1999 GT-Suite Users Conference

Mean-Value Cylinder Model

MEAN VALUE CYLINDER

- Fast-executing cylinder representation
- Replaces detailed cylinder in GT-Power model
- Allows GT-Power to be shared by design engineers (detailed cylinder) and control system engineers (mean value cylinder)
- Air system can be further simplified for speed increase

VOLUMETRIC EFFICIENCY

- **Volumetric efficiency map**
  - **Nominal map is a function of speed and pressure ratio across engine**
  - **May also include default pressure ratio correction per Heywood**
  - **Map may be extended to be a function of any sensed GT-Power quantity**
  - **Maps can be populated either by detailed GT-Power results or experimental results**

FUEL ENERGY DISTRIBUTION

- **Fuel energy distribution maps**
  - **Fuel energy to crankshaft torque**
  - **Fuel energy to exhaust energy**
  - **Nominal maps are functions of speed and air/fuel ratio or intake pressure**
  - **Maps may be extended to be functions of any sensed GT-Power quantity**

CYLINDER PRESSURE

- **Cyclic pressure variation is normally not produced by mean-value models MVM**
- **In GT-Power MVM, crank angle-varying pressure is (optionally) calculated through use of idealized P-V relation:**
  - **User controls peak pressure and shape of pressure curve after TDC to match detailed P-V curve**
  - **Iterative process ensures that IMEP matches the value obtained from the fuel energy map**

TORQUE PRODUCTION

- **EngCylMeanV connects to the cranktrain in same way as detailed cylinders**
- **If cylinder pressure is calculated, phasing between cylinders (and cylinder-to-cylinder changes) are accounted for and torque is calculated from the pressure**
- **If cylinder pressure is not calculated, cranktrain calculates only mean brake torque**

INCREASED CALC. SPEED

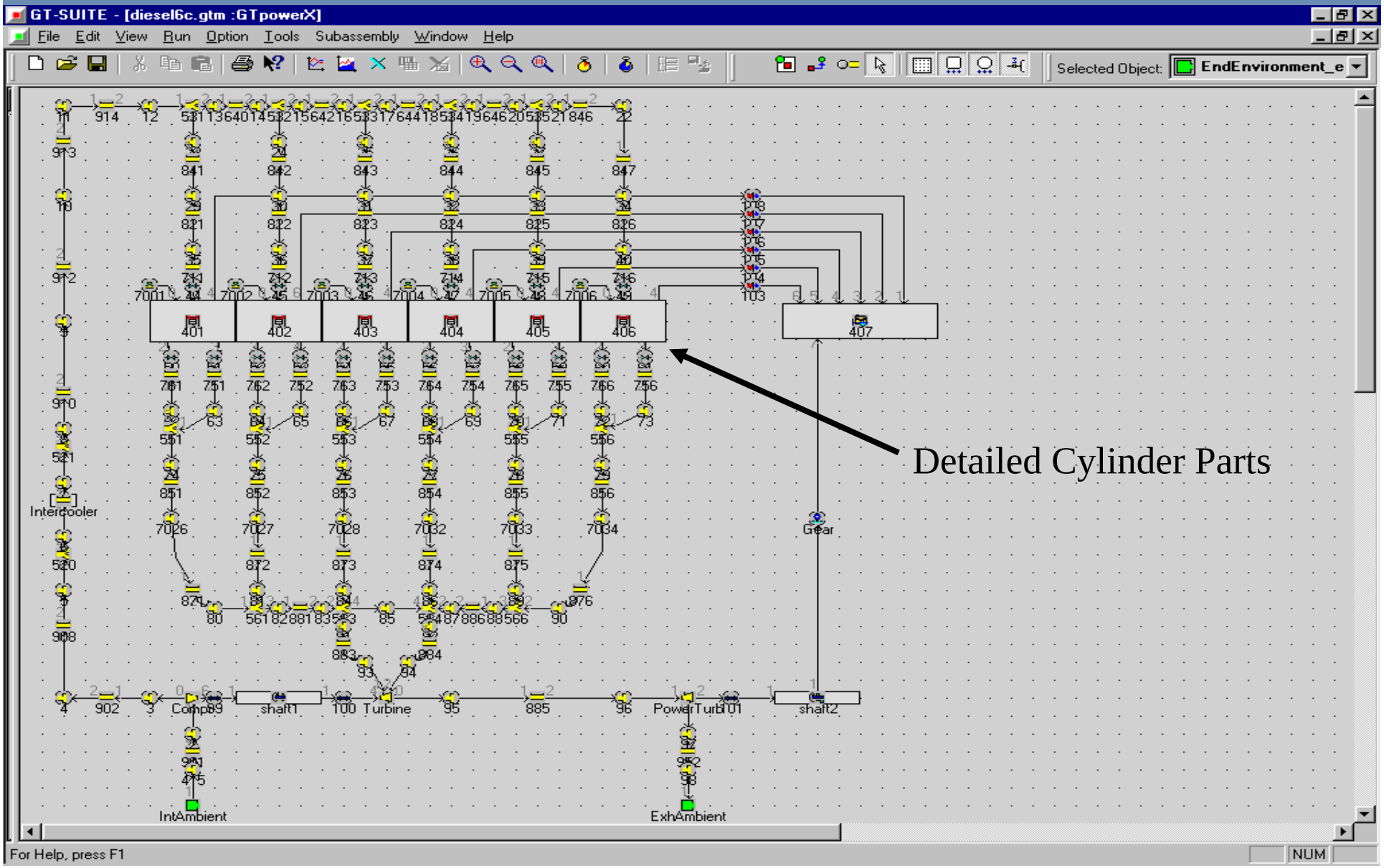
- **EngCylMeanV may be substituted directly for a detailed cylinder part - moderate change in run time**
- **Intake and exhaust piping may be simplified to a lumped-volume system with filling-and-emptying - substantial change in run time**
- **Multiple cylinders can be represented by one EngCylMeanV part - further run speed up**

