DTI Consultation: Deadline 14th April 2006

Energy Review: ***Our Energy Challenge***

Executive Summary

This response is in addition to the general response from the CRed Programme submitted separately. This response deals with some aspects in more detail – some of which are of a more technical nature.

Energy Security is an important issue which must be addressed. As the UK is now a net importer, steps should be taken to stop all future exports of gas as started again on 12th April 2006. The level of gas storage should be increased well above the planned target of 9% by 2010 to around 20% comparable with other EU countries. If the proportion of gas generation is to increase above its 35% then this storage requirement should be increased proportionally further. The issue of energy security and low carbon should be treated as two separate time scales. One should address the longer term from 2025 – 2050 when many options become available. The second should map the strategy for the next 20 years. It may be necessary to extend the life of existing nuclear stations and possible construction of one or two more new ones to cover the period up to 2025. By that time newer technologies such as large scale carbon capture and sequestration could make important contributions, they will not do so in the short term. Other technologies such as micro-generation, tidal etc could become more prevalent by 2025. It is thus important tot separate the two timescales.

Intermittency issues are just as important with nuclear plant as with renewables, but opportunities for short term response using mutli-shaft CCGT should be revisited rather than the current wisdom of installing only single shaft machines.

The opportunity of linking hydrogen generation as a storage mechanism should be integrated with the intermittency issue of wind and provide a mechanism to exploit renewables at the periphery of the UK without the need for overhead transmission lines.

There are serious issues regarding the "Rebound Effect" or "Comfort Taking" in the domestic market and these need to be addressed possibly by the use of smart metering techniques including multiple tariffs at each hour of the day.

Fuel Poverty should be decoupled from energy policy and tackled by other means. In addition consideration should be given to reverse tariff structures, where low consumers pay at a low rate, but the rate then increases above a threshold. In this way the fuel poor will be protected and the correct market signals will be sent to the higher consumers with regard to investing in energy conservation technologies.

Carbon Emission trading has the potential to drive the low carbon economy. The UK has to be congratulated in setting tough standards when allocating the total number of credits. There is an important need to reconsider the allocation within each sector to avoid the perverse situation that inefficient plant are effectively rewarded at the expense of more efficient ones.

The Renewable Obligation is a mechanism to promote Renewable Energy generation, but this should be extended to include renewable heat and CHP Heat in a Heat Obligation. There is a strong case in the case of large consumers to make the obligation on the consumer rather than the Supplier while retaining the supplier responsibility for domestic and small consumers. The advantage of this is that the Heat and Renewable obligations could be linked and organisation this would stimulate innovation towards the most effective reduction in carbon emissions.

Planning rejections of renewable projects is a barrier to more widespread development of such projects. There should be a prime requirement in all planning applications to consider the local electricity consumption and the progress made towards meeting the declared regional renewable target in all planning applications.

1. The CRed (Community Carbon Reduction Programme)

The CRed Programme has core funding from EEDA (the East of England Development Agency) and has being taking up the challenge declared in the Energy White Paper (2003) to move towards a low carbon economy. It goes further than a 60% reduction by 2050 by recognising the importance (as outlined in the White Paper) that significant progress must be made by the 2020s if this aspiration is to be achieved. The CRed target is thus for a 60% reduction in carbon emission within the leading bodies associated with CRed by 2025.

The CRed Programme recognises the need for a multi-pronged approach towards carbon reduction involving technical measures directed at energy conservation, the promotion of renewable energy technologies, and last, but certainly not least, the need to engage the public at large, businesses, and other bodies in an awareness campaign particularly directed at the interface of technology and social acceptance of new ideas.

CRed is based in the University of East Anglia and is actively working with the management of the University to seek ways to reduce carbon emissions on the campus. In addition it has a partnership with Newcastle University and HSBC to promote the Low Carbon future.

2. Security of Electricity Generation in the future

The Energy Review notes(on page 37) that the storage capacity of gas is just 4% of demand and this has reflected the issue of historic self sufficiency unlike other countries such as France which it is stated has a storage capability of 25% with Germany and Italy not far behind. France uses little or no gas for electricity generation and this storage thus reflects the need solely for domestic and other non electricity generation uses. Even the planned increased in UK storage to 9% by 2010 will be only half the figure for other large EU15 countries. In the UK gas provides around 40% electricity generation and may increase to 60% if current trends suggested in the Energy Review continue.

