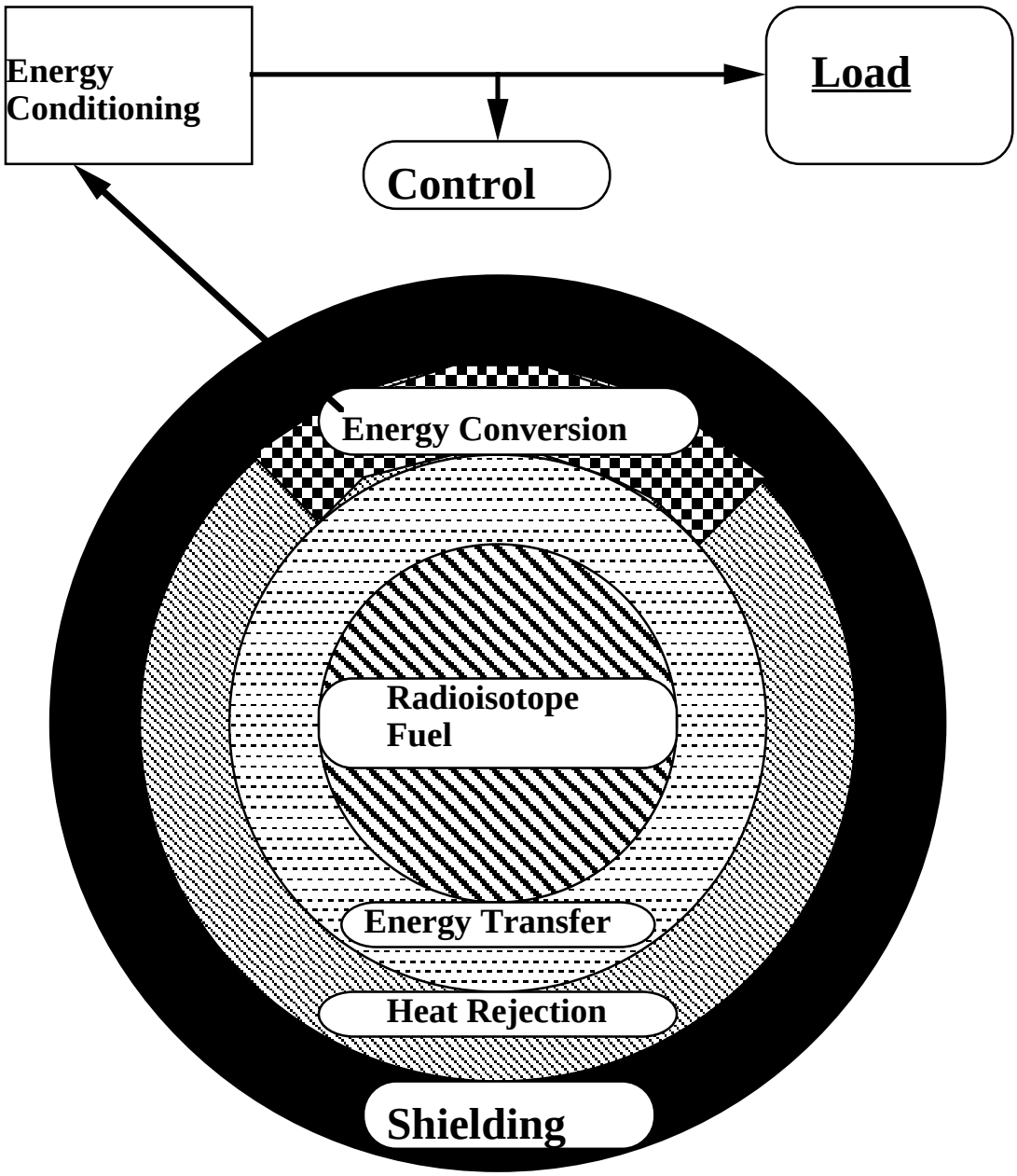
Basic Elements of Static RTG's



Power Generated by Radioisotopic Heat Sources

Power (t) = **Initial # of Radioisotopes** N_o

Decay Rate, s-1 $l = \frac{\ln 2}{t_{1/2}}$

Energy Released Per Decay MeV E

Number of Radioisotopes Left After t Years $\exp -\left(\frac{t \cdot \ln 2}{t_{1/2}} \right)$

$$\text{Power (t)} = \frac{N_o \cdot E \cdot \ln 2}{t_{1/2}} \exp -\left(\frac{t \cdot \ln 2}{t_{1/2}} \right)$$

Important Characteristics of Radioisotopic Heat Sources

Physical Properties

- Isotope
- Type of Radiation
- Energy of Decay
- Half Life
- Curies/gram
- Curies/Watt
- Watts/gram
- Total kWh Realizable

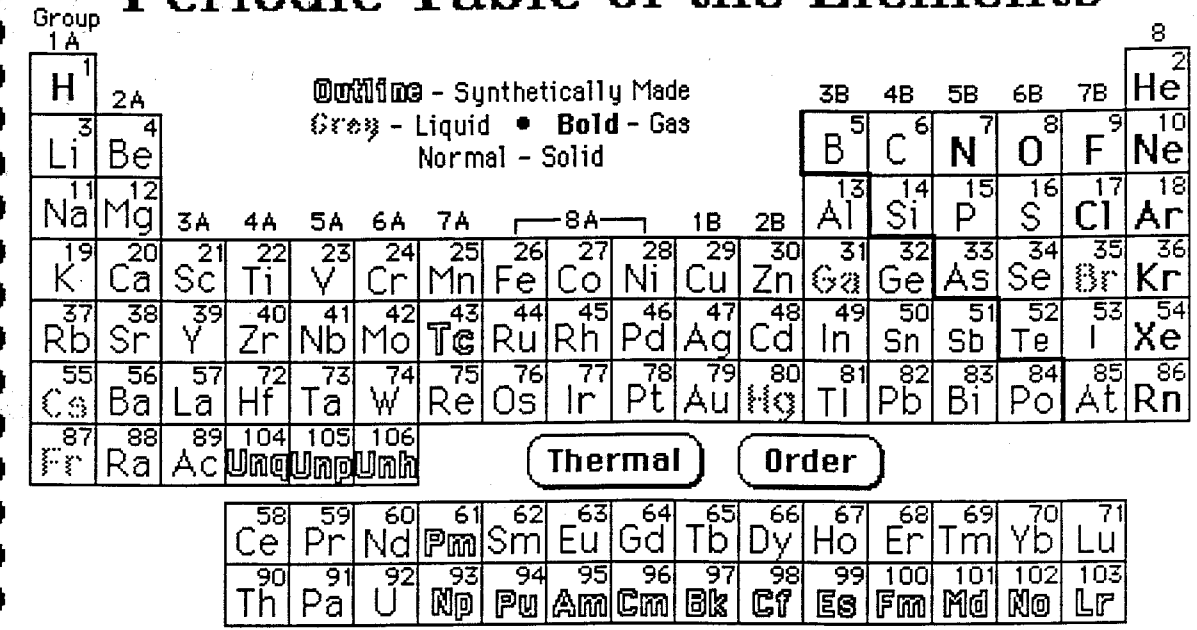
Commercial Properties

- Form of Compound
- Melting Point
- Isotopic Purity
- % Isotope in Compound
- Watts/g (compound)
- Watts/cm3 (comp.)

