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GREEN HYDROGEN AND FORMULA 1: ADVANCING SUSTAINABLE COMPREHENSIVE APPROACHES FOR F1 RACING IN THE MENA REGION

Feryal Fekri*

ABSTRACT

Formula 1 (F1) has embarked on sustainability initiatives, notably the 'Countdown to Zero' campaign aimed at achieving carbon neutrality by 2030. This article delves into F1's sustainability efforts, focusing on the integration of green hydrogen as a promising solution for reducing carbon emissions, particularly within the Middle East and North Africa (MENA) region. Despite the novelty of green hydrogen in F1, its potential applications in powering vehicles and supporting event logistics are explored. Additionally, the article examines MENA's significance in F1's sustainability agenda, given its abundant renewable energy resources and strategic position in hosting Grand Prix races. The feasibility of transitioning F1 cars to sustainable alternatives, including electric vehicles, hydrogen-powered cars, and e-fuels, is scrutinized, highlighting challenges and opportunities. Furthermore, the article discusses sustainable practices that can make F1 events more sustainable. It refers to sustainable practices previously implemented in past F1 Grand Prix races, assesses their applicability to the MENA region, and suggests innovative practices that the MENA can implement; these include the installation of solar canopies in F1 circuit parking lots and the use of bio-fuelled trucks for event logistics. Investment in sustainable aviation fuel (SAF) emerges as another avenue for F1 to mitigate its carbon footprint, potentially through partnerships with airlines present in the MENA region, such as Emirates. Ultimately, this article underscores the imperative for F1 to embrace sustainable practices, not only to align with societal trends but also to lead the charge in environmental stewardship within the realm of motorsport.

Keywords: Formula 1, Green Hydrogen, Net Zero, MENA, Sustainability.

1. INTRODUCTION

Formula 1 (F1), regulated by the Fédération Internationale de l'Automobile (FIA), has risen to become one of the world's most prestigious and widely followed annual sporting series since its establishment in 1950.[1] The F1 season, marked by a series of races known as the Grand Prix, unfolds across continents, captivating millions of fans worldwide. With 20 drivers representing 10 teams, the competition intensifies as they vie for triumph in both the Drivers' Championship and the Constructors' Championship.[2] However, beneath the adrenaline-fueled excitement lies a pressing environmental challenge that has been argued to make F1 an unsustainable sport.[3]

Environmentalists and several prominent F1 drivers, including Lewis Hamilton, have voiced growing concerns about the environmental impact of F1.[4] Whilst these concerns are relatively recent, F1 has acknowledged them since the release of its sustainability report in 2019, which detailed the sources of CO_2 emissions within the sport, as summarized in **Figure 1**. According to this report, F1 emitted 256,551 tonnes of CO2 per season.[5] In response, Stefano Domenicali, the president and CEO of F1, stated, 'Everyone understands the need for change.'[6]

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1 Abhay Maurya, 'Formula one (f1) Car: A Scientometric Study' (2021) 7(5) IJARIIE 1463.

2 Alice S Zheng, 'After Abu Dhabi: Restoring Integrity and Accountability in Formula 1' (2024) 47(1) The Columbia Journal of Law & the Arts 107.

3 Paulo Mourao, 'Smoking Gentlemen—How Formula One Has Controlled CO2 Emissions' (2018) 10(6) Sustainability 1841.

4 Laurence Edmondson, 'The environment will pose F1's biggest challenge in the 2020s' (ESPN.com, 30 December 2019) <www.espn.com/f1/story/_/id/28395224/the-environment-pose-f1-biggest-challenge-2020s> accessed 28 May 2024.

5 F1, Sustainability Strategy Report (2019), available at: https://corp.formula1.com/uploads/2019/11 (last accessed 28 May 2024).

6 Lawrence Barretto, 'Net Zero Carbon: How Formula 1 is going to meet this ambitious target by 2030' (F1 - The Official Home of Formula 1 Racing, 28 September 2022) <www.formula1.com/en/latest/article/net-zero-carbon-how-formula-1-is-going-to-meet-this-ambitious-target-by-2030.5QsK9NpYbz7pXp7423I3iJ> accessed 28 May 2024.

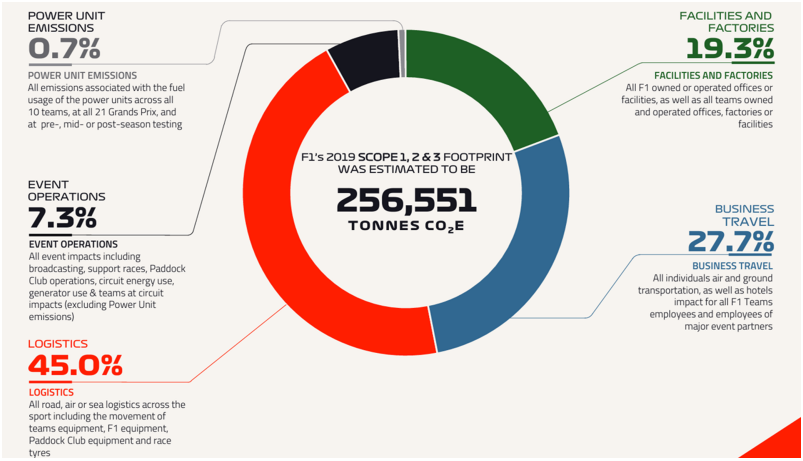

Figure 1: This pie chart illustrates the distribution of CO2 emissions by source within F1, based on data from F1's 2019 sustainability report.[7]

In the report, F1 introduced two key sustainable strategies: "Countdown to Zero" and "Positive Race Print."[8] "Countdown to Zero" aims for carbon neutrality by 2030, focusing on reducing emissions across car design, logistics, and event operations. "Positive Race Print" seeks to ensure F1 events positively impact host communities through job creation, education programs, infrastructure improvements, and promoting diversity and inclusion.[9]

This article will primarily focus on the 'Countdown to Zero' initiative and its goal of reducing carbon emissions by 50 percent by 2030. This commitment underscores F1's acknowledgment of the urgent need to mitigate its environmental impact and align with broader societal trends towards environmental consciousness. However, achieving net-zero emissions requires more than aspirations; it demands concrete strategies and innovative solutions.[10]

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7 F1 (n 5).

8 ibid.

9 ibid.

10 Ferrari N.V, Sustainability Report (2019), available at: https://cdn.ferrari.com › network › media › pdf (last accessed 21 June 2024).

In recent years, the Middle East (ME) has emerged as a key player in hosting F1 Grand Prix races.[11] The region's first F1 event took place in Bahrain in 2004.[12] By 2021, the season's final race in Abu Dhabi attracted over a hundred million TV viewers and 153,000 attendees in person.[13] This article focuses on the integration of green hydrogen into F1 events within the Middle East and North Africa (MENA) region to help make F1 racing more sustainable. Green hydrogen, produced through the electrolysis of water using renewable energy sources, emerges as a promising solution in the pursuit of sustainable energy as it offers a clean alternative to fossil fuels.[14] The MENA region is endowed with abundant renewable energy resources, particularly solar power, which can be harnessed to produce green hydrogen.[15]

By examining current sustainability practices in F1, the potential for green hydrogen adoption, and the specific needs and capabilities of MENA countries, this article aims to provide a roadmap for advancing sustainable approaches in F1 events. In light of these considerations, this article seeks to address two fundamental questions, namely:

(i) Is transitioning F1 cars from fossil fuels to sustainable alternatives feasible?; and

(ii) How can green hydrogen contribute to make F1 events more sustainable?

