Nuclear Energy in the Context of India's Energy Policy

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प्रयास

Overview

- Part I. – Role of Nuclear Energy in India's Energy Mix
- Part II. – Neglected Areas in Energy Policy
- Part III. – Way Forward

Recent attention to nuclear energy

- Indo-US Nuclear Deal
  - Cooperation on peaceful use of nuclear energy
  - Import of nuclear plants and fuel
- Debate / Discussion around
  - Energy Security
    - India's energy needs growing but resources of coal, oil, gas, hydro are insufficient
    - Need to add large amount of nuclear generation capacity
    - Nuclear renaissance and India should not lag behind
  - Global Warming
    - Nuclear plants do not emit CO2 so provide environmental benefits

What is energy security?

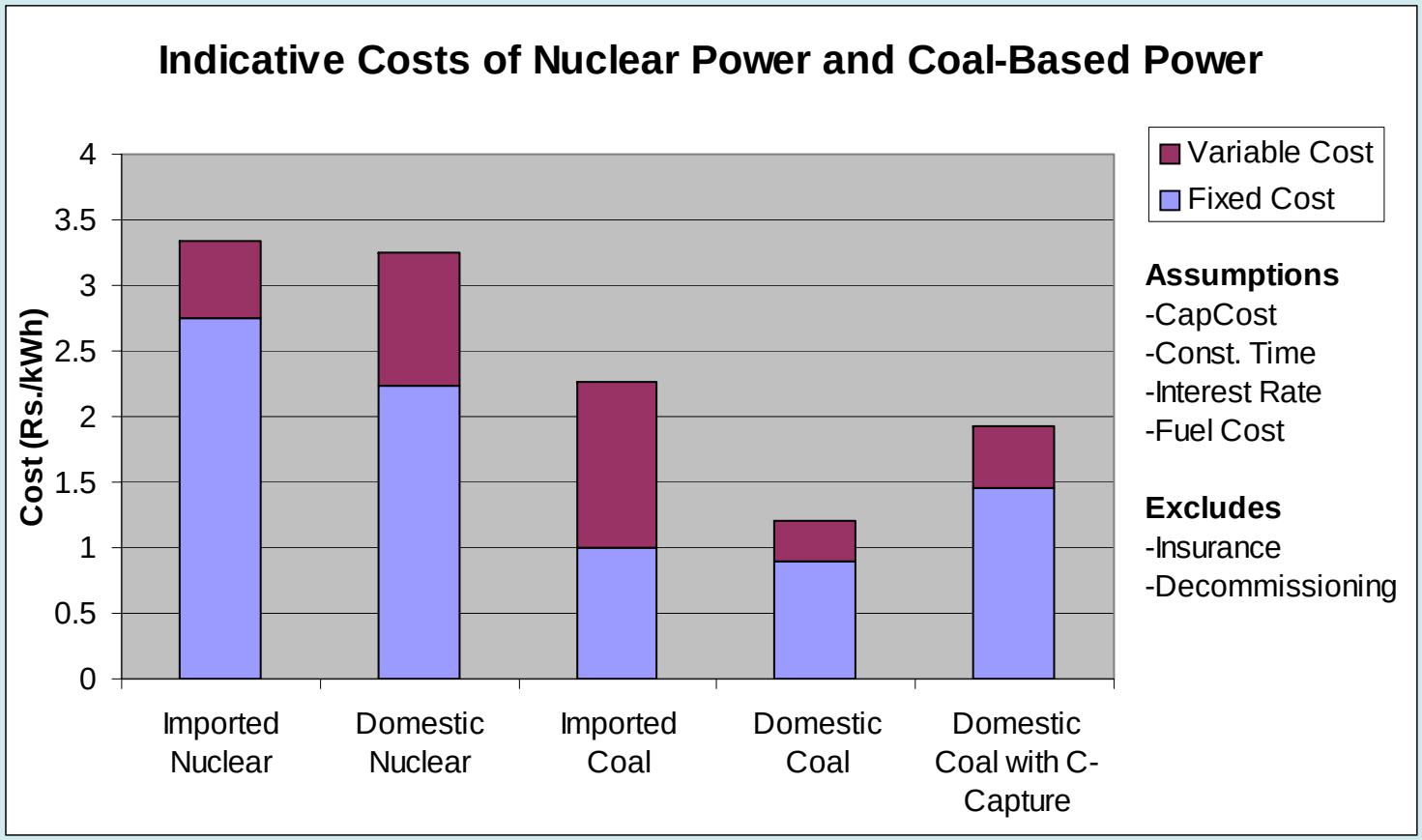
- Energy security
  - Lifeline energy to all
  - Meet demand at competitive prices
  - Able to withstand reasonably expected shocks and disruptions
- Risks to consider
  - Supply risks – disruptions or shortages
  - Market risks – sudden increases in prices

