Responding to the Crisis of the Filling of the GERD : An International Insurance Approach ?

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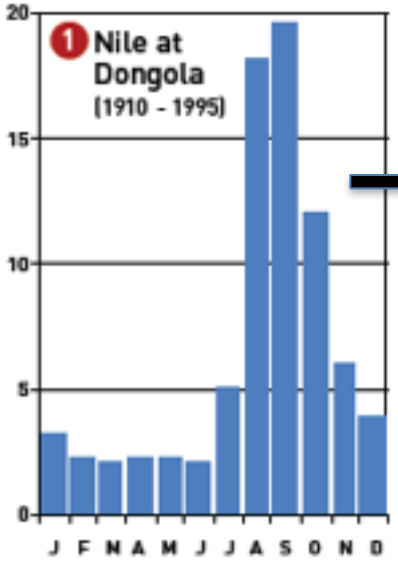
Outline of Presentation

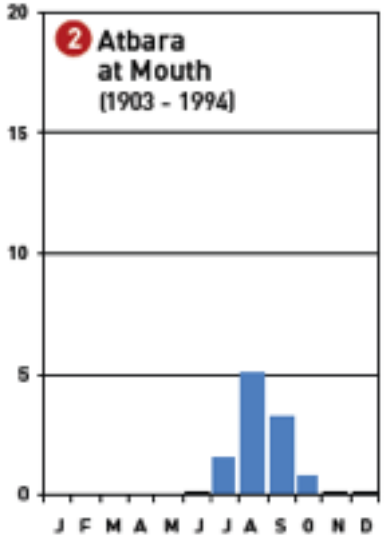
- Overview of Nile Hydrology
- The Crisis of GERD Filling
- A Primer on Hydropower
- Uncertain Future of Nile Flows
  - Natural Variability
  - Impacts of Filling Policies
- Modeling Approach
- Engineering Impacts and Risks
- Economics Impacts and Risks
- Sharing the Risks: A Case for Insurance

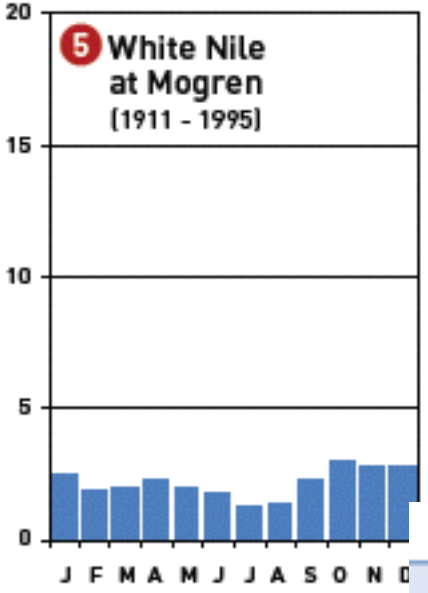
HYDROLOGIC REGIME

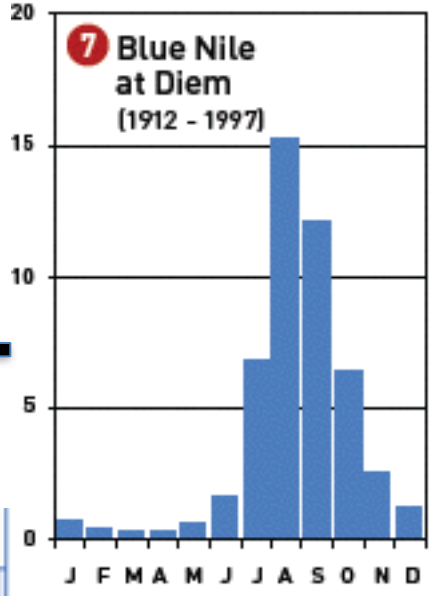
Mean annual flow of the Nile and main tributari

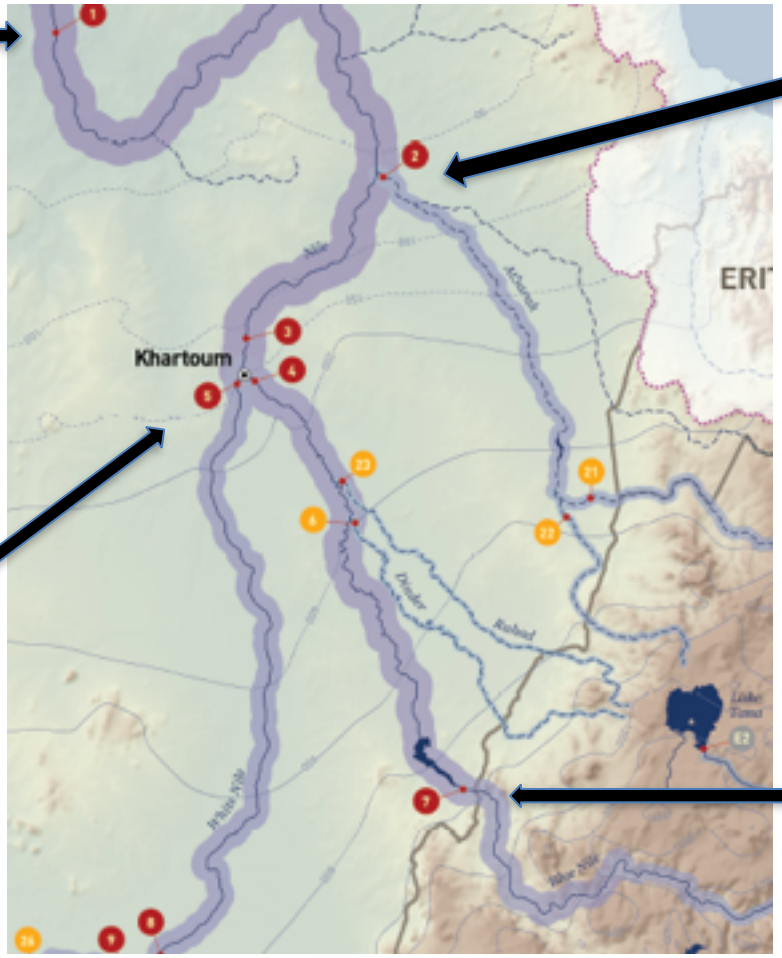
Nile Hydrology











Nr	River and Station Name	Data Period	Avg Ann Flow [km³]
1	Main Nile at Dongola	1890 - 1995	84.1
2	Atbara at mouth	1903 - 1996	11.1
3	Main Nile at Tamaniat	1911 - 1995	72.7
4	Blue Nile at Khartoum	1900 - 1995	48.3
5	White Nile at Mogren	1911 - 1995	26.0
6	Dinder at mouth	1907 - 1997	2.8
7	Blue Nile at Diem	1912 - 1997	48.7

Treaties Impacting Eastern Nile

- 1891 Protocol between Great Britain and Italy
  - Italy agrees no irrigation works on Atbara to impact Nile
- 1902 – Treaties between Great Britain and Ethiopia
  - King of Ethiopia engages to construct no work to arrest flow to Nile without Agreement of GB or Anglo-Egyptian Sudan
- 1925 Exchange of Notes between Great Britain and Italy
  - "hydrolic rights" of Egypt and Sudan to Nile
- 1929 agreement between Egypt and GB (for Sudan and Colonies)
  - that no works on Nile without Egypt's Consent
- 1959 Republic of Sudan and United Arab Republic (Egypt)
  - Bi-lateral allocation of the Entire Nature Flow arriving at Aswan

1959

- Inflow at Dongola 84
- Lake Nasser Loss 10
- Net Available 74

		Current
• To Egypt	55.5	61.5
• To Sudan	18.5	12.5
• To Others	00.0	0.0
• TOTAL	74.0	74.0

