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## A Rising Tide in Renewable Energy: The Future of Tidal In-Stream Energy Conversion (TISEC)

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2008]

## A RISING TIDE IN RENEWABLE ENERGY: THE FUTURE OF TIDAL IN-STREAM ENERGY CONVERSION (TISEC)

### I. INTRODUCTION

The idea of generating energy from moving water has existed for thousands of years.<sup>1</sup> Hydropower was one of the earliest forms of renewable energy used by mankind.<sup>2</sup> Modern Civilizations' energy needs, however, have increasingly been fulfilled by fossil fuels.<sup>3</sup> This reliance has created severe environmental and sociological problems.<sup>4</sup> These problems, such as global climate change and continuously rising energy prices, will continue to affect the entire human race until a practical alternative for fossil fuels is found.<sup>5</sup>

Fortunately, such an alternative is not far off.<sup>6</sup> Hydropower is currently the largest source of renewable energy in the United States, creating 90,000 megawatts (MW) of power and accounting for ten percent of the country's generated energy.<sup>7</sup> Nevertheless, developers continue to expand that capacity by creating more effi-

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1. See Diane Greer, *Ecoentrepreneurs Develop Hydropower Technologies*, IN BUSINESS, May-June, 2005, at 13 (detailing history of hydropower).

2. See GEORGE HAGERMAN & BRIAN POLAGYE, ELECTRIC POWER RESEARCH INSTITUTE, METHODOLOGY FOR ESTIMATING TIDAL CURRENT ENERGY RESOURCES AND POWER PRODUCTION BY TIDAL IN-STREAM ENERGY CONVERSION (TISEC) DEVICES, 2, (2006), [http://www.epri.com/oceanenergy/attachments/streamenergy/reports/TP-001\\_REV\\_3\\_BP\\_091306.pdf](http://www.epri.com/oceanenergy/attachments/streamenergy/reports/TP-001_REV_3_BP_091306.pdf) (discussing history of tidal barrages). Going as far back as the eighth century, evidence has shown that several European peoples built "tidal storage ponds behind dams that were filled by the incoming tide . . . . These gates were closed at high tide and the trapped water directed back to the sea through a water wheel to mill grain." *Id.*

3. See *Renewable Ocean Energy: Tides Currents and Waves: Oversight Field Hearing Before the H. Subcommittee on Energy and Mineral Resources*, 109th Cong. 3 (2006) [hereinafter *Field Hearings*] (statement of Thelma Drake, Vice Chairman, Subcomm. on Energy and Mineral Resources, H. Resources Comm.) (citing current supply of renewable energy).

4. See generally Ian H. Rowlands, *Global Climate Change and Renewable Energy Exploring the Links*, in *Switching to Renewable Power*, in SWITCHING TO RENEWABLE POWER: A FRAMEWORK FOR THE 21ST CENTURY 62, 62-63 (Volkmar Lauber ed., Earthscan Publications Ltd., 2005) (discussing origins of global warming).

5. See *id.* (exploring reasons behind Kyoto protocol).

6. See Greer, *supra* note 1, at 13 (discussing alternatives to fossil fuels).

7. See *id.* (detailing current use of hydropower in United States). Generally, a megawatt of power can fulfill the power needs of 700 to 800 families. See *id.*

cient and commercially viable technologies that are capable of meeting the country's ever-growing energy needs.<sup>8</sup>

The first fully functioning tidal turbines, called Tidal In-Stream Energy Conversion (TISEC) devices, were installed in New York City's East River in December 2006.<sup>9</sup> The project, developed by Verdant Power, and known as the Roosevelt Island Tidal Energy (RITE) Project, consists of freestanding turbines that are similar to electricity generating windmills, but are placed underwater.<sup>10</sup> The twenty-foot long, four-ton turbines are placed in swift moving water which passes over the turbine blades causing them to rotate and create electric power.<sup>11</sup> TISEC devices are unlike traditional hydropower in that they are placed in the natural flow of water rather than holding it back.<sup>12</sup> This type of "free-flow" technology results in minimal environmental impact.<sup>13</sup>

TISEC devices have great promise largely because the revolutionary design reduces the impact on the surrounding environment.<sup>14</sup> They are also attractive to developers because TISEC devices are easy to install and easy to connect to the existing power infrastructure.<sup>15</sup> In fact, the test turbine in the RITE project was fully operational and providing power to local customers soon after being installed.<sup>16</sup> This turbine began to generate about 150 kilowatts of energy for a nearby supermarket without even a flicker of the lights.<sup>17</sup> Eventually the entire underwater project, consisting of 200 to 300 turbines, will be able to generate ten megawatts of electricity, enough to power over 8,000 homes.<sup>18</sup>

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8. See *Field Hearings*, *supra* note 3 (statement of Thelma Drake, Vice Chairman, Subcomm. on Energy and Mineral Resources) (noting potential of renewable energy to provide for general population).

9. See *Powering Up with Underwater Turbines* (N.Y. Times video broadcast Jan. 2, 2007) [http://video.on.nytimes.com/?fr\\_story=a16561a2d9322a0e5953813fd7c930aa6fd8e41e](http://video.on.nytimes.com/?fr_story=a16561a2d9322a0e5953813fd7c930aa6fd8e41e) (last visited Nov. 5, 2007) [hereinafter N.Y. Times video] (detailing physical attributes of Verdant Power's East River turbines).

10. See *id.* (comparing similarities of underwater turbines to land windmills).

11. See *id.* (describing functionality of turbines).

12. See *Field Hearings*, *supra* note 3 (statement of Michael Bahleda, President, Bahleda Management and Consulting, LLC) (discussing logistics of kinetic hydropower).

13. See *id.* (citing lack of water impoundment as reducing environmental impact).

14. See Ian Urbina, *In Search of New Power Source, City Looks Underwater*, N.Y. TIMES, July 10, 2004, at B3 (discussing impact of TISEC).

15. See *id.* (explaining ease of connecting to grid due to fact that electricity is produced locally and therefore does not need to travel great distance over grid).

16. See N.Y. Times video, *supra* note 9 (signifying speed and ease in assembly).

17. See Urbina, *supra* note 14 (discussing commercial practicality of TISEC).

18. See *id.* (presenting large scale ability of TISEC).

The idea of generating energy through the use of TISEC devices has long been envisioned, yet only recently has it become commercially practical.<sup>19</sup> Consequently developers have begun to take steps to capitalize on TISEC's advancements.<sup>20</sup> Officials in San Francisco began talks concerning the installation of turbines near the Golden Gate Bridge, and developers have applied for permits for TISEC projects from Maine to Alaska.<sup>21</sup> So far, there have been forty-six permits issued by the Federal Government with an additional fourteen more permits pending.<sup>22</sup>

TISEC technology has already overcome several hurdles, but to reach mainstream application it will likely face additional challenges.<sup>23</sup> This Comment focuses on the possibility of creating commercially viable, mainstream tidal energy, and the obstacles that must be overcome for that possibility to become a reality. Section II explains what tidal energy is and how TISEC devices work.<sup>24</sup> Section III outlines why tidal energy is an attractive alternative to current energy production methods.<sup>25</sup> Section IV discusses the significance of the Federal Energy Regulatory Commission's (FERC) decision to exempt Verdant Power from having to obtain a license to operate its test turbines for the RITE project.<sup>26</sup> Finally, section V examines the potential impediments that might prevent the development of tidal energy.<sup>27</sup>

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19. See Greer, *supra* note 1, at 13 (highlighting goals of hydropower).

20. See *All Things Considered: Power Turbines will Rely on Tidal Forces* (National Public Radio Oct. 19, 2006) (detailing surge of interest in TISEC projects).

21. See *id.* (discussing recent popularity of alternative methods of energy production).

22. See Federal Energy Regulatory Commission, Hydrokinetics: Issued and Pending Permits, <http://www.ferc.gov/industries/hydropower/indus-act/hydrokinetics/permits.asp#issued> (last visited Nov. 5, 2007) (listing issued and pending permits).

23. See *Field Hearings*, *supra* note 3 (statement of Sean O'Neill, President, Ocean Renewable Energy Coalition) (discussing logistics of kinetic hydropower).

24. For a further discussion of TISEC, see *infra* notes 28-74 and accompanying text.

25. For a further discussion of the drawbacks to other energy production methods, see *infra* notes 75-155 and accompanying text.

26. For a further discussion of FERC's decision to exempt the first stages of Verdant Power's East River TISEC plant for the regulatory process, see *infra* notes 156-87 and accompanying text.

27. For a further discussion of the future hurdles facing TISEC, see *infra* notes 188-337 and accompanying text.

## II. TISEC DEVICES AND THE IDEA OF TIDAL ENERGY

First used in Europe, tidal mill systems have been generating power for centuries.<sup>28</sup> During high tide, gates would close and trap water in a storage pond.<sup>29</sup> The water was then released through a channel during low tide that would turn a water wheel.<sup>30</sup> This same process is still used today in systems called tidal barrage.<sup>31</sup>

There are several large barrage tidal power plants existing today, including the 240 MW La Rance plant in France, the 20 MW plant in Nova Scotia, and the 0.5 MW plant in Russia.<sup>32</sup> These plants were built in the mouths of bays or estuaries, allowing the tide to flow in, and forcing the seawater to flow back out through turbines.<sup>33</sup> Tidal barrage plants constructed this way rely on the potential energy created by the disparity of heights between the higher contained tidal water and the lower ocean water outside the impoundment after the tide has receded.<sup>34</sup>

These tidal power plants are similar to traditional hydropower facilities because they rely on the potential energy contained in the height of water behind a dam.<sup>35</sup> TISEC devices rely on the kinetic energy generated by the water's motion.<sup>36</sup> TISEC devices, unlike tidal plants, rely on the natural movement of the tide to turn the turbines instead of a conventional system of water impoundment.<sup>37</sup>

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28. See SIDNEY BOROWITZ, *FAREWELL FOSSIL FUELS: REVIEWING AMERICA'S ENERGY POLICY* 168 (1999) (detailing history of tidal energy).

29. See *id.* (explaining procedure of tidal barrages).

30. See *id.* (illuminating power production methods).

31. See The Rance Tidal Power Plant, Power from the Ocean, <http://www.edf.fr/html/en/decouvertes/voyage/usine/usine.html> (last visited Nov. 5, 2007) (describing attributes of Rance Tidal Plant).

32. See ROGER BEDARD ET AL., *ELECTRIC POWER RESEARCH INSTITUTE, NORTH AMERICAN TIDAL IN-STREAM ENERGY CONVERSION TECHNOLOGY FEASIBILITY STUDY* (2006) [http://www.epri.com/oceanenergy/attachments/streamenergy/reports/008\\_Summary\\_Tidal\\_Report\\_06-10-06.pdf](http://www.epri.com/oceanenergy/attachments/streamenergy/reports/008_Summary_Tidal_Report_06-10-06.pdf) (detailing current large scale non-conventional hydropower plants).

