

Workshop on
Engineering Challenges of Deploying New Solar Energy Capacity in India
At the Royal Academy of Engineering, London

Outlook for Solar Energy in India

S. Sundar Kumar Iyer



Department of Electrical Engineering and
Samtel Centre for Display Technologies
Indian institute of Technology Kanpur
Kanpur - 208 016, India



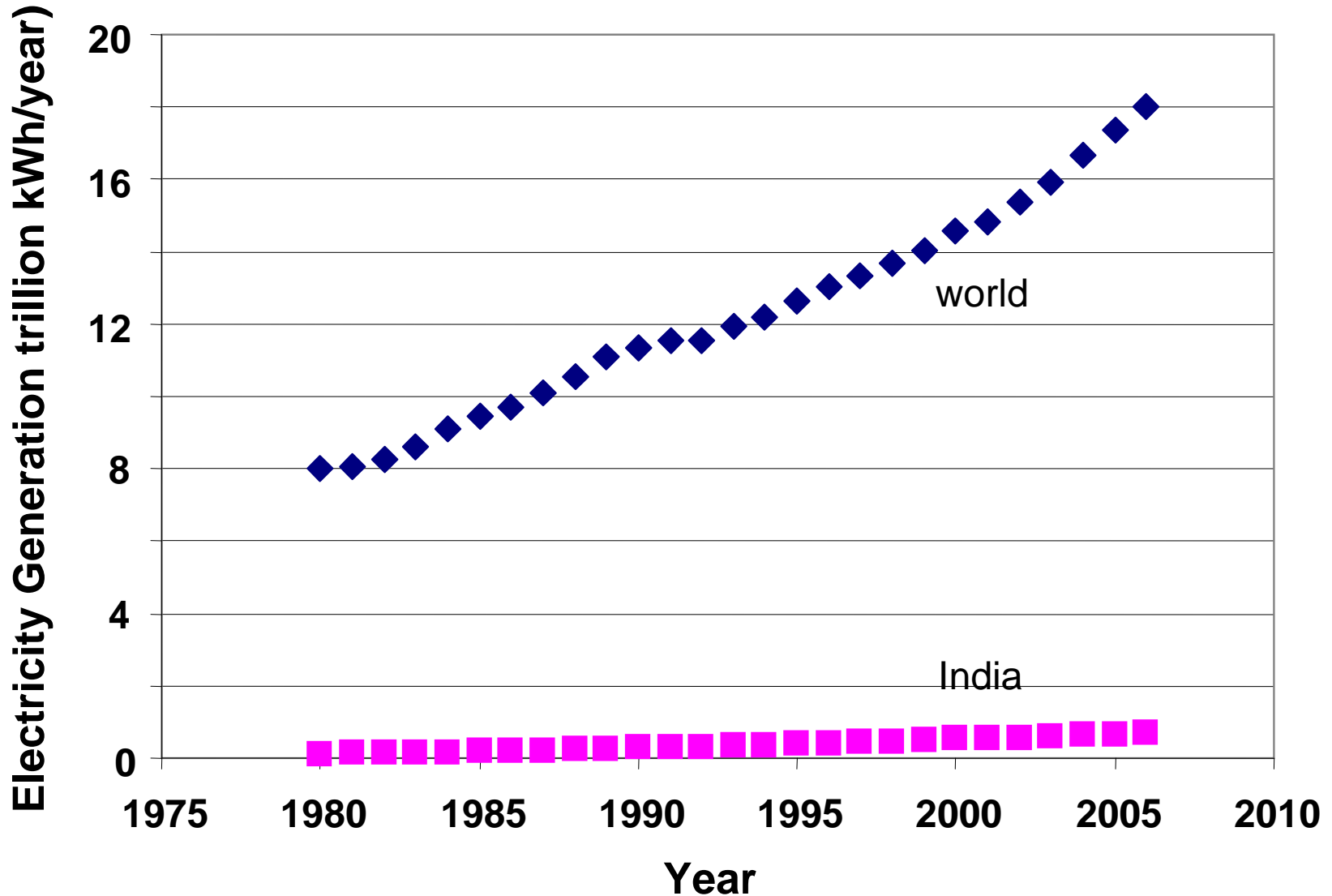
28th September, 2009

Outline

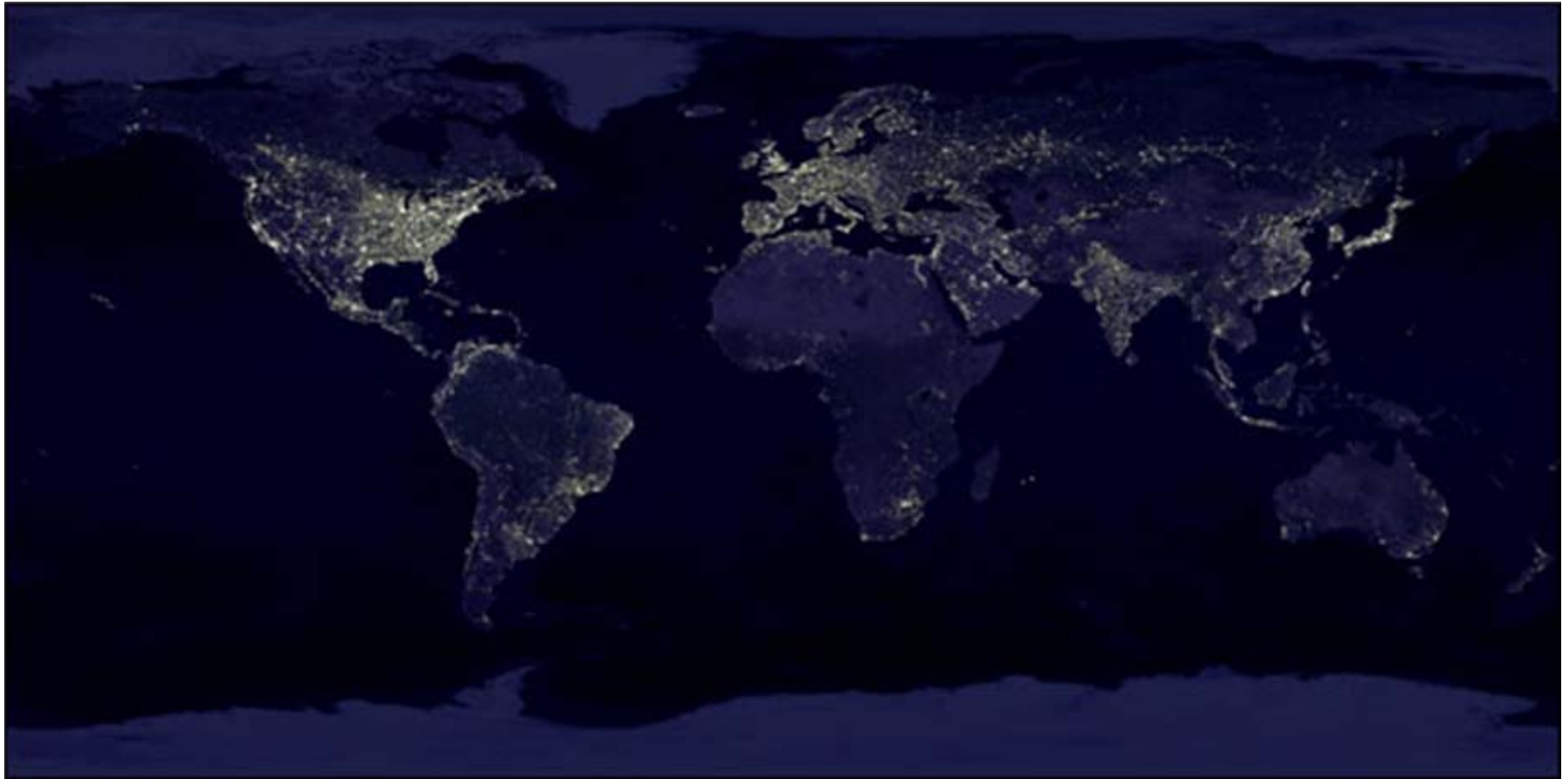
- The potential
- Government policy
- The eco-system
 - research, manpower, industry and capital

