“双碳”行动的消费维度

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摘 要：目前“双碳”行动已在生产领域“热”起来了，相对而言，消费领域还处在预热状态。“双碳”行动直指高度能源依赖的现代生活、矫正过多物质消耗的消费方式、引导循环再生的可持续消费，是对消费行为的外在紧约束。低碳消费的国际经验主要是减少家庭和办公室人均碳排放、鼓励电动出行和低耗交通、鼓励再生利用和循环经济等。促进我国绿色低碳消费主要在食品、衣着、交通、居住、用品、能源等八个方面发力，其中制止食品浪费、建立新型饮食文化是首要任务。食品浪费现象主要缘于共餐式餐饮方式、餐饮企业利润导向、传统饮食文化影响、经费支出来源等。建议开展建立绿色低碳餐饮消费方式的专题研究和试点，依靠群众，探索使《反食品浪费法》落实的模式。

关键词：“双碳”行动 绿色低碳 消费方式 食品浪费

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一、一石激起千层浪

2020年9月，习近平主席在第75届联合国大会上宣布了中国二氧化碳排放力争于2030年前达到峰值、努力争取2060年前实现碳中和的“双碳”目标。该目标宣布后，在国内特别是经济领域引起了强烈反响，大量媒体和论坛等纷纷以“双碳”为题进行讨论，从专家到企业家都热情参与，热议不断，言必称“碳”。

2021年，国家层面先后出台了《关于完整准确全面贯彻新发展理念做好碳达峰碳中和工作的意见》《2030年前碳达峰行动方案》《关于深入打好污染防治攻坚战的意见》，对实现“双碳”目标做好了顶层设计，使实现“双碳”目标正式进入行动阶段（本文把做好碳达峰、碳中和工作统称为“双碳”行动）。

“双碳”目标本来是一个从生态环境领域提出的命题，却在全社会引起了巨大的反响，值得深思。其原因就在于中央指出的“实现碳达峰、碳中和是一场广泛而深刻的经济社会系统性变革”。如果把“经济社会”看作是由“生产”和“消费”两大板块组成的，可以看到，目前“双碳”行动主要是在生产领域“热”起来了，相对而言，消费领域还处在预热状态。绿色低碳消费是“双碳”行动的重要内容，努力探索“双碳”行动对人的消费方式的影响和挑战，积极倡导绿色低碳消费方式，具有重要的现实意义。

二、“双碳”行动的基本格局

我国“双碳”行动的主要目标是，到2025年，初步形成绿色低碳循环发展的经济体系，重点行业能源利用

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效率大幅提升。单位国内生产总值能耗比2020年下降13.5%；单位国内生产总值二氧化碳排放比2020年下降18%；非化石能源消费比重达到20%左右；森林覆盖率达到24.1%，森林蓄积量达到180亿立方米。到2030年，经济社会发展全面绿色转型取得显著成效，重点耗能行业能源利用效率达到国际先进水平。单位国内生产总值能耗大幅下降；单位国内生产总值二氧化碳排放比2005年下降65%以上；非化石能源消费比重达到25%左右，风电、太阳能发电总装机容量达到12亿千瓦以上；森林覆盖率达到25%左右，森林蓄积量达到190亿立方米；二氧化碳排放量达到峰值并实现稳中有降。到2060年，绿色低碳循环发展的经济体系和清洁低碳安全高效的能源体系全面建立，能源利用效率达到国际先进水平，非化石能源消费比重达到80%以上，碳中和目标顺利实现。

为了实现上述目标，需推动完成八项任务：①推进经济社会发展全面绿色转型；②深度调整产业结构；③加快构建清洁低碳安全高效能源体系；④加快推进低碳交通运输体系建设；⑤提升城乡建设绿色低碳发展质量；⑥加强绿色低碳重大科技攻关和推广应用；⑦持续巩固提升碳汇能力；⑧提高对外开放绿色低碳发展水平。

可以看到，上述任务中，能源、交通、城乡、碳汇等都是与人们消费行为密切相关的，推进经济社会发展全面绿色转型更是直接倡导绿色低碳生活方式。这说明“双碳”行动不仅倒逼人类生产方式的绿色转型，也在催化人们生活方式的深刻变革，培育绿色低碳生活方式迫在眉睫、呼之欲出。

三、“双碳”行动对消费方式的挑战

人的生活方式以两种途径对生态环境产生影响：一种是直接影响，即生活中产生的排放物和废弃物会给生态环境增加压力；另一种是间接影响，即生活方式会给生产领域传递信号，导致生产过程对生态环境带来危害。倡导和培育绿色生活方式有利于同时在这两个方面降低对生态环境的压力，因此长期以来受到重视，被列为我国生态文明建设中的重要内容。“双碳”目标的提出，在原有基础上对培育绿色低碳生活方式提出了更新和更高的要求。

第一，“双碳”行动直指高度能源依赖的现代生活。随着我国经济快速发展和人民生活水平的极大提高，人们的消费方式也进入了日益依赖能源消耗的模式。今天的生活中，住房乘用电梯、电器依靠电源、餐饮使用燃气、冬季需要供暖、出行消耗燃油等，不仅须臾不可离开能源，而且生活消费的能耗强度也逐渐增强。在化石能源为主的能源结构下，这种能耗强度不断升高的消费方式产生了更多的碳足迹。与世界人均能耗相比，我国人均能耗水平是低的，但14亿多人口使得总的消费碳排放量变成一个大数。“双碳”行动主要是推动以能源结构调整和节约使用能源为主体内容的能源革命，这就对现行的生活能源消费格局提出了强烈的变革要求。近年来，国家采取了诸如加快折旧、给予补贴等惠民政策，加快了高能耗家用电器的更新，使电动汽车等新能源车大量替代了燃油汽车等，对于降低能耗和污染物排放及碳排放起到了很大作用。随着“双碳”行动深入推进，现行高度依赖能源消耗的社会消费习惯和消费模式还将发生深刻变化，低碳消费是未来消费方式的重要导向。

