PURPA and Superconducting Magnetic Energy Storage: Energy Conservation, Environmental Protection and Entrepreneurial Opportunity in the Next Technological Revolution

I. INTRODUCTION

Superconductivity is the ability of a substance to carry electric current with virtually no resistance.[1] Recent developments in superconductivity have the potential to revolutionize computer technology,[2] power transmission,[3] medicine,[4] transportation,[5] nuclear

1. In 1911, the Dutch scientist Heike Onnes discovered that some materials superconduct at temperatures near absolute zero, or −459.7° Fahrenheit (−273° Celsius). Reaching this cold temperature requires use of the refrigerant liquid helium, which is scarce, a nuisance to handle, and currently costs $11 per gallon. Ramirez, *Superconductors Get Into Business*, FORTUNE, June 22, 1987, at 114, 115. Therefore, superconductor applications were limited. By 1986, scientists raised the temperature necessary for superconductivity to −390° Fahrenheit (−234° Celsius). This warmer temperature still required the exclusive use of liquid helium. *See* 133 CONG. REC. S4170 (daily ed. Mar. 30, 1987) (statement of Sen. Durenberger). However, early in 1987 a breakthrough occurred when University of Houston scientist Paul Chu discovered that certain ceramic materials superconduct as high as −284° Fahrenheit (−153° Celsius). This temperature is within the reach of the refrigerant liquid nitrogen, which is plentiful, can be carried around in a styrofoam cup, and costs 22 cents per gallon. Ramirez, *supra*, at 115. This advance in superconductor technology opened the door to an extensive variety of superconductor applications. *See infra* notes 2 to 8. Since 1987, further advances have raised temperatures required for superconductivity to −243° Fahrenheit (−153° Celsius). *See* Waldrop, *Superconductors Hotter Yet*, 239 SCI. 730 (1988). Yet problems remain. The brittle nature of the new superconducting ceramics makes them difficult to use. "It will be necessary to understand how to make these brittle, rather intractable ceramics in the form of wires. These materials like to react with water. You powder them and drop them into water and they look a bit like Alka Selzer. They are not nice materials in many respects." *Superconductivity: Hearing before the Subcomm. on Energy Research and Development of the House Comm. on Science, Space and Technology*, 100th Cong., 1st Sess. 168 (1987) [hereinafter *Superconductivity: Hearing*] (statement of Dr. Robert A. Laudise, AT&T Bell Laboratories). But solutions are possible. *See, e.g.*, Murr, Hare & Eror, *Shock-Compression Fabrication of High-Temperature Superconductor/Metal Composite Monoliths*, 329 NATURE 37 (1987).

2. The use of superconductors for integrated circuit interconnections would make it possible to manufacture integrated circuits 100 times more dense than present technol-

fusion,[6] national defense,[7] energy storage and environmental protection.[8] Auspicious predictions by scientists and government officials reflect their optimism over these discoveries.[9] Superconductivity has the potential to rejuvenate the American economy by creating a new American "industrial revolution."[10] "Every man, woman, and child in the world today can be affected by this technology."[11]

---

ogy permits. Computers would be faster and more powerful. *See* 133 CONG. REC. S4170 (daily ed. Mar. 30, 1987) (statement of Sen. Durenberger).

3. Presently, of the electricity transmitted through power lines, eight per cent is lost in transmission and distribution due to resistance. This is known as "line loss." Superconductors have virtually no resistance. Thus, if superconductors were used as power lines, there would be virtually no line loss. *See* Ramirez, *supra* note 1, at 118. *See also Superconductivity: Hearing, supra* note 1, at 150 (statement of Dr. Thomas T. Claudson, Associate Director, Pacific Northwest Laboratory).

4. Medical diagnostic equipment, such as MRI (Magnetic Resonance Image) scanners, currently rely on old and expensive superconductor technology to create high-powered magnetic fields for body imaging. The new discoveries in superconductivity may make MRI scanners smaller, cheaper, more powerful, and more widely available. *See* 133 CONG. REC. S4170 (daily ed. Mar. 30, 1987); for a general discussion of MRI scanners, *see also* P.L. CORIO, STRUCTURE OF HIGH-RESOLUTION NMR SPECTRA (1966).

5. Superconductivity produces a large magnetic field, thus making levitating vehicles a possibility. *See* Federal Advanced Superconducting Transportation Act, S. 1794, 100th Cong., 1st Sess. (1987).

