ATHENA DPAP Review Q&A

ATHENA

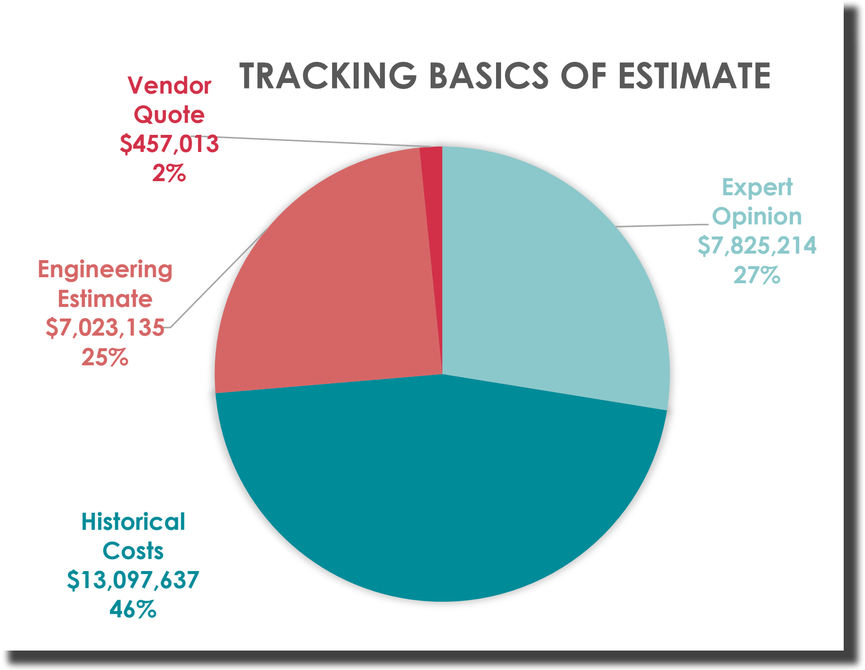
Question: Provide source of costing for each sub-system

EIC Detector Proposal Advisory Panel Meeting, December 13-15, 2021

Question: Provide source of costing by sub-system

- Answer: Fractional breakdown of costing source is shown as a pie-chart for each sub-system:
  - Link to individual costing EXCEL files: https://www.dropbox.com/sh/54l13m8t4h3xcrd/AAAaJ2nKjdUaUKATmG8mhUWBa?dl=0
  - Slide 3 provides costing breakdown by sub-system
  - Tracking: Slides 4-7 (Overview is shown on Slide 4)
  - PID: Slides 8-12 (Overview is shown on Slide 8)
  - Calorimetry: Slides 13-20 (Overview is shown on Slide 13)
  - Far Forward: Slide 21
  - Far Backward: Slide 22
  - DAQ: Slide 23

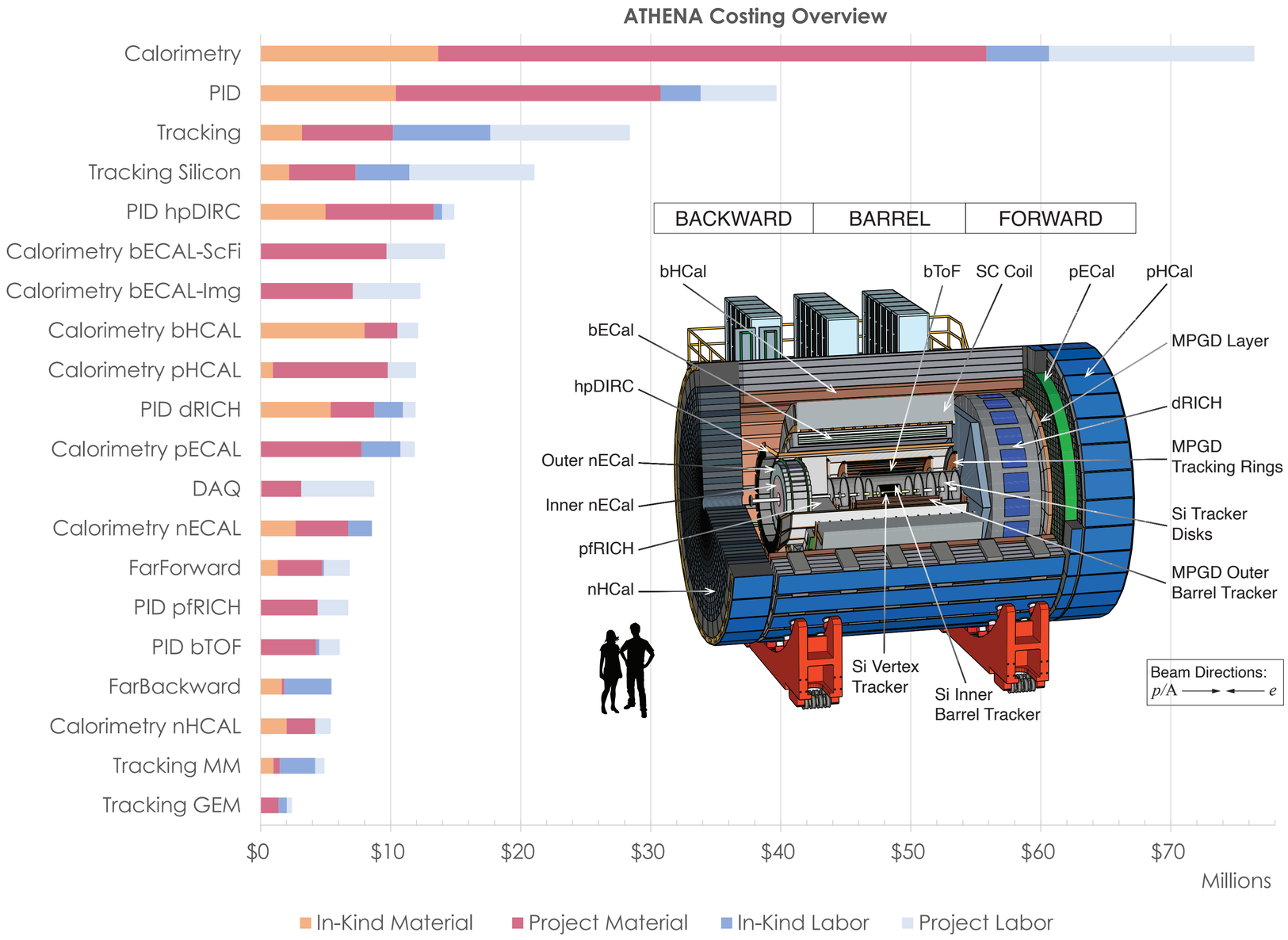
Example for Tracking: Shown for each costing dashboard on top left: Slides 4-23



