Possible Operating Space for Laser IFE*

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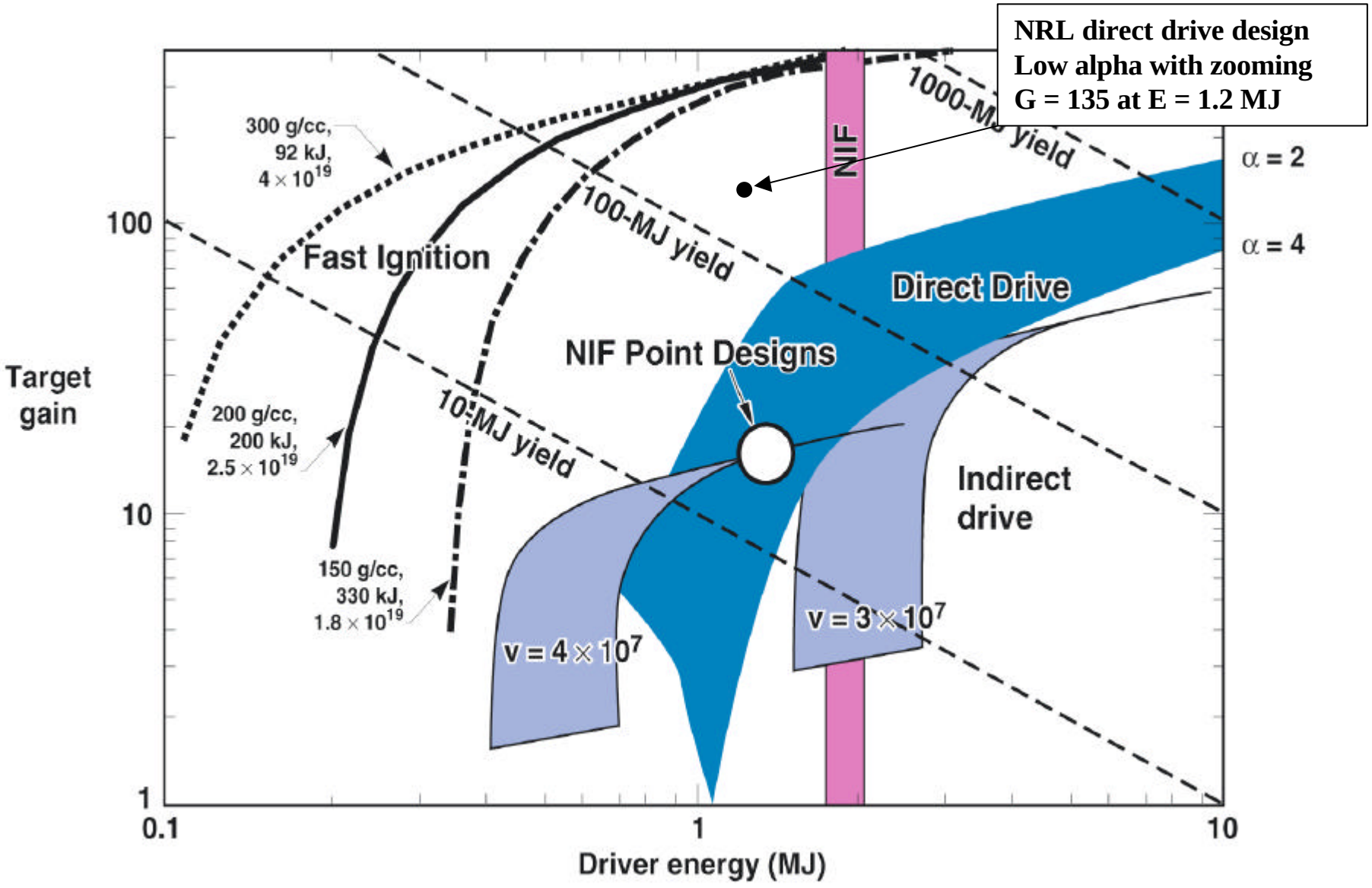
