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Topic:

Renewable energy integration with the distribution grid

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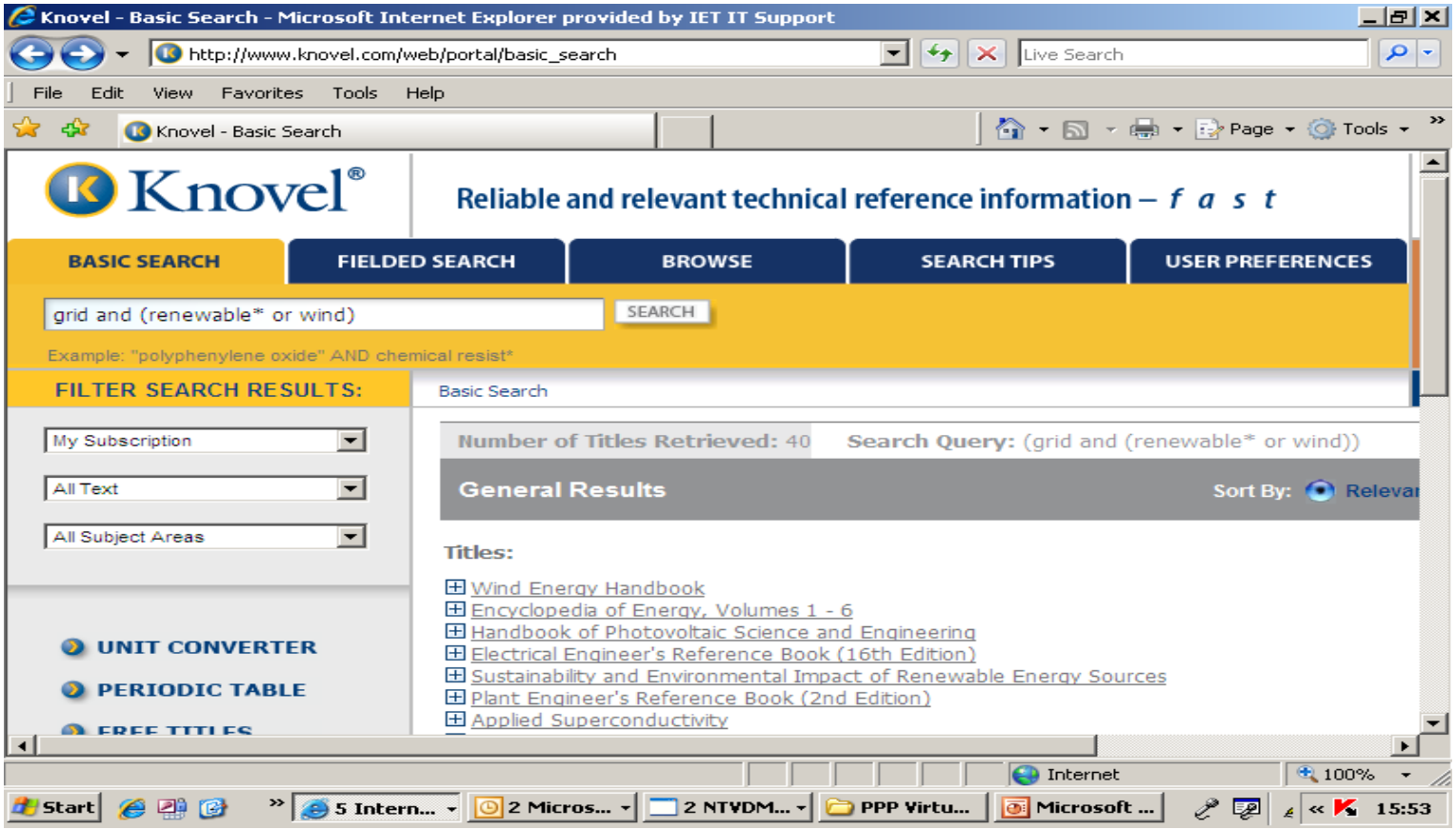

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Here is a section from Knovel e-book ***"Wind Energy Handbook":***

10.5.3 Measurement and Assessment of Power Quality Characteristics of Grid-Connected Wind Turbi - Microsoft Internet Explor...

