HARVARD PROJECT ON CLIMATE AGREEMENTS

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“30.60”目标下中国碳交易减排效率的提高：基于广东省碳市场实践的思考

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要点：

- 广东现有两个碳排放权交易所市场试点（深圳和广州），未来还将建设粤港澳大湾区碳市场，有低碳领域的创新地域优势。
- 2020 年 9 月，中国宣布将在 2030 年前实现碳达峰，并力争在 2060 年达成碳中和。为履行“30.60”目标下的职责，大湾区需选择经济发展损耗更小、实施效率更高的方式来减少排放，增强抵御气候变化影响的韧性，促进疫情后经济绿色复苏。
- 在核算方法上，生产侧和消费侧的全生命周期核算应成为城市、园区和企业参与碳交易的方法基础。
- 中国碳交易市场的活跃度有待提高，未来可逐步向中小企业和个人安全开放碳市场，并在风险控制的前提下将跨境贸易纳入碳交易机制中。
- 目前，地方试点和全国碳市场碳配额基本实行免费分配，未来可考虑有偿分配和免费分配合理混搭，建立透明、公平和动态碳交易配额分配机制
- 在电力行业基础上，全国碳市场下一步还将纳入其他高碳重点行业，应促进地方试点与全国碳市场平衡、错位发展，提高减排效率

为实现 1.5 摄氏度的控温目标，需在2030年前削减一半以上的全球年排放总量（即250-300亿吨二氧化碳当量），并于本世纪中叶前后实现总体净零排放（IPCC,2018；UNEP,2021）。城市地区贡献了全球总排放量的70%以上，既有巨大的减排压力，也有可观的减碳潜力（Seto et al., 2014）。

得益于防疫策略的成功，粤港澳大湾区国际和国内贸易得以快速恢复，总体实现了经济的正增长。同时，大湾区尤其是广东省脱碳步伐不断加快，2020 年碳排放强度（即单位 GDP 二氧化碳排放）比 2015 年下降 22.35%，超额完成了“十三五”计划的减排目标。广东省碳排放配额累计成交量连续七年稳居全国第一，2020 年度广州市和深圳市碳排放履约工作均克服了疫情的困难顺利完成，企业履约率达 100%。

广东是中国的低碳前沿地区之一，现有两个正在运营的碳排放权交易所市场试点，并将很快领导粤港澳大湾区碳市场的建设，有低碳领域的创新地域优势。面向碳达峰碳中和

的“30.60”目标，大湾区需选择经济发展损耗更小、实施效率更高的方式来减缓气候影响，同时促进疫情后经济绿色复苏和行业可持续发展。从碳排放权交易的角度，有以下几个相关的要点：

1. 生产侧和消费侧的全生命周期核算应成为城市、园区和企业参与碳交易的方法基础

随着经济发展，城市大多会演变为消费终端，退出大部分的制造业生产。园区和企业更是高度依赖外界的资源能源输入，驱动上游供应链的相关排放，并存在排放外溢风险（Chen et al., 2020）。几乎所有粤港澳大湾区城市消费碳排放高于本土直接碳排放，香港、广州和深圳等尤为显著，可见涵盖上游活动的全生命周期减排尤为必要（图 1）。

目前，中国碳核算数据库（CEADs）建立了中国省级碳排放清单（http://lca.cityghg.com）；生态环境部环境规划院、北京师范大学和中山大学联合发布了中国产品全生命周期温室气体排放系数库（http://lca.cityghg.com）。建立公开可验证的产品碳数据库和核证体系，可为企业参与公平碳交易提供方法基础，推动生产活动和居民消费的低碳转型。

