The Ultimate Dilemma for Artificial Capitals:

Ever scarcer natural resources claim

Ever larger artificial capital

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Solow's Growth Eq. : $g_Y = A + \alpha g_K + \beta g_L$

g_Y: GDP rate; A: S&T term; g_K:Capital; g_L : Labor

- The Solow Theory states that there can be a stable growth path on the following assumptions.
- Assumption 1: g_K's weight α and g_L's weight β are fully substitutable and self-adjusting to a possible optimum.
- Assumption 2: "A" term concerned with technological development shares by far the greater part of the GDP growth rate.

Solow, R.M.: *Review of Economics and Statistics*, 39(1957)

Robert Solow's Creed Stated in 1974

- "If it is very easy to substitute other factors for natural resources, then there is no 'problem'. The world can, in effect, get along without natural resources, so exhaustion is just an event, not a catastrophe."

Solow, R. M. (1974) *Amer. Econ. Review* 64

Stiglitz too confirmed the growth pass

- If one views the simple model presented as a reasonable first approximation, not only is sustained growth in consumption per capita feasible, but the optimal rates of utilization of the resource for reasonable values of the parameters is of the order of magnitude observed for many natural resources. There seems to be no presumption that a situation in which there is a “thirty years” reserve of a natural resource is indicative of excessive consumption of the resource.
- It is noticeable that neoclassical and pro-Keynesian theorists are, in concert, growth-oriented and opposed to admit the decisive importance of natural resources.

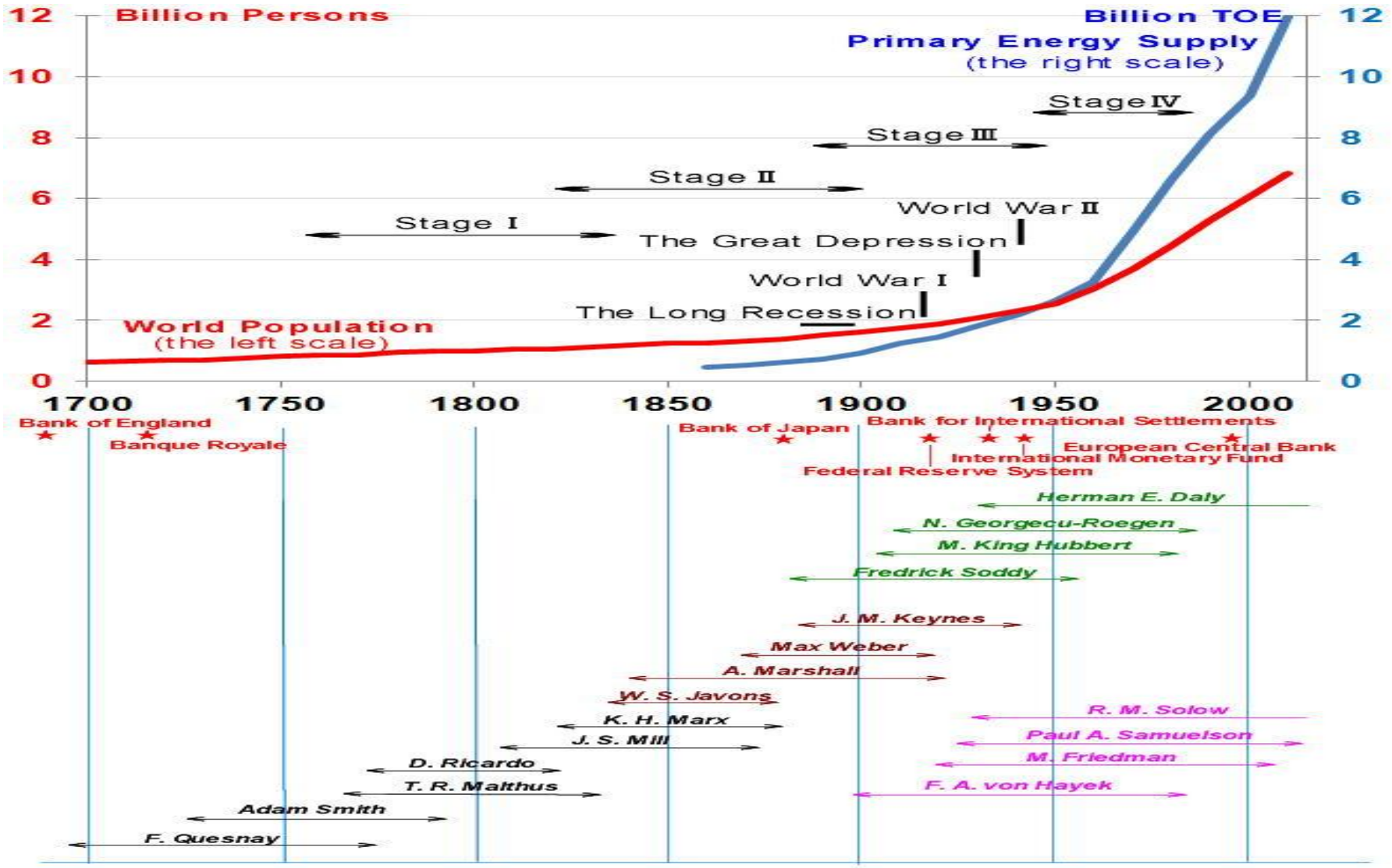
Stiglitz, J. E. (1974). ‘Growth with Exhaustible Natural Resources: Efficient and Optimal Growth Paths.’ *Review of Economic Studies* 41:123-138

