中国居民蛋白质摄入低碳之路

安利公司

摘要

蛋白质是人体所需的重要营养素，在人体代谢活动、免疫抗体、神经冲动传导等方面都扮演着重要角色。根据联合国粮食及农业组织的相关数据显示，粮食体系在全球温室气体排放量中占比超过三分之一。在全球资源压力和环境挑战不断增加的背景下，必须认识到低碳蛋白质摄入对全球可持续发展有着重要影响。各国政府将食品相关排放融入自身气候目标的制定，食品企业也纷纷采取行动助力全球应对气候变化。作为世界上人口最多的国家之一，中国在推动低碳发展和资源可持续利用方面发挥着重要的作用。

食品系统具有上下游产业链条长、行业跨度大、居民影响力广泛等特点，与畜牧业、制造业、物流运输、食物消费等息息相关，是全球应对气候变化最大的驱动力之一。随着中国居民生活水平提高及蛋白质需求的增加，营养和粮食安全是食品行业面临的一个巨大挑战。同时，中国居民越来越关注饮食健康。植物蛋白具有营养健康与低碳环保多重优点，受到越来越多中国消费者青睐，逐渐成为一种时尚饮食习惯。

植物蛋白行业在中国具有良好的政策环境，消费市场以及资本市场前景光明，但同时也面临一些问题和挑战。基于以上背景，本报告通过广泛的研究，剖析行业发展现状，探索中国居民蛋白质摄入的低碳路径和减排潜力，并提供植物蛋白行业低碳发展建议，以促进可持续蛋白质摄入的实践和普及。本报告深入研究了中国居民的蛋白质摄入来源，对比分析了植物蛋白和动物

蛋白在原材料和生产制造等环节的碳排放，对中国居民蛋白质摄入的低碳潜力进行评估。本报告提倡通过减少肉类消费、选择更可持续的蛋白质来源、促进食物多样性和减少食物浪费来实现中国居民蛋白质摄入的低碳之路。

本报告希望激发更广泛的讨论和行动，鼓励政策制定者、企业、社会组织和广大公众共同努力，将可持续蛋白质摄入理念融入到我们的日常生活。人类饮食结构正在塑造环境未来，让我们在蛋白质摄入低碳之路上携手并进，创造一个更可持续、更健康美好的未来。

1、植物蛋白低碳发展全球趋势及国际经验

1.1 气候变化与食物系统

气候变暖对人类当代及未来生存发展造成严重威胁和挑战。联合国政府间气候变化专门委员会（IPCC）于 2021 年 8 月发布的特别报告指出，除非各国能统一行动，立即、迅速和大规模地减少温室气体排放，否则很可能在 2040 年前达到或超过《巴黎协定》设定的 1.5℃温控目标。

食物系统是一个由食物生产、加工、分配、制备和消费相关的所有要素和活动组成的复杂巨系统，贡献了全球 1/3 的温室气体排放，成为全球气候变化最大的驱动力之一。其中，畜牧业占农业、林业和土地利用（AFOLU）部门全球温室气体排放量的 60%以上。目前世界人口总数已突破 80 亿，由于人口增长、城市化、收入增加及其他经济社会因素，蛋白质需求在全球范围内正在增加，尤其是中低收入国家。营养和粮食安全仍是食品行业的一个巨大挑战，如果不改变现在的饮食模式，2050 年的蛋白质需求将会比现在多出 50%，那么动物蛋白的需求量也会同步增加，这会导致温室气体排放量的快速提升。

《巴黎协议》中建议全球粮食系统需要从 2040 年起成为净碳汇，而转向植物性饮食模式是食物系统减碳效果最显著、经济成本较低的举措之一。IPCC 第六次评估报告（AR6）中首次专门评估了需求侧行为改变对于碳减排的作用。改变生活方式和行为到 2050 年可以使温室气体排放量减少 40%-70%。在食物系统需求侧，IPCC 鼓励人们改变饮食习惯，转向平衡可持续健康饮食，减少食物损失和浪费，而在各类举措中，植物性饮食具有最大的减排潜力。EAT-Lancet 也指出，仅仅是植物性饮食结构的改变，就可能将个人食物碳足迹减少 2/3。

1.2 植物蛋白优势

植物性蛋白质相比动物性蛋白质更为低碳。牛津大学网站 Our world in data 通过调研 119 个国家近 4 万家农场并分析各类蛋白质食品碳足迹数据，得到 100 克不同类型蛋白质的碳排量范围值与均值。不同类型蛋白质碳排放差异巨大，但动物蛋白碳排放远高于植物蛋白。联合国提出减少食品部门的排放需要在从生产者到消费者的所有阶段进行变革，其中一条较为有效的减排措施就是将粮食系统转向富含植物的饮食—即增加植物蛋白的摄入、减少动物性和饱和脂肪类型食品的饮食模式。

此外，植物性蛋白饮食习惯大概率会产生较低的疾病风险。富含优质蛋白质的红肉含有较多的饱和脂肪酸和胆固醇，过多地摄入这些食物会增加肥胖、心血管疾病和某些肿瘤的发病风险，也会影响血脂水平。有研究表明，食用红肉（牛肉、猪肉或羊肉）与 2 型糖尿病、结直肠癌和乳腺癌的患病风险相关，尤其是加工过的肉类含有大量钠、硝酸盐、亚硝酸盐和其他防腐剂，可能会增加癌症风险。由于健康相关的负面影响，世界癌症研究基金会和世界卫生组织也推荐植物性饮食。

1.3 国际行动与趋势

为应对气候挑战，各国政府将食品相关排放融入自身气候目标的制定。例如，丹麦政府为食品和农业部门设定了 2050 年前需达到气候中和的目标，这在一定程度上会提高畜牧的成本，从而可以减少人们对动物性食品的购买。英国研究与创新部门（UKRI）在 2022 年发布了替代蛋白的路线图，同时，英国政府预计在食物系统的研究中投资 1.2 亿英镑以支持替代蛋白的相关研究。

近年来植物蛋白概念成为全球新风尚，以 Beyond Meat、Impossible

Foods 为代表的全球植物蛋白龙头企业已获得多轮融资，前者已于 2019 年在美国纳斯达克成功上市，目前市值 9 亿美元左右（截至 2023 年 4 月），后者也在积极筹划上市中。自 2010 年以来，全球植物性肉类替代品年销售额的年平均增长率为 8%，近年来全球植物基饮品市场的年增长率为 33%。目前，欧美是植物蛋白产品的主要消费市场。2021 年，北美占据全球植物蛋白补充剂市场的 40%，年增长率约为 8.5%，其中美国在北美市场中占主导地位。欧洲在 2016 年占据了全球范围内植物基食物 39%的市场。

