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Working Group (WG) III's Contribution to the IPCC's Fourth Assessment Report (AR4): Be Sure to Read the Fine Print

Executive Summary

The Summary for Policymakers (SPM) of Working Group III (Mitigation), released on May 4, is available on the IPCC website, ***www.ipcc.ch***. In an effort to assist the public's evaluation of the strong claims made in the SPM and the subsequent use of those claims by the media and public policymakers, this review will evaluate WG III's conclusions.

The first of WG III's key findings concerns mitigation potential, the amount of greenhouse gas emission control that can be achieved at a given price and date. The finding reads:

> Both bottom-up and top-down studies indicate that there is substantial economic potential for the mitigation of global GHG emissions over the coming decades, that could offset the projected growth of global emissions or reduce emissions below current levels *(high agreement, much evidence).*"

While this conclusion seems straightforward, and has been presented in the media that way, both the definition of the terms used and the assumptions made in deriving the numerical estimates are anything but straightforward. The Marshall Institute has examined the definitions of terms and assumptions underlying this conclusion and finds it unsupportable for the following reasons:

1. The agreement between top-down and bottom-up models is purely fortuitous.
2. Much of the analysis depends on use of the SRES (IPCC Special Report on Emission Scenarios) scenarios, which have been widely criticized as unrealistic.
3. The analysis assumes a perfect market, a condition that exists only in economic models – real markets are far from perfect.
4. The total mitigation potential estimated from bottom-up studies is based on adding sectoral results calculated from widely different baselines, an invalid technique.
5. The top-down estimates were derived by interpolating results for model runs for 2100, an imprecise modeling approach.
6. Economic potential is based on assumptions that do not reflect the known behavior of companies and individuals in real markets.
7. The estimate of global potential assumes universal application of available technology, an unrealistic assumption.

As a result, either WG III's estimates of mitigation potential are too high or the projection of the cost of mitigation is too low.

A second WG III conclusion that has already attracted a large amount of attention concerns the cost of starting on a pathway that will lead to eventual stabilization of atmospheric concentrations of greenhouse gases. The conclusion reads:

> In 2030 macro-economic costs for multi-gas mitigation, consistent with emissions trajectories towards stabilization between 445 and 710 ppm CO_2-eq,[1] are estimated at between a 3% decrease of global GDP and a small increase, compared to the baseline (see Table SPM.[4]). However, regional costs may differ significantly from global averages *(high agreement, medium evidence)*.

The cost of maintaining a stabilization pathway grows rapidly. WG III concludes:

> In 2050 global average macro-economic costs for multi-gas mitigation towards stabilization between 710 and 445 ppm CO_2-eq, are between a 1% gain to a 5.5% decrease of global GDP. For specific countries and sectors, costs vary considerably from the global average. *(high agreement, medium evidence)."*

As with the case of estimates of mitigation potential, estimates of the costs of stabilization are based on a large number of assumptions. WG III gives the following summary of the key assumptions:

> Most models use a global least cost approach to mitigation portfolios and with universal emissions trading, assuming transparent markets, no transaction cost, and thus perfect implementation of mitigation measures throughout the 21st century. Costs are given for a specific point in time.

None of these assumptions represents the world as we know it.

1. Universal emissions trading does not exist today and is highly unlikely to exist any time in the foreseeable future. It would require all countries to join either the Kyoto Protocol or whatever agreement is reached for the post-2012 period.
2. Transparent markets do not exist in many countries and, desirable as they are, a climate change agreement is an unlikely mechanism for creating them.
3. Transactions have costs. The costs may be high or low, but they have to be taken into account.
4. As with perfect markets, perfect implementation exists only in economic models. Government policies are rarely perfect, and in too many cases are actually counter-productive.

As with short-term mitigation potential, this means that either the cost of starting on a stabilization pathway or the atmospheric concentration of carbon dioxide at stabilization or both will be higher than projected by WG III.

Introduction

The Summary for Policymakers (SPM) of Working Group III (Mitigation)'s contribution to the IPCC's Fourth Assessment Report was released on May 4 and is available on the IPCC website, ***www.ipcc.ch***. In an effort to assist the public's evaluation of the strong claims made in the SPM and the subsequent use of those conclusions by the media and public policymakers, this review will evaluate WG III's conclusions. Previous Marshall Institute reports have evaluated the SPMs from WG I (Science) and WG II (Impacts, Adaptation and Vulnerability).[2]

A key element in any IPCC report is the treatment of uncertainty. WG III uses a two-factor **qualitative** assessment of uncertainty, the first term describing the degree of agreement in the literature on the finding, the second term describing the amount of evidence available in the literature. Expert judgment is used to assign both parameters. The terms used are shown in Table SPM A.1, which is reproduced below.

