

Controlling climate change

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On-line questions

Final, October 26, 2009

Chapter 1

1. Are human activities responsible for the climate change we have seen over the past 50 years?
2. What are the main substances that affect the radiative balance of the earth atmosphere and what is their relative contribution when looking at their contribution to radiative forcing increases? How big is the role of the sun in comparison to human induced effects?
3. Can impacts of the changed climate already been detected, in light of the fluctuations in annual temperatures and precipitation due to the natural variability of the climate? And how can climate change impacts be separated from other man made impacts?
4. How good are climate models in predicting changes in climate?
5. CO₂ concentrations in the atmosphere are now higher than they have been for a long time in the earth history. How long is that time period?
6. Why is there such a large range in the estimates of the expected global mean temperature in the year 2100? What are the most important factors explaining this range?
7. How much can local climate change differ from the global average and why is that the case?
8. What is the risk of melting of the Greenland ice sheet and what would be the implications for sea level? What is the time frame over which this could occur?
9. What is the difference between exposure, impact and vulnerability?
10. How serious are the risks of climate change for people in Africa? What is the difference with the risks for people in Europe and why is that the case?
11. What are the threats of climate change to nature and biodiversity? How does that threat compare with that from other human induced effects? What does this mean for nature protection policies?
12. How does climate change affect the realization of improved income, welfare and living conditions of people in developing countries? How important are development patterns in developed and developing countries for future climate change?

Chapter 2

1. What are the advantages and disadvantages of the Global Warming Potential in dealing with the weighting of different greenhouse gases? What are the arguments for using a particular time period for the GWP? Do you think the 100 year time period chosen for the weighting of gases in the Kyoto Protocol is right? Look up which greenhouse gases have a long residence time in the atmosphere. Is the GWP concept also good for dealing with those gases?
2. Compare the contribution of greenhouse gases to the 2004 emissions with that towards radiative forcing since 1750. How do you explain the differences?
3. Look up what the emissions of the Kyoto Protocol greenhouse gases are for your country, what the sources of those emissions are and how this compares to the global picture.
4. Look up what the accounting rules are for emissions from countries under the UNFCCC. Is this system based on end-use allocation or point of emission allocation? How does the system deal with exported goods? Do you think the current accounting system should be changed? If so, why and what would be the practical implications?
5. Look up the total emissions of Kyoto greenhouse gases of your country, the emissions per capita and the emissions per unit of GDP. How does your country compare on these indicators with other countries and with the world average? Find the distribution of emissions between people in your country. How many people in your country emit more than the world average?
6. Compare the cumulative emission of all greenhouse gases from the countries in the OECD and with economies in transition (Annex-I countries as defined in UNFCCC) with those of developing countries for the period since 1850 and since 1950. Should cumulative emissions in your opinion determine the degree of responsibility for emission reductions? If so, what would be the right time period and why?
7. Calculate your personal greenhouse gas emissions, using one of the available tools on the web. Compare the emissions per unit of energy used in the tool with those of box 2.2. Make sure the contribution from your food consumption is included. What are the biggest contributions to your personal emissions? Find out what you could do to halve your personal emissions and what this would cost you.
8. What has been the contribution of the Montreal Protocol to the reduction of radiative forcing of greenhouse gases? Compare that with the reduction that is likely to be achieved by the implementation of the Kyoto Protocol. Look up what the most recent projections are for the future use of HCFCs and HFCs. How much could that contribute to increased warming?
9. What are the assumptions on population growth, economic growth rates, energy use and land use for each of the 6 IPCC SRES marker scenarios? Compare these assumptions with actual developments over the period 1990 till present for the world and for Africa. Compare the emissions projections from the IPCC SRES scenarios with actual emission trends. Do you agree with some recent statements that actual emissions are higher than the worst case scenario?

10. What are the projected emissions for your country for the period till 2020, 2030 or other future dates? What assumptions have been made on population, economic growth, energy use and land use? Do you think these assumptions are plausible? What has been assumed for policies to reduce emissions? Are there scenarios available for emissions under aggressive emission reduction policies?

