— Commission Energy 2030 —

Review Process

Answers to Questions 1-9 by Review Panels

Preliminary Remarks to the Review Panels:

Several typographical errors have been noted in the CE2030 preliminary report. There is no need to communicate them; they have been identified and will be corrected.

Also, two disturbing "slip of the tongue" factual errors have been noticed:
- Figure 2.1 on page 30: the legend on the right hand side is incorrect;
- Figure 3.10 on page 74: the figure as it stands does include the SPE data, but it was forgotten to remove the grey sentence in the figure caption.

These errors will be corrected and an "updated version" will soon be available on the CE2030 website.

As regards the actual substantive contents of the report, no changes will be made until the Review Process has come to an end and until the Final Report will be issued. The final report will take into account the relevant remarks & comments made here in these questions and in the statements to be received by the Review Panels.

The answers to the questions below have been provided by several permanent and non-permanent members of the CE2030 (JDR, JA, JMS, WDH, SP, BL, RB) and by D. Gusbin of the FPB. The final editing has been performed by the Chair of the CE2030.

CREG		
N°	**Auteur**	**Question**
1	**Guido Camps**	At page 17 of the report, under the heading of the Concrete Recommendations, it is written : "Towards an efficient long tem perspective, Belgium should not commit to quota for local production of renewable energy, but rely on market mechanisms where carbon value is the best guide and should plead for (perhaps ambitious) quota (in % terms) of supply of renewable energy to the end customers coupled to full EU exchangeability of green certificates, so that investors are stimulated to invest at the best locations in Europe".
		1. where in the report is a simulation available on the different market values for carbon, at 15% reduction and 30% reduction respectively?;
		2. where in the report is there an interference made with EU expected policies on EU reduction ?

1.1.

This recommendation focuses on the carbon-free nature of renewable sources and a balanced European energy mix. Therefore, to avoid interference between all kinds of support schemes, and to have transparency (see e.g., http://ec.europa.eu/environment/climat/pdf/ec_green_final_report051117.pdf) the best measure to reduce CO_2 emissions is to have a penalty on CO_2 emissions. That measure should be the best guide to promote emission free energy conversion, as it penalizes the "pollutant" emission directly.

In addition, the focus should be on a balanced European energy mix, without forcing a too expensive burden on the Belgian system, and as such quota on supply might be defendable. The logic behind it is as follows: it is not because Belgium has a limited potential for renewable energy "production" because of geographical circumstances that Belgian citizens should not contribute to overall European renewable generation. An acceptable way to do so is to fix quota on supply with exchange possibility of certificates of origin of production for suppliers. Local (i.e., Belgian) production is not necessarily to be excluded, but should be carefully guided through an "appropriate" penalty scheme.

As to the specific question, the carbon value depends on the constraint on CO_2 emissions (in mathematical terms, it is the shadow variable of the constraint) and on the reduction options accounted for in the model (e.g. nuclear, CCS etc.). It is determined by the marginal abatement cost for the country. So for each CO_2 reduction percentage and set of reduction options, there is a single carbon value as shown by the Figures 8.20 & 8.21 of the CE2030 report and Table 8 of the BFP report. The energy mix (including the renewable percentage) is available for each of these runs and is summarized in Table 8.8 of the CE2030 report, with more details available in Annex D of the FPB report).

1.2.

EU reductions were not dealt with in the study made for the CE2030, only reductions of energy related CO_2 emissions on the Belgian territory have been studied.

The recommendation is made on general background knowledge based on economics principles.

VREG		
N°	**Auteur**	**Questions**
2	**André Pictoel**	1. Zit er geen contradictie in de logica dat men de productie van hernieuwbare energie binnen een Europees referentiekader wil analyseren, terwijl alle CO2-analyses uitgaan van een a-priori vastgelegde inspanning binnen de Belgische context?
		2. Wat is de relevantie van een scenario met dergelijke extreem hoge CO2-schaduwkosten (mede als gevolg van het opleggen van een Belgische CO2-inspanning)? In het meest beperkende scenario (geen nukes, geen CO2-opslag en C02-30%) heeft dit een meerkost van 1000€/MWh! Is het niet aannemelijk dat een dergelijke kost een extra boost geeft aan allerlei andere technologieën, waarmee geen rekening werd gehouden? (het is niet duidelijk hoe de impact hiervan op de vraag naar energie werd meegerekend: men spreekt over een scenario met “soaring fuel prices” in de orde van 100$/barrel, maar de impact van het beperkende cenario is maar liefst een verachtvoudiging van deze prijs! Is de impact hiervan op de vraag naar energie correct verrekend?)
		3. Wat hernieuwbare betreft, wordt in het model impliciet rekening gehouden met een beperking voor wat betreft de meeste technologieën (zoals PV en wind) op basis van een aantal assumpties. Wat echter meer vragen oproept, is de behandeling van biomassa. Als je uitgaat van het huidige ondersteuningskader in Vlaanderen, dan zie ik geen enkele reden waarom het percentage biomassa, zeker in de meest extreme scenario’s, niet zou moeten boomen met een zeer positieve impact op de CO2-uitstoot? In alle berekeningen komt men immers tot de conclusie dat gas (indien men post-Kyoto doelstellingen zal hebben) en steenkool (zonder post-Kyoto doelstellingen) de energievectoren worden. Is het denkbaar dat hier een fout in de modellering zit? Zouden de analyses cijfermatig kunnen worden uitgewerkt na aanpassing voor biomassa-influx? (Noot: je kan je inderdaad de vraag stellen of het ethisch en op andere vlakken verantwoord is om een

		massale influx van buitenlandse biomassa te hebben, maar deze problematiek wordt in het rapport niet belicht (met als gevolg dat je kan argumenteren dat er een bias is richting nukes)

2.1.

There is no contradiction since the recommendation follows from analysis and evaluation of the results obtained with the model runs with enforced CO_2 reduction on the Belgian territory. The results show that some expensive local renewable generation in Belgium penetrates as a consequence of very high carbon values, leading to a conclusion that (from the standpoint of European carbon-free energy conversion), renewable generation (or even other kinds of carbon abatement) can be cheaper in some countries outside Belgium. A European approach alleviates the financial burden for the Belgian economy, as is the case with the European Emission Trading Scheme mechanisms. However, although the European approach is cheaper than a purely Belgian approach, there are also non-negligible costs involved.

Our study does not exclude the use of European instruments. Section 9.4 deals with this explicitly, in the post-scenario analysis. The point is that, in the interest of transparency, effectively three post-Kyoto scenarios have been considered in the CE2030 study: 0% (baseline), -15% and -30% energy related domestic CO_2 reduction in 2030 compared to 1990. For each of those domestic reductions, the mix and the costs have been evaluated and it is argued that some part of the reduction can be obtained abroad, but that a substantial part will have to be done locally. Renewable energy is one element of the overall energy mix.

A good equilibrium is to be sought between European renewable generation and local production. Hence the possibility to opt for a particular amount of justified local production.

See also the answer to questions 1.1 and 1.2.

2.2.

The relevance or interest of such a scenario is to deliver the following message: *without nuclear and CCS, and assuming no change as to the behavioural reaction*[1] *of economic agents as regards energy savings, and assuming the same level of net electricity imports as in the reference scenario, it will be very costly to the Belgian economy to reduce its energy CO_2 emissions by 30% in 2030 on the Belgian territory alone.*

[1] "Behavioural reaction" is to be understood as follows. The demand for energy services will be affected by the energy prices (including the carbon values) through estimated price elasticities. So, higher prices will lead to energy savings by a reduced demand for energy services (in addition to opting for more energy-efficient technologies). But the price elasticities are assumed to be unaffected in the different scenarios.

In other words:

1) The implementation of appropriately designed and well-targeted policies aimed at increasing the awareness of consumers for "cost-effective" energy saving potentials might change the perception and behaviour of consumers so that they become more "price elastic". This might allow reaching the same reduction objective at lower (accounting) cost.
   Relying on an increase of electricity import from abroad, may likewise lead to a lower cost.
   However, this has not been assessed due to lack of information on the costs of such policies, to the need of adapting the modelling accordingly and to the fact that the national PRIMES model has been used rather than the (heavier and more time consuming) European version of the model for the analysis of electricity exchanges in the CO_2 reduction scenarios. Moreover, the proper use of the European PRIMES model would have required the definition of reduction constraints in other EU countries which was out of the scope of the study for CE2030.
2) Belgium could, in principle, take part of the future European climate policy without nuclear and CCS but at lower costs than estimated in the above scenarios provided it decreases its own percentage of reduction or it applies it to all GHG or it calls on flexible mechanisms to achieve the reduction target. This has been discussed qualitatively in Section 9.4 of the CE2030 report. But it has not been assessed quantitatively nor has the economic impact been evaluated of an electric system relying solely on renewables and natural gas (security of electricity supply).
3) Different combinations of 1) and 2)

What are the "other" technologies the questioner has in mind? We could then check whether they are taken into account or not in the model. However, technologies such as fuel cells and carriers such as hydrogen are considered by PRIMES.

See also the answer to question 2.1 above.

(…"soaring fuel prices"…)
See question 8.9.b

2.3.

For wind and PV, there are explicit ceilings set on the installed capacities in Belgium at the horizon of 2030 (according to the Supporting Document A.10 by J. De Ruyck, the ceilings represent reasonable maximum achievable "technical" potentials). On the other hand, there are no such ceilings for biomass because biomass cannot only be produced on the Belgian territory but also imported from abroad, and as far as imports are concerned, it is difficult if not impossible to set limits on the imports, in practice. Therefore, (increasing) supply cost curves plotting biomass supply against cost are used instead. The model itself determines the equilibrium price and quantities of biomass (where supply = demand).

Biomass consumption in the different PRIMES scenario results range from 96 PJ (reference scenario) to max 119 PJ (Bpk30 scenario). This is to be compared to the supply potentials estimated by JDR, i.e. 80 PJ for domestic biomass and 136 PJ for imported biomass. In all scenarios, Belgium would import biomass from abroad.

In fact, the questioner implicitly agrees upon the fact that our domestic biomass resources are pretty limited, and the question is: why not import massively? He gives himself part of the answer by wondering if massive import is acceptable, sustainable and at what cost?

In the supporting document A.10 in the report it was mentioned that import is virtually unlimited because we are a pretty small country. Keeping in mind a more global context (e.g. EU as a whole cannot afford unlimited import) 'reasonable' limits have been proposed in this note, with up to 136 PJ_{th}/year in a limited growth rate scenario and up to 200 PJ_{th} as reasonable intake.

In practice however and as indicated in the report section 7.1.2.3, page 97, no severe limitations have been given in the PRIMES calculations, and a cost curve has rather been used to express the market limitations for biomass imports. The biomass supply cost curve cannot be released as it is commercial input from ECN (Petten). The biomass supply cost curve was derived using the BIOTRANS model developed by ECN. It is a model of biomass production and trade in the EU. There are some reports and descriptions on the web (http://www.biomatnet.org/publications/1685fin.pdf).

It should be mentioned that within the present limitations, our import dependency in 2030 for biomass is already high, and that higher impact on the conclusions would mean enormous amounts of biomass import and high pressure on a (soaring?) biomass cost. We should also not forget the pressure on the environment caused elsewhere by massive biomass for energy. Already now, criticism is heard for the fact that a company as Electrabel already massively imports biomass for power plants such as Awirs 4, and much care must be taken to guarantee this biomass to be obtained in a sustainable way. On the overall, there is a tendency from authorities to refrain massive import of biomass rather than to encourage it.