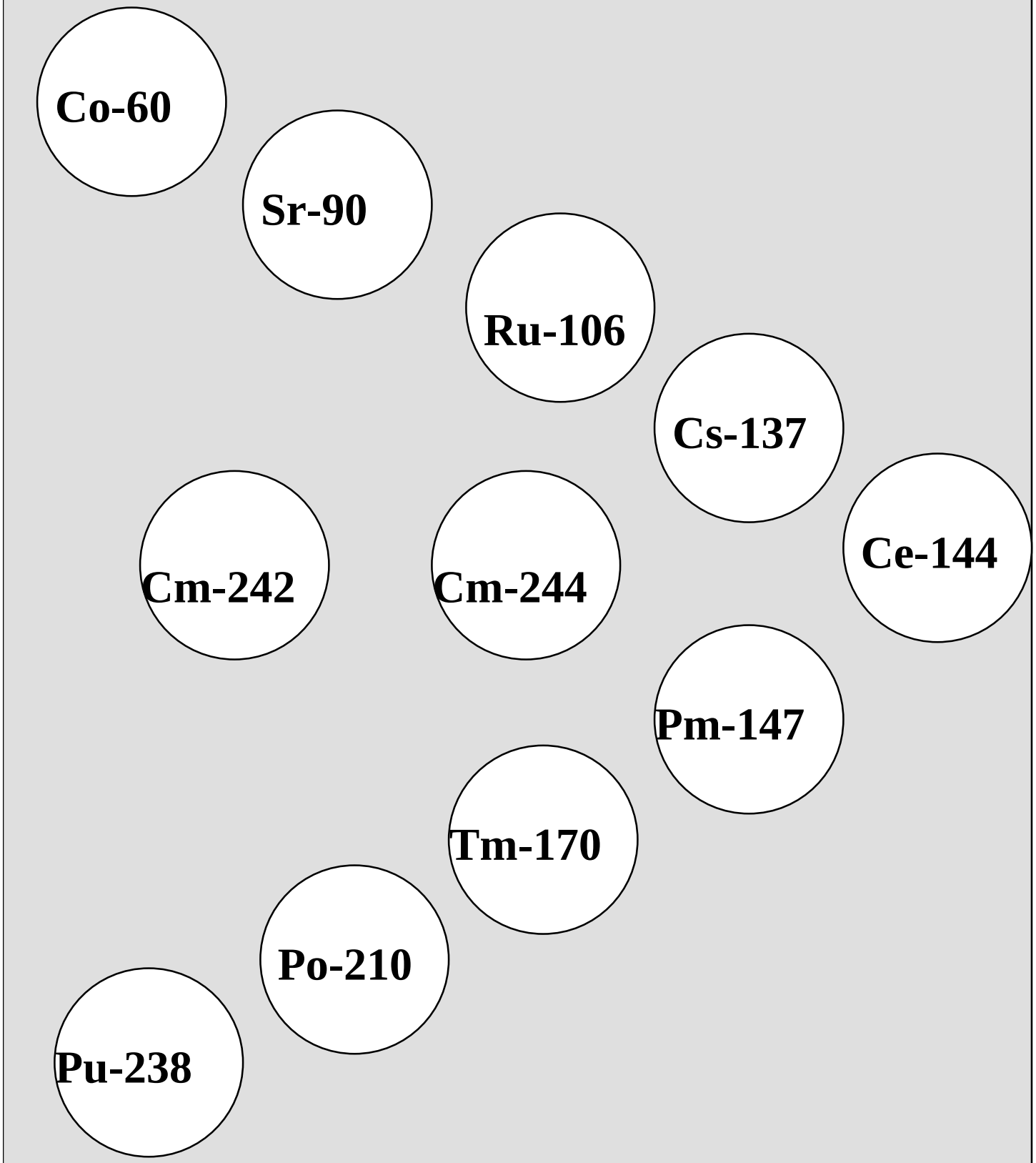
Production Properties

- Recovery From Power Reactor Fuel
- Production Rate in Power Plants
- Availibility
- Price

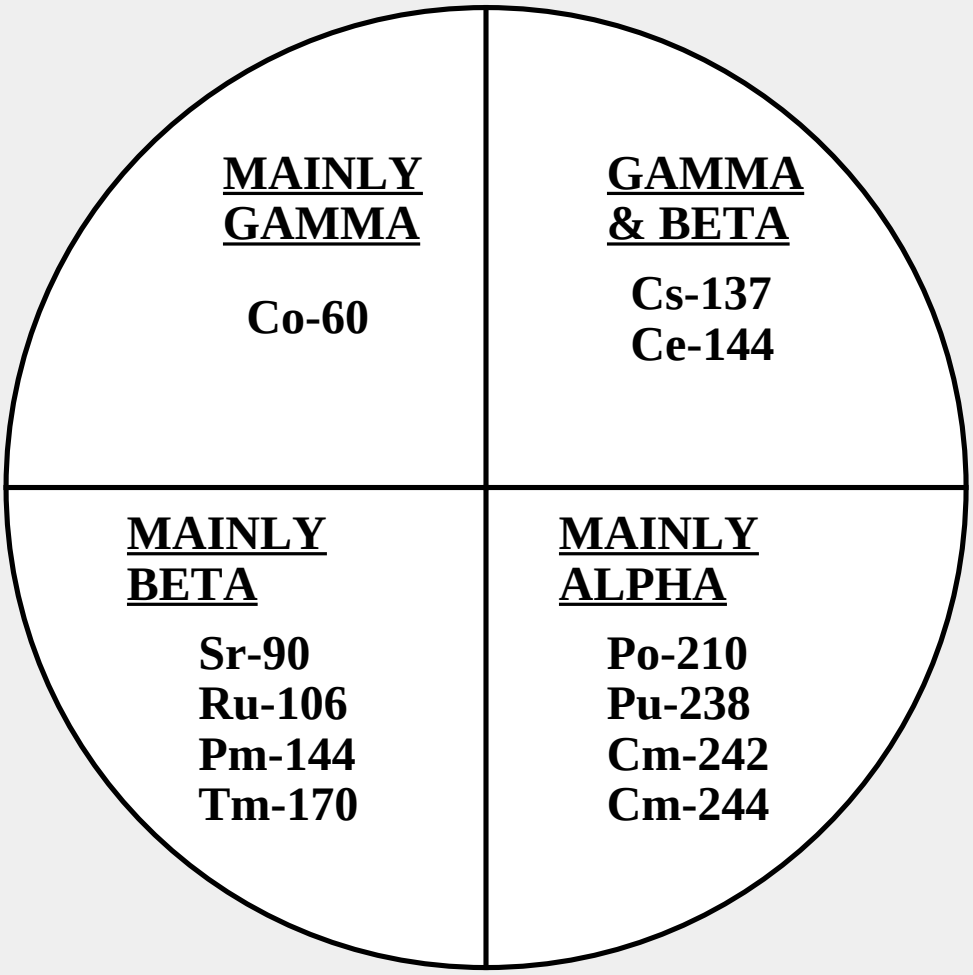
Periodic Table of the Elements



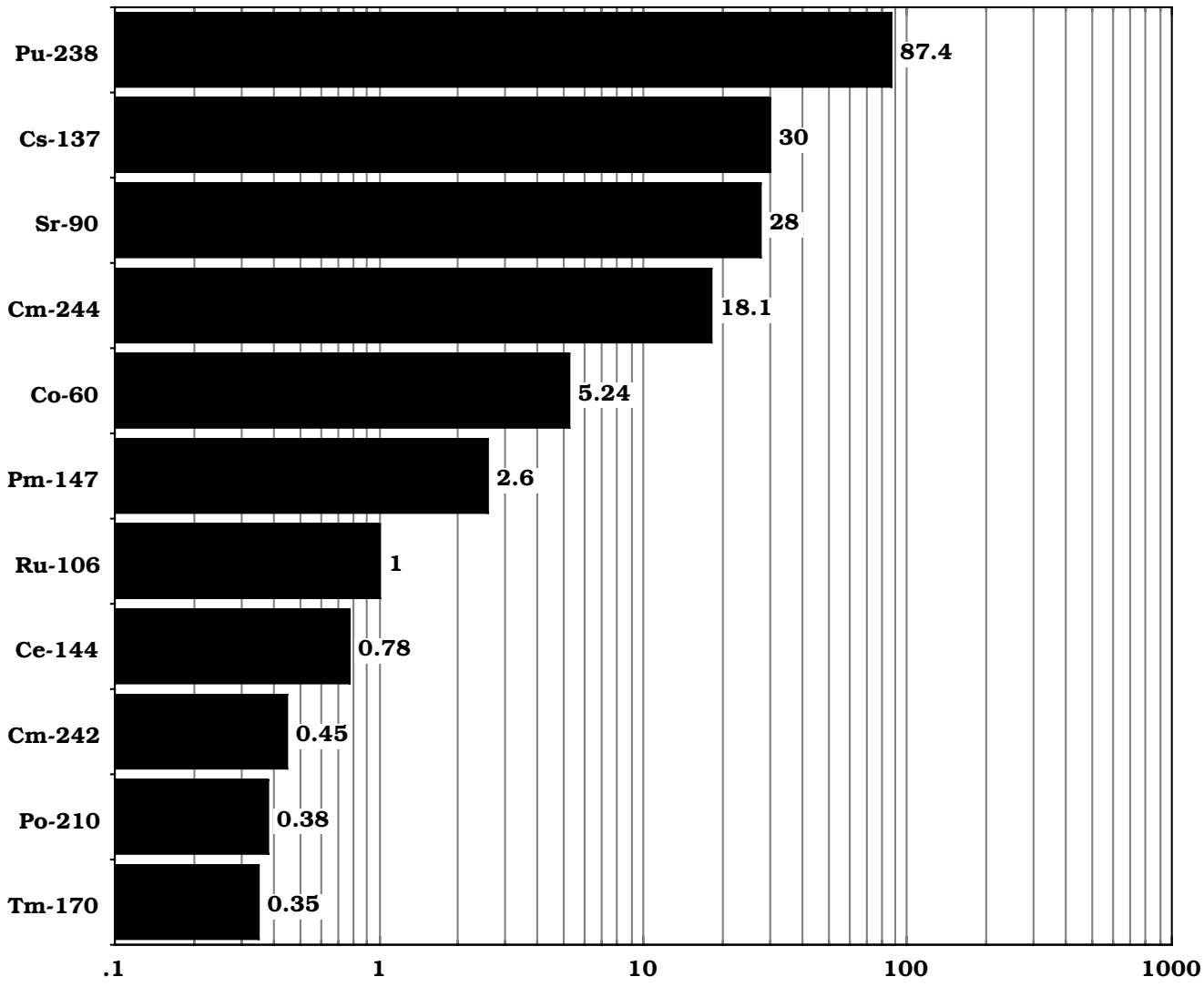
Most Commonly Used Isotopes for Radioisotope Heat Sources



