

# IRON DOME AIR DEFENSE SYSTEM: BASIC CHARACTERISTICS, LIMITATIONS, LOCAL AND REGIONAL IMPLICATIONS

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## INTRODUCTION

**T**he role of Israel's qualitative military superiority has frequently been highlighted in its repeated military gains against the Arab States since 1948, which are heavily criticized in the context of international law by international organizations.

During World War II, Germany's advance toward Palestine through North Africa prompted the British to provide military training to a group of Jews. As of the end of World War II, the anti-British struggle of the Jews started. The decisive factors for the 1948 Arab-Israeli War were the increased capacity of the

Jewish groups, which used to carry out terrorist attacks against the British in Palestine before 1948, the fighting experience of the Haganah forces gained against the Nazis in Europe, the inexistent fighting experience of the Arab States, and the military gains made before the first cease-fire. Israel's military capacity was the main decisive factor in many turning points, such as the destruction of the Egyptian, Jordanian and Iraqi aircrafts on the ground during the 1967 Arab-Israeli War and the armored advance by Sharon toward Cairo in 1973. One could argue that the technical capability and know-how in terms of military and espionage are the main factors that ensured Israel's survival in the region, in addition to the external support it received. It is possible to make such an argument against a historical backdrop, which consists of problematic Israeli practices in the region in terms of international law, the Resolution 242 (1967) of the United Nations Security Council that calls for Israel to withdraw within its borders before 1967, and the United Nations General Assembly Resolution 379, which describes Zionism as a form of racism.

The Iron Dome Air Defense System is one of the most important military elements of Israel's deterrence capability in the region. The Iron Dome system, which is considered to be superior to widely-known air defense systems such as the Patriot with its basic technical data, constitutes one of the main defense capabilities of Israel, who has troubled relations with its neighbors and has struggles with other actors in the region; and it is the most important component of the multi-layered air defense system together with the David's Sling system. The period after the Second Intifada called for the need to develop this system. While common meth-

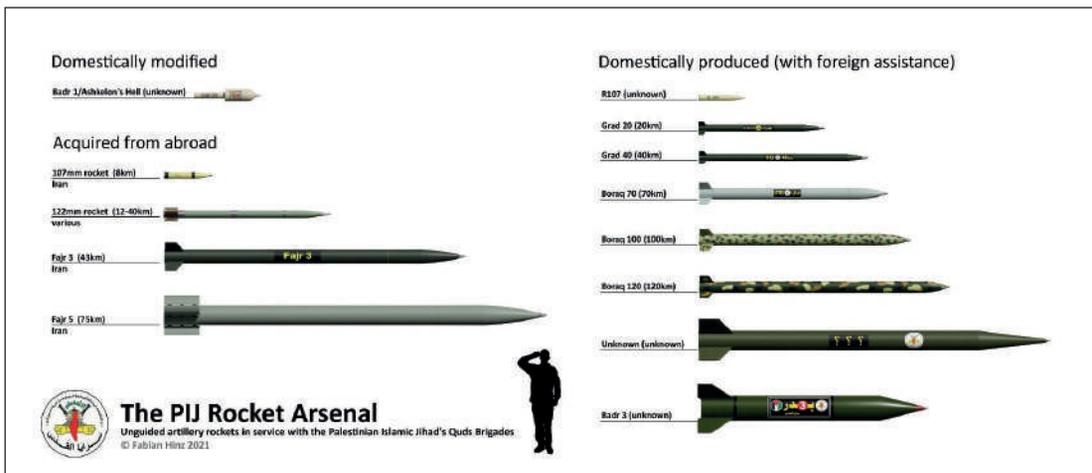
ods used in the First Intifada were civil disobedience and tools such as sticks, stones and slings; the increasing capacity of the regional actors that oppose the Israeli policies in Palestine, who resorted to the increased use of small arms, explosives and rockets after the Second Intifada, forced Israel's hand to respond accordingly. Nevertheless, it should also be highlighted that the Iron Dome, despite its worldwide reputation as the most successful air defense system, does not provide full protection. That is the reason why actors such as Hamas and the Islamic Jihad prioritize saturation strikes. Firing up simple rockets in large numbers in a volley, makes total defense impossible and its psychological impact grows as some rockets penetrate the Iron Dome and hit Israeli settlements. This is a favored and prioritized method, since Hamas and Hezbollah have an increased inventory of rockets, thanks to the transfer thereof through the territories of Iran, Iraq, Syria and Lebanon, which has also enabled the development of sophisticated homing missiles in recent years. The formation of this corridor enabling such a capacity was also a major factor in the assassinations of al-Muhandis and Qasem Soleimani.

