Annex D – Basis for Targets

The following sections describe the basis for the setting of each of the sector targets. In general, the levels at which the targets have been set derive from a combination of the expected effects of the policy measures proposed, plus the estimated effects of the continuation of existing policy measures and an assumed level of autonomous change.

Industry & mining

Assumptions

In the absence of any further improvements in energy efficiency, the 'business as usual' total energy consumption across the industry & mining sector is assumed to increase in proportion to the projected sectoral GDP, which is itself assumed to grow according to an extrapolation of recent trends in its share of total GDP. The result is that total consumption in 2030 would reach 1,421 PJ, of which 284 PJ is the consumption of mining.

Quantifiable effects of measures

The effects of the 12L tax incentive are based on an assumption (described in more detail in Annex C) that the rate of uptake will increase in proportion to the size of the effect that 12L has on the NPV of energy efficiency projects. Based on the rate of uptake seen to date, it is expected that additional savings of 70 PJ would result from a continuation of 12 L in its current form. Adjustments to 12L in order to increase its level of take-up are expected to yield further savings of 42 PJ.

The combination of mandatory energy management plans for the most energy intensive enterprises plus incentivising the development of energy management systems (with ISO50001 certification where appropriate) for other enterprises is expected to yield savings of 55 PJ by 2030 in the manufacturing sub-sector plus a further 10 PJ in the mining sub-sector. This is based on observations of international experience described in the literature, where savings of 5% are typically recorded in enterprises that introduce energy management systems. An allowance has then been made for the fact that energy management systems have already been introduced in a number of large enterprises, under the UNIDO IEE programme.

Total savings of about 42 PJ are expected to result from the provision to SMEs of audits, targeted advice and information, and the dissemination of best practice. Of this, about 7 PJ of savings are expected to occur in the mining sub-sector. This estimate derives from the results obtained from similar schemes internationally, where opportunities for savings of up to 20% are often identified. Assuming 50% participation levels, and a 50% uptake of identified opportunities, this leads to expected savings of about 5% among SMEs, which translates to about 3% across the whole targeted sector.

Minimum energy performance standards (MEPS) for motors are expected to yield total energy savings of at least 2 PJ. This estimate is based on the results of a simple spreadsheet model of the stock of industrial motors. The introduction of MEPS and energy efficiency labelling for packaged motor-driven systems, along with the introduction of an energy efficiency endorsement label to operate alongside existing labelling schemes, are together estimated to yield a further 4 PJ of savings, giving a total of 6 PJ across the industry & mining sector. It may be assumed that about 1 PJ

of this will occur within mining. Overall, this represents a somewhat conservative estimate of the total savings that may be expected from standards and labelling, since it does not include the savings that may be realised through the introduction of minimum mandatory design standards for industrial boilers (for which insufficient data was available to allow an estimate to be made).

The total savings expected from the measures defined are therefore approximately 137 PJ across the whole industry & mining sector. A further 70 PJ of savings are expected to result from a continuation of the existing 12L, giving a total of 207 PJ. Of this total, about 185 PJ is expected to occur in the manufacturing sub-sector, which represents about 16% of the projected 2030 total. The total expected saving within mining is estimated to be about 40 PJ.

Targets

Two targets are proposed for the industry & mining sector:

- 16% reduction in the weighted mean specific energy consumption of manufacturing
- 40 PJ cumulative annual saving from energy efficiency interventions in mining

The manufacturing target is based on the expected effects of the measures described above. The expected savings of 184 PJ represent 16% of the projected 2030 consumption in the manufacturing sub-sector. The target is consistent with an assumption of an average 5% energy saving in the energy-intensive process-specific activities (e.g. blast-furnaces, smelters, cement kilns etc.) along with an average 30% saving in generic energy-using activities (HVAC, lighting, pumps, conveyers etc.) including the effects of behavioural change.