What is energy security? *(Contd.)*

- Reducing risks
  - Reduce the requirements for energy through efficiency and structural changes in economy
  - Reduce dependence on imports
  - Diversify fuel choices and sources
- Ideal source for secure energy supply
  - Inexpensive
  - Long term and sustainable supply
  - Not dependent on imports
  - Safe

Likely cost of nuke power

No official estimate yet of Nuclear power tariff !



Gas (CCGT) costs = Rs. 2.23 per kWh

MIT study on future of nuclear power

- Found nuclear power is expensive than coal and gas in base case
- Nuclear power competitive with gas but not coal if all following changes occur:
  - Construction costs decrease by 25%
  - Construction time decrease from 5 to 4 years
  - Uncertainties removed so cost of capital for nuclear is same as coal/gas
- Study said changes plausible but unproven
- Nuclear power competitive with coal and gas if carbon costs $100-200 per ton carbon equivalent. But study notes that coal and gas improvements also likely at these carbon costs
- LBL study says that the several of the base case assumptions differ considerably from historical data and therefore require more justification and investigation.

Import dependence and Resource adequacy

- India - limited supply of Uranium ➔ need for Fast Breeder Technology
- Worldwide supply of uranium at current prices and current consumption likely to last for 85 years
- More may be mined at higher prices
- If nuclear capacity increases, supply will last for shorter period
- With import of reactors and uranium, India may be vulnerable to disruption of supply

Safety

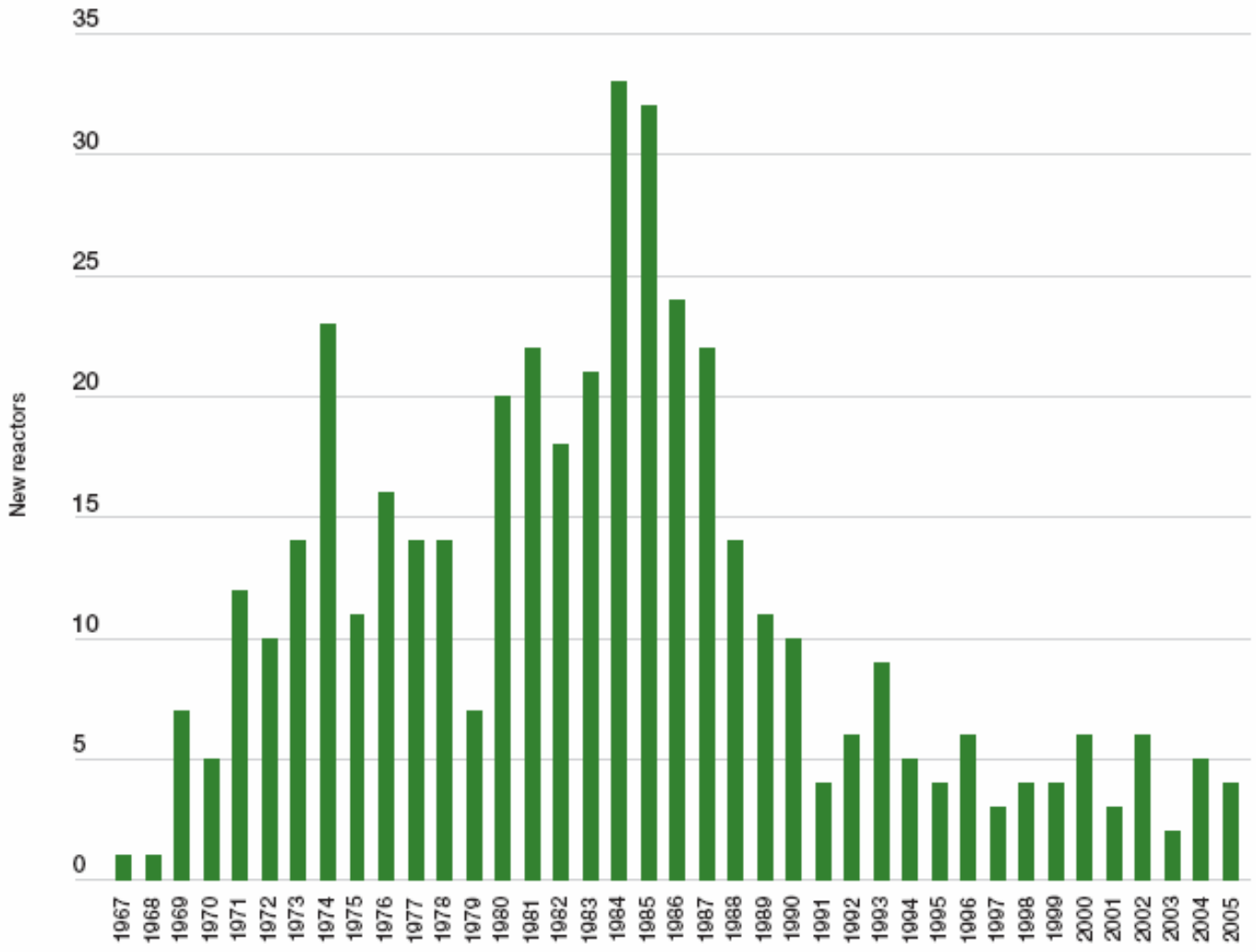
- Complex technological systems have risk of serious accidents because:
  - (1) Complexity of interactions; (2) Tight coupling between sub-systems
  - So difficult to foresee all possible accident modes and errors understood after the fact
  - Small events can trigger bigger failures
  - Therefore, safety assessment of nuclear plants is very difficult → small probability of large accident

