INTEL CLIMATE CHANGE POLICY STATEMENT

Updated December 2017

Executive Summary

There is a strong scientific consensus that climate change is happening and that human activities have played a contributing role. The main questions today concern what steps can be taken to mitigate the warming trend and help communities and regions adapt to the present-day and anticipated impacts of the warming that already is occurring. Intel Corporation believes that global climate change is a serious environmental, economic and social challenge that warrants an equally serious response by governments and the private sector. By its nature, climate change is a global problem that defies simple "silver bullet" solutions or contributions by a narrow group of countries or a few industry sectors. Addressing climate change requires leadership, both by individual governments and companies.

Intel exercises leadership both in reducing our own footprint and in working with others to influence the development of sound public policies. With respect to reducing our own footprint, we take seriously the work of the UN-affiliated Intergovernmental Panel on Climate Change (IPCC). The IPCC, in its 2007 Fourth Assessment Report, estimated that in order to stabilize CO2 emissions in the atmosphere at 450 parts per million (ppm) in 2050 (a goal that many climate change experts have advocated), greenhouse gas (GHG) emissions need to be reduced by 85% compared to levels observed in 2000.[i] Intel considers this a good metric and is committed to track and report our own GHG emissions reduction progress against that benchmark. (See the Addendum of this document for information on our progress to date).

The Paris Agreement

At the Paris Climate Conference (COP21) in November 2015, the first-ever universal, legally-binding global climate deal was reached. This collaborative agreement between world governments, known as "The Paris Agreement" entered into force on November 4, 2016, and set out a global action plan to put the world on track to avoid dangerous climate change by limiting global warming to well below 2°C[ii]. So far, more than 150 countries have ratified the Paris Agreement. To achieve this goal, countries should "reach global peaking of greenhouse gas emissions as soon as possible…Each party shall prepare, communicate and maintain successive nationally determined contributions that it intends to achieve.[iii]"

The Paris Agreement represents a signal step forward in the development of global climate policy. It allows countries to determine their own emissions reduction commitments. This feature made it favorable for most of the world's countries to come forward and sign up for commitments. In addition, however, the Paris Agreement set up a transparency regime whereby company commitments are open for review and critique by other companies. This combination of features provides the basis for a prospective process whereby countries increase the level of their reduction commitments over time, leading to greater progress on climate change mitigation than has been possible before. Notwithstanding these features of the agreement, in May 2017 the U.S. announced its intention to withdraw the U.S. from the Paris Agreement. At the same time, signals were sent indicating the U.S. might be willing to reengage with the Paris process under undefined terms.

Intel Climate Policy Engagement

Intel actively shapes international, national, and sub-national climate change policies, working closely with governments and other stakeholders. At the international level, Intel chairs the Business Institute for Sustainability (BIS). BIS is a global coalition of companies and trade associations from diverse industries committed to constructive and responsible participation in the international policy process concerning global climate change. Intel is also a long-standing member of the Business Environmental Leadership Council (BELC) of the Center for Climate and Energy Solutions (C2ES), (formerly the Pew Center on Climate Change), a non-profit organization that seeks to influence the development of climate policy.

At the national level, Intel is a leader in advancing progressive climate policies. During the debates over cap-and-trade legislation in the U.S. Congress, Intel was the lead high tech company engaging in the process. Long-term, Intel plays a leadership role in the environment, energy and climate committees of its lead trade associations, such as the Semiconductor Industry Association (SIA) and the Information Technology Industry Council (ITI) in the U.S. and the European SIA and Digital Europe in Brussels. C2ES also works on U.S. domestic climate policy issues.

Summary of Policy Principles

This document articulates the principles that Intel follows in engaging on climate change policy at all levels of government and in all geographies. In the *Addendum*, we summarize key supplementary information, including our view regarding the state of climate science, Intel's climate change footprint, our actions to reduce that footprint, and our external engagements regarding climate change policy.

Intel shapes public policy responses to climate change, both at the international level and in the countries and regions where we operate. Our engagement includes both unilateral activities as well as participation in several climate-focused organizations. In general, we believe that climate change is a classic economic externality. The solution lies in finding ways to "price carbon" and the damaging climatic impacts of greenhouse gases (GHGs). We further believe that climate policy should focus on waste emissions of GHGs and that regulations should be designed to promote cost-effectiveness and technological innovation. More specifically, our policy influencing actions are guided by a set of policy principles, including:

General Policy Principles

- **Science-based approach.** Climate policy should be based upon the latest and best available scientific information. The UN's Intergovernmental Panel on Climate Change (IPCC) is the primary global source on consensus science on climate change, its causes and effects.
- **U.S. engagement in the international policy process**: Notwithstanding the decision to withdraw from the Paris Agreement, Intel believes the U.S. government should be actively engaged in the development of international climate change policies, through the UN negotiating process and other multi- and bi-lateral venues, to ensure any resulting international agreements are realistic and pragmatic. We strongly support continued U.S. participation in the international process, including reentry into the Paris Agreement process.
- **Shared solutions**: A central tenet of international climate policy negotiations should be ensuring that all countries – developing and developed – make a contribution by implementing programs to mitigate the future extent of climate change. For equity, economic and political reasons, the contributions of different countries do not need to be the same in design or equal in scope. However, all must contribute appropriately if we are going to be able to mitigate climate change to acceptable levels at an acceptable cost. These precepts are firmly enshrined in the Paris Agreement.
- **Mitigation and adaptation**: Scientists believe that some degree of climate change is inevitable given past greenhouse gas emissions into the atmosphere. For this reason, governments, industry and civil society need to focus on both *mitigation* (reducing new loadings) and *adaptation* (dealing with already-initiated climate effects). Whether such policies and actions are spoken of in terms of climate preparedness, resilience or in other ways, it is critical that society deal with what *will* happen as well as try to prevent what *might* happen. Adaptation policies should maximize the use of natural systems such as wetlands, both existing and newly-created or –restored, as "soft infrastructure" that can increase community resilience. Governments also should promote the use of information and communications technology (ICT) in helping countries and communities prepare for and adapt to climate change.
- **Focus on emissions, not use of essential gases**: The semiconductor manufacturing process requires the use of fluorinated gases (F-gases). Despite years of research into alternatives, no viable substitutes exist or are on the R&D horizon. These same gases, however, are frequent targets of climate-focused restrictions due to their high global-warming potential (GWP). Recognizing this potential conflict of technical needs and climate science, the semiconductor industry – led by Intel – has dramatically reduced its F-gas emissions over time even as the industry has grown (see the Addendum for details). Nonetheless, tension remains between these two trends. Governments can resolve this conflict by focusing their restrictions and limits on emissions of GHGs not the use thereof. This will allow governments to both meet their policy objectives and protect industries like semiconductors where the bulk of their emissions come not from waste gases like CO2 but rather the use of gases in their production processes.
- **Market-based solutions**: Governments should employ market-based policy approaches wherever possible. Reliance on market approaches is the only way governments can achieve the deep level of emissions reductions required to meet current UN goals

(85% reduction by 2050) at an acceptable cost. Different specific measures will be appropriate in different countries and various governments have implemented a variety of market-based approaches already. Cap-and-trade systems, other forms of emissions trading, and direct or indirect carbon taxes are all means of pricing carbon and providing emissions reducing incentives at lower cost than many traditional command-and-control approaches.

- **Renewable energy and energy efficiency programs:** 100% of Intel's U.S. and E.U. electricity supply and approximately 80% of its global electricity use is either directly purchased as renewable energy or through Renewable Energy Credits (RECs) or generated from on-site alternative energy installations. We support the expansion of renewable energy supplies through a variety of Federal policies. We can support, for example, a national Renewable Portfolio Standard (RPS) as long as it incorporates some flexibility to recognize that the availability of renewables varies significantly from region to region and as long as it includes an ability to meet some portion of renewables quota via energy efficiency. These features are critical to containing cost increases and ensuring reliability. We believe energy efficiency generally is the easiest and cheapest way to reduce GHG emissions. As such we generally support Federal incentive, deployment and research programs that have the objective of expanding the energy efficiency market.
- As a general matter, Intel supports the growth of the renewable energy market as well as an expansion of energy efficiency programs at the state level. We prefer market-driven approaches over mandates, but recognize that many states are pursuing renewable portfolio standards and energy efficiency mandates imposed upon electric utilities in their jurisdiction. Where mandates are considered, they should take electricity cost impacts into consideration, any potential risk to reliability or quality of service, and balance those with the goal of growing the market for renewables and energy efficiency.
- **Innovation-friendly product energy efficiency requirements**: Increasingly, governments are imposing energy efficiency requirements on products as a way of reducing GHG emissions from the power sector. ICT products are a frequent target of such policies due to their proliferation in the marketplace. Examples of such programs include Energy Star in the U.S. and the Energy-Related Products (ErP) Directive in Europe. Some of these efforts, like Energy Star and the Electronic Product Environmental Assessment Tool (EPEAT), started in one country (the U.S.) and have spread to other markets. Government programs to require or encourage more energy-efficient ICT products should take pains to avoid stifling innovation and expanded product functionality. This can be done in many ways. For example, like products should be compared to like products in setting power consumption limits. This ensures that power limits on a fully-featured personal computer, for example, are not set based on the power consumption of more functionally-limited products like tablets. In addition, efforts to reduce standby power should not discourage the development of so-called "smart grid-ready" or network-connected devices.
- **ICT-enabled energy efficiency**: As an example of cost-efficient policies, governments should emphasize promoting end-use energy efficiency, since analyses have shown this is where the greatest and least-expensive climate progress can be made. Specifically, government energy efficiency programs and policies should promote the enabling role of ICT applications to drive gains throughout the economy. This role of ICT is known as "Intelligent Efficiency."

