



ENGI 128

INTRODUCTION TO ENGINEERING SYSTEMS

Lec 12:

Thermodynamics II: Energy Dissipation,
Vehicle Powertrains, and Car Talk

“Understand Your Technical World”

Energy Storage

Potential energy can be stored

- The unit is Joules
- How much work can I do if I discharge, burn, or metabolize this thing?

Power is rate of energy use

- Units are Joules/sec

You can store energy in lots and lots of ways...



Hot Stuff

Because its easy to get things hot!



Gasoline Engine



Gasoline Engine

Converts chemical energy to mechanical energy through *heat*

Four Steps (Strokes):

1. Intake:

- Suck air/fuel in

2. Compression

- Compress the air/fuel mixture

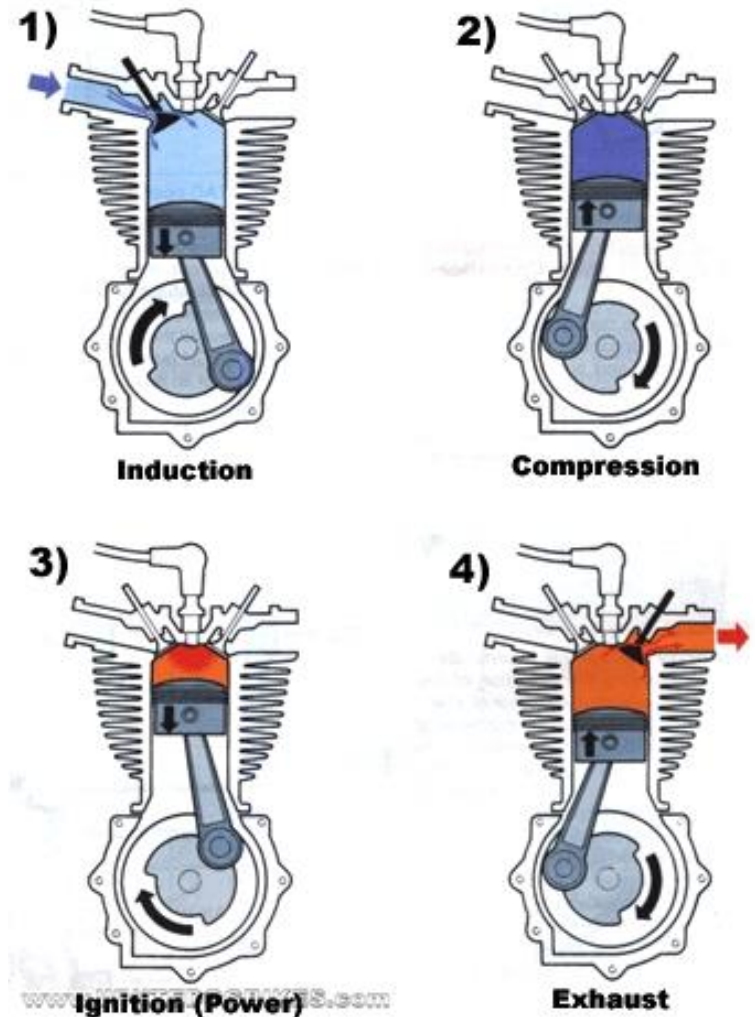
3. Combustion

- Burn the Fuel → Heat the air
→ Expand the air → Move the piston

4. Exhaust

- Push hot air/burnt fuel out

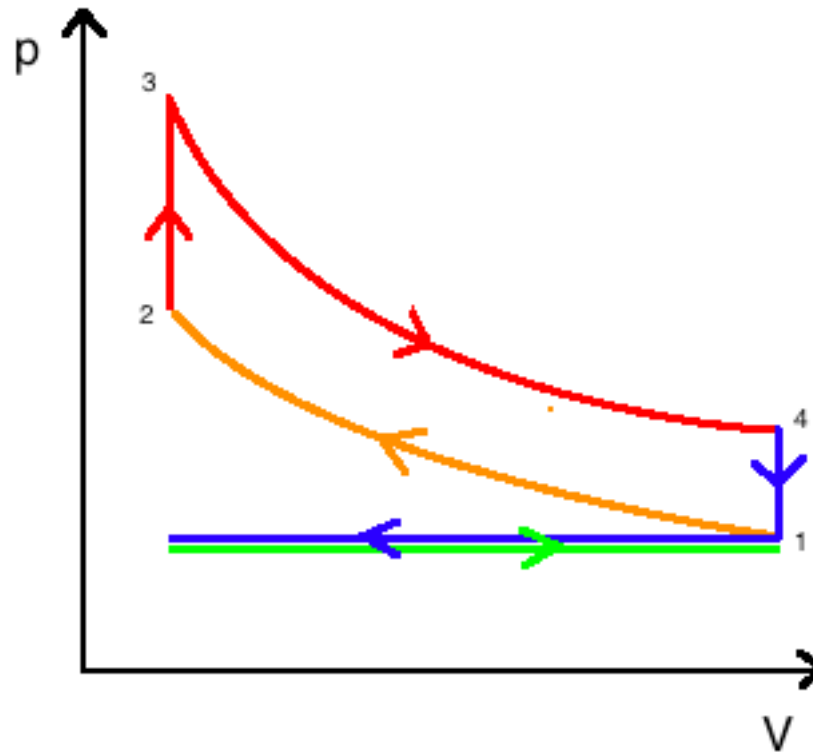
The 4 Stroke Cycle



[engine parts]

Thermodynamics: The Otto Cycle

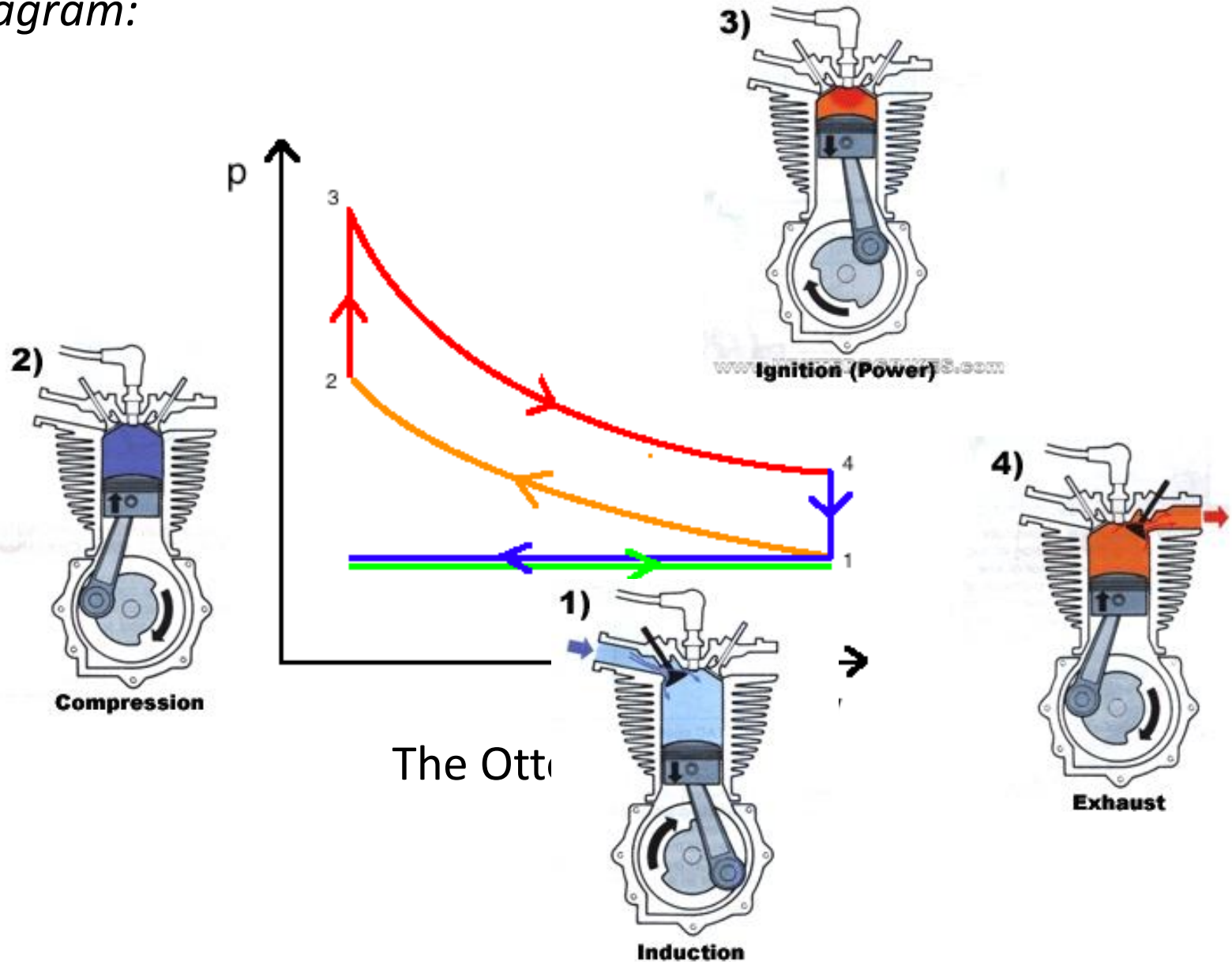
A common way to analyze thermodynamic systems is with a graph of pressure vs. volume: a *P-V Diagram*:



