Sustainability Assessment

Armasuisse Tiger II Partial Replacement
Air Force of the Swiss Confederation

Prepared by
Koetz & Duncan LLC

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Contents

Executive Summary

Koetz and Duncan has prepared a Sustainability Assessment for an aircraft procurement under consideration by the government of Switzerland for Partial Replacement of F-5 Tiger II Aircraft.

The Assessment evaluated the three candidate aircraft in the procurement, the Eurofighter Typhoon, the Dassault Rafale, and the Saab Gripen for the expected air emission loadings of carbon dioxide (the primary greenhouse gas) and nitrogen oxides (component of ground level ozone) based on a standardized mission performance parameter.

The Swiss Government plans retirement of the F-5s starting in 2010 and acquisition of replacement aircraft. New aircraft would be integrated with 3 squadrons of upgraded F/A-18C/D Hornets that comprise the rest of its fighter fleet. Currently, a budget of 2.2 billion Swiss francs ($1.9 billion) has been designated.

Sustainability data and information is significant in the Partial Tiger Replacement for several reasons. First, there is an issue of public concern regarding the role of the military. With its system of direct democracy, Switzerland is virtually the only country in the world where major arms acquisitions can go to a national vote. Since a first initiative for a Switzerland Without an Army was voted on in 1989, referenda have been called regarding various issues including procurements.

In addition, as a signatory to both the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol, Switzerland has agreed to meet emission reduction targets designed to reduce the loading of greenhouse gasses into the atmosphere to a level below that which may cause damage from global warming. The April 2009 National Inventory Report submitted by the Federal Office for the Environment (FOEN) indicates that although Switzerland has reduced its greenhouse gas emission 2.7 per cent below1990 levels, the original goal of 10 percent below 1990 level, and new goals of 20 percent below 1990 by 2020 and 50 percent below 1990 by 2050 will require significant additional reductions to achieve.

At the same time, military services around the world are facing the growing challenge of encroachment. This lack of capacity to use air, land, and water assets in an ecosystem for non-wartime military purposes stems from the growing competition for—and shrinking supply of—natural assets available in the wake of regulatory controls, preference for alternative uses, and growing populations.

Under the Kyoto Protocol, only emissions from multilateral operations pursuant to the United Nations Charter are exempted, therefore greenhouse gas emissions generated by domestic training and operations of all branches of armed forces are included in the national inventories submitted under the Protocol. Although the Swiss Air Force has succeeded in reducing its emission output through consistent reductions in fuel use since 1990, more stringent goals set out by the Swiss Government will drive requirements to continue on this downward trend and find more sustainable ways to operate in the coming decades.

Sustainability Assessment Results

The Sustainability Assessment criteria included fuel use rates and emission levels from operation of a single aircraft of each type for one year for 150 hours in a standardized sortie configuration. The Assessment results show the Saab Gripen with the highest Sustainability Quotient for the two performance categories evaluated: mission hours per emission, and sorties per emission.

Summary Figure 1. **CO_2 and NO_X Sustainability Quotients**

	Gripen	Rafale	Typhoon
Hours per 1,000 tonnes CO_2	**65**	38	33
Sorties per 1,000 tonnes CO_2	**56**	33	28
Hours per 1,000 tonnes NO_X	**7.9**	4.6	4.0
Sorties per 1,000 tonnes NO_X	**6.8**	3.9	3.4

In addition, Relative Performance Parameters developed using the Saab Gripen emission baseline for a 22 aircraft purchase indicated only 12 Dassault Rafale or 11 Eurofighter Typhoon aircraft could operate within the same emission levels on an annualized basis using the mission performance parameters in the assesment. The total sortie capacity is also markedly lower for the Typhoon and Rafale. Moreover, the choice of the Gripen also translates to a functional emission offset that would other wise carry significant cost beyond the procurement spending.

Application of Results

Given the circumstances surrounding security and environmental needs in Switzerland and the trend toward "Green Procurement" in public purchasing, use of comparative data for the alternative options in the Partial Tiger Replacement can support a win-win outcome in balancing these concomitant public policies drivers.

Current Green Procurement guidelines from the European Union are based on the premise that goods, services and works with a reduced environmental impact throughout their life cycle are green if they compare favorably to goods, services, and works with the same primary function. Although all natural assets are of importance to both the national and environmental security of Switzerland, international and domestic obligations for emission control and reductions lend weight and significance to use rates of limited airshed infrastructure capacity.

The three aircraft alternatives provide both similar and differentiated aspects and characteristics in achieving mission performance goals for the Swiss Air Force. Based on both the Sustainability Quotients for the three aircraft as well as Relative Performance Factors, the Gripen aircraft provides a higher performance capacity for the airshed use rate compared with the Rafale and Eurofighter, and can be considered more sustainable with regard to critical emission levels for carbon dioxide and nitrogen oxides.