随着经济社会发展，健康、养生、环保成为消费者关心的议题。根据加拿大国家研究委员会 2019 年 3 月发布的一项研究显示，消费者对于植物蛋白替代品需求不断增长的驱动因素主要包括以下几点：人们对于富含蛋白质的饮食以及植物蛋白益处的认知不断提高；由于人口增长，全球对蛋白质的需求增加；对环境保护和动物福利的关心等。ADM 发布的《2023 年八大全球消费者趋势》则显示，环境保护生产有责、社会责任主动承担、均衡营养全面滋养、多元蛋白更多选择，成为驱动 2023 年营养领域创新的驱动因素之一。报告揭示全球超过半数（52%）的消费者认为自己是弹性素食者，即饮食中既包括动物蛋白，也包括植物蛋白或其他替代蛋白。在这 52%的消费者中，近 2/3 定义其饮食风格为“尝试摄入更多植物基食品”，推动了植物蛋白的发展。

2、 中国居民蛋白质摄入低碳洞察和分析

2.1 中国居民蛋白质摄入分析

根据全国营养调查（CNNSs）在国家层面进行的一系列营养调查，中国居民总蛋白质摄入量基本持平，主要来源为谷类和动物性食物，但是蛋白质来源的占比却有显著变化。1992 年，中国居民动物性蛋白质的摄入量占总

蛋白质的 18.9%，而到 2015 年，这一比例提高到了 35.2%。肉、蛋、奶供给量的大幅增加得益于农业现代化程度的提高，比如机械化水平的明显提升 。在这近 20 年间，由于饮食“西化”和对于谷类食物营养价值的错误认知，导致来源于谷类的蛋白质摄入比例有明显下降趋势，下降的程度在 8.6%-16.8%左右；而大豆类蛋白质的摄入则维持在一个较为稳定的水平。

1993-2015 年城乡居民膳食蛋白质的主要来源

2.2 中国蛋白质供应水平稳步增长，进一步驱动植物蛋白快速发展

中国是世界上人口最多的国家之一，同时也是最大的肉类消费国。随着 GDP 增长和居民生活水平的大幅提升，中国蛋白质供应水平稳步增长。现阶段中国蛋白质供应仍呈现为植物蛋白为主、动物蛋白为辅的结构。若中国人均畜产品蛋白占有量达到欧美水平，则畜牧业的排放达峰会出现在 2034 年，温室气体排放量将达到 4.89 亿吨二氧化碳当量。

居民对于蛋白质满足功能性的需求渐渐转移到对于健康多样、环保低碳的需求，人们对可持续肉类替代品兴趣越来越强烈，进而将驱动植物蛋白的快速发展。杜邦公司一项研究指出，中国是全球植物蛋白增长最快的市场之

一，预测 2020-2025 年里，由于人们对健康和可持续发展的兴趣增加，对肉类蛋白质替代品的需求将增加 200%。

2.3 植物蛋白在中国的发展具有良好的政策环境

植物蛋白相较于动物蛋白的碳排放强度要显著降低，且与中国植物性为主、动物性为辅的膳食传统契合，推广植物蛋白在中国具有良好的政策环境。

中国于 2020 年 9 月首次提出“2030 年碳排放达峰，2060 年实现碳中和”的“30·60 目标”。为全面落实上述目标，中国制定了碳达峰、碳中和的“1+N”政策体系。2021 年 10 月 24 日发布的《中共中央 国务院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》，作为碳达峰碳中和“1+N”政策体系中的“1”，对指导和统筹“双碳”工作起到纲领性作用。《意见》提出要“加快推进农业绿色发展，促进农业固碳增效”。

紧随其后于 10 月 26 日发布的《2030 年前碳达峰行动方案》，作为“N”系列政策中的首要文件，对后续出台的“N”系列政策起到统领作用。《行动方案》进一步明确要“大力发展绿色低碳循环农业，推进低碳农业模式”。

2021 年 8 月，农业农村部等六部委发布《“十四五”全国农业绿色发展规划》，提出要“打造绿色低碳农业产业链，推进农产品加工业绿色转型，建立健全绿色流通体系，促进绿色农产品消费”。

2022 年 1 月，国家发改委等部门发布《促进绿色消费实施方案》，提出要“加快提升食品消费绿色化水平，完善粮食、蔬菜、水果等农产品生产、储存、运输、加工标准，大力推广绿色有机食品、农产品”。

从减碳的角度看，相较于动物基食物，植物基食物可有效降低温室气体排放，对于农业碳减排是一种潜力巨大的解决方案。同时，中国具有“以植

物性食物为主、动物性食物为辅”的膳食传统，国务院发布的**《国民营养计划（2017—2030 年）》中提出要“发展食物营养健康产业，以优质动物、植物蛋白为主要营养基料，**加大力度创新基础研究与加工技术工艺，开展双蛋白工程重点产品的转化推广”。因此植物蛋白在中国的发展具有良好的政策环境。

2.4 中国消费市场对于植物蛋白产品的认可度逐步提升

根据《中国可持续消费报告 2022》，近半数的消费者愿意付出超过 5%的溢价去购买低碳食品。

根据新西兰农业部与咨询机构于 2017 年对中国 2000 名一二线城市居民进行的线上调查结果显示，**39%的中国消费者选择减少肉类摄入量。**在考虑肉类和乳制品的替代品时，62.4%的受访者选择蔬菜作为肉类替代品，61.5%的受访者选择豆制品、仿制肉等作为肉类替代品，位居第二;52.8%的受访者选择植物蛋白饮料作为乳制品的替代品。

市场表现方面，以植物蛋白饮品、植物肉为代表的植物蛋白食品饮料受到中国消费者越来越多的认可。根据天猫食品发布的《2022 食品饮料创新热点》报告，**“植物能量”成为 2022 年度食品饮料行业六大热点之一**，《报告》显示中国消费者购买过的植物基食品饮料以豆奶，椰奶等传统植物基饮料和燕麦奶，芝麻奶等新兴植物基饮料为主，植物基饮品已成为消费者营养补充的常规选择。根据益普索中国 2023 年 4 月发布的《中国餐饮发展趋势洞察》，在健康可持续化背景下，植物基产品崛起，牛排、红烧肉是消费者感兴趣的植物肉产品。