MEAN VALUE CYLINDER

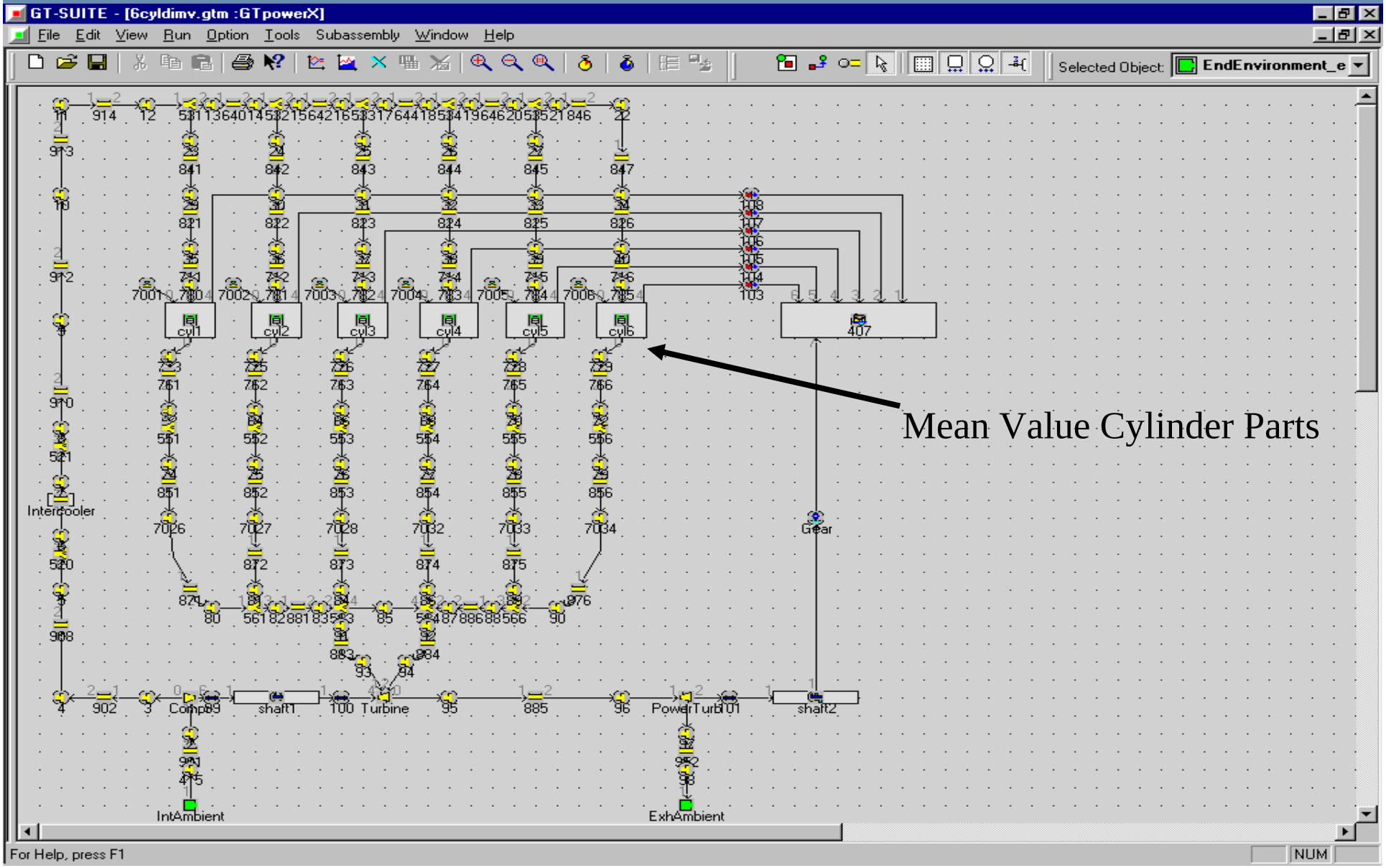
EXAMPLE

- **Convert detailed model of turbocharged 6-cylinder diesel engine to mean value model**
- **Different levels of detail possible for different analysis needs**