This article is divided into 6 sections. After this introductory section, Section 2 looks at the relationship between sports and sustainability. Section 3 provides a historical background of F1 in the MENA region, examines how the MENA region has contributed to F1's net zero targets, and explores the symbiotic relationship between the MENA region and F1. Section 4 addresses question (i) by evaluating the feasibility of alternative sustainable fuels for F1. Section 5 focuses on answering question (ii) by exploring green hydrogen initiatives through case studies, assessing their applicability and sustainability for the MENA region. Atlas, Section 6 concludes the article

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11 S Zheng (n 2).

12 'Formula 1 announces TV, race attendance and digital audience figures for 2021' (F1 - The Official Home of Formula 1 Racing, 17 February 2022) <www.formula1.com/en/latest/article/formula-1-announces-tv-race-attendance-and-digital-audience-figures-for-2021.1YDpVJIOHGNuok907sWcKW> accessed 18 June 2024.

13 S Zheng (n 2).

14 Arturo de Risi, Gianpiero Colangelo and Marco Milanese, 'Advanced Technologies for Green Hydrogen Production' (2023) 16(6) Energies 2882.

15 Marek Jaszczur and others, 'Massive Green Hydrogen Production Using Solar and Wind Energy: Comparison between Europe and the Middle East' (2023) 16(14) Energies 5445.

and provides policy recommendations for the MENA region to advance net-zero ambitions in F1.

2. SPORTS AND SUSTAINABILITY

In their research, Hautbois and Desbordes identified a significant gap in the literature concerning the topic of sustainability in sport.[16] Similarly, this paper finds that despite growing concerns regarding F1's environmental impact, there is a noticeable lack of peer-reviewed literature on enhancing F1's sustainability through the use of green hydrogen, particularly in the MENA region. To address this gap, a deep and thorough literature review was conducted to understand sustainability in sport and the efforts F1 has undertaken to become a more sustainable sport.

On September 25, 2015, the United Nations (UN) Assembly set forth guidelines for the 2030 Agenda for Sustainable Development, introducing 17 Sustainable Development Goals with 169 targets and indicators.[17] This initiative, rooted in the Brundtland report of 1987, defines sustainable development as meeting current needs without compromising future generations' ability to meet theirs.[18] The UN aimed to eradicate extreme poverty, fight inequality and injustice, and address climate change through these goals.[19]

In recent years, sport has emerged as a significant economic activity, contributing 3.3% to the EU's GDP in 2021.[20] Thus, Bácsné-Bába and others argue that sporting events carry a responsibility to be sustainable. They suggest that such events should be leveraged not only for their economic impact but also for their potential to convey environmental values, principles, and legacy to host communities.[21] Sánchez-Sáez believes that these aspects

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16 Christopher Hautbois and Michel Desbordes, 'Sustainability in Sport: Sport, Part of the Problem … and of the Solution' (2023) 15(15) Sustainability 11820.

17 United Nations General Assembly, 'Transforming our world: the 2030 Agenda for Sustainable Development' (25 September 2015) UN Doc A/RES/70/1.

18 World Commission on Environment and Development. Our Common Future; Oxford University Press: Oxford, UK, 1987.

19 ibid.

20 Maira Ulloa, Estela Inés Farías-Torbidoni and Jordi Seguí-Urbaneja, 'Sport Events and Sustainability: A Systematic Review (1964-2020)' (2023) 153 Apunts Educación Física y Deportes 101.

21 Éva Bácsné-Bába and others, 'Sustainability-Sport-Physical Activity' (2021) 18(4) International Journal of Environmental Research and Public Health 1455.

can generate positive social, economic, and environmental effects, which are the three pillars of sustainability.[22]

Hautbois and Desbordes state that when addressing significant issues like environmental protection, social connections, and business responsibility to society, sport might seem like an inconsequential factor. However, it can serve as both a prime example and a cautionary tale regarding sustainability.[23] Essentially, sport is both a contributor to the problem and a potential part of the solution. It contributes to the problem because it hosts some of the largest events, attracting massive crowds that travel by air, significantly increasing the carbon footprint. Additionally, the construction of infrastructure for these events often involves thousands of workers, sometimes with little regard for human rights, leading to issues such as violence, harassment of minorities, poverty, and forced expropriation.[24]

McCullough, Orr and Kellison claim that the relationship between sport and sustainable development extends beyond environmental concerns.[25] From a similar viewpoint, Domínguez et al. argue that sustainable development in sport includes various aspects such as promoting teamwork, overcoming gender barriers, enhancing education quality, fostering sport inclusivity, and building alliances to support sustainable principles.[26] Sustainability has increasingly permeated sports organizations, events, and corporate social responsibility initiatives.[27] However, McCullough, Garrido and Vernet emphasize that merely recognizing sustainability is insufficient; more proactive efforts from stakeholders are necessary.[28]

In the context of F1, the sport has introduced numerous technologies and innovations that have benefited society and helped reduce CO2 emissions throughout its history.[29] Today, F1 holds immense significance in the world

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22 Juan Antonio Sánchez-Sáez, 'Sports events as a local development instrument' (2019) 14(41) Culture, Science and Sport 91.

23 Hautbois and Desbordes (n 16).

24 ibid.

25 Brian P McCullough, Madeleine Orr and Timothy Kellison, 'Sport Ecology: Conceptualizing an Emerging Subdiscipline Within Sport Management' (2020) 34(6) Journal of Sport Management 509.

26 T. Domínguez, P. Garrido and B. Vernet, 'Sport, integrity and sustainable development: The importance of integrity in sport in the 2030 Agenda' (2019) 63 Encuentros Multidisciplinarios 1.

27 McCullough and others (n 25).

28 ibid.

29 Imoh Ime Ekanem, Aniekan Essienubong Ikpe and Eyo Sunday Abia, 'Atlas 11. International Congress on Advanced Scientific Studies And Interdisciplinary

of motorsport, distinguishing itself through its focus on technological advancements.[30] Acting as a testing ground for automotive manufacturers and engineers, F1 enables the development and refinement of cutting-edge technologies.[31]

One notable example is the introduction of hybrid power units in F1, which has been a major technological breakthrough.[32] These power units combine a traditional internal combustion engine with energy recovery systems, such as kinetic energy recovery systems (KERS) and heat energy recovery systems (ERS). The hybrid power units have not only increased the overall power output of the cars but have also improved fuel efficiency and reduced emissions.[33] Furthermore, this technology has had a significant impact on the wider automotive industry, encouraging the development of more sustainable and eco-friendly powertrain solutions.[34]

However, F1's commitment to sustainability does not end there. F1 believes it can continue to be a pioneer for the auto industry, working with the energy and automotive sectors to drive down carbon emissions globally by pushing the boundaries of technology.[35]

3. A HISTORICAL REVIEW OF F1 IN THE MENA REGION

Historically, only two African countries have ever hosted a F1 Grand Prix: Morocco and South Africa. The Moroccan Grand Prix, first organized in 1925 in Casablanca, held world championship status once in 1958 but has not

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Research', Evolution Of Formula One (F1) Motorsports And Its Top-Notch Advancement In Engineering Innovations Across The Racing Industry (Liberty Academic Publishers 2024) 107.

30 Anne Tjønndal and Hans Erik Næss, Innovation, Sustainability and Management in Motorsports: The Case of Formula E (Palgrave Macmillan Cham 2021).

