

# ROADMAP TO ZERO EMISSIONS

**SUBMISSION TO THE AD HOC WORKING GROUP ON  
THE DURBAN PLATFORM FOR ENHANCED ACTION**

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# ROADMAP TO ZERO EMISSIONS

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*The Built Environment in a Global Transformation to Zero Emissions*



## INTRODUCTION

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Architecture 2030 is a non-profit, non-partisan, and independent organization with straightforward goals:

- ⦿ to achieve a dramatic reduction in the energy consumption and greenhouse gas (GHG) emissions of the built environment by changing the way buildings, developments and cities are planned, designed, and constructed; and,
- ⦿ to forward the development of adaptive built environments that can manage the impacts of climate change, preserve natural resources, and access low-cost, renewable water and energy resources.

This submission focuses on the design of the United Nations Framework Convention on Climate Change (UNFCCC) 2015 agreement, and in that context, addresses the role and emissions reductions necessary in the urban built environment – currently responsible for over 70% of all greenhouse gas emissions – in order to keep global average temperature increases under 2°C above pre-industrial levels.\*

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## EXECUTIVE SUMMARY

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The United Nations Framework Convention on Climate Change (UNFCCC) conference will convene in Paris in 2015. The goal is to reach a new agreement to prevent dangerous climate change, applicable to all countries, by keeping global average temperature increases under 2°C above pre-industrial levels. Meeting this threshold requires phasing out GHG emissions from worldwide energy systems by the second half of the 21<sup>st</sup> century. In short, this phaseout of carbon emissions should underpin all climate policy efforts.<sup>1,2</sup>

Urban areas are responsible for over 70% of global energy consumption and CO<sub>2</sub> emissions, mostly from buildings. By 2030, a staggering 82 billion square meters (900 billion square feet), an area roughly equal to 60% of the total building stock of the world, will be built and rebuilt in urban areas worldwide. This projection provides an unprecedented opportunity to reduce fossil fuel CO<sub>2</sub> emissions by setting the entire global Building Sector on a path to peak emissions quickly, and completely phase out CO<sub>2</sub> emissions by about 2050.

To reach this goal, Architecture 2030 has prepared a roadmap to showcase two key Building Sector initiatives:

- ⊙ **Roadmap 2050** guidelines and action items for developed and developing countries to formulate custom Building Sector CO<sub>2</sub> emissions reduction schedules to 2050, and
- ⊙ **A Building Sector Finance Facility** program to assist developing countries in planning, designing, building, and financing low-carbon and zero carbon built environments.

The intent of this roadmap is to simplify and quantify a flexible, measured approach to reducing fossil fuel CO<sub>2</sub> emissions from the Building Sector through readily accessible, easily understandable methods and metrics that can be applied throughout the globe.

## BACKGROUND

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Working Group 1 of the Intergovernmental Panel on Climate Change's (IPCC) 5th Assessment Report confirms the necessity for immediate and sustained global action on climate change: we must remain well below the 2°C global average temperature threshold (above pre-industrial levels) to prevent dangerous anthropogenic interference with the climate system.

From the IPCC's 5th Assessment Report, a number of timeline scenarios (Representative Concentration Pathways or RCPs) have been defined, RCP8.5, RCP6.0, RCP4.5, RCP2.6, and >85% *below* 2°C, each plotting amounts of carbon emissions and resulting global average temperatures. The only scenario with a high probability (85% or greater chance) of keeping under the 2°C threshold is when global CO<sub>2</sub> emissions from fossil fuels peak quickly and reach zero by about 2050 (see APPENDIX A, Graphs 1 and 2).<sup>3,4</sup>

Parties to the UNFCCC have committed to limiting the maximum global average temperature increase to no more than 2°C above pre-industrial levels.<sup>5</sup> However, even if the GHG emissions pledges made at the UNFCCC conferences in Copenhagen (2009) and Cancun (2010) are fully met, the world is on a trajectory for a global average temperature increase of over 3°C, with a 20% chance of exceeding 4°C.<sup>6</sup>

Given these scenarios, it is clear we must explore rapid but feasible routes to reach zero global fossil fuel CO<sub>2</sub> emissions by the middle of the century. This challenge has led Architecture 2030 to develop the following *Roadmap to Zero Emissions*: two key Building Sector initiatives to quickly reduce fossil fuel CO<sub>2</sub> emissions and finance low-carbon/zero carbon built environments.

## PREMISES

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- ⊙ Today, over half of the world population lives in urban areas.<sup>7</sup>
- ⊙ Urban environments (cities) are responsible for over 70% of global GHG emissions.<sup>8</sup>
- ⊙ Between 2011 and 2030, the world population is expected to increase by 1.35 billion (from 6.97 billion to 8.32 billion).<sup>9</sup>
- ⊙ Urban areas are projected to gain about 1.35 billion people by 2030, absorbing the entire population growth estimate from 2011 to 2030.<sup>10</sup>
- ⊙ Total world building stock today is approximately 150 billion square meters (m<sup>2</sup>), consisting of approximately 75% residential and 25% commercial floor space.<sup>11</sup>
- ⊙ Each year from 2013 to 2025 approximately 3.53 billion m<sup>2</sup> of building floor space will be built new, and 1.93 billion m<sup>2</sup> of buildings will be rebuilt (replacement of older building stock) in urban areas worldwide.<sup>12</sup>
- ⊙ By 2030, over 80 billion m<sup>2</sup> of buildings will be built new and rebuilt in urban areas worldwide, an area roughly equal to 60% of the total building stock of the world.<sup>13</sup> Global building construction during this period (by percentage) is projected to occur in the following areas:
  - **38%** China
  - **15%** U.S. / Canada
  - **9%** India
  - **9%** Latin America
  - **9%** Middle East / Africa
  - **12%** Other emerging
  - **4%** Western Europe
  - **4%** Other developed
- ⊙ China and the U.S. / Canada will account for approximately 53% of all new and rebuilt building floor space over the next 15 years,<sup>14</sup> but the role of a global agreement will be critical for reducing emissions in the remaining 47% of global construction.
- ⊙ Much of the world is projected to be built and rebuilt over the next two decades, with the energy and emissions patterns of this construction locked-in for many years (average building and infrastructure lifespans are 80 and 120 years, respectively<sup>15</sup>). Today we have a once-in-a-lifetime opportunity to address climate change by creating low-carbon and zero-carbon cities, districts, and buildings that:
  - dramatically reduce their environmental impact and exposure,
  - create environmental adaptability,
  - ensure access to inexpensive and renewable site energy sources,
  - minimize vehicle miles traveled, and
  - minimize consumption of natural resources, undeveloped land, and potable water.

