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Thank you, Madam Chairman, Ranking Member Inhofe and distinguished members of the Committee for the privilege of contributing to the important discussion taking place here today. The testimony I will provide is my own and does not represent the viewpoint of my employer, the Arlington, Virginia-based investment bank Friedman, Billings, Ramsey & Company, Inc.

As an energy policy analyst for Wall Street institutional clients, I evaluate potential investment impacts of government and regulatory actions for the men and women who manage other people's money. This affords me an opportunity to engage financial investors, corporate management teams and policymakers in intellectually honest discussions regarding the challenges of balancing environmental stewardship with economic growth and national security.

My testimony today addresses three areas relevant to discussion regarding U.S. greenhouse gas emissions reductions: the nature of energy investments; potential unintended consequences related to market-based regulatory frameworks; and the durability of such frameworks when sovereigns confront serious economic hardship.

I. THE NATURE OF ENERGY INVESTMENTS

Energy investments require significant capital outlays over long periods of time, pushing returns for financial investors far into the future. The prospect of significant changes to regulations governing energy sector investments can introduce uncertainty that diminishes investors' perceptions of value. A dollar today, after all, is worth a dollar. A dollar next year is worth less than a dollar today because today's dollar could earn a year's interest in a bank account in the meantime. The 80% possibility of a dollar next year is worth still less.

Financial investors seek returns that outperform industry benchmarks. An investor's charter or institutional mandate may define the class and type of portfolio assets in which he or she might invest. These choices may vary considerably across different firms, funds and asset classes but, whatever the criteria, timeframe or style involved, investors generally seek to allocate the capital entrusted to their care to the highest-yielding investments among competing alternatives.

Capital-intensive firms compete for investor dollars to fund their operations. When investor perceptions of project value diminish, corporations must offer investors either higher guaranteed returns (in the case of debt) or larger portions of ownership (in the case of equity) in order to secure financing. When securities issuers and institutional investors cannot agree, investment may stall. When issuers face higher costs of capital for essential investment, it can deter discretionary spending on research and development and hurt long-term competitiveness.

Cost-of-capital concerns are unlikely to be the only reason why a number of emissions-intensive energy and industrial producers have asked Congress to quickly enact clear and enduring greenhouse gas emissions controls; by the same token, it is reasonable to assume that these concerns do play a role in corporate decision-making.

Other stakeholder communities have called for urgent action on climate change. Several environmental advocacy groups warn that recent warming trends may lead to irreversible feedback loops unless governments can slow, stop and reverse global anthropogenic emissions in the near term. Still others have suggested that U.S. leadership might promote more-rapid uptake of new emissions standards by U.S. trading partners, including less-developed economies that are currently exempt from the Kyoto Protocol. Leaving aside the question of whether scientific data demand a rush to action, the nature of energy investments may present several challenges for policymakers considering actions to address climate change.

First, the energy industry is a world of large numbers and vast quantities that can magnify the impact of policy changes. According to 2004 EPA greenhouse gas emissions data (the most recent available), U.S. fossil fuel combustion yielded 5,656.6 $TgCO_2E$ (teragrams of carbon dioxide equivalent)[1]. Of this, 1,860.2 $TgCO_2E$ came from transportation and 2,290.6 $TgCO_2E$ came from electricity generation. The corresponding consumption data are also awe-inspiring. Our nation uses more than 20 million barrels of oil each day and light-duty vehicles operating on American roads consume approximately 140 billion gallons of gasoline each year. Given that gasoline combustion yields approximately 20 pounds of CO_2 per gallon, these numbers add up quickly, making the annual carbon footprint of U.S. motor gasoline approximately 1,250 $TgCO_2E$.

This means that an economy-wide $1/metric ton CO_2 charge, whether as a tax or as a cost of purchasing emissions credits, would increase the cost of gasoline by approximately $1.25 billion per year. Likewise, coal-fired power plants generated approximately two billion megawatt-hours of electricity using approximately one billion tons of coal in 2005.[2] Because the combustion of one [short] ton of coal yields approximately two metric

[1] IPCC methodology represents total emissions in terms of their "global warming power" using a standard unit of grams of carbon dioxide equivalency. By this mechanism, methane is 21 times more heat-trapping, making one gram of methane equivalent to 21 grams of CO_2. Total U.S. greenhouse gas emissions in 2004 were 7,074.4 $TgCO_2E$. Source: EPA *Inventory of Greenhouse Gas Emissions and Sinks, 1990-2004,* released April 2006. Table ES-3.