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10.5.3. Measurement and assessment of power quality characteristics of grid connected wind turbines

Determination of the power quality of wind turbines and prediction of their performance in service is not straightforward and IEC 614200-21 (IEC, 2000b) has been written to provide guidance. There are a number of difficulties when assessing the power quality of wind turbines as their performance will depend on:

- the design of the entire wind turbine (including the aerodynamic rotor and control system),
- the conditions of the electrical network to which it is connected, and
- the wind conditions in which it operates.

For example, simple measurement of voltage variations at the terminals of a test turbine is not satisfactory as ambient levels of flicker in the electrical network and the X/R ratio of the source impedance at the test site will obviously have a great impact on the outcome. Hence, for evaluating flicker, a procedure is proposed where current measurements are made of the output of a test turbine and used to synthesize the voltage variations which would be caused on distribution networks with defined short-circuit levels and X/R ratios of their source impedance. This is illustrated in Figure 10.18 and is referred to in the Standard as simulation using a 'fictitious grid'. These voltage variation's are then passed through a flicker algorithm to calculate the flicker which the test turbine would cause on the defined networks. When the installation of the particular turbine is considered at a point on

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….and from Knovel's *"Energy Storage for Power Systems":*

3.3 Energy Storage and Renewables - Microsoft Internet Explorer provided by IET IT Support

http://www.knovel.com/knovel2/Show_Text.jsp?SetID=7100523&SpaceID=0&VerticalID=0&BookID=1395&NodeID=5622911&SearchType=0&SearchMod

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Storage applicatio

only a small fraction of the energy demand in a house, a community electricity utility, storage may not be essential since the other components energy-delivery system, such as oil or gas or the utility grid, can maintain s when the Sun is not shining or the wind not blowing.

In the case of wind energy, recent studies suggest that up to 20% of peak de on the British power system (which is within the immediate reserve margin) be absorbed without storage intervention although fluctuations on the tim of seconds to minutes would require an additional regulation duty to be p on conventional generating plants, and would increase the need for short reserve capacity placed, for example, in the storage system.

In the long term one can expect that renewable sources will generate incr amounts of electrical energy. At first, storage capacity will not be essential, solar- or wind-generated electrical energy will normally be fed into utility which have adequate reserve capacities for damping the fluctuations i intermittent input, in the same way that they balance their electricity loads

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from Knovel's *"Sustainability and Environmental Impact of Renewable Energy Sources"*:

3.7 Small Grids and Isolated Systems - Microsoft Internet Explorer provided by IET IT Support

http://www.knovel.com/knovel2/Show_Text.jsp?SetID=63491598&SpaceID=0&VerticalID=0&BookID=1227&NodeID=1885437639&SearchType=0&SearchMc

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economic climate. In the longer te... the full range of possible technologies) may become competitive; the greatest potential is for small-scale embedded generation using gasification, pyrolysis or high-speed steam engine-based plant. In the short term, small-scale (100 to 500 kWe) dedicated plants for use on farms or by rural industry has the greatest potential. In the medium term, when increased demand for electricity could be causing the grid to become overloaded and unreliable, then larger (1 to 20 MWe) embedded biomass generation plant providing end-of-grid support may become an attractive alternative to reinforcing the grid.

7 Small Grids and Isolated Systems

Smaller power systems, very often island-based, have provided the context for a number of the first demonstrations of renewable energy, primarily motivated by the higher local costs of conventional electricity generation. Island power systems range in size from hundreds of kilowatts to megawatts, and are usually supplied from diesel generator sets. Wind turbines have often been the most appropriate replacement technology, partly due to the generally good wind resource available on islands, but also due to the relative ease with which wind turbines can be connected to the electricity system, provided that the penetration levels are kept reasonably low.