Grand Ethiopian Renaissance Dam

- The GERD (the 8th largest reservoir on Earth)

  will soon join

- Egypt's High Aswan Dam (3rd largest)

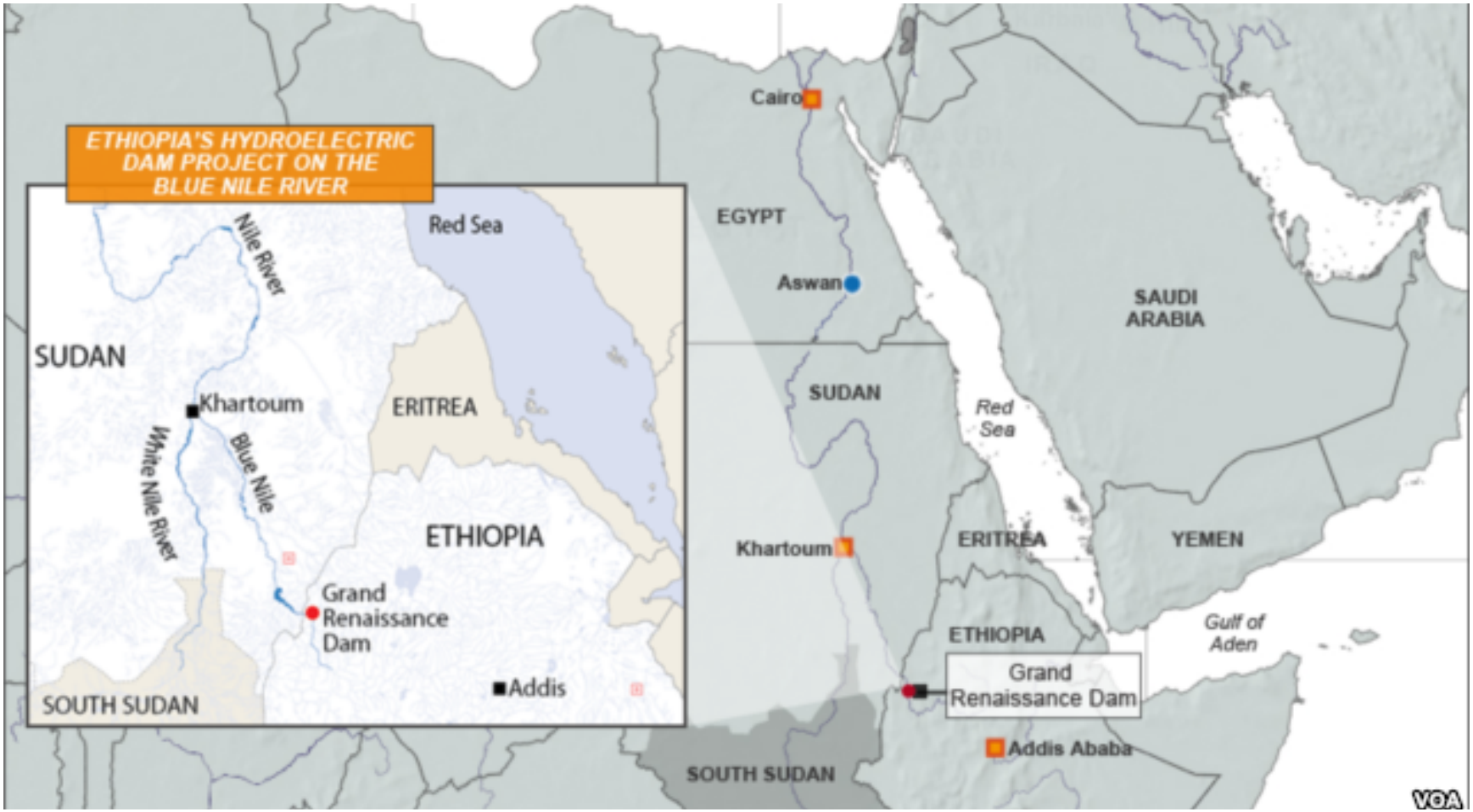
  in the unprecedented combination of

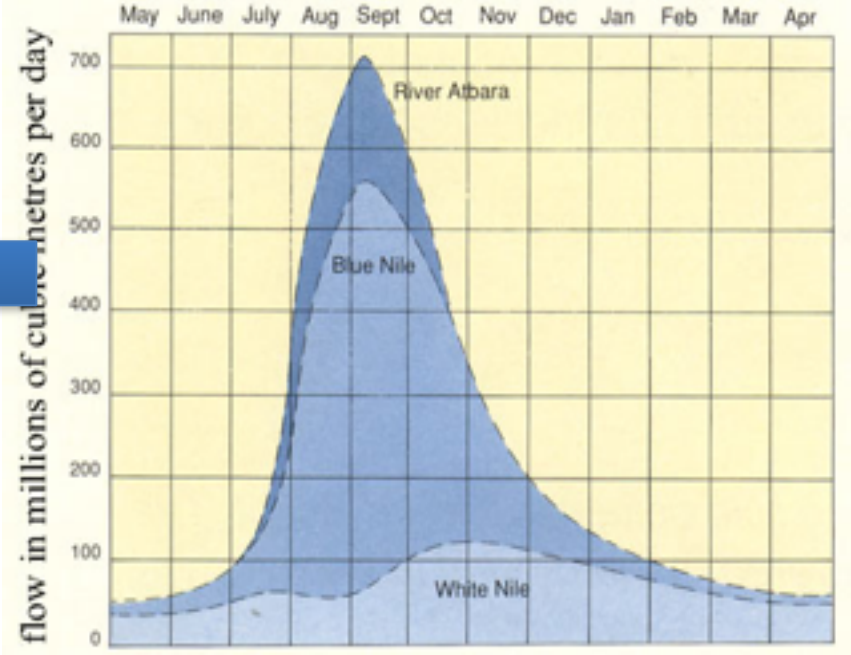
- two major, multipurpose dams operating on the same river system with
- no agreement for coordination in place.

Grand Ethiopian Renaissance Dam

- At 6,000 MW, the dam will be the largest hydroelectric power plant in Africa when completed, as well as the 8th largest in the world.
- No IRRIGATION JUST HYDROPOWER
- The reservoir at 70 billion cubic meters will be one of the continent's largest. Able to hold the 1.4 times he mean annual flow of the Blue Nile with is 75% of Nile flow reaching Egypt and Sudan.
- According to the Ethiopian government, as of Summer 2016, the dam is 70% complete. Could start filling in less than a year !!!!!!!

Why is it a CRISIS ?
The GERD's Location



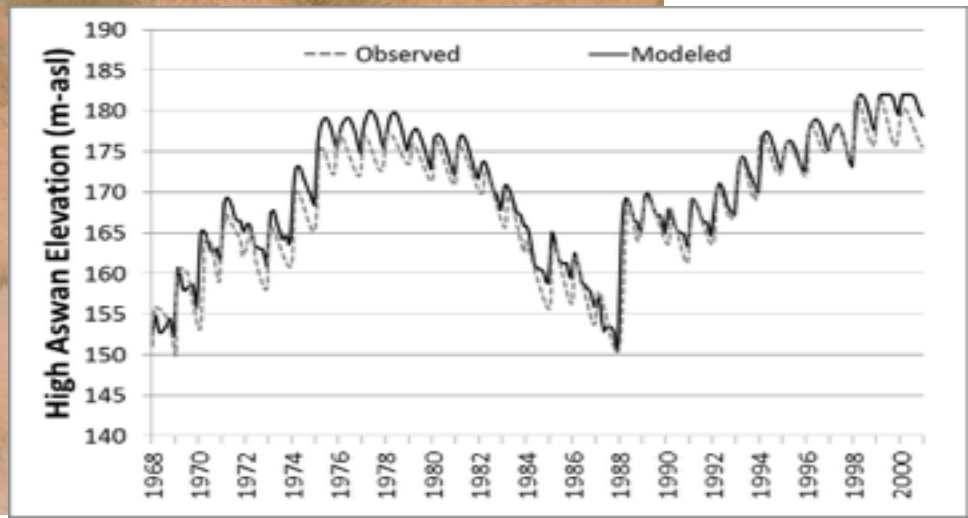


High Aswan Dam

Filling the GERD with IMPACT EGYPT
BUT HOW AND BY HOW MUCH?