The mining sector target is based on an estimate of the typical savings achieved by the major mining companies over recent years combined with a synthesis of their stated energy saving targets expressed for the near future. Note that the mining target is expressed as a bottom-up summation of the effects of individual energy savings initiatives, because neither specific energy consumption (energy per unit of product mined) nor energy intensity (energy per unit of economic output) is a satisfactory proxy for energy efficiency in mining.

Overall impacts

The expected impact at the sector level is that there will be a 15% reduction in energy consumption attributable to efficiency improvements across the industry & mining sector by 2030 relative to a 2015 baseline. This represents the saving that would be observed through a decomposition analysis conducted in 2030 after the effect of structural change and changes in activity level are accounted for. The figure of 15% is derived from a weighted mean between the 16% reduction in SEC for manufacturing (which, all else being equal, would translate to an impact of 16% energy saving) and the 40 PJ target energy saving in the mining sub-sector.

Commercial buildings

Assumptions

The overall building stock is assumed to increase in proportion to expected sector share of GDP. This in turn is expected to grow according to an extrapolation of recent trends, which will see the commercial sector's share of GDP reach about 49% by 2030. This rate of growth in the building stock, combined with assumptions about the turnover rate of buildings, means that about half of the

2030 total stock of commercial buildings consist of buildings constructed or extensively refurbished since 2015.

Targets

The target proposed for the commercial buildings sector is a 37% reduction in the specific energy consumption (annual energy consumption per m^2) of lettable / habitable floor area across the sector. This target is based on an assumption that the average specific energy consumption of buildings constructed after 2015 will be 54% lower by 2030 relative to a 2015 baseline. Of this improvement, about 22% is attributable to the effects of building standards already in place. in other words, it is assumed that even if building standards were not tightened any further, the average performance of new buildings constructed between 2015 and 2030 would be 22% better than the current baseline performance.

Retrofits of existing buildings are assumed to result in an average improvement in specific energy consumption of 20%. Since new buildings are assumed to account for half of the 2030 building stock, the weighted mean of these improvements is a 37% reduction in specific energy consumption across the whole sector.

Overall impacts

It is expected that the sector disaggregation of available energy consumption data in 2030 will broadly match that of today, which will make it impossible to perform a decomposition analysis at a detailed level. The Energy Balance Table data combines the public and commercial sectors into a single sector, and this situation is expected to continue to 2030. The high-level impact of the expected energy savings in the commercial buildings sector will therefore not be separable from those in the municipal services or public buildings sectors. Across the combined public & commercial sector, it is expected that there will be a 37% reduction in energy intensity in 2030 relative to a 2015 baseline, which is a weighted mean of the 37% savings in commercial buildings described here, combined with the corresponding savings from the municipal services and public buildings sectors.

Public buildings

The assumed rate of increase in the total number of public buildings, and the rate of turnover, are taken from the Department of Energy's draft Energy and Climate Change Strategy (ECCS) for the Public Buildings Sector. This indicates that about 54% of the total stock of public buildings in 2030 will consist of buildings constructed since 2015.

Quantifiable effects of measures

The effects of the measures proposed are divided into two categories: new buildings and existing buildings.

Savings relating to new buildings are expected to amount to 25 PJ annually by 2030. Most of this saving results from the effects of tightened building standards. A simple spreadsheet model of the stock of new public buildings applied a trajectory for tightening of building standards that reached a level in 2030 that gives a specific energy consumption 72% lower than today's standards. However, in keeping with the principle of 'Leading by Example', and assuming the use of green procurement in the negotiation of leases, it is assumed in the model that the public sector leads changes in building standards rather than merely responding to them by procuring buildings whose performance is three years ahead of the trajectory of building standards. In this way, the stock of public buildings

built between now and 2030 has a performance that is on average 54% better than the current new-build.

In addition to this, it is assumed that behavioural change and improved awareness among building occupants results in a further saving of 10% relative to the projected baseline consumption, with the result that the overall specific energy consumption of post-2015 buildings is 64% lower in 2030 than the current level.

