Ensuring Development Through Energy Security in the Democratic Republic of Congo

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TEXAS
The University of Texas at Austin

Vision

Goal 1

Incentivize the private sector to take a leading role in drilling and developing necessary energy infrastructure, increasing electrification to a rural populace, while retaining royalties from profit.

Goal 2

Use royalties collected from private firms to continue investing in energy autonomy, which will lead to a shift towards renewable energy and ensure the DRC will thrive in the future of the energy realm.

Goal 3

Strategize the most effective ways to implement renewable energy; create a tangible, succinct, and enforceable timeline in order to sustain for the energy consumption of 94 billion KWh in 2040.

Agenda

Current Landscape	• Statistics and data on the DRC
Oil	• Reasons for investing in oil; how to do it
International Pressure	• Using external pressure to combat corruption
Natural Gas	• Reasons for investment, best practices
Sustainability	• Rehabilitation of hydropower plants, exploring geothermal energy
Timeline	• Plans for execution until 2040

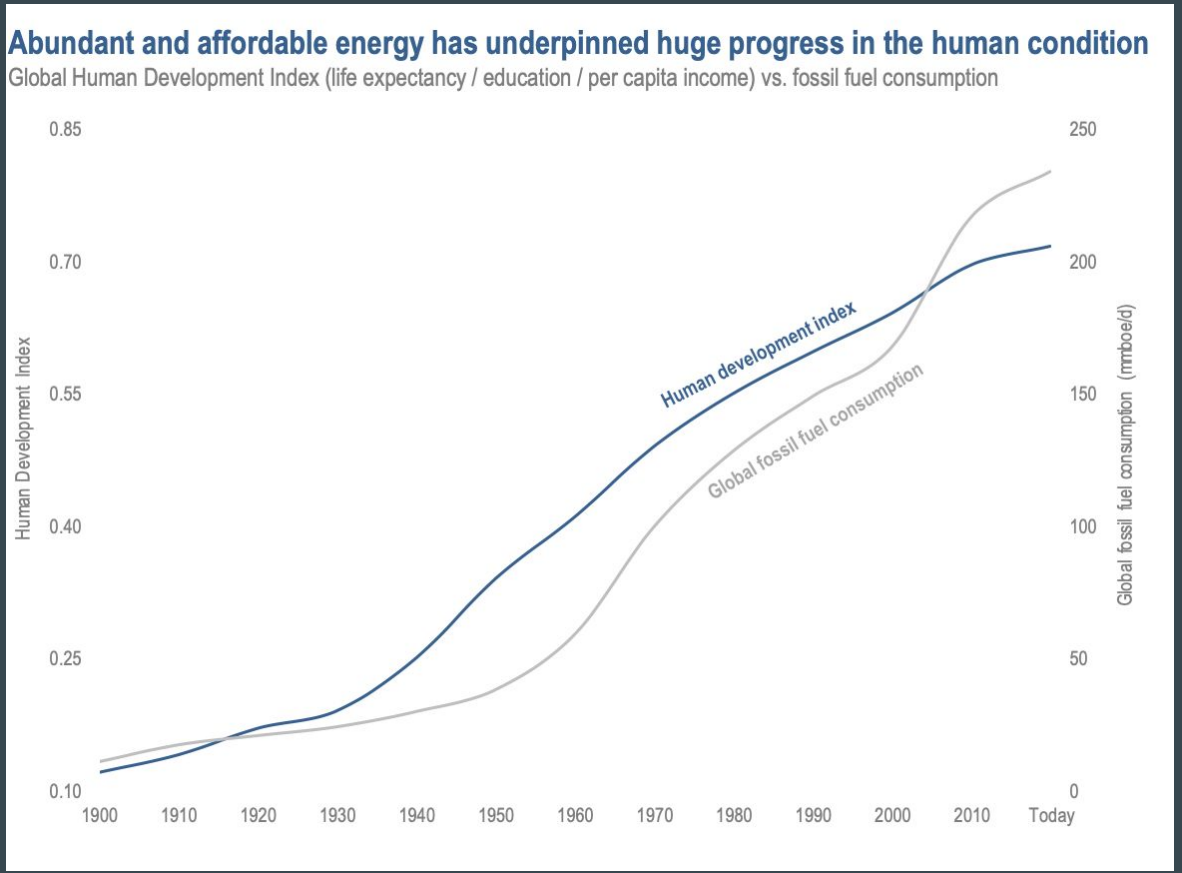
Current Landscape

GDP: $47.32 billion (2019); Per-Capita $501

Languages: French, Swahili, Kongo,Luba-Kasai, Lingala

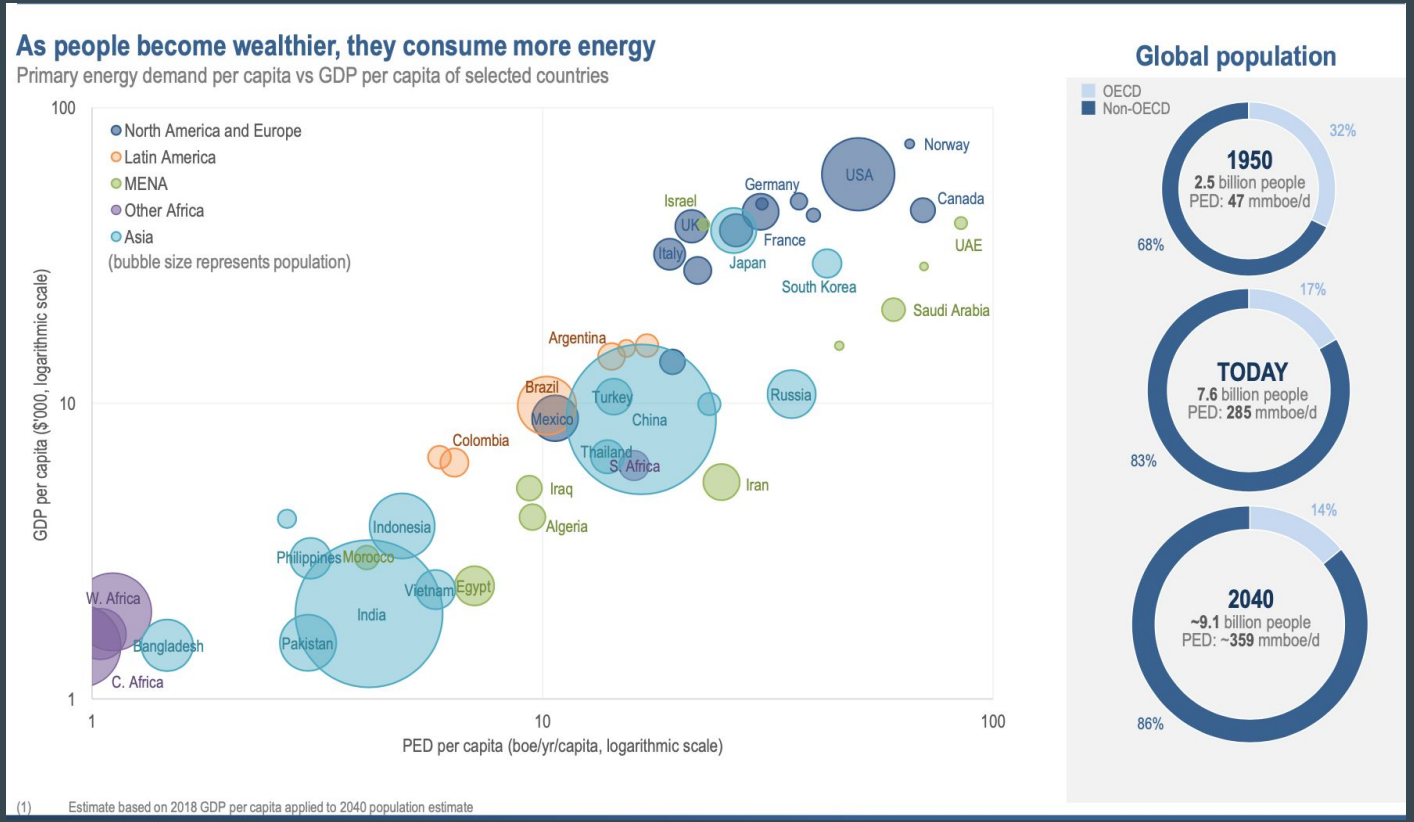
	2000	2018	2030	2040
Population (millions)	47	84	120	156
Access to electricity (% of pop.)	7	9	16	21
Access to clean cooking (% of pop.)	3	3	4	5

Why Begin with Oil?



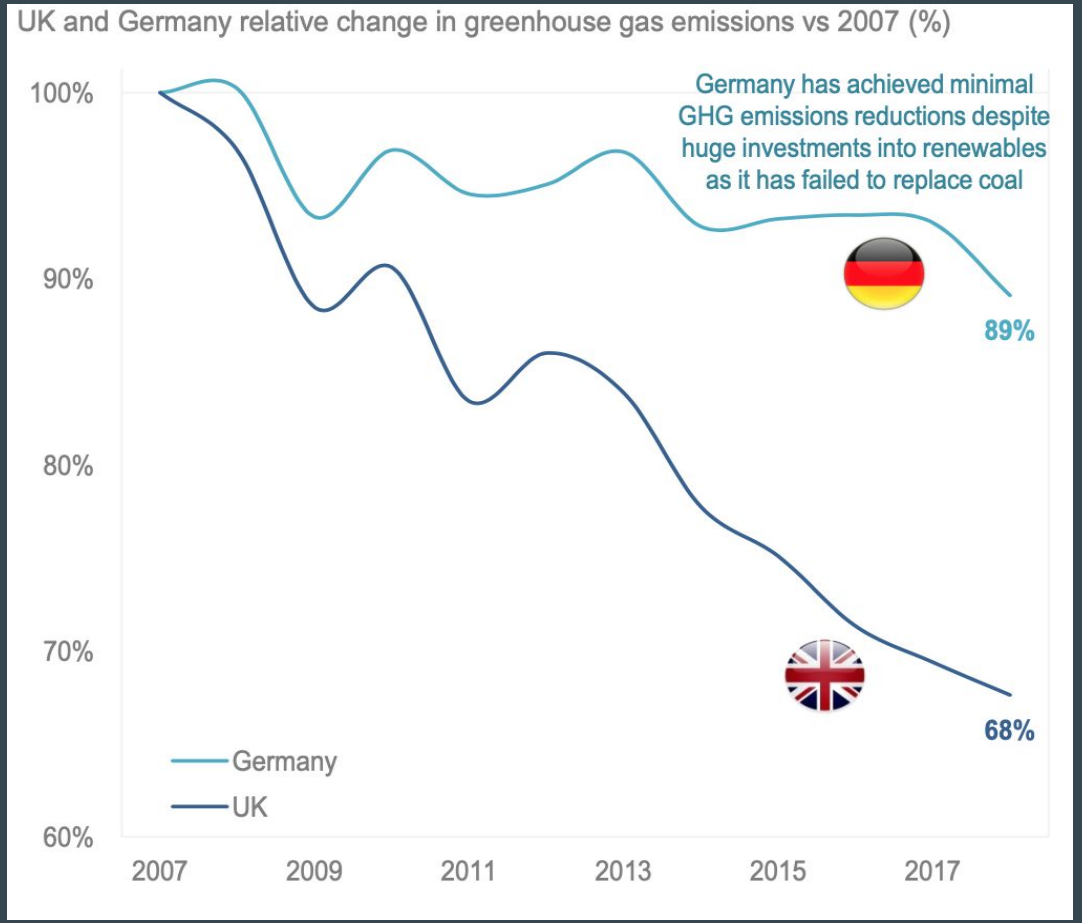
Source: World Health Organization; United Nations, Rystad Energy

Why Begin with Oil?



Source: UN Population Division, Bloomberg, BP Statistical Review of World Energy, BP Energy Outlook

Why Begin with Oil?



