

JINSA's Gemunder Center for Defense and Strategy

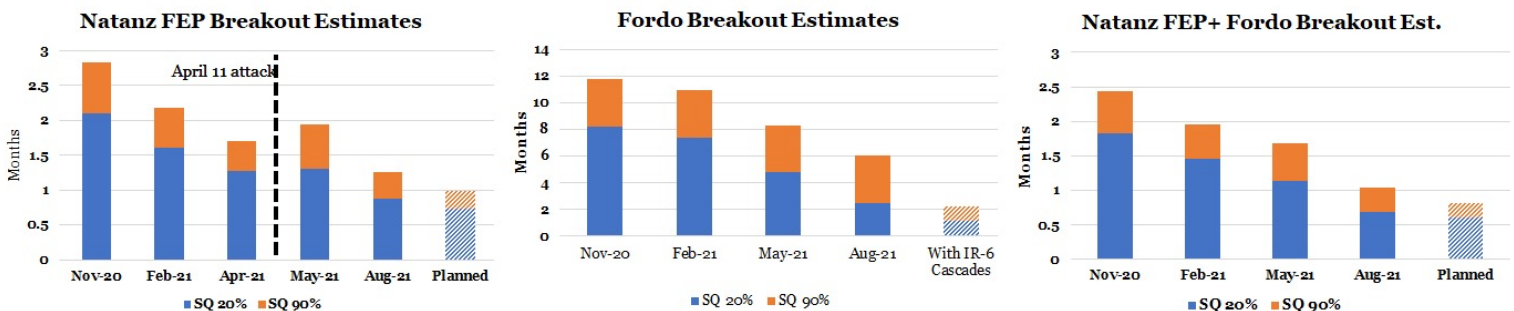
Iran's Looming Centrifuge Breakout

Blaise Misztal - Vice President for Policy
Jonathan Ruhe - Director of Foreign Policy

The International Atomic Energy Agency's (IAEA) recent report on Iran's nuclear activities shows how, despite attention-grabbing progress in its enrichment of 20 and 60 percent uranium, Iran's greatest advances toward a nuclear weapons capability in the near-term will likely come from its research and deployment of thousands of new, much more efficient centrifuges. If Iran's current plans for expanding its enrichment facilities move forward, it could reach the point of being able to produce enough fissile material for a nuclear weapon in well under one month. However, two covert attacks since July 2020 targeting Tehran's ability to manufacture these machines, appear to have bought valuable time. How much time is unclear because Iran continues to block international inspectors' access to its nuclear facilities. The Biden administration should push Iran to fulfill its legal obligations to allow inspections while strengthening credible U.S. and Israeli military alternatives to open-ended nuclear diplomacy that only enables Iran to continue advancing its nuclear program.

What Happened?