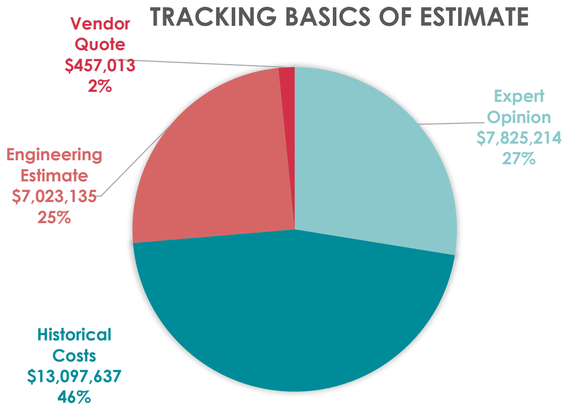
Costing

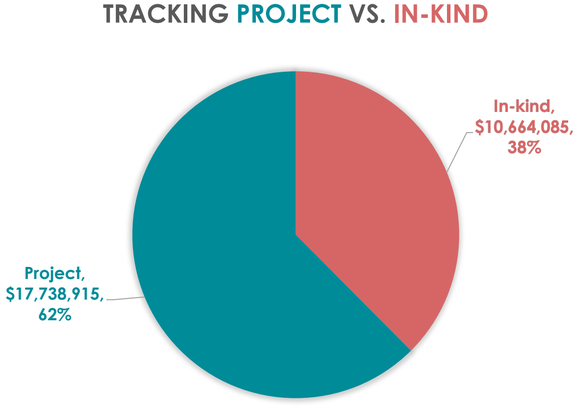
- ATHENA costing for sub-system construction in 2021 USD:
- Largest cost drivers:
  - Calorimetry
  - PID
  - Tracking
- Total for sub-system construction in 2021 USD: $166M

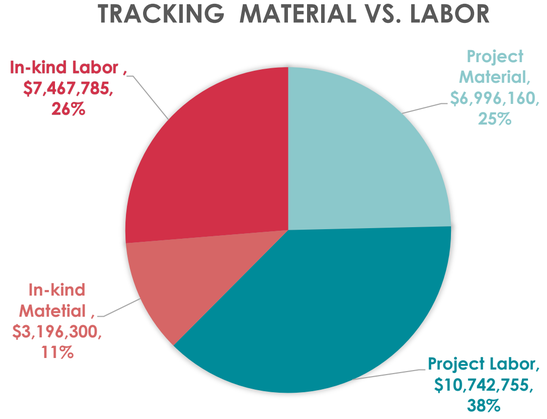
	In-Kind	Project	Total	
Material	$30M	$76M	$106M	64%
Labor	$19M	$40M	$59M	36%
Total	$49M	$116M	$166M	
	30%	70%		