Geo-specific Policy Principles

- **U.S. domestic action**: The U.S. government should continue to advance its own domestic climate policy initiatives, whether by legislation or by administrative action. While recent steps have been initiated at the Federal level to reverse or alter a number of previous U.S. climate initiatives, alternative approaches need to be developed if the U.S. is to reduce its climate change footprint. Those approaches should adhere to the above general principles.
- **U.S. state-level action**: Policy abhors a vacuum. The slowdown/reversal in climate policy action at the Federal level almost certainly will lead to increased activity at the state level. While we strongly prefer Federal to state action, we engage at the state, city and utility supplier level in those states where we have significant operations or other interests. In general, beyond adhering to the above general principles, we typically prefer state actions that are coordinated in a regional or multi-state basis, increasing the size of policy markets, reducing the patchwork effect of localized actions and decreasing cost impacts.
- **EMEA action**: The EU Climate and Energy Framework incorporates Member-state national greenhouse gas reduction (GHG) targets and an ambitious emissions trading system (ETS) to meet its obligations under the Paris Agreement. The EU exit of the United Kingdom may present challenges in the area of climate and environmental policy for the EU given, in particular, the UK's prominent role in driving the climate policy. In the ongoing development and reform of

the Policy Framework, Intel supports an emissions trading scheme that delivers the optimum reduction in carbon emissions at lowest cost. Linkage of the EU ETS with other compatible schemes is encouraged. In the evolution of the broader Framework, Intel supports equitable burden sharing across all economic sectors as well as recognition of and credit for prior voluntary industry efforts to reduce climate-harming emissions. Finally, it is important that the EU give consideration of the impact of future measures on EU competitiveness, by, for example, taking into account in the design of the system the risk of "carbon leakage".

- **China action:** China should continue to work with the U.S. under the existing bilateral agreement on climate. As part of that engagement, China should continue its commitment to implementing the Paris Agreement. Because China wants to grow its semiconductor sector, it should facilitate growth by focusing any greenhouse gas reduction requirements on the emissions of fluorinated gases, not the ability to use such gases. We support China's use of market-based greenhouse gas reduction approaches, including the developing national-scale emissions trading regime. We also support the expansion of renewable energy purchasing in China through market incentives. In addressing climate emissions associated with products, we encourage China to avoid product energy efficiency requirements that stifle innovation. Finally, we urge China to embrace the role of "Intelligent Efficiency" as the quickest, cheapest way to reduce the carbon intensity of the Chinese economy.

Addendum

The State of Climate Science

Climate change is happening and human activities have played a strong contributing role. The main questions today concern what steps can be taken to mitigate the warming trend and help communities and regions adapt to the present-day and anticipated impacts of the warming that already is occurring.

Since 1990, the Intergovernmental Panel on Climate Change (IPCC), established by the United Nations, has periodically (every 5-6 years) released assessments of the state of climate science. The Panel includes a diverse mix of hundreds of scientists from around the world, and its reports represent a synthesis of thousands of scientific papers on climate change. In addition, the Panel produces a "Summary for Policy Makers" for each Assessment Report, which is approved by diplomats from nearly all countries of the world.

2013 saw the publication of the IPCC's "Fifth Assessment Report." Among the more important findings of the Fifth Assessment are:

- The conclusion that much of the observed global warming over the past 50 years is due to human activities is now viewed as "extremely likely" (95% probability), upgraded from the "very likely" (90%) conclusion of the previous assessment.
- Even dramatic future reductions in greenhouse gas emissions cannot forestall the climate change resulting from past emissions. Many changes that have been observed may be irreversible.
- Estimates of future sea level rise have been significantly increased.[iv]
- Nearly 200 worldwide scientific organizations have stated their position that climate change has been caused by human activity.[v] A few examples include:
- The National Center for Atmospheric Research, sponsored by the National Science Foundation, states, "The amount, or concentration of CO_2 gas in the atmosphere has risen more than 40% since the industrial revolution. CO_2 concentration in the atmosphere is now at its highest point in the last 800,000 years. Each year, the CO_2 concentration increases by about 0.5%. Despite the normal variability of Earth's climate, which includes periods of natural warming and cooling, scientists now expect that the greenhouse gases added to the atmosphere from human activity will cause the overall temperature trend to continue increasing."[vi]
- The American Meteorological Society published an Information Statement in 2012 that states, "It is clear from extensive scientific evidence that the dominant cause of the rapid change in climate of the past half century is human-induced increases in the amount of atmospheric greenhouse gases, including carbon dioxide (CO_2), chlorofluorocarbons, methane, and nitrous oxide. The most important of these over the long term is CO_2, whose concentration in the atmosphere is rising principally as a result of fossil-fuel combustion and deforestation. While large amounts of CO_2 enter and leave the atmosphere through natural processes, these human activities re increasing the total amount in the air and the oceans."[vii]
- Recognizing the complexity of the physical and natural processes involved, and the difficulty in modeling these processes, and a lack of knowledge of future greenhouse gas emissions, the IPCC and others typically employ a range, or uncertainty band, when projecting the amount of global warming that could occur with or without society taking aggressive mitigation actions. Uncertainty also surrounds other climate change impacts like extreme weather events. In the absence of significant decreases in emissions, the planet is likely to warm more than 2°C above pre-industrial temperatures during the 21st Century, and could warm by more than 4°C. This level of warming is likely to be accompanied by significant sea level rise, as well as impacts to water resources, ecosystems, and human health. Although uncertainty surrounds how climate change may affect some types of extreme weather events, there is a high degree of certainty that heat waves have and will continue to increase in frequency and severity, and that heavy precipitation events will be more frequent in many regions.