Table SPM A.1: Qualitative definition of uncertainty

Level of agreement (on a particular finding) ↑			
	High agreement, limited evidence	High agreement, medium evidence	High agreement, much evidence
	Medium agreement, limited evidence	Medium agreement, medium evidence	Medium agreement, much evidence
	Low agreement, limited evidence	Low agreement, medium evidence	Low agreement, much evidence
	Amount of evidence (number and quality of independent sources) →		

This is a better approach than the approaches used by WG I and WG II, where expert judgment is used to assign probabilities, creating a false impression that the authors conducted a statistical analysis.

Key Findings

The WG III findings that have attracted the most attention are their estimate of the greenhouse gas mitigation (control) potential as a function of cost in 2030, and the costs in 2030 and 2050 for starting on a path towards stabilization of the atmospheric concentration of greenhouse gases. These findings are discussed in detail below, followed by comments on some of WG III's other findings.

Mitigation Potential

The first of WG III's key findings concerns mitigation potential, the amount of greenhouse gas emission control that can be achieved at a given price and date. The finding reads:

> Both bottom-up and top-down studies indicate that there is substantial economic potential for the mitigation of global GHG emissions over the coming decades, that could offset the projected growth of global emissions or reduce emissions below current levels *(high agreement, much evidence).*

This finding is quantified in Tables SPM.1 and SPM 2 for bottom-up and top-down studies, respectively.

***Table SPM 1:** Global economic mitigation potential in 2030 estimated from bottom-up studies*

Carbon price (US$/t$CO_2$-eq)	Economic mitigation potential, (GtCO_2-eq/yr)	Reduction relative to SRES A1B (68 GtCO_2-eq/yr), %	Reduction relative to SRESB2 (49 GtCO_2-eq/yr), %
0	5-7	7-10	10-14
20	9-17	14-25	19-35
50	13-26	20-38	27-52
100	16-31	23-46	32-63

Table SPM 2: Global economic mitigation potential in 2030 estimated from top-down studies			
Carbon price (US$/$tCO_2$-eq)	Economic mitigation potential, ($GtCO_2$-eq/yr)	Reduction relative to SRES A1B (68 $GtCO_2$-eq/yr), %	Reduction relative to SRESB2 (49 $GtCO_2$-eq/yr), %
20	9-18	13-27	18-37
50	14-23	21-34	29-47
100	17-26	25-38	35-53

tCO_2-eq stands for metric tonne carbon dioxide equivalent; $GtCO_2$-eq stands for billion metric tones carbon dioxide equivalent. Carbon dioxide equivalent is calculated using factors that convert emissions of other greenhouse gases to an equivalent amount of carbon dioxide based on their projected impact on the climate system. In this calculation, a pound of methane is equivalent to 21 pounds of carbon dioxide, a pound of nitrous oxide is equivalent to 296 pounds of carbon dioxide, etc.

While this conclusion seems straightforward, and has been presented in the media that way, both the definition of the terms used and the assumptions made in deriving the numerical estimates are anything but straightforward. You have to read all the "fine print" in WG III's SPM to fully understand what this seemingly simple statement means.

The Marshall Institute has read the fine print and finds that WG III's conclusion is unsupportable for the following reasons:

1. The agreement between top-down and bottom-up models is purely fortuitous.
2. Much of the analysis depends on use of the SRES scenarios, which have been widely criticized as unrealistic.
3. The analysis assumes a perfect market, a condition that exists only in economic models—real markets are far from perfect.
4. The total mitigation potential estimated from bottom-up studies is based on adding sectoral results calculated from widely different baselines, an invalid technique.
5. The top-down estimates were derived by interpolating results for model runs for 2100, an imprecise modeling approach.
6. Economic potential is based on assumptions that do not reflect the known behavior of companies and individuals in real markets.
7. The estimate of global potential assumes universal application of available technology, an unrealistic assumption.