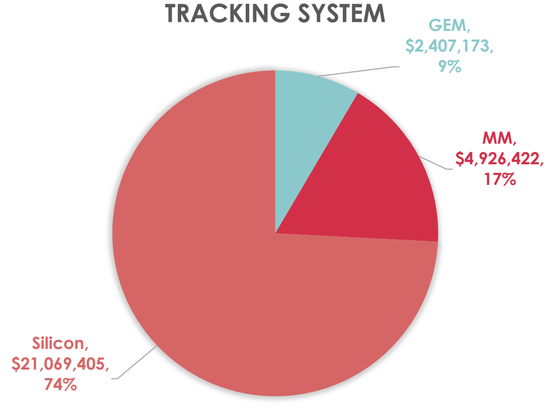


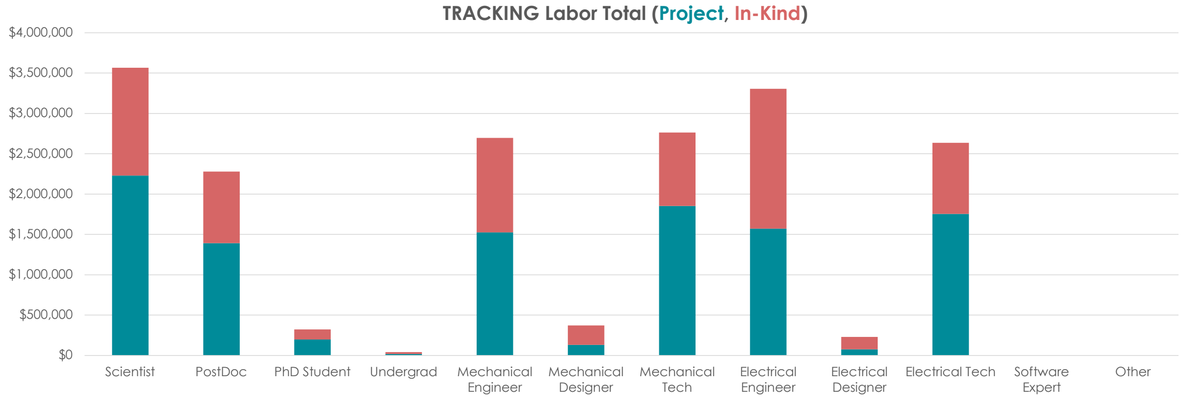
Costing - Tracking Overview

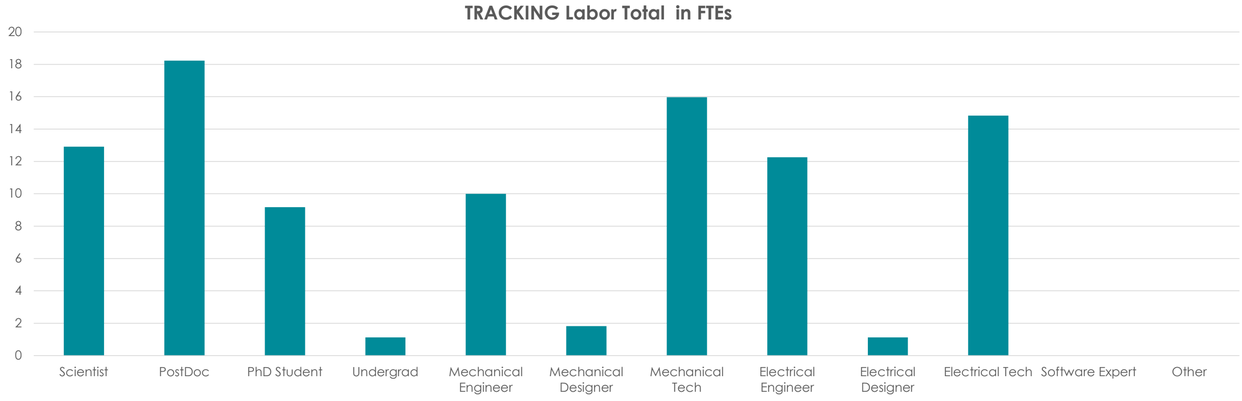




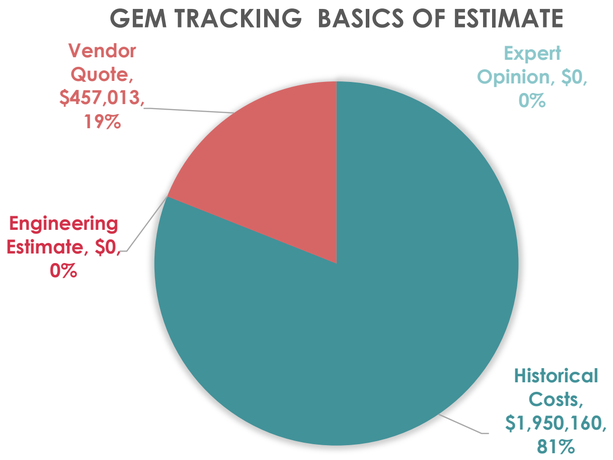


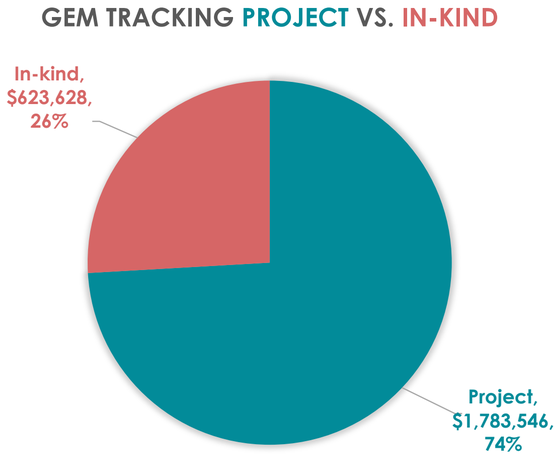


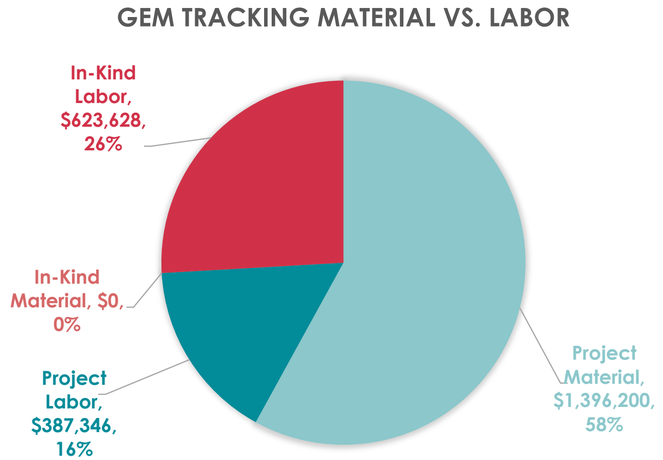