Chapter 3

1. With the help of figure 3.3 and the information in chapter 1, try to formulate your own position on what climate change constitutes “dangerous anthropogenic interference with the climate system”. What role is there in your argumentation for the costs of taking action?
2. Do you agree with the statement that scientists should not determine what constitutes “dangerous anthropogenic interference with the climate system”? If not, why?
3. Concentrations of greenhouse gases in the atmosphere correlate with cumulative emissions (see also chapter 2). There is also the requirement for global emission to peak by a certain year for each level of stabilization. Can you explain why both statements are right, although at first sight they look contradicting?
4. Make an estimate of equilibrium sea level rise for stabilization at 450, 550, 650 and 750 ppm CO₂ eq. Try to incorporate the contribution from melting of land ice. Why does it take so long before equilibrium sea level is reached?
5. A number of studies suggest that global greenhouse gas emissions for stabilization at 450 ppm CO₂eq should become negative towards the end of the century. How could this happen?
6. Why is it so important to have a reliable baseline projection when analyzing what ought to be done to get on a trajectory to stabilization of atmospheric greenhouse gas concentrations? Try to find baseline projections for your own country, published in different years in the period 1980-2005. How do these baseline projections compare? What are the assumptions in these baselines that have the most influence on the outcomes?
7. What are the major causes of the differences in modelling results for the role of the different mitigation options in reaching stabilization?
8. Put a list together of climate change impacts to which adaptation would be impossible or extremely costly.
9. What is the difference between abatement costs, marginal abatement cost and cost to the economy? How can the costs of climate change impacts be compared to the cost of responding to it?
10. Try to find cost estimates for your own country for the impacts of climate change and the mitigation and adaptation response, for a low and a high stabilization scenario. How do they compare?
11. What are some of the most important co-benefits of an aggressive greenhouse gas emission reduction policy in your own country? Try to find quantitative estimates for the value of those co-benefits and compare them with the costs of taking action.
12. What are the strengths and weaknesses of cost-benefit analysis? Would you recommend your government to base its climate policy decisions on a domestic cost-benefit analysis?
13. Look into the Stern review and list the assumptions that were made for the calculation of the costs of climate impacts. Do you consider these assumptions realistic and justified?

Chapter 4

1. Explain the relationship between development objectives, development policy, climate change and policy to control climate change.
2. Why is “low carbon growth and development” important for developing countries, even if their historic contribution to the increased concentrations of greenhouse gases is only about 30%?
3. Make a list of the most important climate impacts that can have direct negative implications for developing countries’ social and economic development.
4. How practical is the Brundlandt definition of sustainable development. How can we operationalise this? Find out for your own country how sustainable development is defined and put into practice. Are specific indicators used? And how is climate change covered in these sustainable development efforts?
5. What are the most important ways climate change can be mainstreamed into the social and economic policies of your own country? Give examples, if available, of what has been implemented.
6. How is the issue of energy security seen in your own country? What is the relationship with climate change and climate change policy? What are the opportunities to reduce the reliance on oil imports (if applicable)?
7. Try to find how the Chinese sustainable development plans are being implemented. What are the most recent achievements in the various policy areas? Compare the Chinese achievements with those of some developed countries.
8. Find out what the biggest city in your country is doing to integrate climate change concerns into its policies to make the city liveable. Include air pollution control and its benefits for reducing climate change.
9. Explain how the improvement of agriculture output and protecting forests for water management and biodiversity reasons can have a positive contribution to combating and adapting to climate change.
10. How are the various macro-economic policies in your country affecting climate change? Are there any examples of changes in macro-economic policy that were specifically taken to help combating climate change? If your own country does not have such examples , find examples elsewhere.
11. Do you think providing all people in the world with access to modern forms of energy is at odds with combating climate change? How could this be done so that climate change is not exacerbated?
12. Find a good example of a country with a “low carbon development and growth plan”, preferably your own country. How effective is the plan? Is their resistance against it in society and if so why? How do economic growth projections of the plan compare to those for other countries ?
13. List some key success factors for a mainstreaming policy that can effectively integrate climate change into the main socio-economic policy decisions of a country.

