Expansion scenarios based on current technology

A probable world-wide expansion of nuclear energy has to be based on the 2nd/(3rd) reactor generation, which means current PWR or BWR technology and evolutionarily developed advanced PWR and BWR versions [innovative new systems (4th generation) are not expected before 2030 !]

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Two simple linear expansion scenarios aiming at a significant CO_2–effect (only for electricity production) starting 2005

Today: 365 GW = 16 % world electricity production (5-6 % primary energy)
I : until 2040 to ⅓ world electr.prod.(with 2% increase/y): 1500 GW, i.e.40/y
II: until 2060 to ½ world electr.prod.(with 2.5% increase/y): 4400 GW, i.e.80/y

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Enormous capital needed:
- for scenario I: 3000 – 9000 bill. € (40 new GW-systems per year)
- for scenario II: 9000 – 26000 bill. € (80 new GW-systems per year)

Effect on enrichment capacity (and on additional waste disposal needs/y):
Scenario I: demand is increased by a factor of ~4 in 2040
Scenario II: demand is increased by a factor of 12 in 2060

Effect on uranium resources:
Scenario I: Reserves/resources [A] exhausted ~ 2033
speculative resources [B] exhausted ~ 2065
Scenario II: Reserves/resources [A] exhausted ~ 2026
speculative resources [B] exhausted 2050

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speculative resources [B] exhausted 2050

Effect on cumulative safety risks:
(assuming German „PWR-standard“: core melting accident probability according to 1989 GRS reactor safety study is $p_1 = 3.6\ 10^{-6}$ /y;
consideration of possible improvements to $p_2 = 10^{-6}$/y or even $p_3 = 10^{-7}$/y)

Cumulative core melting probability within 50 years:

	$p_1 = 3.6\ 10^{-6}$	$p_2 = 10^{-6}$	$p_3 = 10^{-7}$
Scenario I (2040:1500 GW)	27%	8%	1%
Scenario II (2060:4400 GW)	80%	22%	2%

→ significant safety improvements necessary for political/public acceptance

First consequences and open questions:

→ significant safety improvements beyond current technology necessary for political/public acceptance (unlikely to be reached within next decades!)

→ uranium resources will probably not meet a significant expansion strategy (however, for forseeable future, plutonium based breeder technology is unproven, especially proliferation-prone, and economically not attractive)

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Recently, IEA (ETP 2008)suggested a 45000 bill. $ program (2010 – 2050) to be invested into energy savings, efficiency, renewables, nuclear and improved fossil technology (50-55 Gt CO_2 savings).
According to „blue scenario“: 32 GW new nuclear capacity annually
→ 25% nuclear electricity production in 2050 (~ win of “CO_2 –free” primary energy share: ~ 3%)
Nuclear investment (1300 GW) will eat up 1/6 ± of total investment with only marginal CO_2 – effect.

→ Which countries could afford the high investment needs? What are the proliferation related ramifications when newcomers invest nevertheless?