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第二，“双碳”行动矫正过多物质消耗的消费方式。随着消费水平的提高，现代生活中物质产品的生产链条在拉长，从原材料到最终品的环节在增多，产品的精细化和精致化导增加了很多过程性中间产品，例如产品的奢侈装饰、过度包装等。在近年来快速增长的快递、外卖业中，2016年全国快递312.8亿件，2020年达到833.6亿件，4年增长166%，人均快递业务量达到60件；2021年上半年达到494亿件，估计全年将突破1000亿件，人均达到72件。2016年全国网上外卖用户2.09亿，2020年达到4.19亿，4年增长100%；2016年手机网上外卖用户1.94亿，2020年达到4.18亿，4年增长115%。2020年，全国外卖行业总体订单量超过171亿单（韦洪莲，2021）。我国每天的快递业务量已突破3亿件，快递包装中大量使用编织袋、塑料袋、纸封套、包装箱、木箱、胶带以及缓冲物等，2020年快递包装废物总量超过1000万吨（章轲，2021；中国环境与发展国际合作委员会课题组，2021； 中金公司，2021）。这些快递包装物在其生产过程中也消耗了很多能源并排放了温室气体，因此控制其过度使用也是“双碳”行动的重要内容。

第三，“双碳”行动引导循环再生的可持续消费。生活水平提高导致生活消费中物质消耗增加是难以避免的，人民生活也不能因为“双碳”的要求而不再改善。因此，为了在不断提高人民消费质量的前提下尽量减少物耗增加而产生的碳排放，必须加强对这些物质消费后的废弃物进行循环再生利用，即在减量化基础上加强其资源化，这是“双碳”行动的重要内容。我国目前正在制定《快递包装废物污染控制技术规范》，其中规定快递包装废物的利用处置应按照循环使用、再生利用、降解处理、焚烧处置、填埋处置的优先顺序进行选择。事实上，随着固体废物处置中的环保要求日趋严格，我国垃圾处理填埋和焚烧的成本是上升的。中国环境保护产业协会研究发现，如果按焚烧1吨废塑料排放3.03吨二氧化碳、中和1吨二氧化碳需种55棵梭梭树计算，2019年中国规上企业塑料制品产量为8184.2万吨，产生废塑料6300万吨，其中31%（约1953万吨）焚烧，则将排放约5918万吨二氧化碳。因此，提高废弃物的回收利用或循环再造，可以减少处置成本，相应减少碳排放。

总之，“双碳”目标和“双碳”行动本质上是新增的对消费行为的外在紧约束，我国由于人口多、消费量大，这种新增约束与人民不断提升消费的需求之间，客观上存在一定矛盾冲突，因此正确处理二者关系，精准把控二者节奏，是“双碳”行动的关键之处，总的方针应该是鼓励消费、反对浪费。

四、中国促进绿色低碳消费的主要成效

历史上我国长期出于物质匮乏状态，因此社会消费的主体形态是节约和回用。这种消费理念深深地影响了社会大众的消费习惯，也主导了国家对于社会消费的政策制定过程。进入21世纪，我国政府陆续出台了100多份鼓励绿色低碳消费的政策文件，分别涉及节能节水、环境标志、能效标识、有机产品、绿色食品、绿色建筑、绿色产品、绿色交通、政府绿色采购等多种消费类型，这些政策包括财政补贴、税收减免、价格优惠、投资支持、金融便利、志愿行动等，努力引导社会消费向绿色低碳方向前进。

（一）鼓励绿色低碳消费的若干政策

1.节能标识：国家对电冰箱、空调等耗能产品进行能耗测定，分别在产品上贴上能耗高、能耗中、能耗低

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等标签，以鼓励消费者选择节能型产品。

2.环境标志：从1993年开始实行这项制度，国家对那些环境友好型的产品给予环境标志认证，引导消费者购买和使用。

3.阶梯水价：各地对单位和家庭根据耗水程度收取水费，使用量超过基本需求定额的需缴纳更高价格的水费，越是缺水的地区则阶梯水价越高，以此鼓励节约用水。

4.家电更新补贴：对于能耗高的旧家电产品，如果提前更换新的节能性产品，国家给予适当补贴，或旧产品冲抵部分新产品价格。

5.新能源车补贴：国家对电动汽车等新能源家用交通工具给予适当补贴，以降低消费者购车成本，鼓励新能源车替代燃油汽车。

6.共享单车：很多城市为共享单车提供场地和其他扶持措施，使共享单车快速普及到城市各个地方，以此减少交通压力和汽车尾气排放。

7.政府绿色采购：国家将节能标识和环境标志产品优先纳入政府采购清单，通过市场手段引导产品生产企业转向生产更多的绿色产品。

8.有机产品：国家对不使用农药化肥生产的高质量农产品等给予认证，授予有机产品标签，鼓励公众消费，并引导更多企业进行绿色生产。

（二）绿色低碳消费的实效

中国环境与发展国际合作委员会《绿色转型与可持续社会治理》报告反映了以下绿色低碳消费的实际成效：

据保守估算，2017年高效节能空调、电冰箱、洗衣机、平板电视、热水器等五类产品国内销售近1.5亿台，近5000亿元，有机产品产值近1400亿元，绿色饭店企业1500家，单体绿色建筑项目达到4500个，绿色食品标志产品31000多种，新能源汽车销售77.7万辆，共享单车投放量超过2500万辆。根据阿里研究院发布的《2016年度中国绿色消费者报告》，2015年，阿里网络销售平台上有50大类、2亿绿色篮子商品（绿色篮子商品是具有节资节能、环境友好、健康品质三大绿色属性的商品集合），绿色篮子消费额占阿里销售平台的11.5%。到2018年底，环境标志认证覆盖了100多类产品，产品价值4万多亿元。

五、低碳消费转型的国际经验

实现碳达峰碳中和是一个国际趋势，很多国家做出了相关承诺，并采取措施推进低碳消费进程。本文根据2021年完成的中国环境与发展国际合作委员会《绿色转型与可持续社会治理》报告整理出以下相关国际经验。

2010年提出的《联合国可持续消费和生产模式十年方案框架》涉及七个主要领域：可持续公共采购、旅游、消费者信息、建筑与建设、食物系统、生活方式、教育。可以看到，这些几乎覆盖了人们生活的所有具体方面。瑞典战略环境研究基金会研究表明，如消费转向更具可持续性的产品和服务，温室气体减排量可以达到

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40%(中国环境与发展国际合作委员会课题组,2021)。