Agreement Between Top-down and Bottom-up Models

While the agreement between the two approaches appears to be impressive, it is actually the result of luck. WG III acknowledges that there are significant differences between the two approaches at the sectoral level. This means that the top-down approach gives significantly higher numbers than the bottom-up approach for some sectors, but significantly lower numbers for others. The global agreement between these two approaches is like the classic case of the man with one foot in a scalding bath, the other on a block of ice — on average he was comfortable.

Use of Unrealistic SRES Scenarios

SRES A1B and B2 refer to scenarios documented in the IPCC Special Report on Emission Scenarios, published in 2000. The SRES scenarios have been widely criticized as being unrealistic. These are baseline scenarios, i.e., they assume that no overt action is taken to control greenhouse gas emissions. This is an unrealistic assumption, since a variety of actions are currently being taken to control greenhouse gas emissions, some voluntary, some mandatory, and more are planned for the future. Other criticisms of these scenarios include the fact that the scenarios with high CO_2 emission rates, which lead to high levels of temperature rise, are unrealistic.[3]

These and other criticisms of the SRES scenarios led the Select Committee on Economics of the UK House of Lord to conclude: "There are significant doubts about some aspects of the IPCC's emission scenario exercise, in particular, the high emission scenarios."[4]

WG III defends the SRES scenarios against some of these criticisms. Overall, WG III finds:

> Baseline emissions scenarios published since SRES, are comparable in range to those presented in the IPCC Special Report on Emission Scenarios (25-135 GtCO2-eq/yr in 2100).

This statement is correct if the total range of scenarios published since 2000 is considered. However, the figure (SPM.4) that WG III provides in support of this conclusion shows that, for 2100, two of the six SRES marker scenarios project emissions in 2100 substantially above the 75% percentile of the projections published since 2000. WG III's figure offers confirmation of the criticism that the high emission SRES scenarios are unrealistic.

Looking the post-2000 scenarios in more detail, WG III concludes:

> Studies since SRES used lower values for some drivers for emissions, notably population projections. However, for those studies incorporating these new population projections, changes in other drivers, such as economic growth, resulted in little change in overall emission levels. Economic growth projections for Africa, Latin America and the Middle East to 2030 in post-SRES baseline scenarios are lower than in SRES, but this has only minor effects on global economic growth and overall emissions.

While this is true for 2030, the SRES scenarios project emissions out to 2100. Errors such as overestimating economic growth rates compound, leading to larger effects for longer time periods. An error that is small in 2030 can be significant in 2100. In reality, the many factors that will affect emissions and environmental conditions in 2100 are essentially unknowable.

Assumption of Perfect Markets

WG III defines carbon price as "the cost per unit of carbon dioxide equivalent emissions avoided or reduced," i.e., the direct cost of applying technology. It is the cost created by a carbon tax or other regulation that drives the application of technology. Some economists assume a perfect market in which as soon as the carbon price is equal to the cost of applying a technology, that technology will be applied. However, because of inertia, imperfect information and other "market imperfections," markets are not perfect. It will take a higher carbon price than the cost of applying technology to drive application of the technology to the extent assumed. Because of this reality, WG III's estimates of mitigation potential are too high. Alternatively, this is equivalent to saying that WG III's projection of the cost of mitigation is too low.

Bottom-up Studies Used Widely Different Baselines

WG III's definition of bottom-up studies reads:

> ***Bottom-up studies*** are based on assessment of mitigation options, emphasizing specific technologies and regulations. They are typically sectoral studies taking the macro-economy as unchanged.

For its bottom-up assessment, WG III evaluated seven economic sectors (energy supply, transportation, buildings, industry, agriculture, forestry, and waste management), then summed the sectoral results. This would be a valid approach if each of the sectors used the same methodology to obtain its estimate. But as WG III admits, the seven sectors used four different baselines for estimating what sectoral conditions would be in 2030 if no action were taken. Each baseline contains different assumptions, particularly about the amount of energy-efficiency technology that would already have been applied. The more energy efficiency applied in the baseline, the less potential for mitigation and the higher its cost.

The baseline differences were not trivial: the agriculture, forestry and waste management sectors used the SRES A1B baseline, which has global emissions of 68 billion metric tonnes CO_2-eq in 2030. The industry sector used the SRES B2 scenario, which has global emissions of 49 billion metric tonnes CO_2-eq in 2030. The energy and transportation sectors used the IEA's World Energy Outlook 2004 baseline, which is similar to SRES B2, and the building sector used a baseline that was between SRES A1B and B2. Adding estimates derived from such different baselines is a case of adding "apples and oranges;" it yields a number, but no one knows what that number means.