FGTB		
N°	**Auteur**	**Questions**
3	**Anne Panneels**	1. sur base de quoi faites-vous l'hypothèse que les réacteurs de Tihange 2 et 3 et de Doel 3 et 4 pourraient fonctionner pendant 60 ans sans investissements supplémentaires ? Estimez-vous que la sécurité de ces centrales serait assurée sans investissements et si oui, sur quoi basez-vous cette assertion ?
		2. Qu'est-ce qui vous permet de remettre en question l'estimation de la commission européenne selon laquelle le CSS serait opérationnel en 2020 ?
		3. Que répondez-vous à l'analyse de Mr Eichhammer qui estime que le potentiel de mesures d'économies d'énergie économiquement rentables à l'horizon 2020 est bien plus important que ce que suppose le rapport préliminaire ?
		4. Les scénarios étudiés par la CE2030 excluent la possibilité d'échange de permis d'émissions de CO2 entre pays européens. L'utilisation d'un tel marché (qui existe déjà pour certains secteurs) permettrait d'abaisser significativement le coût de la réduction des émissions de CO2 en Belgique et en Europe. Les scénarios étudiés dans le cadre de l'étude demandée par le Ministre Tobback (réalisée avec le même modèle PRIMES et le même scénario de référence) incluait par contre ce marché, mais jusqu'en 2020 seulement. Pouvons-nous connaître l'impact d'un tel marché (pour l'ensemble des émissions en Europe)sur les coûts de réduction des émissions en Belgique en 2030 ? Pour réaliser les scénarios de l'étude pour le Ministre Tobback, le modèle PRIMES a de toute façon été utilisé jusqu'en 2030 (comme indiqué page 67 de cette étude). Ces chiffres pour 2030 pourraient en tout cas être utilisés pour une première estimation de ces impacts à l'horizon 2030.
		5. Quelles sont vos réactions aux analyses et objections formulées par le professeur J-P van Ypersele ?

3.1.

As is explained in the main report of the AMPERE report (Section E.7), [http://mineco.fgov.be/ampere.htm] there is no finite lifetime of a *system*; only components have a determined lifetime. The same applies to nuclear power plants: subject to stringent safety standards, the only real lifetime of a nuclear power plant is an economic one.

Please recall that before the nuclear phase-out law in Belgium took effect, there was no pre-defined operational lifetime of the Belgian NPPs. Every ten years, there was a major ten-year overhaul ("revision décennale" : "tienjaarlijkse revisie") after which the plant got the green light for another ten years. These ten-year overhauls still take place, but a "non-natural" limit has been legally imposed through the nuclear phase-out law: 40 years. However, technically speaking, no major difference is to be expected between the third and a possible fourth and fifth ten-year overhaul for the four youngest units Doel 3&4 and Tihange 2&3, so that no major investments (beyond the usual maintenance and replacement costs and as compared to the third ten-year overhaul) are expected.

The most critical component for the actual duration of the operational life is the reactor vessel. The integrity of the reactor vessel (with regard to embrittlement due to neutron bombardment) is guaranteed for a duration of 60 years (and even more) and there is no need for extra investments in addition to the inspection programs that are applicable (and that have been adapted to take into account possible corrosion).

In these units, the steam generators have been replaced (with now alloys that are sufficiently corrosion resistant) so that also here no major investments are expected.

In any case, it will be up to the safety authorities to define the conditions under which the power plants can continue operation.

Please note also that for the older units, Doel 1&2 and Tihange 1, an extra investment for operational prolongation of 30% and 25% of a new investment, respectively, has been assumed. Since these units will have their steam generators already replaced by 2015, it is likely that the actual costs for longer operational life might be lower than estimated here, leaving some margin for the younger units, if that would have been estimated as too low. Please note also that some major replacements (such as the rotors of the low-pressure steam turbines) usually go along with efficiency improvements, leading to a very quick pay back of these replacements.

The above estimates are based on engineering judgment and conversations with nuclear operators and reactor vendors in Belgium and abroad.

3.2.

The qualification « operational » has to be defined.

If it means that full scale demonstration plants have been fully tested, that the technology is available for large size industrial applications with profitable costs for private companies, that all legal aspects related to CO_2

property and environmental protection are solved, it is evident that CSS will not be operational in 2020.

If it means that some pilot plants give encouraging results, that most of technical problems are identified and more or less solved, that large public funds could be injected in projects, then we can claim with the CEU that CSS will be "operational" in Europe around 2020.

Past experiences of large industrial projects, for example pressurized fluidized coal combustion (more than 30 years of development), underground coal gasification (more than 40 years of development with no practical achievements), fuel cells for mobile applications (more than 50 years of research), are practical examples showing the big distance between pilot, prototype and industrial real commercial dissemination.

Considering all the problems to be solved for CO_2 storage (listed in document of the US Department of Energy : www.sc.doe.gov/productiongeo/publication/CO2report), 2020 is not a realistic deadline.

In the 2006 brochure "ENERGY FUTURES" from the EC (ISBN 92-79-01639-3), it is clear from the EURENDEL Delphi survey involving more than 3.000 scientist that the time horizon for CO_2 capture and storage is between 2020 and 2030.

A positive point is the launching in spring 2006 by the CEU of a "Technology platform for zero emission fossil fuel power plant" (www.ec.europa.eu/research/energy). One of the goals is to divide the costs of the CO_2 treatment by a factor 2 comparing with conventional techniques. This initiative gives a positive signal to CSS.

It must be pointed out that especially the storage of CO_2 on Belgian territory by 2030 is questionable. There are some theoretical possibilities, as outlined in the report and although the numbers must be adjusted, there remains large uncertainty to have routine commercial storage possibility in Belgium by 2030. Especially for storage, European potentials (such as e.g., off shore aquifers in Norwegian territorial waters) or averages should not be transposed onto individual countries. Storage is very country specific. The situation will be further clarified in the final report.

3.3.

The CE2030 wishes to deal with the remarks of its non-permanent members in its own internal review. This independent review should not influence the external review, and therefore, it is not appropriate to comment on these reflections here. The external reviewers are invited to evaluate and comment upon the comments by Dr. Eichhammer.

3.4.

The scenarios of the CE2030 are selected to calculate the cost of domestic energy-related CO_2-emission reduction efforts under various circumstances. Given the obvious uncertainties surrounding the post-Kyoto institutional architecture, domestic reduction measures will remain important in the coming decades and therefore the CE2030 provides relevant information to policymakers.

Once a national reduction target for 2030 is negotiated, the total reduction effort can be distributed over domestic measures and the use of flexible instruments. With a reduction target of e.g. 25%, Belgium can opt to reduce domestic emissions by e.g. 15% and make use for the remaining reductions of flexible instruments. Other partitions are of course possible. As a result, the scenarios of the CE2030 are consistent with national reduction policies that include the use of flexible instruments.

The impact of flexible instruments on the total cost of climate policy will be significant but difficult to predict up to 2030. With a national reduction target of 25% and 15% domestic reductions, the *total* cost of climate policy will be higher than in the case of just a domestic reduction of 15%, since the non-domestic efforts need to be paid for as well.

The price of a permit to emit CO_2 is difficult to predict and does not only depend on evolutions inside the EU but also on the openness of the EU ETS for JI and CDM earned allowances.

In addition, the current pilot scheme – EU ETS- suffers from overgenerous grandfathering procedures in several countries. This problem will disappear in the next ETS periods since the share of auctioned allowances will gradually increase (this share is now 5%).

Finally, it is quite possible that the future national reduction targets will depend on the progress made with the international use of flexible instruments; the targets can be higher when widespread *flexmex* offers significant cost savings potentials. Especially under the latter case, the cost of domestic reduction efforts deserves careful analysis.

In conclusion: The option to use European trading of emission permits will always be beneficial for a country as a whole, compared to only domestic efforts. In the CE2030 simulations with PRIMES different emission limitations (varying between 15 and 30% —in addition to effectively "no reduction" in the Baseline) have been analyzed for Belgium in isolation. This is certainly useful to have an idea of the cost of emission limitation in the presence of EU emission trading: a 30% limitation with EU emission trading might lead to a domestic 15% PRIMES simulation without emission trading (whereby the *total* costs will then be between the domestic 15% and 30% reduction cases).

A complete analysis of costs with EU emission trading would require assumptions on nuclear and economic development in all EU countries and this is beyond the mandate of this commission.

<u>Note</u>: The FPB is drafting a paper that puts together the results of the "Energy 2030" study and the "Climate study" for Minister Tobback (or more precisely part of the results) at the horizon 2030 taking into account the European

dimension of GHG reductions and GHG emissions other than energy CO_2 (clearly subject to certain hypotheses on a European scale). This paper will not be as exhaustive as the studies themselves, but it aims at throwing a comparable light on the climate change and energy policy issues for Belgium. The non-EU dimension is however totally out of the scope of the analysis.

3.5.

Same answer as in 3.3.

The CE2030 wishes to deal with the remarks of its non-permanent members in its own internal review. This independent review should not influence the external review, and therefore, it is not appropriate to comment on these reflections here. The external reviewers are invited to evaluate and comment upon the comments by Prof. J-P van Ypersele.

FGTB		
N°	**Auteur**	**Questions**
4	**Fre Maes**	Het rapport stelt dat er moeilijk energie te besparen valt in het transport. 1. Inhoeverre werd nagegaan of een "modalshift" emissies in deze sector kan beperken en aan welke kostprijs?
		2. Werd rekening gehouden met de 2de spoorontsluiting van de Antwerpse haven, het wegenvignet, de IJzeren Rijn...?
		3. Men stelt dat de vraag ongevoelig is voor prijsstijgingen. In het hoge olie hoge gas scenario van het FPB in de Tobback studie ziet men een vermindering van -1.5 (2010) en -2.6 (2020) tov. van het basisscenario. Terwijl dit reeds een onderschatting is tov; reële cijfers, gezien het brandstofverbruik in 2005 daalde met -10% voor Super en - 1% voor Diesel en de eerste 4 maanden van 2006 bedroeg dit (afh. van de bron) -8% tot -15% voor benzine en +3% tot -6% voor Diesel.

4.1.

In the road transport sector there is already an important tax on fuel and this effectively acts as a powerful CO_2 tax. The result is that the cost of emission reduction in the transport sector is much higher than in other sectors. This is an undisputable fact. A *modal shift* may be justified for other reasons than energy intensity: reduction of congestion and accidents can be good reasons. This type of modal shift could generate a small “free” CO_2 emission reduction.

A "Modal shift" has not been analyzed in the PRIMES runs for the CE2030 study. The evolution of transport activity (pkm and tkm) and the allocation among transport modes is an input of the PRIMES model (which comes from the EU SCENES transport network model). Those data have been considered as given in CE2030. [See e.g., http://www.iww.uni-karlsruhe.de/SCENES/; http://www.transforum-eu.net/IMG/pdf/scenes.pdf].

If one wants to change the assumptions (level of activity or modal allocation), it is possible and PRIMES evaluates then the impact on energy consumption and emissions. This approach was followed in the study for Minister Tobback (cf. scenarios with additional measures).

Furthermore, in the CO_2 constrained scenarios, the Carbon Value makes the model change the level of transport activity in reaction to higher energy costs. In other words, the transport activity in the CO_2 constrained cases is not the same as in the baseline, and this also affects energy consumption and emissions of the transport sector.

A study of a "modal" shift for transportation exceeds the energy issue and should be undertaken in the realm of a full rethinking of the overall *mobility* issue (including logistics aspects of the economy, major infrastructure rethinking and investments, other approaches for residential and office, service & commercial building implantation and construction, and work-organization philosophies, etc) and this is well beyond the mandate of the CE2030. Also, a full European-wide approach should be considered as transit-type transportation is not negligible for a country like Belgium.

4.2.

These particular aspects have not been dealt with.

But it is not expected that this will generate large shifts in "modal shift". In the EU, one expects for 2020 a growth of freight transport (+50%) that is stronger than that of passenger transport (+20%). The share of road is not expected to decrease significantly and the strongest growth is for air travel. This has been documented by several EU studies on transport.

4.3.

In the Energy 2030 report, it is not stated that consumers are insensitive to price changes. The report just makes the point that because of the already high taxes it is relatively more difficult to reduce demand in the transport sector than elsewhere. Recently there have been relatively strong and unexpected price increases for oil products and this has indeed generated quantity changes and substitutions for gasoline and diesel. The reduction of transportation fuel consumption in 2005 is indeed intriguing but can be transitory.

