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本验证规范是联合国工发组织支持的“绿色丝绸之路项目”的成果之一，意在结合相关国际经验，为绿色工业园区建设提供相关管理建议和技术方面的指导。并希望今后为工发组织制定相关验证规范和标准提供可参考的基础，为海陆丝绸之路沿线国家绿色工业园区的发展做出贡献。

This verification manual is one of the achievements of Green Silk Road project supported by the United Nations Industrial Development Organization (UNIDO). It combines related international experiences and aims to provide management advice and technical guidance for Green Industrial Park development. The verification manual will serve as a reference basis for UNIDO-led norms and standards formulation in the future and contribute to the development of Green Industrial Parks along the Maritime and Continental Silk Roads.

# 中文目录（Contents of Chinese version）

# Contents of English version (英文目录)

# 前言

绿色工业园区是指以可持续发展理念、清洁生产要求、循环经济理念和工业生态学原理为指导，通过物质流或能量流传递等方式寻求物质闭路循环、能量多级利用和废物最小化的途径，从而形成资源共享和副产品互换的产业共生组合，最大限度的提高资源能源利用效率，从工业生产源头上将污染物的产生降至最低的一种新型工业园区。绿色工业园区作为绿色经济发展的重要载体，是未来实现区域绿色经济发展的关键所在。

为指导一带一路沿线国家实施绿色工业园区战略实施，推广“UNIDO 绿色丝绸之路项目”成果，特制定本规范。

本规范规定了绿色工业园区的验证程序，规定了验证过程的原则性和通用性要求。对于一个行业类工业园区，应根据本规范的要求，制定具体的验证规范。

经联合国工发组织中国南南工业合作中心委托和授权，本规范为首次发布，由中国环境科学研究院起草。

# 1 适用范围

本规范规定了 UNIDO 绿色工业园区验证的各方职责、验证程序、验证申请、基础审核、验证评估、验证报告编制、验证报告审核、验证发布、验证升级等工作的通用性和技术性要求。

本规范供参与 UNIDO 绿色工业园区验证的验证机构、验证申请者（园区）等机构与人员开展绿色工业园区验证工作时使用。

# 2 规范性引用文件

ISO 9001 质量管理体系

ISO 14001:2004 环境管理体系

ISO 50001:2011 能源管理体系要求及使用指南

HJ274-2015 《国家生态工业示范园区标准》

UNIDO 绿色丝绸之路项目绿色工业园区建设指导原则

# 3 术语和定义

下列术语和定义适用于本规范。

## 3.1 绿色工业园区

指以可持续发展理念、清洁生产要求、循环经济理念和工业生态学原理为指导，通过物质流或能量流传递等方式寻求物质闭路循环、能量多级利用和废物最

小化的途径，从而形成资源共享和副产品互换的产业共生组合，最大限度的提高资源能源利用效率，从工业生产源头上将污染物的产生降至最低的一种新型工业园区。

### 3.2 绿色工业园区验证

绿色工业园区验证是受政府、工业园区或其他相关方委托，依据相关标准和法规，综合运用科学测试、数理统计以及专家辅助评价等方法，对所委托的绿色工业园区进行科学、客观、公正的评估和分析。

### 3.3 绿色工业园区验证办公室

联合国工业发展组织中国南南工业合作中心全面负责UNIDO绿色工业园区验证工作，并设立绿色工业园区验证办公室（以下简称“办公室”），主要负责制订和发布相关验证规范、确认验证机构、颁发证书、宣传推广等。

### 3.4 绿色工业园区验证指导委员会

是绿色工业园区验证的最高决策管理机构，由联合国工业发展组织中国南南工业合作中心成立，由联合国工发组织官员、专业技术人员及高级顾问等人员组成，对绿色工业园区发展相关重大事项进行评议和决策的机构（以下简称“委员会”）。

### 3.5 绿色工业园区验证指导委员会秘书处

是UNIDO绿色工业园区验证指导委员会的事务性管理机构（以下简称“秘书处”），暂时设在中国环境科学研究院，受绿色工业园区验证办公室委托，主要从事绿色工业园区验证的常规事务性管理工作，包括验证机构审核登记、监督验证机构的验证过程、安排验证评审专家审查验证报告等。

### 3.6 验证专家组

验证专家组由本规范涉及的环境、能源、经济、产业等相关领域具有专业知识和技术水平的专家组成，主要职责是协助秘书处审核验证报告、对绿色工业园区进行验证评估等。专家组成员由UNIDO绿色工业园区验证指导委员会选定，管理工作由委员会秘书处负责。

### 3.7 验证申请者

一般指准备进行 UNIDO 绿色工业园区验证的园区。

### 3.8 验证机构

指经办公室确认并接受验证申请者委托，依据《UNIDO 绿色工业园区导则》，对申请者提供的环境、经济数据及管理机制进行科学、客观的验证评价，并向秘书处提交验证报告的机构。

### 3.9 验证报告

指验证机构在对绿色工业园区进行数据收集和分析评估后，依据《UNIDO 绿色工业园区导则》，编制完成并提交秘书处的验证报告。报告应包含园区概述、指标评估、验证结果等相关内容，详见附录有关规定。

