Rechargeable power source for electric vehicles

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Introduction

The goal of the research is to find optimal energy storage devices that are well suited for electric vehicles. The initial stage of the research is to compare several secondary batteries, generally known as rechargeable batteries, relative to their discharge performance. Characterizing these secondary batteries will provide the knowledge to begin researching hybrid power sources which call for rechargeable batteries. More frequently used batteries were chosen as well as some newer and less common batteries.

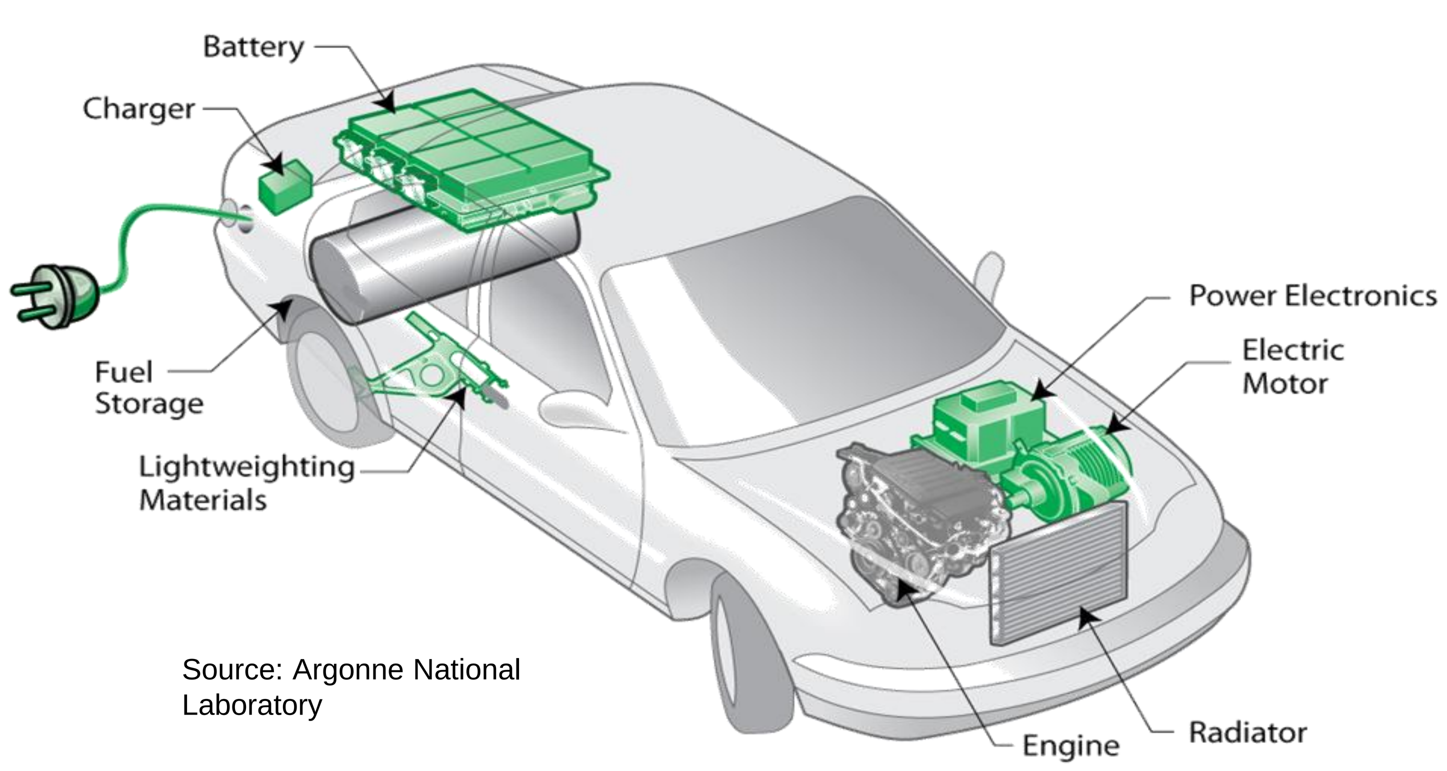