Chapter 5

1. Find the primary energy use of your country and see where your country stands compared to other countries in terms of energy use and GDP. What is the composition of primary energy supply in terms of energy carriers and how does this compare to the global average? How dependent is your country on imported fossil fuel and where are these fuels coming from? What is the projected composition of primary energy supply in the future for your country? Is security of energy supply a political issue in your country?
2. What percentage of the population in your country has no access to electricity? Are there plans in place to provide these people with electricity in the future? And by what means?
3. Check the latest data on global fossil fuel reserves and resources from the IEA and British Petroleum. Find out for what fuel price these estimates are valid. Compare the data from the two sources and explain the differences. What do you think about the “peak oil” theory? Will fossil fuel scarcity help us in controlling climate change?
4. What are the sources of electricity in your country (both in terms of capacity installed and electricity delivered)? Find the “capacity factor” (the percentage of time the source is delivering electricity to the grid) for each of the sources.
5. What are the GHG emission from total energy use and from electricity generation and what are the most important sources of emissions from energy use apart from electricity generation in your country?
6. Find the average emission of CO₂ (in kgCO₂ per MWh) for the electricity generated in your country. And how do individual power plants and renewable energy installations compare in terms of their energy efficiency and CO₂ emissions per MWh?
7. What is the nuclear power capacity in your country? Are there any plans for expansion? How is reactor safety ensured? What is done with the radioactive waste? What do you think about the risk of proliferation of nuclear weapons as a result of applying nuclear power for electricity generation?
8. What is the contribution of hydro, wind, biomass and geothermal power to the electricity generation in your country? What are the plans for expanding this potential? Find estimates of the cost of electricity generated from these sources. How do these costs compare to those of fossil fuel generated electricity? What policies are being used to promote the use of these renewable energy sources?
9. What is the potential of solar energy in your country and region? What types of solar energy are already being used? What role could North Africa and the Middle East play in providing solar energy to Europe?
10. What is the potential of CO₂ capture and storage in reducing CO₂ emissions? When would this technology be able to make a significant contribution? How do emissions from fossil fuel power plants with CCS compare to emissions from non-fossil electricity generation? What are the risks of CO₂ capture and storage and how do these risks compare to other risks in industrialized societies? How can these risks be managed?
11. In evaluating costs of emission reduction options in electricity supply both costs per kWh and costs per tonne of CO₂ avoided can be used. What measure is best used for what purpose?

12. What policies are being used in your country to create incentives for emission reductions in the electricity sector? How effective have these policies been? Given the situation in your country, what would in your opinion be the most effective mix of policy instruments to realize a significant reduction of emissions in the power sector in the future?

Chapter 6

1. Find the average transport distance per person and the modal split in the city you live in. How does this compare to the average for cities in your country and how does it compare to cities in other countries? Are any measures taken in your city to reduce total travel distance or shift modal split to public transport and/or cycling and walking? How effective are these measures?
2. What is the modal split of freight transport in your country? What has been the trend of this modal split over the past 10-20 years? Is there any policy or measure in place in your country to reduce freight transport or shift the modal split away from road transport? How effective is the policy?
3. How much is transport contributing to air pollution in your country? Are policies to reduce air pollution contributing to reducing GHG emissions? What climate mitigation policies could contribute to reducing air pollution?
4. What is the contribution of transport to the GHG emissions of your country. What is the trend in transport emissions?
5. What is the current contribution of aviation and shipping to global GHG emissions? Estimate what the contribution of your country is, using the assumption that half of the emissions of an international flight or shipping trip is allocated to the country of departure and half to the destination country. How do these emissions compare to the total emissions of your country? How does the aviation contribution change if you assume a multiplying factor of 4 in light of the overall effect of emissions at altitude? How much does it cost to compensate emissions for a flight from your country to another continent? What do you think about this compensation?
6. Find the average occupancy of cars, buses, trams, metro and trains in your country and estimate the average emission per passenger kilometre.
7. How successful are Bus Rapid Transit Systems in your part of the world? Are they an option for or have they already been applied in your country? Look at a number of cities where they have been applied and list factors that could lead to failure of these systems. What are success factors?
8. What is the CO₂ emission of the car you own or the car you would like to own if you had the money? How does this compare to the most fuel efficient car on the market in your country? Compare the effectiveness of various policies to promote the purchase of fuel efficient cars. What policy is most effective?
9. Discuss the various options to reduce emissions from freight transport. What is in your opinion the most effective policy in your country?
10. Discuss the pros and cons of biofuel for transport. Estimate the net CO₂ savings from biofuels currently on the market in your country. Would it be better to reserve biomass for generating electricity and heat instead of turning it into biofuel?
11. What is the prospect of electric vehicles in your country? What is the driving range for electric vehicles currently on the market? What are the net CO₂ emissions per kilometre given the CO₂ emissions per kWh of electricity in your country? How does this compare to the emissions of the most fuel efficient gasoline or diesel vehicle? Are hydrogen fuel cell

vehicles a better alternative than “all electric vehicles?