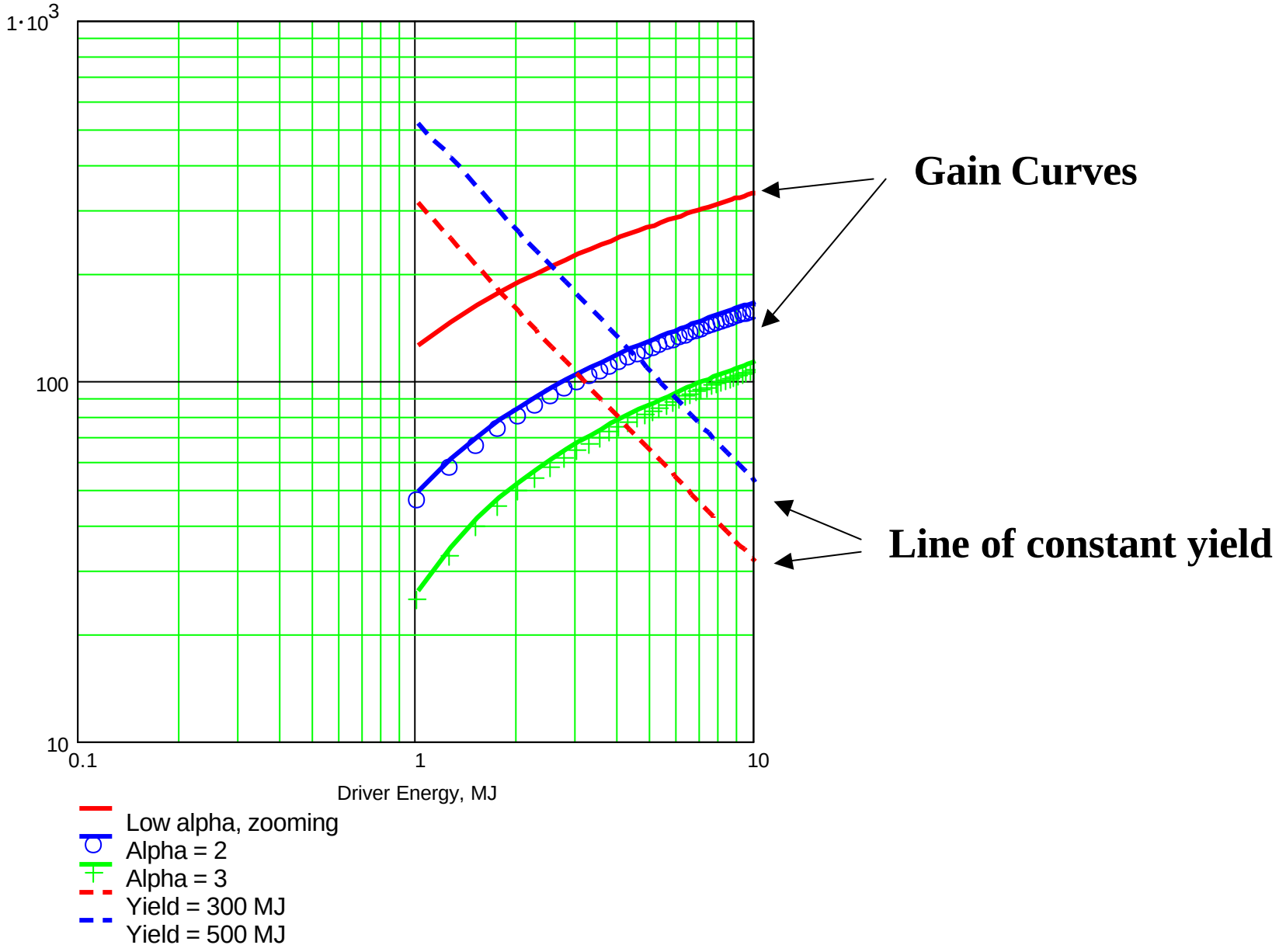
There are many possible laser-driven gain curves to use