Savings in public buildings constructed before 2015 are expected to amount to 10 PJ annually by 2030. Retrofits to the fabric of the buildings is expected to yield annual savings of about 4 PJ, which is equivalent to an average saving of 15% across the whole stock of pre-2015 buildings. This is broadly consistent with the draft ECCS, which envisaged a three-tier approach to retrofitting public buildings where the current condition of the building would determine whether it received a minor, moderate or major retrofit.

The remaining 6 PJ of savings in pre-2015 public buildings are assumed to result from a combination of behavioural change and raised awareness, applying green procurement to the purchase of plug-load items and improved management of building energy consumption (for example, through the designation of 'energy champions' throughout public buildings).

Targets

The target proposed for public buildings is for a 50% reduction in the specific energy consumption (annual energy consumption per m^2) of lettable / habitable floor area across the sector. This is based on the estimated savings of 35 PJ described above, relative to the projected total energy consumption of public buildings for 2030, which is expected to reach 70 PJ.

Overall impacts

It is expected that the sector disaggregation of available energy consumption data in 2030 will broadly match that of today, which will make it impossible to perform a decomposition analysis at a detailed level. The Energy Balance Table data combines the public and commercial sectors into a single sector, and this situation is expected to continue to 2030. The high-level impact of the expected energy savings in the public buildings sector will therefore not be separable from those in the municipal services or commercial sectors. Across the combined public & commercial sector, it is expected that there will be a 37% reduction in energy intensity in 2030 relative to a 2015 baseline, which is a weighted mean of the 50% savings in public buildings described here, combined with the corresponding savings from the municipal services and commercial sectors.

Municipal services

Assumptions

Demand for lighting and water pumping services and for transportation services are all assumed to grow in proportion to the projected population growth. The result is that total consumption in the absence of any further improvements in efficiency would be expected to reach 20 PJ for streetlighting and water, and another 20 PJ for transportation by 2030.

A simple spreadsheet model was used to estimate the energy savings that could be achieved in meeting the demand for streelighting services, traffic lights, water supply and wastewater treatment. The model used the assumption that existing pumping systems would be upgraded with

variable speed drives and more efficient motors over a five-year time period, and that further optimisation of systems would take place after another 10 years. Street lighting upgrades were assumed to take place over a two year period, with a further upgrade to LED lighting after another 5 years had elapsed.

Quantifiable effects of measures

The spreadsheet model indicated that savings of almost 5 PJ would result from upgrades to streelighting, traffic lights and water services. It was estimated that almost 1 PJ of these savings had already been realised through the current EEDSM programme. The 4 PJ of future savings represents 20% of the 2030 consumption expected under a business as usual projection.

Targets

Two targets are proposed for the municipal services sector:

- 20% reduction in the energy intensity (measures as energy consumption per head of population served) in the provision of electricity-intensive municipal services (namely, streetlighting, traffic lights, water supply and wastewater treatment).
- 30% reduction in the fossil fuel intensity of municipal vehicle fleets (measures as total fossil fuel consumption per head of population served).

The municipal services target is based on results of a simple spreadsheet model for estimating the potential savings from retrofitting streetlights and optimising pumping systems between now and 2030. The estimates were adjusted to take account of the savings that have already been achieved to date through the EEDSM programme.

The vehicle fleet target is based on the assumption that a 20% improvement in the technical efficiency the fleet (as per the Transport Sector target) is complemented by additional savings of 10% from a combination of driving training, optimising vehicle usage and substitution of alternative fuels.

Overall impacts

It is expected that the sector disaggregation of available energy consumption data in 2030 will broadly match that of today, which will make it impossible to perform a decomposition analysis at a detailed level. The Energy Balance Table data combines the public and commercial sectors into a single sector, and this situation is expected to continue to 2030. The high-level impact of the expected energy savings in the municipal services sector will therefore not be separable from those in the public buildings or commercial sectors. Across the combined public & commercial sector, it is expected that there will be a 37% reduction in energy intensity in 2030 relative to a 2015 baseline, which is a weighted mean of the 20% savings in municipal services and the 30% savings in municipal vehicle fleets described here, combined with the corresponding savings from the public buildings and commercial sectors.

