

Oil & War



by

Captain Paul E. Mawn USN (Ret.)

Introduction

The 1st half of 1942 was the “worst of times” for Americans & our allies since:

1. Nazi Germany was dominating Europe, except for the UK, which was under attack
2. The Imperial Japanese military was seemingly invincible in Asia and the Pacific
3. America was engaged in but not prepared for a 2-front war on opposite sides of the world
4. In the Battle of the Atlantic, German U Boats had sunk over 200 ships including 22% of the oil tankers serving the US East Coast refineries & oil product terminals. As a result, over 5,000 civilians and allied military were killed, which was twice the number of deaths (i.e. 2,370) at Pearl Harbor on 7 December 1941 “*A day which will (or at least should) live in infamy*” .
5. On the Homefront, my father enlisted in the US Navy and soon was on his way to the Pacific.

However, the US citizens pulled together and overcame adversity with great sacrifices & costs. Fortunately at the time, the US had the world’s greatest petroleum resources. Except for the Korean and Vietnam Wars, the acquisition & delivery of petroleum products to the military has been a key strategic & tactical factor in every US major conflict since the start of the 20th century. During World War II, oil availability was particularly the crucial difference between victory and defeat for both the Allies and the Axis powers.

World War I (oil impact)

The “oily” beginning

Oil became a key factor in military might in the decade before World War 1 when the UK Royal Navy and US Navy shifted from coal to oil as a source of power for their fleets which soon was emulated by other major countries. By 1939, all naval vessels in the world and 85% of the merchant ships were burning oil for their propulsion. At the start of the 20th century, Russia was the world largest oil producer and responsible for over 50% of the global crude oil production. In August 1914 at the start of World War 1, the overseas oil imports for the UK and France came mostly from Iran, Mexico and the USA but German crude oil imports came overland from Romania. However for both geological and political reasons, the Russian oil fields declined significantly right after the Russian Revolution in 1918. Thus, the pre-war military logistics strategy of most countries was based on horses and other animals and there was worldwide oil glut since petroleum had few uses beyond making kerosene for lighting. This “*War to end of all Wars*” which started in 1914 was only:

- 55 years after the start of the petroleum industry following Colonel Drake’s initial well in Titusville (PA)
- 21 years after the 1st US made gasoline powered automobile by the bicycle mechanic Duryea Brothers
- 11 years after the 1st successful gasoline engine airplane flight by the bicycle mechanic Wright Brothers
- 6 years after the 1st production of Henry Ford’s “*Model T*” automobiles

Nevertheless, most of the key military innovations used were oil fired such as: submarines, tanks, airplanes and motorized transport. As trucks replaced horses, aeroplanes were used initially for reconnaissance which led to fighter planes as a counterforce as well as dropping a few bombs on the enemy while in the air. The British Army started the war with 250 planes, 827 motorcycles which had increased to 55,000 planes, 56,000 trucks and 34,000 motorcycles by the end of 1918. During the World War I, 80% of all the Allied petroleum consumption came from the US with the US Navy playing a key role in protecting oil transports to Europe from being sunk by German U boats.

World War II (oil impact)

During WWII, the Achilles’s heel of the Berlin to Tokyo Axis powers is shown in the oil consumption chart for the US, Germany & Japan (Figure 1). From 1940 to 1945, the German oil consumption including military use shown on the lower left dropped by 86%. During this same period, the total Japanese petroleum consumption in the lower right chart declined by 92%. However from 1940 to 1945, the total US petroleum demand increased 35% but the US military demand increased by a factor of 35 (i.e. from 14.6 MBD* to 525 MBD*).

Figure 1: US vs. Axis oil demand in World War II

US vs. Axis oil demand in World War II

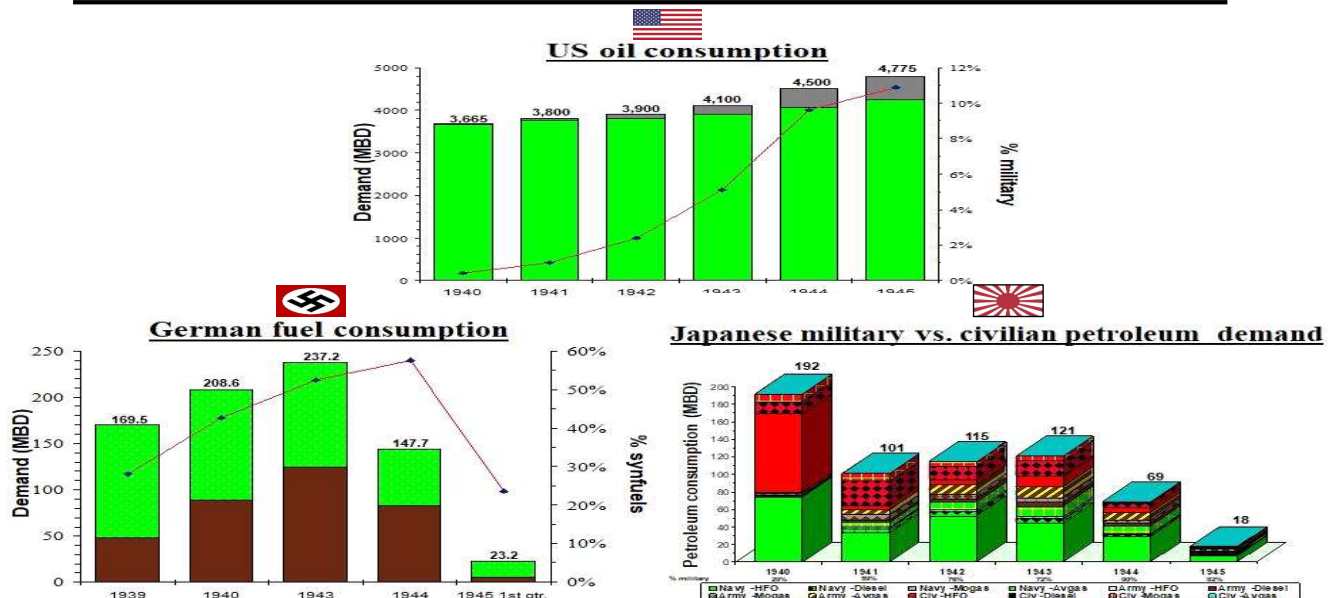
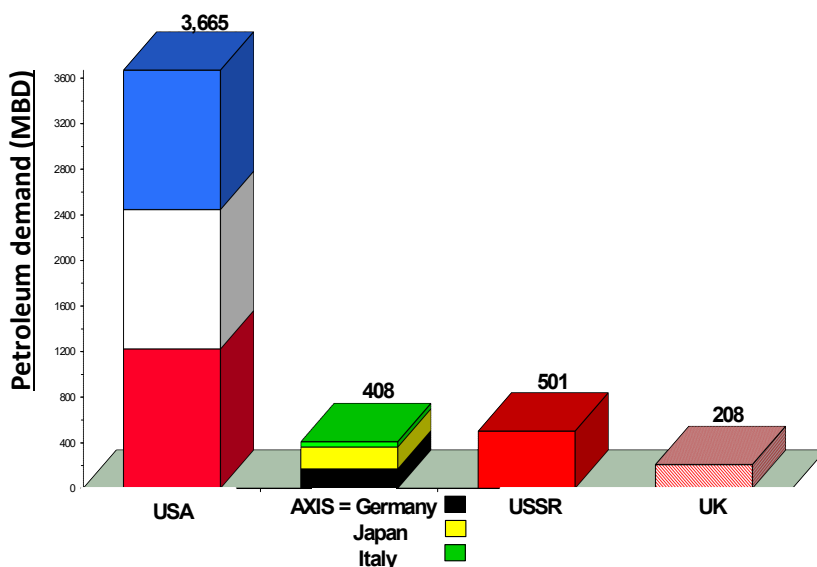


Figure 2

US Petroleum demand vs. other countries - 1940



At the start of World War II, the USA was also the world’s largest petroleum consumer with 9 times the total combined oil demand of the 3 major Axis countries (Figure 2). The US 1940 “oily” posture reflects the enviable American position as the leading crude oil producer in the world which reinforced the energy self-sufficiency of the US at that time. As frame of reference, the entire Middle East in 1940 only produced 240 MBD* of crude.