Simple fits have been used in past studies



Fitting equations for laser gain curves

- **Fast Ignitor**

  $G_{fi} = 300+144 \ln(E_d)$

- **Direct drive, low** α **with zooming (includes NRL design point)**

  $G_1 = 119.3 + 86.0 \ln(E_d)$

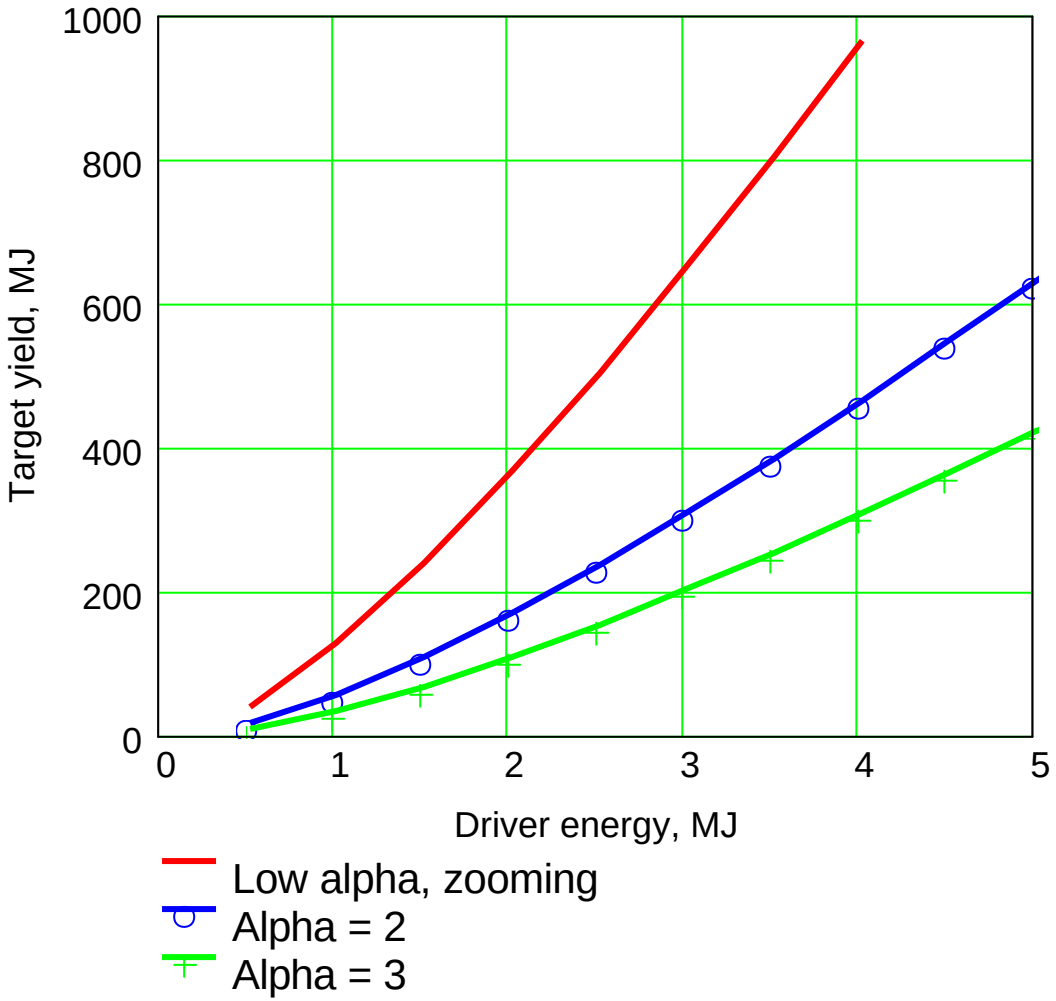
- **Direct drive,** $\alpha = 2$

