

8 March 2011

AFOLU Guidance: Example for Calculating the Long-Term Average Carbon Stock for ARR Projects with Harvesting

As set out in VCS document *AFOLU Requirements*, ARR or IFM projects with harvesting shall include the loss of carbon due to harvesting in the quantification of project emissions. This document provides examples for calculating the long-term average carbon stock for a variety of ARR projects scenarios with harvesting. The same ideas can be applied to IFM projects with harvesting.

Scenario 1: ARR project with a small harvest at the end of the harvest cycle

An ARR project is developed on grassland where the GHG emission reductions and removals in the baseline scenario (BE) are 20 tCO₂e annually. The project crediting period is 20 years and the harvest cycle is 21 years. A harvest of approximately half the standing stock is planned in year 21. This simplified scenario assumes no project or leakage emissions of CO₂, N₂O or CH₄ are generated from activities in the project scenario.

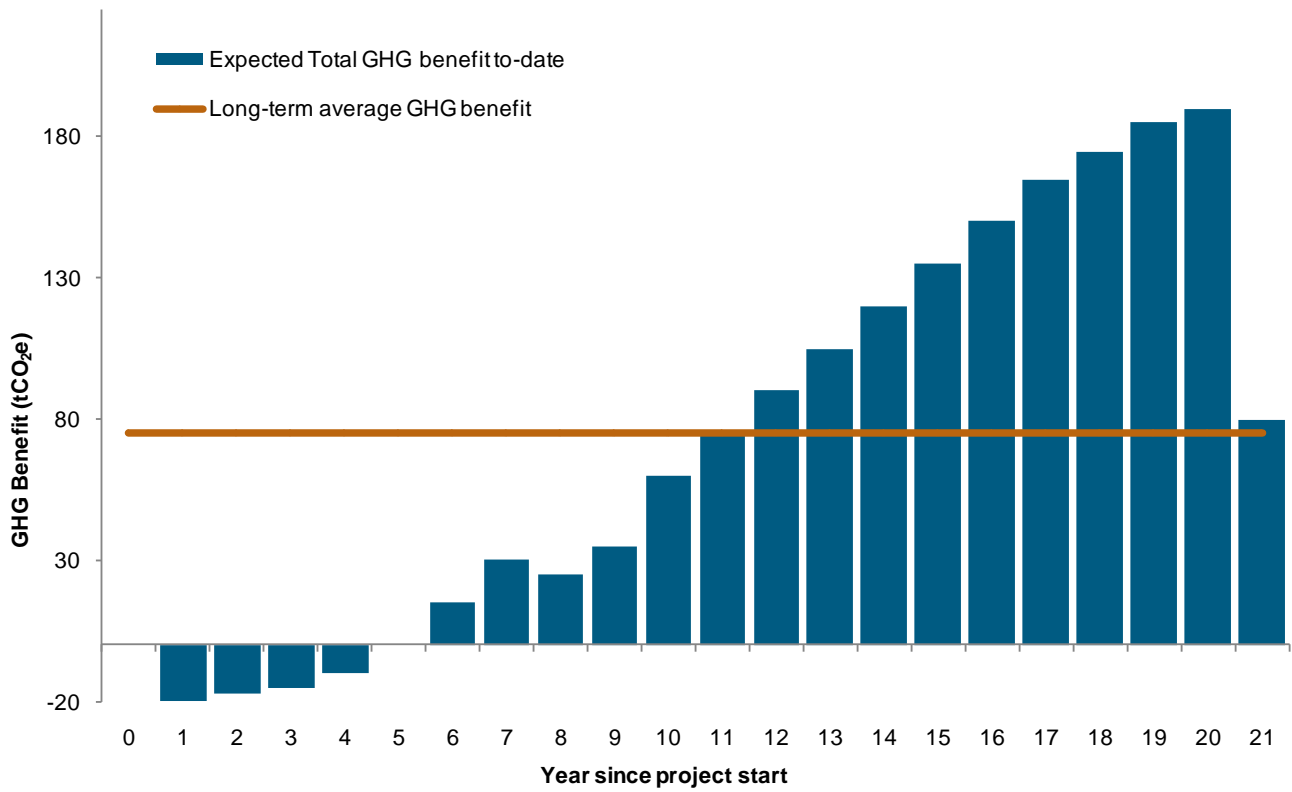
In year one, the project begins with clearing the land. In the following years, carbon is sequestered as aboveground biomass from ARR activities.