33. See PATRICK McCULLY, *SILENCED RIVERS* 232 (2nd ed. 2001) (discussing operation of large scale tidal plants).

34. See United States Department of Energy Office of Energy Efficiency and Renewable Energy, *Proceedings of the Hydrokinetic and Wave Energy Technologies Technical and Environmental Issues Workshop*, 5 n.3 (Mar. 24 2006) [hereinafter *Environmental Issues Workshop*], [http://hydropower.inl.gov/hydrokinetic\\_wave/pdfs/hydro\\_workshop\\_proceedings.pdf](http://hydropower.inl.gov/hydrokinetic_wave/pdfs/hydro_workshop_proceedings.pdf) (explaining physics of hydropower). The formula for potential energy (PE) is  $PE = mgh$ , where  $m$  = mass,  $g$  = gravitational force, and  $h$  = height. See *id.*

35. See *id.* at 5 (describing physics of conventional hydropower).

36. See *id.* (explaining physics behind kinetic energy). The formula for kinetic energy (KE) is  $KE = \frac{1}{2} mv^2$ , where  $m$  = mass and  $v$  = velocity. See *id.*

37. See *id.* (suggesting environmental benefits of tidal turbines when compared to conventional hydropower).

There are two different types of TISEC devices: (1) horizontal axis; and (2) vertical, or cross flow axis.<sup>38</sup> Horizontal axis turbines are the more recognizable type because they closely resemble conventional windmills.<sup>39</sup> The rotational axis is horizontal to the ground and parallel to the direction of the flow.<sup>40</sup> Vertical axis turbines have their axis perpendicular to the direction of the flow, much like how a revolving door has its axis perpendicular to the flow of pedestrians.<sup>41</sup> Horizontal axis turbines are closer to being commercially viable in part because they share similarities with wind turbines.<sup>42</sup>

Both versions of TISEC devices are incredibly versatile and are designed to work in a variety of locations.<sup>43</sup> TISEC systems can work equally well in smaller flows such as natural streams, tidal straights, and estuaries, as they do in large flows like rivers and ocean currents.<sup>44</sup> Man made flows like canals, aqueducts, by-pass channels, and discharge flumes can also have TISEC devices added to them in order to create an energy production system.<sup>45</sup> To operate in such diverse water systems, TISEC devices can either be unidirectional or bidirectional in order to extract as much energy from a flow as possible.<sup>46</sup> Unidirectional TISEC devices are better suited for use in streams or rivers where the flow is consistently in the same direction.<sup>47</sup> Bidirectional TISEC devices, on the other hand, work best in tidal flows where the flow frequently changes direction.<sup>48</sup>

The potential to generate energy from moving water is very promising.<sup>49</sup> A 1998 Department of Energy study estimated that in the United States, there is an undeveloped instream capacity of

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38. See *Environmental Issues Workshop*, *supra* note 34, at 7 (describing different types of TISECs).

39. See *id.* (detailing attributes of two different types of TISECs).

40. See BEDARD, *supra* note 32, at 3 (describing horizontal axis turbines).

41. See *id.* (describing vertical axis turbines).

42. See *Environmental Issues Workshop*, *supra* note 34, at 7 (discussing commercial practicality of TISEC).

43. See *id.* at 9 (specifying adaptability of TISEC devices).

44. See *id.* (discussing flexibility of TISEC devices).

45. See *id.* (explaining how TISEC can be adapted into pre-existing systems).

46. See *Field Hearings*, *supra* note 3 (statement of Sean O'Neil, President, Ocean Renewable Energy Coalition) (describing different renewable ocean energy technologies).

47. See *Environmental Issues Workshop*, *supra* note 34, at 9 (illustrating unidirectional TISEC devices).

48. See *id.* (illustrating bidirectional TISEC devices).

49. See *Field Hearings*, *supra* note 3 (statement of Michael Bahleda, President, Bahleda Management and Consulting, LLC) (*citing* DOE-Id-11263 Feasibility Assessment of the Water Energy Resources of the United States for New Low Power

70,000 MW.<sup>50</sup> Even if only half of these sites are commercially viable, there could still be upwards of 40,000 MW of power available.<sup>51</sup> While a single TISEC device creates a relatively small amount of power, generally ranging from 25 kW to 250 kW depending on turbine size and water velocity, the turbines can be grouped together in farms to produce power equal to that of a conventional power plant.<sup>52</sup> In Washington's Puget Sound it is estimated tidal energy could create as much energy as two nuclear power plants.<sup>53</sup> Free-flow technology could even be added to existing conventional hydroelectric sites in order to extract more energy from their discharge streams.<sup>54</sup>

TISEC devices are the best technology currently available to capture hydropower because the source does not necessarily need to be constant in order to create an effective energy source so long as it is predictable.<sup>55</sup> A utility company must know exactly when and how much energy will be available.<sup>56</sup> This presents the most formidable problem for other renewable energy sources, such as solar and wind power, where the unpredictability of weather conditions dictates the availability of energy.<sup>57</sup>

Weather variability is not an issue with tidal energy because the tides are driven by the moon and will always reoccur every twelve hours and twenty-five minutes.<sup>58</sup> As a result, TISEC devices can produce power for sixteen hours a day.<sup>59</sup> Another advantage of tidal energy is that the density of water is 832 times that of air.<sup>60</sup> As a result, TISEC devices have the ability to extract more energy at lower velocities.<sup>61</sup> In fact, TISEC devices can be effective in water

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and Small Hydro Classes of Hydroelectric Plants, 2006) (discussing future potential of TISEC).

50. See Greer, *supra* note 1, at 14 (exemplifying possible potential for TISEC).

51. See *id.* (demonstrating practical possibility for future energy generation).

52. See *id.* (noting potential for large TISEC projects).

53. See Lukas Velush, *Tides Hold Promise of Electricity: Underwater Currents could be Harnessed to Help Light our Homes, Under a Dream the Snohomish County PUD Hopes Will become Reality*, THE HERALD (Everett, WA), Feb. 11, 2007 (demonstrating power potential of TISEC systems).

54. See *id.* (discussing creative possibilities for TISEC).

55. See HAGERMAN, *supra* note 2, at 2 (citing benefits of reliable tides).

56. See *id.* (detailing benefits of regular energy production).

57. See *id.* (comparing TISEC to unpredictable weather patterns needed for other renewable energy plants).

58. See *id.* (citing time frame for reoccurring tides).

59. See Greer, *supra* note 1, at 14 (stating energy production potential of TISEC devices).

60. See *id.* (discussing potential of turbines when rotated by denser medium).

61. See *id.* (comparing TISEC to windmills).

that is moving as slowly as three knots (five feet per second).<sup>62</sup> Consequently, when comparing a windmill and a TISEC turbine of similar size, the TISEC will produce forty times more power.<sup>63</sup>

TISEC's greatest benefit may be its ability to be installed wherever energy is needed.<sup>64</sup> This includes both heavily populated and consequently high demand areas such as urban centers, and extremely rural areas that are traditionally difficult to serve by today's energy production methods.<sup>65</sup> Verdant's RITE project demonstrates how urban centers can have their energy supplied by TISEC projects.<sup>66</sup> Integrating TISEC systems to an urban grid system is relatively easy because TISEC systems are in close proximity to the actual consumers of the electricity, making the need for a transmission grid obsolete.<sup>67</sup>

TISEC devices can also benefit rural communities.<sup>68</sup> One third of the world's population does not have access to electricity, but does have access to moving water.<sup>69</sup> By using TISEC devices, these communities could finally be provided with efficient access to energy.<sup>70</sup> Verdant Power is currently working with the Brazilian government to bring TISEC systems to rural villages in the Amazon basin in order to supply them with electricity.<sup>71</sup> TISEC devices would also lower the tremendously high costs many rural communities face when producing energy.<sup>72</sup> Energy production using diesel engines in rural Alaskan villages costs up to eighty cents per kilowatt hour.<sup>73</sup> Developers are exploring the possibility of using

62. *See id.* (indicating utility of TISEC in even slow moving sources).

63. *See* Paul Davidson, *Catch a Wave, Throw a Switch*, USA TODAY, Apr. 19, 2007, at 1B (comparing windmills to tidal turbines).

64. *See id.* (discussing benefits to urban centers); *see also* Thomas F. Armistead, *Wave and Tidal Generation Open a New Frontier for Renewables But Explorers Struggle as they hack through the Regulatory Thicket*, 258 ENGINEERING NEWS-RECORD 26 (2007) (discussing benefits to rural areas).

65. *See* Davidson, *supra* note 63, at 1B (discussing use in urban settings); *see also* Armistead, *supra* note 64, at 26 (detailing use in rural areas).

66. *See* Peggy Shaw, *Lunar Power in the Big Apple*, MULTIHOUSING PROFESSIONAL, Jan. 2007, at 66, available at [http://www.multihousingpro.com/pdf/Multihousing\\_Professional\\_Janp66\\_69.pdf](http://www.multihousingpro.com/pdf/Multihousing_Professional_Janp66_69.pdf) (detailing benefits to urban areas).

67. *See id.* (discussing benefits of avoiding grid).

68. *See* Armistead, *supra* note 64 (exploring benefits to rural communities).

69. *See* Adelle Caravanos, *Member Profile: Trey Taylor, Using Hydropower to Empower Sustainable Communities*, UPDATE, May/June 2007, available at <http://www.nyas.org/snc/updatePrint.asp?updateID=125> (discussing opportunities available to TISEC).

70. *See id.* (stating benefits to rural communities).

71. *See id.* (discussing future Verdant plans).

72. *See* Armistead, *supra* note 64, at 26 (exploring burdens on rural communities).

73. *See id.* (detailing productions costs).



200 VILLANOVA ENVIRONMENTAL LAW JOURNAL [Vol. XIX: p. 193

TISEC turbines in these villages, which would greatly reduce the cost of energy.<sup>74</sup>

### III. THE NEED FOR TIDAL ENERGY

In February 2007, the United Nation's Intergovernmental Panel on Climate Change (IPCC) stated the debate was resolved concerning the legitimacy of global warming.<sup>75</sup> The IPCC report concluded the cause of global warming was likely due to human activity.<sup>76</sup> The IPCC called on major emitters to take the lead and begin cutting emissions.<sup>77</sup> With only ten percent of the nation's energy needs currently coming from renewable and alternative energy sources, the most promising path to lower emissions in the United States is by increasing the amount of renewable energy.<sup>78</sup> TISEC is one of the most attractive renewable sources for a variety of reasons.<sup>79</sup> One of the main reasons for TISEC's appeal is that it does not pose the same environmental and safety hazards that other energy technologies do.<sup>80</sup> Fossil fuels, conventional hydro-power, barrage tidal systems, wind farms, and solar thermal plants all have significant drawbacks that are avoided by TISEC devices.<sup>81</sup>

#### A. Fossil Fuels

Fossil fuels, such as oil, coal and natural gas, are limited commodities that are trapped in the Earth's crust.<sup>82</sup> These "gifts from God" are finite and will eventually run out.<sup>83</sup> The fact that the oil

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74. *See id.* (noting benefits to rural communities).

75. *See* John Donnelly, *Debate Over Global Warming is Shifting: Some Skeptics Resolute, Others Revisiting Views*, BOSTON GLOBE, Feb. 15, 2007, at 2A (discussing findings of IPCC).

76. *See* Bryan Walsh, *Raising the Climate Stakes*, TIME, Feb. 19, 2007, at 18 (detailing finding of IPCC).

77. *See id.* (discussing solutions for global warming).

78. *See Field Hearings*, *supra* note 3 (statement of Thelma Drake, Vice Chairman, Subcomm. on Energy and Mineral Resources) (outlining problems associated with fossil fuels and possible solutions).

79. *See id.* (exploring benefits of TISEC).

80. *See id.* (statement of Michael Bahleda, President, Bahleda Management and Consulting, LLC) (discussing environmental benefits of TISEC).

81. For a further discussion of the drawbacks of other forms of energy, *see infra* notes 82-155 and accompanying text.

82. *See* BOROWITZ, *supra* note 28, at 41 (presenting overview of fossil fuels).