Intel's Climate Change Impacts

A useful way to categorize a company's carbon footprint is in terms of which part of our operations the GHG emissions arise from. This typically is done in terms of "scopes":

- Scope 1 emissions arise from on-site operations (manufacturing, onsite fuel combustion, refrigerant leaks and onsite air and auto fleets).
- Scope 2 emissions are those associated with electricity purchased from off-site suppliers.
- Scope 3 emissions are those associated with a company's value chain which includes indirect upstream and downstream impacts such as supply chain, logistical operations, employee commuting, product use, business travel, and waste disposal.

The semiconductor industry's negative, direct contribution to the climate change problem is small relative to most other

sectors of the U.S. economy. According to EPA's 2015 GHG emissions inventory, the entire semiconductor industry was responsible in that year for 5.0 million metric tons of CO_2-equivalent Scope 1 emissions.

The semiconductor fraction amounted to only 0.164% of the total U.S. emissions of over 3 billion metric tons.[viii] This compares favorably to other sectors. The power plant sector accounts for 66% of total U.S. emissions. All of U.S. manufacturing industry contributes 22% of total GHG emissions. In other words, despite being the country's second-largest export sector, the semiconductor industry accounts for less than 0.4% of total U.S. industrial climate emissions.[ix] This is not to say that our relatively small contribution to the problem excuses us from action. Indeed, as noted below in the discussion of our emissions reduction efforts, our contribution is small precisely because of actions we have already taken and we remain committed to future actions as well.

Intel's direct contribution to climate change, which we annually report via our annual Corporate Responsibility Report and the Carbon Disclosure Project (CDP), is a fraction of the overall semiconductor industry contribution. Based on Intel's most recent Corporate Responsibility Report, our own Scope 1 emissions in 2016 were around 976,000 metric tons, approximately 20% of the industry total.

Intel's Actions to Reduce Our Carbon Footprint

Recognizing that climate change is a problem that can only be addressed by broad contributions from all sectors of society, Intel has undertaken a series of actions and programs to reduce its carbon footprint. These initiatives include the following:

Scope 1 Emissions Reductions

Semiconductor manufacturing depends on a small number of critical production inputs. "Critical" in our business typically means that there are no feasible substitutes for a chemical or material. Despite many years of research and development investment by Intel and others, for example, fluorinated gases play an essential role in our fabs. That is difficult from a climate change perspective, however, because of the high-global warming potential (GWP) of such gases. Their high-GWP has made fluorinated gases (or F-gases) a prime target of climate change regulators around the globe.

Recognizing this concern, Intel led the semiconductor industry in working with the U.S. EPA and the European Commission in developing a global goal to reduce our F-gas emissions. This effort started in 1996 and represents the most successful voluntary industry climate emissions reduction program ever undertaken. The official goal was to reduce industry emissions 10% by 2010, with 1995 emissions as the baseline. The industry as a whole exceeded this goal, with Intel going well beyond the goal: by the end of 2010, Intel achieved approximately a 50% emissions reduction in absolute terms, and a more than 80% reduction on a normalized, per chip basis.

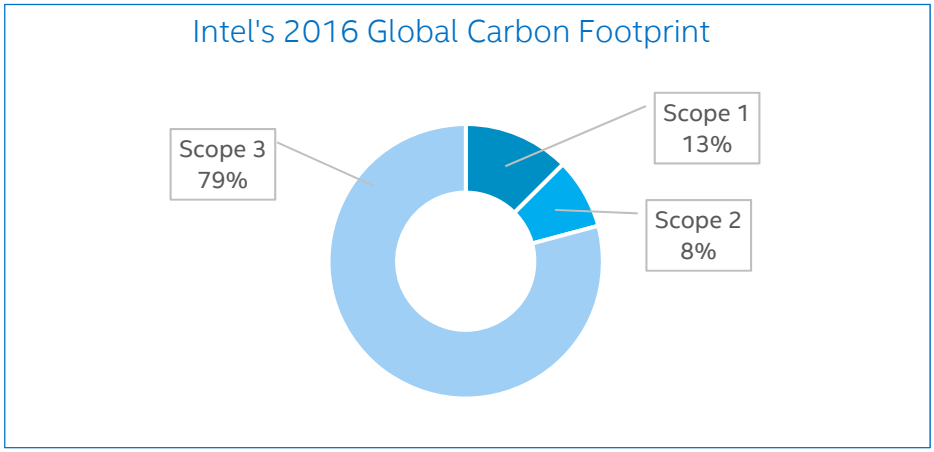

Figure 1. Shows the relative proportions of each scope as part of Intel's total global carbon footprint. Source: Intel.

These significant GHG emission reductions have been achieved through emission reduction strategies including:

- **Point-of-use (POU) abatement**. Tool-level POU GHG abatement units are utilized for tool installations where feasible, and implemented at all new tool installations. POU abatement is the primary GHG reduction method for semiconductor manufacturing.
- **NF_3 remote plasma chamber cleans**. An advance in chemical vapor deposition (CVD) chamber cleaning that virtually eliminates PFC emissions from the process, by using NF_3 gas in a remote plasma source. Intel utilizes this in more than 70% of all chamber cleans.
- **Chemical substitution**. This GHG reduction method involves the selection of chemicals with lower GWPs and is limited to available chemicals that provide similar performance to existing chemicals.
- **Process optimization.** This method involves optimizing equipment and processes to consume less chemical.
- **Energy conservation projects.** Intel's global energy conservation program focuses on reducing onsite fuel consumption through various projects such as optimization of chilled and hot water facilities from heat recovery and boiler efficiency improvements, and optimization of fuel requirements for thermal abatement equipment.