Imprecise Approach for Top-down Studies

WG III defines top-down studies as follows:

> ***Top-down studies*** assess the economy-wide potential of mitigation options. They use globally consistent frameworks and aggregated information about mitigation options and capture macroeconomic and market feedbacks.

For its top-down assessment, WG III interpolated the results of economic modeling studies looking at the cost of stabilizing the atmospheric concentrations of greenhouse gases. These studies typically are run to 2100 and use more "broad brush" assumptions than would be used in a model that was looking specifically at the impacts of a carbon price in 2030. Top-down studies also ignore the substantial transition costs that would be involved to make the large scale changes in the economy that WG III assumes.

Economic Potential Based on Unrealistic Assumptions

WG III defines economic mitigation potential as the mitigation potential calculated on the basis of "social costs and benefits and social discount rates." Social benefits take into account the non-climate savings to society for application of greenhouse gas emission control technology. For example, if, in addition to controlling greenhouse gases, a technology controls local air pollutants such as ozone, the cost of that technology is reduced by the estimated value of the local air pollution control. Social costs are the other side of the coin. If, in addition to direct costs, a technology creates indirect costs for society, those indirect costs are added to the cost of the technology. For example, if a technology reduced employment, it might be debited for the societal cost of this impact. IPCC acknowledges that its evaluation of societal cost and benefits is incomplete, but at least some are taken into account. WG III does not give a range for social discount rates, only saying that they are lower than private discount rates. In past reports, WG III has indicated that social discount rates are typically about 5%. Companies typically use discount rates of 15% or more.

WG III acknowledges that the definition of economic potential does not reflect the choices companies and individuals would make. Those choices create a technology's market potential, which is smaller than its economic potential. WG III does not estimate market potential, but it is obvious from the discussion of barriers to the implementation of mitigation options, that market potential is not just smaller, it is much smaller, than economic potential. WG III says that governments could close the gap between economic and market potential with suitable policies, such as regulations limiting the amount of greenhouse gas emissions.

Global Application of Technology

WG III's estimates assume global application of control technologies. A large part of the potential for controlling greenhouse gas emissions is in buildings, agriculture and forestry, where it is difficult to conceive of anything approaching universal application of advanced technology. Also, the majority of the potential is in developing countries, who have said that they need to grow their economies before they can consider control of greenhouse gases. Even if they were willing to make greenhouse gas mitigation a priority, they would have to build technical capacity and reform their institutions to attract investment for the huge number of projects that would be necessary to achieve WG III's estimates.

WG III's estimates assume that all of the technology is either available or will become available in the next few decades. The phrase "will become available in the next few decades" refers to the technologies identified on Table SPM.3 which are projected to be commercialized before 2030. Some of these technologies, e.g., inert electrodes for aluminum manufacture, have been under development for long periods of time without the breakthrough needed to make them commercial. While the Marshall Institute is an advocate of technology development and strongly believes that the only way to significantly reduce carbon dioxide emissions without crippling the global economy is through the application of more and better technology, we are not naive enough to predict when and how that technology will be commercialized, nor do we believe that anyone is wise enough to know when.

Predicting eventual success in reducing greenhouse gases to the levels WG III says is possible will require the use of *all* technologies, including some, like nuclear and carbon capture and storage, that face strong opposition from environmental groups. WG III acknowledges the political opposition to nuclear power, but assumes that it will be overcome. The Marshall Institutes hopes that WG III's assumption about the deployment of all technological options is correct. WG III does not discuss the opposition to carbon capture and storage.

Cost of Stabilization

A second WG III conclusion that has already attracted a large amount of attention concerns the cost of starting on a pathway that will lead to eventual stabilization of atmospheric concentrations of greenhouse gases. The conclusion reads:

> In 2030 macro-economic costs for multi-gas mitigation, consistent with emissions trajectories towards stabilization between 445 and 710 ppm CO_2-eq, are estimated at between a 3% decrease of global GDP and a small increase, compared to the baseline (see Table SPM.4). However, regional costs may differ significantly from global averages *(high agreement, medium evidence)*.