For security of supply, and bearing in mind the difficulties already noted in the last winter, the storage capacity for NON electricity generation use should be comparable with those of other countries listed above. If such a large planned electricity generation from gas occurs by 2020, the storage should be much larger. In total and if gas is to be a backbone of electricity generation, the UK should be aiming for in excess of 25% storage by 2025, if not in excess of 30%.

Furthermore now that the UK is a net importer of gas, the wisdom of reversing the flow to export gas (as announced on the BBC news this evening: 12th April 2006) should be questioned. It should be held in reserve for a more secure future.

Closure of much of the existing coal generation – partly as a result of the LCPD, closure of all the Magnox reactors, and the planned closure of most of the AGRs by 2020 will leave a major shortfall in generating capacity. Following the current trend of only building new gas stations will lead to severe issue of security even if supplies come in both from piped gas and LNG. Most scientists believe that the Peak Oil year will be within the next decade with gas following shortly after that, so a major failing of the Energy Review is that it does not properly address the issue of global gas and oil supplies, but merely addresses the UK perspective. The UK may be running out, but so is the world as a whole.

The feasibility study of carbon sequestration at Peterhead is to be welcomed, but even if shown to be viable, and constructed, this will only make a very small impact on carbon dioxide emissions. Carbon sequestration could well be a very important component of carbon reduction in the longer term future (2030 onwards), but it will have little impact before that time. It is thus important that other strategies are also promoted which can start to deliver savings in the period up to 2025.

Even if the targets of 20% generation by renewables (not just installed capacity) is met, there will be difficult decisions needed to address the gap in demand and supply. Electricity consumption has been rising continuously at 1.8% per annum since the mid 1980s, and apart from last year where there was a welcome very small reduction, there is little indication that this trend will not continue for several reasons:

increased population
decreased household size
increased use of heat pumps which will conserve primary energy and reduce carbon emissions overall (as these require electricity to operate).

Even with proactive conservation, it will be difficult to even stabilise consumption at the present level, and it is thus difficult to see this shortfall between demand and supply being bridged even with the 20% renewables without the use of coal (before sequestration is properly developed) leading to increased carbon emissions, the increased use of gas and the attendant security issues, or the retention of a nuclear capability.

There is a strong argument to extend the lifetime of all AGR stations (as already happened with Dungeness). There is precedent here as most Magnox stations were designed for 20 – 25 years operation, but, with a few exceptions, the majority will be around 35 – 40 years at time of closure). There is a strong case to ensure diversity of generation that the capability should not drop below the current 20% level (which is 5% down on a few years ago) for the next decade so as to ***buy time*** (i.e. for the period beyond 2025) for a wider deployment of renewables. It could be achieved by an extended life time, and possibly the construction of one or at most 2 new stations.

Studies have been completed showing that micro-generation could provide significant amount of electricity by 2040 or 2050 and that a non-nuclear long term future might be possible, but this is in a completely different time frame. The Review should consider both the long term objective in the period post 2025 when many attractive options will become possible, and in addition the short term up to 2025 which is a more difficult situation to address if both energy security and lower carbon emissions are to be addressed.

3. Intermittency and Transmission Issues

The Review raises the point often raised about intermittency in terms of renewables. In the longer term (post 2025) with a balanced portfolio of renewables from wind through biomass, solar, and marine technologies, this will be less of a problem. However, what is often forgotten is that conventional generation plant do trip and the sudden loss of Sizewell B in a matter of a minute is something that the National Grid Company has to provide compensation for at the present time. The total wind generating capacity in the UK is almost exactly the same as Sizewell B, and the time over which wind drops is a much more prolonged period than the loss of conventional plant.

It is true that as the proportion of wind generation grows, the problem becomes rather more of an issue, but the question of this intermittency and transmission line problems which were also raised could be addressed by hydrogen storage where at any time renewable generating capacity in excess of demand could be used to electrolyse water, the hydrogen being used later either in fuel cells (of which there is little mention in the Review), direct combustions for electricity generation, or as a transport fuel. This idea is also in line with the CRed response to the DTI consultation in October 2005 entitled "*Adjusting Transmission Charges for Renewable Generators in the North of Scotland*" (see pages 10 – 14 of HYPERLINK "http://www.dti.gov.uk/energy/consultations/s_185_cons_responses_2.pdf" www.dti.gov.uk/energy/consultations/s_185_cons_responses_2.pdf).