2.5 植物蛋白板块在资本市场热度不减

中国市场方面，中国植物蛋白市场近年来开始升温，目前投资者关注的

重点领域主要集中在植物肉板块。根据 IT 桔子数据，2022 年食品饮料行业融资 138 起，较 2021 年减少 49%，在食品饮料行业整体融资遇冷的情况下，以植物基为代表的“健康食品”概念受到资本青睐，大约有 22 家相关企业获得融资。植物肉方面，植物蛋白先锋品牌星期零 STARFIELD 自 2020 年 8 月获得云九资本领投，愉悦资本、经纬中国跟投的千万级美元的 A 轮融资以来，2022 年 1 月又完成 1 亿美元 B 轮融资，这是自 2019 年成立以来完成的第 4 轮融资；成立于 2020 年的植物肉品牌 Hey Maet 已完成 3 轮融资，包括两轮千万元级别融资。植物饮品方面，成立于 2020 年的新锐品牌 oatoat 在 2020 年到 2021 年获得三轮融资。整体而言，除星期零已获得 B 轮融资外，植物蛋白板块的大多数项目是天使轮或种子轮融资。

2.6 传统食品巨头和新兴企业加速布局植物蛋白产品

植物蛋白概念在中国的接受度与传播度日渐变广，许多传统食品巨头和新兴企业都采取行动来布局植物蛋白产品。

现代农牧与食品产业企业新希望集团于 2021 年 4 月设立植得期待生物科技有限公司，布局植物基食品、替代蛋白食品的研发；肉制品巨头双汇通过收购杜邦蛋白、杜邦食品的方式来加大公司对植物肉产品的投入；全球主要的豌豆蛋白生产企业双塔集团投资新建 10 万吨豌豆精深加工项目以扩大豌豆蛋白产能。此外，星巴克于 2021 年推出首款植物基饮品星怡杯燕麦拿铁，此后又推出星冰乐燕麦拿铁、巴旦木仁植物奶咖啡等植物基饮品；肯德基联合国内植物蛋白食品品牌星期零推出植物肉酥油条饭团和金沙咸蛋黄植物肉酥饭团，并不断丰富其植物基产品。

植物蛋白粉方面，中国市面上的植物蛋白粉品牌主要有安利纽崔莱、汤臣倍健、中粮可益康等，主要产品有纽崔莱多种植物蛋白粉、汤臣倍健蛋白

粉（植物型）、中粮可益康蛋白质粉（植物型）。大部分植物蛋白粉以大豆蛋白、小麦蛋白、豌豆蛋白为蛋白质来源，以使得植物蛋白粉所含各种氨基酸种类和比值更接近人体内的氨基酸组成，易于被人体消化吸收和利用。

2.7 中国植物蛋白低碳发展面临一定挑战

植物蛋白在中国的发展面临一定挑战。首先，**植物蛋白的产品碳足迹信息欠缺**。目前我国的蛋白粉市场以乳清蛋白粉为主，供低碳消费者选购的植物蛋白食品选择较少。市面上的植物蛋白中，披露其产品碳足迹信息的更是寥寥无几，不够充分的低碳信息披露为绿色消费者的采购决定造成困扰。其次，**国内食品领域的低碳标准缺失，企业低碳行为缺乏指引**。植物基产品是近几年兴起的新兴事物，对于低碳的关注也是在 2020 年双碳目标提出后达到了新的高度。目前我国与食品相关的低碳标准还较为空白，由于缺乏统一标准，食品生产企业的低碳行为缺乏指引。最后，**消费者对于低碳理念的认知有待进一步加强。**根据《中国可持续消费报告 2022》，消费者对于低碳消费生活方式的理解更倾向于绿色出行、环保材料、循环再生方面，对于植物基食品消费行为的低碳影响的了解还不是很充分，对于植物蛋白在营养、低碳方面与动物蛋白的对比信息也有待进一步加强。

3、推动中国植物蛋白行业低碳发展建议

3.1 重新定位农业支持政策，支持农食系统向营养健康和绿色低碳协同发展

一直以来中国农业支持政策以保障粮食安全为核心，近期实施了一系列有利于可持续发展目标的改革，在保障粮食安全、减少对环境污染等方面取得显著成效。

双碳目标的提出对农业发展提出了更高要求，农食系统需向营养健康、

绿色低碳、更具包容性和韧性方向转型。因此，应重新定位农业支持政策，引导农食系统从多角度、多层面向多目标发展，突出绿色低碳发展的重要目标要求，以实现国家提出的有关健康、环境、双碳等重大战略。一方面，引导居民膳食模式向营养健康方向转型。目前农业支持关注主粮生产，对其他营养健康食物的支持政策较少。而目前居民膳食不均衡，谷物、食用油和红肉消费较多，蔬菜、水果、水产品和奶制品摄入量明显不足，这会增加超重或肥胖及其相关非传染性疾病风险。应进一步支持营养健康食物生产如优质植物蛋白的生产和消费，增强对该类食物的获取能力。另一方面，加强对农业绿色低碳发展支持力度。尽管目前农业政策增加了对绿色农业支持力度，但重点围绕农业水土资源短缺退化、环境污染加剧等问题，未来应更加关注"双碳"发展目标，支持低碳食品全产业链发展。

3.2 优化农业支持重点领域，促进以植物蛋白为代表的营养低碳食物生产和消费

植物蛋白食品具有营养价值全面、碳足迹远小于动物蛋白的特点，满足双碳背景下低碳转型的发展需要，同时符合中国国民饮食结构的多元化需求。因此可从供应端和需求端协同发力，优化农业支持重点领域，促进以植物蛋白为代表的营养低碳食品生产和消费。在供应端，提高营养低碳食物的产量和供给能力，加强科技支持政策，如加强植物蛋白、植物肉等研发支持，提供营养健康食物的生产水平。在需求端借鉴国际先进经验，通过补贴（税收）和食品标签引导消费者形成健康膳食意识，如德国通过取消动物产品的消费税减免，并对蔬菜、水果和豆类提供消费补贴，引导消费者减少动物产品的消费，用蔬菜和豆制品替代动物产品，形成对健康和环境都有益的膳食结构。对低收入人群采取消费支持措施，如增加农村低收入居民转移支付或发放食

物消费券，缩小城乡营养摄入水平差异。

3.3 关注植物蛋白领域发展，激发以植物蛋白为代表的产业发展活力

人类饮食结构与农食系统碳排放总量关系密切。目前传统食品巨头和新兴企业正在加速布局植物蛋白产业，市面上植物蛋白产品丰富多样，植物蛋白产业发展已初具规模，未来市场广阔。因此可从多方面着手进一步推动植物蛋白产业持续增长。