Many examples of such systems exist, stretching back as early as 1982 at Block

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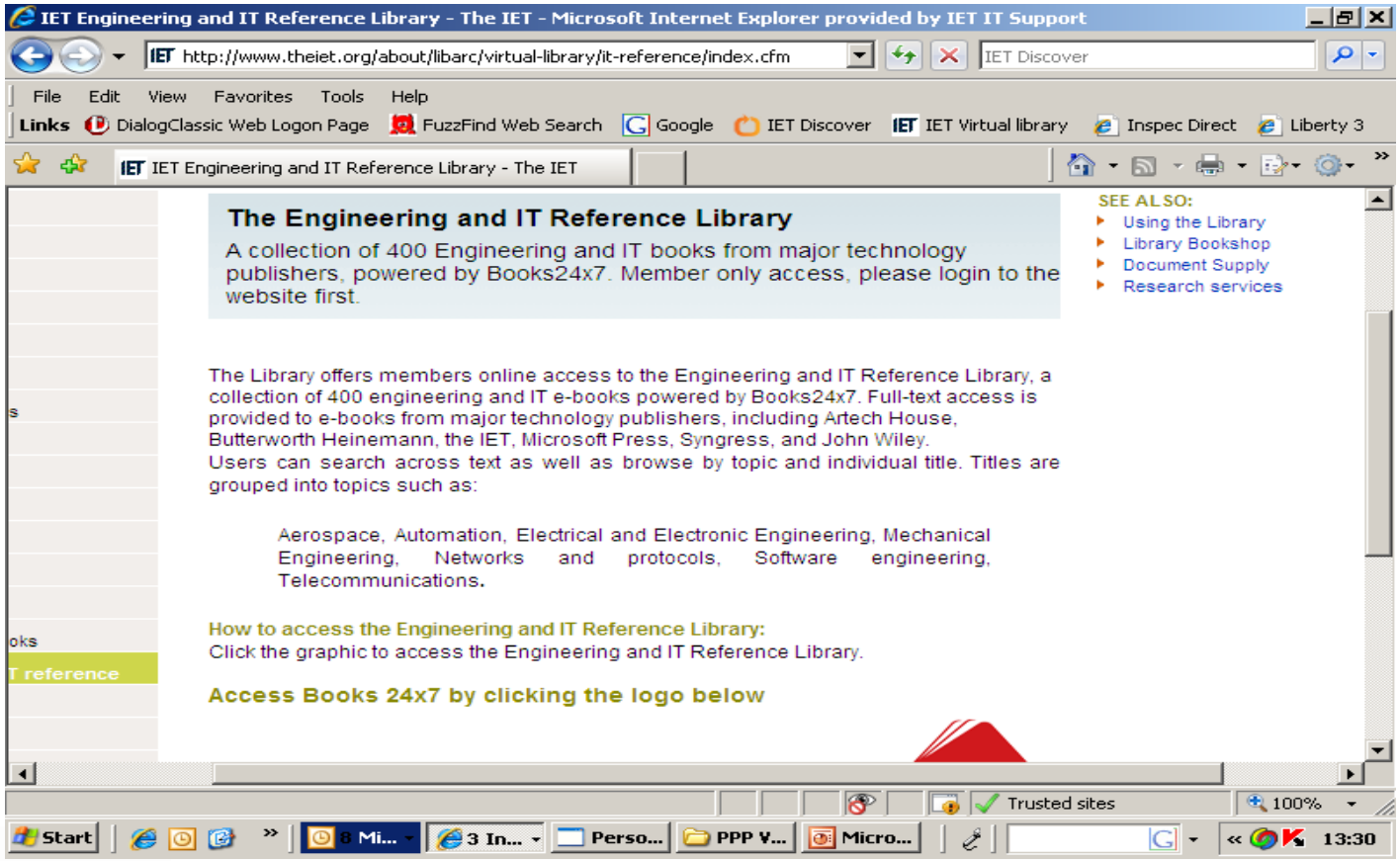