Choosing more sustainable alternatives in regard to emission capacity offers the opportunity to expand operational capability, reduce costs, create equity in the form of credits, contribute to legal compliance, and expand community acceptance of the operational use. Relative sustainability factors can also contribute to overall decision-making in acquiring environmentally preferable or green products.

The Swiss Air Force currently operates approximately 270 fixed- and rotary-wing aircraft, with a primary front-line air-defense fleet consisting of 33 F-18 Hornets and 54 F-5 Tiger IIs. A total of 110 F-5E/F fighter aircraft (98 single-seat F-5E, 12 two-seat F-5F) were originally procured—72 in 1976 and another 38 in 1981.

The vintage 1960s/1970s design of the F-5 is considered by the Swiss Air Force to be obsolete for many operational capabilities needed to meet national security requirements. F-5 fighters lack capacity to supervise, control, and defend airspace, considered a paramount security requirement "for the assertion of the sovereignty of a State, particularly of a neutral State, which must guarantee it by its own means."[1] In addition, aging airframes generate safety and maintenance requirements.

The Swiss Government plans retirement of the F-5s starting in 2010 and acquisition of replacement aircraft. New aircraft would be integrated with 3 squadrons of upgraded F/A-18C/D Hornets that make up the rest of its fighter fleet. Currently, a budget of 2.2 billion Swiss francs ($1.9 billion) has been designated for the purchase. An initial evaluation RFP issued in 2008 to four manufacturers: Boeing (F-18); Dassault (Rafale); Eurofighter (Typhoon), and Saab (Gripen), with Boeing electing not to compete. Key actions in the procurement include:

- January 2008: Armasuissse issues the first request for a proposal in the Partial Tiger Replace ment (TTE) program addressed to four aircraft manufacturers: Boeing, Dassault, Eurofighter and Saab. Boeing declines participation in April 2008, and remaining competitors plan for first offer submittal in mid-2008 with a decision, budget, and acquisition authorization by the Department of Defense, Civil Protection and Sport (DDPS) expected as part of Switzerland's 2010 budget.
- December 2008: Tests with the three candidates for the Partial Tiger Replacement (TTE) are completed.
- January 2009: Armasuisse issues an updated RFP requesting proposals for 22 aircraft and details of the number of deliverable aircraft possible under budget of CHF 2.2 billion.
- March 2009: The Swiss Ministry of Defense (MoD) announced the decision on the Partial Tiger Replacement would be delayed until 2010, pending results of a first draft a report on the country's defence policy due in December 2009.

[1] Armasuisse Press Release "Partial Tiger Replacement Acquisition: Four Airframe Manufacturers Invited to Present Their Offers," January 17, 2008

Public Concern

Switzerland, with its system of direct democracy, is virtually the only country in the world where major arms acquisitions can go to a national vote. Since a first initiative for a Switzerland Without an Army was voted on in 1989, referenda have been called against the Procurement of F/A-18 aircraft; against revision of military legislation; and for a second initiative for a Switzerland Without an Army and for a Civilian Peace Service (rejected in the wake of the 911 attacks). A pending vote against the procurement of replacement aircraft for retiring F-5 fighters will be scheduled in 2010 or 2011.

Noise, air, and water pollution issues are also generating active opposition to many activities in Switzerland. Around one in every six residents of Switzerland is exposed to unacceptably high levels of noise, according to the Federal Environment Office. Practices such as heliskiing (banned in Germany, France, Austria and Liechtenstein but permitted by the Swiss government and the Federal Civil Aviation Office) are controversial due to noise, air emissions, and the use of mountain airfields and landing pads situated in environmentally protected areas. In 2008, a public referendum aimed at preventing Swiss Air Force training flights in tourist regions of the country (virtually the entire nation) was defeated, but public acceptance issues remain.[2]

Emission Capacity: Airshed Supply Limits in Switzerland

As a signatory to both the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol, Switzerland has agreed to meet emission reduction targets designed to reduce the loading of greenhouse gasses into the atmosphere to a level below that which may cause damage from global warming. Emissions from Swiss military aviation operations are included in national totals, thus the emissions profile of aircraft replacement options are an element of strategic decision-making by Swiss leadership to meet both national security and environmental security goals.

The Kyoto Protocol, a 178-nation accord, is a 1997 annex to the 1992 UNFCCC that imposed mandatory requirements on 37 industrial nations to reduce greenhouse gas emissions by an average of five per cent below 1990 levels by 2010. The Swiss Parliament ratified the Kyoto Protocol in 2003, setting a target to reduce its carbon dioxide (CO2) emissions to ten per cent less than 1990 levels by 2010. New legislation came into force in 2000 to ensure that the Kyoto target was achieved. Swiss public and private enterprises have taken measures to reduce their emissions, but based on the most recent inventory of greenhouse gas emissions submitted to the United Nations, Switzerland must do more to reach targeted levels.