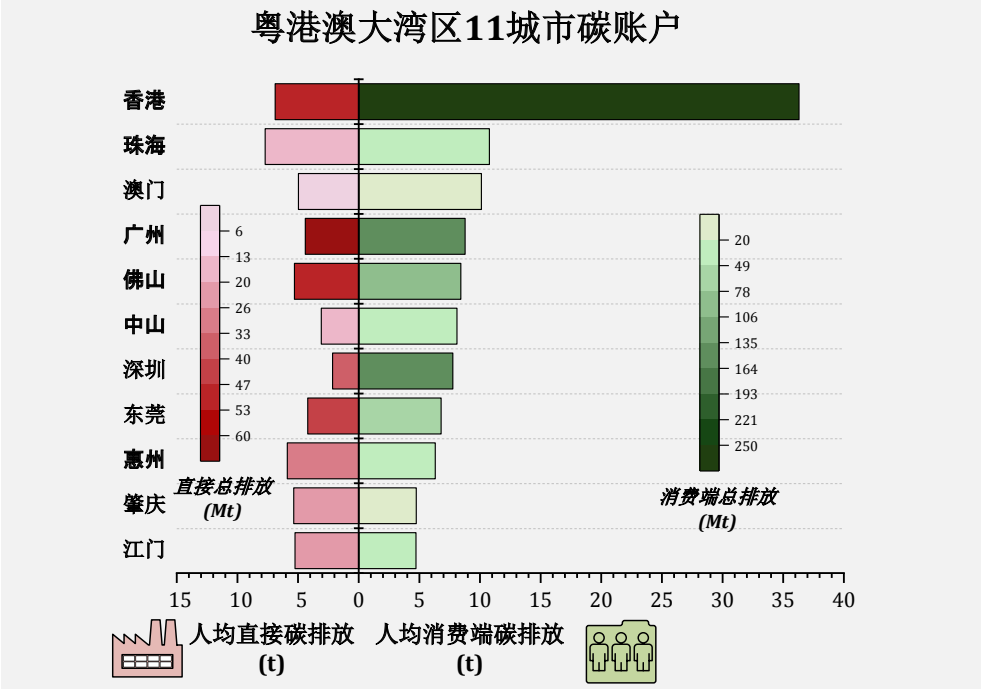

图 1 粤港澳大湾区城市本土和消费端碳账户

（数据来自作者核算）

2. 在重点行业大型高碳企业的基础上，可逐步向中小企业和个人安全开放碳市场

中国碳交易市场的活跃度有待提高。以广东省为例，由于准入门槛的限制和减排积极性的差异，所涉及的企业单位仍然很有限。应以“30.60”目标为契机，吸引更多的投资者和专业人员，进一步扩大碳交易控排行业范围和降低控排企业门槛，提高碳市场的减排贡献。

中国多个城市正探索利用碳普惠机制（PHCERs）[1]来促进中小企业和居民的减排。相比碳市场，目前使用 PHCER 信贷的减排量仍较低。以广州为例，2020 年共 16 个自愿减排项目减排量约为 12.19 万吨二氧化碳当量。

值得注意的是，中小企业和个人虽然减排潜力巨大，但核查方法完备度和成熟度较低，抵御碳交易风险的能力也比大型企业弱（图 2）。未来需提高碳抵消方法和数据的准确度，保证碳市场的安全开放。

3. 将进出口贸易纳入碳交易体系可减少排放跨境泄露，但需注意控制金融风险

在《欧洲绿色协议》的引导下，欧盟提出了碳边境调节机制（Carbon Border Adjustment Mechanism, CBAM），针对欧盟进口的部分商品征收碳边境税以限制跨境碳泄露。如若中国碳交易市场与欧盟进行对标，需研究如何合理地将进出口贸易纳入碳交易体系中。一个可能的尝试是，基于粤港澳大湾区碳排放权交易市场，推动港澳投资者参与广东碳排放权的交易，探索跨境交易机制。当然，跨境贸易涉及到多个国家和地区的经济往来，情况复杂多变。因此，在跨境碳减排过程中，监控区域和部门的金融风险至关重要（图 2）。