  $G_2 = 47.2 + 48.0 \ln(E_d)$

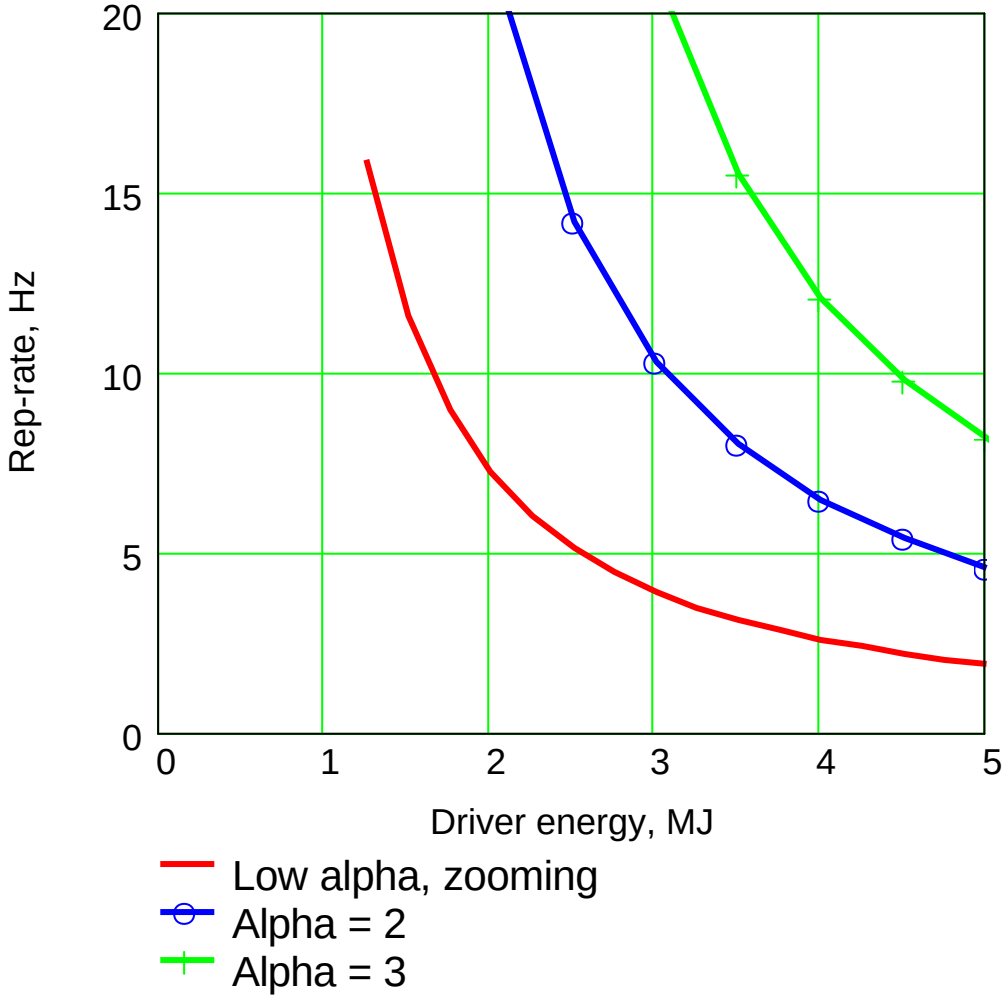
- **Direct drive,** $\alpha = 3$

  $G_3 = 25.0 + 36.1 \ln(E_d)$

Target yield vs. driver energy for different gain curves



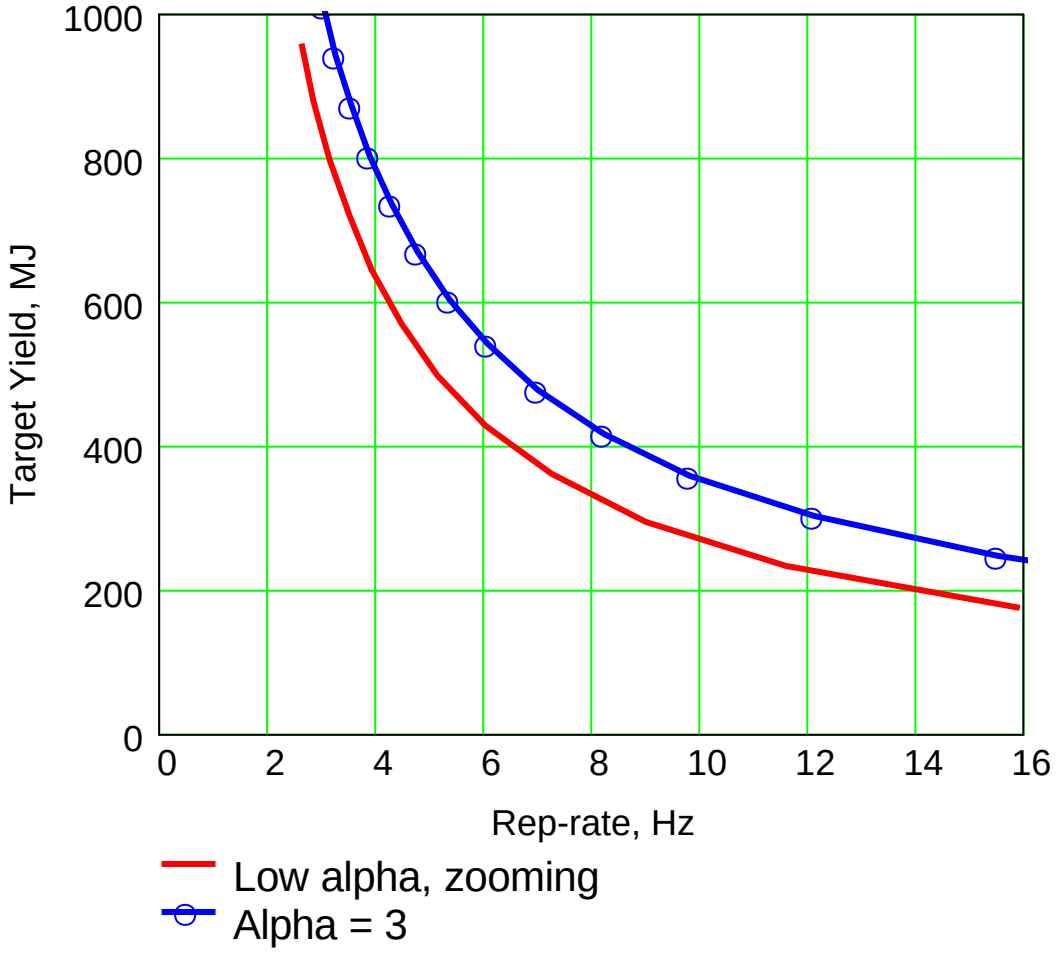
Rep-rate vs. driver energy for constant net power with different gain curves