BLUE NILE

A PRIMER on RESERVOIRS AND HYDROPOWER

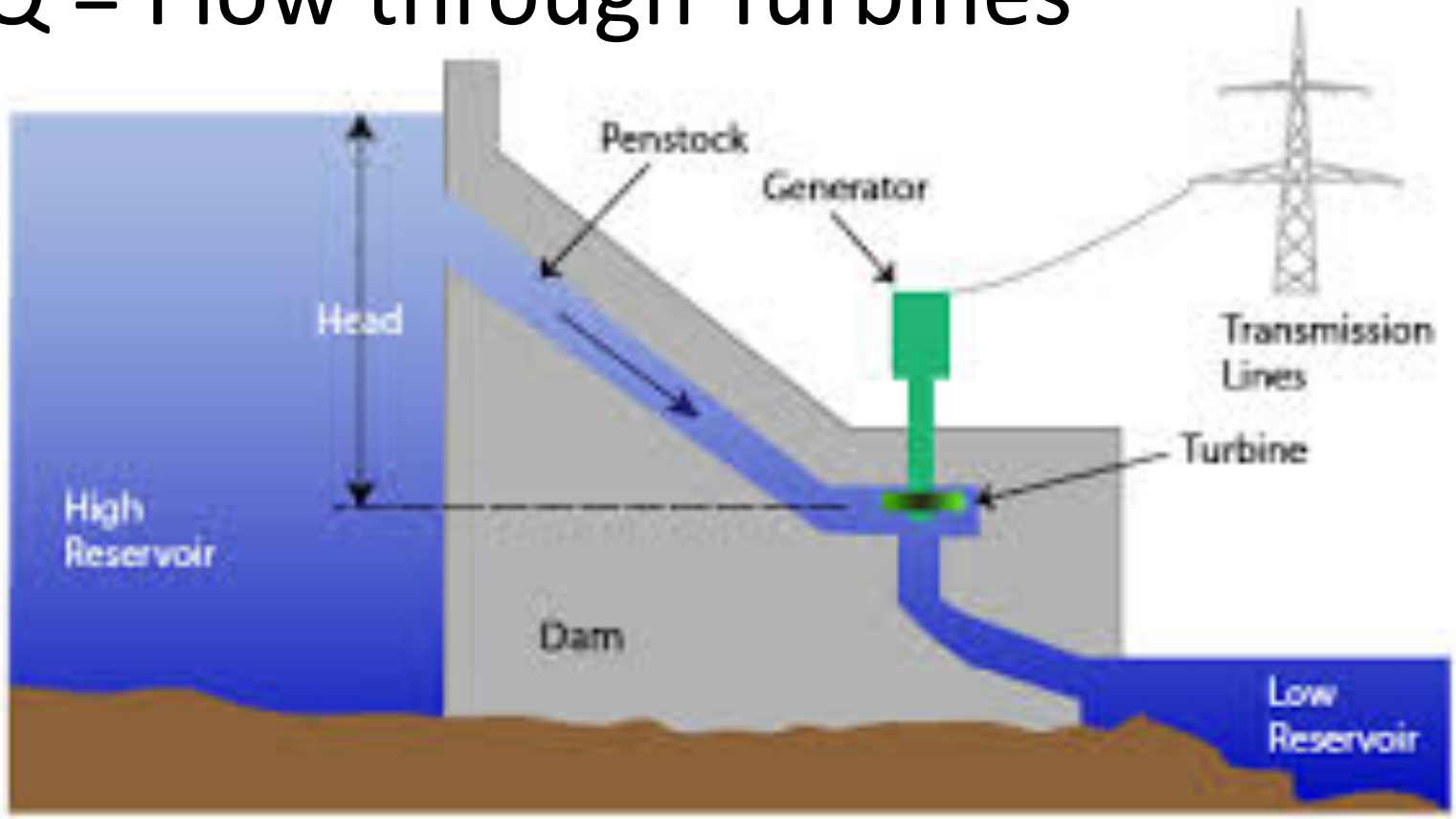


Converting Potential to Mechanical to Electrical Energy

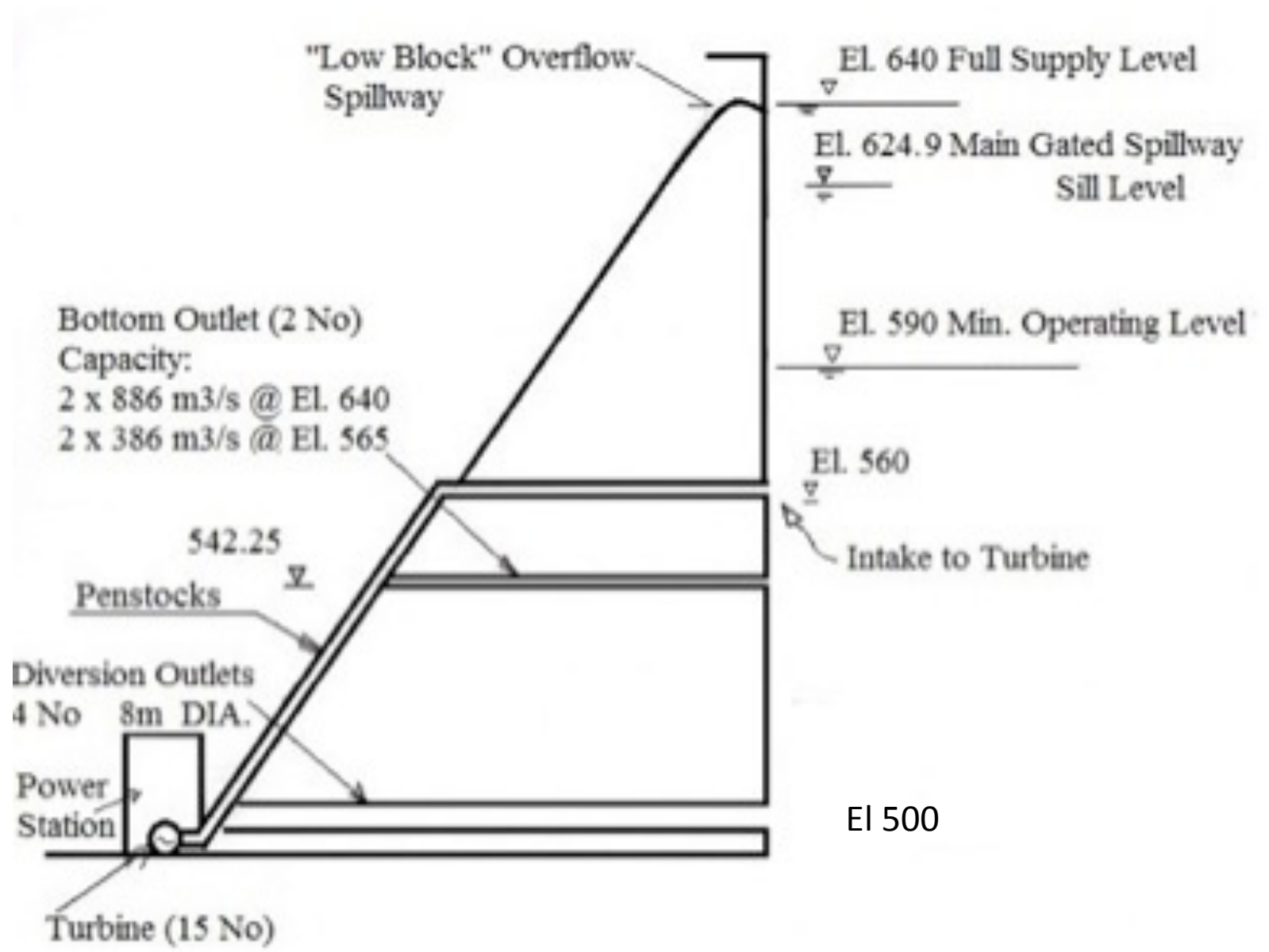
$$HP = a * H(t) * Q(t)$$

H = Elevation Difference

Q = Flow through Turbines



GERD STORAGE FEATUREs

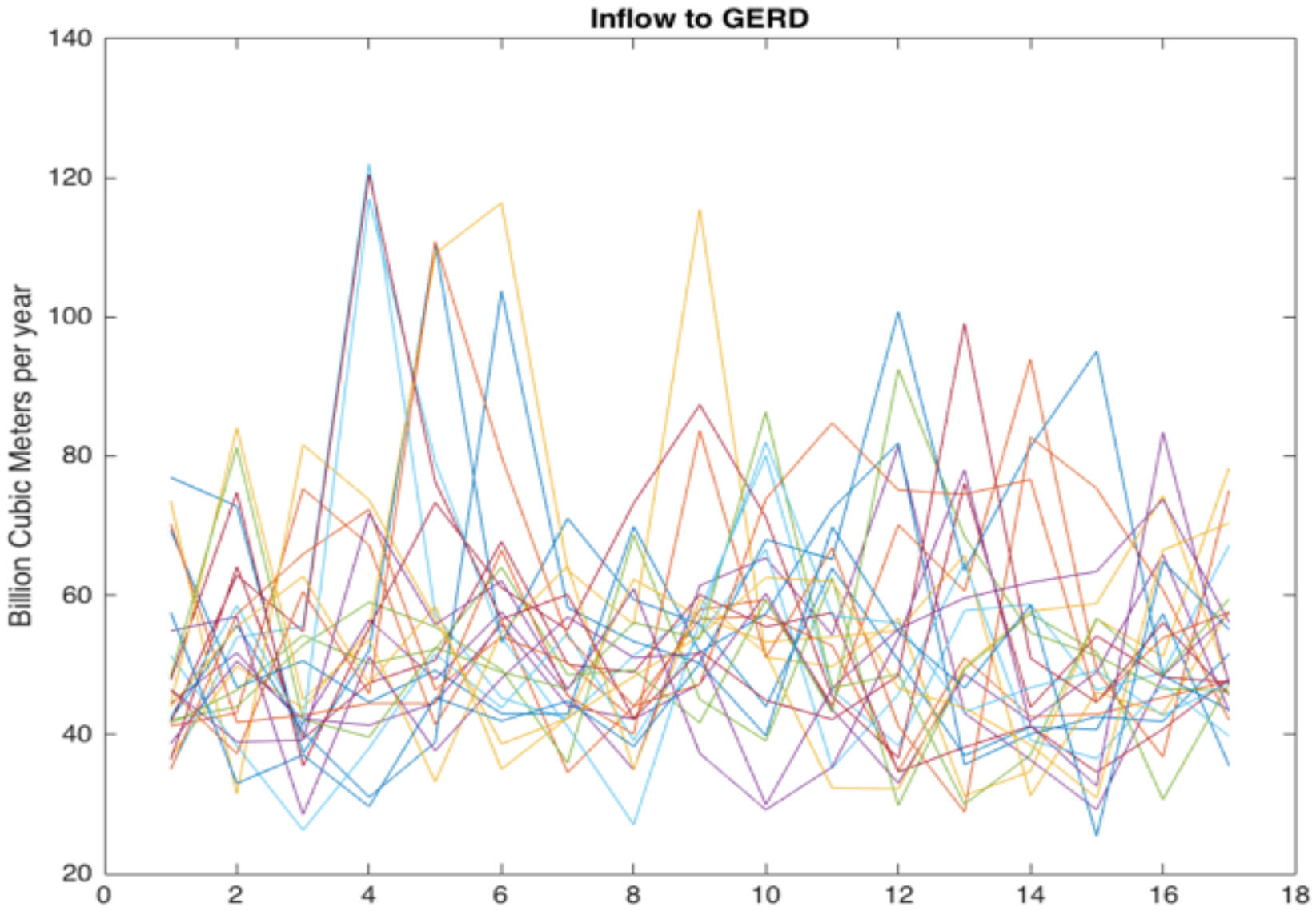


	Volume