1 “碳普惠”机制允许参与者从自愿减排项目或某些具有社会价值的个人低碳活动中获取碳币。

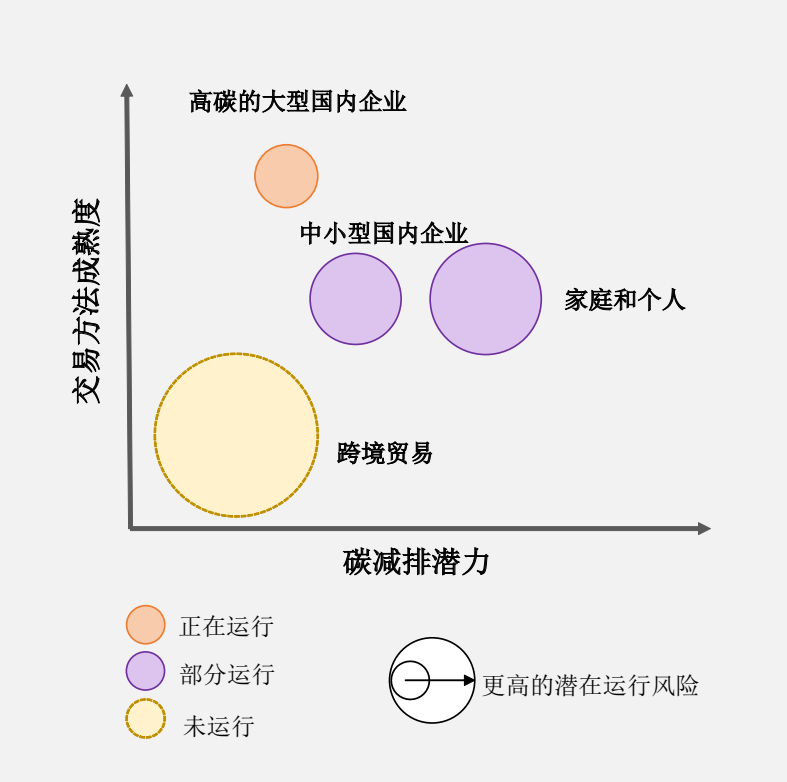

图 2 碳排放权交易体系与市场参与者

4. 需要进一步建立透明、公平和动态碳交易配额分配机制，推动碳市场高效运行

碳配额分配机制对碳市场高效运行起决定性作用。在碳配额分配方法上，目前地方试点较多采用历史排放法，此外历史强度法、基准线法等方法也有采用。例如，针对电力行业，全国碳市场对 2019-2020 年配额实行全部免费分配，并采用基准法确定重点排放单位所拥有机组的配额量。

在碳交易的成熟阶段，分配方法应根据各地企业的实际情况，将有偿分配（如配额拍卖）和免费分配合理混搭，并实现分产业的多层级配额分配。数据核查是配额分配的重要基础。未来需准确核查具体行业和企业历史碳排放和预期碳排放总量，进一步构建一个透明、公平和动态碳交易配额分配机制，推动碳市场高效运行。

5. 促进地方试点与全国碳市场平衡、错位发展，多举措提高减排效率

全国碳市场在首个履约周期纳入发电行业企业 2000 多家，2021 年累计成交碳排放配额 1.79 亿吨。在电力行业成功运行基础上，全国碳市场下一步还将纳入建材、有色金属、钢铁、石化、化工等高碳行业。

未来，粤港澳大湾区碳市场应与国家碳市场有不同的“生态位”。将达到特定排放量阈值以上的高碳排企业纳入全国碳市场的同时，鼓励大湾区城市围绕国家碳排放量阈值以下的较高排放企业开展试点工作。市场参与者应当建立粤港澳三地间的资源互补与协同减排机制。此外，还应多举并重，增加绿色税收、绿色金融等配套政策，大力配合碳交易的工作，激励企业主动创新、自愿减排，深度发掘企业减排潜力，进一步提高减排效率。

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INCREASING THE EMISSIONS-REDUCTION EFFICIENCY OF CARBON TRADING SCHEMES IN CHINA UNDER THE "30.60" TARGET: REFLECTION ON THE CARBON MARKETS OF GUANGDONG PROVINCE, CHINA

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Key Points:

- Guangdong currently has two pilot carbon-emissions-trading markets (in Shenzhen — and in Guangzhou, for the remainder of Guangdong Province). The Guangdong—Hong Kong—Macao Greater Bay Area (GBA) carbon market will be established in the near future. Therefore, Guangdong Province has regional advantages in innovation in the low-carbon field.
- In September 2020, China announced its intention to peak carbon emissions by 2030 and achieve carbon neutrality by 2060. To meet its responsibilities under the "30.60" target, GBA needs to choose a less costly and more efficient way to reduce emissions, build resilience to climate impacts, and promote green economic recovery from the COVID-19 pandemic.
- In terms of accounting methods, life-cycle accounting from production and consumption perspectives should be the methodological basis for cities, parks, and enterprises to participate in carbon trading.
- Trading activity in China's carbon markets needs to be increased. In the future, carbon markets can gradually be opened to small and medium-sized enterprises and individuals, and cross-border trade can also be included in carbon trading mechanisms, with proper risk management.
- At present, carbon quotas in local pilots and the national market are allocated freely. In the future, a reasonable mix of auctioned allocation and free allocation can be considered to establish a transparent, fair, and dynamic carbon-quota-allocation mechanism.
- After starting with the electricity industry, the national carbon market will continue to include other key high-carbon industries; China should seek balanced development between local pilots and the national carbon market to improve the efficiency of emission reduction.