具体而言,在转向低碳消费方面,主要有以下国际经验:

1.减少家庭和办公室人均碳排放

2021年德国提出到2030年将基于消费层面的人均温室气体排放量比2016年减少一半,具体路径包括提高消费者对"个人消费足迹"认知、食物浪费减半、自行车使用量增加一倍以及将电子商务中通过认证的可持续产品市场份额提高到34%等。

2017年瑞典制定了通过五方面来跟踪主要消费领域温室气体排放轨迹的计划,包括个人交通、航空旅行、食品、建筑、纺织品等,并以此作为区域排放跟踪的补充。

2021年日本国会通过修改了《全球变暖对策促进法》,规定到2050年实现脱碳社会(碳中和)。环境部门在全国推广"酷选择"运动,包括少用空调的"凉装""暖装"运动、合理使用交通工具的"智能移动"、节能高效照明的"点亮未来计划"等。

2.鼓励电动出行、低耗交通

发达国家以汽车、航空为主的交通旅行消费是碳排放的主要来源之一,因此,他们比较强调交通运输方式的低碳化转变。2011年德国出台了《国家电动交通工具发展计划》,2016年推出了包括对混合/非混合动力电动汽车的环保补贴等在内的诸多采购激励政策,对4万欧元以下的电动汽车,纯电动车最高补贴9000欧元,混动车补贴6750欧元;对4万欧元以上的电动汽车,纯电动车最高补贴7500欧元,混动车5625欧元;此外新电动车可10年免缴汽车税。

为降低燃油机动车碳排放,2020年德国修订了《机动车税法案》,对碳排放较高的车增税,对低排放车减税,排放量不超过95克CO2/千米的汽车免税,但若二氧化碳排放上升,纳税额将会上升。2021年德国通过了《推广清洁和节能汽车法》,要求公共机构提高清洁汽车采购比例,使电动汽车采购比例在2021~2025年达到22.5%,2026~2030年达到32.5%。

瑞典1/3的碳排放来自交通行业,且车辆以相对老旧的高耗能大型车为主。2018年瑞典推出"奖惩系统",化石燃料需缴纳增值税和燃料税(碳和能源税),车主还需缴纳年度汽车税。2019年瑞典电动汽车注册比例达到了18%的历史高点。

日本从2000年起推出环境标志系统,对符合一定排放和燃料效率标准的汽车予以认证。2009年,对电动汽车、燃料电池汽车、天然气汽车、插电式混动汽车、清洁柴油汽车等"下一代汽车"实施减税计划。2020年日本财年预算共有汽车相关税收2.6万亿日元,占总税收的2%。

3.鼓励再生利用和循环经济

对物质产品进行循环利用是降低碳排放的主要路径之一。《欧盟生态指令2009/125/EG》旨在到2020年降低欧盟能耗约9%,到2030年降低16%。2020年欧盟又发布了《新循环经济行动计划:创造一个更清洁和更具竞争性的欧洲》,覆盖了电子和信息通信技术、电池和车辆、包装、塑料、纺织品、建筑住房、食品、水和营养物质在内的主要商品价值链。从2025年起,欧盟废弃物管理法规将要求对纺织品进行专门回收。

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德国在1991年就出台了《包装条例》，提出了著名的生产者责任延伸制度，要求生产者对产品的最终去向负责，从而鼓励产品设计中做到易拆解、易回收。2020年德国实施新修订的《循环经济法》，倡导改变“丢弃文化”，要求生产商、零售商、销售平台等把过去当作垃圾丢弃的商品或其包装物进行捐赠或再利用。2021年新修订的《包装法》规定所有一次性塑料瓶和易拉罐均收取0.25欧元的法定押金。从2023年起，餐厅、外卖商店、咖啡店等必须提供多用途容器，以便提高其重复使用比例。

日本提出了“循环型社会”理念，旨在扩展循环经济的范围，使整个社会都尽量做到资源循环使用。2000年通过的《循环型社会形成推进基本法》强调垃圾的减少、重复利用和循环利用，覆盖包装、家电、食物、汽车等多个领域。日本汽车工业协会制定了《推动报废汽车数量减少、重复使用和循环利用的产品设计阶段提前评估指南》，指导设计易于拆解分类的新款汽车。有的服装产商和销售商开展“衣服到衣服再循环”运动，回收旧衣服送给世界各地有穿衣需求的群体，无法被重新利用的衣服则会被处理成燃料或隔音材料进行循环使用。2021年通过的《塑料资源循环法》规定到2050年实现塑料材料的循环利用。

以上国际经验只是大量经验做法中的一部分，总体上可以看出，出于保护生态环境和稳定全球气候的要求，人类已经在努力反思和改造原有的生产和生活方式，这些努力中的每一个行动都比较微观和具体，但积少成多、集腋成裘，总体的效应就很大，这是与生产体系转型比较注重大规模企业行动不同的消费体系转型的特点。

六、中国绿色低碳消费之路

在开展“双碳”行动、实现“双碳”目标进程中，加快推进生产领域的绿色转型与大力促进绿色低碳消费是“鸟之双翼”，比翼齐飞方为正道。

我国是一个人口多、资源紧、经济强的发展中国家，人们的生活方式具有二重性：一方面具有天人合一的人与自然和谐共生理念，其生活方式（包括消费模式）具备节约、简朴、循环等特征基因，总体上是属于绿色低碳范围的，这与历史上我国长期处于物质贫乏状态有关。另一方面，我国近几十年来经历了快速的工业化和城市化进程，人民生活水平迅速改善，西风东渐之下，一些过度消费、浪费型消费观念和行为有所蔓延，又出现了与可持续发展不相吻合的现象。这两种情况并存于现实之中，正面临绿色发展和“双碳”行动的挑战。

在“双碳”行动背景下，怎样促进绿色低碳消费、培育绿色生活方式？2022年国家发展改革委等七部门印发的《促进绿色消费实施方案》做出了清晰的部署，总体思路是，面向碳达峰、碳中和目标，大力发展绿色消费，增强全民节约意识，反对奢侈浪费和过度消费，扩大绿色低碳产品供给和消费，完善有利于促进绿色消费的制度政策体系和体制机制，推进消费结构绿色转型升级，加快形成简约适度、绿色低碳、文明健康的生活方式和消费模式。

