Economic Impact of Kigali Amendment Ratification

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7/23/2018

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Executive Summary

A debate is under way as to whether U.S Senate ratification of the Kigali Amendment to the Montreal Protocol will be good for the U.S. economy. At its heart the treaty aims to replace hydrofluorocarbons (HFC) refrigerants with a new class of lower global warming potential hydrofluoroolefins (HFO) refrigerants with developed countries sending money to the United Nations to assist developing countries with the cost of conversion. The Obama Administration approved U.S. participation, but never sent it to the Senate for ratification. The refrigeration industry is now asking President Trump to refer the treaty to the Senate for ratification.

We find ratification will not improve our balance of trade deficit as claimed by the refrigeration industry, and will cost US consumers up to a peak cost of $8 billion a year in refrigerant premiums, and up to $2 billion in investments for refrigerant recycling equipment. In addition the US will send the United Nations Multilateral Fund $1.3 billion to assist developing countries switch to HFO refrigerants with much of that investment wasted or spent on administrative costs. All for a reduction in global warming that is too small to measure.

An industry financed study, "Economic Impacts of U.S. Ratification of the Kigali Amendment" by JMS Consulting, makes the claim ratification of the Kigali Amendment will improve the US balance of trade $12.5 billion a year, adding 33 thousand jobs. This is based on a single assumption that ratification will provide regulatory certainty to encourage industry R&D investment to create uniquely advanced products with a new refrigerant that will create a competitive advantage in foreign markets. However, over the last two decades US air conditioning and refrigeration equipment manufacturers led the world in improving equipment energy efficiency by 40 to 750 percent! During that same period export share of the US market barely grew while imports increased five-fold.

A big reason for the increase in imports is equipment manufacturers themselves moved production to other countries. Almost half our imports are now coming from NAFTA allies Mexico and Canada, with China and South Korea supplying another 37 percent. Clearly, our competitive advantage did not save American jobs in the past, and is unlikely to do so in the future. Not ratifying Kigali will establish regulatory certainty just as surely as ratification.

The industry financed study also claims Kigali follows the successful United Nations Montreal Protocol example of switching refrigerants to lower ozone depletion. In reality there is doubt stratospheric ozone changed much after 1997. Money contributed to the Multilateral Fund over the next two decades had little impact, and we are committed to continue paying into the fund until 2030. Continued payments have had the perverse effect of rewarding countries that are slow to switch refrigerants. The US could have walked away from the treaty twenty years ago with little environmental impact. Kigali extends US participation in the Montreal Protocol requiring almost $1.3 billion in contributions between 2019 and 2050.

Notice there is no explanation of how ratification works to provide this regulatory certainty. Section 115 of the Clean Air Act requires the EPA to write regulations to support treaties. The NRDC wants to test Section 115 in court to allow international treaties to override

US sovereignty to force the EPA to regulate in favor of the new refrigerants without involving Congress. Carbon dioxide regulation would be next.

False Industry Assumptions

Most of the growth in the refrigeration industry is coming from increased air conditioning and refrigeration use in China, India, Latin America, and Africa. The International Energy Agency released a report in May, The Future of Cooling[1], that projected that, "The global stock of air conditioners in buildings will grow to $5.6 billion by 2050, up from $1.6 billion today."

The JMS Consulting study, "Economic Impacts of U.S. Ratification of the Kigali Amendment"[2], indicates the Heating, Ventilating, Air Conditioning, and Refrigeration (HVACR) industry will reverse a growing trade imbalance by becoming more competitive. The claim is the industry will invest $1 billion over a decade in research and development if the Kigali Amendment is ratified. This would lead to superior products developing countries will be "eager" to buy. Imports will decrease and exports will increase. The new refrigerant itself will not offer efficiency improvements, and may be less efficient in some applications.