6. The historical problem with developing the "clean" power of nuclear fusion has been containment; no known material can withstand 360 million degrees Fahrenheit. Superconducting magnetic fields might be able to contain such a reaction by creating a magnetic trap around the fusion material. *See generally* L. ARTSIMOVICH, CONTROLLED THERMONUCLEAR REACTIONS (1964).

7. A ground-based free electron laser coupled with a superconducting magnetic energy storage (SMES) facility would introduce a new era of weaponry. Such a system could provide not only strategic defense, but also tactical, discriminatory offensive capability without the problems of operator vulnerability or fallout. Such a system would require approximately 400 megawatts of stored energy. A. Carter, Directed Energy Missile Defense in Space 22-24 (Apr. 1984), *reprinted in* CONGRESSIONAL RESEARCH SERVICE, SHOULD THE U.S. FEDERAL GOVERNMENT SIGNIFICANTLY INCREASE THE EXPLORATION AND/OR DEVELOPMENT OF SPACE BEYOND THE EARTH'S MESOSPHERE?, H.R. DOC. No. 257, 98th Cong., 2d Sess. 1243, 1263-65 (1984). A SMES facility of proper size could provide such electrical output instantaneously. *See infra* note 16, and accompanying text.

8. Energy storage and the resulting environmental impact are the subject of this article.

9. "As additional breakthroughs occur, the effect on our standard of living—indeed, our way of life—could be dramatic and unprecedented, in areas as diverse as transportation, energy, health care, computers and communication." President's Message to Congress Transmitting Proposed Legislation on Superconductivity Competitiveness, 24 WEEKLY COMP. PRES. DOC. 248 (Feb. 23, 1988). "[T]he practical commercial and military applications . . . are staggering." 133 CONG. REC. S4170 (daily ed. Mar. 30, 1987) (statement of Sen. Durenberger).

10. H.R. 3217, 100th Cong., 1st Sess. § 2(a)(1) (1987).

11. Ritchie, *Trying to Become Another Cal Tech*, OREGON BUS., Jan. 1988, at 58 (quoting Dr. Lawrence Murr of the Oregon Graduate Center).

This comment will propose that entrepreneurs invest in the construction of small-scale[12] superconducting magnetic energy storage (SMES) facilities, which would encourage energy conservation and environmental protection, in addition to earning profits. The first part of this comment explains how using SMES facilities to store electrical power would protect the environment. The second part explores practical modes of developing an independently owned and operated SMES facility within the scope of existing federal energy regulation.

II.
SMES, ELECTRICAL POWER, AND THE ENVIRONMENT

Superconductors have two properties that are relevant to energy storage. First, superconductors create a strong magnetic field.[13] When manufactured in the form of a solenoid, the result of this magnetic field is the creation of "persistent current."[14] In other words, electricity flowing through a superconducting solenoid will not dissipate so long as the solenoid remains superconducting. Therefore, whatever quantum of energy is stored in a SMES facility can be withdrawn with virtually no loss.[15] Second, the energy stored in a SMES facility can be completely withdrawn instantaneously.[16] Because the energy is stored as magnetic electric current, there is no need for time consuming, inefficient, and expensive chemical or mechanical conversion to electricity. With these two properties, therefore, SMES represents the near-perfect in energy storage efficiency.

An on-line SMES facility would have two major impacts. First, SMES would affect the domestic energy situation by promoting the efficient use of existing power production facilities, thereby reducing the need to construct new facilities. Second, SMES would affect environmental protection. It would promote conservation of natu-

12. On the order of 80 megawatts. *Cf., e.g.*, Loyd, *Bechtel's Program in Superconducting Magnetic Energy Storage*, 2 SUPERCURRENTS 1, 3 (1987) (proposing a 5000 megawatt SMES facility).

13. *See* B.I. BLEANEY & B. BLEANEY, ELECTRICITY AND MAGNETISM 399-402 (1976).

14. J. BLATT, THEORY OF SUPERCONDUCTIVITY 307-41 (1964).

15. Actually, since power is supplied as AC, 3% of the power stored in a SMES is lost in converting power from AC to DC then back again. Loyd, *supra* note 12, at 3. However, this must be considered in comparison to other forms of energy storage, none of which approach near-perfect efficiency as does SMES.

16. "Superconducting stores have the advantage over chemical stores of being dischargeable in a fraction of a second." Newhouse, *Superconducting Devices*, in SUPERCONDUCTIVITY 1294 (R. Parks ed. 1969).

ral resources, such as coal, oil and gas. The technology would also enhance the productivity and marketability of intermittent alternative energy sources, such as wind and solar power.