As to the difference between the model outcome and recent oil consumption statistics, the answer is not easy as many mechanisms and parameters are involved.

Firstly, to put the "soaring price" scenario into perspective, it is worth saying that the impact of this scenario on fuel prices in the transport sector is an increase of about 16% compared to the reference scenario.

Secondly, 2005 is the first year where oil consumption for road transport drops and it would be interesting to see whether this trend is confirmed in 2006. Does the drop come from passenger transport and/or freight transport (diesel)?

Thirdly, if there is a correlation between trends in oil prices and trends in energy consumption, there are many other factors that can influence oil consumption like the economic context and expectations by households about future incomes. Pessimistic expectations influence negatively the use of transport and therefore oil consumption (i.e. income elasticity). Specific measures also play a role like the free access of some employees to public transport. So a more detailed analysis would certainly be required to capture the key elements of the recent changes.

Fourthly, recent econometric analyses confirm the low price elasticity of oil consumption in transport.

Fifthly, the development of the transport sector in PRIMES is in line with historical evolution and may be felt rather conservative. It might be possible that the sector will evolve differently in the future.

In the Preliminary Report, there is no specific information on price elasticities. The report of the FPB merely stresses that the price elasticities in transport are low. Some more information could be provided in the final report.

Short run and long run price elasticities as well as income elasticities are part of the PRIMES model and taken into account. In PRIMES the short run elasticity is equal to -0.3 which is in line with recent econometric analyses.

It must be pointed out that there is not feedback of higher costs on the macroeconomic landscape (through the GEM-E3 model).

ICEDD (Institut de Conseil et d'Etudes en Développement Durable (ex Institut Wallon))		
N°	**Auteur**	**Question**
5	**Yves MARENNE** **5.1**	Le rapport de la CE2030 indique clairement qu'il est nécessaire que les hausses de prix se répercutent en totalité sur le consommateur toutefois même s'il ouvre la porte à beaucoup d'exceptions. De même, les 'Recommandations concrètes' du rapport rappellent que 'l'énergie est rare et qu'elle devrait avoir une valeur élevée' mais l'ensemble du rapport envisage les pistes pour maintenir les prix les plus faibles possibles en comptant sur l'information des consommateurs et sur les progrès technologiques pour diminuer les consommations. Deux pistes qui ont montré, depuis 30 ans, toute l'étendue de leur impuissance.
	5.2	**Comment les auteurs du rapport envisagent-il de limiter efficacement les consommations d'énergie sans agir sur les prix ? Pourquoi ne pas réintroduire la notion de fiscalité à cliquet ou même de fiscalité croissante sur l'énergie** ? Ceci permettrait d'amortir l'effet négatif des hausses attendues des prix des énergies, de générer des recettes fiscales qui permettraient de financer des programmes massifs d'économies d'énergie et de sécuriser les différents opérateurs (professionnels mais aussi résidentiels) sur les prix qu'ils auront à payer demain et donc d'orienter efficacement leurs politiques d'investissement ?
	5.3	**Par rapport à la production électrique, quelle garantie existera-t-il à l'avenir que les moyens nécessaires seront investis, à temps, dans les unités nécessaires dans le cadre d'un marché libéralisé** (par exemple, dans la nouvelle tranche nucléaire ou encore dans l'unité thermique avec séquestration du carbone envisagées dans le rapport) **?**
	5.4	Par rapport au transport, CE2030 part de l'hypothèse implicite que le système actuel pourra se perpétuer indéfiniment alors qu'à l'évidence le transport routier est le secteur qui est le plus dépendant du pétrole. C'est aussi celui où la croissance des consommations est la plus forte et où les possibilités de substitution sont les plus faibles. En clair c'est le plus fragile à des fluctuations fortes des prix. Si donc cette hypothèse de stabilité du système transport est peut-être envisageable jusqu'en 2030, elle est très vraisemblablement fausse à plus long terme que

		ce soit pour des questions de congestion des infrastructures, de changements climatiques ou de manque de ressources fossiles. Par ailleurs, le rapport signale, justement et à plusieurs reprises, qu'un nouveau système énergétique prend du temps pour se mettre en place et qu'il est donc nécessaire d'anticiper les évolutions les plus prévisibles. Le rapport signale enfin que, par rapport au transport, il faut adopter une attitude globale et envisager toutes les mesures sans tabous. **Quelles sont alors les principales mesures préconisées par les auteurs du rapport, pour diminuer la dépendance pétrolière des transports ?**
	5.5	Dans la mesure où les transports en commun sont nettement moins consommateurs d'énergie, **quelles sont les mesures concrètes envisager par les auteurs du rapport pour assurer leur développement ?** La question est d'autant plus cruciale et d'actualité que la libéralisation des chemins de fer pourrait mettre en péril la viabilité de certains services, tant que les externalités du marché ne sont pas prises en compte dans les prix des énergies ?
	5.6	**Pourquoi les auteurs n'abordent-ils pas la question des générateurs de mobilité ?** Le besoin de mobilité ne naît pas de nulle part. C'est la dilution de l'habitat et des activités économiques qui les génère. Les différents niveaux de pouvoir, en ce compris les communes, sont donc concernés puisque ces dernières ont une large autonomie en matière d'aménagement du territoire.

5.1

There is an important distinction to be made between social costs and prices of energy. In a market economy approach the best results are achieved when social costs are minimized and when prices equal (marginal) social costs. When there are important environmental problems, or energy scarcities, it is important to signal them to all consumers. In this way they only decide to consume energy when the value of this consumption to them covers at least all costs to society.

It may be that the report mixes up costs and prices in some paragraphs. If so, that will be corrected.

The goal of the CE2030 is not to strongly increase energy prices but to compute the optimal mix of technologies to realize specific domestic climate policy targets. The used model is programmed to select the least expensive technologies, leading to the lowest possible energy and electricity costs and price increases. In absolute terms, the lowest possible energy price increases in most scenarios are high when compared to current price levels, and those increases, if they occur in reality, should be fully transferred to the end customers (except perhaps for a socially weak fraction of the population, but that should remain an exception to the general rule).

5.2

To realize the domestic CO_2-emission reductions in the used scenarios, high carbon values or policies that imitate the impact of these carbon values are absolutely needed. Hence, the CE2030 does not at all suggest that significant CO_2 reductions are possible without price increases.

Actually, this raises an interesting question: what will be the future prices of energy? If we were very sure about the future prices we could all be very rich by buying energy (or stocks of oil companies) now (and vice versa if we were sure about a price decrease). Given the large fluctuations we have seen in the past, we have to be careful on isolating all our consumers from the world prices of energy.

5.3

In a free and open market, private agents decide themselves on the timing and execution of investment plans. Regulators have, however, several fiscal and price instruments to steer the private energy companies and to avoid deliberate underinvestment.

In a liberalized market, there will only be sufficient investments if there is a sufficient return on investment. This means prices that reflect scarcity and regulations on new investments that are not too stringent.

As a matter of fact, the liberalized market does not guarantee that adequate capacity will be available on time. The government can only provide a stable and attractive framework for investors to get them into Belgium for setting up the necessary capacity here. In that respect, the last 10 years have not been very "welcoming".

With regard to nuclear, the official statement is still that the phase out will be executed although the political environment on this is changing, both in Belgium and abroad (the IEA is in favor of nuclear input, many countries are changing their policy, and the EC is reported to advice positively on nuclear); this is not seen by the market as a stable framework. On coal, the present government policy to request premature closure of existing coal-fired plants and the uncertainty on future allocation schemes for CO_2 allowances makes it very difficult for investors to consider this option. Governments should abstain from detailed intervention in technology choices: all that is needed is a clear CO_2-emission framework, by contractually defining and freezing the rules of the game for emission trading and the allocation of permits (whether by grandfathering or auctioning). This would allow certain interested operators to choose the coal option (e.g., for reasons of security of supply and fuel-mix portfolio management) and to internally rearrange emissions or to buy the necessary permits on the market. Most (almost all) power plants currently announced are gas fired, but with the present high gas prices, these plants will certainly not be base load and are unable to replace nuclear or coal, unless one is willing to do so at high cost. So in fact, both options for base load (nuclear and coal) do not have any back up now from the regulatory framework, as was the case before liberalization.

With regard to wind, the support schemes differ from the four regulatory authorities concerned, which can hardly be seen as a transparent and consistent framework. Just as with the uncertainty on "CO_2 levies through emission allowances" as discussed above, careful reflection on the level of subsidies (being "negative levies") "promised" is important. When committing to support through subsidies one must recognize *now* what the future impact will be on the electricity prices or the public finances. Changing the rules of the game later on if it is then felt to be too expensive, is to be advised against. Investors in wind farms must know at the time of investment what the rules of the game are. As an example, it should be recognized that, if the support scheme currently decided for off-shore wind farm(s) is applied to all three concessions now granted (846 MW), the total support on a 20 year basis will add up to more than 5 billion Euro[2]. This result only includes the cost of the guaranteed price for the green certificates and the cost of balancing and the cable have yet to be added.[3] This level of subsidies is indeed very large and one must be aware of it and reflect on it *now* before actual investment commitments take place. Investors need a contractual guarantee, and the regulators (especially the CREG) must accept that these support expenses are to be forwarded to the customers.

The CE2030 has the duty to draw attention to the magnitude of these support schemes and it is in this spirit that some of its recommendations have to be seen:

- have a stable (frozen) regulatory framework, including support-schemes and CO_2 & other environmental levies;
- develop the (considerably far off-shore) wind farms on a step by step basis, with firm guarantees for those farms committed to, but with the possibility to halt further development if the outcome of the first phases is questionable;
- support expensive renewable development by recycling some of the revenues obtained from operational-life extension of the current nuclear power plants. Such action allows routes for earmarking the money needed for these support schemes.

In addition, the need for having new operators is generally recognized. But given the situation described above, it is hard to see which primary energy source a new operator can choose from if he wants to offer base load in Belgium. The virtual power plants concept (capacity auctioning by the historic incumbent) which was intended to help newcomers to step into the market, has not brought new investments and VPP's are no longer legally backed-up. If newcomers have to be attracted, they to be able to use "home generation" as back up, hence the need for high voltage lines towards Germany and the

[2] Here, for simplicity, annuities have been neglected. The computation is as follows:
(216 MW x 3500 h/y x 20 y x 107 €/MWh) + (630 MW x 3500 h/a x 20 a x 90 €/MWh) = 5.6 x 10^9 €.

[3] Taking into account all costs (construction, cable & balancing), these 846 MW off shore, producing about 60 TWh over its lifetime is therefore about twice the construction cost of an EPR of 1700 MW that would run for 60y at 8000 h/y, thereby producing about 820 TWh.

UK. Otherwise, e.g., the selling of sites will not bring any new investments. Again, a stable framework, now for the transmission system operator, is needed to perform these investments.

Further on the transmission-system side, the current annual tariffs (annual in theory, but in practice actually trimester tariffs are being applied) do not allow good housekeeping nor do they stimulate a future investment vision. The multi-annual tariffs announced (and decided in principle in 2005) are still not available due to the lack of a Royal Decree. Government should take the necessary steps for actual implementation. Also, a proper balance must be found by the Regulator between its drive to continually lower the transmission tariffs and the needed grid investment expenses. To find this right balance, and to avoid annoying court cases, international / European Commission benchmarking may be helpful.

5.4

First of all it is not clear that there is an absolute problem of oil availability in the next 50 years. The quantities of unconventional oil that are available are larger than the conventional oil quantities; these will be developed if prices stay as high as they are now. In the short term there may be supply interruptions of oil. Possible solutions are natural gas vehicles etc, but this has not been studied in detail in the Energy 2030 report.

Furthermore, the availability of oil does not imply that transportation should become oil-independent shortly after 2030. Steep fuel price increases will however reduce the average fuel consumption in rich economies. When this evolution proves to be successful, our individual transportation system will remain especially dominant.

The problem of congestion is not really a priority for energy modelling. Less congestion will however improve average fuel efficiency.

5.5

Firstly, public transport is only less polluting than private transport if the occupancy ration is sufficiently high. This is not the case at off-peak hours for busses and some trains.

