

# **Leaping Over the Jaws of the Dragon: How Practical is a Taiwan Airlift?**

## **Evan D'Alessandro**

### **Introduction**

Lonnie Henley (US Army Defense Intelligence Officer for East Asia (Ret.)) in a 2021 congressional hearing stated:

"I am aware of no study in the United States or Taiwan examining Taiwan's wartime consumption rate of critical materials, its peacetime stockpiles, or which stockpiles would likely be lost to [China's People's Liberation Army (PLA)] fires. There is no assessment of what must get through a blockade to keep Taiwan alive, what types of material in what quantities, or what Taiwan's domestic production of food, water, supplies, and equipment might be under wartime conditions. And to the best of my knowledge, no one has considered in detail how to get enough material through a PLA air and maritime blockade, day after day, week after week, while working to break down the blockade itself."<sup>1</sup>

This paper seeks to answer some of these questions by critically assessing whether Taiwan can survive an ironclad naval blockade via an airbridge by creating an open-source model of a Taiwanese airbridge. This model demonstrates that while an airbridge cannot indefinitely sustain Taiwan, it can buy Taiwan between 5 to 24 weeks of time to allow governments to decide how to combat Chinese aggression and support Taiwan.

### **The Berlin Airlift**

To assess the feasibility of a major airlift to supply a large population one must study the Berlin Airlift. In 1948, Joseph Stalin stopped all road and rail traffic into Berlin hoping to

---

<sup>1</sup> Testimony before the U.S.-China Economic and Security Review Commission Hearing on Cross-Strait Deterrence.

force the Allies to turn it over to him. In response, a massive airlift was used for 11 months keeping Berlin supplied and out of Soviet hands, overseen by the US's master airlifter William H. Tunner. This was no easy feat as pre-blockade, Berlin had imported 15,500 tons of supplies/day.<sup>2</sup>

Flying the necessary supplies into Berlin was a simple math problem: a C-47 carries 3 tons, a C-54 carries 10 tons, a C-74 and C-124 carries 25 tons.<sup>3</sup> Flying vast numbers of aircraft in multiple trips each day they were able to keep the city running. It was estimated that 4,000 tons/day would be Berlin's survival minimum.<sup>4</sup> Once the airlift began it was shown Berlin needed 4,500 tons/day, a 71% reduction in supply consumption from normal.<sup>5</sup>

Coal represented 65% of all cargo and was required to keep the city's electricity running and homes heated. After coal came food, with flour being the largest import at 646 tons/ day.<sup>6</sup> Eventually the airlift's success allowed an increase in the "requirements" to 5,620 tons/day. For civilians this was 3,084 tons of coal, 1,435 tons of food, and ~300 tons of other supplies for a total of 4,827 tons. For the city's Allied military units 763 tons of supplies were required, for a final total of 5,620 tons/day.<sup>7</sup> By the airlift's end, 154 British planes of all types alongside 300 US C-54's delivered 9,000 tons of supplies daily to the city.<sup>8</sup>

Of course there are obvious differences between Berlin in the 1940s and Taiwan today. Berlin's population was 2.5 million, while Taiwan has 25 million. Berlin was a mere hour flight from West Germany, while Taiwan is at least 12 hours away from the US. Berlin relied upon coal which is easily transportable, whereas Taiwan relies upon oil and natural gas which are difficult to move by air. Berlin was not responsible for most of the world's advanced semiconductor production, whereas Taiwan is. The planes have also changed; the

---

<sup>2</sup> Tunner, *Over the Hump*. pg. 159

<sup>3</sup> *Tunner*. pg. 159

<sup>4</sup> *Tunner*. pg. 159

<sup>5</sup> *Tunner*. pg. 198

<sup>6</sup> *Tunner*. pg. 203, 205

<sup>7</sup> *Tunner*. pg. 207

<sup>8</sup> *Tunner*. pg. 218

Berlin Airlift's C-54's could carry 10 tons, while today a C-5 can carry 140 tons.

Furthermore, Berlin's planes while occasionally harassed by the Soviets, were not flying directly into the jaws of a potentially hot war.<sup>9</sup> Despite these differences there are important lessons to be learned.

Making the Berlin Airlift into a friendly competition for the pilots and ground crew dramatically improved productivity and kept morale high.<sup>10</sup> The airlift's success was used as a propaganda weapon, keeping the tonnages open source embarrassed the Soviets and kept up morale for those under blockade.<sup>11</sup> For propaganda the little things matter too. The candy drops to Berlin's children proved extremely effective and are an enduring story to this day.<sup>12</sup>

To lessen the load, the operation should evolve by changing procedures and techniques as new and better ideas are identified. Expanding the existing airbases to work better with larger aprons, new runways, more transport linkages, and even building new airports where possible are examples of necessary evolution.<sup>13</sup> Militarily this is an extremely complex logistical operation, not just flying in supplies, but also keeping the airlift itself working.<sup>14</sup> Among many things this means there must be a clear chain of command to centralize decision-making and increase responsiveness.<sup>15</sup> All these lessons should be applied to an airlift for Taiwan as well.

### **What does Taiwan Have and Need?**

To sustain basic human life one needs food, water, and shelter. In modern societies one also needs electricity to adequately provide for food and water. Water and shelter will not be directly affected by a Chinese blockade, but food and electricity could be.