Source: BP Stats

The Strategy

Gross Revenue
$100

10%
Royalty
$10

90%
Available Crude Oil
$90

67%
Cost Recovery
$60.00

100%
Private Company
$60.00

33%
Profit Crude Oil
$20.00

60%
Contractor
$12.00

40%
DRC
$8.00

90%
Private Company
$10.80

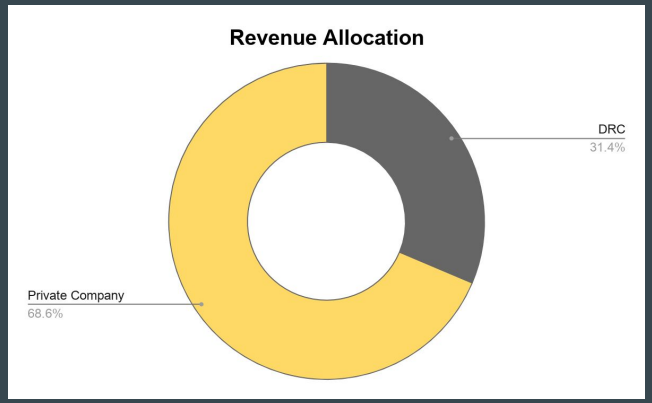
10%
DRC Carried Interest
$1.20

Capacity Building Pmt
$2.16

20%

Net Profit Oil
$8.64

80%



*Based on $100 revenue: $ figures rounded for illustrative purposes
**See slides 28 and 29 for full breakdown

International Pressure

United States

Client Implications:

- United States Department of Commerce
- United States Development Financial Cooperation

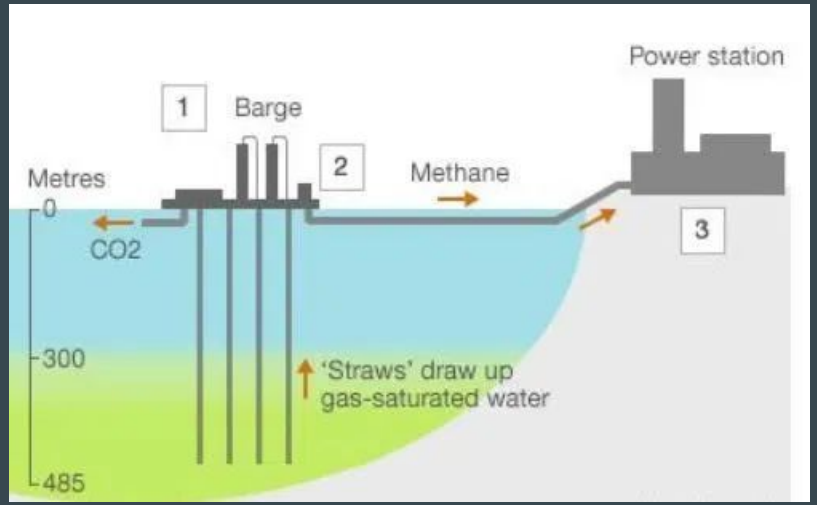
International Organizations

Client Implications:

- United Nations
- World Bank
- Africa National Bank

Extraction of Natural Gas: Lake Kivu

- KivuWatt project in Rwanda: ContourGlobal
  - Phase 1: $142M; 25 MW
  - Phase 2: $183M; 75MW



- DRC has the right to 30 billion cubic meters of methane.
- The methane can produce 350 MW over 55 years.
- Extraction would release pressure on the gas which would decrease methane emissions, increasing the quality of life in the area.

Future Sustainability: Hydroelectricity

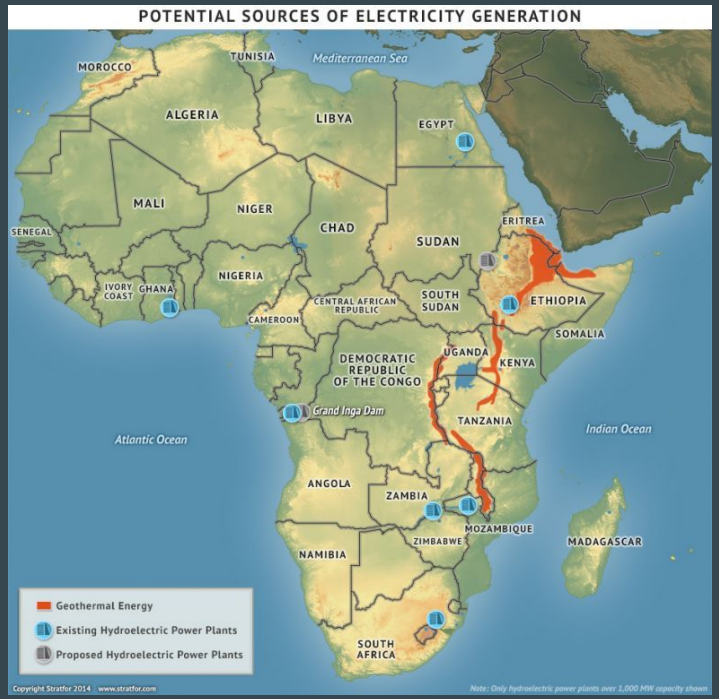
Rehabilitation of Inga 2 dam

- Cost to rehabilitate:
  - $884 million
- Additional Energy:
  - 32,132 MW
- Greenhouse gas emissions saved:
  - 70 million tonnes
- GDP saved by avoiding blackouts:
  - 1.7%