## ROADMAP TO ZERO EMISSIONS

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*Roadmap to Zero Emissions* proposes to establish guidelines for two key Building Sector initiatives: *Roadmap 2050* and a *Building Sector Financing Facility*. Combined, these initiatives address the massive urbanization occurring worldwide over the next two decades, and provide a pathway with a high probability of keeping global average temperature increase under 2°C, peaking CO<sub>2</sub> emissions in the Building Sector quickly, leading to zero CO<sub>2</sub> emissions by mid-century. The initiatives are equitable and take common but differentiated responsibilities and capabilities into account by allowing each country to establish specific sector reduction targets according to its needs and capabilities, as well as providing a financial mechanism for developing countries to implement building sector strategies with appropriate levels of support.

The two key components of the *Roadmap to Zero Emissions* are:

1. *Roadmap 2050* provides guidelines for individual countries to develop customized Building Sector CO<sub>2</sub> emissions reduction schedules, and the Action Items needed to reach zero CO<sub>2</sub> emissions by 2050:

- a. **Building Sector CO<sub>2</sub> Emissions Schedule Guidelines:**

Achieve a total annual Building Sector (residential, commercial, and institutional building operations) CO<sub>2</sub> emissions level, relative to Building Sector CO<sub>2</sub> emissions in 2015, within the following range:

- 0% to -15% in 2020
- -15% to -30% in 2025
- -30% to -45% in 2030
- -45% to -60% in 2035
- -60% to -75% in 2040
- -75% to -90% in 2045
- -90% to Zero CO<sub>2</sub> emissions in 2050
- Zero CO<sub>2</sub> emissions in 2055

- b. **Action Items Guidelines:**

- i) New Buildings – Design new buildings and major renovations to meet a site energy use intensity (EUI) of the following percentage below the regional (or country) average for each building type:

- 70% in 2016
- 80% in 2020
- 90% in 2025
- Carbon Neutral in 2030

*The term “major renovation” means a sufficiently extensive renovation so that the entire building can meet the energy targets for new buildings.*

*Carbon neutral is defined as a building that is designed and constructed to require a greatly reduced quantity of energy to operate, meeting the balance of its energy needs from sources that do not produce CO<sub>2</sub> emissions and therefore result in zero net CO<sub>2</sub> emissions.*

*Site EUI (building energy consumed at the building site in Btu/sf/year or kWh/ m2/year) reduction targets for new buildings and renovations are accomplished by implementing low-cost/no-cost efficiency and sustainable design strategies and practices, and by generating on-site renewable power, and/or by importing non CO<sub>2</sub>-emitting energy.*

ii) Existing Buildings, Developed Countries – Renovate a minimum of 2% to 3% of the total existing building stock each year to meet a site EUI of 50% below the regional (or country) average for each building type.

iii) Existing Buildings, Developing Countries – Renovate a minimum of 1.5% to 2% of the total existing building stock each year to meet a site EUI of 50% below the regional (or country) average for each building type.

*For example, buildings that meet the 2012 International Energy Conservation Code (IECC 2012) are approximately 50% below the U.S. regional average site EUI for a building type.*

iv) *Building Products* – Specify building products that meet a CO<sub>2</sub> emissions reduction of the following percentage below the product category average of:

- 35% in 2015
- 40% in 2020
- 45% in 2025
- 50% in 2030

2. *A Building Sector Financing Facility* through the Green Climate Fund, green infrastructure bonds, and other climate relevant financial initiatives, supporting developing countries to finance:

- a. Building renovations that meet the *Roadmap 2050* (b)(iii) site EUI target.
- b. Passive and active renewable energy systems for:
  - buildings that meet the *Roadmap 2050* (a) and (b)(i),(b)(ii), (b)(iii) site EUI target, and
  - installations (with energy storage) at critical facilities - hospitals, schools, senior housing - to protect against power outages.
- c. New buildings and major renovations that are designed to meet site EUI targets of (b)(i).
- d. Access to expert and technical support services for sustainable planning, adaptable infrastructure and renewable energy systems, and professional design and engineering services for buildings and renovations that meet the (a) and (b)(i),(b)(ii), (b)(iii) targets.
- e. Developing and delivering equitable access to information and tools for sustainable, low-carbon/zero carbon planning and building, and no-cost/low-cost on-site renewable energy/natural resources systems (e.g., passive heating and cooling, water catchment and storage, solar hot water, daylighting, and natural ventilation systems) to users at all levels of the planning and building process.
- f. Private/public partnerships to develop and implement city and district scale roadmaps and solutions for adaptable, low-carbon/zero-carbon urban planning, transit, infrastructure, energy systems, and buildings.

## CONCLUSION

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Rapid global urbanization and the necessity for a complete phaseout of GHG emissions call for a major transformation in the built environment, from a post-WWII fossil-fuel-reliant and consumptive model, to one that essentially emits zero carbon. The time frame for transformation has been established by the UNFCCC's global average temperature increase threshold of 2°C above pre-industrial levels, and the IPCC's 5th Assessment Report.

If framed and institutionalized properly, Building Sector (building operations) agreements, adopted in Paris in 2015, will lead to actions that result in a sustainable and zero carbon sector. The agreements would lead countries to contribute to a sector phase out of fossil fuel CO<sub>2</sub> emissions by the middle of this century. The process of negotiations under the Ad Hoc Working Group on the Durban Platform for Enhanced Action (ADP), and other relevant fora, could catalyze dialogue and enhanced global cooperation among and between architects, urban planners, designers, and manufacturers of building-related products and services.

*Roadmap to Zero Emissions* provides an initial set of initiatives based upon successful, existing programs and actions developed to meet the fossil fuel CO<sub>2</sub> emissions reduction targets of a high probability of holding global warming below 2°C (see APPENDIX A, Graph 2). The following are representative of those initiatives that could be scaled up, replicated, enhanced, or serve as models:

- ⊙ The U.S. Energy Independence and Security Act of 2007 (Section 433), and Executive Order 13423, requires all new federal buildings and major renovations to be zero carbon by 2030.<sup>16</sup>
- ⊙ The EU directed member states to ensure that all new buildings are nearly zero-energy by 2020.<sup>17</sup>
- ⊙ The California Energy Commission's 2007 Integrated Energy Policy Report is scheduled to adjust Title 24 (building energy code) updates to require all new residential construction to be zero-net-energy (ZNE) by 2020, and all new commercial buildings ZNE by 2030.<sup>18</sup>
- ⊙ New buildings in China's Severe Cold, Cold, Hot Summer, and Cold Winter zones, must be designed to an energy efficiency improvement of 65% compared to 1980 buildings.<sup>19</sup>
- ⊙ Germany plans to improve the energy efficiency renovation rate of its existing building stock from 1% to 2%, and later to 3% per year.<sup>20</sup>
- ⊙ Urban 2030 Districts, consisting of private/public partnerships in five U.S. cities, implement incremental district-wide energy, water, and transportation emissions reduction targets to 50% in large urban areas by 2030. Twelve additional 2030 Districts are currently forming in cities across the U.S. and Canada.<sup>21</sup>
- ⊙ The 2030 Palette, a freely accessible, highly visual, integrated, and user-driven online platform was launched in November 2013. The platform puts the principles, actions, and tools behind low-carbon/zero-carbon and adaptive built environments – from regions, cities and communities, to buildings and building elements – at the fingertips of professionals and non-professionals worldwide (a UN / World Bank Sustainable Energy For All commitment<sup>22</sup>, see APPENDIX B.)<sup>23</sup>

