



# **Development and Leadership of Research Consortia: Lessons learned and possible road ahead for continued innovation**

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IEEE Summer Power Meeting

Panel on Organizing Research Consortia

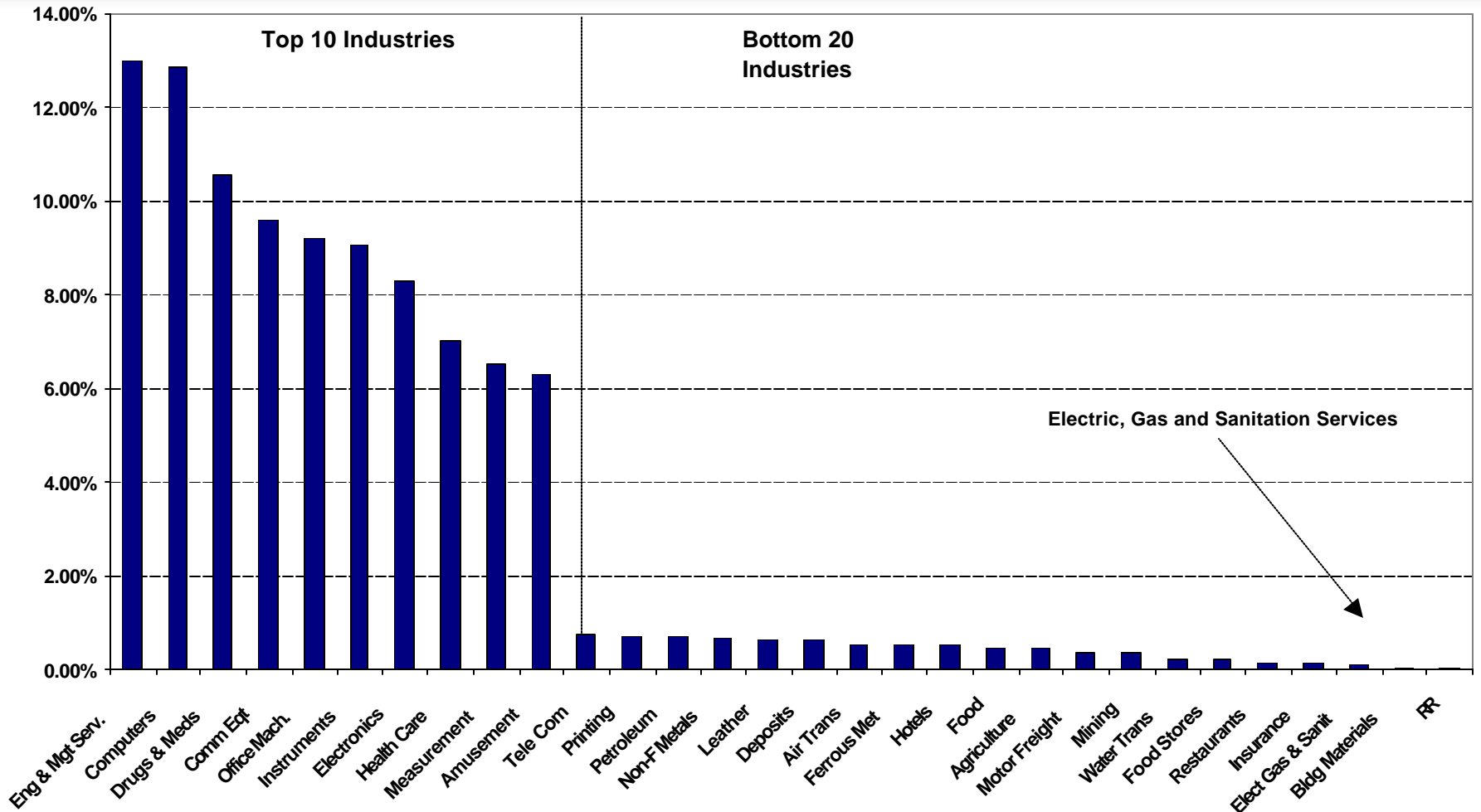
*July 24, 2002, Chicago, IL*

**EPRI**

# Context: Increasingly Stressed Networks

- Urbanization is putting pressure on local infrastructures.
  - During 1988-98, total U.S. electricity demand grew by 30% but transmission network grew by 15%.
  - Last 25-year annual growth of about 2.1% nationally, would result in a 50% increase by 2020;
  - Today's projected 3% annually, a 50% increase by 2014; in urban areas in less than 10 yrs...
- Increasing inter-regional bulk power transactions strain grid capacity
- Environmental considerations, energy conservation, & cost competition require greater efficiency.
- Infrastructure investment is declining in an environment of regulatory uncertainty.
- Infrastructure R&D funding is declining in an environment of increased competition.

# Context: R&D Expenditures



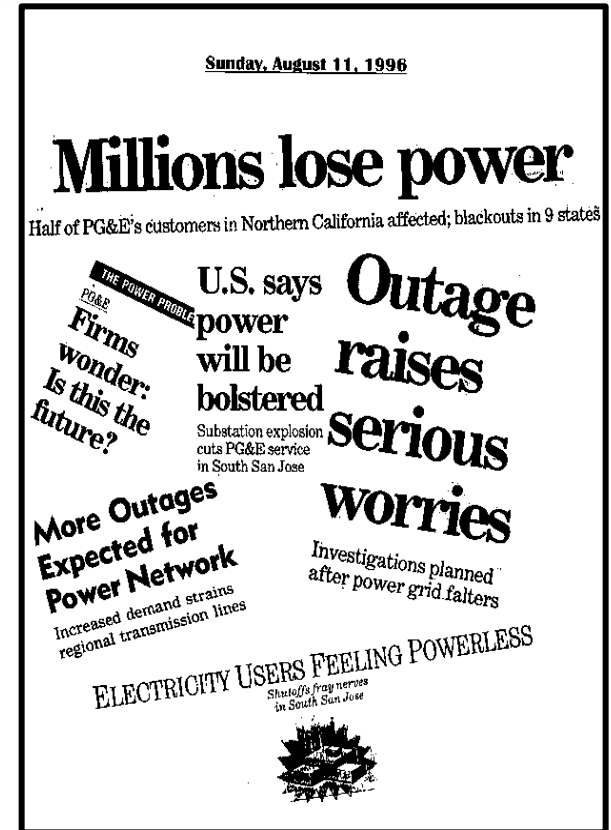
# Complex Interactive Networks/Systems

## The Reason for this Initiative:

“Those who do not remember the past are condemned to repeat it.”

*George Santayana*

- Two faults in Oregon (500 kV & 230 kV) led to...
  - ...tripping of generators at McNary dam
  - ...500 MW oscillations
  - ...separation of the Pacific Intertie at the California-Oregon border
  - ...blackouts in 13 states/provinces
- Some studies show with proper “intelligent controls,” all would have been prevented by shedding 0.4% of load for 30 minutes!



August 10, 1996

EPRI

# EPRI/DoD Complex Interactive Networks Initiative

- Develop tools that enable secure, robust and reliable operation of interdependent infrastructures with distributed intelligence and self-healing abilities