### 3.10 验证声明

由秘书处出具的声明，主要内容是对绿色工业园区的验证结果进行简要评述。

### 3.11 验证证书与标识

验证证书由办公室授予。验证标识（文字、图形或其组合）由办公室确定，以使 UNIDO 绿色工业园区验证活动与其他活动区别开来。

## 4 验证各方职责

### 4.1 绿色工业园区验证办公室

(1)、对 UNIDO 绿色工业园区验证的全过程进行管理和指导；

(2)、对验证机构进行资质确认；

(3)、批准和发布 UNIDO 绿色工业园区验证相关规范，如验证规范、管理办法等技术指导性文件；

(4)、颁发验证证书；

(5)、宣传 UNIDO 绿色工业园区的意义和验证成果。

### 4.2 UNIDO 绿色工业园区验证指导委员会

对绿色工业园区发展相关重大事项进行评议和决策。

### 4.3 绿色工业园区验证指导委员会秘书处

(1)、协助 UNIDO 绿色工业园区验证办公室、指导委员会的工作；

(2)、负责验证机构登记入册，并进行日常监督和管理；

(3)、对验证申请者的基础审核结果进行审查备案；

(4)、对验证过程进行监督和管理；

(5)、组织审核验证报告；

(6)、组织审核园区升级评估报告；

(7)、拟写验证声明并提请办公室审核发布。

### 4.4 验证专家组

协助秘书处对验证报告、升级评估报告进行技术审核。

### 4.5 验证申请者

(1)、向办公室提出绿色工业园区验证申请、升级申请；

(2)、选择验证机构；与验证机构签订验证服务合同，清楚规定各自的责任和义务，及可公开数据范围、纠纷处理等条款；确定验证费用，并向验证机构支付费用；

(3)、协助验证机构编制验证报告，对验证工作提供必要的资料和数据支持。

### 4.6 验证机构

(1)、接受验证申请者的验证委托，审核验证可行性，并及时把基础审核结果提交秘书处备案；

(2)、编制完成验证报告、升级评估报告并提交秘书处；

(3)、按照 GB19001-2008 建立质量管理体系并有效运行。

## 5 验证程序

绿色工业园区验证规范的主要步骤如下：

(1)、验证申请

(2)、基础审核

(3)、验证评估

(4)、验证报告编制与审核

(5)、发布验证声明、授予验证证书

(6)、申请升级、审核升级、授予升级

具体程序如图 1 所示：

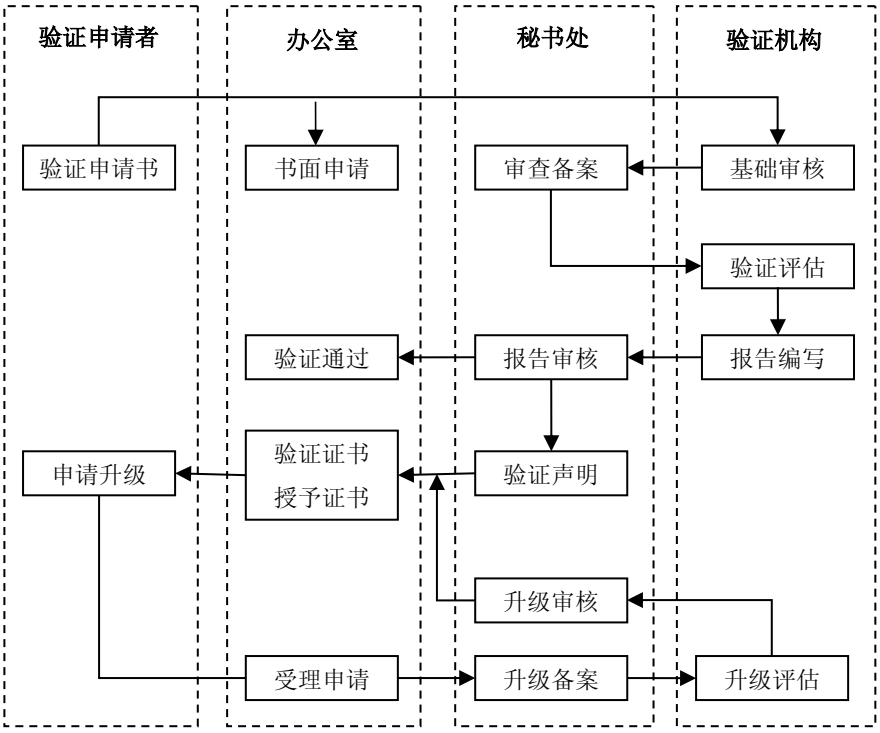


**图 1　绿色工业园区验证程序**

## 6 验证申请

6.1 验证申请者首先向办公室提出申请；

6.2 办公室接受申请后，验证申请者可选择验证机构，并委托验证机构进行基础审核；

6.3 验证申请书主要包括以下三部分内容：

（1）、园区概况：园区简介、经济发展现状、产业结构等；

（2）、基础条件：园区需满足开展绿色工业园区验证的各项基础条件，如无重大环境安全事故、ISO14000 环境管理体系、集中式污染处理设施等；

（3）、服务合同：园区委托第三方开展验证评估的合同。

## 7 基础审核

7.1 秘书处对验证机构所提供的验证申请书和相关文件进行审核，全面了解园区情况，并确认所提供的资料和信息是否完整。基础审核过程可参照表 1《验证申请基础审核表》中所列出的条件进行审查。

**表 1　验证申请基础审核表**

| 序号 | 条件 | 是否满足 | |
|---|---|---|---|
| | | 是 | 否 |
| 1 | 园区概况。 | | |
| 2 | 园区近三年未发生环境安全事故的证明。 | | |
| 3 | 所获得ISO9000、ISO14000、ISO50000或其它相关证书。 | | |
| 4 | 园区已有集中式污染处理设施情况说明。 | | |
| 5 | 与验证机构签订的服务合同。 | | |
| 6 | 园区的安全应急计划。 | | |
| 7 | 其他材料，包括： | | |
| | 当年工业增加值增长率高于园区所在地工业增加值增长率 | | |
| | 园区GDP三年年均增长率不低于园区所在地GDP三年年均增长率 | | |
| | 人均工业增加值≥15万元/人 | | |
| | *其他待补充* | | |
| | | | |
| **8** | **申报者提供足够的文件和数据。** | | |

7.2 当所有条件都符合时，秘书处可以受理验证申请，并开展验证工作。

# 8 验证评估

## 8.1 一般规定

8.1.1 园区所有污染处理设施运行稳定，同时不会产生二次污染，能达到健康安全标准。

8.1.2 由园区统计部门出具的经济、环境统计数据，并经管委会认可后交付验证机构使用。

## 8.2 统计数据的审核

8.2.1 统计数据是由园区统计部门认可或具有相关资质的第三方机构提供的反映园区经济发展和生态环境质量的数据，验证机构应向园区提供数据清单以供园区按照清单要求提供数据，同时验证机构应对已有数据是否符合验证要求进行审核。

8.2.2 验证申请者需要提供的统计材料有（但不局限于）：

(1)、园区基本信息，包括经济数据、社会数据、产业发展数据等，如工业增加值、工业用地面积、从业人口等；

(2)、园区资源使用状况，如煤耗、电耗、水耗等；

(3)、园区各类污染物产生及排放数据，如 COD 排放量、废水产生量等；

(4)、园区污染集中处理设施可研报告及运行情况。

8.2.3 统计数据审核要求如下：

(1)、已有数据是否由园区认可（签字或盖章）；

(2)、已有数据是否满足国家、行业或地方有关标准和规范；

(3)、已有数据一致性是否满足验证要求。

## 8.3 验证评估

8.3.1 完成统计数据的审核后，验证机构应依据《UNIDO 绿色工业园区导则》对绿色工业园区进行验证；

8.3.2 按照《UNIDO 绿色工业园区导则》要求，验证指标可分为管理指标、污染物指标和资源指标；

(1)管理指标主要包括园区组织机构、环境管理体系、废物管理、危险化学品管理、应急机制、健康和安全保护机制等方面，验证申请者按照表 2《绿色工业园区管理指标验证评估表》提交书面材料，验证机构对每项内容做出“是”或“否”的评估。只有当每项内容都为“是”的评估结果时，则认为验证申请者满足绿色工业园区的要求。

**表 2　绿色工业园区管理指标验证评估表**

| 序号 | 管理指标 | 评估 | |
|---|---|---|---|
| | | 是 | 否 |
| 1 | 园区管理机构中是否针对绿色工业园区创建成立了专项管理机构。 | | |
| 2 | 园区近年来是否编制过绿色工业园区相关规划（如生态工业园区规划、循环化改造规划等）。 | | |
| 3 | 园区是否建立ISO14000或其它相关环境管理体系。 | | |
| 4 | 园区在推行环境友好型产品方面是否出台相应的鼓励政策（如生态设计、绿色采购、绿色认证等）。 | | |
| 5 | 园区是否建立了废物回收体系。 | | |
| 6 | 园区是否拥于废物资源化处理企业，如无，是否与园外相关企业建立代谢关系。 | | |
| 7 | 园区对危险化学品管理是否建立了专项制度。 | | |
| 8 | 园区是否建立固定的健康安全机构给企业在健康安全管理方面提供相关帮助。 | | |
| 9 | 园区是否建立了应急响应机制来应对各类突发公共事件。 | | |

(2)污染物指标，主要是强度指标，即单位工业增加值污染物产生（排放）量或单位生产总值的污染物产生（排放）量，污染物种类应根据所在区域的主要污染物控制类别进行选择，指标值的选取应根据所在区域的相关标准和规范。如在中国的工业园区可选污染物为国家控制污染物，包括 COD、氨氮、$SO_2$、$NO_x$ 等，指标值可参考《综合类生态工业园区标准 HJ274-2009》，如表 3《绿色工业园区污染物指标验证评估表》所示。

**表 3　绿色工业园区污染物指标验证评估表**

| 序号 | 污染物指标 | 标准值 | 园区值 | 评估 |
|---|---|---|---|---|
| 1 | 单位工业增加值COD排放量（kg/万元） | ≤1 | | |
| 2 | 单位工业增加值氨氮排放量（kg/万元） | ≤1 | | |
| 3 | 单位工业增加值$SO_2$排放量（kg/万元） | ≤1 | | |
| 4 | 单位工业增加值$NO_x$排放量（kg/万元） | ≤1 | | |
| 5 | 单位工业增加值废水排放量（t/万元） | ≤9 | | |
| 6 | 单位工业增加值固废产生量（t/万元） | ≤0.1 | | |
| 7 | 单位国内生产总值碳排放量（t/万元） | ≤2 | | |