## THREAT ENVIRONMENT AND ITS EVOLUTION

The emergence of Israel's threat perception with regard to ballistic missiles can be traced back to Egypt's joint missile program with the Soviet Union launched after the 1967 War with a view to balancing Israel's air superiority. During the Yom Kippur War, Egypt launched three Scud-Bs missiles to the Canal region, which failed to hit their targets. When Egypt abandoned its mis-

sile program with the Camp David process in 1978-79, it was now Iraq who posed the missile threat, having carried out the most developed ballistic missile program in the period after the Iran-Iraq War. Iraq's directly targeting of Israel with its strikes against Tel Aviv and Haifa highlighted Israel's weakness in terms of air defense systems. The post-war embargoes against Iraq weakened its missile

capability as Syria and Iran acquired ballistic missiles.<sup>1</sup> Over the years, these countries procured and/or developed missiles with increasing range and precision. In particular, Iran's ballistic missile program developed with the know-how support<sup>2</sup> of countries such as North Korea and China has posed the most important national security threat for Israel as of the current situation.



<sup>1</sup> Jean-Loup Samaan, "Another Brick in the Wall: The Israeli Experience in Missile Defense", U.S. Army War College-SSI, April 2015, p. 2  
<sup>2</sup> "Iran's Missile Program: Past and Present",



A snapshot of the Iron Dome as it intercepts the incoming missiles.

Having already ended the state of war against Egypt and Jordan with the Camp David agreement and against the Middle East states, as well as against civil war-ridden Syria with the Oslo process, the threat perception of Israel diminished and it entered an actual and legal normalization process with the Gulf states. Therefore, Israel prioritized its threat perception against non-state actors. Israel's security bureaucracy considers the expanding influence of Iran in the Middle East through supporting non-state armed actors as a high-priority problem. In line with these developments, it is observed that the security environment in 2020 caused these actors' missiles to rise to upper ranks in the

ordering of threat perceptions. In addition to the threat posed by Iran's ballistic missile program, the possibility of Iran-backed non-state actors reaching precision strike capabilities as well as the missile inventory expansion and technological advance by the Houthis<sup>3</sup> in addition to Hezbollah, Hamas and the Islamic Jihad, are naturally causes for concern for Israel.

Israel's concerns about operations against Hezbollah's precision guided missile projects in Syria can also be explained in this context. In fact, when a hostile non-state actor in a neighboring country acquires precision strike capabilities, its strike power can reach

<sup>3</sup> Adnan Abu Amer, "Israel adds Yemen to its active combat fronts", Middle East Monitor, 12 January 2021.

a level almost similar to that of a state. In other words, such an environment would mean that Hezbollah and Hamas acquire an offensive air power capable of striking vital targets inside Israel without even having their own aircrafts.<sup>4</sup>

In this period, the possibility that these actors can initiate coordinated and simultaneous surprise attacks against strategic targets in the country has started to even become a chronic threat for Israel. The strategic points to be targeted by this threat include power plants, desalination facilities, depots that conserve materials harmful to public health, oil and natural gas infrastructure, airports, military bases, parliament and government buildings as well as air defense batteries, refineries and the nuclear power plant in Dimona.<sup>5</sup> It is observed that the missiles launched from Lebanon and Gaza breached Israel's air defense and hit Sderot, Ashkelon, Tel Aviv and the neighboring cities. After the tensions in Sheikh Jarrah, a power plant in Ashkelon and the Eilat-Ashdod oil pipeline were hit by rockets, which constitutes an example in this regard.

