To **UNFinity**...and beyond!

Dr. Jenifer C. Shafer

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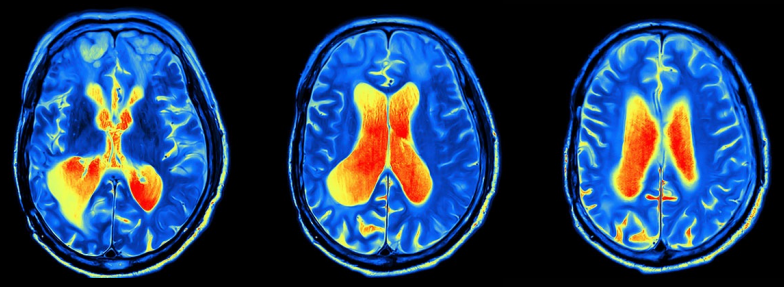
?

Waste

1 H																	2 He
3 Li	4 Be											5 B	5 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg											12 Al	13 Si	14 P	15 S	16 Cl	17 Ar
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
55 Cs	56 Ba	Ln	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au
87 Fr	88 Ra	An	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Cn	113 Nh	114 Fl	115 Mc	116 Lv	117 Ts	118 Og
		55 La	56 Ce	57 Pr	58 Nd	59 Sm	60 Eu	55 Gd	56 Tb	57 Dy	58 Ho	59 Er	60 Tm	61 Ho	62 Er	63 Tm	
		89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lu	

