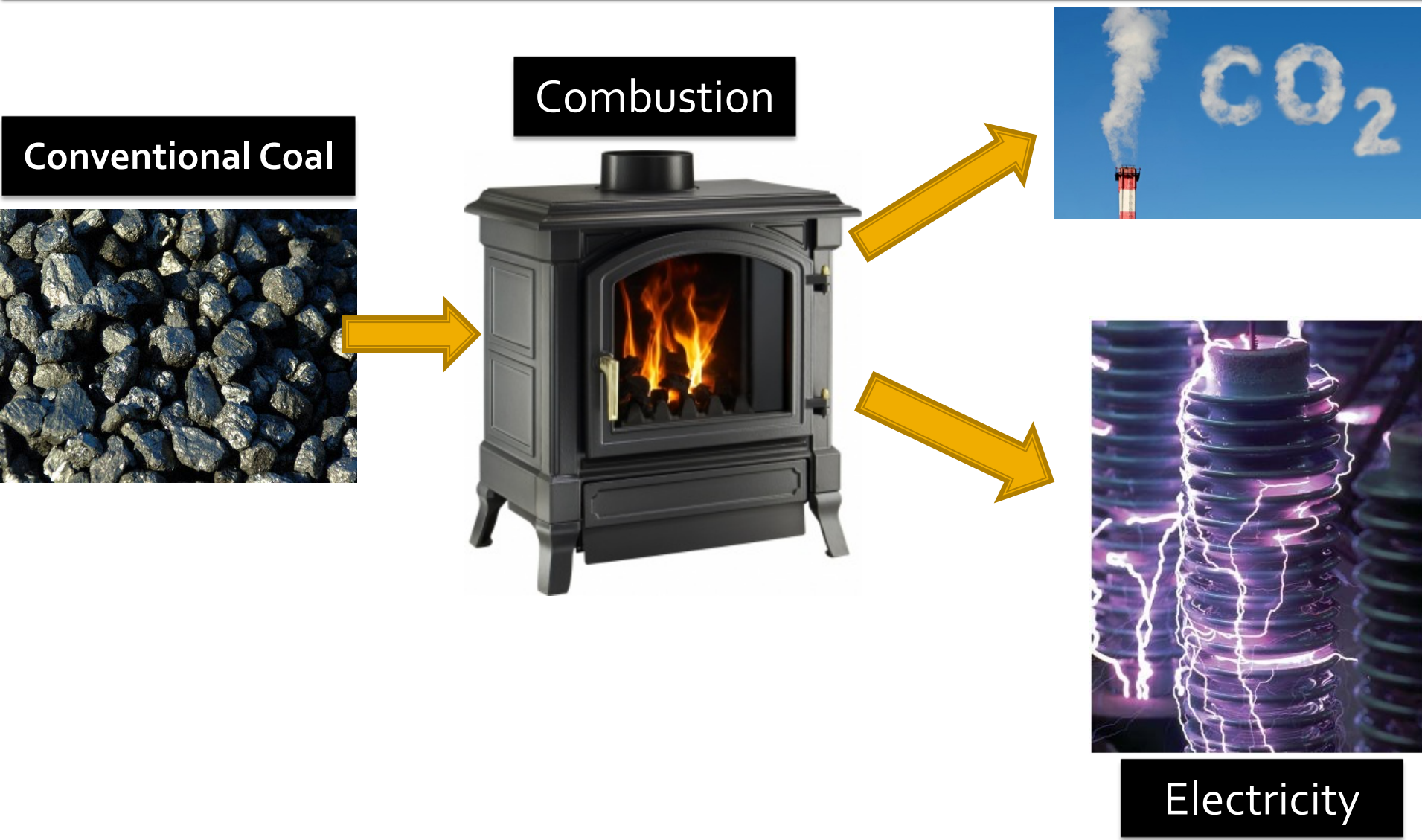


# Carbon Emissions Technology Improvements: Coal

Grateful to Robert McDougall, Dileep Birur, and Terry Walmsley

---

# Coal combustion



# Emissions intensity (EI) technology effect

Conventional  