The Potential

World Electricity Generation

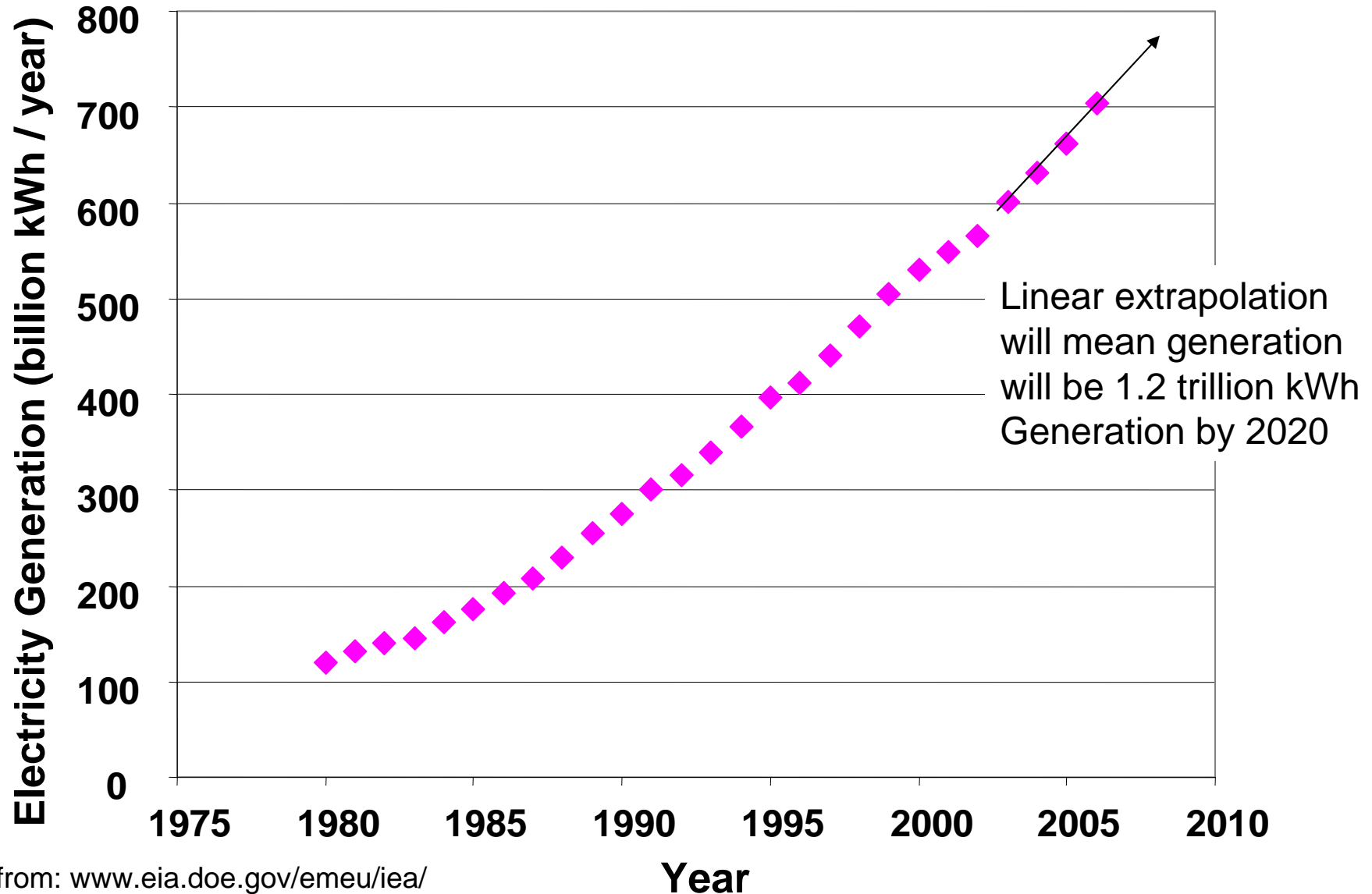