12. Compare the costs of electric scooters in countries where they are on the market. What are the limiting factors for mass introduction of these electric scooters?
13. Compare policies in your country to reduce GHG emissions from transport with the list of effective policies in table 6.7.

Chapter 7

1. What is the share of buildings (residential and commercial) in total final energy use in your country? How does this compare to other countries? What are the most important components of this energy use?
2. What is the current energy use per square meter of residential buildings in your country? How does this compare to the standard for new houses (if there is no standard in your country, then compare to another country in your region)? What is the most energy efficient residential building in your country and how does that compare internationally?
3. How much does the building sector in your country contribute to total GHG emissions in the country? Specify both direct and indirect emissions. What has been the trend in these building sector emissions and what are the projected changes over the next 20 years?
4. What is the contribution of refrigeration, cooling and air-conditioning to the building sector GHG emissions in your country? Are there significant emissions of so called Montreal gases?
5. What is the energy use of heating and cooling equipment and appliances in your own home. Compare these with the best available equipment on the market in your country today and with the legal standards, if available.
6. Identify possibilities to reduce energy use and improve the efficiency of energy use in your own home. Separately look at behaviour change as a way to reduce energy use. Calculate the pay-back time of these measures. Investigate if there are subsidies or other incentives available to reduce the investments required.
7. Make a comparison of building codes of countries where they are mandatory.
8. Make a comparison of the effectiveness of appliance standards versus appliance labelling.
9. How are demand side management (DSM) programmes aiming at energy efficiency improvement working? How are incentives created for utilities to embark on these programmes. Find some examples of successful DSM programmes in the USA and elsewhere.
10. Find some examples of successful Energy Service Companies (ESCO's) in different countries. What are success factors for ESCO's?

14.

Chapter 8

1. Find the contribution of industry and waste management to the total GHG emissions of your country. Look at both direct and indirect emissions. What are the most important contributors? How much of the industrial products used is imported and from which countries?
2. Find two examples of products where replacement of energy intensive raw materials or reducing the amount of raw materials used has led to a significant improvement in the indirect emissions of making or using the product.
3. Compare energy and carbon efficiency of steel, cement and aluminium production in some of the most important producing countries. Does the choice of efficiency indicator change the ranking of the most efficient countries?
4. Have any emission reduction measures been applied in the steel, cement, aluminium or

chemical industry in your country? How does their CO₂ emission per tonne of product compare with that of producers in other countries?

5. What is the prospect of using CO₂ capture and storage (CCS) in industry to reduce CO₂ emissions?
6. What are the most important sources of fluorinated gases (covered under the Kyoto or the Montreal Protocol) global industry is emitting ? What alternatives exist to eliminate or reduce these emissions?
7. What are the GHG emissions of waste management in your country? What are the most important options to reduce these emissions? Are there any policies in place to make that happen?
8. Find companies in your country or your region that are implementing voluntary actions on reducing GHG emissions and evaluate their performance. How do these voluntary actions compare with other companies in their sector domestically and abroad?
9. What are the most important changes in the EU Emission Trading System that have been agreed for the period after 2012 compared to the system currently in place? What are the differences with emission trading systems considered or in place in other industrialised countries? How are the various emission trading systems dealing with concerns of loss of competitiveness by companies under an emission trading system compared to competitors not subject to such a system?
10. What are the prospects of using regulation to reduce GHG emissions from industry and waste management? Under what circumstances could regulation be more effective than carbon prices created by emission trading systems or taxes?