上述所有指标的计算方法见附录一。

(3)资源指标，主要用于表征园区对各类资源的依赖程度和资源利用效率，包括土地资源、水资源、能源等，可通过表 4《绿色工业园区资源指标验证评估表》进行评估。

**表 4　绿色工业园区资源指标验证评估表**

| 序号 | 资源指标 | 标准值 | 园区值 | 评估 |
|---|---|---|---|---|
| 1 | 单位工业增加值工业土地占用量（$m^2$/万元） | ≤10 | | |
| 2 | 单位工业增加值新鲜水消耗量（t/万元） | ≤9 | | |
| 3 | 单位工业增加值综合能耗（t标煤/万元） | ≤0.5 | | |
| 4 | 工业重复用水率（%） | ≥75 | | |
| 5 | 工业固体废物综合利用率（%） | ≥85 | | |
| 6 | 可再生能源占比（%） | ≥12 | | |
| 7 | 绿化覆盖率（%） | ≥35 | | |
| 8 | 工业余热回收利用率（%） | ≥30 | | |
| 9 | 单位国内生产总值二氧化碳排放量年均削减率（%） | ≥3 | | |
| 10 | 推行清洁生产企业污染物排放量占园区污染物排放总量平均比重（各类污染物占比平均）（%） | ≥20 | | |

上述所有指标的计算过程见附录 1。

# 9 验证报告编制与审核

9.1 验证报告主要包括以下内容：

- 验证简介
- 基础审核
- 验证评估
- 验证结论
- 附录

详细的验证报告格式提纲参见附录二。

9.2 验证机构完成验证报告后，验证机构主管需要对验证报告进行复核，并提交给秘书处备案审核。

9.3 秘书处对验证报告进行审核，必要时可邀请专家组进行协助，具体的审核原则如下：

(1)、验证审核过程无任何跟园区有利益关系的单位或个人参与；

(2)、报告中各项数据的都应出自园区统计部门提供的数据报表，报告应附有相关证明材料；

(3)、报告对园区的所有管理指标都附有相关的证明材料；

(4)、报告对园区的所有污染物指标和资源指标都进行了准确的核算；

(5)、报告真实客观的反映了园区发展的实际情况。

9.4 如有必要，秘书处可安排专家组结合验证报告对验证申请者进行现场验证。

# 10 验证声明、验证证书及标识

## 10.1 验证声明

10.1.1 验证声明是秘书处对验证结果进行简要概述的文件。

10.1.2 验证声明要简要说明以下内容：

- 验证结果概述
- 验证评估结果概述
- 验证结论
- 验证时间

### 10.2 验证证书

10.2.1 UNIDO 绿色工业园区验证办公室对通过验证的园区发放绿色工业园区验证证书。验证证书用以承认验证声明的有效性。

10.2.2 验证证书包括证书编号、园区名称和注册地址、通过验证和规范序号、有效期、等级、签发人（签字）等信息。

10.2.3 验证申请者应严格按照有关规定使用验证证书。出现下列情况的，应视情节严重程度，暂停或吊销证书：

(1)、园区发生重大变动已无法对绿色工业园区工作提供支持的；

(2)、在验证过程中弄虚作假的；

(3)、转借验证证书的；

(4)、造成严重环境污染后果和经济损失的。

### 10.3 验证标识

10.3.1 经过 UNIDO 绿色工业园区验证办公室许可，且通过绿色工业园区验证的园区方能使用验证标识。

10.3.2 任何使用验证标识的组织和个人都必须遵守以下原则：

(1)、在任何情况下，验证标识都不得以某公司及其某产品或服务的形式使用；

(2)、验证标识不得在任何公司名称、产品名称、服务名称、域名或网页标题中使用；

(3)、验证标识的复制必须根据绿色工业园区验证办公室的相关规定进行；

(4)、园区应对验证标识的使用负责。

## 11 验证证书升级

验证证书分为三个等级，从低到高依次为三星、四星和五星，分别代表园区绿色化建设的持续改进能力，有效期均为三年。

(1)、首次申请并通过验收后授予三星绿色工业园区证书。

(2)、园区在授予证书满一年后可向办公室申请升级星级，每次升级需满足污染物指标和资源指标较前一次验证报告降低（或提升）5%。

(3)、升级申请者选择验证机构对园区污染物指标和资源指标进行核算评估

是否满足“降低（或提升）5%”的升级要求。

(4)、验证机构以书面报告形式向秘书处提交升级评估报告；

(5)、秘书处审核升级评估报告、拟写升级声明并提请办公室审核发布；

(6)、对于五星园区由秘书处不定期组织验证机构抽查园区污染物指标和资源指标，对于指标未达到前期升级评估报告的，限期整改以达到升级评估报告指标要求，若限期仍未达标的，予以降级处理。

(7)、对于被授予三星绿色工业园区三年内没有申请升级星级的，给予注销绿色工业园区证书，取消 UNIDO 绿色工业园区称号。

# 附录

## 一、指标解释

园区管理机构应指定或专门设立职能部门，负责评价指标涉及数据的调查收集、汇总统计工作，并协调各关联单位开展相关工作。测算评价指标所需的相关数据，应尽量从法定统计渠道或统计文件中获取；无法获取的，园区管理机构应建立相应的数据收集统计工作机制。

- 人均工业增加值（万元/人）

  指园区内工业企业从业人员人均创造的工业增加值。

  计算公式如下：

$$\text{人均工业增加值（万元／人）}=\frac{\text{园区工业增加值（万元）}}{\text{园区年末工业企业从业人员}}$$

  数据来源：统计部门

- 园区 GDP 三年年均增长率（%）

  指园区 GDP 的三年年均增长率。

  计算公式如下：

$$\text{园区}GDP\text{三年年均增长率(\%)}=\left[\left(\frac{\text{当年}GDP\text{（万元）}}{\text{三年前}GDP\text{（万元）}}\right)^{\frac{1}{3}}-1\right]\times 100\%$$

  数据来源：统计部门

- 单位工业增加值 COD 排放量（kg/万元）

  指园区万元工业增加值排放的废水中污染物所需化学需氧量。不包括园区居民生活污水所需的化学需氧量。

  计算公式如下：

$$\text{单位工业增加值COD排放量（}kg\text{／万元）}=\frac{\text{园区工业COD排放总量(}kg\text{)}}{\text{园区工业增加值总量(万元)}}$$

  数据来源：环保部门、统计部门

- 单位工业增加值氨氮排放量（kg/万元）

  指园区万元工业增加值排放的废水中氨氮排放量。不包括园区居民生活污水的氨氮排放量。

计算公式如下：

$$\text{单位工业增加值氨氮排放量（}kg\text{／万元）}=\frac{\text{园区工业氨氮排放总量}(kg)}{\text{园区工业增加值总量}(\text{万元})}$$

数据来源：环保部门、统计部门

- 单位工业增加值 $SO_2$ 排放量（kg/万元）

指标解释：指园区万元工业增加值向大气中排放的 $SO_2$ 量。

计算公式如下：

$$\text{单位工业增加值}SO_2\text{排放量（}kg\text{／万元）}=\frac{\text{园区工业}SO_2\text{排放总量}(kg)}{\text{园区工业增加值总量}(\text{万元})}$$

数据来源：统计部门、环保部门

- 单位工业增加值 NOx 排放量（kg/万元）

指标解释：指园区万元工业增加值向大气中排放的 NOx 量。

计算公式如下：

$$\text{单位工业增加值NOx排放量（}kg\text{／万元）}=\frac{\text{园区工业NOx排放总量}(kg)}{\text{园区工业增加值总量}(\text{万元})}$$

数据来源：统计部门、环保部门

- 单位工业增加值废水排放量（t/万元）

指园区单位工业增加值排放的工业废水量，不包括企业梯级利用的废水和园区内居民排放的生活废水。

计算公式如下：

$$\text{单位工业增加值废水排放量（}t\text{／万元）}=\frac{\text{园区工业废水排放总量}(t)}{\text{园区工业增加值总量}(\text{万元})}$$

数据来源：环保部门、统计部门

- 单位工业增加值固废产生量（t/万元）

指园区单位工业增加值产生的工业固体废物量。

计算公式如下：

$$\text{单位工业增加值固废产生量（}t\text{／万元）}=\frac{\text{园区工业固体废物产生量}(t)}{\text{园区工业增加值总量}(\text{万元})}$$