hd = 7%

Net power = 1000 MWe

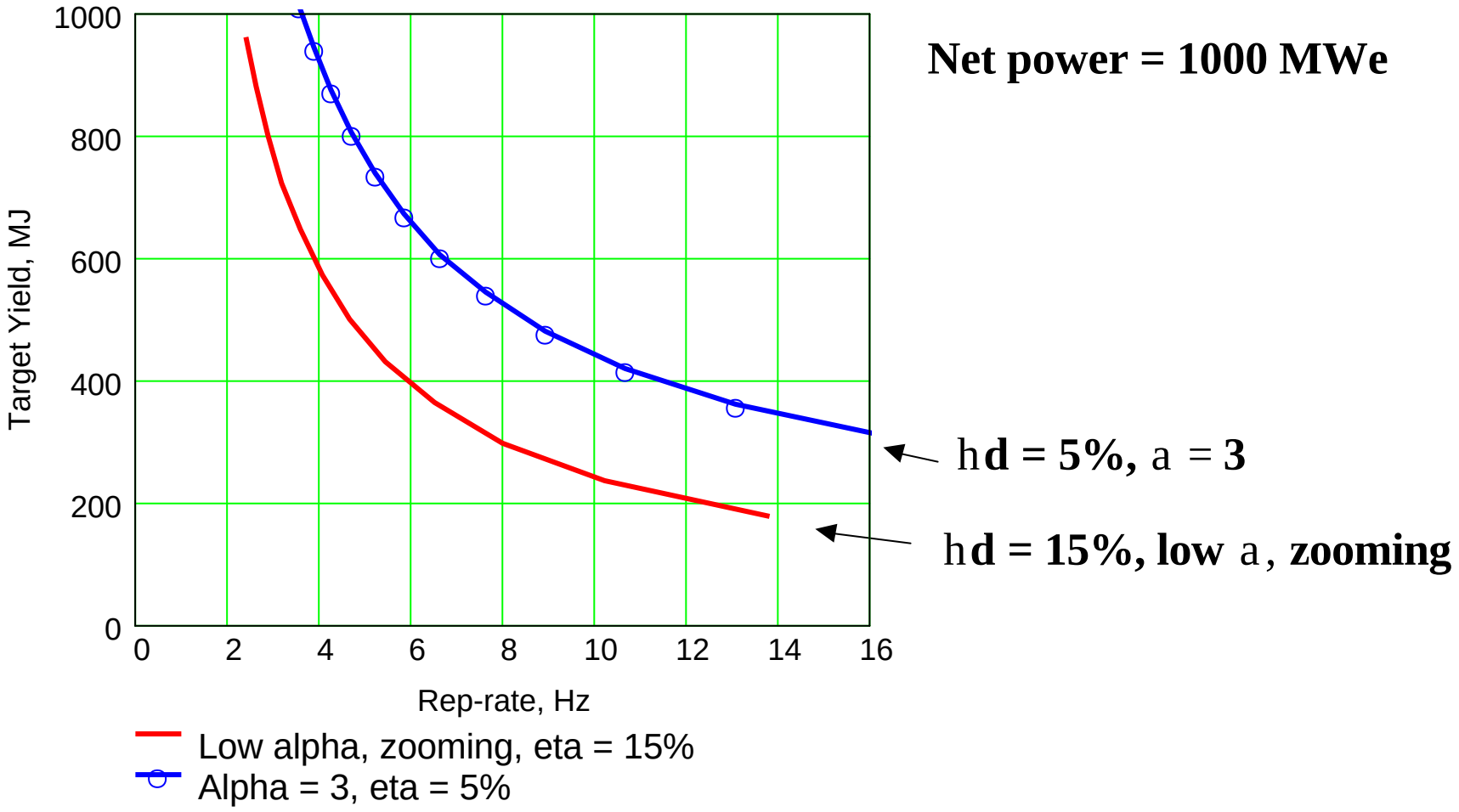
Yield vs. rep-rate for constant net power and fixed driver efficiency