*MBD = 1,000 barrels/day (42 US gallons per barrel)

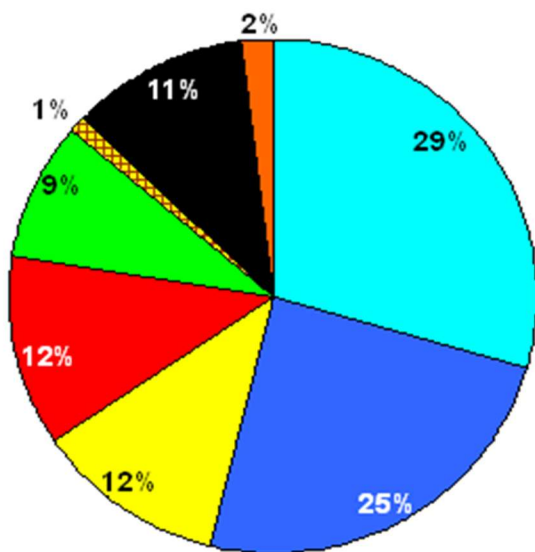
1. World War II - Germany

1.1 - Energy supply before World War II

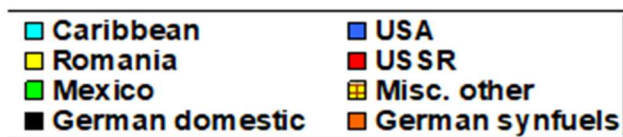
As shown in figure 3, Germany consumed 169 MBD* oil equivalent of energy in 1939 of which 22% was synfuels as shown in brown (i.e. 122 MBD of oil vs USA oil demand of 3,600 MBD). Germany had little crude oil or private cars but ample coal for their coal fired railroad transportation. In the mid 1930's, @ 70% of the German oil supply arrived via tankers from the Western Hemisphere which was cut off when World War II started in 1939 by a successful Allied Naval blockade. To compensate for this shortfall, Nazi Germany had to increase oil imports by barge or rail from the USSR and Romania which in 1936 equaled only 24% of their oil supply. As a result, Germany had to increase their production & use of synfuels which surged to 52% of the total demand for oil by 1943. However by 1945, their supply of synfuel was virtually depleted.

Figure 3

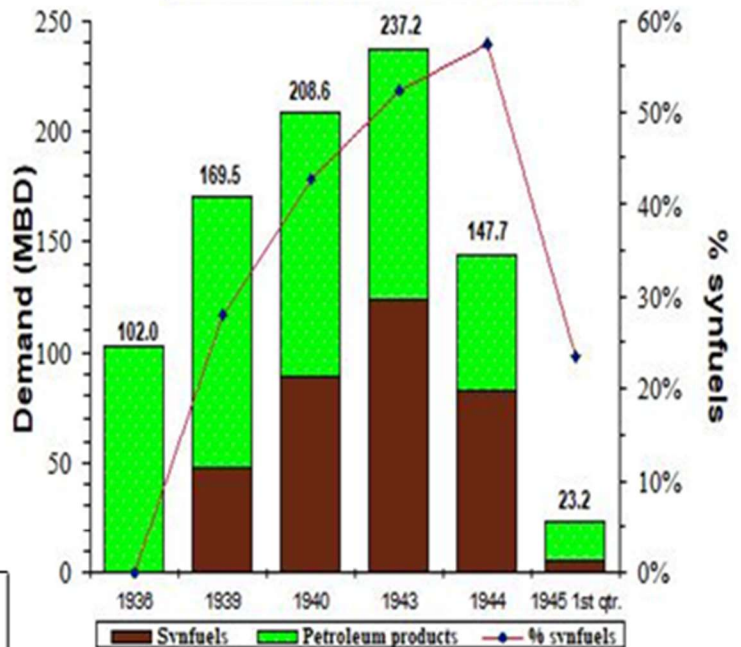
German fuel status –World War II



Source of fuel supply - 1936



German fuel consumption



*MBD = 1,000 barrels/day (42 US gallons per barrel)

1. World War II - Germany (continued)

1.2 - German logistics strategy & "blitzkrieg"

When Italy invaded Ethiopia In Oct 1935, Mussolini almost faced an oil embargo. In the following year, the Soviets abruptly shut off delivery of gasoline to their large chain of gasoline stations throughout Germany. Thus recognizing the key importance of oil, Hitler's war strategy known as the "blitzkrieg" (i.e. "lightning war") had to be fierce but short leading to a quick decisive victory before Germany ran out of petroleum. To this end in the 1930's, Hitler built an extensive transportation network in Germany with the autobahn for motor vehicles and expanded the rail systems to quickly move Germany troops when required (note: see figure 4). During the Nazi invasion of Poland which started World War II, Germany had 15 million barrels (i.e. 121 MBD equivalent or 0.3 days supply) in their strategic oil reserves. While the 1939 German "blitzkrieg" into Poland worked surprisingly well, this successful non-stop invasion consumed the equivalent of 64% of the total German oil consumption. In a similar manner, Hitler's armed forces overran Norway, the Low Countries, and France in the spring of 1940 but were then able to add 5 million barrels of stolen oil (i.e. the equivalent of 5 MBD* or 0.04 days supply) to the German strategic petroleum reserves).

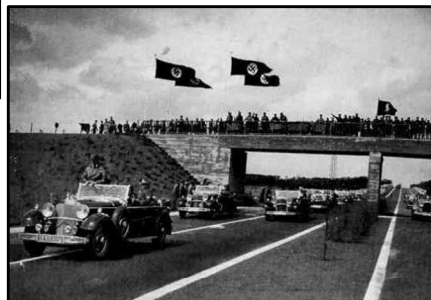
Figure 4
German Logistics
for the "blitzkrieg"



Paucity of cars on the autobahn



German autobahn



Hitler opening the autobahn



German railroad network



German trains moving the military

In the fall of 1940, Germany waged a massive aerial bombardment of the British Isles and seemed on the verge of dominance in Europe. The related German marine strategy was to embargo the United Kingdom of all necessary imports including petroleum with their U- Boat wolf packs under Admiral Doenitz which almost worked. During the war, U-boats sank over 5,000 allied merchant ships hauling over 12 million tons of cargo which resulted in the loss of over 15,000 merchant seamen. However, the Brits refused to give up due to their blood, sweat, tears, determination and grit as well as significant aid from the American Navy and Merchant Marine.

1. World War II - Germany (continued)

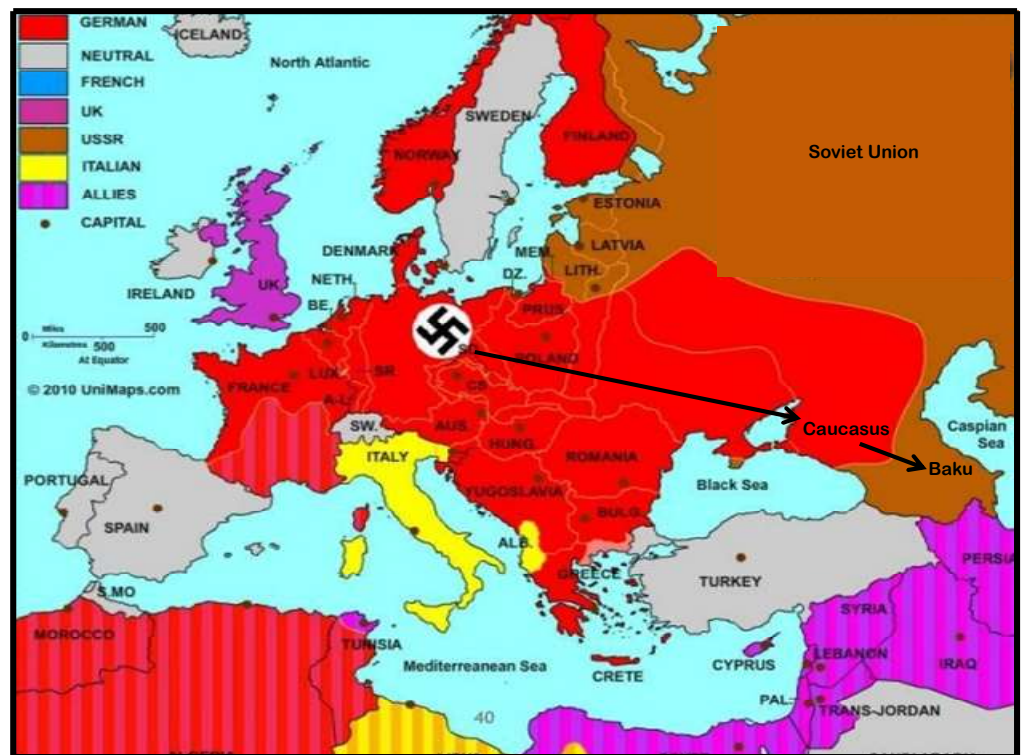
1.3 -The Nazi Grand Strategic Prize

However despite the German-Soviet Nonaggression Pact signed in August of 1939, the invasion of Russia in June 1941 was seen by Hitler as a necessity to meet their anticipated petroleum needs by seizing the oil fields in Baku and the Caucasus. In this attack known as Operation Barbarossa, 3 million German soldiers with 600,000 motor vehicles and 625,000 horses struck along a wide front which caught Stalin off guard. The Germans erroneously believed this new “*blitzkrieg*” would take less than 10 weeks. In early 1942, Berlin made plans to subsequently march onwards for the oil in Iran and Iraq and then to India after their capture of the Caucasus. Hitler’s grand strategy was to have one attack through southern Russia and another from the southwest via North Africa (note: see figure5). In July 1942, the Germans seemed on their way to achieving that goal and reached the highest point of expansion in the Caucasus and Europe by mid-August. However these “*blitzkrieg*” German victories required large amounts of petroleum causing the Nazi’s to outrun their supply lines and lose their advantage of speed and surprise. Thus, this push in Russia for the Caucasus and the quest for oil resulted in the Germans running short of petroleum.