H. Daly restored the essentialness of natural resources

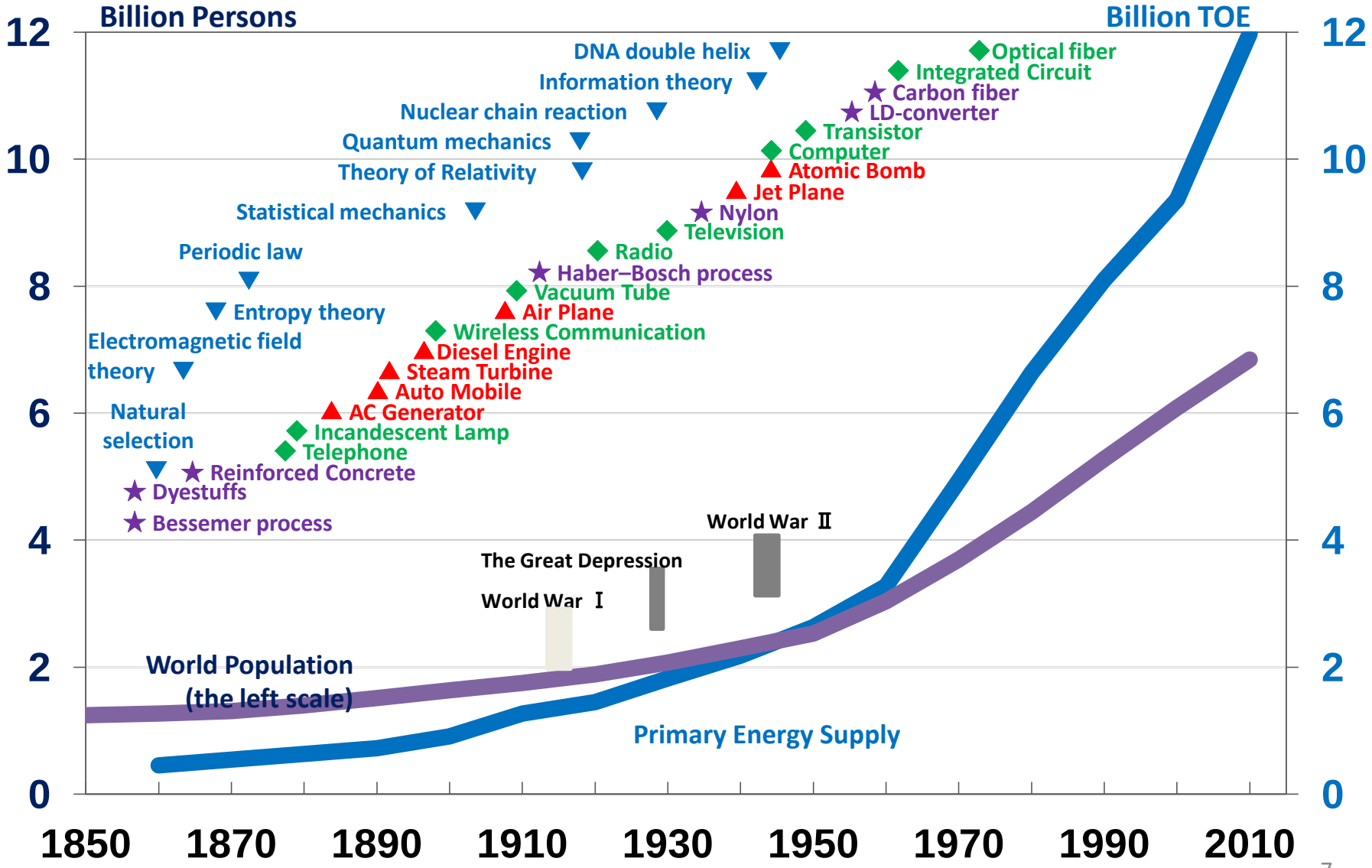
- "Man-made and natural capital are fundamentally complements and only marginally substitutes."
- "Man-made capital is itself a physical transformation of natural resources which come from natural capital. Therefore, producing more of the alleged substitute (man-made capital), physically requires more of the very thing being substituted for (natural capital)-the defining condition of complementarity!"

