

1. I do not agree with Mr Gingrich's comments. I will take the second part of his comments first – “the most you can argue for, I think, is more research.” Although there are certainly aspects of the climate system that we don't understand fully, and which probably do merit additional research, we have a very sound understanding of the fundamental science of climate change at this point, such that “more research” is really not what we need at this point, in my opinion. We already know that the planet is warming; we already know with pretty good precision how much it has warmed in the past 100–150 years; and the Intergovernmental Panel on Climate Change (IPCC) wrote in 2007 that “most of the observed increase in global average temperatures since the mid-20th century is *very likely* due to the observed increase in anthropogenic GHG concentrations.” It is true that we are not yet certain what the *effects* of global warming will be (e.g., how much warmer will it get by 2100, how much will the sea level rise, how strong will hurricanes get, how will food supply be affected), so I suppose one could plausibly argue that we oughtn't take action against global warming until we are more certain that the likely effects are severe enough to warrant it. Hence, one could possibly agree with Mr Gingrich that more research is called for until we are more certain that action is warranted. However, I disagree with this advice, and I would not advise delaying action until we obtain such certainty, because delaying until we are certain is most likely the same as delaying until it is too late. If we are going to limit future warming to, say, 2 °C or 3 °C, then we must act immediately to drastically reduce our emissions of greenhouse gases.

Therefore – getting back to the first part of Mr Gingrich's quote – I would say that there *is* evidence to justify a large government centralized response, and quickly. For sure there is evidence (surface thermometer record, glacier record, arctic sea ice record) that shows the planet is warming; the question is, does this evidence argue for centralized government action? I would say yes. The IPCC noted (2007, p 48) that “overall it is expected that benefits will be outweighed by the negative health effects of rising temperatures,” which suggests that climate change is, on the whole, bad for us. But does that mean we should act to stop it? Again, I would say yes. The National Research Council recommended (2011, p 59) that “In order to minimize the risks of climate change and its adverse impacts, the nation should reduce greenhouse gas emissions substantially over the coming decades...it is the committee's judgment that the most effective strategy is to begin ramping down emissions as soon as possible.” Dessler and Parson also noted (2010, p 120) that “Relying on adaptation while doing nothing to slow or stop climate change would mean putting no limits on how much change we must adapt to – gambling that we can effectively, and at acceptable cost, endure or adapt to any amount of climate change.” I would tell Mr Gingrich that is a gamble we should not take. The evidence suggests that delaying action will be more costly than taking action.

2. a. The Kyoto Protocol is an international treaty outlining the method (i.e., the protocol) by which countries will achieve the stated goal of the United Nations Framework Convention on Climate Change, which is to “stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.” Generally speaking, the method entails countries voluntarily committing to cut their emissions of carbon dioxide and other greenhouse gases by the end of 2012 (relative to 1990 emissions levels). The goal (paraphrased from above) is to keep concentrations of GHGs in the atmosphere low enough that human-induced climate change does not pose a threat to our collective well-being.
- b. I hate to be a pessimist, but I find it highly unlikely that we will have a successor to the Kyoto Protocol in place by the end of 2012. There are certain challenges that would have to be overcome in order for a new agreement to be ratified internationally, and each of these challenges is quite difficult politically. Dessler and Parson list three such challenges, calling them (1) national commitments, (2) timing, distribution, and sequencing of commitments, and (3) implementation and review. Other writers on the topic have noted other challenges as well, but we can stick with these three for now. The challenge for national commitments is to get countries to voluntarily agree to cut their emissions. Although many countries did, in fact, make such a commitment under the Kyoto Protocol, many of those countries were not able to meet their goals, and therefore might be less likely to make such a commitment again in the future. Also, so far, China and the United States have both been unwilling to commit to reducing emissions of carbon dioxide, and without the participation of these two countries, any international agreement is meaningless even if it is passed. One of the reasons that China and the US have been unwilling to make such a commitment is the second issue involved – timing, distribution, and sequencing of commitments. The key issue here is whether developing countries (like China) should be required to cut emissions at the same time as everybody else, or if developed countries (like the US) should have to cut first. Developing countries argue that it is the emissions of developing countries that have caused climate change so far, and it is only fair that those countries responsible for the problem be the first to take steps to solve it. Furthermore, it is not fair to ask people in poor countries to give up their chance to achieve the same lifestyle and benefits as people who were lucky enough to have been born in a rich country. The US, in response, argues that it is too great an economic burden to cut emissions if our trade competitors (China, India, Brazil, etc.) don’t have to do the same – it puts us at too great a disadvantage. This impasse seems quite difficult to overcome. Finally, even if we can resolve those two issues, how can we make sure that countries meet their commitments this time around? There is no clear-cut mechanism to put “teeth” into an international agreement and hold countries responsible for meeting their commitments. But without such a mechanism, many countries will be unwilling to participate – why should one country voluntarily cut its emissions if other countries can ignore the agreement and get

away with it? None of these challenges have easy answers, and from what I have seen so far, our world leaders (especially in the US, I'm sorry to say) are not willing to make bold but difficult compromises for the better welfare of all.