Safety and health effects *(Contd.)*

- More probability of small mishaps & risks associated to fuel cycle…
- Routine releases of radioactive elements from nuclear plants
- Study of villages around RAPS found much higher incidences of congenital deformities, cancers, and other diseases compared to villages further away from plant
- Safety and public health concerns in India much greater because of weak regulatory institutions.

Nuclear renaissance?

Figure 1.1 Installation of new nuclear capacity onto grid



Nuclear renaissance? *(Contd.)*

- Not a single new reactor ordered in the US in the last 30 years that was not subsequently cancelled..
- Many European countries moving away
  - Germany and Spain – phasing out of nuclear
  - Sweden – no more nuclear reactors
  - Italy – all four reactors shut down after Chernobyl
  - Austria, Belgium, Norway, Denmark, Netherlands – cautious about building new reactors until nuclear waste issue resolved.

Nuclear renaissance? *(Contd.)*

- Inherent difficulties with technology
  - One measure of rate of learning is the % reduction in costs for each doubling of the cumulative volume of production
  - Learning rate for nuclear plants = 6%
  - Learning rates for solar-PV & CCGT = 32-34%

Nuclear energy and Global warming

- Uranium mining, milling, enrichment, transport and waster storage, reactor construction and decommissioning all have some CO2 emissions.
- Estimates of CO2 emissions vary from 10 - 130 g/kWh. (coal burning emits ~ 800 g/kWh)
- Even nuclear power contributes to global warming, albeit to a lesser extent than coal.

Nuclear energy and Global warming *(Contd.)*

- Even with optimistic assumption of addition of 63,000 MW of nuclear capacity by 2031, nuclear energy will be only ~ 10% of power generation
- If this 63,000 MW is instead generated
  - from coal plants – the additional emissions would be 8% of the Indian emissions, or
  - from gas plants (usual or with CHP) – the additional emissions would be 4 – 2.6% only!
- Nuclear power is likely to remain small part of India's energy mix and small contributor to CO_2 reduction

Nuclear energy – Global warming & the USA…

- USA has the biggest contribution in creating the problem of Global Warming… Indian emissions (per capita) are likely to remain much lower even in the future,
- But USA is promoting Nuclear in India to reduce Indian emissions, while it has neither signed KYOTO nor is building nuclear!

An irony of sorts…

- Part I. – Role of Nuclear Energy in India's Energy Mix
- Part II. – Neglected Areas in Energy Policy
  - Coal Sector
  - Gas Sector
  - Cooking fuel for 70% of the population
- Part III. – Way Forward

Estimation of coal reserve

- Over 50% of coal bearing area (12,200 sq km) is yet to be systematically explored. It has prognosticated resources of 143 Bt
- Additional 67 Bt of prognosticated resources found in Gujarat during oil exploration
- This 210 Bt not included in inventory of coal reserves *(while we talk of country not having sufficient coal)*

Productivity improvement in mining

Comparison of Productivity of Coal Mining (tonnes/man/shift)