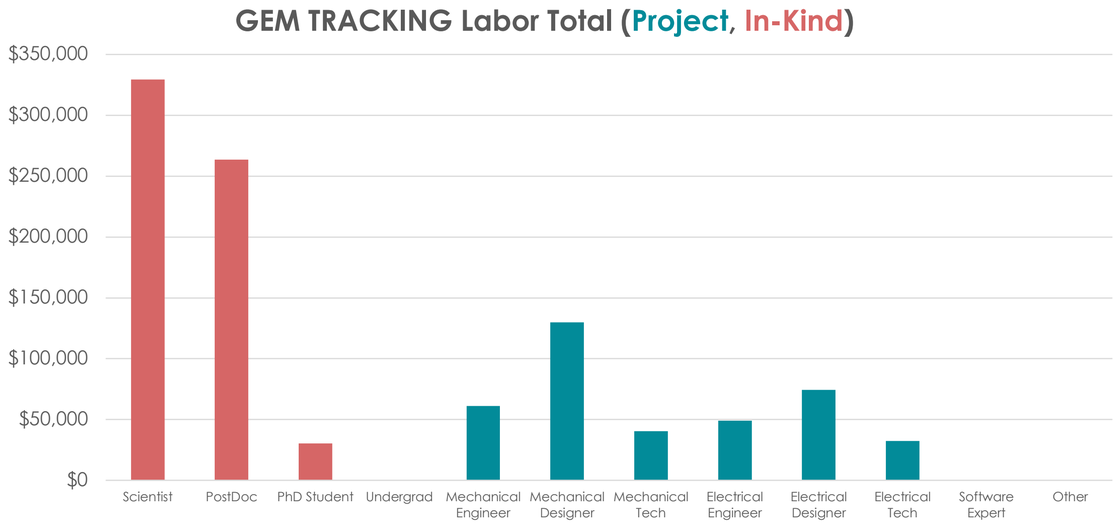


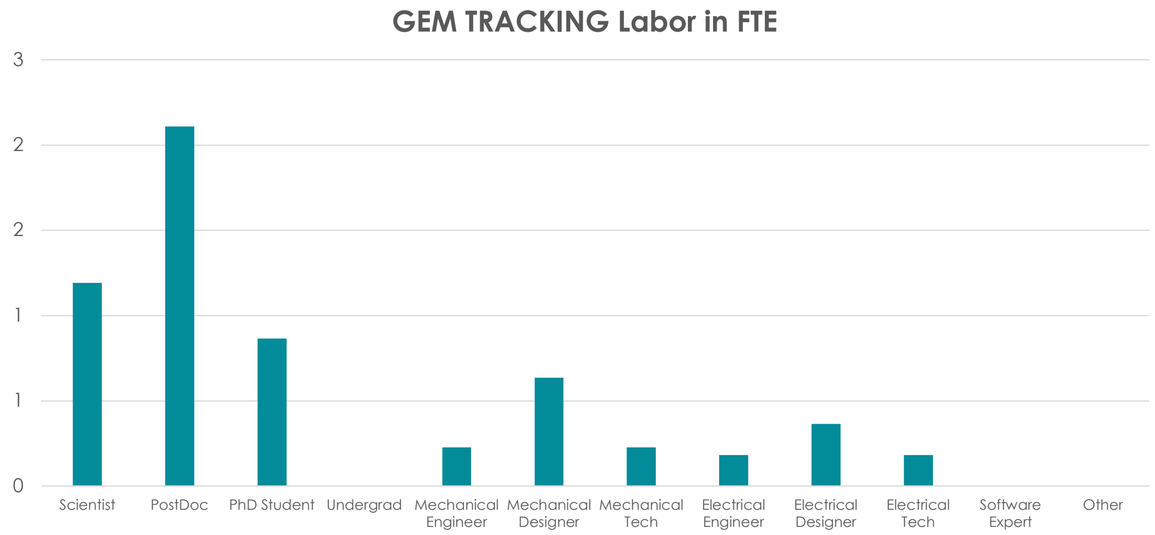
Costing - Tracking GEM



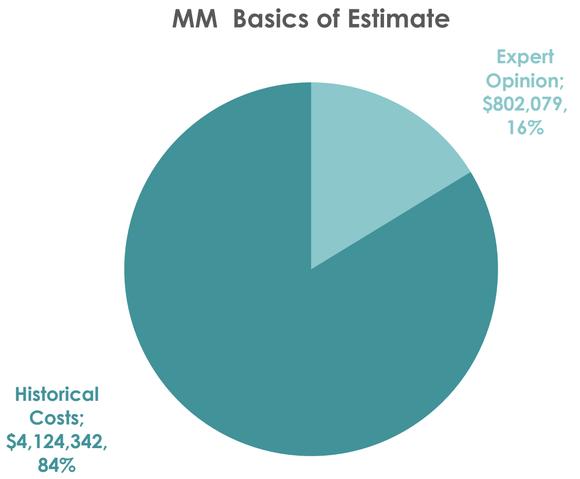


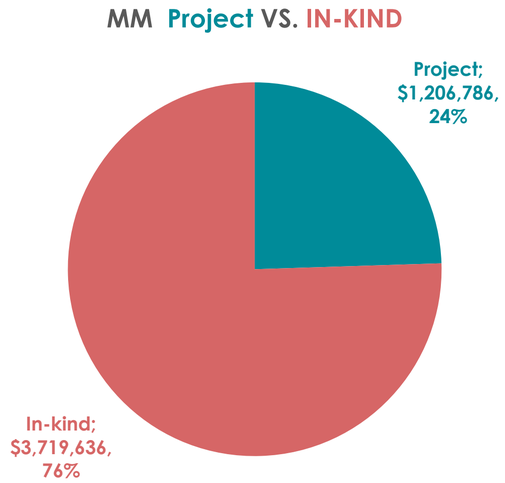


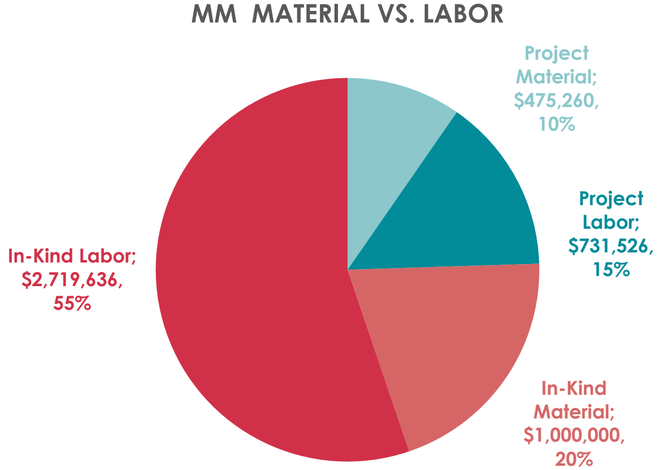


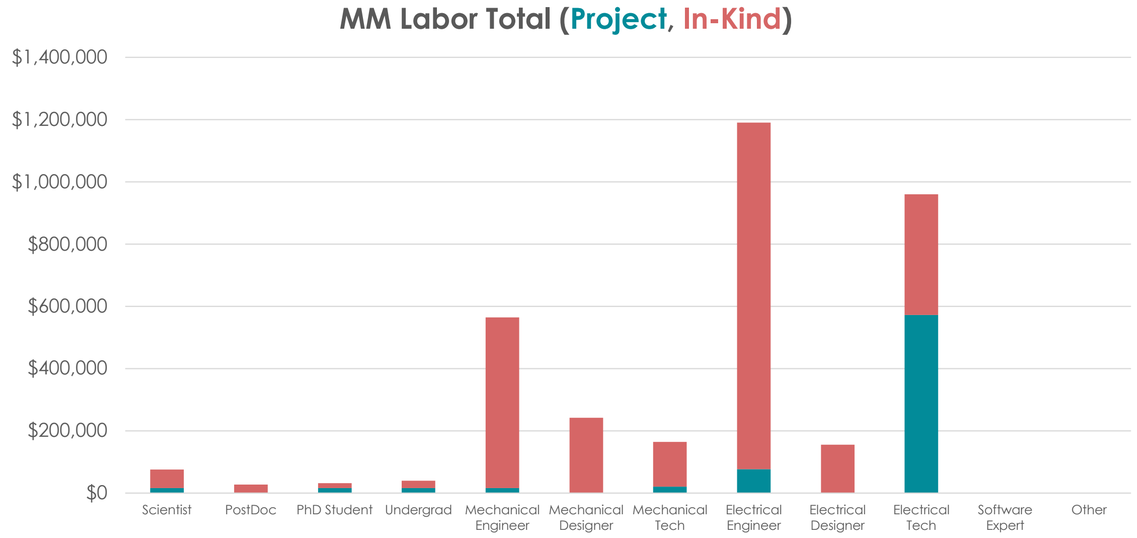