---

<sup>9</sup> *Tunner*. pg. 185

<sup>10</sup> *Tunner*. pg. 179-181

<sup>11</sup> *Tunner*. pg. 180-181

<sup>12</sup> *Tunner*. pg. 208

<sup>13</sup> *Tunner*. pg. 211

<sup>14</sup> *Tunner*. pg. 182, 184

<sup>15</sup> *Tunner*. pg. 186

Taiwan imports various foodstuffs from across the world, and in 2018 had a 35% food self-sufficiency rating,<sup>16</sup> and the country also suffers dramatic food wastage in the storage process.<sup>17</sup> It therefore imports large amounts of food, often from the US.<sup>18</sup> However, a closer look reveals for staple foods (e.g. fruit, vegetables, aquatic products, and meat) the situation is better as ~20% of those categories are on average imported. Importation varies significantly across sectors. For example, rice is overproduced but 94% of non-rice cereals must be imported.<sup>19</sup> In 2011 (the most recent hard numbers available), the Council of Agriculture found 12,848,017 metric tons of food were imported<sup>20</sup> or about 35,200 tons/day.

While not all foodstuffs are easily airliftable (meats and fish for example), many foodstuffs are. This means the Taiwanese diet may need to change, but there should not be nutritional deficits though caloric deficits could arise if not enough food is flown in.

For energy, the picture is complicated and bleak. Taiwan imports 72,343,027 tons/year of coal, roughly 200,000 tons/day.<sup>21</sup> For oil, Taiwan consumes 974,000 barrels/day, of which 726,000 barrels of that are refined locally, but only a small amount of crude is produced by Taiwan itself.<sup>22</sup> For natural gas it uses 24.9 billion m<sup>3</sup> per year (~68,200,000 m<sup>3</sup> daily), most of which (24.7 billion m<sup>3</sup>) is imported in liquid natural gas (LNG) form by tanker.<sup>23</sup>

Getting in food and energy are the bare sustenance requirements. To thrive, Taiwan requires the importation of various advanced products, most notably the components needed to produce integrated circuits and advanced machinery.<sup>24</sup> Taiwan is well known for its

---

<sup>16</sup> Andoko et al., “Review of Taiwan’s Food Security Strategy.”

<sup>17</sup> Andoko et al.

<sup>18</sup> “新\_農產品進口值前十大國家(地區).”

<sup>19</sup> Chung, “Kept in Reserve.”

<sup>20</sup> Council of Agriculture, Executive Yuan, R.O.C., “Food Supply & Utilization, Annual Report, 2011, Import by Food Groups.”

<sup>21</sup> Worldometer, “Taiwan Coal Reserves and Consumption Statistics.”

<sup>22</sup> British Petroleum, *Statistical Review of World Energy*.

<sup>23</sup> British Petroleum.

<sup>24</sup> “Chinese Taipei (XXB) Exports, Imports, and Trade Partners.”

semiconductor manufacturing and wishes to keep it on the island.<sup>25</sup> Given this dependence, the US and others should endeavor as much as possible to fly in the required materials and fly out completed chips. Still, energy deficits probably will restrict some manufacturing even if materials are available.

The Taiwanese government recognized these potential problems and has begun expanding its strategic stockpiles.<sup>26</sup> This includes “energy, food, daily necessities, medical supplies, disaster relief, sand and gravel [for construction] ... critical raw materials as semiconductor materials and equipment, automotive batteries, active pharmaceutical ingredients and 15 additional important industrial materials.”<sup>27</sup>

These moves have resulted in investments in the food supply chain increasing cold storage (preventing wastage), and stockpile maintenance of 900,000 tons of rice.<sup>28</sup> As LNG stockpiles will last for 11.2 days based on storage at two LNG shipping terminals, plans have been made for expansion to five terminals with 14 day’s worth of storage.<sup>29</sup> The oil reserve is unaffected and is supposed to cover at least 30 days of regular consumption.<sup>30</sup> Information on strategic coal reserves could not be found.

In summary Taiwan currently imports ~35,200 tons of food, 200,000 tons of coal, 974,000 barrels of oil, and 68,200,000 m<sup>3</sup> of natural gas per day. Current stockpiles could sustain Taiwan between a half to a full month without support.

### **What Aircraft are Available?**

In this airlift there would be a menagerie of aircraft, with military and civilian aircraft coming from all over the world (see Appendix 1).<sup>31</sup> In a crisis the US Civil Reserve Air Fleet

---

<sup>25</sup> Wasser, Rasser, and Kelley, “When the Chips Are Down.”

<sup>26</sup> Ministry of Foreign Affairs, Republic of China, “Taiwan Shores up Strategic Stockpiles to Forge Resilient Future.”

<sup>27</sup> “National Development Council-Program for Promoting Six Core Strategic Industries.”

<sup>28</sup> Chung, “Kept in Reserve.”

<sup>29</sup> Chung.

<sup>30</sup> Taiwan Research Institute, “Oil Security and Stability.”

