Proposal for Independent Graduate Project in Environmental Science and Policy

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Minding the Gap At The Local Level: Differences Between Greenhouse Gas Reductions Needed and Targets Selected, and Between Production- and Consumption-Based Inventories

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January, 2011

Statement of Purpose

The 111th Congress has failed to adopt legislation to restrict anthropogenic greenhouse gas emissions. The 112th Congress is expected to contain larger numbers of Republican members in both the House and the Senate, and Republicans are projected to be in the majority in at least the House. Most new members of the Republican congressional delegation reportedly deny the existence of dangerous anthropogenic climate change (Johnson, 2009), and consequently there is virtually no chance of enactment of effective national climate change legislation until at least 2013.

With this failure of leadership, strong state and local initiatives to respond to climate change are needed now more than ever. Dangerous amounts of greenhouse gases have already been pumped into the atmosphere, and emissions have outpaced even the most pessimistic projections of the Intergovernmental Panel on Climate Change (IPCC). The sooner that greenhouse gas emissions are reduced, the better humanity's chances of averting potentially tragic—and potentially irreversible—changes in the world's climate. Although state and local climate change initiatives cannot hope to achieve the impact of federal legislation, they can achieve significant emissions reductions.

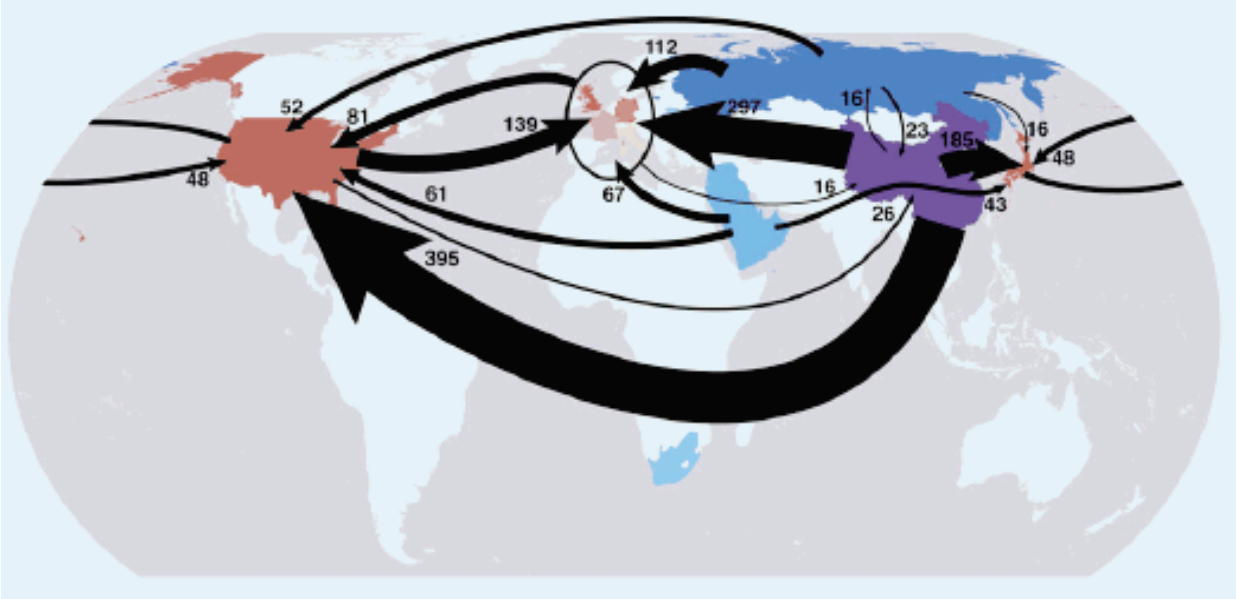
Like many other cities in the U.S. and around the world, the city of Alexandria, Virginia has developed a draft climate change action plan. Alexandria's city council has already adopted the "Alexandria Environmental Action Plan – 2030" (EAP), approved unanimously by council members on June 29th, 2009 (Alexandria, 2009a). The EAP includes goals for the citywide reduction of greenhouse gas emissions to 2005 levels by 2012, to 20% below 2005 levels by 2020, and to 80% below 2005 levels by 2050. These targets are the same as those adopted by the Metropolitan Washington Council of Governments (MWCOG) in its National Capital Region Climate Change Report, adopted in November of 2008.