The April 2009 National Inventory Report submitted by the Federal Office for the Environment (FOEN) recorded Swiss greenhouse gas emissions in 2007 at 51.3 million metric tonnes (MMT), a decline of 1.9 MMT from 2006, and a level 1.4 MMT (2.7 per cent) less than in 1990.[3]

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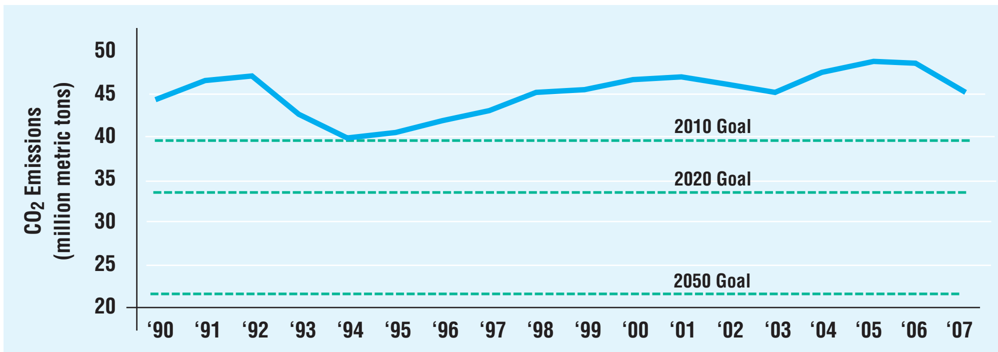
[2] http://www.saf21.info/download/news/news08.pdf

[3] *National Inventory Report 2009, Submission of 15 April 2009 under the Untied Nations Framework Convention on Climate Change and Under the Kyoto Protocol,* Federal Office of the Environment of the Swiss Confederation, p.15.

In an effort to follow the European Union policy looking to limit future global warming to two degrees Celsius, Switzerland has modified its current goal of 10 percent below 1990 levels by 2010 to a new target of twenty percent below 1990 levels by 2020. A further target of 50 percent below 1990 levels by 2050 is planned. The FOEN has indicated the 2000 Carbon Dioxide laws would have to be revised to achieve the new reduction target.

Figure 1. **Switzerland's CO_2 Reductions against Goals**



The introduction of high bypass-ratio turbofan engines and increasing cycle pressure ratios has reduced aircraft noise and fuel consumption. However, increasing recognition of the environmental effects of air transport (including military aviation) is a prominent issue for future technology development.

In the European Union, organizations such as the Advisory Council for Aeronautics Research in Europe (ACARE) support engine and airframe technology development to achieve emissions reduction goals. However, emission control technology for military fighter aircraft generally addresses smoke and other combustion residuals in relation to minimizing detection. All three Partial Tiger Replacement candidates highlight fuel efficiency in their technical and marketing data, although related emission rates or benefits are not specifically identified.

Military Emissions and encroachment

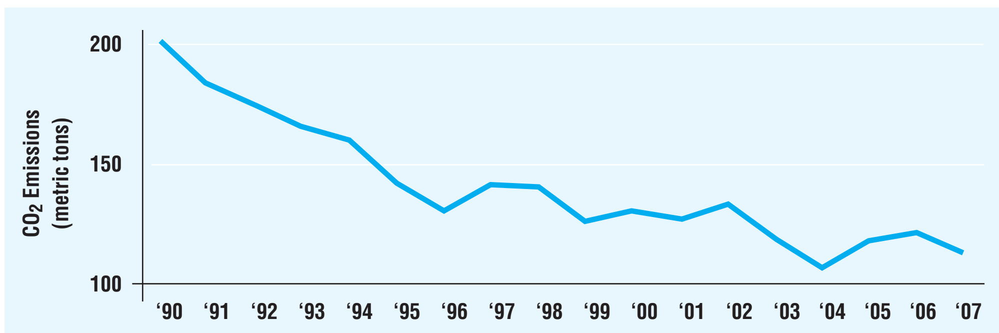
Military services around the world are facing the growing challenge of encroachment—the inability to own or access sufficient "Natural Infrastructure" (NI) capacity to meet the mission to organize, train, and equip the armed services. This problem stems from the growing competition for—and shrinking supply of—rights to use air, land, and water elements that comprise NI in an ecosystem for military purposes. These supply constraints can result from regulatory control of supply and access, preference for alternative uses, and growing populations. Loss of airshed supply available for residual material loading (e.g. greenhouse gases) is one example of encroachment due to reduced NI capacity.

Under the Kyoto Protocol, only emissions from multilateral operations pursuant to the United Nations Charter are exempted from the emissions limits designed to control loading. Greenhouse gas emissions generated by domestic training and operations of all branches of armed forces are included in the national inventories submitted under the protocol.