Source: World Bank

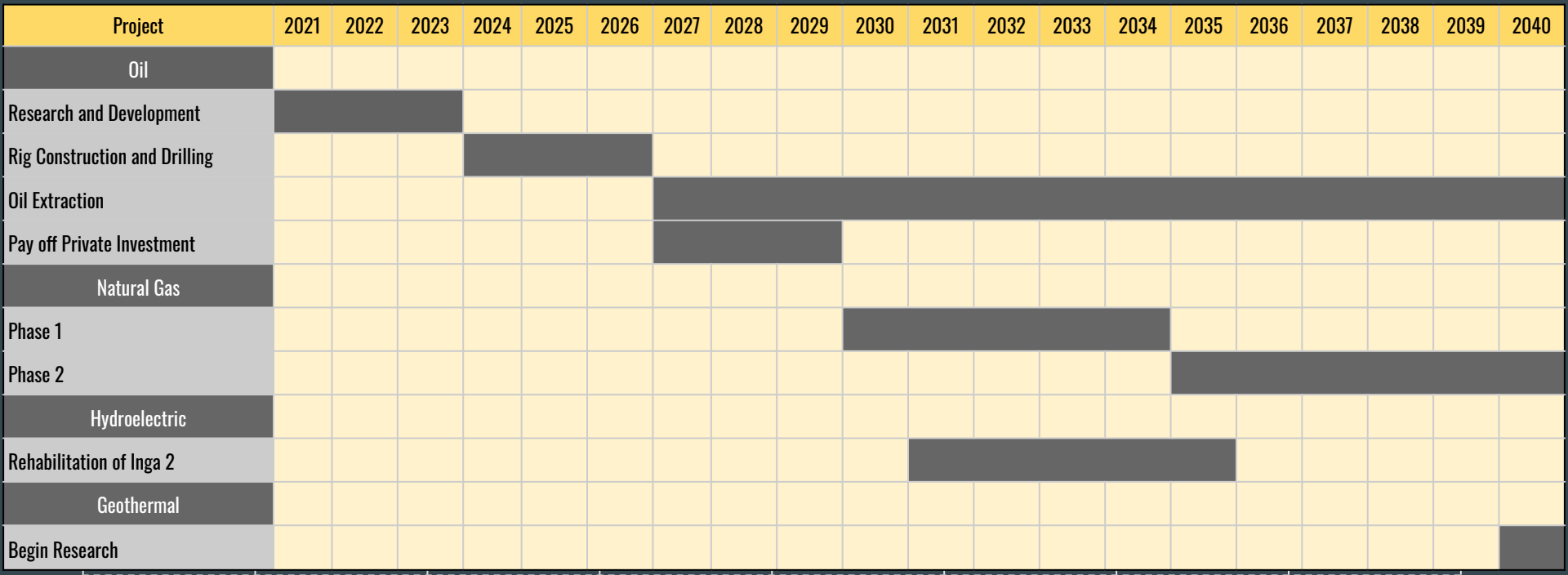
Future Sustainability: Geothermal Energy

- High potential for geothermal energy plants along the East African Rift
- Kenya's success with geothermal can be matched by the DRC in the far future



Source: Geothermal Development Company, KenGen

Timeline


Project
2021
2022
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2029
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2031
2032
2033
2034
2035
2036
2037
2038
2039
2040
Oil
Research and Development
Rig Construction and Drilling
Oil Extraction
Pay off Private Investment
Natural Gas
Phase 1
Phase 2
Hydroelectric
Rehabilitation of Inga 2
Geothermal
Begin Research

Conclusion

The Team

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Sophomore Psychology major in the Liberal Arts Honors Program

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Freshman Civil Engineering student in the Cockrell School of Engineering

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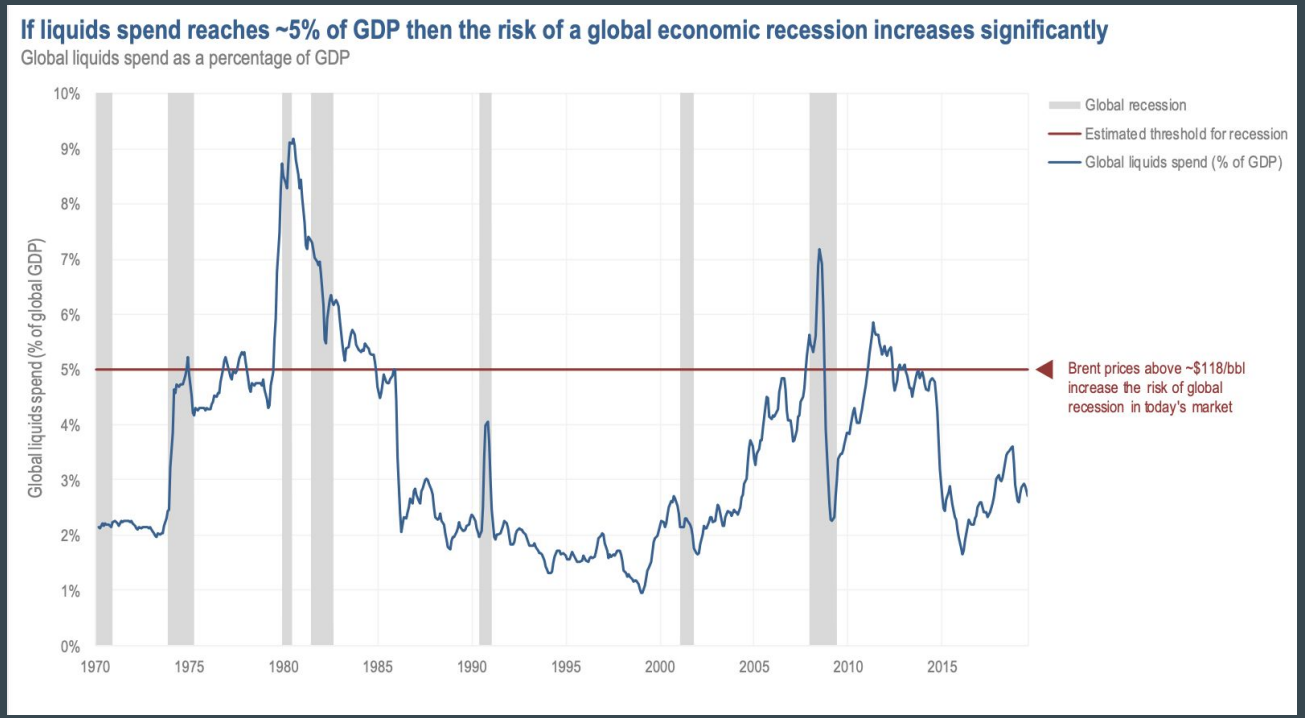
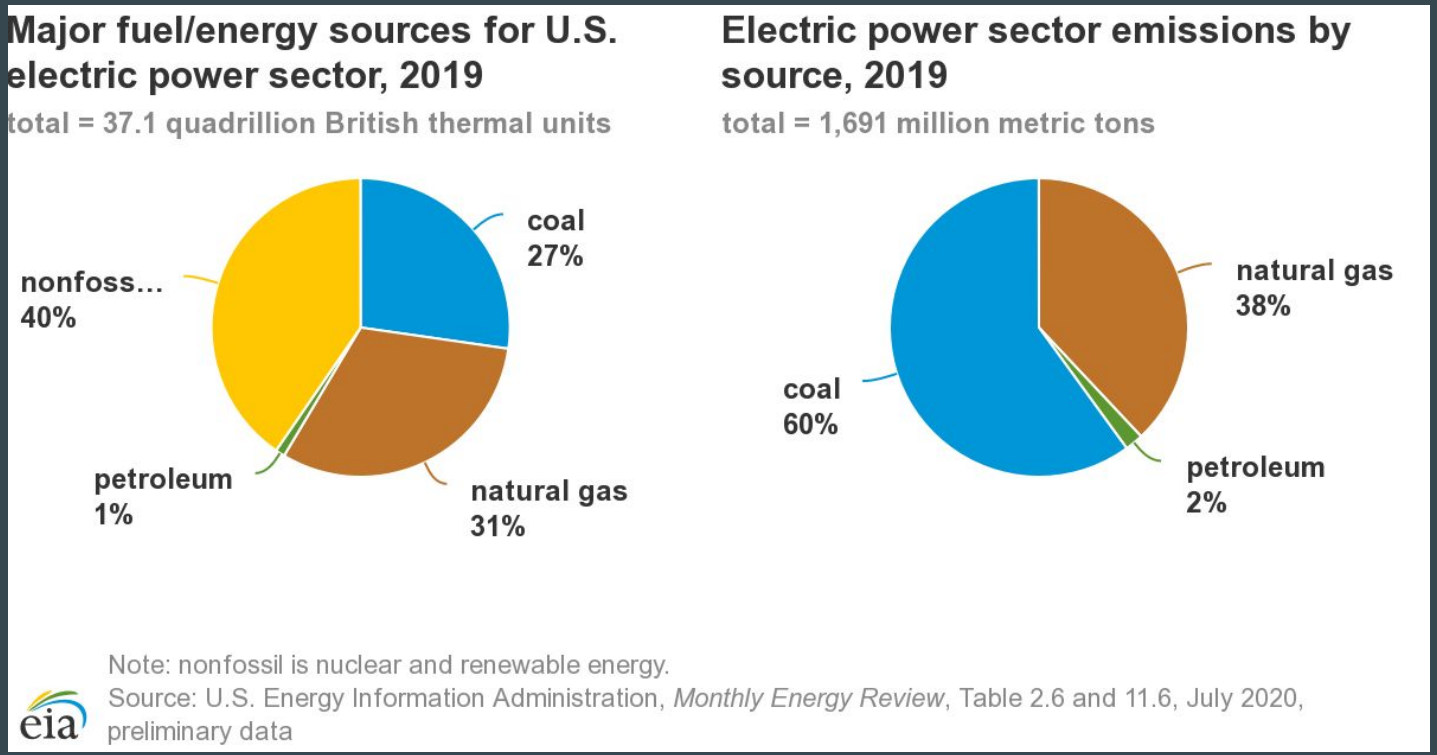
Quick Decrease in Oil Demand Would Ferry an International Recession