83. *See* Rowlands, *supra* note 4, at 22-3 (discussing production peak nature of crude oil). While the market will not signal the point when worldwide production of crude oil has peaked, it has in certain areas, and a general pattern is followed, namely, a progression of pre-peak, at peak, and decline phases. *See id.* Oil production in Norway, the United Kingdom, Texas and Alaska have each followed this pattern. *See id.* As production begins to slope downward, decline in the large

industry is using costly procedures and advanced technology to explore unfavorable locations such as the polar region of the Caspian Sea or the extreme depths of the ocean indicates the amount of oil located in easy to reach locations is already running out.<sup>84</sup> In addition to the supply decrease in recent years, demand has been increasing at staggering rates, resulting in record prices for fossil fuels.<sup>85</sup> Assuming the demand for oil will continue to increase, some suggest that we are currently at a critical point where oil prices may begin to spiral out of control.<sup>86</sup>

Using alternative energy could be the answer to reducing the demand for fossil fuels.<sup>87</sup> A recent study found "Britain could generate up to 20 percent of the electricity it needs from waves and tides. . . about 12,000 megawatts a day at current usage, or three times what Britain's largest power plant produces now."<sup>88</sup> The amount of energy produced through tidal energy could greatly reduce the current reliance on oil, and it could replace, or at least lengthen, the lifespan of the fossil fuels.<sup>89</sup>

In addition to the limited future of fossil fuel reserves, another reason to avoid fossil fuel use is that it is the leading factor accelerating global climate change.<sup>90</sup> Global climate change is caused primarily by the buildup of carbon dioxide gases in the atmosphere that act as a blanket, increasing the Earth's temperature.<sup>91</sup> The concentration of carbon dioxide gas in the atmosphere has greatly increased over time, from an average of 280 parts per million (ppm) in 1750 to approximately 370 ppm in 2007.<sup>92</sup> This increase is largely due to the burning of fossil fuels.<sup>93</sup> Some projections indicate that by the middle of the next century the average temperature

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fields is offset for a temporary period by increased production in smaller fields, causing a plateau period, but this merely delays the inevitable downward slope decline that follows. *See id.*

84. *See id.* at 31 (asserting production peak has occurred).

85. *See* Associated Press, *Crude Oil Futures Trade Above \$96 Again*, N.Y. TIMES, Nov. 3, 2007, at C7 (detailing record \$96.24 per barrel price for oil).

86. *See id.* at 33 (predicting future situation where oil demand outweighs supply).

87. *See* Urbina, *supra* note 14 (predicting 10 megawatt field planned for East River could replace 65,000 barrels of oil each year).

88. Heather Timmons, *A Renewable Source, and Clean, But Not Without Its Critics*, N.Y. TIMES, Aug. 3, 2006, at C1 (discussing potential of renewable energy to replace shrinking oil reserves).

89. *See id.* (citing possibilities for future of energy).

90. *See* Rowlands, *supra* note 4, at 4 (analyzing impact of fossil fuels on environment).

91. *See id.* at 62 (describing causation of global climate change).

92. *See id.* at 63 (providing evidence of atmospheric change).

93. *See id.* (concluding presence of human role in global climate change).

202 VILLANOVA ENVIRONMENTAL LAW JOURNAL [Vol. XIX: p. 193

will increase by as much as 4.5 to 6.0 degrees Fahrenheit, provided the present rate of carbon dioxide emissions is maintained.<sup>94</sup> To put that increase in context, the earth's average temperature decreased by 5.0 degrees Fahrenheit during the last ice age.<sup>95</sup> Clearly, small temperature changes can have drastic effects on the climate.<sup>96</sup> The amount of greenhouse gases produced each year could be drastically reduced by switching to alternative forms of energy like tidal power, therefore slowing the progression of climate change.<sup>97</sup> For example, the ten megawatt field proposed for the RITE project would replace 65,000 barrels of oil and reduce carbon emissions by 33,000 tons every year.<sup>98</sup>

## B. Other Forms of Renewable Energy

When compared to conventional energy production methods, the environmental effects of renewable energy sources are typically considered "benign."<sup>99</sup> Yet in reality, their effect on the environment can be significant.<sup>100</sup> Large-scale renewable energy plants are more likely to have a physical, rather than a chemical impact on the environment.<sup>101</sup> In contrast to other renewable sources, TISEC devices have almost no physical impact on the environment.<sup>102</sup> Conventional hydropower, wind power, solar power, and other previous attempts at tidal power using the barrage method all have raised

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94. See BOROWITZ, *supra* note 28, at 46 (speculating on future impact of global climate change).

95. See *id.* at 47 (contextualizing temperature change).

96. See *id.* (describing effects of small temperature change).

97. See Urbina, *supra* note 14 (discussing possible environmental benefits).

98. See *id.* (hypothesizing changes with switch to renewable energy).

99. See ORGANIZATION FOR ECONOMIC COOPERATION AND DEVELOPMENT (OECD), ENVIRONMENTAL IMPACTS OF RENEWABLE ENERGY 7 (1988) (comparing renewable energy to fossil fuels). The OECD is a group of 30 countries that seeks to help democratic governments make decisions regarding their role in the market economy. See Organization for Economic Co-operation and Development (OECD), *About OECD*, [http://www.oecd.org/pages/0,3417,en\\_36734052\\_36734103\\_1\\_1\\_1\\_1\\_1\\_1\\_1,00.html](http://www.oecd.org/pages/0,3417,en_36734052_36734103_1_1_1_1_1_1_1,00.html) (last visited Nov. 5, 2007). OECD is best known for its publications and its statistics, covering a wide range of economic and social issues. See *id.*

100. See ORGANIZATION FOR ECONOMIC COOPERATION AND DEVELOPMENT, at 7 (exploring environmental impact of renewable energy projects).

101. See *id.* (contrasting renewable energy with fossil fuels).

102. See BEDARD, *supra* note 32, at 2 (speculating TISEC has little environmental effect). While the lack of TISEC projects has limited the exact certainty that this can be known, prototypes and research suggests that any effect would be small compared to other energy production methods. See *id.* (analyzing TISEC environmental impact).

significant environmental concerns that have stunted their main-stream application.<sup>103</sup>

### 1. *Conventional Hydropower*

In order for conventional hydropower to work, both a dam and a reservoir must be built.<sup>104</sup> These ecological alterations can wreak havoc on the local ecosystem and drastically affect the environment.<sup>105</sup> For all practical purposes, this has caused the construction of new, large-scale hydropower plants to cease.<sup>106</sup>

The greatest problem facing large hydropower projects is that they drastically change the physical nature of the land.<sup>107</sup> When a large hydropower project blocks a river it alters the natural layout of the terrain.<sup>108</sup> The reduction of the flow in the river increases the sedimentation in the reservoir, causing the riverbed upstream to rise and become more prone to flooding.<sup>109</sup> At the same time, sediment-free water released downstream by the dam at a high velocity causes accelerated erosion of the riverbed, delta, and seashore.<sup>110</sup>

Hydroelectric power also affects local wildlife.<sup>111</sup> Large hydropower projects displace animal life by creating large bodies of water in spots that formerly constituted habitable land.<sup>112</sup> Large hydropower projects also have a negative effect on aquatic life by altering the navigability of the waterways.<sup>113</sup> This effect is especially pro-

103. For a further discussion of the drawbacks of other renewable energy methods, *see infra* notes 104-55 and accompanying text.

104. *See* McCULLY, *supra* note 33, at 2-3 (examining grandness of massive dams).

105. *See* Union of Concerned Scientists; Environmental Impacts of Renewable Energy Technologies (Union of Concerned Scientists), [http://www.ucsusa.org/clean\\_energy/renewable\\_energy\\_basics/environmental-impacts-of-renewable-energy-technologies.html](http://www.ucsusa.org/clean_energy/renewable_energy_basics/environmental-impacts-of-renewable-energy-technologies.html) (last visited Nov. 5, 2007) (adapted from MICHAEL C. BROWER, COOL ENERGY: RENEWABLE SOLUTIONS TO ENVIRONMENTAL PROBLEMS (2nd ed. 1992)) (examining environmental effects of dams).

106. *See id.* (discussing results of governmental regulation on new dams).

107. *See* ORGANIZATION FOR ECONOMIC COOPERATION AND DEVELOPMENT, *supra* note 99, at 75 (stating major environmental effects of dams).

108. *See id.* (discussing immediate changes dams create).

109. *See id.* (investigating long term effects dams create).

110. *See id.* at 77 (exploring downstream effects dams create).

111. *See* WORLD COMMISSION ON DAMS (WCD), DAMS AND DEVELOPMENT: A NEW FRAMEWORK FOR DECISION-MAKING. THE REPORT OF THE WORLD COMMISSION ON DAMS 75 (Earthscan 2000), *available at* <http://dams.org//docs/report/wcdreport.pdf> (stating impact dams have on wildlife).

112. *See id.* (exploring accommodations wildlife is forced to make).

113. *See* ORGANIZATION FOR ECONOMIC COOPERATION AND DEVELOPMENT, *supra* note 99, at 78 (exploring environmental impact on aquatic life).

nounced on migratory species, whose migration route essentially becomes blocked.<sup>114</sup>

Furthermore, traditional hydropower may not be as beneficial an alternative to fossil fuels as originally thought.<sup>115</sup> Recent scientific research has shown that large hydroelectric projects actually contribute to greenhouse gases because the decaying plants that accumulate in the large reservoirs behind the dams emit carbon dioxide and methane.<sup>116</sup> Recent studies have also concluded that emissions from reservoirs may account for between one and twenty-eight percent of greenhouse gases.<sup>117</sup>

Another major effect of conventional hydropower is the displacement of massive numbers of people who used to live on the land now designated for the reservoir.<sup>118</sup> The Three Gorges Dam on the Yangtze River in China demonstrates a recent example of this displacement.<sup>119</sup> The dam will displace close to two million persons when its reservoir reaches full capacity in 2009.<sup>120</sup> Worldwide, it is estimated that hydropower projects have displaced forty to eighty million persons.<sup>121</sup> Another effect on the human population is the possibility of a dam failure, posing a huge risk to downstream populations.<sup>122</sup> This danger is heightened in seismic areas where the risk of a failure is dramatically increased.<sup>123</sup> Earthquakes can be the final event that causes the failure of an already structurally unsound dam resulting in catastrophic damage and loss of life downstream.<sup>124</sup>

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114. See *id.* at 78 (examining effect on fish); see also Union of Concerned Scientists, *supra* note 105 (discussing changes existing hydropower plants make to accommodate fish). In Washington several hydropower plants recently had to reduce their output by up to 1000 MW in order to accommodate the migration patterns of endangered salmon. See Union of Concerned Scientists, *supra* note 105 (detailing Washington plant's changes).

115. See McCULLY, *supra* note 33, at 141-42 (exploring negative chemical impact of hydropower).

116. See *id.* (discussing impact of large algae growths associated with conventional hydropower).

117. See WCD, *supra* note 111 (speculating on extent of global warming caused by conventional hydropower).

118. See *id.* (examining effect on human population).

119. See McCULLY, *supra* note 33, at lvii (presenting single example of human displacement).

120. See Associated Press, *Timely Resettlement for Chinese Dam Urged*, N.Y. TIMES, Oct. 15, 1999, at A17 (stating estimations of effect on local populations).

121. See *id.* (quantifying effect large scale hydropower has had on populations).

122. See ORGANIZATION FOR ECONOMIC COOPERATION AND DEVELOPMENT, *supra* note 99, at 80 (citing other risks associated with massive hydropower projects).