Residential sector

Assumptions

The following assumptions form the basis of estimates for the likely effect of energy efficiency policy measures and for the formulation of targets in the residential sector:

- World Bank projections for annual population growth were used to estimate the total population for each year through to 2030. On the basis of these projections, total population in 2030 is estimated to reach about 55.3 million
- Recent declining trends in the average size of households were extrapolated through to 2030, with the result that the average household size in 2030 is estimated to be 2.79
- The result of these two trends is a growth in the total number of households, to reach 19.8 million by 2030
- Recent trends in the share of households by LSM band were extrapolated to 2030, with the following results:
    - 5% of households in LSMs 1-3 (down from 12% today)
    - 18% of households in LSMs 4 & 5 (down from 28% today)
    - 42% of households in LSMs 6 & 7 (down from 36% today)
    - 35% of households in LSMs 8-10 (up from 24% today)
- Energy intensity per household by LSM band was assumed to remain at the same levels as those estimated from the results of the household energy surveys conducted during the development of the EETMS

Based on these assumptions, it was estimated that the total annual final energy consumption in the residential sector would reach 304 PJ by 2020, 351 PJ by 2025 and 405 PJ by 2030 if there were no improvements in efficiency.

Quantifiable effects of measures

Appliance-related measures

Three components of the package of policy measures relate specifically to household appliances: successive tightening of appliance minimum energy performance standards (MEPS); introduction of an energy endorsement label; scrappage scheme for appliances.

It is envisaged that, between now and 2030, MEPS for each category of appliance would be tightened twice, each time by a single 'band' on the energy label. Table 1 shows the effect of tightening standards in this way on the minimum energy performance of appliances sold. It is assumed that the effect of appliance labelling (both the existing labelling system and the proposed new energy endorsement label) will complement the effect of MEPS such that the average energy performance of appliances sold will change by the same percentages as those shown in Table 1. In other words, it is assumed that, as MEPS are tightened, the distribution sales versus performance level will not change in shape, but will merely shift towards higher performance levels.

Table 1 Effect of tightening MEPS on the minimum performance of a range of appliance types

Appliance	Current (proposed) MEPS	% change by moving up to next band	% change by moving up one further band
Refrigerator	B	27% by moving to A	22% by moving to A+
Freezer	C	21% by moving to B	27% by moving to A
Dishwasher	A	11% by moving to A+	11% by moving to A++
Washing machine	A	13% by moving to A+	12% by moving to A++
Tumble dryer	C	12% by moving to B	14% by moving to A
Air conditioner	B	6% by moving to A	Better than A not yet defined
Electric geyser	B	54% reduction in standing losses by moving to A	Better than A not yet defined

A simple spreadsheet model was used to estimate future trends in ownership levels of key appliances, based on the assumptions described above relating to household numbers and distribution between LSMs. Ownership rates of appliances within each LSM band were assumed to remain the same as those estimated from the results of the household energy surveys conducted under the EETMS development, as described in Annex C. This is a reasonable assumption, since the ownership levels of appliances are a strong determinant of which LSM band a household is assigned to. The spreadsheet model also assumed that, when a new appliance is purchased, it replaces one already in use. in reality, this may not always be the case, but the purpose of the scrappage scheme is to make this scenario more likely.

The spreadsheet model was used to project expected future annual sales for each category of appliance, from which it was possible to determine the impact on total energy consumption of the changes in energy performance of new appliances sold. The results of the model indicate an expected saving of 31 PJ annually by 2030, which is additional to the 15.5 PJ annual saving that is expected to result from the continuing effects of the existing MEPS and labelling schemes. This overall saving of 46.5 PJ equates to 11.5% relative to the projected 2030 baseline total consumption. The corresponding figures for 2020 and 2025 are 7.6 PJ (2.5%) and 24 PJ (6.9%) respectively.