Source: World Health Organization; United Nations, Rystad Energy

Coal is the dominant CO2 emissions source related to electricity generation



Inga 2 Dam Research

Safeguard Policies Triggered	Yes	No	TBD
Environmental Assessment (OP/BP 4.01)	X		
The environmental impacts of the rehabilitation of the Inga 1 and Inga 2 hydropower plants are moderate and manageable. Only a fraction of the water from the huge Congo River is diverted into Inga 1 and Inga 2 intake canal for hydropower production and there is very little effect on the hydrological regime of the Congo River as a result of the Project. The transmission line from Inga to the Kingatoko substation in Kinshasa passes mostly through agricultural land. A sensitive forest area near the Inga hydropower station has been avoided, and the transmission lines pose manageable environmental impacts. An Environmental and Social Impact Assessment, including an Environmental and Social Management Framework and Plan, were adopted by the Project and disclosed in December, 2006. A resettlement action plan (RAP) has been prepared for the transmission from Inga to the Kingatoko substation in Kinshasa, the RAP includes impacts of grid extension.			
Natural Habitats (OP/BP 4.04)		X	
Forests (OP/BP 4.36)		X	
Pest Management (OP 4.09)	X		
The project includes control of black flies, a vector for onchocerciasis in the project area, through the use of the pesticide permethrine. A pest management plan was developed and disclosed in March, 2007. It is expected that a services contract with WHO/APOC to support the black fly control program at Inga will be signed in April 2011.			
Physical Cultural Resources (OP/BP 4.11)	X		
A framework for managing cultural property was prepared and released to the infoshop in January 2007. Potential sensitive sites include caves in the vicinity of the project area.			
Indigenous Peoples (OP/BP 4.10)		X	
Involuntary Resettlement (OP/BP 4.12)	X		
OP/BP 4.12 were triggered as civil works of the transmission line will require land acquisition. A resettlement policy framework (RFP) was prepared and disclosed in-country 1/18/2007 and at Infoshop-01/18/2007. The adoption by SNEL and appropriate disclosure of the detailed resettlement plan for the Inga-Kinshasa transmission line is a condition of appraisal.			
Safety of Dams (OP/BP 4.37)	X		
Consistent with OP 4.37, and according to ToRs developed in consultation with the relevant Bank specialist, a review of dam safety at the Inga site was completed in June 2007. No significant concerns were identified, but a strengthened program of maintenance, monitoring, and emergency preparedness was recommended. A covenant requiring the preparation and adoption by SNEL of an Emergency Preparedness Plan (EPP) by December, 2007, was included as a covenant in the legal agreement for the Project; however, to-date no such Plan has been adopted. The consulting firm that had prepared a draft EPP in 2007 has been recruited to revise and complement the EPP by May 2011. A panel of experts on dam safety has been appointed, with five experts on geotechnical, electromechanical, dams, sedimentology and concrete, and is scheduled to initiate its mandate in April 2011.			
Projects on International Waterways (OP/BP 7.50)	X		
OP7.50 applies to Projects that involve the use of international waterways. The Inga rehabilitation component (Component 1) will involve the use of the River Congo, an international waterway that DRC shares with 8 countries and, as such, OP7.50 does apply. However, the Inga dam is a "run of the river" plant, and the proposed activities (rehabilitation of the dam, dredging and reprofiling of the intake canal) will not modify the water volume nor its quality. On this basis, and as set out in paragraph 7(a) of OP7.50, this Project is exempt from the requirement to notify other riparian states about the Project, as the activities will alter neither the quality nor the quantity of the water flowing to other riparian states, nor will the Project be adversely affected by the other riparians' possible water use.			