Fission Products

Nuclear Batteries



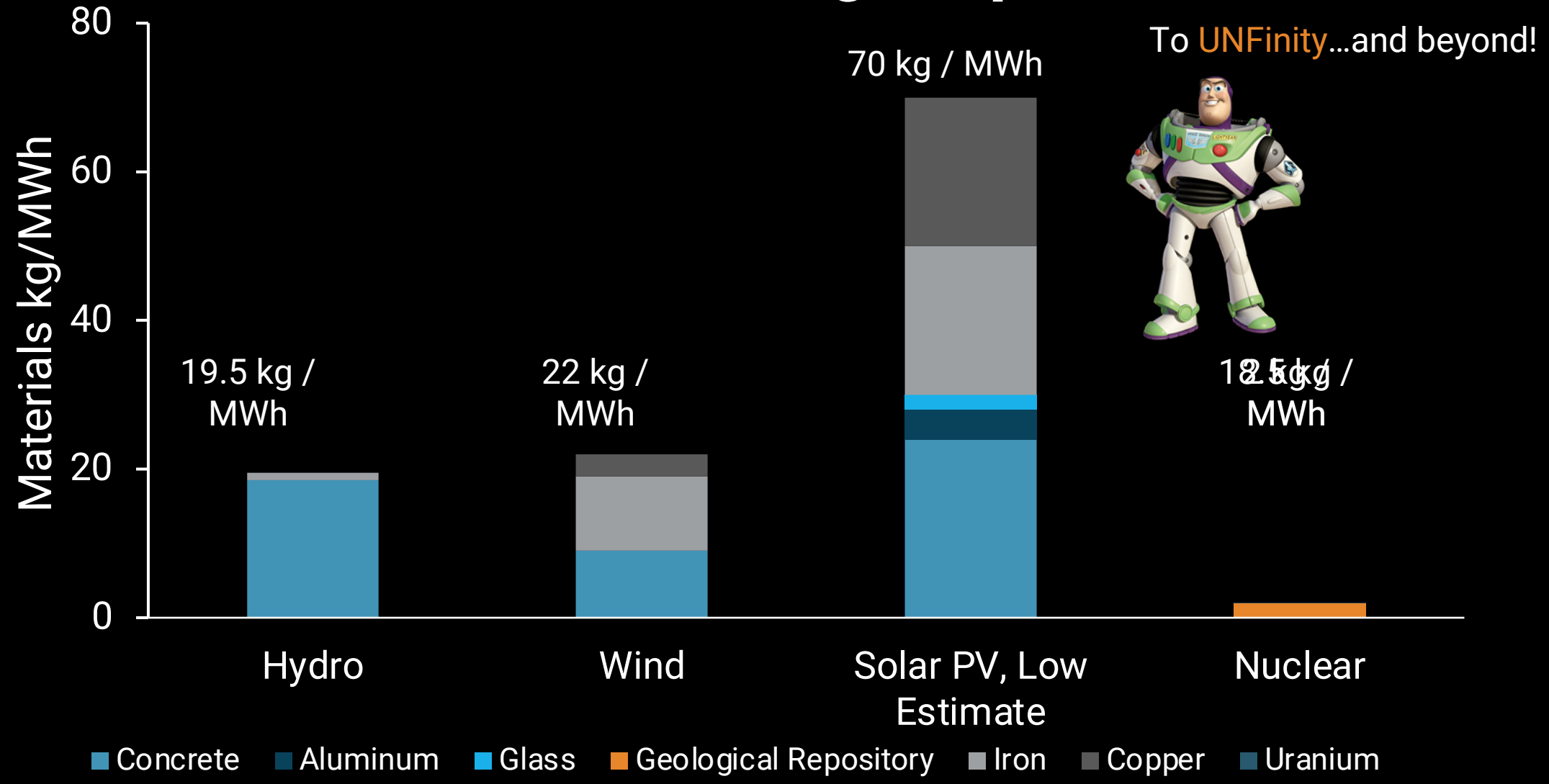
Nuclear Medicine

~$2 billion in UNF

~$10 billion in UNF

~$46 billion in UNF