A. *Energy Conservation*

With few exceptions, public utilities currently dissipate surplus electric power during hours when demand for electricity is low.[17] To avoid this waste, a SMES facility could store excess electric power "essentially forever."[18] SMES would eliminate the needless and costly waste of power produced during off-hours, thereby conserving energy as well as increasing the efficiency of electrical generation and distribution systems. SMES would ultimately result in the need for fewer power plants (or at least fewer additional ones).

Congress has recognized that storing off-hour electricity for use during peak demand increases the efficient use of available electricity.[19] Various storage techniques have been attempted, but with limited success. "Pumped hydro" is the storage system most extensively used by electric utilities.[20] Other means of large-scale electricity storage are fuel cells (using hydrolysis), chemical batteries, flywheels and compressed air.[21] But these systems lack the SMES advantages of near-perfect efficiency and complete, instantaneous discharge.

B. *Environmental Impact*

By cutting waste in energy production and distribution, SMES would promote environmental conservation on three levels. First, SMES would reduce depletion of natural resources such as petroleum, coal, natural gas and uranium.[22] Second, it would reduce

---

17. M. RICE, AN ANALYSIS OF PURPA AND SOLAR ENERGY 28 (1980).

18. Ramirez, *supra* note 1, at 118.

19. Federal Nonnuclear Energy Research and Development Act of 1974, Pub. L. No. 93-577, § 6(b)(3)(C)(ii), 88 Stat. 1878 (codified as amended at 42 U.S.C. § 5905(b)(3)(C)(ii) (1982)).

20. M. RICE, *supra* note 17, at 28 (citing the *29th Annual Electrical Industrial Forecast*, ELECTRICAL WORLD Sept. 15, 1978, at 74. Pumped hydro is a system in which water is pumped, using off-hour electricity, from a low reservoir to a higher reservoir. During peak load the cycle is reversed, the water turning a turbine on its way back to the lower reservoir. *Id.*

21. *Id.* A flywheel storage facility is a system in which electrical energy is converted to rotational energy by using off-hour electricity to spin a circular device. A compressed air storage facility uses off-hour electricity to compress air into a pressure chamber. For both storage systems, the cycle is reversed during peak load times. Inefficiency as a result of power loss occurs both during the conversion to mechanical energy and during the period in which the energy is stored.

22. Through increased efficiency in the use of existing power plants, SMES could

pollution.[23] Third, the implementation of SMES would make alternative energy sources more viable. An efficient storage system, such as SMES, would "make possible the use of electric energy from solar sources such as wind, which might otherwise be unusable."[24] Wind and solar power sources are intermittent and therefore potentially unreliable power producers. When coupled with an efficient storage system, however, intermittent alternative energy resources which were previously unusable could be harnessed by storing their output over an extended period of time, then introducing the stored energy into the power grid during periods of peak demand. Coupling an alternative energy producer with SMES would diminish the need to rely on coal, gas, oil and nuclear power.[25]

But like many other technological innovations, SMES poses a potential environmental hazard: a SMES facility would produce an immense magnetic field. Estimates on the upper limits of the magnetic field superconductors could create range from 800,000 to three million gauss.[26] Because fields of this strength have never been produced on earth, the actual effects of such a field are not known. According to some physicists, however, the threat to the environment and humans is surmountable by erecting physical shields around the facility.[27] This argument is supported by the fact that magnetic fields from SMES facilities dissipate quickly (to ten or

---

reduce the need for new power plants by up to 15 percent. Krause, *Superconductors*, ENVIRONMENTAL ACTION Nov.-Dec. 1987, at 18-19. *See also* Loyd, *supra* note 12, at 6 ("SMES offers an environmentally benign way to extend the capacity of our power industry while preserving fossil fuels.").

23. SMES has the potential to "cut waste in energy production and distribution [which would mean] less depletion of natural resources and less creation of pollution." Krause, *supra* note 22, at 18.

24. M. RICE, *supra* note 17, at 29.

25. Nuclear power, being a constant-cycle generator, will also be enhanced. With SMES, dissipating the power produced by nuclear plants during off-hours would no longer be necessary. The need for "peaking generators" (i.e., electric generating facilities that produce power for a few hours during periods of high demand) would also be diminished. *See Superconductivity: Hearing before the Subcomm. on Transportation, Aviation and Materials and the Subcomm. on Science, Research and Technology of the House Comm. on Science, Space and Technology*, 100th Cong., 1st Sess. 166, 173 (1987).

