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CERTIFIED DECARBONIZATION

PROFESSIONAL - CDP OVERVIEW

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MODULE
4

Building Operational and Embodied Carbon, Kyoto Protocol, and Beyond.

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CERTIFIED DECARBONIZATION PROFESSIONAL - CDP OVERVIEW

Reducing operational energy, embodied carbon in building materials and construction, and converting to low-carbon fuels or renewable energy reduces building carbon. The year a project is built or installed releases 13-18% of its carbon footprint, with the rest being operational carbon. Embodied carbon is increasing in low- or zero-energy buildings due to lower operational energy needs.

Learning Objectives

- Introduction
- Climate change and sectoral decarbonization approaches
- Strategies for a decarbonization-built environment
- **Building Operational and Embodied Carbon, Kyoto Protocol, and Beyond.**
- Professional certification for decarbonization audits
- Carbon, GHG, and Sustainability Accounting
- Summary and Resources
- ASHRAE CDP Practice Test V.4.1: Test Your Knowledge!



INTRODUCTION

- Reducing operational energy in buildings and embodied carbon in building materials and construction.
- Switching to low-carbon fuels or renewable energy.
- Examining carbon embodied in buildings and strategies for managing energy use.
- 13-18% of a building's total carbon footprint is released in the year of construction or installation.
- Low- or zero-energy buildings are increasingly incorporating embodied carbon due to reduced operational energy requirements.
- Adopted on 11 December 1997, entered into force on 16 February 2005.

BUILDING OPERATIONAL AND EMBODIED CARBON, KYOTO PROTOCOL, AND MORE.

- Operates as a commitment to limit and reduce greenhouse gas emissions in industrialized countries and transition economies.
- Requires countries to adopt mitigation policies and report periodically.
- Based on the United Nations Framework Convention on Climate Change, binds developed countries.
- Places a heavier burden on developed countries due to their largely responsible role in high GHG emissions.



UNDERSTANDING EMBODIED CARBON



- Defined as the carbon cost of construction or manufacturing.
- Refers to total primary energy consumed and released from processes like material extraction, manufacture, transportation, and fabrication.
- Cost is typically calculated from the point of material extraction to the factory gate or construction site.
- Whole life cost calculation from material extraction to the grave is more accurate.
- Uncertainty of demolition methods and volume of materials recovered and recycled pose challenges.
- 'Embedded carbon' and 'embodied carbon' often used interchangeably due to lack of formal definition.
- Advantage of retaining both terms, albeit with different definitions.

UNDERSTANDING EMBODIED CARBON +

- In terms of whole-life carbon emissions, Yohanis and Norton (2002) identified four main components:
- Initial embodied energy: the energy used to initially produce the building, which includes the energy used for the abstraction, processing, and manufacture of the building's materials, as well as their transportation and assembly on site.
- Recurring embodied energy: the energy required to renovate and maintain the building throughout its lifespan.
- Operational energy refers to the energy required to run the building, which includes providing heating, cooling, lighting, and powering its various appliances.
- Demolition energy: the energy required to demolish and dispose of the building at the end of its life.



CALCULATING EMBODIED ENERGY AND CARBON IN CONSTRUCTION MANAGEMENT



- New field in construction management, used to justify locally sourced or lower-carbon materials.
- Simple selection of figures with knowledge of material and use.
- Importance of defensible calculations of embodied energy, justifying boundaries, factors, approximations, assumptions, and uncertainty levels.
- Developers should design tools for frequent updates of these factors using authoritative sources.

DIGITAL TECHNOLOGIES AND DECARBONIZATION IN ENERGY SECTOR

- In 2022, the energy sector accounted for 42% of global carbon emissions.
- Digital technologies are crucial in measuring, innovating, and developing a responsive closed-loop system for decarbonization.
- Four pillars of energy sector decarbonization: efficiency, electrification, low-carbon energy, and carbon capture and storage.
- Businesses should base their decarbonization and digitization business cases on operational improvements and risk mitigation.
- Design digitization solutions for responsible usage to ensure optimal use of electricity and resources.
- Despite a 50% increase in renewable electricity capacity in 2023, greenhouse gas emissions continue to rise.
- Digital technologies are instrumental in measuring parameters in real time and taking prompt action to correct or escalate problem