- c. If we don't succeed in reaching an agreement to replace the Kyoto Protocol, then we can only expect emissions of greenhouse gases to continue to rise, which means a continued increase in the CO₂ concentration in the atmosphere, and a continued rise in the global average temperature. This is sometimes called the "business as usual" scenario. The IPCC considered this case and predicted that the planet would warm by about 3 °C in the next ~100 years, which would likely have significant negative impacts on us. Of course, this prediction could be proven wrong if, for instance, somebody discovers a way to make solar energy or wind energy as reliable and inexpensive as fossil-fuel-based energy, or if people voluntarily alter their behavior dramatically, or if a plague comes through and wipes out a significant portion of our populace, or if the world suffers a widespread economic collapse. However, none of these possibilities seem like things on which we should rely, and the last two are certainly not something for which we should hope. Therefore I would say that, if we don't pass a "new Kyoto" soon – and it looks like we won't – then we are probably in for several degrees of warming in the next 100 years, with all the negative consequences that warming will bring with it.
3.
 - a. "Carbon pricing" means making it expensive to emit carbon dioxide (and/or, perhaps, other greenhouse gases) into the air, i.e., to put an economic penalty on emissions of CO₂. The goal of carbon pricing is to make people alter their behavior and emit less CO₂. The idea is that if it costs money to emit CO₂, people will emit less of it.
 - b. Economists consider a carbon tax to be "close to the economic ideal" because it corrects a market inefficiency, or, to put it in economic terms, it internalizes an external cost. Currently, there is no cost to emit CO₂, even though emitting CO₂ causes harm to others on the planet – there is an *external cost* when companies (or individuals) emit CO₂. Thus, the price that companies pay when they (for example) manufacture an item is lower than the true cost of manufacturing that item, because the company is not asked to pay for their CO₂ emissions. A carbon tax would force companies (and/or other entities) to pay (close to) the true cost of their actions – thus moving us (closer) to an economic ideal.
 - c. Passing a carbon tax is very unpopular with politicians. Although it has been proposed, the idea has never gained much traction. I think there are at least four reasons why. First, individual citizens don't want to see their electric bills increase, so a carbon tax is not popular with many individual citizens. Second, the tax is not favored by many industries, because those industries don't want to see their costs rise and their profits fall – and these industries often wield a lot of influence over our politicians. Third, although a carbon tax may benefit our society *in the long run* by staving off devastating global warming, it is likely to cause us economic pain in the short term, and politicians are

acutely aware of short-term phenomena that affect their chances of re-election. Finally, taxes are, in general, very unpopular in our country right now – I have heard it said that Republicans only like the word “tax” if it is followed by “cut”, and Democrats only like the word “tax” if it is followed by “on the rich”. A carbon tax does not meet either of these criteria – hence is not popular with either party.

- d. A carbon tax offers *price certainty* whereas a cap-and-trade scheme offers *emissions certainty*. Companies are likely to favor price certainty – they want to know what their costs will be in the future, so they can plan accordingly. (Some additional details in case you don’t see what I mean: Suppose, for instance, that Technology A would cost a company a lot of money, but would help them reduce their emissions by a known amount. Under a carbon tax, the company could decide if Technology A is worth the money – i.e., if they would save more than they would spend. But under cap-and-trade, where the future price of an emissions allowance is uncertain, companies would not be able to determine if Technology A is an economic winner or an economic loser.)
 - e. If the government is not interested in carbon pricing, there are at least three other strategies they (meaning our elected leaders) could try to implement. First, they could just pass a law that says “Certain industries or facilities are not allowed to emit more than XXX tons of carbon dioxide per year” – this type of regulation is sometimes used to control other types of pollution which are known to be hazardous to human health. Second, they could use public money (tax dollars) to subsidize activities (by either people or companies) that reduce CO₂ emissions – for instance, rebates could be given to families that put solar panels on their rooves to heat the water in their homes. Third, they could appeal to people to make voluntary choices that reduce our emissions of CO₂ – drive a Prius instead of a Hummer, for instance. I would call it highly unlikely that any of these measures, even in combination, could reduce emissions by 50% in the next 40 years. Why do I think so? Largely I am going on the conclusions of noted economist William Nordhaus, who wrote that “To a first approximation, raising the price of carbon is a necessary and sufficient step for tackling global warming. The rest is at best rhetoric and may actually be harmful in inducing economic inefficiencies.” If we want to slow or stop global warming, we have to reduce emissions, and if we want to reduce emissions, we have to raise the price of emitting until it hurts enough to change people’s behavior. (It’s going to hurt. It has to. If it doesn’t hurt, people won’t do anything differently than what they do now.)
4. a. The current US policy is to rely almost solely on adaptation. I guess you could argue that we rely only “mostly” on adaptation because there are government subsidies for “green energy” companies and other initiatives the might reduce CO₂ emissions – these should, rightly, be considered mitigation measures. Therefore I can see somebody saying that we rely mostly on adaptation. However, my opinion is that “solely on