[2] EIA *Electric Power Annual With Data for 2005*, updated November 9, 2006.

tons (2,000 kg) of CO_2, charging coal-fired generators $1 per metric ton of CO_2 would increase costs by approximately $2 billion per year at current consumption levels.[3]

Second, recent history illustrates how policy changes that appear to modify small components of energy use may also meaningfully impact the economics of related and supporting industries. The Renewable Fuels Standard established by the Energy Policy Act of 2005 and the corresponding withdrawal of MTBE from the nation's fuel supply increased the ethanol content of gasoline from approximately 3% to approximately 4.1% over the course of a year, a modest change. Although gasoline prices rose dramatically during periods of ethanol scarcity at the height of the summer driving season, this effect disappeared by the end of 2006 and gasoline prices have resumed their traditional relationship to crude prices and refinery margins. On the other hand, the year-on-year impact on corn prices was much starker. Actual corn prices realized by farmers in December 2006 rose to almost $3/bushel, more than a 50% increase above year-earlier prices of $1.92/bushel in December 2005.[4]

Third, the growth rates of energy use, greenhouse gas emissions and economic output tend to be closely correlated, although developed economies tend to operate more efficiently on a per-unit CO_2 basis. The U.S. economy currently grows faster than the growth rate of its energy use, fossil fuel use and overall greenhouse gas emissions (3.0% versus 1.2%, 1.2% and 1.1%, respectively).[5] On the other hand, the sole year of carbon emissions reductions during the past fifteen years arrived as a result of the September 11,

[3] According to EIA *Fuel and Energy Source Codes and Emissions Coefficients*, burning one short ton (2,000 pounds) of anthracite yields 3,852 pounds of carbon dioxide. The ratios are higher for bituminous (4,931 lb/short ton) and lower for subbituminous (3,715 lb/short ton) and lignite (2,791 lb/short ton). The 2:1 ratio offers a convenient back-of-the-envelope estimate for discussion purposes. Note that carbon dioxide values are usually expressed in metric tons (2,200 pounds).

[4] These prices could potentially normalize somewhat if USDA early planting reports suggest new acreage has come on-stream.

[5] *Inventory of Greenhouse Gas Emissions and Sinks, 1990-2004,* released April 2006. Table ES-8.

2001 terrorist attacks and associated economic losses – annual greenhouse gas emissions fell 1.3% and the growth rate of GDP fell from 3.7% to 0.8%[6].

Russia provides an even more marked example. Russian President Vladimir Putin ratified the Kyoto Protocol on November 5, 2004, fulfilling the second of two tests required under the treaty before its cap-and-trade system acquired the binding force of international law: a minimum of 55 countries had to commit to participate and the participating countries had to represent at least 55% of the world greenhouse gas emissions levels in 1990 (Russian participation contributed 17.4% of 1990 greenhouse gas emissions towards the cumulative total of nearly 62%). According to the U.N., Russian greenhouse gas emissions levels decreased 32% (from 2,974.9 $TgCO_2E$ to 1,944.8 $TgCO_2E$) between 1990 and 2004 with the collapse of Russia's industrial economy.[7] At a credit price of $10/metric ton of CO_2, this lost capacity has a potential value of $10 billion per year in emissions credits sales, an attractive financial choice for a nation that generated $613 billion in economic output in 2004. On the other hand, this wealth transfer ultimately rewards economic contraction instead of providing an incentive for Russia to reduce its "brown" (conventional) energy production and increase its "green" energy production.

In developing economies, income increases can spur greater transportation and electricity use of fossil fuels without the declining carbon intensity of GDP demonstrated by the U.S. In the absence of domestic reforms, it appears that China's transportation-related carbon emissions growth will continue to accelerate in the future, once that nation's highway system (which essentially doubled in size between 1990 and 2003, with most of that growth during the final four years) expands to support the approximately 600% increase in per capita personal income and licensed drivers and more than fourfold growth in motor vehicles over the same period of time. Already, economic expansion has led to tenfold growth in Chinese greenhouse gas emissions between 1980 and 2000 and

[6] Source: Bureau of Economic Analysis.

[7] U.N. Framework Convention on Climate Change, *Highlights from Greenhouse Gas (GHG) Emissions Data for 1990-2004 for Annex I Parties*, p. 16, released November 2006

Chinese emissions reached 3,222.4 $TgCO_2E$ in 2002, making it the world's second largest source of greenhouse gases. Between 2002 and 2004, automobile ownership rose another 30% and, during that period, greenhouse gas emissions levels rose to 4,707.3 $TgCO_2E$.