Source: World Bank

Positive Externalities of Inga 2 Rehabilitation

3. With its vast, untapped hydropower resources, DRC holds the key to the continent's energy solutions in the form of clean, renewable and affordable power. It thus has a critical regional role to play in Africa's energy future. The Congo River basin alone holds almost 30 per cent of Africa's total fresh surface water reserves and the world's largest hydropower potential in any one single river basin. The greatest source of hydroelectric potential is the Inga rapids on the Congo River. When considering the average potential hydropower output of 774 TWh per annum, the DRC stands third behind China and Russia. When expressed as firm power capacity, the Congo River potential is equivalent to 100,000 MW or 13 percent of global hydropower potential. About 40% of this potential is located at the Inga site at an estimated potential capacity of 45,000 MW.

4. Hydropower plays both mitigation and adaptation roles in addressing climate change. Avoided GHG emission through hydropower can be significant, particularly in Africa and specifically in DRC where forest resources are used for fuel. Increasing the share of hydropower in the energy generation portfolio in DRC or the region, can reduce CO2 emissions significantly by displacing other high carbon generation. In the Africa Region, increasing the share of hydropower through regional trade could save 70 million tonnes per year of CO2 emissions. At today's carbon prices, viable hydropower share can potentially increase by 50 percent. Increased generation at Inga site through rehabilitation of Inga 1 and 2 (this project) and in the future through Inga 3 and Grand Inga, will not only have low lifecycle GHG emissions, but will contain the lion's share of the annual CO2 emissions reduction. Additionally, hydropower can help mitigate the local environmental problems associated with inefficient and polluting sources of energy (such as small diesel power generators) and add to the reliability and resiliency of power system within DRC and the regional power pools.

5. But the hydropower potential remains mostly untapped with serious access and development implications. Today, only a total installed power generating capacity of about 2,100 MW is in place in the Inga 1 and Inga 2 and other smaller hydropower stations, including those in the Katanga Province, of which less than half the capacity is operable. Lack of sufficient transmission and distribution capacity means that the vast majority of DRC's population and its economy are under-served. At about 6 percent, household access to electricity services is now less than the pre-war period level, and particularly low compared to the average of Sub-Saharan countries access rate of 31 percent, with two thirds of the total electrified households in Kinshasa alone. Power outages averaging more than three hours in length are experienced more than 180 days per year. As a result, firms are frequently forced to rely on expensive back-up generators. The economic cost of these outages can be conservatively estimated at 1.7 percent of GDP (AICD study, 2009).

Source: World Bank

Cost of putting in roads

Table A The unit costs of road construction and maintenance

2006 US$

Type	Unit	Lower quartile	Median	Upper quartile
Construction (paved) <50km	US$/lanekm	349,523	401,646	613,929
Construction (paved) >50km	*US$/lanekm*	*209,427*	*290,639*	*344,135*
Rehabilitation (paved) <50km	*US$/lanekm*	*220,186*	*352,613*	*505,323*
Rehabilitation (paved) >50km	*US$/lanekm*	*194,679*	*299,551*	*457,714*
Periodic maintenance (Paved)	*US$/lanekm*	*81,854*	*158,009*	*235,157*
Regraveling	*US$/lanekm*	*12,835*	*15,625*	*19,490*

Note: Italicized text denotes sample sizes large enough to provide reliable unit-cost predictions

