

## 6 New Analysis - SOS Supply/Demand Index Ireland 2006 and 2020

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This S/D Index is one of the three elements proposed as part of an 'EU standard' for the security of energy supply (Scheepers et al, 2007). This paper describes the results of the quantification of the S/D Index for Ireland for the years 2005, 2006 and for 2020. The results are presented in section 6.1. The quantification is based on a new model and data for Ireland. A short description of the essence of the S/D index and results for the EU-27 and its Member States (MS) is presented in section 6.2. The results for the EU-27 MS enable a comparison with respect to the relative position of Ireland. The PRIMES based quantifications as reported in (Scheepers et al., 2007) have been directly used for this comparison. Section 6.3 provides more details on the data assumptions for Ireland.

The 2005 and 2006 quantification is based on a combination of data sources:

- The 2005 and 2006 national energy balances,
- Eurostat (2004, 2006) or PRIMES model results for the year 2005 (EC, 2006) supplemented with information from other sources (for example IEA, 2006).

In addition, ECN has quantified the S/D index for the year 2020 based on two scenarios:

- The 'Trends to 2030' scenario that has been recently updated (EC, 2006) based on PRIMES model results. The results of that quantification have also been reported in (Scheepers et al., 2007) and are summarised here (in section 6.2), mainly for comparison purposes.
- SEI forecast for 2020, in which 30% of the electricity is produced by renewable sources and 6% of the transport fuel by bio-fuels (this forecast was prepared by the Economic and Social Research Institute, ESRI, for SEI in October 2006).

Since the S/D Index model has been modified and improved in certain areas, the results of the previous quantification for Ireland (SEI, 2006) are not comparable to the quantifications presented here. Moreover, the 2005 value was partly based on provisional data for the year 2005. The definite 2005 figures in the most recent SEI energy balance are somewhat different. Therefore, the 2005 quantification is an update in order to enable a sensible comparison with the year 2006 and the forecast for the year 2020.

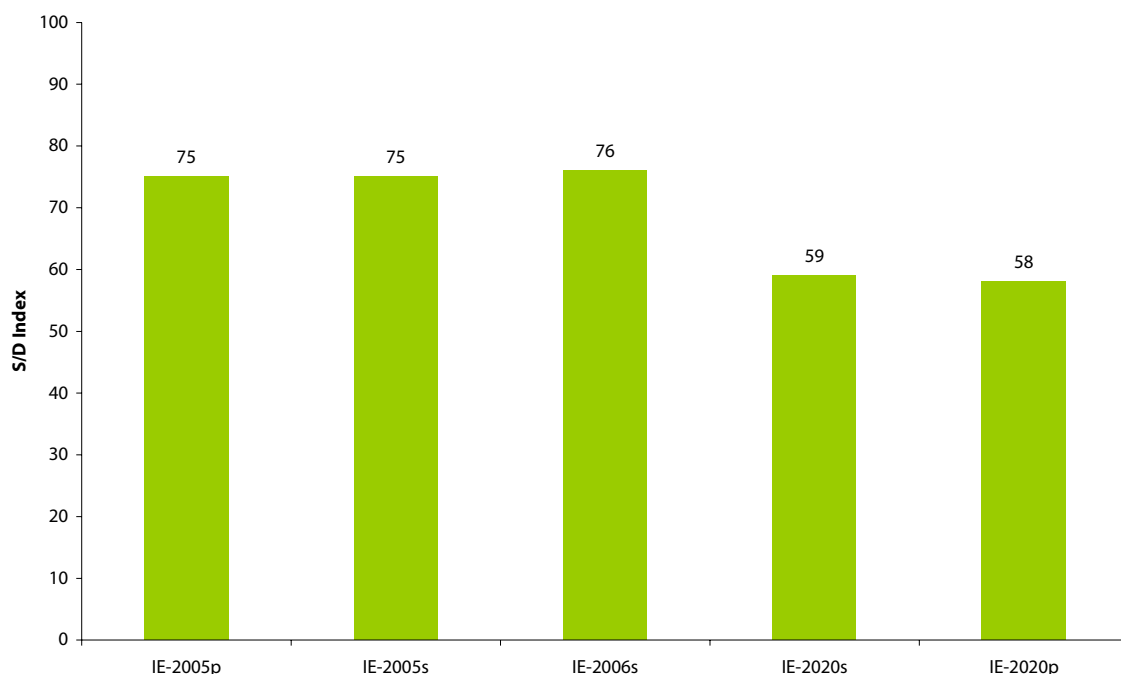
### 6.1 Results for Ireland

Five cases have been quantified for Ireland:

<b>IE-2005p</b>	Quantification of the year 2005 based on the PRIMES baseline (EC, 2006), supplemented with data from other sources (Eurostat, EC, IEA).
<b>IE-2005s and IE-2006s</b>	Quantification of the S/D index for 2005 and 2006 based on the energy balances of these years provided by SEI, supplemented with data from other sources (Eurostat, EC, IEA).
<b>IE-2020s</b>	Quantification of the year 2020 based on the SEI forecast, supplemented with data used for the IE-2020p (PRIMES).
<b>IE-2020p</b>	Quantification of the year 2020 based on the PRIMES baseline (EC, 2006). Data not provided by the PRIMES baseline are taken equal as in the IE-2005p case (PRIMES).

The results are summarised in the figure 44 and table 13. In addition to the overall S/D index, the table provides the sub-scores and the weighing factors with which the sub-scores are combined into the overall S/D index.

**Figure 44: S/D Index – Ireland**



Source: ECN

### 2005 and 2006

The results indicate a score of 75 and 76 for 2005 and 2006, which compares well to the other EU27 MS cases (shown in table 14). Ireland's S/D index is the third best score in comparison to the other EU member states (MS). The difference in the 2005 scores based on the SEI and the PRIMES energy balances is marginal. The changes from 2005 to 2006 are negligible.

The relatively high scores for Ireland are caused by high sub-scores in the PES (primary energy sources). The PES sub-scores are quite high (96-97) as oil and gas are imported from within EU and Norway. The oil and gas scores are therefore 100 (IE-2005s and IE-2006s). The C+T scores are moderate (52 and 55), mainly due to the relatively low CHP share in the electricity production (about 2.2 and 5.4%), which results in a score of only 9 and 22 in the C+T heat part.

### 2020

It should be noted that the development up to 2020 may be rather scenario specific. The 2020 S/D Index score drops to about 59 (SEI energy balance) or to 58 (PRIMES energy balance). Ireland then drops to the 9<sup>th</sup> position (see table 14) but is still well above the average score of the 27 MS (53), see table 14. This decrease in the 2020 score is mainly determined by the assumption on the origins of the oil and gas imports. In 2005 (Eurostat, 2007) and 2006 (assumption as for 2005) these imports stem from the UK and Norway.

For MS that are net exporters (e.g. UK) or that have low shares of imports coming from outside EU/Norway (like Ireland) in the year 2005, a generic assumption has been imposed for the year 2020. The main reason is that such origin data are not known from the scenarios. In addition, the expectation is the increased import dependencies in 2020 will also result in larger shares to be imported from outside the EU/Norway. It is assumed that 50% of the imports of oil and gas come from outside the EU/Norway. In 2004 the shares of oil and gas imported from the UK were 30 and 100%, respectively. With the UK moving from a net exporter to a net importer for these fossil fuels, Ireland may have to import substantial portions from outside the EU/Norway on the long term.

If the shares imported from outside EU and Norway increase even more substantially than the generic 50% assumption, a further significant drop in the S/D Index can be expected. This would indicate a considerable increase in exposure to potential SOS disruptions.

Ways to mitigate such exposure could be to decrease the share of oil and gas in the PES mix (76% in 2020 SEI forecast) e.g. by increasing the share from renewable energy sources. A specific example would be to increase the share of renewables (bio-fuels, 6% in the SEI forecast) in the transport sector, at the expense of the oil based fuels. From the cases it can be concluded that Ireland's S/D Index is largely determined by the origin of the imported oil and gas, given the large share of oil and gas in the primary energy mix (81% in 2006 and still 76% in the 2020 SEI forecast). Changes in the origins of these oil and gas imports could cause the S/D Index to worsen on the mid and longer term.