<sup>31</sup> Turner, *Over the Hump*. pg. 178, 214

would be activated comprising 268 long-range international aircraft and 145 short-range international aircraft.<sup>32</sup> There would also be some help from US military and friendly military's strategic airlift aircraft. However, they would likely be strained preparing for (or if necessary, supporting) a war. From military aircraft boneyards the US would reactivate as much mothballed airlift capability as possible. Currently there are 55 C-5's and 227 C-130's cargo planes in boneyards, but the rate they could be reactivated is unknown.<sup>33</sup>

Domestic Taiwanese airlines would immediately be put into service, contributing a mix of 255 freighters and passenger aircraft. Taiwan, the US, and other allies would try chartering any cargo aircraft willing to fly but determining exactly how many would be willing is difficult to impossible. Minimally there would be some willing to fly out of a sense of patriotism for supporting an independent democracy (as demonstrated by Ukraine) or for money (which the US would likely be willing to lavish on those agreeable).

Commercial planes from non-military boneyards are another source of aircraft, but accurate numbers are hard to estimate due to aircraft's temporary placement into boneyards due to Covid. The US and the European Union could also buy or seize Boeing and Airbus planes as they come off the production line to put into service. This would provide at least 45 new planes/week.<sup>34</sup> While passenger aircraft from air carriers could be utilized for transporting cargo as passenger freighters (preighters), proper estimation of their number is impossible and thus must remain an open question.

In summary, by Week 1, 655 aircraft would be available for use, increasing to 1,619 by the month's end, and 5,033 by the year's end. For further details see Appendices 1 and 3.

---

<sup>32</sup> USAF Air Mobility Command, "Civil Reserve Air Fleet." Accessed April 5, 2022

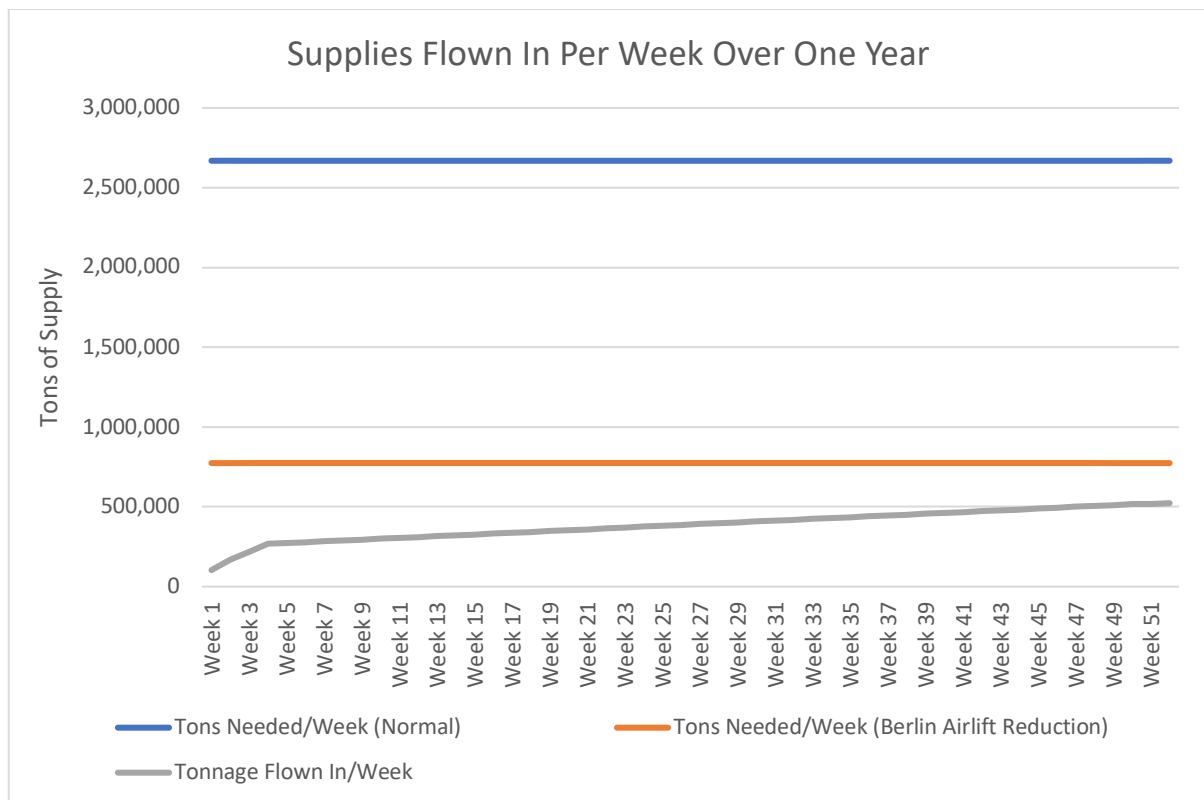
<sup>33</sup> "Map & List of Airplane Boneyards"; Thisdel and Seymour, *World Airliner Census*.; D'Alessandro, Evan. Personal review and calculation using Google Earth image of 309<sup>th</sup> Aerospace Maintenance and Regeneration Group at Davis-Monthan Air Force Base, Tucson, Arizona. Photo date; 12/14/19.

<sup>34</sup> Airbus, "Airbus Provides Suppliers with an Update on Production Plans"; Boeing, "Commercial Airplanes Fact Sheet."