26. Gleick, *Breakthrough Seen in Magnetic Research*, N.Y. Times, Mar. 18, 1987, at A14, col. 2, *reprinted in* 133 CONG. REC. S4173 (daily ed. Mar. 30, 1987) (citing National Magnetic Laboratory estimates). Magnetic fields are measured in gauss units. The earth's magnetic field, which moves the needle of a compass, is approximately one-half of a gauss. *Id.* A household magnet, such as those used to hold notes to a refrigerator, produces a magnetic field measuring one hundred gauss. Ramirez, *supra* note 1, at 118. One of the most powerful magnets ever produced, at the National Magnetic Laboratory, can sustain a magnetic field of 230,000 gauss. Gleick, *supra*, at A14, col. 2.

27. Krause, *supra* note 22, at 20.

twenty gauss) at distances greater than a few hundred feet.[28]

In light of the potential hazards, a comprehensive study of environmental effects should be undertaken before any SMES facility is built. Such a study should, at a minimum, examine the effects of long-term SMES field exposure on people, animals (especially bird migrations guided by the earth's magnetic field) and plants.[29] It may be that careful selection of site location for SMES facilities will solve these and other undetermined potential environmental hazards, but attention needs to be focused on the problems before a SMES facility is constructed. As with many technological innovations, benefits must be weighed against costs. If adequate solutions can be found for its potential hazards, SMES should on balance be a benefit to the environment.

III.
SMES AND PURPA

Congress enacted the Public Utility Regulatory Policies Act of 1978 (PURPA)[30] with the purpose of encouraging traditional utilities to conserve energy, promote increased efficiency in the use of energy resources and generating facilities, and provide equitable retail electric rates to consumers.[31] Section 210 was specifically intended to encourage development of small power production

28. Loyd, *supra* note 12, at 5.

29. MRI (Magnetic Resonance Image) scanners, *see supra* note 4, produce similar types of fields and therefore safeguards employed during MRI scanner use might successfully be applied to SMES. Some potential health and safety hazards might be avoided by assessing the health and safety effects of using MRI scanners. *See, e.g.*, Shellock, Schaefer & Gordon, *Effect of a 1.5 T Static Magnetic Field on Body Temperature of Man*, 3 MAGNETIC RESONANCE IN MEDICINE 644 (1987) (no statistically significant change in body temperature as a result of high strength magnetic fields). However, a SMES facility will inevitably create exposure for longer periods of time than is the case with MRI scanners. And SMES, in order to function effectively, will require the generation of stronger magnetic fields than MRI scanners. *See* Geise, The Future Role of High Temperature Superconductors: What We Must Do to Use Them (Jan. 13, 1989) (Argonne National Laboratory presentation to the 1989 Superconductor Applications Convention) (SMES predicted to require magnetic field strength of between 2 and 3T).

30. Public Utility Regulatory Policies Act of 1978 (PURPA), Pub. L. No. 95-617, 92 Stat. 3117 (codified as amended in scattered sections of 15, 16, 30, 42, 43 U.S.C.) (1982).

31. PURPA § 101, 92 Stat. 3120 (1978) (codified as amended in 16 U.S.C. § 2611 (1982)); Federal Energy Regulatory Comm'n v. Mississippi, 456 U.S. 742, 746 (1982); Kansas City Power & Lighting Co. v. State Corp. Comm'n, 238 Kan. 842, 854-55, 715 P.2d 19, 28, *cert dismissed for lack of substantial federal question*, 479 U.S. 801 (1986).

facilities (SPPFs).[32] Congress felt SPPFs could, in part, achieve PURPA's intent through the conservation of nonrenewable natural resources and the utilization of renewable resources. However, obstacles historically impeded the development of SPPFs: "[T]raditional electric utilities were reluctant to purchase power from, and sell power to, the nontraditional facilities" and "regulation by state and federal utility authorities imposed financial burdens upon the nontraditional facilities and thus discouraged their development."[33] To remedy this situation, Congress enacted Title II of PURPA, requiring utilities to interconnect with, sell power to, and purchase power from qualifying facilities.[34]

Traditional utilities felt Congress had exceeded its authority in promulgating PURPA's Title II requirements, but the Supreme Court upheld PURPA's constitutionality. The Court found that PURPA, by legislating the actions of purely intrastate utilities, does not infringe upon state sovereignty in violation of the tenth amendment[35] or the Commerce Clause.[36] Additionally, another case held that PURPA does not violate the fifth amendment by proscribing the taking of lands for facility construction without just compensation.[37]

If a privately owned SMES facility could qualify as a SPPF under PURPA, the SMES facility would be able to purchase electric power during hours when demand is low, then sell that same power

---

32. PURPA § 210, 16 U.S.C. § 824a-3 (1982); Federal Energy Regulatory Comm'n v. Mississippi, 456 U.S. at 750.

33. Federal Energy Regulatory Comm'n. v. Mississippi, 456 U.S. at 750-51. The general uneasiness of the traditional electric utilities over SPPFs was explained by Senator Percy:

> Many utilities are worried about the effects that technically unreliable equipment might have on their systems. Some fear solar generators would require expensive backup arrangements for critical peak periods, while eroding demand most of the time. For these reasons some utility companies refuse to interconnect with small power systems, or charge prohibitive electrical rates.