JMS Consulting in Figures E5 and E6 on page 6 makes the claim ratification of the Kigali Amendment will improve the US balance of trade $12.5 billion a year, adding 33 thousand jobs, and will have additional indirect and induced impacts. JMS estimates U.S. domestic demand will be the same with or without Kigali.

We find this argument unpersuasive. Equipment efficiency has been increasing for years while the trade imbalance grew. Table 1 below shows imports of equipment have grown steadily from 12 percent in 1997 to 35.5 percent, or $18.5 billion in 2016. This is more than a five-fold increase from 1997. Exports only grew from a 14.8% market share in 2000 to 16.3% in 2016.

Table 1: HVACR Historic Trade Balance – 2016$

Year	Domestic Demand $ millions	Imports $ millions	Imports %	Approximate Trade Balance $ millions	Approximate Exports $ millions	Exports %
1997	28,300	3,388	12.0 %	-	-	-
2000	34,232	5,071	14.8 %	0	5,000	14.8%
2010	39,269	11,775	30.0%	5,000	6,800	17.3%
2016	52,137	18,523	35.5%	10,000	8,500	16.3%

Source: First 4 columns "Economic Impacts of U.S. Ratification of the Kigali Amendment", Table 4.1, page 29, fifth column Appendix A-4 question 1 from "Questionnaire for Industry Experts", columns 6-7 author calculation

Two decades ago the Seasonal Energy Efficiency Ratio (SEER) of air conditioning systems averaged 10 BTUs/watt-hour. The US Department of Energy[3] increased the minimum SEER to 13 in 2006, 14 in 2015, and now is set at 15. Standard heat pump systems with up to 20 SEER are available. Newer split systems average about 30 SEER, and geothermal systems are rated up to 75 SEER. The industry $1 billion R&D investment amounts to only $100 million a year, or

0.2 percent of the $57 billion annual revenue of the HVACR business in the US. Given the incredible increase in efficiency over the last two decades, it is unlikely the incremental new R&D investment will lead to significant efficiency improvements to attract foreign buyers to US equipment.

Table 2 shows the trade imbalance grew most likely because of offshore cost advantages, and NAFTA. We see Mexico and Canada, accounting for 48 percent of imports, China 27 percent, and South Korea 10 percent. This tracks changes in other US manufacturing industries as a result of out-sourcing production for lower cost. The HVACR industry could decrease US imports dramatically by simply bringing production back to the US!

Table 2: 2016 HVACR Imports by Country

Country	Imports $ millions	Percent
Mexico	8,002	44 %
China	4,837	27 %
South Korea	1,857	10 %
Canada	686	4%
Japan	671	4 %
Total	18,134	

Source: "Economic Impacts of U.S. Ratification of the Kigali Amendment", Table 3.2, page 23

The new refrigerant has been under development for over a decade, and the EPA delisted HFC refrigerants for new mobile air conditioning uses in 2011. Auto makers have already designed over a dozen car models using HFO. With the rest of the world planning to switch to HFO regardless of what the U.S. does, the industry will have to react and build compatible equipment for the export market with or without Kigali, and is likely already far along in the design process. It is likely imports will continue to grow, and exports will not grow significantly with or without Kigali.

Manufacturing jobs will most likely be switched away from HFC based products to HFO based products. HFC compatible equipment will phase out, and HFO compatible equipment will ramp up. American manufacturers have no restrictions from exporting HFOs, and HFO compatible equipment to other countries with or without Kigali. As a matter of fact, American manufacturers built their first HFO factory in 2010 in China, while they only began producing HFOs in this country in 2017. Kigali only serves to force this costlier choice on the US public whether they like it or not.

Cost Impacts to US Consumers

The industry financed economic impact report ignored the costs of ratifying Kigali. HFC refrigerants currently cost $4 to $6/pound on Amazon compared to $40 to $60/pound for HFO according to the proprietary information in the EPA's 2016 Regulatory Impact Analysis[4] in its Significant New Alternatives Policy for stationary air conditioner, and refrigeration sources.

