

| Turbine | Country | Diameter | | Swept Area m ² | Power kW* | Specific Power W/m ² | No. of Blades | Rotor Orientation | Control | Approx Date Installed |
|--------------|---------|----------|----|------------------------------|--------------|---------------------------------------|------------------|-------------------|---------|--------------------------|
| | | m | ft | | | | | | | |
| Enertech | USA | 4.0 | 13 | 12 | 1.5 | 122 | 3 | downwind | stall | 1975 |
| Jacobs** | USA | 4.3 | 14 | 14 | 3 | 210 | 3 | upwind | pitch | 1976 |
| Riisager | Denmark | 10 | 33 | 79 | 22 | 280 | 3 | upwind | stall | 1976 |
| Kuriant | Denmark | 9 | 30 | 64 | 11 | 173 | 3 | downwind | stall | 1977 |
| NIVE | Denmark | 10 | 33 | 79 | 22 | 280 | 3 | upwind | stall | 1978 |
| Mehrkam | USA | 12.2 | 40 | 117 | 40 | 342 | 4 | downwind | stall | 1978 |
| Carter | USA | 10 | 33 | 79 | 25 | 318 | 2 | downwind | stall | 1979 |
| HVK | Denmark | 10 | 33 | 79 | 22 | 280 | 3 | upwind | stall | 1979 |
| US Windpower | USA | 12.2 | 40 | 117 | 30 | 257 | 3 | downwind | pitch | 1980 |
| HVK-Vestas | Denmark | 15 | 49 | 177 | 55 | 311 | 3 | upwind | stall | 1980 |
| Bonus | Denmark | 15 | 49 | 177 | 55 | 311 | 3 | upwind | stall | 1981 |

*Rated at 60 Hz in the USA, 50 Hz in Denmark. **Reused.

er was building for several years (see Table 4-2. Wind Turbines Independently Developed in the Mid-1970s to early 1980s).

Meanwhile, Riisager's turbines and those of competitors were steadily growing in size as well as number. This would have a significant effect on later Danish energy policy because wind turbines were now producing commercial quantities of electricity. By 1979 there were 24 wind turbines operating in Denmark, representing more than 700 kW. Of these, three-fourths were Riisager's.

Although a direct descendant of Juul's Gedser design, the configuration used by Riisager and his imitators presented technical challenges that limited its ability to be scaled-up further. The passive fantails didn't allow direct control of the turbine's yaw. Though simple, they didn't permit the operator to turn the turbine out of the wind when needed, for example, to service the machine. Similarly, the rotor was weak if the nacelle swung around downwind of the tower. Though there were some 200 Riisager and derivative turbines operating in California alone in 1985 (see Figure 5-25. Struts and stays), the design had reached a dead end. Further progress awaited steps being taken elsewhere on Denmark's Jutland Peninsula.

Tvindkraft: The Giant That Shook the World

Those around in the late 1970s may remember seeing magazine photographs of Danish

students and volunteers carrying a massive wind turbine blade out of a tent (see Figure 4-12. Tvind people power). That photo captured the world's imagination. It was one of those rare historical moments that became a beacon to citizens everywhere who wanted to develop renewable energy by themselves, for themselves, and for their community's benefit.

Yes, they were not ordinary students. They were on a mission, and they knew at the time they were



Figure 4-12. Tvind people power. The photo seen around the world in 1978 as students at the Tvind School carry one of the wind turbine blades from its assembly hall to the wind turbine. The action sent a political message: Together we are strong. We want wind power and we will build it ourselves. (Tvind School)