Chapter 9

1. What are the top 10 countries in terms of deforestation and what is their collective contribution to global CO₂ emissions? What is the main cause of deforestation in these countries? Try find different sources and look for differences in the data. What is causing these differences?
2. Find recent estimates of peat land emissions from the countries contributing most to these emissions.
3. What are the most effective measures that can be taken in the agriculture sector to reduce GHG emissions or increase the carbon reservoirs in agricultural soils? How does the potential for CO₂ relate to that for N₂O and CH₄? What is the contribution of developed and developing countries to the potential?
4. Make an estimate of the emissions resulting from your own dietary pattern. What could you do in terms of shifting the composition of what you eat to reduce these emissions with 30%? What would be the effect on global emissions if all people (except the poor) would do the same?
5. For a country with significant deforestation try to find estimates for the potential to reduce forestry emissions through forest management (including all possible measures) from top-down and bottom-up assessments. Can you explain the differences?
6. What are the potential drawbacks from increased forest cover as a mitigation measure?
7. What is the current situation in the major food crop producing countries with respect to the share of grains and oilseeds used for biofuel production? What is the influence of this on world food commodity prices? Are there any proven examples of the use of food crops being used for biofuel that have caused malnutrition or hunger amongst poor people?
8. What policy measures have been taken in your own country to reduce GHG emissions from agriculture. Are these policies aligned with other agriculture policies or do they have opposite effects? What changes in general agriculture policies and subsidies would you recommend to maximise the reduction of GHG emissions from agriculture in your country?
9. Compare the costs of avoiding the deforestation of a piece of land in different countries. What methods are being used for making these calculations? Try to explain the differences in outcomes.
10. Compare the forest protection policies of Brazil, Indonesia and Congo. What are the lessons you could draw from this comparison?
11. Select a country that contributes significantly to global deforestation and try to provide practical answers to the questions posed on p 257. Try to show how this country could benefit economically from retaining its forest.
12. What are the synergies and trade-offs of measures to reduce emissions from forestry and agriculture and measures to adapt forestry and agriculture to a changed climate?

Chapter 10

1. Compare the outcomes of the McKinsey global abatement cost curve analysis (see figure 10.2) with the overall result of the IPCC Fourth Assessment report (figure 10.1), at global and sector level. What explains the differences? Are assumptions used in the cost calculations in these two exercises comparable?
2. Have a look at the results of top-down and bottom-up global potential estimates in the IPCC Fourth Assessment report at sector level. Can you explain the differences?
3. Do you agree with the conclusions in the section on geo-engineering that it is dangerous to seriously consider implementing these approaches? What do you think about increased research on geo-engineering? Have a look at recent literature on the issue and check what people cover under the term geo-engineering. Do they include regular mitigation options that can be fully controlled? If so, what do you think about including those options under the term geo-engineering?
4. Find estimates of the overall mitigation potential and the costs in your own country or a country in your region for the 2020, 2030 and 2050 time horizon, if available. Find out what cost curve assumption have been used and compare the results for different cost curves.
5. Find estimates of the impact on GDP from strategies to get to deep reductions of GHG emissions over time in your country or a country in your region. Compare those estimates with global estimates (see e.g. table 10.2). Also compare the GDP impact with the projected increase of GDP from economic growth over the same timeframe. And also try to find the GDP impact of climate change under a business as usual scenario. What other economic indicators could you think of for evaluating the economic impact of climate change and responses to climate change?
6. Oil exporting countries are very concerned about the impacts of climate change policies in other countries on their revenues from oil export in the future. How big are these impacts? Do you think these countries are right in asking compensation for the loss of oil revenues?
7. What are the most recent estimates of the investments required to transform the world economy into a low carbon one (i.e. moving to a stabilised 450-500 ppm CO₂eq situation)? And how much additional investment does that imply compared to what would have to be invested anyway in a BAU scenario? Are energy savings compensating the additional investment?
8. What strategies to increase security of energy supply are counter-productive when it comes to controlling climate change? Can you find examples of countries adopting such counter-productive strategies?
9. Try and find estimates of the additional employment created by climate policies in your country or a country in your region. In which sectors are these new jobs to be found? Compare that with estimates of loss of employment due to these climate policies in other sectors.
10. Evaluate the situation in a middle income developing country with respect to the needs for advanced low carbon technology and the strategies the country is following to apply those technologies. What is the main strategy the country is following? How successful has it been? What are the major barriers the country is facing (both national and international ones)?