- Joint innovative research
  - EPRI and
  - Office of the Deputy Under Secretary of Defense for Science and Technology/Army Research Office
- Government Industry Cooperative University Research (GICUR)
- Information package at: <http://www.epri.com/targetST.asp?program=83>

# EPRI/DOD Complex Interactive Network/Systems Initiative

**“We are sick and tired of them and they had better change!”**

*Chicago Mayor Richard Daley on the August 1999 Blackout*



## Complex interactive networks:

- *Energy infrastructure:* electric power grids, water, oil and gas pipelines.
- *Telecommunication:* information, communications and satellite networks. Sensor and measurement systems and other continuous information flow systems.
- *Transportation and distribution networks*
- *Energy Markets, banking and finance*

1999-2001: \$5.2M/year-  
equally funded by DoD/EPRI

**Develop tools that enable  
secure, robust and reliable  
operation of interdependent  
infrastructures with distributed  
intelligence and self-healing  
abilities**

**EPRI**

# RFP–June 1998:

## IX. University Consortia

- Only universities will be considered for funding. Proposals may include private sector and other organizations, but those organizations must be funded by some other means.
- Funding is contingent on universities working collaboratively within a consortium. Each consortium will act as a virtual institution, comprising a lead university and one or more affiliated universities.
- Since consortia participants may be geographically separated, it is expected that research teams will use the Internet and other electronic media for interaction.
- Each consortium will have one primary research focus under the overall program. However, interactions between consortia are encouraged.