The Review (on page 55) discusses the question of generating plant coming on line quickly. While it is true for hydro, the question is less clear for coal as is stated unless the set is already warm and is solely used for balancing mechanism duty under BETTA. For sets which are cold to time to first generation and synchronism can be as high as 24 hours. The Review dismisses the ability of CCGT stations to respond quickly. However, there is an issue here on the type of generating facility provided. In the past, Open Circuit Main Gas Turbines, many of which have now been closed, could respond far faster than coal and in a matter of 3 – 5 minutes. Many of the first generation CCGT stations had multi shaft generators, i.e. the gas turbines had separate generators from the steam turbine(s). In such stations the gas sections could be run without the steam and thus could form a rapid response and an important balancing mechanism function particularly as more renewables come on line. Later CCGT stations often have common shaft turbines – i.e. a single generator on a combine shaft served by both the gas and steam turbines, and these indeed are less flexible. Without compromising market forces, it would make sense if within the portfolio of each generating company there was a requirement for a minimum percentage of fossil fuel plant or hydro which could react quickly (i.e. having pure hydro, or multi-shaft CCGT).

The Domestic Sector – micro generation and conservation issues

The Review briefly mentions the issue of the "Rebound" effect or "Comfort Taking" on page 30. This is a serious issue as theoretical projections of actual savings from domestic conservation measures such as loft insulation and cavity wall insulation have not be realised and as reported at the Solar Cities Conference in Oxford (April 4th – 5th 2006), often only 30 – 40% of savings are actually achieved with the remainder taken by increased temperatures. The same also is partly true when more efficient electrical appliances become available, there is an increase in the number of appliances used in the home.

Such "Comfort Taking" problems mean that studies which merely examine the physical and economic potential of conservation measures often over estimate the potential saving and underestimate the cost of tonne of carbon dioxide saved. When all UK houses are at a standard equivalent at least to the latest (2006) Building Regulations, then this will no longer be a problem, but many houses are well below this standard. Unless methods can be found to adequately address the social dimension within this issue claims that up to 50% savings could be achieved in existing housing stock could be wide of the mark. However, with adequate information, the shortfall arising from "Comfort Taking" might be reduced.

Energy Policy in the past has always focussed on providing supply to meet demand, but with the exception of some load management schemes for large businesses, little has been done to limit demand and minimise effects of "Comfort Taking".

An acceptable form of demand control might be achieved by widespread use of smart metering and innovative tariff structure (issues of Fuel Poverty and related issues are covered in the next section). Smart metering can come in several forms and in the most basic form might merely be remote metering, but other options are possible including tariffs adjusted according to time of day and displayed prominently within a prominent place in each premises. The technology also exists to have multiple tariffs at each time of day. For instance when the margin of supply over demand is small, then each consumer would be allowed a realistic tariff a normal maximum consumption rate of say 1 kW (sufficient for a few lights, a television and a small electric kettle). However, above that demand (say 1.5 – 2.5 kW), the tariff might double, and if a person wanted an even higher level - say a washing machine, tumble drier, kettle etc, and even higher tariff would apply. However, when the supply - demand margin became greater the higher tariffs might disappear altogether and normal tariffs would apply.

Such an approach would allow freedom of choice so any one could always choose to do as they pleased, but if they did so at critical times they would have to pay potentially penal rates. If they adjusted their activities just slightly they would pay no more. Such a novel approach to tariffs would become important as renewable generation became more prevalent, and would educate the population to react effectively with what is a limited resource.

Much has been written recently about micro-generation, but some critical issues which do not appear to be addressed and need consideration are:

> The potential of micro-CHP may not be as great as often projected unless integrated in a joined up way with other aspects. In winter there is no problem, as there are ample opportunities to dispose of waste heat for space heating and hot water. In summer, there is no requirement for space heating and only limited requirement for hot water. Since heat must always be rejected whenever electricity is generated, this would limit the amount of electricity generated in summer, and could produce unexpected effects such as a shortfall of generating capacity in summer, if an over concentration of micro CHP results from any initiative. Carefully planned integrated development is needed for instance combining micro CHP with solar PV. However, combining micro CHP with solar thermal

would make an incompatible combination and make no sense at all as solar thermal by itself provides excess hot water in summer.