## The Routes

There would be three main routes flying into Taiwan. A northern route from the US through Tokyo, the Ryukyu Islands, and then Taiwan. A central route from the US through the various Pacific islands to Taiwan, and a southern route from Australia through the Philippines to Taiwan. All routes allow for all airplane types on them and are relatively resistant to both kinetic and cyber attacks against them. Taiwan's airport infrastructure would be easily able to handle the flight numbers coming in each day. For further details see Appendix 3.

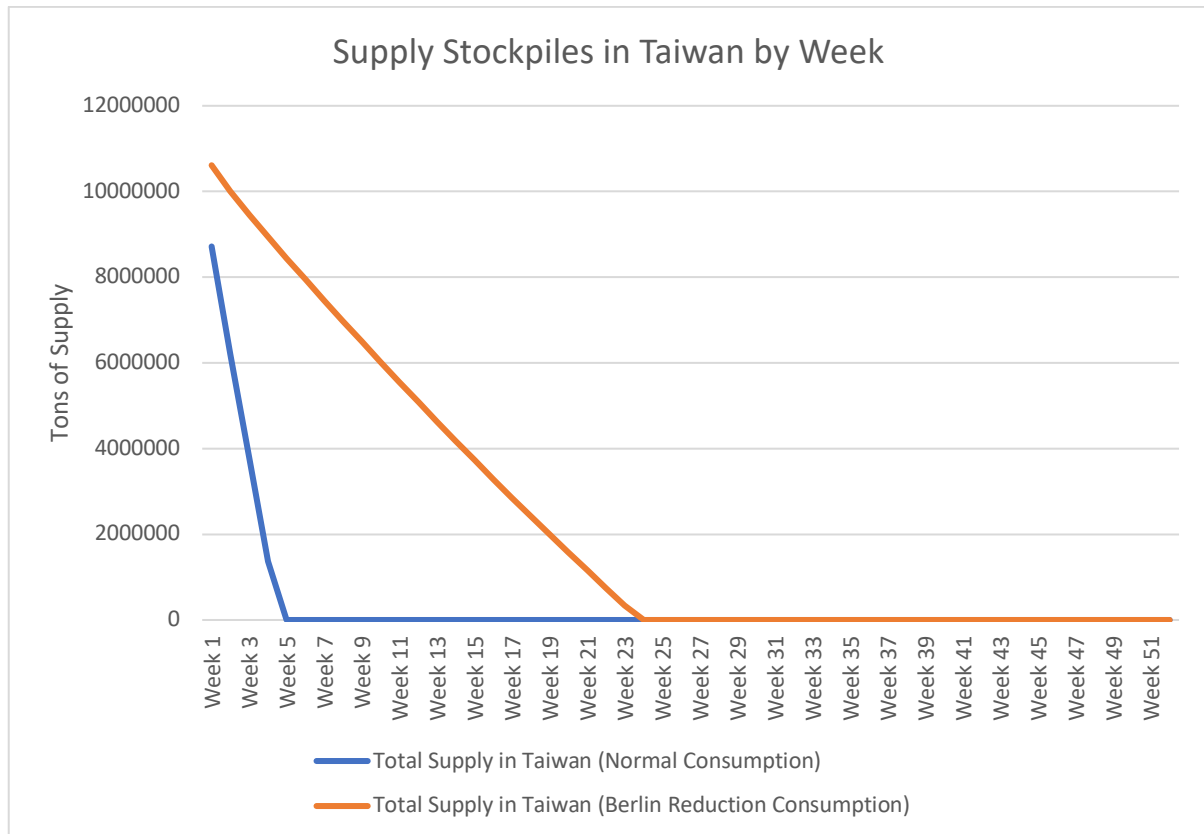
## Conclusion – An Airlift Doable?



**Figure 1.** Total Supply Tonnage Airlifted by Week

2,800,000 tons/week of supplies are needed, or 750,000 tons/week if Taiwan reduces supply consumption in the same proportion as Berlin did during the airlift (15,500 tons/day to 4,500 tons/day, a 71% decrease). The model shows the airlift would bring 38,000 tons/day

(266,000 tons/week) to Taiwan by Week 4 with tonnage increasing over time. This model assumes all aircraft are fully utilized year-round if available, with all cargo treated by weight only and not specific cargo type. All assumptions are found in Appendix 3 with full model details available upon request.



**Figure 2.** Total Tons of Supplies in Taiwan per Week With a Successful Airlift

If consumption rates remain the same (2,800,000 tons/week) Taiwan will run out of supplies by Week 5. If consumption rates are reduced by the same proportion as Berlin, Taiwan runs out of supplies in Week 24. This supply reduction will be the determining factor in Taiwan’s ability to hold out in a blockade. Note that due to the large tonnage, Figure 2 does not display that ~50% of supply requirements per week in a reduced scenario are being flown in by Week 24, which increases to ~75% by the year’s end.



Further analysis reveals existence of enough airlift capacity to fly in Taiwan's daily food requirements from Week 4 onward, meaning the airlift could prevent Taiwan from being starved out. This scenario however would mean that little fuel could be airlifted in for military, government, and refrigeration purposes. Thankfully, Taiwan's climate is tropical/subtropical, which means heating to prevent hypothermia is not a necessity.<sup>35</sup>

Another key takeaway is that it is easier to have stockpiles than flying cargo in, making such stockpiles (for example the only two LNG terminals) prime targets for the Chinese. Hardening, dispersing, and increasing stockpiles would help Taiwan buy time in crisis scenarios and potentially dissuade China from attempting a blockade to begin with.