- Herman E. Daly "*Beyond Growth*" (1996) p.76

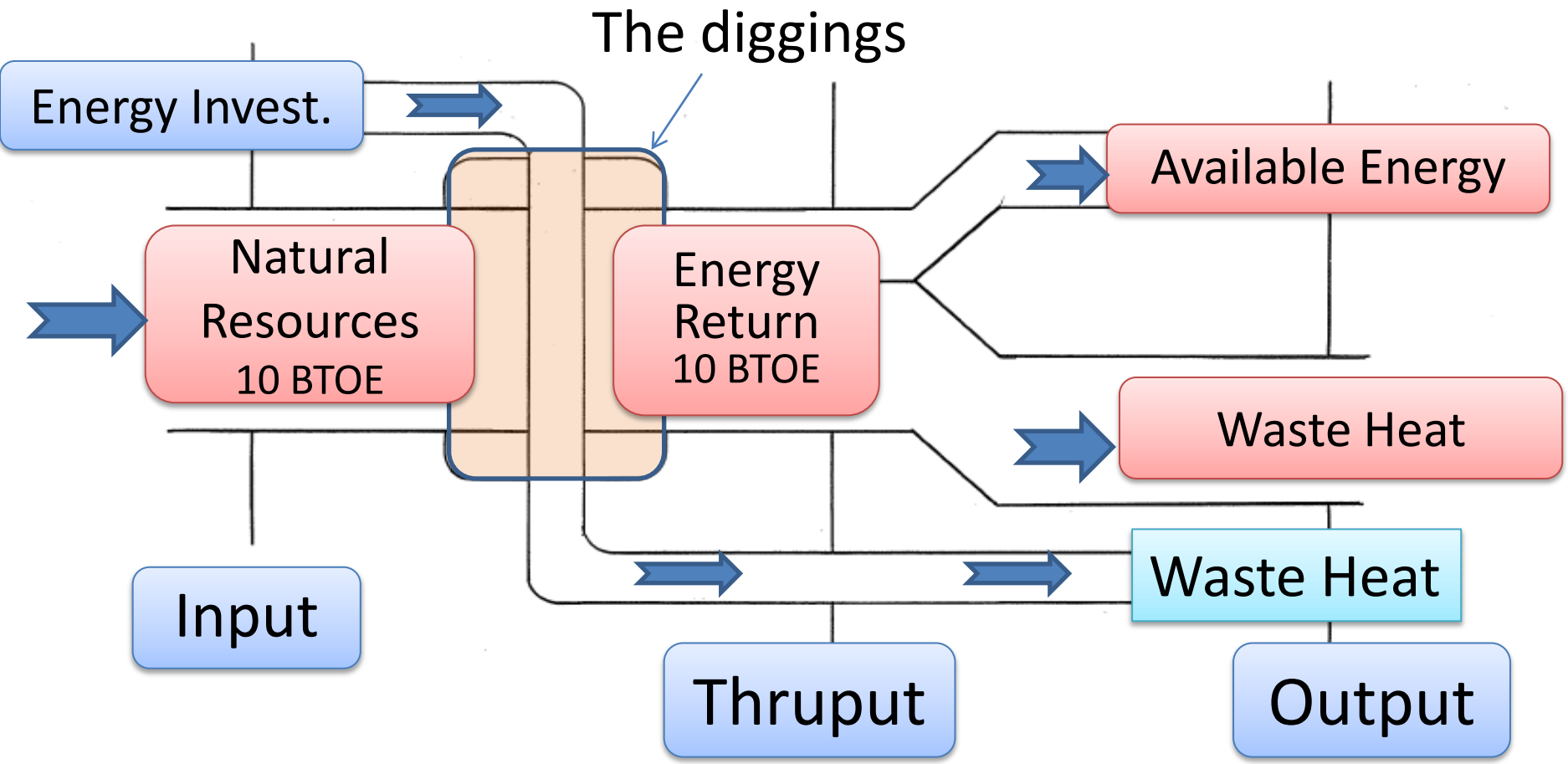
Economic Thoughts vs. P & E Growth



Science & Technology, and the World P. & E.