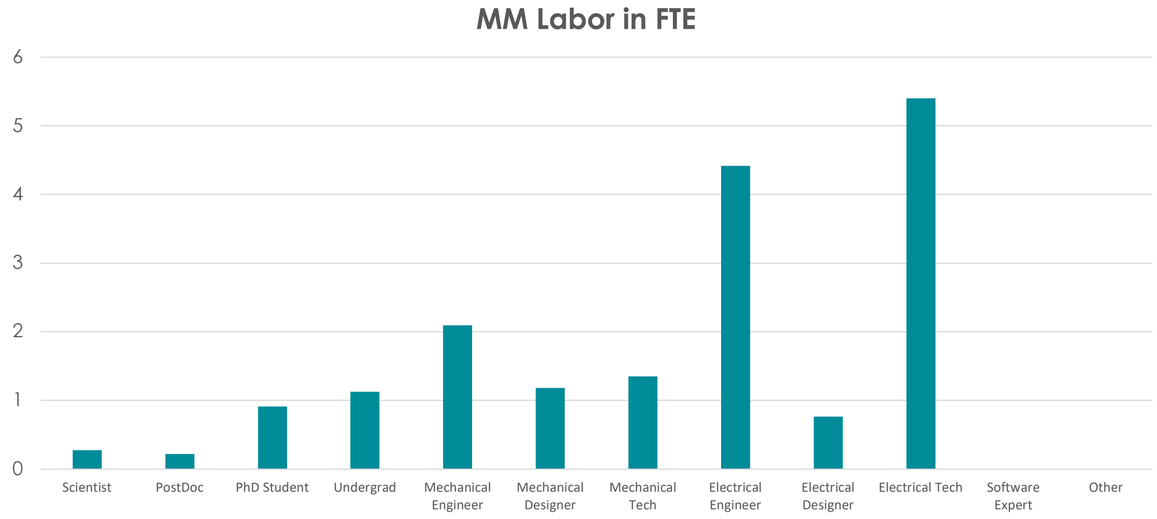
Costing - Tracking MM



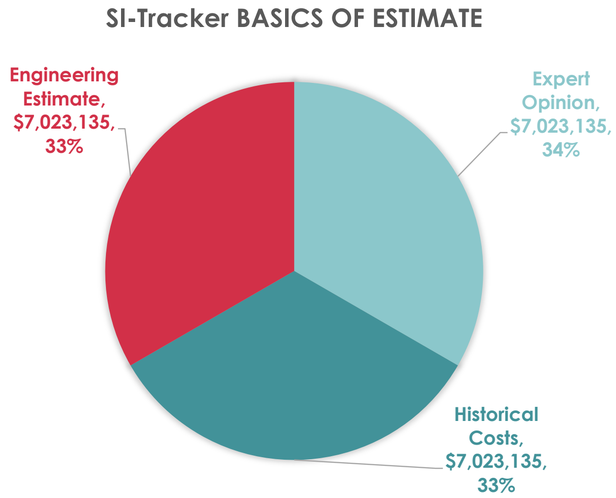


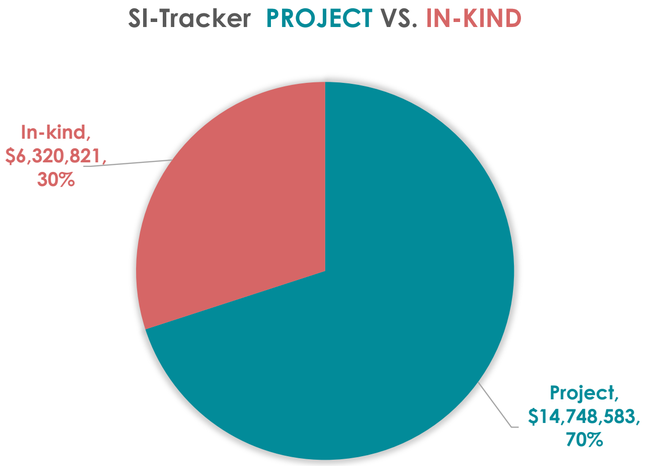


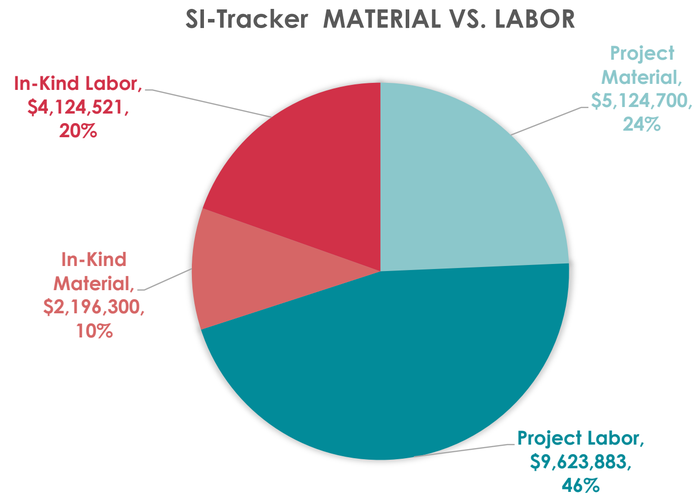


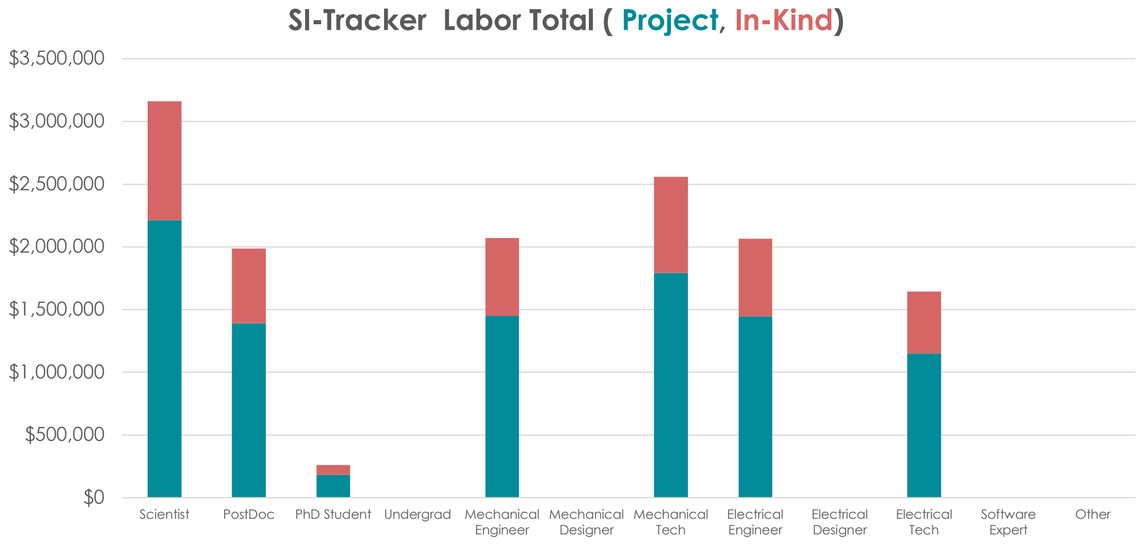


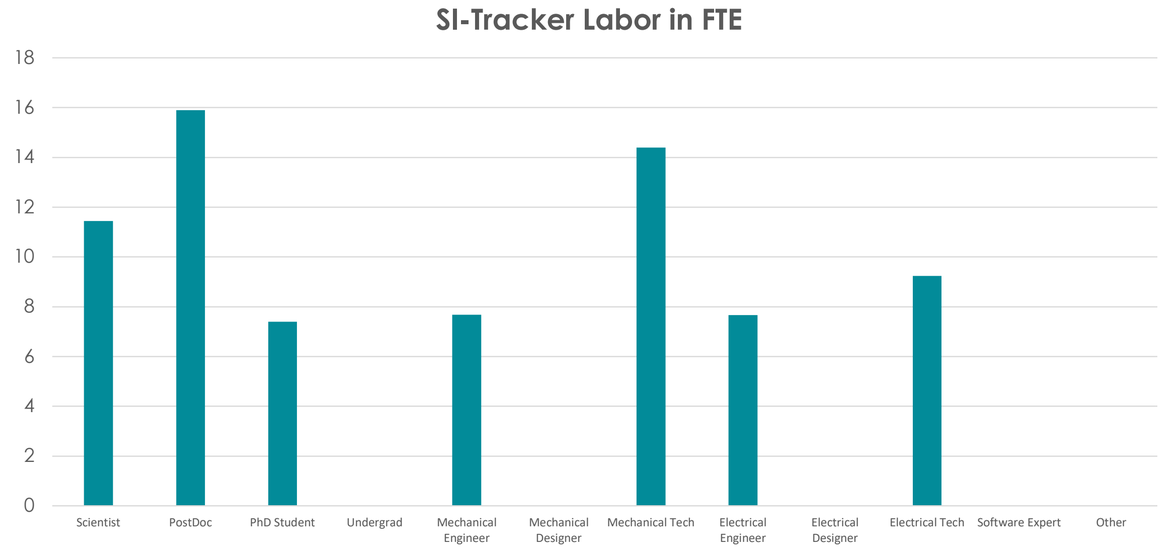
Costing - Tracking Silicon