While HFO costs will likely come down with time, HFC costs will go up considerably for the repair of existing equipment.

HFO is flammable where HFC is not, therefore, HFO refrigerant can't simply be used as a replacement in older equipment which may last 10 to 20 years. The older generation of refrigerant, CFC with high ozone depletion potential, now sells for $35 to $175/pound on Amazon when you can find it. Grand View Research[5] estimated US fluorocarbon refrigerant use at 116,000 tons in 2016. A realistic $35/pound refrigerant cost differential between HFC and HFO yields $8 billion a year in added cost to US households, motorists, and businesses that rely on air conditioning and refrigeration. For example, higher refrigerant cost will add about $100 per new car and for new air conditioning equipment, or repair.

According to the US Bureau of Labor Statistics[6] there were 332.900 air conditioning and refrigeration mechanics and installers in 2016, and they are required to recycle refrigerant. Car dealers I have talked to are reporting recycling equipment cost is ranging from $5,000 to $9,000 each. So, otherwise un-needed recycling equipment cost may place a one-time $2.3 billion burden on the economy.

In addition, Treaty ratification comes with US commitments to send about $40 million a year to the United Nations as part of the UN Multilateral Fund[7] out to 2050, for a total transfer of $1.3 billion. The Multilateral Fund provides money to developing countries to offset the cost of switching refrigerants. The expanded availability of food refrigeration offers incredible potential to reduce food waste, and food borne illness, and to improve the lives of the poorest people in developing countries. Because of the added expense of the new products, the access to refrigeration will slow, meaning more unnecessary deaths from food borne illnesses.

We note on page 76 of the 2016 SNAP Final Regulation[1], Underwriters Laboratory commented, "Clause 7.5.1.2 of ANSI/ASHRAE 15-2013 does not permit refrigerated products using refrigerants other than those having a flammability classification A1 or B1 (i.e., non-flammable refrigerants) to be installed in public corridors and lobbies." Ice machines and water coolers are often installed in lobbies and corridors, but will not be allowed with HFO refrigerant.

The Impact on US sovereignty

Notice there is no explanation of how ratification works to provide regulatory certainty for the refrigeration equipment industry. Section 115[8] of the Clean Air Act requires the EPA to write regulations to support treaties. This has never been tested in court. The EPA actually did regulate in favor of a new refrigerant in 2016, but a legal challenge overturned the regulation with the DC Appeals court stating the EPA could not use ozone regulating authority to regulate for global warming in case 15-1328 (Mexichem Fluor v. Environmental Protection Agency). The DC Appeals Court rejected a plea for an en banc hearing, from the National Resource Defense Council and two refrigerant companies who hold patents on the new refrigerant, for reconsideration stating the intervenors were "rent-seekers trying to use the government to foreclose their competitors' products", and "arguments mask their true interest in this case, which is to have government choose market winners and losers". The NRDC wants to test Section 115 in court to allow international treaties to override US sovereignty to force the EPA

to regulate in favor of the new refrigerants without involving Congress. Carbon dioxide regulation would be next.

Environmental Impact

The EPA claimed the switch to HFO's in the 2016 SNAP regulation would only lower GWP by 14 million metric tons of CO_2 equivalent. The earlier automotive regulation was expected to save 32 million metric tons. Using the Carbon Tax Temperature Savings Calculator paid for by the EPA, the reduction will impact global temperatures by 0.001 °C by 2100[9].