It is thought that the missile capacity of Hezbollah, which was troubling for Israel in the 2006 War, has been technological-ly developed and increased to 130,000 in number.<sup>6</sup> In 2017, the Israeli army estimated that the groups in Gaza have around 12,000-13,000 rockets. Hamas has approximately 8,000 rockets while the rest is in possession

of the Islamic Jihad.<sup>7</sup> The spread of the Syrian civil war into the neighboring regions and the suitable environment for the transfer of know-how, technology and ammunition among non-state actors are likely to have increased this number, including the rockets which were used in the intermittent clashes during the last four years.

According to the Israeli military intelligence, the majority of the rockets in possession of Hamas consists of short-range ammunition up to 40 kilometers in range such as 107 mm Chinese and Iranian rockets, and 122 mm Grad rockets. While the Qassam missiles can target the cities around Gaza such as Sderot and Netivot, other cities such as Ashkelon, Ashdod and Beersheba (Beersheba) remain within the range of 122 mm Grad rockets. Furthermore, the Fajr-5 missiles with 75 kilometers range and Khaybar M302 with 160 kilometers range<sup>8</sup> pose a threat all the way to Tel Aviv and Haifa. The Islamic Jihad is in possession of C8K rockets in small numbers, which were acquired from Muammar Qaddafi's Libya. Both of these organizations have rockets that can strike Israeli targets within a range of 15 kilometers.<sup>9</sup>

Currently, missile defense is an indispensable element for Israel's defense besides its offensive capabilities and passive defense approach. In this context, Israel builds and develops a layered air defense system against missile and rocket threats emanating from Iran, Syria, Lebanon and

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<sup>4</sup> Uzi Rubin, "Israel and the Precision-Guided Missile Threat", BESA, 16 June 2021.

<sup>5</sup> Nadav Shragai, "Is Israel prepared for an all-out missile attack?", Jewish News Syndicate, 4 March 2021.

<sup>6</sup> Shaan Shaikh, "Missiles and Rockets of Hezbollah," Missile Threat, Center for Strategic and International Studies, 26 July, 2018.

<sup>7</sup> Raphael S. Cohen vd., "From Cast Lead to Protective Edge", RAND, 2017, p. 130.

<sup>8</sup> Jeremy Bender, "These Are The Rockets Hamas Has Been Shooting At Israel", Business Insider, 11 July 2014.

<sup>9</sup> "From Cast Lead to Protective Edge"

**Rocket Ranges from Gaza into Israel During Protective Edge**



SOURCE: "Ranges of Hamas's Rockets," Stratfor, July 9, 2014.  
RAND RR11 088-5.1

The defense doctrine of Israel has four main pillars; deterrence, early warning, active defense and a quick and decisive response on the battlefield. In accordance with Israel's missile defense architecture with its layered structure and its doctrine, establishing deterrence to prevent attacks constitutes the first line of defense. When deterrence fails and clashes erupt, Israel aims to initiate early warning, reconnaissance and active defense in order to deny the first strike capability to the adversary and destroy missiles in the air. Nevertheless, the passive defense elements such as the civil defense network that consists of infrastructure and early warning systems step in when some missiles overcome the mentioned precautions. The fact that Israel failed to prevent destruction in its domestic areas due to the difficulty of destroying hostile launchers during the 2006 War has emphasized the requirement to prioritize active and passive defense. After this stage and in the following years, the Iron Dome has become the most distinctive preventive system.<sup>12</sup>

As of today, Israel's layered air defense system architecture is as follows:<sup>13</sup>

- Iron Dome: 4-70 km
- David's Sling: 40-300 km
- Arrow 2: 500 km
- Arrow 3: 2,400 km