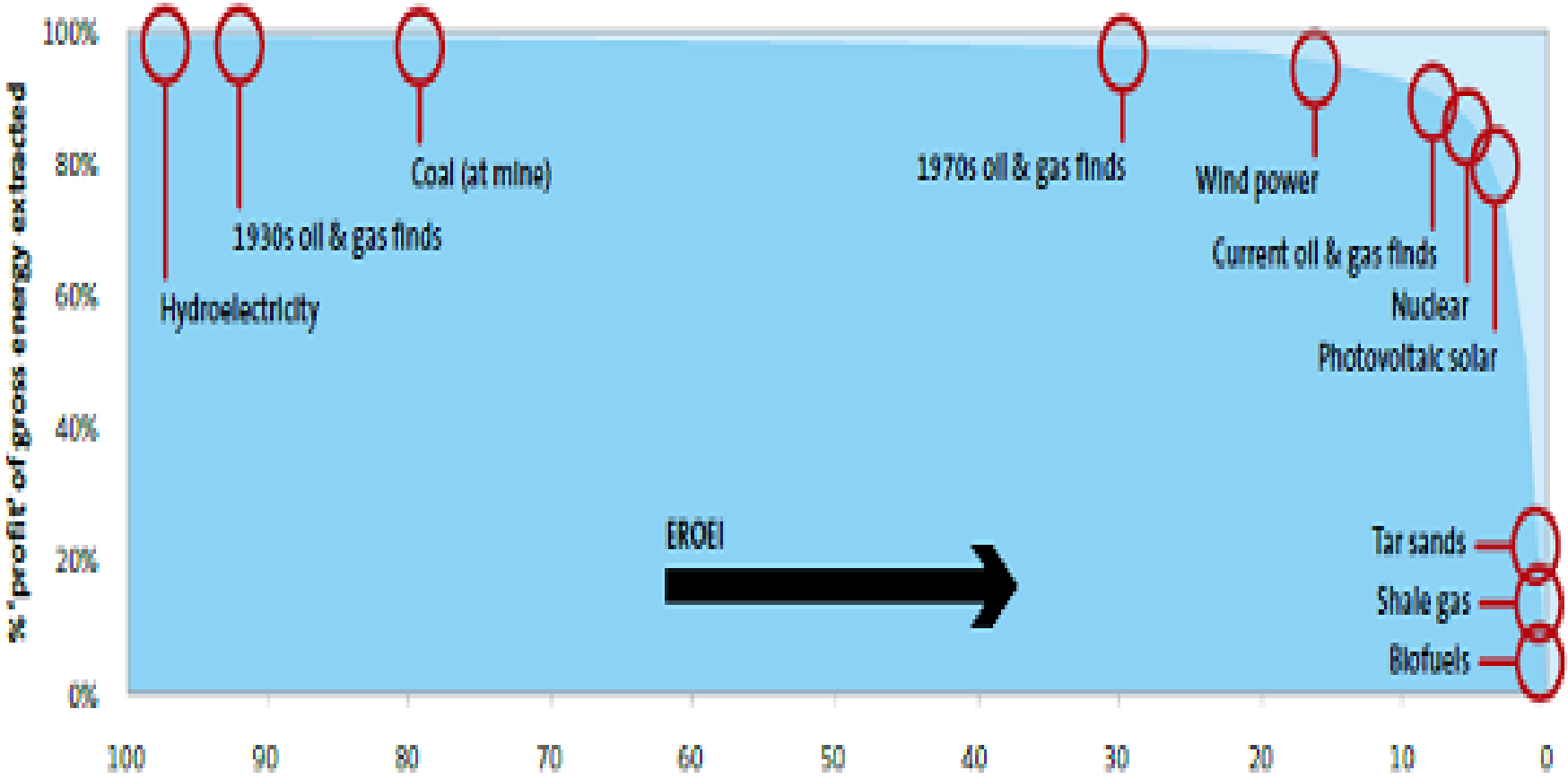


EROEI = Energy Return / Energy Invest.