In the case of Switzerland, both military aviation and off-road vehicles were included in the 2009 Inventory. Based on the fuel usage data submitted by the Swiss Air Force for the 2009 Inventory, the total CO_2 emissions for aviation were 115,000 metric tonnes, a 58% reduction from the 1990 level of 200,000 metric tons.[4]

Chart 2 below shows the emission reductions achieved by the Swiss Air Force. The contribution of the Swiss Air Force has been significant, but as discussed above, Switzerland's emission loadings are not tracking to meet targets, indicating more will have to be done, and this may include further reductions from the Armed Forces.

Figure 2. **Switzerland's Military Aviation CO_2 Reductions**



Green Public procurement in the European Union

In a 2008 communication, the Commission of the European Communities discussed development of Green Public Procurement (GPP), defining it as "...a process whereby public authorities seek to procure goods, services and works with a reduced environmental impact throughout their life cycle *when compared to goods, services, and works with the same primary function that would otherwise be procured"*[5] (emphasis added).

A preliminary set of common GPP criteria has been established for product and service groups including those related to energy, but the provision contains no restrictions as to type or nature of the goods that can be categorized as green or environmentally preferable. A similar set of provisions is already included in the Federal Acquisition Regulations (FAR) in the United States.

[4] *National Inventory Report 2009, Submission of 15 April 2009 under the Untied Nations Framework Convention on Climate Change and Under the Kyoto Protocol,* Federal Office of the Environment of the Swiss Confederation, p.105.

[5] COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS, "Public Procurement for a Better Environment," COMMISSION OF THE EUROPEAN COMMUNITIES, COM(2008) 400/2, p. 5.

Accessing Sustainability Advantage

Environmental and sustainability factors are a significant issue being raised regarding the Swiss decision to replace the F-5s. Choosing a more sustainable alternative can expand operational capability, reduce costs, create equity in the form of credits, contribute to legal compliance, and expand community acceptance of the operational use.

Regulatory policies and procurement programs do not define environmental preference or green procurement to limited categories of products and services. Therefore, environmentally preferable options can be identified for vital procurement programs in defense for aircraft, engines, spare parts, tents, or maintenance services whose performance is greener than competing alternatives.

Given the trend toward "Green Procurement" in public purchasing and the circumstances surrounding security and environmental needs in Switzerland, establishing a positive comparative profile among the alternative options in the Partial Tiger Replacement can support a balanced approach to these concomitant public policies drivers. This Sustainability Assessment provides data and information in the Airshed category of affected NI capacity to assist in comparing alternatives under review for the Partial Tiger Replacement.

Sustainability Profile™ Methodology

A Sustainability Profile™ depicts the operational sustainability and environmental preferability of product or service acquisitions based on relative Natural Infrastructure use rates per unit of performance. Natural Infrastructure means the quantified units of available air, land, and water assets (Natural Infrastructure capacity or NI) that will be used by the product or service to achieve the intended performance goal or output.

Evaluating procurement options based on relative use rates of air, land, and water assets available from the affected ecosystem market is an advanced method of environmental analysis that enables decision-makers to select environmentally preferable of green options that:

a) minimize natural infrastructure capacity use,
b) optimize levels of performance outcome at a baseline NI use rate, or
c) any or some combination of both

By identifying investment choices that demonstrate the maximum performance potential for a baseline NI use rate, the Sustainability Profile expands decision-making options beyond basic impact/mitigation assessments that generally constrict operational capability to include options that balance required performance with NI use.

A Sustainability Profile quantifies NI use types (e.g., surface, subsurface, feedstock, absorption capacity) for each NI element (air, land, water) used in the following lifecycle phases:

- Sourcing (supply chain, energy)
- Built infrastructure emplacement
- Operations and Maintenance
- Controlled residual loadings

Specific NI elements and use types for particular lifecycle phases are evaluated in individual Sustainability Assessments.™ A Sustainability Assessment™ is a modular component analysis of a Sustainability Profile that assesses one or more specific lifecycle phases, NI elements, and use types based on a standardized performance parameter for the product or service being acquired. The results of the Sustainability Assessment are expressed in terms of a Sustainability Quotient (SQ).™ This index of performance achieved relative to NI required allows a quantified comparison among procurement alternatives.

The SQ is determined by dividing the unit of performance under evaluation by the amount of a Natural Infrastructure element required for the product or service to perform:

Figure 3. **Sustainability Quotient (SQ)™**

$$\frac{\text{Unit of Performance}}{\text{NI Capacity Used}} = \mathbf{SQ}^{\text{TM}}$$

The unit of performance is based on a normalized or standardized depiction of the intended performance of the product or service, but actual performance data can be used when available. A SQ can be calculated for one or more performance parameters of the product or service under consideration in the decision.

