2020**		**2005**	**2012**	**2020**	**2012**	**2020**	**2005**	**2012**	**2020**	**2012**	**2020**
	ktoe	**ktoe**	**ktoe**	**ktoe**	**ktoe**	**ktoe**	**ktoe**	**ktoe**	**ktoe**	**t/toe**	**kt**	**kt**	**kt**	**kt**	**kt**	**kt**	**kt**	**kt**	**kt**	**kt**
Coal&Petcoke	267	153	286	406	363	232	287	232	285	3.92	1592	909	1125	909	1117					
Oil	649	897	1020	832	731	740	937	662	690	3.1	2579	2294	2905	2052	2139					
Natural Gas	358	369	471	428	596	659	777	662	778	2.382	1019	1570	1851	1577	1853					
Renewables	61	62	100	163	138	148	150	202	345											
Sub Total	**1335**	**1481**	**1877**	**1829**	**1828**	**1779**	**2151**	**1758**	**2098**											
Electricity	386	496	665	660	686	571	708	538	630											
Total	**1723**	**1977**	**2542**	**2489**	**2514**	**2350**	**2859**	**2296**	**2728**		**5190**	**4773**	**5881**	**4539**	**5109**	**1038**	**955**	**1176**	**908**	**1022**
Gasoline & LPG	950	1115	1598	1826	1908	1704	2003	1670	1873	2.931	5352	4994	5871	4895	5490	5352	4994	5871	4895	5490
Gasoil, Diesel, DERV	679	851	1833	2369	2673	2724	3727	2606	3259	3.069	7270	8360	11438	7998	10002	7270	8360	11438	7998	10002
Fuel Oil	20	22	25	17	0	0	0	0	0	3.182	54					54	0	0	0	0
Biofuels	0	0	0	1	56	146	179	201	464											
Electricity	1	2	2	5	5	5	5	5	95											
Total Surface	**1650**	**1990**	**3458**	**4218**	**4642**	**4579**	**5914**	**4482**	**5691**											
Jet Kero	374	400	629	857	970	659	800	659	800	2.989	2562	1970	2391	1970	2391					
Total	**2023**	**2389**	**4086**	**5075**	**5612**	**5238**	**6714**	**5141**	**6491**		**15184**	**15324**	**19700**	**14862**	**17883**	**12677**	**13354**	**17309**	**12893**	**15492**
al																				
Coal/Petcoke/Ovoids	647	282	333	281	254	183	126	163	112	3.961	1113	725	499	646	444	1113	725	499	646	444
Peat	725	606	299	273	280	214	147	213	146	4.25	1160	910	625	905	621	1160	910	625	905	621
Oil	371	620	888	1109	1208	1230	1382	1300	1210	3	3327	3690	4146	3900	3630	3327	3690	4146	3900	3630
Natural Gas	117	252	439	522	669	728	805	592	516	2.382	1243	1734	1918	1410	1229	1243	1734	1918	1410	1229
Renewables	45	40	40	44	44	43	41	61	103											
Sub Total	**1905**	**1800**	**1999**	**2229**	**2455**	**2398**	**2501**	**2329**	**2087**											
Electricity	356	427	548	646	733	714	741	684	648											
Total	**2261**	**2226**	**2547**	**2874**	**3187**	**3112**	**3242**	**3013**	**2735**		**6844**	**7058**	**7187**	**6861**	**5923**	**6844**	**7058**	**7187**	**6861**	**5923**
ial&Public Service																				
Coal & Peat	33	6	4	24	24	26	26	26	23	4	96	104	104	104	92	96	104	104	104	92
Oil	640	597	590	587	550	337	282	256	60	3.069	1802	1034	865	786	184	1802	1034	865	786	184
Natural Gas	94	177	293	390	394	384	458	297	225	2.382	929	915	1091	707	536	929	915	1091	707	536
Renewables	0	0	0	3	15	14	14	120	143											
Sub Total	**767**	**780**	**887**	**1004**	**983**	**761**	**780**	**699**	**451**											
Electricity	240	310	481	728	822	896	1040	885	998											
Total	**1007**	**1090**	**1368**	**1735**	**1807**	**1656**	**1821**	**1584**	**1449**		**2826**	**2053**	**2060**	**1597**	**812**	**2826**	**2053**	**2060**	**1597**	**812**

The Government's and the Academy's strategies insofar as they impact on renewable electricity generation requirements are compared in the following tables.

comparison of Energy Policy Alternatives

	Renewable Energy Requirements in 2020	
	NREAP	**Academy**
Renewable Energy Use	**ktoe**	**ktoe**
Estimated in 2010	859	793
Plus Underreported Biomass Use	0	100
	859	893
Plus Additional		
RES-H, heating requirement	371	303
RES-T, transport requirement	347	228
RES-E, electricity requirement	692	506
Total	**2269**	**1930**