# RFP- June 1998:

## IX. Evaluation Criteria

Proposals will be evaluated based on the following:

- Responsiveness to the RA
- Vision and technical merit
- Potential impact on furthering the missions of EPRI and the Department of Defense
- Innovation of the scientific approach
- Competency of the proposer, including recent related experience as well as existing personnel and facilities
- Technology transfer potential
- Value provided, including willingness to share any costs
- Capability for electronic communication and cooperation within the consortium

# RFP-June 1998:

## IX. Evaluation Criteria

### Excluded Research

- Research into passive infrastructures, such as conventional roads, building, pipes, and wires
- Research into systems operated by a single controller
- Research that is primarily directed at evolutionary advancement of *existing* knowledge of complex interactive networks

### Program Scope

- Awards are for a period of three years. They may be extended for up to two additional years.
- Awards will be announced in the second half of 1998.

# EPRI/DoD CIN/S Initiative: Funded Consortia

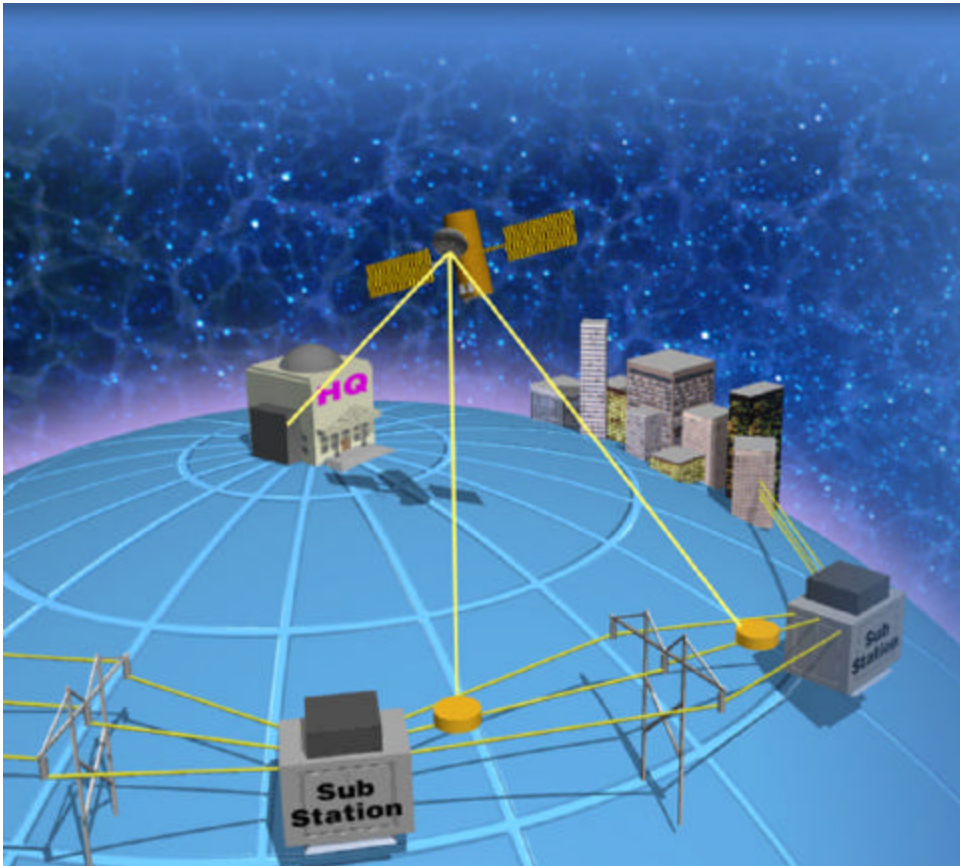
107 professors in 26 universities were funded. Over 360 publications and 19 technologies in the 3-year Initiative