总体目标是，到2025年，绿色消费理念深入人心，奢侈浪费得到有效遏制， 绿色低碳产品市场占有率大幅提升，重点领域消费绿色转型取得明显成效，绿色消费方式得到普遍推行，绿色低碳循环发展的消费体系初步形成。到2030年，绿色消费方式成为公众自觉选择，绿色低碳产品成为市场主流，重点领域消费绿色低碳发展模式基本形成，绿色消费制度政策体系和体制机制基本健全。

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促进绿色低碳消费、培育公众绿色生活方式，主要在八个方面发力：

1.加快提升食品消费绿色化水平

引导消费者树立文明健康的食品消费观念，合理、适度采购、储存、制作食品和点餐、用餐。加强对食品生产经营者反食品浪费情况的监督。深入开展“光盘”等粮食节约行动。推进厨余垃圾回收处置和资源化利用。把节粮减损、文明餐桌等要求融入市民公约、村规民约、行业规范等。

2.鼓励推行绿色衣着消费

推动各类机关、企事业单位、学校等更多采购具有绿色低碳相关认证标识的制服、校服。倡导消费者理性消费，按照实际需要合理、适度购买衣物。规范旧衣公益捐赠，鼓励企业和居民通过慈善组织向有需要的困难群众依法捐赠合适的旧衣物。鼓励单位、小区、服装店等合理布局旧衣回收点，强化再利用。

3.积极推广绿色居住消费

推进农房节能改造和绿色农房建设。因地制宜推进清洁取暖设施建设改造。全面推广绿色低碳建材，推动建筑材料循环利用。大力发展绿色家装。鼓励使用节能灯具、节能环保灶具、节水马桶等节能节水产品。倡导合理控制室内温度、亮度和电器设备使用。加快生物质能、太阳能等可再生能源在农村生活中的应用。

4.大力发展绿色交通消费

合理引导消费者购买轻量化、小型化、低排放乘用车。进一步提高城市公共汽电车、轨道交通出行占比。加强行人步道和自行车专用道等城市慢行系统建设。鼓励共享单车规范发展。

5.全面促进绿色用品消费

加强绿色低碳产品质量和品牌建设。鼓励引导消费者更换或新购绿色节能家电、环保家具等家居产品。大力推广智能家电，通过优化开关时间、错峰启停，减少非必要耗能，参与电网调峰。推动电商平台和商场、超市等流通企业设立绿色低碳产品销售专区，在大型促销活动中设置绿色低碳产品专场，积极推广绿色低碳产品。

6.有序引导文化和旅游领域绿色消费

完善机场、车站、码头等游客集聚区域与重点景区景点交通转换条件，推进骑行专线、登山步道等建设，鼓励引导游客采取步行、自行车和公共交通等低碳出行方式。制定发布绿色旅游消费公约或指南，加强公益宣传，规范引导景区、旅行社、游客等践行绿色旅游消费。

7.进一步激发全社会绿色电力消费潜力

各地应组织电网企业定期梳理、公布本地绿色电力时段分布，有序引导用户更多消费绿色电力。在电网保供能力许可的范围内，对消费绿色电力比例较高的用户在实施需求侧管理时优先保障。持续推动智能光伏创新发展，大力推广建筑光伏应用，加快提升居民绿色电力消费占比。

8.大力推进公共机构消费绿色转型

推动国家机关、事业单位、团体组织类公共机构率先采购使用新能源汽车，新建和既有停车场配备电动

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汽车充电设施或预留充电设施安装条件。鼓励和推动文明、节俭地举办活动。

七、待解的难题：制止食品浪费

在上述促进绿色低碳消费、培育绿色生活方式的任务中，加快提升食品消费绿色化水平被摆在第一位，值得重视。习近平总书记曾经对制止食品浪费做过专门批示，国家出台了反食品浪费法，这说明在“吃”这个天字第一号事项中，十分有必要建立绿色低碳的消费模式。

2021年4月29日《中华人民共和国反食品浪费法》开始施行，到2021年底已经有八个月时间，这段时间内，食品浪费现象仍然存在。当前，食品浪费现象依然较为突出。根据世界自然基金会与中国科学院地理与资源研究所发布的《2018中国城市餐饮食物浪费报告》，中国餐饮业人均食物浪费量为93克／人·餐，浪费率为11.7%；初步测算，2015年我国城市餐饮业餐桌上食物浪费量在1700万~1800万吨；朋友聚餐、商务宴请平均每餐每人食物浪费量分别为107克、102克，家庭聚会每餐每人食物浪费量为95克（中金公司，2021）。

食品要经过很长的生产链才能生产出来，在其种植、加工和丢弃后处理中都要大量消耗能源和物质，所以食品是一种“高碳”产品。浪费型的食品消费方式与“双碳”目标不符，也为我国节俭型的优秀传统文化所不容。冰冻三尺非一日之寒，在国家出台《反食品浪费法》之后较长时间内食品浪费仍然较为常见，说明食品浪费背后有很深的背景，制止和消除之需要“动大手术”。

客观上说，没有一个消费者有意浪费食品，但食品浪费现象却仍时有发生，深入分析可能有四个原因：一是传统共餐式的餐饮方式不易事先确定菜品的总消费量，容易出现过量备菜。二是餐饮企业的利润导向，在营销上倾向于向消费者推荐和提供过量食品。三是饮食文化的影响，主人为了面子好看而过度点菜。四是支出来源的原因，公款消费更容易引起过度消费。这说明食品浪费，除了当前订立一些引导性、限制性制度以防止过度消费外，还需要从建立新型饮食文化、探索新型就餐方式等根子上解决问题，这必然是一个长期探索和转变的过程。

饮食文化是大众文化，探索符合中国优秀饮食文化传统、满足“双碳”目标要求的绿色低碳餐饮方式，也需要走群众路线，让人民群众来想办法、提方案。我们要建设美食大国，但不能成为浪费大国。建议 “双碳”行动中负责建立绿色低碳生活方式的有关部门为此进行专题研究，在若干地区进行试点探索，真正使《反食品浪费法》落实到可实践、可推广的模式上。

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Carbon Peak and Carbon Neutrality: A Consumption Dimension