The second column shows the to-date GHG emission reductions and removals in the project scenario. The annual change in GHG benefit is the additional GHG emissions reduced or removed each year in the project scenario ($PE_t - PE_{t-1}$). The expected total GHG benefit column shows for every year the to-date GHG emission reductions and removals from the project scenario minus the baseline scenario ($PE_t - BE_t$). The long-term average GHG benefit (LA) is determined by averaging the expected total GHG benefit for the length of the project (74.88 tCO₂e in this scenario). The final column is the total number of GHG credits available to the project. This amount is subject to buffer withholding.

The amount of credits issued to the project begins when the project is reducing or removing emissions in the project scenario relative to the baseline scenario (ie, year six). For each year, the net removals are issued as credits until the long-term average is reached. In this example, the long-term average is reached in year 11.

	Baseline scenario: to-date GHG emission reductions and removals at year t	Project scenario: to-date GHG emission reductions and removals at year t	Annual change in GHG benefit	Expected total GHG benefit to-date	Total credits available each year
Year	tCO ₂ e	tCO ₂ e	tCO ₂ e	tCO ₂ e	VCUs
t	BE	PE	$PE_t - PE_{t-1}$	$PE_t - BE_t$	
0	20	20	0	0	0
1	20	0	-20	-20	0
2	20	2.5	2.5	-17.5	0
3	20	5	2.5	-15	0
4	20	10	5	-10	0
5	20	20	10	0	0
6	20	35	15	15	15
7	20	50	15	30	15
8	20	45	-5	25	0
9	20	55	10	35	10
10	20	80	25	60	25
11	20	95	15	75	9.88
12	20	110	15	90	0
13	20	125	15	105	0
14	20	140	15	120	0
15	20	155	15	135	0
16	20	170	15	150	0
17	20	185	15	165	0
18	20	195	10	175	0
19	20	205	10	185	0
20	20	210	5	190	0
21	20	100	-110	80	0
Sum				1572.5	74.88
LA				74.88	

The graph illustrates the expected total GHG benefit of the project and the long-term average.