Secondly, one should compare the social cost of a trip with the price charged and this for all transport modes. This means higher private transport prices in the peak but probably also higher prices for peak public transport (see DE BORGER, B. and PROOST, S. (2001), *Reforming transport pricing in the European Union: A modelling approach*, Edward Elgar Publishing Limited, Cheltenham, pp. 424).

In addition, the promotion of public transport is not a goal in energy modelling. The choice of transportation means is not only a matter of fuel efficiency and cost per journey but also depends on time values, offered flexibility, and the opportunity cost of public funds. This is a very complex issue beyond the mandate of the CE2030.

5.6

It is not clear that urban planning is the main generator of transport trips and there is in general no easy solution. When considering the optimal urban form, one needs to take into account many other factors than energy use: separation of production activities with negative externalities (pollution, noise) and housing, specialized work places for different members of the family, preference for green areas etc…

See also earlier responses (e.g., 4.1), but as for point 5.5, the use of regulation to streamline housing and working decisions has not been studied specifically in the Energy 2030 report and is beyond the mandate of the CE2030.

ICEDD (Institut de Conseil et d'Etudes en Développement Durable (ex Institut Wallon))		
N°	**Auteur**	**Question**
6	**Didier Goetghebuer**	"La question posée au début du rapport est : Comment assurer un avenir énergétique durable à notre société avec les contraintes suivantes : offre d'énergie en quantités suffisantes et fiables (reliability), propre (sufficiently clean) et à un prix acceptable ? Hors, nous savons que le Négawattheure (l'énergie non consommée) est la "forme" d'énergie la plus durable à tout point de vue (balances des paiements, épuisement des ressources, risques géopolitiques, emplois générés localement, émissions polluantes, …), mais que son développement est lié, soit à une crise (rupture d'approvisionnement, guerre, …), soit à une croissance des prix supérieurs à celui du coût de la vie (indice des prix). Autrement dit, tout faire pour garantir des "Prix acceptables" n'est-ce pas envoyer un mauvais signal au citoyen-consommateur qui, tôt ou tard, devra réduire drastiquement sa demande en énergie (ne pas confondre avec ses besoins !) pour permettre à notre société d'être durable ?

6.

Part of the answer to question 5.1 is repeated.

There is an important distinction to be made between social costs and prices of energy. In a market economy approach the best results are achieved when social costs are minimized and when prices equal (marginal) social costs. When there are important environmental problems, or energy scarcities, it is important to signal them to all consumers. In this way they only decide to consume energy when the value of this consumption to them covers at least all costs to society.

It may be that the report mixes up costs and prices in some paragraphs. If so, that will be corrected.

Furthermore, the goal of "acceptable prices" should be interpreted within the very challenging environment of post-Kyoto commitments. The CE2030 scenarios do not advocate for low prices but for the lowest possible prices that make it possible to realize domestic emission reduction targets with respecting existing regulatory frameworks.

ODE Vlaanderen			
N°	**Auteur**	**Questions**	
7	**Jo Neyens**	1.	welke toekomstige kostendalingen afgeleid uit leercurves werden in het PRIMES model toegepast voor de diverse hernieuwbare energietechnieken?
		2.	welke indirecte CO2-emissies werden ingerekend voor windenergie en fotovoltaische zonne-energie en is daarbij voor zonne-energie rekening gehouden met de evolutie van de technologie naar lagere energiebehoefte bij toekomstige verbeteringen van productietechniek(minder silicium, minder kritische zuiverheidsgraad) en bij de toepassing van nieuwe materialen (dunnefilmcellen zonder silicium)?
		3.	waarom is er een kritische grens van 400 MW voor de netintegratie van fotovoltaische zonne-energie? Dat opgestelde vermogen komt overeen met 40 W per inwoner, hetgeen lager is dan het huidige vermogen per inwoner in het Groothertogdom Luxemburg (58 W/inw), waar er geen sprake is van moeilijke netintegratie of hoge kosten.
		4.	vanwaar komt het lage beperkende marktgroeicijfers voor windenergie (11%), dit in tegenstelling tot de gemiddelde Europese marktgroei van 32% in de afgelopen periode 1995-2005 (referentie: European Wind Energy Association, www.ewea.org).
		5.	Vanwaar komt het lage marktgroeicijfer voor fotovoltaische zonne-energie (20-25% per jaar), dit in tegenstelling tot de historische Europese marktgroei van 39% gedurende de afgelopen 10 jaar en zelfs 50% in de periode 2000-2005? De Europese industriefederatie EPIA rekent voor de periode 2006-2010 in een conservatie
		6.	waarom werd wel rekening gehouden met de mogelijkheid van Carbon Storage, maar worden de opportuniteiten voor elektrische energie-opslag niet behandeld (bvb. Redox flow batterijen voor windparken enz.)?

7.1

The figure below shows the hypotheses as to the decrease in investment costs of four key renewable technologies.

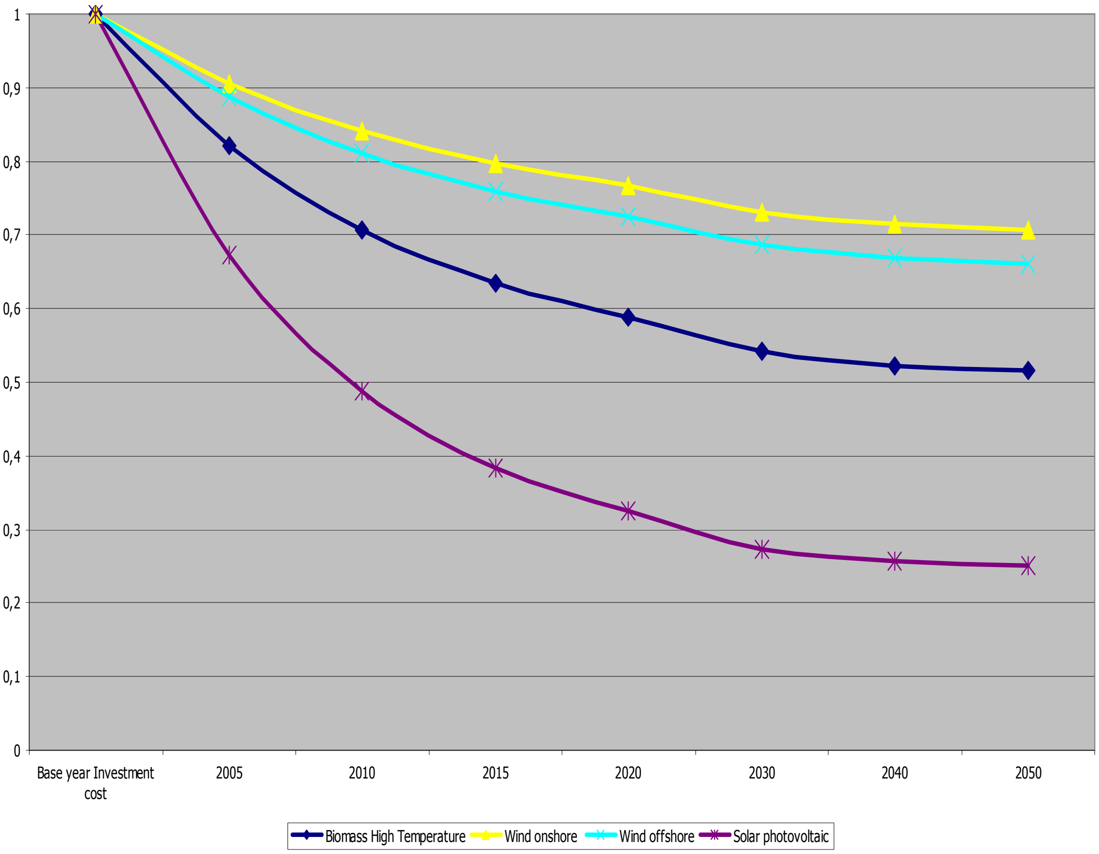


Figure 1: Evolution of investment costs for some renewable technologies as used in the PRIMES database.

7.2

Only <u>direct</u> CO_2 emissions have been taken into account (i.e. pollutants emitted during energy transformation and combustion) irrespective of the fuel and technology used.

7.3

Careful reading of the preliminary report (page 152) shows that it is not said that the full cost over 2 billion € is necessary when crossing the 400 MW point. The respective paragraph in the report is much more qualified than the statement of question 7.3.

A lot depends on the spread of the injection points and on the way PV will be introduced in the system. In a "blind" support scheme (450 €/MWh certificate price without actual precise metering), one could argue that nothing is needed (although this would be an annual subsidy "cost" of 360 M€ for 1GW installed power, 800 h per year), not counting other protection systems in the grid. If PV is introduced in a market compatible way, active & precise measurement has to be introduced, which allows to correctly assess the input from PV and then put a real market price on it. This leads to the cost of the order of 2 G€, being an estimated guess of 6 million meters, at 300 € per metering point (100 € for the meter, 180 € for its installation, 20 € for the supporting software for data acquisition). It is evident that this cost is not only to be attributed to PV, but it is clear that without it, a sustainable introduction of massive amounts of local generation with a different market value is impossible.

The extra 2 G€ to be installed in the grid is due to the two way protection system and the redundancy that has to be introduced in the distribution grid. Here technologies are needed that still must be developed (see e.g., the "SmartGrids platform" of the EU http://ec.europa.eu/research/energy/pdf/smartgrids_en.pdf). Examples of such systems are microgrids and energy islands. Many technological breakthroughs are still needed to get there, so an effective cost estimate is extremely difficult. Clearly, again, these investments are not only due to PV, but are needed for all types of microgeneration that might be introduced (microturbines, micro-CHP, windharvesters, ….)

The 40 W per inhabitant is of course of no importance at all. Installations will have the size of around 1 kW if they have to be somewhat economic, and thus the protection system has to be developed for such installations.

7.4

It should first be stressed that no growth limitations have been imposed to PRIMES (see report section 7.1.2.3, page 97). For the scenarios, the growth rates are determined by PRIMES itself. This can be observed from the detailed results in annex D of the FPB report where growth rates are given per period of 10 years, and where temporary growth rates up to 99% per year can be observed. The sole limitations applied are overall potential limits and cost curves on biomass import (see also question 2.3 about biomass import).

In chapter 8 of the CE2030 report, which relies on the numbers provided in the supporting document on renewable energy, it is tried to "confront" these PRIMES growth rates with "realistically expected" growth rates (based on manufacturing capacities in a worldwide market). The report makes an exercise and points to the major challenges if the growth rate is much higher than what is believed to be "realistic". It is not said in the report that the "more ambitious" growth rates are impossible; the aim of that section, nevertheless, is to draw attention to what they mean. The moral to the story is that the PRIMES results should not be taken at face value but, depending on one's point of view, should be considered as a major/daunting challenge or as a very probable overestimate.

It is true that in the CE2030 report the considered *overall* average growth rates may seem conservative (as compared with the currently observed actual growth rates in the field), but these take into account the challenges of far off-shore wind, and the fact that, as potential limits are getting closer, growth rates will slow down. One should realize that annual growth rates of 20 to 30% sustained for the next 25 years (translating into an exponential growth) seem very unlikely.

Coming back to the scenarios performed, when analysing the PRIMES results in detail, one finds temporary extreme growth rates (up to 99% for PV and 68% for wind in 2010-2020), but rapidly decreasing after booming. On the average and over a long period, the overall growth rates do not exceed these specified in the report, at least for wind and biomass. It should also be stressed that consequently wind and biomass virtually reach their potential limits in all scenarios except the baseline one (see summary Table in the conclusions and recommendations, and Figure 2 for bkp30 cases).

The possible growth in solar PV is more subject to discussion, since the PRIMES results indicate much higher growth scenarios than first expected. As is illustrated in Figure 2, below, solar PV 'booms' in the -30% CO_2 scenarios when nuclear phase out is assumed, and in particular when CCS is considered not to be available. To achieve the latter figure a *continuous* growth of 40% per year must be taken from now till 2030.