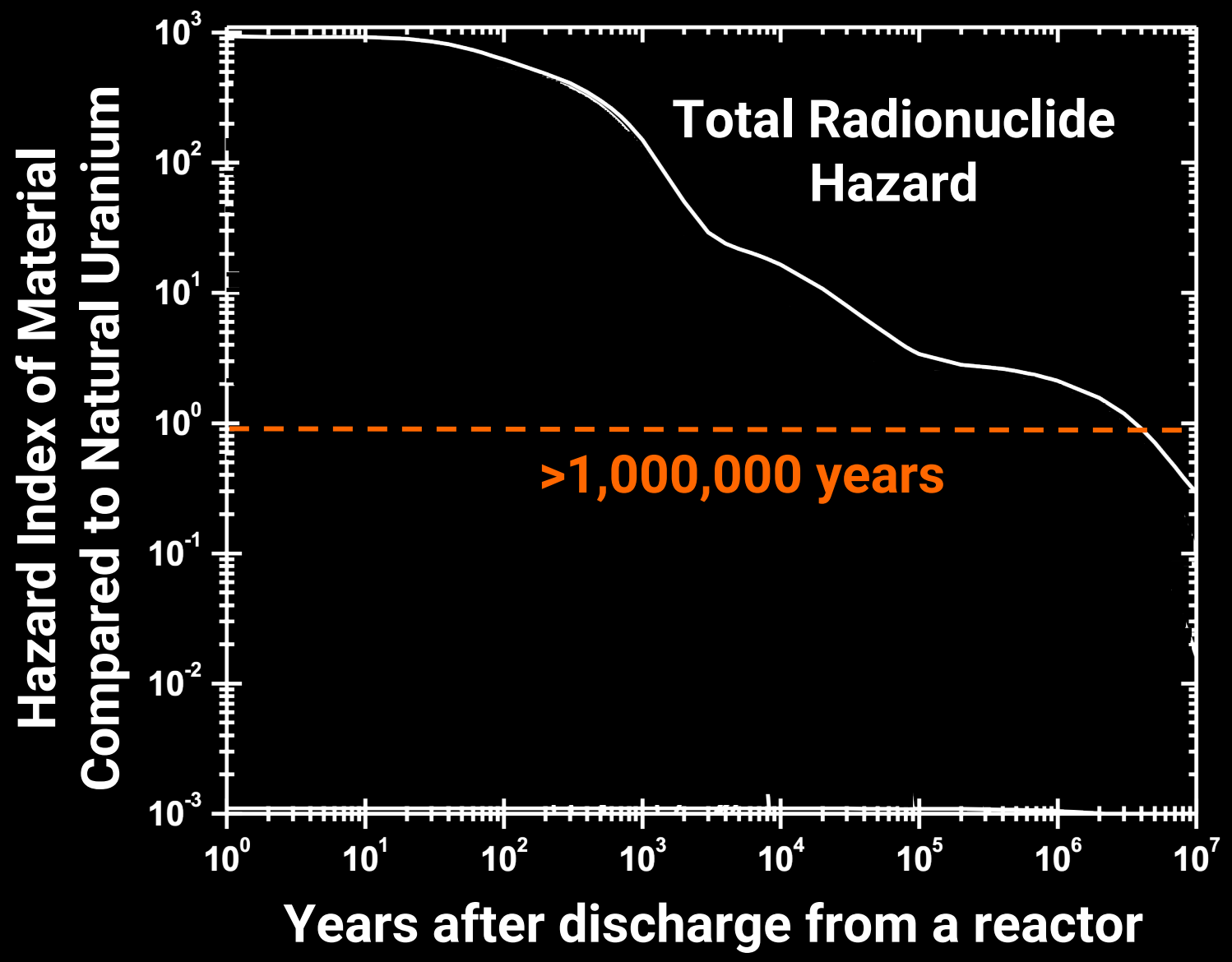
Raw Materials Mining Requirements

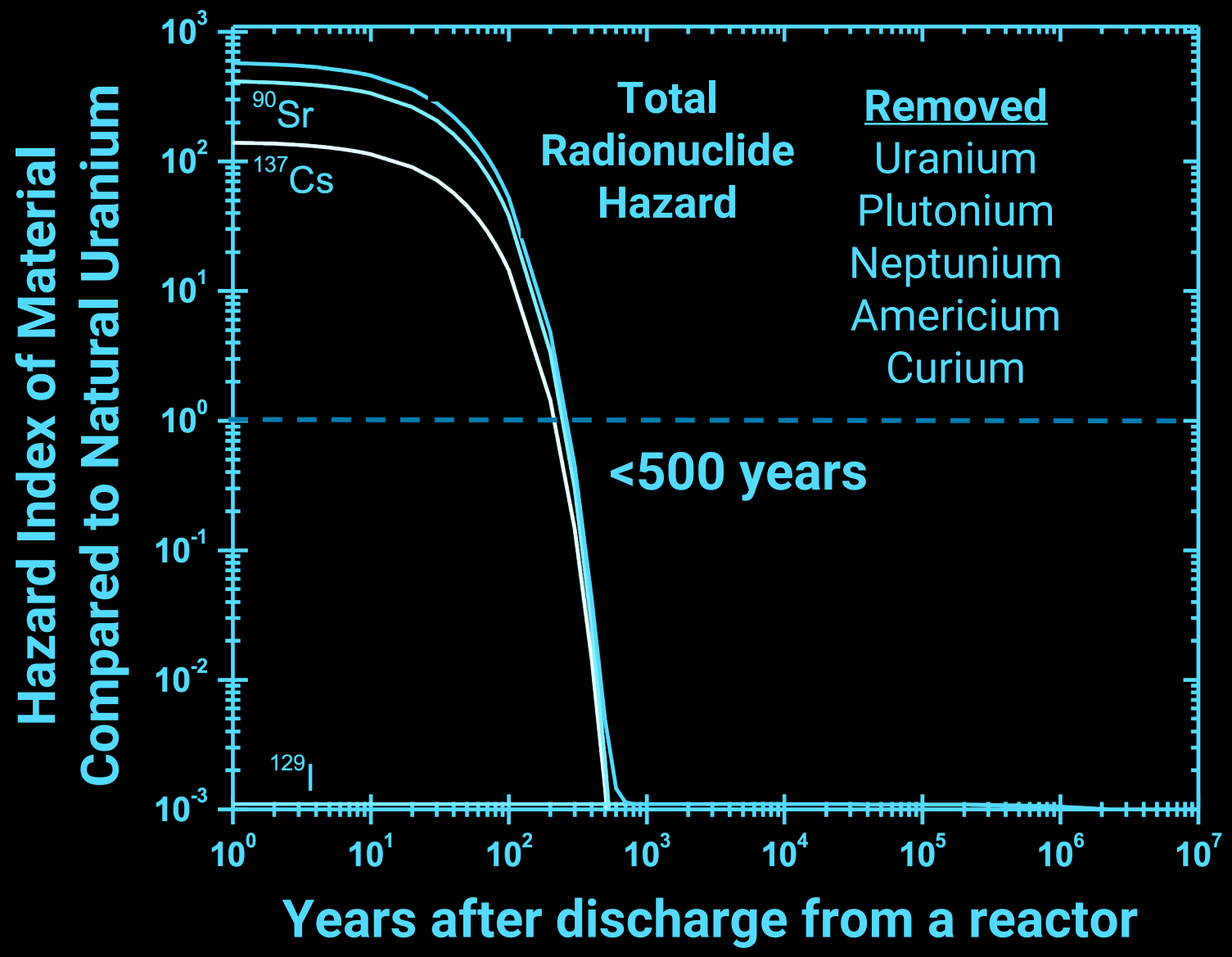


To UNFinity…and beyond!