	Open Cast	Under-ground	Overall
CIL (05-06)	7.5	0.7	3.3
SCCL (05-06)	9.6	0.9	1.7
USA (03)	77.4	29.5	50.4
Australia (04)	80.2	40.0	65.9

Research & development

- In spite of importance of coal to energy security in India and the issues regarding quality, R&D expenses are paltry
  - Rs 60 cr out of Rs. 50,000 cr turnover
  - R&D expenditure should be at least 10 fold more to meet the of 1% norm

Summary – Coal

- Knowledge of coal reserves abysmal
- Coal companies need to be reformed
- Technology up-gradation is required, at all levels, from coal mining to coal use

Coal sector urgently requires major improvements if energy security is to be ensured

Natural Gas sector

- GoI introduced NELP about 8 years ago to spur exploration and development in oil and natural gas
- Significant gas reserves found (that can power 25 Enrons) helping India move towards self-sufficiency in gas
  - Controversy about gas pricing
  - Lack of gas utilization policy and
  - Concerns about non-competitive industry structure…

Gas utilization and Pricing policy

- No gas utilization and pricing policies
- These policies necessary to balance economic efficiency, affordability, and energy security
- Must address the amount and price for essential sectors such as fertilizers and power to ensure reliability and affordability
- Must ensure that the pattern of gas production and consumption is consistent with having an adequate supply of fuel now and in the future

No attention to industry structure

- Usually, precautions are taken to ensure competition if competitive market is desired
  - Vertical unbundling,
  - Multiple sellers in competitive segment
  - Regulation of monopoly (& essential) segment
- GoI is allowing vertical integration and creation of national oligopolies
  - Private gas producers can lay transmission lines, distribute and market the gas
- GoI has not articulated such a plan for the gas industry even though it did it for the power industry which was harder to do.

Failure to attend to the energy needs of the poor

- Nearly 70% of Indian population uses non-commercial fuels (wood and dung) for cooking
  - Severe shortage of these fuels – Rural poor, particularly women spend several hours a day collecting fuel
  - Lakhs of people die each year because of indoor air pollution due to bad cooking stoves,
  - Estimated 50% of Rs 10,000 Cr of Kerosene subsidy wasted – adulteration with petrol
- Little is being done about this environmental and energy crisis at home