	74 BCM
	47. **BCM**
	15 BCM
	3.5 BCM
	1. **BCM**
	0 BCM

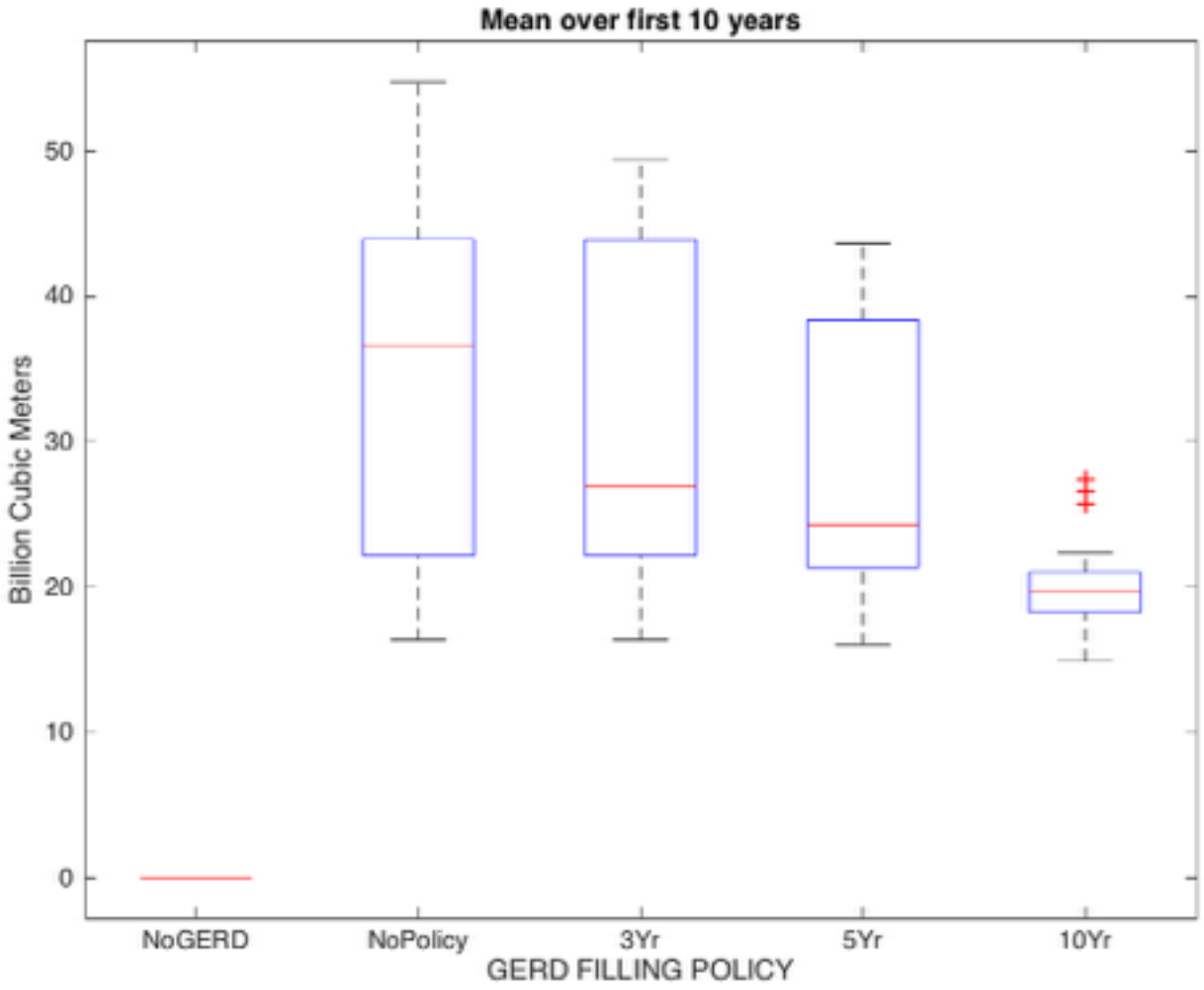
GERD FILLING POLICY ASSESSED

- Minimum Release of 30 BCM per Yea
  - The Blue Nile flow exceeded 95% of the time
  - The 1 in 20 year Drought
- 4 rates of Filling to Top of Conservation Pool
  - Unconstrained
  - 3 years
  - 5 years
  - 10 years