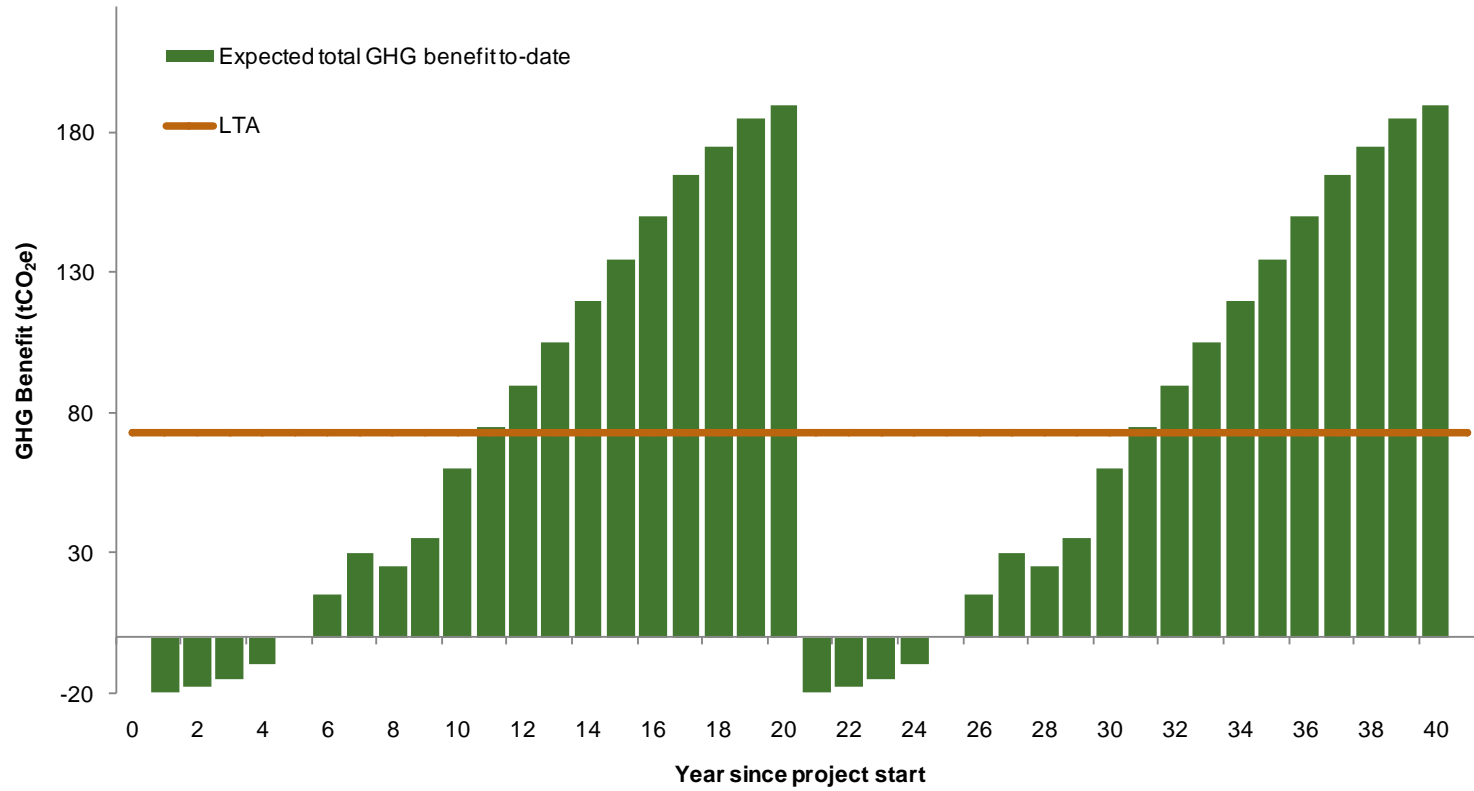
Scenario 2: ARR project with two harvest cycles and a return to baseline at the end of the harvest cycle

An ARR project is developed on grassland where the GHG emission reductions and removals in the baseline scenario (BE) are 20 tCO₂e annually. The project crediting period is 40 years. A harvest of all the standing stock is planned in year 41. The long-term average GHG benefit shall be calculated over the 41 year period. This simplified scenario assumes no project or leakage emissions of CO₂, N₂O or CH₄ are generated from activities in the project scenario.

The method for calculating the long-term average GHG benefit is the same for scenario 2 as in scenario 1 above. Because of the expected harvest, the long-term average GHG benefit (LA) is 72.80 tCO₂e in this scenario.

The graph on the following page illustrates the expected total GHG benefit of the project and the long-term average.