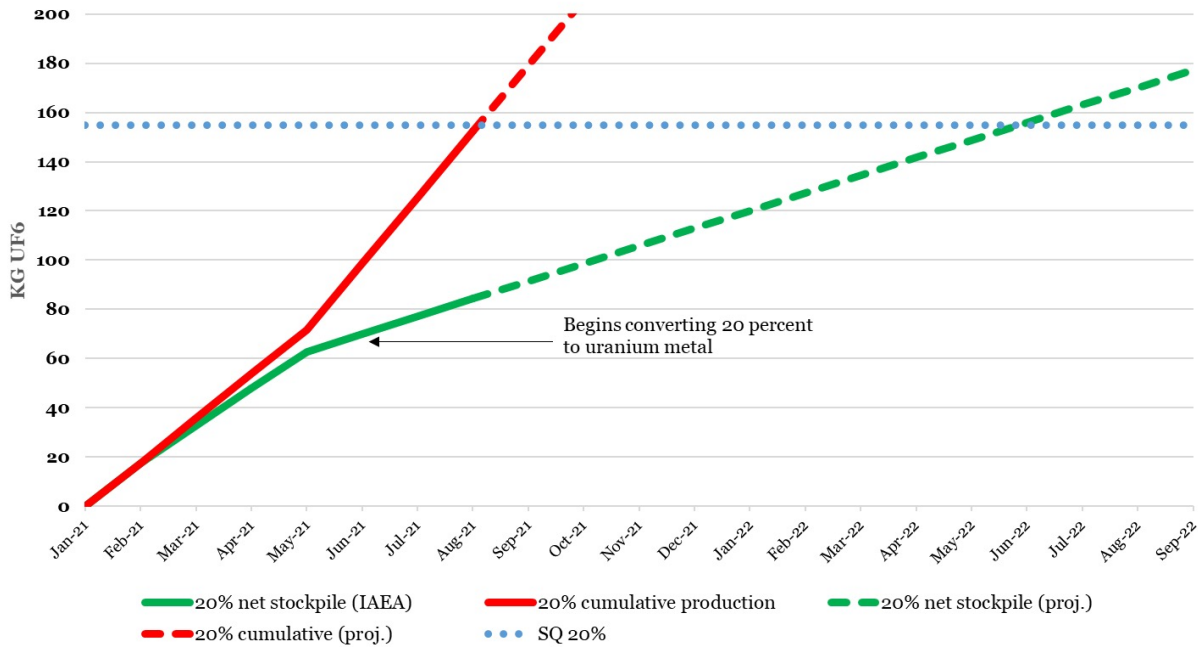
- Data from the latest International Atomic Energy Agency (IAEA) [quarterly report](#) on Iran's nuclear program highlights several dangerous trends:
 - Continued growth of Iran's 20 percent and 60 percent enriched uranium stockpiles;
 - Ongoing installation of additional centrifuges at Natanz and Fordo enrichment facilities;
 - Escalating research and development (R&D) of advanced centrifuges; and
 - A perilously small "breakout" timeframe to enrich enough fissile material for a nuclear weapon – now perhaps as little as one month.



Why Is It Important?