**Table 13: S/D Index Ireland**

	IE-2005p		IE-2005s		IE-2006s		IE-2020s		IE-2020p	
	Weight/Share	Score	Weight/Share	Score	Weight/Share	Score	Weight/Share	Score	Weight/Share	Score
<b>S/D index</b>		<b>74.5</b>		<b>75.3</b>		<b>75.7</b>		<b>59.1</b>		<b>57.8</b>
<b>Demand</b>	0.3	<b>55.8</b>	0.3	<b>57.0</b>	0.3	<b>55.8</b>	0.3	<b>57.3</b>	0.3	<b>55.8</b>
Industry	0.18	100	0.21	100	0.19	100	0.20	100	0.17	100
Residential	0.24	44	0.23	44	0.23	44	0.19	40	0.23	40
Tertiary	0.18	62	0.16	62	0.15	62	0.17	66	0.19	66
Transport	0.40	40	0.40	40	0.42	40	0.44	42	0.41	42
<b>Supply</b>	0.7	<b>82.5</b>	0.7	<b>83.5</b>	0.7	<b>84.2</b>	0.7	<b>59.9</b>	0.7	<b>58.6</b>
<b>C+T</b>	0.3	<b>53.7</b>	0.3	<b>52.2</b>	0.3	<b>55.0</b>	0.3	<b>56.0</b>	0.3	<b>58.0</b>
Electricity	0.3	70	0.3	67	0.3	68	0.3	71	0.3	78
Gas	0.3	71	0.3	71	0.3	71	0.3	71	0.3	71
Heat	0.2	11	0.2	9	0.2	22	0.2	22	0.2	21
Tr. Fuels	0.2	45	0.2	45	0.2	45	0.2	45	0.2	45
<b>PES</b>	0.7	<b>94.9</b>	0.7	<b>96.3</b>	0.7	<b>96.7</b>	0.7	<b>61.5</b>	0.7	<b>58.9</b>
Oil	0.57	97	0.58	100	0.54	100	0.52	50	0.54	50
Gas	0.24	100	0.23	100	0.27	100	0.24	59	0.29	59
Coal <sup>51</sup>	0.16	78	0.17	78	0.16	79	0.12	74	0.10	74
Nuclear	0.00	100	0.00	100	0.00	100	0.00	100	0.00	100
Ren. ES	0.03	100	0.02	100	0.03	100	0.11	100	0.07	100
Other	0.00	100	0.00	100	0.00	100	0.01	100	0.00	100