数据来源：环保部门、统计部门

- 单位国内生产总值碳排放量（t/万元）

指园区单位国内生产总值的二氧化碳排放量。

计算公式如下：

$$\text{单位国内生产总值二氧化碳排放量（}t\text{／万元）}=\frac{\text{园区工业二氧化碳排放量}(t)}{\text{园区国内生产总值(万元)}}$$

二氧化碳排放量可根据发展改革委发布的《省级温室气体清单编制指南（试行）》，二氧化碳排放量计算公式为：

二氧化碳排放量＝（燃料消费量（热量单位）×单位热值燃料含碳量－固碳量）×燃料燃烧过程中的碳氧化率

其中，燃料消费量＝生产量+进口量－出口量－国际航海（航空）加油－库存变化；燃料消费量（热量单位）＝燃料消费量×换算系数（燃料单位热值）；燃料含碳量＝燃料消费量（热量单位）×单位燃料含碳量（燃料的单位热值含碳量）；固碳量＝固碳产品产量×单位产品含碳量×固碳率；净碳排放量=燃料总的含碳量-固碳量；实际碳排放量=净碳排放量×燃料燃烧过程中的碳氧化率。固碳率是指各种化石燃料在作为非能源使用过程中，被固定下来的碳的比率，由于这部分碳没有被释放，所以需要在排放量的计算中予以扣除；碳氧化率是指各种化石燃料在燃烧过程中被氧化的碳的比率，表征燃料的燃烧充分性。单位热值含碳量和碳氧化率可参照发展改革委发布的《省级温室气体清单编制指南（试行）》。

数据来源：统计部门

- 单位工业增加值工业土地占用量（$m^2$/万元）

指园区单位工业增加值所占用的工业用地面积。工业用地面积指工业园区规划建设范围内按照土地规划作为工业用地并已投入生产的土地面积。工业用地指工矿企业的生产车间、库房及其附属设施等用地，包括专用的铁路、码头和道路等用地，不包括露天矿用地。

计算公式如下：

$$\text{单位工业增加值工业用地占有量（}m^2\text{／万元）}=\frac{\text{园区工业用地面积}(m^2)}{\text{单位工业增加值(万元)}}$$

数据来源：统计部门

- 单位工业增加值新鲜水消耗量（t/万元）

指园区内工业企业产生的单位工业增加值所消耗的新鲜水资源量。

计算公式如下：

$$\text{单位工业增加值新鲜水耗（}t\text{／万元）}=\frac{\text{园区工业用新鲜水耗总量（}t\text{）}}{\text{园区工业增加值总量（万元）}}$$

数据来源：统计部门、环保部门

- 单位工业增加值综合能耗（t 标煤/万元）

指园区内工业企业产生的单位工业增加值所消耗的综合能耗量。

计算公式如下：

$$\text{单位工业增加值综合能耗（}t\text{标煤／万元）}=\frac{\text{工业综合能耗总量（}t\text{标煤）}}{\text{园区工业增加值总量（万元）}}$$

数据来源：统计部门、环保部门

- 工业重复用水率（%）

指在一定的计量时间内，园区内工业企业在生产过程中使用的工业重复用水量与工业用水总量的比值。

其中，工业用水重复利用量指园区内工业企业在确定的用水单元或系统内，使用的所有未经处理和处理后重复使用的水量的总和，即循环水量和串联水量的总和。循环水量指在确定的用水单元或系统内，生产过程中已用过的水，再循环用于同一过程的水量。串联水量指在确定的用水单元或系统，生产过程中产生的或使用后的水，在用于另一单元或系统的水量。

工业用水总量指园区工业企业在确定的用水单元或系统内，使用的各种水量的总和，即工业用新鲜水量和工业重复用水量之和。

计算公式如下：

$$\text{工业重复用水率（\%）}=\frac{\text{园区工业重复用水量（吨）}}{\text{园区工业用水总量（吨）}}\times 100\%$$

数据来源：统计部门、环保部门

- 工业固体废物综合利用率（%）

指工业固体废物综合利用量占工业固体废物产生量(包括综合利用往年贮存量)的百分率。

工业固体废物综合利用量：指工业园区内工业企业产生的，通过回收、加工、循环、交换等方式转化为可以利用的资源、能源和其他原材料的固体废物量(包括当年利用往年的工业固体废物贮存量)，如用作农业肥料、生产建筑材料、筑路等。综合利用量由原产生固体废物的单位统计。

计算公式如下：

$$\text{工业固体废物综合利用率（\%）} = \frac{\text{工业固体废物利用量（吨）}}{\text{工业固体废物产生量（吨）} + \text{综合利用往年贮存量（吨）}} \times 100\%$$

数据来源：统计部门、环保部门

- 可再生能源占比（%）

指园区内工业企业的可再生能源使用量与能源消耗总量的比值。

其中，可再生能源是指在自然界中可以不断再生并有规律地得到补充或重复利用的一次能源。包括太阳能、水能、生物质能、地热能、氢能、风能、波浪能以及海洋表面与深层之间的热循环等非化石能源。仅包括人们通过一定技术手段获得的，并作为商品能源使用的部分。

计算公式如下：

$$\text{可再生能源占比（\%）} = \frac{\text{工业企业可再生能源使用量（吨标煤）}}{\text{工业企业综合能耗总量（吨标煤）}} \times 100\%$$

数据来源：统计部门

- 园区绿化覆盖率（%）

指园区内各类绿地的总面积占园区用地总面积的百分比。

计算公式如下：

$$\text{园区绿化覆盖率（\%）} = \frac{\text{园区内各类绿地的总面积(平方米)}}{\text{园区用地总面积(平方米)}} \times 100\%$$

数据来源：城市建设部门

- 工业余热回收利用率（%）

工业余热是指在工业生产过程中，以环境温度为基准线排出的热载体所释放

的热量。工业余热回收利用率指回收利用的工业余热资源量占工业总余热资源量的百分数。

计算公式如下：

$$\text{工业余热回收利用率（\%）} = \frac{\text{工业余热回收利用量（吨标煤）}}{\text{工业余热总量（吨标煤）}} \times 100\%$$

数据来源：统计部门

- 单位国内生产总值二氧化碳排放量年均削减率（%）

  指园区内的单位国内生产总值所产生二氧化碳排放量的年均削减率。

  计算公式如下：

$$\text{单位国内生产总值二氧化碳排放量年均削减率（\%）} = \left[1 - \left(\frac{\text{当年单位国内生产总值二氧化碳排放量（吨／万元）}}{\text{上一年单位国内生产总值二氧化碳排放量（吨／万元）}}\right)\right] \times 100\%$$

  数据来源：统计部门

- 推行清洁生产企业污染物排放量占园区污染物排放总量平均比重（各类污染物占比平均）（%）

  指园区各类污染物重点排放企业开展清洁生产的比重。

  计算公式如下：

$$\text{平均比重（\%）} = \frac{\overline{\sum \text{开展了清洁生产审核的污染物}\ i\text{排放企业排放量}}}{\text{污染物}\ i\text{的排放总量}} \times 100\%$$

  污染物 $i$ 分别指化学需要量、氨氮、二氧化硫、氮氧化物。

  数据来源：统计部门、环保部门

# 二、验证报告 参考格式

**目录**

# PREFACE

Green Industrial Parks refer to a new type of industrial parks, which are guided by the concept of sustainable development, the requirements of cleaner production, the idea of circular economy and the principle of industrial ecology, through the material or energy flow seeking ways for closed material circulations, multi-stage energy use and waste minimization, thus forming an industrial symbiosis of resources sharing and by-product exchanges, with the maximum improvement of resources and energy utilization efficiency, and the minimum pollutants generated from the industrial production sources. As an important carrier of green economic development, Green Industrial Parks are of key importance to achieving regional green economic development.

This verification manual is formulated to provide guidance of Green Industrial Parks strategy for countries along the Maritime and Continental Silk Roads and to promote the achievements of UNIDO Green Silk Road Project.