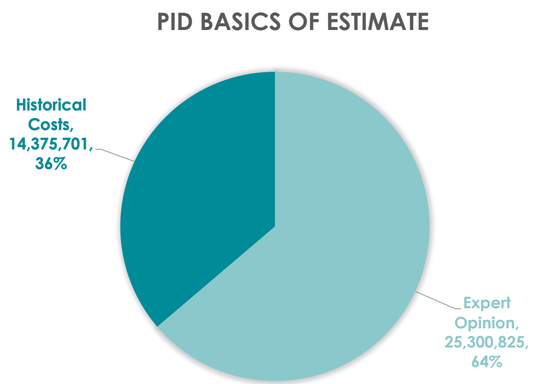


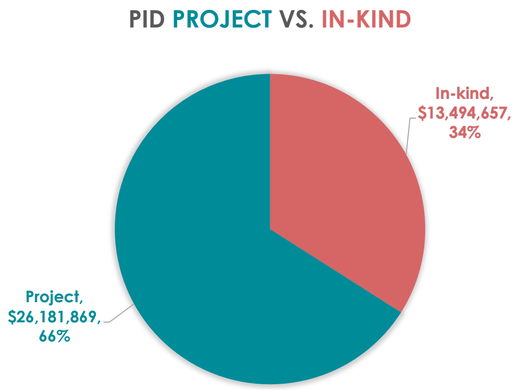


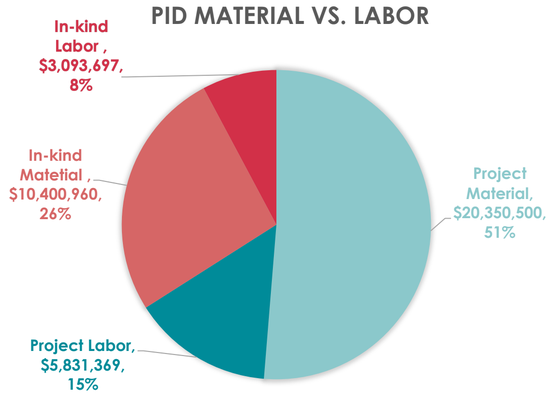


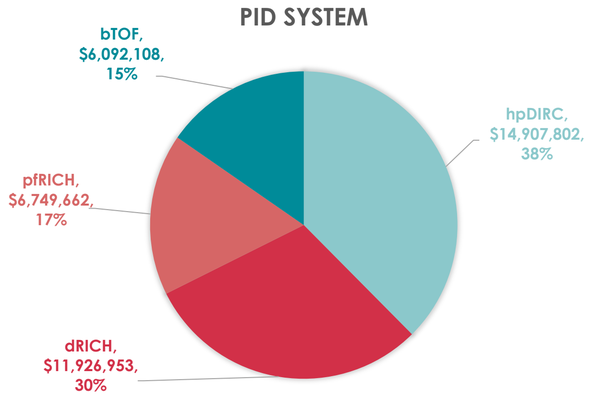


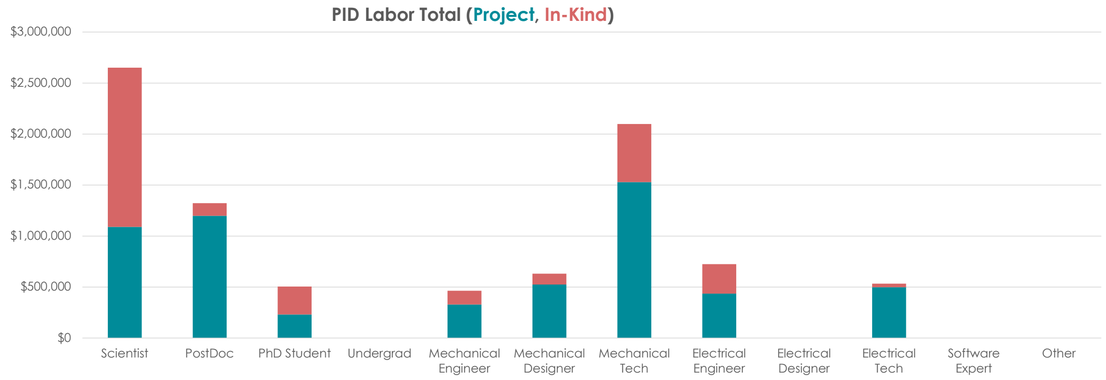
Costing - PID Overview

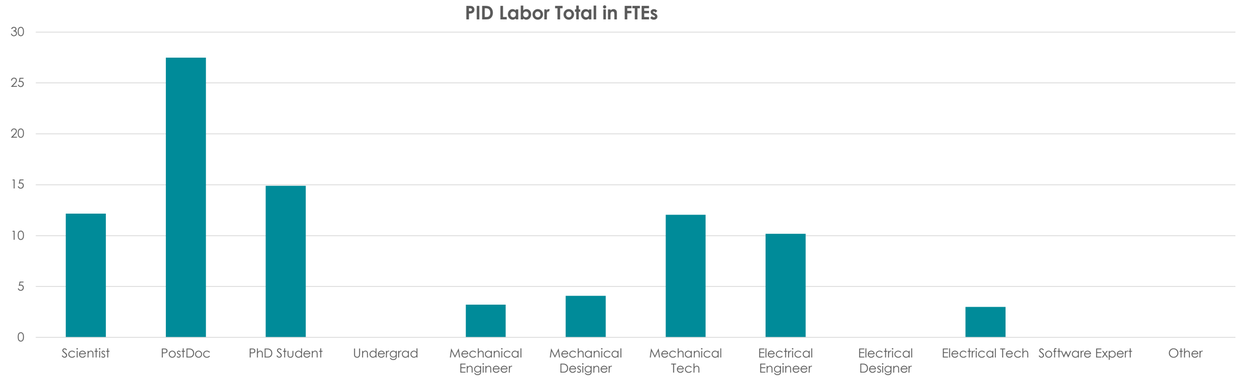