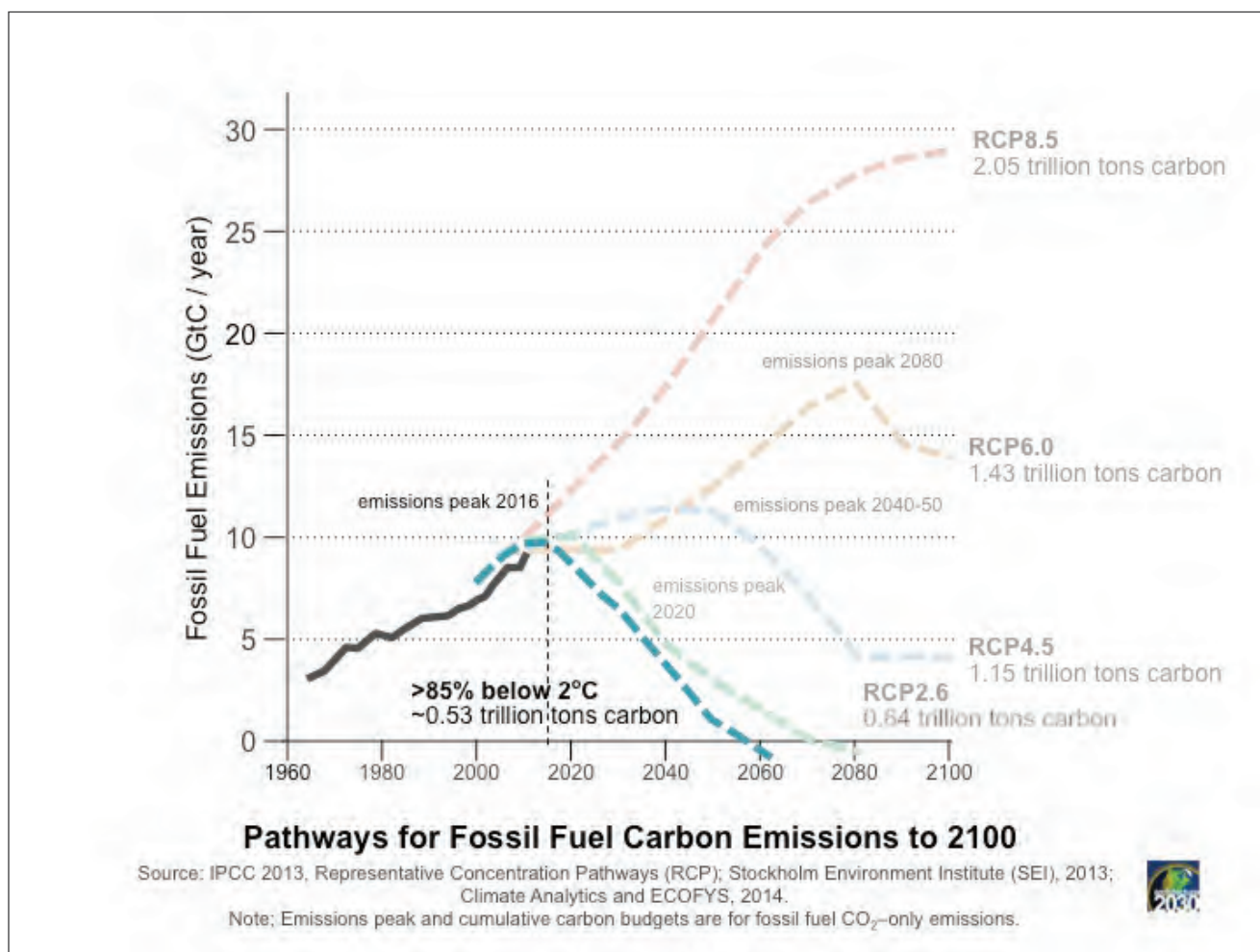


*Roadmap to Zero Emissions* is a flexible and dynamic approach to achieving zero CO<sub>2</sub> emissions reductions in the global Building Sector. Additional initiatives will be continually forthcoming as collaborative efforts produce new methods for achieving compliance. Simply put, the *Roadmap to Zero Emissions* facilitates the transition to a world with zero GHG emissions – a world the IPCC says must be rapidly built, beginning today.

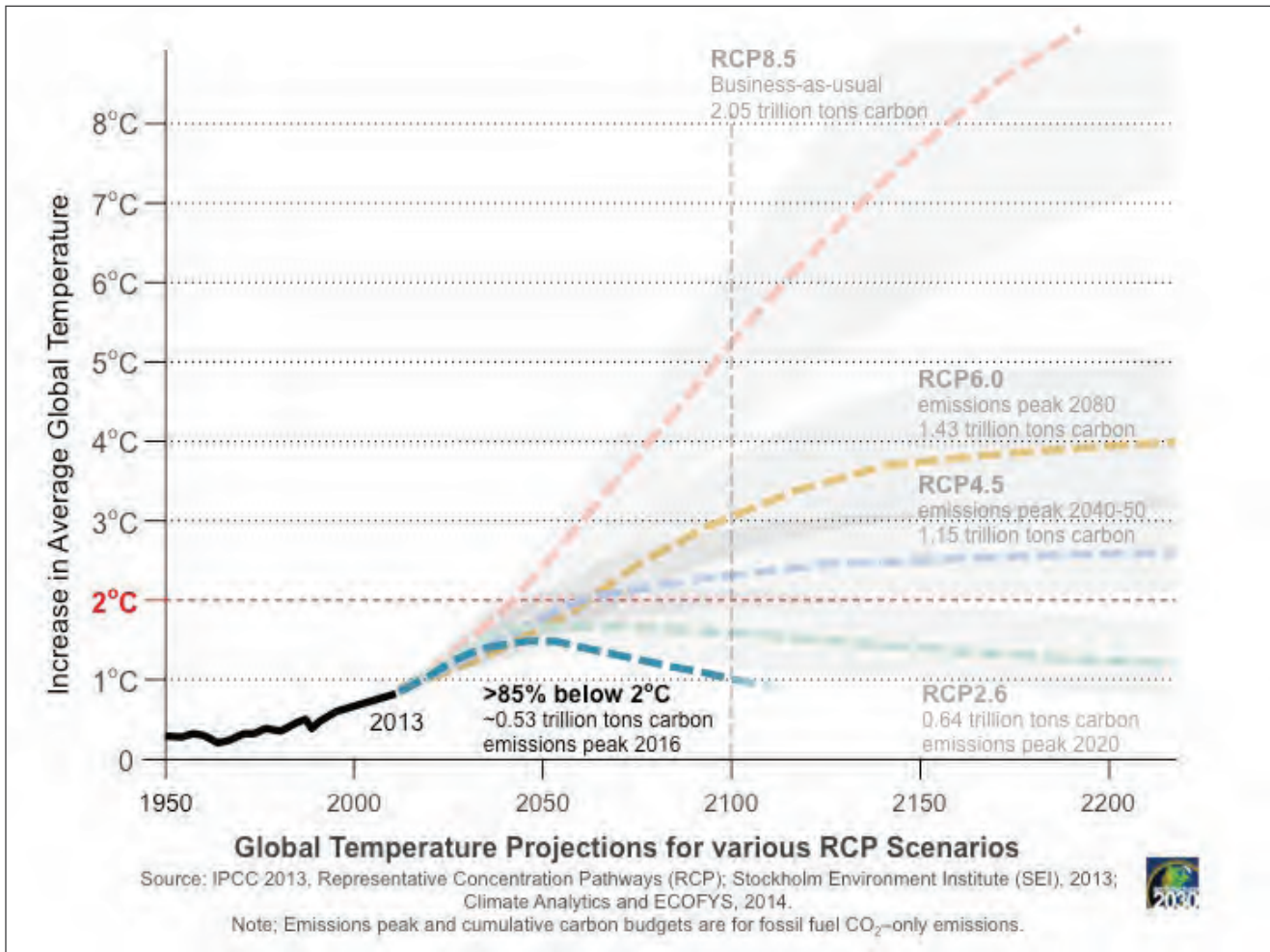
## APPENDIX A: Timelines, Projections, and Targets