- adaptation” is a better description, because I don’t think that our mitigation measures are enough to make any noticeable difference in emissions or in the warming that results.
- b. The statement by the Pew Center is a mix of positive and normative, pretty heavy on the normative. We don’t know what “substantially” means when they say “substantially reducing” – is a 5% cut in emissions substantial? What about a 10% cut? What about a 20% cut? These are normative judgements. Also we don’t know what the “worst” impacts are. If Miami is under water from sea level rise, is that one of the “worst” impacts, or is it perfectly acceptable? This is another normative judgement. To make this statement a truly positive statement, it would have to be changed to say “Emissions of greenhouse gases must be reduced by at least XXX% in order to prevent Outcome YYY.”
 - c. If the statement is true, it implies that the current US policy is inadequate, because our current policy does not call for “substantially reducing greenhouse gas emissions” – hence we will be unable to avoid “the worse impacts of climate change.”
 - d. The major texts we have read this semester agree with the statement by the Pew Center. The National Research Council recommended (2011, p 59) that “In order to minimize the risks of climate change and its adverse impacts, the nation should reduce greenhouse gas emissions substantially over the coming decades...it is the committee’s judgment that the most effective strategy is to begin ramping down emissions as soon as possible.” Dessler and Parson noted (2010, p 120) that “To limit the impacts we and our descendants must suffer or adapt to, it is also necessary to reduce the emissions that are causing human-driven climate change.” The IPCC noted (p 19) that “there is *high confidence* that neither adaptation nor mitigation alone can avoid all climate change impacts; however, they can complement each other and together can significantly reduce the risks of climate change.... Many impacts can be reduced, delayed, or avoided by mitigation.... Delayed emission reductions significantly constrain the opportunities to achieve lower stabilisation levels and increase the risk of more severe climate change impacts.” All of these statements agree with the Pew Center statement.
 - e. I do agree with the Pew Center statement, even though a couple of normative claims are embedded in it, and even though it requires me to look in my crystal ball to predict the future. It has been estimated that stabilizing CO₂ at 550 parts per million in the atmosphere – a doubling of the pre-industrial level – would require us to cut CO₂ emissions by about 50% in the next 90 years, which I do consider “substantial.” (These numbers would be approximately consistent with the IPCC’s “B1” scenario, for instance.) Furthermore, even if we do stabilize at 550 ppm, we are likely to see about 3 °C of warming in the next 90–100 years, which will likely bring a number of challenges with it (extreme weather, spread of disease, higher sea level, etc.). Therefore, to avoid even more extreme changes – i.e., to “avoid the worst impacts of climate change” – we must cut emissions by at least that amount, i.e., “substantially reducing

greenhouse gas emissions is essential.” Hence I would agree with the statement from the Pew Center.

- f. Even if the statement from the Pew Center is correct, one could argue that the United States should *not* change its policy. That is, we should continue to rely mostly or solely on adaptation to deal with climate change, and should not introduce any new mitigation measures. There are at least two main reasons for this. (1) Even if the US cuts our emissions significantly, it will not have a significant effect on the CO₂ concentration (or the resulting climate) unless China, India, Brazil, and other rapidly industrializing countries do the same. It does not make sense for us to introduce a new policy that is likely to have significantly negative economic impact but doesn't deliver any significant positive benefit. (2) It will cost the US less to adapt to climate change than it would to slow or stop climate change. Drastic cuts in our CO₂ emissions would raise energy prices, would dampen industrial productivity, and would hurt our economy in general. It might reduce our gross domestic product (GDP) by a few percent, which is significant. If we rely solely on adaptation to deal with climate change, it will cost us something (e.g., we might have to build higher sea-walls in low-lying areas), but it probably won't cost as much as some form of drastic cut in CO₂ emissions. Noted economist Bjorn Lomborg has argued that it is much cheaper to adapt to climate change than it is to slow or stop it.