IV. SUSTAINABILITY ASSESSMENT - PARTIAL TIGER II REPLACEMENT

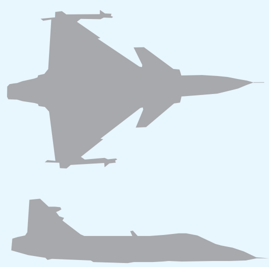
A Sustainability Assessment for the Tiger II Replacement was performed to compare the relative natural infrastructure use rates for carbon dioxide (CO_2, primary greenhouse gas) and nitrogen oxide (NO_x) emission loadings among the three contending aircraft, Sustainability Quotients were developed for two key performance parameters:

- 150 hours annual operations per aircraft
- total annual sorties per aircraft

Based on the data generated for the Sustainability Quotients, Relative Performance and Operational Factors were also developed for Operable Aircraft, Total Sorties, and Emission Offset Value.

A Analytic Framework

1. Aircraft Evaluated:

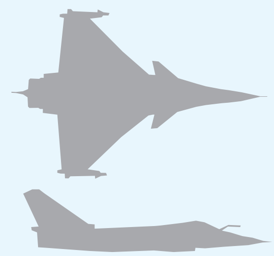


Saab Gripen

Volvo Aero RM12 (x1)

54 kN/12,150 lb
military thrust

80.5 kN/18,100 lb
with afterburner

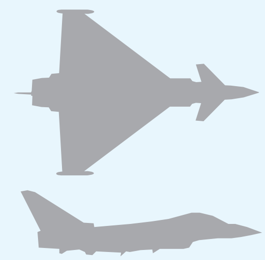


Dassault Rafale

Snecma M88-2 (x2)

50.04 kN/11,250 lb
military thrust

75.62 kN/17,000 lb
with afterburner



Eurofighter Typhoon

Eurojet 200 Engine (x2)

60 kN/13,500 lb
military thrust

90 kN/20,250 lb
with afterburner

2. Assessment Parameters:

Natural Infrastructure Element: Airshed

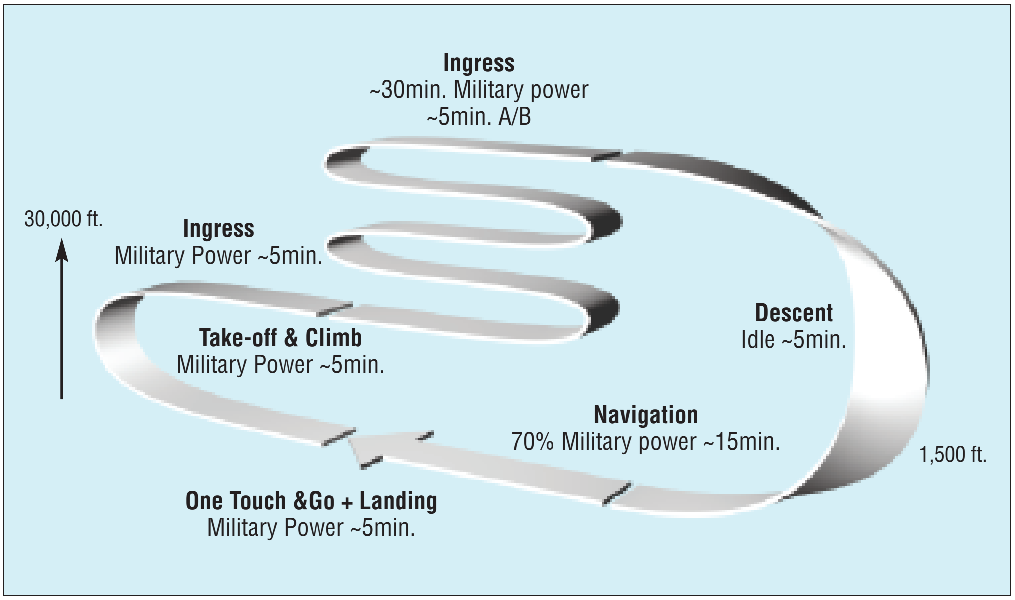
Lifecycle Phase: Controlled Residual Loading

Controlled Substance(s): Carbon Dioxide
Nitrogen Oxides

Standardized Performance:

- 150 hours annual operations per aircraft (22 aircraft total)
- 70 minute standardized sortie (as depicted in Figure 4)

Figure 4. **Standardized Operational Sortie**



3. Assessment Criteria

Using the Sustainability Assessment (SA) model, input data on specific fuel consumption, sortie phases, throttle settings, and duration was used to generate fuel use totals per sortie, per annual aircraft operating year, and for the partial fleet replacement of 22 aircraft. Sortie phases, throttle settings and duration were calculated using the standardized Operational Sortie Configuration in Figure 4.