123. See *id.* (noting enhanced danger in areas of seismic activity).

124. See *generally id.* (detailing possible danger of dams in seismic areas).

## 2. *Barrage Tidal Power Plants*

Barrage tidal power plants operate by damming incoming tidal water at high tide and then letting it back out through a turbine.<sup>125</sup> These vast structures create sweeping changes that affect navigation, recreation, and the environment in their coastal areas.<sup>126</sup> Since most previous tidal barrage systems were built in estuaries, they had an effect on the breeding zones and migratory paths for many aquatic creatures.<sup>127</sup> The main reason barrage tidal systems did not become widespread was because of the extensive amount of area required in the estuary to hold the necessary amount of water.<sup>128</sup> The dramatic effect on waterfowl as well as the logistics of finding a large enough area to construct the barrage system kept the system from being practical.<sup>129</sup> Tidal barrage systems have such a large impact on the environment that today it would be nearly impossible to get the permits needed to construct them.<sup>130</sup> For example, a proposed commercial scale tidal barrage project planned for the Bay of Fundy in Canada would have altered the tides as far away as Boston.<sup>131</sup>

## 3. *Wind Farms*

The greatest problem with wind power is its negative effect on the human environment.<sup>132</sup> In order to generate an efficient amount of energy, a substantially sized wind farm containing multiple windmills must be built near the coastline where winds are strongest and most consistent.<sup>133</sup> This, however, causes wind farms to compete with other uses such as recreation and tourism, while negatively affecting property values within the surrounding residential communities.<sup>134</sup>

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125. See HAGERMAN, *supra* note 2, at 2 (listing existing tidal barrage plants). The existing examples include plants on the La Rance River in France, the Kislaya Gubskaya in Russia, and the Annapolis Royal Nova Scotia. See *id.*

126. See ORGANIZATION FOR ECONOMIC COOPERATION AND DEVELOPMENT, *supra* note 99, at 82 (exploring environmental impact on coastal zone).

127. See *id.* (stating effect on ocean life).

128. See *id.* (examining large area needed tidal barrage systems).

129. See McCULLY, *supra* note 33, at 232 (discussing large amount of physical space needed to build barrage system).

130. See Davidson, *supra* note 63 (exploring drawbacks to tidal barrage systems).

131. See *id.* (illustrating problems facing tidal barrage systems).

132. See ORGANIZATION FOR ECONOMIC COOPERATION AND DEVELOPMENT, *supra* note 99, at 39 (summarizing problems facing wind power development).

133. See *id.* (discussing ideal situation for wind power plant).

134. See *id.* at 40 (examining opposition to wind farms based on visual intrusion).

Noise pollution from windmills is an additional concern.<sup>135</sup> One study showed that the windmill itself was audible at a distance of 4500 feet upwind, and 7000 feet downwind.<sup>136</sup> It has also been shown the rotors of a windmill can occasionally interfere with television and radio reception.<sup>137</sup> This not only creates an obvious annoyance, but may also cause serious interference problems with vital communications like emergency services or air traffic control.<sup>138</sup> The windmills may create dangerous conditions for surrounding inhabitants by shedding blades in extreme weather or throwing ice from the blades in colder conditions.<sup>139</sup> Due to the nuisance and danger caused by windmills, they can only be constructed in areas that are isolated from residential developments to minimize the detrimental effects on the local population.<sup>140</sup> This isolation requirement for windmills requires the electricity generated by windmills to be transmitted over vast distances in order to reach areas where it can ultimately be used.<sup>141</sup> During this process transmission lines become further congested and energy is lost.<sup>142</sup>

#### 4. Solar Thermal Plants

Solar thermal plants convert heat energy into electrical energy through the use of turbines.<sup>143</sup> There are two different methods: (1) using mirrors to reflect sunlight to a central power tower; and (2) distributing the collectors through a field of receptors.<sup>144</sup> Although solar thermal plants do not create air pollution and are one of the more environmentally friendly renewable energy technologies, they nevertheless create practical and environmental problems.<sup>145</sup>

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135. *See id.* at 41 (outlining noise problems associated with windmills).

136. *See id.* (stressing possible high noise levels).

137. *See* ORGANIZATION FOR ECONOMIC COOPERATION AND DEVELOPMENT, *supra* note 99, at 41 (discussing common problems associated with wind power).

138. *See id.* (highlighting seriousness of interference problem).

139. *See id.* (proposing dangers associated with windmills). While the likelihood of a blade being thrown is extremely small it has occurred in the past. *See id.* A unit on the Isle of Ushant in France threw one of its blades 200 meters and it has been calculated that a windmill could throw its blade up to 850 meters. *See id.*

140. *See* ORGANIZATION FOR ECONOMIC COOPERATION AND DEVELOPMENT, *supra* note 99, at 42 (examining distance required to avoid nuisance from windmill's high noise level).

141. *See* Davidson, *supra* note 63 (describing distance problems).

142. *See id.* (discussing drawback of distance).

143. *See id.* at 27 (summarizing solar power process).

144. *See* ORGANIZATION FOR ECONOMIC COOPERATION AND DEVELOPMENT, *supra* note 99, at 27 (describing different solar power methods).

145. *See id.* at 28-9 (examining environmental impacts of solar power).

The most significant problem with solar thermal power is the large amount of land needed to build a plant.<sup>146</sup> There are few places where such a large amount of land is available, and where the sun is strong enough to support a solar plant.<sup>147</sup> This drawback greatly limits the number of places where a solar plant is feasible.<sup>148</sup> Additionally, all forms of solar energy are severely restricted by the lack of storage capacity.<sup>149</sup> This severely hampers solar thermal energy's commercial viability.<sup>150</sup>

It has also been suggested that due to the vast size of large solar projects, and the large amount of heat these projects create, solar thermal power can affect the local climate.<sup>151</sup> By producing heat waste that is discharged into the atmosphere, solar thermal plants can alter the weather and climate of the surrounding area.<sup>152</sup>

Safety concerns associated with solar thermal plants exist because stray reflected light can severely damage human eyesight.<sup>153</sup> Therefore, a plant must be isolated from population centers to ensure this will not happen.<sup>154</sup> These concerns have significantly limited the commercial appeal of solar thermal power.<sup>155</sup>

#### IV. FEDERAL ENERGY REGULATORY COMMISSION'S EXPERIMENTAL EXEMPTION: THE VERDANT RULINGS

In 2005, FERC issued two rulings that allowed Verdant Power to test its RITE tidal turbines without first obtaining a license from FERC.<sup>156</sup> These rulings, which in the industry came to be known as the Verdant Rulings, removed a major barrier for TISEC devices.<sup>157</sup>

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146. *See id.* at 29 (discussing one major problem with use of solar power).

147. *See* Union of Concerned Scientists, *supra* note 105 (detailing flaws of solar power). Solar power plants require about one square kilometer for every 20-60 MW generated. *See id.*

148. *See id.* (citing large scale of most solar power plants).

149. *See* Andrew C. Revkin & Matthew L. Wald, *Solar Power Captures Imagination, Not Money*, N.Y. TIMES, July 16, 2007, at A1 (exploring drawbacks to solar energy).

150. *See id.* (detailing barriers to solar energy commercialization).

151. *See* ORGANIZATION FOR ECONOMIC COOPERATION AND DEVELOPMENT, *supra* note 99, at 29 (suggesting large scale effects of solar power).

152. *See id.* (indicating effects of influx of heat on weather).

153. *See id.* (discussing human dangers associated with solar power).

154. *See id.* (stating isolation requirement).

155. *See id.* (concluding lack of commercial acceptance due to multiple problems).

156. *See* Verdant Power LLC, 112 F.E.R.C. ¶ 61143 (July 27, 2005) (stating no permit needed for temporary turbines).

157. *See id.* (permitting start of project for Verdant Power).



The Federal Power Act (FPA) gives FERC the authority to license and regulate all traditional hydropower projects in the United States that are located on navigable waters.<sup>158</sup> FERC further determined in its AquaEnergy Group Ltd. decision that the FPA grants FERC the authority to regulate non-traditional hydropower projects as well.<sup>159</sup> In AquaEnergy, FERC found that even though no traditional dam, water conduit, or reservoir existed, it still had authority to license the project because each individual turbine could be considered a “powerhouse” thereby putting them under the jurisdictional language of the FPA.<sup>160</sup>

The FERC process consists of three stages.<sup>161</sup> First, developers must obtain a preliminary permit from FERC.<sup>162</sup> This preliminary permit gives the permit holder priority at the site so it can study the feasibility of the project and line up financing.<sup>163</sup> Second, developers can apply for a license to construct and operate a hydropower project for up to fifty years.<sup>164</sup> Third, once licensed, developers must operate the project in compliance with the terms of FERC’s license.<sup>165</sup> Verdant Power, in complying with the FPA, began its RITE project by applying for a preliminary permit.<sup>166</sup> At first, FERC issued a ruling requiring Verdant to get a license in order to operate its test facilities.<sup>167</sup> FERC cited Section 23(b) of the FPA, which requires hydroelectric facilities to be licensed if their purpose is to “develop electric power.”<sup>168</sup> FERC, however, revised that stance in

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158. See 16 U.S.C. § 817(b) (2000) (granting regulatory power to FERC).

159. See AquaEnergy Group, LTD, 102 F.E.R.C. ¶ 61242 (Feb. 28, 2003) (determining FPA granted FERC power to regulate all forms of hydropower).

160. See *id.* (discussing definition of term powerhouse).

161. See Preliminary Permits for Wave, Current, and Instream New Technology Hydropower Projects, 118 F.E.R.C. ¶ 61,112 (Feb. 15, 2007) (detailing FERC process of licensing hydropower projects).

162. See *Oversight Hearing on Opportunities, Issues, and Implementation of Section 388 of the Energy Policy Act of 2005 Before the Senate Committee on Energy and Natural Resources*, 110th Cong. 4 (2007) (testimony of J. Mark Robinson Directors Office of Energy Projects Federal Energy Regulatory Commission), available at [http://energy.senate.gov/public/\\_files/RobinsonTestimony.pdf](http://energy.senate.gov/public/_files/RobinsonTestimony.pdf) (discussing FERC role in licensing process).

163. See Preliminary Permits for Wave, Current, and Instream New Technology Hydropower Projects, 118 F.E.R.C. ¶ 61,112 (Feb. 15, 2007) (discussing purpose of preliminary permit).

164. See *id.* (detailing purpose of FERC license).

165. See *id.* (stating continued compliance of developer is necessary).

166. See Verdant Power LLC, 67 Fed. Reg. 41,716 (Feb. 11, 2005) (applying for FERC permits).

167. See Verdant Power LLC, 100 F.E.R.C. ¶ 62,162 (Sept. 9, 2002) (approving initial permits for RITE project).

168. See *FERC says Unique Experimental Hydro Project can Supply Power to Two Customers without a License; Kelly Presents Her Own, Unique Interpretation of the Law*,

a later ruling when it laid out three conditions that, if met, would allow a hydroelectric facility to bypass the FPA license requirement.<sup>169</sup> FERC stated Verdant could operate its RITE project if: (1) the technology was experimental; (2) the proposed facilities would be temporary in order to conduct tests for the preparation of a license application; and (3) the power generated was not transmitted into, or displaced from the national electric grid.<sup>170</sup>

FERC found Verdant's original test turbines represented "experimental, tidal-power technology" that would be used for eighteen months to collect data needed for the preparation of a license application.<sup>171</sup> FERC was concerned, however, with Verdant's proposal to provide two customers with power.<sup>172</sup> It stated that if Verdant transmitted power, it needed a license like any other hydropower project.<sup>173</sup> FERC based this on the fact it had previously held that if a hydropower project is connected to the interstate electric power grid and displaces power it is affecting interstate commerce.<sup>174</sup> FERC's test would require a license for any experimental equipment that had any impact on commerce, including the displacement of even the slightest amount of power in the grid.<sup>175</sup> This created a problem for Verdant because the only way Verdant could fully test the tidal turbines was to connect them to the grid so Verdant could effectively study and evaluate the efficiency of the equipment in generating electricity.<sup>176</sup>

Verdant filed a request to modify the FERC ruling.<sup>177</sup> Verdant argued it could comply with FERC's third requirement by: (1) providing the power to the customer free of charge; and (2) compen-

FOSTER ELECTRIC REPORT (Foster Associates, Inc. Bethesda, Md.), Aug. 3, 2005, at 30 [hereinafter *Hydro Project can Supply Power*] (discussing regulatory power of FERC).

