

Short Course on Renewable Energy

Offered By

**Jan F. Kreider, PhD, PE
Professor, University of Colorado**

COURSE OUTLINE

Renewable energies are available and offer opportunities for economical expansion of both electrical generation capacity and thermal energy supply in Tunisia. This course will describe easy methods of screening renewable resources for Tunisia by end use and by location within the country. Attendees will learn to use standard methods for assessing renewable energy systems and examining their life cycle economics. Focus areas for this course will include solar thermal power, solar photovoltaics and wind power generation. Other forms of distributed electrical generation will also be discussed briefly.

COURSE BENEFITS

After completing the course, you will be able to:

- Analyze renewable energy opportunities anywhere in Tunisia
- Undertake schematic renewable energy system designs
- Analyze the cost-effectiveness of each renewable energy type
- Be familiar with the latest software design and assessment tools
- Prepare and present a written energy assessment to the owner

LECTURER:

Jan F. Kreider, PhD, PE is Professor at the Civil, Environmental, and Architectural Engineering Department in the University of Colorado at Boulder. He has conducted renewable energy assessments and system designs all over the world in the past 25 years. He is also the author 12 books and over 200 technical articles and reports on renewable energy applications to buildings and building energy efficiency.

COURSE SCHEDULE

The course is scheduled over five days to be delivered in one morning and one afternoon session. Each session is 2-hours long with one short break. Homework will be assigned on days 1, 2, and 3.

<i>Day</i>	<i>Session 1 (2 hours)</i>	<i>Session 2 (2 hours)</i>
Day-1	Introduction to Solar and Wind Power	Overview of Economic Analysis of Renewable Energy
Day-2	Introduction to Solar Energy Measurements	State-of-the-art Computer Simulation and Screening Tools for Solar Assessment
Day-3	Session 2.2 continued	State-of-the-art Computer Simulation and Screening Tools for Wind Power
Day-4	Solar and Wind System Design Study	Electricity Storage for Wind and Solar Systems
Day-5	Alternate Distributed Generation Technologies	Field Data Analysis and Closure

COURSE CONTENTS

The topics to be discussed during the short course are outlined below:

DAY 1:

Introduction Solar and Wind Power:

- Data sources and temporal resolution
- Conversion systems description
- Example projects

Overview of Economic Analysis

- Discussion of common economic analysis methods used to determine the cost-effectiveness of energy efficiency measures.
- Presentation of calculation procedures suitable for Life-Cycle Cost (LCC) analysis, internal rate of return (IRR)

DAY 2:

Solar Energy Measurements

- Set up day-long insolation measurements - horizontal and tilted surfaces (east, west, south orientations)
- Photovoltaic panel measurements and efficiency study; resistive loads

Computer Tools for Solar Assessment

- Standard systems designs - solar thermal, photovoltaic
- Basic solar system and component calculations
- Discussion of several computer simulation tools suitable for solar energy analysis
- Hands on use of tools

(Discussion of homework)

DAY 3:

Computer Tools (Continued)

- Basic exercises and case studies using computer
- Economic analysis and optimization using computer tools
- Calculation of energy and cost savings due to renewables use in buildings

Computer Tools for Wind Assessment

- Standard systems designs - on grid, off grid
- Basic wind system conversion calculations
- Discussion of several computer simulation tools suitable for wind power analysis
- Hands on use of tools

(Discussion of homework)

DAY 4:

Solar and Wind System Design Study

- Discussion of required input for actual system design
- Procedures and outcomes of feasibility studies
- Estimation of energy and cost savings due to solar, wind and combined systems

Electricity Storage for Wind and Solar Systems

- Discussion of storage approaches
- Storage calculations
- Computer tool use for storage sizing and economic analysis

(Discussion of homework)

DAY 5:

Alternative Distributed Electrical Generation Technologies

- Presentation of the benefits of various feasible DG technologies - microturbines, fuel cells, combustion engines and others
- Selection approaches for system design.
- Cogeneration systems with distributed generation; computer tool

Field Data Analysis and Closure

- Discussion of solar radiation data and presentation of results
- Discussion of solar photovoltaics data and presentation of results
- Summary overview of course objectives achieved

COURSE TEXTBOOKS

Principles of Solar Engineering, Goswami, Kreith and Kreider, 2d Edition, Taylor and Francis, New York, 2000..

Distributed Generation, Borbely and Kreider, CRC Press, Boca Raton, FL, 2001.

COURSE SUPPORT MATERIALS

1. Hourly weather data for a year for several sites - solar, wind, temperature.
2. Class notes provided by instructor in advance will be distributed to students
3. Various software packages for student use only
4. Personal computers for class sessions
5. LCD projector for lectures
6. One copy of each textbook listed above