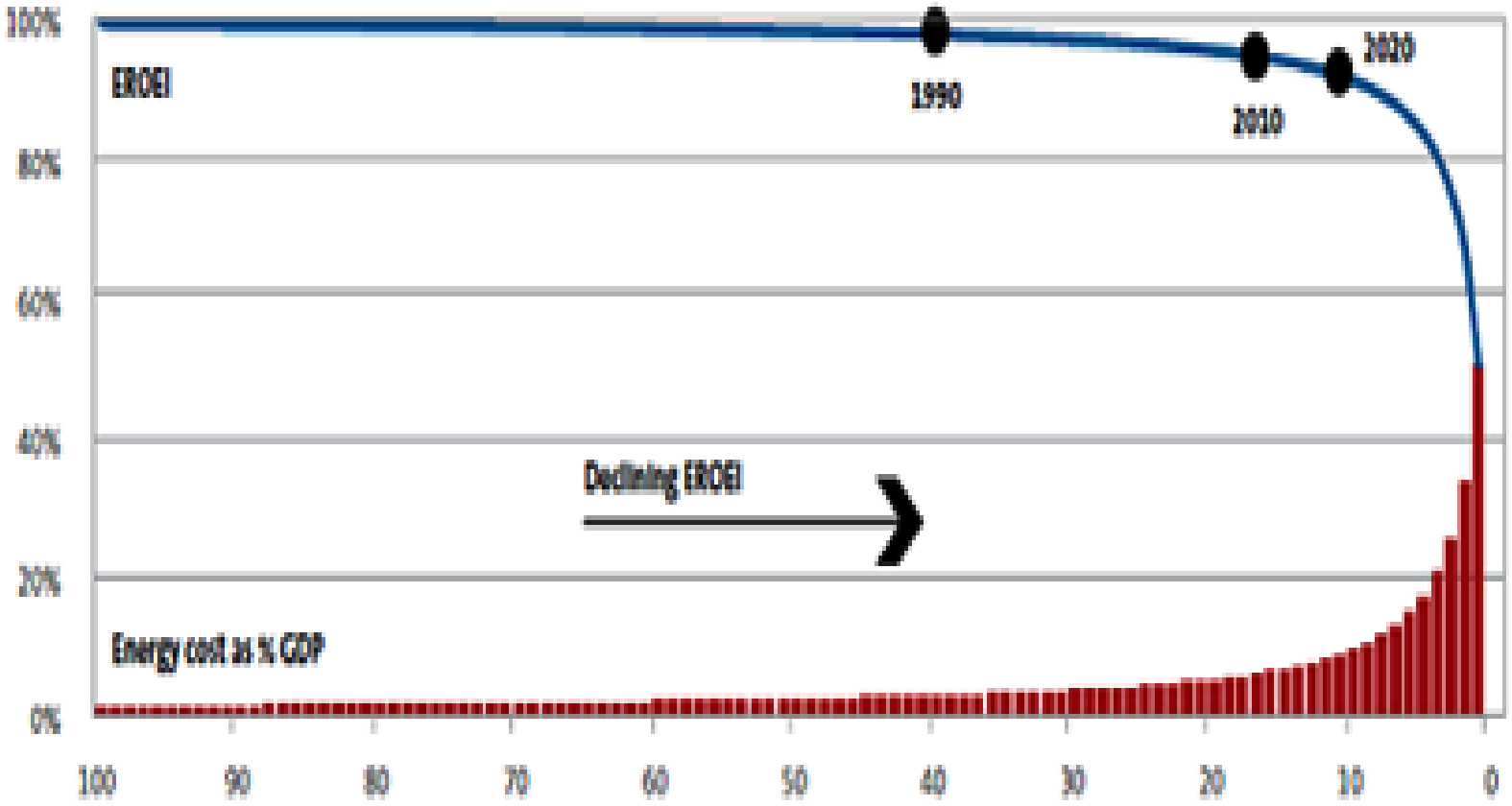
Σ Inputs = Σ Thruputs= Σ Outputs

Ever Deteriorating ERoEI



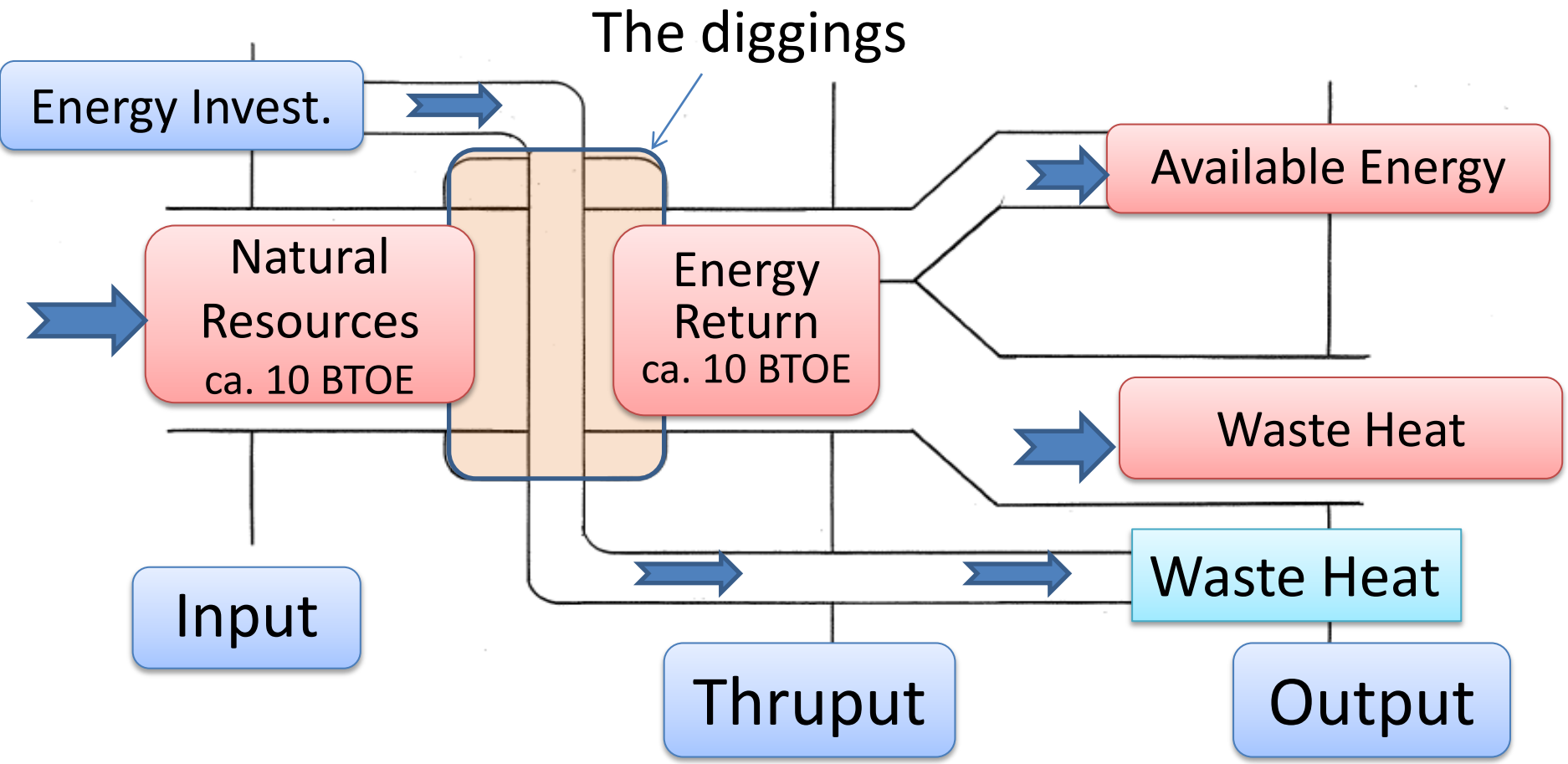
Souce:http://www.tullettprebon.com/Documents/strategy insights/TPSI_009_Perfect_Storm_009.pdf

The Modern Civilization Cannot Stand If the Average EROEI Falls Below 90%



Source: Tim Morgan "Life after growth"

EROEI = Energy Return / Energy Invest.



Σ Inputs = Σ Thruputs= Σ Outputs

Concluding Remarks

- Science and technology cannot resist or overcome this trend of degradation in ER ratio: they must simply accept it and adapt thereto.
- Far from seeking for growth, a simple sustenance is coming on the verge of crisis like the ‘cliff’ of the ER ratio.
- The Growth/Degrowth topic is not a problem of policy option but of historical inevitability.