169. See Verdant Power LLC, 111 F.E.R.C. ¶ 61024 (Apr. 14, 2005) (discussing Verdant's options).

170. See *Id.* (stating conditions under which Verdant could operate RITE).

171. See *id.* (restricting testing of turbines).

172. See *id.* (discussing impacts on interstate commerce).

173. See *id.* (denying new technology is any different than traditional projects).

174. See Verdant Power LLC, 111 F.E.R.C. ¶ 61024 (Apr. 14, 2005) (*citing* *Year-year Power and Equipment*, 78 F.E.R.C. ¶ 61,172 (1997); *Habersham Mills*, 57 F.E.R.C. ¶ 61,351 (1991), *aff'd*, *Habersham Mills v. FERC*, 976 F.2d 1381 (11<sup>th</sup> Cir. 1992); *Fairfax County Water Authority*, 43 F.E.R.C. ¶ 61,062 (1988)) (holding any activity impacting interstate commerce requires permit).

175. See *Hydro Project can Supply Power*, *supra* note 168 (detailing conflict between ruling and Verdant's plans).

176. See *id.* (discussing structure of Verdant test).

177. See Verdant Power LLC, 111 F.E.R.C. ¶ 61024 (Apr. 14, 2005) (summarizing Verdant's request for clarification or rehearing).

sating Consolidate Edison of New York, Inc. and the New York Power Authority for the power that would be displaced during the test.<sup>178</sup> Verdant argued that as a result of these two steps there would be no economic impact on any entity or on interstate commerce.<sup>179</sup> FERC found this arrangement acceptable and issued a second ruling finding that because Verdant would make the parties whole, its test would have no net impact on the electric grid or on interstate commerce.<sup>180</sup> FERC, therefore, allowed Verdant to test its turbines without being licensed by FERC under the FPA.<sup>181</sup>

This second ruling was a major advance for experimental technology and one that was specifically recognized by Pat Wood, FERC's Chairman at the time.<sup>182</sup> Mr. Wood issued a statement, in conjunction with the ruling, indicating that FERC ruled in this manner to encourage the development of new technologies by making it easier to gain FERC approval.<sup>183</sup> While the ruling removed a significant hurdle for TISEC and other experimental devices, it did not create a blanket exemption or a limited licensing program.<sup>184</sup> FERC stated that it would evaluate a project's need for a license on a case-by-case basis.<sup>185</sup> In fact, much of the current process remained the same after FERC's landmark ruling.<sup>186</sup> The ruling did not create an exception to the requirement that a developer receive all necessary state permits, meet all environmental regulations, and receive a FERC license before constructing a permanent facility.<sup>187</sup>

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178. *See id.* (detailing conditions for Verdant's permit).

179. *See id.* (stating Verdant's reasons turbines should be exempt).

180. *See id.* (holding no impact on interstate commerce).

181. *See id.* (granting exemption to Verdant).

182. *See* Press Release, F.E.R.C., Commission Order Aims to Promote Development of New Submarine Hydropower Technology (Apr. 13, 2005), available at <http://www.ferc.gov/news/news-releases/2005/2005-2/04-13-05-hydro.asp> (detailing FERC ruling). "Today the Commission did its part to encourage the development of new electric generation technologies by providing regulatory relief. We need to ensure that new ideas are fostered and not impeded by existing requirements." *Id.*

183. *See id.* (stating FERC's commitment to new technology).

184. *See* *FERC Looks to Push Hydropower Innovation, Creates Test for Experimentation without License*, INSIDE F.E.R.C., Apr. 18, 2005, at 10 (stating no sweeping change in policy made).

185. *See id.* (maintaining that FERC will evaluate each case individually).

186. *See* DEVINE TARBELL & ASSOCIATES, INC., *INSTREAM TIDAL POWER IN NORTH AMERICA; ENVIRONMENTAL AND PERMITTING ISSUES 3-1 TO 3-2* (June 2006), available at [http://www.epri.com/oceanenergy/attachments/streamenergy/reports/007\\_Env\\_and\\_Reg\\_Issues\\_Report\\_060906.pdf](http://www.epri.com/oceanenergy/attachments/streamenergy/reports/007_Env_and_Reg_Issues_Report_060906.pdf) (listing licensing requirements).

187. *See id.* (discussing other requirements for TISEC project).

## V. FUTURE OF TIDAL ENERGY

There are three general areas that may slow the commercial viability of TISEC technology: (1) regulation; (2) legality; and (3) funding.<sup>188</sup> The Electric Power Research Institute (EPRI) noted how difficult it is for new technologies, in particular TISEC, to get the proper permits and licenses to begin testing.<sup>189</sup> In a report, the EPRI stated:

Because these technologies are untested in the US, there is only information from temporary testing activities and environmental impact studies based on research and comparisons of similar technologies. This will pose more challenges to permitting the initial ocean energy power plants since there is no licensing precedent and the 'novelty of the technology will likely trigger cautious environmental assessments and extensive approval processes.'<sup>190</sup>

## A. Regulatory Issues

Currently, there is an extensive federal regulatory structure in place for a TISEC project, which must safely navigate before the project can be licensed to produce energy.<sup>191</sup> FERC has ultimate authority to oversee the entire process, but it relies on the reports of several other agencies in deciding whether to grant or deny a license.<sup>192</sup> In its considerations, FERC is required by statute to give equal consideration to the energy purposes and the environmental and recreational drawbacks of a project.<sup>193</sup> In order to receive a federal license, a company wishing to install TISEC devices must get the approval of the Army Corp of Engineers (Corps), the state's environmental department, the National Oceanic and Atmospheric Administration (NOAA), the United States Fish and Wildlife Service (USFWS), and the United States Coast Guard (USCG).<sup>194</sup> Ma-

188. For a further discussion of the three areas creating obstacles, see *infra* notes 191-337 and accompanying text.

189. See Esther Whieldon, *FERC's Permitting Process for Tidal and Wave Power Projects Comes Under Fire*, INSIDE F.E.R.C., Dec. 11, 2006, at 1 (examining barriers to TISEC advancement).

190. *Id.*

191. See DEVINE TARBELL & ASSOCIATES, INC., *supra* note 186 (summarizing regulatory structure).

192. See 16 U.S.C. § 817(1) (2000) (outlining agencies reporting to FERC).

193. See 16 U.S.C. § 797(e) (2000) (dictating how FERC is to consider projects).

194. See DEVINE TARBELL & ASSOCIATES, INC., *supra* note 186, at 3-2 (discussing agency requirements for getting permit).

or problems have developed due to the configuration of the current FERC system, but there have been recent efforts to correct those flaws.

1. *Current Process*

The FPA dictates FERC may not approve a license for a hydro-power project unless the Corps has found that the project will not affect the navigational aspects of the waterway.<sup>195</sup> A developer must therefore consult and seek a permit from the Corps before proceeding in the FERC licensing process.<sup>196</sup> Approval under FPA Section 4(e), however, will normally eliminate the need for the developer to obtain a permit from the Corps under Section 10 of the 1899 River and Harbor Act.<sup>197</sup>

While the Corps has yielded some of its authority to other agencies under the FPA, it has not relinquished all of its power.<sup>198</sup> The Corps is still responsible for guaranteeing that Section 404 of the Clean Water Act (CWA) is upheld.<sup>199</sup> That provision mandates that no one discharge dredged material into navigable waters.<sup>200</sup> This provision will be triggered with the installation of a TISEC device; therefore, a project developer must confer with the Corps to receive the proper permit.<sup>201</sup> The Corps is also concerned with the impact that a project might have on historical sites because of its jurisdiction under Section 106 of the National Historic Preservation Act.<sup>202</sup> Of particular interest to TISEC developers is the possibility of shipwrecks in the site area.<sup>203</sup>

Federal law gives state governments a large role in regulating TISEC projects.<sup>204</sup> State environmental departments have authority

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195. See 33 C.F.R. § 221.1(e)(2) (2007) (detailing Corps responsibility).

196. See *id.* (discussing Corps regulatory oversight).

197. See 33 C.F.R. § 221.1(f)(1)(i) (2007) (detailing preemption of River and Harbor Act).

198. See *id.* (holding 404 permit still required).

199. See 33 U.S.C. § 1344 (2000) (assigning Corps to uphold CWA).

200. See US Army Corps of Engineers, Regulatory Program Overview, <http://www.usace.army.mil/cw/cecwo/reg/oceover.htm> (last visited Nov. 5, 2007) (describing Corps' oversight).

201. See *id.* (discussing activities requiring Section 404 permits).

202. See 16 U.S.C. § 470(f) (2000) (requiring protection of historical sites).

203. See Gilbert P. Sperling, Gen. Counsel, Verdant Power Inc., Speech at the Albany Law School Environmental Outlook Journal Symposium: Combating Climate Change, Legal Issues of Alternative Energies (Apr. 18, 2007), available at [http://podcasts.classcaster.org/blog/event\\_podcasts/2007/04/19/environmental\\_outlook\\_symposium\\_combating\\_climate\\_change\\_legal\\_issues\\_of\\_alternative\\_energies](http://podcasts.classcaster.org/blog/event_podcasts/2007/04/19/environmental_outlook_symposium_combating_climate_change_legal_issues_of_alternative_energies) (discussing search for shipwrecks).

204. See 33 U.S.C. § 1341 (2000) (outlining state responsibility).

to regulate a TISEC project through issuing Water Quality Certificates under Section 401 of the CWA.<sup>205</sup> Section 401 dictates a state must issue a Water Quality Certificate before a developer proceeds with a TISEC project.<sup>206</sup> This is because Section 401 prohibits construction or operation of a facility “which may result in any discharge into the navigable waters” without first obtaining a permit from the state.<sup>207</sup>

With the TISEC devices there are several possible problems the state will specifically look at to prevent under its CWA authority.<sup>208</sup> The most important problem the state will seek to prevent is water quality degradation.<sup>209</sup> Water quality degradation could have multiple causes, such as the release of toxins from riverbeds, the introduction of pollutants into the water, temperature change, or a derogatory impact on the surrounding wetlands.<sup>210</sup>

In addition to water quality concerns, NOAA and USFWS are concerned with the health and well-being of the animal life near a TISEC project.<sup>211</sup> Individually, NOAA is responsible for oceanic marine life that would be threatened, and USFWS is concerned with inland wildlife.<sup>212</sup> In particular, both agencies are concerned with threats to endangered species because they are charged with enforcing the Endangered Species Act.<sup>213</sup>

The greatest concern for a TISEC project surrounds the possible harm to marine life.<sup>214</sup> One source of worry about TISEC devices is the possibility that a turbine blade striking a fish could kill or injure it.<sup>215</sup> Under the Marine Mammal Protection Act<sup>216</sup> and the Magnuson-Stevens Fishery Conservation and Management Act,<sup>217</sup> NOAA and USFWS must issue findings to FERC before any

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205. *See id.* (granting state authority to regulate projects).