Scope 2 Emissions Reductions

Emission reduction strategies related to Scope 2 emissions and energy conservation include:

- **Energy conservation projects.** Since 2008, Intel has invested more than $175 million at our facilities worldwide. To date, these projects have saved more than 3.9 billion kWh of energy.
- **Green building design**. To reduce the environmental impact from our manufacturing sites and buildings, we have incorporated green design standards and building concepts into our construction of our facilities for many years. Our current policy is to design all new buildings to a minimum Leadership in Energy and Environmental Design (LEED) Gold certification. Many of our existing buildings have also been LEED certified. To date, we have achieved LEED certification for more than 14.5 million square feet of space in 45 buildings, or approximately 25% of our total operational space.
- **On-site Alternative energy installations.** Around the world, Intel has facilitated the installation of more than 60 on-site projects to use solar, wind, fuel cell, and other alternative energy sources directly connected to our facilities and using all the energy generated to reduce our grid energy supply demand. As part of the 2015 White House Climate Pledge, Intel committed to increase the installation and use of onsite renewable energy to three times the 2015 levels. In 2016, we increased our on-site, greener alternative energy installations by nearly 50% compared to 2015.
- **Green power purchases**. Since 2008, Intel has been the largest voluntary corporate purchaser of green power in the US, according to the U.S. EPA. A combination of Renewable Energy Certificates (RECs), contracted renewable power from our suppliers and on-site alternative energy projects earned us this distinction. In 2016, this commitment added to our already 100% green power in the U.S. to include all major European Union (EU) countries where Intel operates, through a combination of direct purchase renewables and RECs. This currently equates to approximately 80% of Intel's global electricity usage as renewable energy.
- **Data Center Virtualization**. Our Information Technology (IT) organization has improved efficiency of our data center operations to increase compute, storage, and IT customer capabilities while maintaining a flat carbon footprint.

Scope 3 Emissions Reductions

Additionally we focus on reducing our indirect carbon footprint, through various Scope 3 emission reduction strategies, including:

- **Product energy efficiency improvements**. Beyond our own Scope 1 and 2 emissions, another way in which we impact the climate is through the emissions associated with generating the electricity necessary to power our products and the products of our customers. Intel has made significant improvements to the energy efficiency of its products over recent product generations. Pursuing Moore's Law, Intel has consistently decreased the energy consumption of its products while increasing their performance. Figure 3 below shows