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Abstract: *China's manufacturing sector is on the move towards carbon peak and carbon neutrality, but carbon-neutral consumption has yet to take off. As the external constraints to consumption behaviors, carbon peak and carbon neutrality (CPCN) commitments will transform energy-dependent modern lifestyle and excessive material consumption and encourage circular and sustainable consumption. According to international experience, low-carbon consumption can be achieved primarily by reducing per capita household and office carbon emissions and encouraging e-mobility, low-carbon mobility, recycling and circular economy. In promoting green and low-carbon consumption, China should focus on eight areas, including food, clothing, transportation, housing, consumer goods and energy. Among them, a priority is to prevent food waste and establish a new food culture. Food waste stems from various reasons, such as communal dining, the profit-driven business practices of catering companies, the influence of traditional dining culture, and dining on public funds. We suggest conducting special research and pilot programs on green and low-carbon dining consumption, involving the masses, and exploring ways for the implementation of the Anti-Food Waste Law.*

Keywords: *Carbon peak and carbon neutrality (CPCN) initiatives, green and low-carbon, consumption mode, food waste*
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1. A Tossed Stone Raises a Thousand Waves

In September 2020, President Xi Jinping announced at the 75th session of the United Nations General Assembly that China would commit itself to reaching carbon peak before 2030 and carbon neutrality before 2060. The carbon peak and carbon neutrality (CPCN) goals have stirred extensive discussions among the Chinese public and especially economists. The topic of CPCN has been widely discussed in numerous articles published by the media and through opinions shared at public forums. Experts and entrepreneurs have all joined the fray.

In 2021, the Chinese government issued *Working Guidance for Carbon Dioxide Peaking and Carbon Neutrality in Full and Faithful Implementation of the New Development Philosophy*, *Action Plan for Carbon Dioxide Peaking before 2030* and *Opinions on Fighting the War on Pollution*. These policy documents have laid out a top-down design and initiated the implementation stage for CPCN goals.

CPCN goals have aroused broad public discussions far beyond ecological and environmental spheres. As noted by the CPC Central Committee, the reason is that "carbon peak and carbon neutrality are an extensive and profound economic and social transformation." Such a transformation - if divided in the two segments of production and consumption - is incomplete since CPCN initiatives in the production sphere are not matched by progress in the consumption sphere. Green and low-carbon

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consumption is a key aspect of CPCN initiatives. It is of great practical significance to reveal how CPCN initiatives will influence and challenge people's ways of consumption and advocate green and low-carbon ways of consumption.

2. Overview of China's CPCN Action Plan

China's CPCN initiatives aim to form a green and low-carbon economic system for circular development by 2025 with significant energy efficiency improvements in key sectors; reduce energy consumption per unit of GDP by 13.5% and CO_2 emissions per unit of GDP by 18% from 2020; increase the share of non-fossil fuel consumption to around 20%, forest coverage to 24.1% and forest biomass to 18 billion cubic meters. By 2030, China aims to achieve great progress in greening its economic and social development across the board and reach internationally advanced levels in terms of energy efficiency in key energy-consuming sectors; significantly slash total energy consumption per unit of GDP; reduce CO_2 emissions per unit of GDP by over 65% from 2005; increase the share of non-fossil fuel consumption to around 25%, expand total installed wind and solar capacity above 1.2 terawatts; reach a forest coverage rate of 25% and forest biomass of 19 billion cubic meters, and peak and steadily decrease CO_2 emissions. By 2060, the goal is to fully establish an economic system of green and low-carbon circular development with a clean, safe and efficient energy sector, lead the world in energy efficiency, raise the share of non-fossil fuel consumption to over 80%, and achieve carbon neutrality.

Achievement of the above goals entails eight priorities: (i) The all-round green transition of economic and social development; (ii) industrial restructuring; (iii) a clean, low-carbon, secure and efficient energy system; (iv) low-carbon mobility; (v) green and low-carbon urban and rural development with better quality; (vi) green and low-carbon technology development and application; (vii) carbon sink capacity; (viii) green and low-carbon opening up.

Among those priorities, energy, mobility, urban and rural development and carbon sink are all closely related to consumer behaviors. The green transition of economic and social development calls for green and low-carbon lifestyles. Aside from greening the economy, CPCN initiatives will also transform people's ways of life. There is an urgent need for the public to embrace green and low-carbon lifestyles.

3. Challenges of CPCN Initiatives to Consumer Behaviors

People's ways of life will influence the ecological environment directly by emitting pollution and wastes and indirectly by encouraging environmentally harmful ways of production. By reducing environmental pressures on both production and consumption sides, green lifestyles have received great importance from policymakers as a key aspect of China's ecological civilization. Recent announcement of the CPCN goals puts forth higher requirements on adopting green and low-carbon lifestyles.

First, CPCN initiatives are targeted at transforming energy-dependent modern lifestyles. Amid China's rapid economic development and rising living standards, consumer behaviors have also become increasingly energy-dependent. Energy consumption has become essential in every aspect of people's life from elevator to home appliances, gas-fueled cooking, winter heating and gasoline-fueled mobility. The intensity of daily energy consumption is increasing as well. With fossil fuels still dominating the energy mix, energy-intensive consumer behaviors have left a larger carbon footprint. Despite per capita energy consumption below world average, China's total consumer carbon emissions are very high given its population of 1.4 billion. CPCN initiatives are an energy revolution that will transform the current energy mix, consumption pattern and efficiency. Over recent years, the Chinese government has introduced a flurry of policies on equipment depreciation and issuance of subsidies to replace energy inefficient home appliances and promote electric and other new-energy vehicles, exerting significant effect on reducing energy consumption, pollution and carbon emissions. Further implementation of CPCN initiatives will continue to transform the current energy-dependent consumer behaviors and

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consumption modes, setting the stage for low-carbon consumption as a future trend.