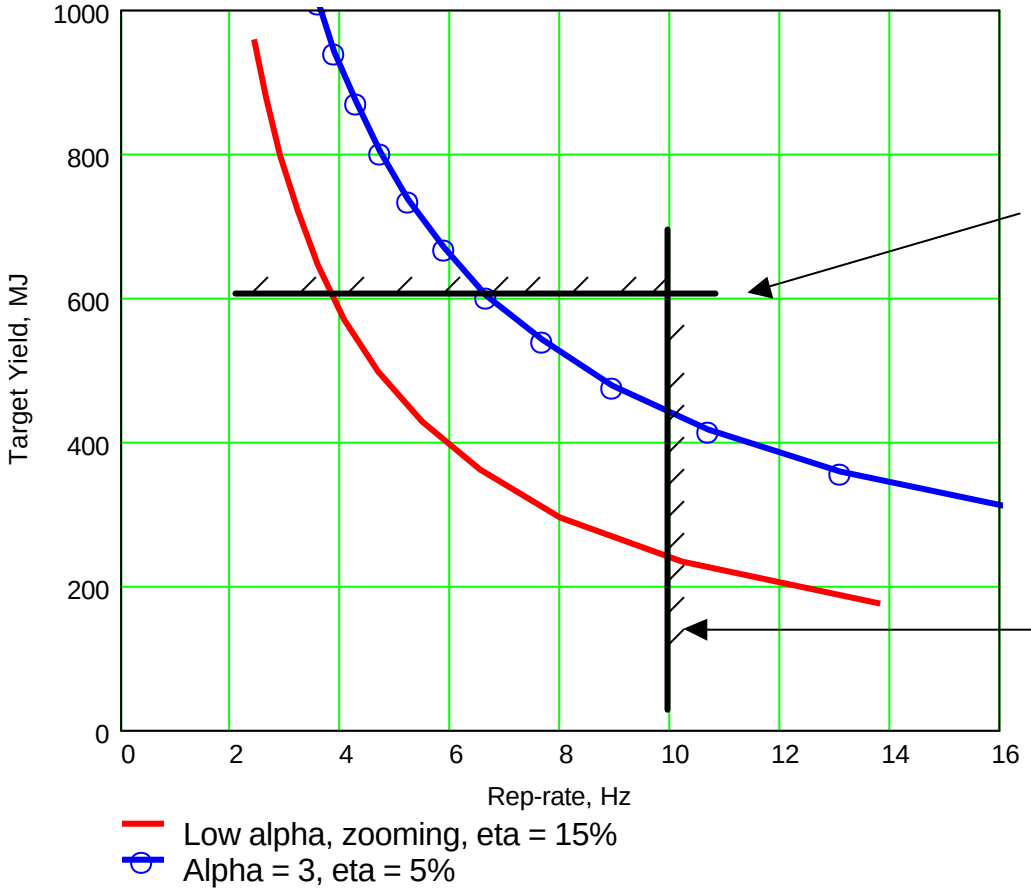
Net Power = 1000 MWe

hd = 7%

Yield vs. rep-rate for constant net power and a range of driver efficiencies



Yield / rep-rate operating space – an example

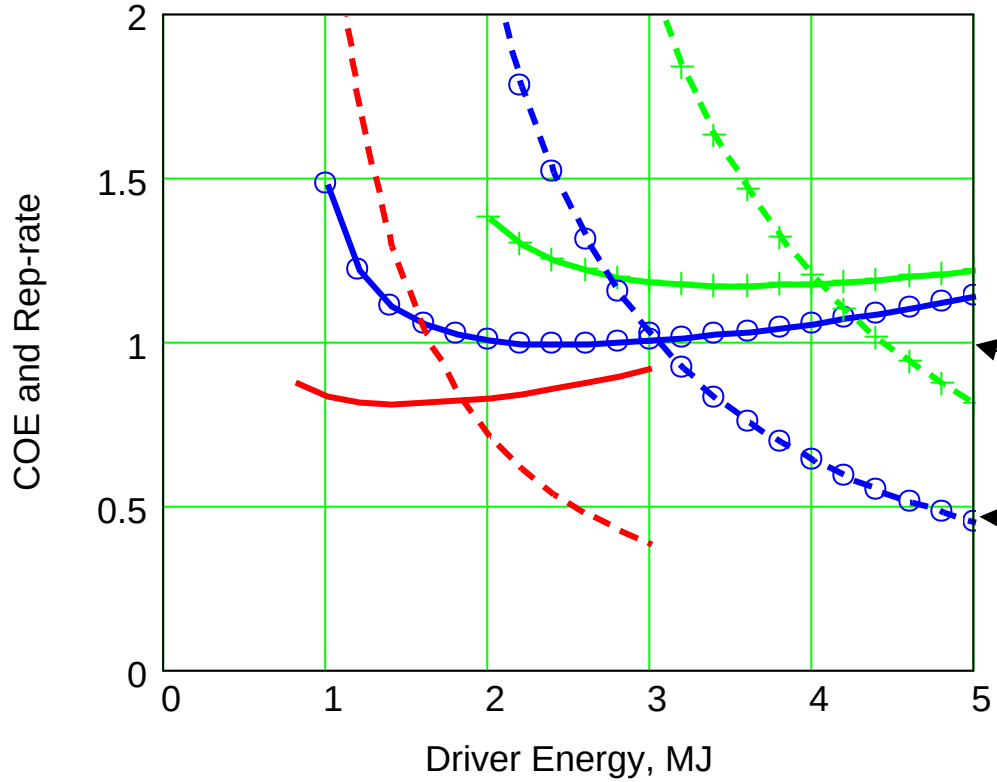


Limit on max yield, e.g., set by first wall limits for given wall design and radius

Limit on max rep-rate, e.g., set by chamber clearing or target injection velocity

As chamber radius increases, the max yield typically increases, but max rep-rate might decrease (longer clearing time, limited target transit time). Constraints would shift up and left.