This simple modeling demonstrates that Taiwan could be kept alive by an airlift for an extended period of time if they were able to reduce consumption, but not as long as Berlin's 11 months. This would still allow the US and its allies time to intervene trying to break the blockade and/or fight a war. If by mid-year, when supplies are predicted to run out, the blockade hasn't been broken, then it is likely that the US and Taiwan have literally or effectively lost the resulting war or confrontation and the blockade becomes irrelevant as China will have won.

Of course, this model assumes Taiwan would politically be able to hold out and the US would be willing to intervene. While this is difficult to assess we have seen a recent interest from Taiwan in extending their compulsory military service after seeing the Ukrainian's success, indicating a willingness to fight.<sup>36</sup> We have also seen that larger democracies will rally to the cause of the small democracy being bullied by a large dictatorship. Couple this with President Biden's statements on US intervention supporting

---

<sup>35</sup> Britannica, "Taiwan - Climate."

<sup>36</sup> "Taiwan Weighs Extending Compulsory Military Service beyond 4 Months."

Taiwan,<sup>37</sup> and it seems plausible that both sides would be at a minimum willing to engage in an airlift to buy more time.

This model does not account for potential destruction of supplies through accidents, infrastructure breakdown, direct war activities or sabotage. While refugee movement is more difficult on an island with a naval blockade, many civilians would likely want to leave. Large numbers of people could be evacuated from the island, through accurate estimates of refugee flows is difficult to impossible. They could be easily evacuated using the preighters to fly in supplies and fly out people. Beneficently, evacuating refugees would both remove them from the line of fire and reduce overall supply consumption. Because of the distances involved weather in key locations could be a limiting factor especially during the typhoon season. How active the Chinese will be in harassing and engaging aircraft is difficult to discern especially as the airlift wears on.

An airlift keeping Taiwan alive will be an extremely complex operation. If one can get supplies in (which it appears can be done), can get the governments to work together (which to make this work they would have to), if the Taiwanese people will stand up to protect their country (which seems plausible), and if the world will support them (which appears likely), it can be done. Fundamentally an airlift keeping Taiwan alive is a delaying action to give governments time to combat China's aggressive moves. In that role it buys at least five weeks, which as we have seen in Ukraine, is quite a lot of time.

---

<sup>37</sup> Mason and Brunnstrom, "White House Repeats No Taiwan Policy Change; Experts See Biden Gaffe."

## Works Cited

- Airbus. "Airbus Provides Suppliers with an Update on Production Plans," May 27, 2021. <https://www.airbus.com/en/newsroom/press-releases/2021-05-airbus-provides-suppliers-with-an-update-on-production-plans>.
- Andoko, Effendi, Wan-Yu Liu, Hua-Jing Zeng, and Agnes Sjöblom. "Review of Taiwan's Food Security Strategy." *FFTC Agricultural Policy Platform (FFTC-AP)*, September 10, 2020. <https://ap.fftc.org.tw/article/2570>.
- Boeing. "Commercial Airplanes Fact Sheet," December 31, 2021. <https://investors.boeing.com/investors/fact-sheets/default.aspx>.
- Britannica. "Taiwan - Climate." Accessed April 4, 2022. <https://www.britannica.com/place/Taiwan/Climate>.
- British Petroleum. *Statistical Review of World Energy*. 70th edition., 2021. <https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2021-full-report.pdf>.
- "China Airlines." In *Wikipedia*, March 31, 2022. [https://en.wikipedia.org/w/index.php?title=China\\_Airlines&oldid=1080316050](https://en.wikipedia.org/w/index.php?title=China_Airlines&oldid=1080316050).
- The Observatory of Economic Complexity. "Chinese Taipei (XXB) Exports, Imports, and Trade Partners." Accessed March 26, 2022. <https://oec.world/en/profile/country/twn>.
- Chung, Oscar. "Kept in Reserve." Website. Taiwan Today. Ministry of Foreign Affairs, Republic of China (Taiwan), May 1, 2021. <https://taiwantoday.tw/news.php?unit=8&post=200663>.
- Clark, Bryan, Adam Lemon, Peter Haynes, Kyle Libby, and Gillian Evans. "Regaining the High Ground at Sea:" Center for Strategic and Budgetary Assessments, 2018. [https://csbaonline.org/uploads/documents/CVW\\_Report\\_Web\\_1.pdf](https://csbaonline.org/uploads/documents/CVW_Report_Web_1.pdf).
- Council of Agriculture, Executive Yuan, R.O.C. "Food Supply & Utilization, Annual Report, 2011, Import by Food Groups," 2011. <https://eng.coa.gov.tw/ws.php?id=2447834>.
- "EVA Air." In *Wikipedia*, April 1, 2022. [https://en.wikipedia.org/w/index.php?title=EVA\\_Air&oldid=1080444436](https://en.wikipedia.org/w/index.php?title=EVA_Air&oldid=1080444436).
- Heathrow Airport. "Daily Operational Data Report," February 28, 2022. <https://www.heathrow.com/company/local-community/noise/noise-reports-and-statistics/reports/operational-data/daily-operational-data/daily-operational-data-report-28-02-2022>.
- Airplane Boneyards. "Map & List of Airplane Boneyards." Accessed April 5, 2022. <https://www.airplaneboneyards.com/airplane-boneyards-list-and-map.htm>.
- Discover The Philippines. "Map and List of Philippine Airports." Accessed April 5, 2022. <https://www.discoverthephilippines.com/philippine-airports/>.
- Mason, Jeff, and David Brunnstrom. "White House Repeats No Taiwan Policy Change; Experts See Biden Gaffe." *Reuters*, October 22, 2021. <https://www.reuters.com/world/china/white-house-repeats-no-taiwan-policy-change-experts-see-biden-gaffe-2021-10-22/>.
- Ministry of Foreign Affairs, Republic of China. "Taiwan Shores up Strategic Stockpiles to Forge Resilient Future." Website. Taiwan Today. Ministry of Foreign Affairs, Republic of China (Taiwan), July 9, 2021. <https://taiwantoday.tw/news.php?unit=&post=203809>.
- "National Development Council-Program for Promoting Six Core Strategic Industries." Accessed March 26, 2022. [https://webcache.googleusercontent.com/search?q=cache:8e70AuTmkfYJ:https://www.ndc.gov.tw/en/Content\\_List.aspx%3Fn%3D2D827BFE7E3598BE+&cd=7&hl=en&ct=clnk&gl=us&client=safari](https://webcache.googleusercontent.com/search?q=cache:8e70AuTmkfYJ:https://www.ndc.gov.tw/en/Content_List.aspx%3Fn%3D2D827BFE7E3598BE+&cd=7&hl=en&ct=clnk&gl=us&client=safari).