The cost of maintaining a stabilization pathway grows rapidly. WG III concludes:

> In 2050 global average macro-economic costs for multi-gas mitigation towards stabilization between 710 and 445 ppm

> CO_2-eq, are between a 1% gain to a 5.5% decrease of global GDP. For specific countries and sectors, costs vary considerably from the global average. *(high agreement, medium evidence).*

Stabilization Pathways

It is important to understand the concept of stabilization pathways before attempting to evaluate the basis for these cost estimates. The UN Framework Convention on Climate Change has as its ultimate objective stabilization of atmospheric concentrations of greenhouse gases at a level that would avoid dangerous anthropogenic (human-induced) interference with the climate system. The dangerous level has not been defined, so most studies look at a range of levels. While potential human impacts on the climate system are very complex, involving the emissions of both greenhouse gases and aerosols as well as impacts on the ability of the Earth's surface to absorb or reflect solar radiation, most discussions of stabilization simplify that complexity to a discussion of carbon dioxide concentration.

Once carbon dioxide is emitted, it stays in the climate system for a very long time. The climate system includes the atmosphere, oceans, and biosphere. The only natural way of removing it is transfer to the deep ocean, which is a slow process. Stabilization of atmospheric concentration of carbon dioxide requires that net emissions of carbon dioxide eventually approach zero. It is the net emissions of carbon dioxide that are important because carbon dioxide can be removed from the atmosphere by increasing biological activity (growing forests or fertilizing the oceans to increase plankton growth) or it can be prevented from reaching the atmosphere with carbon capture and storage technology.

Because a relatively fixed portion of emitted carbon dioxide accumulates in the atmosphere (the rest is transferred to oceans and biosphere) and stays there for a long time, it is possible to estimate of the amount of carbon dioxide that can be emitted for any stabilization level. Initially it was assumed that stabilization would require an immediate reduction in emissions that became more stringent as time proceeded. However, in a landmark paper, Wigley, Richels and Edmonds (WRE) argued that a more cost-effective way to approach stabilization would be to allow emissions to rise for a period of time while new, cheaper technology was developed, then reduce them more sharply.[5] Based on this logic, they constructed emission pathways to stabilization at different carbon dioxide concentrations. Each of these pathway peaked some time in the future; the higher the stabilization level, the higher the peak emission rate and the later the date of the peak. WRE stressed that there were an infinite number of pathways that could be constructed for any stabilization level, but their pathways, known as the WRE curves, are widely used.

WG III accepts the WRE logic in the following statement:

> In order to stabilize the concentration of GHGs in the atmosphere, emissions would need to peak and decline thereafter. The lower the stabilization level, the more quickly this peak and decline would need to occur.

Costs of Stabilization Pathways

Top-down economic models are used to evaluate the cost of following stabilization curves, and the results are usually expressed in terms of percent of global GDP; the absolute numbers are in trillions of dollars. As with the case of estimates of mitigation potential, estimates of the costs of stabilization are based on a large number of assumptions. WG III gives the following summary of the key assumptions:

> Most models use a global least cost approach to mitigation portfolios and with universal emissions trading, assuming transparent markets, no transaction cost, and thus perfect

implementation of mitigation measures throughout the 21st century. Costs are given for a specific point in time.

Global modeled costs will increase if some regions, sectors (e.g. land-use), options or gases are excluded. Global modeled costs will decrease with lower baselines, use of revenues from carbon taxes and auctioned permits, and if induced technological learning is included.

None of these assumptions represents the world as we know it.

1. Universal emissions trading does not exist today and is highly unlikely to exist any time in the foreseeable future. It would require all countries to join either the Kyoto Protocol or whatever agreement is reached for the post-2012 period.

2. Transparent markets do not exist in many countries and, desirable as they are, a climate change agreement is an unlikely mechanism for creating them.

3. Transactions have costs. The costs may be high or low, but they have to be taken into account.

4. As with perfect markets, perfect implementation exists only in economic models. Government policies are rarely perfect, and in too many cases are actually counter-productive.

The only current climate change mitigation mechanism that has the potential for global coverage is the Kyoto Protocol's Clean Development Mechanism (CDM). CDM allows developed countries or companies operating in developed nations to receive emission credits for mitigation projects carried out in developing nations. It also allows developing nations to receive emission credits, which can be sold to developed nations, for mitigation projects they carry out on their own. The CDM does not meet the four assumptions WG III uses in its estimate of cost for stabilization pathways.

