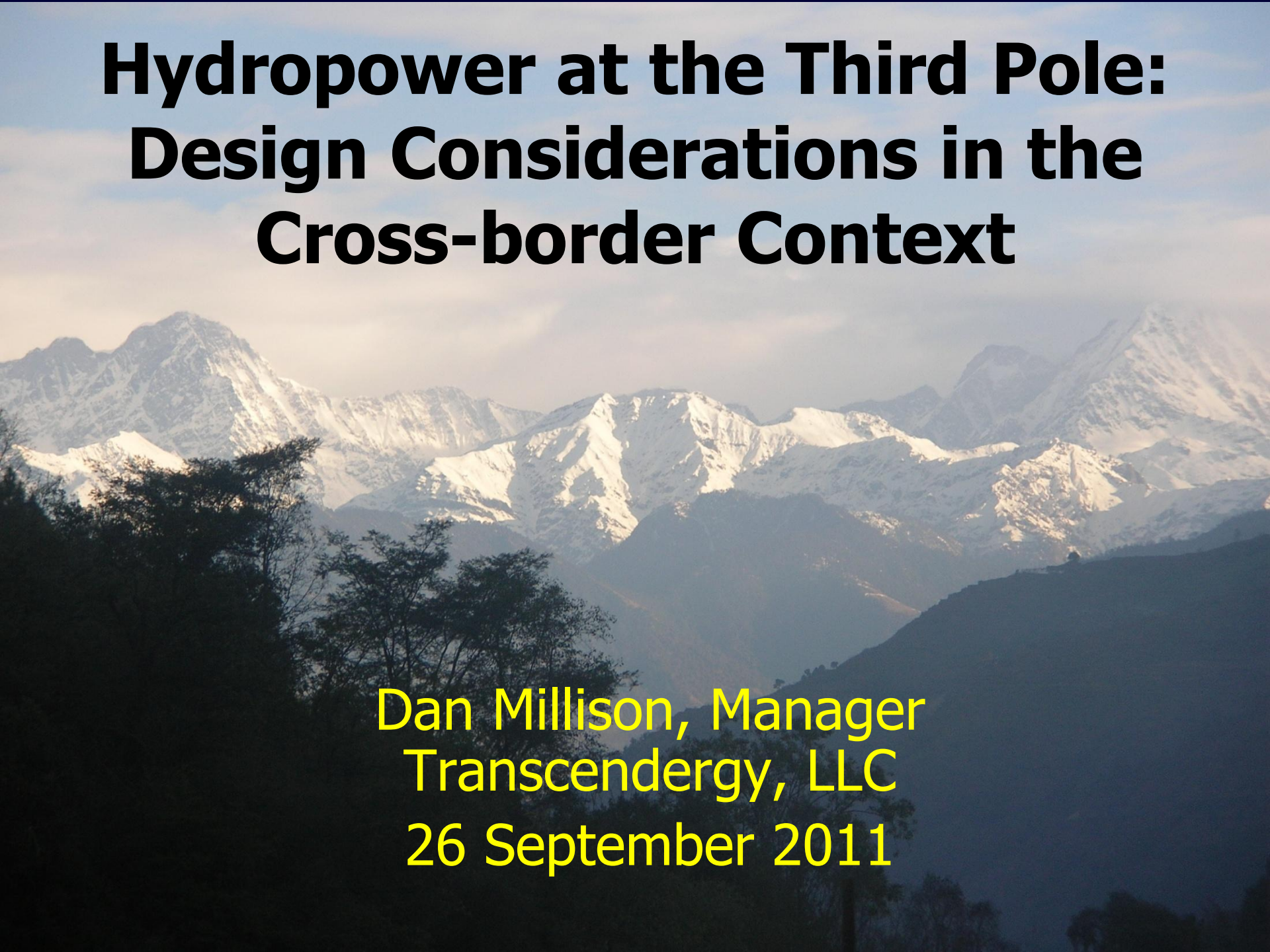
Hydropower at the Third Pole: Design Considerations in the Cross-border Context