The southern drive to Baku from North Africa was planned almost totally on the new “*principle of complete mobility*” created by General Erwin Rommel & his “*Afrika Korps*”. However, this “*mobility*” warfare also created dangerous vulnerability in supply lines since Rommel was absolutely dependent upon ample supplies of fuel and other vital supplies via a 1,000 miles long supply chain which also consumed a lot of fuel in transportation in addition to their combat needs. Rommel’s grand goal was to push through Cairo, Palestine, Iraq & Iran on the

to Baku and the Caucasus oil production fields and refineries in the Southeastern part of the Soviet Union.

Figure 5
Europe & North Africa - 1942



1. World War II - Germany (continued)

1.3 -The Nazi Grand Strategic Prize (continued)

Rommel initially won stunning victories in North Africa against British and later US forces and became known by all as the “Desert Fox”. However at one point, 85% of his transport was provided by captured British and American vehicles and several of the battles were for each other’s fuel dumps. The Axis powers felt they were on the verge of victory until they moved their campaign to Egypt when the Allies started to successfully fend off the German attacks in North Africa. Furthermore, German and Italian military codes were broken that significantly helped in attacking the Axis shipping and supply lines. The British forces capitalized on Rommel’s very long and highly vulnerable supply lines & the Germans essentially ran out of gas. Thus, oil was a significant factor in the defeat of the Afrika Korps in the desert of North Africa since a large % of the Italian maritime supply convoys were destroyed by British aircraft and submarine attacks based mainly in Malta.

Furthermore, the Germans seriously miscalculated their supply needs as well as the vast size of Russia and the amount & tenacity of Soviet manpower despite the death or capture of almost 8 million Russians killed in the 1st year. As a result, Hitler’s invasion of Russia lasted several months rather than rather the expected several weeks which in turn compounded the severe German shortages of oil and other supplies. Furthermore, the Luftwaffe calculated a need for 15,000 planes by 1942 to beat Russia which would then consume the equivalent of 60% of the world’s petroleum oil supply from 1935 to 1936. However, Germany could physically not obtain that amount of

Figure 6



Der Führer & energy/ aviation czar– Field Marshal Göring

oil since the USA produced over 59% of the world oil production during the World War II. With the German defeat in North Africa and Russia by mid-1943, Hitler’s dream of capturing the oilfields of Baku and the Caucasus was now a fantasy. Thus, the German grand strategy eventually failed for several reasons including:

1. Allied attacks on German fuel supply lines
2. Fierce Russian resistance
3. Allied code breakers.

Germany then faced a huge fuel crisis and named Field Marshall General Hermann Goëring (a WWI ace) as the Nazi energy Czar. He was charged to ramp up the coal-based synthetic oil production as well as to serve as the head of the Luftwaffe (see figure 6).

1.4- Nazi synthetic oil production

Although Germany did not have much oil, it had abundant coal resources as well as the most advanced chemical industry in the world. At that time, I.G. Farben Company was the world leader in chemistry whose scientists had invented the hydrogenation method to produce high-grade liquid fuel from coal. In June 1932, Hitler met with the chairman of the Farben Company to discuss the following Nazi media attacks against the company:

- Farben was a tool of “international financial lords” and “money-mighty Jews” since some Jews held senior positions at I.G. Farben, as well as
- Farben was promoting & marketing a very expensive project to manufacture synthetic oil from coal.

1. World War II - Germany (continued)

1.4 - Nazi synthetic oil production (continued)

I.G. Farben argued that synthetic fuels from coal could cut Germany's dependence on foreign oil and also reduce the pressures on foreign exchange. Hitler was then convinced to endorse the further development of a synthetic oil industry. Since 1921, Standard Oil of New Jersey (i.e. **SONJ** which is now ExxonMobil) had unsuccessfully been exploring alternatives to crude oil and viewed the Farben patented technology as a clear threat to its business. As a result, **SONJ** acquired the Farben patent rights in 1929 for synfuels outside of Germany in exchange for 2% of **SONJ**'s stock valued at \$35 million. Obviously, **SONJ** had no need to produce synthetic fuels (i.e. synfuels) because of the oversupply of crude oil at that time and wanted to ensure that each company stay out of the other's main fields of activity. The US crude surplus and the "Great Depression" made the synthetic oil production uneconomical and 10 times the price of crude oil from Texas and the other states on the Gulf of America. The aviation fuel potential of hydrogenation won Farben the support of the Luftwaffe and later the German Army which also lobbied on behalf of Farben to ensure that Germany's oil supply would be adequate for its war plans. Subsequently, Farben continued as an independent company but in reality became "Nazified" with the removal of all Jewish officials as well as the anti-Nazi chairman, Carl Bosch. When Germany invaded Poland on 1 September 1939, 14 hydrogenation plants were producing almost 72 MBD* (i.e. 46% of the total German oil supply & 95% of the total German military aviation gasoline). Between 1940 & 1943, synfuel production almost doubled to 124 MBD* (i.e. 57% of total German oil consumption; 92% of aviation gasoline & 50% of the German gasoline supply). However, the synfuel plants were frequently bombed by Allied aircraft and could only produce a low octane fuel which was not good for aircraft without further expensive and time-consuming complex refining. *MBD = 1,000 barrels/day (42 US gallons/ barrel)



Figure 7

Farben synfuels plant - Auschwitz

Furthermore, the Nazi war economy including the synfuel fuel industry was based on slave labor which made up 33% of the total work force in the German synthetic fuels industry in 1944. Several I.G. Farben synfuel plants were eventually built. The largest of which in Southwest Poland is shown in the Figure 7 which was located in a small town called Oswiecim (i.e. in German translated as Auschwitz). This industrial complex (which also included the newer Birkenau & Mankowitz synfuels facilities & a synthetic rubber plant) was not far from the current border of the Czech Republic & Slovakia & west of the city of Krakow. The I.G. Farber owners & management became enthusiastic partner with the Nazi SS. This Auschwitz complex contained over 30,000 inmates as a source of their very cheap labor force and also served as a Nazi "death camp" where over 1.1. million men, women & children were Nazis systematically murdered among whom almost **1 million were Jewish**



Figure 8 - Auschwitz inmates

1. World War II - Germany (continued)

1.5 - The noose tightens - Nazi Germany runs out of oil and is defeated

Despite all the propaganda about “*blitzkrieg*”, the day-to-day movement of the German fighting forces involved an average of 1.1 million horses throughout World War II. The German Army had the greatest use of equestrian transport during any military conflict in history (note: see figures 9 to 11). Of the 322 German divisions in 1943, only 52 were armored or motorized. The German Wehrmacht actually had more veterinarians in uniform than medical doctors and most infantry divisions marched into battle on foot with their weapons and supply trains propelled almost entirely by four-legged horsepower. During the disastrous Russian campaign in the summer of 1941 as well as for most of the rest of World War II, the transportation of 80% of the German rifle companies marched into battle on foot with their weapons and supplies loaded onto wagons pulled by 3 horses.

Figures 9 to 11

Oil = Axis “Achilles’s heel” compensated in part by animals



Luftwaffe aircraft being moved to the runway by horse power



German soldiers resting with cow & horse power still standing



Wehrmacht artillery in Russia aided by horses

1. World War II - Germany (continued)

1.5 - The noose tightens - Nazi Germany runs out of oil and is defeated (continued)

The German light and mountain infantry divisions had an even greater proportion of animals and the cavalry divisions were naturally mainly dependent on the horse. German Army trucks often had to be pulled by oxen when they had no fuel. German tanks were often sent to the front by rail and then pulled to the battlefield by animals or trucks to save fuel. The allies by comparison enjoyed the strategic advantage due to the ability of the USA to mass produce motorized vehicles with low unit costs and rapid quantity production which was coupled with worldwide easy access to relatively inexpensive fuel. For example during World War II, the Germans produced @ 375,000 trucks for their Army which mostly had 2-wheel drive but they were always short of trucks. On the other hand, the Americans alone made over 800,000 trucks of which most were 4-wheel drive 2½ ton vehicles driven by relatively inexpensive gasoline or diesel fuel of which the allies had ample supply.

After the capture of Libya in 1943, the Allies were able to launch intensive but costly raids on Ploesti in Romania where over 50% of the refining capacity was destroyed by the end of that summer. Shortly after the invasion of Europe on “D Day”, the Allies then set a new priority target: the German **synthetic fuels plants** which were subsequently bombed all over Germany. The Allied goal was to deny oil to the Nazi armed forces. For example on 12 May 1944, 935 Allied bombers and fighter escorts bombed many synthetic factories including the giant I.G. Farben plant (see figure 6). Before these May attacks, synfuel produced in Germany averaged 92,000 MBD* which dropped to 5,000 barrels per day by September 1944 after subsequent, frequent bombing raids (see figure 12). The Russians also captured the Romanian oilfields in mid-1944 which deprived Hitler of even more crude oil. The German fuel picture was so bad in the autumn of 1944 that the Luftwaffe was forced to operate with only 10% of the minimum required aviation gasoline. At that time, even breweries were converted to making fuel. Without fighter planes to protect the fuel plants, the destructive impact of the Allied raids grew. By fall of 1944, the D-Day invasion had widened and driven the Germans out of France and the Soviets were also pushing the Germans from the east. Hitler threw in everything to launch his last counter offensive known as “**The Battle of the Bulge**”. A key objective of the German plan for this frozen Belgian battlefield was to seize the American fuel dumps on the way to Antwerp. On 17 December, a unit of the Wehrmacht was within a thousand feet or so of the grand prize called the Stavelot supply dump when the Allies set some fuel ablaze to create a wall of fire. Since the map used by Germans was not updated, it failed to show the correct location and magnitude of the fuel dump. Thus, the German Army missed this prize and went around the thin wall of fire instead of through it. The oil at the Stavelot dump would have enabled the German forces to push through to Antwerp and to the English Channel at a time when the Allies were disorganized and confused. However as result of the “*fog of war*” & bad intelligence, the German Nazis failed to prolong the war in Europe by losing “**The Battle of the Bulge**”.