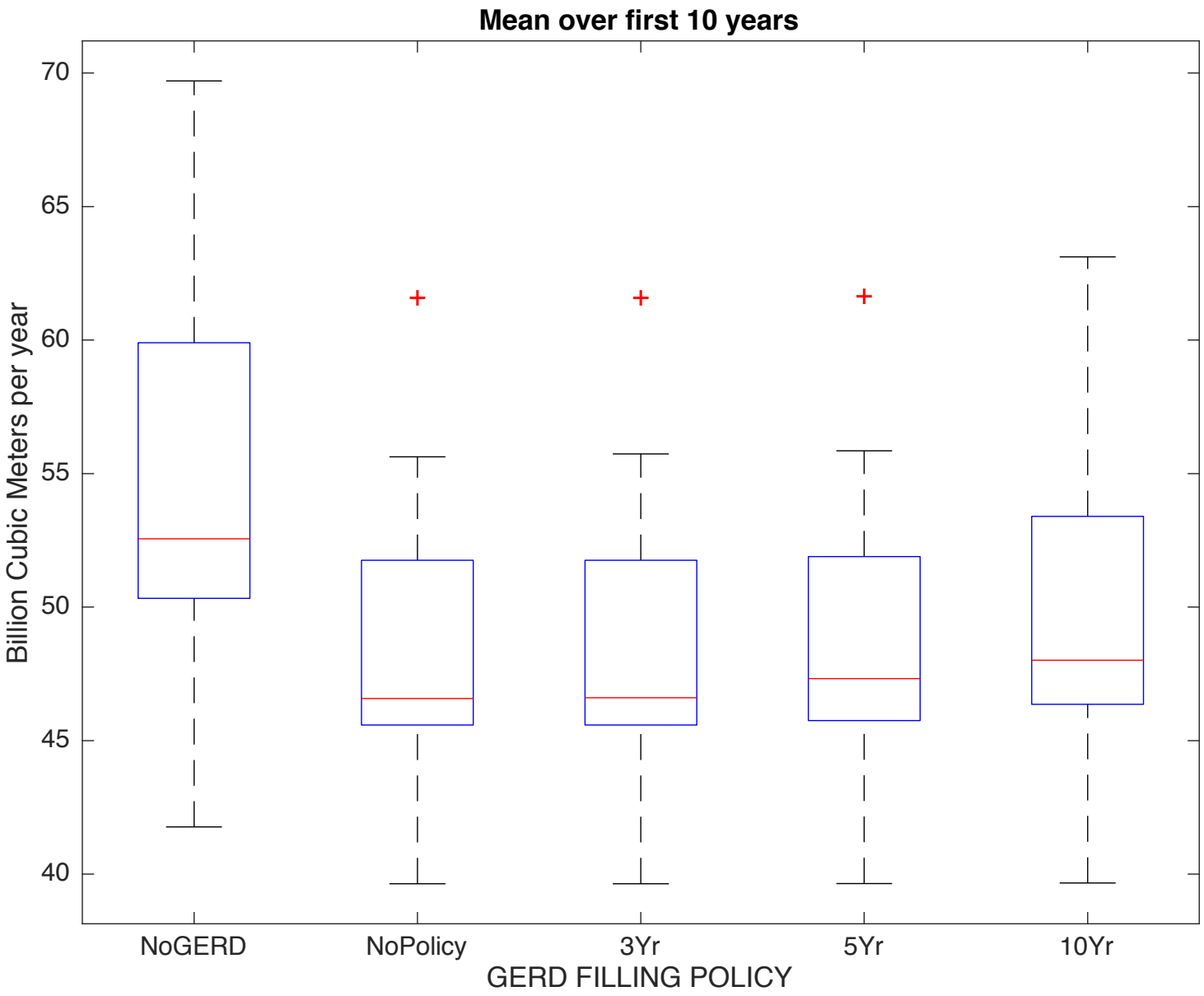
Simulated Inflow Sequences



GERD STORAGE



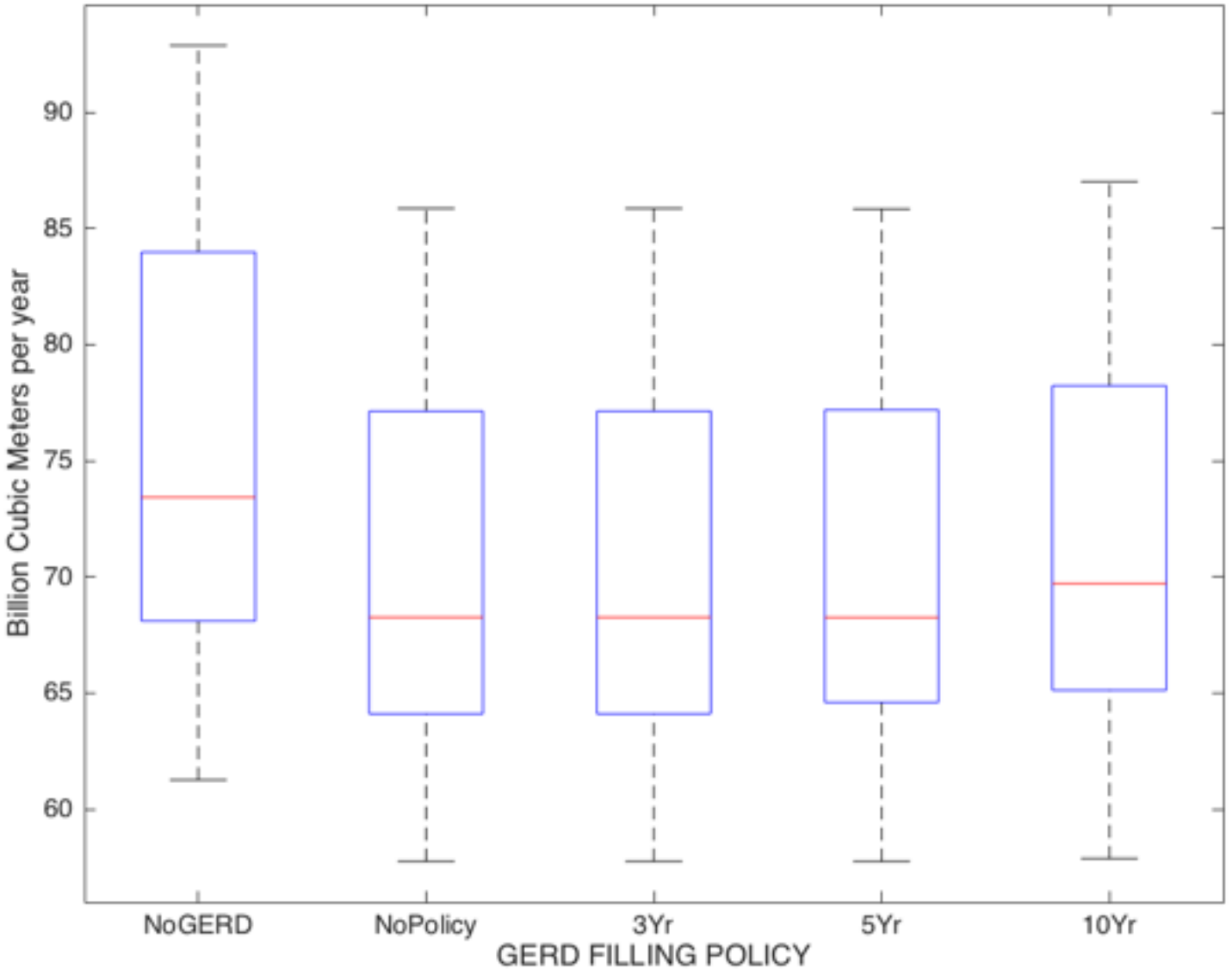
GERD RELEASE



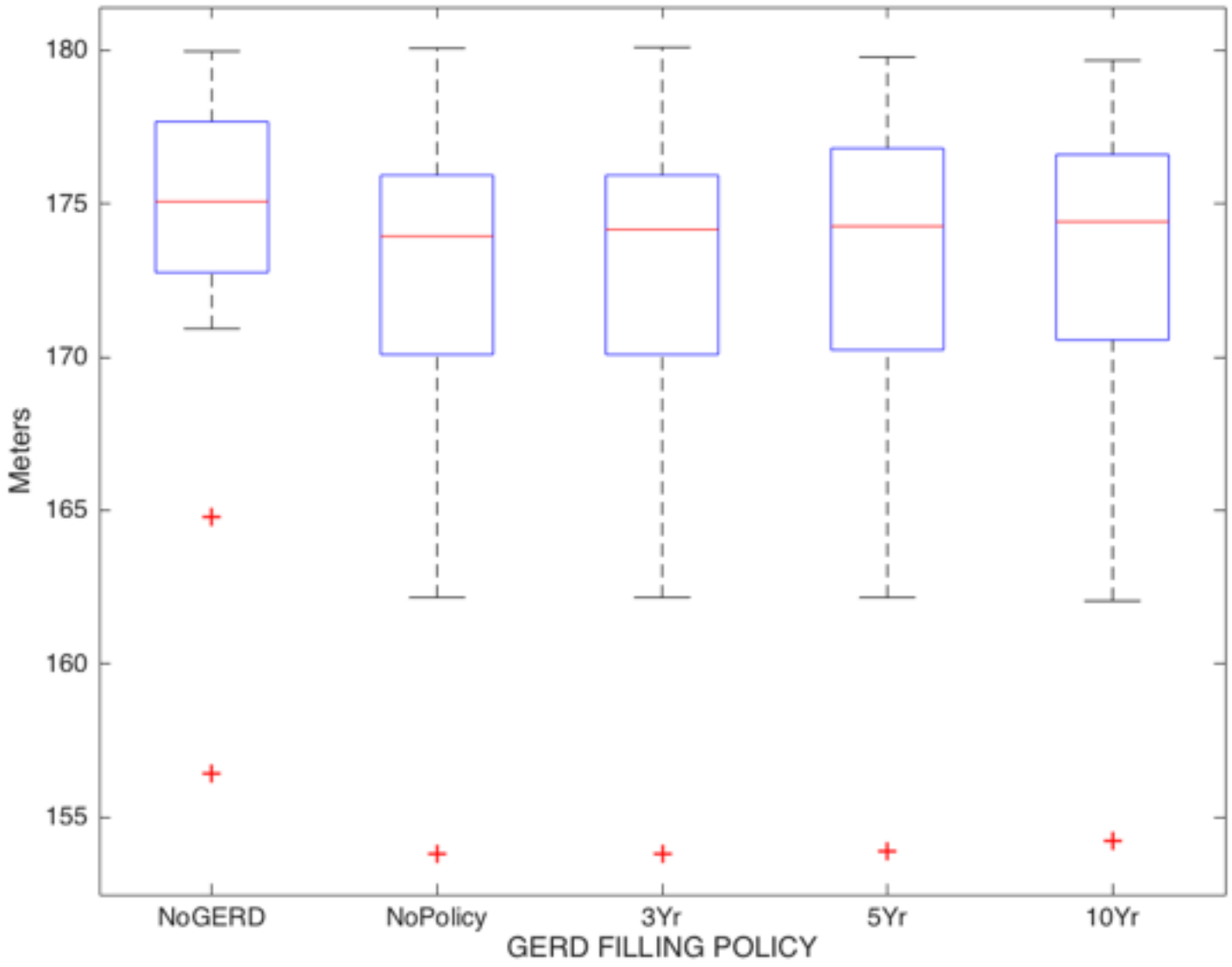
IMPACTS TO EGYPT

- IMPACT ON INFLOW
- IMPACT ON STORAGE
- IMPACT ON HYDROPRODUCTION

INFLOWS


Billion Cubic Meters per year
90
85
80
75
70
65
60
NoGERD
NoPolicy
3Yr
5Yr
10Yr
GERD FILLING POLICY