31 Fayez Alanazi, 'Electric Vehicles: Benefits, Challenges, and Potential Solutions for Widespread Adaptation' (2023) 13(10) Applied Sciences 6016.

32 Zbigniew STĘPIEŃ, 'A new generation of F1 race engines – hybrid power units' (2016) 167(4) Combustion Engines 22.

33 Albert Boretti, 'Changes of E-KERS Rules to Make F1 More Relevant to Road Car' (2018) 3(1) Advances in Technology Innovation 26.

34 Ime Ekanem and others (n 29).

35 Christopher Schneiders and Claudio Rocha, 'Technology Innovations and Consumption of Formula 1 as a TV Sport Product' (2022) 31(3) Sport Marketing Quarterly 186.

hosted a race since then.[36] Similarly, the South African Grand Prix began in 1934 at the Prince George Circuit in East London, Cape Province. Although interrupted by World War II, it was revived in 1960 and joined the F1 World Championship calendar in 1962. The race was popular until it was suspended after the controversial 1985 race due to apartheid. It returned briefly in 1992 and 1993 after the end of apartheid but has not been held since.[37] Plans to revive the race in 2024 have been abandoned.[38] However, Stefano Domenicali, the CEO of F1, emphasized that reintroducing Africa to the F1 calendar is a definitive priority in the coming years.[39]

In contrast, the ME has become a significant hub for F1 since the first Bahrain Grand Prix two decades ago. The Abu Dhabi, Bahrain, Qatar, and Saudi Arabia Grands Prix collectively attracted over half a million fans last year, boasting one of the youngest and most diverse fanbases in the sport.[40]

Contracts with ME countries have extended their annual Grand Prix races up until 2030 and beyond, reflecting a long-term commitment to the sport. For instance, in December 2021, F1 announced a multi-year deal with Abu Dhabi, ensuring the Yas Marina Circuit will host F1 races until at least the end of 2030.[41] Similarly, the Saudi Arabian Grand Prix is scheduled to continue until at least 2030, with races initially held at the street circuit in Jeddah before moving to a new complex in Qiddiya.[42] Qatar, which first

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36 '1958 Morocco Grand Prix - RACE RESULT' (F1 - The Official Home of Formula 1 Racing) <www.formula1.com/en/results.html/1958/races/168/morocco/race-result.html> accessed 29 May 2024.

37 Kenneth Mcleod, 'Facts and History About the Grand Prix in South Africa' (Grand Prix Adventures, 11 October 2022) <https://grandprixadventures.com/news/southafricagp-history-facts.php> accessed 29 May 2024.

38 Matt Kew, 'F1 pauses South African GP plans for 2024' (Motorsport, 6 June 2023) <www.motorsport.com/f1/news/f1-pauses-south-african-gp-plans-for-2024/10479404/> accessed 29 May 2024.

39 ibid.

40 'Formula 1 and beIN SPORTS agree ten-year deal to exclusively broadcast F1 across MENA & Turkey' (F1 - The Official Home of Formula 1 Racing , 24 February 2024) <https://corp.formula1.com/formula-1-and-bein-sports-agree-ten-year-deal-to-exclusively-broadcast-f1-across-mena-turkey/> accessed 29 May 2024.

41 Luke Smith, 'Abu Dhabi signs new 10-year F1 contract as season finale' (Autosport, 9 December 2021) <www.autosport.com/f1/news/abu-dhabi-signs-new-10-year-f1-contract-as-season-finale/6866629/> accessed 29 May 2024.

42 Adam Cooper, 'Saudi Arabia GP on calendar for at least a decade, says F1' (Autosport, 27 February 2021) <www.autosport.com/f1/news/saudi-arabia-gp-on-calendar-for-at-least-a-decade-says-f1-5529528/5529528/> accessed 29 May 2024.

appeared on the calendar in 2021, has a 10-year contract to host the Grand Prix annually until 2032, initially at the Losail circuit, with a new complex under construction.[43] The Bahrain Grand Prix, with the longest-running contract in F1 history, is set to continue until at least 2036.[44]

3.1 Symbiotic Relationship between ME and F1

As the ME's presence in F1 has expanded, so has its sustainability initiatives at its Grand Prix events. For instance, Saudi energy giant Aramco, in collaboration with F1 and Aston Martin Racing, aims to achieve 100% sustainable fuel by 2026.[45] At the Yas Marina Circuit in Abu Dhabi, a partnership with Emerge, a Masdar and EDF Group Joint Venture, resulted in the installation of 5,795 square meters of solar panels, generating 1,506.70 kWp of clean energy across the venue.[46] Additionally, a collaboration with Farnek, a leader in smart and green facility management, led to the conversion of circuit lighting to LED fixtures, reducing carbon emissions by 31%.[47]

Similarly, the Bahrain International Circuit (BIC) implemented energy-saving measures, including a new building management system, upgrades to more efficient air conditioning chillers, and the replacement of all lighting with LED lights. These initiatives resulted in over 30% energy savings.[48] The solar park at BIC produced over 5 million kWh of clean energy in its first year, offsetting 3,108 tonnes of carbon and winning the Event Innovation Award at the F1 Promoter Awards in London.[49]

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43 Adam Cooper, 'F1 confirms Qatar GP on 2021 calendar as part of long-term deal' (Autosport, 30 September 2021) <www.autosport.com/f1/news/f1-confirms-qatar-gp-on-2021-calendar-as-part-of-long-term-deal/6678313/> accessed 29 May 2024.

44 Adam Cooper, 'F1 extends Bahrain GP deal to 2036' (Autosport, 11 February 2022) <www.autosport.com/f1/news/f1-extends-bahrain-gp-deal-to-2036/8044438/> accessed 29 May 2024.

45 'The Aramco and Aston Martin Racing strategic partnership' (ARAMCO) <https://europe.aramco.com/en/creating-value/technology-development/aramco-and-aston-martin-strategic-partnership> accessed 3 July 2024.

46 'Environmental Sustainability Policy' (Yas Marina Circuit) <www.yasmarinacircuit.com/en/sustainability-policy> accessed 29 May 2024.

47 ibid.

48 'Bahrain Grand Prix wins F1 award for Innovation' (Bahrain News Agency, 9 February 2024) <www.bna.bh/en/BahrainGrandPrixwinsF1awardforInnovation.aspx?cms=q8FmFJgiscL2fwIzON1+Dt0tuA1Yp+wLOvyigCzH9ns=> accessed 29 May 2024.

49 ibid.

However, this collaboration is not solely philanthropic. As one of the most esteemed and technologically sophisticated racing series, F1 has consistently adapted to the shifting demands of the automotive industry.[50] As the world progresses, F1 must continue to evolve to address future demands. A crucial element in F1's future is the adoption of sustainable practices.[51] With increasing concerns about climate change and environmental impact, it is essential for F1 to reduce its carbon footprint, especially given growing pressure from businesses and investors. Increasingly, many key stakeholders understand the clear link between sustainable business practices and financial performance.[52]

As a result, in 2020, following the 2019 announcement that F1 aims to achieve net zero carbon as a sport by 2030, both F1 and FIA announced their adherence to the United Nations Sport for Climate Action Framework.[53] F1's plans to achieve net zero carbon by 2030 align with the framework's requirements for signatories.[54] By joining, F1 commits to implementing the framework's principles and collaborating with stakeholders to advance climate action in sports.[55]

One could argue that F1 needs to collaborate closely with the host countries of its Grand Prix races to advance sustainability initiatives through promotion, implementation, and development of green hydrogen;[56] this partnership exemplifies a symbiotic relationship where both parties benefit

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50 Saeed Asadi Bagloee and others, 'Autonomous vehicles: challenges, opportunities, and future implications for transportation policies' (2016) 24(4) Journal of Modern Transportation 284.