Figure 12
Allies bombing a German synfuels plant



*MBD = 1,000 barrels/day (42 US gallons per barrel)

1. World War II - Germany (continued)

1.5 - The noose tightens - Nazi Germany runs out of oil and is defeated (continued)

Although the Germans had the advantage of surprise at the “*Bulge*”, they did not have enough resources and the German offensive was finally stopped and pushed back on Christmas Day 1944. By the end of 1944, German units were operating from one fuel shipment to another and often had to change their preferred operational plans to reduce fuel consumption. In 1945, the Wehrmacht was grounded for lack of fuel and their new Tiger & Panther tanks were running on fumes since at that time the Germans were never more than 30 days away from running completely out of fuel. Thus, the German Army tried to wage a war of mobility but had no mobility due to lack of fuel. By February 1945, German production of aviation fuel was down to a trickle equaling about 0.5% of the aviation gasoline production during the first four months of 1944. The fuel shortage at this time made it impossible for the Luftwaffe to properly train new fighter pilots which in turn increased the effectiveness of the allied bomber forces. Thus, the average number of flight training hours for new German pilots dropped 52% from 240 hours in 1942 to only 110 hours in 1944. (**note:** British and US flight training hours for new pilots averaged about 350 hours). Typically in the last 2 years of the war, German Luftwaffe airplanes were pulled to runways from aviation hangers and parking locations by horses, cows and oxen, as shown in figure 9. By the end of the war, the German war machine was running on empty and Germany was forced to unconditionally surrender on 7 May 1945.

Figures 13 to 16: The 1,000 year Reich is finally kaput!



Going!



Going!



Going!



Gone!

2. World War II - Japan

2.1 - Energy supply before World War II

In the 1930's, Japan was a densely populated country with few natural resources, especially oil. As a result of military victories against China in 1895 & Russia in 1905, Japan gained territory & some related mineral rights. By the late 1920's, Japan had complete control of Manchuria which became Japan's life line for many raw materials. After the assassination of a pro-West Japanese prime minister in 1930, an ultra-nationalistic and militaristic government took control of Japan which gave rise to

Source of fuel supply – Japan 1940

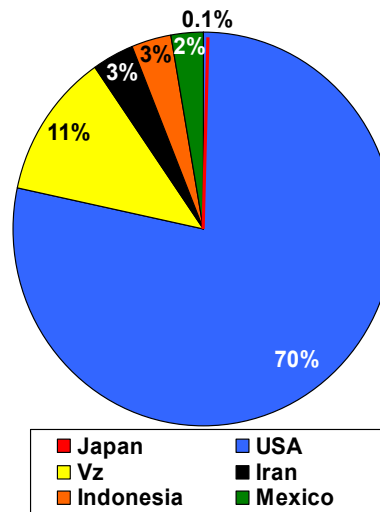
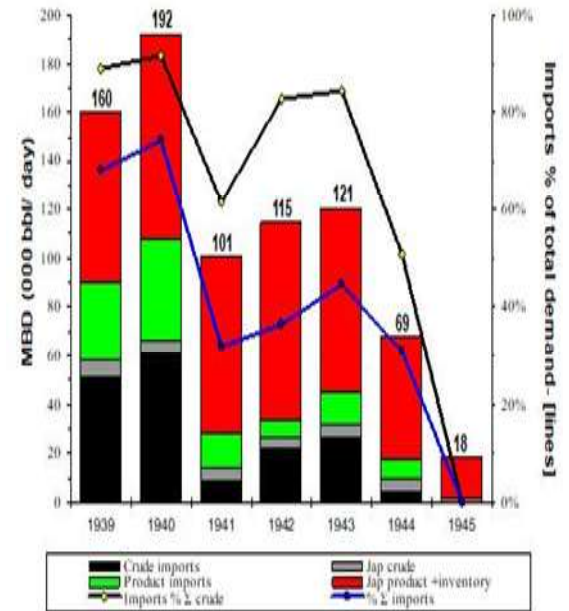


Figure 17

Japanese petroleum demand



“The Greater East Asia Co-Prosperity Sphere” known in Japan as the **“The Imperial Way”** (i.e. Asia controlled by Japan). Under this imperative push for strategic resources, the Imperial Japanese Army focused on: Manchuria, North China, Mongolia and the Soviet Union while the Imperial Japanese Navy was ordered to concentrate on: the Dutch East Indies (i.e. Indonesia), Indochina (i.e. Vietnam) and various Pacific islands. In 1938, Japan imported 106 MBD* but only produced 7% of their domestic and military oil requirements (i.e. 7 MBD* with 80% of the balance imported from the USA and 10% from the Dutch East Indies). Furthermore in Japan, 25 oil companies with 37 refineries had only a total distillation capacity of 22 MBD* (i.e. 22% of the Japanese demand). Thus, the balance of their oil demand had to be imported as finished petroleum products (note: By 1940, the USA produced over 3,699 MBD* or 63% of the world petroleum production and Japan reached the peak of oil consumption for the next 5 years of war as shown in figure 17. Furthermore, 60% of the internal Japanese petroleum product market was controlled by the Stanvac Company [now ExxonMobil] and the Rising Sun Company [now Royal Dutch Shell Oil]. With sizeable coal reserves, the Japanese attempted to establish a synthetic fuel industry as did the Germans but failed due to the lack of technical expertise as well as shortages of alloy and catalytic metals required for synfuel production. In recognition of this oil handicap, the Imperial Japanese Navy initially owned and operated its own petroleum refinery in 1921 to primarily manufacture heavy fuel oil for the fleet and added another refinery in 1943. The Imperial Navy also owned and directly operated its own coal mine in Korea. On the other hand, the Imperial Army only directly operated 1 refinery which was opened in 1943 as well as a synthetic fuel plant in Manchuria. Just prior to Pearl Harbor, Japan had enough oil stockpiled for 2 years of normal consumption which represented only a one year supply during war, primarily due to the increased requirements to fight a naval war. In a report for the US Navy, it was estimated that over 75% of the avgas used by the Japanese planes attacking Pearl Harbor on 7 December 1941 was derived from California crude oil that was refined in Japan or avgas refined on the US West Coast.

*MBD = 1,000 barrels/day (42 US gallons per barrel)

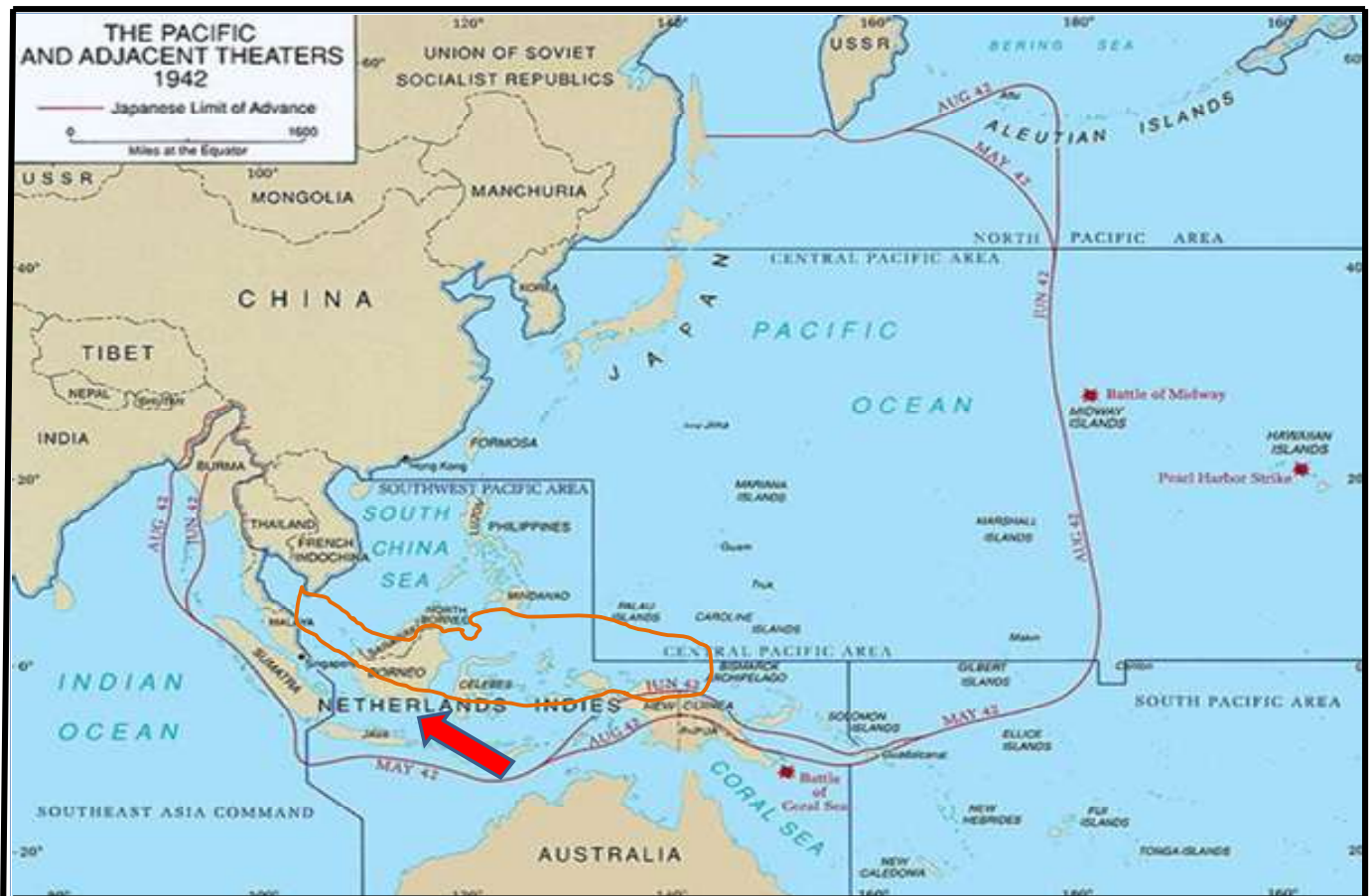
2. World War II - Japan (continued)