一是推进低碳食品标准建设。2023 年 4 月，国家发改委等多部门联合印发《碳达峰碳中和标准体系建设指南》，提出要围绕通用标准，以及碳减排、碳清除、碳市场等发展需求构建双碳标准体系。农食系统碳减排不容忽视，而食品领域的低碳标准推出则有助于推进植物蛋白等产业稳健发展，明确营养低碳食品在当前发展阶段的重要地位。目前，零碳食品相关标准制定工作也在摸索之中。2022 年，江苏省制定《零碳负碳农产品温室气体排放评价技术规范》，开创了我国零碳负碳农产品认证标准制定的先河。

二是鼓励食品企业绿色低碳转型。食品企业直接接触广大消费者，其自身绿色低碳发展实践对培养居民绿色低碳饮食理念有重要促进作用，同时食品企业推出绿色低碳产品能够刺激居民低碳食品消费需求。目前，已有不少食品企业从多方面着手开展碳中和实践，加大绿色低碳食品开发，主动将碳中和目标纳入企业未来的发展战略，增加科研技术投入研发低碳生产技术。

案例--安利纽崔莱低碳发展实践

制定碳中和路线图，建设全产业降碳

安利于 2023 年发布碳中和路线图，承诺 2038 年实现企业碳中和，并制定五步走的碳中和路线。

2023 年，率先实现蛋白粉全线产品碳中和，目前在售 8 款产品将全部达成“零碳”；

2025 年，中草药保健品实现全线产品碳中和，同时实现（相对基准年）二氧化碳绝对排放量减少 30%的目标；

2030 年，在中国建成安利全球首家“零碳工厂”，构建一套国际领先、清洁高效的能源体系，同时驱动产业链上下游合作伙伴的低碳转型；

2035 年，实现（相对基准年）二氧化碳绝对排放量减少 75%的目标；

2038 年，实现安利企业运营的全面碳中和目标。

推出“中国首款零碳蛋白粉”，用科学数据突显植物蛋白减排表现

在“低碳社会”、“低碳经济”受到广泛关注的今天，低碳产品对消费者产生更强的吸引力。越来越多的生产企业开展产品碳足迹核算，制定减少产品温室气体排放、实现节能减排的路径，同时通过推出低碳产品助力培育绿色消费习惯，支持可持续生产和消费。

核算选择了覆盖不同人群、产品形态丰富的 8 款植物蛋白粉作为调研对象。在植物蛋白粉从“摇篮”到“大门”各生命周期阶段，碳足迹贡献最大的是原材料包装、生产阶段的用电和蒸汽消耗过程及大豆分离蛋白获取阶段，占比约 80%。其他原材料获取阶段的环境影响相对较小。

植物蛋白粉相较于动物蛋白粉的减碳效果明显。根据一项针对不同乳制品产品的碳足迹分析结果，每千克乳清粉末制品的碳足迹为 7.4kgCO(2)e，比每千克安利植物蛋白粉（麦香味）（540g）高 76%。

安利共披露 8 款蛋白粉产品碳足迹，并通过抵消的方式实现该 8 款产品全部达成碳中和。

3.4 加强膳食指导和营养教育，打造低碳时尚饮食消费模式

低碳环保、大食物观、健康养生等多重驱动下，未来植物蛋白市场广阔。中国双碳目标提出后，消费者越来越重视全球气候变化、低碳环保等问题，并乐于在日常生活中践行绿色低碳消费方式，78%的消费者认为低碳消费信息能够影响个人消费选择。此外，新冠疫情带来人们的健康意识高涨，健身成为一种新潮的生活方式。植物蛋白作为一种低碳食品，能够满足消费者的

营养需求和低碳诉求，作为营养膳食补充剂具有广阔的市场前景。

通过多种形式开展营养膳食教育和指导，覆盖广泛人群。通过公益广告向公众普及营养知识，倡导增加蔬菜、水果及优质蛋白摄入的低碳饮食结构。在农村和城镇社区开展营养知识课堂，引导科学合理膳食，从而预防和控制营养不良及相关疾病。

发挥大数据、电商、区块链等数字经济优势，促进植物蛋白市场消费增长。互联网的发展为新兴理念的传播提供了便捷途径；电商渠道和快递物流的发展，为用户购买植物蛋白提供便捷方式，降低用户购买成本；区块链技术能够实现食品溯源，不论从食品安全还是低碳种植的角度，都能够提升消费者的信任度。植物蛋白可乘数字经济的东风，通过微博、小红书、直播等新兴渠道和传播方式，提升消费者对于低碳消费信息的感知度，从而进一步影响低碳消费行为。

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Research Report on Low Carbon Path to Dietary Protein Intake of Chinese Residents

Amway Corporation

Executive summary

Proteins, as crucial nutrients for the human body, hold a vital role in metabolic processes, the functioning of immune antibodies, nerve impulse conduction, and so on. Data from the Food and Agriculture Organization of the United Nations underscore that the food system contributes to over one-third of global greenhouse gas (GHG) emissions. In a world marked by escalating global resource demands and environmental crises, it is imperative to acknowledge the substantial influence of protein consumption on global sustainable development. Governments around the world are incorporating food-related emissions into their own climate goals, and food companies are also taking actions to help the world combat climate change. As one of the most populous nations globally, China assumes a pivotal role in advancing low-carbon development and the sustainable utilization of resources.

The food system, characterized by its long upstream and downstream industry chains, wide industry span, and extensive influence on residents, is closely intertwined with animal husbandry, manufacturing, logistics, transportation, and food consumption. It stands as one of the greatest driving forces in global climate change mitigation. With the improvement of living standards and the increasing demand for protein in China, nutrition and food security pose significant challenges to the food industry. Concurrently, Chinese residents are paying more attention to dietary health. Plant protein, with its nutritional health benefits and low-carbon environmental advantages, is increasingly favored by Chinese consumers, gradually becoming a fashionable dietary habit.

The plant protein industry in China benefits from a favorable policy environment, promising consumer and capital market prospects, yet it also encounters certain issues and challenges simultaneously. Based on extensive research and insights from the industry, the report aims to explore avenues for reducing carbon emissions associated with protein consumption in China. This report provides recommendations to promote sustainable protein practices and raise the awareness of residents. The report delves into an in-depth analysis of the sources of protein intake among Chinese residents, comparing the carbon emissions associated with plant and animal proteins throughout their entire lifecycle, from raw materials to manufacturing processes. Through this analysis, the report evaluates the potential for decarbonization in protein consumption among Chinese residents. The report

advocates a low-carbon approach to protein intake for Chinese residents, emphasizing strategies such as reducing meat consumption, opting for more environmentally friendly protein sources, encouraging dietary diversity, and minimizing food wastage.