Coal



LOW  
CARBS

SUGAR  
FREE

EI

technology

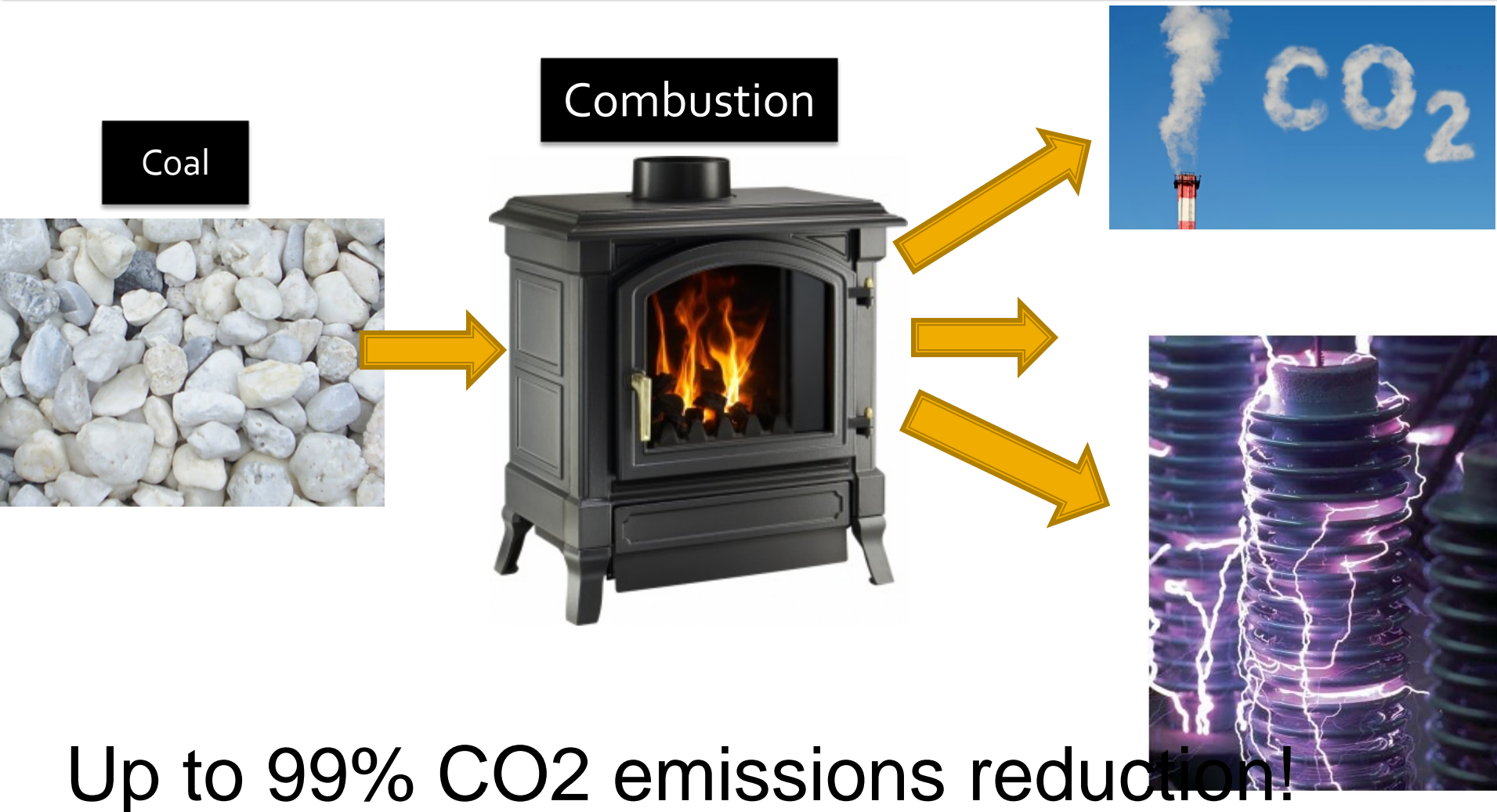
Clean Coal



99%

SUGAR  
New!

# “Clean COAL” combustion with EI



Up to 99% CO<sub>2</sub> emissions reduction!