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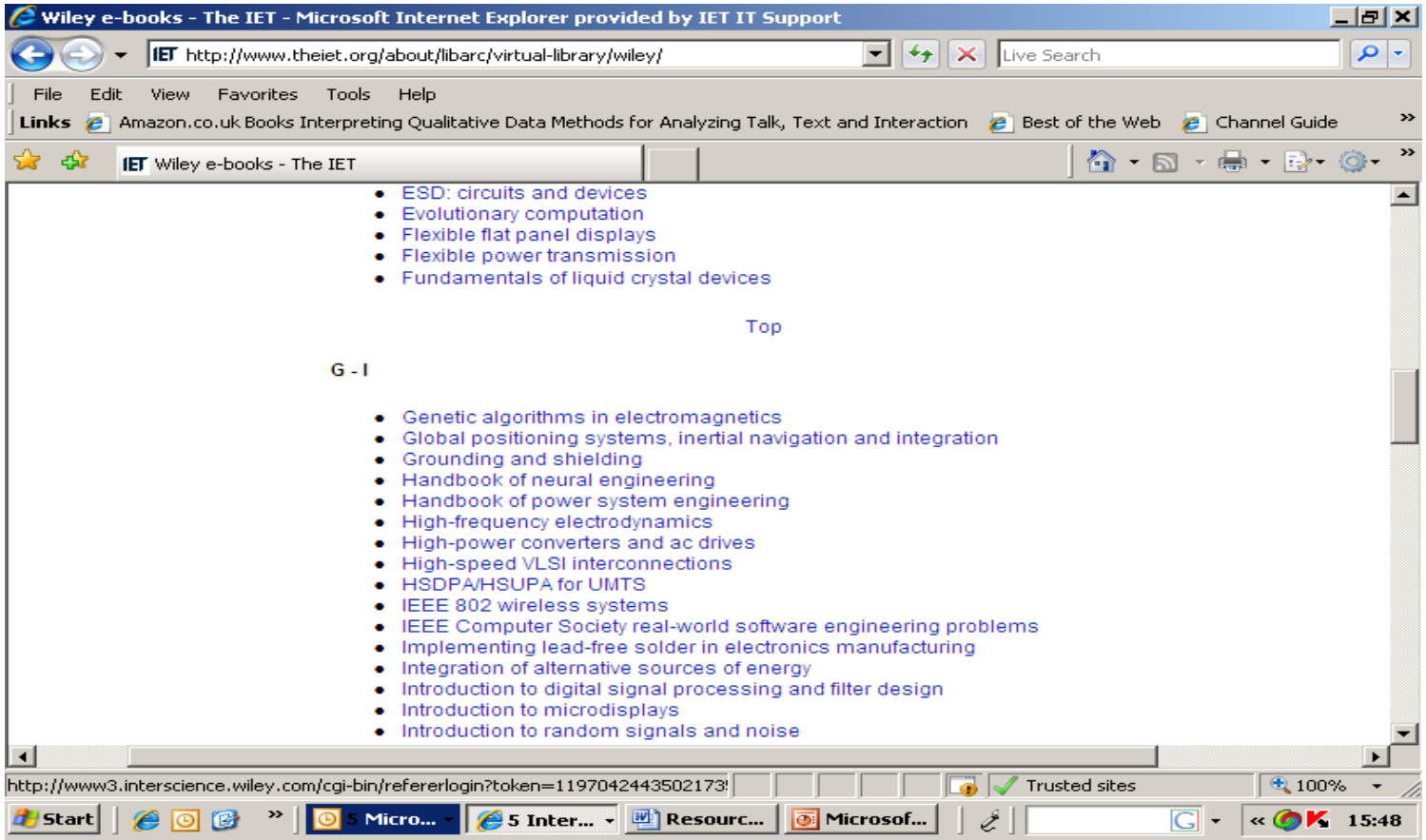

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This Wiley e-book covers grid integration: *"Integration of Alternative Sources of Energy"*:

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Here is a summary of ***Integration of Alternative Sources of Energy***". The whole book is searchable….