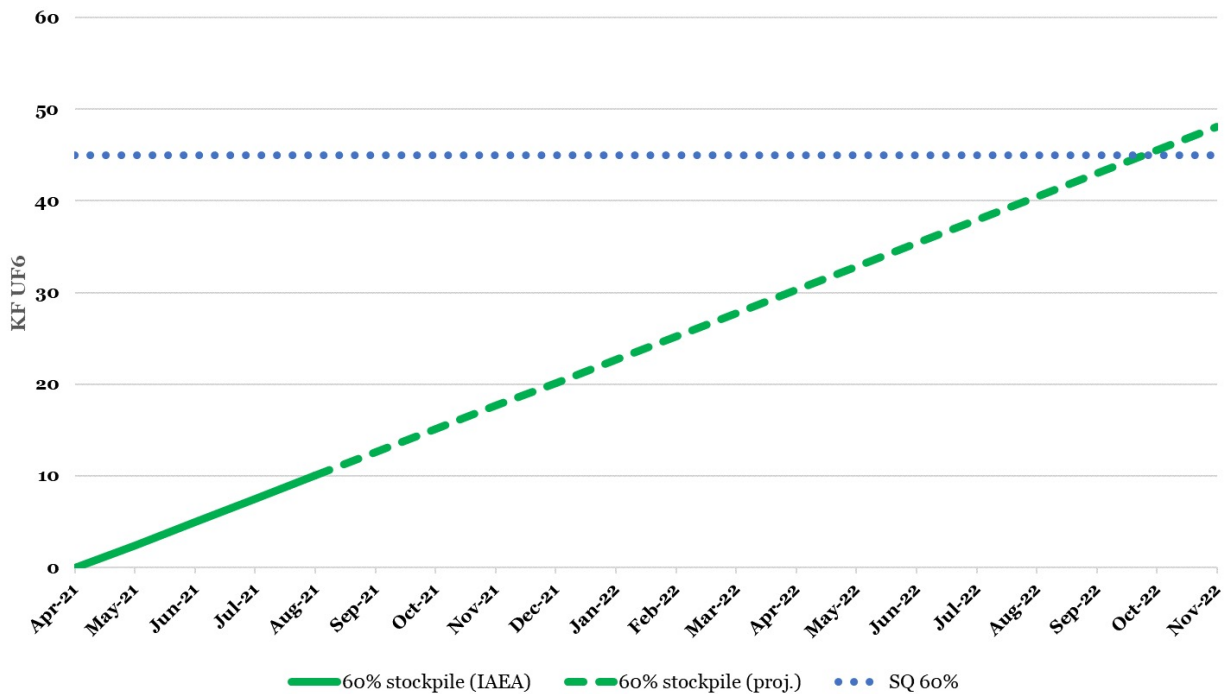
- While it is the growth of Iran's 20 and 60 percent stockpiles that might seem most alarming and [receives](#) most of [the headlines](#), the most serious Iranian nuclear challenge in the near-term is its growing fleet advanced centrifuges.
 - Iran's stockpile of 20 and 60 percent enriched uranium remain below levels required to produce, with further enrichment, a nuclear weapon. They will not cross these critical thresholds, at current production rates, until mid-2022.
 - A much more immediate reduction of Iran's breakout timing could come from the planned installation of advanced centrifuges, particularly the IR-6, at Natanz and Fordo.
 - This planned expansion would drop Iran's breakout timing to near-zero.
 - Recent sabotage of Iran's centrifuge production plants might have slowed down this process, but with Tehran blocking international inspectors, there is insufficient information to determine the state of Iran's centrifuge manufacturing capabilities – and therefore the timeline for further expansion of its enrichment facilities.
 - These ongoing centrifuge advances raise serious questions, as voiced by Biden administration officials, about the supposed benefits to the United States of JCPOA reentry, since it would not reverse Iran's [invaluable know-how](#) from centrifuge R&D.
 - A strict JCPOA return also would allow Iran simply to mothball, rather than destroy, these advanced centrifuges, enabling a massive expansion of enrichment capacity [starting four years from now](#).
- Iran is actively reducing the growth of its stockpile of 20 percent enriched uranium – which represents nine-tenths of the effort to achieve fissile material.
 - Since starting in January, Iran cumulatively has enriched an estimated 152 kg uranium to 20 percent at a rate of 19 kg/month.
 - This is nearly a “significant quantity” (SQ) – enough to produce one bomb's worth of fissile material, with further enrichment, roughly 155 kilograms of 20 percent enriched uranium hexafluoride, or UF₆.
 - This shows that Iran's claim, in June, to have produced 108 kg at an average rate of 40 kg/month over the preceding three weeks was [provocatively overstated](#).
 - However, Iran's actual stockpile of 20 percent enriched uranium stands at only 84 kg.
 - As it did in 2012-14 after Israeli Prime Minister Netanyahu [drew a redline](#) at a bomb's-worth of 20 percent enriched uranium, Tehran is reducing its stockpile to keep it below this critical threshold.
 - To limit its stockpile, Iran has been converting some of it to [uranium metal](#), which, while worrisome because this process is one of the steps to a nuclear weapon, means this material can no longer be used to enrich fissile material.
 - Assuming Iran continues producing, and diverting, 20 percent uranium at its current rate, it will achieve an SQ approximately in June-July 2022.