In April of 2009, Alexandria released an inventory of calendar year 2005 emissions of greenhouse gases and criteria air pollutants (Alexandria, 2009b). In conducting the inventory, the city used the Local Government Operations Protocol (LGOP) for calculating government operations emissions. The LGOP was developed by the International Council on Local Environmental Initiatives (ICLEI) in partnership with the California Air Resources Board and the California Climate Action Registry. For communitywide emissions, Alexandria used the Clean Air & Climate Protection Software (CACP) package, also developed by ICLEI. As with the U.S. national emissions inventory prepared annually by the Environmental Protection Agency (EPA), the ICLEI methodologies used by Alexandria account for emissions resulting from energy and fuel use inside the jurisdiction's borders, but do not account for emissions resulting from consumption of goods produced outside the jurisdiction's borders.

Production-based greenhouse gas emissions inventories have significant shortcomings. Most fundamentally, production-based inventorying results in leakage; emissions associated with the production of goods imported (by the nation or sub-national jurisdiction) are ignored. As stated by Larsen and Hertwich, "As more industry activities are outsourced to developing countries, local reduction of GHG [greenhouse gas] emissions are *not* necessarily a sign of global GHG mitigation." (Larsen and Hertwich, 2009, p. 797) No governmental jurisdiction is isolated; we all rely on resources and products grown, raised, built, or transported from somewhere else in the global marketplace. From an economic perspective, using production-based emissions inventories will penalize areas engaged in fossil fuel intensive industries, whether or not it is efficient—in terms of global and regional economic productivity and carbon emissions mitigation—for them to do so. From an ethical perspective, consumption-based accounting is

the truest measure of our impact on the environment; consumption drives production, and the average American consumer enjoys a standard of living scarcely imaginable to the billions of people living in the developing world.

Figure 1. Largest interregional fluxes of emissions embodied in trade (Mt CO_2 y^{-1}) from dominant net exporting countries (blue) to the dominant net importing countries (red). Fluxes to and from Western Europe are aggregated to include the United Kingdom, France, Germany, Switzerland, Italy, Spain, Luxembourg, The Netherlands, and Sweden. (Davis and Caldeira, 2010, p. 5688).



According to the U.S. Energy Information Administration, 5,753.7 million metric tons of carbon dioxide were emitted by the U.S. in 2004 (EIA, 2005), based on a production-based inventory. With a population that year of 293,045,739 (U.S. Census Bureau, 2011), this works out to per capita CO_2 emissions of 19.6 tons. Using a consumption-based approach, Davis and Caldeira (2010) estimate U.S. per capita CO_2 emissions in 2004 of 22.0 tons, an increase of 12 percent over the reported figure.

Despite the leakage problem, production-based inventorying has its advantages. Consumption-based inventories are usually conducted in one of two ways (Larsen and Hertwich, 2009). In one, national input-output economic data is analyzed to estimate the emissions associated with various industrial sectors, based on the average emissions intensities of those sectors, with adjustments made for the proportion of domestic and foreign end use consumption. In the other, life-cycle assessments are constructed by aggregating the emissions associated with various individual products and services into an estimate of total household consumption. In contrast, production-based inventorying can accurately measure fossil fuel use—the predominant source of carbon dioxide, the predominant greenhouse gas—by directly measuring the production and sale of fuels at the beginning of the pipeline.