Second, CPCN initiatives will mitigate excessive material consumption. With rising standards of consumption, the chain of material production in modern life becomes extended and involves more processes from raw materials to the final product. Consumer demand for product refinement has led to a splurge on auxiliary materials such as luxurious product decoration and packaging. Recent years have seen a surge in China's courier and food delivery services. China's express delivery sector handled 31.28 billion parcels in 2016 and 83.36 billion parcels in 2020, up 166% in four years, or 60 parcels per person; this volume increased to 49.4 billion parcels in the first half of 2021 with annual total expected to exceed 100 billion parcels, or 72 parcels per person. The number of online food delivery users in China has increased from 209 million in 2016 to 419 million in 2020, up 100% in four years; among them, those who ordered meals via mobile devices jumped from 194 million in 2016 to 418 million in 2020, up 115% in four years. By 2020, China's food delivery sector handled over 17.1 billion orders (Wei, 2021). Each day, China's express delivery sector processes over 300 million parcels, which consume large volumes of woven bags, plastic bags, paper envelopes, cardboards, wooden boxes, tapes and cushions. In 2020, China's express delivery industry generated over 10 million tons of packaging waste (Zhang, 2021; CCICED Task Force, 2021; CICC, 2021). Production of those packaging materials also consumed large volumes of energy and emitted greenhouse gases. Curbing the excessive use of packaging materials, therefore, should be a key element of CPCN initiatives.

Third, CPCN initiatives will facilitate circular and renewable sustainable consumption. As living standards rise, material consumption will increase, and recycling waste becomes the only option to reduce carbon emissions. Recycling on the basis of reduction is a key element of CPCN initiatives. China is drafting the *Technical Standard for Parcel Waste and Pollution Control*, which requires courier waste disposal to follow the priority of reuse, recycling, degradation, incineration and landfill. In fact, stringent environmental requirements have already pushed up the cost of waste landfill and incineration. According to the China Association of Environmental Protection Industry (CAEPI), China's large enterprises made 81.842 million tons of plastic products in 2019 and that would mean 63 million tons of waste plastics; if 31% of which - or some 19.53 million tons - were incinerated, this would generate some 59.18 million tons of CO_2 emissions. Waste reuse and recycling will, therefore, reduce both the cost of disposal and carbon emissions as well.

In a nutshell, CPCN goals and initiatives put additional constraints over consumer behaviors. For China as a populous country with a large consumer demand, such additional constraints are in conflict with growing consumer demand. A key aspect of CPCN initiatives is to balance carbon emissions mitigation with consumption. The general principle is to encourage consumption and oppose waste.

4. Progress of China's Green and Low-Carbon Consumption

In China's decades-long material scarcity, frugality and reuse have emerged as dominant consumer behaviors. Those concepts of consumption have profoundly influenced consumer habits and swayed policymaking. Since the dawn of this century, the Chinese government has enacted over 100 policy documents to encourage green and low-carbon consumption in such areas as energy and water conservation, environmental and energy efficiency labels, organic products, green food, green buildings, green products, green mobility, and green government procurement. A broad range of policies, including fiscal subsidies, tax exemption, price preference, investment support, financial convenience and voluntary activities, have been offered to expedite the green and low-carbon consumption transition.

4.1 Policies for Green and Low-Carbon Consumption

(i) Energy efficiency label: The State requires energy consumption measurement and labeling for energy-consuming products such as refrigerators and air conditioners, whose level of energy

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consumption should be labeled to encourage consumer choice of energy-efficient products.

(ii) Environmental label: Since 1993, the State has implemented the environmental labelling program to certify and promote environmentally-friendly products.

(iii) Tiered water rate: Corporate and individual users are charged water tariffs at rates according to their monthly water consumption. Higher water rates are applied beyond a certain threshold of consumption and for water scarce regions to encourage water conservation.

(iv) Home appliance allowance: The State offers allowances or price discounts for households to replace energy-inefficient old home appliances with energy-efficient ones.

(v) New energy vehicle allowance: The State offers allowances for the purchase of electric vehicles and other new energy vehicles to reduce the cost of new energy vehicles for end consumers and encourage the substitution of gasoline vehicles with new energy ones.

(vi) Bike-sharing: Many cities provide bike-sharing venues and other supportive measures to extend bike-sharing services to every corner of the city to ease traffic pressures and vehicle emissions.

(vii) Green government procurement: The State gives priority to products with energy and environmental labels for government procurement to incentivize the manufacturing of green products.

(viii) Organic products: The State certifies high-quality agricultural products free from pesticides and fertilizers and issues them organic product labels to encourage green consumption and manufacturing.

4.2 Effects of Green and Low-Carbon Consumption

As reported in the *Green Transition and Sustainable Social Governance* published by the China Council for International Cooperation on Environment and Development (CCICED), China has achieved the following results of green and low-carbon consumption:

By conservative estimate, in 2017, China's sales volume of energy-efficient air conditioners, refrigerators, washing machines, flat panel TVs and water heaters was close to 150 million units, or 500 billion yuan, and output of organic products was close to 140 billion yuan. In the same year, China had 1,500 green hotels, 4,500 green buildings, and over 31,000 products labelled as green food. Over 777,000 new energy vehicles were sold, and more than 25 million shared bikes were put into use. According to the *China Green Consumer Report 2016* released by the Ali Research Institute, there were 200 million green basket commodities in 50 categories available over Alibaba's online sales platform in 2015 (green basket commodities are energy-efficient, eco-friendly and wholesome), and green basket consumption accounting for 11.5% of Alibaba's gross sales volume. By the end of 2018, the environmental label certification covered over 100 types of products worth more than 4 trillion yuan in China.

5. International Experience of Low-Carbon Consumption Transition

Many countries have committed to carbon peak and carbon neutrality (CPCN) as an international trend and taken actions to expedite low-carbon consumption. Based on the CCICED's *Green Transition and Sustainable Social Governance* completed in 2021, this paper has identified the following international experiences:

The United Nations *10-Year Framework of Programmes on Sustainable Consumption and Production Patterns* adopted in 2010 involves 10 priority areas including sustainable public procurement, tourism, consumer information, building and construction, food system, lifestyles, and education. These areas have covered almost all specific aspects of people's life. According to a study by the Swedish Foundation for Strategic Environmental Research, a consumption shift to more sustainable products and services would reduce greenhouse gas emissions by 40% (CCICED Task Force, 2021).

Specifically, the following international experiences for low-carbon consumption are worth referencing:

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(i) Reducing per capita household and office carbon emissions. In 2021, Germany pledged to halve its per capita greenhouse gas emissions at the consumption level by 2030 from 2016 by raising consumer awareness of their "personal consumption footprint," halving food waste, doubling bicycle use, and increasing the market share of certified sustainable products in e-commerce to 34%, among other measures.