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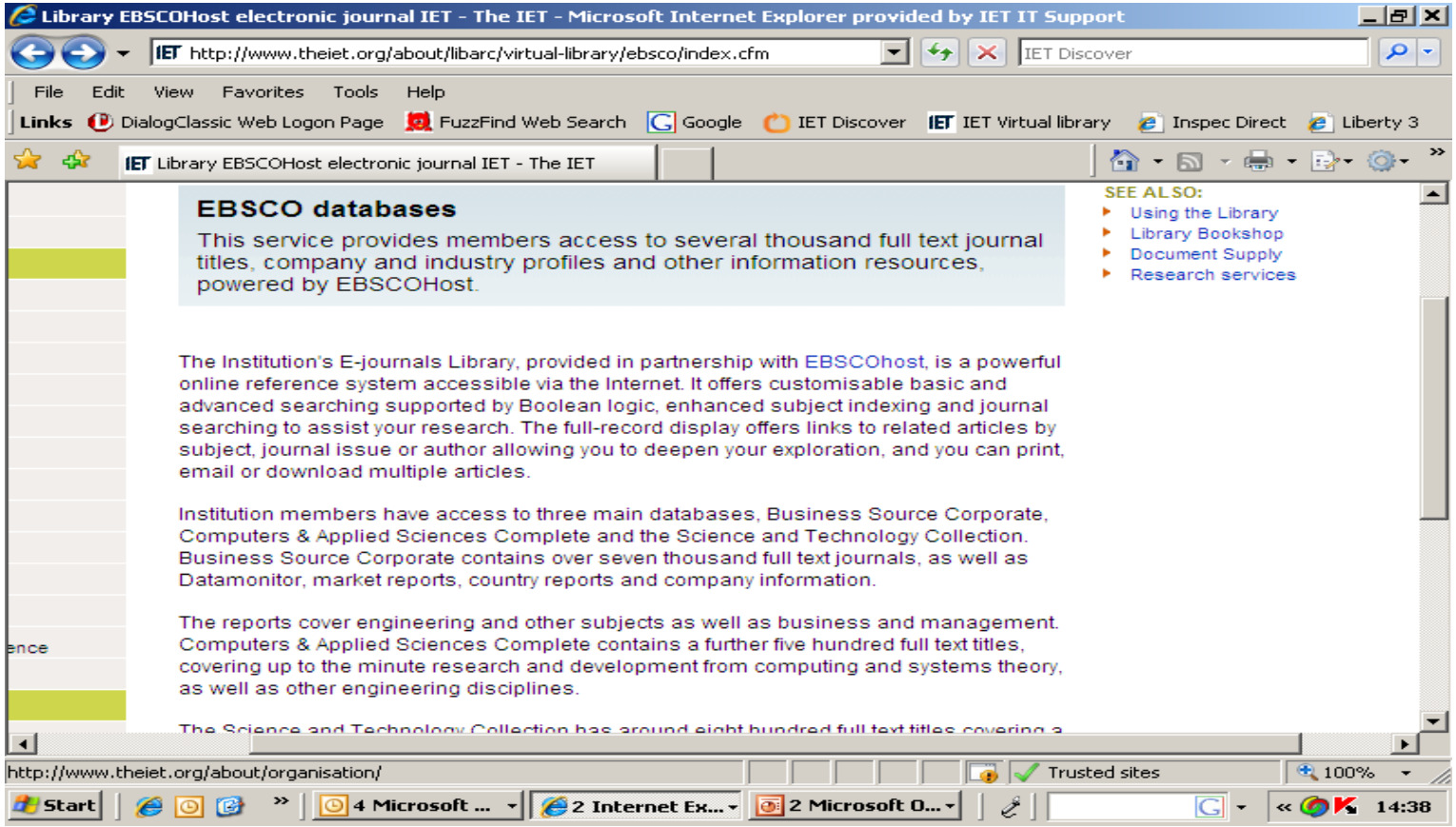