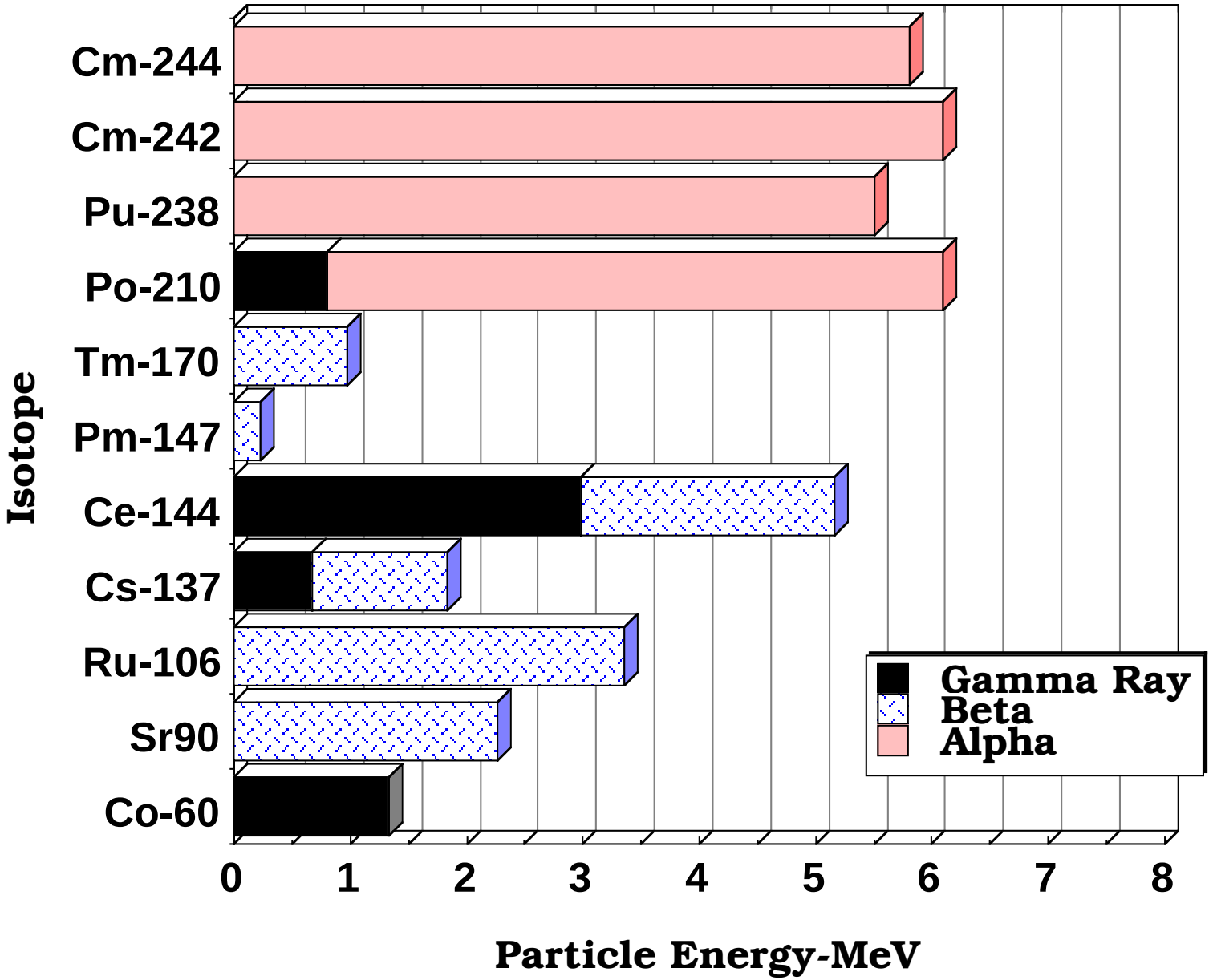
Main Decay Mode Of Most Favored Radioisotopes