Source: ECN

## 6.2 Description of the S/D Index and Results for the EU-27

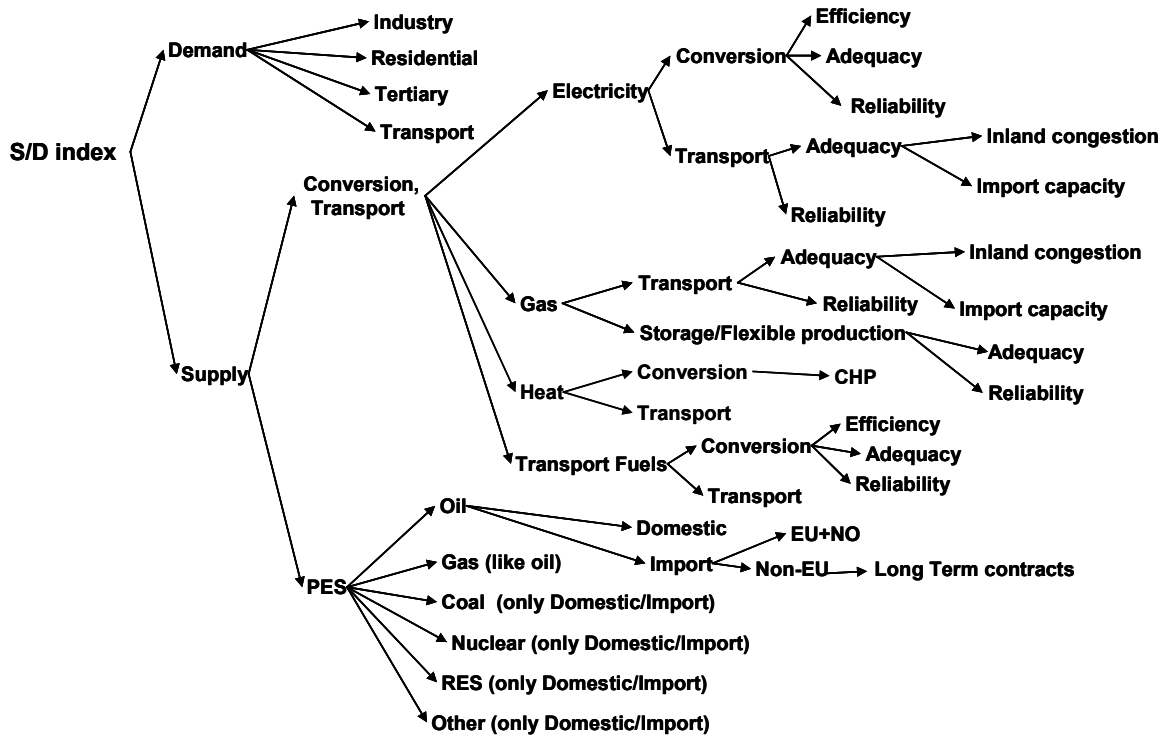
### Supply/Demand Index

The S/D index aims at review and assessment of energy SOS in the medium and longer run. The S/D Index covers final energy demand, energy conversion and transport and primary energy sources (PES) supply. It uses four types of inputs, two objective types and two types of a more subjective nature. The objective inputs concern the shares of different supply and demand types (i.e. for demand: industrial use, residential use, tertiary use and transport use; for supply: oil, gas, coal, nuclear, RES and other) and the values characterizing capacity and reliability in conversion and transport based on the secondary energy carriers (electricity, gas<sup>52</sup>, heat and transport fuels). Figure 45 displays the conceptual model of the elements considered in the overall S/D Index.

<sup>51</sup> Includes Peat. The category including coal and peat is often listed as 'Solids' in energy balances.

<sup>52</sup> The updated S/D Index model now has a separate branch for the secondary energy carrier Gas.

Figure 45: The S/D Index Model Structure



Source: ECN

The subjective inputs concern the weights that determine the relative contribution of the different components in the Index (such as the relation between supply and demand outputs in the Index, or the relation between EU imports and non-EU imports) and the scoring rules for determining various Index values reflecting different degrees of perceived vulnerabilities.

#### Quantitative Results for the EU-27 and its Member States

The use of the S/D Index is illustrated with examples for the EU-27 and its Member States for they years 2005 and 2020. The examples are based largely on objective information contained in energy balances, derived from mainly Eurostat (Eurostat, 2006) and IEA statistics (IEA, 2006) and the 'EU Trends to 2030 - update 2005' baseline scenario (EC, 2006). The S/D Index model combines that information with weighing factors and scoring rules, using existing indicators where possible. The most important uncertainties are scrutinised by some sensitivity analyses. The base case and indicative results for the year 2005 and 2020 are displayed in table 14, respectively, ordered by SOS position: the higher the S/D index value, the better the SOS position.