# El assumptions

- Assume El is cost free
  - Therefore we get free “sugar” (coal)
- Utilized by all regions

# The most crucial assumption:

**Sugar free = Free sugar**  
**(Coal tech costs = Clean coal tech costs)**

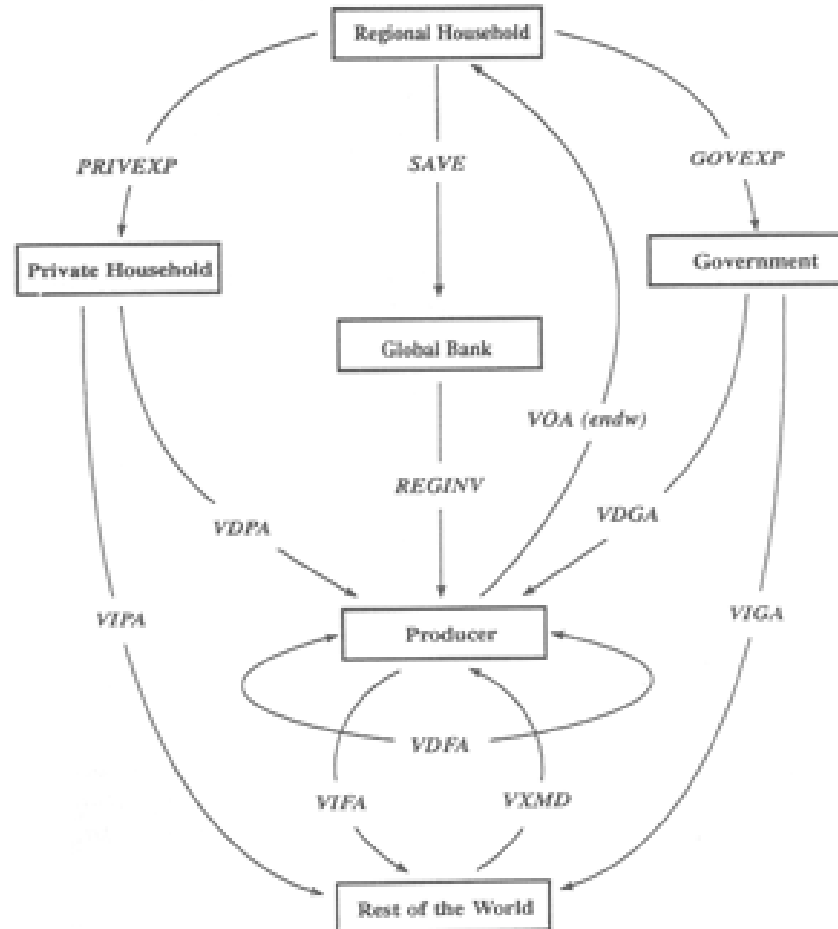
**CO<sub>2</sub> capturing costs = Efficiency gain**

# Extension to GTAP-E emission accounting

- GTAP-E accounts for emissions
  - Main model equation...  $gco2pd(i,r) = qpd(i,r);$
- Extend the emissions accounts to also capture Emission Intensity (EI)
  - EI represents emissions reduction technology
  - Levels equation...  $GCO_2PD = QPD * EI$
  - Updated main model equation becomes...  
 $gco2pd(i,r) = qpd(i,r) + ei(i,r);$