Regardless of the methodology used, greenhouse gas mitigation efforts can only be evaluated and compared if emissions inventories can be compared from one locale, region, or nation to another, or from one period to another in the same jurisdiction. Production-based emissions inventorying is currently the norm at all levels of government in the U.S., and the relatively low cost of production-based inventories makes them more attractive—and easier to carry out

regularly—for cash-strapped cities and states. However, since production-based emissions inventories somewhat underestimate the climate impact of residents of the developed world, U.S. jurisdictions using such inventories in working to mitigate climate change are likely misunderstanding and misrepresenting the intended impact of the emissions reduction targets they select.

The adoption of greenhouse gas mitigation targets by U.S. governmental jurisdictions is, by necessity, a political process. Unfortunately, this process is unlikely to either keep pace with scientific progress in understanding the dangers of anthropogenic climate change and the scale of the responses needed, or to be based on a clear understanding by policymakers (let alone the voting public) of the numbers involved. These difficulties compound the more fundamental obstacle of lukewarm public support for aggressive action to reduce greenhouse gas emissions.

It is my thesis that emissions reductions targets being considered are likely to be inadequate to avoid dangerous anthropogenic climate change. This study will place the greenhouse gas reduction targets adopted by the City of Alexandria in context with both the emissions reductions recommended by current science and with targets being considered by other U.S. political jurisdictions, and will estimate the difference between emissions as measured by the production-based emissions inventory methodology used by Alexandria and a consumption-based emissions inventory estimate of the author's own actual emissions. By examining both the gap between recommended emissions reductions and the targets chosen, and the likely gap between inventoried emissions and actual emissions, this study will assess the accuracy and efficacy of the climate change mitigation goals espoused by Alexandria. In addition, comparing consumption-based inventories with production-based inventories will illuminate the limits of and boundaries between individual voluntary action to address climate change and policy responses by government.

Objectives

There are several objectives to the study:

1. To summarize current recommendations for emissions reduction targets indicated by climate science;
2. To identify examples of greenhouse gas emission reduction targets proposed by governments in the U.S.;
3. To examine the different methodologies being used to quantify emissions, and the assumptions and approaches on which they are based;
4. To estimate the author's own emissions using a consumption-based approach, and understand the information needs and barriers in the way of doing so;
5. To understand the lifestyle changes necessary to reduce emissions to recommended levels;
6. To compare my individual consumption-based emissions estimate with the production-based inventory conducted by the city of Alexandria, and with other emissions inventories for the state and the U.S. as a whole.
7. To discuss the implications of the inventory comparisons and current scientific mitigation recommendations for the emissions reduction targets being considered by the City of Alexandria and other U.S. jurisdictions.

Rationale

Global climate change is widely considered the most pressing environmental danger facing the world. Despite years of accumulating evidence and scientific findings regarding the effects of

continuing to pump greenhouse gases into the atmosphere, emissions of greenhouse gases are outpacing even the highest trajectories for emissions projected by the Intergovernmental Panel on Climate Change (IPCC) (US GCRP, 2009).

The U.S. Senate failed to adopt climate change legislation during the 111th Congress. Given the staunch opposition of the Republican Party to responding to (or even acknowledging) anthropogenic climate change, and the anticipated increase in numbers of Republican members of both the House and Senate, it is highly unlikely that federal climate change legislation will be enacted prior to 2013. The Environmental Protection Agency (EPA) has the regulatory authority to restrict greenhouse gas emissions, as established by the April, 2007 Supreme Court decision *Massachusetts v. EPA*, and the agency has issued regulations targeting large point sources. However, on June 10, 2010 the Senate narrowly defeated an amendment offered by Alaska Senator Lisa Murkowski (R-AK) to block the EPA's authority to regulate greenhouse gases. Murkowski's amendment gained 47 votes, including all Republican Senators and six Democrats; with anticipated Republican gains in the Senate in the 2010 mid-term elections, a similar effort is likely in 2011. Consequently, it is highly unlikely that EPA will establish an economy-wide price signal on carbon dioxide and other greenhouse gases, given the risk of further inflaming opponents in Congress.