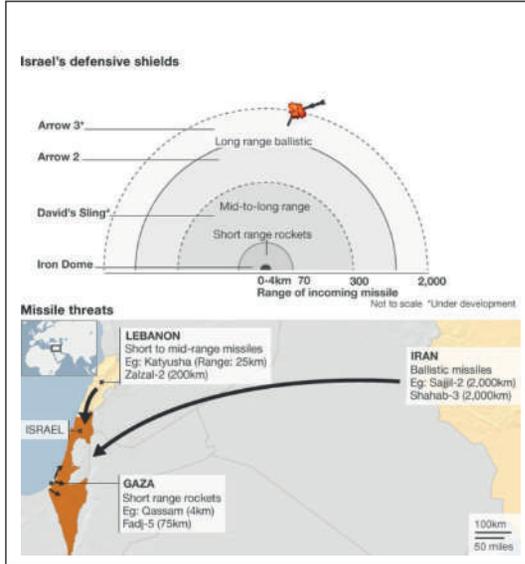
the Palestinian groups in Gaza.<sup>10</sup> The main objective for Israel is about buying time for decision-makers in case of an attack in order to make the necessary evaluations and to determine the course of action accordingly.<sup>11</sup>

<sup>10</sup> Emily B. Landau and Azriel Bermant, "Iron Dome Protection: Missile Defense in Israel's Security Concept", INSS.

<sup>11</sup> Seth J. Frantzman, "How Israel's missile defense organization is preparing for the threats of the future", Defense News, 23 April 2021.

<sup>12</sup> Elizabeth M. Bartels, "Is Iron Dome a Poisoned Chalice? Strategic Risks from Tactical Success", RAND, 29 November 2017.

<sup>13</sup> The Data is acquired from the CSIS-Missile Threat.



Source: <https://www.bbc.com/news/world-middle-east-20498971>

## THE DEVELOPMENT PROCESS OF THE SYSTEM

When Israel joined the "Strategic Defense Initiative" launched by Ronald Reagan in 1983, it proved its awareness about missile defense technologies. Yet, the Israeli army had a doubtful approach and opposed<sup>14</sup> this move on the grounds that Israel had to allocate its limited resources to offensive doctrines such as preemptive attacks and fighting on hostile territory, due to reasons such as its lack of strategic depth and the ongoing fighting environment. However, presumably due to the ongoing trend among Israel's adversaries to supply missiles, the efforts within the framework of the US-Israel partnership and the US financial aid, led to the

development of the Arrow system by the IAI (Israel Aerospace Industry).<sup>15</sup>

From 1996 to 2005, the US and Israel had a series of joint work and tests on developing tactical high-energy laser systems; however, these projects were shelved after it was decided that the projects would not reach the expected efficiency and all of the costs amounting to 600 million dollars were covered in full by the US.<sup>16</sup>

Besides that, as Hamas started to attack the settlements and neighboring areas near Gaza in 2001, and the need for a short-range air defense system against the rising threats particularly in the south became urgent, Israel started to consider the proposals and decided on the Iron Dome project by Rafael Systems. The SKYGUARD system, which was conceptually developed on paper by Northrop Grumman, was considered to be high-cost. Funds for the Iron Dome project were allocated by the Research and Development Bureau (RDB) of the Ministry of Defense and Rafael.<sup>17</sup> The impact of Hezbollah's missile attacks during the Thirty-Four Day War of 2006 hastened the process for developing a short-range air defense system, since almost 4,000 rockets fell on Israel during the war.<sup>18</sup> Nevertheless, the Nagel committee of experts, which was formed due to additional budgetary needs, was assigned to prepare a detailed inquiry and after three months of work, the committee's report was presented to Director-General Gabi Ashkenazi and Minister Amir Peretz of the Ministry

<sup>14</sup> "Iron Dome Protection: Missile Defense in Israel's Security Concept".

<sup>15</sup> Jean-Loup Samaan, "Another Brick in the Wall: The Israeli Experience in Missile Defense", U.S. Army War College-SSI, April 2015, p.