Iran's 20 Percent Stockpile



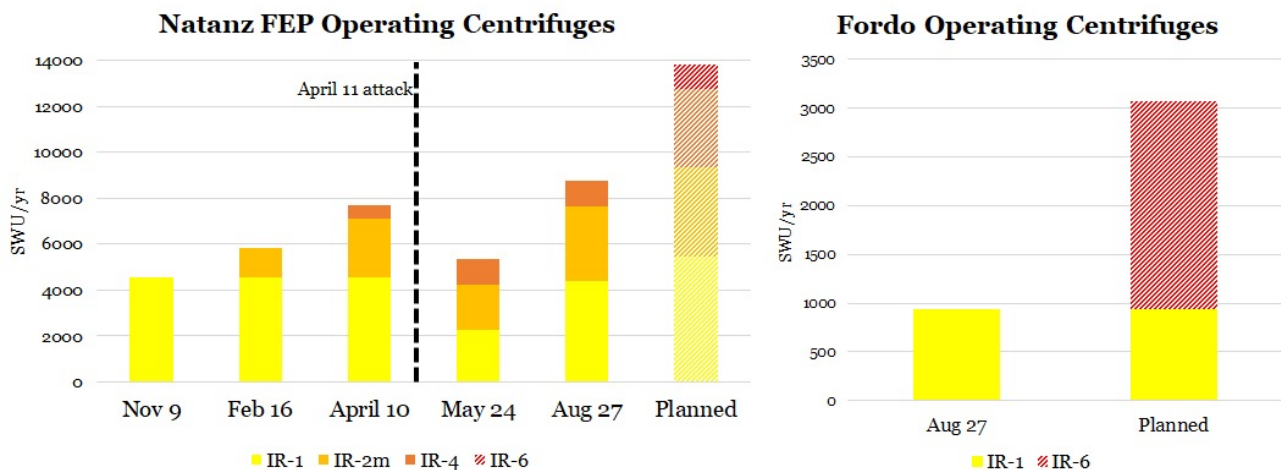
- Iran's existing stockpile and current production of 60 percent enriched uranium are limited.
 - Its current stockpile of roughly 10 kg of 60 percent uranium is less than one-quarter of an SQ, with an average production rate since April of around 2.5 kg/month.
 - Enrichment to this level is confined solely to its relatively small R&D facility.
 - At its current pace, Iran will not reach an SQ (roughly 45kg) until approximately October 2022.

Iran's 60 Percent Stockpile

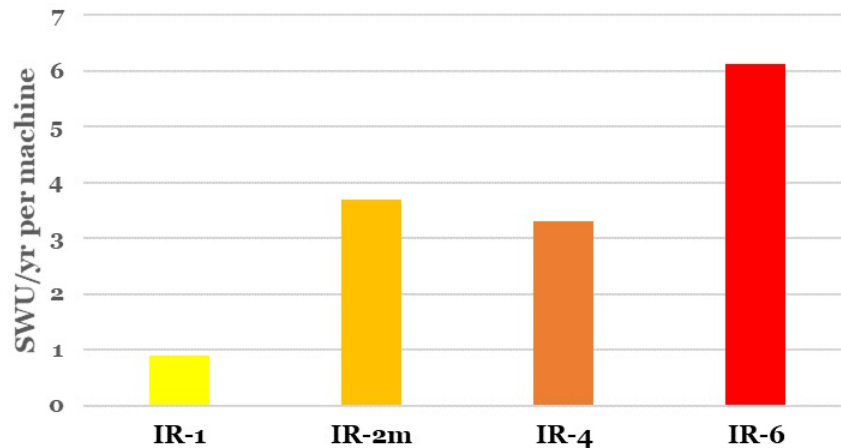


- In the near-term, Iran’s greatest advances toward a nuclear weapons capability are likely to come from its ongoing efforts to phase out its aging IR-1 centrifuge fleet with smaller numbers of much more productive centrifuges.
- Beginning [November 2020](#), Iran installed and used growing numbers of advanced – and much more efficient – IR-2m and IR-4 centrifuges at its Natanz Fuel Enrichment Plant (FEP).
 - Tehran then kicked this effort into overdrive after a covert April 11 attack on FEP, which took offline perhaps [as many as half](#) of the site’s operating IR-1 machines.
 - Shortly after the strike, Iran informed the IAEA of new plans to expand FEP significantly by [running thousands](#) more advanced IR-2m, IR-4 and IR-6 centrifuges.
 - It also informed the IAEA of ambitious plans to significantly expand R&D capacity for advanced centrifuges at its Pilot Fuel Enrichment Plant (PFEP) at Natanz.
 - Iran’s aggressive centrifuge expansion at Natanz enabled it to negate the setbacks from the April 11 attack within only 3-4 months
 - However, this expansion appears to have been interrupted in June 2021 by a covert attack on a centrifuge plant in Karaj (see below).