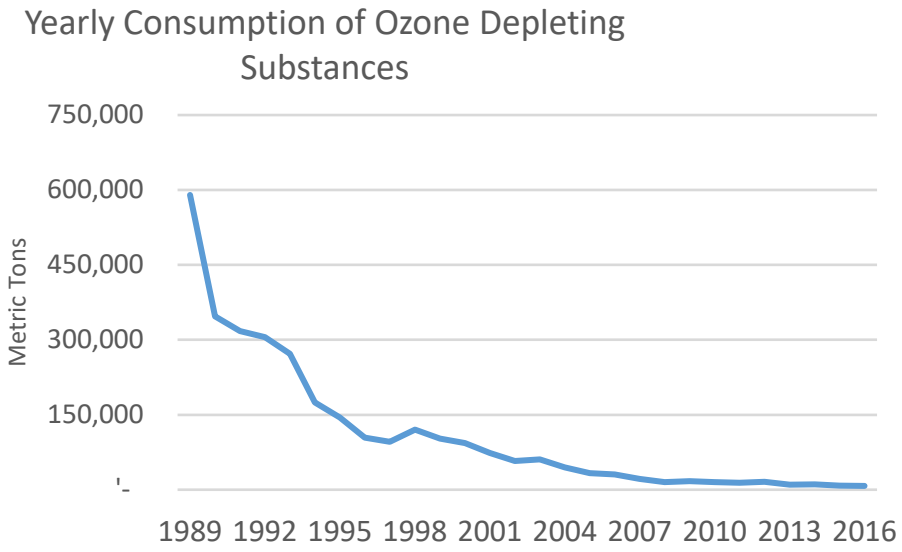
The Myth of the Success of Montreal Protocol

The Montreal Protocol is often called the United Nations most successful program. In reality there is doubt upper atmosphere ozone changed much after 1997. Money contributed over the next two decades had little impact, and we are committed to continue paying into the Multilateral Fund until 2030. Continued payments have had the perverse effect of rewarding countries that are slow to switch refrigerants. The US could have walked away from the treaty twenty years ago with little environmental impact.

A Noble prize winning paper published by Mario Molina and F. Sherwood Rowland in 1974 theorized manmade chlorine and bromine were shrinking the amount of stratospheric ozone that protects people from cancer causing high intensity ultraviolet light (UVB). The 1987 Montreal Protocol to reduce ozone depleting chemicals is a treaty designed to replace stratospheric ozone depleting chemicals, primarily chlorofluorocarbon (CFC) based refrigerants with hydrofluorocarbons (HFC).

The Multilateral Fund was created to transfer money and technology from developed countries to developing countries, so-called "Article 5" countries consuming less than 0.3 kilograms of CFC per person per year. Since then, 144 countries have received $3.7 billion in grants for over 6,300 projects according to the UN Multilateral Fund website. Chart 1 below shows by 1997, consumption of ozone depleting chemicals fell 85 percent globally, decreasing by 95 percent by 2006 and 99 percent by 2016 (Chart 1). The final phase out for developing countries is targeted for 2030. The United States contributed $867 million, or 23 percent of the fund.

Chart 1



Source United Nations Environment Program with weighting by ozone depletion potential

The budget from 1991 to 2017 is shown below in Table 3 below. The Multilateral Fund Secretariat[10] reported spending through 2010 was $2 billion for ozone depleting refrigerant consumption reduction and technical assistance, $0.3 billion for direct production sector investment, and $0.3 billion for administrative expense.

Table 3: Multilateral Fund Spending by UN Agency 1991 to 2017

Agency	**US $**
Multilateral Fund Secretariat	338,408,164
UN Development Program	856,140,534
UN Environment Program	308,058,127
UN Industrial Development Organization	885,511,632
UN World Bank	1,248,028,876
Cash	82,372,420
Total	3,718,519,425

Source: UN Multilateral Secretariat website[11]

Refrigerant **c**onsumption reduction and technical assistance is basically education and planning that includes the set-up of UN offices around the world. The UN loosely defines "administration expense". The portion of spending with the maximum impact is the assistance to manufacturers to change over to low ozone depletion substances which only received 13% of the money spent. No doubt some degree of spending on planning and education is required, but the

relative spending seems off. The UN itself only used $1.2 billion out of $2.6 billion spent to calculate the per ton cost of the program in the 2010 report. The UN Development Program provides more detail on their spending on six broad areas shown in Table 4.