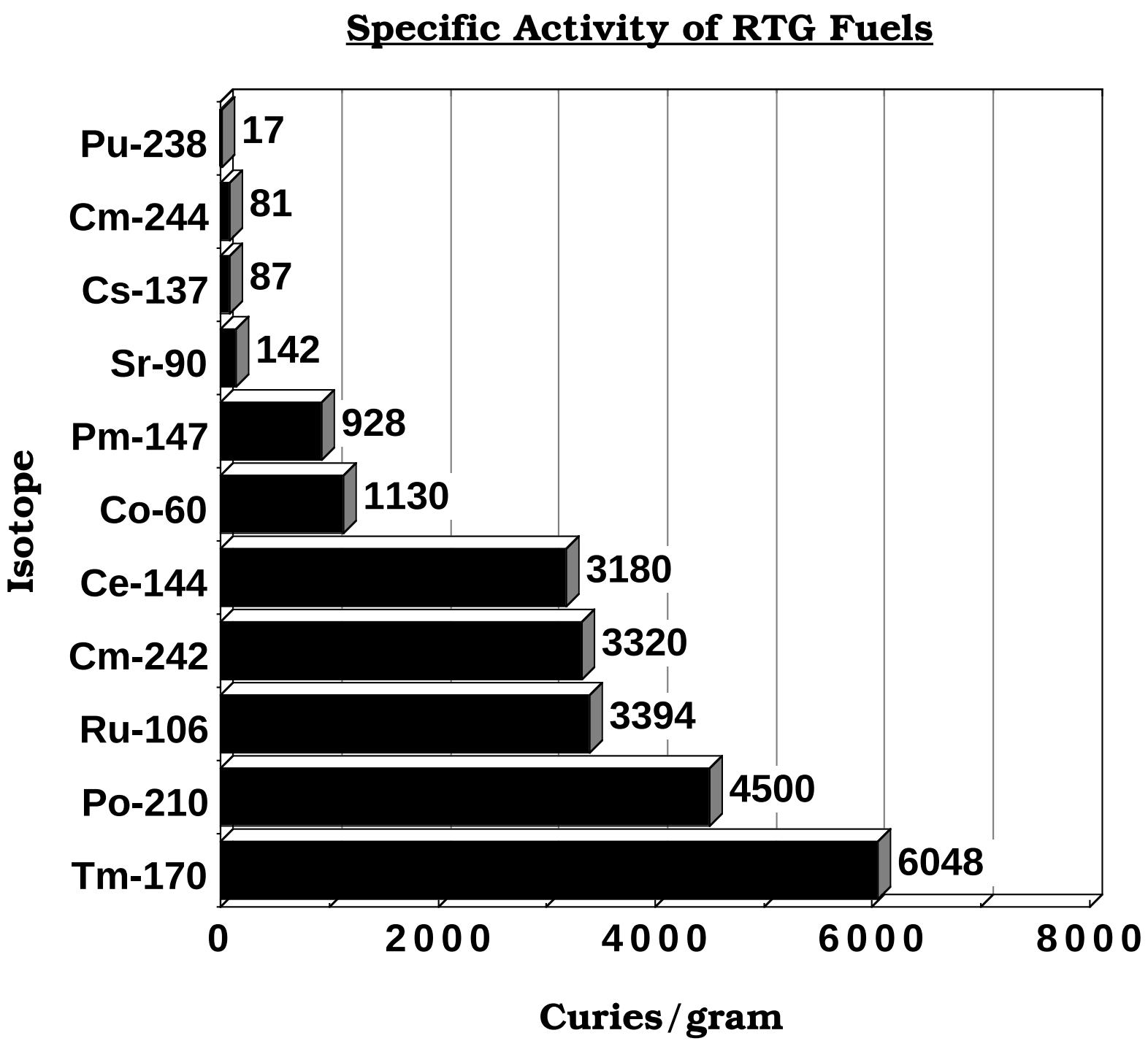


Half Life of RTG Fuels

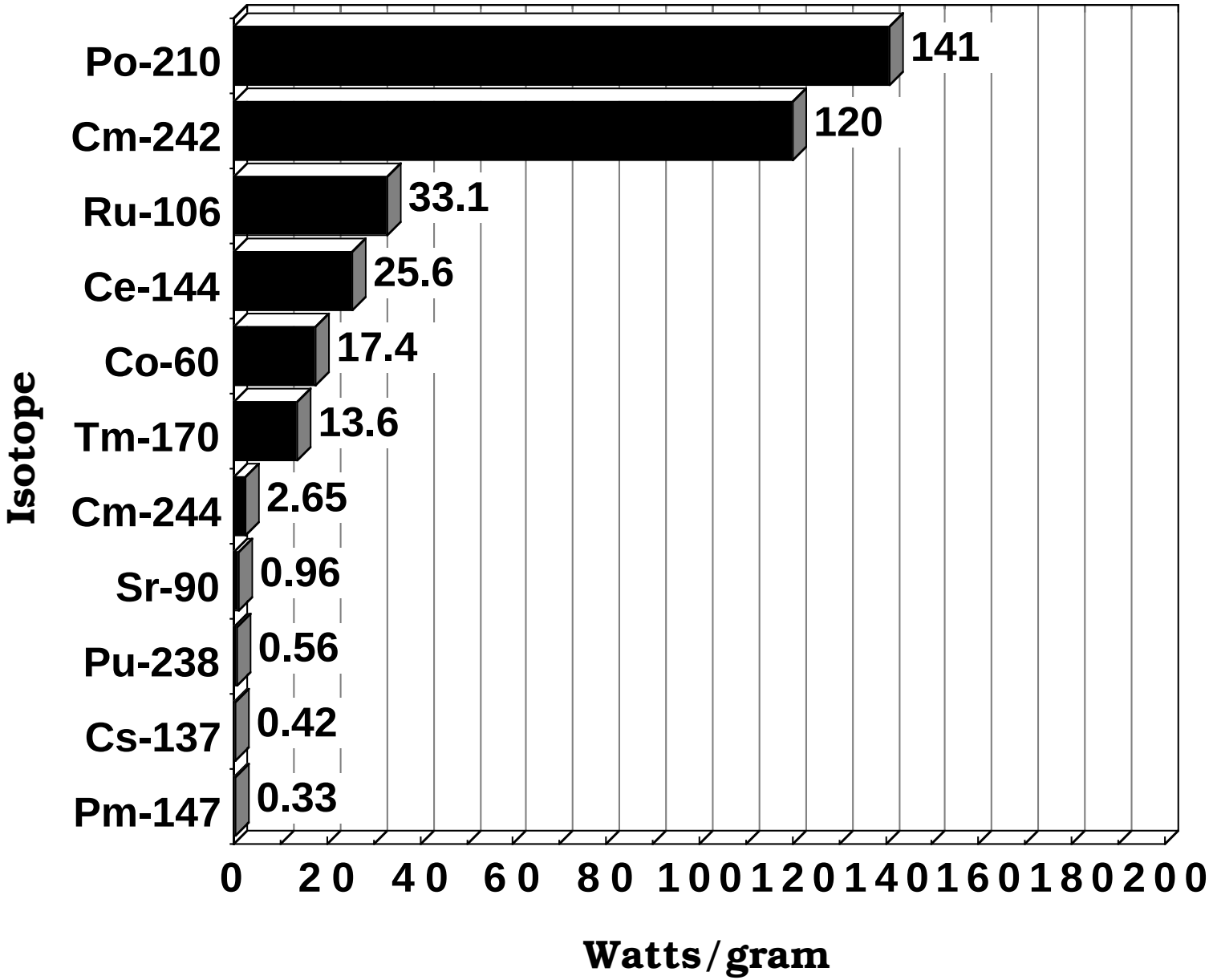


Decay Energy of Radioisotopes

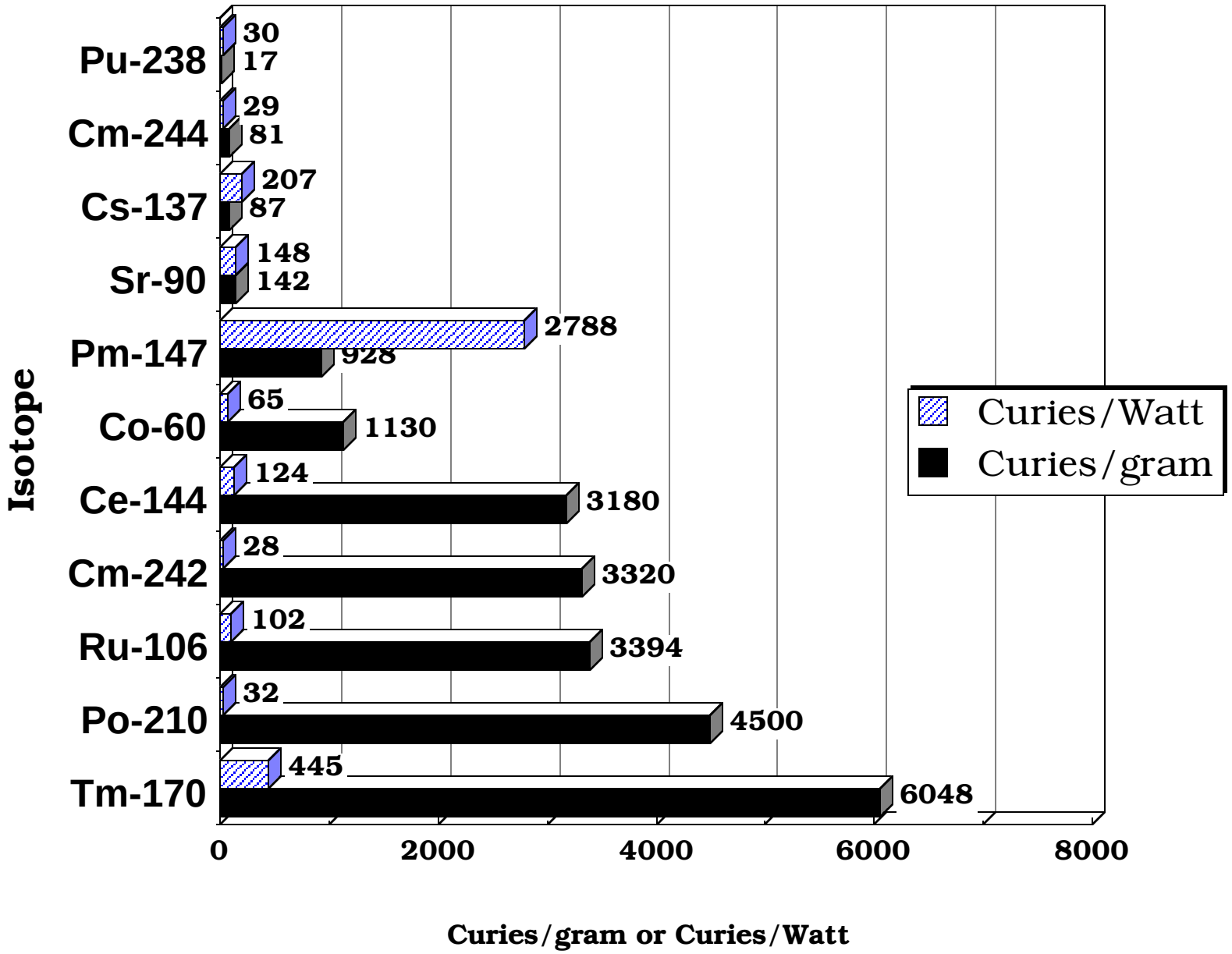



Specific Activity of RTG Fuels
Isotope
Pu-238
Cm-244
Cs-137
Sr-90
Pm-147
Co-60
Ce-144
Cm-242
Ru-106
Po-210
Tm-170
17
81
87
142
928
1130
3180
3320
3394
4500
6048
0
2000
4000
6000
8000
Curies/gram