	Natanz FEP (Current)	Natanz FEP (Planned)	Fordo FFEP (Current)	Fordo FFEP (Planned)	PFEP R&D Lines 4/6 (Current)
IR-1	4,890	6,072	1,044	1,044	0
IR-2m	870	1,044	0	0	0
IR-4	348	1,044	0	0	153
IR-6	0	164-174	0	328-348	164



Estimated Centrifuge Output



- Iran plans to effectively triple capacity at the smaller and deeply buried Fordo enrichment facility, by installing several hundred IR-6 centrifuges there.
 - Through R&D, Iran has started learning how to use these advanced centrifuges to enrich 20 and 60 percent uranium at scale.
 - Previously, it had only used IR-1 centrifuges for enrichment above 5 percent.
- Combined with continued growth of its 20 percent stockpile, Iran already has shrunk its breakout window to one month or less, which will recede further as expansions proceed.
- Going forward, the key determinant of Iran's expansion timeline will be its centrifuge manufacturing capacity, which also has been targeted by recent covert strikes.
 - A July 2020 [explosion destroyed](#) a facility being built at Natanz for mass-producing advanced centrifuges, after which Iran restarted construction [nearby underground](#).
 - A July 2021 study assessed this facility would not be completed until the [first half of 2023](#).
 - Another [covert strike](#), in June 2021, significantly damaged an operational plant at Karaj for making IR-1, IR-2m, IR-4 and IR-6 parts, though there is no public assessment of the exact extent of the damage or its effect on Iran's ability to produce advanced centrifuges.
 - (Non-)events since then suggest Karaj may have been a vital production chokepoint, as Iran's installation of advanced centrifuges at Natanz and Fordo has not made significant progress since the June attack.
 - Instead, since then Iran has relied primarily on pre-existing surplus stocks of IR-1 centrifuges to expand capacity at Natanz.

- Unlike the April attack against ongoing enrichment activities at Natanz FEP, the effects of which already have been counteracted, the two strikes on centrifuge production sites appear to have bought the United States and its partners valuable time to develop more effective means for preventing a nuclear Iran.
- Because Iran has been blocking international inspectors' access to its nuclear facilities since February 2021, despite a [one-sided and ineffective deal with the IAEA](#) in September, the status of its centrifuge assembly plants is currently unknowable.
 - Most recently, on September 26 Iran blocked [IAEA access](#) to the centrifuge manufacturing plant at Karaj.

What Should the United States Do Next?

- Rather than its current focus on JCPOA reentry, the Biden administration should instead focus on highlighting Iran's violation of its foundational and legally binding obligations to allow IAEA inspectors access to its facilities, and organize international pressure, including UN sanctions, if necessary, to force Iran to resume real-time monitoring.
 - As the Biden administration warns that time is running out for a deal, it cannot know how much time is left without having a full accounting of Iran's nuclear program.
 - As demonstrated by the uncertain statuses of the Natanz and Karaj centrifuge plants, such an accounting is impossible without international inspections.
 - As a signatory of the Non-proliferation Treaty, Iran is legally obliged to abide by IAEA safeguard requirements and allow the IAEA to carry out inspections.
 - These obligations exist regardless of the JCPOA and Iran is in clear violation of them.
- As the standing offer of sanctions relief, including going beyond what is required under the JCPOA, gets the United States no closer to reining in Iran's nuclear program, Washington [should undertake](#) a range of credible military readiness activities – including [tangible support](#) for Israel's [freedom of action](#) – to deter and if necessary deny Tehran's further progress toward nuclear weapons capability.

DISCLAIMER

The findings and recommendations contained in this publication are solely those of the authors.