Micro wind generation is a promising technology although deployment has been limited at present and there are technical questions to address such as exactly what the load factor of such devices is, what effect turbulence effects on roof mounted devices has on loading and mechanical integrity of such device etc. However, with experience these questions should be resolved. Projections suggest that each micro wind might generate 0.5 MWh – 1 MWh per annum and as such qualify for a single Renewable Obligation Certificate. However, it appears that most if not all suppliers are reluctant to deal in single ROCs and financial benefits for those householders who want to do their bit are not forthcoming. Reviewing the legislation relating to ROCs to require all suppliers to purchase verifiable ROCs generated by householders would go along way to overcome this problem.

Fuel Poverty

Fuel Poverty is an important social issue which needs attention. However, incorporating measures to tackle Fuel Poverty within an energy policy is not conducive to a policy to reduce carbon emissions and improve energy security. A critical problem is the issue of "Comfort Taking", such that those who are currently Fuel Poor may be unable to afford to heat their homes adequately, and as they are taken out of this situation their comfort levels will increase and as temperature increases within their dwellings so will the energy consumption and consequential carbon emissions. The introduction of Deregulation saw prices in both gas and electricity fall dramatically and this it is cited, along with other measures, such as the winter fuel allowance, as an important reason as to why the number of people classed as Fuel Poor has reduced. In addition, and, and as stated in the Review, even the recent rises in energy prices means that in real terms they are still cheaper than they were 20 years ago.

The problem with this approach is that with relatively cheaper energy prices to address the issue of Fuel Poverty it is sending the wrong monetary signals to the majority of people who are not Fuel Poor for investment decisions into energy conservation and renewable technology at the domestic scale. This primarily arises from the construction of most tariffs. In the past, the majority of tariffs had a standing charge and a single unit rate. The situation at present is that the majority have two tariff rates, with the first set of units below a threshold consumption level at a much higher rate than those above the threshold. This means that those who are poor or energy conservation conscious are paying proportionally more for the energy they use than the high consumers.

A novel approach has been adopted by Irkutskenergo in the newly emerged privatised market in Russian where the tariff structure is the reverse of the above and should tackle both Fuel Poverty and address issues of conservation. Below a threshold consumption level, set at a socially acceptable norm, there is a lower tariff rate, but above that threshold the rate is much higher. For consumers with an average consumption there is no difference between the two approaches, but with this reverse tariff approach, those who are on low consumption, either being fuel poor or energy conservation conscious pay less, but those who consume more than average pay more, and in this way the correct market signals are sent to those in this category to make conservation measures more attractive financially. It is not for Government to intervene in a Market Economy, but Government could require all suppliers to introduce tariffs which are of this reverse type.

Not only would this type of tariff address the issue of fuel poverty in an era of rising energy prices, but make investment decisions for the future more balanced than they are now.

Carbon Emission Trading

The UK Government is to be applauded on its stance in setting allocations under the UK NAP which are arguably the toughest in Europe, and unlike many countries is in the spirit of the UKs commitment to the Kyoto Protocol. However, while the overall allocation demonstrates a clarity of thinking, the allocations within the sectors was done in a way which often rewarded inefficient plant and against those who were early movers in adopting energy conservation technologies. It was done purely on a historic basis, and not based on the relative efficiency of plant compared to the sector norm. It has been argued that early action might have been done anyway, but the problem with this argument is that the first stages in conservation are usually the most cost effective, and the present system of allocation requires all plant in a sector to reduce by a similar amount. Those who are ahead of the game at the start will find it much more difficult to comply as they have completed the easy options already, whereas those who were inefficient at the start were rewarded with higher allocations. The problem did not stop there as greater utility of plant was not considered a valid reason for additional allocation.

This has had a perverse situation at the University of East Anglia, for instance. We have been concerned that the high quality CHP plant that we have cannot be used effectively in summer because we cannot dispose of the heat as there is little demand for heat at that time. We had the perverse situation that when our demand for electricity was at its lowest, we had to import the highest amount. To address this problem in an environmentally sound way we have installed an adsorption chiller which it is expected will save around 700 tonnes of carbon dioxide a year because we will import less electricity. However, to do this we will have to run our existing CHP plant more continuously and as such will emit more carbon dioxide directly on site, but this will be more than compensated by reduction in centralised electricity plant. Because we are running existing plant more continuously it does not qualify as a new entrant. The problem is that UEA is now penalised for this action of a net saving to the country and will have to buy more credits simply because it is at the forefront of such development.