51 Ms Aswathy Sreenivasan and Dr Suresh M, 'Factors influencing sustainability in start-ups operations 4.0' [2023] Sustainable Operations and Computers 4.

52 Enovation Consulting, Racing Towards A Sustainable Future: A Review Of The Global Sustainability Performance Of Motorsport Championships (Sustainable Championships Index 2022) <https://static1.squarespace.com/static/609fc4f7632adb003064547d/t/62036e5c97b6876d86be8303/1644392032587/Sustainable+Championships+2022+Index_Racing+towards+a+sustainable+future.pdf> accessed 19 June 2024.

53 'Formula 1 and FIA sign United Nations' Sports for Climate Action Framework' (F1 - The Official Home of Formula 1 Racing, 22 January 2020) <www.formula1.com/en/latest/article/formula-1-and-fia-sign-united-nations-sports-for-climate-action-framework.4ClwISJuvX2IHWwqquWaQA> accessed 20 June 2024.

54 ibid.

55 ibid.

56 ibid.

through mutual cooperation.[57] In other sports sectors, symbiotic relationships have proven effective in promoting environmental sustainability. For instance, the partnership between Major League Baseball (MLB) and the Natural Resources Defense Council (NRDC) has facilitated eco-friendly practices within baseball stadiums and raised awareness about environmental issues among fans and the broader community.[58]

F1's commitment to achieving net zero carbon by 2030 aligns closely with the ambitions of ME countries striving to meet their targets under the Paris Agreement. The ultimate aim of the Paris Agreement is to limit the global average temperature increase to below 2°C from pre-industrial levels, with efforts focused on achieving a more ambitious target of 1.5°C.[59] As part of this agreement, countries have committed to specific reductions in their carbon emissions by 2030 through their Nationally Determined Contributions (NDCs), which can be achieved using various methods and strategies.[60]

Across different global regions, major fossil fuel-exporting nations, such as those in the ME, are anticipated to face a heightened impact from decreased fossil fuel extraction necessary to achieve global NDC objectives.[61] Therefore, a close partnership with F1 can help the ME countries hold more sustainable Grand Prix races which will result in lower CO2 emissions.[62]

Moreover, several ME countries have set targets to achieve net-zero carbon emissions domestically.[63] For instance, the UAE became the first country in the MENA region to announce its aim to reach net-zero carbon emissions by 2050. Since then, the UAE has invested in numerous clean

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57 NRDC, Game Changer: How the sport industry is saving the environment (R-12-08-A, 2012).

58 ibid.

59 Paris Agreement, opened for signature 12 December 2015, 55 ILM 2016 738 (entered into force 4 November 2016), art 2(1)(a).

60 ibid, art 4.

61 Mohammad M Khabbazan and Christian von Hirschhausen, 'The implication of the Paris targets for the Middle East through different cooperation options' (2021) 104 Energy Economics 105629.

62 Aymen Almoayed, 'How major sporting events are boosting Middle East economies' (World Economic Forum, 30 April 2023) <www.weforum.org/agenda/2023/03/sports-middle-east/> accessed 18 June 2024.

63 Amith Passela, 'Yas Marina Circuit outlines plans for venue and Abu Dhabi GP to be net-zero carbon by 2040' (The National, 24 November 2023) <www.thenationalnews.com/sport/f1/2023/11/24/yas-marina-circuit-outlines-plans-for-venue-and-abu-dhabi-gp-to-be-net-zero-carbon-by-2040/> accessed 19 June 2024.

energy projects, such as solar, wind, and nuclear, with the goal of reducing reliance on gas for electricity generation.[64]

One significant initiative is the two-gigawatt Al Dhafra solar power plant in Abu Dhabi, among the world's largest solar projects. Expected to power 200,000 homes, this plant is projected to cut the capital's carbon dioxide emissions by more than 2.4 million tonnes annually. Moreover, Abu Dhabi's F1 Yas Marina Circuit has committed to achieving net-zero carbon status for the Etihad Airways Abu Dhabi Grand Prix by 2040, underscoring its dedication to sustainability efforts.[65]

As sustainability initiatives gain traction in F1 events across the ME, the region not only advances F1's goal of achieving net zero carbon by 2030 but also sets the stage for exploring the feasibility of transitioning F1 cars to sustainable alternatives and the potential of green hydrogen powering F1 events, as outlined in question (i) and (ii) of this article.

4. IS TRANSITIONING F1 CARS FROM FOSSIL FUELS TO SUSTAINABLE ALTERNATIVES FEASIBLE?

Referring to **Figure 1**,[66] it is evident that although racing cars constitute less than 1% of all F1 CO2 emissions, they are the most visible and marketable element of the sport. Environmental experts argue that the influence and example set by highly popular sports organizations are their most substantial impacts on the environment.[67] Ross James Brawn, former F1 managing director of motor sports and technical director, emphasizes, "The message from the race car is almost 100% of what we do."[68] Consequently, F1 has been exploring new technologies to reduce its environmental impact,[69] such

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64 ibid.

65 ibid.

66 F1 (n 5).

67 Madeline Coleman, 'Can F1 Stay Fueled?' (Sports Illustrated, 21 April 2023) <www.si.com/formula1/2023/04/21/f1-stay-fueled-climate-change> accessed 29 May 2024.

68 ibid.

69 What is the F1 Impact Report and why does it matter?' (F1 - The Official Home of Formula 1 Racing, 16 April 2024) <www.formula1.com/en/latest/article/explained-what-is-the-f1-impact-report-and-why-does-it-matter.4c5wcOQrypfLR6yHaZhB 9I> accessed 29 May 2024.

as adopting electric and hydrogen-powered vehicles and using more sustainable fuels instead of fossil fuels.[70]

4.1 Electric Vehicles

Around the world, jurisdictions are increasingly phasing out fossil fuel vehicles, with some cities planning to ban them from downtown areas by 2030. Montreal is amongst these cities,[71] and California in the U.S. has also implemented bans on their sales over the coming decades.[72] This raises questions about whether F1 can continue to operate in such environments.

Beyond this concern lies a more fundamental question: can F1 transition to electric vehicles? Ross Brawn suggests that currently, this transition is not feasible. He acknowledges that F1 has taken note of the evolving regulations but highlights several challenges.[73] Firstly, Formula E (FE) holds exclusive rights to organize the sole full-electric championship until 2039, as approved by the FIA.[74] Launched in 2014, FE is now a FIA sanctioned single-seat world championship and the world's first fully electric racing series.[75]

Moreover, today's electric vehicles are not suited to the demands of F1 racing.[76] F1 races typically last between 90 minutes to two hours, reaching speeds of up to 300 kilometers per hour, while Formula E races are shorter, lasting around 45 minutes, with average speeds of approximately 173 miles per hour.[77]

Another significant factor is the sensory experience: the noise and energy generated by internal combustion engines (ICE) remain integral to the

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70 Justin Rowlatt, 'Formula 1 boss Ross Brawn says hydrogen could be future fuel' (BBC Sport, 15 July 2021) <www.bbc.com/sport/formula1/57842205> accessed 29 May 2024.