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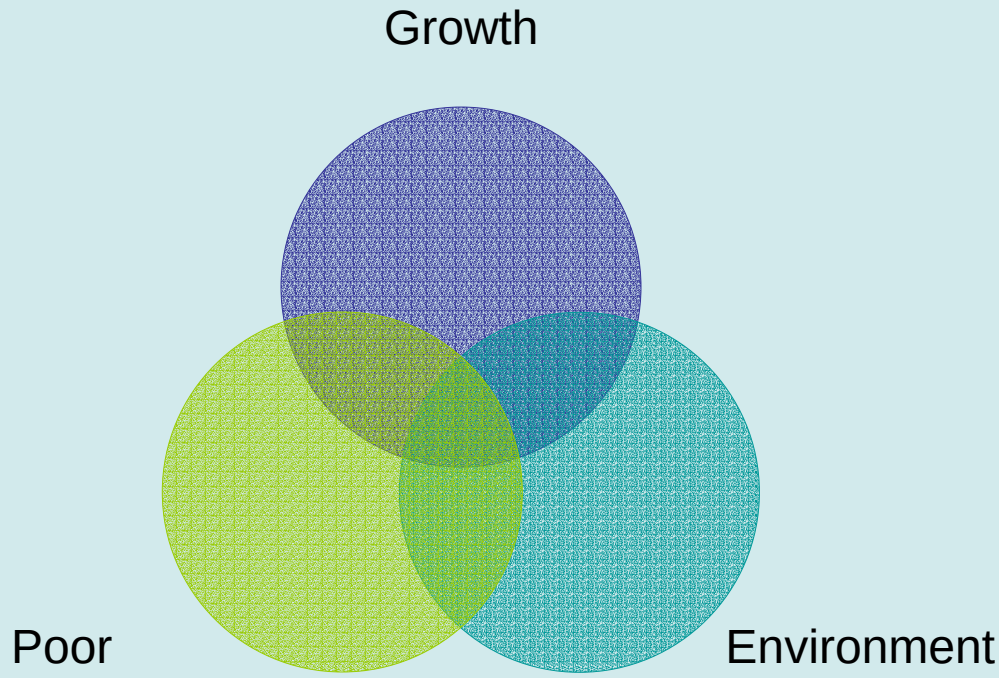
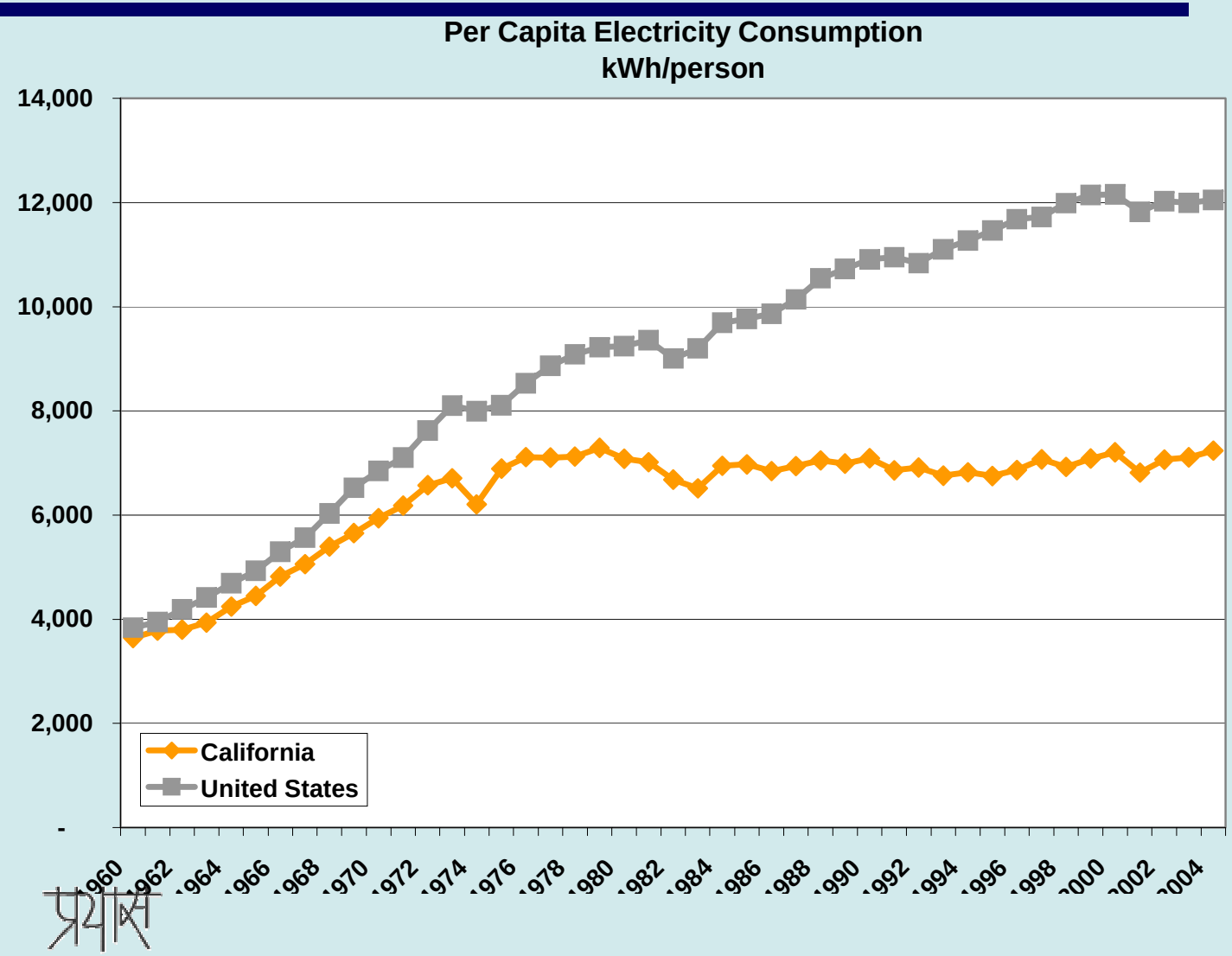
  - Design a desirable future …