The lack of federal legislative action places more importance on mitigation at the state and local level. Like many cities, Alexandria, Virginia is developing a draft climate change plan, including specific targets for greenhouse gas emissions reductions. Notwithstanding the limited amount of emissions reductions possible through changes in city government actions and policies—especially in a Dillon Rule state such as Virginia—there are two fundamental measures on which Alexandria's climate change plan should be evaluated. ("Dillon Rule" states are those in which local jurisdictions have only those authorities explicitly granted by the state legislature, instead of having any authority not explicitly curtailed by the state legislature.) These are, firstly, the appropriateness of the emissions reduction targets selected, and secondly, the accuracy of the emissions inventory methodology used with respect to actual emissions.

Although the 2007 reports issued by the IPCC constitute the largest, most comprehensive recent scientific consensus statement informing decisions on greenhouse gas emissions targets, the reports were based on research conducted only through 2005. Since that time, and since the publication of the IPCC reports, research into climate related science, trends, and impacts has accelerated. Unfortunately, the broad conclusion of this research is that our situation has become increasingly dire, and that "[m]any indicators are currently tracking near or above the worst case projections from the IPCC AR4 [Fourth Assessment Report] set of model simulations" (Copenhagen Diagnosis, 2009). Sharp emissions reductions are needed almost immediately to forestall dangerous climatic and oceanic changes for life on Earth. Before policymakers set emissions targets, it is vitally important that they know what the most current science has to say about what those targets should be.

Similarly, it is imperative that policymakers understand the accuracy of the emissions inventory methodology used. A mitigation plan based on even the most appropriately gauged emissions reduction targets will become a plan for failure if it is not based on an accurate measurement of emissions, and a clear understanding of the likely leakage resulting from the inventorying methodology used.

Like the national emissions inventories conducted under the methodology established by the IPCC, the emissions inventory methodology used by the City of Alexandria focuses on direct, end use of fossil fuels and of electricity by city residents and businesses, and does not include

estimates of emissions resulting from consumption of goods produced outside the city, such as food consumption and purchases of vehicles and home appliances. Consequently, the inventory is likely to underestimate actual emissions, and provide a somewhat misleading picture of the city's climate change goals and accomplishments.

By exploring both the appropriateness of emissions reduction targets selected and the comparative size of direct fuel use and consumption-based emissions, this study will help quantify the gap between where Alexandria is aiming and the per capita emissions reductions recommended by the current science. The individual consumption-related emissions estimate will also provide a ground-level perspective on informational needs for calculating personal emissions, optimal personal steps for reducing emissions, and the limits of local and state action.

Methodology

The first part of the study will consist of a review of the latest scientific recommendations on the amount of greenhouse gas emissions reductions needed to avoid dangerous anthropogenic global warming, relying primarily on the findings of major national and international governmental agencies and organizations, including the IPCC, the U.S. National Academy of Sciences (NAS), the National Oceanic and Atmospheric Association (NOAA), and others. The recommendations for greenhouse gas emissions targets will be compared with the emissions targets included in Alexandria's draft climate change plan. In addition, Alexandria's emissions reduction targets will be compared with some being adopted by other cities, states, and regions in the U.S., and the reduction targets included in recent legislation before Congress. Cities used for comparison will be those of similar size, predominantly but not necessarily exclusively in the U.S. Proposals for Virginia State emissions reduction targets will be compared with targets adopted by Virginia's neighbors, including Maryland and other members of the Regional Greenhouse Gas Initiative (RGGI), as well as one or more states participating in the Western Climate Initiative. Reduction targets will be compared on the basis of the breadth and proportion of emissions sources targeted, the inventorying methodology used, and the size of and timelines for emissions reductions.

The second part of the study will consist of:

1. A comparison of the inventory methodology used by Alexandria with other methodologies used by state and local governments, and by the Environmental Protection Agency (EPA) and other federal agencies in calculating national emissions for the U.S.;
2. A review of estimates of consumption-related greenhouse gas emissions and inventorying methodologies;
3. A personal inventory of the author's emissions; and
4. An analysis of the different individual emissions figures resulting from the various methodologies.