It is essential that the new National Allocation Plan addresses these anomalies and allocates credits inversely in proportion to the relative efficiency of each plant within its own sector – i.e. a plant with higher efficiency than average would get more credits than average, and conversely less efficient plant would be allocated fewer credits. In this way good practice, early action, and innovative development such as at UEA would be correctly rewarded.

Renewable Obligation and Heat Obligation

The Renewables Obligation has been a method to encourage the development of renewable energy projects, although, because it does not differentiate between technologies, it has favoured mostly for wind or biomass related projects. The value of the Buy Out funds has been of the order of £150 million to £200 million, and if as implied by the review this will rise to £1 billion, this would imply an increasing shortfall in meeting the actual target set which should be of concern.

The Renewable Obligation largely compensated Renewable generators for imbalances charges deviations from contract positions arising under NETA and subsequently under BETTA. Renewable generators such as wind are much more susceptible to these charges than conventional generators because of the less predictability of the resource. However, small CHP plant of the order of 1 – 5 MW plant have generally been adversely affected since the introduction of NETA and unlike the Renewable Obligation there has been nothing to offset the reduction in export income as a result. CHP on this scale is an important way to compact carbon emissions and indeed the University of East Anglia fell by 33% between 1999 and 2000 as a result of such a measure. Following the introduction of NETA, the take up of new CHP of this type has been limited and in some year that has been a small reduction in capacity. CHP is critical to reducing carbon emissions and saving energy resources, but financial planning for such schemes is difficult with the possibility of imbalance charges, or unrealistically low prices paid by suppliers who themselves are concerned that they may be more exposed to imbalance charges if as many CHP plant are run in heat demand lead mode.

There has been discussion that CHP could offset Renewable Obligations, but this is counter to the encouragement of new renewables. Instead there should be a Heat Obligation which covers not only renewable heat (which might be direct heat or CHP), but also high quality CHP where demonstrable carbon emissions can be verified. Sometimes such CHP plant are run with heat dumping to allow some generation when heat demand is low as in summer, and obviously such dumping should be excluded and deducted from any potential Heat

Obligation as proposed. Indeed CRed responded to the DTI in October 2005 in the consultation relating to the Future Energy Solutions Report entitled "Renewable Heat and Heat from Combined Heat and Power Plants - Study and Analysis". A key paragraph from that response is reproduced below:

> *"CRed thus believes that a Heat Obligation should be available for all good quality CHP plant and be credited wherever there is metering of sufficient quality for verification. CRed further believes that any chilling provided by trigeneration should also be credited as Heat Obligation Certificates. However, CRed also believes that, despite the small gain from embedded generation, any heat dumped during the summer months should be deducted from any Heat Obligation Credits gained so as to optimise the reduction of carbon dioxide. CRed believes that the chilling element of the Heat Obligation should only be applied to cases where there is a replacement of existing chilling facilities (e.g. for scientific equipment) or in new buildings where air-conditioning would be installed. CRed does not believe any credit should be given to install chilling for the purpose of air-conditioning in existing buildings which to date have not had such, except where rooms are converted for specialised scientific/computing facilities."*

The Gill Report recommended against the introduction of a Heat obligation and instead recommended the use of capital Grants. The main reason for this is that a capital grant provides a mechanism to assist installation, but in no way does it guarantee delivery or optimum performance of the plant after commissioning. CRed believes there is much scope in a well-constructed Heat Obligation to drive forward the low carbon economy. Good management is essential for optimum delivery of the benefits of low carbon strategies as the following box demonstrates.

During the consultation prior to the implementation of the Renewable Obligations consideration was given as to where the obligation should lie: i.e. the generators, the transmission licence holder, the supplier, the District Network Operator or the Consumer. Correctly, the Supplier was chosen in this situation. However, in the case of a Heat Obligation, the question of who the Supplier actually is is difficult to define in many cases which behind part of the Gill Report thinking. It would be unmanageable to have anything other than an Obligation on the Supplier in the domestic market, but there is scope for alternative approaches for medium and large businesses, particularly those already covered by the EU-ETS scheme.