206. *See id.* (detailing authority of state under CWA).

207. *See id.* (detailing what triggers 401 permit requirements).

208. *See* DEVINE TARBELL & ASSOCIATES, INC., *supra* note 186, at 3-7 (detailing areas CWA is concerned with).

209. *See id.* (highlighting requirements of CWA).

210. *See id.* at 2-22 (discussing possible contamination of water from leaking fluids).

211. *See id.* at 3-9 (detailing responsibility of each government agency).

212. *See id.* (explaining split of authority over wildlife between two agencies).

213. *See* 16 U.S.C. § 1531 (2000) (granting power to protect endangered species).

214. *See* DEVINE TARBELL & ASSOCIATES, INC., *supra* note 186, at 2-11 (specifying possible environmental effects on aquatic life).

215. *See id.* at 2-11 (discussing potential repercussions of striking fish).

216. 50 C.F.R. § 216 (2007).

217. 16 U.S.C. § 1801 (2000).

214 VILLANOVA ENVIRONMENTAL LAW JOURNAL [Vol. XIX: p. 193

hydropower license is approved.<sup>218</sup> This is to ensure that the project does not have a significant impact on the local aquatic life.<sup>219</sup>

In order to prove this was not a problem, Verdant spent over one million dollars to track and count fish in the East River while conducting tests for the RITE project.<sup>220</sup> Testing the environmental effect of TISEC systems on fish can sometimes be unusual. In one British test frozen fish were shot at a piece of metal that was supposed to test the effects of turbine blades would have on fish."<sup>221</sup> For the RITE project Verdant deployed an array of technology to study the fish populations in the East River.<sup>222</sup> It installed a large-scale array of 24 split-beam hydroacoustic transducers as well as a high frequency Dual Frequency Identification Sonar (DIDSON) unit.<sup>223</sup> In addition Verdant's customized software counts every fish that passes near the TISEC turbines.<sup>224</sup>

After the studies, Verdant was finally able to gain approval for the RITE project by showing there was less than one percent chance that a fish would be struck by the turbines.<sup>225</sup> So far, Verdant has shown most fish observed around the RITE project just swim around or through the turbine blades.<sup>226</sup> This has created the new fear, however, that larger fish will hide behind the turbines and pick off smaller fish when they swim through the blades.<sup>227</sup> The

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218. See DEVINE TARBELL & ASSOCIATES, INC., *supra* note 186, at 3-10 (identifying reporting requirements under various federal regulations).

219. See *id.* (emphasizing responsibility of NOAA and USFWS to provide consultation on each project).

220. See *Verdant Proceeds with 'Free-Flow' Hydro Backed by FERC; Gets Equity Investment*, ELECTRIC UTILITY WEEK (Platts, The McGraw-Hill Companies, New York, N.Y.) Sept. 11, 2006, at 8 (discussing expenditures in complying with environmental regulations).

221. Timmons, *supra* note 88, at C1.

222. See Verdant Power, Environmental Monitoring, <http://verdantpower.com/what-environmonitor> (last visited Nov. 5, 2007) (outlining different technology used by Verdant).

223. See *id.* (describing equipment used by Verdant).

224. See *id.* (detailing Verdant's software).

225. See *Environmental Issues Workshop*, *supra* note 34, at 58 (noting probability of fish strike in East River is extremely low).

226. See Anthony DePalma, *East River Fights Effort to Trap Its Currents for Electricity*, N.Y. TIMES, Aug. 13, 2007, at B1 (discussing results of Verdant studies). Verdant tests have shown that a pressure wave forms in front of the turbine blades that the natural pressure-sensing abilities of fish detects and allows the fish to avoid the blades. See NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION, RESPONSE TO COMMENTS ON THE NOTICE OF COMPLETE APPLICATION FOR THE ROOSEVELT ISLAND TIDAL ENERGY PROJECT LOCATED IN THE EAST CHANNEL OF THE EAST RIVER MANHATTAN, NEW YORK/QUEENS COUNTY 3 (2005), available at <http://elibrary.ferc.gov/idmws/common/opennat.asp?fileID=10812832>.

227. See Sperling, *supra* note 203 (discussing new problems with RITE project).

problem now is finding a way that the turbine project does not make more favorable conditions for predators thereby having a negative effect on smaller fish.<sup>228</sup> Verdant, as part of its preliminary permit, agreed to maintain its observation of marine life and continue to resolve the problems that arose.<sup>229</sup>

Another wildlife concern stems from the Migratory Bird Treaty Act,<sup>230</sup> which requires the TISEC project not harm aquatic birds.<sup>231</sup> In order to comply with this requirement, companies must commit hours of observation to local aquatic birds to ensure none of the birds are endangered species that could be affected by the projects.<sup>232</sup> Particularly, the turbines must not interfere with any birds that may dive into the water to catch fish.<sup>233</sup>

Finally, the United States Coast Guard (USCG) must approve any project under the Aids to Navigation Act.<sup>234</sup> This requirement assures a project will not restrict or interfere with waterways.<sup>235</sup> Specifically, the USCG requires that before any developer places a structure in any navigable waters, it must apply for USCG authorization.<sup>236</sup> Generally, the USCG will seek to minimize the impact a project has on navigation and will require that the area around the TISEC project be cordoned off.<sup>237</sup>

Gaining approval for a new TISEC project requires federal, state, and local approvals.<sup>238</sup> The authorizations required by FERC do not even address the required state and local permits, which will also be required.<sup>239</sup> Environmental protections under state law will

228. See *id.* (discussing impact on fish).

229. See *Environmental Issues Workshop*, *supra* note 34, at 58 (detailing future studies).

230. See 16 U.S.C. § 701 (2000) (granting Department of Interior power to protect migratory birds).

231. See DEVINE TARBELL & ASSOCIATES, INC., *supra* note 186, at 3-11 (detailing requirements of act on projects, specifically aquatic birds).

232. See *Environmental Issues Workshop*, *supra* note 34, at 57 (examining requirements for complying with Migratory Bird Act).

233. See Greer, *supra* note 1, at 14 (discussing requirements to prevent harming birds).

234. See 33 C.F.R. § 62 (2007) (enumerating how to notify Coast Guard of any changes to navigable water).

235. See DEVINE TARBELL & ASSOCIATES, INC., *supra* note 186, at 3-12 to 3-13 (discussing waterway requirements of Coast Guard).

236. See 33 C.F.R. § 64.21 (2007) (detailing marking and notification requirements).

237. See New York State Department of Environmental Conservation, DEC Permit Application Detail, available at <http://www.dec.ny.gov/cfm/xtapps/entapps/index.cfm?view=detail&applid=602183> (last visited Nov. 5, 2007) (detailing USCG requirements for RITE project).

238. See *Speed Bumps*, *supra* note 247 (discussing permitting process).

239. See *id.* at 3-1 (introducing various permits that may be required).



216 VILLANOVA ENVIRONMENTAL LAW JOURNAL [Vol. XIX: p. 193

likely require a similar process to the federal one.<sup>240</sup> TISEC developers fear that the cumbersome permit process, and its associated cost, will inhibit investment.<sup>241</sup> The costs during this study period can also be overbearing for a startup company.<sup>242</sup> Verdant, for example, has spent four and a half million dollars performing studies to comply with the requirements of a licensing application.<sup>243</sup> The total cost so far for Verdant's RITE project has been twenty million dollars, meaning that the studies alone represent almost twenty-five percent of the total project cost.<sup>244</sup> For a traditional hydropower project the same study costs generally represents only two to five percent of the project total.<sup>245</sup> Investors may avoid TISEC projects all together and instead turn to more established energy production methods with proven financial returns.<sup>246</sup> It is likely that the current process with its long and daunting regulatory process could easily derail a TISEC project.<sup>247</sup>

## 2. Future Process

The most serious problem for TISEC and other emerging technologies is that the current regulatory scheme was developed to deal exclusively with traditional hydropower facilities.<sup>248</sup> Therefore, the current regulatory process is, as stated by the Chief Executive of Verdant Power: "extremely biased towards doing nothing."<sup>249</sup> The process of obtaining a FERC license weighs against new and experimental technology because regulators are often fearful of the dangers created by unknown and unique energy technologies.<sup>250</sup>

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240. See *id.* at 3-28 to 3-42 (summarizing Massachusetts' and Maine's permit requirements).

241. For a further discussion of funding issues, see *infra* notes 292-337 and accompanying text.

242. See Sperling, *supra* note 203 (discussing challenges facing TISEC projects).

243. See *id.* (stating cost of Verdant in complying with regulations).

244. See *id.* (calculating cost of reports compared to total costs).

245. See *id.* (comparing RITE project to typically traditional hydropower projects).

246. See Michael Schmidt, *Panel Told Ocean Energy Technologies Face 'Almost Insurmountable' Hurdle*, INSIDE ENERGY (Platts, The McGraw-Hill Companies, New York, N.Y.), Sept. 25, 2006 at 7 (indicating investors favor proven projects like wind over newer ones such as TISEC).

247. See *Speed Bumps on the Road to Commercialization (Speed Bumps)*, IN BUSINESS, May-June 2005, at 16 (discussing multiple hurdles that must be overcome for TISEC to reach commercialization).

248. See *id.* (discussing reasons for complex regulatory structure).

249. Timmons, *supra* note 88.

250. See *id.* (examining reasons for new technology bias).

Meeting the current regulatory requirements of state and federal agencies can be a daunting task for companies wishing to pursue tidal power.<sup>251</sup> The current process requires a developer to plan up to seven years in advance before submitting a license application.<sup>252</sup> For a start-up company it is very likely that having to wait seven years before becoming operational will result in its money drying up.<sup>253</sup> The new and unfamiliar technology made it difficult for Verdant to get the needed operational tests permitted.<sup>254</sup> For example, in order to get two test turbines into the East River, Verdant had to address eighty-seven distinct environmental issues and produce nearly 2000 pages of written reports.<sup>255</sup> The sheer amount of approvals that must be obtained creates a nearly insurmountable hurdle for developers.<sup>256</sup>

The other major problem with the current FERC process is that a sort of “land grab” effect has occurred.<sup>257</sup> Developers have attempted to claim as many promising sites as possible by applying for multiple preliminary permits.<sup>258</sup> This site banking was due to the fact that a preliminary permit from FERC was relatively easy to obtain and gave the holder an exclusive right to develop the site.<sup>259</sup> This problem exploded in 2005 when EPRI issued its comprehensive report on the amount of energy TISEC devices could extract from sites around the United States.<sup>260</sup> Once developers learned TISEC could almost immediately be competitive with conventional

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251. See *Field Hearings*, *supra* note 3 (statement of Michael Bahleda, President, Bahleda Management and Consulting, LLC) (discussing extent of permits required for projects).

252. See Sperling, *supra* note 203 (criticizing FERC process). A developer must begin its consultations and studies on a hydropower project five to five and a half years before submitting a license application and then wait an additional two years before FERC issues a license. See *id.*

253. See *id.* (stating start-up companies have limited financial resources).

254. See *Environmental Issues Workshop*, *supra* note 34, at 10 (comparing regulations for new technology to conventional hydropower).

255. See *id.* (emphasizing extent of regulations).

256. See *Speed Bumps*, *supra* note 247 (summarizing institutional prejudices in gaining funding).

257. See *Tidal Energy Turf War* (New Hampshire Public Radio (NHPR) broadcast July 16, 2007), available at <http://www.nhpr.org/node/13473> (comments of Robert Cupina, FERC Deputy Director for the Office of Energy Projects) (discussing problems associated with land grab).

