SENATE COMMITTEE ON ENERGY, UTILITIES AND COMMUNICATIONS
Senator Steven Bradford, Chair
2023 - 2024 Regular

Bill No:	AB 1172	**Hearing Date:**	6/20/2023
Author:	Calderon		
Version:	4/17/2023 Amended		
Urgency:	No	**Fiscal:**	Yes
Consultant:	Nidia Bautista		

SUBJECT: Integrated energy policy report: fusion energy

DIGEST: This bill requires the California Energy Commission (CEC) as part of its 2025 integrated energy policy report (IEPR) to include an assessment of the potential for fusion energy to contribute to California's power supply.

ANALYSIS:

Existing law:

1) Declares the policy of the state to encourage the use of nuclear energy, wherever feasible, recognizing that such use has the potential of providing direct economic benefit to the public, while helping to conserve limited fossil fuel resources and promoting clean air. (Public Resources Code §800)

2) Prohibits any nuclear fission thermal powerplant from being permitted in the state until the federal government approves technologies to reprocess the spent nuclear fuel rods, and the CEC reports to the Legislature affirmative findings of that federal action. (Public Resources Code §25524.1)

3) Requires the CEC to conduct assessments and forecasts of all aspects of energy industry supply, production, transportation, delivery and distribution, demand, and prices and use these assessments and forecasts to develop and evaluate energy policies and programs that conserve resources, protect the environment, ensure energy reliability, enhance the state's economy, and protect public health and safety. (Public Resources Code §§25000, et seq.)

4) Requires the CEC to adopt the IEPR every two years, which must contain an overview of major energy trends and issues facing the state, including, but not limited to, supply, demand, pricing, reliability, efficiency, and impacts on

public health and safety, the economy, resources, and the environment. (Public Resources Code §§25300-25327)

5) Requires the CEC to incorporate firm zero-carbon resources into the IEPR in a timely fashion. (Public Resources Code §25305.5)

This bill:

1) Requires the CEC, as part of the 2025 edition of the IEPR, to include an assessment of the potential for fusion energy to contribute to California's power supply. Requires the assessment to include:

   a) Identifying necessary regulatory actions required to deploy fusion energy within California's energy system.

   b) Identifying the regulatory actions required to bring fusion power plants online.

   c) Analyzing steps needed to create a skilled and trained fusion energy workforce.

   d) Identifying state and federal investments available for fusion energy, including aneutronic fusion, to market in California.

2) Defines "aneutronic fusion" to mean fusion energy that uses fuel that does not qualify as a byproduct material, as defined in the Code of Federal Regulations, and for which the primary fusion is aneutronic, meaning it does not carry more than one percent of the total energy released and the outputs of the primary fusion reaction do not qualify as byproduct material.

Background

Integrated Energy Policy Report (IEPR). The IEPR provides a cohesive approach to identifying and solving the state's pressing energy needs and issues. The report, which is crafted in collaboration with a range of stakeholders, develops and implements energy plans and policies. SB 1389 (Bowen and Sher, Chapter 568, Statutes of 2002) required the CEC to conduct assessments and forecasts of all aspects of energy industry supply, production, transportation, delivery and distribution, demand, and prices. The CEC is then required to use these assessments and forecasts to develop energy policies that conserve resources, protect the environment, ensure energy reliability, enhance the state's economy,

and protect public health and safety." The CEC adopts an IEPR every two years and an update every other year.

Nuclear energy. There are two fundamental ways to release energy from nuclear reactions: fission and fusion of atomic nuclei. Nuclear fission is a process where the atomic nucleus splits apart; nuclear fusion is where atomic nuclei combine (or fuse) together. Both processes are theorized to generate energy. In nuclear fission, the process often yields some combination of particles and energy, often with radioactive decay. In nuclear fusion, the process can manifest as either an absorption or release of energy, sometimes with radioactive decay.