IMPACT ON STORAGE



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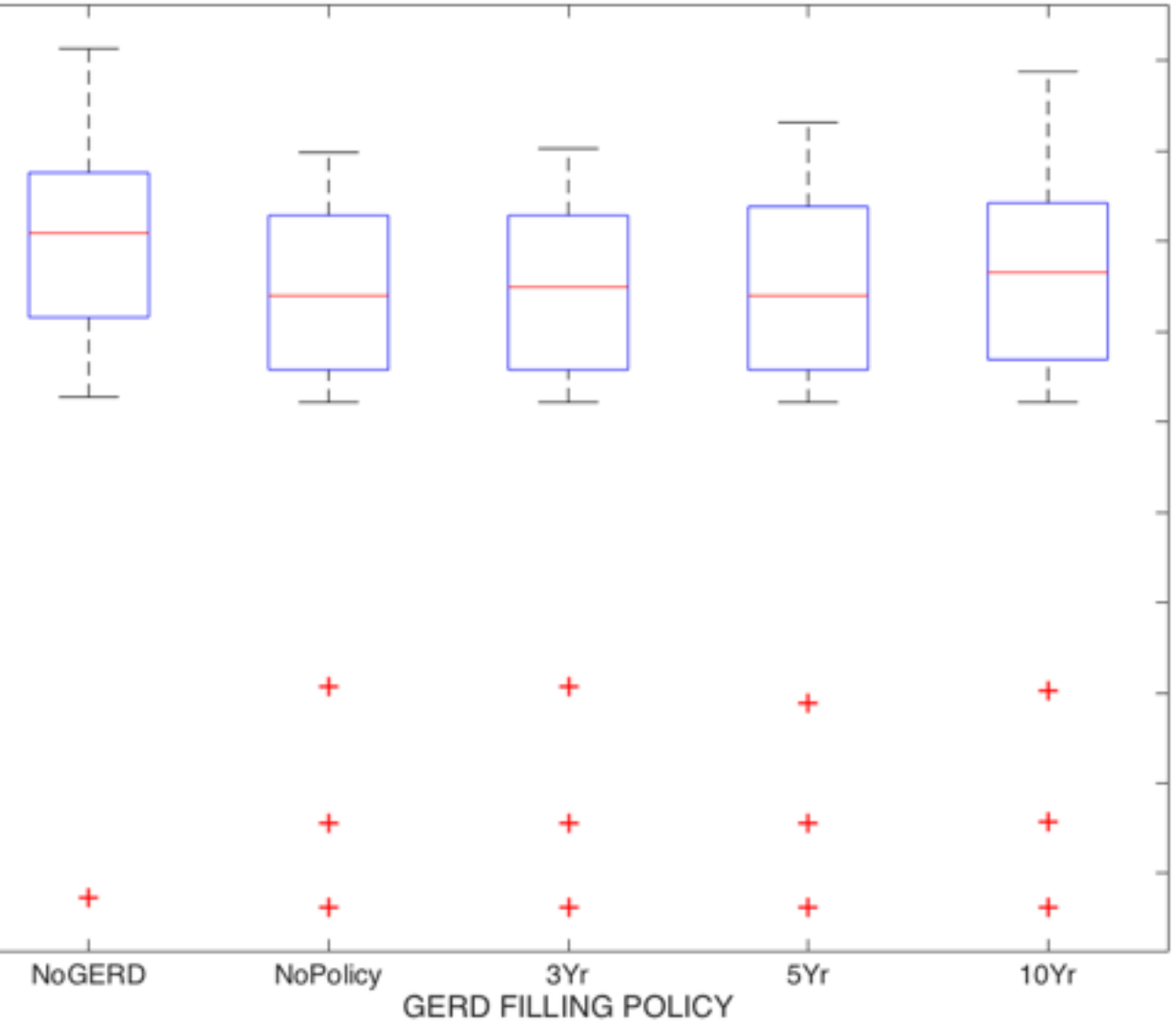
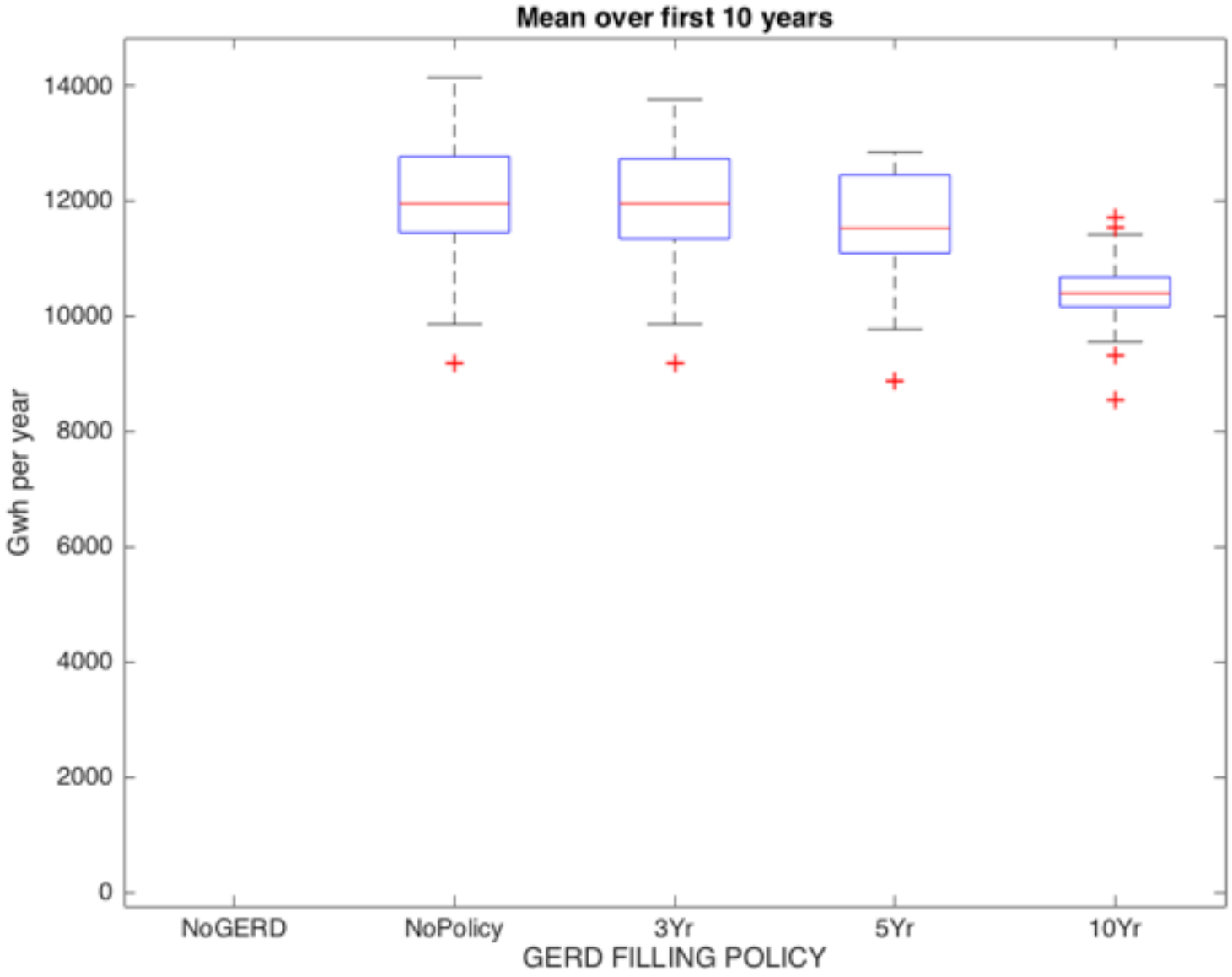


Trade Off

- How Much is Ethiopia Impacted by a slower fill policy?

- Let’s look at impacts on GERD Hydropower

GERD Hydropower



What is the Value if GERD Hydrower

- Average Annual Generation for a minimum annual release of 30 BCM is estimates at
- 11,000 GWh
- At $0.10 per kwh give an annual revenue of