- While it has the potential for global coverage, it is limited to countries that have ratified the Kyoto Protocol, thus excluding the U.S. and Australia. African and other least developed nations routinely complain that they are not receiving CDM projects, the lion's share of which are going to rapidly developing countries like China.

- While the CDM's operations at the global level are reasonably transparent, its operation at the national level is no more transparent than for any other economic activity. For some countries this means a high level of transparency, for many others, little or no transparency.

- CDM's transaction costs are high. Its procedures for approval and verification of projects are long and complex. The CDM assesses a share of the credits issued to pay the cost of operating the mechanism and another share to fund adaptation projects in the least developed nations.

- Implementation of the CDM is far from perfect. Certain categories of projects, e.g., nuclear and carbon capture and storage, are excluded from consideration. As experience has grown, so has the predictability of the project approval process, but projects still have to be approved on a case-by-case basis, meaning that projects involving new and innovative approaches face an unpredictable reception.

Experience with CDM indicates that it is highly unlikely that any system could achieve the idealized operation assumed in the economic studies that are the basis for WG III's conclusion. As with short-term mitigation potential, this means that either the cost of starting on a stabilization pathway or the atmospheric concentration of carbon dioxide at stabilization or both will be higher than projected by WG III.

WG III's observation that costs will rise if regions, sectors, options or gases are excluded is correct. The continued resistance from developing nations to accepting emission reduction targets means that over half of current emissions would not be covered by the supposedly global system. A number of European countries have actively opposed including nuclear in any emission trading scheme, limiting the effectiveness of this important technology. Resistance to the inclusion of carbon capture and storage technology in emission trading schemes has been growing, and while it may eventually be overcome, it is likely that restrictions will be placed on use of this technology that will make its application more costly.

Climate change policy is not developed in a vacuum, and at both the national and international level, countries consider a broad range of other policy objectives when making decisions. This is desirable because it tends to ensures that society's other needs are also being considered, but it makes the simplistic approach embodied in economic models unrealistic. There have been studies that consider the implications of non-ideal policy implementation,[6] but WG III's SPM does not present their results.

The term "induced technological learning" requires some discussion. Technology has been improving steadily since the dawn of civilization. Retrospective studies indicate that the energy efficiency of the U.S. economy has improved by about 1% per year, and economic models incorporate that improvement into their projections. Some economists have argued that establishing appropriate climate change policies would "induce technological learning," significantly increasing this rate of improvement. If so, the cost of reducing emissions would be decreased.

There is little question that creating a carbon price would lead to a short-term improvement in energy efficiency. Energy is a major controllable cost for many industries, and companies devote significant effort to attempting to reduce energy costs. Projects are implemented when they are economically attractive, and many companies have a portfolio of projects that would be attractive at a higher energy price. Artificially raising the price of energy by burdening it with a carbon price would lead to the implementation of some of these projects and a short-term increase in the rate of energy efficiency improvement. This type of increase was noted in the mid-1970s, when energy prices rose after the first Arab oil embargo. There is no indication that this higher rate of improvement could be sustained on a longer-term basis. After the initial response to higher oil prices in the 1970s, the rate of energy efficiency improvement returned to its historic average.

WG III's SPM provides nothing more than the assertion that induced technological learning can reduce mitigation costs. While there is a growing set of economic modeling studies that show the value of this effect, the Marshall Institute is not aware of any studies documenting its real-world existence. Like so many of WG III's results, it appears to exist only in the idealized world of economic models.

Negative Costs for Stabilization

For both 2030 and 2050, WG III presents a range of costs for starting on a stabilization pathway. The cost is obviously a function of the stabilization level: the lower the level, the higher the cost. Some studies report negative costs, which seems too good to be true. As in most cases, if it seems too good to be true, it isn't true. WG III explains negative costs as follows:

> Although most models show GDP losses, some show GDP gains because they assume that baselines are non-optimal and mitigation policies improve market efficiencies, or they assume that

> more technological change may be induced by mitigation policies. Examples of market inefficiencies include unemployed resources, distortionary taxes and/or subsidies.