Dan Millison, Manager
Transcendergy, LLC

26 September 2011

Hydropower design: 1st principle

$$e^- \sim h \times Q$$

e^- = electricity output

h = head drop

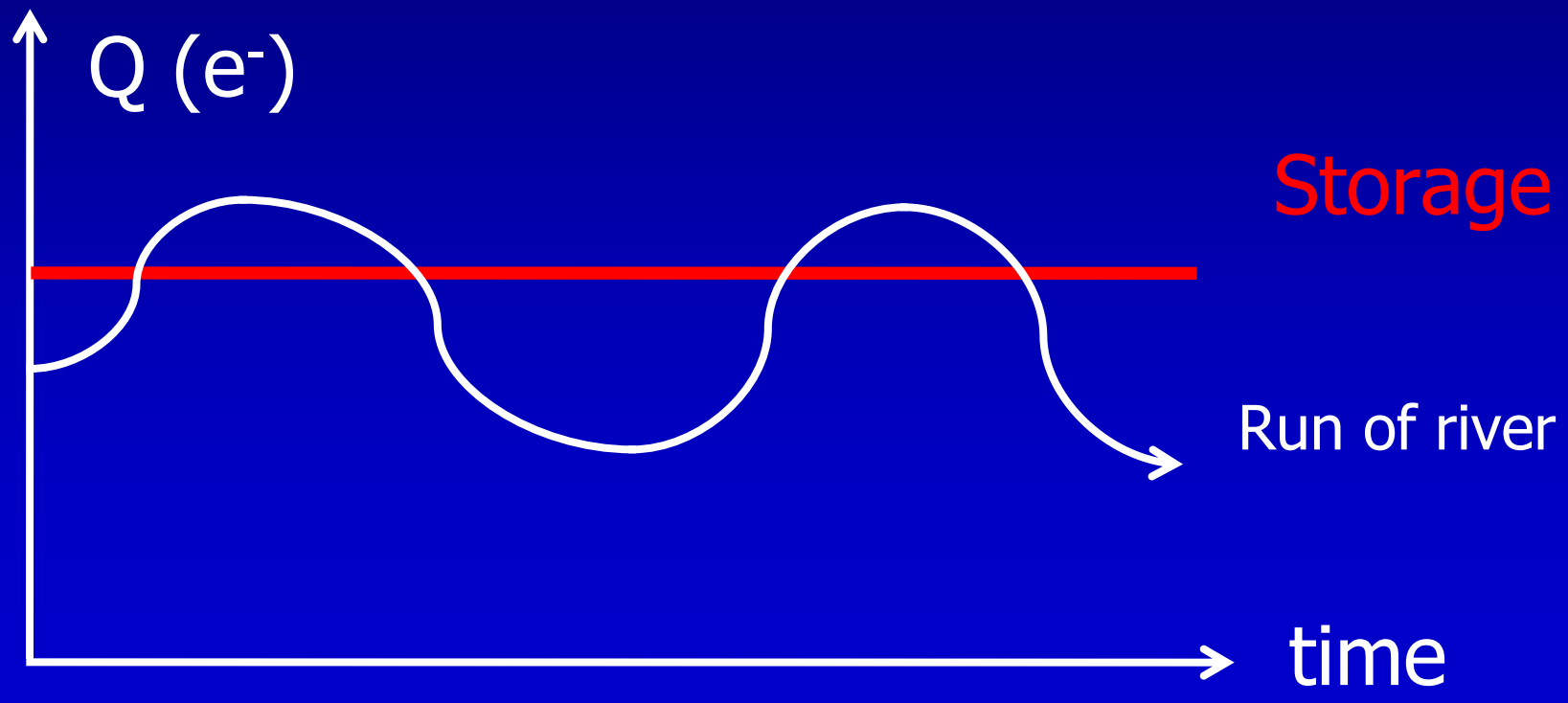
Q = flow

Principle applies to all scales, but says nothing about design details….

Optimizing Energy Output

Storage: trade weather risk for safeguards risks; firm power dispatch (baseload & peaking)

Run-of-river: small / no reservoir; intermittent generation; preferential dispatch?