Finally, policymakers may wish to consider that Washington timelines are often shorter than those that govern energy projects. Congress appropriates money on an annual basis and reconvenes every two years. Presidential terms are only four years long and the federal government balances its budget in five-year windows. Even the six-year terms of U.S. senators fall short of the time periods that may be required to approve permits for new refineries (a seven-year story), to produce oil from the Arctic National Wildlife Refuge (optimistically, eight to 10 years) or to fully upgrade the efficiency of the U.S. passenger vehicle fleet (potentially 15 to 20 years).

II. UNINTENDED CONSEQUENCES OF MARKET-BASED SYSTEMS

A tax on the end-user consumption of greenhouse-gas-emitting fuels would provide the most economically efficient means of limiting emissions. The shortcomings of this approach have been well documented. Consumption taxes tend to be regressive and, depending on their magnitude, they may negatively impact the growth rate of GDP. Significant new taxes also appear politically unviable at the present time. In light of these shortcomings, many policymakers and industry stakeholders have supported market-based cap-and-trade programs.

Cap-and-trade programs offer several advantages. In theory, a market-based mechanism for emissions reductions will offer corporations the flexibility to choose between undertaking new capital investment, purchasing emissions credits from cleaner producers or shutting down production entirely. Cap-and-trade systems should reward those participants who outperform established targets or meet goals ahead of scheduled dates by allowing them to monetize accumulated credits through sale to other entities. Imposing a cap-and-trade program is unlikely to provoke an adverse capital markets response, either. To the extent that financial investors can account for emissions credits or capital projects within their revenue and cost projections, a clearly-defined cap-and-trade trajectory can be factored into long-term equity valuations.

But cap-and-trade mechanisms also have shortcomings. The architecture of a credit-trading system requires policymakers to consider which entities will be regulated, how allowances will be allocated and whether or not to provide for a "safety valve" in the event that market prices for credits materially exceed entities' economically sustainable ability to pay. The Senate Energy and Natural Resources Committee treated these topics during its climate summit on April 4, 2006. Testimony offered during that event appeared to suggest regulating mobile sources upstream (at the refinery or extraction site) in order to facilitate implementation and stationary sources downstream (at the smokestack) to encourage end-user innovation.

Although placing the regulatory burden on the shoulders of corporations could mitigate regressive effects for low-income consumers, it may not eliminate them entirely: power producers and oil companies are likely to pass through some portion of higher costs to the entire consumer population. This approach could weaken the price signals that might motivate individuals to alter their consumption behaviors.

The principle of cap-and-trade is likely to work best under circumstances where regulated entities can engage in economic, technologically-viable, green behaviors to earn credits for future use or sale, as in the case of the scrubber installations during phase I of the Acid Rain Program and, more recently, the hundreds of thousands of megawatts of scrubbed capacity planned by U.S. coal-fired power plants in order to meet Clean Air Interstate Rule targets. Otherwise, a cap becomes, in practical terms, a tax on production that may impose the greatest impact on producers with the thinnest margins or the smallest cash reserves.

Carbon dioxide (CO_2) from fossil fuel combustion makes up more than 85% of U.S. greenhouse gas emissions, far outstripping potential offsets available to regulated entities from projects that stem emissions of gases like landfill methane, or PFCs and HFCs from industrial production. Although science may soon make great strides towards secure sequestration of CO_2 in underground reservoirs, this option is not available to U.S. emitters today. Likewise, it may be years or decades before the nation can rely upon predominantly green energy sources that replace today's conventional energy production, like second generation, waste-based biofuels, electric cars powered by hydrogen fuel cells and new electric generating capacity from nuclear power plants.

Several legislative proposals address the challenge of implementing a cap-and-trade system within an economy that depends on today's industrial technology by allocating large blocks of credits to existing emitters in early years and decreasing these allocations in subsequent years. This, too, may lead to unintended consequences. During the 1995-1999 first phase of Acid Rain Program sulfur dioxide (SO_2) credit trading, coal-fired emissions sources in operation prior to 1996 were given allowances of 2.5 lb SO_2 per million British thermal units (mmBtu). Although the biggest emitters faced the lowest per-Btu cost of retrofitting and quickly amassed a bank of 11.65 million emissions allowances (30% of total allocation), most power plants east of the Mississippi preferentially turned to a different brown mechanism for meeting their targets (switching to lower-sulfur coal from the Powder River Basin) instead of the green choice to install flue gas scrubbers.

The large bank of emissions allowances kept prices low (in the $100-200/allowance range) and gave utilities the freedom to delay capital expenditures, but utilities' wait-and-see strategy later exhibited several weaknesses. First, rail dislocations out of the Powder River Basin increased effective fuel costs for utilities by driving demand for sulfur credits. Second, when the 2005 Gulf of Mexico (GOM) hurricanes disabled a significant proportion of GOM natural gas production, noncommercial traders bet that power utilities would need to fall back on high-sulfur coal to generate electricity, bidding the thinly-traded market for sulfur emissions allowances up above $1,500 per ton.