Fuel consumption calculations were performed using rates and factors published in the technical data sheet for the engines evaluated. In the case of the Gripen, specific fuel consumption rates for all power settings were provided by the manufacturer. For "Idle" setting, Typhoon and Rafale consumption rates were derived using ratios of known settings in relation to the specific fuel consumption rate at "Idle" setting provided for the Gripen.

Fuel consumption was calculated per engine, per aircraft. For the EJ200 engine used on the Eurofighter Typhoon, specific fuel consumption rates are published as a range. The calculations in this Assessment used the lower range value. Mission profile, altitude, or operational differentials other than those depicted in the standardized sortie configuration may result in greater or less fuel use and differentiated emission levels.

Emission co-efficients used in the SA model are from published results of actual emissions for wing-mounted F100 engines on F-15 aircraft. The co-efficients from the comparable F100 engine were applied in the absence of specific data for the aircraft engines examined in this Assessment.

[6] *Rapid measurement of emissions from military aircraft turbine engines by downstream extractive sampling of aircraft on the ground: Results for C-130 and F-15 aircraft,* Chester W. Spicer, et al, Atmospheric Environment 43 (2009), pp. 2612–2622.

Sustainability Quotients

The following Sustainability Quotients apply to operation of a single aircraft of each type for one year based on 150 hours annual operations in the standardized sortie configuration and the resulting fuel use and emissions:

Figure 5. **Hours per thousand metric tons Carbon Dioxide**

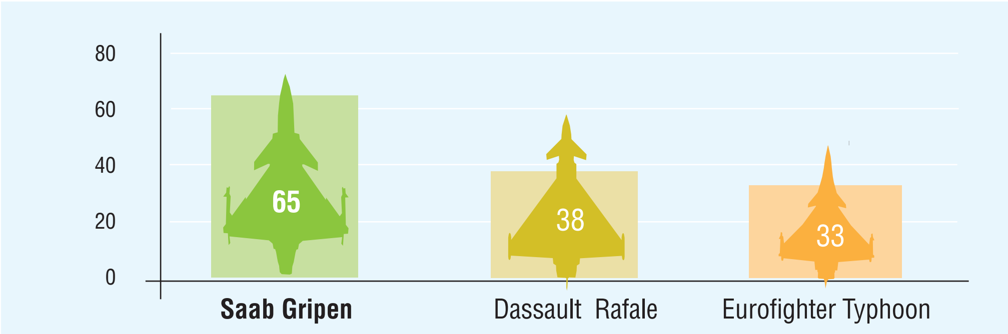


Figure 6. **Hours per thousand metric tons Nitrogen Dioxide**

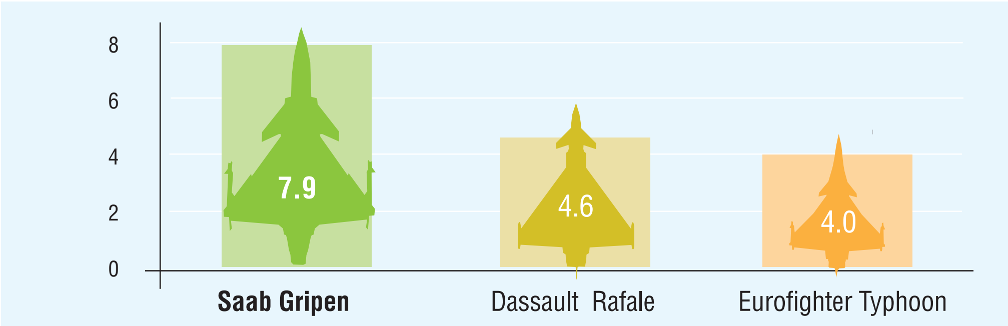


Figure 7. **Sorties per thousand metric tons Carbon Dioxide/Aircraft**

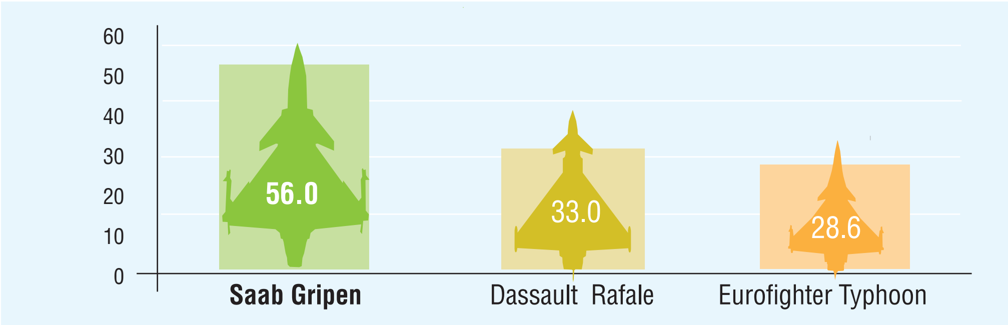
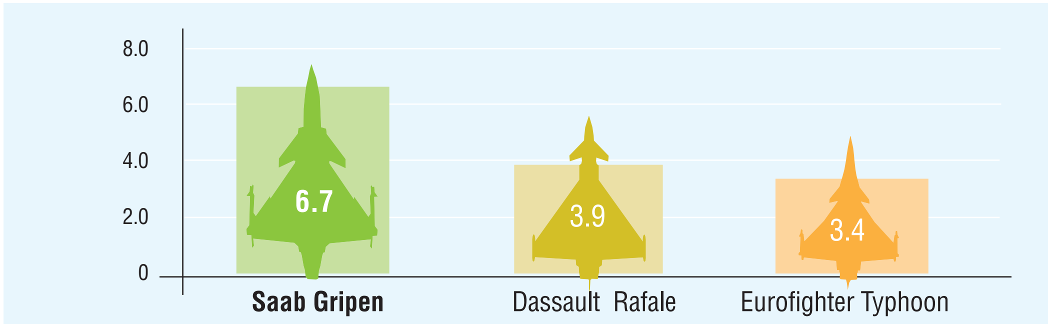


Figure 8. **Sorties per metric tons Nitrogen Dioxide/Aircraft**



Relative Performance and Operational Factors

The fuel use and emission totals for 22 Gripen aircraft operating in the standardized performance parameters allows for further comparison among the three alternatives competing in the Partial Tiger Replacement.

Figure 9 is Total Operable Aircraft—the number of Rafale or Typhoon jets that could operate in the standardized performance parameters and remain within the Gripen emission limit. Next is Total Annual Sorties for the Rafale and Typhoon within the same emission level as 22 Gripen aircraft.