Night Lights Across the Earth

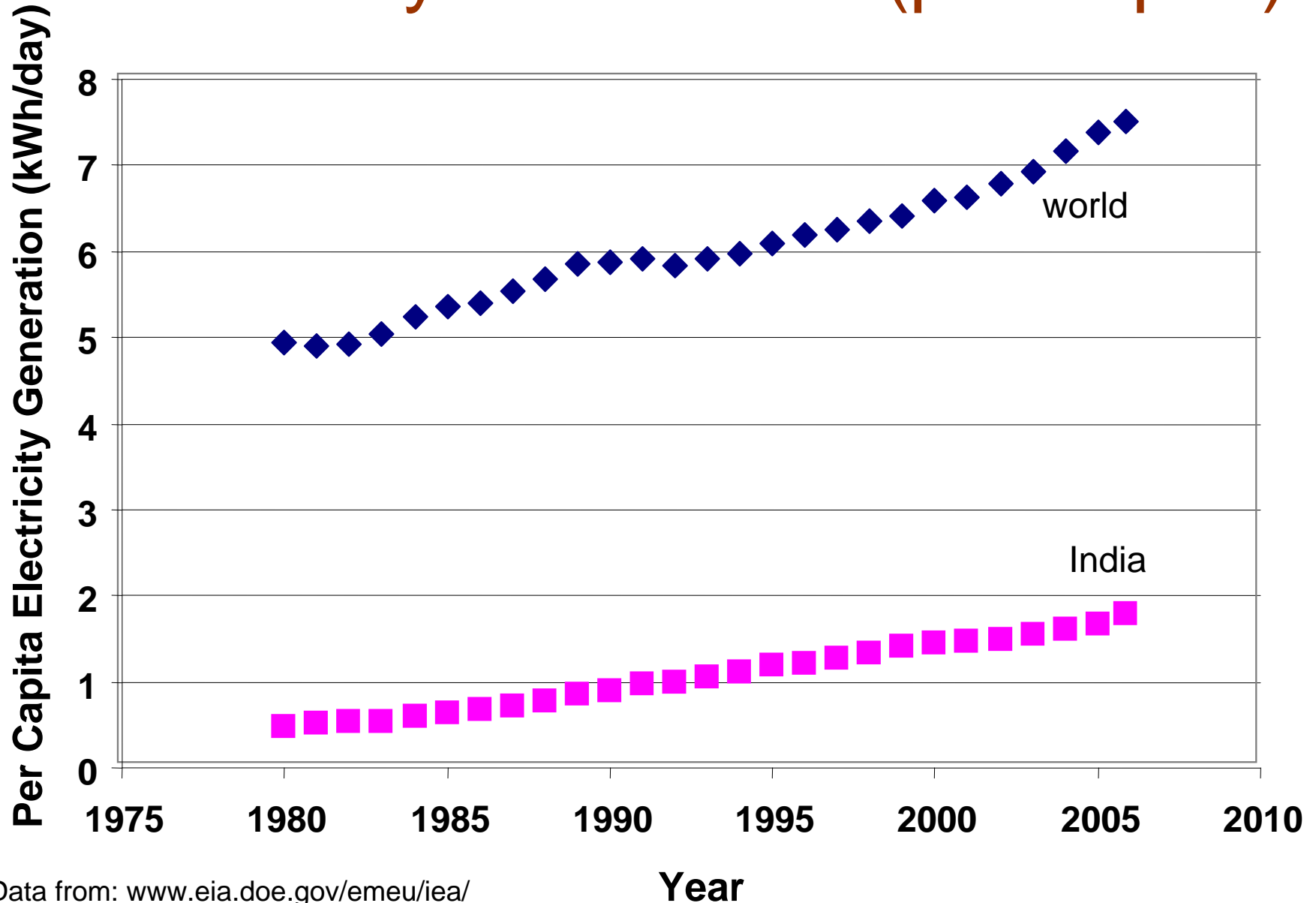


http://science.nasa.gov/headlines/images/lights/earth_lights.jpg

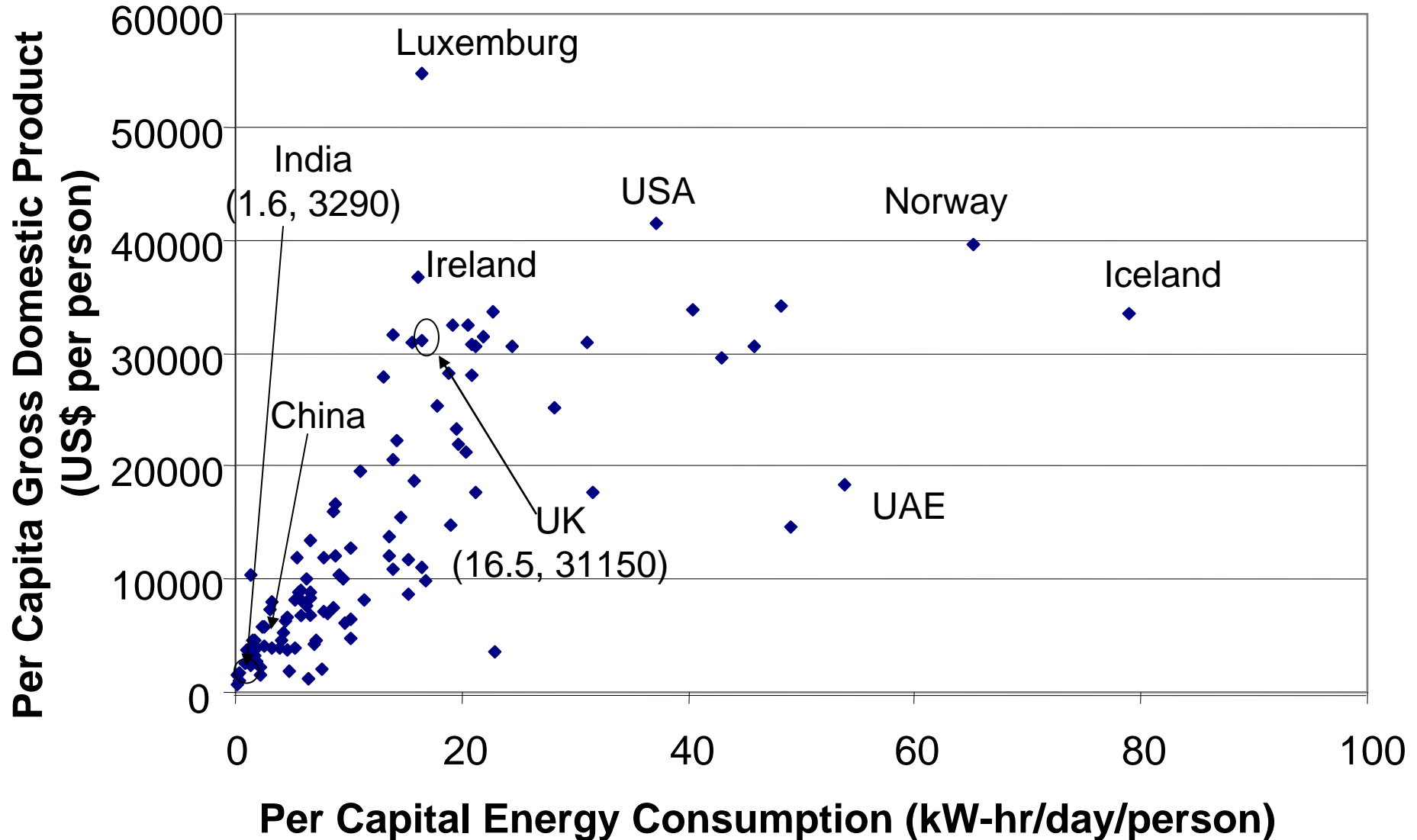
India Electricity