<sup>16</sup> Seth J. Frantzman, "How did Iron Dome's strategic depth transform Israel's defense?", The Jerusalem Post, 10 April 2021.

<sup>17</sup> A.g.e.

<sup>18</sup> "Iron Dome Protection: Missile Defense in Israel's Security Concept"

The USA has significantly contributed to the current state of the Iron Dome through joint training and sharing of information and experience, in addition to its financial support. Israel shares the experience as well as the outcomes of its air defense system with the USA.

of Defense. It was approved by Prime Minister Ehud Olmert in February 2007.<sup>19</sup> Peretz stated that the concept of the Iron Dome was feasible and according to Olmert, its development was inevitable. However, the required additional budget created problems and Ehud Barak, who became the Minister of Defense in 2007, reevaluated the other options including the SKYGUARD and concluded that the development of the Iron Dome was a necessity. Consequently, the needed amount was met by the budget of the Ministry of Defense and the contract for the first Iron Dome system consisting of two batteries was signed. The project was carried out under the RDB project team by Rafael Systems; ELTA, which developed the ELM 20-84 AESA Radar; and M-Prest, which developed the command-control system.<sup>20</sup> The project work continued at such a fast and intense pace that they requested a response from the religious authority for the project team, which would allow working during the Shabbat holiday. After long working days, the first tests were made in July 2008 and after the last tests in July 2010, the system was completed in

March 2011. The Iron Dome became operational on April 7, 2011 when a Grad missile launched from Gaza was intercepted.

According to Seth Frantzman, following the process where the Ministry of Defense preferred the Iron Dome, a campaign was launched in Israel in favor of the SKYGUARD and against the project, which caused problems for the bureaucrats and the project officials. Afterwards, a commission with representatives from the US reevaluated the laser-based projects and the SKYGUARD. During the Obama administration, Americans appreciated the achievements of the Iron Dome and agreed with the Israeli officials for an annual aid amounting to 205 million dollars for preventing any export obstacles and ensuring that the project remains 'Israeli'. Afterwards, American material support to the project increased and as of 2016, a memorandum was signed between the US and Israel, which raised the American annual support for the Iron Dome and its components up to 500 million dollars. At this point, Frantzman's claims point out that even though the United States supports Israel's ballis-

<sup>19</sup> "How did Iron Dome's strategic depth transform Israel's defense?"

<sup>20</sup> A.g.e.



An Iron Dome battery deployed in Ashkelon, March 2021.

tic missile defense in general, the Iron Dome project in its initial stage was launched despite the US, not with the support of the US, and it has come to its current status with the support of the latter. Nevertheless, in the following years, the US has significantly contributed to the current state of the Iron Dome through joint training and sharing of information and experience in addition to its financial support. Israel shares the experience as well as the outcomes of its air defense system with the US.<sup>21</sup>

## TECHNICAL SPECIFICATIONS

The Iron Dome is the most combat-proven multi-tasking system that is capable

of implementing air defense in very short range (V-SHORAD) and is equipped at the same time with a C-RAM (Counter-anti-rocket, artillery and mortar). Furthermore, it is also effective against platforms and ammunitions such as aircrafts, helicopters, UAVs, cruise missiles and precision guided missiles.<sup>22</sup> The Iron Dome consists of three central components, which are detection and tracking radar, battle management and weapon control, and missile firing unit. A system battery is composed of radar, a command-control center and three or four batteries. Each battery is able to launch 20 Tamir missiles, and 600 to 800 missiles are kept ready for launch. According to ELTA, the ELM 20-84 AESA Radar has the capacity for

<sup>21</sup> "How Israel's missile defense organization is preparing for the threats of the future"

<sup>22</sup> "Celebrating 10 Years Of Iron Defense", <https://www.rafael.co.il/iron-dome-10years/>.