# Shock the model $\Rightarrow$ Results

El shock

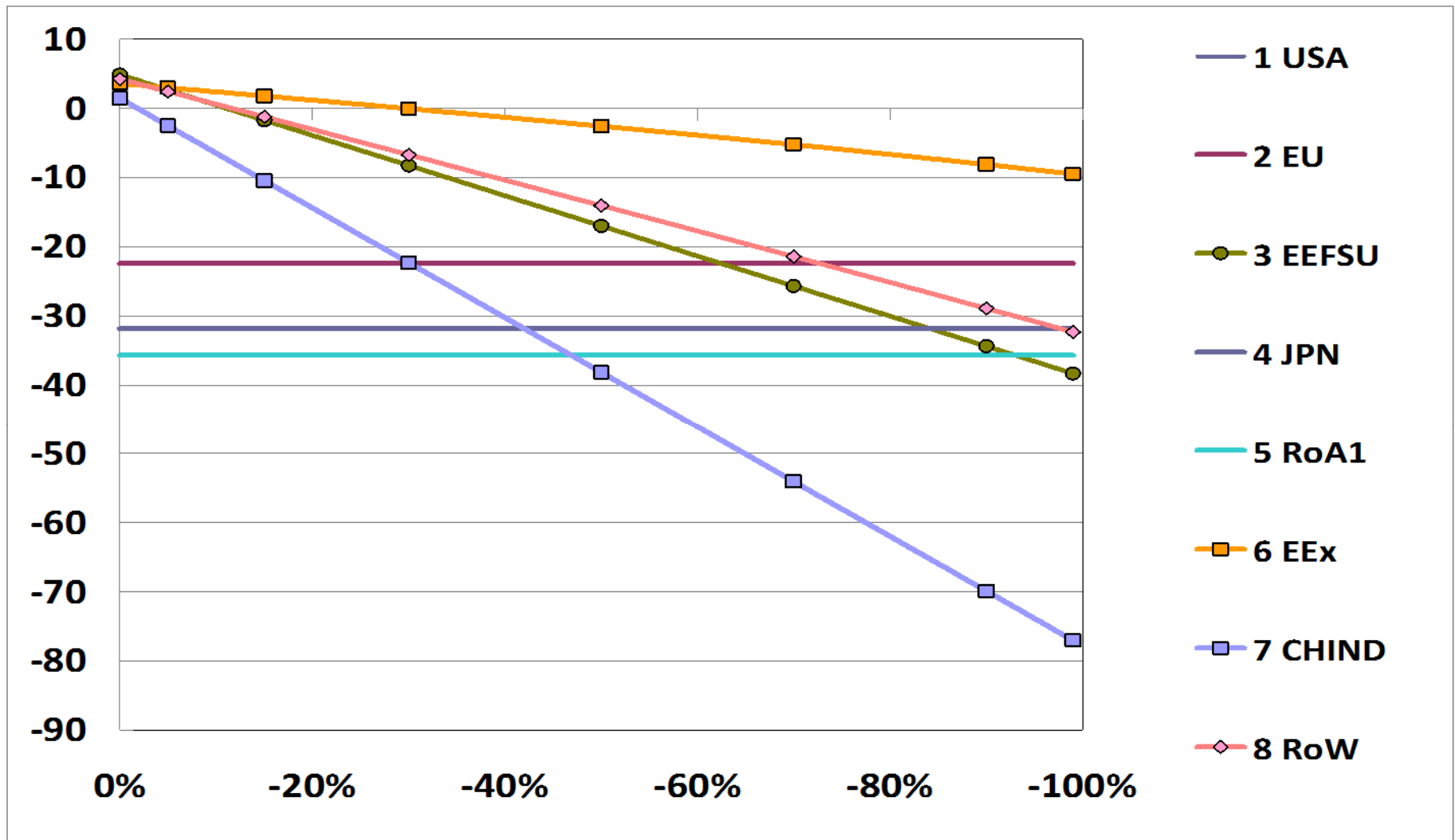


Results

34 sec  
😊  
Thanks to Mark!