Comparable results from the DLR study supported by Greenpeace (see http://www.greenpeace.org/raw/content/belgium/nl/press/reports/energy-revolution-a-sustainab-2.pdf) have been included in Figure 2 for the year 2030 (leading to nearly the same GHG reduction of -30% in 2030). As can be seen on this figure, the CE 2030 scenarios are even more optimistic for wind, somewhat less for biomass, and -in particular- far more booming for PV in three out of the four scenarios shown. In the DLR case an average growth rate for PV of 29% is observed, which is not that much in excess of the 25% maximum considered by CE 2030 (Tables 9.2 & 9.3, page 151).

It should also be stressed that in the bpk30s scenario (*no nuc, no CCS*), the combined installed capacities of wind and PV reach almost 50% of the total installed capacity, with obvious problems for backup and dispatchability.

In conclusion, it cannot be said that CE2030 underestimates the potential impact of renewables, certainly not when comparing with the DLR (Greenpeace) results.

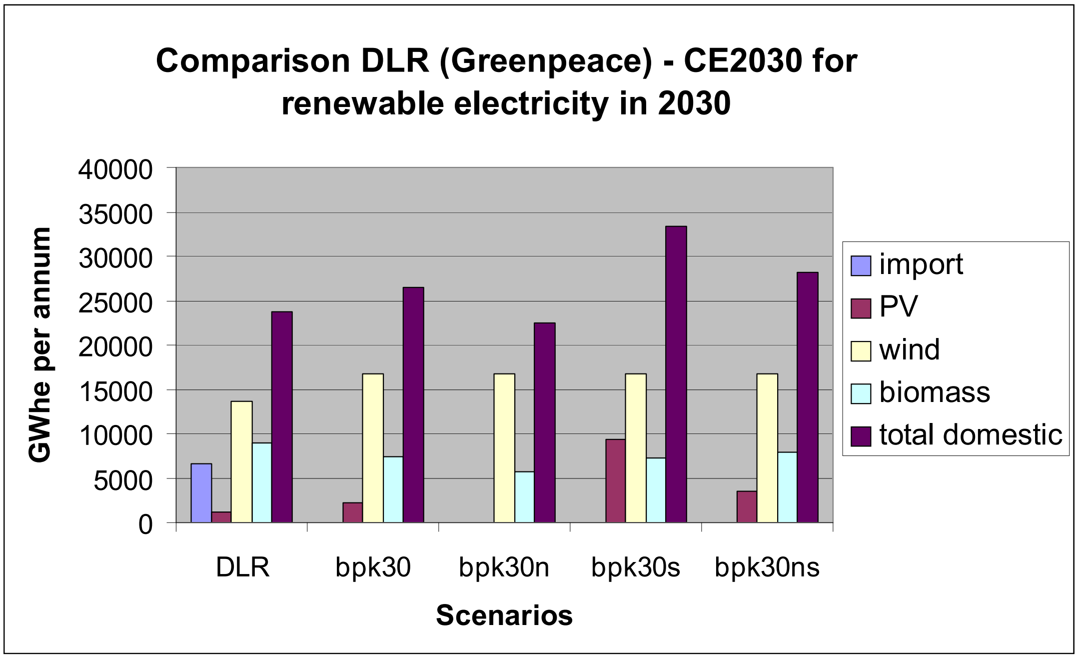


Figure 2: Comparison between comparable results from DLR (Greenpeace) and CE2030. Source for DLR : 'Energy revolution : a sustainable pathway to a clean energy future for Belgium', Figure 10, http://www.greenpeace.org/raw/content/belgium/nl/press/reports/energy-revolution-a-sustainab-2.pdf

7.5

See answer to question 7.4

7.6

The answer is very clear. It is very unfortunate to say, but there are no real breakthroughs in long term storage of electric energy. Redox flow batteries have been announced several years ago, and even a 15 MW combination gas fired power plant/Redox flow batteries has been announced as prototype. Very little noteworthy has emerged until now and nothing new is found in the literature since then. Other types of storage are not seen, except indirectly through hydrogen, that may find its way, although efficiency wise not the best option, reflected in high costs. Therefore, solutions for wind balancing have to be found in a different way.

The link between Carbon Capture and Storage and the storage of electric energy as such made in the question is not very clear. CCS seems to have a future —although the time scale is uncertain; hence our reservations for availability of routine commercial CCS in Belgium by 2030—, whereas electricity storage has been investigated for more than a century now, and no real large-scale solutions are to be foreseen. The large scale routine and commercial availability of redox-flow batteries is assessed be very unlikely.

BBLV (Bond beter leefmilieu)		
N°	**Auteur**	**Questions**
8	**Bram Claeys**	Klimaatbeleid
		1. Op welke basis zijn de CO2-reductiedoelstellingen voor 2030 vooropgesteld? Dezelfde reductiedoelstellingen worden immers in EU-verband naar voor geschoven voor 2020.
		2. Waarom is geen scenario onderzocht waarbij gedeeltelijk beroep kan worden gedaan op de flexibele mechanismen voorzien door het Kyotoprotocol?
		Levensduurverlenging
		3. De Commissie gaat er van uit dat de 7 Belgische nucleaire reactoren kunnen blijven functioneren tot een levensduur van 60 jaar. a. Wat Doel3 en 4 en Tihange 2 en 3 betreft, gaat men er van uit dat de levensduurverlenging geen bijkomende investeringen vraagt. De stoomturbines van deze reactoren werden na 20 jaar dienst vervangen. Wat doet de Commissie vermoeden dat de turbines nu 40 jaar zullen kunnen functioneren? b. Hoe reageert de Commissie in dit verband op de vaststelling van het federaal planbureau (in PP95) dat *"Voor lover wij weten, is er weinig gekend over het Gantal Belgische kerncentrales dot zestig jaar economisch en zonder risico's kan draaien. Ln Frankrijk wordt geschat dot slechts de heift van de kernreactoren v!iftig à zestigjaar kan draaien."* c. Prof. D'haeseleer wordt in de pers geciteerd met een verwijzing naar reactoren in de USA die 60 jaar zouden draaien. Klopt dit citaat? Indien wei, zouden wij graag de referenties ervan krijgen. Voor lover wij weten zijn een aantal reactoren inderdaad vergund voor 60 jaar, maar draaien ze nog niet zolang. d. De ontmanteling van de kerncentrales blijft door de levensduurverlenging buiten de tijdshorizon van de studie. Denkt de commissie dat de momenteel aangelegde provisies zullen volstaan voor de ontmanteling?

		<u>Nieuwe kerncentrale</u>
		4. De nucleaire scenario's voorzien een nieuwe kerncentrale in België voor 2030. De kost daarvan wordt vastgesteld op 3,06 miljard euro. . a. Deze kost is gebaseerd op de Finse EPR. Hoe realistisch is deze kost? Voor deze eenheid van 1600 MW bepaalden Areva en Siemens de kostprijs op 3,2 miljard euro. Ondertussen loopt het project zoveel vertraging op en kende het zoveel technische problemen dat de kostprijs momenteel geschat wordt op 5,2 miljard euro. b. De Finse centrale wordt gefinancierd met een krediet van 1,95 miljard euro aan een nooit gezien lage intrestvoet van 2,6%. En de Franse regering heeft het project gesponsord met e_en exportkrediet van 610 miljoen euro. Verwacht de commissie voor de nieuwe Belgische centrale een analoge ondersteuning? c. Welke locatie in België acht de commissie meest geschikt om de nieuwe centrale te bouwen? d. De commissie verwijst voor hernieuwbare energie (PV en offshore wind) naar de bijkomende kost voor de noodzakelijke aanpassingen aan het elektriciteitsnetwerk. Ook voor een grote nieuwe kerncentrale van 1700 MW lijken aanpassingen aan het elektriciteitsnetwerk ons noodzakelijk. Werd er rekening gehouden met deze "extra kost" bij de kostprijsbereking voor de kerncentrale?
		<u>Uraniumprijs</u>
		5. Daar waar de prijzenevolutie van gas, aardolie en steenkool in rekening wordt gebracht, wordt de prijsevolutie van uranium, dat ook voortdurend schaarser wordt, blijkbaar niet in rekening genomen. Het uranium is de afgelopen les jaar acht keer duurder geworden, en men verwacht een vervijftienvoudiging. Het EIA stelt in haar World Energy Outlook 2006 dat het uraniumerts 5%, en de splijtstof 15% van de stroomproductiekost van een kerncentrale uitmaakt. Het *Uranium Information Center* schat dat "a doubling of the UjOs price would increase the fuel cost for a light water reactor by 26% and the electricity cost about 7%."1 Dit is met andere

		woorden geen verwaa rloosbaar aandeel. Prof. D'haeseleer betwistte ondertussen herhaaldelijk (in de media en in de Kamer) dat uranium significant bijdraagt aan de productiekost. Kan deze stelling jets meer worden toegelicht?
		Hernieuwbare energie
		6. De commissie voorziet geen import van groene stroom of biomassa. Waarom niet?
		7. De commissie gaat voor wind op land uit van een groei van 10% per jaar. Dit is te laag. De reële groei voorbije 5 jaar was gemiddeld 50 %. En de capaciteit kan in België tot 2010 jaarlijks blijven groeien met 40 % per jaar tot 950 MW2. De commissie ziet slechts in 2020, 718 MW geïnstalleerd vermogen op land voor heel België.
		8. Over de Thornton-bank stelt prof. D'haeseleer dat er nog geen windturbines van 5 MW op 28 km uit de kust gebouwd zijn. Ln augustus ditjaar werd 25 km voor de Schotse kust in een waterdiepte van 44 m een 5 MW windturbine opgerichV, met medewerking van een Belgisch bedrijf. Voor de Duitse kust (op 45 km) worden in 2008,12 windturbines van minstens 5 MW gebouwd. Waarop baseert de commissie haar scepsis ten opzichte van offshore windparkontwikkeling?
		Energiebesparing
		9. De commissie voorzag geen scenario met doorgedreven energiebesparing. Nochtans bewijst het onderzoek van DLR, gepubliceerd op vraag van Greenpeace4 dat energie-efficiëntie de sleutel is in de evolutie naar de koolstofarme economie. Tegen 2050 kan de Belgische energievraag met 40% dalen, mits een doorgedreven politiek ter promotie van energie-efficiëntie. Dr. Eichhammer wijst in zijn nota naar aanleiding van de ontwerpaanbevelingen van de commissie eveneens op het onderschatten van het energiebesparingspotentieel. a. Waarom werd een dergelijk scenario niet onderzocht? Voigens het laatste jaarrapport van de CREG, is intussen de vraag naar elektriciteit in België tussen 2004 en 2005 gedaald met 0,7%. Voigens

		Europese statistieken is onze binnenlandse elektriciteitsconsumptie zelfs met 1,1% gedaald tijdens dezelfde periode. b. Hoe reageert de commissie op de kritiek dat het Primes-model de kosten voor energiebesparing overschat.
		10. Betekent het uitgangspunt in de transportsector, waar men uitgaat van gelijkblijvende normen en een sterke bijkomende stijging van de transportvraag, geen overschatting van de kosten van CO2 reductie? .
		11. Waarom werd het reductiepotentieel in niet-energiegerelateerde broeikasgasemissies niet bestudeerd? Uit de studie die het federaal plan bureau uitvoerde voor minister Tobback blijkt nochtans dat hier veel goedkopere reductiepotentiëlen te vinden zijn.
		<u>Productiecapaciteit</u>
		12. Het maximaal opgevraagd~ piekvermogen in België is volgens Elia 13,7 GW. De geïnstalleerde capaciteit in België is 15,6 GW. Er is momenteel voldoende capaciteit beschikbaar om de piekvraag te kunnen opvangen. Wanneer er vorigjaar netto 7 tot 8 % elektriciteit ingevoerd is, is dit niet het gevolg van gebrek aan productiecapaciteit maar van economische keuzes. Onderschrijft de commissie deze vaststelling?