258. See *Developer asks FERC to Deny Preliminary Permits to Questionable Tidal Energy Projects (Developer asks FERC)*, FOSTER ELECTRIC REPORT, (FOSTER ASSOCIATES, INC. Bethesda, M.D.), Aug. 2, 2006, at 23 (stating developers have abused the process).

259. See *Preliminary Permits for Wave, Current, and Instream New Technology Hydropower Projects*, 118 F.E.R.C. ¶ 61,112 (Feb. 15, 2007) (detailing characteristics of preliminary permit).

260. See HAGERMAN, *supra* note 2 (estimating potential of TISEC).

sources, it peaked developers' interest in each promising site contained in the EPRI report.<sup>261</sup> Developers began to take advantage of the FERC process and secure sites right away.<sup>262</sup> Some original requests were extremely broad, asking for entire coastlines or entire counties.<sup>263</sup> Some have speculated that certain developers are trying to gain control of a site only to auction it off later to the highest bidder.<sup>264</sup> Verdant, along with other TISEC developers, the Ocean Renewable Energy Coalition, and Morgan Stanley, submitted complaints to FERC about the current process.<sup>265</sup> They asked FERC to review its temporary licensing process because it was preventing serious developers from possibly developing the same sites without first paying so called 'ransom' fees.<sup>266</sup> Verdant asked FERC to require a showing of viable technology before issuing a preliminary permit.<sup>267</sup> The fear was that if FERC continues to issue preliminary permits to companies not prepared to develop the sites, it would cause another unnecessary delay in the development of TISEC.<sup>268</sup> More importantly, such delays may even discourage investors who may not wish to invest money into TISEC companies because they realize all the prime sites have already been claimed.<sup>269</sup>

In response to comments that the FERC licensing process was weighted against new hydro-technology and the criticism over possible site banking, FERC re-evaluated its permitting process.<sup>270</sup> In 2007, FERC decided to apply an interim approach of strict scrutiny to all applications.<sup>271</sup> In this approach, FERC will process new per-

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261. See *OnPoint: Renewable Energy: Tidal power experts discuss technological advancements, roadblocks to implementation* (E&ETV Mar. 22, 2007), available at [www.eenews.net/tv/transcript/586](http://www.eenews.net/tv/transcript/586) (statement by Mr. George Hagerman, senior research associate at the Virginia Tech Advanced Research Institute and member of EPRI's Ocean Energy Project Team) (discussing start of land grab phenomenon).

262. See *id.* (discussing rush to secure sites).

263. See NHPR, *supra* note 257 (discussing permit applications).

264. See *Developer asks FERC*, *supra* note 258 (analogizing illegitimate power companies to past technology companies who registered domain names and sold at premium during internet boom).

265. See NHPR, *supra* note 257 (citing wide range of complaints about current process).

266. See *id.* (discussing fear that companies may hinder legitimate development of TISEC).

267. See *id.* (exploring solutions to illegitimate permitting).

268. See *id.* (detailing concern of companies seeking to advance TISEC technology that they will have to compete with companies merely holding sites).

269. See *id.* (speculating on long term effects of site banking).

270. See Michael Burhnam, *Entrepreneurs Start Testing Waters for Offshore Hydro-power*, GREENWIRE, Mar. 2007, available at [http://eenews.net/special\\_reports/new\\_wave/](http://eenews.net/special_reports/new_wave/) (discussing FERC response to land grab issue)

271. See *id.* (detailing FERC decision to revamp permit process).

mit requests with an attempt to limit the boundaries of the sites and prevent site banking.<sup>272</sup> FERC has also begun to require progress reports and projected schedules from permit holders, and FERC can cancel a permit if progress is not shown.<sup>273</sup> FERC also proposed a goal to establish a fast track licensing process for new hydropower technology.<sup>274</sup> This fast track process would be available for new technology projects that are five megawatts or smaller, removable on short notice, and located in waters without environmental concerns; the process would allow them to be licensed in as few as six months.<sup>275</sup> FERC would wave some pre-application studies and would instead require monitoring during the license term.<sup>276</sup> The new process would allow developers to test new technology by installing it and connecting it to the national electric grid while eventually leading to a pilot license for the project.<sup>277</sup>

## B. Legal Issues

Other forms of renewable energy have run into long, difficult, and costly legal battles that have hindered efforts to produce clean energy.<sup>278</sup> A prime example is the litigation surrounding the Cape Wind project.<sup>279</sup> First hailed as an exciting and landmark project that would rival developments in Europe, the Cape Wind project quickly became synonymous with litigation, environmental protests, and setbacks.<sup>280</sup> In 2001, Cape Wind Associates began looking to

272. See *New York Tidal Energy Company*, 119 F.E.R.C. ¶ 62,175 (May 31, 2007) (discussing new strict scrutiny approach).

273. See *id.* (discussing requirements of new permits).

274. See Press Release, F.E.R.C., Commission Announces Pilot Project Licensing Process for New Hydropower Technologies (July 19, 2007), available at <http://www.ferc.gov/news/news-releases/2007/2007-3/07-19-07-hydro.asp> (proposing new process for permits).

275. See *id.* (detailing proposed FERC permit process).

276. See F.E.R.C., THE PROPOSED LICENSING PROCESS FOR HYDROKINETIC PILOT PROJECTS: A FRAMEWORK FOR DISCUSSION 3 (2007), available at <http://www.ferc.gov/EventCalendar/Files/20070904090801-white-paper.pdf> (outlining FERC proposals). FERC drafted this white paper to lay out its initial policy towards experimental hydro-technologies and, in anticipation of the Hydrokinetic Technologies Pilot Project Workshop FERC held on Oct 2, 2007, to serve as a starting point for discussions of what FERC's future policy should consist of. See *id.*; see also Federal Energy Regulatory Commission, Hydrokinetics, <http://www.ferc.gov/industries/hydropower/indus-act/hydrokinetics.asp> (last visited Nov. 5, 2007) (presenting FERC policy toward TISEC technology).

277. See *id.* (discussing similarities to Verdant Rulings).

278. See Beth Daley, *On the Horizon?*, BOSTON GLOBE, Oct. 15, 2006, at 1B (indicating that Cape Wind has become controversial public works project).

279. See *id.* (examining divisive issues surrounding Cape Wind).

280. See Scott Kirsner, *Sound Decisions*, BOSTON GLOBE, Dec. 17, 2001, at C1 (outlining past legal history of Cape Wind). "Opponents worry the windmills

build a \$600 million wind farm in Nantucket Sound off the coast of Massachusetts.<sup>281</sup> When the idea was first proposed, there was no question Nantucket Sound made sense for a wind farm.<sup>282</sup> Its gusty coastline presented perfect conditions to recreate wind farms like those off the coast of Denmark, where wind energy has become a key component of the country's electric grid.<sup>283</sup> Those perfect conditions quickly changed, however, due to legal and political challenges initiated by area residents and environmental groups.<sup>284</sup>

While the Cape Wind project has survived the legal challenges brought against it so far, there is no question it has been a costly battle.<sup>285</sup> Gaining public support and overcoming lawsuits when the majority of the local community is against the project is a difficult task and it can be difficult to overcome for a small startup company looking to develop new technology.<sup>286</sup> The risk of costly litigation is lower for TISEC projects mainly because TISEC devices have little to no effect on the local aesthetics, reducing the "not in my back yard" phenomenon.<sup>287</sup> In fact, Verdant Power's RITE project has had the support of the Roosevelt Island community.<sup>288</sup> At one point, when New York state officials were slow in approving the necessary permits, the president of the Roosevelt Island Residents Association told Verdant: "[y]ou just give us the word and we're going to Albany on buses to get that permit for you. We want this

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could serve as pole-mounted Cuisinarts for seabirds. They believe they'd be an eyesore for those on land, especially at night, when they'll be illuminated to warn off boats and aircraft. They're concerned about the windmill farm being abandoned if Cape Wind can't make money on it, or after the windmills' useful life ends in about 25 years." *Id.*

281. *See id.* (providing background to Cape Wind development).

282. *See* Jeffrey Krasner, *Offshore Wind Farm Blows into Cape View*, BOSTON GLOBE, July 28, 2001, at A1 (speculating Nantucket Sound project could meet majority of energy needs for Cape Cod region and would establish Massachusetts as world leader in renewable power).

283. *See* Donald MacGillis, *Powerful Wind*, BOSTON GLOBE, June 13, 2005, at A14 (discussing benefits of Denmark's wind power).

284. *See* Rick Klein, *Mass. is Urged to Lead the Way on Wind Farms*, BOSTON GLOBE, June 3, 2006, at A1 (highlighting legal and political battles that derailed Cape Wind project).

285. *See* Ten Taxpayers Citizen Group v. Cape Wind Assocs., LLC, 373 F.3d 183, 190 (1st Cir. 2004) (detailing resident action against Cape Wind developers over project's failure to receive permit from Commonwealth of Massachusetts before beginning construction); *see also* Alliance to Protect Nantucket Sound Inc. v. U.S. Dep't of the Army, 398 F.3d 105 (1st Cir. 2003) (describing activist group argument that Corps of Engineers was required to circulate Environmental Assessment report for public comment before issuing permit to Cape Wind).

286. *See* Shaw, *supra* note 66 (discussing importance of community approval).

287. *See id.* (detailing benefits of TISEC).

288. *See id.* (showing benefits of community support to RITE project).

power project in our backyard.”<sup>289</sup> This does not mean litigation is completely avoidable; it is possible that environmental groups or shipping companies might challenge a large scale TISEC project.<sup>290</sup> As Cape Wind has shown, however, support or lack thereof from the local community can greatly affect the timeline of a project.<sup>291</sup>

### C. Funding Issues

Inadequate funding is perhaps the most debilitating barrier to TISEC commercialization.<sup>292</sup> Without funding, there is little hope companies will be able to build and test prototypes and develop competitive technology.<sup>293</sup> Wind power serves as a good historical guide to the effects of proper funding for an emerging technology.<sup>294</sup> In 1980, wind energy cost twenty-five cents per kilowatt hour (kWh).<sup>295</sup> Today it costs as low as four and a half cents per kWh.<sup>296</sup> The current cost of tidal energy is approximately six to eight cents per kWh, but with proper funding to enable further TISEC research, that cost could significantly decrease.<sup>297</sup> There are three possible sources of funding: the federal government, state governments, and private investment.<sup>298</sup> Each source is important to the general scheme of researching and developing TISEC technology.<sup>299</sup>

In order to get TISEC off the ground, the technology will require not only an easier licensing process from the federal govern-

289. *Id.*

290. See Letter from Wayne Huebschman, Port Captain, Express Marine Inc., to FERC (Apr. 20, 2007), available at <http://elibrary.ferc.gov/idmws/common/opennat.asp?fileID=11333290> (outlining possible navigational problems with RITE project).

291. See Klein, *supra* note 284 (discussing opposition to Cape Wind).

292. See *Environmental Issues Workshop*, *supra* note 34, at 10 (discussing lack of capital formation and funding for research and development).

293. See *id.* (describing costs associated with developing and testing prototypes).

294. See *Field Hearings*, *supra* note 3 (statement of Sean O’Neil, President, Ocean Renewable Energy Coalition) (drawing comparison between wind and tidal power).