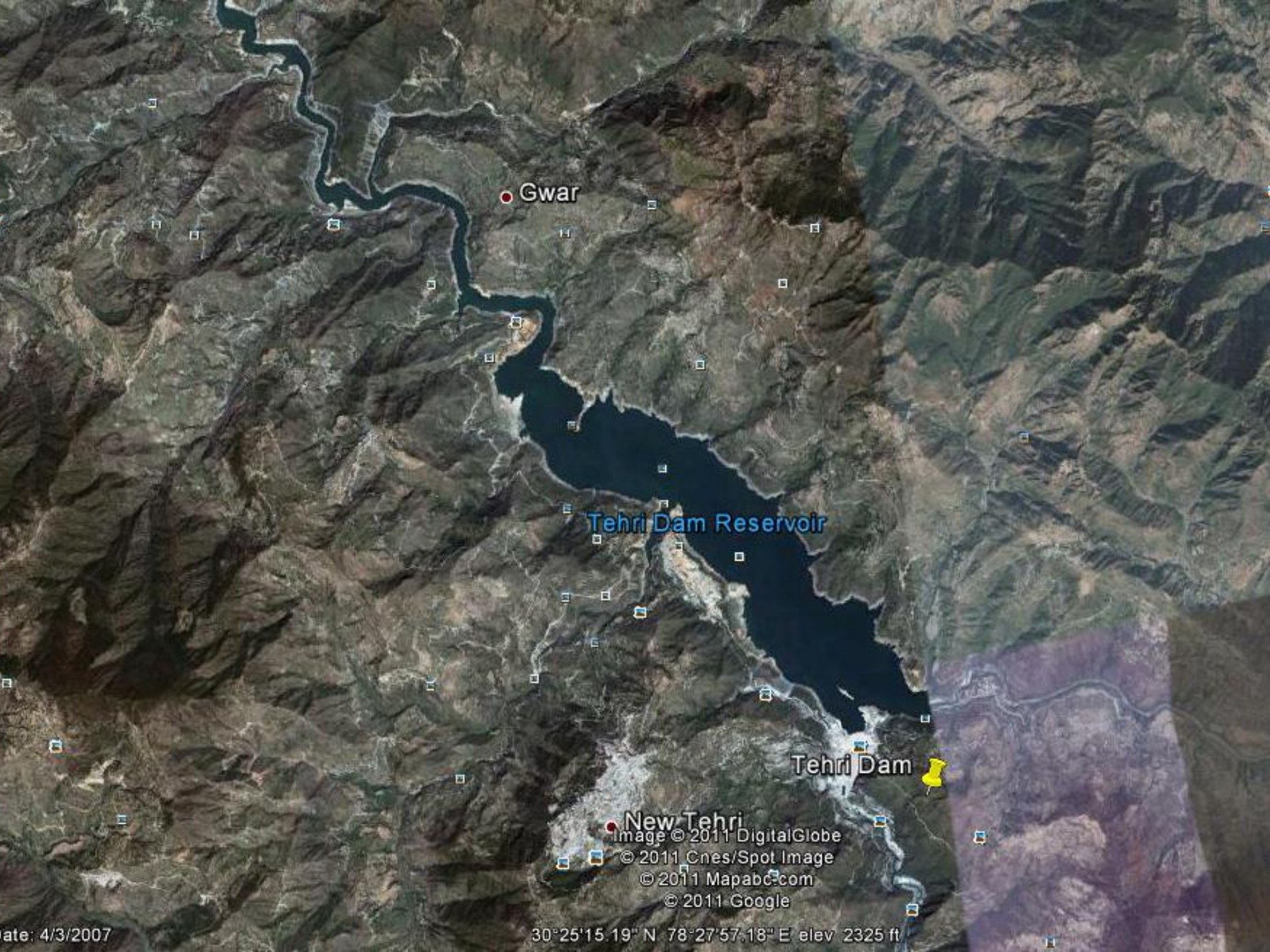


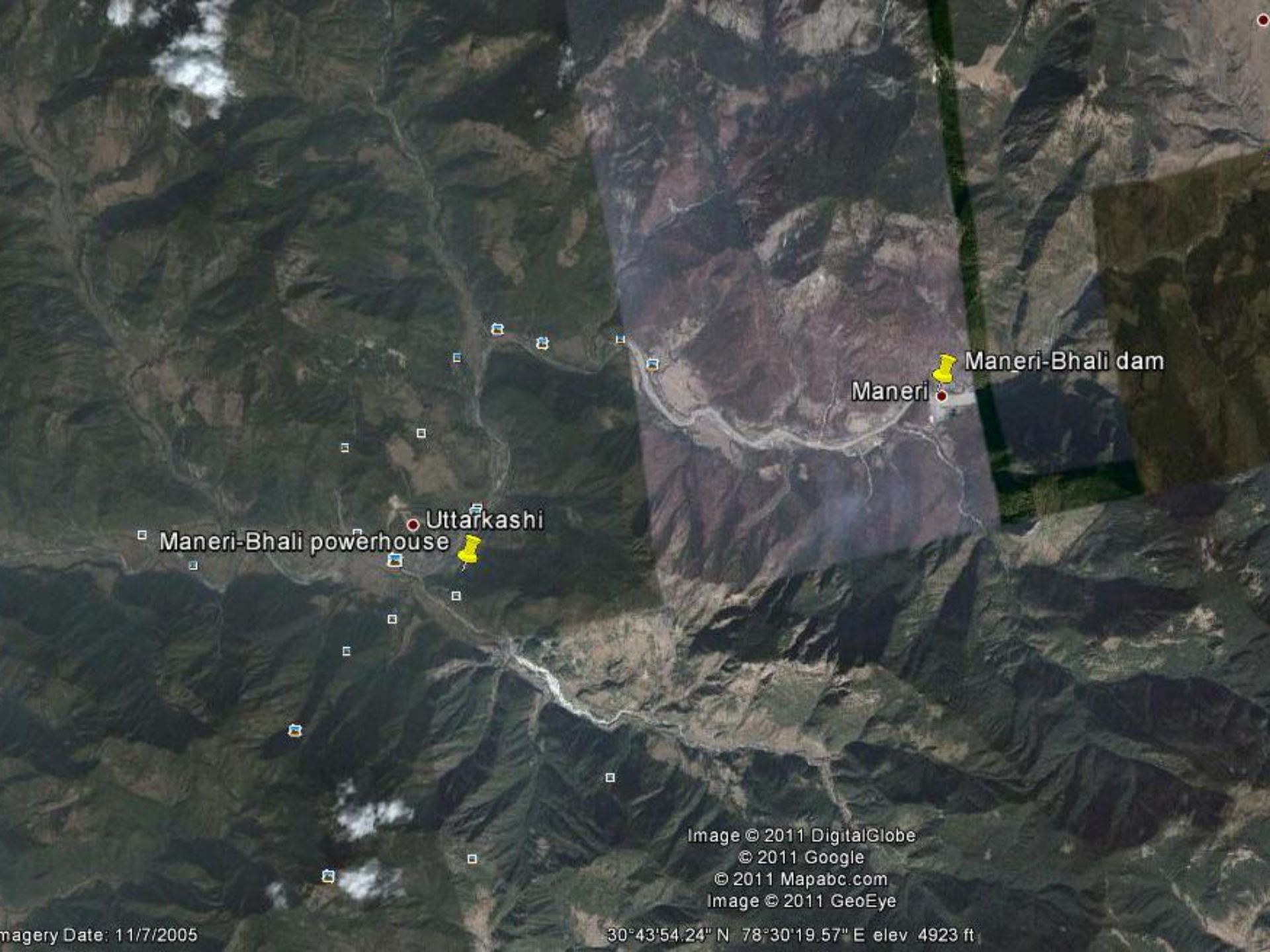
Design Optimization

- Traditional economies of scale / least-cost analyses favor storage designs…
  but what about externalities?

- "Classic" design:
  - Jinping I – 3600 MW (PRC)
  - Nam Theun 2 – 1000 MW (Lao PDR)
  - West Seti – 800 MW (Nepal)
  - *Tehri and Kotli Bhel - 1000 MW (India)*


Zigui
Three Gorges Dam-View Scenic Area
Image © 2011 TerraMetrics
Image © 2011 DigitalGlobe
© 2011 Mapabc.com
30°51'35.66" N 110°57'41.16" E elev 633 ft
Date: 3/14/2009


Gwar
Tehri Dam Reservoir
Tehri Dam
New Tehri
Image © 2011 DigitalGlobe
© 2011 Cnes/Spot Image
© 2011 Mapabc.com
© 2011 Google
ate: 4/3/2007
30°25'15.19" N 78°27'57.18" E elev 2325 ft