This verification manual specifies the verification procedure of Green Industrial Parks, as well as the general principles and requirements of the verification process. For a sector-specific industrial park, detailed verification specification should be formulated based on this manual.

This verification manual is first released and drafted by the Chinese Research Academy of Environmental Sciences, as entrusted by the UNIDO Center for South-South Industrial Cooperation in China (UCSSIC/China).

# 1 APPLICABLE SCOPE

The verification manual specifies the general and technical requirements for the UNIDO Green Industrial Parks verification, including verification responsibilities, verification procedures, verification application, preliminary review, evaluation, report preparation, report review, report release, upgrading verification, etc.

The verification manual is for the use of verification institutes, applicants (industrial parks) and institutes as well as personnel for UNIDO Green Industrial Parks verification.

# 2 NORMATIVE REFERENCES

ISO9001 Quality Management System

ISO14001:2004 Environmental Management System

ISO 50001:2011 Energy Management Systems

HJ274-2015 Standard for National Demonstration Eco-industrial Parks

UNIDO Green Silk Road Project Guidelines for UNIDO Green Industrial Parks

# 3 TERMS & DEFINITIONS

The following terms and definitions apply to this verification manual.

## 3.1 Green Industrial Parks

Green Industrial Parks refer to a new type of industrial parks, which are guided by the concept of sustainable development, the requirements of cleaner production, the idea of circular economy and the principle of industrial ecology, through the material or energy flow seeking ways for closed material circulations, multi-stage energy use and waste minimization, thus forming an industrial symbiosis of resources sharing and by-products exchange, with the maximum improvement of resources and energy utilization efficiency, and the minimum pollutants generated from the industrial production sources.

## 3.2 Green Industrial Parks Verification

Green Industrial Parks verification refers to the scientific, objective and fair evaluation and analysis of industrial parks, which is entrusted by government, industrial parks or other relevant parties, by using comprehensive methods including scientific tests, mathematical statistics and expert evaluations, according to relevant standards and regulations.

## 3.3 Green Industrial Parks Verification Office

The UNIDO Centre for South-South Industrial Cooperation in China (UCSSIC/China) has the overall responsibility for the verification of UNIDO Green Industrial Parks and will set up a Green Industrial Parks verification management office (hereinafter referred to as “the Office”) to formulate and publish relevant verification specifications, identify verification institutes, issue certificates, organize

promotional activities, etc.

### 3.4 Green Industrial Parks Verification Steering Committee

Green Industrial Parks Verification Steering Committee (hereinafter referred to as “the Committee”) is the supreme body for decision-making and management for Green Industrial Parks verification, established by UCSSIC/China and composed of UNIDO officials, administration officials and senior consultants. The Committee will review and make decisions on major issues regarding the Green Industrial Parks development.

### 3.5 Secretariat of Green Industrial Parks Verification Steering Committee

Secretariat of Green Industrial Parks Verification Steering Committee (hereinafter referred to as “the Secretariat”) is the daily affairs management body of the Committee, temporarily set up with the Chinese Research Academy of Environmental Sciences. The Secretariat is entrusted by the Office to engage in routine management work of the Green Industrial Parks, including examining and registering verification institutes, supervising the verification process by verification institutes, arranging experts to review verification reports, etc.

### 3.6 Verification Experts Group

Verification Experts group consists of experts with professional knowledge and skills in areas related to the verification, including environment, energy, economy, industry, etc. Its main duty is to assist the Secretariat to review the verification report and evaluate the Green Industrial Parks. Members of the Expert Group will be selected by the Committee and managed by the Secretariat.

### 3.7 Verification Applicants

Applicants generally refer to the industrial parks requesting UNIDO Green Industrial Parks verification.

### 3.8 Verification Institutes

Verification Institutes refers to institutes identified by the Office and entrusted by the applicants. The verification institutes will evaluate scientifically and objectively on the environment and economic statistics and the management mechanism provided by the applicants, according to “the UNIDO Green Silk Road Guidelines for Green

Industrial Parks", and then submit the verification report to the Secretariat.

### 3.9 Verification Reports

Verification Reports refer to reports prepared by verification institutes after data collecting, analysis and evaluation based on "the UNIDO Green Silk Road Guidelines for Green Industrial Parks", and then submitted to the Secretariat. Verification reports should include the following contents: summary, evaluation of indicators, results, etc. Refer to Appendix II for details.

### 3.10 Verification statement

Verification statement will be issued by the Secretariat and briefly comment on the verification results.

### 3.11 Verification Certificate and Logo

The Office issues certificates to the qualified applicants. The Office also defines the Logo (text, graphics, or a combination) to be used, so as to distinguish the UNIDO Green Industrial Parks verification from other activities.

## 4 RESPONSIBILITIES OF ALL PARTIES

### 4.1 Green Industrial Parks Verification Office

(1) Provide management and guidance for the whole process of UNIDO Green Industrial Park verification;
(2) Identify verification institutes;
(3) Formulate and publish specifications related to UNIDO Green Industrial Parks verification, such as verification standards, management principles and other technical guidance documents;
(4) Issue verification certificates.
(5) Organize activities to promote the UNIDO Green Industrial Parks and disseminate achievements.

### 4.2 Green Industrial Parks Verification Steering Committee

Review and make decisions on major issues regarding the Green Industrial Parks development.

### 4.3 Secretariat of Green Industrial Parks Verification Steering Committee

(1) Assist the work of the Office and the Committee;

(2) Register the verification institutes and conduct routine supervision;

(3) Record review the preliminary review results by the verification institutes;

(4) Supervise and manage the verification process;

(5) Review verification reports;

(6) Review upgrading evaluation reports;

(7) Draft verification statements and submit it to the Office for release.

### 4.4 Verification Experts Group

Assist the Secretariat to review the verification reports and Green Industrial Parks upgrading evaluation reports.

### 4.5 Verification Applicants

(1) Apply to the Office for Green Industrial Parks verification or upgrading verification.

(2) Choose a verification institute and entrust the institute to produce preliminary review and verification report; sign a service contract with the entrusted institute, which clearly defines responsibilities and obligations of the two sides, the scope of public data, disputes settlement and other terms; pay the verification fee in time.

(3) Assist verification institutes in drawing up verification reports; provide necessary information and data.

### 4.6 Verification Institutes

(1) Accept the entrustment of applicants to verify the feasibility and submit the preliminary review to the Secretariat for record review;

(2) Prepare verification reports or Green Industrial Parks upgrading evaluation reports and submit them to the Secretariat;

(3) Establish a quality management system according to the GB19001-2008 and operate effectively.

# 5 VERIFICATION PROCEDURES

The main steps of Green Industrial Parks verification are as follows:

(1) Application for verification

(2) Preliminary review

(3) Verification evaluation

(4) Verification report preparation and review

(5) Release verification statement; issue verification certificate

(6) Application for upgrading, review of upgrading request and issue upgrading certificate.