In 2017, Sweden adopted a five-pronged plan to track greenhouse gases in consumer sectors like personal mobility, air travel, food, buildings and textiles as supplemental measures for regional emissions trading.

In 2021, the Japanese parliament adopted an amendment to the *Act on Promotion of Global Warming Countermeasures*, which calls for establishing a decarbonized society by 2050 (carbon neutrality). Environmental authorities launched the "Cool Choice" campaign nationwide to encourage less use of air conditioning by wearing cool or warm clothes and promoting smart mobility and energy-efficient lighting.

(ii) Encouraging e-mobility and low-consumption transportation. In the developed world, road vehicles and air transport are chief sources of carbon emissions, which make the case for a transition towards low-carbon mobility. In 2011, Germany enacted the *National Development Plan for Electric Mobility*. In 2016, Germany introduced environmental subsidies and other incentives of up to 9,000 euros each for electric-only vehicles and 6,750 euros each for plug-in hybrids priced below 40,000 euros, or up to 75,000 euros each for electric-only vehicles and 5,625 euros each for plug-in hybrids priced above 40,000 euros. Moreover, new electric vehicles are exempted from motor vehicle tax for 10 years.

In 2020, Germany amended the *Motor Vehicle Tax Act* to curb carbon emissions from gasoline-fueled vehicles by raising tax on vehicles with high CO_2 emissions and rewarding climate-friendly vehicles with an annual tax bonus. While vehicles with emissions of no less than 95gCO_2/km will be exempted from the motor vehicle tax, those with higher CO_2 emissions will be taxed more heavily. In 2021, Germany adopted the *Clean Vehicle Directive (CVD)*, which requires 22.5% of buses purchased between 2021 and 2025 to be zero emissions, and this quota will reach 32.5% from 2026 to 2030.

Transportation accounts for one third of Sweden's carbon emissions, and the Swedish vehicle fleet is dominated by old, heavy and energy-intensive vehicles with high CO_2 emissions. In 2018, Sweden imposed VAT and fuel tax (carbon and energy tax) on fossil-fuel vehicles and subjected car owners to an annual vehicle tax. In 2019, electric vehicles accounted for 18% of total vehicle registrations in Sweden, a record high.

Since 2000, Japan has introduced an environmental label system to certify vehicles that meet certain emission and fuel efficiency standards. Since 2009, "next-generation vehicles" including electric vehicles, fuel cell vehicles, natural gas vehicles, plug-in hybrids and clean diesel vehicles have been entitled to tax exemption. In the fiscal year of 2020, Japan collected 2.6 trillion yen from vehicle-related taxes, accounting for 2% of its total tax revenue.

(iii) Encouraging recycling and circular economy. Recycling physical products is one of the key pathways for reducing carbon emissions. The European Union's Ecodesign Directive (Directive 2009/125/EC) aims to cut energy consumption in the EU by 9% by 2020 and 16% by 2030. In 2020, the EU released *A New Circular Economy Action Plan For a Cleaner and More Competitive Europe*, which encompasses major commodity value chains from ICTs, batteries and vehicles, packaging, plastics, textiles, buildings, food, water and nutrients. Since 2025, the EU's waste management regulations will require textiles to be recycled.

As early as in 1991, Germany enacted the *Packaging Ordinance*, which adopted the famous extended producer responsibility (EPR) system that holds producers accountable for the environmental impacts of their products throughout product lifecycle, thus encouraging dismantlable and recyclable product designs. In 2020, Germany adopted an amendment to the *Circular Economy Act*, which calls for transforming the "throw-away" culture. It requires manufacturers, retailers and sales platforms to donate

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or reuse commodities or their packages. The *Packaging Act* amended in 2021 has imposed a statutory deposit of 0.25 euros each on all throwaway plastic bottles and tin cans. Since 2023, restaurants, takeaway shops and coffee bars must all provide multi-purpose containers to increase the ratio of reusable items.

Japan embraced a "circular society" concept to broaden the scope of circular economy and promote resource recycling throughout the society. The *Basic Act on Establishing a Circular Society* enacted in 2000 calls for the reduction, reuse and recycling of wastes in sectors like packaging, home appliances, food, and automobiles. The Japan Automobile Manufacturers Association (JAMA) has enacted guidance for the early assessment of product design stage for the reduction, reuse and recycling of end-of-life vehicles (ELVs) for the design of dismantlable new vehicles. Some apparel makers and distributors have launched a "garment to garment recycling" campaign to recycle old clothes for those in need around the world. Unrecyclable clothes would be recycled as fuels or sound insulation materials. The *Act on Resource Circulation for Plastics* adopted in 2021 stipulates that all plastic materials should be recyclable by 2050.

The above international experiences are just part of global experiences for the transition towards low-carbon consumption. For the purpose of protecting the environment and tackling climate change, mankind has worked very hard to reflect upon and change their ways of life and work. Unlike in the production sector with large-scale corporate actions, specific and individual efforts in the consumption sector will combine to make a great difference.

6. China's Path towards Green and Low-Carbon Consumption

In moving towards carbon peak and carbon neutrality (CPCN), green transition in the production sector and the promotion of green and low-carbon consumption are the "two wings of a bird." Progress should be made on both fronts to move things forward.

In China, a populous developing country with strong economic fundamentals and limited natural resources, there is a duality in people's lifestyles: As rooted in its traditional culture of man and nature as one and in harmony, the Chinese people are used to leading a frugal and simple life and recycling old items, which chime with green and low-carbon concepts and have to do with China's material scarcity in history. On the other hand, China has experienced rapid industrialization and urbanization over the past decades and drastically improved people's living standards. Under the influence of Western culture, excessive and wasteful consumption has gained ground to the detriment of sustainable development. Both consumer behaviors exist in reality and pose opportunities and challenges to green development and CPCN initiatives.

The question is how to promote green and low-carbon consumption and foster green lifestyles in the context of CPCN goals? In 2022, the National Development and Reform Commission (NDRC) and six other ministerial agencies laid out clear arrangements in the *Implementation Scheme for the Promotion of Green Consumption* to promote green consumption, enhance public conservation awareness, oppose luxurious, wasteful and excessive consumption, increase the supply and consumption of green and low-carbon products, improve systems and policies to encourage green consumption, facilitate the green transition of consumption structure, and form simple, moderate, green, low-carbon, civilized and healthy lifestyles and consumption modes.