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- **Title: Distributed generation and renewable planning with a linear programming model**
  Author Sadeghzadeh, S.M.; Ansarian, M.
  Author Affiliation: Electr. Eng. Dept., Shahed Univ., Tehran, Iran
  Conference Title: 2006 First IEEE International Power and Energy Conference (IEEE Cat. No. 06EX1339) p. 6 pp.
  Publisher: IEEE , Piscataway, NJ, USA
  Publication Date: 2007 **Country of Publication:** USA
  ISBN: 1-4244-0273-5 **Material Identity Number:** XX2007-00826
  U.S. Copyright Clearance Center Code: 1 4244 0273 5/2006/$20.00
  Conference Title: 2006 First IEEE International Power and Energy Conference
  Conference Date: 28-29 Nov. 2006 **Conference Location:** Putra Jaya, Malaysia
  Language: English **Document Type:** Conference Paper (PA)
  Treatment: Practical (P); Theoretical (T)

- **Abstract:** In this paper a long term planning for distributed generation and renewable resources is applied. The dependence on fossil fuel imports render the adoption and diffusion of distributed generation technologies and renewable resources a field of research increasingly recognized as important. This study contains both technical and economic feasibility of the distributed generation and renewable concept highlighting a set of items that must be investigated before this opportunity can be adequately pursued. Among them are understanding the technological impact, evaluating the kind of penetration in the distribution grid, developing planning procedures that incorporate dispersed generation into distribution systems, designing interfaces between distributed generation technologies and existing distribution systems. The above clearly requires adequate modeling, and the presentation will focus on this point. The experimental work is applied to Iran' Power system as a real power system. The planning results are presented and discussed. (21 Refs)

And another ….

- **Title: Integrating renewable energy sources into European grids**
  Author Hammons, T.J.
  Author Affiliation: Glasgow Univ., UK
  Conference Title: Proceedings of the 41st International Universities Power Engineering Conference (IEEE Cat No. 06EX1501) p. 10 pp.
  Publisher: IEEE , Piscataway, NJ, USA
  Publication Date: 2006 **Country of Publication:** USA CD-ROM pp.
  ISBN: 978 186135 342 9 **Material Identity Number:** XX-2007-00749
  U.S. Copyright Clearance Center Code: 978 186135 342 9/2006/$20.00
  Conference Title: Proceedings of the 41st International Universities Power Engineering Conference
  Conference Date: 6-8 Sept. 2006 **Conference Location:** Newcastle upon Tyne, UK
  Language: English **Document Type:** Conference Paper (PA)
  Treatment: Practical (P)

- **Abstract:** This paper examines the integration of new sources of renewable energy into the power systems in Europe-challenges and possible solutions, application of wind power prediction tools for power system operation, new tasks that create new solutions for communication in distribution systems, wind power in Greece, integration of dispersed generation in Denmark, EdF and distributed energy resources in France, and new renewable sources in Italy, The paper also examines the European Commission Technology Platform's vision paper on Electricity Networks of the Future that was published in January 2006. In this respect, drivers towards smart grids, grids today, and key challenges for smart grids of the future are critically assessed. (15 Refs)

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And another….

- **Title: Renewable energy and distributed generation in rural villages**
  Author Balakrishnan, J.
  Author Affiliation: TDND Canada, Toronto, Ont., Canada
  Conference Title: 2006 International Conference on Industrial Information Systems (IEEE Cat No. 06EX1355C) p. 6 pp.
  Publisher: IEEE , Piscataway, NJ, USA
  Publication Date: 2006 **Country of Publication:** USA CD-ROM pp.
  ISBN: 1 4244 0322 7 **Material Identity Number:** XX-2007-00546
  U.S. Copyright Clearance Center Code: 1 4244 0322 7/2006/$20.00
  Conference Title: 2006 International Conference on Industrial Information Systems
  Conference Date: 8-11 Aug. 2006 **Conference Location:** Peradeniya, Sri Lanka
  Language: English **Document Type:** Conference Paper (PA)
  Treatment: Economic aspects (E); Practical (P)