The report is designed to foster more extensive discussions and inspire action. It seeks to motivate policymakers, businesses, social organizations, and the public to collaborate in weaving the notion of sustainable protein consumption into our daily routines. The way we structure our diets is profoundly molding the environment of the future, so let's unite on the path towards low-carbon protein intake to fashion a healthier and more sustainable future.

1. Global trend and international experience of plant proteins low carbon development

1.1 Climate change and food system

Climate change poses serious threats and challenges to human survival and development in both contemporary and future contexts. A special report released by the Intergovernmental Panel on Climate Change (IPCC) in August 2021 pointed out that unless countries take unified action to immediately, rapidly, and massively reduce GHG emissions, it is highly likely that the 1.5°C limit goal set in the Paris Agreement will be reached or exceeded before 2040.

The food system is a complex, extensive system encompassing all elements and activities associated with food production, processing, distribution, preparation, and consumption. It is responsible for one-third of global GHG emissions, making it a major contributor to global climate change. Livestock farming currently constitutes over 60% of the global GHG emissions within the agriculture, forestry, and other land use (AFOLU) sector. Presently, the global population has surpassed 8 billion individuals. Owing to factors such as population growth, urbanization, rising incomes, and various economic and social influences, there is a growing demand for protein worldwide, particularly in low- and middle-income nations. Nutrition and food security continue to pose significant challenges for the food industry. Should current dietary patterns persist, protein demand in 2050 is projected to surge by up to 50% compared to current levels. Correspondingly, the demand for animal protein will also rise, resulting in a rapid escalation of GHG emissions.

The Paris Agreement stipulates the necessity for the global food system to transition into a net carbon sink by 2040. Transitioning to a plant-based diet stands out as one of the most substantial and cost-effective measures to curtail carbon emissions within the food system. IPCC unveiled the findings of the Sixth Assessment Report (AR6), which marks the first comprehensive evaluation of the role of behavior change on the demand side in reducing carbon emissions. It asserts that modifications to our lifestyles and behaviors could potentially lead to a 40%-70% reduction in GHG emissions by 2050. IPCC, from the food demand side, encourages individuals to alter their dietary choices, embrace balanced, sustainable, and healthy eating patterns, and minimize food loss and waste as part of the solution. Among all the solutions mentioned, plant-based diets emerge as the most promising solution, showing significant decarbonization potential. In addition, EAT-Lancet advocates that, a shift towards a plant-based dietary structure alone can reduce an individual's carbon footprint by a significant two-thirds.

1.2 Advantages of plant proteins

Plant proteins consistently exhibit a lower carbon footprint compared to their animal-based counterparts. Based on research conducted on nearly 40,000 farms in

119 countries and an analysis of carbon footprint data for various protein sources, Our World in Data, an online publication affiliated with the University of Oxford, has determined the range and average carbon emissions associated with 100 grams of different proteins. There exists a substantial disparity in carbon emissions between various protein sources, with animal proteins surpassing plant proteins by a wide margin. The United Nations (UN) has proposed that mitigating emissions within the food sector necessitates transformations across all stages, spanning from producers to consumers. One notably effective measure for emission reduction involves transitioning food systems toward plant-rich diets, characterized by a higher inclusion of plant protein, reduced consumption of animal-based foods, and lower intake of saturated fats.

Additionally, a plant-based protein diet is likely to result in lower disease risks. Red meat rich in high-quality protein contains higher levels of saturated fatty acids and cholesterol. Excessive intake of these foods may increase the risk of obesity, cardiovascular disease, and certain tumors, and also influence the blood lipid levels. Research has revealed that the consumption of red meat (such as beef, pork, or mutton) is linked to an increased risk of type 2 diabetes, colorectal cancer, and breast cancer. Notably, processed meats contain significant amounts of sodium, nitrate, nitrite, and other preservatives, which may heighten the risk of cancer. Given the adverse health impacts associated with red meat consumption, both the World Cancer Research Fund (WCRF) and the World Health Organization (WHO) advocate for plant-based diets.

1.3 International actions and trends

Facing the climate change challenge, governments also consider carbon emissions associated with food system. For instance, the Danish government has established the target of achieving climate neutrality in the food and agricultural sector by 2050. This may result in increased costs for livestock production, subsequently reducing demand for animal-based foods. In 2022, the UK Research and Innovation (UKRI) unveiled a roadmap for alternative proteins, with the UK government anticipated to invest 120 million pounds in food system research to bolster studies related to alternative proteins.

In recent years, the concept of plant protein has emerged as a prominent global trend. Pioneering companies in the plant protein sector, exemplified by Beyond Meat and Impossible Foods, have secured substantial rounds of financing. Beyond Meat, for instance, successfully went public on the Nasdaq in the United States in 2019 and currently boasts a market value of approximately US$900 million (as of April 2023). Meanwhile, Impossible Foods is actively preparing for a potential public offering. Since 2010, the annual average growth rate of global plant-based meat substitutes has been 8%. Furthermore, in the past several years, the global plant-based beverage market has experienced a remarkable annual growth rate of 33%. Nowadays,

Europe and the United States stand out as the primary consumer markets for plant protein products. In 2021, North America held a substantial 40% share of the global plant protein supplement market, boasting an annual growth rate of approximately 8.5%. Within North America, the United States emerged as the dominant force in the market. In 2016, Europe claimed a significant 39% share of the global market for plant-based foods.

Considering economic and social development, health, wellness, and environmental preservation have emerged as focal points of consumers. A study conducted by the National Research Council of Canada in March 2019 attributed the growing demand for plant protein substitutes to several key factors. Firstly, individuals are becoming increasingly conscious of protein-rich diets and the advantages of incorporating plant proteins. Secondly, the global population's rapid expansion has led to a heightened demand for protein. Lastly, growing concerns related to environmental preservation and animal welfare have also played a significant role in driving this trend.

According to ADM's Top Eight Global Consumer Trends in 2023, key drivers of innovation in the nutrition sector this year include a heightened emphasis on environmental responsibility in production, active engagement in social responsibility, a focus on balanced and comprehensive nutrition, as well as an array of protein choices. ADM's research reveals that 52% of consumers worldwide identify as flexitarians, meaning their diets incorporate animal proteins, plant-based or alternative proteins. Among these consumers, nearly two-thirds describe their dietary style as "looking forward to more plant-based foods", a trend that has significantly propelled the growth of plant proteins industry.