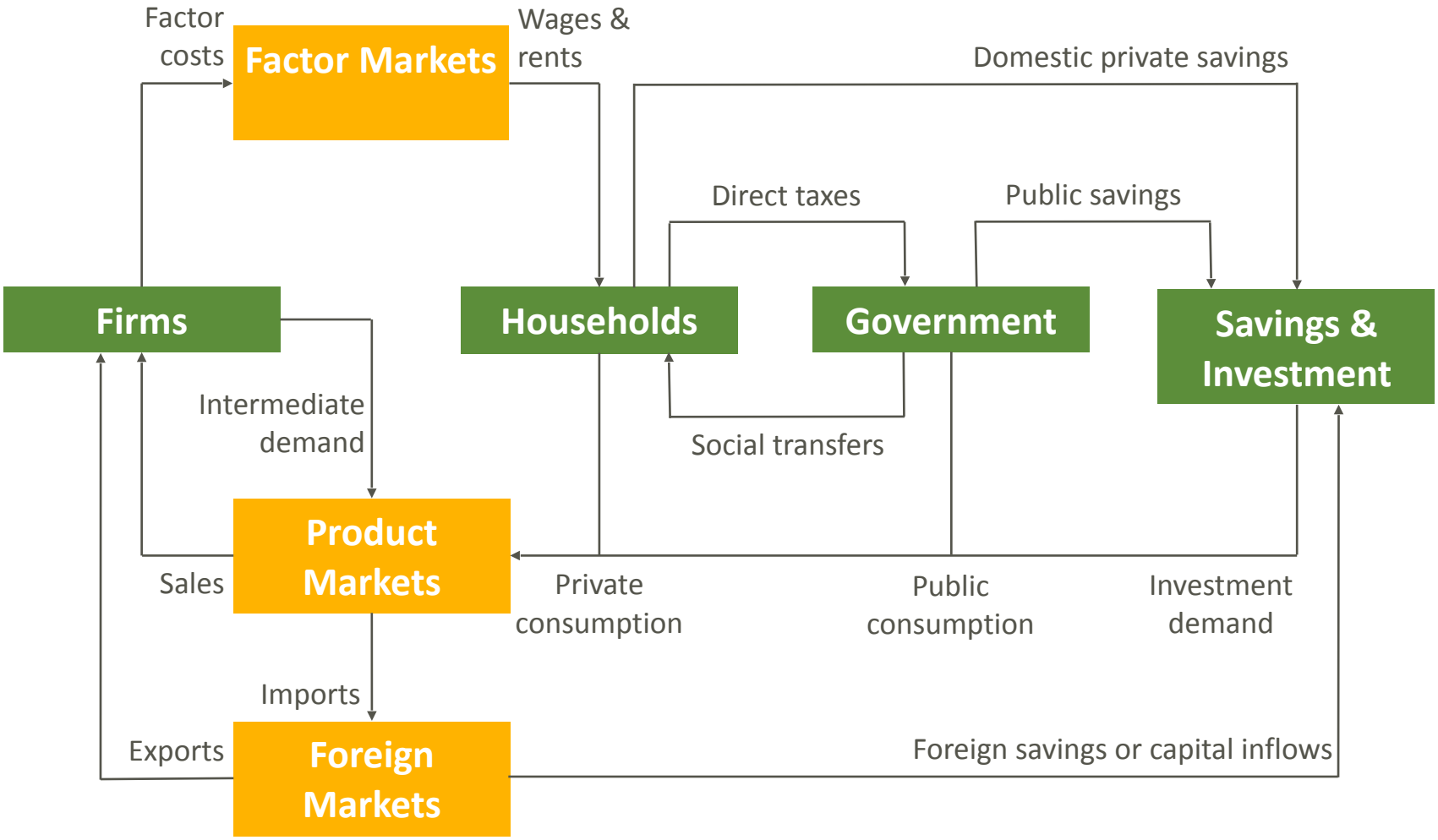
$1.1 billion

- Power in Kenya was selling at $0.14 per kwh

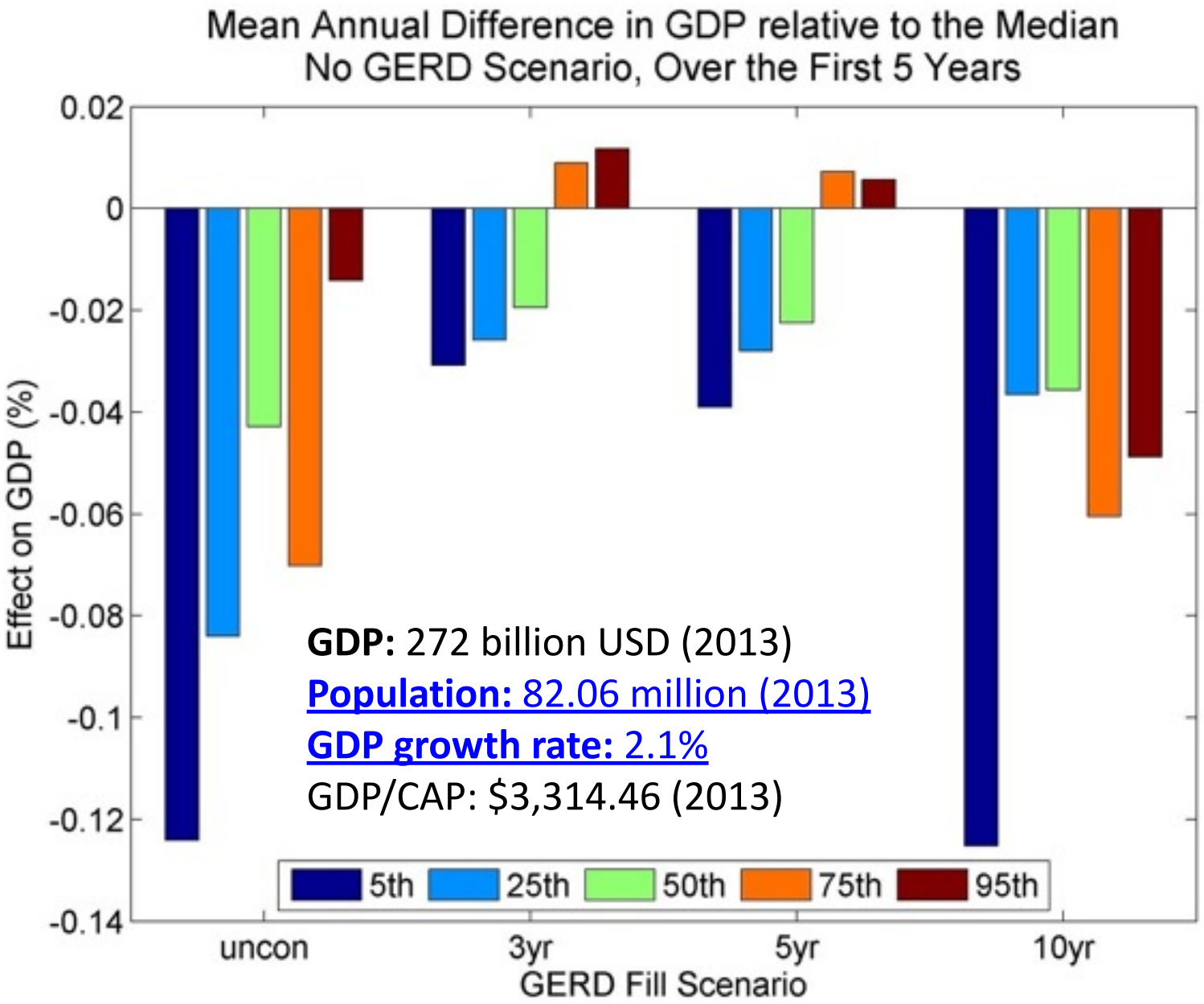
From Engineering to Economics

- The previous was reporting on Engineering Indicators
- What if we look at Economic Indicator
- We performed a Hydro-Economic Analysis

EGYPT - CGE


Factor costs
Factor Markets
Wages & rents
Domestic private savings
Direct taxes
Public savings
Firms
Households
Government
Savings & Investment
Intermediate demand
Social transfers
Product Markets
Sales
Private consumption
Public consumption
Investment demand
Imports
Exports
Foreign Markets
Foreign savings or capital inflows

Effect on GDP (relative)



What is the Impact on Average

- On the Average 1,480 Gwh lost at HAD

	EGYPT GDP		ETHIOPIAN GDP	
	$ Million/year			
Filling	5%	Mean	5%	Mean
NO GERD	0	0	0	0
UnConst	350	117	1,000	1,200
3 yr	117	58	950	1,186
5 yr	87	55	950	1,154

The Risks to Egypt of the GERD Filling

- Loss Hydropower and Irrigation Flow
  - On average small much less that gains at GERD
- BUT impacts are on low income and Farmers a very politically volatile segment of the Egyptian Economy
- Poor Society-Wide understanding of the greatly reduced role the Nile plays in Egypt Economy
- The Incredible Role it plays in national identity, psyche, and pride.
- Is there Room for Cooperation?

The Risks to Ethiopia GERD Filling Policies

- Loss Hydropower Revenues & Repayment Issues & slowing of Economic Growth
- The GERD has been funded significantly by domestic bonds
- Society-Wide understanding of an inflated role the GERD will play in Ethiopian Economy
- The Incredible Role GERD plays in national identity, psyche, and pride.
- JUST LOOK AT THE NAME
- Is there Room for Cooperation

A proposal

- The international community develop an insurance scheme similar to the Hydrologic Risk Fund of the Senegal River Basin or Crop Insurance.
- This will insure Both Egypt and Ethiopia against the losses they both fear from extreme events and allow them to develop an agreement based upon the clear win-win of the “mean-state” of the Nile.
- What do you think?