- “Starlux Airlines.” In *Wikipedia*, April 4, 2022.  
[https://en.wikipedia.org/w/index.php?title=Starlux\\_Airlines&oldid=1080932069](https://en.wikipedia.org/w/index.php?title=Starlux_Airlines&oldid=1080932069).
- AP News. “Taiwan Cancels Airline Flights as Typhoon Approaches,” September 11, 2021.  
<https://apnews.com/article/storms-weather-taiwan-philippines-typhoons-6dcd57bf105785e097b46a96c962dbe5>.
- Taiwan Research Institute. “Oil Security and Stability.” Accessed March 26, 2022.  
<https://www.trien.tri.org.tw/oil-security-and-stability>.
- Reuters. “Taiwan Weighs Extending Compulsory Military Service beyond 4 Months,” March 23, 2022, sec. China. <https://www.reuters.com/world/china/taiwan-weighs-extending-compulsory-military-service-beyond-4-months-2022-03-23/>.
- Testimony before the U.S.-China Economic and Security Review Commission Hearing on Cross-Strait Deterrence, § U.S.-China Economic and Security Review Commission (2021). [https://www.uscc.gov/sites/default/files/2021-02/Lonnie\\_Henley\\_Testimony.pdf](https://www.uscc.gov/sites/default/files/2021-02/Lonnie_Henley_Testimony.pdf).
- Thisdel, Dan, and Chris Seymour. *World Airliner Census*. Flight International, 2019.  
<https://www.flightglobal.com/reports/world-airliner-census-2019/136424.article>.
- “Tigerair Taiwan.” In *Wikipedia*, April 1, 2022.  
[https://en.wikipedia.org/w/index.php?title=Tigerair\\_Taiwan&oldid=1080524172](https://en.wikipedia.org/w/index.php?title=Tigerair_Taiwan&oldid=1080524172).
- Tunmer, William. *Over the Hump*. Berlin Airlift 50th Anniversary Commemorative Edition. Air Force History and Museums Program, 1998.
- U.S. Air Force. “Air Mobility Command.” Air Force, August 2021.  
<https://www.af.mil/About-Us/Fact-Sheets/Display/Article/104566/air-mobility-command/>.
- USAF Air Mobility Command. “Civil Reserve Air Fleet.” Air Mobility Command, August 2021. <https://www.amc.af.mil/About-Us/Fact-Sheets/Display/Article/144025/civil-reserve-air-fleet/>.
- Wasser, Becca, Martijn Rasser, and Hannah Kelley. “When the Chips Are Down.” Center for New American Security, January 2022. <https://s3.us-east-1.amazonaws.com/files.cnas.org/documents/CNAS-Report-Semiconductor-game-Jan-2022-final-b.pdf?mtime=20220201140415&focal=none>.
- Worldometer. “Taiwan Coal Reserves and Consumption Statistics,” 2016.  
<https://www.worldometers.info/coal/taiwan-coal/>.
- Tableau Software. “新\_農產品進口值前十大國家 (地區),” 2020.  
[https://public.tableau.com/views/\\_\\_370/sheet2?:embed=y&:showVizHome=no&:host\\_url=https%3A%2F%2Fpublic.tableau.com%2F&:tabs=no&:toolbar=yes&:animate\\_transition=yes&:display\\_static\\_image=no&:display\\_spinner=no&:display\\_overlay=yes&:display\\_count=yes&:loadOrderID=0](https://public.tableau.com/views/__370/sheet2?:embed=y&:showVizHome=no&:host_url=https%3A%2F%2Fpublic.tableau.com%2F&:tabs=no&:toolbar=yes&:animate_transition=yes&:display_static_image=no&:display_spinner=no&:display_overlay=yes&:display_count=yes&:loadOrderID=0).