Nuclear fission electricity generation is commercially available today, such as the Diablo Canyon Nuclear Powerplant. Very generally, for fission-based electricity generation, the atomic splitting releases heat and energy which is used to boil water; the water produces steam, which turns a turbine to generate electricity. Electricity generation based on fusion has yet to become commercially viable, and is still in research and development. There are multiple fusion methods that are currently being pursued for use in a commercial reactor system. Similar to fission, the released energy from a fusion process would be converted to heat, which in turn is converted to electricity via a conventional generator cycle. Although the fusion reaction theoretically does not produce significant or long-lived radioactive byproducts, the high-energy particles irradiate the surrounding reactor vessel and associated components. The irradiated material could pose potential disposal problems similar to those for the irradiated fission reactor vessel. Nuclear fusion continues to be actively pursued, unlike nuclear fission, is there are less waste products, no risk of a nuclear melt down, and fusion power provides more energy for a given weight of fuel than any fuel-consuming energy source currently in use. The aim of any controlled fusion process is to achieve "ignition," which occurs when enough fusion reactions take place for the process to become self-sustaining, with fresh fuel then being added to continue it. Once ignition is achieved, there is net energy yield – about four times as much as with nuclear fission. According to the Massachusetts Institute of Technology, the amount of power produced increases with the square of the pressure, so doubling the pressure leads to a fourfold increase in energy production.

Technological "breakthrough." The world's most powerful laser fusion facility, the National Ignition Facility (NIF) at Lawrence Livermore National Laboratory, was completed in March 2009. Using its 192 laser beams, NIF is able to deliver more than 60 times the energy of any previous laser system to its target. In December 2022, a team at NIF conducted the first controlled fusion experiment in history to reach the ignition milestone, meaning it achieved a net energy gain,

producing more energy from fusion than the laser energy used to drive it. Andrew Sowder, senior technical executive at the Electric Power Research Institute (EPRI) was quoted in *POWER Magazine* describing the ignition milestone as akin to getting the first man in orbit. "You're not to the moon yet, but you've shown you can get the person in space. This is kind of a first step."

Comments

Fusion energy is nascent technology. Multiple reports have stated that commercially available nuclear fusion technology may be decades away. Determining the potential of fusion energy as a meaningful source of electricity requires a leap ahead of the current stage of research and demonstration, to consider cost and scale. At this stage, cost is astronomical and scale is tiny. It is likely that the CEC will be challenged to predict the extent and timing of the significant innovations needed to achieve commercial viability. However, the sponsor of the bill, TAE Technologies, says they believe their technology to be on cusp of becoming commercially available, and, therefore, aligned well with the timing of the 2025 IEPR reporting requirement in this bill. However, it is possible there may not be much more information than what may be available today, and, as a result, there may little for the CEC to report.

Need for amendments. This bill includes a definition for "aneutronic fusion" in order to distinguish the use of hydrogen and boron, in particular, from systems more typically discussed which use tritium and may result in additional neutrons. TAE Technologies, argues that the definition is a needed to ensure the CEC considers their form of fusion technology which they feel is too often overlooked. However, they acknowledge that a regulatory framework for fusion energy is still in development at the federal level. Commonwealth Fusion Systems writes in support, if amended, of this bill that the definition for aneutronic fusion should be removed. They propose amendments that will include the aneutronic process without including the definition in statute. Given that there are nearly three dozen groups worldwide conducting research into fusion energy it may be premature to codify a definition which may be developed as part the federal regulatory framework. *As such, the author and committee may wish to amend this bill to delete the definition of "aneutronic fusion," ensure the "fusion energy" definition encompasses the varied processes, and defer to the CEC to define the term "aneutronic fusion" for the purposes of the assessment.*

FISCAL EFFECT: Appropriation: No Fiscal Com.: Yes Local: No

SUPPORT:

Clean Power Campaign
Commonwealth Fusion Systems
Fusion Industry Association
Fusion is Tomorrow's Energy
TAE Technologies

OPPOSITION:

None received

ARGUMENTS IN SUPPORT: According to the author:

> California's commitment to creating climate resiliency policies has positioned the state as a leader in the renewable energy industry. To reach carbon neutrality by 2045 and an exacerbated need for electricity, the state must continue investing in existing and promising renewable clean energy sources. There have been several millstones highlighting the promising progress of the nuclear fusion industry. Active stakeholders are on the path to creating commercially variable reactors that can safely generate clean energy to power cities and municipalities. AB 1172 is an effort to analyze how California can safely integrate fusion energy technology as a renewable energy source. Identifying regulatory requirements and adoption hurdles is critical to deploying clean fusion energy and meeting our climate goals.

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