# Assessment of a small reactor at 10kWe

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**Abstract.** Radioisotopic power systems (RPS), even coupled with dynamic conversion, will hardly be able to provide a few kilowatt. Their limit is intrinsic: their power is limited by the amount of radioisotope, and their mass is proportional to it. Small reactors cannot compete with RPS under 1 kWe, but they could be of interest for multi-kW missions. The objectives of this study were to assess what would be the technical options and the corresponding level of performance of a 5 to 10kWe fission power system.

The first trade-off concerns the reactor type: fast neutron or thermal neutron. The study is based on conventional fuels (pins type, UO2). With these fuels, moderated cores are smaller, but not scalable to high power systems. Indeed, high power systems will require high temperature radiators and consequently high temperature reactors. This is not compatible with efficient moderators. Impact of this option on the system mass has been assessed, also taking the shield into account. At this power level, heat pipe reactor is considered as the best option.

The balance of plant is always a critical choice, and has been reassessed considering classical conversion options (thermoelectricity, Stirling, Brayton). The assessment shows that high temperature systems are not competitive at this power level. They are penalized by the mass of the reactor and its shielding. American Stirling is clearly the best option when coupled with a moderated reactor, but our assessment shows that Stirling remains competitive even coupled with a fast high temperature reactor. Mass of the reactor is balanced by a better efficiency.

The conclusions are that Stirling machines are of great interest for small reactors, as well as for RPS, and that a fast reactor would be the best option, considering scalability, and a limited penalty in mass. In this frame, the thermoacoustic option could be an attractive candidate.