To reach the 1.5° C climate target, global annual emissions need to be halved by 2030 (i.e., reduced by 25-30 billion tons carbon dioxide equivalent [CO_2e] annually), and achieve overall net-zero emissions around mid-century (IPCC, 2018; UNEP, 2021). Urban areas contribute more than 70% of

global CO_2 emissions and therefore both contribute greatly to climate change and have considerable potential for carbon reduction (Seto *et al.*, 2014).

Owing to the success of its prevention strategy against COVID-19, GBA's international and domestic trade has recovered rapidly, supporting growth of its economy. Simultaneously, the pace of decarbonization in the GBA, especially in Guangdong Province, continued to accelerate. In 2020, the carbon intensity (i.e., CO_2 emissions per unit of GDP) decreased by 22.35% compared with 2015, exceeding the reduction target set by the Thirteenth Five-Year Plan of China. The cumulative turnover of carbon quotas (i.e., trading activity) in Guangdong Province has ranked first in China for seven consecutive years. In 2020, Guangzhou and Shenzhen achieved a 100% compliance rate among enterprises with ETS-compliance obligations, despite the disruption of COVID-19.

Guangdong, one of the low-carbon frontiers in China, currently has two operating carbon-market pilots, and will soon lead the construction of the GBA carbon market. To meet the "30.60" target of carbon peak and carbon neutrality, GBA should take a less costly and more efficient path to mitigate climate impact, and meanwhile promote a green economic recovery and sustainable development in a post-pandemic era. From the perspective of carbon trading, there are several key points that are relevant:

1. Life-cycle accounting from production and consumption perspectives should be the methodological basis for cities, parks, and enterprises to participate in carbon trading.

Most cities will evolve into consumption terminals and withdraw from most manufacturing production as their economies develop. Industrial parks and enterprises are even more highly dependent on resource and energy inputs from outside, driving emissions associated with upstream supply chains, with the risk of emission spillovers (Chen *et al.*, 2020). Almost all GBA cities have higher consumption-based carbon emissions (CBE) than territorial carbon emissions (TCE), especially Hong Kong, Guangzhou, and Shenzhen, suggesting the need for a reduction of life-cycle emissions covering upstream activities (Figure 1).

At present, Carbon Emission Accounts and Datasets (CEADs) has established China's provincial emissions inventory (http://lca.cityghg.com); The Chinese Academy of Environmental Planning, Beijing Normal University, and Sun Yat-sen University jointly released the China Products Carbon Footprint Factors Database (http://lca.cityghg.com). Establishing a public and verifiable product carbon database and certification system can provide a methodological basis for enterprises to participate in fair carbon trading, which will advance a low-carbon transition of production and household consumption.