71 Linda Gyulai, 'Montreal's climate plan includes ban on non-electric cars downtown by 2030' (Montrealgazette, 11 December 2020) <https://montrealgazette.com/news/local-news/montreal-releases-climate-plan-including-ban-on-non-electric-cars -downtown-by-2030> accessed 29 May 2024.

72 Emma Newburger, 'California bans the sale of new gas-powered cars by 2035' (CNBC, 25 August 2022) <https://cnb.cx/3dY00QT> accessed 29 May 2024.

73 Coleman (n 68).

74 'What is Formula E?' (The Official Home of Formula E) <www.fiaformulae.com/en/what-is-formula-e> accessed 29 May 2024.

75 ibid.

76 Tjønndal and Næss (n 30).

77 James Gilboy, 'Here's Why Formula 1 Can't Go Electric Yet, Explained with Simple Science' (The Drive, 9 January 2021) <www.thedrive.com/accelerator /37321/heres-why-formula-1-cant-go-electric-yet-explained-with-simple-science> accessed 29 May 2024.

passion and excitement of F1.[78] Recent research conducted by F1 in partnership with Ipsos MORI Social Research Institute found that one in four fans identified noise as a key factor in the sport's appeal.[79] In certain interviews, F1 drivers like Lewis Hamilton have expressed their dissatisfaction with the reduction in engine noise within the sport as well.[80]

The outcome for F1 Grand Prix events in light of impending national bans on fossil fuel vehicles remains uncertain. However, in an interview with an Italian publication, F1 CEO Stefano Domenicali stated firmly that the series "will never go electric." Instead, he emphasized synthetic fuels, also known as e-fuel, as the preferred solution.[81]

4.2 E-fuel

'E-fuel," short for 'electrofuel', presents a promising alternative to traditional petrol and diesel for vehicles equipped with ICE. Whilst electric cars face challenges in terms of cost-effective manufacturing, e-fuels offer a potential long-term solution for extending the lifespan of ICE vehicles,[82] which will remain prevalent on roads long after F1 and various countries strive to achieve their net-zero emission targets.

Produced by using electricity to split water into hydrogen and oxygen, e-fuels entail combining hydrogen with CO2 captured from the air through chemical synthesis. However, this process demands a significant amount of electricity, presenting its own set of challenges and criticisms.[83] Despite these challenges, F1 advocates for e-fuels and is actively working towards producing its own completely carbon-neutral e-fuel. The current generation of F1 cars runs on 'E-10' fuel, a blend of 90% petrol and 10% renewable ethanol. Collaborating with Saudi petroleum natural gas company

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78 Tjønndal and Næss (n 30).

79 'Formula 1 reveals details of fan segmentation research' (F1 - The Official Home of Formula 1 Racing, 3 July 2018) <www.formula1.com/en/latest/article/formula-1-reveals-details-of-fan-segmentation-research.19u9fkhcB8cOocIwAacuow> accessed 29 May 2024.

80 Michelle Foster, ''It drives me mad!' - Karun Chandhok's three-fold solution to F1's racing problems' (PlanetF1, 31 January 2024) <www.planetf1.com/news/karun-chandhok-solution-f1-racing-problems> accessed 29 May 2024.

81 Simone Filippetti, 'Da Imola al trono di Ecclestone, la F1 del manager orgoglioso del suo «Paeseanalogico»' (Il Sole 24 Ore, 20 February 2023) <www.ilsole24ore.com/art/da-imola-trono-ecclestone-f1-manager-orgoglioso-suo-paese-analogico-AE0aQnPC?refresh_ce=1> accessed 29 May 2024.

82 Gautam Kalghatgi, 'Development of Fuel/Engine Systems—The Way Forward to Sustainable Transport' (2019) 5(3) Engineering 510.

83 ibid.

ARAMCO, F1 aims to develop a 100% sustainable fuel for use in all F1 cars by 2026.[84] This has the potential to benefit not only F1 but also nearly two billion cars worldwide, as it is designed to be compatible with most existing vehicles. If successful, this fully sustainable e-fuel could revolutionize the automotive industry by reducing the environmental impact of all new and existing ICE road vehicles globally. By 2030, an estimated 1.4 billion such vehicles will be on the road, with only 8% expected to be purely electric. These fuels could also significantly impact major polluting sectors such as heavy road transport, shipping, and aviation.[85]

In 2022, an agreement was made to stop selling new ICE cars in the EU by 2035, a decision also adopted by the UK.[86] However, just before the EU's 2035 decision was voted on by national governments in March 2023, the German government, along with Italy, Bulgaria, and Poland, unexpectedly opposed it. They insisted that sales of new ICE cars should still be allowed after 2035 if they use e-fuels.[87] This debate was particularly relevant to automotive giants Porsche and Ferrari, as a ban on ICE cars would greatly affect their traditional and high-performance car sectors.[88] The European Commission agreed to this demand and is now working on creating a new EU vehicle category specifically for cars that can only operate on carbon-neutral fuels.[89]

Consequently, numerous car manufacturers and ambitious start-ups are already showing interest in e-fuels as the future solution. For example, Porsche has invested over $100 million in an e-fuel project based in Chile, which saw its first commercial shipment of e-fuels in November of the

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84 'The Aramco and Aston Martin Racing strategic partnership' (n 45).

85 'How sustainable fuels can benefit the world' (F1 - The Official Home of Formula 1 Racing, 17 April 2024) <www.formula1.com/en/latest/article/how-sustainable-fuels-can-benefit-the-world-and-are-more-than-just-the.7wgO1hvSIoVBrVqpuL0sEc> accessed 29 May 2024.

86 'EU ban on the sale of new petrol and diesel cars from 2035' (European Parliament, 11 March 2022) <www.europarl.europa.eu/topics/en/article/20221019STO44572/eu-ban-on-sale-of-new-petrol-and-diesel-cars-from-2035-explained> accessed 29 May 2024.

87 ibid.

88 Ivana Kottasová, 'EU was set to ban internal combustion engine cars. Then Germany suddenly changed its mind' (CNN, 24 March 2023) <https://edition.cnn.com/2023/03/24/cars/eu-combustion-engine-debate-climate-intl/index.html> accessed 29 May 2024.

89 European Parliament Resolution of 5 May 2022 on the Commission's 2021 Rule of Law Report (2021/2180(INI)) [2022] OJ C 368/01, recital 11.

previous year.[90] The decision to invest in Chile is strategic because of its abundant wind energy resources.[91] However, achieving complete carbon neutrality in the e-fuel production process requires that the fuel is extracted and transported using exclusively renewable energy sources, highlighting the substantial progress still needed in this area.[92]

Moreover, as research into e-fuels advances, it becomes evident that their practical applications might primarily be limited to the racing and heritage car markets. This is due to their exceedingly high production costs, as highlighted by a Porsche research and development executive, who estimates the current cost at £37.24 per imperial gallon, significantly exceeding that of regular unleaded petrol.[93] Additionally, e-fuels require a substantial amount of renewable energy to achieve carbon neutrality in the production cycle, a capacity currently lacking in countries like the UK.[94] When comparing the energy demands of e-fuels to battery electric vehicles (BEVs), it is argued that e-fuels consume more energy on a mile-per-mile basis than what is required to power an electric car.[95] It can be argued that the widespread adoption of e-fuels across all automotive sectors seems improbable in the foreseeable future.[96]

F1 CEO Domenicali has highlighted that by 2035, when certain governments mandate the sale of only zero-carbon emission vehicles, approximately two billion cars equipped with internal combustion engines will still be on the roads.[97] He suggests that the carbon emissions from these vehicles could potentially be balanced out with sustainable fuels, such as the one being developed by F1.[98] F1's commitment to sustainability is evident in their aim

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90 Stephen Edelstein, 'Porsche breaks ground on its synthetic fuel plant' (Motor Authority, 14 September 2021) <www.motorauthority.com/news/1133564_porsche-breaks-ground-on-its-synthetic-fuel-plant> accessed 29 May 2024.