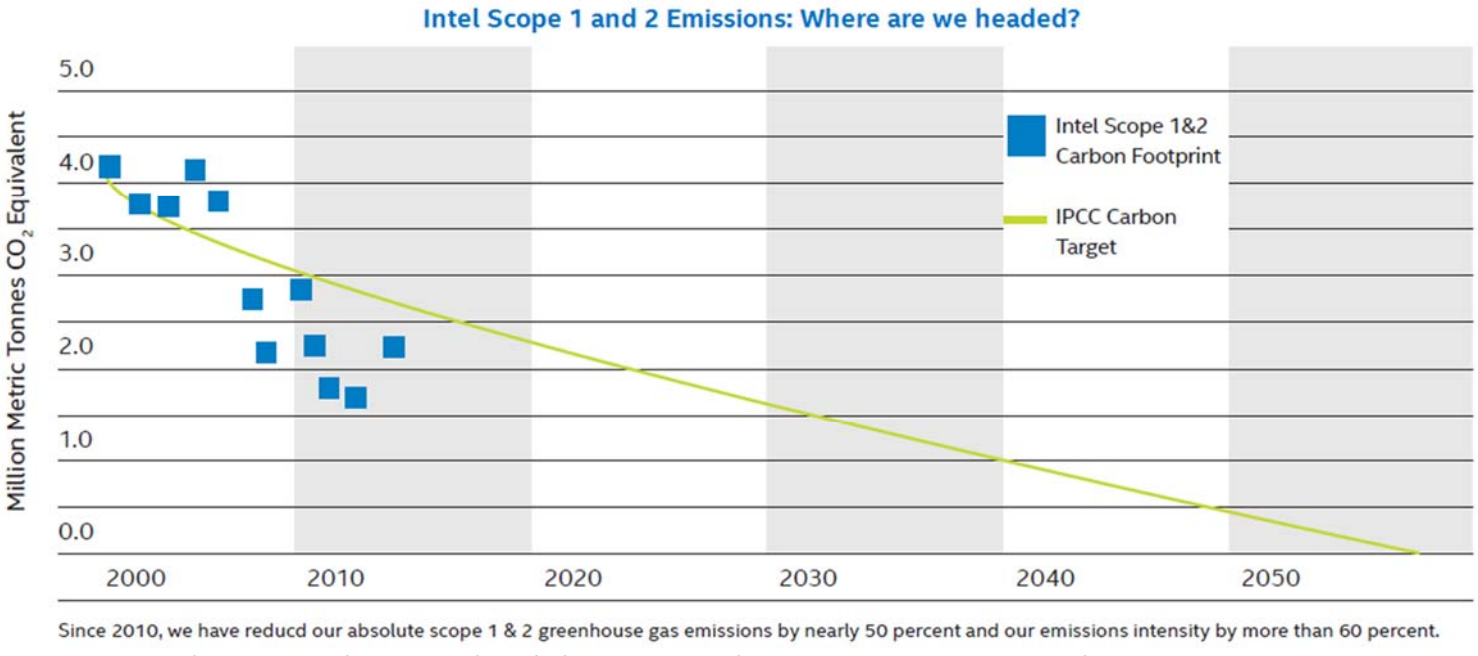

Figure 2. Intel emissions reduction trends, including Scope 1 and Scope 2 emissions. Source: Intel.

how Intel has dramatically reduced the power consumption of its products while dramatically increasing their computing capability over the last 40 years.

- **Logistics and distribution.** We reduce the GHG emissions related to our transportation and logistics network by using suppliers with more efficient fleets, optimizing packaging to reduce shipments or lower shipping weight, and by increasing local sourcing. Intel continuously works with transportation and logistics providers to further reduce their environmental impact and collaborate with organizations such as the Global Logistics Emissions Council to drive change through the transportation and logistics industry.
- **Employee commuting programs.** Intel implements numerous employee commuting programs that reduce the environmental impact of employee trips to and from work. The programs vary based on local sight needs and available options, but include programs such as:
- **Carpool/vanpool (Rideshare).** This program offers special parking allowances for permitted employees that commit to carpooling to work each day, thus reducing the number of cars on the road.
- **Electric vehicle (EV) charging stations.** To date, Intel has installed more than 125 EV charging stations across the globe. This is one of the largest corporate-wide installations of charging stations in the U.S.
- **Public transport support and shuttle buses.** Depending on the local public transport options, various public transport options are supported by Intel, including reduced rates or reimbursement of fees or buses to transport hubs, such as train/light rail stations. Intel provides shuttle buses at certain locations.
- **Onsite amenities.** Intel provides cafes, fitness centers, medical and dental, dry cleaning, banking, and other services to reduce employee offsite trips.
- **"Green" fleets for employee leased vehicles.** Intel works closely with our transportation suppliers to achieve GHG reductions, primarily by offering more hybrid and alternative fuel vehicles, as well as vehicles with a higher mile-per-gallon rating. As of the end of 2016, approximately 73% of our transportation fleet met our definition of "green".
- **Business travel.** Intel lowers its carbon footprint due to employee business travel through various methods,