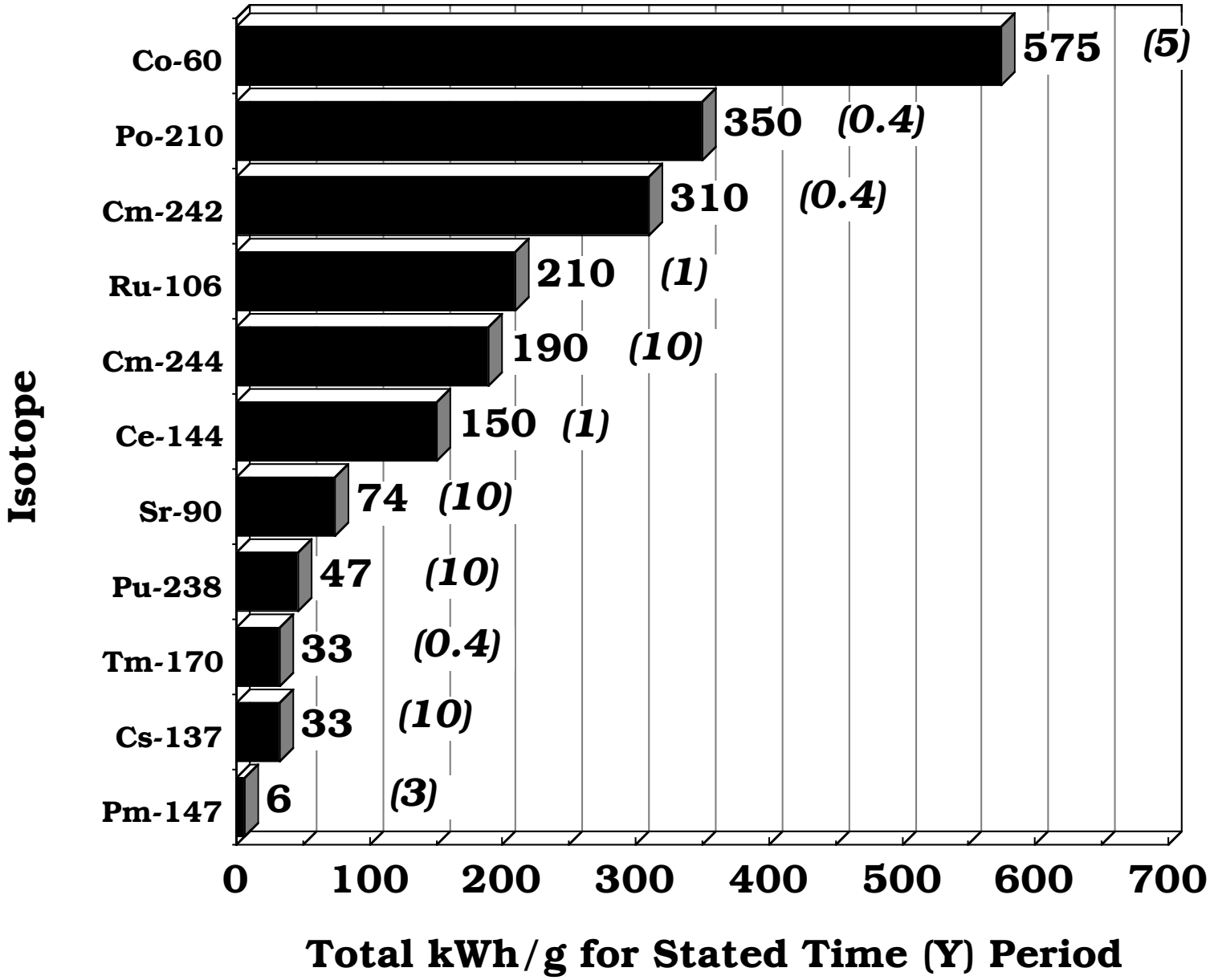
Power Density in RTG Isotopes



Comparison of Specific Activity and Activity Required to Produce a Watt

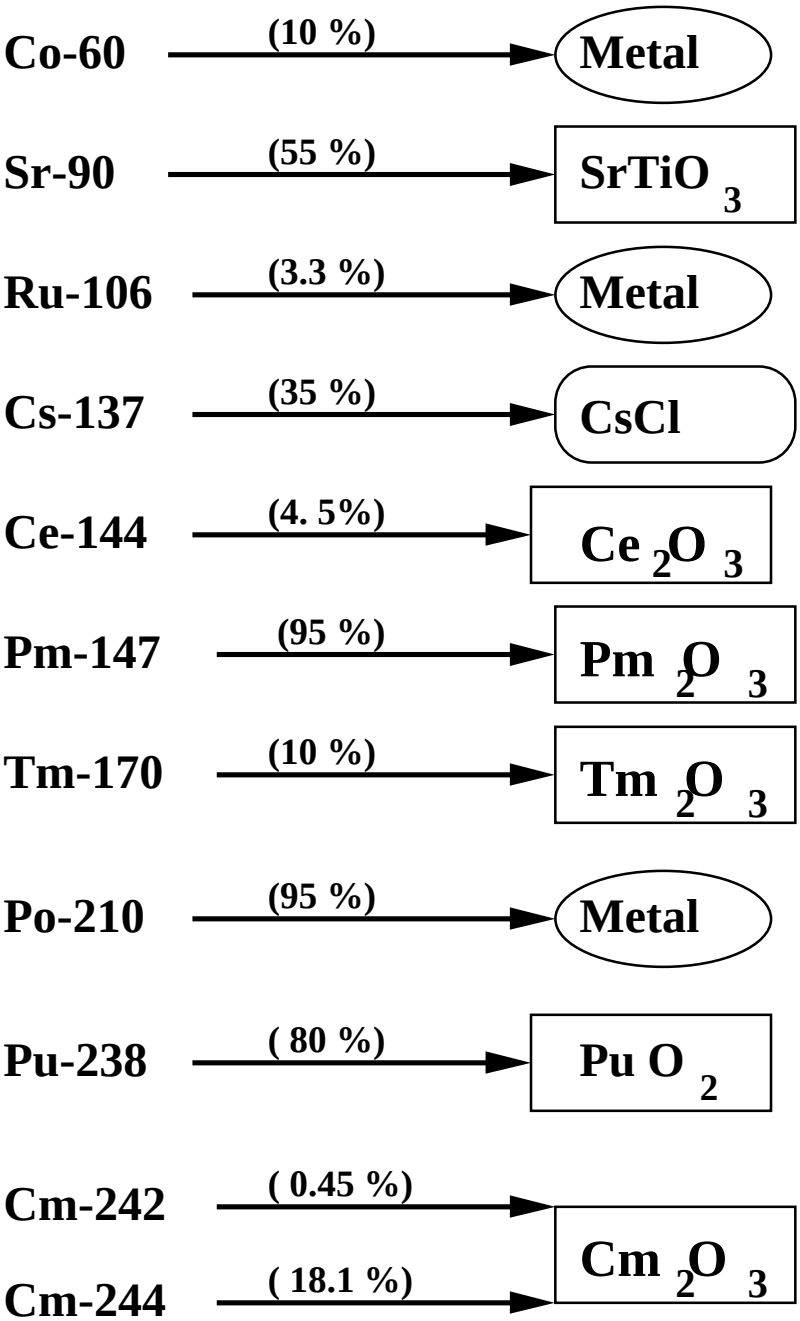


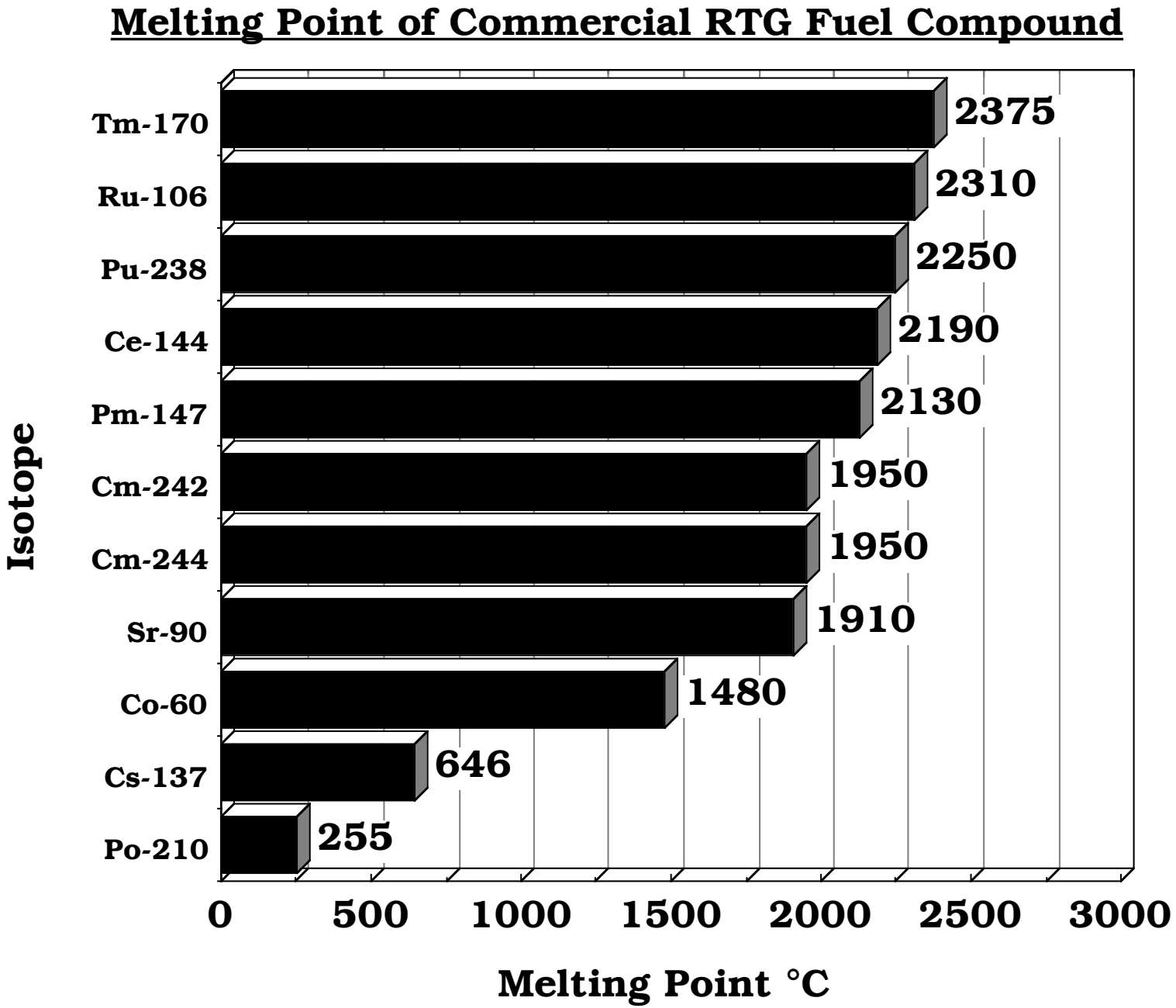
Total Energy Content in RTG Fuels For Reasonable Mission Times