## Appendix 1 – Total Plane Inventories

Some proportion of the following planes will be available for use in an airlift, see Appendix 3 for availability assumptions.

Entity	Aircraft	Total Numbers	Cargo Capacity per Aircraft (tons)
<b>Taiwanese Airlines</b>			
<b>China Airlines<sup>38</sup></b>	B747 Freighter	18	125
	B777 Freighter	10	115
	A321 Preighter	25	14
	A330 Preighter	23	16
	A350 Preighter	14	16
	B777 Preighter	10	70
<b>Eva Air<sup>39</sup></b>	B777 Freighter	8	115
	A321 Preighter	22	14
	A330 Preighter	12	16
	B777 Preighter	34	70
	B787 Preighter	33	85
<b>Starlux Airlines<sup>40</sup></b>	A321 Preighter	13	14
	A330 Preighter	8	16
	A350 Preighter	17	16
<b>TigerAir<sup>41</sup></b>	A320 Preighter	26	10
<b>Cargo Airline Charters<sup>42</sup></b>			
	B737 Freighter	263	20
	B757 Freighter	478	44
	A330 Freighter	83	75
	B747 Freighter	303	125
	B767 Freighter	313	58
	B777 Freighter	204	115
	MD-11 Freighter	118	100

<sup>38</sup> “China Airlines.”

<sup>39</sup> “EVA Air.”

<sup>40</sup> “Starlux Airlines.”

<sup>41</sup> “Tigerair Taiwan.”

<sup>42</sup> Thisdel and Seymour, *World Airliner Census*.

<b>Commercial Boneyard Reactivation</b>			
	Mixed	Unknown	Various
<b>United States Military</b>			
<b>Civil Reserve Air Fleet (CRAF)</b> <sup>43</sup>	Long-range international	268	NA
	Short-range international	145	NA
<b>Air Force Mobility Command</b> <sup>44</sup>	C-5	52	140
	C-17	222	85
	C-130	428	20
<b>Military Boneyard Reactivation</b> <sup>45</sup>	C-5	55	140
	C-130	277	20
<b>New Aircraft Production</b>			
<b>Airbus</b> <sup>46</sup>	A220 Preighter	14/month	5
	A320 Preighter current	65/month	10
	A320 Preighter potential future	75/month	10
<b>Boeing</b> <sup>47</sup>	B737 Preighter current	31/month	7
	B737 Preighter potential future	50?/month	7
	B767 Freighter	1/month	58
	B777 Freighter	2/month	115
	B777 Preighter	1/month	70
	B787 Preighter	5/month	85

<sup>43</sup> USAF Air Mobility Command, "Civil Reserve Air Fleet." Accessed April 5, 2022

<sup>44</sup> U.S. Air Force, "Air Mobility Command." Accessed April 5, 2022, Numbers estimated from numerous inconsistent military wing sources.

<sup>45</sup> "Map & List of Airplane Boneyards"; Thisdel and Seymour, *World Airliner Census.*; D'Alessandro, Evan. Personal review and calculation using Google Earth image of 309<sup>th</sup> Aerospace Maintenance and Regeneration Group at Davis-Monthan Air Force Base, Tucson, Arizona. Photo date; 12/14/19.

<sup>46</sup> Airbus, "Airbus Provides Suppliers with an Update on Production Plans."

<sup>47</sup> Boeing, "Commercial Airplanes Fact Sheet." Accessed April 5, 2022

## **Appendix 2 – Routes**

### *Northern Route*

Path: Seattle/Tacoma to Anchorage, then onto Tokyo Narita, to fly to the Ryukyu Islands, and finally land in Taiwan.

Resiliency: This route is a very resilient short-range route as there are many airports on mainland Japan and on the Ryukyu Islands (on Okinawa, Miyakojima, Tarama, Ishigaki, Hateruma, and Yonaguni) to back up any runways that could be put out of commission.

### *Central Route*

Path: Los Angeles and San Francisco to fly to Honolulu then onto Guam, Tinian, or Saipan and finally onto Taiwan.

Resiliency: The Honolulu to Guam route can be broken up as there are many small airports between Honolulu and Guam. The former carrier Air Micronesia (now United Airlines) flies this route routinely. For Guam, Tinian, and Saipan to Taiwan there are no intermediate airports. However, the only missiles that China currently possesses that can reach to those airports are DF-26's of which there are a very limited inventory meaning they would not be able to repeatedly put out of commission such airports for an extended duration.<sup>48</sup>

### *Southern Route*

Path: Australia, then to the Philippines, and onward to Taiwan.

Resiliency: There are many airports in Luzon in the northern Philippines including Basco and Itbayat to fly out of, and the route is flown heavily commercially.<sup>49</sup>

### *Other Considerations*

The final approach to Taiwan would be at low altitude to avoid Chinese surface to air missiles and on final approach they would use Taiwan's mountains to shield themselves. This increases fuel consumption due to lower attitude flying but given the ranges would not have a measurable effect on the airbridge.