91 ibid.

92 Falko Ueckerdt and others, 'Potential and risks of hydrogen-based e-fuels in climate change mitigation' (2021) 11(5) Nature Climate Change 384.

93 'eFuels to supplement electric mobility on the road to becoming CO2 neutral' (Porsche Newsroom) <https://media.porsche.com/mediakit/innovation-sustainability-performance/en/innovation-sustainability-performance/synthetic-fuels> accessed 29 May 2024.

94 Bethany Massey, 'POLE POSITION: is Formula 1 leading an e-fuel revolution?' (BDB Pitmans, 8 March 2024) <www.bdbpitmans.com/insights/pole-position-is-formula-1-leading-an-e-fuel-revolution/> accessed 29 May 2024.

95 ibid.

96 ibid.

97 'How sustainable fuels can benefit the world' (n 85).

98 ibid.

for their ICE-hybrid cars to run on e-fuel by 2026. Transitioning from 10% renewable fuel in 2022 to 100% in just a few years is ambitious, requiring rapid expansion of production. However, Symonds, F1's chief technical officer, assures that F1 is on track, having collaborated closely with ARAMCO.[99] ARAMCO will produce fuel from two plants, one in Saudi Arabia and another in Spain. For over 70 years, F1 has been a leader in innovation, developing highly efficient power units and hybrid systems.[100] Now, the sport is dedicated to driving a green revolution worldwide. Brawn emphasizes F1's role in pushing technology forward, leading to genuine advancements applicable in passenger vehicles and race cars.[101] He stresses that setting competition objectives, such as the pursuit of the best sustainable fuel for F1 cars, motivates manufacturers to invest millions in development, yielding widespread societal and environmental benefits that will help reach net zero emission targets eventually.[102]

4.3 Hydrogen Powered Cars

Whilst F1 is committed to achieving its net zero targets through the use of e-fuels, an alternative technological solution has been gaining momentum: hydrogen power. Although the technology may not be ready for the 2026 cycle of F1 engine regulations, it holds significant potential for the future. The recent collaboration between Red Bull Advanced Technologies and French racing car constructor ORECA on the hydrogen-fuelled Le Mans sportscar concept has reignited interest in hydrogen power for motorsports.[103] The H24 concept, which aims to introduce a hydrogen class of cars at the 2024 Le Mans 24 Hours, has prompted discussions about its viability for F1.[104]

If successful, hydrogen-powered cars could revolutionise high-performance racing by producing zero carbon emissions, with water being the only by-product. In a hydrogen fuel cell, hydrogen is oxidised into positive hydrogen ions and electrons, generating the current needed to power the drive motor.

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[99] ibid.
[100] ibid.
[101] ibid.
[102] ibid.
[103] '24 Hours of Le Mans 2024: H2 prototypes on track Saturday June 15 | 24h-lemans.com' (Lemans24, 27 March 2024) <www.24h-lemans.com/en/news/24-hours-of-le-mans-2024-h2-prototypes-on-track-saturday-june-15-58451> accessed 29 May 2024.
[104] ibid.

The electrons then react with oxygen to produce water, making the process environmentally friendly.[105]

The H24 concept car is serious about performance, initially targeting GT3 levels. It aims to produce approximately 550kW (730hp) at 17,000rpm, with a top speed of 300km/h and acceleration from 0 to 100km/h in around 3.4 seconds. Whilst the first version may not meet F1's performance demands, it represents a crucial step towards advancing hydrogen technology for Grand Prix racing.[106]

The potential of hydrogen has also garnered interest from major manufacturers. Mercedes, for example, is investing in hydrogen-powered electric motors. INEOS, a co-owner of Mercedes, is a leader in hydrogen production technology, using electrolysis to split water molecules into hydrogen and oxygen. This expertise could pave the way for hydrogen's integration into F1.[107]

However, several challenges remain before hydrogen can be a viable option for F1. The technology must first match F1's performance standards and then address the associated costs. F1's current hybrid rules have been criticised for focusing solely on technology without considering the financial implications for manufacturers.[108] This is a concern that F1 CEO Stefano Domenicali has acknowledged, emphasising the need to balance technological advancement with cost-efficiency to attract and retain manufacturers.[109]

In response to the growing interest and potential of hydrogen technology, the FIA, F1, and Extreme H (XH) have formed a Hydrogen Working Group. This technical group aims to monitor the progression and development of hydrogen technology relevant to both road and race cars. The group will explore the use of hydrogen in fuel cells and battery technology, as well as in combustion engines. Additionally, the working group will examine the necessary infrastructure, storage, charging, transportation, handling, and safety implications for a hydrogen-powered championship. XH will serve as

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[105] Alberto Boretti, 'Hydrogen internal combustion engines to 2030' (2020) 45(43) International Journal of Hydrogen Energy 23692.

[106] Jonathan Noble, 'Analysis: Could hydrogen power be F1's future solution?' (Autosport, 28 January 2021) <www.autosport.com/f1/news/analysis-could-hydrogen-power-be-f1s-future-solution-5333753/5333753/> accessed 29 May 2024.

[107] ibid.

[108] ibid.

[109] ibid.

a proving ground for hydrogen power development and implementation, with its first race scheduled for February 2025.[110]

Pat Symonds has indicated that the next generation of engines might be the last to use liquid hydrocarbons, with hydrogen being a likely successor.[111] Ross Brawn has also highlighted hydrogen as a way to retain the noise and emotion associated with F1 while moving towards a sustainable future.[112]

Most oil companies, including Aramco, Shell, and ExxonMobil, are investing heavily in hydrogen technology.[113] However, challenges such as energy-intensive hydrogen production, the need for pressurised storage tanks, and the lack of a dedicated supply network remain.[114] Despite these obstacles, companies like Toyota and Honda have been producing hydrogen fuel cell cars for years, and conventional engines are being tested. Toyota's hydrogen combustion-engined Corolla and its collaboration with Yamaha on a hydrogen-powered V8 exemplify the potential for hydrogen in motorsport.[115]

For now, F1's focus remains on sustainably fuelled hybrids, which align with the interests of teams, manufacturers, and sponsors.[116] However, the hydrogen-powered cars at Le Mans 2024 could offer a preview of F1's long-term future. Whilst hydrogen is not the immediate solution for F1, it represents a promising path towards a more sustainable and innovative future for motorsport.

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110 'Extreme H, FIA and Formula 1 to establish joint Hydrogen Technical Working Group' (Extreme E, 3 December 2023) <www.extreme-e.com/en/news/1128_Extreme-H-FIA-and-Formula-1-to-establish-joint-Hydrogen-Technical-Working -Group> accessed 29 May 2024.

111 Justin Rowlatt, 'Formula 1 boss Ross Brawn says hydrogen could be future fuel' (BBC Sport, 15 July 2021) <www.bbc.com/sport/formula1/57842205> accessed 29 May 2024.

112 ibid.