8.1

As said in the CE2030 report, the CE2030 does not advocate one or the other reduction limit. All we do is to provide scenario results that permit policy decisions based on the interpretation of the obtained results. European targets (as known up to November 2006) have been quoted in § 9.4.3 of the CE2030 report. Note that those reductions concern *greenhouse gases* and not just CO_2.

The choice for the reductions in the CE2030 study was inspired by the wish to have transparent scenarios. Note that PRIMES is only able to deal with *energy-related CO_2 emissions*. Rather than a-priory assumptions on flexible mechanisms, non-CO_2 GHG and non-energy-related CO_2 emissions, we have opted for two clear cut CO_2 limitations: -15% and -30% domestic reduction of energy-related CO_2 emissions. Taken together with the Baseline, hence three scenarios (0, 15% and 30% reduction have been considered). In a post-scenario evaluation, then, these reduction limits have been evaluated and interpreted against the light of flexible-mechanisms and other gases. From that discussion it is clear that the CE2030 results remain useful and pertinent if the EU were to opt for reductions larger than 30% GHG emissions by 2030 (as our reduction of energy-related domestic CO_2 emissions remains compatible with GHG reduction limits larger than 30% and up to perhaps 40% to …45%...). The issuers of the CE2030 report believe that there is sufficient information available to be able to draw sensible conclusions.

See also answer to question 3.4.

8.2

See earlier questions and question 8.1.

8.3

See already the answer to question 3.1.

8.3.a

We assume that the questioner means replacement of steam generators and not steam turbines (although the issue of steam turbine replacement in some units will be dealt with below).

The original steam generators used the Nickel-based austenitic steel, alloy Inconel 600, for the heat exchanger tubes, which was shown to be insufficiently resistant against corrosion under stress, leading to cracks (this deficiency is usually referred to "stress-corrosion cracking"). For some time, the affected tubes were blocked, removing all safety concerns, but decreasing the power output of the power station (since the heat-exchange surface was reduced). The reasons for that "stress-corrosion cracking" behavior have been identified, leading to the introduction of the more resistant alloy Inconel 690, characterized by a different percentage of certain alloying elements (especially more Chromium). Since about 15 years, test have been performed on this new alloy 690, which no longer shows this cracking tendency observed earlier in alloy 600. The new steam generators in all Belgian nuclear units (to date, all of them except Doel 1) utilize this new alloy 690. According to the current scientific and technical knowledge and experience, it is not expected that the new steam generators would have to be replaced before the power plants have reached 60 years of operational life. This is well documented in the scientific & technical nuclear materials literature.

As to the steam turbines, the rotors of the low pressure turbine have been replaced in Doel 3 and Tihange 1 & 2, and are planned to be replaced in Doel 4 and Tihange 3 in anticipation of potential problems but more importantly to benefit from increased efficiency because of improved and better turbine technology. This means that the costs of these replacements have been / will be paid back very quickly. So as far as investment costs are concerned, these replacements are of minor importance.

8.3.b

We assume that this conclusion in France has been made at the time that some cracks were observed in some reactor-vessel covers. In the mean time, these covers have been replaced and there is no fundamental reason why the French PWR power stations would not be able to operate safely for 60 years. However, as with all power stations, the evaluation must be made continuously, and especially at each 10-year overhaul.

Not that in the mean time in the USA 47 reactors have received a license to operate until the age of 60 year, whereby most of these reactors are of the PWR type.

8.3.c

W. D'haeseleer has not made that statement. If so reported in the media, then this is incorrect. At present, 4 reactors are operational for longer than 40 years, the oldest one being 42 years; see http://www.iaea.org/programmes/a2/index.html. According to the USNRC (http://www.nrc.gov), presently 47 reactors have received a license extension for operation to 60 years, 8 applications are under review and 27 submittals have been announced by letter of intent to the NRC. About 70 out of the 103 reactors wish to have a license until 60 years. As far as we know, there are no power stations for which a license renewal has been requested and that has been denied.

8.3.d

All the details can be found in the supporting document of the CE2030 report by J.-M. Streydio, P. Tonon, P. Klees : "*Nuclear power solutions in Belgium to an energy mix*", especially in its annexe 2 : "*Nuclear Provisions*".

In summary, the Act on nuclear provisions stipulates in Article 11, § 3 and 4 that "*if during decommissioning operations (or for the management of irradiated fissile materials), the provisions prove to be less than the decommissioning cost, the nuclear operators shall pay SYNATOM the amount required to cover the excess cost of decommissioning at the time this is due".*

> The comparison between, on the one hand, the estimates made by ONDRAF-NIRAS for the costs of finally disposing of the radioactive waste from spent fuel and decommissioning the plants that will have accumulated over the 40-year operational life specified by the Act of January 2003 and, on the other hand, the method and state of establishing the financial reserves that will be required to carry out this disposal and decommissioning of the plants within the specified time frame shows that the provisions thus established will be capable of meeting the financial commitments. However, this implies that these provisions will continue to be established and managed on the basis of achievement of the final objective for which they are intended.

8.4

In the PRIMES database, the total investment cost of one new nuclear power plant in Belgium is set equal to 1800 €/kW for operation after 2020 (expressed in € of 2005). This figure includes the financial charges paid during the construction of the plant (8 years – interest rate of 8.5%) which adds up to the overnight investment cost of the power plant. It also includes the decommissioning costs (12 to 15% of the plant costs).

The figure used for the total investment cost assumes that one new nuclear unit can be constructed on an existing site; consequently investment costs are taken to be a lower than for a new nuclear power plant on greenfields where site preparation costs have to be included (e.g., total investment costs for greenfield situations are roughly 2440 €/kW in 2005 and 2230 €/kW in 2020) [Ref. Nov 2005 database PRIMES --Newtec.xls-- not publicly available]. This approach applies to all power generation technologies, including renewables. This cost reduction applies to a single additional unit and not to the others.

This should be compared with the database of the TIMES-EE model [Ref University of Stuttgart; IER], where for the year 2020, a total investment cost for an EPR-type reactor of about 1660 €/kW has been assumed (not specifying whether this includes site preparation costs). The PRIMES figures have clearly not be assumed to be too low.

In the scenarios, the competitiveness of nuclear compared to other power generation options depends on the assumptions on capital costs, fixed costs and variable costs (part of which is the fuel cost). The figure below compares the power generation costs for three different types of power plants operating 7800 hours per year with the techno-economic data and fuel prices as used in the scenario analysis, but with different carbon values. In order to assess the sensitivity of nuclear power generation costs to capital costs, we have also plotted alternative generation cost figures corresponding to other assumptions as to the investment cost of nuclear.

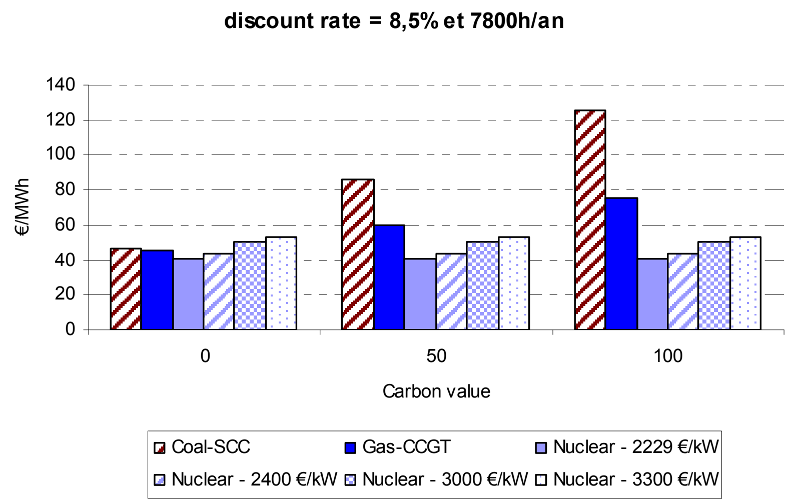


Figure 3.

Of course, there are many other parameters one can "play with" and the ranking could be different (e.g. cost parameters of coal and gas fired plants, fixed and variable costs of nuclear plants, discount rate, load factors ...). However, the cost parameters of nuclear must be very unfavorable in order not to be a cost-effective option for base load electricity production when the carbon value is higher than 50 €/t CO_2.

The figure below shows the ranking when the nuclear fuel cost is increased by 50% compared to figure used in the previous figure (12 €/MWh instead of 8 €/MWh).

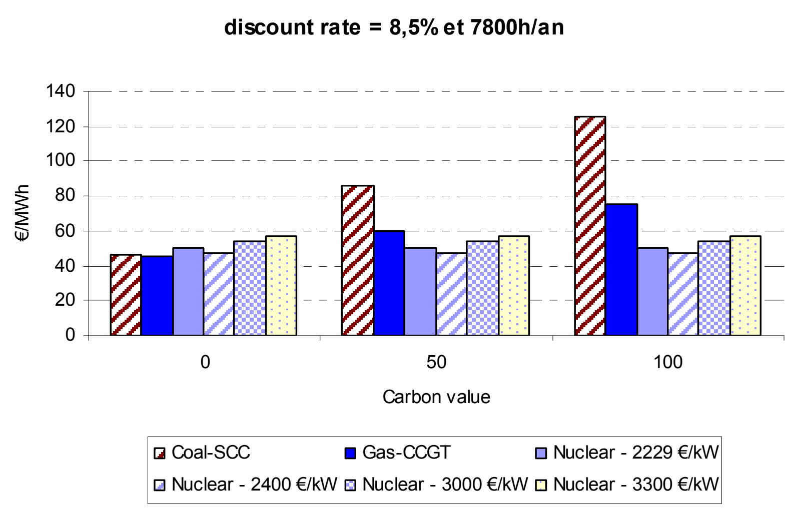


Figure 4.

8.4.a

According to publicly available information, the price of 3 G€ has been given by the operator; the real contractual price (with AREVA) has to our knowledge not been disclosed.

It is not surprising that there is a delay for such "first-of-a-kind" (FOAK) project, whereby the original planning was perhaps too optimistic. This has been indeed the first EPR built (and the first Gen III PWR reactor in the world). The EPR was generically ready for construction, but ever country has its own regulatory customs and its own rules, forcing the generic design to be adapted to the local circumstances. Perhaps also the time for the original licensing process has been underestimated. In Belgium, about two years would be added to the minimal construction time to account for the ins and outs of the licensing process.

The same applies to the price for such a FOAK. It is to be expected that by the year 2015-2020 several such Gen-III units will have been built and because of international competition the real price will decrease.

All of the above, however, is unrelated to the PRIMES results. For PRIMES, a particular total investment cost has been assumed and the computations have been done with those data. See the figures above.

8.4.b

The fact that France may have "subsidized" this reactor by granting an export credit has perhaps more to do with "technology support" since the French will likely consider nuclear power as a future export product, but this is unrelated to the viability of nuclear power as such. Also, this FOAK in Finland has certainly been considered by the French as a good exercise for the next reactor in France, planned in Flamanville. Unless there are stringent and exceptional circumstances (e.g., security of supply) the philosophy of the CE2030 is that nuclear power is to compete in an open market under the same conditions (internalization of external costs etc) and on a level-playing field with other generation modes.

8.4.c

It seems that Doel would be a logical place for the next unit since the site was/is ready to accommodate a Doel 5. But the CE2030 does not exclude that other sites may be available.

8.4.d

The present situation of the grid should not be taken as a basis here, as many developments in the broader Antwerp region are to be seen in the next decade, so before a possible new nuclear power plant will come onto the grid.

The connection of a possible high power (1700 MW) nuclear power plant in Doel has to be seen within the framework of the overall development of the grid around the Antwerp harbor.

In that respect, the 400 kV system will be developed further in order to support the growing demand of the chemical industry. These investments will have to take place regardless of a new nuclear unit.

If that system is built, which will be the case by the time a new 1700 MW nuclear power plant comes on to the grid, the extra investments needed will be limited.