295. See *id.* (citing cost of wind energy).

296. See *id.* (discussing reduced cost when technology matures).

297. See *Field Hearings*, *supra* note 3 (statement of Sean O’Neil, President, Ocean Renewable Energy Coalition) (predicting same reduction in cost for TISEC); see also DePalma, *supra* note 226 (discussing cost of electricity produced by RITE).

298. See Timmons, *supra* note 88, at C1 (noting success of projects depends on variety of funding sources).

299. See *id.* (discussing importance of adequate funding).

ment, but also help in funding research and development.<sup>300</sup> Investments from governments have already occurred overseas, where the British Government invested more than \$47 million into research and development of ocean energy.<sup>301</sup> The British Government also invested an additional \$93 million to advance the technology from the research stage to the commercial stage; there has already been a call for the United States to match The British Government's aggressive actions.<sup>302</sup>

The United States Government has, thus far, provided only limited financial support to the development of tidal energy technology.<sup>303</sup> The Energy Policy Act of 2005 instructed the Department of Energy to make incentive payments to renewable energy producers, and tidal energy was, for the first time, included on the list of production types eligible.<sup>304</sup> Unfortunately, these incentives have done little to help develop the technology and instead focus on helping existing energy production methods to maintain their current production.<sup>305</sup> The Department of Energy only pays incentives once the technology is up and running, producing electricity for general consumption.<sup>306</sup> More federal money is needed, however, for research and development purposes in order to bring the technology to the point where it can be effectively commercialized.<sup>307</sup>

The Bush Administration took a step backwards in assisting new forms of hydropower, in its original 2007 Federal Budget.<sup>308</sup>

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300. *See id.* (explaining utility companies will not invest until technology is useable).

301. *See id.* (detailing British investment in TISEC).

302. *See id.* (comparing British and United States Government investment in TISEC). Representative William D. Delahunt of Massachusetts has proposed that the United States build an ocean energy research center off the Massachusetts coast, much like the one already operating in Britain. *See id.* Likewise, Representative Jay Inslee of Washington has led the charge to give greater financial support to tidal energy. *See* Press Release, Jay Inslee, Inslee Supports Energy Package He Helped Shape (Aug. 4, 2007), available at [http://www.house.gov/apps/list/press/wa01\\_inslee/pr\\_070804\\_energypackage.shtml](http://www.house.gov/apps/list/press/wa01_inslee/pr_070804_energypackage.shtml) (detailing efforts of Inslee in advocating tidal energy).

303. *See* Mark Clayton, *US to Cut Funds for Two Renewable Energy Sources*, CHRISTIAN SCIENCE MONITOR, Sept. 15, 2006, at 2 (discussing past federal monies granted to small hydropower projects).

304. *See* 42 U.S.C. § 15851 (2000) (amending Energy Policy Act of 1992, 42 U.S.C. § 13317(a)) (creating subsidies for TISEC technology).

305. *See id.* (outlining incentives for active hydropower projects).

306. *See id.* (listing federal appropriations for assessment of renewable energy sources).

307. *See Speed Bumps*, *supra* note 247 (citing financial needs of TISEC).

308. *See* Clayton, *supra* note 303 at 2 (discussing fact that most TISEC is not developed to extent where private utility companies will purchase energy).

Declaring hydropower a “mature technolog[y]” that needed no further federal funding, the administration eliminated funding for hydropower research.<sup>309</sup> A Department of Energy spokeswoman justified the elimination by writing: “[t]ough choices had to be made, and we had to realign priorities. . . . Some programs within the energy-efficiency budget have reached a point to be considered mature technologies” that no longer warranted funding.<sup>310</sup> At the same time the Department of Energy will spend nearly \$600 million on fossil fuel research and development in 2007, including \$427 million on coal, which is the greatest contributor to greenhouse gases.<sup>311</sup> With the shift of control in Congress after the November 2006 elections, the Democrats made funding renewable energy projects a priority.<sup>312</sup> In 2007, Congress passed a bill authorizing \$50 million a year in funding for tidal energy research.<sup>313</sup>

Even with newfound federal support, however, state funding may become the most important avenue for TISEC funding.<sup>314</sup> It is easier for a developer to receive funding from a state government rather than the federal government; this makes state funding a more attractive option to start-up projects with a limited lobbying budget.<sup>315</sup> State governments are often more interested in seeing the development of new technologies in their locality because of the probability that it may create more jobs for the state.<sup>316</sup>

State governments have already shown they are willing to take the lead in financing TISEC and other new forms of energy generation technology.<sup>317</sup> Many states have been open to supplying grants to companies that are researching new forms of energy.<sup>318</sup> For example, Verdant Power received a two and a half million dollar grant from the New York State Energy Research & Development Author-

309. *See id.* (describing budget provisions).

310. *Id.*

311. *See* Revkin, *supra* note 149 (detailing Department of Energy expenditures).

312. *See* Steven Mufson, *Pelosi Plans Informal Negotiations on Energy Bill*, WASHINGTON POST, Oct. 11, 2007, at A06 (stating Democratic leaders consider energy legislation a priority). Speaker Pelosi stated she still considered energy legislation a “top priority” after Republican leaders blocked an effort to establish a conference committee in order to merge the energy bills that were passed by the House and Senate. *See id.*

313. *See* H.R. 6, 110th Cong. § 292(c) (as passed by House, Jan. 18, 2007) (appropriating funds to tidal research).

314. *See* *Speed Bumps*, *supra* note 247 (discussing past and future state funding of TISEC projects).

315. *See id.* (examining solutions to TISEC funding problems).

316. *See id.* (exploring benefits of TISEC to local economy).

317. *See id.* (detailing past state funding of TISEC projects).

318. *See id.* (discussing active role states take in providing funding).



ity for its East River project.<sup>319</sup> States have also started using a market-based system called Renewable Portfolio Standard (RPS) to fund new renewable energy technologies.<sup>320</sup> RPS requires that a certain percentage of the state's electricity is generated by renewable sources.<sup>321</sup> Utilities can either use renewable energy sources themselves or purchase credits from other companies.<sup>322</sup>

Private investment is the final and crucial area where TISEC can find funding.<sup>323</sup> While state and federal grant programs are important to jumpstart TISEC, private investment will ultimately bring TISEC technology to a point where it is fully commercially viable.<sup>324</sup> Currently, the basic problem, according to Mike Bahleda of the Electric Power Research Institute, is that TISEC technology is not yet "developed enough for the typical utilities to make an investment; the technologies do not meet their performance standards for return."<sup>325</sup> Private investors are, however, starting to notice the promising future of TISEC.<sup>326</sup>

Large commercial power companies have shown the most potential as private investors as they are beginning to recognize the possibilities for tidal energy.<sup>327</sup> Recently, General Electric (GE), Norsk Hydro (a major Norwegian power company), and E.ON (a large German utility company) all have pledged money for small ocean power projects.<sup>328</sup> As Mark Huang, GE's Senior Vice President for Technology Financing explained: "[tidal power] is an untapped renewable energy source. . . there is no where to go but up."<sup>329</sup>

The most recent influx of investment has been from a form of venture capital investments called "clean tech." These investments are made in companies seeking to develop environmentally friendly technology, including companies developing new forms of renewa-

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319. See ELECTRIC UTILITY WEEK, *supra* note 220, at 8 (noting state's financial support of renewable energy); see also *East River Turbines*, CONSTRUCTIONEER, June 6, 2006, at 8 (detailing costs of East River project); see also Greer, *supra* note 1, at 13 (discussing funding issues for new projects).

320. See *Speed Bumps*, *supra* note 247 (explaining procedure of RPS).

321. See *id.* (detailing requirements of RPS).

322. See *id.* (stating options available to utility companies).

323. See *id.* (discussing private funding options).

324. See *id.* (examining importance of private investment).

325. *Speed Bumps*, *supra* note 247.

326. See *id.* (detailing promising future of private investment).

327. See Timmons, *supra* note 88 (discussing institutional investors).

328. See *id.* (listing past investments by large utility companies).

329. *Id.* (discussing potential for TISEC technology).

ble energy.<sup>330</sup> The prospect of investing in environmentally progressive companies has attracted some notable and serious investors who are not looking to make an ideological statement but rather to make smart investments that will eventually offer returns.<sup>331</sup>

The growth in “clean tech” has been substantial.<sup>332</sup> In 2005, there was \$1.6 billion invested in environmentally conscious companies.<sup>333</sup> In 2006, that amount grew to a record \$3.6 billion.<sup>334</sup> This increase made “clean tech” the fifth-largest venture capital investment category in the United States.<sup>335</sup> Even Verdant Power’s RITE project has benefited from “clean tech” investments.<sup>336</sup> In 2007, Boston-based Tudor Investment Group has committed \$15 million to Verdant Power.<sup>337</sup>

## VI. CONCLUSION

In light of the mounting problems associated with fossil fuels, TISEC is an attractive alternative due to its versatility and limited environmental impact.<sup>338</sup> If the funding, regulatory, and legal barriers are removed or made more easily avoidable, it is possible that TISEC could be commercially viable in the near future.<sup>339</sup> The potential energy TISEC could provide is significant enough and the technology is simple enough that an overly burdensome regulatory process and lack of funding would be a grave mistake.<sup>340</sup> TISEC

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330. See *Speed Bumps*, *supra* note 247 (summarizing idea of investing in clean technologies).

331. See *Green is good; Investors See Money in Energy-Saving Technologies*, THE TIMES (LONDON), Oct. 28, 2006, at 23 (detailing growth of venture capital for renewable energy).

332. See Press Release, Cleantech Venture Network, 2006 European and North American Cleantech Venture Investment Totals \$3.6 Billion (Feb. 15, 2007), available at <http://cleantech.com/index.cfm?pageSRC=PressReleases> (extolling benefits of environmentally friendly venture capitalism).

333. See Tom Henderson, *Cleantech Becomes Catalyst*, CRAIN’S DETROIT BUSINESS, Nov. 20, 2006, at 13 (discussing growth in environmentally friendly venture capital).

334. See Cleantech Venture Network, *supra* note 332 (explaining company goal).

335. See THE TIMES (LONDON), *supra* note 331 (comparing environmentally friendly venture capital to rest of market).

336. See Shaw, *supra* note 66 (discussing private investment in RITE project).

337. See *id.* (detailing investment by Tudor in RITE).

338. See DEVINE TARBELL & ASSOCIATES, INC., *supra* note 186, at 2-1 (discussing predicted environmental impact of TISEC devices).

339. See N.Y. Times video, *supra* note 9 (documenting practicality of Verdant’s East River TISEC project).

340. See *Field Hearings*, *supra* note 3 (statement of Sean O’Neil, President, Ocean Renewable Energy Coalition) (discussing future possibility of ocean energy).

226 VILLANOVA ENVIRONMENTAL LAW JOURNAL [Vol. XIX: p. 193

could begin a wave of environmentally friendly energy production that could slowly phase out fossil fuels and improve the environment, while never sacrificing performance.

*Michael B. Walsh*

## THE ENVIRONMENTAL HEARING BOARD REVIEW

The Villanova Environmental Law Journal is proud to continue the Environmental Hearing Board Review. The Review provides Casenotes and Comments reflecting upon decisions of the Pennsylvania Environmental Hearing Board and areas of the law pertinent to practitioners before the Board. The Review seeks to contribute to the practice of and to promote the scholarship of environmental law in Pennsylvania.

Consisting of five appointed judges, the Environmental Hearing Board is a statutorily created agency with state-wide trial court jurisdiction over certain environmental cases and appellate jurisdiction over actions of the Department of Environmental Protection. Appeals from the Board are taken to the Commonwealth Court of Pennsylvania.