The Obama administration provided significant material support to the Iron Dome Project.

up to 1100 targets for Air Surveillance purposes.<sup>23</sup> The Tamir missiles that the system uses for air defense functions are 3 meters long, 16 cm in diameter and are equipped with multiple fins and electro-optical sensors.<sup>24</sup> Considering these features, the use of the system is costly. The system, with a range of 4 to 70 kilometers<sup>25</sup>, can operate day and night in all weather conditions, has a fast reaction time and can catch salvo shots.

It is also compatible with vertical launch interceptor, warhead and variable time fuse, mobile launcher and various radar and detection systems. The Iron Dome system has the capability to counter multiple threats at the same time.<sup>26</sup> It was only sold to the US in 2009 with two batteries. Israel has taken a firm stance against the overseas sales of the system. It has been stated that the system sold to the US is also very similar to the

<sup>23</sup> "ELM-2084 MMR Multi Mission Radar", <https://www.iai.co.il/p/elm-2084-mmr>.

<sup>24</sup> "Iron Dome Air Defence Missile System", Army Technology, <https://www.army-technology.com/projects/iron-dome/>.

<sup>25</sup> Ari Kattan, "Future Challenges for Israel's Iron Dome Rocket Defenses", Center for International & Security Studies, U. Maryland, 2018.

<sup>26</sup> "Iron Dome Air Defence Missile System"

system in Israel. Even though the difference is relatively small, the "monkey model" distinction between the original system of the defense industry and the one produced for export is found in the deal between the two actors. It is understood that Israel's distant attitude continues when it comes to sharing. As a matter of fact, Moshe Patel, director of the Israel Missile Defense Organization, expressed some vague opinions on April 23, 2021 about the source codes to be given to the US and emphasized the concerns about how a superpower such as the US will preserve these codes, which sent an important signal about this issue.<sup>27</sup> In the beginning of 2021, Israel gave permission to the US to deploy these systems in its bases in Europe, the Gulf region and the Far East. The entire system is 100 million dollars per battery. Extremely speculative figures are expressed regarding the cost of the system per prevention, with some figures ranging from 20 thousand dollars<sup>28</sup> to 80 thousand dollars<sup>29</sup> or even 100 thousand dollars.<sup>30</sup> Even though one can assume that the cost for ammunition will drop as production goes up, the rate remains unknown. Nevertheless, the cheapest rocket that the system uses costs no more than 100 dollars. Such an asymmetry in costs constitutes one of the main dynamics of Israel's relations with the regional actors, particularly with Hamas and Hezbollah.

The Iron Dome has variants for use on land and on sea platforms. The naval vari-

ant called C-Dome was developed for protecting strategic sea and land assets. It is stated that the naval variant of the Iron Dome will be mounted, against Hezbollah's growing 122 mm Grad rocket capability, on the German-made Sa'ar 6-Class Corvette, which was delivered to Israel on December 2, 2020.<sup>31</sup> There is also a stand-alone variant of the Iron Dome called I-Dome, which brings together various components in the same vehicle to be mounted on motorized and mechanized units for the protection of military zones and critical infrastructure facilities.<sup>32</sup>

The Iron Dome protects critical infrastructure and specific areas of importance with interceptive ammunition that explodes within one meters of hostile missiles. Two important elements of the system provide advantages compared to the traditional approach of missile defense. The first element is the capability of the system to precisely track incoming rockets, which enables the selection of rockets to be launched, the interception of these missiles, and the prevention of civilian losses.<sup>33</sup> The second is that the performance of the interceptor missiles employed by the system are better than their counterparts.<sup>34</sup> The Iron Dome in its current state is much more advanced than its initial state in 2011. The modifications over time equipped the system with the capability of achieving more effective prevention in high-

<sup>27</sup> "How Israel's missile defense organization is preparing for the threats of the future".

<sup>28</sup> "How did Iron Dome's strategic depth transform Israel's defense?"

<sup>29</sup> Eli Meron and Eli Bar-On, "The cost problem of Iron Dome and the solution", Israel Hayom, 5 Mas 2019.