2.2 - Imperial Japan's Grand Prize and Strategy

As a result of continued Japanese aggressiveness in Indochina and the Tripartite Pact with Hitler and Mussolini, the US banned the export of steel and scrap iron to Japan in September 1940. The supply of US oil continued to be shipped to Japan until Indochina was invaded in July 1941 when the US imposed a total trade embargo against Japan, including oil, which of course led to the day that will live in infamy on 7 December 1941. Given nearly total energy dependence on foreign imports, the Initial Japanese strategic thrust was to seize and control the oil fields of Royal Shell in the Dutch East Indies (i.e. Indonesia; See **red arrow** on figure 18) and Borneo which in total produced 165 MBD* in 1940 (i.e. equivalent to the entire crude oil production of Europe ex Russia & Romania). These areas also contained 90% of the worlds' natural supply of rubber which was soon controlled by Imperial Japan. Indochina (i.e. Vietnam) and Malaysian were also seized for rubber & other crucial resources. Japan assumed the that he stolen resources in the Southern zone of "*The Greater East Asia Co-Prosperity Sphere*" would ensure their ability to maintain control a "*Pacific Wall*" for the long term.

Figure 18

Japanese petroleum strategic solution



*MBD = 1,000 barrels/day (42 US gallons per barrel)

2. World War II - Japan (continued)

2.3 - The noose tightens - Japan runs out of oil and is defeated

The first quarter of 1943 was the peak period for oil imports to Japan. The Japanese Navy required at least 18MBD* and the Imperial Army consumed 6 MBD*. As a frame of reference, the US fuel demand for the war in the Pacific was 46 MBD* in 1942, 77 MBD* in 1943 which became significantly higher in 1944 and 1945.

Figure 19

USS Blackfish (SS 421) attacking a Jap cargo

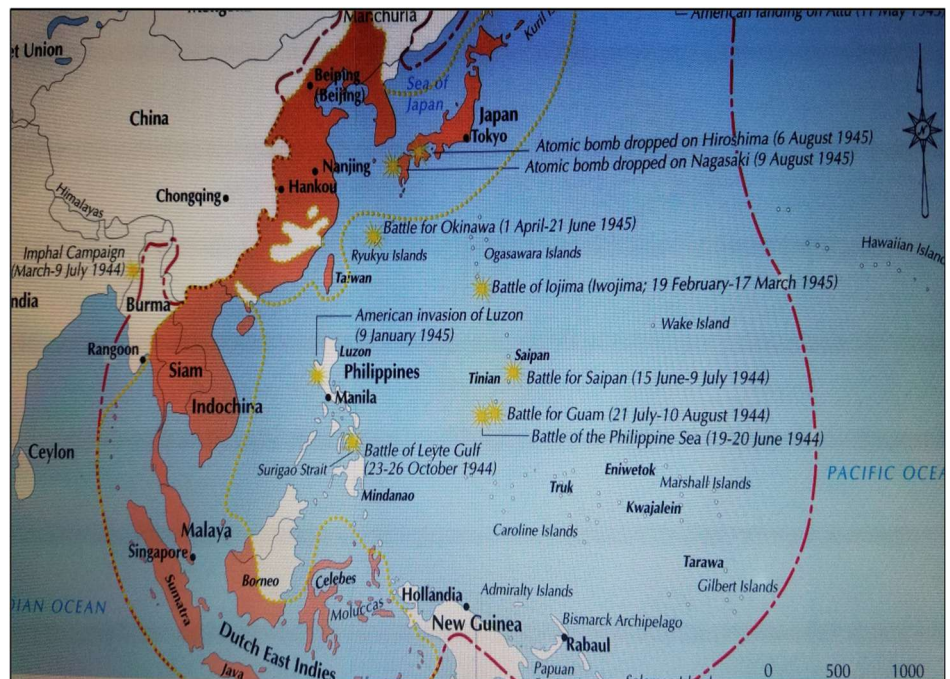


As a result of the sinking of tankers by US submarines, the Japanese refineries were extremely short of crude oil. Thus, the US bombing campaign of Japanese refineries generally did not need to be started in earnest until 1945. After the recapture of the Philippines and the invasions of Iwo Jima & Okinawa, the US Army Air Corps and Naval aviators subsequently destroyed more than 66% of the Jap total refinery crude capacity. (see Figure 20). The resulting shortage of avgas forced a significant reduction in aviation operations and pilot training hours (including the elimination of navigation courses and the start of kamikazes with only enough fuel for for a 1-way trip). Furthermore, the Japanese did not return skilled

In 1944, the petroleum supply chain for Japan was cut in half and completely dried up by 1945 due in large part to US submarines targeting the Japanese merchant fleet, including tankers (see Figure 19). 56% of all Japanese merchant and naval ships were sunk due to aerial bombs or submarine launched torpedoes. In fact, US submarines in the Pacific were responsible for over 50% of all marine vessels sunk during World War II. On the other hand, Japanese submarines targeted war ships which turned out to be strategically ineffective. In 1943, the oil production under Japanese conquered territories was 132 MBD* but only 46MBD* (i.e. 35%) actually made it to Japan courtesy of the US Submarine Force. In addition, an American sub sank a Japanese cargo ship which by chance happened to be transporting a significant amount oil production equipment and expert personnel.

Figure 20

Western Pacific (1944 – 1945)



pilots to train at flight schools but kept them in the front-line units where they were more likely to be killed. The lack of fuel by the Japanese also significantly affected their loss of the Battle of Leyte Gulf.

*MBD = 1,000 barrels/day (42 US gallons per barrel)

2. World War II - Japan (continued)

2.2 - The noose tightens –Japan runs out of oil and is defeated (continued)

On 15 August 1945, Emperor Hirohito announced the surrender of Japan on the radio and the unconditional Japanese surrender was formally signed on board the *USS Missouri* (BB 63) on the 2 September 1945. The Imperial Japanese Foreign Minister (Toshikazu Kase) subsequently stated: "*When Japan embarked upon war, there were two vulnerable spots in her armor. These were: shipping and oil.*"

Figure 21

The fall of the rising sun



Japanese strategic crucial errors

1. Pearl Harbor - No 3rd wave to hit **oil** reserves
2. Pearl Harbor - missed the carriers
3. Underestimated US submarine fleet threat
4. Grossly underestimated America resolve & might
5. Myopically missed US intel & code breaking skills
6. Neutralize their "**Achilles's Heal**" (i.e. Oil)

As noted above, Japan made the following "**oily**" related strategic crucial errors during World War II:

1. On 7 December 1941, Japanese Admiral Isoroku Yamamoto **failed** to send a 3rd attack wave to Oahu **to destroy the oil reserves** of the Pacific fleet at Red Hill, despite the fact that oil availability was a key reason for the Japanese decision to go to war
2. Due to bad intelligence, the Japanese Navy **did not destroy the US carriers** at Pearl Harbor, which were at sea on maneuvers
3. The Imperial Japanese Navy greatly **underestimated** the subsequent effectiveness of **US submarines** to intercept Japanese oil supplies, particularly from the Dutch East Indies
4. Except for Admiral Yamamoto (Commander-in-chief of the Combined Imperial Japanese Fleet & Harvard alumnus), the Japanese government grossly **underestimated American resolve, manpower, industrial base & technology**
5. Finally, the Japanese military myopically **overlooked the US intelligence skills** such as cracking the Japanese diplomatic "Purple" & Naval codes.

Thus as Arnold Schwarzenegger said in The Terminator, "**Sayonara baby!**"

Figure 22



3. World War II - USA

Unlike World War 1, the major military inventions of World War II were not oil powered (e.g. radar, sonar, technologically driven productivity of the defense industrial base and the atomic bomb). However, oil played an essential role in the ultimate Allied victory in World War II with petroleum-based explosives, artificial rubber, napalm as well as the massive fuel consumption to move allied surface ships, submarines, planes, tanks & motor vehicles.