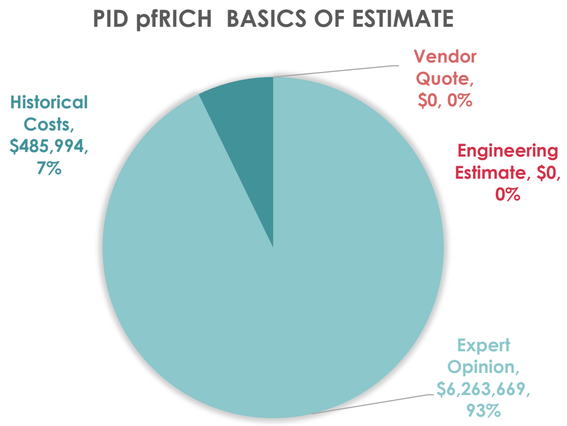


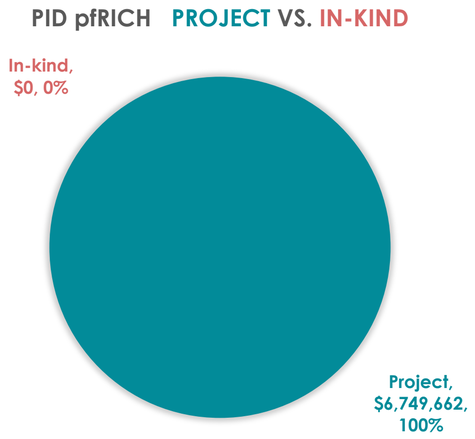


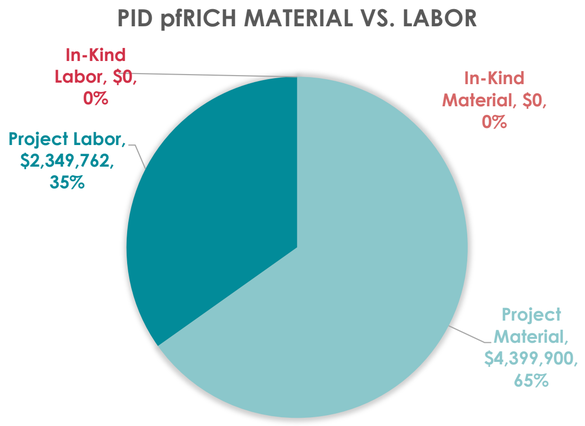


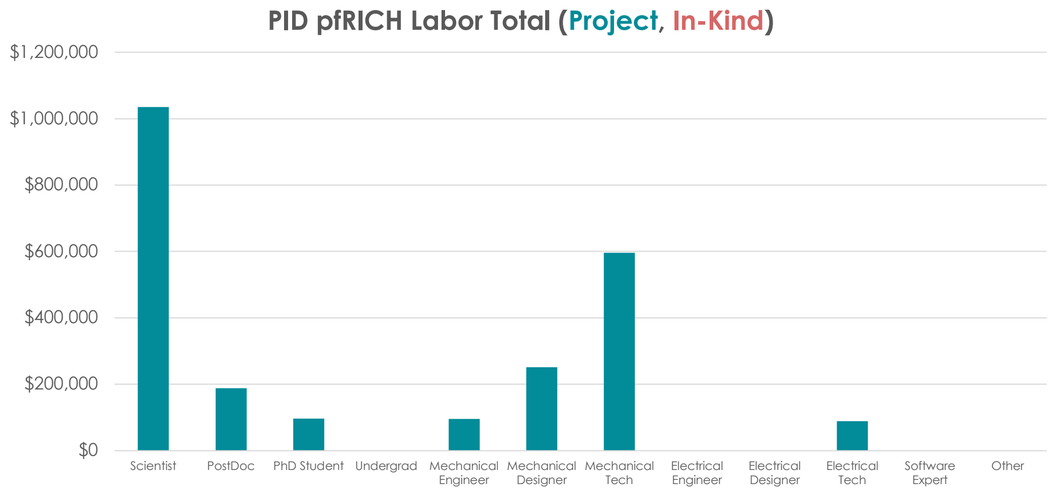


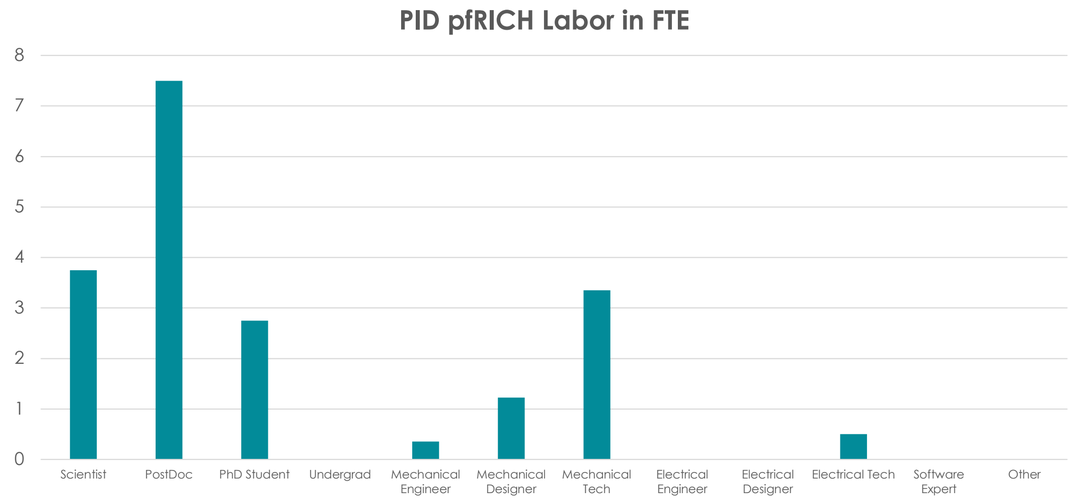
Costing - PID pfRICH



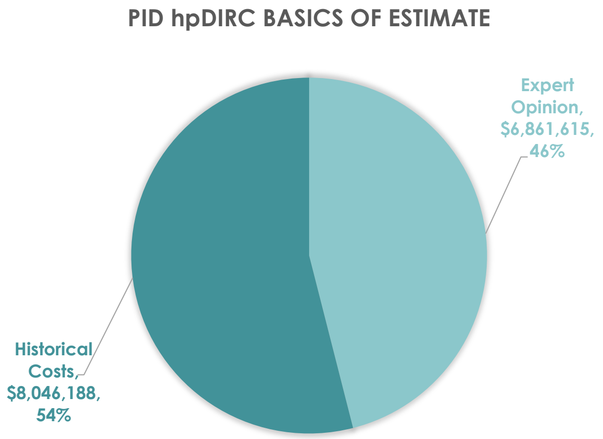


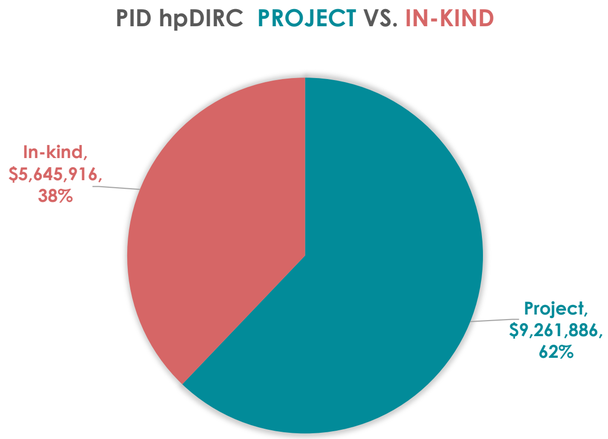