The Otto Cycle

Thermodynamics: The Otto Cycle

P-V Diagram:



[Whiteboard: work done in PV diagram]

Reversibility

Is the Otto cycle reversible?

What about the steam engine?

Why or why not?

Energy Dissipation

Brakes

Honda CBR600RR



Converts mechanical energy into thermal energy



Ferrari FXX



Space Shuttle

Energy in low earth orbit

$$e = \frac{1}{2} mv^2$$

$$v = 7,900 \text{ meter/sec}$$

$$m = 100,000 \text{ kg}$$

$$g = 9.8 \text{ m/s}^2$$

$$e = 3,120,500,000,000 \text{ Joules.}$$

Where does it all go?



Heat!

The Space shuttle gets hot! (really hot)...

...and heats up the air around it



Thermodynamics in Reverse: Getting Cold

Getting Somewhat

Getting Somewhat Cold

- Ice Shipping
- Reefer Cars

Getting Cold for real

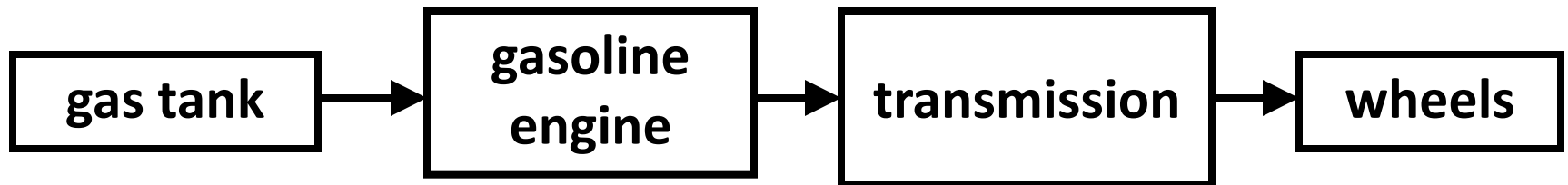
- Mechanical refrigeration
- Reefer Cars, redux