Reprocessing could bring U.S. nuclear energy to a *post-resource* world

The hidden "fuels" of renewable energy | The unpublished notebooks of J. M. Korhonen (jmkorhonen.net)


Total Radionuclide Hazard
>1,000,000 years
Hazard Index of Material Compared to Natural Uranium
Years after discharge from a reactor
10^3
10^2
10^1
10^0
10^{-1}
10^{-2}
10^{-3}
10^0
10^1
10^2
10^3
10^4
10^5
10^6
10^7


Hazard Index of Material Compared to Natural Uranium
10^3
10^2
10^1
10^0
10^{-1}
10^{-2}
10^{-3}
^{90}Sr
^{137}Cs
^{129}I
Total Radionuclide Hazard
Removed
Uranium
Plutonium
Neptunium
Americium
Curium
<500 years
10^0
10^1
10^2
10^3
10^4
10^5
10^6
10^7
Years after discharge from a reactor

Current challenges and a path forward

COST

Massive facilities
($20-60B)

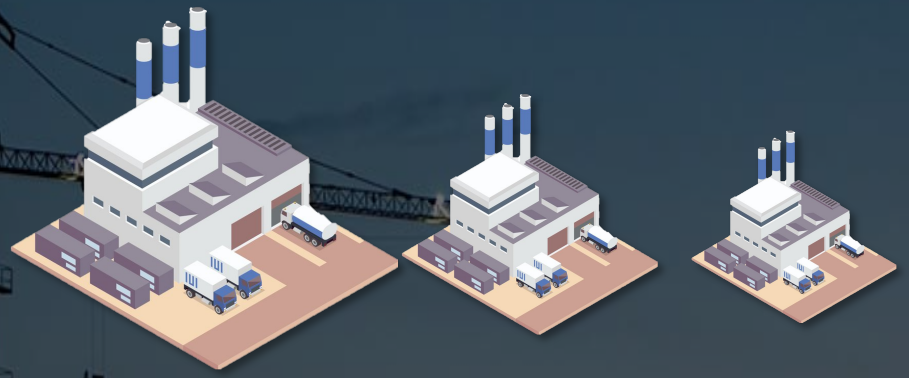
SAFEGUARDS

Pure plutonium streams
Lack of in-process monitoring

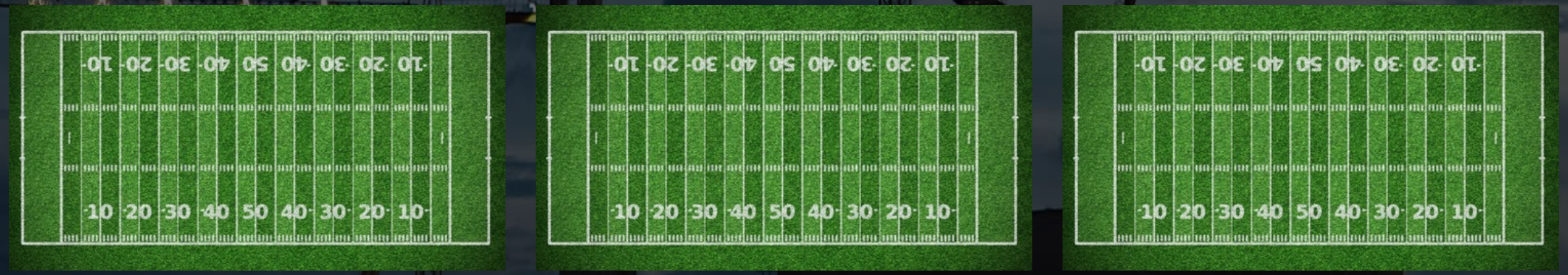
C.U.R.I.E.