Table 4: Spending by Category by UN Development Program 2018 Plan

Category	**US $ millions**
Administration	43.4
Inclusive & Sustainable Growth	14.1
Climate Change & Disaster Resilience	2.0
Democratic Governance	1.5
Responsive Institutions	1.5
Development Impact & Effectiveness	1.5
Gender Equality	1.5
Total	65.4

Source: UN Development Program Transparency website[12]

The list of projects does not inspire confidence the money is being spent on actual reduction of ozone depleting substances. Other agencies provide very little transparency, and none provide details of the individual consumption reduction projects. Spending beyond 2006 has certainly had diminishing returns. Total spending on ozone depleting substances from 1991 to 2006 equaled $4,649/ton of reduction, the 2007 to 2016 equaled $47,598/ton, and if forecasted spending from 2017 to 2020 eliminates all remaining consumption will rise to $90,501/ton. If it takes until 2030 for full elimination it will likely cost as much for the last 1% reduction as for the first 95%; $2.6 billion.

A recent study[13], found, for unknown reasons, total upper atmosphere ozone hasn't changed since 1997 but the upper stratosphere, and upper troposphere have seen ozone increases while lower stratospheric ozone has declined. By 1997, 85 percent of CFC production had ceased, and further reductions had no impact on total ozone levels. The US could have walked away from the treaty at that point, saved a lot of money, with no negative environmental impact.

Options for Withdrawal from the Kigali Amendment

Option 1 – We can withdrawal from the Montreal Protocol in its entirety with one year notice. This option saves $1.3 billion in future US contributions to the United Nations, avoids distracting the US Senate from other priorities to debate ratification, and closes the door for future adoption of the Kigali Amendment. See Appendix A for a draft of a withdraw letter.

Option 2 – Do nothing. This avoids distracting the US Senate from other priorities to debate ratification, but leaves the door open for future administrations to ratify the Kigali Amendment, and to send funds to the United Nations.

Option 3 – Send the Kigali Amendment to the Senate with a recommended "no" vote. This settles the issue in the firmest way. However, lobbying by industry and environmental groups has caused a number of Republican Senators to commit to voting for ratification. These Senators would need to be convinced to change their intended vote.

References

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Appendix A, Draft Letter to Withdrawal from the Montreal Protocol

Ozone Secretariat United Nations Environment Programme (Date)
P. O. Box 30552
Nairobi, Kenya
Email: Ozoneinfo@unep.org

RE: Montreal Protocol

Mr. Secretary,

We are pleased the original goal of the Montreal Protocol on Substances that Deplete the Ozone Layer has essentially been met with a drop in consumption of ozone depleting chemicals of 99 percent as of 2016, as reported by your organization. The United States has contributed almost one billion dollars, or 23 percent of all funds, to the United Nations Multilateral Fund to aide 144 developing "Article 5" countries to transition to non-ozone depleting chemicals.

We have grave concerns about the re-direction by the Kigali Amendment away from reducing ozone depletion to reducing the use of chemicals, particularly refrigerants, with higher global warming potential. HFC is an efficient, non-ozone depleting, non-flammable, inert, and low cost refrigerant. HFO is potentially less efficient, and flammable with a current cost ten or more times higher than HFC.

About one billion people live below subsistence levels with little food security, and a high incidence of food-borne illnesses. For many countries a key goal should be to establish a "cold chain" from farm to market to avoid food waste, and potential illness. Switching refrigerants will add cost, and could be a distraction to this effort for a global warming reduction that cannot even be measured on a global scale. The expected over one billion dollars of new contributions to the Multilateral Fund by the United States would be more than offset by higher refrigerant prices and the need to replace refrigerant recycling equipment because of flammability concerns.

Therefore, please be advised, in compliance with Article 19, the United States will withdrawal from the Montreal Protocol effective one year from today.