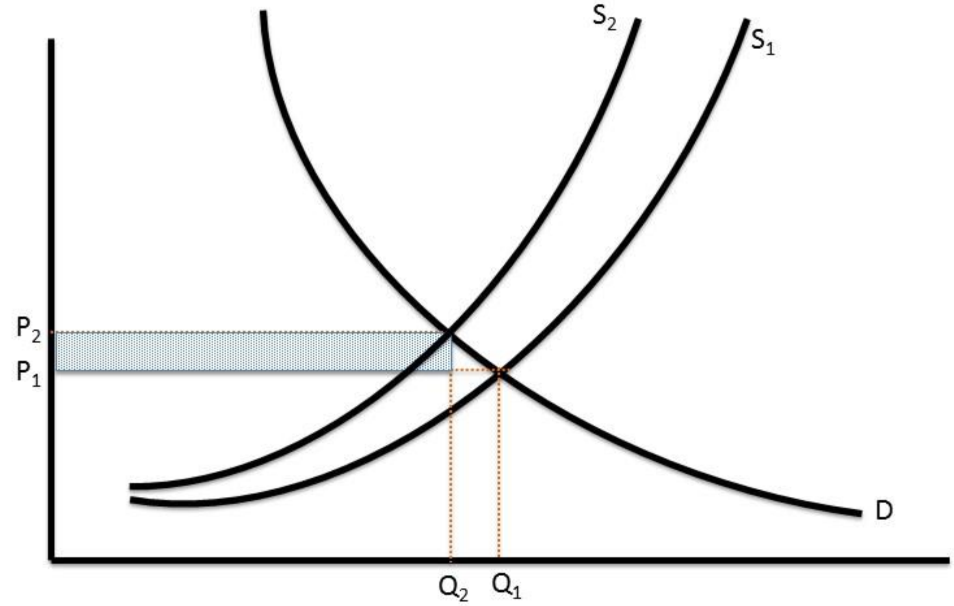
Calculation of wealth transfer from keeping California's oil in the ground



The figure above is not to scale, but illustrates the calculation. The curtailment of California oil production shifts the supply curve from S_1 to S_2, lowering production from Q_1 to Q_2 and raising price from P_1 to P_2. The transfer of wealth on the remaining Q_2 units sold is the difference between P_2 and P_1 multiplied by Q_2, *i.e.*, the shaded rectangle.

The range of demand elasticities that Stockholm Environment Institute considers is -0.25 to -0.3, while the supply elasticity range they analyze is 0.2 to 1.0. As SEI points out, the change in world oil consumption for every barrel of reduced California supply is the ratio of the demand elasticity to the supply elasticity minus the demand elasticity: $e_d/(e_s-e_d)$.

The largest change would occur if supply were less elastic (0.2) and demand were more elastic (-0.3): -0.3 / (0.2-(-0.3)) = -0.6, which I will call Case Large. The smallest change would occur if supply were more elastic (1.0) and demand were not so elastic (-0.25): -0.25 / (1.0-(-0.25)) = -0.2, which I will call Case Small.

One can do the wealth transfer calculation for a 1 barrel reduction, but to avoid many zeros after decimal points, I consider a more realistic 100,000 barrel per day (bpd) reduction in California's production.

As shown above, For Case Large, this would cause a market-wide reduction in consumption of -0.6 x 100,000 = 60,000 bpd (shown as Q_1 minus Q_2 in the figure) or about 0.06% of world consumption (assuming worldwide consumption of about 100 million bpd). Given the -0.3 demand elasticity, this means that the world price must have risen by 0.2% (-0.06/0.2= -0.3). With a base price of $70/barrel (and assuming the real price of oil would otherwise stay constant) this implies a price increase of $0.14/barrel ($P_2$ minus P_1 in the figure). The total transfer from consumers to producers is then $14m (99.94m barrels X $0.14/barrel) per day, which is the shaded rectangle in the figure above. At 0.5 ton GHG/barrel (SEI's number) – a 30,000 ton per day reduction from 60,000 bpd reduction in consumption -- that means the wealth transfer from consumers to producers is $467 per ton of reduced GHGs (=$14m/30,000 tons).

For Case Small, this would cause a market-wide reduction in consumption of 20,000 bpd (Q_1 minus Q_2 in the figure) or about 0.02% of world consumption (assuming worldwide consumption of about 100 million bpd). Given the -0.25 demand elasticity, this means that the world price must have risen by 0.08% (-0.02/0.08= -0.25). With a base price of $70/barrel (and assuming the real price of oil stays constant) this implies a price increase of $0.056/barrel ($P_2$ minus P_1 in the figure). The total transfer from consumers to producers is then $5.6m (99.98m barrels X $0.056/barrel) per day, which is the shaded rectangle in the figure above. At 0.5 ton GHG/barrel (SEI's number) – 10,000 ton per day reduction from 20,000 bpd -- that means the reduced GHG induces a transfer from consumers to producers of $560 per ton (=$5.6m/10,000 tons).

If one takes the mean of the demand elasticity SEI considers, -0.275 (SEI considers from -0.25 to -0.3), and the mean of their supply elasticity range, 0.6 (SEI considers from 0.2 to 1.0), the change in world oil consumption for every barrel of reduced California supply is: -0.275 / (0.6-(-0.275)) = -0.31.

This implies that a 100,000 bpd reduction in California supply would cause a market-wide reduction in consumption of 31,000 bpd (Q_1 minus Q_2 in the figure) or about 0.031% of world consumption (again assuming worldwide consumption of about 100 million bpd). Given the -0.275 demand elasticity, this means that the world price must have risen by 0.113% (-0.031/0.113= -0.275). With a base price of $70/barrel, this implies a price increase of $0.0791/barrel ($P_2$ minus P_1 in the figure). The total transfer from consumers to producers is then \$7.9m (99.97m barrels X \$0.0791/barrel) per day. At 0.5 ton GHG/barrel this is a 15,500 ton per day reduction, so the reduced GHG induces a transfer from consumers to producers of \$510 per ton (=\$7.9m/15,500 tons).

Finally, one can also put together the price increase with the GHG content of 0.5 ton/barrel to calculate that this policy would be the equivalent of a worldwide tax on GHGs of between \$0.11/ton (Case Small) and \$0.28/ton (Case Large), or \$0.16/ton based on the mean demand and supply elasticities SEI assumes.