Converting UNF Radioisotopes Into Energy

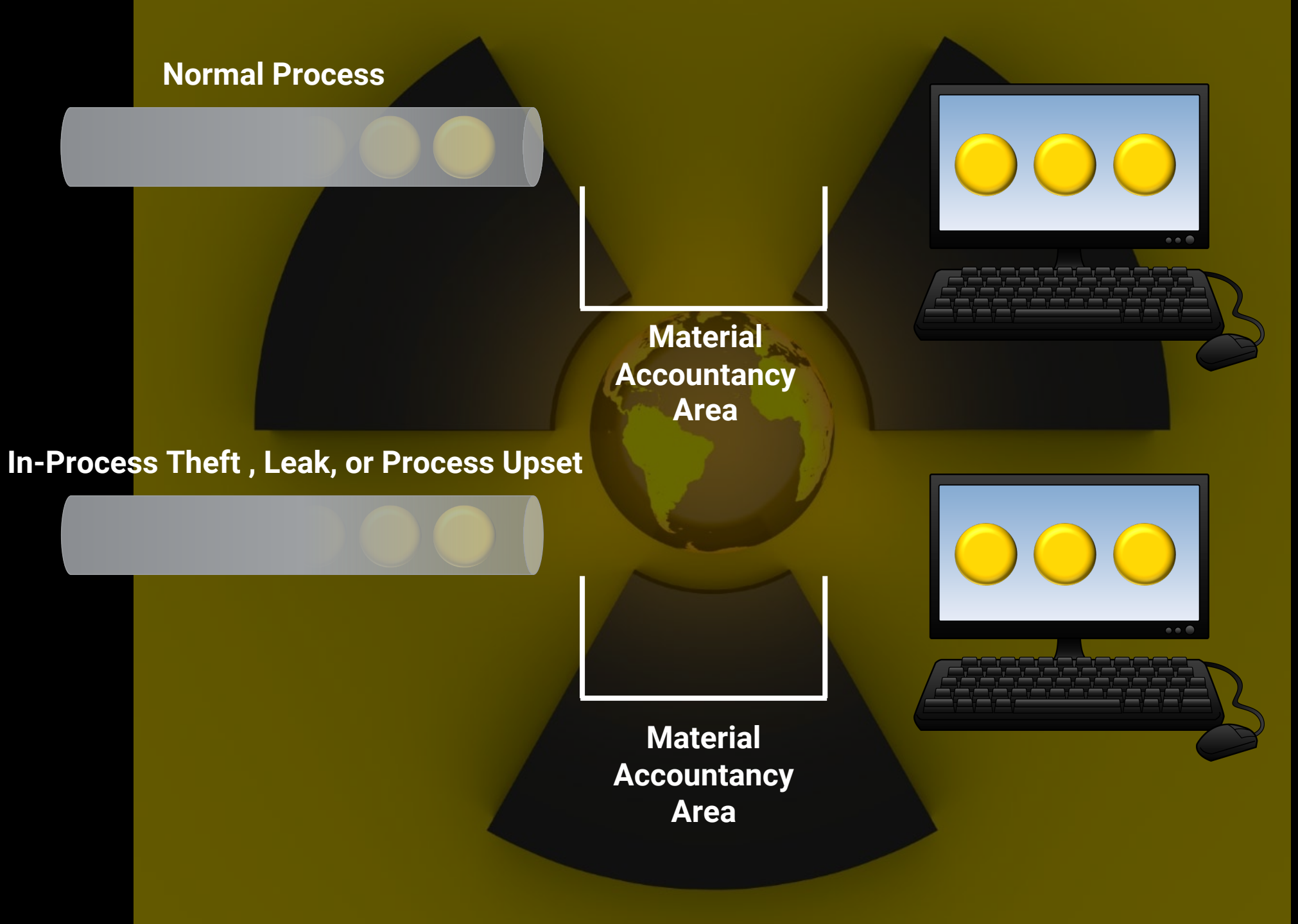
Concrete & rebar drive facility cost (50%)



Driver to manage facility volume



~900’


Normal Process
Material Accountancy Area
In-Process Theft , Leak, or Process Upset
Material Accountancy Area

CURIE aims to change two main paradigms regarding UNF recycling:

1) **Reprocessing is too expensive to be commercially viable**
2) **Effective facility safeguarding only adds additional cost with no performance value**

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