Year <i>t</i>	Baseline scenario: to-date GHG emission reductions and removals at year <i>t</i>	Project scenario: to-date GHG emission reductions and removals at year <i>t</i>	Annual change in GHG benefit	Expected total GHG benefit to-date	Total credits available each year
	tCO ₂ e	tCO ₂ e	tCO ₂ e	tCO ₂ e	VCUs
	<i>BE</i>	<i>PE</i>	$PE_t - PE_{t-1}$	$PE_t - BE_t$	
0	20	20	0	0	0
1	20	0	-20	-20	0
2	20	2.5	2.5	-17.5	0
3	20	5	2.5	-15	0
4	20	10	5	-10	0
5	20	20	10	0	0
6	20	35	15	15	15
7	20	50	15	30	15
8	20	45	-5	25	0
9	20	55	10	35	10
10	20	80	25	60	25
11	20	95	15	75	7.80
12	20	110	15	90	0
13	20	125	15	105	0
14	20	140	15	120	0
15	20	155	15	135	0
16	20	170	15	150	0
17	20	185	15	165	0
18	20	195	10	175	0
19	20	205	10	185	0
20	20	210	5	190	0
21	20	0	-210	-20	0
22	20	2.5	2.5	-17.5	0
23	20	5	2.5	-15	0
24	20	10	5	-10	0
25	20	20	10	0	0
26	20	35	15	15	0
27	20	50	15	30	0
28	20	45	-5	25	0
29	20	55	10	35	0
30	20	80	25	60	0
31	20	95	15	75	0
32	20	110	15	90	0
33	20	125	15	105	0
34	20	140	15	120	0
35	20	155	15	135	0
36	20	170	15	150	0
37	20	185	15	165	0
38	20	195	10	175	0
39	20	205	10	185	0
40	20	210	5	190	0
41	20	20	-190	0	0
Sum				2985	72.80
LA				72.80	