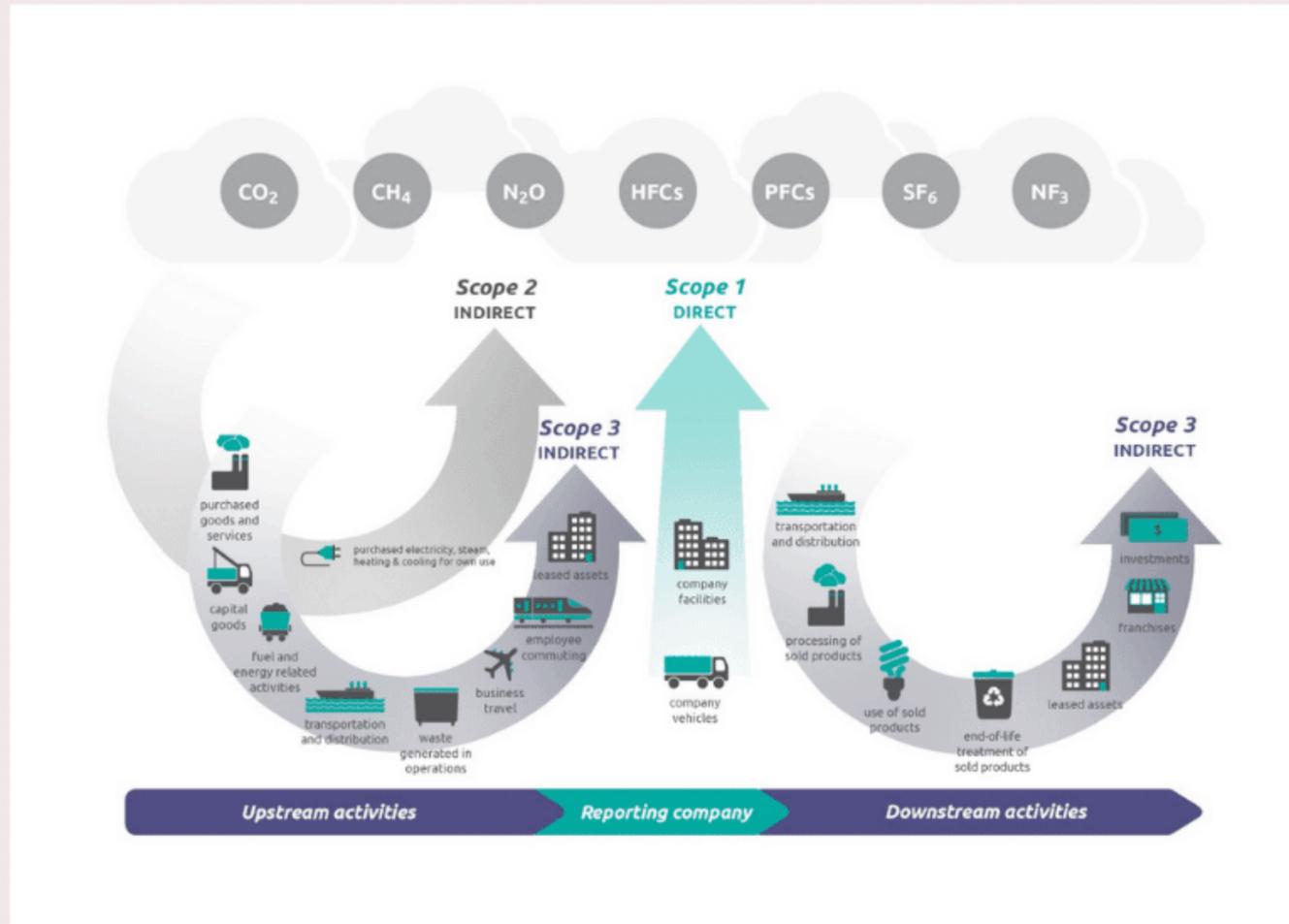
KYOTO MECHANISMS OVERVIEW

- Established flexible market mechanisms based on trade of emissions permits.
- Countries meet targets through national measures and three market-based mechanisms: International Emissions Trading, Clean Development Mechanism (CDM), and Joint Implementation (JI).
- Encourages GHG abatement to start where it's most cost-effective, like in developing countries.
- Promotes green investment and leap-frogging, allowing for the use of cleaner infrastructure and systems.



KYOTO PROTOCOL'S GREENHOUSE GAS EMISSIONS

Cities must account for seven gases: CO₂, CH₄, N₂O, HFCs, PFCs, SF₆, NF₃.