113 Dominic Tobin, 'Hydrogen-powered F1 cars? New fuel under consideration in research project' (Motor Sport Magazine, 7 December 2023) <www.motorsportmagazine.com/articles/single-seaters/f1/hydrogen-powered-f1-cars/> accessed 29 May 2024.

114 ibid.

115 ibid.

116 'How sustainable fuels can benefit the world' (n 85).

5. HOW CAN GREEN HYDROGEN CONTRIBUTE TO MAKE F1 EVENTS MORE SUSTAINABLE?

As nations and F1 strive for a more sustainable future, previous host countries of F1 Grand Prix races have implemented various eco-friendly practices with their needs and unique circumstances. For instance, the Las Vegas Grand Prix launched a first-of-its-kind water conservation programme in efforts to implement technologies that can reduce, and eventually offset, outdoor water consumption at large-scale sporting events.[117] At the Miami Grand Prix, a local NGO donates F1's food surplus to local agencies,[118] and the Silverstone Circuit is actively raising public awareness about sustainability through various campaigns and initiatives during the Grand Prix.[119]

This section will explore some sustainable initiatives and assess their applicability and suitability for the MENA region, considering its unique conditions and requirements, with reference to sustainable practices previously taken by countries.

5.1 Dutch Grand Prix: Sustainable Transportation

In 2022, 97% of the visitors to the F1 Heineken Dutch Grand Prix used sustainable transportation to and from the venue.[120] Many visitors arrived by train or bicycle; on race days, the Dutch Railways transported 10,000 passengers per hour.[121] However, replicating this model in the MENA region presents significant challenges due to the region's harsh environment and inadequate public transportation infrastructure. The extreme temperatures in

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117 'F1 shares sustainability progress in first Impact Report' (F1 - The Official Home of Formula 1 Racing, 16 April 2024) <www.formula1.com/en/latest/article/f1-makes-significant-progress-in-sustainability-as-first-impact-report.4jk1NFk81TMXP6EyL dg10k> accessed 29 May 2024.

118 Trish Christakis, 'F1 Miami Grand Prix donates leftover food to homeless nonprofit' (CBS, 8 May 2024) <www.cbsnews.com/miami/news/f1-miami-grand-prix-donates-food-to-homeless-chapman-partnership-south-florida/> accessed 20 June 2024.

119 'Local Community' (Silverstone) <www.silverstone.co.uk/about/local-community> accessed 2 July 2024.

120 'Dutch Grand Prix Raises the Bar for Sustainable Transportation - Dutch Grand Prix' (Dutch Grand Prix, 17 August 2023) <https://dutchgp.com/en/sustainable-transportation/> accessed 29 May 2024.

121 ibid.

the MENA make biking impractical for most of the year, and many MENA countries lack the extensive and efficient public transport systems found in the Netherlands.[122]

When it comes to each F1 Grand Prix host introducing its own eco-friendly practices, the country's specific conditions play a crucial role. What works for one country may not be feasible for another. Therefore, it is essential for each country to recognize the appropriate initiatives it can take, and the FIA and F1 must help fund these initiatives.

5.2 F1's Partnership with DHL for Sustainable Transport

In 2023, F1 partnered with DHL to introduce biofuel-powered trucks for the European races, which achieved an 83% average carbon emission reduction.[123] DHL plays a crucial role in powering the enormous logistical effort of transporting up to 1,400 tons of high-value freight to each race, including race cars, tires, spare parts, fuel, broadcast equipment, and marketing and hospitality equipment.[124]

Similarly, in the MENA region, initiatives like those undertaken by Red Sea Global (RSG) highlight the potential for sustainable fuel adoption in F1 racing. RSG, a pioneering Saudi company renowned for its sustainable practices, has set a precedent by converting its entire supply chain fleet to low-carbon biofuels sourced from used cooking oil within the Kingdom.[125] With plans to expand its sustainable vehicle fleet to between 700 and 800 units by 2030, RSG is spearheading a transformative shift towards eco-conscious transportation in Saudi Arabia.[126]

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122 ibid.

123 'Formula 1's use of DHL biofuel-powered trucks reduces carbon emissions by an average of 83%' (F1 - The Official Home of Formula 1 Racing, 19 September 2023) <https://corp.formula1.com/formula-1s-use-of-dhl-biofuel-powered-trucks-reduces-carbon-emissions-by-an-average-of-83/> accessed 19 June 2024.

124 Adam Wieczorek, 'Logistics in Racing Sports on the Example of F1' (2019) 82 Transport Economics and Logistics 143.

125 'RSG Becomes First Saudi Company to Use Only Sustainable Fuels in All Supply Chain Vehicles' (Red Sea Global) <www.redseaglobal.com/en/-/rsg-becomes-first-saudi-company-to-use-only-sustainable-fuels-in-all-supply-chain-vehicles> accessed 2 July 2024.

126 ibid.

This illustrates how the MENA region can leverage existing green technologies for events like the ME F1 Grand Prix.[127] By integrating these technologies locally, ME Grand Prix hosts can lead the charge in making F1 racing more environmentally sustainable, utilizing domestic innovations instead of relying solely on international solutions.[128]

5.3 France and Spain: Solar Canopies for Parking Lots

Given the MENA region's abundant access to solar power, placing solar canopies on parking lots at F1 venues is recommended, similarly to what was done at the Barcelona-Catalonia Circuit.[129] MENA countries are leveraging their natural sunlight, much as they did with oil, aiming to increase their renewable energy share from 5.6% in 2016 to 20.6% by 2035, with solar power as a major contributor.[130] This region has already installed solar panels in many circuits, such as Bahrain,[131] and adopting France's policy of installing solar canopies over parking lots could prove highly sustainable.

France's 2023 policy mandates that outdoor car parks with over 80 spaces cover at least half their area with solar canopies,[132] potentially adding the equivalent of ten nuclear power plants' worth of solar panels atop parking lots.[133] Utilizing already cleared spaces near consumers, such as F1 fans, these

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127 'DHL Takes Green Logistics to the Next Level for Formula 1 Racing' (Transport and Logistics ME, 5 June 2023) <www.transportandlogisticsme.com/smart-logistics/dhl-takes-green-logistics-to-the-next-level-for-formula-1-racing> accessed 2 July 2024.

128 ibid.

129 'Canopy project at the Barcelona-Catalonia Circuit' (CIRCUTOR, 23 July 2023) <https://circutor.com/en/success-stories/canopy-project-at-the-barcelona-catalonia-circuit/> accessed 2 July 2024.

130 'Solar investments soar across the Middle East' (World Future Energy Summit) <www.worldfutureenergysummit.com/en-gb/future-insights-blog/solar-investments-soar-across-the-middle-east.html> accessed 29 May 2024.

131 'F1 Powered by Solar: Bahrain exceeds target to offset Formula 1 Gulf Air Bahrain Grand Prix emissions' (F1 - The Official Home of Formula 1 Racing, 19 March 2022) <https://corp.formula1.com/f1-powered-by-solar-bahrain-exceeds-target-to-offset-formula-1-gulf-air-bahrain-grand-prix-emissions> accessed 29 May 2024.

132 Michael Birnbaum, 'New French law will blanket parking lots with solar panels' (Washington Post, 6 February 2023) <www.washingtonpost.com/climate-solutions/2023/02/06/france-solar-parking-lots/> accessed 29 May 2024.