Generation



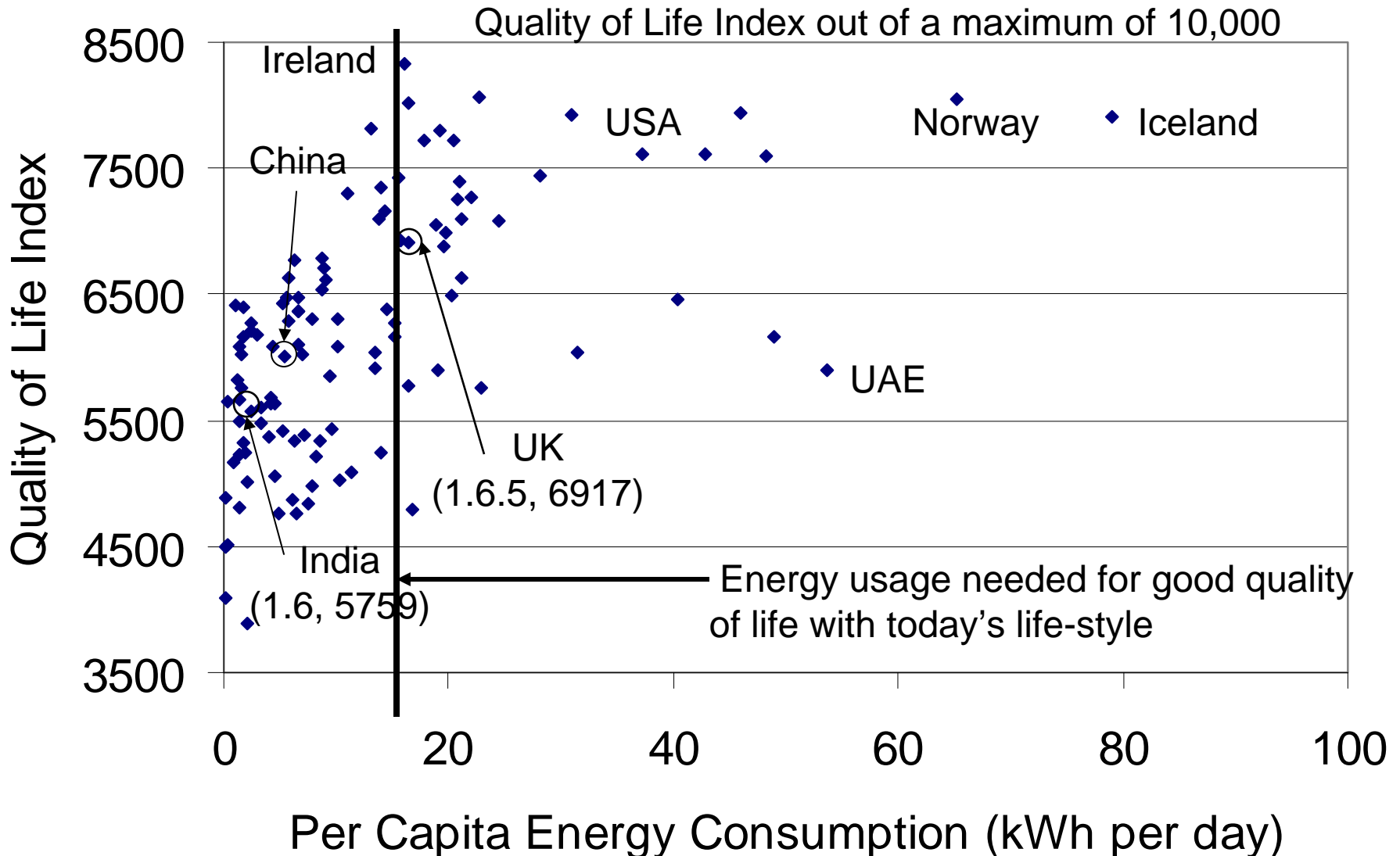
Electricity Generation (per capita)