Normalized COE and rep-rate (10's of Hz) for different gain curves



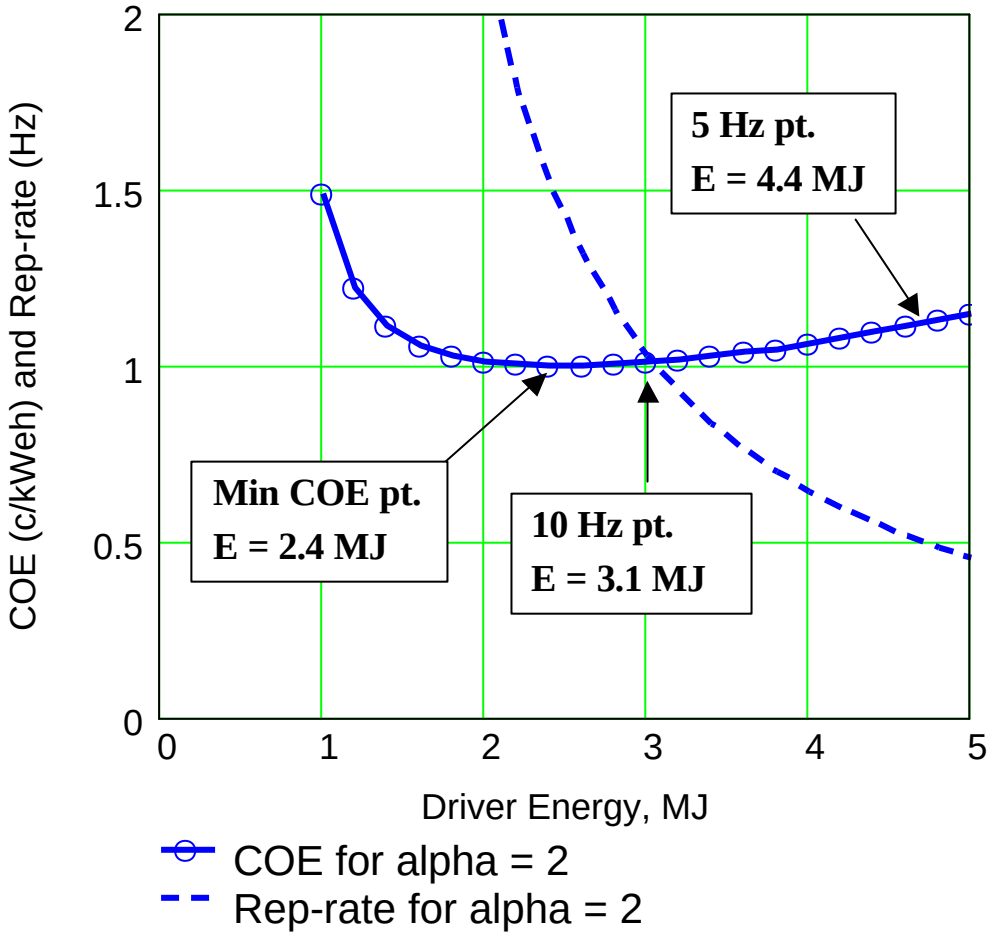
hd = 7%

COE normalized to:
Ed = 2.4 MJ
α= 2 gain curve

10 Hz

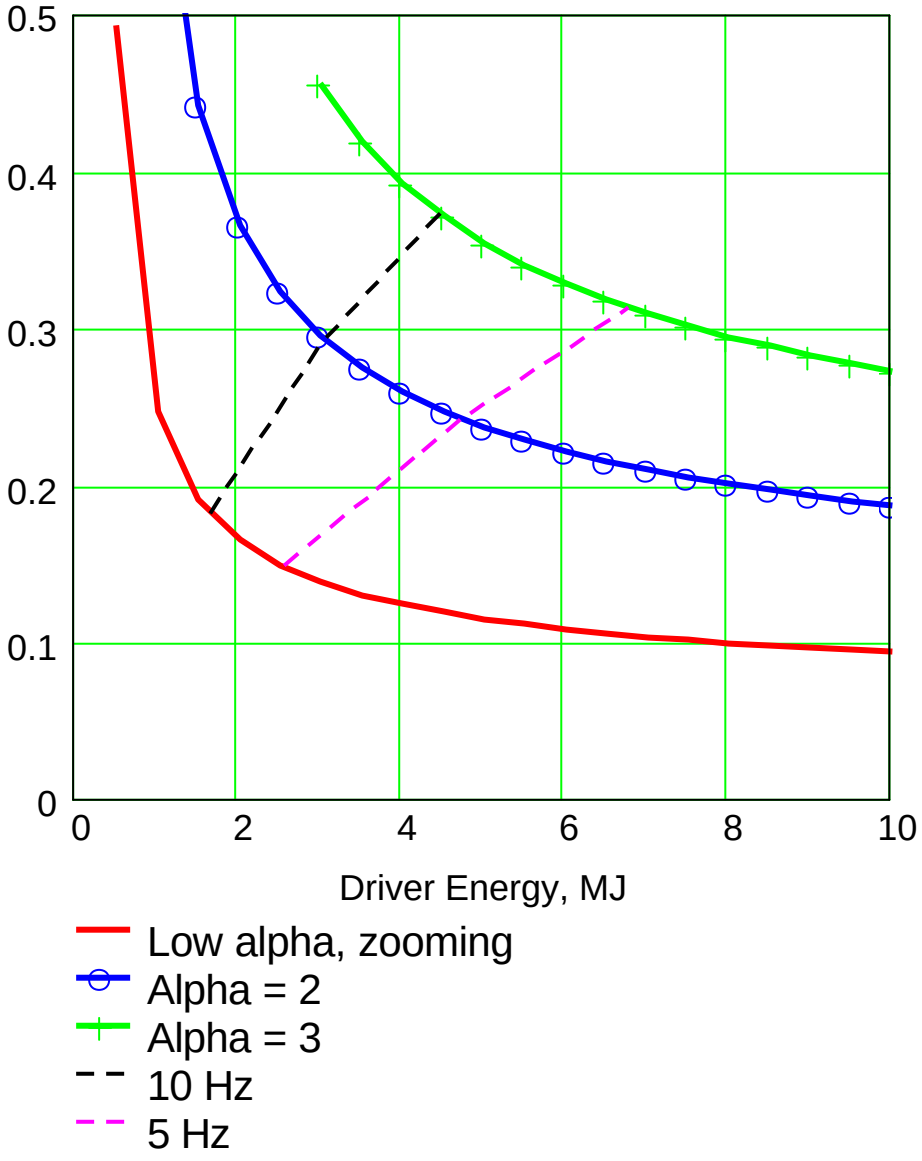
5 Hz

Rep-rate constraints could prevent operating at minimum COE point



E (MJ)	RR (Hz)	COE (norm.)
2.4	15	1.00
3.1	10	1.01
4.7	5	1.11

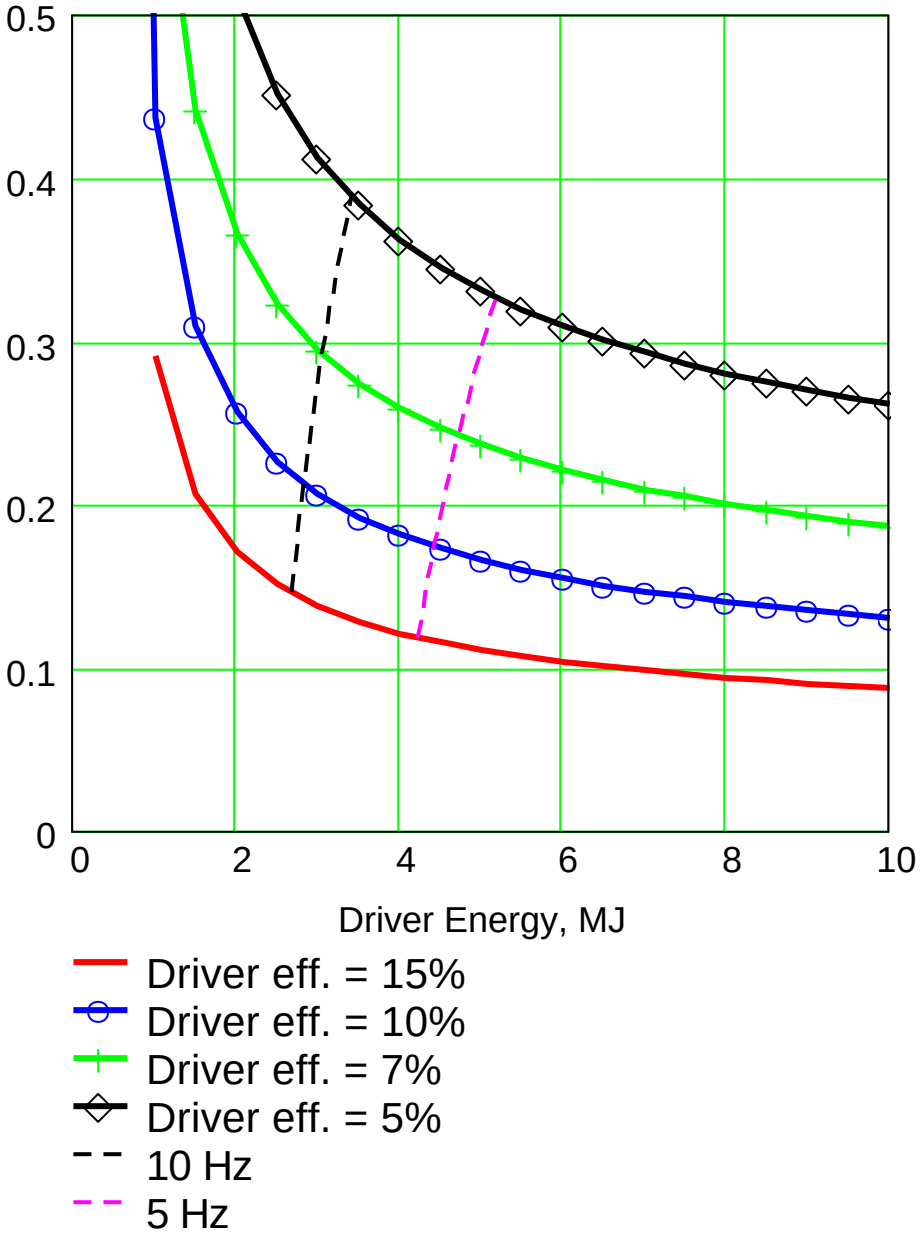
Driver recirculating power fraction vs. driver energy for different gain curves



η_d = 7%

5 and 10 Hz points for 1000 MWe are indicated. Over this range of rep-rates, the driver RPF ranges from 15% - 37%.

Driver recirculating power fraction vs. driver energy for different driver efficiencies



α= 2 Gain Curve

5 and 10 Hz points for 1000 MWe indicated

Summary

- **The operating space for laser IFE depends largely on the target gain versus driver relationship**
- **Key operating parameters for the chamber are target yield and pulse rep-rate**
  - For the range of gain curves considered, yield varied from ~250 MJ to over 750 MJ for rep-rates of 5-10 Hz
  - Chamber dynamics (required radius vs. yield, clearing time) and possibly target injection constraints will set maximum rep-rate
- **Constraints on rep-rate can lead to off-optimal operating point with somewhat higher COE**
- **Driver recirculating power fraction at minimum COE point can be 30% or higher.**
- **These are only illustrative examples - specific results will depend on constraints, costs and performance characteristics of the selected chamber, driver, and target and also on the desired net power of plant.**