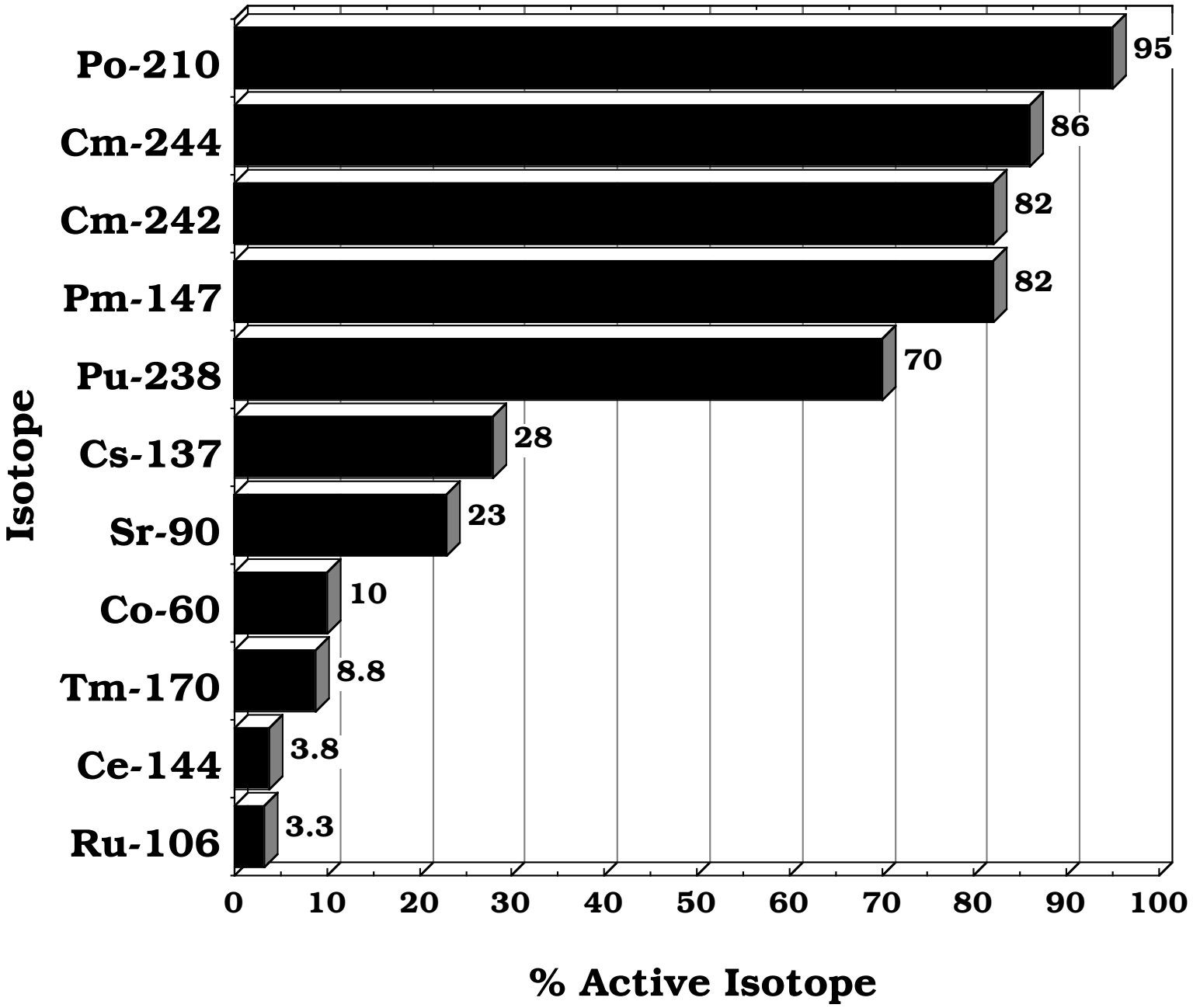
Commercial Fuel Form

(% Isotope in the Metallic Element)

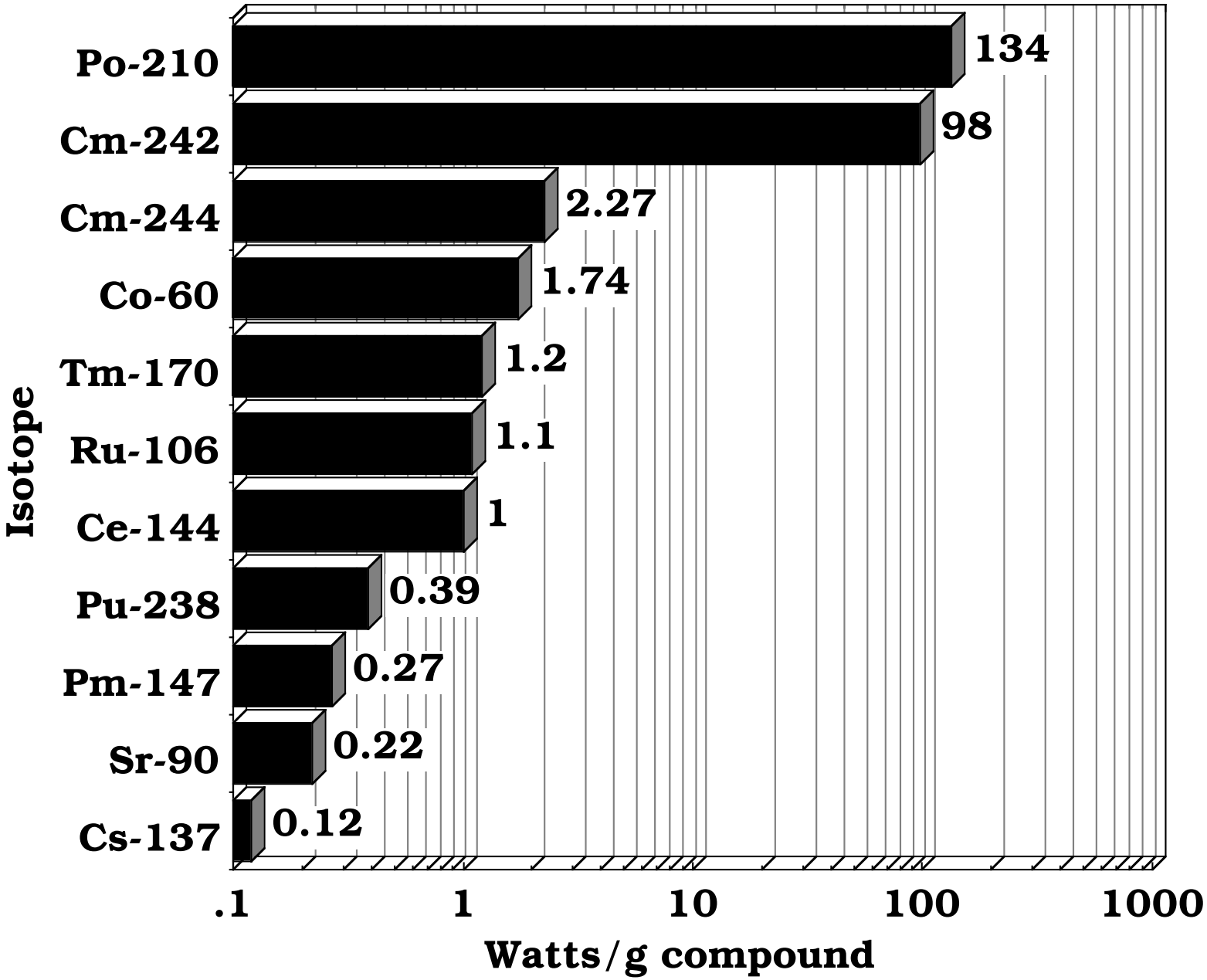



Melting Point of Commercial RTG Fuel Compound
Isotope
Tm-170
Ru-106
Pu-238
Ce-144
Pm-147
Cm-242
Cm-244
Sr-90
Co-60
Cs-137
Po-210
2375
2310
2250
2190
2130
1950
1950
1910
1480
646
255
0
500
1000
1500
2000
2500
3000
Melting Point °C