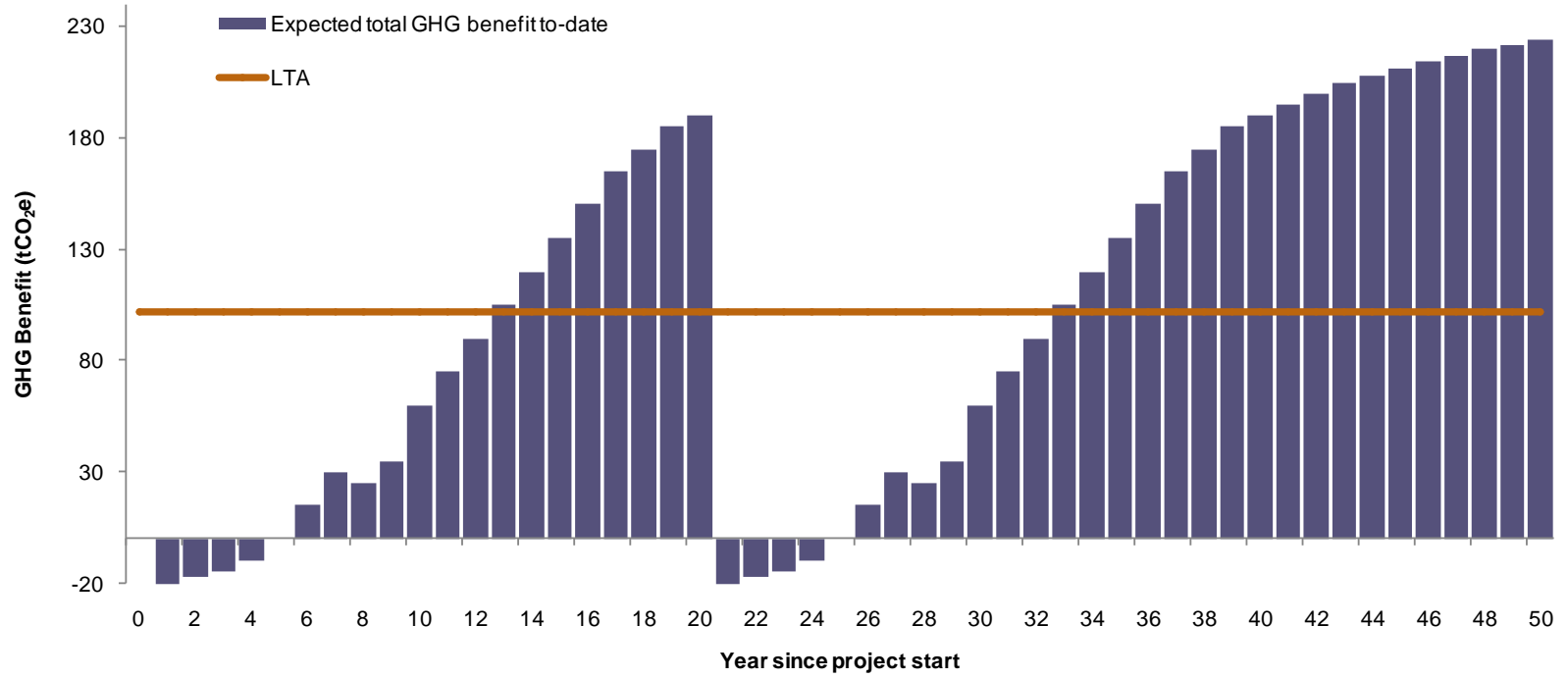
Scenario 3: ARR Project under a conservation easement and no intention to harvest after the project crediting period, with one planned harvest event