<sup>30</sup> "Iron Dome (Israel)", CSIS-Missile Threat

<sup>31</sup> Barbara Opall-Rome, "Israel Navy to double Iron Dome defenses on new surface ships", Defense New, 27 March 2017.

<sup>32</sup> "Celebrating 10 Years Of Iron Defense"

<sup>33</sup> Elizabeth M. Bartels, "Is Iron Dome a Poisoned Chalice? Strategic Risks from Tactical Success". RAND, 29 November 2017.

<sup>34</sup> A.g.e.

er altitudes and more interception in lower altitudes. It is able to launch more missiles and rockets compared to its earlier state.<sup>35</sup> The last tests after the latest developments were carried out in March 2021.<sup>36</sup>

## PERFORMANCE

While the producer company Raytheon predicted that the Iron Dome will have a 90 percent success ratio<sup>37</sup>, which can be tested in different attacks, a 20 percent ratio of penetration was achieved by Hamas alone on May 11 when it launched approximately 100 missiles in half an hour. Therefore, such an optimistic prediction is possible in terms of accuracy and at least in psychological terms. Particularly the debates about the effectiveness of the system against missiles with a non-linear course is another aspect that is emphasized by the evaluations on the J-80 that fell upon Mishmeret in March 2019.

Operational in 2011, the Iron Dome was first tested against intense missile and rocket attacks during the Operation Pillar of Defense that was launched against Gaza in November 2012. During the fighting that claimed many civilian lives, a total of 1,456 rockets and missiles were fired to Israel.<sup>38</sup> Rafael Systems claims that the Iron Dome

made 400 interceptions.<sup>39</sup> During the Operation Protective Edge in 2014, 4,500 projectiles were fired to Israel from Gaza. Rafael Systems states that the number of interceptions during this operation was 700. At this point, calculating the statistics on whether or not the Iron Dome intercepted the missiles, which would result in the loss of life and material harm based on its calculations will not yield a clear result. According to Israel's statements, the success rate was 85 percent.<sup>40</sup> Nevertheless, it is a fact that the Iron Dome has significantly reduced the loss of life and material damage for the Israeli side. It is claimed that the developments over time and increased number of batteries make the system better. At this point, the comparison between the 2006 Israel-Hezbollah War in which 44 Israelis were killed and Israel's operations against Gaza in which it suffered single digit losses might give an idea yet fail to lead to a clear conclusion. This is because there are some details that could affect the conclusions to be drawn from the comparison, such as Hezbollah's closer contact with Iran, its unblocked position and its larger manpower in addition to the topographical differences between the regions.

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<sup>35</sup> Yaakov Lappin, "Gaza's terror factions place Iron Dome under new scrutiny", JNS, 14 May 2021.

<sup>36</sup> "Iron Dome Air Defence Missile System", Army Technology, <https://www.army-technology.com/projects/iron-dome/>.

<sup>37</sup> "Celebrating 10 Years Of Iron Defense"

<sup>38</sup> "Is Iron Dome a Poisoned Chalice? Strategic Risks from Tactical Success"

<sup>39</sup> "Celebrating 10 Years Of Iron Defense"

<sup>40</sup> Raphael S. Cohen vd., "From Cast Lead to Protective Edge", RAND, 2017, p. 136.

## CONCLUSION

As Udi Dekel pointed out in 2019, despite the efforts for developing multi-layered air defense systems in the last 30 years, Israel's adversaries observe the change in its capacity and devise new methods for gaining the upper hand against, neutralize and wear down Israel's air defense systems. The methods such as saturating Israel's air defense system through simultaneous salvos of missiles and/or rockets from different areas and making it miss its targets; expanding the inventory with innovative missiles and rockets, cruise missiles, autonomous ammunitions, coordinated drone attacks and similar ammunitions of superior quality; as well as acquiring tens of thousands of missiles, rockets and UAVs and utilizing them in salvos during combat in order to penetrate Israel's air defense systems were relatively successful, as shown in the period after the Sheikh Jarrah incidents.<sup>41</sup> While there is no information about the autonomous ammunition capability of Hezbollah and Hamas and it was observed that they use mini armed UAVs to some ex-

tent, there is also no indication that they have the capability to utilize drone swarm technology. Nevertheless, the Houthi attack against the Abqaiq facilities, in which drones were used in a coordinated manner, shows the extent of potential threats against Israel from Iran-backed actors and forms the basis of Dekel's warnings. In this context, the acquisition of technologies by Israel's adversaries, which are developed with great power and make detection and interception harder, prove to be another challenge.<sup>42</sup>

