COMMENTS OF THE CLEAN AIR TASK FORCE ON THE DRAFT REPORT OF THE SEAB TASK FORCE ON THE FUTURE OF NUCLEAR POWER

September 20, 2016

The draft report correctly identifies a number of the key obstacles and challenges to expansion of nuclear energy, and we agree with a number of its recommendations, especially in the area of expanding NRC capability to license non light water reactors. CATF also applauds the report's recognition of the need for demonstration of multiple technologies, as well as consideration of alternative structures for administering the government role. CATF also agrees with the report's laser focus on dramatically lowering nuclear capital costs to the $2,000/kw price range; without such an aggressive target being achieved, nuclear innovation is not likely to be commercially or environmentally relevant.

Our comments here focus on non-regulatory aspects of advanced reactor development and deployment:

- The draft report seems to envision a nuclear deployment rate after 2030 only slightly better than past business as usual. In particular, the report states that "the Task Force has assumed a target range for this initiative of 3,000 to 5,000 megawatts electric (MWe) annually." However, such a rate is not consistent with numerous analyses suggesting that dealing with climate change may require a tripling or quadrupling of the current nuclear fleet.[1] (see Figures 1 and 2 below) Rather than identifying a US deployment goal, we suggest moving to a target for international deployment of nuclear energy. If the primary aim is to address climate change, then a global target is more relevant. In addition to climate change, we suggest mentioning the potential importance of nuclear in addressing global development, energy access, and energy needs beyond the grid such as industrial processes and the synthesis of zero carbon transportation fuel. The ambition for nuclear expansion should be stated globally and increased substantially to a target of 50-100 GW per year.

- For nuclear to make a meaningful contribution on such a scale in relevant time

[1] See, e.g., Joint Global Change Research Institute, Pacific Northwest National Laboratory, presentation to Implications of Paris, First Workshop, College Park, MD, 4 May 2016 (JGCRI, College Park, MD, 2016); http://bit.ly/JCRI-Paris. (1,614 GW of installed capacity of nuclear required by 2035).

frames, a radically different production and commercial model will be required in addition to core technical innovations. Specifically, the industry will need to move toward a commodity factory-based manufacturing approach more akin to the way airline production or combined cycle plants are built – on one- to two-year time frames. This strategic "manufacturing model" imperative is not reflected in the report, and deserves attention in any strategy development..

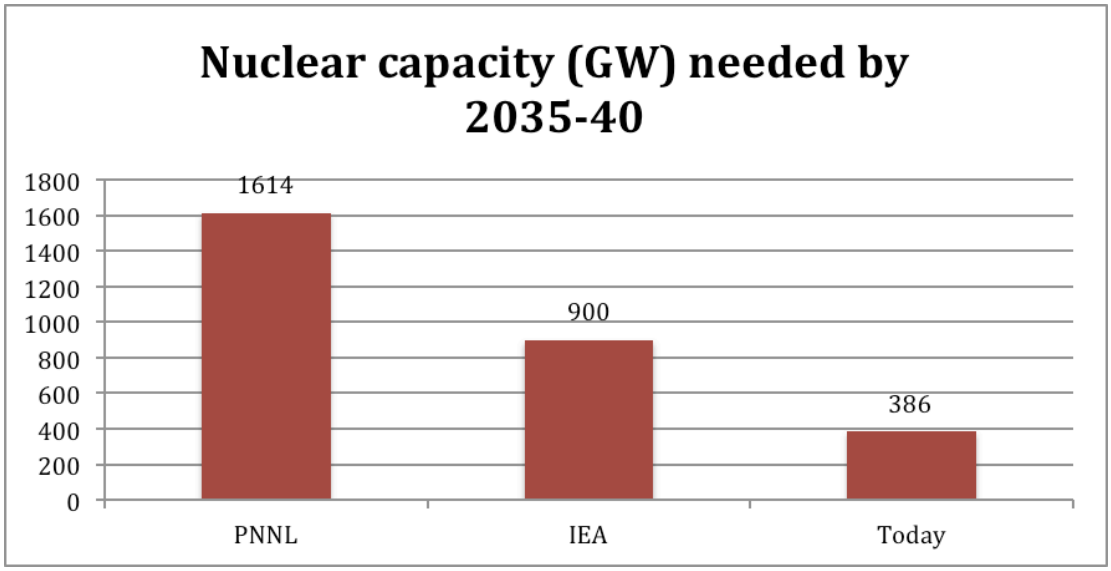

Figure 1. *Nuclear capacity needed to meet climate targets by various estimates, and implied annual construction rate. (Source: Clean Air Task Force from PNNL, IEA, WNA)*