For all routes it is possible to fly both narrow-bodies and wide-bodies along them meaning that all aircraft can be used on any route. Given the distances involved it would take 2 days to fly the routes roundtrip - so for any given plane there would be 3 trips a week with 1 day a week for maintenance.

### *Taiwanese Infrastructure*

Given these estimates, by Week 4 there are ~1,600 aircraft in the airlift (~533 aircraft flying each route), with 800 aircraft landing each day and taking off each day in Taiwan (total = ~1,600 flights). These flights would be distributed across the 6 airports with 8 runways on the north and east of Taiwan, with each runway averaging 4 landings and 4 takeoffs per hour. If necessary, the west side can be used but planes must fly through the heaviest portion of the SAM belt over the Taiwan Strait. The west side would add 3 airports with 5 runways for a total of 13 runways with each runway averaging 2.4 landings and 2.4 takeoffs per hour. For reference Heathrow handles 27 take offs and landings per hour (capacity = 830 flights/day).<sup>50</sup>

---

<sup>48</sup> Clark et al., "Regaining the High Ground at Sea:"

<sup>49</sup> "Map and List of Philippine Airports."

<sup>50</sup> Heathrow Airport, "Daily Operational Data Report."

## Appendix 3 – Model Assumptions

### *Base Assumption*

- China would be able to impose a full sea blockade of Taiwan and would prevent any ships from docking in Taiwan. The Chinese Coast Guard's inventory includes 130 large patrol ships, 70+ fast patrol combatants, 400+ coastal patrol craft, and approximately 1,000 inshore and riverine vessels<sup>51</sup> before even considering the Chinese Maritime Militia. Thus, a blockade should be well within their capabilities.

### *Supply Assumptions*

- All supplies are the same and are transported equally.
- There is assumed to be a coal stockpile of 30 days to match the 30-day oil stockpile.
- There is no use of liquid natural gas (LNG) in this model, assuming that it would not be airlifted into Taiwan. This is because it is not truly transportable by air and the workaround to move it by air is extremely inefficient. If no LNG could be transported it would mean a -16% decrease in total energy availability on the island.<sup>52</sup> While this seems high, as it is certain that in wartime energy requirements would change and it would not be necessary (nor will it be likely) that industry can run full capacity, thus reducing the need for energy production. Thus, even without LNG Taiwan's grid could sustain itself.
- Taiwan can reduce supply consumption to the same proportion that Berlin could during 1948-9 (historically 15,500 tons/day pre-blockade to 4,500 tons/day, a 71% decrease). While this is a loose approximation of supply reduction, a detailed look at requirements and how much consumption could be reduced requires detailed study of the Taiwanese economy, energy sector, and other factors and is beyond the scope of this paper.
- There is no accounting for loss of supplies by accidents, infrastructure breakdown, wastage, the effects of war and/or sabotage.

### *Aircraft Availability Assumptions*

- No reduction in plane numbers over time, either as a result of accidents or military activity.
- There is little allied involvement in the airbridge itself (US and Taiwan only).
- Where allied involvement occurs it is only with 10% of their military airlift.
- Taiwanese airlines - 100% of aircraft available to you immediately.
- Taiwan cargo airline charters - Week 1, Taiwan can charter 12% of global capacity, increasing another 12% of global capacity every week up to a limit of 50% of global capacity.
- Commercial boneyard reactivation - Week 1, 1% of global capacity can be reactivated, increasing another 1% of global capacity every week up to a limit of 50% of boneyard capacity after 1 year. As these number cannot be estimated, it is assumed that 6 cargo narrow-bodies, 6 cargo wide-bodies, 6 preighter narrow-bodies, and 6 preighter wide-bodies become available each week.
- US Civil Reserve Air Fleet (CRAF) - CRAF is 25% activated in Week 1 after activation and 100% activated in second week after activation, Taiwan gets 25% of CRAF capacity.

---

<sup>51</sup> Caitlin Campbell, *China's Military: The People's Liberation Army*, CRS, R46808, June 4, 2021, p. 33

<sup>52</sup> Based on modeling for a wargame written by the author. The full model is available upon request.



- USAF Air Mobility Command - 10% of Air Mobility Command is allocated to Taiwan.
- Military boneyard reactivation - Week 1, 1% of global capacity can be reactivated, increasing another 1% of global capacity every week up to a limit of 50% of boneyard capacity after 1 year.
- New aircraft production per week - Boeing and Airbus - governments purchase and seize 100% of production of Airbus and Boeing.
- Passenger airlines - air travel will continue around the world, and no passenger aircraft can be spared.

*Other Assumptions*

- Full load is used in every plane, and there is no over- or under- filling.
- There is no large-scale evacuation of people from the country and that the population remains stable.
- The weather allows for planes to fly in every day to offload supplies. It appears likely that during typhoon season there would be at least some days preventing access to the island.<sup>53</sup>
- There are sufficient people/equipment to unload the planes and then sufficient infrastructure to move the offloaded supplies. Given that Taiwan is a first world nation with well-developed public infrastructure, and that this is a national emergency it seems likely that such infrastructure and people would be available.

---

<sup>53</sup> “Taiwan Cancels Airline Flights as Typhoon Approaches.”