Note that these results differ from those presented in Annex C (Cost Benefit Analysis). Those results are more conservative, as they attempt to separate out the direct attributable effects of tightening MEPS from any 'business as usual' trends. Because South Africa is integrated into the global market for appliances (in particular, the EU market), it may be assumed that even if local MEPS were not tightened at all, there would still be a steady upward trend in the efficiency of new appliances sold. The figures derived in Annex C were based on the conservative assumption that only first-time purchasers of appliances would be sufficiently price-constrained that they would be directly affected by tighter MEPS. For all other categories of purchaser, it was assumed that any trends of increased efficiency of purchased appliances represents 'business as usual'.

Buildings-related measures

Three components of the package of policy measures relate specifically to buildings: successive tightening of building standards; energy performance certificates for residential buildings; financial incentives to undertake thermal improvements of existing dwellings.

Based on the assumptions on population growth and trends in household size, it is estimated that there will be 3.6 million additional households by 2030 relative to 2015. Assuming an average annual replacement rate of existing residential buildings of 1%, this implies the overall total of new builds is therefore expected to be about 6.25 million, each of which provides an opportunity for energy savings through tighter building standards.

A synthesis of available estimates from the literature suggests that the application of aggressively tightened building standards could result in annual savings of 6 GJ per new home. Given that tighter standards would not be introduced in a single step at the beginning of the strategy period, it is assumed that only half of these savings would actually be realised in new builds between now and 2030, giving a total saving of 19 PJ by 2030, or 4.6%.

With regard to energy efficiency retrofits in existing buildings, estimates in the literature suggest that the total heating and cooling load could be cost-effectively reduced by 30% in many cases. Assuming that savings of this magnitude are realised in 50% of homes by 2030, and assuming that heating and cooling account for 20% of total energy consumption in the average household, energy efficiency retrofits could account for savings of around 3% of total sectoral consumption by 2030.

Effects of other measures

Three other measures complete the package of policy measures proposed for the residential sector: awareness-raising and the provision of information; engaging municipalities in developing and disseminating materials; energy savings obligation on distributors.

The last of these measures is a mechanism whereby the full effects of other measures (particularly those relating to buildings) may be realised. It is not therefore expected to yield any additional savings beyond those that have already been quantified. The other two measures are expected to have an effect by means of stimulating behavioural change. Given the difficulty both of quantifying the effect of behavioural change and of attributing it to a specific cause, the effects of these measures cannot be determined with any certainty. It is therefore tentatively assume that further savings of 10% by 2030 may result from these measures.

Other factors

None of the measures proposed for the residential sector specifically addresses lighting. This is because a continued shift from incandescent lamps towards CFLs is considered to be part of the 'business as usual' trend. Eskom have already distributed 64 million CFLs to households (equivalent to about 4 lamps per dwelling) as part of their mass rollout programme, and it is assumed that incandescent lamps will be virtually eliminated in the near future even in the absence of any additional policy measures.

Between now and 2030, it is likely that LEDs will take over as the dominant lighting technology in homes, which will lead to additional energy savings of up to 50% per lamp. However, it is impossible to determine at this stage whether this shift will occur autonomously, or whether some policy intervention would be necessary to accelerate it. For the purpose of the current strategy, it is assumed that any future improvements in lighting efficiency happen autonomously, and are therefore not attributed to the policy measures described. However, the effects of these improvements in efficiency will be observable when trends in energy consumption are monitored in the future, so it is necessary to estimate their likely magnitude.

Based on Eskom data on the mass rollout of CFLs, it is estimated that the lamps already distributed will lead to annual savings of about 14 PJ. Taking into account the projected increase in the number of households and improvements in living standards, it is estimated that a further 12 PJ annual reduction in consumption (relative to 'business as usual') will be attributable to the completion of the shift to CFLs by 2030. Further savings resulting from a 60% penetration of LED lighting would amount to 4 PJ by 2030, giving a total saving of 16 PJ, or 4% of the projected 2030 baseline.