The City of Alexandria has opted to use the "Local Government Operations Protocol" methodology developed by ICLEI – Local Governments for Sustainability to track greenhouse gas emissions associated with city government operation, and to use the Clean Air and Climate Protection (CACP) software package (developed by the State and Territorial Air Pollution Program Administrators, the Association of Local Air Pollution Control Officials, ICLEI, and Torrie Smith Associates) to estimate community-wide greenhouse gas emissions (Alexandria OEQ, 2009). Using ICLEI's methodology, greenhouse gas emissions are divided into three scopes, to avoid double counting (Figure 2).

Figure 2. Categorization of greenhouse gas emissions in Alexandria, Virginia inventory (Alexandria OEQ, 2009, p. 10).

Sector	Description
Scope 1 Emissions – All direct emissions sources located within the city's geopolitical boundary	
Residential Buildings	Natural gas and fuel oil used in residential buildings
Commercial/government Buildings	Natural gas and fuel oil used in commercial/government buildings
Industrial Facilities	Natural gas and fuel oil used in industrial facilities
Onroad Vehicles	Gasoline and diesel fuel used by vehicles traveling on roads within the city's boundaries
Offroad Equipment	Gasoline and diesel fuel used by off-road equipment (landscaping, construction, etc.)
Locomotive Engines	Diesel fuel used by Amtrak and other locomotive engines
Wastewater Treatment	Direct emissions from wastewater treatment facilities
Electric Generating Units	Coal consumption to generate electricity
Solid Waste Disposal	Direct emissions from energy-from-waste
VOC Area Sources	VOC emissions from architectural coatings, degreasing, graphic arts, consumer products, and gasoline service stations
Scope 2 Emissions – Indirect emissions limited to electricity consumption within the city, but the associated emissions occur outside of the city's boundary	
Residential Buildings	Electricity consumption in residential buildings
Commercial/government Buildings	Electricity consumption in commercial/government buildings
Industrial Facilities	Electricity consumption in industrial facilities
Locomotive Engines	Electricity consumption associated with Metro trains
Scope 3 Emissions – Indirect emissions that result as a consequence of activity within the city, but the associated emissions occur outside of the city's boundary	
Solid Waste Disposal	Indirect emissions from disposing of city-generated solid waste outside of the city

Using the CACP software, Alexandria's inventory counted a total of 2.64 million metric tons of CO_2 equivalent greenhouse gases (CO_2e) in 2005. This figure does not include the emissions generated by two energy producing facilities inside the city limits: the Mirant Potomac Generating Station (estimated 2005 CO_2e emissions: 1.478 million metric tons) and the Covanta Waste-to-Energy Facility (estimated 2005 CO_2e emissions: 318,092 metric tons). The city's inventory doesn't count these facilities' emissions because most of the energy they produce is sent to the grid and used outside the city; the city *does* count the emissions associated with 100% of the energy used by consumers within the city. Dominion Virginia Power is the sole electricity provider for Alexandria consumers, and the emissions resulting from the power used by residents, commercial and industrial industries, and government were calculated using factors based on the mix of fuel types used in the region, as determined by the North American Electric Reliability Council (NERC) region 09 – Southeastern Electric Reliability Council/Excluding Florida (Alexandria OEQ, 2009).

The city's population in 2005 has been given as, variably, 133,953 or 135,854 individuals (Alexandria Planning Department, 2010). Consequently, per capita CO_2e emissions in 2005 are calculated to be between 19.43 and 19.706 metric tons. This is slightly under the 21.44 metric

tons CO_2e per capita reported by the U.S. Environmental Protection Agency (EPA) in its 2010 inventory report (U.S. EPA, 2010).