123 CONG. REC. 25,848 (1977). "Lower electricity and capital costs mean less gross profits." 123 CONG. REC. 32,419 (1977) (statement of Sen. Hart).

34. PURPA Title II, 92 Stat. 3134 (1978) (codified as amended in 16 U.S.C. § 761 (1982)).

35. Federal Energy Regulatory Comm'n v. Mississippi, 456 U.S. at 758-71.

36. *Id.* at 753-58.

37. Kansas City Power & Lighting Co. v. State Corp. Comm'n, 238 Kan. 842, 715 P.2d 19, *cert. dismissed for lack of substantial federal question*, 479 U.S. 801 (1986). When the United States Supreme Court dismisses an appeal for lack of substantial federal question, the dismissal operates as a decision on the merits and fully binds the lower courts. Hicks v. Miranda, 422 U.S. 332, 344-45 (1974); Mandel v. Bradley, 432 U.S. 173, 176 (1977); *see also* Carpenters Pension Trust v. Kronschnabel, 632 F.2d 745, 748 (9th Cir. 1980).

back when demand is high. Such a SMES facility would operate consistently with the intent of PURPA to promote energy efficiency and conservation. Furthermore, such a facility would provide a net gain for environmental protection, and earn profits from the sale of electricity at a higher rate than the purchase rate.

The following subsections review the key issues involved in starting and operating a privately owned SMES facility under the protection of PURPA. These key issues are: status as a qualifying facility, compelled interconnection, purchase and sale of electricity, and rates for purchase and sale of electricity.

A. *Qualifying Status*

Section 201 of PURPA defines a SPPF as a facility which "produces electric energy solely by the use, as a primary energy source, of biomass, waste, renewable resources, or any combination thereof; and has a power production capacity . . . not greater than eighty megawatts."[38] A plain reading of this language would not appear to include energy storage facilities within PURPA's definition of a SPPF, unless the term "produces" encompasses the reselling of stored electric energy. However, legislative history indicates that storage facilities were meant to be included: "The definition of small power production facility includes solar electric systems, wind electric systems, systems which produce electric energy from waste or biomass, and *electric energy storage facilities.*"[39] It thus seems that a SMES facility, as an electric energy storage facility, is also a small power production facility within the meaning of PURPA.

Congress gave the Federal Energy Regulatory Commission (FERC) the authority to further define "qualifying power production facility" for purposes of PURPA.[40] FERC has defined a qualifying facility as one that meets certain specified requirements[41] relating to maximum facility size and fuel use.[42] Like PURPA's, FERC's maximum allowable facility size is eighty megawatts.[43]

---

38. PURPA § 201, 16 U.S.C. § 796 (1982).

39. COMM. OF CONFERENCE, JOINT EXPLANATORY STATEMENT, H.R. REP. NO. 1750, 95th Cong., 2d Sess. 89, *reprinted in* 1978 U.S. CODE CONG. & ADMIN. NEWS 7797, 7823 (emphasis added).

40. PURPA § 201, 92 Stat. 3134-35 (1978) (codified as amended in 16 U.S.C. § 796 (1982)).

41. 18 C.F.R. § 292.101 (1988).

42. *Id.* § 292.203(a).

43. *Id.* § 292.204(a). Although 80 megawatts is not a large amount of electricity by electric power industry standards, an 80-megawatt SMES unit using the new superconductor technology should be sufficiently cost-effective to provide net profits when cycling every 24 hours.

FERC's fuel use requirement states that "[t]he primary energy source of the facility must be biomass, waste, renewable resources, geothermal resources, or any combination thereof."[44]

As in PURPA, the FERC fuel use requirement does not appear on its face to encompass energy storage. An energy storage facility alone, without any on-site power generation facilities, would not use any of FERC's listed energy source inputs.[45] Rather, an independent SMES facility's only input would be electricity derived from external power generation facilities and supplied through interconnection with existing electric utility distribution systems. But in keeping with congressional intent, FERC recognized that "electric energy storage facilities such as electro-chemical systems, flywheels or pumped storage units qualify as long as they do not involve the primary use of fossil fuels as direct inputs to the storage cycle."[46] Thus, SMES facilities seem to be both within FERC's and PURPA's definition of a qualifying small power production facility.

