Manufacturing – Technology challenges (5-10 and 10-20 years)

- EUV infrastructure (source, masks, resists, pellicles, inspection)
- Next generation patterning
- Variability and process control (atomic dimensions, interfaces)
- Metrology and inspections
- Process sensors, real-time data acquisition and analytics
- Continuation of scaling
- Uncertainty in roadmap

Manufacturing – Economic challenges (5-10 and 10-20 years)

- Equipment/materials development costs
- Supply chain R&D costs
- Overall manufacturing costs
- Design costs

How do the challenges affects energy efficiency, cost and scaling ?

- Traditional node/cost trend will be limited by manufacturing capabilities
- Next “thing” will likely augment, not replace CMOS
- Therefore, need to invest more heavily in areas like:
  - Design tools
  - Silicon photonics
  - 3D
  - Heterogeneous packaging
- How will we reduce costs by ~10X if IoT is to be realized?

What role for public/private partnership between DOE and industry?

- Continue to invest in fundamentals where DOE and national labs have unique infrastructure and where time horizons and costs are challenging
  - Patterning
  - Metrology
  - Variability reduction and process control
  - Materials