Additional RES-E requirement	**GWh**	**GWh**
Ocean	230	0
Onshore wind	5527	4365
Offshore wind	1632	0
Biomass	659	1520
Total	**8048**	**5885**

Additional Electrical Capacity Required	**MW**	**MW**
Ocean	75	0
Onshore wind	2042	1570
Offshore wind	519	0
Biomass in existing peat stations	0	0
Total	**2636**	**1240**
Additional investment requirement	€bn	€bn
As per Appendix IV +SRF Plantation Costs	8.3	3.9

Conclusions

The conclusions to be drawn from the above are that adopting the strategy put forward by the Academy would:

- Enable Ireland to fully comply with its obligations under the EU's 20/20/20 Strategy.
- Would reduce the electricity sector capital requirements by €4.4bn.
- Would reduce the cost of our energy imports in 2020 by €1350m p.a., at present day prices.
- Would avoid having to pay for GHG emission permits at an estimated cost of €300m p.a. in 2020.
- Would significantly improve both GNP and the Balance of Trade.
- Would assist employment creation in Ireland as:
    - Energy efficiency and conservation investment ,
    - Renewable energy development in the residential, commercial/services and industrial sectors
    - Short rotation forestry development

  would provide far higher employment opportunities in Ireland, per €m investment, than investment in the electricity or automotive sectors.

The implementation of the Academy's strategy would however require a significant redirection of capital and human resources from energy supply to energy efficiency and conservation at the end users site.

In the industrial and commercial sectors achieving the conservation targets would require a significant expansion in the scale of energy services companies operating in Ireland and a programme to retrain engineers and architects in the application of the required technology. But the payback periods for conservation measures in the sector are generally sufficiently short to be self-financing. Achieving the renewable targets in these sectors will require a level of grant or loan financing as the payback periods are generally longer.

In the domestic sector most conservation and renewable investments generally have longer payback periods. Thus the existing grant scheme, currently costing €50m p.a. will need to substantially expanded, but with a clear focus on investing in the most cost effective solutions.

In the transport sector the Academy advocates the application of a graduated scheme of VRT and road tax based on the emissions of the vehicle, including associated power station emissions in the case of plug in electric vehicles. The Academy does not believe there should be a special regime for electric vehicles.

But while this approach will help to achieve the required emission savings from the motor car fleet it does not address the fact that half of road transport emissions come from HGV's. The only viable proposal to address this problem would appear to be Bord Gais' plan to develop the use of compressed natural gas to power HGV's.

This has the advantage that it would:

- Reduce CO_2 emissions by over 20%
- Reduce the cost of our energy imports, as natural gas imports currently cost less than half the cost of diesel, on an energy equivalent basis
- Improve our energy supply security, by reducing the dependence of our transport fleet on oil supplies

It should be noted that similar proposals are being actively examined in North America at the moment.

In proposing an alternative strategy the Academy suggests a much greater emphasis on conservation and demand side management with a corresponding reduction in investment in unnecessary renewables. The amount of renewables in the scenario is a "balancing" figure included in order to meet the target of obtaining 16% of final energy from renewables.

However, given the economic collapse in Ireland over the past three years and the very poor economic growth projections the Academy is of the view that the target date of 2020 in respect of this particular objective should be extended to 2025 and reviewed again in 2015.

Annex 6

List of Acronyms

Acronym	Definition
CCGT	Combined cycle gas turbine
CHP	Combined heat and power
ESRI	Economic and Social Research Institute
EU ETS	European Union Emissions Trading System
GCS	Generation Capacity Statement
GCV	Gross Calorific Value (quantity of heat liberated by the complete combustion of a unit of fuel when the water produced is assumed to be condensed and the heat associated with the water is recovered)
GJ	Gigajoule (Unit of energy commonly used in thermal energy calculations)
GW	Gigawatt (1000 MW)
IAE	Irish Academy of Engineering
IEA	International Energy Agency
LNG	Liquefied natural gas
NREAP	National Renewable Energy Action Plan
MW	Megawatt (Unit of electrical power or generation capacity)
MWh	Megawatt-hour (Unit of energy)
NCV	Net Calorific Value (quantity of heat liberated by the complete combustion of a unit of fuel when the water produced is assumed to remain as a vapour and the heat is not recovered)
NPV	Net Present Value (Present value of future cash flows less the purchase price)
PSO	Public service Obligation
REFIT	Renewable Energy Feed in Tariff
SRF	Short Rotation Forestry