Figure 23
The Wounded Eagle rises



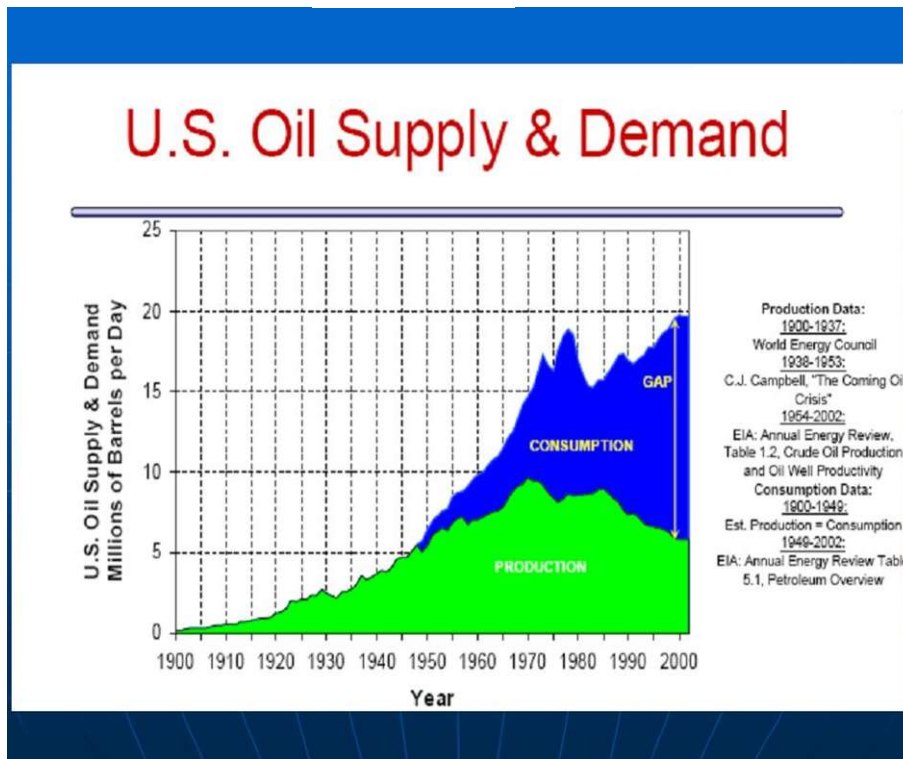
American strategic strengths in WWII

1. Ample crude oil reserves & refining capacity
2. Synergistic teamwork between US & oil biz
3. US Oil tech - expanded toluene production
4. US Oil tech - invented synthetic rubber
5. US Oil tech - developed 100 octane avgas
6. US Oil tech - Big Inch & Little Big Inch Pipelines
7. Motivated heroic warriors

3.1 - Petroleum security of supply

As noted, the main handicap of the WWII Axis powers was their lack of oil. On the other hand, the US was energy self-sufficient and the leading crude oil producer in the world (Figure 24). Furthermore, the expensive synthetic fuel from coal gasification was not economical or needed in the US. The US crude surplus following the Great Depression made the synthetic oil production in the US 10 times the cost of crude oil from Texas.

Figure 24



From 1941 to 1945, the US supplied more than 85% of all the oil used by the Allies during World War II (i.e. 6 billion barrels which equaled the volume of all US oil produced from 1859 (Colonel Drake's initial oil well) up to and including 1941). As a frame of reference, entire Middle East only produced 204 MBD of crude oil in 1940. Furthermore, the US was also the largest consumer of petroleum at the start of World War II (i.e. 3,665 MBD* as show in in figure 24) compared to consumption of the USSR (501 MBD*), UK (208 MBD*), Japan (192 MBD*) and Germany (170 MBD*). Thus without American oil, **World War II** would **not** have been won by the **Allies!**

*MBD = 1,000 barrels/day (42 US gallons per barrel)

3. World War II - USA (continued)

3.2 - Petroleum industry & US teamwork

Six months before the attack on Pearl Harbor, President Roosevelt established the Petroleum Industry Council for National Defense which was headed by Ralph Davies (a Vice President of Standard of California which is now called Chevron). This Council forged an exemplary and successful working relationship between the US oil industry and federal government during World War II (unlike most of the last 2 decades). Until recently, the only remaining residue of this collaboration of the US government & the oil industry was the continued use of the term "PADD" (i.e. geographical segmentation of the US into 5 **Petroleum Administration Defense Districts** which are: I = East Coast, II = Mid-West, III = Gulf Coast. IV = Rocky Mountain states & V = the West Coast).

3.3 - Toluene

For years, toluene had been a marginal by product of petroleum coke production. However after Pearl Harbor, Standard Oil of New Jersey (i.e. now ExxonMobil) greatly expanded their production of toluene from crude oil. As a result during World War II, 65% of the all the toluene used by the Allies as a key component in TNT for explosives. Almost $\frac{2}{3}$ of all the toluene used by the Allies during World War II was provided by just 2 multinational oil companies (i.e. 50% was refined by ExxonMobil and 15% came from Shell Oil).

3.4 Synthetic rubber

"The Imperial Way" area also contained 90% of the world's natural supply of rubber on the Malay Peninsula which was soon controlled by Imperial Japan. However, the US and most allies never suffered from a shortage of rubber thanks to the US oil industry since **Standard Oil of New Jersey** had discovered how to make synthetic rubber from butadiene refined from crude oil. As a result, This discovery allowed the Allied Army caissons to "*Keep on rolling along*".

3.5 - 100 Octane aviation gasoline

The US oil industry continued to push the technology envelope during World War II with the development of several refinery process enhancements such as cat cracking and improved hydrofining. As a result, a prodigious amount of additional gasoline was squeezed from crude oil. In addition, these new refinery units also provided the gateway to make 100 octane avgas that provided allied fighter planes with a technological advantage over the Luftwaffe and Imperial Japanese aviation units. This fuel advantage was especially critical in the "***Battle of Britain***" where the technologically inferior British Spitfire fighter planes had a distinct power thrust advantage over the more advanced and numerous German Messerschmitt fighters. in the late 1930's, the initial drive for higher octane gasoline was particularly driven at **Shell Oil (us)** by a Vice President of Aviation Products. This dynamic leader had maintained his aviation skills acquired as a fighter pilot in World War I and continued to serve in the Army Reserve. In July 1940, this **Shell** VP was recalled to active duty as a major in the US Army Air Corps (**USAAC**). His name was Major James Doolittle who later led the famous Tokyo Raid in 1942 for which he received the **Medal of Honor**. In Winston Churchill's speech in August 1940 praising the Royal Air Force in the "***Battle of Britain***", I think Sir Winston should have added 3 merited final words by saying: "*Never in the field of human conflict was so much, owed by so many, to so few, including Jimmy Doolittle*". After the war, COL Doolittle returned to **Shell Oil** & later was promoted to 4-star General in the USAF Reserve. In 1973, General Doolittle died at age 96.

Figure 25



Colonel James Doolittle USAAC

3. World War II - USA (continued)

3.6 - "Big & Little inch" Pipelines

During World War II, one of the most significant and under-reported positive petroleum developments for the Allies was the design, construction and rapid completion of the "Big Inch" and the "Big Little Inch". These 2 pipelines moved crude oil or finished petroleum products 1,476 miles from Texas to New Jersey (see figure 26). The 24-inch "Big Inch" pipeline was started in August 1942 and completed 12 months later to carry crude oil to the Northeast refineries. The "Little Big Inch" pipeline was 20 inches in diameter and delivered various petroleum products to "break out" product terminals along the way to New Jersey.

Figure 26 - "Big Inch & Little Big Inch" pipeline

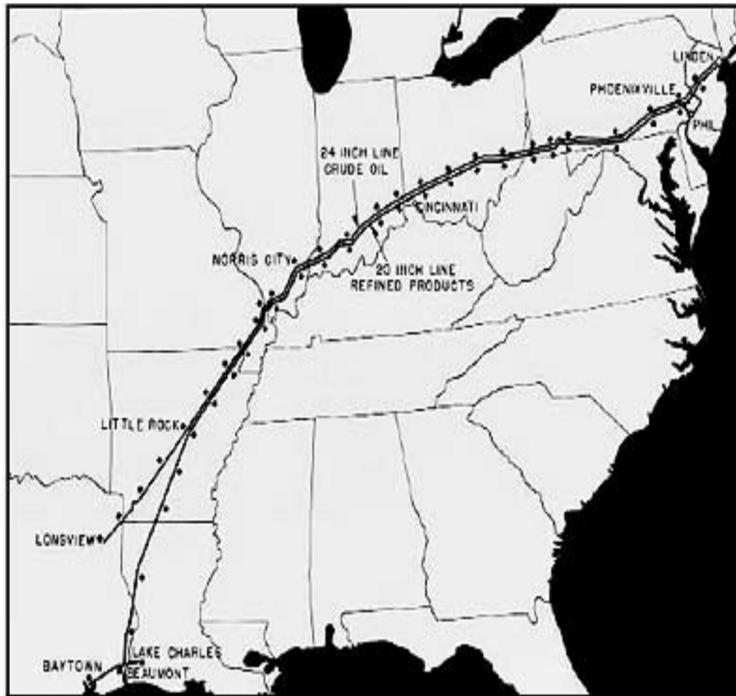


Figure 27 - "Little Big Inch" pipeline



Figure 28 - "Big Inch" Pipeline



These 2 petroleum pipelines were completed in record time (with **no environmental roadblocks**) and carried over 334 MBD* of crude oil to the Northeast refineries and 240 MBD* of finished petroleum product (e.g. gasoline, heating oil and diesel fuel) to the military and East Coast markets. The annual volume of finished petroleum products & crude oil shipped in both of these pipelines was the equivalent of almost 2,500 fully loaded tanker voyages per year (i.e. 5,000 round trip tankers). Thus, these 2 lifesaving pipelines greatly reduced the number of targets for Nazi U-boat wolf packs attacks as shown below:

<u>Year</u>	<u># of tankers sunk* by German U-Boats</u>
1942	97
1943	21
1944	6
1945	2

In addition, the demise of the initial U-boat turkey shoot in 1942 was also aided by improvements in convoy tactic as well as enhanced Anti-Submarine Warfare technology and sailor sonar skills.

sunk* off the US East Coast or in the Western Atlantic, Caribbean Sea & the Gulf of America (formerly called the Gulf of Mexico)

4. Post World War II

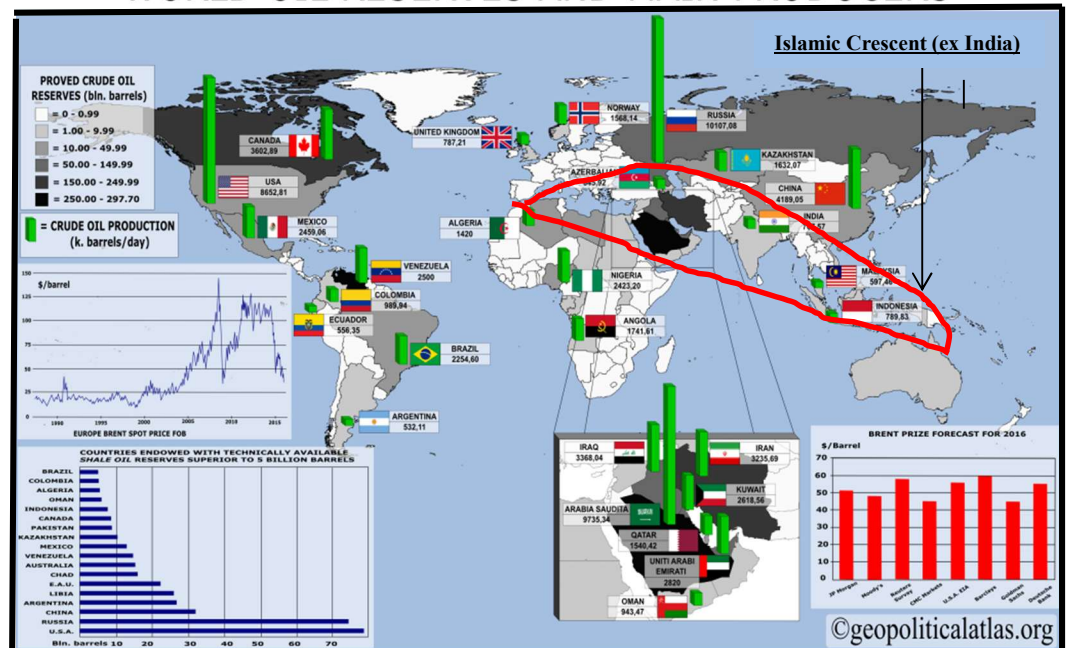
4.1 - "Oily" overview

After World War II, the Korean and Vietnam Wars were the next 2 major US combat engagements but were not really driven or potentially constrained by the petroleum security of supply of any of the combatants. However during the Vietnam War, left-wing radicals falsely claimed that the US was really fighting to protect the oil interests & reserves of the "big bad" international oil industry, despite the fact that Vietnam had less than 0.3% of the global proven oil reserves (i.e. 94% less than the proven oil in North America). However, oil was the underlying foundation on both sides during the Gulf War (i.e. Desert Shield & Desert Storm from 1990 to 1991). In August 1990, the Iraqi dictator Saddam Hussein had almost 9% of the global proven oil reserves & literally stole another 6% by illegally invading Kuwait. Had Hussein been intelligent (which fortunately was not the case), he could have easily whipped down the East coast of Saudi Arabia to pick up another 15% of world oil reserves and then continued to plunder another 6% of total oil reserves in the UAE, Oman & Qatar (See figure 29). Thus, a mad man who was antagonistic to the US would potentially control more than 36% of the global proven crude oil reserves or 50% of the OPEC total proven oil reserves (i.e. near the dangerous "red zone" known as the "Herfindahl Index" of market concentration).

Thus during the Gulf War, the US engaged in justifiable international "trust busting" against a clear and present danger to the security of the US and the world. The current and probably lengthy Worldwide War on Islamic Fundamentalist Terrorism is primarily related to a radical and distorted interpretation of Islam. These Islamists (e.g. El Qaeda and the Taliban) are attempting to convert the world through conquest and fiendish terror.

Figure 29

WORLD OIL RESERVES AND MAIN PRODUCERS



Their ultimate objective is global domination by controlling the proven oil reserves located within an Islamic Crescent Caliphate from Gibraltar to Indonesia as shown the red line in Figure 29. Thus, this area would then contain 54% of the world's proven crude oil reserve or 75% of all of the oil reserves in OPEC.

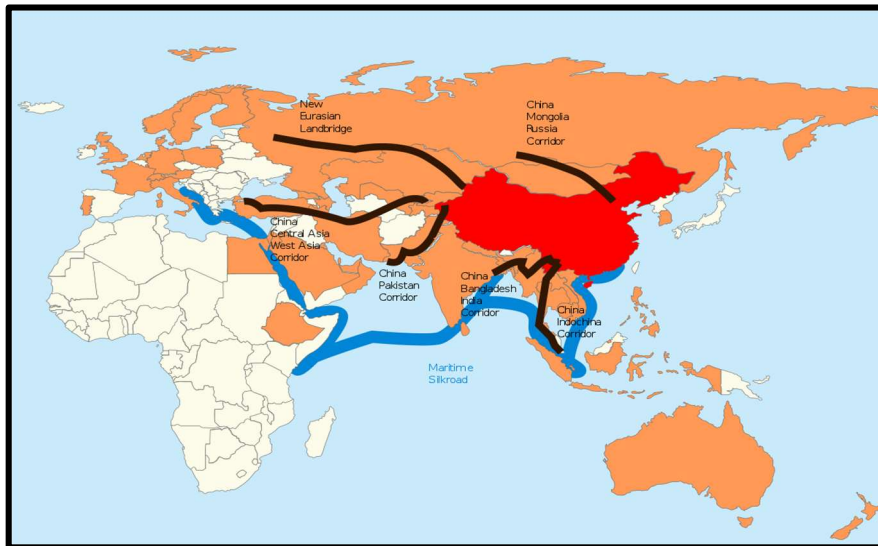
4. Post World War II (continued)

4.2 - "Oily" impact of Russia and especially the Peoples Republic of China (PRC)

In the hopefully unlikely activation of a future hot war with the Russian Federation, petroleum security of supply will not be a key issue since Russia has 5.2% of the global crude oil proven reserves with a crude oil proven reserve to production ratio (i.e. **R/P ratio**) of 26 years but only 1.8% of the world's population. As a frame of reference, the USA has 3.0% of the global crude oil proven reserves with an **R/P ratio** of 10 years and 4.3% of the world's population. However petroleum availability will be a key driving force in a future likely hot or cold war with China which has 18% of the world population but only 1.5% of the global crude oil proven reserve with an **R/P ratio** of 16 years. As a result, China is now on the attack with a very aggressive global forward presence to address their growing gap for petroleum and other essential resources with a development strategy known as the "**Belt and Road Initiative**". In effect, this strategy by the "*Market Leninist*" dictatorship of China is an attempt to re-create the ancient "*Silk Road*" which was a network of routes for commerce that connected the East and the West and named for the lucrative silk trade that started over 200 years before the birth of Christ.

Figure 27

Chinese "Belt & Road Initiative"



The "**Belt**" in this program stands for the overland routes to China shown with **black lines** in figure 27 and the "**Road**" refers to the maritime corridors with a **blue line** through the South China Sea, the South Pacific Ocean, and the wider Indian Ocean area. Key objectives of the modern resurrection of these 2 "**Silk Roads**" are to enhance the Chinese economic power, regional hegemony as well as petroleum security via infrastructure development and investments in Europe, Asia, Africa and Venezuela.

The Chinese Navy already has established a forward deployment base in Djibouti on the Horn of Africa and is looking forward to using future port facilities that they are building in Pakistan. The maritime portion of the new "*Silk Roads*" is particularly crucial since over 80% of world trade is carried over the oceans via ships which for the most part are fueled by petroleum. In addition, over 99% of the transcontinental communications are carried over sea cables in the ocean and food from the sea is expected to increase by an order of magnitude over the next decade. The Chinese elite and key government officials do study history and view the USA as the gold standard for emulation as a world power. As a result, maritime leaders and strategists in China are considered to be serious followers of the late Captain Alfred Mahan US Navy who wrote "*The Influence of Sea Power upon History*" (1660-1787). Furthermore, China now views the Monroe Doctrine as a concept that should also equally apply to China for dominance over Southeast Asia which sounds suspiciously like "*The Greater East Asia Co-Prospereity Sphere*".