FERC provides two methods by which a candidate facility may apply for and receive qualifying status.[47] The applicant decides which method is the proper procedure in a particular circumstance.[48] The first method simply requires the applying facility to supply required information about the facility; no further procedure is mandated.[49] By using this method there is no need to wait for an award of status as a qualifying facility, because the regulation grants status automatically upon application, and does not require FERC review or approval.[50] The weakness of this method is that FERC retains the right to revoke status if it determines that the facility is beyond the scope of FERC's definition of a qualifying facility,[51] thus leaving the owners of the facility in the costly position of having designed and constructed a facility not protected under PURPA.

Because of this problem, FERC created an alternative application

44. *Id.* § 292.204(b).

45. *Id.*

46. [1977-1981 Transfer Binder] Fed. Energy Reg. Comm'n Rep. (CCH) ¶ 32,028, at 32,330-331 (Jul. 3, 1979); 44 Fed. Reg. 38,873 (1979).

47. 18 C.F.R. § 292.207 (1988).

48. Florida Power & Lighting Co. v. Federal Energy Regulatory Comm'n, 711 F.2d 219, 223 (D.C. Cir. 1983).

49. The required information includes name, address, and a brief description of the facility, primary energy source, and capacity. 18 C.F.R. § 292.207(a) (1988); 18 C.F.R. § 292.207(b)(2)(i)-(iv) (1988) (as amended by 53 Fed. Reg. 15,381 (1988)).

50. *Re* Rule-Making Proceeding for Consideration of Cogeneration and Small Power Production, 38 Pub. Util. Rep. (PUR) 352, 360 (1980).

51. 18 C.F.R. § 292.207(d)(1) (1988).

method whereby owners of a proposed qualifying facility may apply directly to FERC for certification of qualifying status.[52] Within ninety days of receiving an application under the second method, FERC issues an order which grants or denies certification of qualifying status; if no order issues within ninety days, certification is deemed granted.[53] If FERC denies certification, the applying facility can bring an action in federal district court to reverse the FERC order.[54]

The broadly inclusive nature of the FERC qualification rules, the express congressional intent to include electric energy storage facilities within the parameters of PURPA, and the further fact that "the criteria for qualifying status are to be interpreted liberally"[55] should ensure that SMES facilities receive PURPA protection as small power production facilities.

B. *Compelled Interconnection*

An interconnection is a physical connection between facilities that allows electricity to flow between them.[56] FERC has promulgated regulations obligating electric utilities to make interconnections with any qualifying facility.[57] The new qualifying facility has the obligation to pay interconnection costs, so long as the costs are nondiscriminatory,[58] with the local public utility regulatory agency determining the manner of payment and whether to permit reimbursement of utility expenses by the qualifying facility.[59]

Because FERC regulations obligating interconnection do not stem directly from the language of PURPA, a number of electric utilities have challenged FERC's authority to promulgate these rules. In *American Paper Institute v. American Power Services*

52. *Id.* § 292.207(b)(1). The application has several parts. First, it requires the name, address, and a brief description of the facility, primary energy source, capacity, and percentage of facility owned by an electric utility. *Id.* § 292.207(b)(2)(i)-(v) (as amended by 53 Fed. Reg. 15,381 (1988)). Second, it requires specification of location in relation to other facilities, and information regarding projected use of petroleum or coal. *Id.* § 292.207(b)(3)(i)-(ii). Third, it requires publication in the Federal Register. *Id.* § 292.207(b)(6). FERC also recently implemented a filing fee of $1300. *Id.* § 381.505.

53. *Id.* § 292.207(b)(5).

54. PURPA § 210(g), U.S.C. § 824a-3(g) (1982).

55. *Re* Rule Making, *supra* note 50, at 360.

56. American Paper Inst. v. American Electric Power Serv. Corp., 461 U.S. 402, 407 (1983).

57. 18 C.F.R. § 292.303(c)(1) (1988); *American Paper Inst.*, 461 U.S. at 407 (citing 18 C.F.R. § 292.303).

58. 18 C.F.R. § 292.306(a) (1988).

59. *Id.* § 292.306(b).

