



# Pine Needle Power Projects

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## Why in News?

Uttarakhand's innovative **pine needle power projects**, aimed at mitigating [forest fires](#) and **generating electricity**, have fallen short of expectations. Despite the vast potential, technological and practical challenges have hindered their success.

## What are Pine Needle Power Projects?

- **Pine Needle Power Projects:** In 2021, the Uttarakhand State government under bio-energy projects announced a scheme to **establish power projects that would use pine needles as fuel to generate electricity**.
  - The original plan was to establish multiple units ranging from **10kW to 250 kW across the State in three phases** (worth about 150 MW).
  - Though the government expected 58 units to be set up, only six units of 250 kW (totally worth 750 kW) have been established.
- **Agency Involved:** Uttarakhand Renewable Energy Development Agency (UREDA).
- **Potential of Pine Needles as a Resource:** 16.36% of Uttarakhand's forest area is covered by chir pine (*Pinus roxburghii*) forests. An estimated **15 lakh tonnes of pine needles are generated annually** in the state.
  - If 40% of this, coupled with agricultural residue, could be utilised, it could significantly aid the state's power requirements and provide employment.
- **Ecological Impact:** Chir pine as an exotic Species prevents the regeneration of localised species.
  - Using pine needles as fuel is more efficient and less polluting than using them as firewood or letting them burn away.

## Renewable Energy from Pine Needles

- Pine needles in India's sub-Himalayan belt pose a fire hazard, yet they also offer the opportunity to be converted into [renewable energy sources like bio-oil, briquettes, or biochar](#).
  - Bio-oil can be used as fuel for engines or furnace oil, while briquettes can be used in **brick kilns or boilers for electricity generation**.
- Researchers from **India's Central Institute of Agricultural Engineering** found that the **flammability of pine needles** makes them a potentially abundant renewable energy source.
  - They can be compacted into **high calorific value briquettes** or converted into **bio-oil through pyrolysis**.
  - The bio-oil has a calorific value of 28.52 megajoules per kilogram and can be used in **blended fuels for engines or as furnace oil**. This makes it a viable alternative to diesel.

## Why have Pine Needle Projects Been Unsuccessful?

- **Technological Limitations:** According to UREDA, the appropriate technology to **sustainably**

use pine needles for electricity generation does not labour yet.

- **Operational Difficulties:** Collecting pine needles is challenging due to the steep forest slopes, vulnerability to animal attacks, and insufficient labour at remunerative rates.
  - Additionally, the moisture content of the pine needles causes lower efficiency and high maintenance for the gasification system.
  - Only a minuscule proportion of available pine needles is currently being collected.

## Key Facts about Chir Pine



- **Family Name:** Pinaceae | **Botanical Name:** Pinus roxburghii.
- **Geographic Origin:** India | **Ecozone Origin:** Indomalaya.
- **Natural History:** It is one of the most important conifers in the Himalayan region which moulds the life of various ethnic and other communities of the region.
  - It is named after **William Roxburgh**, a Scottish botanist known as the founding father of Indian botany.
- **Vegetation Type:** The Chir Pine is well-adapted to the **Montane Temperate Forests** of the Himalayas.
  - The dense canopy of **Chir Pine trees limits the growth of other plants underneath.** However, some shrub species like **Rubus ellipticus, Fragaria vesca, Myrica esculenta,** etc can survive in these pine forests.
- **Geographical Extent:** Distributed across the Himalayan mountains, including Bhutan, India (J&K, Punjab, Himachal Pradesh, Uttarakhand), Nepal, Pakistan, Sikkim, Afghanistan, and southern Tibet.
- **Characteristics:**
  - Coniferous tree-producing pine cones with gymnosperm (naked seeds).
  - Dark-brown, thick deeply longitudinal fissured bark.
  - Leaves grouped three per bundle, slender, flexible, flabellate-triangular in cross-section.
- **Growing Conditions:**
  - Hardy, drought and high-temperature resistant.
  - Requires full sun exposure.
  - Young trees need weekly watering; mature trees need monthly watering.
  - Suitable Locations: Better suited for spacious areas due to its massive root system.
- **IUCN Red List Status:** Least Concern

## UPSC Civil Services Examination, Previous Year Questions (PYQs)

### **Prelims:**

**Q. If you travel through the Himalayas, you are likely to see which of the following plants naturally growing there? (2014)**

1. Oak
2. Rhododendron
3. Sandalwood

**Select the correct answer using the code given below:**

- (a) 1 and 2 only
- (b) 3 only
- (c) 1 and 3 only
- (d) 1, 2 and 3

**Ans: (a)**

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