4. Post World War II (continued)

4.2 - "Oily" impact of Russia and especially the Peoples Republic of China (PRC) - (continued)

The PRC Navy (i.e. known as the PRC Army-Navy) is aggressively playing catch up with the US Navy. Unfortunately over most of the last 2 decades, the US military budgets, assets, weapons, enlistments & training have been seriously degraded. However hopefully, this past dereliction of duty will be turned around under the recent new federal administration in Washington. However for the near future at least, the US will continue to have a more powerful Navy than China (PRC) since:

- Only 2 PRC carriers ("no nukes") vs. 11 US nuclear ("nuke") carriers (plus 1 PRC carrier undergoing sea trials & 1 PRC nuclear powered carrier under construction & a couple more in the planning stages by the PRC)
- PRC Navy has 370 combat ships vs. 299 for the US Navy
- Only 670 PRC Navy operational planes vs. for 4,714 the US Navy plus US Marine Corps
- PRC Navy in total has 61 submarines vs. 63 for the US Navy (USN). However,
- PRC Navy has 54 attack submarines (including only 9 nuclear boats) vs. 49 nuclear USN attack boats
- Only 9 PRC **diesel** Fleet Ballistic Missile (FBM) submarines vs. 14 FBM ("nuke") submarines for the USN
- No significant combat experience by the Chinese Navy
- Limited forward projection and "*Blue Water*" experience of the PRC Navy
- Inferior Chinese logistics train, especially for petroleum

4.3 - Current geopolitics & the "oily" outlook

The "*jury is still out*" regarding our current troubled and divisive geopolitical times in the Ukraine, Russia, Iran, North Korea, the Peoples Republic of China as well as in Europe and the United States. However in all of these as well as many other situations, oil and hydrocarbons in general remains a key component in confronting & resolving the many challenges to our national security. As noted above, petroleum security of supply will not be a key issue for Russia or the USA. Furthermore, the US has a significantly higher % of the ultimate crude oil & natural gas reserves which some recent American politicians have attempted to abandon.

As is the case with current wars and politics, major global inflation is surging not only for oil & but also for the many products made from or transported by petroleum products (e.g. food, plastics, roads, housing and clothing etc.). Thus, current and future politicians as well as military strategists should assess and digest the related petroleum related military quotes on page 22. As Harvard graduate and philosophy professor George Santayana stated in his 1905 book called **Life of Reason**: "*Those who cannot remember the past are condemned to repeat it*"

4.4 - Call for action

Given the complexity of "**Oil & War**", this paper has a lot of data & numbers with hopefully a few interesting new facts & observations. However, I hope that the reader (especially politicians, military leaders & even the major oil company executives) study the important topic of "**Oil & War**" and serve as "*force multipliers*" to promote the following 3 key "*take away*" points of this "**Oil & War**" introspection:

1. Widely publicize crucial importance & synergy of **hydrocarbons & US national security**
2. Push for US **government & oil industry** close **cooperation** (which enhanced our victory in World War II)
3. Elect politicians who will **support**:
 - a. The return of a **strong US military**
 - b. Rekindling a **vibrant US petroleum industry**

Appendix - Oil & War Quotes

- **Adolph Hitler** – *"To fight, we must have oil for our machine."*
- **General Erwin Rommel German Wehrmacht** (2/42) – *"The bravest men can do nothing without guns, the guns nothing without plenty of ammunition, and neither guns nor ammunition are of much use in mobile warfare unless there are vehicles with sufficient petrol to haul them around."* – (8/42): *"The outcome of the battle will depend upon the delivery of fuel at the proper time."*
- **E. Homze** (author of "Arming the Luftwaffe) – *"The Luftwaffe entered the war with fuels that were not of the same quality as those of their Western opponents"*
- **Admiral Karl Doenitz German Navy** – (2/42) *"Can anyone tell me what goods tanks and trucks and airplanes are if the enemy does not have the fuel for them? Yet, the high command can't see it."*
- **General Paul von Kleist German Wehrmacht** – Commander of Panzer Forces in Russia: *"The primary cause of our failure was a shortage of fuel"*
- **Field Marshall E. Milch German Wehrmacht** – German Director Air Armament (4/43) *"The synthetic oil plants are the worst possible place they could hit us. With them stands or falls our ability to fight this war. After all, if the synthetic fuel plants are effectively attacked, not only our aircraft but the tanks and submarines also come to a standstill."*
- **General A. Galland German Luftwaffe** – Commander Luftwaffe Fighter Force: *"The raids of the Allied air fleets on the German fuel supply installations were the most important of the combined factors which brought about the collapse of Germany."*
- **Asahi Shimbun** – Japanese newspaper (1946): *"It was a war begun as a fight for oil and ended by the lack of it."*
- **Professor Wakimura** – University of Tokyo (1946): *"God was on the side of the nation that had the oil."*
- **Toshikazu Kase** – Imperial Japanese Foreign Minister: *"When Japan embarked upon war, there were two vulnerable spots in her armor. These were shipping and oil."*
- **General. George Marshall USA** – (6/42) *"The losses by submarines off our Atlantic seaboard and in the Caribbean now threaten our entire war effort"*.
- **Rear Admiral W.R. Carter USN** – *"Our ships sailed on water but moved on oil and the demand never ceased."*
- **US Strategic Bombing Survey** – (1945) *"The calculations and hopes of the war planners were fixed on the rich oil fields of the Netherlands Antilles."* & (1945) *"In every phase of the war, oil determined Japan's strategy and governed the tactical operations of its navy and air forces"*
- **Lord Curzon** – UK Foreign Secretary during WW I (12/18): *"The Allied cause floated to victory on the wave of oil"*
- **Winston Churchill** – *"Above all, petrol governed every movement"*
- **Marshal Foch French Army** – Head of the French Army prior to the French surrender: *"We must have oil or we will lose the war"*
- **G. Lloyd MP** – ex UK Minister of petroleum *"I think that we would not have won the battle of Britain without 100 octane, but we did have 100 octane."*
- **Field Marshal Archibald Percival Wavell British Army** – aka Lord Wavell (1946) *"The more I see of war, the more I realize how it is all depends on administration and transportation"*
- **Joseph Stalin** – *"The war was decided by engines and octane"*.

About the author



Capt. Paul E. Mawn USN (Ret.)

Captain Paul E. Mawn US Navy (Ret.) grew up in Lynn (MA) and was commissioned as a Navy ensign via NROTC after graduating cum laude in Geology from Harvard College. After communications and intelligence training, he qualified as a surface warfare officer initially on the *USS Spiegel Grove* (LSD 32) and later on the *USS Thaddeus Parker* (DE 369) and the *USS Albert T. Harris* (DE 447). Upon release from active duty, Paul continued to serve in the active Navy Reserve for over 2 decades in a variety of surface warfare assignments as well as industrial security and petroleum logistics billets. Prior to his retiring after Desert Storm on the deck of the *USS Constitution* in Boston harbor (i.e. "*Old Ironsides*"), Captain Mawn was assigned to the CNO Executive Panel (Op 00K) which was an active-duty staff directly reporting to the Chief of Naval Operations (CNO) where he focused on Navy Petroleum related strategy & issues as well as other assigned tasks from the CNO.

Paul received his MBA from Rutgers University and worked in the oil industry in senior line management positions with Exxon and Hess Oil as well as petroleum related consulting projects at: Arthur D. Little Inc., Mercer Management Consulting as a partner & later served as the president of Concord Consulting Group as well as the Chairman of the Advocates for Harvard ROTC & was elected to the Board of Directors of the Harvard Veterans Alumni Organization. For his military related service, Captain Mawn was awarded:

- The Navy Commendation Medal (by the Secretary of the Navy)
- The Patrick Henry Silver Medal for patriotic service (by the Military Order of the World Wars)
- Alumni Leadership Award (by the Harvard Veterans Alumni Organization)
- Certificate of appreciation (by the US Army, 1st Brigade, 1st Region)

Sources: "*America's Bomber Boys Who fought the Air War against Nazi Germany*" by Donald Miller, BP energy outlook, EIA Energy Information Administration, "*Friedrich Bergius and the rise of the German synthetic fuel industry*" by Anthony Strange, "*History of the Great War*" by Jonathan Colin, Hong Kong Economic Journal, "*How World War I ushered in the century of oil*" by Professor Brian Black, "*How important was oil in World War II*" by Keith Miller, "*The impact of German and Japanese Strategy on World War II*" by Jiaxuan Lu, "*Oil in the Pacific War*" Online Encyclopedia, "*Oil and World Power*" in American Nation Encyclopedia, "*Oil Power*" by Keith Reid in the National Petroleum News, "*Present development of Petroleum Refining*" by Takeo Sata in the Bulletin of the Japan Petroleum Institute, "*The Prize- the Epic Quest for Oil, Money & Power*" by Daniel Yergin, "*US Navy Petroleum Strategy*" by Captain Paul E. Mawn USN, "*Where there Strategic Oil Targets in Japan in 1945*" by Manny Horowitz,