Working Group 1 of the IPCC 5th Assessment Report reveals how close we are to a turning point in the earth’s climate system.

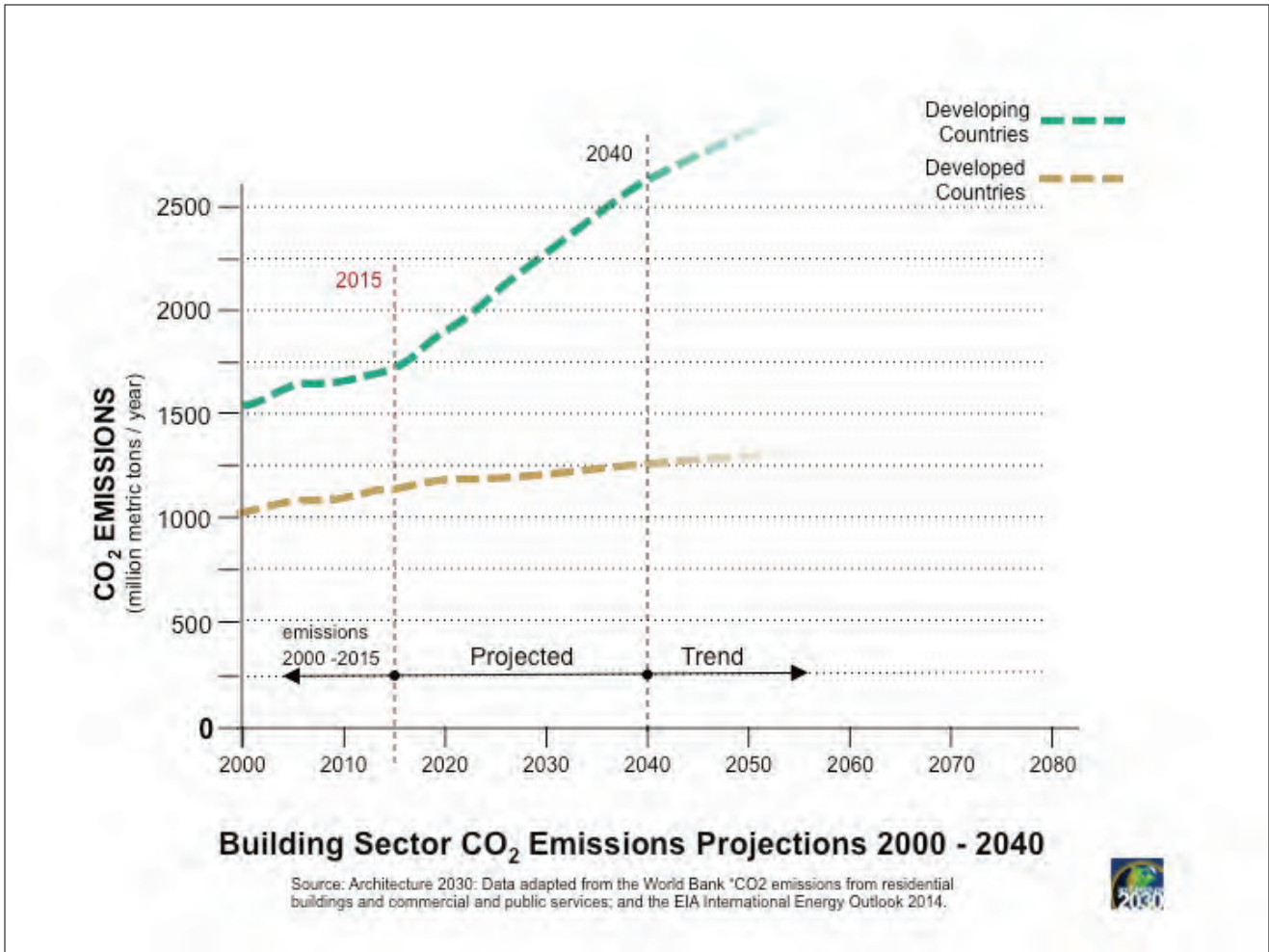
The IPCC report defines a number of timeline scenarios (Representative Concentration Pathways or RCPs) plotting fossil fuel carbon emissions (GtC) and the resulting global average temperatures, depending on global carbon emissions patterns. From the IPCC report, the following timelines have been plotted: “business as usual” (RCP 8.5), then scenarios for global carbon emission peaks in the year 2080 (RCP 6.0), 2040-2050 (RCP 4.5), 2020 (RCP 2.6), and 2016 (>85% below 2°C).