**Table 14: S/D Index, EU-27 and Member States 2005 and 2020 PRIMES Based, EU Trends to 2030**

	<b>2005 Index 0-100</b>		<b>2020 Index 0-100</b>
<b>Denmark</b>	82	<b>Denmark</b>	83
<b>United Kingdom</b>	80	<b>Sweden</b>	71
<b>Ireland</b>	75	<b>Netherlands</b>	70
<b>Sweden</b>	70	<b>United Kingdom</b>	67
<b>Romania</b>	70	<b>France</b>	66
<b>Netherlands</b>	69	<b>Germany</b>	63
<b>EU 27</b>	65	<b>EU 27</b>	62
<b>Czech Republic</b>	64	<b>Romania</b>	61
<b>France</b>	64	<b>Czech Republic</b>	61
<b>Germany</b>	63	<b>Ireland</b>	58
<b>Poland</b>	60	<b>Belgium</b>	55
<b>Bulgaria</b>	59	<b>Poland</b>	55
<b>Belgium</b>	57	<b>Austria</b>	54
<b>Austria</b>	57	<b>Bulgaria</b>	54
<b>Estonia</b>	55	<b>Finland</b>	54
<b>Hungary</b>	55	<b>Spain</b>	50
<b>Finland</b>	53	<b>Hungary</b>	50
<b>Slovenia</b>	52	<b>Slovenia</b>	49
<b>Spain</b>	51	<b>Italy</b>	49
<b>Slovak Republic</b>	51	<b>Estonia</b>	49
<b>Italy</b>	50	<b>Slovak Republic</b>	47
<b>Portugal</b>	47	<b>Portugal</b>	45
<b>Lithuania</b>	45	<b>Lithuania</b>	43
<b>Greece</b>	44	<b>Greece</b>	42
<b>Latvia</b>	40	<b>Latvia</b>	41
<b>Malta</b>	30	<b>Malta</b>	32
<b>Luxembourg</b>	28	<b>Luxembourg</b>	32
<b>Cyprus</b>	25	<b>Cyprus</b>	27

Source: ECN

### 2005 Scores

The average value of the S/D index in 2005 is about 56. The range is from 82 (Denmark) to 25 (Cyprus). The differences between MS are mostly caused by differences in the PES (Primary Energy Sources) parts, caused by both the relatively large spread in the PES sub-index (ranges from 0 to 97, average of 53), see table 15, and the relative high weight of the PES sub-index (0.49) in the total S/D Index. MS with high import dependencies for oil and gas, combined with high shares of these imports originating from outside the EU/Norway, have a relatively low score, i.e. an S/D Index below 50. Such MS include: Cyprus, Luxembourg, Malta, Latvia, Greece, Lithuania and Portugal. On the other hand, MS that are net exporting for gas and/or oil have a relatively high score, i.e. an S/D Index of 60 or higher. Examples are Denmark (82) and the United Kingdom (80). In addition, MS that are net importers but import mainly from within EU/Norway also get high scores. An example is Ireland (75), and to a lesser extent Sweden (70). The Netherlands (69) has a high score due to being a net gas exporter. Romania (70) has relatively low import dependencies for oil and gas, added to moderate shares of coal/nuclear in its PES mix. France (64), Czech Republic (64), Germany (63) and Poland (60) have high scores due to their large shares of nuclear and/or coal in the PES mix. As most of the largest MS (Germany, France, United Kingdom) are part of the best scoring MS, the EU-27 aggregate score is also relatively high (65).