Targets

Two targets are proposed for the residential sector:

- 33% reduction in the average specific energy consumption of new household appliances purchased
- 20% improvement in the average energy performance of the residential building stock

The appliances target is based on an assumption that there will be two successive tightenings of appliance MEPS between now and 2030, as described in Table 1 above. It is further assumed that the effect of appliance labelling ensures that the average energy performance levels of new appliances sold move by the same percentages as the minimum performance levels described in the table. The overall target improvement in average specific energy consumption is derived from a weighted mean of the individual reductions by appliance type, weighted according to expected sales.

The target for energy performance in residential buildings is based on a combination of two factors:

- a 38% improvement in the average energy performance of new dwellings built between now and 2030, through tightening of building standards. This is based on an average year-on-year tightening of 8%, but implemented in three step-changes (in 2018, 2023 and 2028)
- a 12% improvement in the thermal performance of dwellings built before 2015, achieved through thermal retrofits. This is based on an assumption that average savings of 30% per dwelling are possible and that 40% of all dwellings are retrofitted.

New dwellings built after 2015 are expected to account for 32% of all homes by 2030. This is based on the expected rate of increase in the number of households described above, combined with an assumed rate of turnover of 1% of existing buildings, which leads to a total of 6.25 million new builds between now and 2030. A weighted mean of the two percentage improvements described above leads to an overall average improvement of approximately 20% across the whole 2030 stock of buildings.

Overall impact

The overall impact of the measures proposed for the residential sector, plus the effects of measures already in place and of autonomous change, will amount to a 33% sector-wide reduction in final energy consumption from efficiency improvements by 2030 relative to a 2015 baseline. This represents the efficiency improvement that would be seen form a decomposition analysis designed to separate out the effects of: (i) an increase in the number of households; and (ii) improvements in living standards[1]. The causal factors behind this expected impact are as follows:

- Improved appliance efficiency – 11.5% (of which 3.8% results from the standards and labels already in place)
- Improved efficiency of new buildings – 4.6%
- Energy efficiency retrofits to existing buildings – 3%
- Behavioural change – 10%
- Improved lighting technology – 4% (all of which is assumed to be autonomous)

[1] The use of shifts between LSM strata as an analogy to structural effects within a decomposition analysis is described in the supporting documentation to the Energy Efficiency Target Monitoring System.

Transport

Assumptions

The estimates of the effects of the proposed measures, which form the basis for the sector target, are based on the following base case assumptions:

- the current total stock of road vehicles is 9.4 million
- the average annual growth rate in vehicle numbers is 3%. Note that this is slightly lower than the projection made in 2012 by NAAMSA, but this takes into account the downgraded economic growth forecasts since then.
- the average specific fuel consumption of the current total stock of road vehicles is 40% higher than that of the average new vehicle.
- the average age at replacement for road vehicles is 15 years – i.e. about 6.7% of the stock of vehicles is replaced each year.
- the average fuel efficiency of new vehicles will improve steadily year-on-year to reach a level in 2030 where it is 40% better than today

Using a simple spreadsheet model of the stock of road vehicles, these base case assumptions lead to an improvement in the average fuel efficiency of the vehicle fleet of 13% by 2030.

Quantifiable effects of measures

The indicator against which the sector target has been set is the average fuel efficiency of the total stock of road vehicles. Note that this indicator refers to 'ideal' fuel efficiency, which depends on the design and age of vehicles, but not on the behaviour of drivers. Out of the range of measures proposed for the transport sector, three will have a direct impact on this indicator:

- minimum fuel efficiency standards for new vehicles
- stricter roadworthiness tests that include emissions testing
- voluntary agreements with vehicle manufacturers

These measures will have the effect of preventing the poorest performing new vehicles from entering the stock of vehicles; accelerating the rate at which the worst performing older vehicles are removed from the roads and accelerating the rate at which new technologies and innovations are introduced into the South African market.