Fig. 1. Plug-in hybrid electric vehicle (PHEV) diagram

Experimental Design

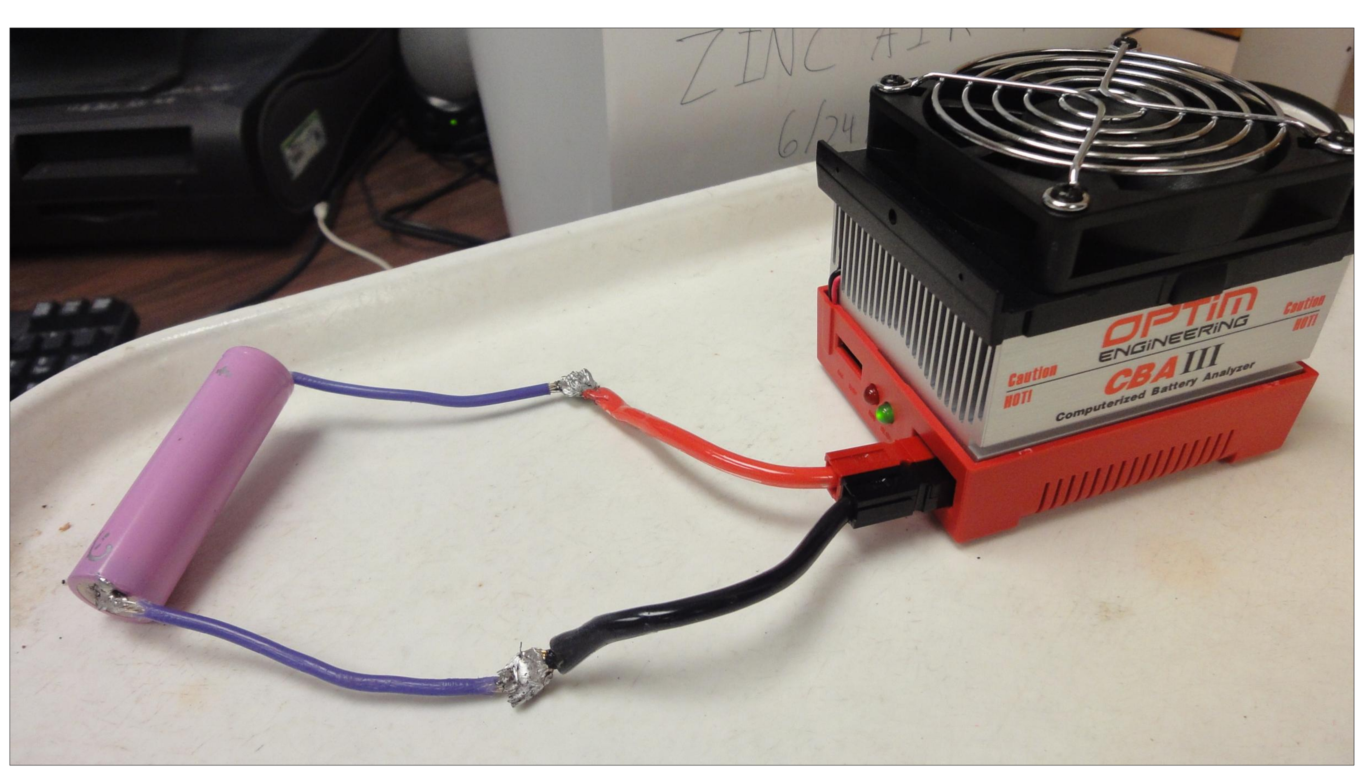

Fig. 2. Discharge of the lithium cobalt battery

The batteries are put through charge cycles using the Turnigy Accucell 6. The batteries are discharged and monitored by the West Mountain Radio Computerized Battery Analyzer III, which records the voltage of the battery every second. The voltage is then plotted against the capacity, which is the product of the discharge current and time.

MATLAB is used to analyze the plots. The area under the curves determine the energy during discharge. The average voltage is used to find the average power supplied.