Figure 9. **Total Operable Aircraft - Gripen Emission Capacity**

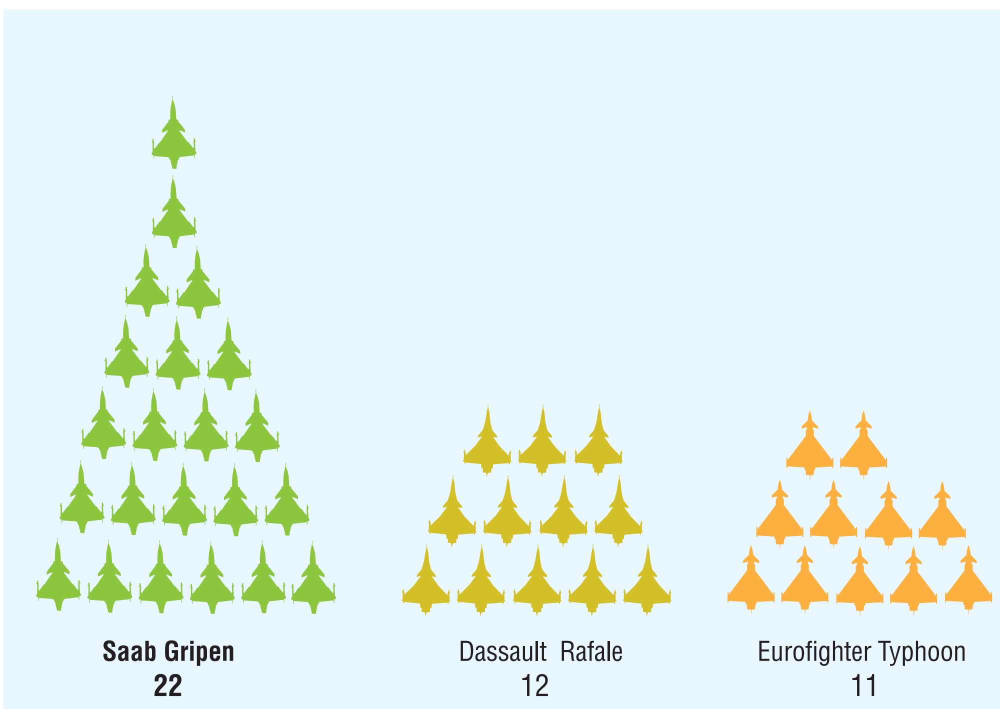


Figure 10. **Total Annual Sorties - Gripen Emission Capacity**

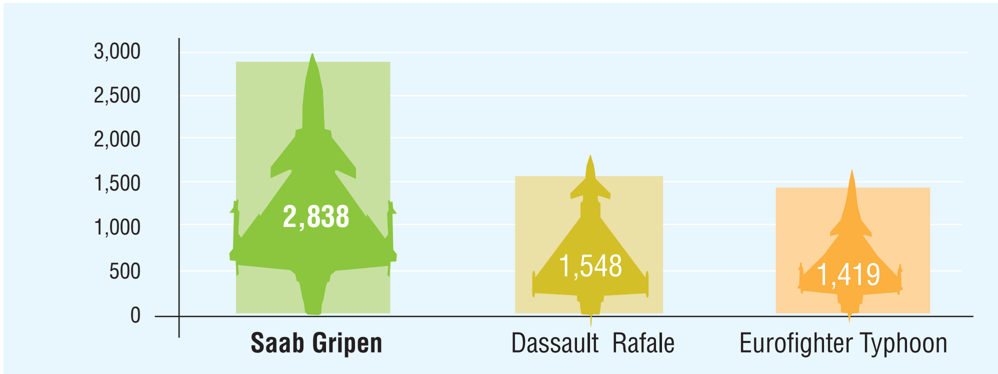


Figure 11 shows the an estimated cost of purchasing offsets for the higher emission levels represented by purchase of 22 Rafale or Typhoon aircraft instead of the Gripen option.

Figure 11. **Emission Offset Value - Gripen Emission Capacity**

Gripen — Rafale Offset Value:

CO_2 - €540,000

NO_x - €911,000

Gripen — Typhoon Offset Value:

CO_2 - €732,000

NO_x - €1,216,000

Summary

Although all natural assets are of importance to both the national and environmental security of Switzerland, international and domestic obligations for emission control and reductions lend weight and significance to use rates of limited airshed infrastructure capacity.

The three aircraft alternatives provide both similar and differentiated aspects and characteristics in achieving mission performance goals for the Swiss Air Force. Based on both the Sustainability Quotients for the three aircraft as well as Relative Performance Factors, the Gripen aircraft provides a higher performance capacity for the airshed use rate compared with the Rafale and Eurofighter, and can be considered more sustainable with regard to critical emission levels for carbon dioxide and nitrogen oxides.

Choosing more sustainable alternatives in regard to emission capacity offers the opportunity to expand operational capability, reduce costs, create equity in the form of credits, contribute to legal compliance, and expand community acceptance of the operational use. Relative sustainability factors can also contribute to overall decision-making in acquiring environmentally preferable of green products.

Building Enterprise Value on Sustainable Foundations

Koetz and Duncan LLC provides strategic advice and consultation on sustainability-based practices that generate cost, price, revenue, and market advantages using innovative and first-mover capabilities in green procurement (including under Federal Acquisition Regulations), supply chain policies, and infrastructure asset management. Our clients span the defense, infrastructure, and investment industries and our services enable firms to both optimize their production system sustainability and secure return on investment from the sustainability value of their products and services to the customers.

Maureen T. Koetz, Esq.

Maureen T. Koetz, Principal Partner, has over twenty-five years of executive and legal experience, most recently as the Acting Assistant Secretary, and Principal Deputy Assistant Secretary for Installations, Environment, and Logistics of the United States Air Force. An expert in global sustainability practices, climate change policy, and green procurement and marketing, Ms. Koetz has served as Environmental Counsel for the Senate Energy and Natural Resources Committee, Environmental Policy Director for the Nuclear Energy Institute, and Counsel to U.S. Senator Pete Domenici. She has been an attorney for the Environmental Protection Agency, and is a veteran of active duty service with the United States Navy Judge Advocate General Corps. Ms. Koetz is an Adjunct Professor of Environmental Finance at NYU-Poly as well as a Visiting Lecturer at the Catholic University School of Engineering and the Industrial College of the Armed Forces. She serves on the Board of Directors of the Coryell Autism Center; other affiliations include the National Defense Industries Association, and New York Building Congress. She is a published author in several areas related to sustainability.

Ms. Koetz has a Juris Doctor from the Washington College of Law at American University, a Bachelor of Arts degree from the American University, and is a member of the Bar of the State of New York.

Dr. Bruce Corning, PhD

Dr. Bruce Corning, PhD is an expert in mathematical modeling development and adaptation that creates practical and reproducible metrics to integrate science, engineering and infrastructure principles in sustainability-related decision-making. Expertise honed over a 35-year career has been applied in project development, management planning, and funding activities at all levels of government. He is the co-developer of the Sustainability Profile,™ a next-generation modeling and analysis system that indexes operational performance requirements against lifecycle infrastructure use rates to identify sustainable options for achieving economic and social goals. Most recently, Dr. Corning developed sustainability performance metrics for the Alexandria Sanitation Authority using concepts of comparative quantification as part of the senior management transition to more sustainable operations. Dr. Corning has also worked with many federal agencies in developing performance-related metrics to support strategy and policy goals, procurement decisions, and funding requests.

Dr. Corning holds a PhD in mathematics from the State University of New York. He has served as Adjunct Professor of Mathematics in the graduate programs of George Washington, Washington University, State University of New York, and American University, specializing in courses that use Bayesian Inference as the underlying framework for decision analysis. His course work also includes methodologies and models for creating algorithms to assign quantitative value to qualitative attributes.

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