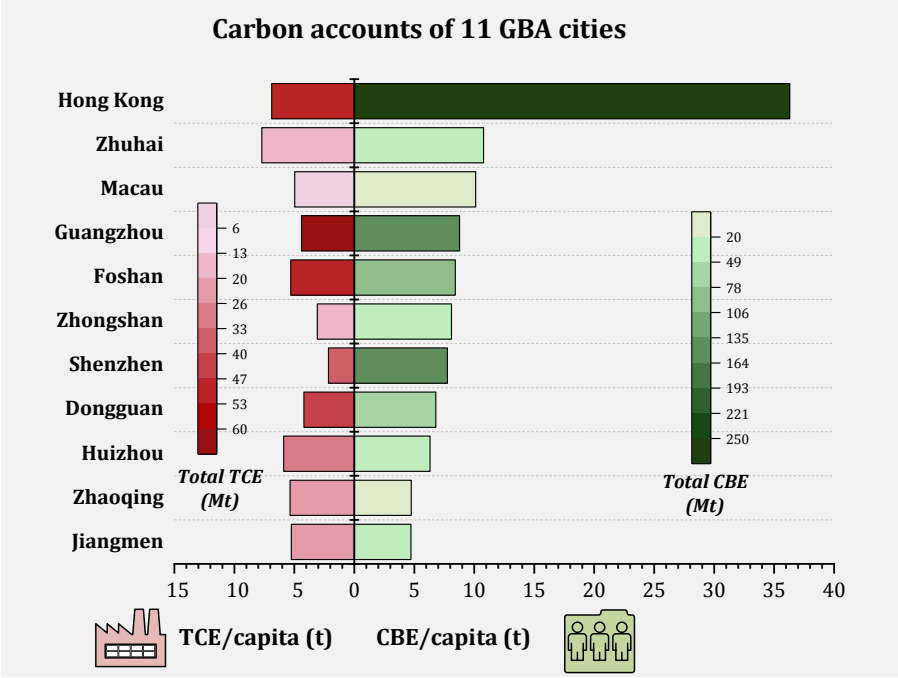

Figure 1: Carbon accounts of GBA cities from territorial and consumption perspectives

(TCE: Territorial carbon emission; CBE: Consumption-based carbon emission; Data are from author's calculation)

2. On the basis of experience with large high-carbon enterprises in key industries, carbon markets should be opened gradually to small and medium-sized enterprises and individuals.

Trading activity in China's carbon markets needs to be increased. Taking Guangdong Province as an example, the enterprises involved are still limited due to the restriction of market access and the lack of strong stimulus policy. GBA should take the "30.60" target as an opportunity to attract more investors and professionals, further expand the scope of emissions-control industries, and lower the threshold of entry, thereby increasing the contribution of emission reduction.

Many cities in China are exploring Puhui Certified Emission Reductions (PHCERs) credits[1] to promote small and medium-sized enterprises and residents to reduce emissions. Compared with carbon markets, the current emissions reduction from use of PHCER credits is still low. In Guangzhou, for example, 16 voluntary emission reduction projects generated offset credits of about 121.9 thousand tons of CO_2e in 2020.

It is worth noting that although small and medium-sized enterprises and individuals have great potential for emissions reduction, their verification methods are less mature, and they have less ability to manage carbon trading risk (Figure 2). To ensure the safe opening of the carbon market, the accuracy of carbon offset methods and data needs to be further improved.

1 The "Tan Puhui" scheme allows such offset credits to be generated from voluntary emissions-reduction projects or from certain individual low-carbon activities that have social value.

3. Incorporating import and export trade into national and local pilot ETSs can reduce cross-border emission leakage, but this should be built on better management of financial risk.

Under the European Green Deal, the European Union (EU) proposed a Carbon Border Adjustment Mechanism (CBAM), which imposes a carbon border tax on certain goods imported to limit cross-border carbon leakage. If China's carbon trading market is to be linked with the EU, it is important to explore how to reasonably incorporate import and export trade into the carbon trading system. One viable approach could be encouraging Hong Kong and Macao investors to participate in carbon trading in Guangdong based on the GBA carbon market and explore cross-border trading mechanisms. Cross-border trade involves economic exchanges among many countries and/or regions, and the situation could be very complicated and volatile. Therefore, it is essential to monitor regional and sectoral financial risks in the process of reducing cross-border-carbon emissions (Figure 2).