Results

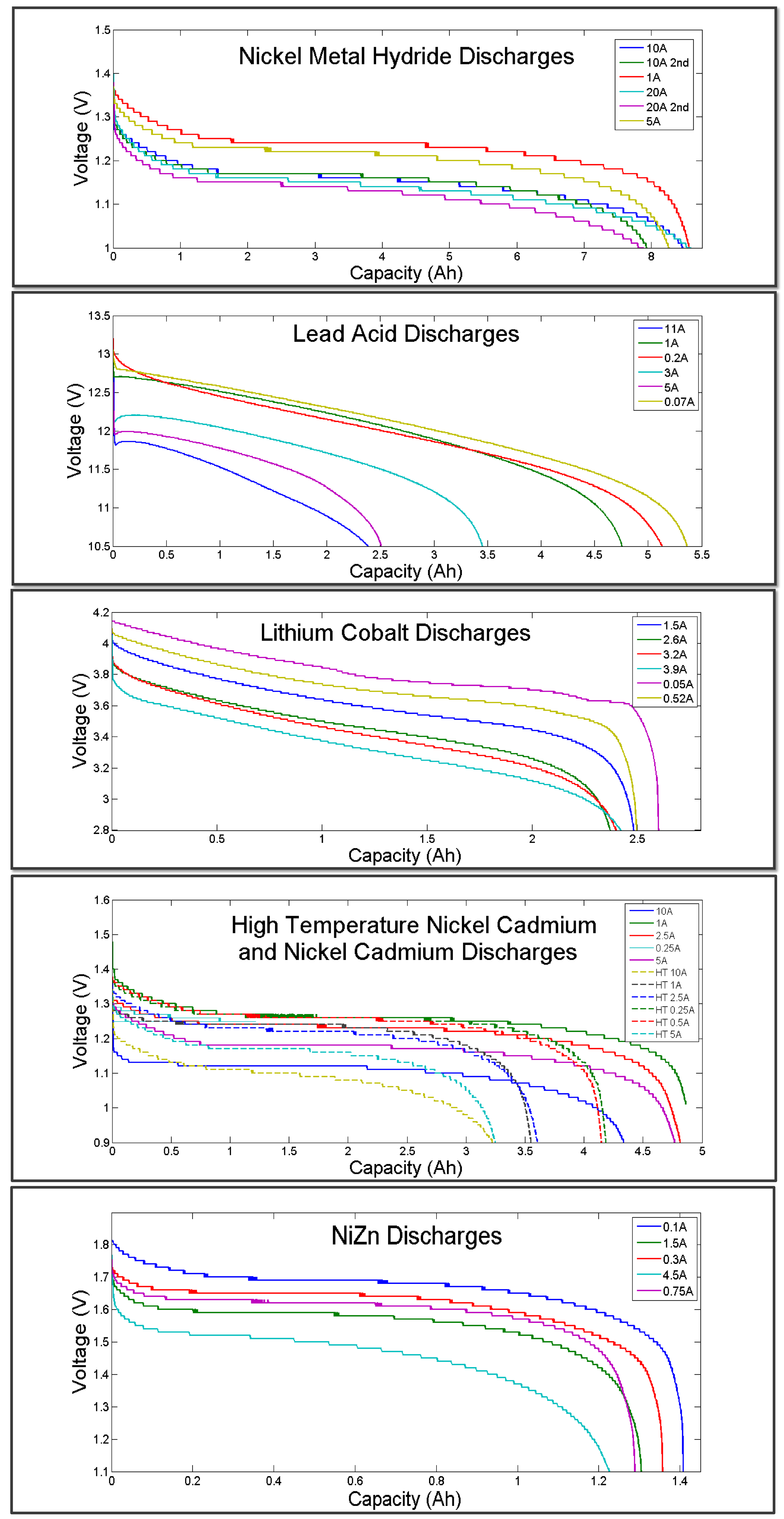

Fig. 3. Discharge curves for each battery at different rates. Legends show the order of the rates in which the batteries were discharged.