Corp.,[60] the United States Supreme Court, by unanimous decision, held that "[t]he authority to promulgate such rules as are necessary to require purchases and sales plainly encompasses the power to promulgate rules requiring utilities to make physical connections with qualifying facilities in order to consummate purchases and sales authorized by PURPA."[61] The Court recognized that without the authority to compel interconnection, FERC could not require utilities to sell and purchase electricity to qualifying facilities.[62] Therefore, the Court reasoned, FERC's power to compel interconnection is implicit in the language of PURPA,[63] and FERC "did . . . not exceed its authority in promulgating the interconnection rule."[64] By virtue of this decision, a qualifying SMES facility will be able to force an electric utility to interconnect for the purpose of sales and purchases.

C. *Purchase and Sale of Electricity*

PURPA gives FERC the authority to require utilities to sell electric energy to qualifying facilities.[65] FERC regulations require an electric utility to sell to a qualifying facility "any energy and capacity requested by the qualifying facility."[66] PURPA also grants FERC the authority to require utilities to purchase electricity from qualifying facilities.[67] FERC, in turn, has issued regulations requiring a utility to purchase any electric energy made available directly to that utility by a qualifying facility.[68] PURPA thus provides "a guaranteed market for the power generated by qualifying facilities by making it a requirement that utilities purchase available energy and capacity from qualifying facilities before buying power from anywhere else."[69]

Additionally, PURPA "gives FERC the authority to order an

60. 461 U.S. 402 (1983).
61. *Id.* at 418.
62. *Id.*
63. *Id.* at 422.
64. *Id.* at 423.
65. PURPA § 210(a)(1), 16 U.S.C. § 824 (1982).
66. 18 C.F.R. § 292.303(b) (1988).
67. PURPA § 210(a)(2), 16 U.S.C. § 824 (1982).
68. 18 C.F.R. § 292.303(a)(1) (1988); *See also* Snow Mountain Pine Co. v. Maudlin, 84 Or. App. 590, 598-99, 734 P.2d 1366, 1370 (1987) (under PURPA and the Oregon law implementing PURPA on the state level an electric utility's obligation to purchase power from a qualifying facility is imposed by law. It is not voluntarily assumed).
69. Greensboro Lumber Co. v. Georgia Power Co., 643 F. Supp 1345, 1373 (N.D. Ga. 1986), *aff'd*, 844 F.2d 1538 (1982) (anti-trust claim by a qualifying facility against a power wholesaler).

otherwise intrastate electric utility to interconnect with another electric utility," so that such an electric utility might transfer ("wheel") power to a qualifying facility.[70] FERC may do so, provided the transfer is in the public interest and would encourage overall energy conservation, optimize efficient use of facilities, or improve the reliability of the electricity distribution system.[71] Compelled transfer to a SMES facility would satisfy all of these requirements.

D. *Rates for Purchase and Sale*

PURPA states that rates for purchases and sales of electricity to and from qualifying facilities are to be just, reasonable and nondiscriminatory.[72] A qualifying facility "is entitled to sell its entire output at the utility's avoided costs[73] and to purchase its entire electric requirement at retail."[74] FERC has adopted rules implementing the avoided costs rule.[75] By requiring the use of avoided costs, "PURPA establishes a guaranteed price which is equal to, or greater than, the price that would be received in a competitive market,"[76] thereby insulating qualifying facilities from competition and promoting the development of SPPFs.

A number of electric utilities challenged the avoided costs rule in *American Paper Institute v. American Power Services Corp.*,[77] but the United States Supreme Court held that it was reasonable for

---

70. West Texas Util. Co. v. Texas Elec. Serv., 470 F. Supp. 798, 839 (N.D. Tex. 1979) (dismissing anti-trust action by intrastate utilities against interstate utilities for unfair competition when interstate utilities wheeled power pursuant to PURPA).

71. *Id.*

72. PURPA § 210(b)(1-2), (c)(1-2), 16 U.S.C. § 824a-3(b)(1-2), (c)(1-2) (1982); 18 C.F.R. § 292.304(a)(1)(i)-(ii) (1988).

73. Generally, avoided costs are "what it would cost the utility to generate the electricity itself or buy it elsewhere." Shawmut Eng'g Co. v. Public Serv. Comm'n, 135 Misc. 2d 345, 347, 515 N.Y.S.2d 394, 395 (Sup. Ct. 1987). Precisely what is included in avoided costs is subject to much debate. For a discussion of the dispute surrounding avoided costs, *see* ALTERNATIVE ENERGY: THE FEDERAL ROLE §§ 7.08-.09 (L. Buck & L. Goodwin ed. 1986). *See also* Miles, *Full-Avoided Cost Pricing Under the Public Utility Regulatory Policies Act: "Just and Reasonable to Electric Consumers?,"* 67 CORNELL L. REV. 1267 (1984).

