

TERMS OF REFERENCE FOR R&D PROJECT

1. **Title of the project:** Comprehensive study on ‘Intelligent & Connected LED Lighting Systems’

2. **Background:**

- The subject area of smart lighting in indoor and outdoor environments focuses on integrating IoT technologies with lighting systems to create energy-efficient, adaptable, and connected lighting solutions with improved functionality, user experience, and sustainability.
- Smart lighting systems have revolutionized the way we interact with and control lighting in our homes, offices, and public spaces. These intelligent lighting solutions, fuelled by cutting-edge technology and automation, offer a surplus of benefits ranging from energy efficiency and cost savings to improved user experience and enhanced safety.
- However, there are gap areas in the standardization of smart lighting which includes interoperability, communications methods/protocols, security, environmental impact etc. Therefore, standardization is of utmost importance in the field of smart lighting to address gap areas and for the success and growth of the smart lighting industry.

3. **Scope for R&D:**

The research and development project will aim to develop a comprehensive set of documents that address the design, performance, interoperability, and safety requirements for intelligent and connected LED lighting systems in India.

The scope of the R&D project encompasses the following:

- Literature review- Conduct a comprehensive review of existing literature which will include international standards, if any, research papers, and technical specifications published by any lighting industry on intelligent and connected LED lighting systems.
- Collecting the data related to manufacturing base, testing facility and import/export of the product and technical regulations/standards followed for export.
- Undertake visits to manufacturing facility (2 each for micro, small, medium and large whichever is available in the country), focused discussion with quality team of manufacturer and carry out in-house testing.
- Undertake visit to one user and one testing lab to gather information through questionnaire regarding the standards regulation, testing methods, connectivity protocols, interoperability, lighting control strategies and components, security and challenges, if any, faced by them.
- Comprehensive report mentioning essential elements of LED intelligence such as performance requirements, lighting control strategies, communication methods (wired and wireless), interoperability, testing methods, any other relevant information on the subject matter.

4. Research Methodology:

The project will involve the following research methodologies:

- a. Undertake literature review in respect of existing literature on LED lighting standards, intelligent lighting systems, smart home and building technologies, and their application in India through desktop study, books, magazines, national and international standards/regulation, technical information available with manufactures (small, medium and large scale), laboratories, or any other source. This will provide a foundational understanding of the subject.
- b. Identifying the stakeholders, including manufacturer, laboratories, etc. for intelligent and connected lighting and the following activities shall be carried out and report prepared and collect the information on the following data:
 - Different variety and raw material
 - Performance requirements
 - Constructional requirements
 - Optical requirements
 - Operational requirements for controllers
 - Testing methods used
 - Standards being followed
 - Marking and labelling
 - Lighting control strategies,
 - Communication methods (wired and wireless),
 - Interoperability
 - Any other relevant information
- c. Study testing framework to evaluate the interoperability of LED lighting products with various communication protocols and smart systems. Perform laboratory testing to assess the technical performance, energy efficiency, and safety of intelligent and connected LED lighting products and systems. This may include testing for luminous efficacy, color rendering, and power consumption.
- d. Create detailed documentation of the research process, findings, and recommendations in the form of a comprehensive report.

5. Expected Deliverables:

- Comprehensive set of technical documents and specifications for intelligent and connected LED lighting.
- Interoperability certification and testing framework.
- Safety guidelines and best practices for the installation and operation of these lighting systems.
- Environmental impact assessment and recommendations for sustainable lighting practices.

6. Criteria for Identification of Proposer to conduct Research work:

- Proposer shall be a expertise in LED technology and intelligent lighting systems.

7. Timeline and Method of Progress Review: 3 Months

Time line	Method of progress
0 to 15 days	Literature review, Desktop Study, Collection of Data
16 to 60 days	Industry Visit and testing of samples (except long duration tests)
60 to 75 days	First Draft Report
76 to 90 days	Consolidation of data, Submission of final report of the project.

8. Support BIS will Provide:

- BIS will provide access to latest editions of standards, required for the project.