- **Abstract:** This paper on renewable energy and distributed generation in rural villages is meant for developing nations like Sri Lanka, where there is neither infrastructure of conventional source of energy nor sufficient conventional energy for distribution in some rural villages. It is intended for a reader population that includes non-engineers, from policy makers in the government to end users in communities, as well. As such the discussion is limited to application and usage of technology only, not extending to in-depth engineering analysis, such that an ordinary citizen to understand and realize the benefits. It discusses technologies and application in conjunction with socio-economic conditions. In essence the paper focuses and proposes viable application of renewable energy and distributed generation in under developed areas of developing nations to reduce the level of disparity in socio-economy. (14 Refs)

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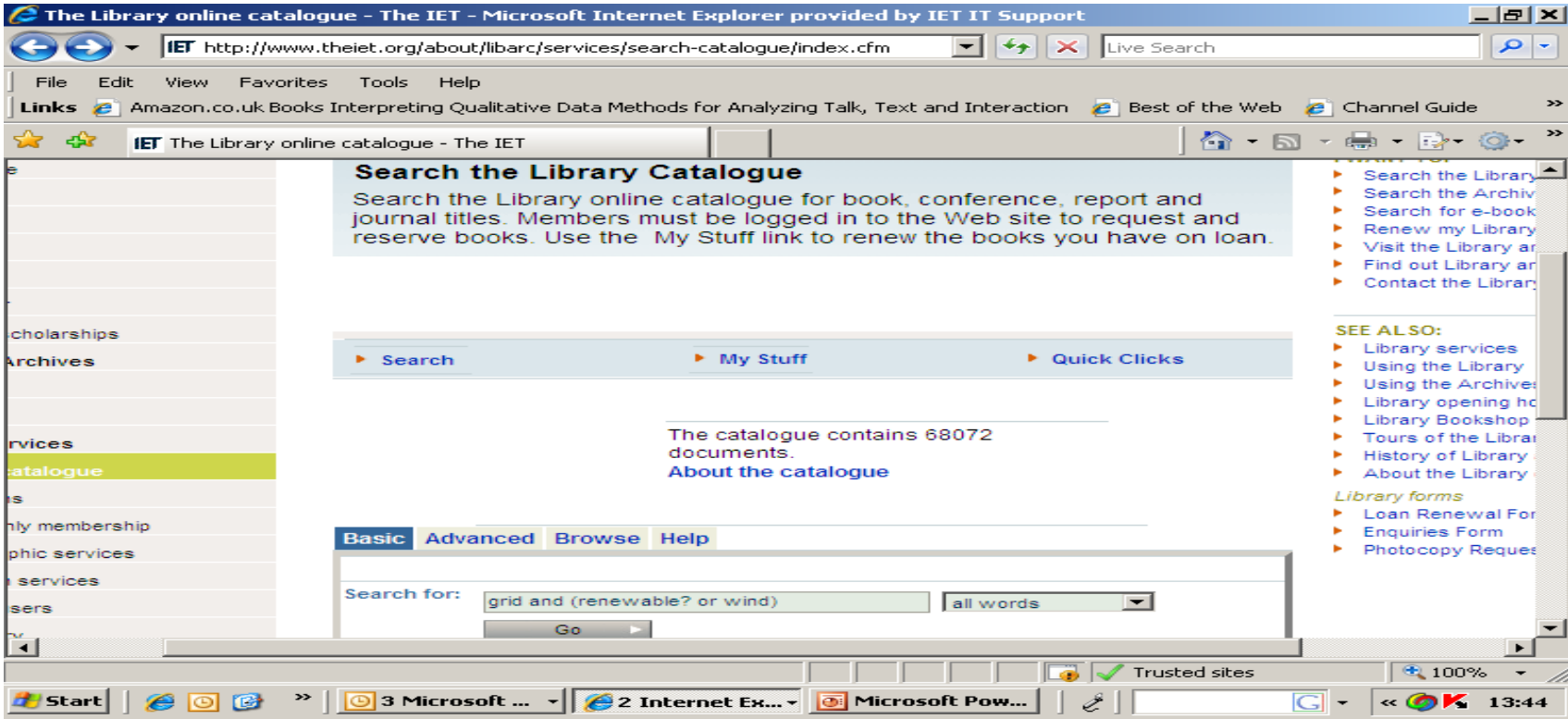