At the economy-wide level, reducing emissions costs money and creates an economic burden. What WG III is saying is that if you start from an economically inefficient baseline and while you are improving economic efficiency, you also apply climate change policy, you can end up with a net gain if the benefits of improved economic efficiency are greater than the costs of climate change policy. This can be true, but it ignores the obvious conclusion that the benefits of economic restructuring would have been greater, if not burdened with the costs of climate policy. It is intellectually dishonest to combine to the two effects and then claim all of the benefits for climate change policy, especially since the effect of that policy is negative.

Other Findings

Three additional WG III findings are discussed below.

> Changes in lifestyle and behavior patterns can contribute to climate change mitigation across all sectors. *(high agreement, medium evidence)*

As a simple statement of fact, this finding is uncontroversial. The way individual consumers use energy is an important factor in overall emissions. If this finding is used as a basis for policy decisions, it becomes very disturbing. Should government regulation be allowed to constrain consumption choices to reduce greenhouse gas emissions? Not too many years ago the German Green Party proposed to reduce greenhouse gas emissions by not allowing Germans to fly internationally on vacation more often than once every five years. The idea was quickly dropped in response to howls of protest. While this is an extreme example, there are many more subtle cases. For example, few would argue against government helping consumers choose energy efficient appliances by creating labeling standards that allow simple comparisons to be made. The effect of these standards has been to create a new aspect of competition, with most manufacturers striving to provide the additional features while maintaining a high level of energy efficiency. Given that there is a wide range of energy efficient appliances on the market, should government ban inefficient models, as has been proposed? If this is done, how would the minimum standard be established and how could we ensure that it was not raised to a level that restricted choice on other features?

> While studies use different methodologies, in all analyzed world regions near-term health co-benefits from reduced air pollution as a result of actions to reduce GHG emissions can be substantial and may offset a substantial fraction of mitigation costs *(high agreement, much evidence).*

There is no question that high levels of local air pollutants, as are common in many large cities in developing nations, cause serious health problems. The question is whether it is more effective to tackle this problem directly by installing cleaner combustion devices or indirectly by reducing fossil fuel use. All available evidence shows that installing pollution control devices is far more cost-effective than reducing fossil fuel use.

> Decision-making about the appropriate level of global mitigation over time involves an iterative risk management process that includes mitigation and adaptation, taking into account actual and avoided climate change damages, co-benefits, sustainability, equity, and attitudes to risk. Choices about the scale and timing of GHG mitigation involve

balancing the economic costs of more rapid emission reductions now against the corresponding medium-term and long-term climate risks of delay (*high agreement, much evidence).*

The Marshall Institute is pleased to see this finding as it validates a policy position that the Institute has been advocating since 2001. It acknowledges that we do not know enough to set a long-term climate change policy and will need to adjust policy as we learn more about both risks and costs. It also acknowledges that climate policy should have a balanced approach, with both mitigation and adaptation playing roles. Finally, it acknowledges that a balance needs to be struck between short-term costs and long-term risks.

Notes

1. CO_2-eq stands for carbon dioxide equivalent, which is calculated using factors that convert emissions of other greenhouse gases to an equivalent amount of carbon dioxide based on their projected impact on the climate system. In this calculation, a pound of methane is equivalent to 21 pounds of carbon dioxide, a pound of nitrous oxide is equivalent to 296 pounds of carbon dioxide, etc.

2. George C. Marshall Institute, 2007: *Working Group (WG) I's Contribution to the IPCC's Fourth Assessment Report (AR4): A Critique*. ***www.marshall.org/pdf/materials/515.pdf*** and George C. Marshall Institute, 2007: *Evaluating Working Group (WG) II's Contribution to the IPCC's Fourth Assessment Report (AR4)*. ***www.marshall.org/article.php?id=526***.
3. See for example: Ausubel, J., 2002: Does Energy Policy Matter? ***www.marshall.org/article.php?id=7***.
4. House of Lords Select Committee on Economic Affairs, 2005: The Economics of Climate Change. ***www.publications.parliment.uk/pa/Id200506/Idselect/Ideconaf/12/12i.pdf***
5. Wigley, T.M.L., R. Richels and J.A. Edmonds, 1996: Economic and environmental choices in the stabilization of atmospheric CO_2 concentrations. *Nature*, 379, 240-243.
6. See for example: Bernstein, P.M., W.D. Montgomery, T.F. Rutherford and G-F Yang, 1999: Effects of restrictions on international permit trading: The MS-MRT model. *The Energy Journal*, Kyoto Special Issue: 221-256.