- U Washington, Arizona St., Iowa St., VPI
  - Purdue, U Tennessee, Fisk U, TVA, ComEd (Exelon)
  - Harvard, UMass, Boston, MIT, Washington U.
  - Cornell, UC-Berkeley, GWU, Illinois, Washington St., Wisconsin
  - CMU, RPI, UTAM, Minnesota, Illinois
  - Cal Tech, MIT, Illinois, UC-SB, UCLA, Stanford
- Defense Against Catastrophic Failures, vulnerability assessment
  - Intelligent Management of the Power Grid
  - Modeling and Diagnosis Methods
  - Minimizing Failures While Maintaining Efficiency / Stochastic Analysis of Network Performance
  - Context Dependent Network Agents
  - Mathematical Foundations: Efficiency & robustness of distributed systems

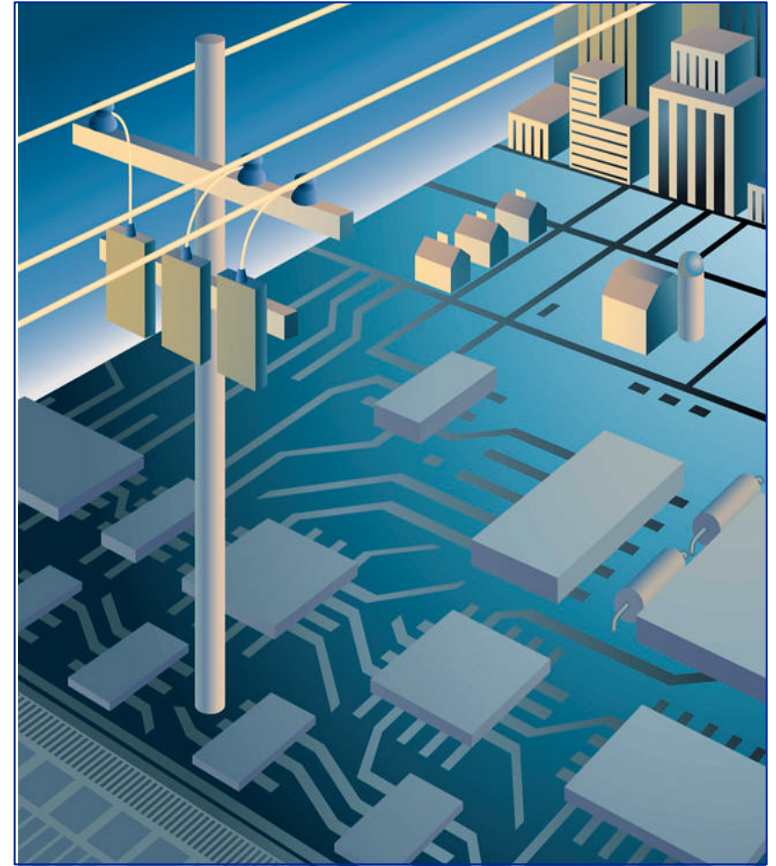
# EPRI/DoD CIN/SI: Widespread Interest & Participation

- Direct participation and collaboration:
  - Exelon and TVA are partners with Purdue, UTenn, Fisk U.
- EPRI / SS&T Interest Group review and advice:
  - AEP, BPA, CEC, CA-ISO, ConEd, CPS-SATX, Duke, EDF, ESKOM, Fortum, GPU Nuclear, Idaho Power, IL Power, ISO-NE, Keyspan Energy, Manitoba Hydro, NYPA, Orange & Rockland Util., Southern Company, TXU, VTT Energy, Wisconsin Energy, WAPA.
- Government: DOC, DOD, DOE, the National Labs., DOS, DOT, FAA, NGA, NSF, and the White House OSTP.
- Other Industry: ABB, CESI, Intel, Pirelli, Powertech, Raytheon, ...
- European Union and Asia

# The Self-Healing, Digital Quality Electricity Superhighway



**Self-Healing Transmission Grid**



**Self-Healing Distribution Network**

# Lessons learned: Some thoughts on successful team formation and continued innovation

Relevant success factors are:

- Technical and organizational infrastructure.
- Clear purpose, language, and communication at all levels.
- Multiple channels for knowledge transfer.
- Senior management and stake-holder support.