GDP and Energy Consumption



Quality of Life vs. Energy Usage



Potential in Electricity Generation

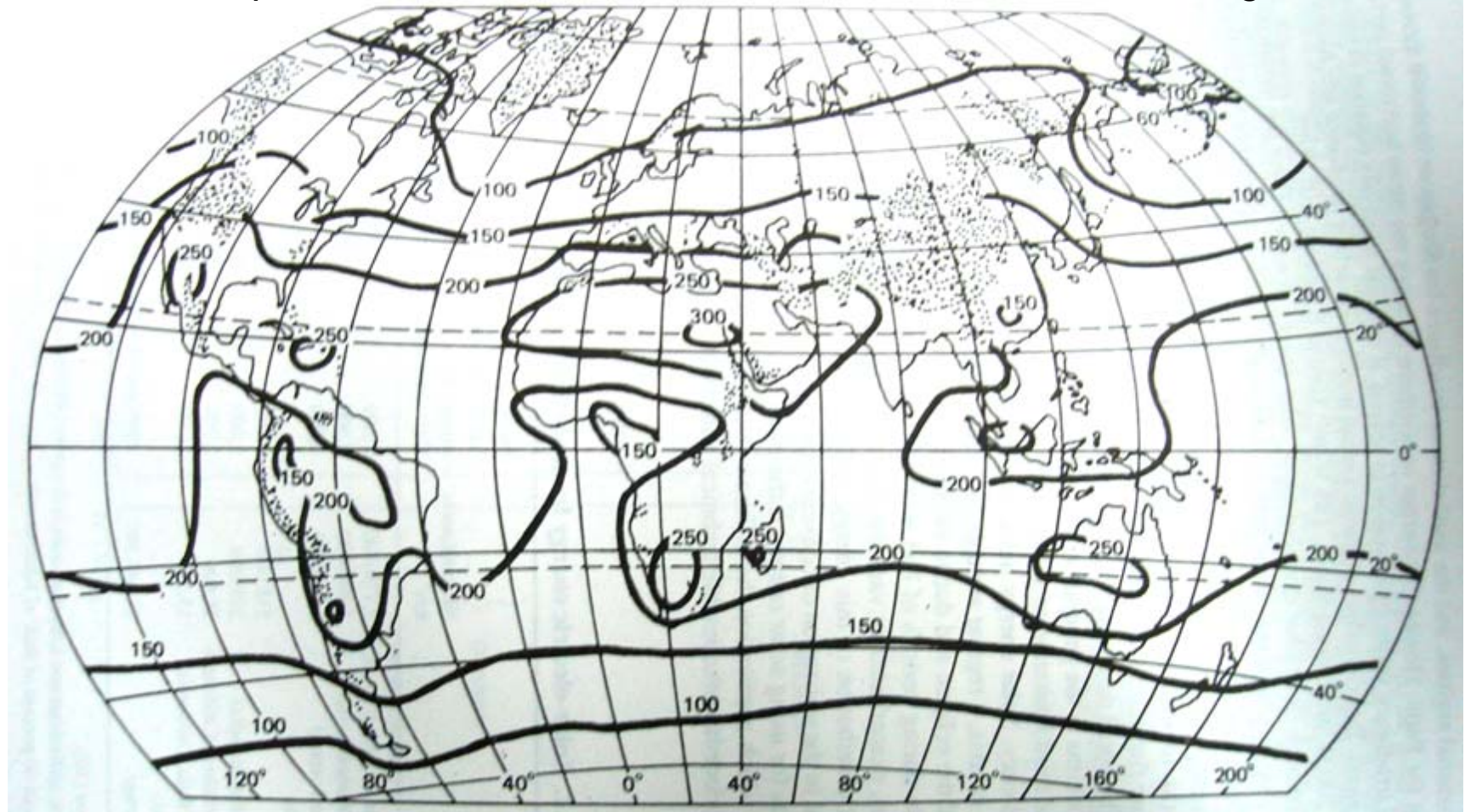
- Linear extrapolation
 - 1.2 trillion kWh Generation by 2020
- World per-capita energy generation parity
 - 3 trillion kWh per year (at least)
- Maximise quality of life index
 - 6 trillion kW per year (at least)

How is this electricity to be generated?