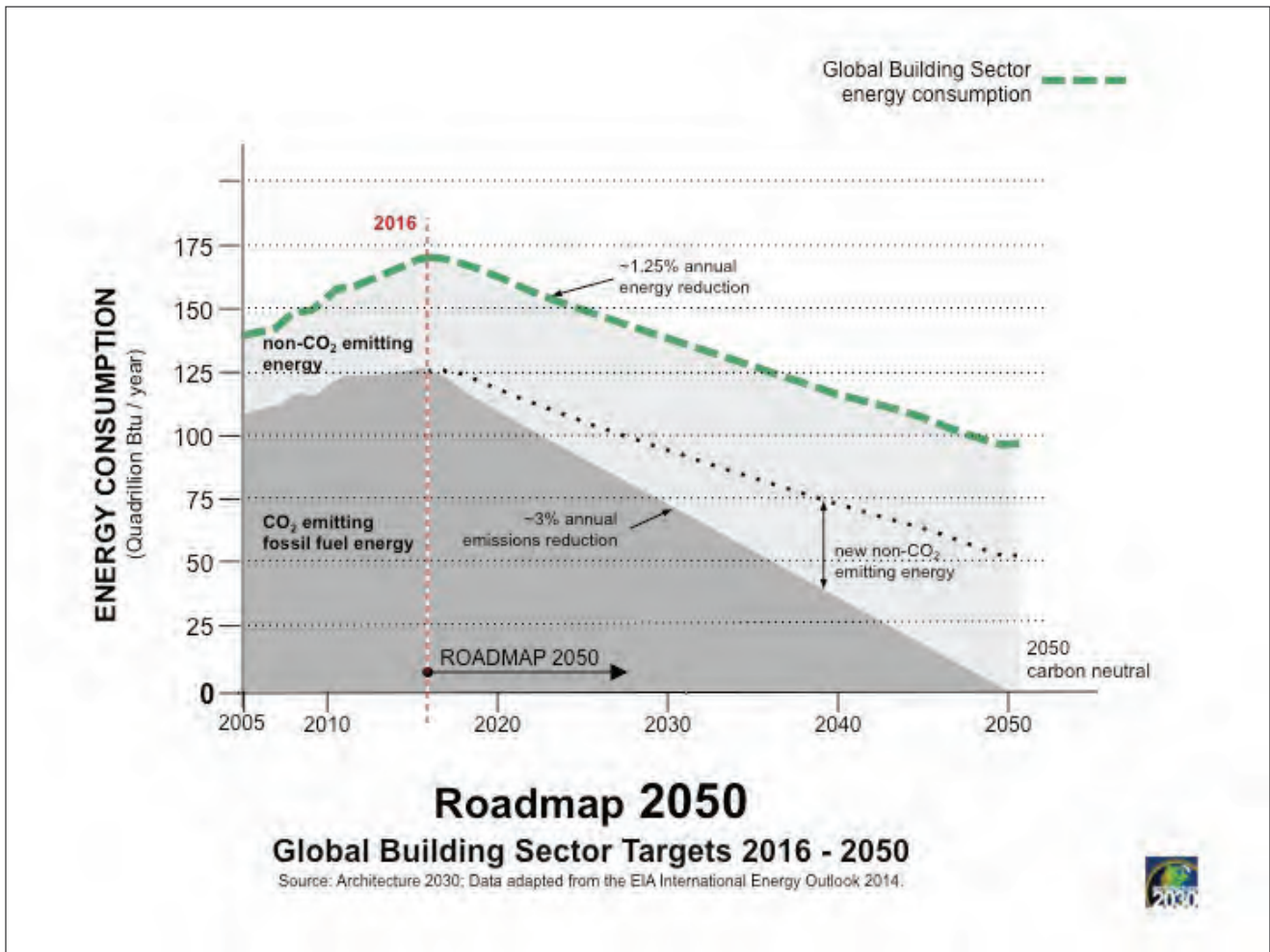
**Graph 1.** A carbon emissions peak by 2016 and complete phaseout of fossil fuel CO<sub>2</sub> emissions by the middle of the century will be necessary for a greater than 85% chance (high probability) of holding global warming below 2°C.



**Graph 2.** If the world exceeds the 2°C threshold, reported models project the planet will keep warming and it will be virtually impossible to bring global average temperatures back to current levels, leaving humanity with a continually warming planet and a deteriorating climate system. The only scenario with a greater than 85% chance of holding global warming below 2°C is to quickly peak worldwide fossil fuel CO<sub>2</sub> emissions and reach zero emissions by the middle of the century.



**Graph 3.** While many countries have been reducing their CO<sub>2</sub> emissions annually, developed and developing countries, as a group, have been steadily increasing their annual CO<sub>2</sub> emissions over the past decade. The U.S. Energy Information Administration's International Energy Outlook 2014, projects that CO<sub>2</sub> emissions from both developed and developing countries will continue to increase to 2040.



**Graph 4.** *Roadmap 2050* establishes a range within which global Building Sector fossil fuel CO<sub>2</sub> emissions quickly peak and reach zero by the middle of the century.

Reaching an agreement on Building Sector schedules at the Paris 2015 conference is a once-in-a-lifetime opportunity to create a zero carbon Building Sector that can change the apparently disastrous course on which we have embarked.

Assumptions: Global new building floor area is projected at 3.53 billion m<sup>2</sup> annually from 2016 to 2030, and 2.65 billion m<sup>2</sup> annually from 2030 to 2050. Global tear down and rebuild floor area is projected at 1.93 billion m<sup>2</sup> annually from 2016 to 2030, and 1.45 billion m<sup>2</sup> annually from 2030 to 2050.<sup>24</sup>