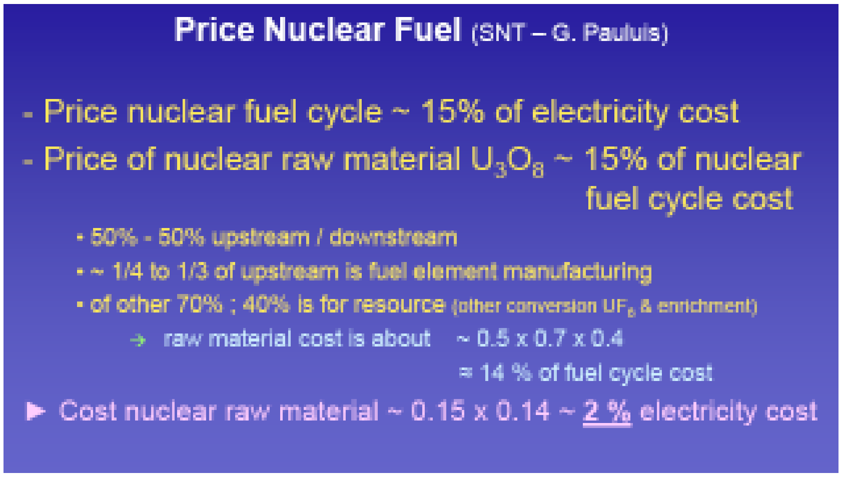
Moreover, by the time that that power plant will become available (in the modeling not appearing before 2025), the power plant of Kallo (2 x 260 MW) will likely be off line.

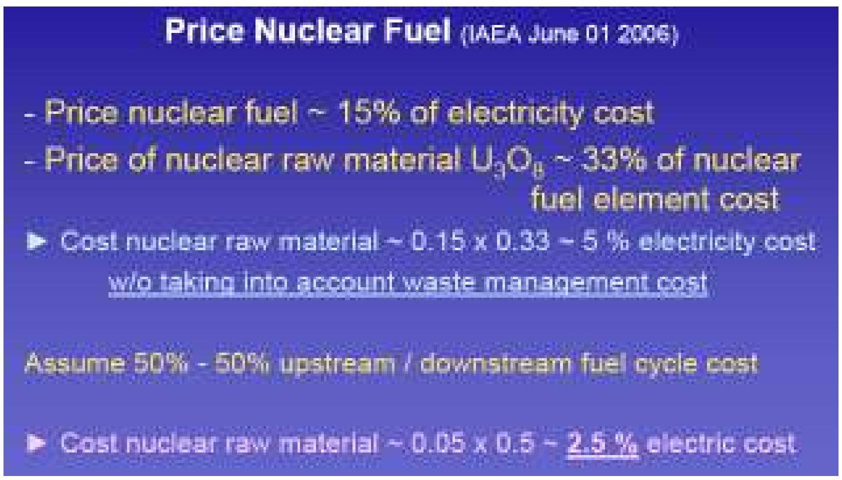
8.5

The PRIMES scenario analyses have been made assuming particular prices for oil, gas, coal and uranium, independent of the actual price levels and fluctuations. It has been assumed that the price of the uranium “fuel costs” (whereby fuel preparation costs are included as well as the waste management costs) remains roughly stable in constant terms over 2000-2030 at 8 €/MWh. In the simulations, the nuclear fuel(-cycle) cost represents 20% of the electricity generation cost in a nuclear power which operates 7800 hours per year (again for operation from the years 2020-2025 on). An increase in fuel cost by 26% implies an increase in electricity generation costs of 5.2% (see also answer to question 8.4).

According to the nuclear-generation cost estimate in the IEA's World Energy Outlook, released on November 07 2006 [IEA, WEO 2006, chapter 13], the following numbers apply: uranium resource cost ~ 25% of total fuel cost, conversion ~ 5%, enrichment ~ 30%, fuel assembly ~ 15% and back end (i.e., waste management) ~ 25%. Furthermore, according to Figures 13.7 and 13.8 of that reference, the fuel(-cycle) cost amounts to 7% to 14% of the total electricity cost, depending on the assumes discount rates and the assumptions for capital investment. All this leads to a contribution of 1.75% to 3.5% of the U_3O_8 resource cost to the overall nuclear kWh cost.

A slightly different estimate, assuming a 50%-50% cost distribution of the back end (fuel-element preparation) versus the front end (waste management) cost has been given on slides 89 to 94 on "Cost of Nuclear Fuel for Electricity Generation" of the "*Summary Power Point Presentation*" (see web site http://www.ce2030.be → Preliminary Report → "Summary Power Point Presentation". For convenience, the slides have been repeated here:





As these estimates are dependent on the assumptions for front end/back end costs (which may differ by country) and on the beginning price of U_3O_8 to consider a relative change, it is fair to conclude that the cost effect of the nuclear raw material U_3O_8 amounts to something of the order of 2 to 5%, but is not expected to go beyond the 5% for the types of reactors and fuel cycles considered for Gen-III reactors.

8.6

On biomass import:
In the scenario analysis, biomass can be either produced domestically or imported. There is no limit imposed on imports of biomass. The consumption of biomass is given by the equilibrium between the supply and demand cost curves (see also answer to question 2.3.).

For green electricity import:
Net biomass import is already partly exporting our problems, and net green electricity import from biomass is even more controversial: by importing green (bio-generated) electricity we even lose the added value of making it ourselves and it also implies transport losses/costs. It seems better to

increase import of biomass and take all the costs into account at this level, imported green (bio) electricity being even less attractive in economic terms.

Import of other green electricity (PV or wind or even hydro) is not an issue as the electrons at the consumer's place will always come from the plant closest by. Import is just import, it cannot be tagged as being green import.

The point is that if one were trying to make a case for net green import on an annual basis, that the country then will not be self sufficient. In terms of security of supply, this is not a good option. In such case, the imported electrons will come from foreign plants located near the border with Belgium (whereby much of it will come from French nuclear power plants).

The point made by the CE2030 on obligations of green electricity supply rather than local generation is different. By opting for supply quota, one guarantees a "sufficient" green electricity mix in Europe, so as to reduce CO_2 emissions on a European scale. However, as Belgium itself should be self sufficient to cover its peak at all times, and should try to be in balance energy wise as well[4] (although this should depend on market circumstances). In any case, sufficient base-load capacity is to be foreseen. This means that Belgium should invest in more classical generation means. Even more so, it could be that because of serious imbalances of renewable energy in Europe, Belgium will have to assist in balancing them by means of classical generation.

So, the issues of a sufficiently green generation mix on a European scale and import/export are completely different issues.

8.7

Same answer as to question 7.4 (see above): the growth rate of 10% must be seen as an average value.

According to the detailed results annex D of the FPB the total installed wind power is around 1100 MW (2900 GWh) in 2010, and exceeds 3000 MW (>9000 GWh) in 2020, in all scenario's except the baseline. This is even beyond the figure of 950 MW in 2010 as mentioned by the questioner.

8.8

Please note that the PRIMES simulations and the CE2030 report include ambitious amounts of off-shore wind, with 3800 MW by 2030.

However, even with ambitious scenario results, it is important to be fully aware of the challenges. As far as we know, there are at present no real *commercial* projects where wind turbines have been placed at such far distances as would be the case for the massive deployment of the Thornton bank (both the current concession and the larger & deeper part of it for which no concession has been granted yet).

[4] And not just in terms of "power".

Having said that, we are aware of the fact that a *prototype* project has been realized (at least part of it) in the recent past: the Beatrice Project. See [http://www.beatricewind.co.uk/home/default.asp and http://www.offshorewindenergy.org/]. It concerns here a prototype project (the demonstration project is part of the EU-supported "DOWNVinD") where it was planned to erect two 5 MW turbines. However, we observe that only one turbine has been installed so far. In principle, 3 years of monitoring are foreseen before more turbines are constructed, and it is not clear when the second turbine will be placed. Note that, even with the distance and depth of this project, it is not a-priory clear that the meteorological conditions of this place can be transposed to the Belgian far off-shore situation.

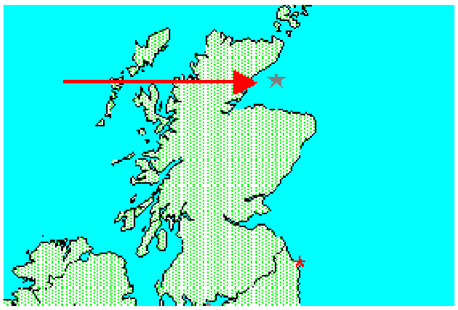


Figure 5: location of the Beatrice off-shore wind prototype project.

Even with this Beatrice prototype project in mind, the CE2030 still believes that it will be a major challenging undertaking to erect the full Thornton bank project as foreseen (and this is even more so for the other currently granted concessions and those that will have to come later to reach the 3800 MW of the scenarios). We do not say at all that it is impossible, only that one should be aware of the serious challenge and the costs, and that those should not be underestimated. It is our advice to be at the same time ambitious but cautious: develop the Thornton bank "meticulously" and stepwise (with sufficient monitoring before continuing). These Belgian off-shore projects can be thé examples internationally for our project developers, engineering companies and dredging companies, for *good stewardship* and *quality*, if erected according to the established engineering rules, without hasty and blind implementation. As to the costs and support, and as said above, a recycling of nuclear-generated revenues after operational extension beyond the phase-out law date, seems an interesting route.

8.9

A response to the comments by Dr. Eichhammer will be provided through the internal review of the CE2030, as explained for question 3.3.

Firstly, all the scenarios under PRIMES, including the baseline scenario, contain further progress towards energy efficiency. With respect to estimates of the reduction potential of energy efficiency measures, PRIMES uses rather high but realistic discount rates while several other approaches use very low discount rates and even interpret discount rates as an expression of existing implementation barriers.

Most of the CE2030 scenarios imply high carbon values to realize domestic emission reduction targets. As a result, the future gains from efficiency investments do strongly increase. As higher prices provide strong incentives to investors, most CE2030 scenarios are scenarios with high investments in energy efficiency improvements.

Next, some thoughts regarding the DLR study.

The DLR study yields no 'proof' (it is model as well, just as PRIMES) that energy demand can be reduced with 32% in 2030 (or 40% in 2050).

In Figure 6 below, a comparison is made between the primary energy demand in 2030 from DLR and comparable scenario's CE2030 (DLR leads to about the same -30% CO_2). From this figure it can be seen that PRIMES considers comparable energy savings, with savings in the extreme bpk30s scenario which are even deeper than in the DLR (Greenpeace) scenario.

Corresponding yearly energy intensity reductions are shown on Figure 7. The intensity reductions are in excess of the reductions from DLR in the case of nuclear phase out, and equal in the case of no CCS and nuclear allowed. All these reduction rates are to be considered as challenging, with costs increasing exponentially with reduction rate.