Annual Mean Global Irradiance

On a horizontal plane at the surface of the earth

W m^{-2} averaged over 24 h



Goswami 2000

With 10% efficient solar cell area of solar cell needed in 2006
India ¹¹ 64 km × 64 km (0.14% area)

Solar Energy Systems

Size	Challenge/ Innovation
10s of Watt	<ul style="list-style-type: none">•Cost of system•Battery technology•Cost, maintenance and replacement of parts
kW to 10s of kW	<ul style="list-style-type: none">•Small energy storage technology•Solar power conversion efficiency•Modularity of power conditioners
100s of kW	<ul style="list-style-type: none">•Generation at low cost•Storage of energy•Delivery of energy to consumer
1 MW +	<ul style="list-style-type: none">•Generating power efficiently and low cost•Linking up islands of power generations sources spread out over different pockets

Government Policy

Solar Energy Policy in India

- National Action Plan on Climate Change
 - Prime Minister's Office; 30th June 2008
- Ministry of New and Renewable Energy (MNRE)
 - <http://mnes.nic.in/>
- Support for research in solar energy harnessing
 - Department of Science and Technology
- Promotion of use of solar energy
- Support at the central and state level

National Action Plan on Climate Change

Released 30th June, 2008

National Solar Mission: The NAPCC aims to promote the development and use of solar energy for power generation and other uses with the ultimate objective of making solar competitive with fossil-based energy options. The plan includes:

- Specific goals for increasing use of solar thermal technologies in urban areas, industry, and commercial establishments;
- A goal of increasing production of photovoltaics to 1000 MW/year; and
- A goal of deploying at least 1000 MW of solar thermal power generation.

Other objectives include the establishment of a solar research centre, increased international collaboration on technology development, strengthening of domestic manufacturing capacity, and increased government funding and international support.

Summary on one of the eight national missions envisioned.

<http://www.pewclimate.org/international/country-policies/india-climate-plan-summary/06-2008>

Complete document: <http://pmindia.nic.in/Pg01-52.pdf>

“...Our vision is to make India’s economic development energy-efficient. Over a period of time, we must pioneer a graduated shift from economic activity based on fossil fuels to one based on non-fossil fuels and from reliance on non-renewable and depleting sources of energy to renewable sources of energy. In this strategy, the sun occupies centre stage, as it should, being literally the original source of all energy. **We will pool our scientific, technical and managerial talents, with sufficient financial resources, to develop solar energy as a source of abundant energy to power our economy and to transform the lives of our people.** Our success in this endeavour will change the face of India. It would also enable India to help change the destinies of people around the world.”

- Prime Minister of India, Dr. Manmohan Singh
30th June, 2008

<http://www.pmindia.nic.in/lispeech.asp?id=690>

Emphasis in the text above is my own for the purpose of this presentation

The Eco-System

Academic Institutions

- Indian Institutes of Technologies at
 - Bombay, Delhi, Guwahati, Kanpur, Kharagpur, Madras, Roorkee and newer IITs
- Indian Institute of Science Bangalore
- Indian Institute for the Cultivation of Science at Calcutta
- National Institutes of Technologies, ...
- Jadavpur University, Anna University, ...

Large number of trained manpower available

Solar Energy Research

- Top academic institutions
- Council of Scientific and Industrial Research labs
 - National Physical Laboratories, ...
- ...

Good facilities for research and development

Industrial Base

- Many companies providing
 - Manufacture
 - System level solutions
 - Applications

Many new and important players in the field

Finance

- Government
- International bodies
- Industrial houses

Product Deployment

- Institutes such as TERI and NBIRT Technology
- Various NGOs
- Various government initiatives

Context Based Innovations

Solar Lanterns for Education

C.Solanki at IIT Bombay

- Many students do not get opportunity to study in day time
- Use of solar lanterns for evening schools
- Replacing kerosene lamps with Solar lanterns
- 10Wp Module, 7 Ah battery and 9 W CFL are used, lanterns are optimized for use in one classroom, suitable for 30-40 students
- Lanterns are given to 550 villages helping 16000 students for study in dark hours

www.nenf.org



We have exciting times ahead!

- Time ripe for solar energy in India
- Necessary factors appear to be aligned

- Let us identify
 - the potential challenges/constraints
 - the possible solutions for these

Let us facilitate use of solar energy in India

Thank you!