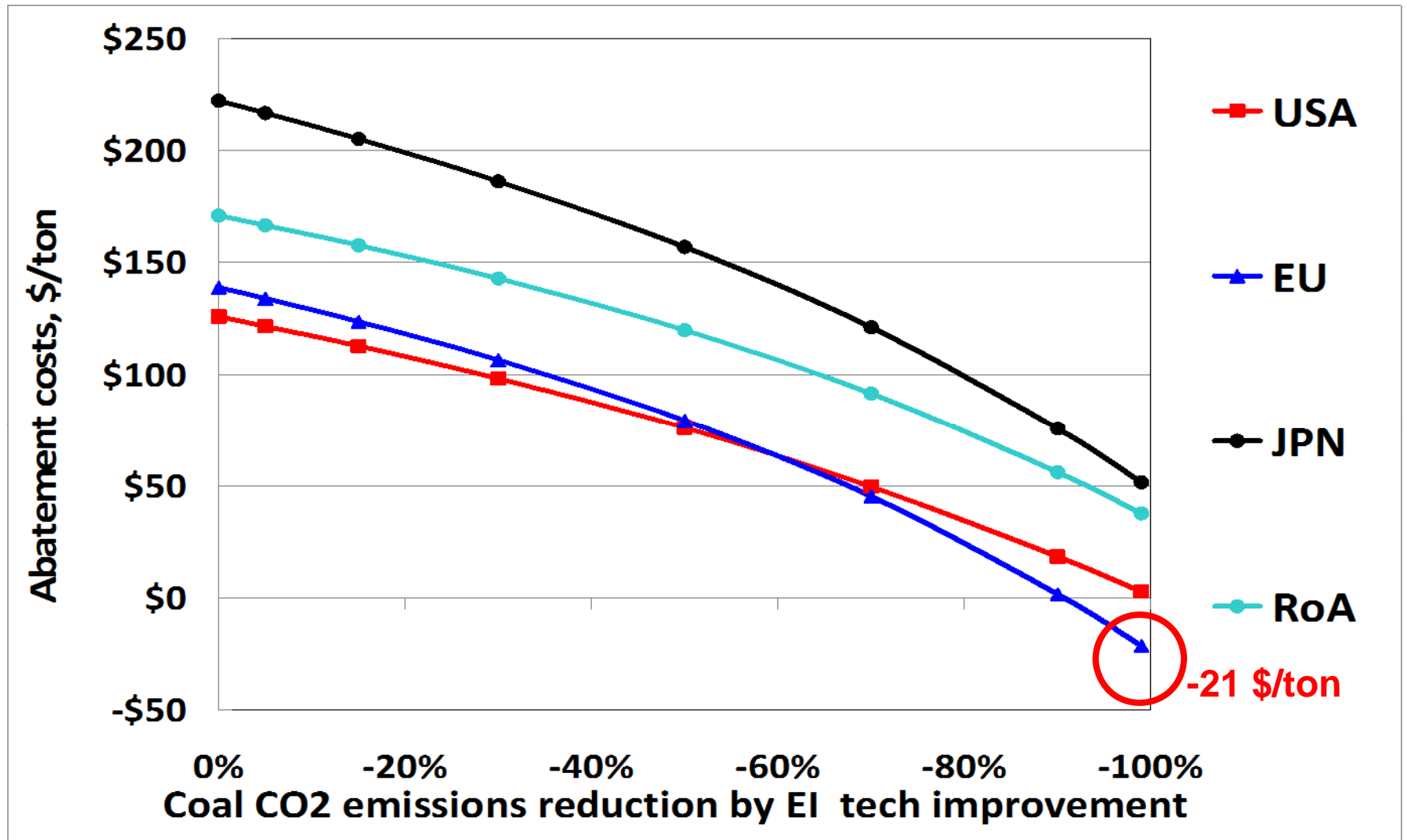
# Percent reduction in emissions



# Welfare effect with EI

	0%	-5%	-30%	-90%	-99%
USA	-0.24	-0.23	-0.17	-0.02	0
EU	-0.39	-0.37	-0.27	0.06	0.12
EEFSU	-0.4	-0.4	-0.35	-0.07	0.02
JPN	-0.53	-0.51	-0.44	-0.2	-0.15
RoA1	-1.19	-1.17	-1	-0.36	-0.21
EEx	-1	-0.98	-0.85	-0.23	-0.06
CHIND	0.08	0.08	0.06	0.01	0
RoW	0.16	0.16	0.14	0.04	0.01

# Abatement costs (carbon tax) per ton of carbon emissions (1997 USD)



# Leakages before and after EI tech

	<b>% reduction in Emissions no EI</b>	<b>% reduction in Emissions EI = -90%</b>
<b>Leakage rate (incl. EEFSU)</b>	<b>11%</b>	<b>-134%</b>
<b>Leakage rate (excl. EEFSU)</b>	<b>7%</b>	<b>-82%</b>

# Resume:

- Introduction of EI tech:
  - achieves Kyoto targets without emissions trading
  - Non-Annex I countries reduce emissions
  - Improvement in welfare in EU, EEFSU and RoW
  - Leakages are eliminated
- **Highly recommend “EI” or “Clean coal” or “Sugar” technology be invented**

**Thank you for your attention!**