Chapter 11

1. Do you agree with the conclusion that regulatory policy instruments are better suited to reducing GHG emissions from actions of consumers and small business and mass products? Can you find examples of non-regulatory instruments that have been effective in those circumstances? What kind of policy instruments in your country or a country in your region have been applied to reduce GHG emissions from small and medium enterprises and how effective have these been?
2. What taxes and levies are in place in your country that have an impact on GHG emissions? Are these taxes and levies effective in delivering these reductions? How could they be improved to become more effective in GHG reduction?
3. What are the strengths and weaknesses of the EU Emission Trading System? How does it compare with some of the emerging emission trading systems in other countries?
4. Look at voluntary agreements on climate and energy in your country or a country in your region. How effective have they been in mobilising industry or other groups in delivering actual energy savings or reductions in GHG emissions? How could these voluntary agreements be strengthened?
5. What subsidies in your country or a country in your region result in maintaining or increasing GHG emissions? How effective are the subsidies that are meant to reduce GHG emissions?
6. Find out how much the government in your country is spending on climate on energy related Research and Development (R&D). What are the amounts spent on specific energy technologies and on energy efficiency improvement? How has the R&D budget changed over the past 30 years? What policies are in place to make private sector R&D more attractive? Have these policies had an impact on private sector R&D budgets?
7. What is your opinion on the use of food “mileage” labelling? Are there any supermarkets in your country applying this kind of labelling? What have been the experiences? Can you think of alternative ways of informing consumers about the implications of their food purchases for the climate?
8. What is the mix of policy instruments on climate change used in your country? How would you rate the effectiveness of the mix in light of the strengths and weaknesses of the various policy instruments and the local circumstances?
9. Compare the current climate policy approaches of China with that of the United States. What are the commonalities and what are the differences? Are competitiveness issues important in shaping these policies?
10. When you compare the EU climate and energy policies and legislation with that of EU Member States, what do you think about the degree to which these policies and legislation are handled at the European level? Are there reasons to shift the balance more towards the EU level or the other way around?

Chapter 12

1. Find out what your country has done in the framework of its membership of the Climate Change Convention and the Kyoto Protocol. What commitments does it have under these legal regimes? What national communications has it submitted? What financial contributions has it made for assistance to developing countries (if applicable)? What activities have been undertaken in the framework of the Clean Development Mechanism (if applicable)?
2. What is the status of the Adaptation Fund, established under the Kyoto Protocol? Where does the Fund receive its contributions from? How much has the fund received in total? How much has been disbursed? Which countries and activities have benefitted?
3. What is the most current status of meeting the emission caps Kyoto Annex-B Parties have under the Kyoto Protocol? Make sure you include the LULUCF, CDM and JI components of the emissions accounting.
4. Check the official emission inventory methods the Parties to the Climate Change Convention have to use for estimating emissions from electricity generation and agriculture. Compare those with the methods that are being used in your country. What is the approximate accuracy of the estimates under the method applied in your country?
5. What is the most current status of the CDM? What is the expected contribution of CDM credits to the compliance of Annex-B Parties to their emission caps under the Kyoto Protocol? What is the share of the credits that will come from African countries? And what will be the share of China? What percentage of registered CDM projects is self financed by host country entities?
6. What is the role of CDM in implementing China's policies on expansion of wind power and improving the efficiency of its electricity generation from coal fired power plants?
7. What has been the impact of the IEA Implementing Agreement on Energy Efficiency and the Renewable Energy and Energy Efficiency Partnership on the improvement of energy efficiency in the associated countries?
8. What has been the influence of the Carbon Disclosure Project on the investment behaviour of associated institutional investors?
9. What are the current international agreements on climate change and their implementation for the period 2013 to 2020? Comparing these agreements with table 12.1, on what path to long term global temperature increase are we now?
10. How much financial support is currently flowing to developing countries for implementation of climate change adaptation and mitigation measures? Make a distinction between private sector, and public sector multilateral and bilateral funding.
11. Compare the measurement, reporting, verification and compliance practices under the Kyoto Protocol with those of the Montreal Protocol and the Treaty on the Non-proliferation of Nuclear Weapons. What are the common elements and the most important differences? What are the respective provisions under the post-2013 climate change agreement? Do you consider the Kyoto Protocol or the post-2013 provisions and practices stringent?