Getting Really Cold

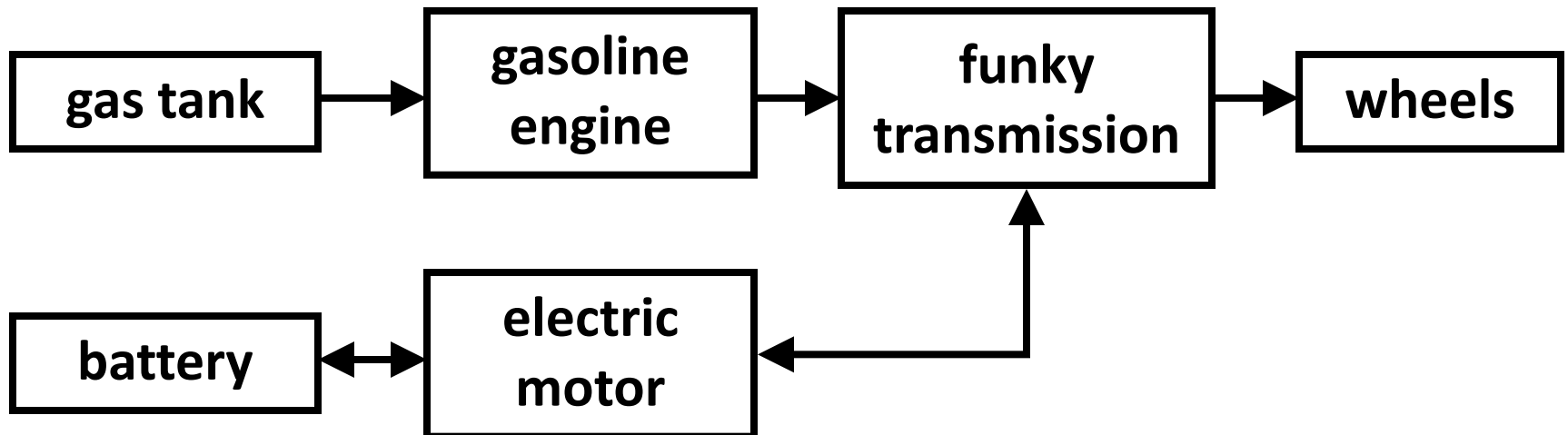
- Low-Temperature Physics

Energy Systems: Powertrains

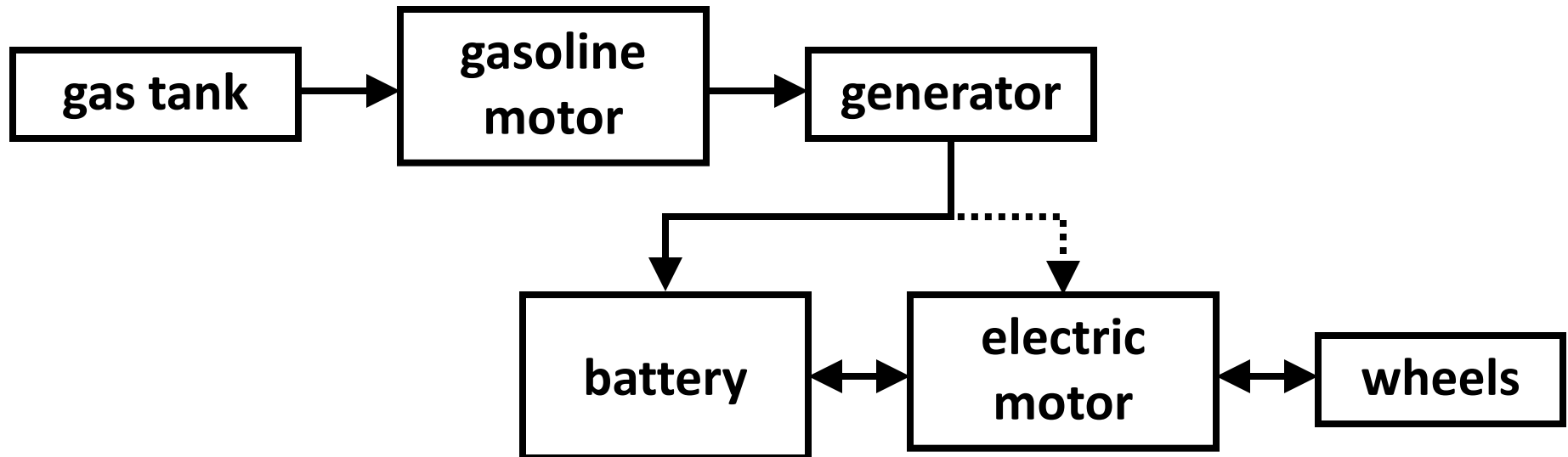
Honda Fit



Toyota Prius



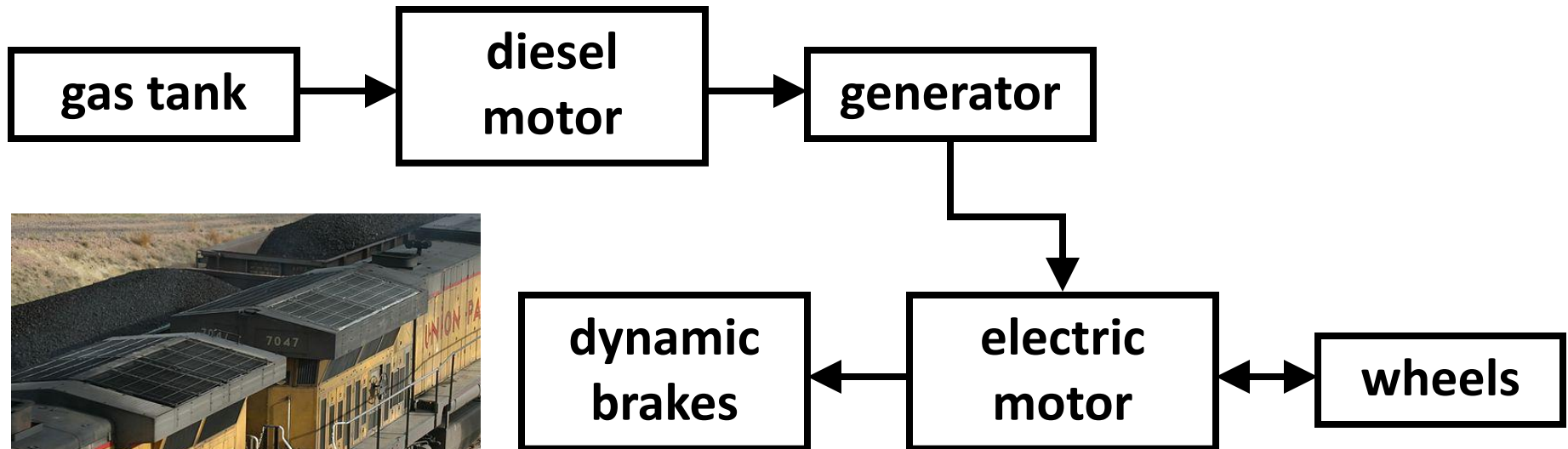
Chevy Volt