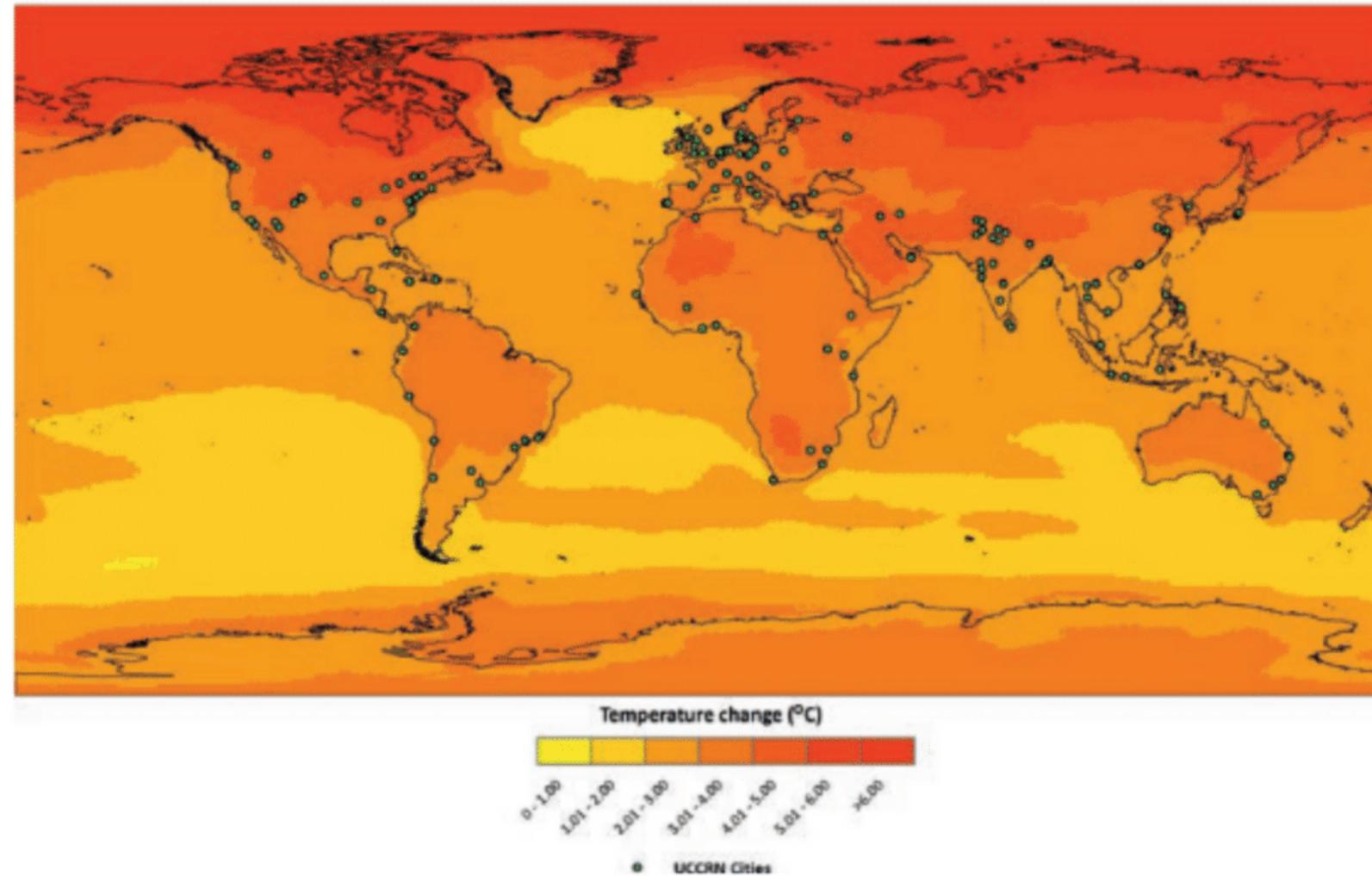


TEMPERATURE CHANGE 2080



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Temperature change 2080s



SCL Figure 2 Projected temperature change in the 2080s. Temperature change projection is mean of 35 global climate models (GCMs) and two representative concentration pathways (RCP4.5 and RCP8.5). Colors represent the mean change in mean annual temperature (2070–2099 average relative to 1971–2000 average). Dots represent ARC3.2 cities. ARC3.2 Cities include Case Study Docking Station cities, UCCRN Regional Hub cities, UCCRN project cities, and cities of ARC3.2 Chapter Authors.

KYOTO PROTOCOL: A BREAKING GROUND IN INTERNATIONAL LAW



- The Kyoto Protocol was adopted during the third Conference of the Parties (COP) in 1997, entering into force on February 16, 2005.
- Inspired by the Montreal Protocol, it sets binding and measurable objectives for countries ratifying it.
- It is the first international application of a cap and trade emission-rights system.
- The protocol distinguishes between initial and final allocations of greenhouse gas emissions.

KYOTO PROTOCOL: A BREAKING GROUND IN INTERNATIONAL LAW +

- The initial period of commitment limits emissions for the period 2008–2012 in relation to 1990.
- Australia signed the papers for Australia's ratification in 2007, making the US the only developed country not yet to ratify it.
- In January 2012, 192 states and the EU were parties to the Convention.
- Canada withdrew from the Protocol in 2011, announcing it would no longer respect its commitments.





THE PARIS AGREEMENT: A NEW MOMENTUM FOR CLIMATE ACTION



- The Paris Agreement departs from the Kyoto Protocol's top-down, market-based strategy.
- Governments develop national goals and enact non-market-based policies.
- The agreement mandates all parties to apply their best efforts through country-level "nationally determined contributions" (NDCs).
- A global stocktake every five years will allow governments to evaluate their climate action and progress toward the agreement's goal.
- Paris aspires to restrict global temperature rise this century to below 2°C above pre-industrial levels and even to 1.5°C.

THE PARIS AGREEMENT: A NEW MOMENTUM FOR CLIMATE ACTION +

- Financial flows, a new technology framework, and improved capacity-building will be needed to reach these ambitious targets.
- The agreement is set to take effect 30 days when 55 countries representing 55% of global emissions deposit their ratification instruments. The deal took effect on November 4, 2016, but climate-skeptic Donald Trump's election has weakened the US's commitment.
- By the middle of the century, we must switch from fossil fuels to sustainable energy to limit global warming.





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