# Lessons learned: Some thoughts on successful team formation and continued innovation (1)

- *Why form consortia?* Research challenges are beyond the scope of any single contractor or university department.
- There is a synergy when researchers, their ideas and teams work together:
  - Innovation is a “team sport”: Innovation is most often achieved when ideas and objects/tools are brought together in novel ways as never before.
- Does teaming lead to elitist “us vs. them” attitudes instead of open communication leading to creative work?

# Some thoughts on successful team formation and continued innovation (2)

- How to identify and prevent such tendencies? Identify potentially divisive issues including allocation of resources among consortia members.
- Setting the theme very early on, before work begins, in clear examination of assumptions, re-visiting groups' vision and re-examining their responsibilities after their selection and at an on-going basis.
- Culture and chief researchers' attitudes play a key role in success or failure of graduate student interactions both within a university and between them.
- How would consortia participants share their progress reports with funders? How often, in what form? Also... satisfying the associated milestones and time-lines.

# Some thoughts on successful team formation and continued innovation (3)

- *Communication*: How would consortia participants share their progress reports inter-/ intra- consortium?
- Avoid “micro managing”: Encourage researchers’ own feeling of excitement for their innovative work and of their control over their activities and contributions.
  - Charge members to develop their own communication processes, make it their responsibility/goal to be successful rather than “micro-managing” this process ourselves.
  - E.g., ask each team to develop its own methods of effectively communicating between the various members of the team.
- Face-to-face meetings with regular interfacing and creating inter-dependence: Formal sets of meetings/opportunistic forms of interaction:
  - Facilitate mechanisms (and allocate budgets and rewards) for collaboration at all levels including graduate students and faculty working together.
  - E.g., student symposia-- request each consortium to provide a few (say 2) challenging problems before the meeting and then have them work on it for three days and present the results.

# Some thoughts on successful team formation and continued innovation (4)

*Organization and Management:* ...bureaucracy and formalism are enemies of creativity and innovation, but nevertheless we do need formal procedures and routines to be able to utilize the creative potential existing in the organization.

- Contracts and IP issues.
- Identify and set clear go/no-go points.
- Ever-present conflict between managing a project to enhance creativity and managing a project to optimize the chances of success and go/no go is part of this, as is regular reporting.
- Clearly and explicitly address/discuss the role of the overall consortium manager: A consistent unifying presence provided by the overall consortium management team.
- What is “optimum” mix and size of consortia?

# Some thoughts on successful team formation and continued innovation (5)

- One of the challenges is managing the program to its overall goals while **balancing varying (or even conflicting) interests of stakeholders**-- that include other commitments and sources of funding.
- Assembling and managing the consortium has to recognize and plan for these somewhat ***competing agendas*** ...
  - ... **communication is the key**--- but how to optimize handling this issue effectively?
- Essential to effective management of "competing agenda" issue is to have ***consistent and frequent external communication*** to the various stakeholders of ***the purpose, progress, and characteristics of the consortium***.

# Some thoughts on successful team formation and continued innovation (6)

- Process of creating knowledge depends on “tapping the tacit and often highly subjective insights, intuitions and hunches of individual employees and making those insights available for testing and use by the company as a whole.” And this requires *redundancy*:
- *Redundancy* encourages frequent dialogue and communication. This helps create a ‘*common cognitive ground*’ and thus facilitates the *transfer of tacit knowledge*. Since members of the consortia share overlapping information, they can sense what others are trying to articulate.
- The EPRI/DoD CINSI has plenty of redundancy, as is clear from the matrix used to analyze the CINSI portfolio...
- However without open and effective communication channels between these overlapping parts, all the benefits of redundancy will be lost... climate is also a key...