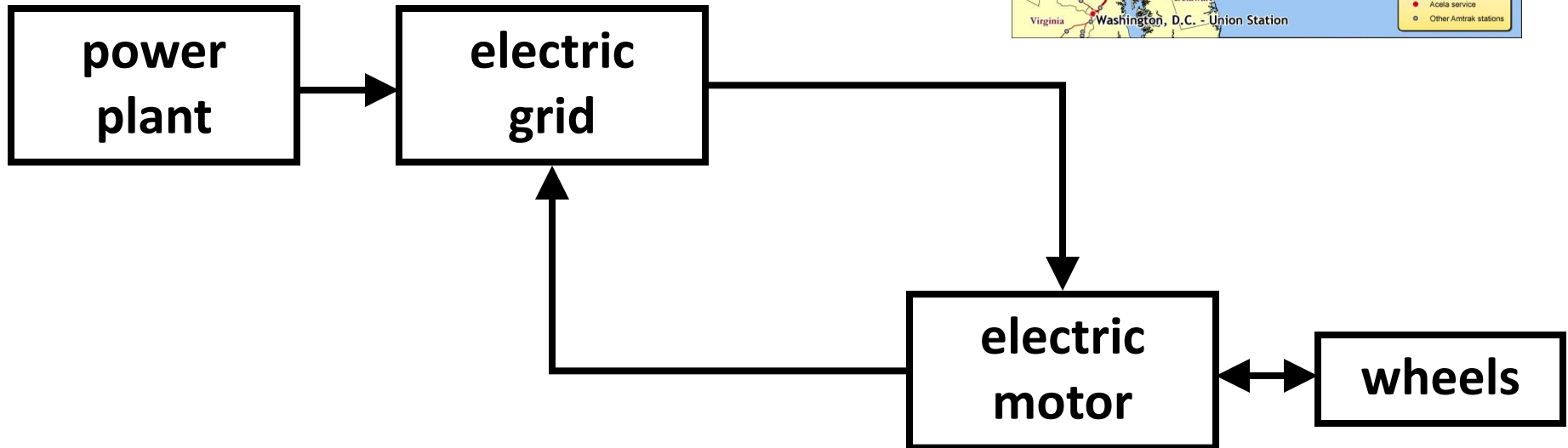
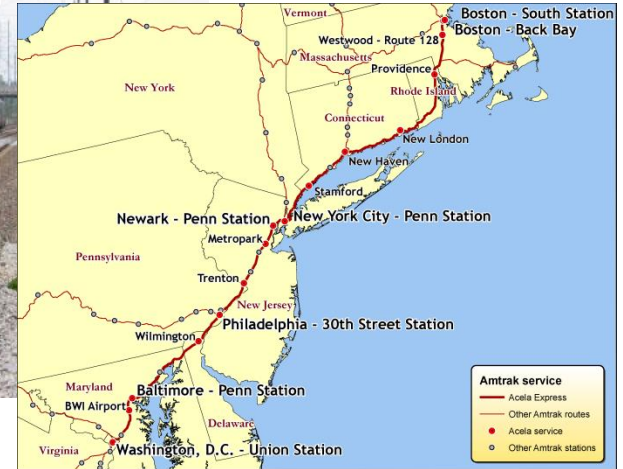
GE AC4400



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Amtrak Acela



Car Talk



Next Class:
DC04
Robot Croquet...
...of Doom!

(Bwah, hah, hah...)



Vehicle Lab