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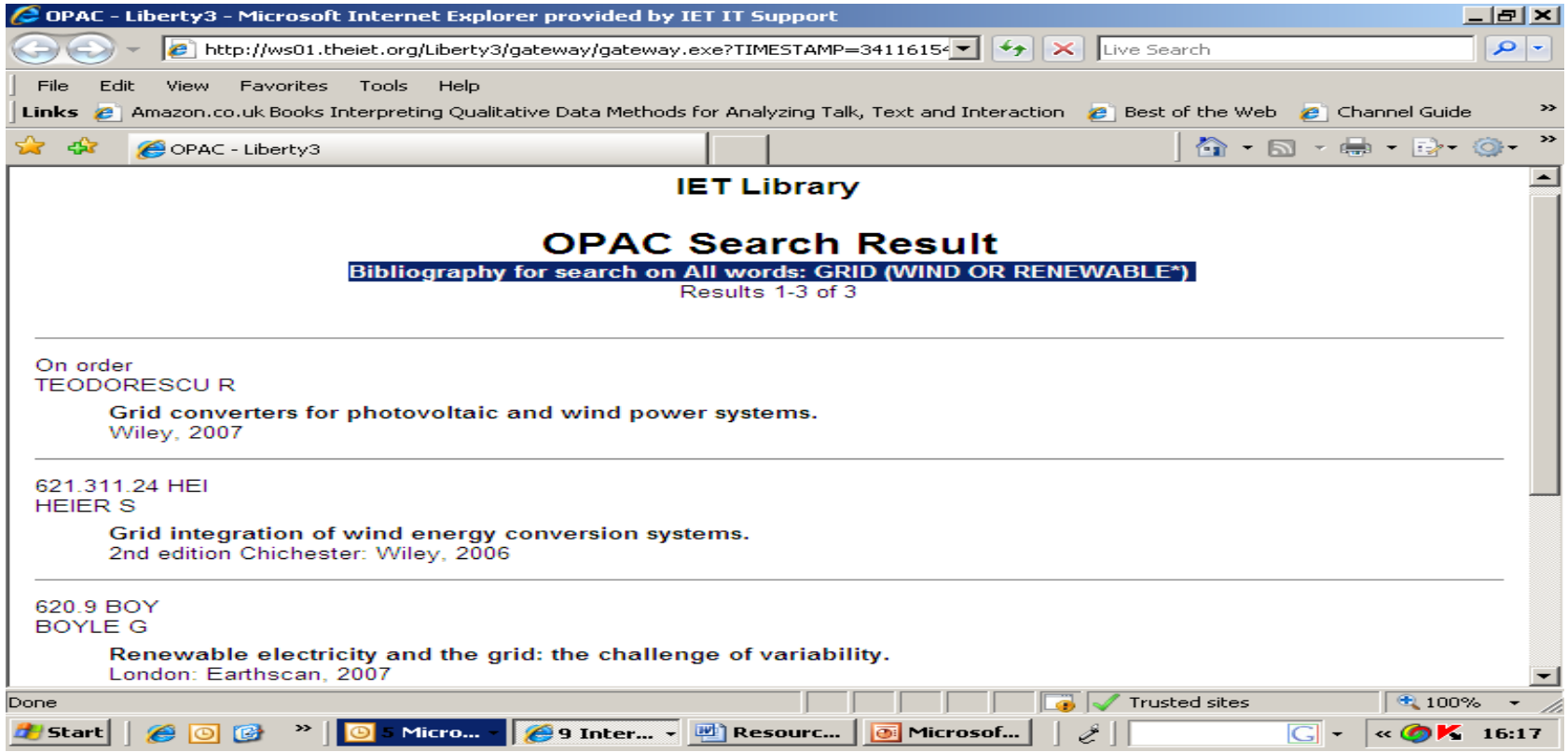

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