Specific steps are as figure 1

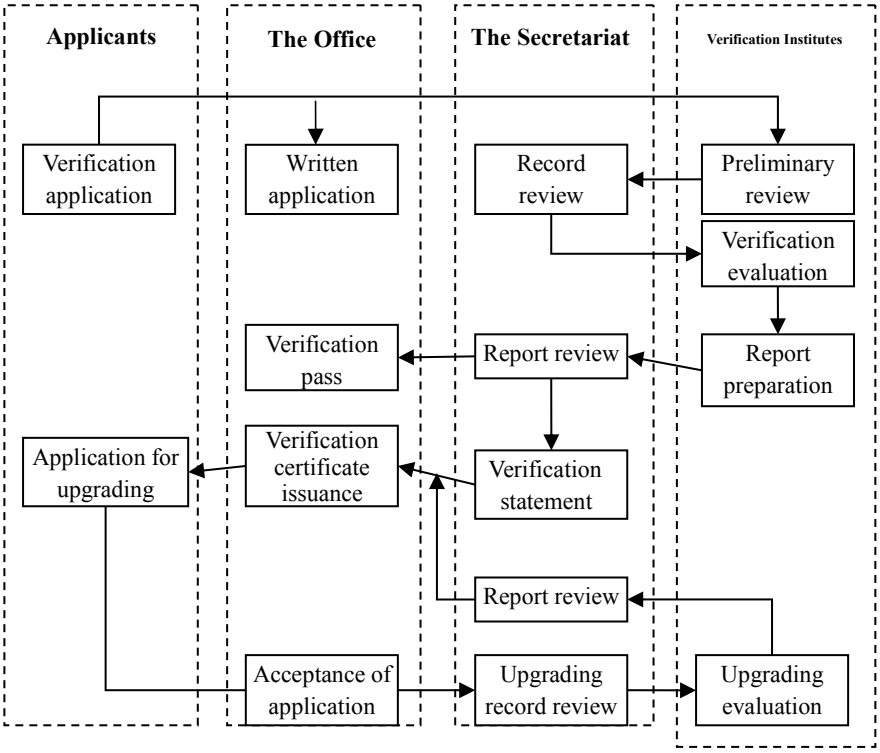


**Figure 1: Green Industrial Parks verification procedure**

# 6 APPLY FOR VERIFICATION

6.1 The applicant applies to the Office for the verification;

6.2 After the Office accepts the application, the applicant entrusts a verification institute for preliminary review;

6.3 The application documents will mainly include three parts as follows:

(1) **Industrial Park Overview**, including park introduction, park economic development status and industrial structure and so on;

(2) **Basic Conditions** required for carrying out Green Industrial Parks verification, such as general records on environmental safety, ISO14000 environmental management system, centralized pollution treatment facilities, etc.;

(3) **Service Contract** between the industrial park and the verification institute for carrying out the verification.

# 7 PRELIMINARY REVIEW

7.1 The secretariat reviews the verification application and related documents provided by verification institutes, get comprehensive understanding of the park and confirm whether the provided data and information are complete. The preliminary review checklist is as follows:

**Table 1： Preliminary Review Checklist**

| No. | Requirements | Whether meet the requirements | |
|---|---|---|---|
| | | Yes | No |
| 1 | Park profile | | |
| 2 | Documents of environmental safety and incidents in the past three years. | | |
| 3 | ISO9000, ISO14000, ISO50000 and other related certificates | | |
| 4 | Note of centralized pollution treatment facilities of the park | | |
| 5 | Service contract signed with verification institutes | | |
| 6 | Safety emergency plan of the park | | |
| 7 | Other materials, including： | | |
| | The industrial added value growth rate higher than that of the park location | | |
| | The three-year average annual GDP growth rate of the park is not lower than that of the park's location | | |
| | The per capita industrial added value≥15000yuan/person | | |
| | *Others to be added* | | |
| | | | |
| 8 | The applicant provides adequate documents and data. | | |

7.2 The secretariat accepts the application for verification when all the conditions listed above are met, and then the verification procedure will move on.

# 8 VERIFICATION EVALUATION

## 8.1 General Provisions

8.1.1 All pollution treatment facilities in the park are in stable operation, do not cause

secondary pollution, and meet the health and safety standards.

8.1.2 The economic and environmental statistics, which are provided to verification institutes, should be issued by the statistics office and approved by the administrative committee of the park.

### 8.2 Statistical Data review

8.2.1 Statistical data are data reflecting economic development and ecological environment quality of the park offered by the statistics office of the park or qualified third party. Verification institutes should provide a data list to the park for data collecting. Meanwhile, verification institutes should examine whether existing data meets validation requirements.

8.2.2 Verification applicants need to provide the following statistical materials (but not limited to)

(1) Basic information of the park, including economic data, social data, industry data such as industrial added value, industrial land area, working population, etc.

(2) The status of resource utilization in the park, such as coal consumption, electricity consumption, water consumption, etc.

(3) Emissions data in the park, such as COD emissions, the amount of wastewater generated, etc.

(4) Feasibility study report and the operation situations of the centralized pollution treatment facilities in the park.

8.2.3 Statistical data review requirements are as follows:

(1) Whether the existing data are approved by the administrative committee of the park (signature or seal);

(2) Whether the existing data meet the national, industrial or regional standards and norms;

(3) Whether the consistency of data meets verification requirements.

### 8.3 Verification evaluation

8.3.1 After completing the review of statistical data, verification institutes should verify based on “UNIDO Green Silk Road Project Guidelines for UNIDO Green Industrial Parks”.

8.3.2 According to the requirements of “UNIDO Green Silk Road Project Guidelines

for UNIDO Green Industrial Parks", verification indicators are divided into management indicators, pollutant indicators and resource indicators.

(1) **Management indicators** mainly include park organization, environmental management system, waste management, hazardous chemicals management, emergency mechanism, health and safety protection mechanism etc. Written materials should be submitted by applicants in accordance with Table 2 "Green Industrial Park management index verification assessment table", and verification institutions will mark "yes" or "no" evaluation for each indicator. Only when all the indicators are marked "yes" that the applicant can be considered as meeting the requirements of the Green Industrial Parks.

**Table 2: Green Industrial Park management evaluation index verification assessment table**

| No. | Management Indicators | Evaluation | |
|---|---|---|---|
| | | yes | no |
| 1 | Whether the park administration has set up a special management mechanism for Green Industrial Park verification。 | | |
| 2 | Whether the park has prepared the Green Industrial Park planning in recent years (such as eco industrial park planning, TTCE planning etc.). | | |
| 3 | Whether the park has established ISO14000 or other related environmental management system | | |
| 4 | Whether the park has issued encouragement policies for environmentally friendly products (such as the introduction of appropriate policies to encourage the ecological design, green procurement, green certification, etc.). | | |
| 5 | Whether the park has established the waste recycling system | | |
| 6 | Whether the park has owned wastes treatment enterprises, if not, whether the park has established a relationship with the metabolic-related businesses outside the park. | | |
| 7 | Whether the park has established a special management system of hazardous chemicals | | |
| 8 | Whether the park has established a health and safety mechanism that can provide help to enterprises in health and safety management. | | |
| 9 | Whether the park has set up an emergency response mechanism to deal with all kinds of public emergencies。 | | |

(2) **Pollutant indicators** mainly refer to intensity indicators, i.e. pollutants generated (emissions) per unit of industrial added value or pollutants generated (emissions) per GDP. Types of pollutants should be selected according to the main categories of pollution control in particular area. The selected index value should be based on relevant standards and norms in the area. For example, pollutants selected from the industrial park in China can be chosen for China's state-controlled pollutants, including COD, ammonia, SO2, NOx, etc. Index value can refer to "HJ274-2015 Standard for National Demonstration Eco-industrial Parks", as shown in Table 3 "Green Industrial Parks pollutant index validation and evaluation table"

**Table 3: Green Industrial Park pollutant indicators verification and evaluation table**

| No. | Pollutant indicators | Standard value | Park values | Evaluation |
|---|---|---|---|---|
| 1 | COD emission per unit of industrial added value (kg/$10^4$yuan) | ≤1 | | |
| 2 | Ammonia nitrogen emission per unit of industrial added value(kg/$10^4$yuan) | ≤1 | | |
| 3 | $SO_2$ emission per unit of industrial added value (kg/$10^4$yuan) | ≤1 | | |
| 4 | NOx emission per unit of industrial added value (kg/$10^4$yuan) | ≤1 | | |
| 5 | Wastewater emission per unit of industrial added value (t/$10^4$yuan) | ≤9 | | |
| 6 | Solid waste generation per unit of industrial added value (t/$10^4$yuan) | ≤0.1 | | |
| 7 | Carbon emissions per unit of GDP (t/ $10^4$yuan) | ≤2 | | |

*Calculation of all these indicators is in Appendix I.*

(3) **Resource indicators**, mainly used to characterize the dependence degree of various types of resources and efficiency of resource use in the park, including land, water, energy, etc. This can be evaluated according to Table 4 "Green Industrial Park resources index validation and evaluation table".