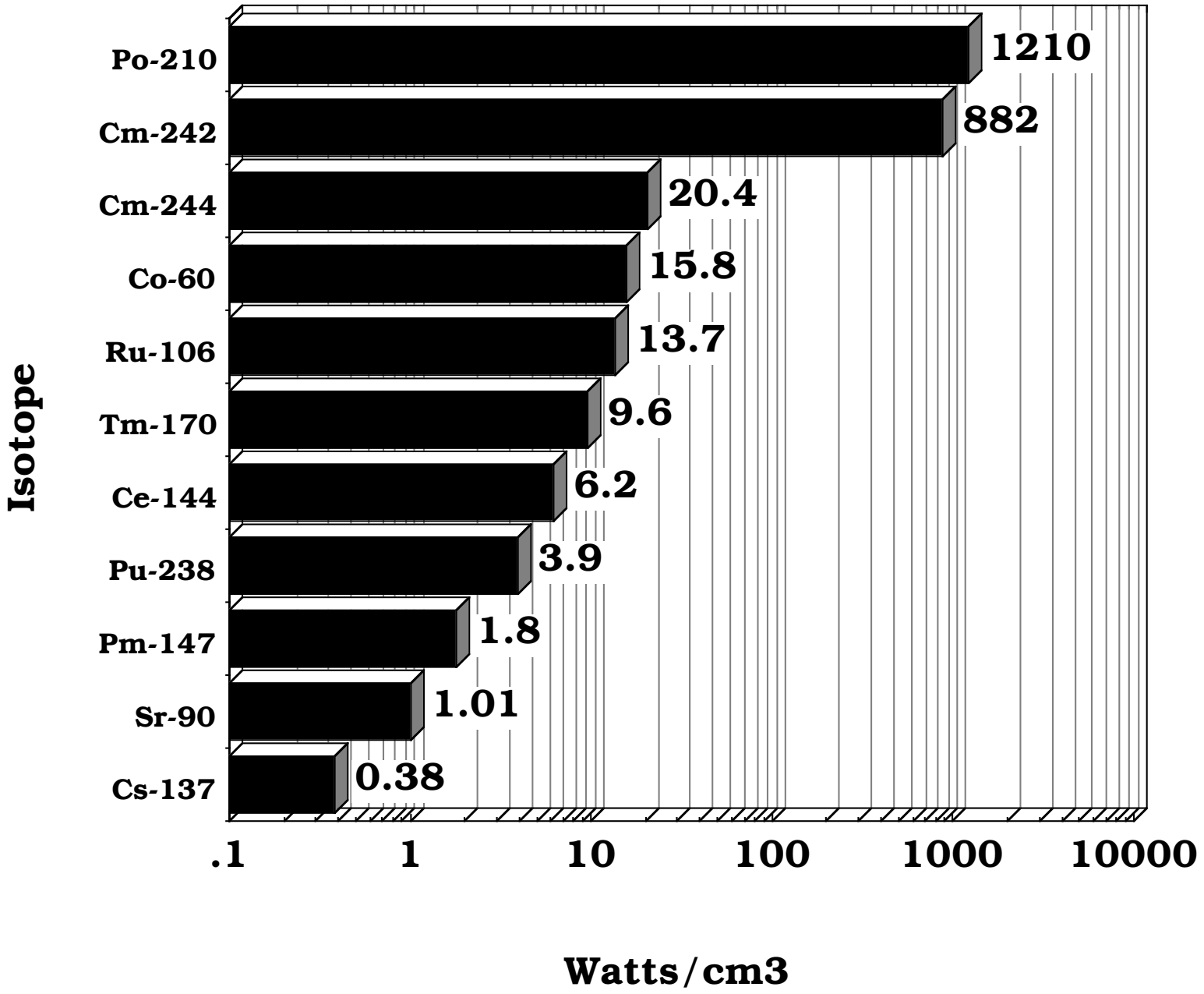
Concentration of Active Radioisotopes



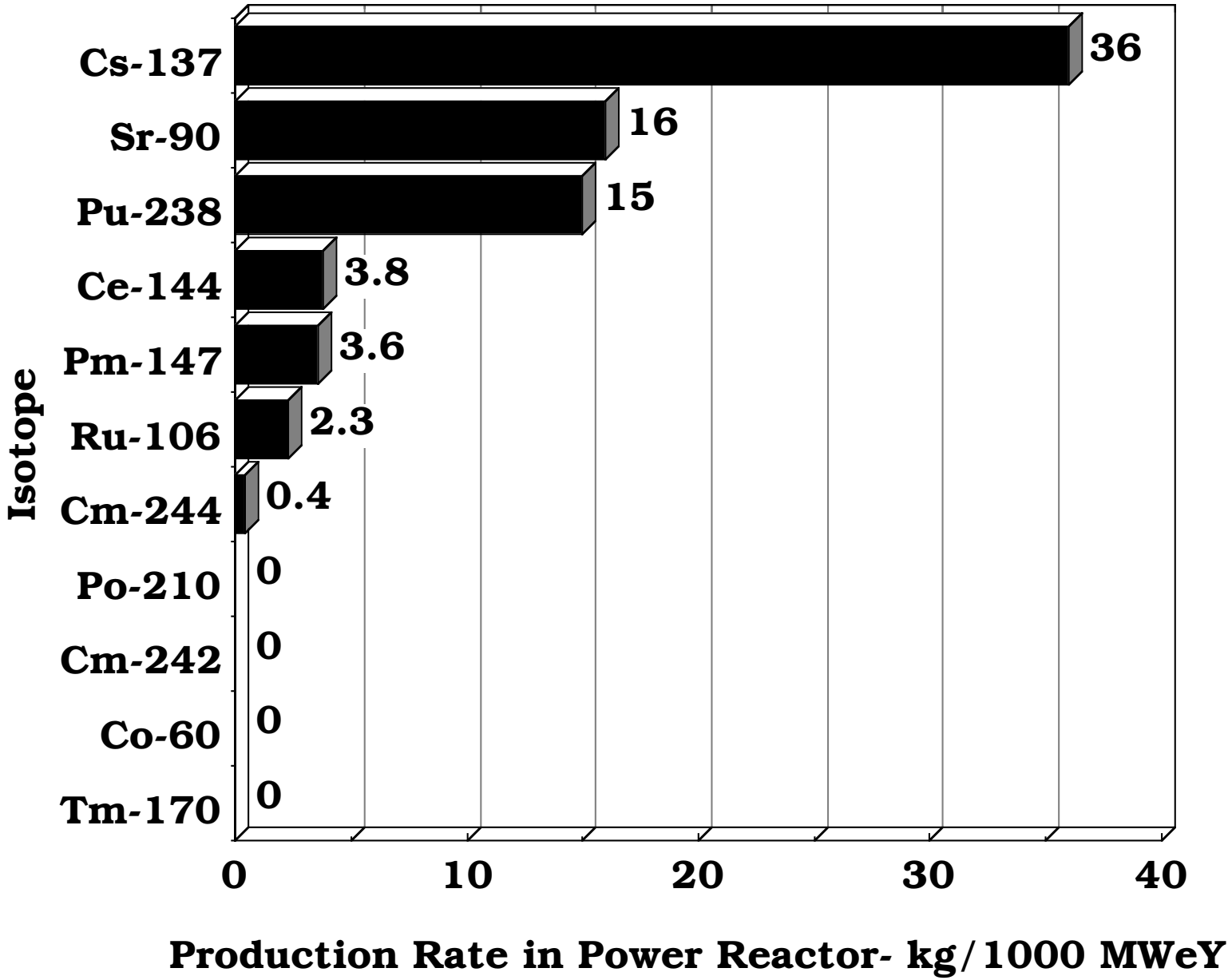
Commercial Specific Power Level of RTG Iostopes