If the domestic and small scale installations are indeed excluded, then the number of sites remaining in say the 5 MWth+ category becomes manageable for alternative methods for developing a Heat Obligation. Unlike the Renewable obligation, CRed believes that for such larger organisations the Heat Obligation should be focussed around the actual consumer/organisation rather than a general requirement for an ill defined supplier. CRed believes that such a scheme has inherent advantages as it focuses the move towards a low carbon economy precisely in the sectors that should be the drivers for such a move. The obligation would be that all relevant sites (i.e. above a threshold size (say 5 MWth), should have an obligation to provide in each year a given percentage of its heat from one or more of the following sources.

Renewable heat from biomass (either in simple form or CHP), direct geothermal heat, solar thermal, wind furnaces, Cofiring in the case of biomass should be discouraged, but might be permitted for an interim period, but only if the biomass is locally obtained.
Heat derived from good quality fossil fuelled CHP units (with the exception that any heat dumped should be

penalised in the counting of Obligation Certificates),

Cooling provided from adsorption chilling except where the sole purpose is to provide air-conditioning in a building which previously did not have such a facility.

The Obligation Certificates should be available to all plant not just the new plant. There was some concern in the definition of the UK-NAP for EU-ETS that insufficient attention was paid to early action and application only to new plant would be a discouragement for future forward look action. Any such discouragement should be avoided if at all possible.

A critical disadvantage of having suppliers as the sole means of providing the obligation can be seen in the operation of the Renewable obligation. Where eligible Obligation Credits are available from a small supplier but only at a low level – e.g. 20 ROCs per annum (e.g. a PV array), it becomes difficult if not impossible to gain the benefit as indicated in section (4) above.

The Heat Obligation certificates would be traded between registered parties in the relevant size range. Some organisation might have a substantial involvement in verifiable heat production which would qualify – others would have none and would be involved via trading or the "buy-out" mechanism. The ultimate goal must be to provide a mechanism to encourage all organisations move towards the low carbon economy.

CRed believes that in the case of biomass CHP or trigeneration that such schemes should be eligible for both Renewable Obligation and Heat Obligation Certificates.

If a direct comparison is made between electric heating and the best fossil fuel (i.e. gas at an efficiency of 90%), then for the same equivalent emission of carbon dioxide the Heat Obligation should be priced at 39.7% of the ROC value implying a figure of £12.85 per MWhfor the year 2005 – 2006 compared to £32.33 per MWh for a ROC..

Cred thus believes that the Renewable Obligation should remain for the foreseeable future and should rest on the Supplier for domestic consumers and small businesses below a given threshold. For larger consumers the obligation should be changed from the Supplier to the Consumer. If there were both a Heat and Renewable Obligation on medium and large consumers there is the possibility of declaring an integrated Total Renewable and Heat Obligation package which would allow innovation and a company to satisfy the combined obligation provided that the economic values of the two Obligations were linked as indicated above. Such an integrated package would be in line with recent EU proposals to have an aggregated renewable energy (not just electricity) commitment by 2020.

8. Planning Consent Issues

There is evidence that many renewable energy schemes and related infra structure projects are turned down at the planning stage. The regional renewable energy targets are not always a prime consideration. There should be a shift for considering projects in isolation to selecting those projects which will best serve the declared renewable energy target for the relevant region. Data now exists as to the electricity demand in each Local Authority Area. It should a requirement at the planning considerations that the Local Authority takes due notice of the electricity demand in their respective area and the extent to which this is being met by renewable energy from within their area. If the rate of planning rejections in an area is such that it is incompatible with the regional renewable energy strategy, the relevant Authority should be required to explain how they will actually achieve their target.

Dr Keith Tovey: Energy Science Director CRed

Example of Good Management enhancing performance of a Low Carbon Strategy

The University of East Anglia completed the construction of a particularly Low Energy Building in the Summer of 2003. While its initial performance was good there was a further 50% reduction in energy demand which was achieved after careful monitoring and the modification of operation strategies. It appears that the University of East Anglia is one of very few organisations which promote such strategies. The University has been similarly assiduous in managing its CHP plant for maximum efficiency.

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