**Table 4:** Green Industrial Park resources index validation and evaluation table

| No. | Resources Indicators | Standard value | Park value | Evaluation |
|---|---|---|---|---|
| 1 | Land area used for industry per unit of industrial added value ($m^2/10^4$yuan) | ≤10 | | |
| 2 | Fresh water consumption per unit of industrial added value (t/$10^4$yuan) | ≤9 | | |
| 3 | Comprehensive energy consumption per unit of industrial added value (tec/$10^4$yuan) | ≤0.5 | | |
| 4 | The industrial water reuse rate (%) | ≥75 | | |
| 5 | Comprehensive utilization rate of industrial solid waste (%) | ≥85 | | |
| 6 | Proportion of renewable energy (%) | ≥12 | | |
| 7 | Green coverage ratio (%) | ≥35 | | |
| 8 | Utilization rate of industrial waste heat (%) | ≥30 | | |
| 9 | Average annual reduction rate of carbon dioxide emissions per unit of GDP (%) | ≥3 | | |
| 10 | Average ratio of pollutants discharged by the industrial enterprises which has carried out cleaner production audit to the total pollutants discharged in the industrial park (%) | ≥20 | | |

*Calculation of all these indicators is in Appendix I.*

# 9 VERIFICATION REPORT PREPARATION & REVIEW

9.1 Verification report mainly includes the following contents:

- Verification Introduction
- Preliminary Review
- Verification Evaluation
- Conclusion
- Appendix

*The detailed outline format of the verification report is in Appendix II.*

9.2 After the completion of the verification report, verification institute executives need to review the report and submit it to the Secretariat for the record review.

9.3 The Secretariat should review the verification report. When necessary, the Secretariat will invite the experts group for assistance. Review principles are as follows:

(1) Without any units or individuals who have interest with the park during the verification audit process;

(2) All the data in the report should be from the data report provided by the statistics department in the park, and the report should be attached with relevant certification materials;

(3) All the management indicators in the report should be attached with related certification documents;

(4) All pollutants and resource index values in the report have been validated accurately;

(5) Reports should objectively reflects the actual development situation of the park.

9.4 The Secretariat can arrange on-site verification based on the verification report by the experts group if necessary.

# 10 VERIFICATION STATEMENT, CERTIFICATE & LOGO

## 10.1 Verification Statement

10.1.1 Verification statement is a brief overview of the verification results by the Secretariat.

10.1.2 Verification Statement includes contents as follows:

- Verification Result Overview
- Verification Evaluation Result Overview
- Conclusion
- Verification Time

## 10.2 Verification Certificate

10.2.1 The Office will issue verification certificates to industrial parks which have passed the verification. Verification certificates are also used to acknowledge the validity of the verification statements.

10.2.2 Verification certificates include certificate number, name of the park and its

registered address, serial number of the verification, validity period, grade, issuer (signature) and other information.

10.2.3 Applicants should use the certificate in strict accordance with relevant provisions. Should there appear the following situations, the certificate will be suspended or revoked, depending on seriousness of the situation:

(1) Major changes have happened in the park and unable to support the work of Green Industrial Park;

(2) Resorting to deceit in the process of verification;

(3) Lending the verification certificate to others;

(4) Causing serious consequences of environmental pollution and economic losses.

### 10.3 Verification Logo

10.3.1 Verification logo can be used only after passing the Green Industrial Park verification and getting permission from the Office.

10.3.2 Any organization or individual who uses verification logo must comply with the following principles:

(1) In any case, the verification logo cannot be used by any given company and in the form of a product or service;

(2)The verification logo should not be used in any company name, product name, service name, domain name or title of webpage;

(3) Replication of the verification logo should be made strictly in accordance with relevant provisions of the Office.

(4) The green industrial park is responsible for the proper use of the verification logo.

## 11 VERIFICATION CERTIFICATE UPGRADING

The certificate is classified in three categories, from low to high as three-star, four-star and five-star, representing the capacity of Green Industrial Parks' consistent

improvement. The certificate is valid for three years.

(1) The three-star Green Industrial Park certificate is granted when the Green Industrial Park passes the first application.

(2) After the certificate is granted for one year， the industrial park can apply to the Office for an upgrade. Each upgrade must meet the requirement that pollutant and resource indicators reduce (or enhance) by 5% compared with the previous verification report.

(3) Applicants for upgrading entrust a verification institute to evaluate whether they meet the requirements of a 5% reduction (or enhancement).

(4) Verification institutes should submit an upgrade evaluation report to the Secretariat in the form of written report.

(5) The Secretariat reviews the upgrade report, prepare the upgrade statement and submit it to the Office for release;

(6) For five-star Parks, the secretariat will organize verification institutes to periodically check pollutant and resource indicators. Those parks whose indicators are not as good as in the upgrade assessment report will be requested to make rectifications within a limited period of time. Parks cannot meet the requirement before deadline will be degraded.

(6) For three-star parks which do not apply for upgrade within three years, their Green Industrial Park certificates and titles will no longer be valid.

## Appendix I: Explanations of Indicators

Park management agency should designate or set up special departments in charge of evaluation which involves collecting survey data, summaries statistics, and coordinate all related units to carry out related work. The data that evaluation required should be obtained from the official statistics channels or statistical document; if data cannot be obtained, the park authority should establish appropriate statistical data collection mechanism.

- **Per capita industrial value added ($10^4$Yuan/Person)**

Per capita industrial value added refers to industrial value added created by one employee in the industrial park in one year

The calculation formula is as follows:

$$\text{Per capita industrial value added}\ (10^4\ \text{Yuan/Person}) = \frac{\text{Industrial value added}\ (10^4\ \text{Yuan})}{\text{Total employee of the industry park}}$$

Data source: Department of Statistics

- **Park GDP average annual growth rate for three years (%)**

Park GDP average annual growth rate for three years refers to average annual growth rate for the last three years

The calculation formula is as follows:

$$\text{Park GDP average annual growth rate for three years}\ (\%) = \left[\left(\frac{\text{GDP this year}}{\text{GDP 3 years ago}}\right)^{\frac{1}{3}} - 1\right] \times 100\%$$

Data source: Department of Statistics

- **COD emission per unit of industrial added value (kg/$10^4$ yuan)**

It refers to the COD emission in wastewater per industrial added value, and it does not include the COD emission from park residents.

The calculation formula is as follows:

$$\text{COD emission per unit of industrial added value}\ (\text{kg}/10^4\ \text{yuan}) = \frac{\text{COD emission (kg)}}{\text{Industrial value added}\ (10^4\ \text{yuan})}$$

Data sources: Departments of Statistics, Environmental Protection

- **Ammonia nitrogen emission per unit of industrial added value (kg/$10^4$ yuan)**

It refers to the ammonia nitrogen emissions in wastewater per industrial added value, and it does not include ammonia nitrogen emission from park residents.

The calculation formula is as follows:

$$\text{ammonia nitrogen emission per unit of industrial added value}\,(\text{kg}/10^4\,\text{yuan}) = \frac{\text{ammonia nitrogen emission (kg)}}{\text{Industrial value added}\,(10^4\,\text{yuan})}$$

Data sources: Departments of Statistics, Environmental Protection

- **$SO_2$ emission per unit of industrial added value (kg/104yuan)**

It refers to the amount of $SO_2$ emissions into the atmosphere per unit ($10^4$ yuan) of industrial added value.

The calculation formula is as follows:

$$SO_2\ \text{emission per industrial added value}\,(\text{kg}/10^4\,\text{yuan}) = \frac{SO_2\ \text{emission (kg)}}{\text{Industrial value added}\,(10^4\,\text{yuan})}$$

Data sources: Departments of Statistics, Environmental Protection

- **NOx emission per unit of industrial added value (kg/$10^4$yuan)**

It refers to the amount of NOx emissions into the atmosphere per unit ($10^4$ yuan) of industrial added value.