While all of these measure will contribute towards improving the fuel efficiency of the overall stock of vehicles, it would be unreasonable to attribute the whole of any such change to the measures implemented. Firstly, vehicle labelling is already in place in South Africa, so there is already a market pull in the direction of more efficient vehicles. Secondly, South Africa is part of a global vehicle market within which there is a strong trend towards improving fuel efficiency, so even if no additional policy measures were introduced, the average performance of new vehicles would improve significantly between now and 2030.

The effect of the proposed measures is therefore assumed to be:

(i) that the average fuel economy of new vehicles in 2030 is 50% better than today (against a base case of a 40% improvement). A 50% improvement is consistent with the estimate of the potential from improved vehicle performance made by the IEA.

(ii) the average age of replacement for vehicles is shortened to 14 years (versus a base case assumption of 15 years).

The simple spreadsheet model indicates that the effect of the measures is that the overall average fuel efficiency of the stock of vehicles in 2030 is 20% better than today, indicating that the measures have contributed a 7 percentage point improvement in average vehicle performance. Based on a projected annual consumption of road vehicles in 2030 of 1,350 PJ, this indicates that the measures have led to an annual energy saving of about 100 PJ. The 20% improvement in average fuel efficiency corresponds to a total saving of about 270 PJ, of which 170 PJ is therefore assumed to be due to the effects of existing measures, plus 'autonomous changes' in vehicle fuel efficiency.

Note that, according to the Department of Transport draft strategy for greenhouse gas emission reductions, improving the fuel efficiency of road vehicles is expected to yield emission reductions of 20,660 kt CO_2 by 2030. Assuming an average carbon intensity for transport fuels of about 70 kt CO_2 per PJ, this implies an energy saving of about 300 PJ annually. Although this is slightly higher than the 270 PJ estimated above, the two figures are broadly consistent. In particular, the Department of Transport draft strategy does not specifically address the effect of driver behaviour, so it may therefore be assumed that this is subsumed into the 300 PJ saving attributed to vehicle efficiency.

Target

The rationale for setting a target only in relation to vehicle efficiency is that this is the only indicator for which an effect may be directly and quantifiably attributable to the measures proposed. For the other three measures (voluntary agreements with operators of private passenger fleets; a national eco-drive strategy; and accreditation for specialist transport sector energy auditors), it will clearly be necessary to set performance targets at the output / outcome level at the time that those measures are implemented. However, it is not feasible to quantify the results of those measures in the form of an energy saving impact. While it would be possible to set targets relating to the extent to which other changes occur (for example, modal shifts from road to rail for freight, and increased use of public versus private passenger transport), the measures necessary to bring about these changes would fall largely outside the remit of the Department of Energy.

The target proposed for the transport sector is a 20% reduction in the average vehicle energy intensity of the road vehicle fleet (energy consumption per km according to the vehicle fuel economy label). This target is based on the estimates described above with regard to the improvement that would result by 2030 if: (i) the average fuel efficiency of new vehicles is 50% better than today; and (ii) the average age at which road vehicles are replaced falls from 15 years to 14 years.

Overall impacts

The overall impact on sector-wide energy consumption of the measures described, plus other measures that fall outside the remit of the Department of Energy, plus the effects of autonomous change, is assumed to be broadly in line with the estimate made in the Department of Transport draft strategy for greenhouse gas emission reduction. Subtracting the effects of fuel switching, their estimate for the annual emission reduction resulting from the package of measures they describe is about 33,000 kt CO_2 by 2030, which corresponds to a saving of about 39%.

Based on the estimate described above that 20% savings may be attributed to improvements in the efficiency of road vehicles (of which 7% derives from the proposed measures and 13% is due to 'autonomous change'), this implies that the remaining 19% saving derives from a combination of modal shifts and driver behaviour within road transport, plus savings from improved vehicle efficiency in rail and aviation.

Agriculture

Assumptions

Based on an extrapolation of current trends in sector share of GDP, if the energy intensity agriculture remains unchanged, the total energy consumption of the sector is expected to reach about 95 PJ by 2030. This is expected to be made up of about 62 PJ of petroleum products and 33 PJ of electricity.