**Table 15: S/D Index and Sub-Indices, EU-27 and Member States PRIMES Based**

	<b>S/D Index</b>	<b>Primary Energy Sources</b>	<b>Conversion and Transport</b>	<b>Demand</b>
<b>EU-27-2005</b>	65.4	65.3	75.1	58.7
<b>EU-27-2020</b>	62.1	56.1	82.7	57.4
<b>BG-2005</b>	59.0	60.4	74.6	45.8
<b>BG-2020</b>	53.9	51.4	82.1	38.3
<b>AT-2005</b>	56.6	44.6	85.5	55.8
<b>AT-2020</b>	54.1	39.0	89.7	53.9
<b>BE-2005</b>	57.2	61.9	61.1	46.9
<b>BE-2020</b>	55.1	51.8	73.3	47.7
<b>CY-2005</b>	25.1	4.4	42.5	46.7
<b>CY-2020</b>	27.0	5.8	43.5	50.0
<b>CZ-2005</b>	64.4	68.3	89.9	40.2
<b>CZ-2020</b>	60.9	60.9	92.2	38.9
<b>DE-2005</b>	62.7	64.9	60.0	60.8
<b>DE-2020</b>	62.9	59.7	71.7	62.0
<b>DK-2005</b>	82.1	93.6	79.0	65.6
<b>DK-2020</b>	82.9	95.9	79.9	63.7
<b>EE-2005</b>	54.8	63.9	48.4	44.6
<b>EE-2020</b>	48.9	49.7	54.4	43.8
<b>EL-2005</b>	43.9	34.1	48.4	56.7
<b>EL-2020</b>	41.8	29.5	53.6	53.7
<b>ES-2005</b>	51.0	37.2	73.8	57.6
<b>ES-2020</b>	50.1	34.5	79.4	54.9
<b>FI-2005</b>	53.4	61.5	51.5	41.6
<b>FI-2020</b>	53.6	61.9	51.5	41.6
<b>FR-2005</b>	63.8	67.8	57.4	61.8
<b>FR-2020</b>	65.7	69.5	61.3	62.5
<b>HU-2005</b>	54.8	49.0	78.3	47.8
<b>HU-2020</b>	49.5	39.9	80.3	43.5
<b>IE-2005</b>	74.5	94.9	53.7	55.8
<b>IE-2020</b>	57.8	58.9	58.0	55.8
<b>IT-2005</b>	49.5	29.3	67.8	69.8
<b>IT-2020</b>	49.0	31.1	67.3	65.6
<b>LV-2005</b>	40.2	31.6	51.8	46.1
<b>LV-2020</b>	40.6	35.0	55.1	39.7
<b>LT-2005</b>	45.1	25.5	60.3	66.6
<b>LT-2020</b>	43.0	22.9	65.7	60.0
<b>LU-2005</b>	28.2	11.2	67.7	28.2
<b>LU-2020</b>	31.7	15.9	70.5	30.2
<b>MT-2005</b>	30.4	0.2	31.8	78.6
<b>MT-2020</b>	32.2	2.5	33.5	79.9
<b>NL-2005</b>	69.4	72.9	90.0	49.2
<b>NL-2020</b>	70.4	75.0	91.4	48.2
<b>PL-2005</b>	60.2	68.5	55.9	49.6
<b>PL-2020</b>	54.8	58.1	60.6	45.4
<b>PT-2005</b>	46.6	27.3	70.7	61.3
<b>PT-2020</b>	45.2	26.8	74.1	55.1
<b>RO-2005</b>	69.9	77.1	86.2	46.9
<b>RO-2020</b>	61.0	63.2	86.3	39.7
<b>SE-2005</b>	70.4	87.5	49.0	57.3
<b>SE-2020</b>	70.6	79.1	64.0	61.2

<b>SI-2005</b>	52.2	49.5	73.0	41.8
<b>SI-2020</b>	49.1	42.9	75.4	40.7
<b>SK-2005</b>	50.6	47.5	80.4	34.8
<b>SK-2020</b>	47.0	42.1	82.3	30.1
<b>UK-2005</b>	79.6	97.0	66.2	60.5
<b>UK-2020</b>	67.4	69.4	72.4	60.8

Source: ECN

### **2020 Scores Using the Updated DG TREN Baseline Scenario**

On average, the S/D Index decreases by almost 3 points compared to 2005 (from 56 to 53), mainly caused by a decrease in the PES sub-index (decrease of 6 points). So, the SOS position is somewhat less in 2020 than in 2005. The division into low/intermediate/high scoring MS does not really change when compared to today's situation (table 14). In an absolute sense, Ireland and the UK observe the largest decrease in S/D Index (drop of 17 and 13 points, respectively), but both remain as relatively high scoring MS in 2020<sup>53</sup>. PES sub-index scores decreases are generally caused by higher import dependencies in 2020 and higher shares of imports from outside EU/Norway. For some MS, a combination of increasing shares of gas and decreasing shares of coal/nuclear also contribute to a decrease in the PES sub-index, and hence in the S/D Index. Some examples of this latter effect are Belgium, Estonia and Poland. The C+T (Conversion and Transport) sub-index increases on average (almost 5 points) due to the improved overall efficiency of electricity generation and higher shares of CHP in electricity production. Changes in the Demand sub-indices are moderate, which on the one hand reflects a 'moving' benchmark value based on the best performing MS, and on the other hand, a stand-still of the residential energy intensity benchmark. On average, a decrease of 2 point is observed, mainly due to a higher value of the residential energy intensity.