Maneri-Bhali dam
Maneri
Uttarkashi
Maneri-Bhali powerhouse
Image © 2011 DigitalGlobe
© 2011 Google
© 2011 Mapabc.com
Image © 2011 GeoEye
magery Date: 11/7/2005
30°43'54.24" N 78°30'19.57" E elev 4923 ft

Tehri Dam

- 1000 MW storage dam + pumped storage plant
- Conceived in 1978; initial operations in 2006
- Resettlement of 50,000 people

Tehri Dam

- Uttarakhand State government officials (mid-2004) on opportunity cost of delays:
  - "we could have done 10 times as much, 10 times faster, with the same amount of money"
  - "we're not doing that again"

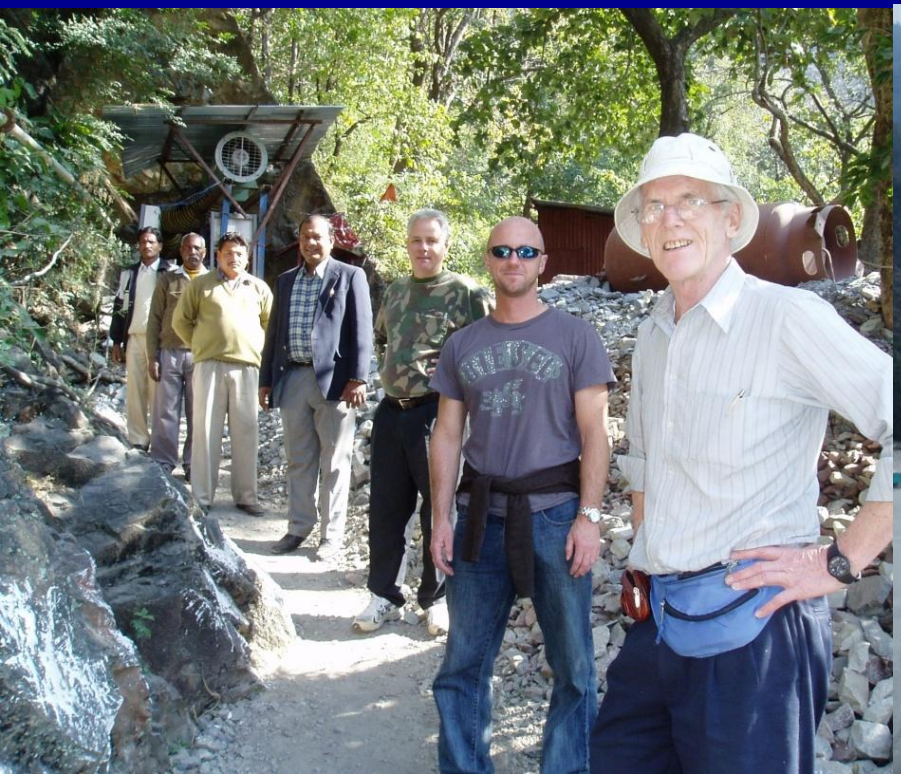
Kotli Bhel – v1

1000 MW storage dam on Kali Ganga

Kotli Bel – externalities matter

Kotli Bel – v2 / Run of River

- KB 1A – 195 MW *
- KB 1B – 320 MW
- KB 2 – 520 MW



Hydro development in the 21st Century

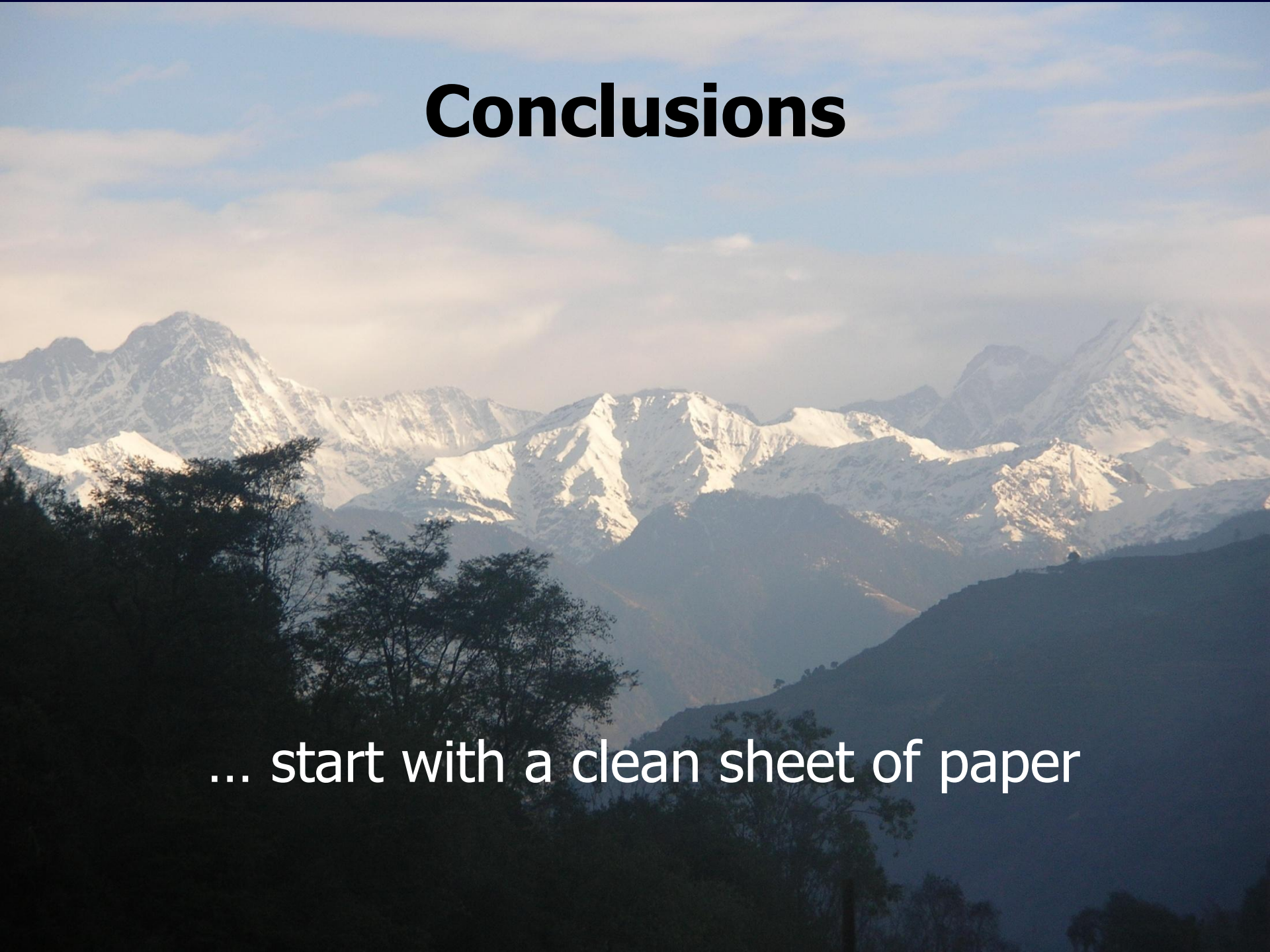
- Financing?
  Not a problem
- Environmental permitting & resettlement?
  No hiccups
- Construction?
  No speed bumps

it's all good

Conclusions

- Classic design ➡ least-cost on paper
- Externalities and opportunity costs matter
- RoR design does not guarantee success
- If the least-cost solution exists only on paper, it is not a solution…

Conclusions



… start with a clean sheet of paper

Technical Cooperation?

- Water conservation, treatment, recycling
- Advanced energy storage
- Cross-border energy trading (GMS model)

Discussion Points

- NT2 – a "global model" for hydropower?
- Nepal - Upper Tamakoshi, Tamakoshi 3, West Seti
- Afghanistan & Tajikistan – Panj, Vaksh, & Amu Darya
- Brazil – Amazon; how to cover life-cycle value, including GHG reductions, on storage vs. RoR? [CTF / GCF context]


© 2011 Mapabc.com
© 2011 Cnes/Spot Image
© 2011 Europa Technologies
Image © 2011 DigitalGlobe
Imagery Date: 12/1/2006
17°57'12.73" N 104°59'15.56" E elev 1806 ft


24 4:36 PM


25 7:20PM


27 5:47PM


27 5:47PM