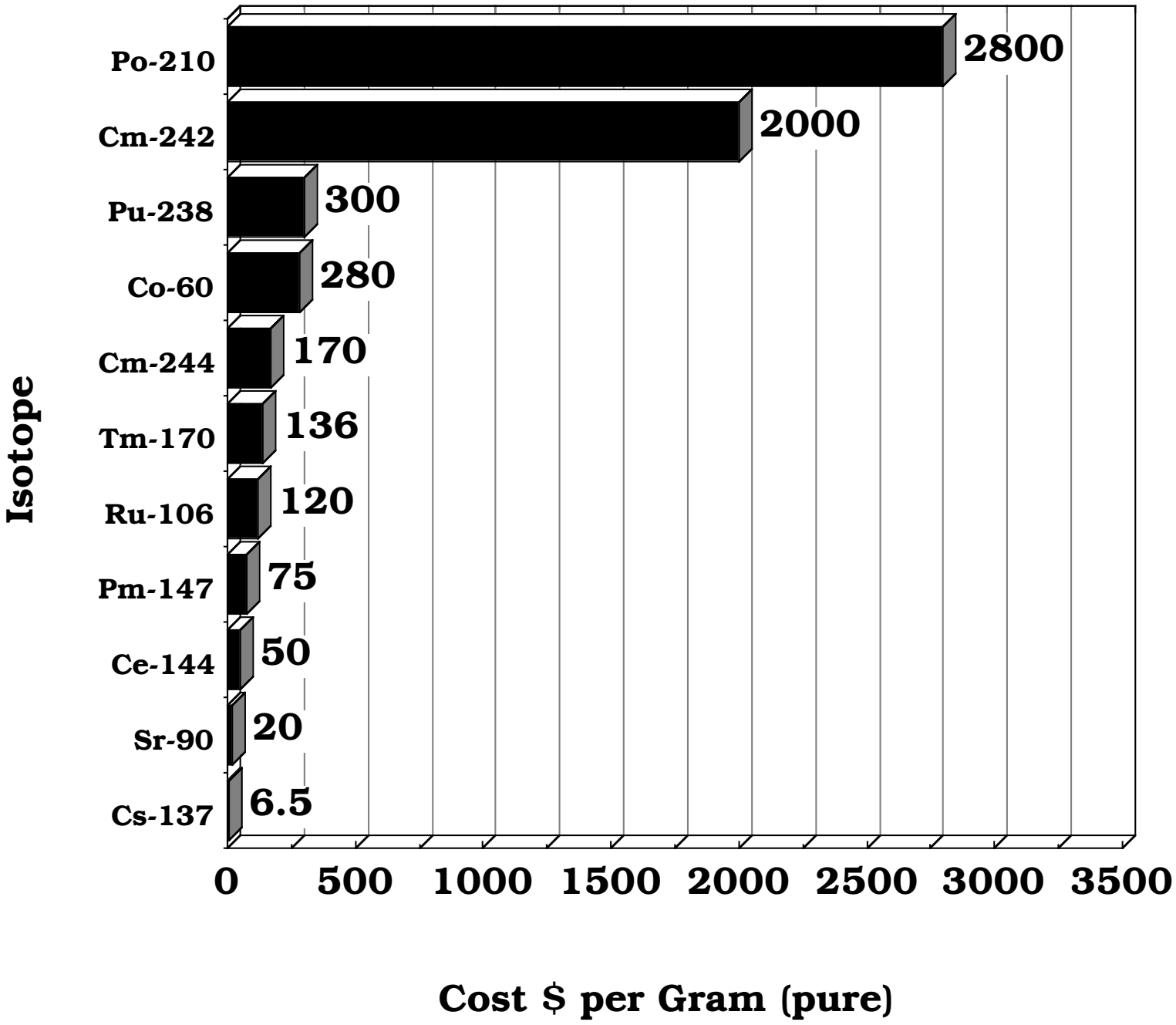
Specific Power Density of Leading Radioisotopes



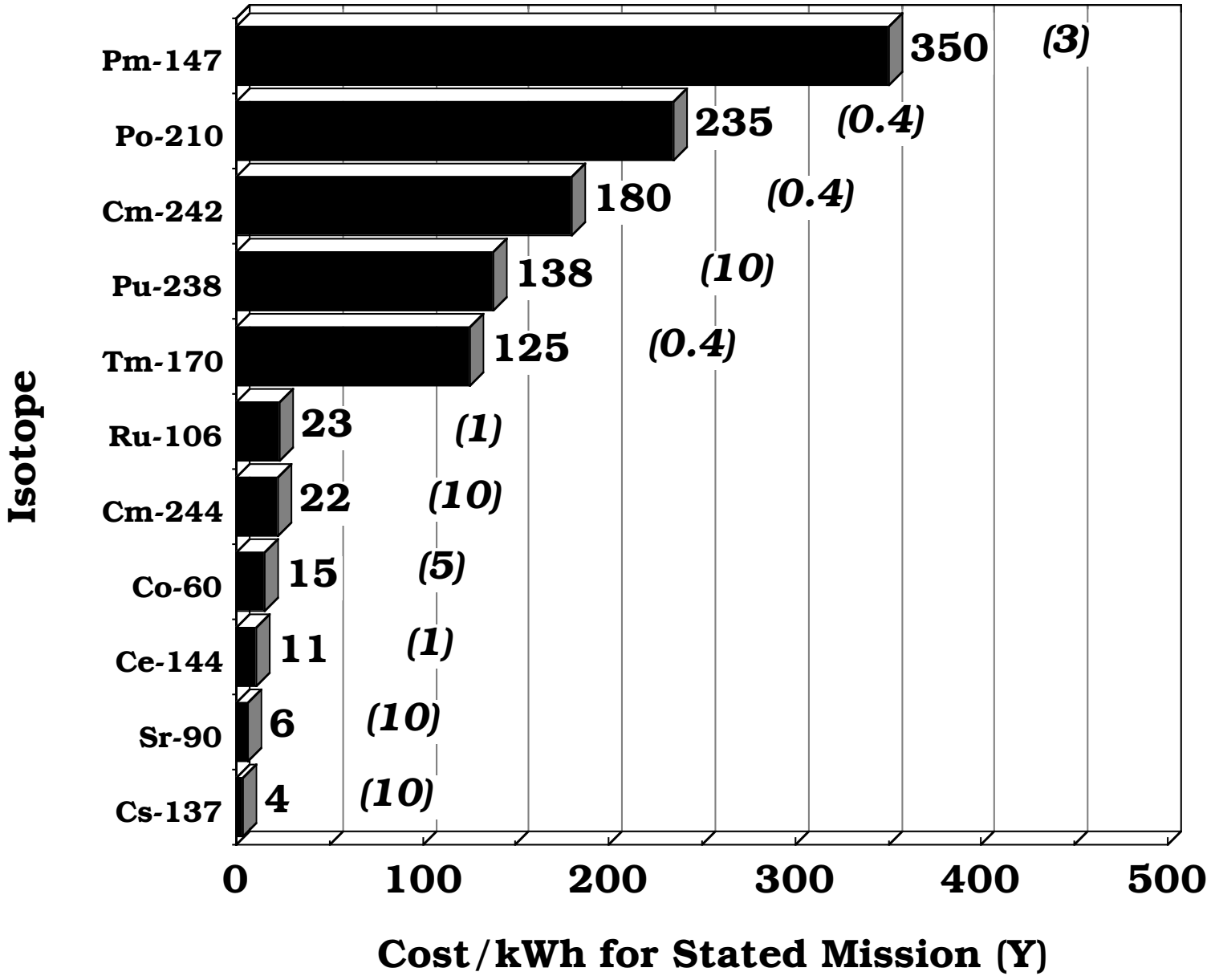
Production of Radioisotopes in Commercial Power Plants



Future Cost of RTG Fuels



Energy Cost For Fuel Only For Reasonable Missions



Comparison of ^{238}Pu With Other Radioisotopes

Radio-isotope	Class of Emitter	Half-Life (yr)	SPON-FIS Half-Life (yr)	BOL/EOL Ratio (11 yr)	Compound Form	Melting Temperature (°F)	Density (gm/cc)	Watts per Gram	Curies per Watt	Pb Shield* Required (in.)
^{238}Pu	α	87.7	5×10^{10}	1.09	PuO_2	4352	10.0	0.39	30	0.1
^{241}Am	α	432.0	2×10^{14}	1.02	AmO_2	3632	10.47	0.097	30	0.7
^{244}Cm	α	18.1	1.4×10^{7}	1.52	Cm_2O_3	3956	9.0	2.27	29	2.0†
^{137}Cs	β	30.0	–	1.29	CsCl	1193	3.2	0.12	207	4.6
^{90}Sr	β	28.0	–	1.31	$SrTiO_3$	3704	4.6	0.22	148	6.0
^{60}Co	γ	5.24	–	4.28	Metal	2723	8.8	1.74	65	9.5

*Approximate lead shield required for 1-kWt heat source for 10 mrem/h at 1 m
†Neutron dose rate is ~500 times greater than ^{238}Pu