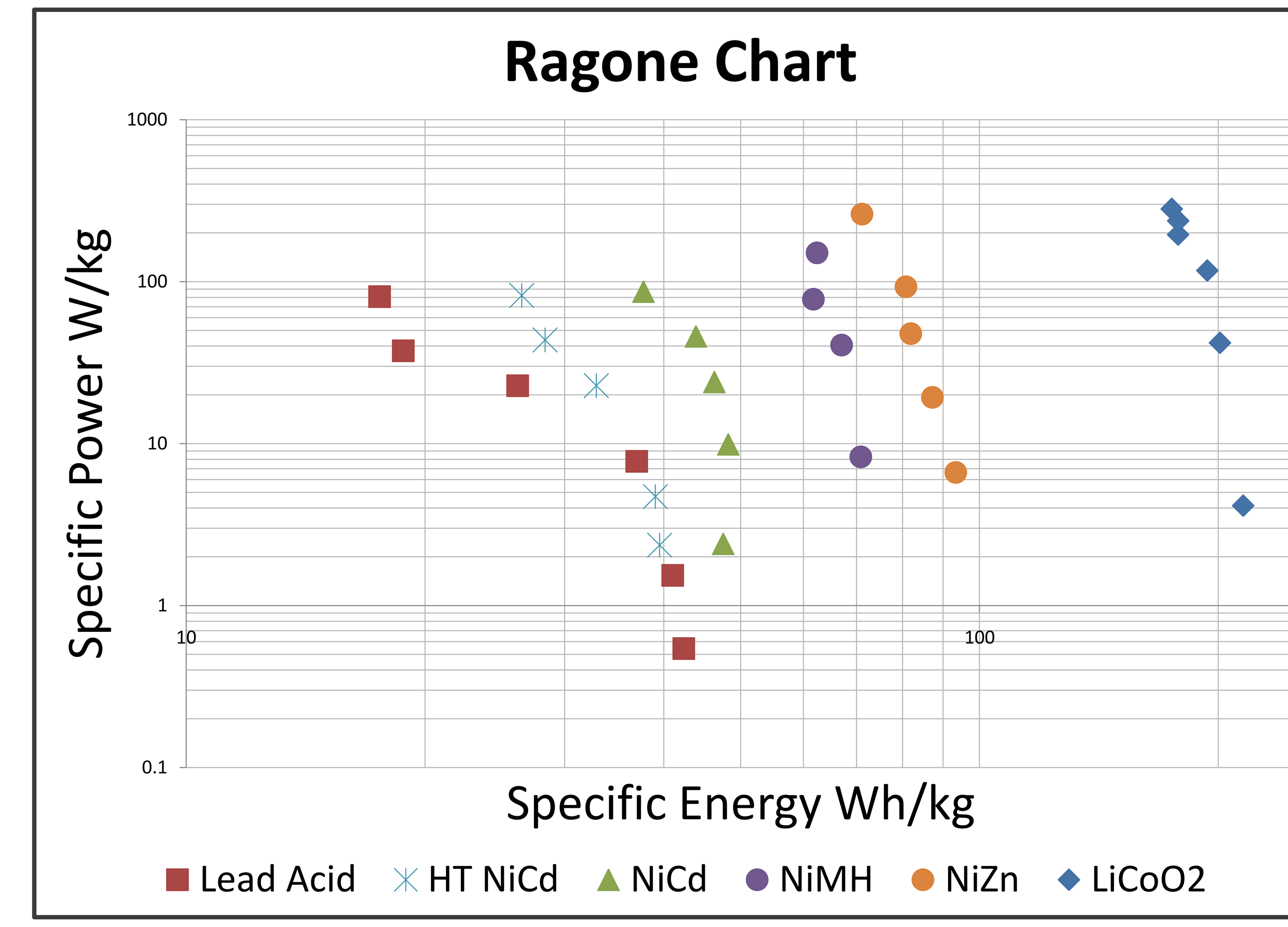

Fig. 4. Ragone Chart with plots calculated from discharge curves

Conclusion

Progress has been made adding data to the Ragone Chart, which is useful to compare the specific energy and power of the batteries.

From the Ragone Chart, Lithium Cobalt holds the most energy density compared to the rest of the rechargeable batteries. Lithium Cobalt is a candidate to begin testing with other power sources to come up with a hybrid source.

Nickel Zinc demonstrated high performance and will be considered in future testing because they are a lot more environmentally friendly compared to the rest of the batteries [1]. High Temperature NiCd underperformed compared to regular NiCd batteries tested at room temperature. There is a tradeoff between capacity and the ability to perform in higher temperatures.

Future Works

The next step will be to begin testing ultracapacitors, which are rated for high power density [2], to determine their energy and power limits. By combining the information gathered on batteries and the information on ultracapacitors, a battery/ultracapacitor hybrid power source will be designed and tested.

Further tests will be done on the NiCd and HT NiCd to see how the batteries will differ at higher and lower temperatures.

References

[1] R. A. Brown, "Nickel-Zinc Battery for Aircraft and Missile Applications," Defense Technical Information Center, 1978

[2] D. Tomal, and N. Widmer, "Electronic Troubleshooting," 3rd ed. McGraw Hill, 2004