An ARR project is developed on grassland where the GHG emission reductions and removals in the baseline scenario (BE) are 20 tCO₂e annually. The project crediting period is 50 years because the project is under a conservation easement and does not intend to harvest after the project crediting period. A harvest event is planned in year 21 and there is no intention to harvest following year 21. This simplified scenario assumes no project or leakage emissions of CO₂, N₂O or CH₄ are generated from activities in the project scenario.

The long-term average GHG benefit (LA) is 102.02 tCO₂e in this scenario.

The graph on the following page illustrates the expected total GHG benefit of the project and the long-term average.

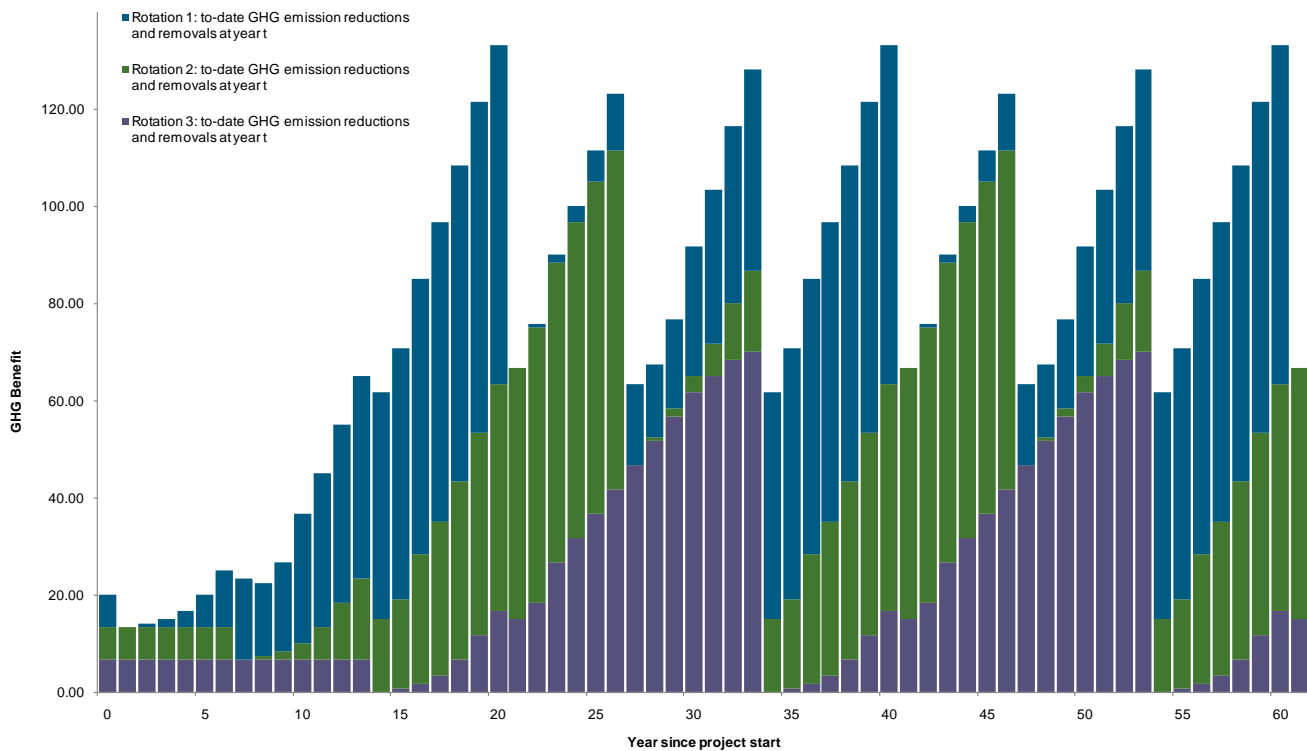
Year <i>t</i>	Baseline scenario: to-date GHG emission reductions and removals at year <i>t</i>	Project scenario: to-date GHG emission reductions and removals at year <i>t</i>	Annual change in GHG benefit	Expected total GHG benefit to-date	Total credits available each year
	tCO ₂ e	tCO ₂ e	tCO ₂ e	tCO ₂ e	VCUs
	BE	PE	PE _{<i>t</i>} - PE _{<i>t-1</i>}	PE _{<i>t</i>} - BE _{<i>t</i>}	
0	20	20	0	0	0
1	20	0	-20	-20	0
2	20	2.5	2.5	-17.5	0
3	20	5	2.5	-15	0
4	20	10	5	-10	0
5	20	20	10	0	0
6	20	35	15	15	15
7	20	50	15	30	15
8	20	45	-5	25	0
9	20	55	10	35	10
10	20	80	25	60	25
11	20	95	15	75	15
12	20	110	15	90	15
13	20	125	15	105	7.02
14	20	140	15	120	0.00
15	20	155	15	135	0
16	20	170	15	150	0
17	20	185	15	165	0
18	20	195	10	175	0
19	20	205	10	185	0
20	20	210	5	190	0
21	20	0	-210	-20	0
22	20	2.5	2.5	-17.5	0
23	20	5	2.5	-15	0
24	20	10	5	-10	0
25	20	20	10	0	0
26	20	35	15	15	0
27	20	50	15	30	0
28	20	45	-5	25	0
29	20	55	10	35	0
30	20	80	25	60	0
31	20	95	15	75	0
32	20	110	15	90	0
33	20	125	15	105	0
34	20	140	15	120	0
35	20	155	15	135	0
36	20	170	15	150	0
37	20	185	15	165	0
38	20	195	10	175	0
39	20	205	10	185	0
40	20	210	5	190	0
41	20	215	5	195	0
42	20	220	5	200	0
43	20	225	5	205	0
44	20	228	3	208	0
45	20	231	3	211	0
46	20	234	3	214	0
47	20	237	3	217	0
48	20	240	3	220	0
49	20	242	2	222	0
50	20	244	2	224	0
Sum				2985	102.02
LA				102.02	