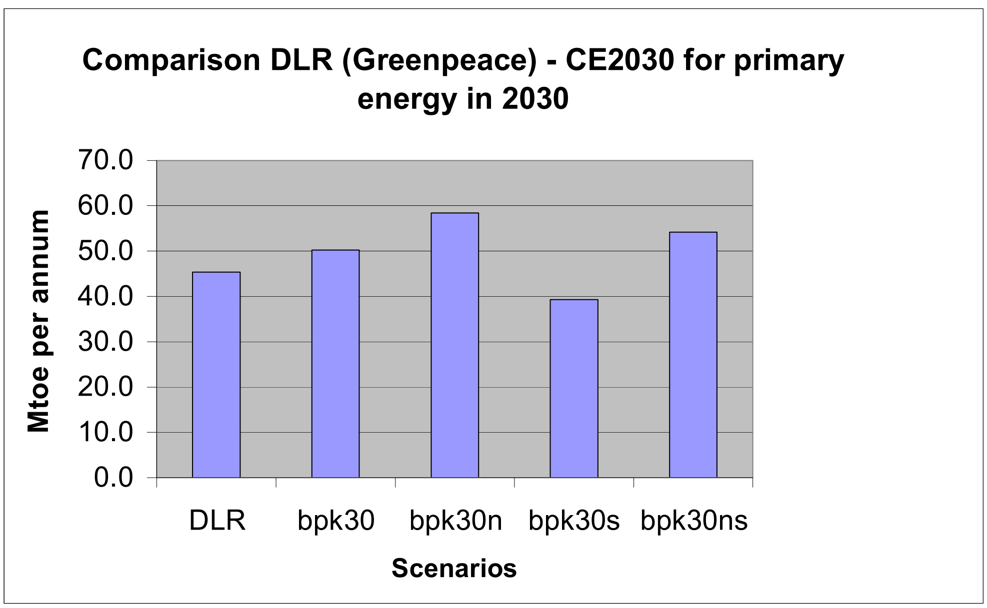


Figure 6 : Comparison between comparable results from DLR (Greenpeace) and CE2030. Source for DLR : 'Energy revolution : a sustainable pathway to a clean energy future for Belgium', http://www.greenpeace.org/raw/content/belgium/nl/press/reports/energy-revolution-a-sustainab-2.pdf*, Figure 1*

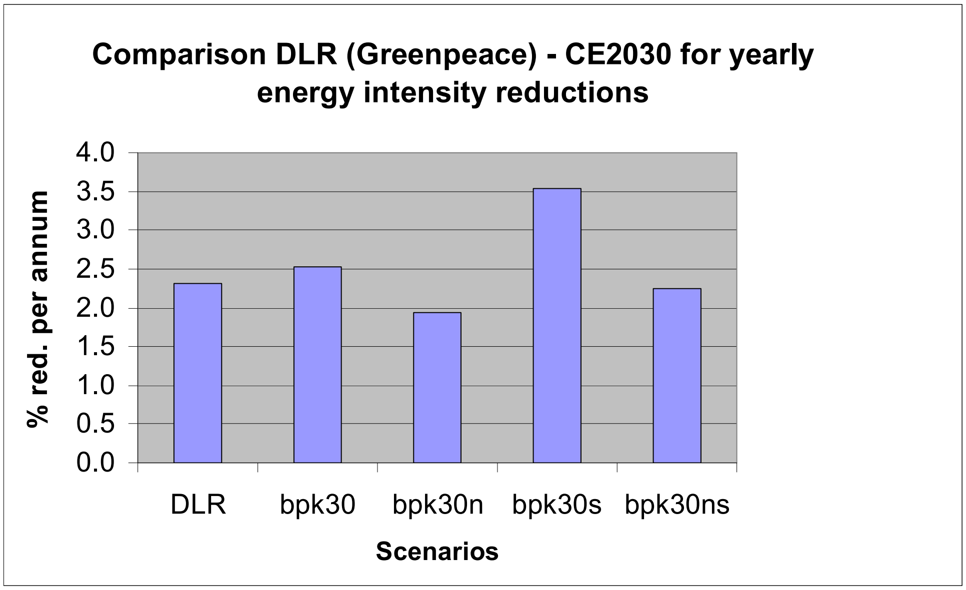


Figure 7 : Comparison between comparable results from DLR (Greenpeace) and CE2030. Source for DLR : 'Energy revolution : a sustainable pathway to a clean energy future for Belgium', http://www.greenpeace.org/raw/content/belgium/nl/press/reports/energy-revolution-a-sustainab-2.pdf, *combination of Figures 1 and 3.*

8.9.a

The final numbers are not available yet; these need to be confirmed later.

Following the (preliminary) statistics below on electricity generation and consumption, one cannot conclude that electricity demand has initiated a decreasing trend. If electricity demand decreased by 0.5% in 2005 compared to 2004, this has mainly to do with “transport and distribution losses” (change in the methodology) whereas electricity generation increased by 1.9% and that is this figure that is relevant for CO_2 emissions.

Recent evolution of electricity generation and consumption (GWh)

Source: DG Energie - SPF Economie (déc 2006); Eurostat (nov 2006)

	2003	2004	2005	05/04	04/03
Total gross electricity production	84615	85441	87026	1,0%	1,9%
Net imports	6410	7778	6304	21,3%	-19,0%
Consumption energy sector	7589	8752	8839	15,3%	1,0%
Transport and distribution losses	3757	3855	4156	2,6%	7,8%
Total final electricity consumption	79681	80611	80201	1,2%	-0,5%

Preliminary figures.
Note that the headings of the last two columns should be interchanged.

From this Table, the change in methodology is obvious (see e.g., the changes in the "consumption energy sector" and "transport and distribution losses").

Other (also preliminary) figures lead to the following:
Electricity consumption [Ref. DG Energy; SPF Economy --prelim communication]:
83 637 GWh in 2005 (preliminary) --to be compared with 83 763 GWh in 2004
→ decrease with 0.15%
Deliveries to end customers [Ref. Regulators]:
80 848 GWh in 2005 -- to be compared to 78 701 GWh in 2004
→ increase by 2.7% but this figure ignores auto production

The CE2030 hopes that the definite figures will be available soon. ***It re-iterates its request to streamline the Belgian statistical approach to have reliable clear-cut figures and sufficiently timely.***

8.9.b

See also the answer to question 2.2.

The used discount rates in PRIMES are based on empirical research and are widely accepted in the academic literature. Of course, public investment projects can be based on different criteria. Since the bulk of energy investment decisions takes place at the private level (households and industry), the choices in the PRIMES model do reflect 'realistic behavior'.

Furthermore, it is important to underline that PRIMES is a behavioral model: it does not only compare the investment costs of more efficient energy technologies with the fuel savings but also accounts for the barriers to the implementation of the proven cost-effective energy saving potential (a separate note on this issue is in preparation and will be posted on the ce2030 web site shortly).

The cost involved are high in the scenarios where energy savings are significant (scenarios without nuclear and CCS) because the model accounts for these barriers. Specific policy instruments are required to remove these barriers to behavioral change. The implementation of these extra policy instruments is *not costless* but could reduce the costs supported by the consumers.

The broader message behind the scenario analyses with PRIMES is not necessarily that, without nuclear and CCS, the costs involved to adapt to CO_2 constraints are high, period; but that the (accounting) costs involved are high in the absence of appropriate policies. [5] For instance, *appropriate* policies could allow price signals to have a more significant impact on energy use and to reduce the costs involved or the carbon value required to achieve the same reduction objective. However, to make a proper assessment of the actual cost reductions, it is necessary to capture all the costs implied by the

[5] Note however that the concept of "cost" needs to be considered with care, as behavioral changes also lead to some sort of (subjective) "cost". In addition, these policies also introduce some sorts of costs (usually referred to as transaction costs etc)

implementation of such policies. This analysis goes beyond the scope of the scenario analysis with PRIMES.

Some general considerations in addition:

To estimate the costs of a demand reduction one needs to distinguish between an assessment of the current policy that is to a large extent a policy of exogenous price shocks and an assessment of other policies.

The effects and costs of the first type of policies can be estimated using statistical techniques by estimating a demand function, this is probably what has been done by the Primes model. The effect of a very different policy is hard to estimate without a careful experiment.

8.10

The evolution of transportation activity is taken from the EU SCENES transport network model (for web references, see answer to question 4.1), which serves as an input for PRIMES. A lower transportation activity would indeed lower the cost of climate policy but at this moment it is too speculative to assume that the reduction of sold transportations fuels in 2006 sets a new long-term trend.

Furthermore, most sources expect a strong increase of freight transport needs and a more limited increase of passenger transport (except air transport). The main reason why carbon reduction costs in the transport sector are high is not the growth of transport needs but the very high excise taxes on oil products (and CO_2) in the transport sector.

See also earlier answers on the transport sector.

8.11

See the answer to question 3.4.

The reduction potentials of non energy-related CO_2 gases has been considered in the post-scenario analysis of Chapter 9 of the CE2030 report (Section 9.4). Note that PRIMES is not capable to deal with those gases.

8.12

This reasoning is not correct and neglects the fundamentals of the power system. First of all, power has to be available for system services (primary reserve and secondary reserve). This has to be subtracted from the installed power. Then there are always power plants that are not available (maintenance for instance). Furthermore, it is observed that the load in summer increases steadily (due to air conditioning), leaving less room for maintenance during a previously low load period. *We are currently definitely short of generation capacity in the peak.*

At first sight, the net electric *energy* import (on an annual basis) is not really linked to installed capacity: this is a market thing. If cheaper electricity is available abroad, it will be brought in. But, a market that has a shortage, as ours, will see high prices, thus will have high prices. In that respect, the high import is linked to the shortage.

BACAS (Belgian Academy Council for Applied Sciences)		
N°	**Auteur**	**Question**
9	**G.Haemers**	1. In case of energy shortage we have to purchase it abroad. What is the effect on the price? Will we only buy "green "or "clean energy"? How will that be guaranteed? 2. Is the absence of a "post Kyoto" really a scenario? 3. how will CCS be developed? 4. The effect of renewals is maybe underestimated. How to accelerate the use and what would be the scenario if penetration rate of renewables would be doubled?

9.1

In case of shortage of oil or gas, world prices will increase. Like all countries, Belgium will trade off energy efficiency efforts, more renewables with the more expensive gas and oil.

Concerning electricity, if markets are short, prices get up. If people know that you are short, there may be a temptation to abuse the market power, so prices may spike (California syndrome). To avoid abuse of market power, it is important to foresee sufficient cross-border transmission lines.

At this moment there is no European certificate system for green electricity. If the “cheapest” power is imported, it most probably will be nuclear from France for the time being. In that respect, the nuclear portion of the electric energy in Belgium should be increased by the amount of import, i.e. 6 TWh should be added to the nuclear part of the pie chart.

Note that in the modelling with PRIMES, the importation of electricity is basically fixed at the actual level in all scenarios. Future imports do not necessarily lead to completely different prices since our neighboring countries face similar long-term challenges.

9.2

The Baseline is just a first scenario, to be able to compare with all other scenarios.

The Baseline clearly has its purposes, since it starts from the current legislation, regulation and policy instruments. If no further action is taken, then the Baseline provides the projected results.

This scenario exercise uses a backwards reasoning: it is clear that the Baseline scenario is not sustainable, and that alternative scenarios are necessary. But it is also important to see what the benefits (in CO_2 reduction) and the costs are of the various scenarios in which different technological options have been allowed or not.

9.3

CSS is a complete chain of three main steps: separation, transportation, storage.

The IEA (International Energy Agency) presented recently (august 2006) in a workshop in San Francisco an overview in the world of CO_2 capture projects and of CO_2 storage demonstration projects (ref: www.cslforum.org/index).

For capture, the projects mainly concern the post-combustion CO_2 extraction, unfortunately it is not the best situation for the long term (low concentration of CO_2 in the flue gases due to the presence of nitrogen). We actually know that integrated solutions like chemical looping combustion are more interesting but need further R and D.

For storage, the majority of the projects are in fact enhanced oil or gas recovery by CO_2 re-injection in oil or gas fields. Only few projects are currently oriented to saline aquifer storage. Commercial outcomes from the North sea (Statoil project) are expected around 2011.

For CO_2 transportation the technologies are classical at a cost of 2-7 € /ton CO_2 per 100km (to compare with capture cost 50-80 €/ton and sequestration cost around 10 €/ton).

If the question 9.3 addresses the particular case of Belgium, we have to point out that the situation regarding CSS is not favorable:

- we have no depleted oil or gas reservoir,
- we probably could use a (small) aquifer in the Kempen/Campine if there is no other use (natural gas storage) --but this remains to be proven--
- we have to investigate the recovery of methane in coal mines with a lot of precautions considering that the greenhouse effect of CH_4 is ~22 time the effect of CO_2. This option requires lot of R and D effort.

Looking at all the partners in the actual FP6 European Commission projects in CO_2 storage www.ec.europa.eu/research/energy (CO2STORE, ENCAP, CASTOR, CO2SINK, CO2GeoNet, ISCC), it is disappointing that no Belgian research team and no industrial company from Belgium are involved in European projects. This indicates that our country will have difficulties to play a leader role in CO_2 separation and sequestration.

If we do not accept to be only followers, and if we want to give a chance to CSS in our country, it is necessary to build in Belgium our own expertise without delay.

See also answer to question 3.2

9.4

See answer to question 7.4