2. Insights and Analysis on the Low Carbon Protein Intake among Chinese Residents

2.1 Analysis of Protein Intake Among Chinese Residents

According to a series of surveys conducted by China's National Nutrition Surveys (CNNSs) at the national level, the total protein intake among Chinese residents has remained relatively stable, primarily sourced from cereals and animal foods. However, there has been a significant change in the proportion of protein sources. In 1992, the intake of animal protein accounted for 18.9% of the total protein intake among Chinese residents, and by 2015, this proportion had increased to 35.2%. The substantial increase in the supply of meat, eggs, and dairy is attributed to the advancement in agricultural modernization, such as the significant improvement in mechanization levels. Over the past nearly 20 years, due to the "Westernization" of the diet and misconceptions about the nutritional value of cereal foods, there has been a noticeable downward trend in the proportion of protein intake from cereals, with a decrease ranging from 8.6% to 16.8%; meanwhile, the intake of soy protein

has remained at a relatively stable level.

The main sources of dietary protein for urban and rural residents from 1993 to 2015

2.2 The protein supply level in China has steadily increased, further driving the rapid development of plant protein.

China is one of the most populous countries in the world and also the largest consumer of meat. With the growth of GDP and a significant improvement in the living standards of its residents, the protein supply level in China has steadily increased. At the current stage, China's protein supply still presents a structure where plant protein is the main source, supplemented by animal protein. If the per capita protein intake from livestock products in China reaches the level of Europe and America, the peak of emissions from the livestock industry will occur in 2034, with greenhouse gas emissions reaching 489 million tons of carbon dioxide equivalent.

Residents' demand for protein, which initially focused on its functional satisfaction, is gradually shifting towards a demand for health diversity, environmental protection, and low carbon footprint. People's interest in sustainable meat alternatives is growing stronger, which will in turn drive the rapid development of plant protein. A study by DuPont points out that China is one of the fastest-growing markets for plant protein globally. It is predicted that between 2020 and 2025, due to the increasing interest in health and sustainable development, the demand for meat protein substitutes will increase by 200%.

2.3 Carbon Neutrality Policy Benefits Plant Protein

The carbon emission intensity associated with plant protein is markedly lower than that of animal protein. Moreover, plant protein aligns well with the traditional Chinese diet, which primarily relies on plant-based rather than animal-based foods.

Furthermore, the development of plant protein is positioned favorably within China's policy environment, particularly in the context of carbon neutrality initiatives.

China first introduced the "30·60 Goal" in September 2020, aiming to "peak carbon emissions before 2030 and achieve carbon neutrality by 2060". To effectively realize these objectives, China has established a "1+N" policy framework for carbon peaking and carbon neutrality. As the "1" in the "1+N" policy framework, the Opinions of the CPC Central Committee and the State Council on Fully, Accurately, and Comprehensively Implementing the New Development Concept and Successfully Advancing Carbon Peaking and Carbon Neutralization, issued on October 24, 2021, serves as a guiding and coordinating document for the "double carbon" efforts. The Opinions emphasizes the need to "accelerate the environmentally sustainable development of agriculture and enhance carbon sequestration and efficiency improvements in the agricultural sector".

Shortly thereafter, on October 26, the Action Plan for Carbon Dioxide Peaking Before 2030 was released. Serving as the central document among the "N" policies within the "1+N" policy framework, this Action Plan takes the lead in paving the way for the introduction of the remaining "N" policies. It provides additional clarity on the imperative to "intensify endeavors in fostering green, low-carbon, and circular agriculture while endorsing the development of low-carbon agricultural practices".

In August 2021, the Ministry of Agriculture and Rural Affairs, along with five other ministries and commissions, issued the 14th Five-Year Plan for Green Development of Agriculture. This plan outlines the objectives of "constructing an eco-friendly and low-carbon agricultural industrial chain, advancing the sustainable transformation of the agricultural product processing industry, creating and enhancing a green circulation system, and stimulating the consumption of eco-conscious agricultural products".

In January 2022, the National Development and Reform Commission, along with other relevant departments issued the Implementation Plan for Promoting Green Consumption. This plan sets forth the objectives of "accelerating the enhancement of the eco-friendly aspect of food consumption; elevating the standards for the production, storage, transportation, and processing of agricultural products, such as grains, vegetables, and fruits; and actively promoting the consumption of green organic food and agricultural products."

From a carbon reduction perspective, plant-based foods hold significant potential for mitigating GHG emissions when compared to their animal-based counterparts. This makes plant-based foods a highly promising solution for reducing carbon emissions in the agricultural sector. Moreover, the traditional Chinese diet predominantly relies on plant-based foods rather than animal-based ones, aligning with the goals outlined in the National Nutrition Plan (2017-2030) released by the

State Council. The Plan emphasizes the importance of advancing the food nutrition and health industry, with a focus on utilizing high-quality animal and plant proteins as fundamental nutritional components. It also advocates for increased efforts in innovative research and processing technologies while promoting the transformation and adoption of key products within the project of "dual protein engineering". Consequently, the development of plant protein enjoys a favorable policy environment in China.

2.4 The recognition of plant protein products in the Chinese consumer market is gradually increasing

According to the China Sustainable Consumption Report 2022, nearly half of consumers are willing to pay a premium of more than 5% to purchase low-carbon foods.

According to an online survey conducted in 2017 by the New Zealand Ministry of Agriculture and Forestry in collaboration with a consulting agency, involving 2,000 residents in first- and second-tier cities in China, it was found that 39% of Chinese consumers opt to decrease their meat consumption. In exploring alternatives to meat and dairy products, 62.4% of respondents opt for vegetables as a meat substitute, 61.5% choose soy products and imitation meat, and 52.8% select plant protein beverages as a dairy substitute.

In terms of market performance, plant protein foods and beverages, exemplified by plant protein drinks and plant-based meat, have been garnering increasing recognition among Chinese consumers. According to the "2022 Food and Beverage Innovation Hot Topics" report released by Tmall Food, "plant energy" has emerged as one of the six focal areas in the food and beverage industry for 2022. The report indicates that the plant-based beverages most purchased by Chinese consumers include traditional options like soy milk and coconut milk, as well as emerging alternatives like oat milk and sesame milk. Plant-based drinks have become a popular choice for consumers seeking nutritional supplementation. Additionally, the Insight into the Development Trend of China's Catering Industry, published by Ipsos China in April 2023, underscores the rising popularity of plant-based products in the context of health sustainability. Notably, steak and braised pork in brown sauce are among the plant-based meat products that have piqued consumer interest.