By 2025, the goal is to establish the concept of green consumption, effectively curb luxurious and wasteful consumption, substantially increase the market share of green and low-carbon products, widely adopt green consumption modes, and initially form a consumption system of green and low-carbon circular development. By 2030, we should make green consumption modes widely accepted among the public, mainstream green and low-carbon products, establish green and low-carbon development modes in key consumption sectors, and improve green consumption policies and systems.

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Priority should be given to the following eight areas in promoting green and low-carbon consumption and fostering green lifestyles:

(i) Promoting green food consumption. We should guide consumers to adopt civilized and healthy food consumption concepts, and encourage moderation in procuring, storing and making food and ordering and consuming meals. We should step up food waste supervision for food producers and operators, carry out the "Clear Your Plates" campaign, and recycle kitchen waste. Food conservation and civilized dining should be written into the code of conduct for citizens and villagers and industry standards.

(ii) Encouraging green clothing. Government agencies, enterprises, public institutions and schools should purchase more uniforms with green and low-carbon labels. Rational consumption should be advocated for consumers to purchase clothes reasonably and rationally. Public-interest donation of old clothes should be standardized to encourage companies and households to donate old clothes as appropriate to those in need. Organizations, residential compounds and apparel stores should be encouraged to set up old clothes recycling points.

(iii) Promoting green dwellings. Priority should be given to the energy efficiency renovation of rural dwellings and the development of green rural dwellings. Renovation of clean heating facilities should be carried out according to local conditions. Efforts should be made to promote green and low-carbon building materials, recycle building materials, and develop green home decoration. The government should encourage the use of energy-efficient lighting equipment, eco-friendly cooking utensils and water-efficient toilets. We should raise public awareness about the reasonable control of indoor temperature, brightness and electrical equipment, and expedite the deployment of biomass, solar energy and other renewables in rural life.

(iv) Developing green mobility. The government should nudge consumers to purchase light-weight, small and low-emission passenger vehicles, and increase the share of bus and rail transport in urban mobility. Greater efforts should be made to develop non-motorized urban mobility systems such as pedestrian and bicycle lanes. We should also encourage the standardized development of bike sharing.

(v) Encouraging green consumption. We should enhance the quality and branding of green and low-carbon products, encourage consumers to replace or purchase energy-efficient home appliances and environmentally-friendly furniture. Great efforts should be made to promote smart home appliances, reduce unnecessary energy consumption, and participate in the peak-load regulation of power grid by optimizing switch time and staggering power consumption. E-commerce platforms, department stores, supermarkets and other distribution enterprises should establish special areas for green and low-carbon products in their daily operations and during promotions.

(vi) Encouraging green consumption in culture and tourism sectors. The government should improve transportation links between tourist hubs such as airports, railway stations and tourist ports, build biking routes and hiking trails, and encourage low-carbon travel such as walking, cycling and public transportation among tourists. Tourism authorities should issue code of conduct or guidance for green tourist consumption, enhance public awareness, and standardize green tourism consumption for scenic areas, travel agencies and tourists.

(vii) Further unleash the potentials of green power consumption. In various localities, power grid enterprises should regularly publish green power time-of-use schedules to encourage green power consumption. Within the power grid capacity, demand-side management should give priority to users with a high share of green power consumption. Smart photovoltaic innovations and building-integrated photovoltaics (BIPV) should be developed vigorously to increase the share of household green power consumption.

(viii) Advancing the green consumption transition of public institutions. Government agencies, public institutions and other organizations should take the lead in procuring new energy vehicles, and EV charging facilities should be installed or reserved. Public events should be held in a civilized and frugal manner.

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7. Food Waste: An Unresolved Problem

Notably, food consumption is given top priority among the above initiatives to promote green and low-carbon consumption and foster green lifestyles. General Secretary Xi Jinping made a special instruction on the avoidance of food waste, and the *Anti-Food Waste Law* also went into effect. This points to the urgency of establishing green and low-carbon ways of food consumption.

Nearly a year has elapsed since the *Anti-Food Waste Law of the People's Republic of China* took effect as of April 29, 2021. Yet during this period, mind-boggling food waste continued.

Staggering food waste occurs everywhere across the country. According to *Report on Food Waste in China's Urban Restaurants* published by the World Wide Fund for Nature (WWF) and the Institute of Geography Sciences & Natural Resources Research of the Chinese Academy of Sciences (CAS), per capita food waste in China is 93 grams/person/meal, which means 11.7% of food is wasted; according to a preliminary estimate, 17 million to 18 million tons of food became wasted on the dining table in China's urban catering industry; food waste reached 107 grams and 102 grams per person per meal for family gatherings and business banquets, respectively, and 95 grams for family gatherings (CICC, 2021).

Food production involves a very long production chain and massive energy and material consumption in planting, processing and disposal. In this sense, food is a high-carbon product. Wasteful food consumption contradicts with carbon peak and carbon neutrality (CPCN) goals and is intolerable under China's traditional culture of frugality. It takes time to change people's habits. Foreseeably, food waste will persist for a long time after China's enactment of the *Anti-Food Waste Law* considering the entrenched culture of food waste.

Food waste, though largely inadvertent, can be attributed to the following reasons: First, traditional communal dining makes it hard to prepare exactly the right amount of food for a table of diners and easily leads to excesses. Second, catering enterprises tend to recommend and provide consumers with excessive food to earn more profits. Third, hosts tend to order more dishes than necessary to show hospitality. Fourth, consumption on public funds is more likely to cause excessive spending. Aside from dissuading and restricting excessive consumption, it is also important to foster a new food culture and explore new dining practices to address food waste, which cannot be accomplished overnight.

Food culture is a mass culture. In exploring green and low-carbon dining practices based on the fine Chinese tradition of food culture, we should seek advice from the people. Our country should be known for delicious food and not for food waste. We suggest that authorities in charge of CPCN initiatives for green and low-carbon lifestyles carry out pilot programs in a few regions for the broad implementation of the *Anti-Food Waste Law*.

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