Irrigation is the largest consumer of electricity in the agricultural sector, estimated by the Department of Energy to account for about 27% of total electricity consumption in the sector. Based on a scaling up of the savings identified in an Eskom study, the potential electricity saving from optimising centre-pivot irrigation systems is estimated to be almost 1 PJ by 2030, which corresponds to a saving of about 3% of total sector-wide electricity consumption. A number of published case studies of individual energy efficiency project in irrigation indicate that savings of 40% are possible in some systems. Based on the figures cited above, it is tentatively assumed that the potential exists for electricity savings of about 2-4 PJ from motor-driven systems, which includes not only irrigation but also drying, cooling / refrigeration and ventilation.

With regard to petroleum products, International experiences suggest that in some cases savings of up to 60% are possible through a combination of improved maintenance of agricultural vehicles and optimisation of their use. Based on an assumption that savings of this magnitude represent one end of a spectrum of savings potentials, it is therefore estimated that a realistic level of savings for the sector as a whole is around 30%, realisable by 2030. Added to this, it must also be assumed that the natural turnover of agricultural vehicles will result in an improvement in fuel efficiency, tentatively estimated to be about 10% by 2030. The total saving of 40% of petroleum products is equivalent to about 26 PJ in 2030.

Targets

The target proposed for the agriculture sector is a total electricity saving of 1 PJ from officially supported energy saving projects. This target is based on the above assumption that sector-wide savings from the optimisation of motor-driven systems amount to about 2-4 PJ annually, but that a significant fraction of that potential will be realised without any official support (i.e. interventions made using own-funds), which will be virtually impossible to monitor.

Note that no specific target has been set for fuel savings in agricultural vehicles, for similar reasons that it is not certain that the data would be available to allow such a target to be monitored. However, it is recommended that the feasibility is explored of conducting surveys for the collection of energy consumption data. If future data availability permits, the situation should be reviewed and consideration given to setting a target for fuel savings in agricultural vehicles.

Overall impacts

The overall impact on sector-wide energy intensity that would be seen in 2030 as a result of the expected savings is a reduction of about 30%. This is assumed to be made up of approximately 10% from electricity savings (mainly optimising motor-driven systems) and 20% from savings of petroleum products (mainly arising from savings in agricultural vehicles).

Power generation and distribution

Assumptions

It is estimated from various sources that there is potential for up to 1.5 GW of power generation from industrial cogeneration and waste heat recovery. However, there are major barriers to its exploitation, including very high investment costs and regulatory issues. The current economic climate precludes investment being considered in many situations, particularly in the metals industries where much of the potential for waste heat recovery is found.

Previous procurements for power generation from industrial cogen during the mid-2000s were not particularly successful, and the level of interest shown in the recent round of bidding under the CogenIPP procurement programme was very low, resulting in only 11 MW of capacity being bid. It is therefore unrealistic to expect a rapid take-up of cogeneration and power from waste heat recovery in the near future.

Targets

Two targets are proposed for the power generation and distribution sector:

- 10 PJ of electricity derived from grid-connected cogeneration and waste heat recovery plant
- Electricity distribution losses below 8%

The first target derives from a relatively conservative assumption regarding the extent to which the identified potential may be exploited. An annual generation of 10 PJ is equivalent to a capacity of about 500 MW_e operating at 60% load factor. Given that the total available capacity under the current CogenIPP procurement programme is 800 MW, this indicates that the target is very conservative.

The second target is based on an assumption that internationally acceptable levels of distribution loss (technical plus non-technical) can be reached and sustained.

Overall impacts

The overall impacts described for other sectors are an indication of the results that would be obtained from conducting a decomposition analysis in 2030 of changes in total final consumption. Since the targets proposed for the power generation and distribution sector relate the supply-side, their effect will not be visible in a decomposition analysis of final consumption. Hence no separate overall impacts are defined for this sector.