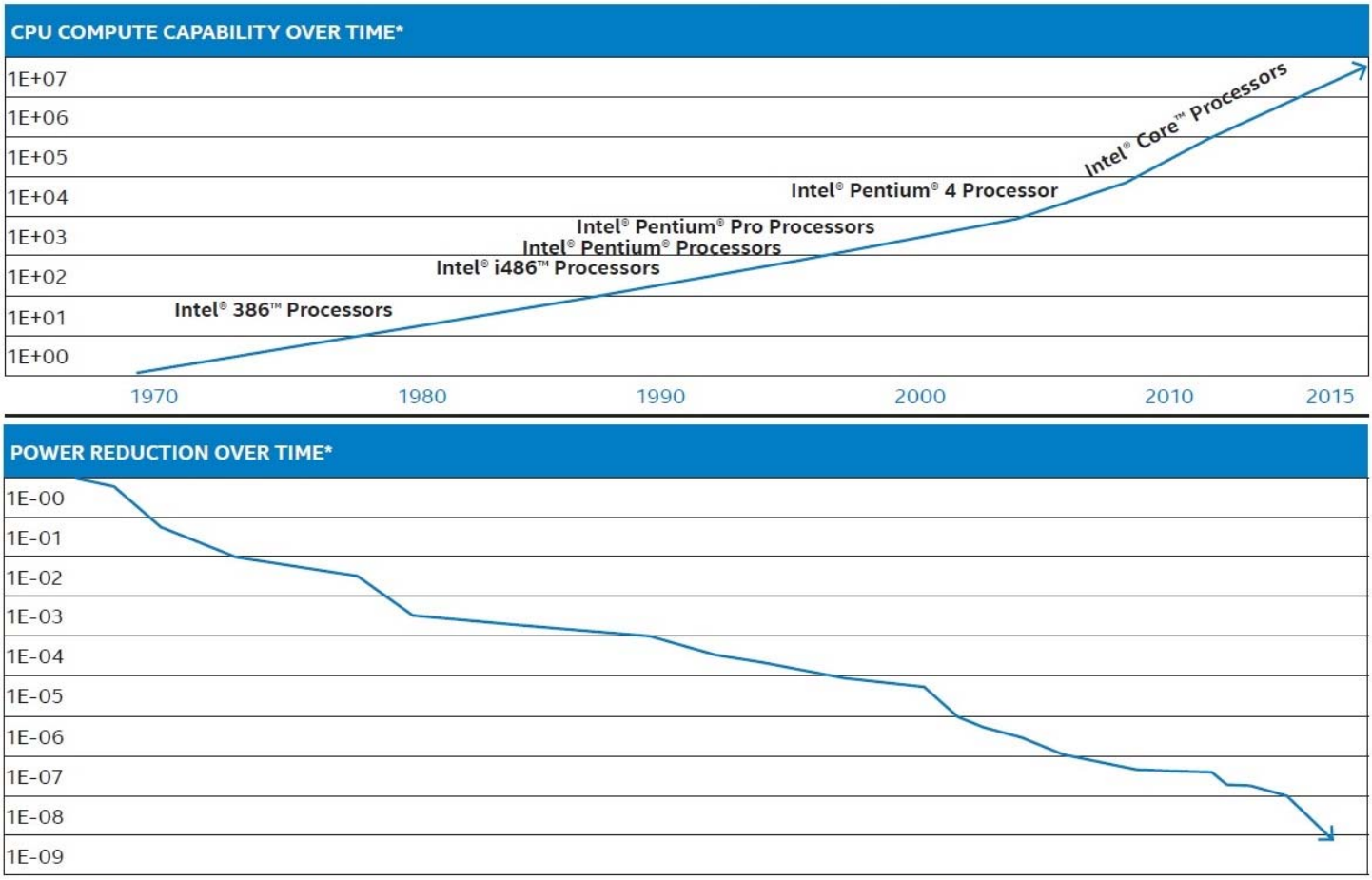

Figure 3. The dramatic efficiency in performance and energy efficiency over time. Source: Intel, 2015. Relative performance chart estimates based on reported MIPS and SPEC CPU scores over this time period (as configurations and workloads change).

including encouraging the use of hybrid vehicles for rental cars by offering reduced rates, promoting "green" hotels, and offering virtual meeting options to reduce overall business travel.

- **Large meetings.** Intel procures green power or RECs to cover many major Intel meeting venues and events (e.g. the Intel Developer Forum)
- **Packaging.** Intel works with logistics and packaging suppliers to drive changes in materials that we use to ship products between Intel sites and to our customers. Our long-term vision is to achieve 100% sustainable packaging for all inbound, outbound, and return shipments.
- **Supply chain.** We work to assess the climate impact of our suppliers and encourage transparency in reporting. In 2016, we requested that our top suppliers participate in the CDP Supply Chain survey and submit baseline data on their own carbon footprint. We achieved a 96% percent response rate.
- **Intel Labs R&D Programs.** Intel Labs has had a number of programs focused on improving energy efficiency and reducing climate emissions, including a focus on sustainable cities, including projects in London and Dublin, where distributed environmental monitoring platforms were deployed to help monitor pollution levels at a fraction of the cost of standard monitoring approaches. These platforms also enable improving the measurement and modelling of micro-climates in a city, informing potential actions to improve conditions.

Our Handprint: Intelligent Efficiency as Part of the Climate Change Solution

Beyond minimizing our contribution to the climate change problem, we are committed to maximizing our contribution to the *solutions* for climate change. We are committed to providing a wide variety of semiconductor products that provide the fundamental building blocks for information and communications technology (ICT)-based energy efficiency products and services that help reduce the rest of the world's climate footprint. These climate-friendly solutions range from the "smart electricity grid" to building energy management systems to "smart logistics" and telecommuting. Our semiconductors also play a key enabling role in harnessing wind and other renewable energy sources and in integrating those sources onto the grid. The accelerating deployment of the "Internet of Things," powered by Intel silicon, promises to bring vast increases in intelligence to the world around us, leading to, among other things, further gains in energy efficiency.

Finally, beyond helping mitigate or reduce climate change, Intel-powered ICT applications can and should play a greater role in assisting society to prepare for and adapt to the degree of climate change that may already be inevitable given historic levels of greenhouse gas emissions. ICT can play many adaptation roles, including high-performance computing applications that permit better prediction and mapping of global warming effects, including severe weather events, as well as sensor networks to monitor and predict the impacts of sea-level rise. So-called "smart agriculture" sensor technologies also help address increased climate-related water stress by enabling much more efficient use of irrigation water. Intel's and the ICT industry's positive, indirect contribution to solving the climate change already is significant and could potentially be even greater. The consulting firm McKinsey and others have studied the marginal cost that society would incur in taking a variety of actions to mitigate climate change. Figure 4 below summarizes the basic finding that end-use energy efficiency actions are the cheapest possible actions society can take to address climate change. As noted below, many of these