The methodology used by Alexandria undercounts actual emissions resulting from residents resource use, due to the exclusion of Scope 3 emissions. One example of this is airplane travel. To quote from the inventory report:

> "There are no airports located in the City of Alexandria. Ronald Reagan Washington National Airport is located in Arlington County, just to the north of the Arlington/Alexandria border. This inventory does not account for GHG and CAP emissions from aircraft traveling from National Airport over the airspace of the city." (Alexandria OEQ, 2009, p.19)

A single roundtrip airplane flight from London to Hong Kong is estimated to produce 3.4 metric tons of CO_2e emissions per passenger (Berners-Lee, 2010).

The ICLEI inventory methodology counts emissions resulting from driving a large, gas-guzzling SUV, but doesn't capture the emissions associated with buying it in the first place. The City of Alexandria does not have the resources to conduct an emissions inventory using the ICLEI methodology more than once every few years; in this context, it is understandable that the City would be unable to accurately measure all emissions resulting from residents' actions, beyond the direct use of fossil fuels and of electricity. Consequently, it is important to understand the extent to which actual emissions exceed the level reported in the emissions methodology, in order to gauge how likely any climate change plan adopted will achieve its goals. Without such an understanding, climate change response policies will be based on an inaccurate view of the size of emissions reductions needed, and their likely effectiveness in avoiding dangerous anthropogenic climate changes.

The personal emissions inventory will depend on several sources of information, including both peer-reviewed sources and the grey literature, and will necessarily involve rough estimates of emissions for at least some forms of consumption. There are a few goals for this portion of the study:

1. To compare the author's emissions with per capita emissions estimated using the ICLEI methodology, in the categories measured by the ICLEI methodology;
2. To estimate the volume of emissions being produced through Alexandrians' daily life which are not being captured under the ICLEI emissions inventory methodology;
3. To discover information gaps in compiling an emissions inventory;
4. To identify the extent to which individual, voluntary efforts can reduce emissions; and
5. To examine the opportunities for and limits on local government policy efforts to reduce emissions.

The personal emissions inventory will be based on two months of data regarding personal driving habits, food consumption, consumer purchases, airline travel and public transportation use, and home energy use. Energy use figures will be based on a combination of estimated per capita heating and cooling (in this case, heating) energy use figures for the author's apartment building, combined with actual energy use resulting from personal electronic devices. The heating energy use figures will be compared with the number of heating degree days for Alexandria for the emissions tracking period, in order to project annual heating and cooling energy use emissions. Energy use figures will serve as the basis for emissions projections, using the energy production technology emissions rates for the area.

The food and personal goods portion of the emissions inventory will necessarily depend, to a large extent, on estimates derived from life-cycle assessments as reported in both peer-reviewed journals as well as the grey literature. I will attempt to track the source of products

consumed, in order to allow subsequent categorization of the embedded emissions as either coming from within the City of Alexandria, outside Alexandria but within the U.S., and from foreign countries. This categorization will make it possible to consider the implications of extrapolating my personal inventory on a broader scale.

Consumption-based emissions inventories typically exclude emissions associated with the production of goods and services exported outside the jurisdiction of focus. My employment is in the services sector, working for a national nonprofit organization located in Alexandria. The organization's emissions stemming from electricity use are captured in the greenhouse gas emissions inventory conducted by the city, but will not be included in my personal emissions inventory. I will attempt, though, to establish a rough estimate of greenhouse gas emissions for the organization's operations. The estimate of my employer's emissions will include those stemming from electricity use, office operations, meetings, and airplane travel (emissions resulting from travel to and from work will be included in my own emissions inventory). I will attempt to estimate the portion of my employer's emissions not accounted for in Alexandria's emissions inventory, in order to help determine my personal net consumption-based emissions (consumption = production – exports + imports). For purposes of comparison to a production-based inventory of Alexandria emissions, a portion of the emissions associated with my job in a membership organization would be considered my personal emissions "exports" to organization members living outside of Alexandria.