# Creative climate dimensions

<b><i>Dimension</i></b>	<b><i>Creative climate</i></b>	<b><i>Uncreative climate</i></b>
Challenge	Enjoyable and energetic	Alienated and indifferent
Dynamism	Excitedly busy	Boringly slow
Idea time	Off task play	Little off task play
Playfulness	Happy, humorous	Dull, serious
Conflict	Debated with insight	Warfare
Openness	Trusting, failure accepted	Suspicious, failure punished
Support	People listen	Critical, negative comments
Freedom	Independent initiatives	Passive, rule bound
Debates	Contentious ideas voiced	Little questioning
Risk taking	Act on new ideas	Detail and committee bound

Source: Ekvall, G., (1991), "Climate", in D. Walker and J. Henry (ed.) *Managing Innovation*, London: Sage

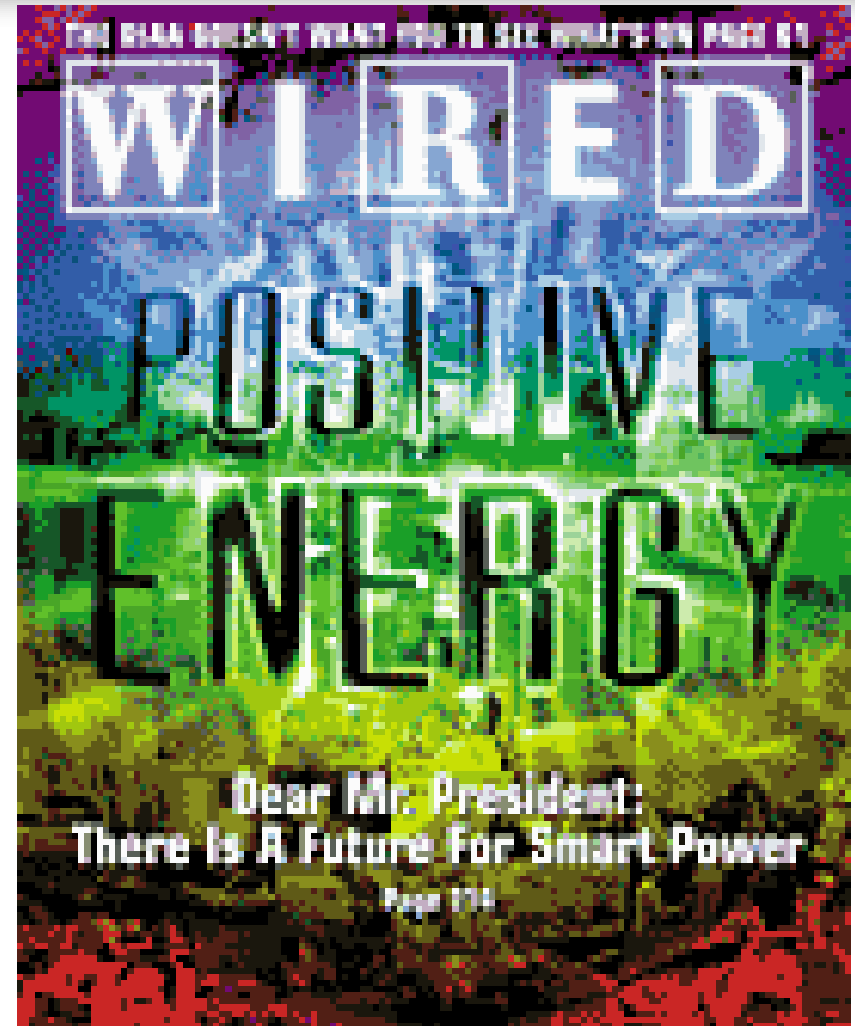
Looking forward: “... not to sell light bulbs, but to **create a network of technologies and services that provide illumination...**”

## The Energy Web:

“The best minds in electricity R&D have a plan: **Every node in the power network of the future will be awake, responsive, adaptive, price-smart, eco-sensitive, real-time, flexible, humming - and interconnected with everything else.**”

Wired Magazine, July 2001

<http://www.wired.com/wired/archive/9.07/juice.html>



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