McKinsey Marginal Cost of Abatement Analysis

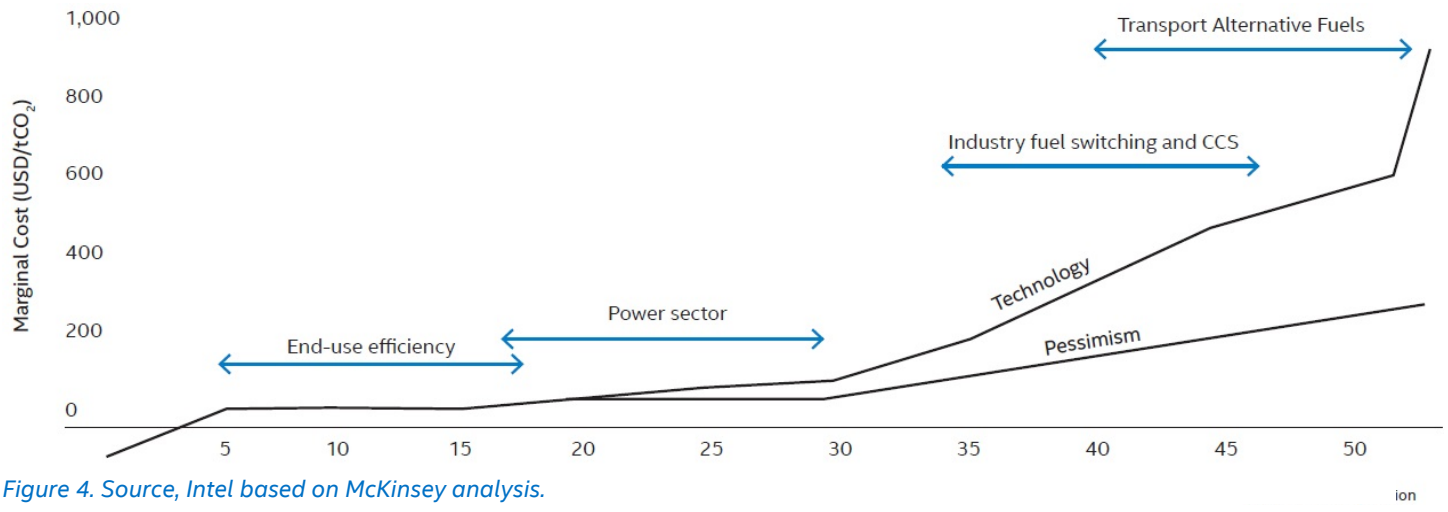

Figure 4. Source, Intel based on McKinsey analysis.

efficiency steps actually come at no cost or a net cost savings to society. Moreover, many of the specific steps that could be taken to increase end-use energy efficiency are driven or enabled by ICT. Examples include home- and building-energy management systems, telecommuting, and 'smart meter' technology to permit demand-side management by electric utilities.[x]

In recent years, many studies have confirmed the climate solutions potential of ICT. The American Council for an Energy-Efficient Economy (ACEEE), for example, analyzed how the expansion of the Internet has coincided, in a cause-and-effect manner, with a period of increasing energy efficiency in the U.S. economy. The ACEEE concluded that, "For every extra Kwh of electricity that has been demanded by ICT, the US economy increased its overall energy savings by a factor of about 10."[xi] ACEEE has gone on to study the energy-efficiency solutions role of ICT in great detail, coining the term "intelligent efficiency" or "systems-based efficiency" as contrasted with the traditional focus on "component-based efficiency":

> *"System efficiency is performance-based, optimizing the performance of the system overall -- its components, their relationships to one another, and their relationships to human operators. One of the cornerstones of systems-based efficiency is information and communication technologies (ICT), such as the internet, affordable sensors and computing capacity that are the foundation upon which systems efficiency are built."*[xii]

A recent global assessment of ICT's potential climate change contribution was conducted by The Boston Consulting Group for the Global e-Sustainability Initiative (GeSI), titled "SMARTer 2020: The Role of ICT in Driving a Sustainable Future." The report concludes that a comprehensive portfolio of ICT-enabled strategies could reduce global climate change emissions by *16.5%* in the year 2020 compared to a "business as usual" baseline. This is equivalent to $1.9 trillion in fuel savings and 21.6 billion barrels of oil on a cumulative basis. This size of this potential ICT contribution to addressing climate change dwarfs most other available strategies and, per the earlier-cited McKinsey analysis, much of what can be done via ICT applications will cost little or in fact create wealth for society.[xiii]

Such a large-scale total contribution is the composite effect of hundreds, if not thousands, of individual applications of ICT. In high-level terms, these applications can be thought of in three broad categories:

- **Automation.** Including industrial robots, computerized logistics, home and building energy management systems, smart motors and the "smart grid."
- **Substitution.** Including video conferencing, e-Commerce and online entertainment.
- **De-Materialization.** Including online banking, digital media content and other examples of converting atoms to bits.

Think of the efficiency of individual ICT devices, whether Intel's central processing unit (CPUs) chips and other integrated circuits or systems-level products like PCs and servers, as component efficiency. Contrastingly, intelligent or systems efficiency is a story best told in terms of the network of ICT devices and services that together provide these types of functionality. The future holds even greater promise for the ICT industry's role as a climate change solutions provider. Increasingly computation is moving into "the cloud", where studies have shown that significant energy efficiency gains can be made.[xiv]

IoT technologies can help manage buildings, industrial operations, and transportation networks to optimize production, minimize operating costs, and conserve natural resources. According to the report "Digital Efficiency: Driving Decarbonization and Unlocking Business Value Across Industries", in a scenario where just a handful of digital solutions are scaled across key industries, it is estimated that they would return $81 billion in annual cost savings to businesses, while avoiding up to 823 million metric tonnes (Mt) of carbon dioxide emission per year.[xv]

To learn more about Intel's commitment to environmental sustainability, visit **www.intel.com/environment**

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