2.5 The fervor surrounding the plant-based protein sector persists undiminished in the financial markets.

In China, the plant protein market has witnessed a surge in activity in recent years, with investors predominantly directing their attention towards the plant-based meat sector. According to ITJUZI, there were 138 financing cases in the food and beverage industry in 2022, reflecting a 49% decrease compared to 2021. Even as the broader food and beverage industry grapples with financing challenges, the

concept of “healthy food”, epitomized by plant-based offerings, has found favor with investors. Approximately 22 related companies have successfully secured funding. In the realm of plant-based meat, a trailblazing brand in the plant protein landscape, STARFIELD, attracted a US$10 million Series A round of financing from Sky9 Capital in August 2020, followed by investments from JOY Capital and Matrix Partners China. Notably, STARFIELD completed a substantial US$100 million Series B round in January 2022, marking its fourth round of financing since its establishment in 2019. Hey Meat, another plant-based meat brand founded in 2020, has successfully completed three rounds of financing, including two rounds securing 10 million yuan each. In the domain of plant-based beverages, oatoat, a newly established brand in 2020, secured funding through three rounds of financing spanning from 2020 to 2021. Overall, most projects within the plant protein sector have secured seed and angel rounds of financing, except for STARFIELD, which secured a B round of financing.

2.6 Traditional food giants and emerging companies are accelerating their layout in plant-based protein products.

As the concept of plant protein gains increasing acceptance and popularity in China, numerous traditional food industry leaders and emerging companies have initiated efforts to penetrate the plant protein product market.

New Hope Group, a company in the modern agriculture, animal husbandry, and food industry, established Expectation Biotechnology Co., Ltd. in April 2021 to focus on the research and development of plant-based and alternative protein foods. The meat product giant Shuanghui increased its involvement in the plant-based meat sector by acquiring shares of DuPont Protein and DuPont Food. Shuangta Group, a global leader in pea protein production, invested in a new 100,000-ton deep processing project to expand its pea protein production capacity. Furthermore, Starbucks introduced its inaugural plant-based beverage, the Chilled Cup Oat Latte, in 2021, and subsequently introduced additional plant-based drinks such as the Frappuccino Oat Latte and the Almond Plant Milk Coffee. KFC, in collaboration with STARFIELD, a domestic plant protein food brand, launched the Plant Meat Crispy Deep-fried Dough Sticks Rice Ball and Jinsha Salted Egg Yolk Plant Meat Crispy Rice Ball, continually expanding their array of plant-based products.

When it comes to planting protein powder, prominent brands in the Chinese market include Amway Nutrilite, BYHEALTH, and COFCO Keyikang. Their primary products encompass Nutrilite’s All-plant Protein Powder, BYHEALTH Protein Powder (plant-based), and COFCO Keyikang Protein Powder (plant-based). Most plant protein powders utilize soy protein, wheat protein, and pea protein as their protein sources. These choices ensure that the amino acids present in plant protein powders, along with their respective ratios, closely resemble the amino acid composition found in the human body. Consequently, these products are easier to

digest, absorb, and utilize.

2.7 The low-carbon development of plant-based protein in China faces certain challenges.

The development of plant-based protein in China faces certain challenges.

Firstly, there is a notable absence of carbon footprint information for plant-based protein products. Presently, the protein powder market in China is predominantly saturated with whey protein powder. The options for low-carbon consumers in the realm of plant protein foods are quite limited. Among the available plant protein products, only a select few provide carbon footprint information. This lack of transparency in disclosing low-carbon information has led to uncertainty among environmentally conscious consumers when making purchasing decisions.

Secondly, within the domestic food industry, there is a noticeable absence of established low-carbon standards, and businesses are lacking proper guidance towards adopting low-carbon practices. The emergence of plant-based products in recent years has coincided with an increased focus on low-carbon initiatives, particularly following the introduction of the dual carbon goals in 2020. Presently, China's low-carbon standards pertaining to food remain relatively undeveloped. The absence of consistent standards has resulted in inadequate guidance for food producers regarding low-carbon practices.

Finally, Consumers' grasp of low-carbon concepts requires further reinforcement. According to the China Sustainable Consumption Report 2022, consumers tend to focus more on low-carbon aspects related to green travel, eco-friendly materials, and recycling, while their awareness of the low-carbon impact of plant-based food consumption remains limited. Enhancing comparative information regarding the nutritional and low-carbon aspects of plant proteins versus animal proteins is also essential.

3. Promoting the Low-carbon Development of the Plant Protein Industry in China

3.1 Repositioning agricultural support policies to promote nutritional health and green low-carbon synergies in the agri-food system

China's agricultural support policies have traditionally focused on ensuring food security, with recent reforms showing significant progress in areas such as reducing environmental pollution while maintaining food security.

The introduction of dual carbon targets places higher demands on agricultural development, requiring a shift in the agri-food system towards nutritional health, green low-carbon practices, and greater inclusiveness and resilience. Therefore, there is a need to reposition agricultural support policies to steer the agri-food system

towards multi-target development from different perspectives and levels, emphasising the crucial objectives of green low-carbon development to realise national health, environmental and dual-carbon strategies. On the one hand, it is imperative to steer dietary patterns towards nutritional health. Current agricultural support focuses primarily on the production of staple grains, with limited policy support for other nutritious foods. However, current diets are unbalanced, with excessive consumption of cereals, edible oils and red meat and insufficient consumption of vegetables, fruits, aquatic products and dairy products, leading to increased risks of overweight, obesity and related noncommunicable diseases. Further support for the production and consumption of nutritious foods, such as high-quality plant proteins, is needed to improve access to such foods. On the other hand, it is crucial to strengthen support for the development of green, low-carbon agriculture. While current agricultural policies have increased support for green agriculture, the focus remains on issues such as scarcity and degradation of agricultural water and soil resources, and escalating pollution. Future efforts should concentrate more on achieving dual-carbon development goals, supporting the comprehensive development of low-carbon food throughout the entire industry chain.