Source: Africon

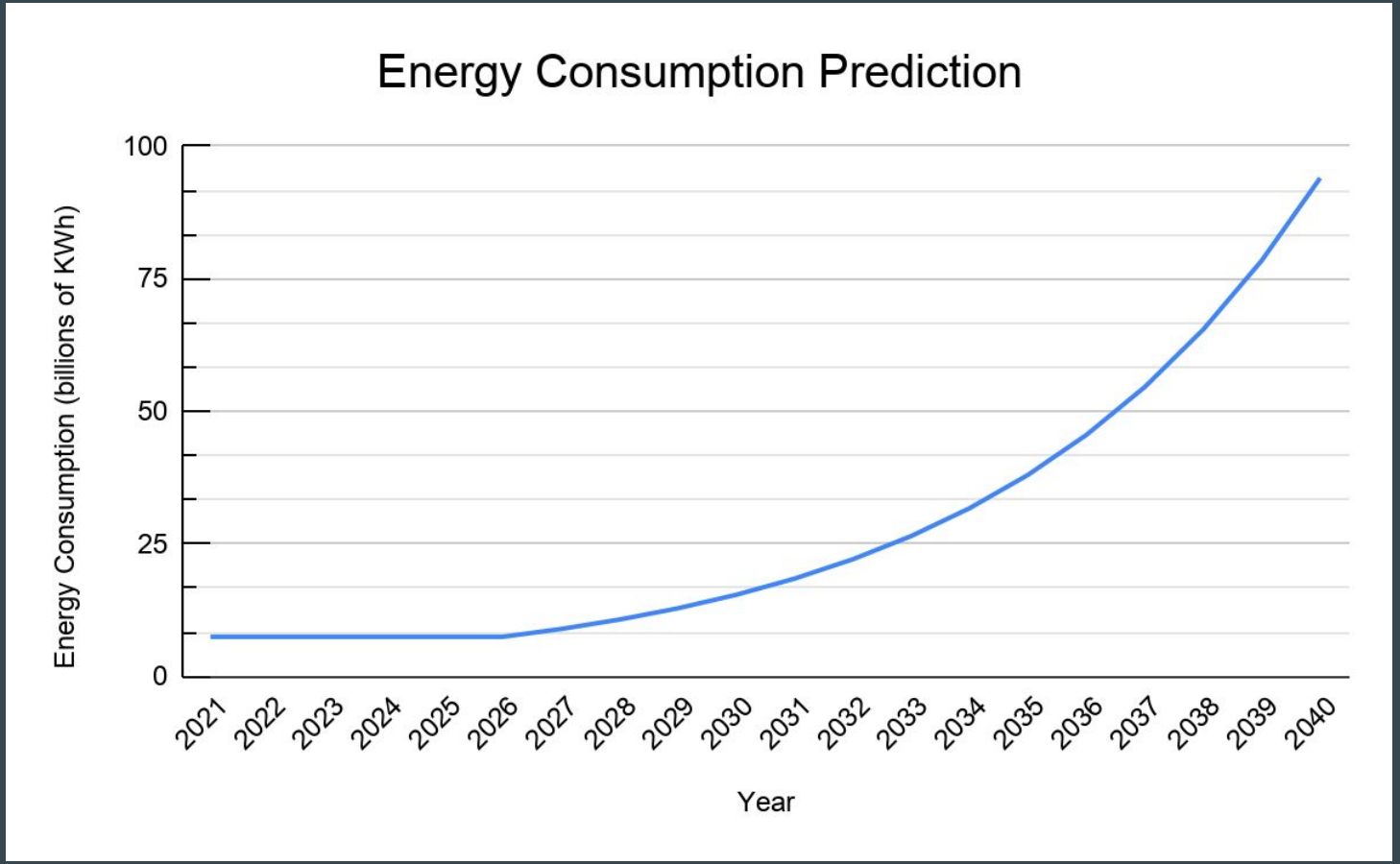
Inga 2 Rehabilitation Cost

14. The project was originally estimated at US$499.1 million, of which IDA financing is US$296.7 million. The remaining US$202.4 is financed by EIB, AfDB, and counterparts (Government of DRC and the National Electric Utility, SNEL). Revised costs of the project are now estimated at US$884.4 million, resulting in a financing gap of about US$385 million. IDA proposes to increase its financing by US$288 million, corresponding to the increase in the components originally financed by IDA. The remaining gap of US$97 million is to be financed by AfDB, KfW and SNEL.

Source:	($ million)
DRC/SNEL	11
International Development Association (IDA)	288
African Development Bank (AfDB)	32
Kreditanstalt für Wiederaufbau (KfW)	54
Total	385

Source: World Bank

IEA Energy Consumption Prediction for DR Congo

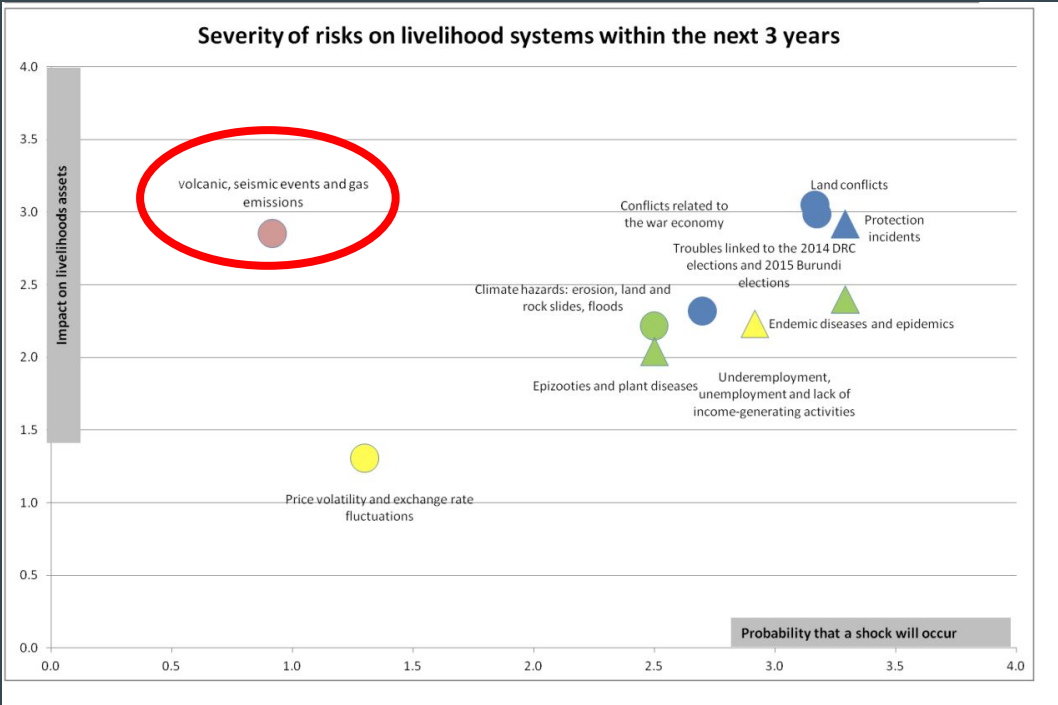


Source: Africa Energy Outlook 2019; International Energy Agency

Energy Consumption Prediction Table for DRC

Year	Energy Consumption	Change per Year
2021	7.46	0
2022	7.46	0
2023	7.46	0
2024	7.46	0
2025	7.46	0
2026	7.46	0
2027	8.94	1.48
2028	10.71	1.77
2029	12.84	2.13
2030	15.39	2.55
2031	18.44	3.05
2032	22.10	3.66
2033	26.48	4.38
2034	31.73	5.25
2035	38.03	6.30
2036	45.57	7.54
2037	54.62	9.04
2038	65.45	10.84
2039	78.44	12.98
2040	94.00	15.56

Extracting the gas in Lake Kivu reduces gas emissions in East DRC, thus decreasing risk on livelihood