A similar set of challenges could confront a cap-and-trade mechanism that includes a "safety valve" to protect economic growth. Most safety valve proposals would enable regulated entities to pay a defined maximum price per metric ton of CO_2 emitted in the event that credit prices exceed established thresholds. This may present a politically appealing compromise, but it could also undermine the market dynamics built into a cap-and-trade system because a safety valve price would need to be, by definition, lower than the projected market price for emissions allowances under conditions of scarcity. When credit prices spike, the expected result would be for regulated entities to pay the safety valve price and continue business as usual, unless the safety valve price is set high enough to make emitters willing to consider new capital investment in green technologies that would offer regulated entities sustainable production cost advantages.

III. DURABILITY OF REGULATION

The first Kyoto compliance phase officially begins in 2008 and continues through 2012, although the EU Emissions Trading Scheme began on January 1, 2005 and electronic trading of Kyoto Clean Development Mechanism credits is scheduled to begin in April of this year. The first phase of the Regional Greenhouse Gas Initiative (RGGI) commences in 2009 and California's Global Warming Solutions Act requires enforceable greenhouse gas regulation to begin in 2012. As this august body and other federal authorities continue their deliberations on climate change, recent events have led some institutional investors to wonder about the durability of existing and proposed climate change regulatory frameworks, particularly once these frameworks begin to require emissions cutbacks sufficiently austere to threaten economic sovereignty.

Canada's 1990 greenhouse gas emissions totaled 598.9 $TgCO_2E$. The Kyoto Protocol set Canada's 2012 target at approximately 563 $TgCO_2E$, a 6% reduction from 1990 levels. 2004 emissions totaled 758.1 $TgCO_2E$, partly as a result of carbon-intensive unconventional oil production in Alberta's tar sands. Evaluating at 2004 levels, this puts Canada 195.1 $TgCO_2E$ behind pace. If Canada's emissions continue to grow as they did between 2000 and 2004 at 1.15% per year, 2012 levels could reach 854 $TgCO_2E$, widening the gap against the Kyoto target to 290 $TgCO_2E$. If emissions allowances rise as high as they did when the EU Emissions Trading Scheme market price peaked at approximately $39/metric ton of CO_2 in April 2006, Canada's annual compliance cost could exceed $11.3 billion, or about 1.33% of GDP. This may seem like a bargain compared to actually reducing emissions, however. A November 2006 study by the Canadian Manufacturers and Exporters lobby projected that reducing Canada's GHG footprint to meet its target would result in annual compliance costs in 2012 of $255 billion, representing approximately 30% of GDP.

In December 2005, as the parties to the RGGI prepared to commit to the regional, multilateral emissions reduction pact in the wake of Hurricanes Katrina and Rita, Massachusetts and Rhode Island decided not to sign the December 15, 2005 Memorandum of Understanding (although both states rejoined the program earlier this year). Massachusetts Governor Mitt Romney justified this move at the time by expressing his concern that power utilities could incur unlimited costs if they exceeded emissions limits. Massachusetts had plausible grounds for concern: winter was fast approaching and natural gas futures were above $14/mmBtu, a situation that threatened to markedly increase state reliance on coal-fired power.

Investors evaluating the share prices of potentially-regulated entities or considering investment in offset projects or secondary-market emissions credits (as non-commercial traders) are likely to be cautious about the possibility that high prices could motivate sovereigns to defect from, or delay implementation of, proposed regulatory mechanisms.

IV. CONCLUSION

An economy-wide, cap-and-trade system to control greenhouse gases that goes into force too far ahead of the development and commercialization of cost-competitive "green" alternatives may not be the most stable or most efficient mechanism by which the United States can modify energy use behaviors in order to address global climate change. A market mechanism may give emitters and financial investors greater flexibility than a system of direct taxation or strict, per-unit regulation, but there may be greater value in providing incentives for the United States' robust venture capital, private equity and capital markets infrastructure to deliver cost-competitive technological solutions to emissions challenges without imposing nationwide caps. Alternatively, it may make sense to take an incremental step by enshrining in law a market-based regulation of particulates from stationary sources similar to the Clean Air Interstate Rule and Clean Air Mercury Rule in a way that gives regulated entities financial motivations to explore emerging carbon capture technologies. Last, ongoing discussion may be further informed by analysis of the comparative national and global economic costs of inaction and limited action vis-à-vis the costs of any comprehensive emissions control program.

This concludes my prepared testimony.