SMALLSAT MISSIONS ENABLED BY CURRENT RADIOISOTOPE POWER SYSTEMS. B. K. Bairstow[1], J. E. Riedel[1], Y. H. Lee[1], T. R. Spilker[1], and S. R. Oleson[2], [1]Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Dr., Pasadena, CA, 91109 (brian.k.bairstow@jpl.nasa.gov, joseph.e.riedel@jpl.nasa.gov, young.h.lee@jpl.nasa.gov, trspilker@yahoo.com), [2]NASA Glenn Research Center, 21000 Brookpark Road, Cleveland, OH 44135 (steven.r.oleson@nasa.gov).

Introduction: The coming decades of planetary science and deep space exploration will likely feature a combination of more ambitious missions within ever more constrained budgets. There is an emerging trend in the mission planning community of using smaller spacecraft to lower mission costs while still gathering significant science. There is anticipation that SmallSats (100-500 kg) could generate significant science returns at a reasonable cost, and could be enabling for future low-cost exploration of the outer planets, such as investigation of possible life-harboring environments of the moons of Jupiter and Saturn.

However, using SmallSats without Radioisotope Power Systems (RPS) to explore the solar system beyond Jupiter/Saturn will prove very challenging. Even just as far from the Sun as Saturn, the solar energy density is but 1% of that at Earth. Solar power in the outer solar system could require very large arrays, which in turn could require support from large spacecraft structures. Furthermore, thermal management in the outer solar system could be prohibitively power-expensive. RPS could addresss both of these challenges by uncoupling power production from solar insolation, and by using excess thermal power for spacecraft heating requirements, thus eliminating the need for the SmallSat to carry a heater.

Currently available RPS present their own challenges for being accommodated by SmallSats, chiefly mass and cost. However, these challenges can be overcome, as demonstrated by the studied Enceladus Express mission concept. This concept uses Multi-Mission Radioisotope Thermoelectric Generators (MMRTGs)—the same power system currently operating on the Curiosity rover on Mars—to power SmallSats bound for Saturn to perform compelling science at Enceladus.

Enceladus is a very exciting scientific target; it may be the most likely place in the solar system beyond Earth to find active life. The Cassini mission has detected a very high degree of thermal activity on that small moon, featuring (probably) continuous water vapor and particulate geysers at the South pole. With plumes of water jetting 100's of km above the surface, samples of subsurface ocean water that may contain evidence of life or pre-biotic processes are available for collection by flyby spacecraft such as the Enceladus Express concept. The use of RPS would be enabling for this mission concept, which would be affordable within the New Frontiers mission cost-cap.

The mission study has further applications, as the spacecraft concept was designed to be a simple, single-MMRTG SmallSat that could be adapted to a number of potential lower-cost outer solar system missions, such as an orbiter in the systems of any of the gas giants, even exploiting the aerogravity assist architecture. Tours of the Trojan asteroids, or other distant planetesimals, are also possibilities, as would be a comet sampler. RPS-powered SmallSats have potential as a very adaptable and attractive mission architecture option to help answer ever more complex questions about the origin and evolution of our solar system.