Therefore, the increasing amount and variety in the arsenals of the adversaries make it difficult for the defense systems to work effectively in detecting and intercepting the projectiles that target Israel. Joint salvos saturate the air defense systems and make it difficult to distinguish between precision guided missiles and other rockets, therefore wearing down Israel's interceptor missile inventory. Currently, the nature of the asymmetrical conflict practically puts Israel in a disadvantageous situation in two aspects. The first is that the production of adversary's

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<sup>41</sup> "A Multi-Arena Missile Attack that Disrupts Israel's Defense and Resilience Pillars"

<sup>42</sup> A.g.e.

missiles and rockets are cheaper<sup>43</sup> and faster compared to the air defense system of Israel. As in the case of Hamas, some missiles can be produced in machine shops under primitive conditions while the countering missiles of the high-technology Iron Dome system are extremely expensive and difficult to produce, which is a serious disadvantage for Israel. The second disadvantage is the gap between the threats and the technological requirements for developing interception systems. Investments on interception systems are very expensive and constitute a heavy burden on the defense budget.<sup>44</sup>

In this context, time ticks against Israel, as Udi Dekel has remarked, due to the fact that the mentioned assault systems are cheap, easy to produce and develop, while the Iron Dome is one of the most battle-tested and the most high-performance air defense systems among its contemporaries. As for the current situation, Israel's advanced air defense technology has proved to be insufficient against the sheer quantity of rockets and missiles launched by Hamas and Islamic Jihad, most of which were domestically produced in limited conditions.

At this point, the statement made in January 2020 by Aviv Kochavi, Chief of General Staff of the Israeli Defense Forces, is of great importance. Stating that war is a solution when all other paths of diplomacy are exhausted, Kochavi remarked that in the next war, whether against Hezbollah or Hamas, the adversary would have immense fire-

power. Kochavi underlined that not only the Israeli army but also the entire nation must be prepared for that and said, "I'm looking at everyone in the eye; it will be intense. We have to prepare for that. We have to prepare for that militarily, on the home front, and mentally." Warning that there can be no war without casualties, Kochavi said that he cannot not guarantee a short war and that Israel will need national resilience.<sup>45</sup> These words are also an indicator of the current situation and underlines the importance of the last layer of Israel's missile defense, which is passive defense and preparedness of civilians and infrastructure.

While it is obvious that Israel is aware of this requirement, it has hastened its efforts for developing directed-energy systems, i.e. laser technology, in order to tackle the mentioned threat elements. There are prospects that this technology will make it possible to eliminate more threats more accurately and cheaper, costing only 5-10 dollars under current conditions. It is useful to remember that similar technologies had been the focus of development efforts between 1996 and 2005, which were unsuccessful.

Unless such a revolutionary development takes place, the time window and the advantage that the Iron Dome provides will likely be lost. In that case, Israel will have to move in accordance with the basics of its defense doctrine and seek to weaken its adversaries with high-quality espionage, detection and preemptive strikes. Nevertheless, chances for success are slim con-

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<sup>43</sup> A.g.e.

<sup>44</sup> A.g.e.

<sup>45</sup> Anna Ahronheim, "Aviv Kochavi: The military chief Israel needs?", The Jerusalem Post, 16 January 2020.

sidering the regional policies of Israel, the geopolitics and the rising capacity of Hamas and Hezbollah as of today. This situation of-

ten suggests that behind Israel's aggressive attitude, there are internal political concerns and goals at play.

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