## APPENDIX B: Bridging the Information Gap

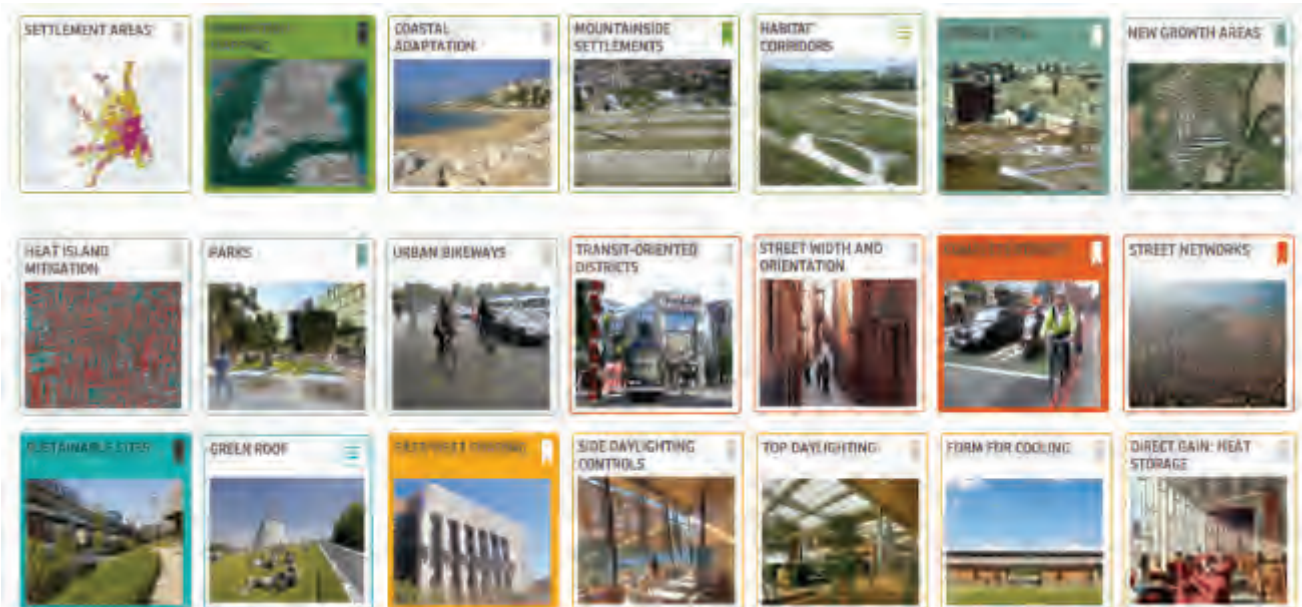
Rapid global urbanization and the necessity for dramatic GHG emissions reductions call for a major transformation to a zero carbon and sustainable built environment. Currently, the complete lack of accessible, accurate, and locally applicable information, across the broad spectrum of the global built environment, is a key barrier to scaling up mitigation and adaptation activities.



Seeking a strategy to address this issue, Architecture 2030 recently launched the *2030 Palette* – a highly visual, integrated, free, user-driven online platform that puts the principles, actions and tools behind low-carbon/zero carbon and adaptable built environments – from regions, cities and communities, to buildings and building elements – at the fingertips of architects, planners, builders, developers, NGO’s, governments, and policymakers worldwide.

The *2030 Palette* disseminates the information needed for both large scale and individual interventions and actions in built environments, in a visually rich, integrated, and useable format, that:

- ⊙ dramatically reduces their environmental impact and exposure,
- ⊙ incorporates a high degree of resiliency,
- ⊙ ensures access to inexpensive, renewable, onsite energy resources, and
- ⊙ minimizes resource, land, and water consumption, vehicle miles traveled, and GHG emissions.



**Illustration 1.** Selection of component elements, called “Swatches,” from the 2030 Palette

The *2030 Palette* contains 54 initial component elements, or “Swatches” that make up sustainable built environments. Each Swatch is constructed in relationship to other component elements through linkages and interactions. Swatches have descriptive names – e.g., *Growth Boundaries*, *Urban Infill*, *Transit Oriented Development*, *Heat Island Mitigation*, *Solar Access*, *Vegetative Cooling*, *Direct Gain: Glazing*, and *Stack Ventilation*. They are ordered logically by scale from region, to city/town, to district, to site, to building, forming a coherent process for creating sustainable built environments.

**Illustration 2.** 2030 Palette - Swatch overview page

Highly complex technical language is curated to be accessible to both professional and non-professional users at all levels of the planning, design, and building process. While the 2030 Palette is global in scope, it fits specific local needs and contexts. It provides the ideal platform for local level capacity building and information exchange.

## APPENDIX C: Architecture 2030 Initiatives

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### 1. The 2030 Challenge | *Buildings, Cities, Products*

- a. To focus the Building Sector on energy and GHG emissions reductions, Architecture 2030 issued the 2030 Challenge in 2006: a global initiative that calls for all new buildings and major renovations to reduce their fossil fuel, GHG-emitting energy consumption:
  - **60%** by 2010
  - **70%** by 2015
  - **80%** by 2020
  - **90%** by 2025
  - **carbon neutral** by 2030
- b. To date, the 2030 Challenge and the AIA 2030 Commitment have been adopted and implemented by:
  - 80% of the top 10, and 70% of the top 20 A/E/P firms in the world (e.g., ARUP, Perkins + Will, HKS, Gensler, SOM, and HOK);
  - 52% of all U.S. architecture firms (2013 *Design Intelligence Survey*), and key national and international professional organizations including the:
    - 80,000-member American Institute of Architects,
    - 162,000-member U.S. Green Building Council,
    - 3,600-member Royal Architectural Institute of Canada,
    - Ontario Association of Architects,
    - Union Internationale des Architectes,
    - Design Futures Council (150 global design leaders),
    - 2,400-member Congress for the New Urbanism,
    - American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE),
    - US Conference of Mayors,
    - International Council for Local Environmental Initiatives.
  - Government agencies at all levels, including the U.S. Federal government, The White House, National Governors Association, U.S. Conference of Mayors, National Association of Counties, the states of Minnesota, California, Washington, and Illinois, and numerous cities and counties across the U.S.
- c. Subsequent widely adopted 2030 Challenges were issued by Architecture 2030 including the :
  - **2030 Challenge for Planning** – addresses existing urban districts and cities, calling for a 50% energy and water consumption, and transportation emissions reduction, by the year 2030.
  - **2030 Challenge for Products** – addresses energy reductions at the smallest scale; building products. This Challenge sets reduction targets for the embodied carbon from the manufacturing and transportation of materials such as cement, steel, wood, and carpet, beginning with a 35% reduction by 2015, incrementally increasing to 50% by 2030.

## 2. **2030 Districts Network** | *District Scale Transformation*

2030 Districts are unique private/public partnerships that unite property owners, managers, and developers with local governments, businesses, and community stakeholders in an aggressive model for urban sustainability. By incorporating creative strategies, best practices and verification methods, the primary target of each 2030 District is to meet a 50% district-wide reduction in existing building energy and water consumption, and transportation emissions by the year 2030.



2030 District members create national partnerships and purchasing aggregation, and share data and other resources. Today, there are currently established 2030 Districts in:

- Seattle, WA; Cleveland, OH; Pittsburgh, PA; Los Angeles, CA; and Denver, CO; with over 100 million square feet of buildings committed, and
- new 2030 Districts being formed in Stamford, CT; Detroit, MI; San Antonio, TX; Dallas, TX; Silicon Valley, CA; New York City, NY; Detroit, MI; Ann Arbor, MI; Albuquerque, NM; San Francisco, CA; Portland, ME; Syracuse, NY; Tacoma, WA; and Toronto, Canada, with interest expressed by many others.

## 3. **Urbanism + 2030** | *Sustainable Urbanism*

To address the challenges associated with the densification of the urban environment, the Congress for the New Urbanism (CNU) has partnered with Architecture 2030 to implement the 2030 Challenge for Planning, an incremental set of performance targets for transforming the built environment from one of the main drivers of climate change to a central part of the solution.