Growth
Poor
Environment

Need to design future differently: It is Possible



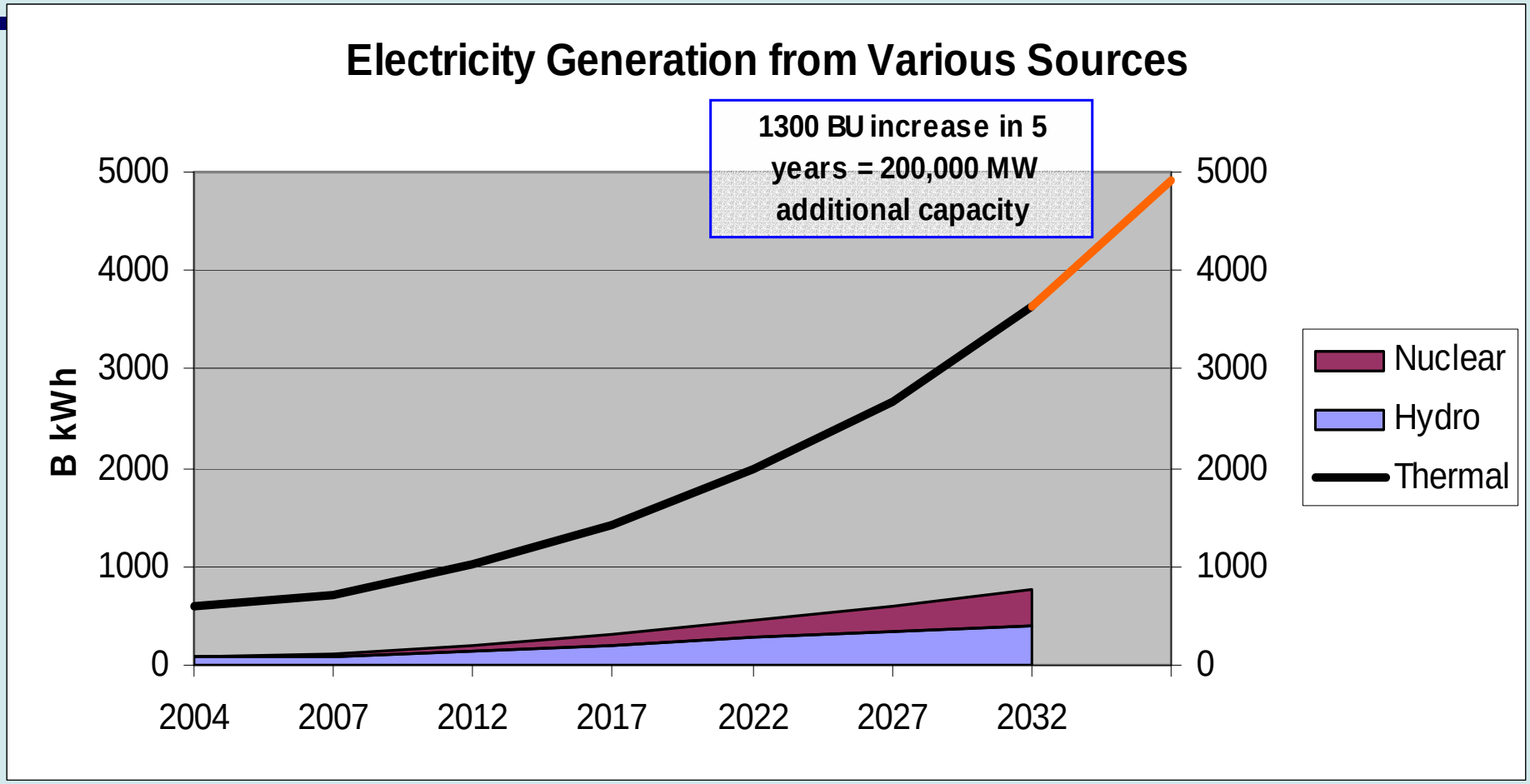
Example of California:

We need more services & more energy, but not essential to follow 'Fuelish' path

Examples

- Transportation: Public transport & Rail → benefits for energy, environment, & poor
- Using gas in CHP mode → improves efficiency by 50% *(40% of recent gas finds used efficiently = additional 10,000 MW)*
- Energy Efficiency – large untapped potential (extraction, transport, and use)
- Intelligent Urban Planning and Development

Urgency of moving away from Fuelish path



Contribution to electricity generation from various sources is indicative only, assumes 63 GW from nuclear power in 2031, and is based on one of several scenarios from Integrated Energy Policy, 2006. However, it demonstrates that an exponential growth trajectory for generation would require capacity additions at the rate of 40,000 MW per year by 2031 and is therefore unrealistic.

Conclusions

- Nuclear power is not a very attractive option
  - Expensive,does not reduce import-dependence, & has safety and security concerns, and
  - Can contribute to a limited extend in GHG reduction
- Can continue in R&D mode **but** should avoid large addition of nuclear power

- Nuclear debate is an example that we are ignoring may viable options – this should stop
- Fascination with Nuclear should not delay progress towards our real challenge of designing the future differently…

Thanks for your attention…

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