Greenhouse gas emissions associated with the Alexandria city government operations are included in the city's inventory. However, additional sources of consumption-based emissions not accounted for in the city's inventory are those resulting from the operations of state and federal government. This, too, is a form of resource consumption, albeit of a public good. Thankfully, I will be able to use published for both state and federal government operations. On the state level, I will use the inventory and projection of greenhouse gas emissions prepared by the State of Virginia's Department of Environmental Quality, and released in December of 2008. Federal government emissions will be significantly larger, due primarily to the emissions associated with the U.S. military. As noted in the 2008 Defense Science Board Task Force report entitled "More Fight – Less Fuel," the Department of Defense is the single largest consumer of energy in the U.S., and is responsible for 78% of energy consumption by the U.S. government (Defense Science Board Task Force, 2008).

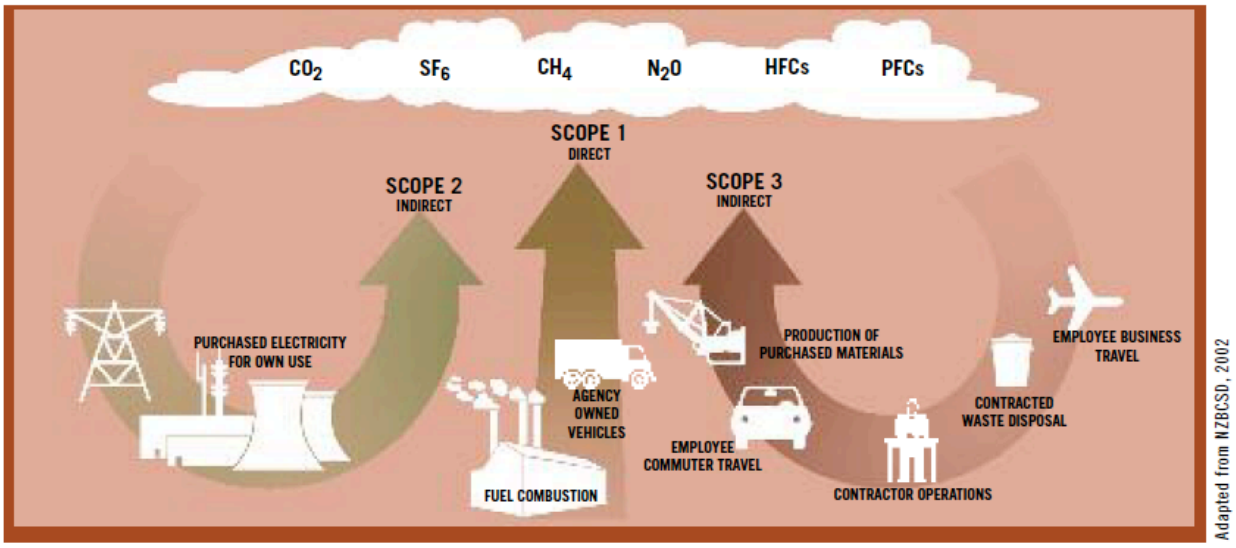
Under Executive Order 13514, signed by President Obama on October 5, 2009, all federal agencies are required to "establish and report to the CEQ [Council on Environmental Quality] Chair and OMB [Office of Management and Budget] Director a comprehensive inventory of absolute greenhouse gas emissions, including scope 1, scope 2, and specified scope 3 emissions (i) within 15 months of the date of this order for fiscal year 2010, and (ii) thereafter, annually at the end of January, for the preceding fiscal year." (Federal Register, 2009, p52118)

Interestingly, the federal government is moving toward accounting for scope 3 emissions—those resulting from consumption of products and services—in its emissions inventories. As noted by the Council on Environmental Quality in its guidance to federal agencies on complying with E.O. 13514:

> Because efforts to account for scope 3 emissions are recent and accepted methods for calculating emissions are evolving, this Guidance utilizes a phased approach for the inclusion of scope 3 emissions in agency inventories. Initial efforts focus on accounting for scope 3 emission categories for which reliable and accessible data are available for estimating emissions, and for which more detailed calculation methodologies have been established. As a result, substantial fractions of the

scope 3 emissions of many agencies will not initially be captured. The goal of this approach is to continually improve scope 3 data quality. (CEQ, 2010, p.13)