## 4. **AIA + 2030 Professional Series** | *Education Edge*

The AIA+2030 Professional Series™ offers the very latest, next-generation design practices to the architecture and design community and is presented in 25 markets across the country and in Canada, from New York City to Toronto to Seattle. This ten-part program provides the design and technology applications needed to produce resilient, carbon-neutral buildings that meet the energy reduction targets of the 2030 Challenge.

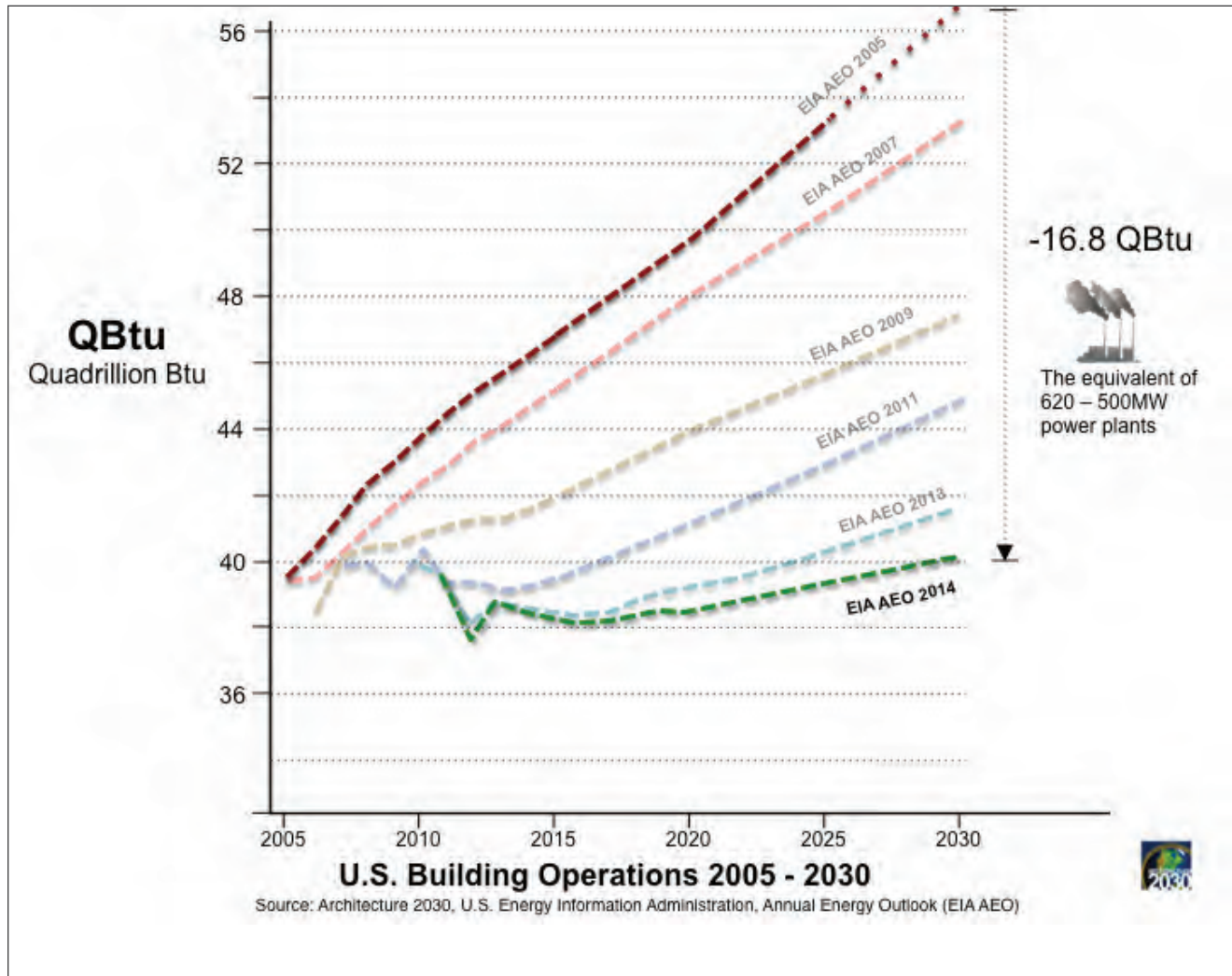




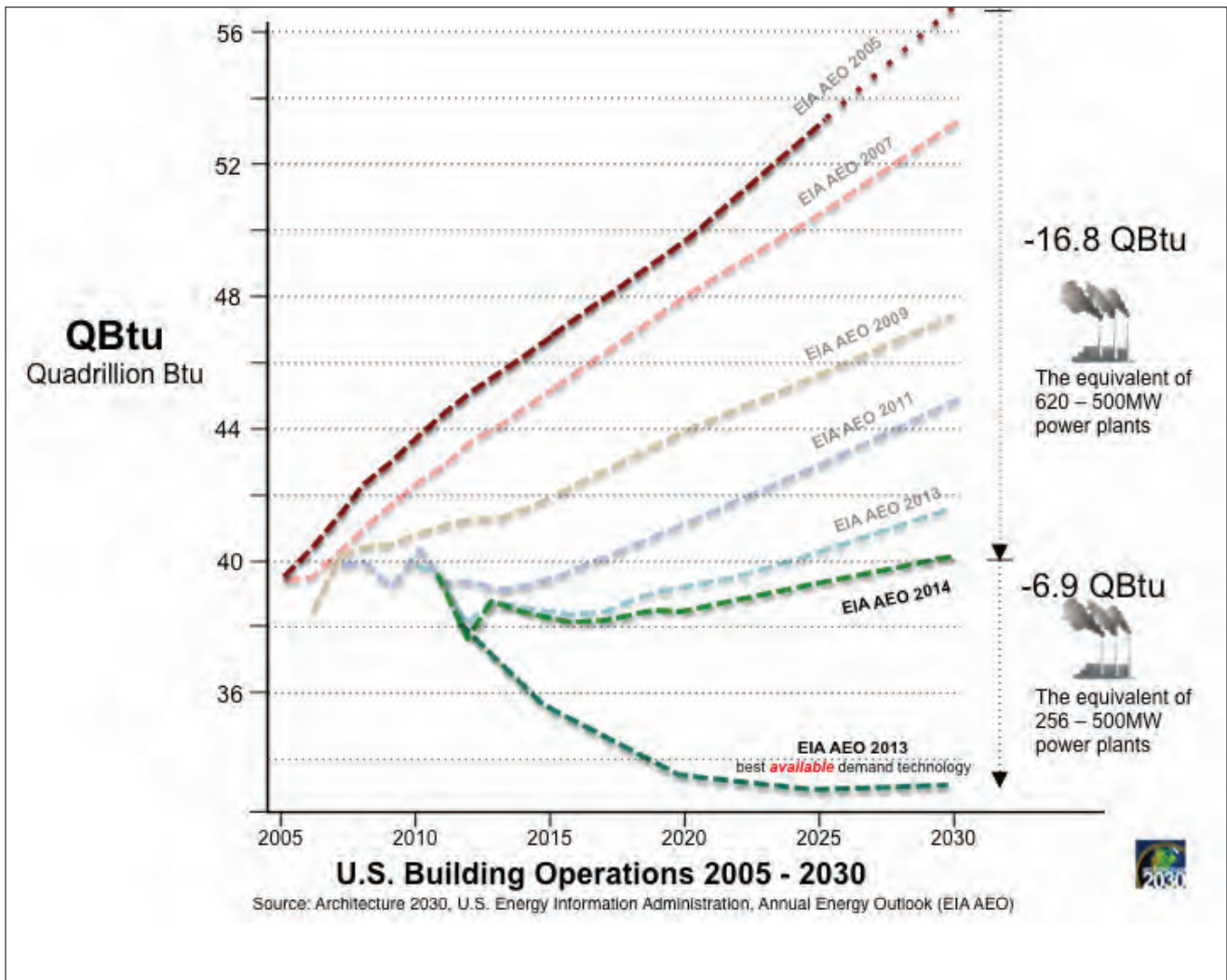
## APPENDIX D: The U.S. Building Sector

For the ninth straight year since issuing the 2030 Challenge, projected U.S. Building Sector energy consumption (building operations) and greenhouse gas emissions to the year 2030 have declined dramatically.

According to the recent U.S. Energy Information Administration's (EIA) Annual Energy Outlook 2014, the reference case (business-as-usual) energy consumption projections to the year 2030 have declined each year since 2005, even taking into consideration the fact that the U.S. will add about 60 billion square feet (5.6 billion square meters) to its building stock from 2005 to 2030.



**Graph 5.** Projected U.S. Building Sector Operations 2005 – 2030.

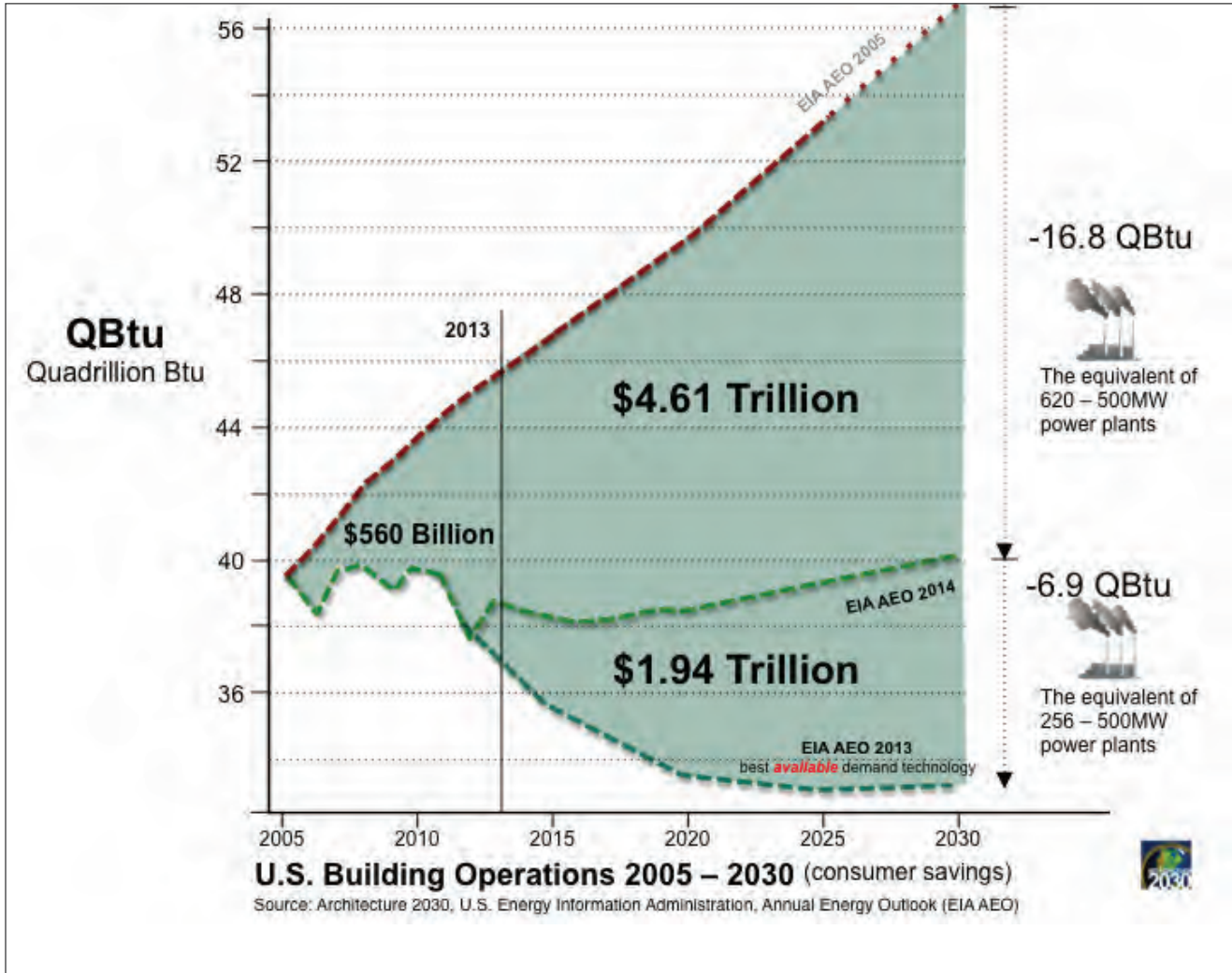


**Graph 6.** Projected U.S. Building Sector Operations 2005 – 2030, Best Available Demand Technology.

The EIA estimates that the entire U.S. building stock in 2030 is expected to be more efficient – consuming less energy per square foot of building floor area – than in 2013. In the reference case, the delivered energy (energy intensity) for residential buildings is projected to drop by 13.4 thousand Btu per square foot of floor area per year (364.8 kWh/m<sup>2</sup>/yr), and for commercial buildings by 17.5 thousand Btu per square foot of floor area per year (476.5 kWh/m<sup>2</sup>/yr).

**The Savings** | *The U.S. Building Sector Leads in Energy and Emissions Reductions*

The EIA's Annual Energy Outlook 2014 early release statistics indicate American consumers have spent \$560 billion less on energy between 2005 and 2013 than was originally projected in 2005, and will spend \$4.61 trillion less on energy between 2013 and 2030 (\$2009).



**Graph 7.** Projected U.S. Building Sector Operations 2005 – 2030, Consumer Savings.

The U.S. Building Sector continues to gather independent momentum and lead the nation on energy and emissions reductions.

## ACKNOWLEDGEMENTS

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