The calculation formula is as follows:

$$\text{NOx emission per unit of industrial added value}\,(\text{kg}/10^4\,\text{yuan}) = \frac{\text{NOx emission (kg)}}{\text{Industrial value added}\,(10^4\,\text{yuan})}$$

Data sources: Departments of Statistics, Environmental Protection

- **The wastewater emissions per unit of industrial added value (t/$10^4$ yuan)**

It refers to the amount of emissions from industrial wastewater per unit of industrial added value, not including corporate cascade utilization of wastewater and resident domestic wastewater discharged in the park.

The calculation formula is as follows:

$$\text{wastewater emission per unit of industrial added value}\ (\text{t}/10^4\,\text{yuan}) = \frac{\text{wastewater emission (t)}}{\text{Industrial value added}\,(10^4\,\text{yuan})}$$

Data sources: Departments of Statistics, Environmental Protection

- **Solid waste generation per unit of industrial added value (t/$10^4$yuan)**

It refers to solid waste generation per unit of industrial added value.

The calculation formula is as follows:

$$\text{solid waste generation per unit of industrial added value}\,(\text{t}/10^4\,\text{yuan}) = \frac{\text{solid waste generation(t)}}{\text{Industrial value added}\,(10^4\,\text{yuan})}$$

Data sources: Departments of Statistics, Environmental Protection

- **Carbon emissions per unit of GDP (t/$10^4$yuan)**

It refers to $CO_2$ emissions per GDP.

The calculation formula is as follows:

$$CO_2 \text{ emissions per GDP } (t/10^4 \text{ yuan}) = \frac{CO_2 \text{ emissions } (t)}{\text{GDP } (10^4 \text{ yuan})}$$

According to 'Guideline for provincial greenhouse gas inventory (Trial)' issued by the National Development and Reform Commission, the carbon dioxide emissions calculation formula is:

Carbon dioxide emissions = [fuel consumption (heat unit) × the amount of carbon per heat unit in fuel − carbon sequestration] × the carbon oxidation rate in the process of fuel combustion

Data sources: Statistics Department

- **Land area used for industry per unit of industrial added value ($m^2/10^4$yuan)**

It refers to the land area used for industry per unit of industrial added value. The land area used for industry refers to the land use for industry which has been put into production according to the land planning within the scope of industrial park planning and construction. Industrial land use refers to the production workshop, warehouse and other ancillary facilities in industrial and mining enterprises, including the use of special railway, port and road use, not including the land use of strip mine.

The calculation formula is as follows:

$$\text{land area used for industry per unit of industrial added value } (m^2/10^4 \text{ yuan}) = \frac{\text{industrial land occupancy } (m^2)}{\text{industrial value added } (10^4 \text{ yuan})}$$

Data sources: Statistics Department

- **Fresh water consumption per unit of industrial added value (t/$10^4$yuan)**

It refers to the fresh water consumed by industrial enterprises per unit of industrial added value.

The calculation formula is as follows:

$$\text{fresh water consumption per unit of industrial added value } (t/10^4 \text{ yuan}) = \frac{\text{fresh water consumption } (t)}{\text{Industrial value added } (10^4 \text{ yuan})}$$

Data sources: Departments of Statistics, Environmental Protection

- **Comprehensive energy consumption per unit of industrial added value**

**(t/$10^4$yuan)**

It refers to the comprehensive energy consumption by industrial enterprises per unit of industrial added value.

The calculation formula is as follows:

$$\text{comprehensive energy consumption per industrial added value (tec/}10^4\text{ yuan)} = \frac{\text{comprehensive energy consumption (tce)}}{\text{Industrial value added (}10^4\text{ yuan)}}$$

Data sources: Departments of Statistics, Environmental Protection

- **The industrial water reuse rate (%)**

It refers to the ratio of industrial water reuse to total industrial water consumption in the manufacturing process in a certain period of time.

Among them, the volume of industrial water reuse refers to sum of all the non-treated and treated reuse water that an industrial enterprise used in a certain water using unit or system, which is the sum of the quantity of recirculating water and quantity of series water. Quantity of series water refers to the volume of water that used in one water-using unit or system after it was used or generated in another water-using unit or system.

The total industrial water consumption refers to all kinds of water that an industrial enterprise used in a certain water-using unit or system that is the sum of fresh water consumption and reuse water consumption.

The calculation formula is as follows:

$$\text{The industrial water reuse rate (\%)} = \frac{\text{volume of industrial water reuse(t)}}{\text{total industrial water consumption (t)}} \times 100\%$$

Data sources: Departments of Statistics, Environmental Protection

- **The comprehensive utilization rate of industrial solid waste (%)**

It refers to the ratio of the comprehensive utilization amount of industrial solid waste to the generated solid waste (including the use of solid waste that stored in former years).

Comprehensive utilization amount of industrial solid wastes: refers to the volume of solid waste generated by industrial enterprises and can be used as resources, energy or other raw materials through reclaiming, processing, recycling, exchanging,

etc.(including the use of solid waste that stored in former years), such as using as agricultural fertilizer, producing building materials, building roads, etc.. The comprehensive utilization amount is counted using the unit of solid waste generated previously.

The calculation formula is as follows:

$$\text{comprehensive utilization rate of industrial solid waste (\%)} = \frac{\text{comprehensive utilization amount (t)}}{\text{industrial solid waste generation (t)} + \text{the amount of solid waste that stored in former years (t)}} \times 100\%$$

Data sources: Departments of Statistics, Environmental Protection

- **Proportion of renewable energy (%)**

It refers to the ratio of renewable energy consumption to total energy use in an industrial enterprise.

Among them, the renewable energy refers to the primary energy that can be constantly regenerated and replenished or reused regularly, including the non-fossil energy such as solar energy, hydropower, biomass energy, geothermal energy, hydrogen energy, wind energy, wave energy, the thermal cycle between the surface of the ocean and the deep, etc...

The calculation formula is as follows:

$$\text{Proportion of renewable energy use (\%)} = \frac{\text{renewable energy use (tce)}}{\text{total energy use (tce)}} \times 100\%$$

Data sources: Statistics Department

- **Green coverage ratio (%)**

It refers to the ratio of sum of all kinds of green area to the area that the industrial park covers.

The calculation formula is as follows:

$$\text{Green coverage rate(\%)} = \frac{\text{sum of all kinds of green area (m}^2\text{)}}{\text{the industrial park area (m}^2\text{)}} \times 100\%$$

Data sources: Urban Construction department

- **Utilization rate of industrial waste heat (%)**

Industrial waste heat refers to the heat released on the basis of ambient

temperature of the discharged heat carrier in the manufacturing process. The utilization rate of industrial waste heat refers to the ratio of the waste energy recovery amount to the total amount of waste heat resources.

The calculation formula is as follows:

$$\text{Utilization rate of industrial waste heat}(\%) = \frac{\text{waste energy recovery amount (tce)}}{\text{total amount of waste heat (tce)}} \times 100\%$$

Data sources: Statistics Department

- **Average annual reduction rate of carbon dioxide emissions per unit of GDP (%)**

It refers to the average annual reduction rate of carbon dioxide emissions per unit of GDP.

The calculation formula is as follows:

$$\text{average annual reduction rate of } CO_2 \text{ emissions per GDP (\%)} = \left[1 - \left(\frac{CO_2 \text{ emission per GDP this year (t/10}^4 \text{ yuan)}}{CO_2 \text{ emission per GDP last year (t/10}^4 \text{ yuan)}}\right)\right] \times 100\%$$

Data sources: Statistics Department

- **Average ratio of pollutant discharged by the industrial enterprises which has carried out cleaner production audit to the total pollutant discharged amount in the industrial park (%)**

It refers to the proportion of the enterprises which implement cleaner production audit among all kinds of major pollutant emission enterprises.

The calculation formula is as follows:

$$\text{average ratio (\%)} = \frac{\overline{\sum \text{ pollutant } i \text{ emission from enterprizes of cleaner production audit}}}{\text{pollutant } i \text{ emissions}} \times 100\%$$

Pollutant *i* refers to COD, $NH_3$-N, $SO_2$, NOx.

Data sources: Departments of Statistics, Environmental Protection

# Appendix II: Reference Format of Verification Reports

CATALOG