Figure 3. Overview of Scopes and Emissions across Activities (Source: World Resources Institute and Logistics Management Institute (LMI), 2010, p. 26)



Finally, the study will discuss implications of the various inventorying methodology results and of reductions targets for the effectiveness of mitigation efforts. Given the continued progress of scientific understanding of the likely effects of climate change and the size of emissions reductions needed for effective mitigation, and the potentially significant disparity between emissions resulting from Americans' daily activity and those emissions measured in inventories, the study will inform analysis of the appropriateness of emissions reduction targets selected by Alexandria and other jurisdictions.

Anticipated outcomes/results

The review of recent scientific literature on the greenhouse gas emissions targets likely to be needed to avoid dangerous climate change, including tipping points for triggering irreversible changes or feedback loops, will provide the yardstick by which to measure the targets being considered within the political process. The survey of emissions reductions targets adopted by cities and states across the U.S., although not exhaustive, should provide context for the emissions targets under consideration by the City of Alexandria.

The project should show A) the likely gap between the emissions reductions indicated by current climate science and the reductions being targeted currently in the U.S., and B) the size of the gap likely to occur between measured and actual emissions due to consumption-related (i.e., non-direct fuel or electricity use) emissions. I anticipate that the combined gaps in A) and B) will be significant, comprising roughly 10 percent. Davis and Caldeira (2010) used a multi-region input-output model to estimate consumption-related national CO_2 emissions in 2004. Under their methodology, all emissions associated with consumer goods were allocated to the end user. They estimate that U.S. per-capita consumption-based emissions of carbon dioxide were 22.0 tons, and that 10.8 percent of consumption-based emissions were due to consumption of imported goods. Peters and Hertwich (2008b) estimated production-based U.S. CO_2 emissions in 2001 of 6006.9 Mt, and consumption-based CO_2 emissions of 6445.8 Mt, a

difference of 7.3 percent. Although these two studies looked only at CO_2 emissions and omitted methane (CH_4) and nitrous oxide (N_2O), I would expect similar differences in CO_2-*equivalent* production- and consumption-based emissions at the local level.

The project should help illuminate the extent to which personal, voluntary actions can reduce emissions, and the policy measures which could facilitate, or are hindering, such reductions. The project will also provide firsthand experience with the changes in lifestyle associated with reductions in emissions of the general size needed to avoid dangerous anthropogenic climate change. I expect this portion of the study to be difficult, frustrating, and eye-opening.

Analysis of the target gaps, inventory methodologies, and personal inventorying and voluntary reduction efforts will help delineate the limits of local government action, the boundaries between reduction efforts at various levels of government, and the level of community involvement necessary to achieve recommended reductions.

Time-line

January 2011	---Outline paper to delineate scope of work and clarify major areas of focus ---Survey of scientific recommendations for greenhouse gas emissions reductions needed to avoid dangerous levels of climate change ---Begin inventorying personal greenhouse gas emissions, through tracking transportation, electricity use, and consumption of food and consumer goods
February 2011	---Complete emissions target recommendations review ---Survey emissions targets specified in climate change plans in U.S. cities, states, regions, recent congressional legislation ---Conclude personal greenhouse gas emissions data collection
March 2011	---Examine emissions inventory methodology used by City of Alexandria, U.S. EPA, and other cities with climate change plans ---Review alternative inventorying methodologies and clarify boundaries used, to allow comparison with personal emissions data
April 2011	---Draft study completed and reviewed (Primary and Field Advisors) ---Comments received (Primary and Field Advisors) and incorporated ---Final review of study (Primary and Field Advisors), comments received and comments incorporated ---Final Draft Study completed
May 2011	---Final Study completed and approved (Primary and Field Advisors)

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