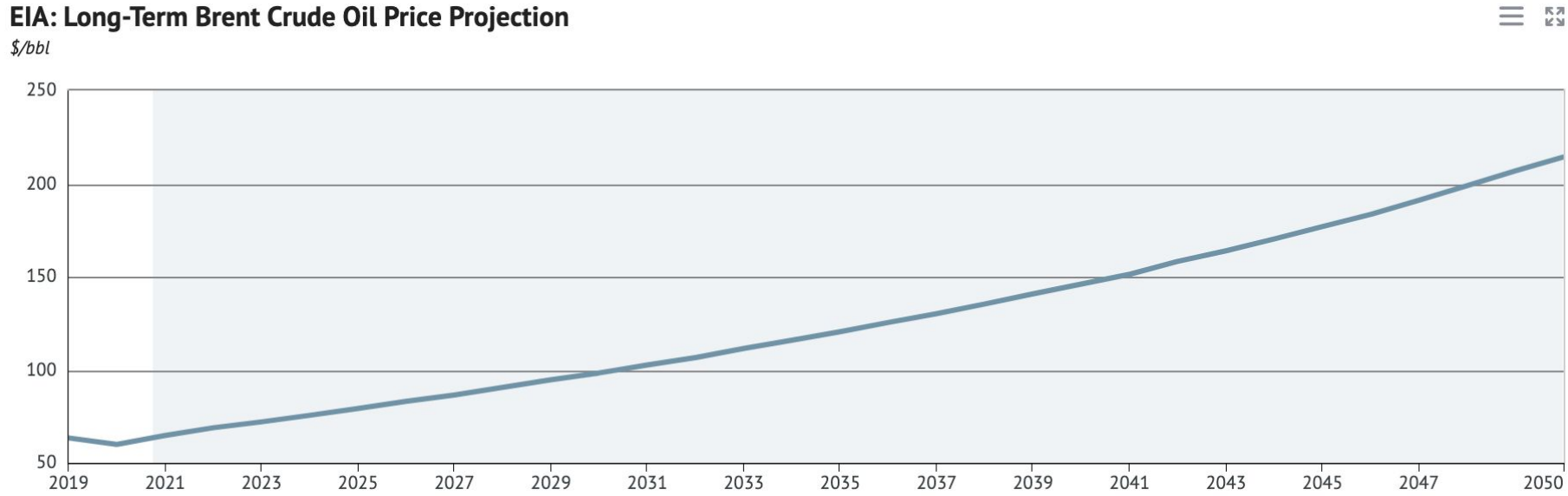
Source: Resilience Systems Analysis Eastern DRC; UNICEF, OECD

World Energy Demand Predictions

World primary energy demand by fuel type

	Levels *mboe/d*				Growth *% p.a.*
	2015	2020	2030	2040	2015–2040
Oil	86.5	92.3	97.9	100.7	0.6
Coal	78.0	80.7	85.8	86.2	0.4
Gas	59.2	65.2	79.9	93.2	1.8
Nuclear	13.5	15.8	20.1	23.8	2.3
Hydro	6.8	7.5	9.0	10.3	1.7
Biomass	28.0	30.1	34.0	37.3	1.2
Other renewables	3.8	6.6	12.9	20.0	6.8
Total world	**276.0**	**298.2**	**339.4**	**371.6**	**1.2**

Oil Price Projections



	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
$/bbl	63.37	59.93	64.69	68.86	72.01	75.53	79.24	83.03	86.48	90.51	94.65	98.29	102.56	106.52	111.48	115.85	120.47	125.41

2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
130.16	135.33	140.77	146.04	151.26	158.23	163.92	170.23	176.89	183.43	191.10	198.94	206.79	214.28

Source: Energy Information Administration

Total Oil Investment and Profit Predictions

Private Company initial Investment			
Land oil rig cost	$30,000,000.00	5	Oil rigs to be built
Refinery cost	$2,500,000,000	100,000	Barrels per day
Total	**$2,650,000,000**		

Oil Revenue Distribution 2021 - 2029	
Private Company	68.60%
DRC	31.40%

Oil Revenue Distribution 2030 - 2040	
Private Company	10.00%
DRC	90.00%

Year	Predicted Oil Price	Total Rigs	Barrels per Rig per Day	Barrels per Year	Barrels Kept in House	Total Revenue	ROI for Private Company	Total Profit for DRC
2021	$64.69	0	0	0	0	$0	$0	$0
2022	$68.86	0	0	0	0	$0	$0	$0
2023	$72.01	0	0	0	0	$0	$0	$0
2024	$75.53	0	0	0	0	$0	$0	$0
2025	$79.24	0	0	0	0	$0	$0	$0
2026	$83.03	0	0	0	0	$0	$0	$0
2027	$86.48	5	20,000	36,500,000	887,988	$3,079,726,763	$2,112,692,559	$967,034,204
2028	$90.51	5	20,000	36,500,000	1,952,144	$3,126,926,434	$2,145,071,534	$981,854,900
2029	$94.65	5	20,000	36,500,000	3,227,417	$3,149,249,990	$2,160,385,493	$988,864,497
2030	$98.29	5	20,000	36,500,000	4,755,690	$3,120,148,225	$312,014,823	$2,808,133,403
2031	$102.56	5	20,000	36,500,000	6,587,156	$3,067,861,268	$306,786,127	$2,761,075,141
2032	$106.52	5	20,000	36,500,000	8,781,965	$2,952,525,053	$295,252,505	$2,657,272,548
2033	$111.48	5	20,000	36,500,000	11,412,201	$2,796,787,828	$279,678,783	$2,517,109,045
2034	$115.85	5	20,000	36,500,000	14,564,247	$2,541,256,964	$254,125,696	$2,287,131,268
2035	$120.47	5	20,000	36,500,000	18,341,625	$2,187,539,398	$218,753,940	$1,968,785,459
2036	$125.41	5	20,000	36,500,000	22,868,395	$1,709,539,636	$170,953,964	$1,538,585,673
2037	$130.16	5	20,000	36,500,000	28,293,226	$1,068,193,692	$106,819,369	$961,374,323
2038	$135.33	5	20,000	36,500,000	34,794,286	$230,834,312	$23,083,431	$207,750,881
2039	$140.77	5	20,000	36,500,000	42,585,086	-$856,597,495	-$85,659,750	-$770,937,746
2040	$146.04	5	20,000	36,500,000	51,921,496	-$2,252,155,298	-$225,215,530	-$2,026,939,768
			Totals	511,000,000	250,972,923	$25,921,836,772	$8,074,742,945	$17,847,093,827