3.2 Optimizing key areas of agricultural support to promote the production and consumption of nutritious, low-carbon foods represented by plant proteins

Plant protein foods, with their comprehensive nutritional value and significantly lower carbon footprint compared to animal proteins, meet the requirements of low-carbon transformation in the dual-carbon context, while also meeting the diversified demands of China's national dietary structure. Therefore, concerted efforts from both the supply and demand sides are needed to optimise key areas of agricultural support to promote the production and consumption of nutritious low-carbon foods represented by plant proteins. On the supply side, it is essential to increase the yield and supply capacity of nutritious low-carbon foods, strengthen technological support policies such as research and development support for plant proteins and plant-based meats, and increase the production level of nutritious foods. On the demand side, based on advanced international experience, guiding consumers towards healthy diets through subsidies (tax incentives) and food labelling is crucial. For example, following Germany's example of removing excise taxes on animal products and providing subsidies for vegetables, fruits and legumes can encourage consumers to reduce their consumption of animal products and replace them with vegetables and legumes, thereby promoting a diet that is both healthier and more environmentally friendly. Consumption support measures for low-income groups, such as increasing transfer payments to low-income rural residents or distributing food vouchers, should be implemented to reduce the gap in nutritional intakes between urban and rural areas.

3.3 Focusing on the development of the plant protein sector to stimulate the development vitality of the industries represented by plant proteins

The structure of human diets is closely related to the total carbon emissions of agri-food systems. Traditional food giants and emerging enterprises are accelerating their layout in the plant protein industry, with a diverse range of plant protein products available in the market. The development of the plant protein industry has begun to take shape, with huge future market potential. Therefore, various measures should be taken to further promote the sustainable growth of the plant protein industry.

First, it is essential to promote the construction of low-carbon food standards. In April 2023, the National Development and Reform Commission and other departments jointly issued the "Guidelines for Building a Carbon Peak and Carbon Neutrality Standards System", proposing to build a dual-carbon standards system around general standards, carbon emissions reduction, carbon sequestration, carbon markets and other development needs. The reduction of carbon emissions in agri-food systems cannot be ignored, and the introduction of low-carbon standards in the food sector can facilitate the robust development of industries such as plant proteins, highlighting the crucial position of nutritionally low-carbon foods at the current stage of development. Work is also underway on standards for zero-carbon foods. In 2022, Jiangsu Province formulated the "Technical Specifications for Evaluating Greenhouse Gas Emissions of Zero-Carbon and Negative-Carbon Agricultural Products", pioneering the establishment of certification standards for zero-carbon and negative-carbon agricultural products in China.

Second, it is crucial to encourage food businesses to undertake green low-carbon transformation. Food enterprises have direct contact with large numbers of consumers, and their own green low-carbon development practices play an important role in cultivating public awareness of green low-carbon eating habits among residents. In addition, the introduction of green low-carbon products by food enterprises can stimulate the demand for low-carbon food consumption among residents. At present, many food companies have initiated carbon-neutral practices from various aspects, intensified the development of green low-carbon food products, and actively incorporated carbon-neutrality goals into their future development strategies, thereby increasing research and technological investment in low-carbon production technologies.

Case Study - Amway Nutrilite Low Carbon Development Practice

Formulating a carbon-neutral roadmap and building an enterprise-wide carbon reduction strategy

Amway published its Carbon Neutral Roadmap in 2023, committing to achieve

corporate carbon neutrality by 2038 and formulating a five-step carbon neutrality roadmap.
In 2023, the company became the first to achieve carbon neutrality for all of its protein powder products, with all eight products currently on the market set to achieve 'zero carbon';
By 2025, traditional Chinese herbal health products will achieve carbon neutrality for all products, while achieving a 30% reduction in absolute carbon dioxide emissions compared to the baseline year;
By 2030, Amway's first "zero carbon factory" will be established in China, building a world-leading clean and efficient energy system while driving the low-carbon transformation of upstream and downstream partners in the industry chain;
By 2035, achieve a 75% reduction in absolute carbon dioxide emissions compared to the baseline year;
By 2038, Amway's business operations will achieve comprehensive carbon neutrality.

Launch of "China's first zero-carbon protein powder" to highlight the carbon reduction performance of plant proteins with scientific data

In today's context of widespread attention to "low-carbon society" and "low-carbon economy", low-carbon products are becoming more attractive to consumers. More and more manufacturing companies are assessing the carbon footprint of their products, identifying ways to reduce greenhouse gas emissions, and setting targets to save energy and reduce emissions. At the same time, by introducing low-carbon products, they are promoting green consumer habits and supporting sustainable production and consumption.
The assessment selected eight types of plant protein powder as research subjects, covering different demographics and product forms. Throughout the life cycle of plant protein powders, from cradle to gate, the largest contributors to the carbon footprint are raw material packaging, electricity and steam consumption during production, and the soy protein isolation stage, accounting for approximately 80%. The environmental impact of other stages of raw material sourcing is relatively small.
Vegetable protein powders have a significant carbon reduction effect compared to animal protein powders. According to carbon footprint analyses of various dairy products, whey powder products have a carbon footprint of 7.4 kgCO_2e per kilogram, which is 76% higher than Amway Plant Protein Powder (Wheat Flavour) at 540 grams per kilogram.

Amway disclosed the carbon footprints of eight protein powder products and achieved carbon neutrality for all eight through offsetting.

3.4 Driven by various factors including environmental conservation, the emergence of "Big Food View", and health and wellness trends, the market potential for plant protein is significant.

Since the introduction of China's dual carbon goals, consumers have shown increasing concern for issues such as global climate change and environmental protection, and are increasingly inclined toward green and low-carbon consumption in their daily lives. A noteworthy 78% of consumers believe that information about low-carbon consumption can influence their personal choices when it comes to what they buy51. Additionally, the COVID-19 pandemic has heightened awareness of health, leading to a surge in fitness as a new way of life. Plant protein, being both nutritionally sound and low in carbon footprint, can cater to the dietary and low-carbon preferences of consumers, and holds substantial market potential as a nutritional dietary supplement.

Providing nutrition and dietary education in a variety of forms to reach a wide range of population groups is essential. Disseminating nutrition knowledge to the public through public service announcements, advocating a low-carbon dietary pattern that increases the intake of vegetables, fruits and high-quality protein, conducting nutrition education classes in rural and urban community centres to promote science-based diets and prevent and control malnutrition and related diseases.

The rapid advancement of big data, e-commerce, and blockchain technology has fueled the growth of the plant protein industry. The expansion of the Internet has facilitated the dissemination of new concepts; the proliferation of e-commerce platforms and efficient delivery services has offered users convenient and cost-effective avenues for purchasing plant protein products; and blockchain technology has enabled food traceability, enhancing consumer trust in terms of both food safety and low-carbon farming practices. In the context of the digital economy and leveraging emerging platforms such as Weibo and Xiaohongshu, as well as communication methods like live streaming, there is potential to enhance consumers' awareness of low-carbon consumption information and guide them further towards adopting low-carbon consumption behaviors.

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