### **Use of Other Scenarios**

It should be noted that the development up to 2020 may be rather scenario specific. Quantification of the policy scenarios, e.g. the "Scenarios on energy efficiency and renewables", (EC, 2006b) rather than the baseline "Trends to 2030" (EC, 2006) scenario may give somewhat different results.<sup>54</sup> In the previous report (Scheepers et al., 2006) other examples of the impact of using other (country specific) scenarios have been presented (for the Netherlands and the UK). The first application of the S/D Index for Ireland (based on the old S/D Index model) is another example (SEI, 2006).

### **Use of the S/D Index as a Benchmarking or Policies Comparison Tool**

The S/D Index model can be used for benchmarking and comparison purposes, for historic recent years (statistics) or for the future (scenarios). For the purpose of an inter MS comparison (benchmarking of MS against each other or e.g. against an average or benchmark value), comparison of future situations will only make sense if the same overall scenario is used for all MS. For the purposes of assessing the possible impact of different policies as resulting in different future developments of the energy system, comparisons for a specific MS or for the EU aggregate make sense. In that case, national MS specific scenarios can be used to observe the effects of changes in the energy system over time, and to assess how policy induced changes may have an effect on the energy system and how different policy options compare to each other. Moreover, changes in S/D index values can be compared to other effects, e.g. the CO<sub>2</sub> reduction over the respective time period (2005-2020).

## **6.3 Data Assumptions for Ireland**

### **2005 and 2006**

For the 2005 and 2006 quantifications, the SEI energy balances were used to the extent possible, resulting in estimates for:

- Final energy demand shares (weights for demand scores),

<sup>53</sup> For MS that are net exporters (e.g. UK) or that have low shares of imports coming from outside EU/Norway (Ireland) in the year 2005, a generic assumption has been imposed for the year 2020, as such origin data are not known from the scenario. It is assumed that 50% of the imports of oil and gas come from outside the EU/Norway. For the other MS, the origins of these imports have been assumed equal for 2005 and 2020.

<sup>54</sup> For the EU-25 as an aggregate, five of these policy scenarios have been quantified for the previous version of the S/D index model (Groenenberg and Wetzelaer, 2007).

- Shares of primary energy sources (weights for PES scores) and
- Import dependencies (used in scoring PES).

It should be noted that the 2006 energy balance contains provisional data.

Other information provided by SEI includes:

- CHP share in electricity production (used in scoring C+T heat part),
- Average efficiency of thermal electricity production (used in scoring electricity).

Eurostat data have been used for the import origin of oil and gas, in particular the share of the imports coming from outside the EU and Norway. In 2005, these shares were 0% (In 2004, these were 2.8 and 0%, respectively, including oil imports from Libya).

The most recent PRIMES scenario data (EC, 2006) have been used as basis for estimates of the final (sectoral) energy intensities.

For the electricity reserve margin and import connection, EC Benchmarking reports have been used, resulting in 10.4% (domestic capacity in relation to peak demand) and 6% (import connection as fraction of domestic capacity), respectively. The CHP shares were provided by SEI and equal 2.2% and 5.4%, for 2005 and 2006, respectively. The most recent PRIMES value for 2005 presents 2.8% for the CHP share.

Values of 40.6% and 41.2% were used for the efficiency of electricity production.

## 2020

From the SEI forecast of the year 2020, the following parameters have been used:

- Final energy demand shares,
- Shares of primary energy sources,
- Average efficiency of thermal electricity production (44.0%).

The CHP share was taken equal to 2006 value (5.4 %). PRIMES had 5.2%.

Other parameters have been assumed to be equal as in the PRIMES case.

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