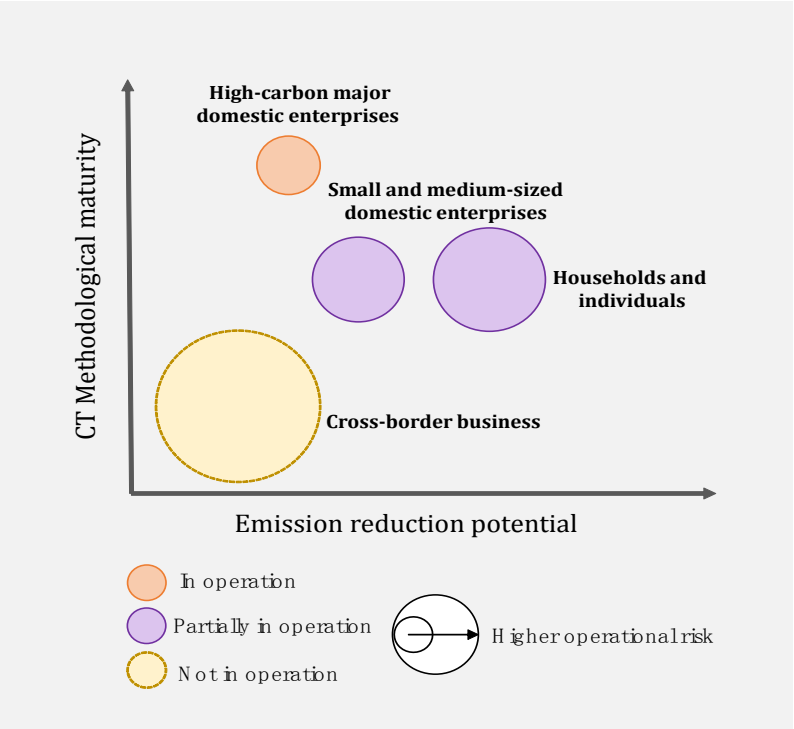

Fig. 2 Carbon trading (CT) systems and market participants

4. A transparent, fair, and adaptive allocation mechanism for carbon trading quotas needs to be further established to promote an effective operation of the carbon market.

The carbon-quota-allocation mechanism plays a decisive role in efficient operation of carbon markets. In terms of carbon quota allocation method, the historical emissions method is used more often in local pilot ETSs in China, as are the historical intensity method and the baseline method. For instance, for the electricity sector, the national carbon market of China has implemented a free allocation of all

quotas for 2019-2020, and the baseline method is used to determine the quota for the emitting units of power generation.

In the mature stage of carbon trading, the allocation method should be mixed with paid allocation method (such as quota auction) according to the actual situation of local enterprises, and realize a multi-layer allocation of quota by industry. Data verification is an important basis for quota allocation. In the future, it is necessary to accurately verify the historical emissions and the projected emissions of industries and enterprises, and build a transparent, fair, and adaptive allocation mechanism for carbon-trading quotas that promotes the efficient operation of carbon markets.

5. China should promote balanced development between local pilots and the national carbon market and improve the efficiency of emissions reduction with multiple measures.

The national carbon market included more than 2,000 enterprises in the power generation industry in the first compliance cycle, with a total of 179 million tons of emissions quotas traded in 2021. Based on the successful operation in the power industry, the national carbon market will incorporate other high-carbon industries such as building materials, non-ferrous metals, steel, petrochemicals, and chemicals in the next step.

Looking forward, the GBA carbon market should have a different "ecological niche" from the national carbon market. High-carbon-emission enterprises that reach specific emissions thresholds should be included in the national carbon market, while other higher-emission enterprises below the national carbon-emission threshold are encouraged to participate in GBA's local pilot market. More generally, market participants should establish a mechanism that allows complementary resources and synergistic emissions reduction among Guangdong, Hong Kong, and Macao. In addition, other supporting policies, such as green taxation and green finance, should also be in the toolbox of emissions mitigation, based on price signals generated by carbon markets. This can encourage enterprises to explore their emissions-reduction and broader decarbonization potential in innovative ways and will further enhance the efficiency of emission reduction.

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ABOUT THE HARVARD PROJECT ON CLIMATE AGREEMENTS

关于哈佛气候协议项目：哈佛气候协议项目（简称哈佛项目）是成立于 2007 年的一个哈佛大学校级倡议，旨在识别和推进应对全球气候变化的科学合理、经济可行和政治务实的公共政策选择。哈佛项目依托世界各地主要学者领袖，对国内外气候变化政策的政策架构、关键设计要素和制度层面进行研究。哈佛项目由哈佛大学肯尼迪学院A. J. 迈耶（A. J. Meyer）能源与经济发展教授 Robert N. Stavins 领导。更多信息请访问哈佛项目网站：www.hks.harvard.edu/hpca。

The Harvard Project on Climate Agreements is a Harvard-University-wide initiative established in 2007 to identify and advance scientifically sound, economically sensible, and politically pragmatic public policy options for addressing global climate change. Drawing upon leading thinkers from around the world, the Harvard Project conducts research on policy architecture, key design elements, and institutional dimensions of international and domestic climate-change policy. The Harvard Project is directed by Robert N. Stavins, A.J. Meyer Professor of Energy and Economic Development, Harvard Kennedy School. For more information, see the Harvard Project's website: www.hks.harvard.edu/hpca.

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