133 Ram Krishnan, Amber Haselhuhn and Joshua M Pearce, 'Technical Solar Photovoltaic Potential of Scaled Parking Lot Canopies: A Case Study of Walmart U.S.A.' (2017) 8(2) Journal on Innovation and Sustainability 104.

canopies also offer the added benefit of shading cars during the hot MENA summers. Whilst the cost is significant, as solar canopies are 50-100% more expensive than conventional solar farms due to their structural requirements, the investment is justified by the MENA's high solar radiation intensity (2000-3200 kWh/m²/year),[134] and the proven profitability in high solar flux areas.[135] Additionally, installing solar rooftops on nearby shops at the F1 circuits could generate enough energy for the shops and support placing electric charging stations in their parking lots, as demonstrated by studies showing the potential deployment of 11.1 GW of solar power from such canopies on Walmart parking lots throughout the USA.[136]

Thus, investing in solar canopies and rooftops not only supports sustainable energy in the F1 venue and circuits but also ensures F1 achieves its net zero emissions by reducing its event operation CO2 emissions, as illustrated by **Figure 1**, which showed the emissions to be 7.3%.

5.4 Investment in Sustainable Aviation Fuel (SAF)

One significant opportunity for F1 to enhance its sustainability efforts is to collaborate with Emirates on the development and use of SAF. Mercedes's F1 team has recently announced its investment in SAF as part of its commitment to achieving net zero carbon emissions by 2030.[137] By incorporating SAF, which is derived from renewable or waste-based materials, Mercedes aims to cut its air travel carbon footprint by nearly 50%, a significant move considering that flights constitute over a quarter of the team's overall carbon emissions.[138]

Similarly, Emirates has demonstrated its pioneering efforts in this field by becoming the world's first airline to operate an A380 demonstration flight

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134 Juan Antonio Sánchez-Sáez, 'Sports events as a local development instrument' (2019) 14(41) Culture, Science and Sport 3868.

135 Krishnan and others (n 133).

136 Swaraj Sanjay Deshmukh and Joshua M Pearce, 'Electric vehicle charging potential from retail parking lot solar photovoltaic awnings' (2021) 169 Renewable Energy 608.

137 'Mercedes become first global sports team to invest in Sustainable Aviation Fuel' (F1 - The Official Home of Formula 1 Racing, 18 July 2022) <www.formula1.com /en/latest/article/mercedes-become-first-global-sports-team-to-invest-in-sustainable-aviation.5uJDcr08Aob3qDOYRCKGmn> accessed 29 May 2024.

138 ibid.

powered entirely by SAF[139]. A strategic partnership between F1 and Emirates could be highly beneficial. F1 could reduce its logistics-related CO2 emissions through incentivized promotion of Emirates, which in return, could offer flights using 100% SAF for F1 teams, drivers, and even fans. Despite the current limited availability of SAF, Mercedes Team Principal Toto Wolff has highlighted its vast potential to revolutionize air travel and reduce environmental impact. Wolff emphasizes that with the frequent travel inherent in motorsports, SAF presents the best current solution for minimizing aviation's carbon footprint.[140]

Referring to **Figure 1**, it can be seen that the bulk of the footprint (45%) came from logistics or emissions from air, sea, and road transportation. 27.7% came directly from business travel. Therefore, leveraging F1's global platform to champion such sustainable practices could set a powerful example and drive broader adoption across industries. Investing in Emirates' SAF initiatives could significantly advance F1's sustainability goals and demonstrate a commitment to leading environmental innovation in sports.

6. CONCLUSION AND RECOMMENDATIONS

In conclusion, the fusion of F1 and sustainability initiatives, especially in the MENA region, offers a ground-breaking opportunity to reshape the dynamics of motorsport and environmental responsibility. F1, renowned for its speed, innovation, and global appeal, has embarked on a journey towards carbon neutrality with its 'Countdown to Zero' initiative, aiming to achieve this milestone by 2030. This ambitious commitment underscores not only F1's acknowledgment of the urgent need for change but also its determination to lead the charge in environmental stewardship within the motorsport realm.

To effectively integrate sustainability into F1 events in the MENA region, the following policy recommendations, based on successful practices from other jurisdictions, are proposed:

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[139] Emirates, 'Emirates operates first demo flight with 100% SAF' (Emirates operates first demo flight with 100% SAF, 22 November 2023) <www.emirates.com/media-centre/emirates-worlds-first-airline-to-operate-a380-demonstration-flight-with-100-sustainable-aviation-fuel/> accessed 29 May 2024.

[140] 'Mercedes become first global sports team to invest in Sustainable Aviation Fuel' (n 137).

6.1 Technological Advancements and Renewable Energy

- **Solar Canopies:** Solar canopies can generate substantial renewable energy, reduce the carbon footprint of F1 events, and provide shade in the hot climates typical of the MENA region.[141] For instance, the Bahrain International Circuit can integrate solar panels similar to those used at the Circuit de Barcelona-Catalunya, which has significantly reduced its energy dependency on non-renewable sources.[142] F1 can partner with ME renewable energy companies and government bodies to fund and install these canopies. The energy generated can be used to power the event, with excess energy fed back into the local grid.[143]
- **SAF**: F1 and ME can collaborate with major regional airlines like Qatar Airways and Emirates to invest in and produce SAF, reducing the carbon footprint of transporting teams and equipment. Emirates has already initiated steps towards using SAF.[144] F1 can capitalize on these initiatives. The ME governments can introduce incentive programs, such as tax breaks or subsidies, to encourage airlines to increase their use of SAF. Additionally, creating partnerships between F1 and these airlines can promote the co-development of new sustainable aviation technologies.[145]

6.2 Community and Stakeholder Engagement

- **Local Food Banks and Waste Management:** As done by the Miami Grand Prix, the ME Grand Prix hosts can partner with local food banks, such as the UAE Food Bank, to donate surplus food and implement comprehensive waste management systems at F1 events.[146]
- **Public Awareness Campaigns:** Launch campaigns, inspired by Silverstone Circuit in the UK, to educate fans and local communities about sustainability efforts using social media, local media outlets, and on-site information booths.[147]

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141 Krishnan and others (n 133).
142 'Canopy project at the Barcelona-Catalonia Circuit' (n 129).
143 Deshmukh and Pearce (n 136).
144 Emirates (n 139).
145 'Five Things You Need to Know About SAF' (Mercedes-AMG PETRONAS F1 Team, 20 July 2022) <www.mercedesamgf1.com/news/five-things-you-need-to-know-about-saf> accessed 21 June 2024.
146 Trish Christakis (118).
147 Silverstone (n 119).

6.3 Investment and Incentive Programs

- **Green Technology Incentives:** Introduce incentive programs for local businesses to invest in green technologies through tax breaks, grants, or low-interest loans. For example, ME can collaborate with domestic logistics companies or international partners like DHL to introduce biofuel-powered trucks for transporting F1 equipment as done in the European races.[148]

6.4 Regulatory Framework

- **Develop and Enforce Sustainability Standards:** Establish and enforce a robust regulatory framework, leveraging the FIA's technical regulations model, in collaboration with regional governments and their international obligations, such as the Paris Agreement, to ensure compliance with sustainability standards.

By implementing these policy recommendations, the MENA region can significantly enhance the sustainability of F1 events, driving tangible progress towards achieving F1's net-zero emissions target. This symbiotic relationship between the MENA region and F1 can serve as a catalyst for sustainable innovation and mutual benefit, aligning with global initiatives like the Paris Agreement and inspiring positive change across industries and communities worldwide.

[148] 'Formula 1's use of DHL biofuel-powered trucks reduces carbon emissions by an average of 83%' (n 123).