74. *Re* Rule-Making, *supra* note 50, at 359.

75. 18 C.F.R. § 292.304(b)(2) (1988); American Paper Inst. v. American Electric Power Serv. Corp., 461 U.S. 402, 406 (1983). For factors used in fixing the rate for avoided costs see 18 C.F.R. 292.304(e) (1988); *see also* Snow Mountain Pine Co. v. Maudlin, 84 Or. App. 590, 600, 734 P.2d 1366, 1372 (1987) (utility must pay "actual avoided costs").

76. Greensboro Lumber Co. v. Georgia Power Co., 643 F. Supp. 1345, 1373 (N.D. Ga. 1986).

77. 461 U.S. 402 (1983).

FERC to promulgate "the maximum rate authorized by Congress and thereby provide incentive for the development of small power production."[78] Furthermore, although avoided costs are the minimum rate established by FERC, avoided costs are not the maximum rate a state utility commission can set.[79]

PURPA also requires that time-of-day[80] rates be used unless they are shown not to be cost-effective.[81] Time-of-day rates improve load management[82] and thereby fulfill PURPA's goal of optimizing efficient use of facilities and resources.[83] Using time-of-day rates, a SMES facility could purchase electricity from a utility during hours when demand and price were low, then sell that same electricity back to the utility when demand and price are high.

IV.
CONCLUSION

Recent technological advances in superconductivity have created an opportunity for entrepreneurs to invest in the construction of small-scale SMES facilities. These facilities would increase energy conservation by promoting the efficient use of power generated by existing power plants. SMES facilities would also promote environmental protection by reducing consumption of scarce natural resources and reducing demand for new power generating facilities.

Not only would this technology produce environmental benefits, but SMES facilities could be economically feasible, indeed profitable, within the regulatory framework of PURPA and the FERC

78. *Id.* at 418.

79. Consolidated Edison Co. v. Public Serv. Comm'n, 63 N.Y.2d 424, 430, 472 N.E.2d 981, 982, 483 N.Y.S.2d 153, 154 (1984) (PURPA does not preempt a state from requiring electric utilities to purchase power from qualifying facilities at a rate in excess of the maximum rate under PURPA), *dismissed for lack of substantial federal question*, 470 U.S. 1075 (1985).

80. Time-of-day rates reflect the demand for electricity at a given point in time. Using time-of-day rates, electric utilities charge more for electricity consumed during periods of high demand. Federal Energy Regulatory Comm'n v. Mississippi, 456 U.S. 742, 747 (1982). For a graph of typical time-of-day demand fluctuation, *see also* M. RICE, *supra* note 17, at 27.

81. PURPA §§ 111(d)(3), 115(b), 16 U.S.C. §§ 2621(d)(3), 2625(b) (1982); Metropolitan Wash. Bd. of Trade v. Public Serv. Comm'n, 432 A.2d 343, 351 (D.C. 1981) (adoption of time-of-day rates by Public Utilities Commission, in an attempt to allocate costs to customers who consumed electricity during peak periods by charging higher prices during peak periods, was justified, because time-of-day rates would promote conservation and the efficient use of facilities and resources by utilities).

82. "'Load Management' is . . . any method for shifting electric power demand away from the load peak." M. RICE, *supra* note 17, at 23.

83. PURPA § 101(2), 16 U.S.C. § 2611(2) (1982). *See also* M. RICE, *supra* note 17, at 23.

rules implementing PURPA. A SMES facility with a capacity of under eighty megawatts would qualify as a "small power production facility" within the meaning of the regulations. As such, a SMES facility operator could compel an electric utility to interconnect with, sell power to, and purchase power from the qualifying SMES. Because PURPA also mandates time-of-day rates, a SMES facility could purchase electricity from a utility during hours when electricity demand and price were low, then sell that same power back to the utility at a profit during hours when electricity demand and price were high.

For reasons of energy conservation and environmental protection, as well as profit potential, SMES technology merits consideration as one means of meeting society's future energy needs.

Robert E. Bovett *

* J.D. 1990, Northwestern School of Law of Lewis and Clark College; B.A. 1987, University of La Verne. This article was written in conjunction with the "Conference on Superconductivity, Energy and the Environment," sponsored and produced by the Environmental Law Caucus of Northwestern School of Law, held at Northwestern School of Law on March 19, 1988. The author wishes to thank Joel Gallob, David Kracke, Nancy Murray and David Narum for their valuable assistance.