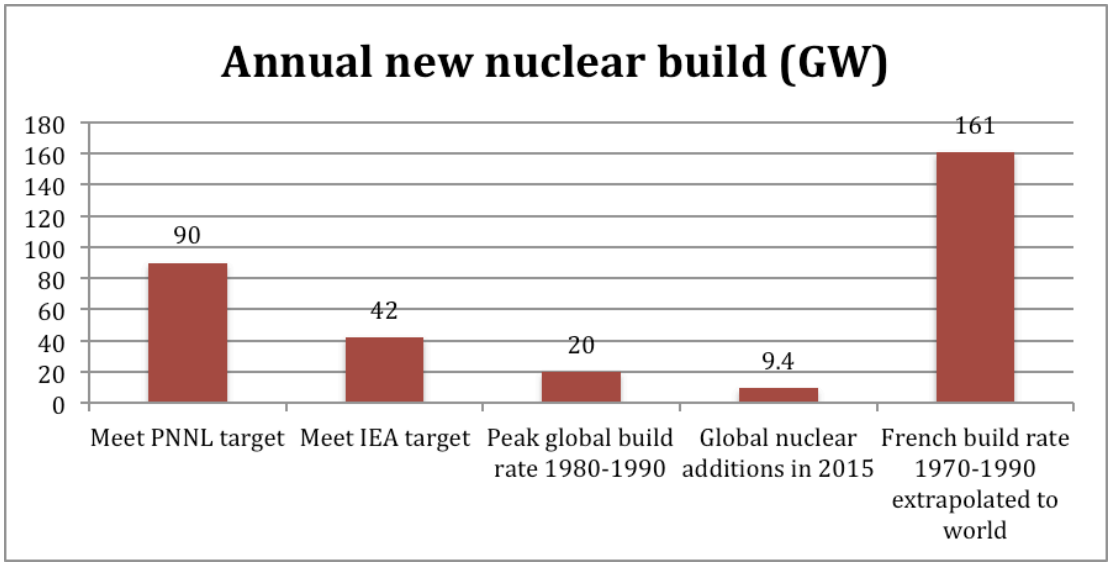

Figure 2. *Annual nuclear build rate required to meet various nuclear energy targets, assuming that half of all current reactors will need to be replaced by 2040. The last bar represents an extrapolation of the French nuclear plant build rate over two decades 1970-90 to the current world as a whole, normalized by GW installed per unit population. (Source: Clean Air Task Force from PNNL, IEA, WNA)*

- An important additional context point here is that nuclear energy – especially advanced reactors – is likely to be deployed first outside of the US in the developing world, as is the case today with the bulk of new build occurring in non-OECD countries; this is where demand is growing and the markets are. So, while the US has an important role to play, that role and enabling strategy should be designed in the context of making advanced technology relevant to global markets. This means the US advanced reactor policy might focus more on ***what is necessary to get advanced reactors to readiness for global commercial adoption***, and less on what is necessary for their deployment in a US environment likely to be characterized by inexpensive gas for some time. This also implies a greater emphasis than is in the report on a fresh look at US civilian nuclear technology export controls with an eye towards accelerating international cooperation.