Scenario 4: ARR project with a rotational planting and harvest cycle

An ARR project is developed on grassland where the GHG emission reductions and removals in the baseline scenario (BE) are 20 tCO₂e annually. The project crediting period is 61 years. Trees are planted in three plots at staggered intervals every seven years. This simplified scenario assumes no project or leakage emissions of CO₂, N₂O or CH₄ are generated from activities in the project scenario.

The following graph illustrates the project scenario GHG emission reductions and removals over time from each rotation.



The table and graph on the following two pages illustrate the expected total GHG benefit of the project and the long-term average GHG benefit (LA) is 60.45 tCO₂e in this scenario.

Year <i>t</i>	Baseline scenario: to-date GHG emission reductions and removals at year <i>t</i>	Rotation 1: to-date GHG emission reductions and removals at year <i>t</i>	Rotation 2: to-date GHG emission reductions and removals at year <i>t</i>	Rotation 3: to-date GHG emission reductions and removals at year <i>t</i>	Project scenario: to-date GHG emission reductions and removals at year <i>t</i>	Annual change in GHG benefit	Expected Total GHG benefit to-date	Total credits available to be issued each year
	tCO ₂ e	tCO ₂ e	tCO ₂ e	tCO ₂ e	tCO ₂ e	PE _t - PE _{t-1}	tCO ₂ e	VCUs
0	20	6.67	6.67	6.67	20.00	0.00	0.00	0
1	20	0.00	6.67	6.67	13.33	-6.67	-6.67	0
2	20	0.83	6.67	6.67	14.17	0.83	-5.83	0
3	20	1.67	6.67	6.67	15.00	0.83	-5.00	0
4	20	3.33	6.67	6.67	16.67	1.67	-3.33	0
5	20	6.67	6.67	6.67	20.00	3.33	0.00	0
6	20	11.67	6.67	6.67	25.00	5.00	5.00	0
7	20	16.67	0.00	6.67	23.33	-1.67	3.33	0
8	20	15.00	0.83	6.67	22.50	-0.83	2.50	0
9	20	18.33	1.67	6.67	26.67	4.17	6.67	0
10	20	26.67	3.33	6.67	36.67	10.00	16.67	13
11	20	31.67	6.67	6.67	45.00	8.33	25.00	8
12	20	36.67	11.67	6.67	55.00	10.00	35.00	10
13	20	41.67	16.67	6.67	65.00	10.00	45.00	10
14	20	46.67	15.00	0.00	61.67	-3.33	41.67	0
15	20	51.67	18.33	0.83	70.83	9.17	50.83	6
16	20	56.67	26.67	1.67	85.00	14.17	65.00	12.96
17	20	61.67	31.67	3.33	96.67	11.67	76.67	0
18	20	65.00	36.67	6.67	108.33	11.67	88.33	0
19	20	68.33	41.67	11.67	121.67	13.33	101.67	0
20	20	70.00	46.67	16.67	133.33	11.67	113.33	0
21	20	0.00	51.67	15.00	66.67	-66.67	46.67	0
22	20	0.83	56.67	18.33	75.83	9.17	55.83	0
23	20	1.67	61.67	26.67	90.00	14.17	70.00	0
24	20	3.33	65.00	31.67	100.00	10.00	80.00	0
25	20	6.67	68.33	36.67	111.67	11.67	91.67	0
26	20	11.67	70.00	41.67	123.33	11.67	103.33	0
27	20	16.67	0.00	46.67	63.33	-60.00	43.33	0
28	20	15.00	0.83	51.67	67.50	4.17	47.50	0
29	20	18.33	1.67	56.67	76.67	9.17	56.67	0
30	20	26.67	3.33	61.67	91.67	15.00	71.67	0
31	20	31.67	6.67	65.00	103.33	11.67	83.33	0
32	20	36.67	11.67	68.33	116.67	13.33	96.67	0
33	20	41.67	16.67	70.00	128.33	11.67	108.33	0
34	20	46.67	15.00	0.00	61.67	-66.67	41.67	0
35	20	51.67	18.33	0.83	70.83	9.17	50.83	0
36	20	56.67	26.67	1.67	85.00	14.17	65.00	0
37	20	61.67	31.67	3.33	96.67	11.67	76.67	0
38	20	65.00	36.67	6.67	108.33	11.67	88.33	0
39	20	68.33	41.67	11.67	121.67	13.33	101.67	0
40	20	70.00	46.67	16.67	133.33	11.67	113.33	0
41	20	0.00	51.67	15.00	66.67	-66.67	46.67	0
42	20	0.83	56.67	18.33	75.83	9.17	55.83	0
43	20	1.67	61.67	26.67	90.00	14.17	70.00	0
44	20	3.33	65.00	31.67	100.00	10.00	80.00	0
45	20	6.67	68.33	36.67	111.67	11.67	91.67	0
46	20	11.67	70.00	41.67	123.33	11.67	103.33	0
47	20	16.67	0.00	46.67	63.33	-60.00	43.33	0
48	20	15.00	0.83	51.67	67.50	4.17	47.50	0
49	20	18.33	1.67	56.67	76.67	9.17	56.67	0
50	20	26.67	3.33	61.67	91.67	15.00	71.67	0
51	20	31.67	6.67	65.00	103.33	11.67	83.33	0
52	20	36.67	11.67	68.33	116.67	13.33	96.67	0
53	20	41.67	16.67	70.00	128.33	11.67	108.33	0
54	20	46.67	15.00	0.00	61.67	-66.67	41.67	0
55	20	51.67	18.33	0.83	70.83	9.17	50.83	0
56	20	56.67	26.67	1.67	85.00	14.17	65.00	0
57	20	61.67	31.67	3.33	96.67	11.67	76.67	0
58	20	65.00	36.67	6.67	108.33	11.67	88.33	0
59	20	68.33	41.67	11.67	121.67	13.33	101.67	0
60	20	70.00	46.67	16.67	133.33	11.67	113.33	0
61	20	0.00	51.67	15.00	66.67	-66.67	46.67	0
Sum							3687.50	60.45
LA							60.45	