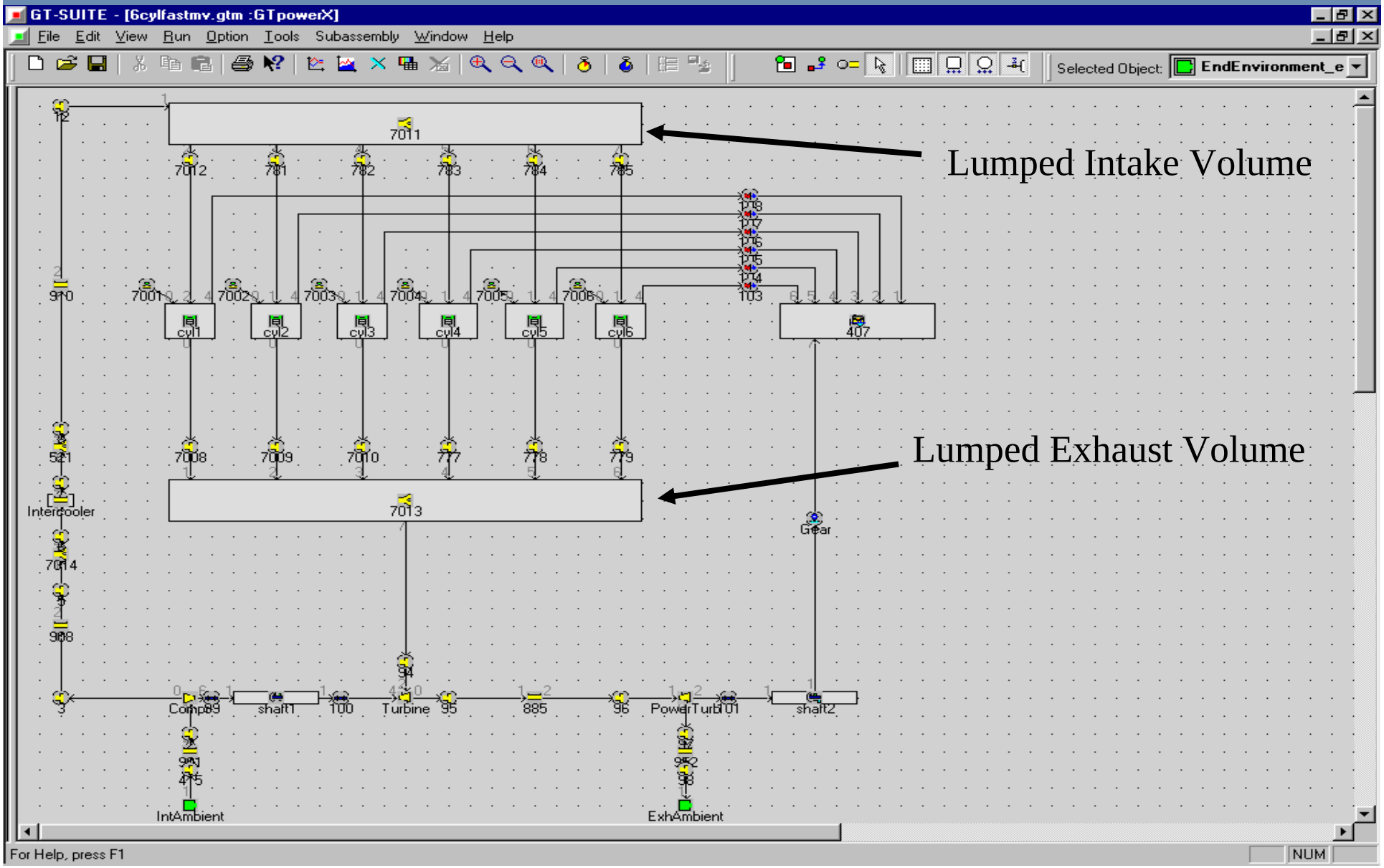
1: DETAILED MODEL



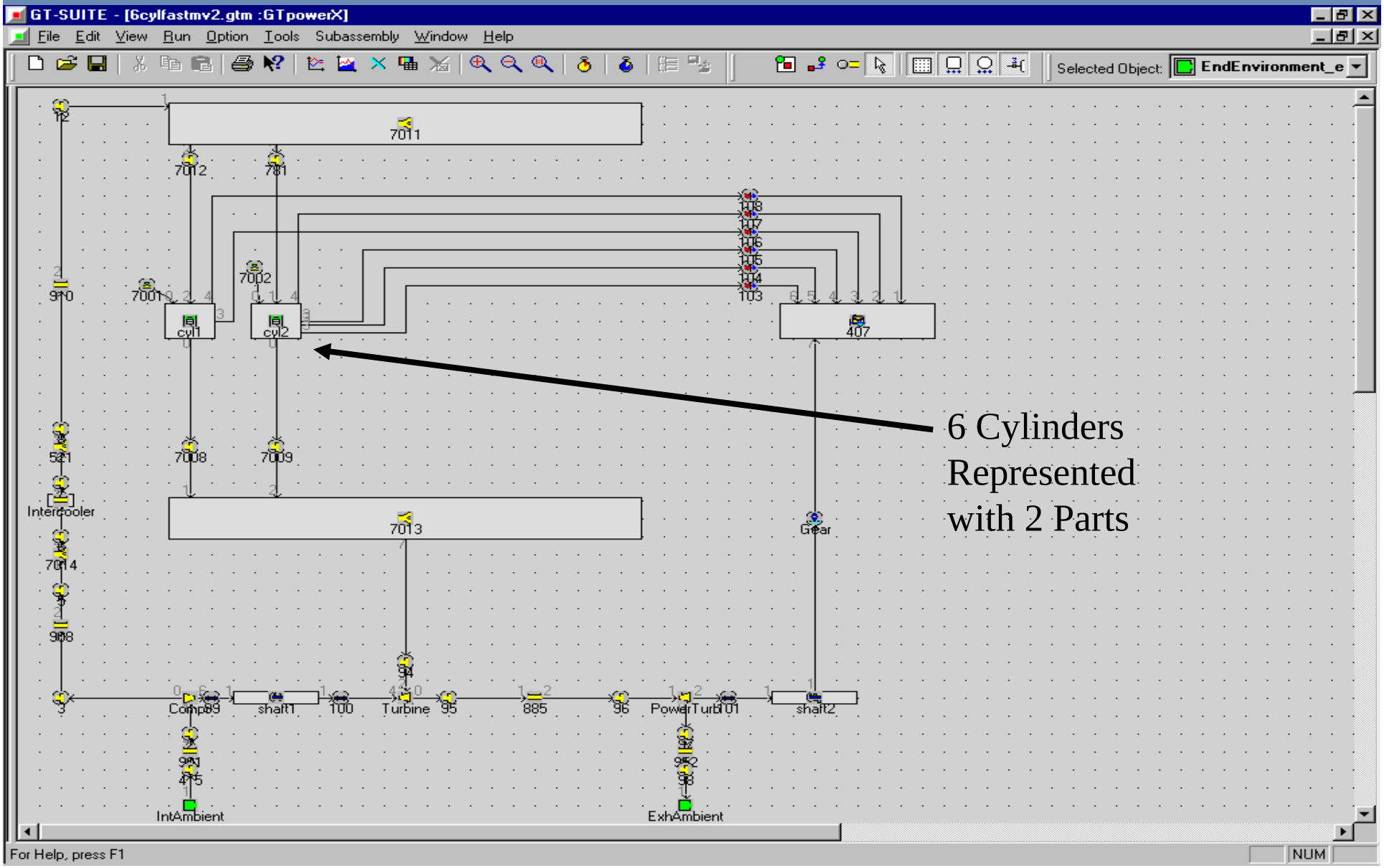
2: CYLINDERS REPLACED



3: AIR SYSTEM SIMPLIFIED



4: CYLINDERS COMBINED



CLOSURE

- **Offers suitable level of detail for control system development efforts**
- **True sharing of models between development engineers and control engineers**