- The report proposes a government-led advanced reactor development program implemented through a public-private partnership, that would down select technologies based on various criteria and guide their development. The report arrives at this recommendation by considering two straw man options – a "laissez-faire" option with virtually no government role except carbon pricing, and a traditional DOE program structure. However, the public-private option envisioned is in some ways a traditional DOE program akin to the FutureGen CCS program,

albeit with more political and fiscal autonomy akin to the Synfuels Corporation. In light of the poor history of government-***driven*** (as opposed to government ***enabled***) large scale commercialization of innovation in the nuclear, CCS and synfuels spaces, it is questionable whether a government-led effort is appropriate in the advanced nuclear space, which is bursting with private sector innovation and at the same time in need of rigorous cost discipline. We believe such a government-driven approach could be even harmful, by rewarding companies that are better equipped to interact with an intricate federal process rather than companies with meritorious technology.

- We are not encouraged by the 25 year deployment timeframe set out in the draft report, and this may be the most pivotal weakness of the proposed public private partnership. Based on a recent survey by our sister organization, the Energy Options Network, of 12 US advanced reactor developers, we believe several developers could be ready for FOAK demonstration overseas within a decade with proper domestic support.

- The report appears to propose a Phase One which includes a two-year DOE lab R&D program. But it is not clear that this R&D (whatever is contemplated) would be appropriately aimed at the key issues faced by the private sector innovation underway; not clear who could effectively specify the R&D paths needed; not clear that DOE labs would be the appropriate researchers (the report explicitly describes the need to use international facilities to substitute for facilities not available in the US); and not clear that DOE lab R&D would be economically efficient without significant changes in contracting practices.

- To facilitate this kind of rapid development timeframe, there is another approach – a government role that supports but does not guide innovation, or attempt to pick winning technologies. The main elements of such a process could include at a minimum:

  - ✓ Creation of federally sponsored sites for demonstration of advanced reactor fuels, materials, and demonstration reactors. The elements of such a site are outlined in Box 1 below, based on an expert and developer elicitation performed by the Nuclear Innovation Alliance in Fall 2015. This would build on but go beyond the parameters of the current GAIN initiative

Box 1: Test bed/demonstration site key attributes

Physical/Technical

- Seismically safe and fully environmentally characterized
- Fuel fabrication, handling, disposition and analysis
- Facilities to accelerate materials qualifications
- Hot cells
- Containment Structure(s)
- Computing power
- Flexibility
  - Multiple sites/multiple countries may be desirable
  - Different services may be located at different sites

Personnel/Management

- Ancillary functions provided (security, water, emergency services, etc.)
  - Alleviates cost concerns for startup companies
- Support staff:
  - Machinists, Technicians, Health physics experts
  - Project manager/site facilitator(s)

Policy/Regulatory/Cost

- Development agency and regulator input/cooperation (e.g. DOE + NRC)
- Power purchase agreements
- Environmental permits in place
- International cooperative agreements
  - Clarification of liability
  - Clarification of IP protection
- An "access-limiting" application
  - Qualification would require a safety case and financial demonstration at a minimum
- Nominal cost to enable small company participation
  - Tiered based on need and desired level of use
- Critical testing procedures to be run and funded by participating companies (to ensure IP but also to allow training)
  - Critical to find private funding

- ✓ A federal cost-share for advanced reactor developer licensing costs. Requiring a significant cost share will ensure that only serious players will apply.

- ✓ Targeted support for FOAK and early commercial demonstration such as technology risk insurance that leaves project construction risk on the developer.

- ✓ An RFP for PPA for FOAK advanced reactor output to federal customers such as military bases.

- ✓ A revisiting of export controls to focus on technology and IP that is truly relevant to national security concerns. As the report suggests in the case of TerraPower, much US-based technology is likely to be developed with foreign partners. The US should want advanced civilian nuclear energy innovation to cross borders rapidly, as long as national security issues are addressed.

- CATF supports the proposal that a quasi-public corporation be established to oversee elements of an advanced nuclear initiative. While we suggest the initiative should be somewhat different from the one described in the report, the management change suggested and the budget certainty would bring needed stability to the advanced nuclear development and demonstration program.

- The report includes no mention of the large potential efficiency and cost benefits of developing advanced power conversion cycle equipment in parallel with development and deployment of advanced fission reactors.. This might be a useful near-term DOE initiative.