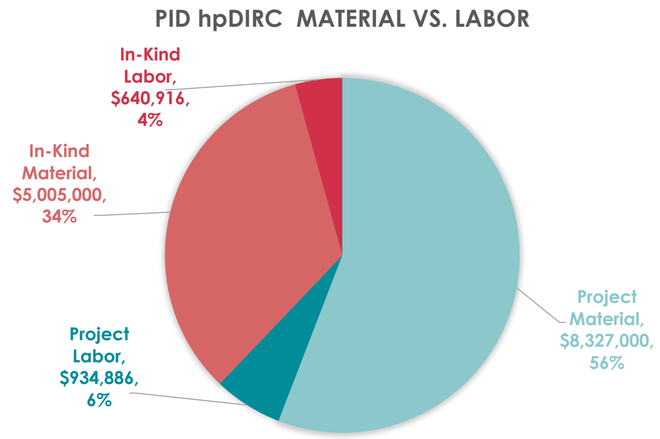


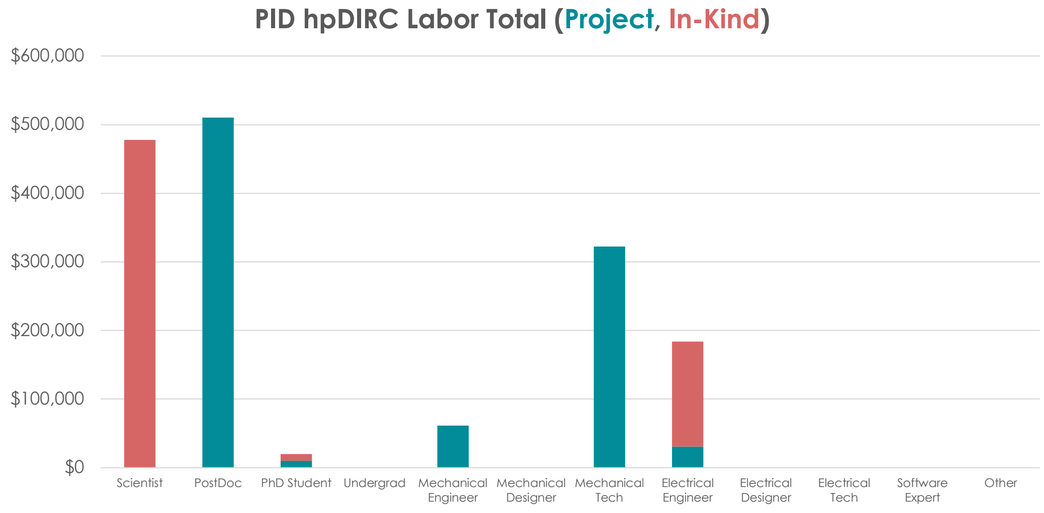


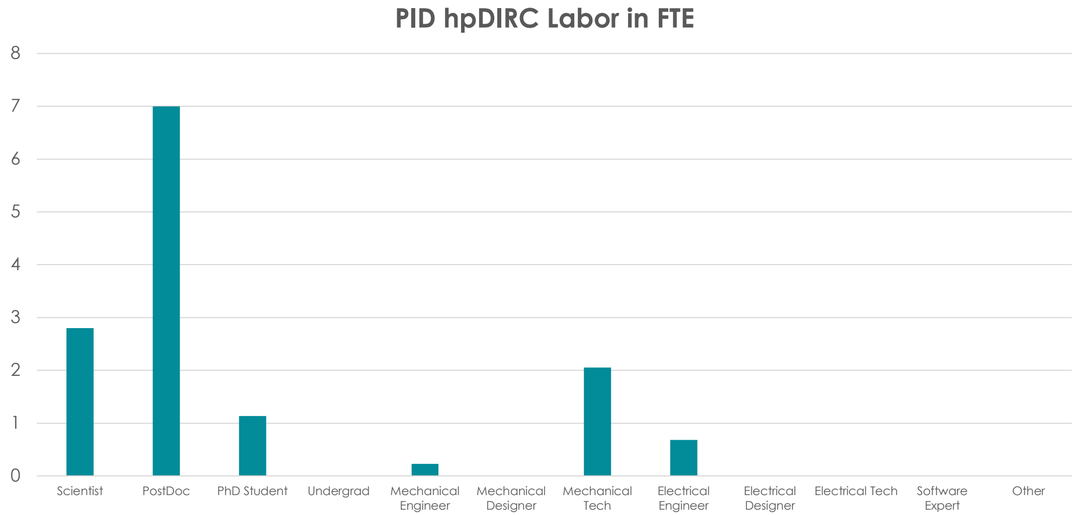
Costing - PID hpDIRC



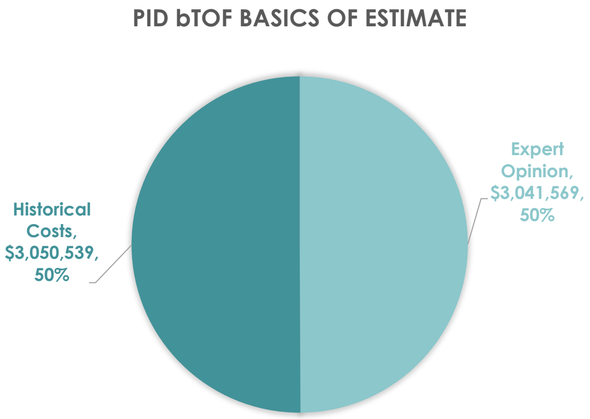


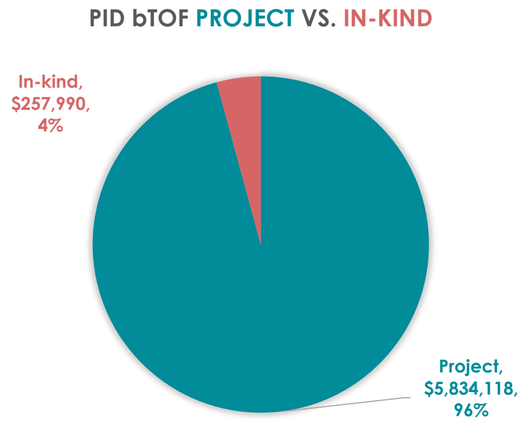


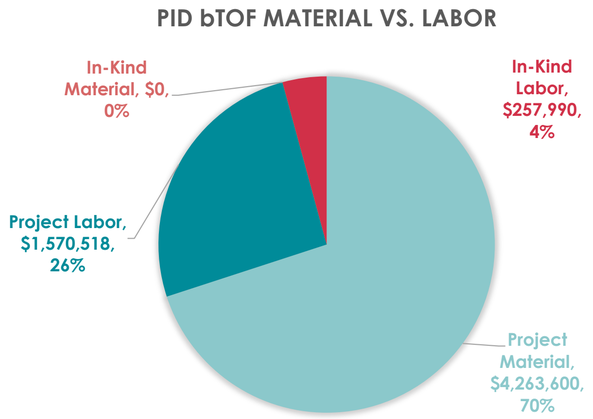


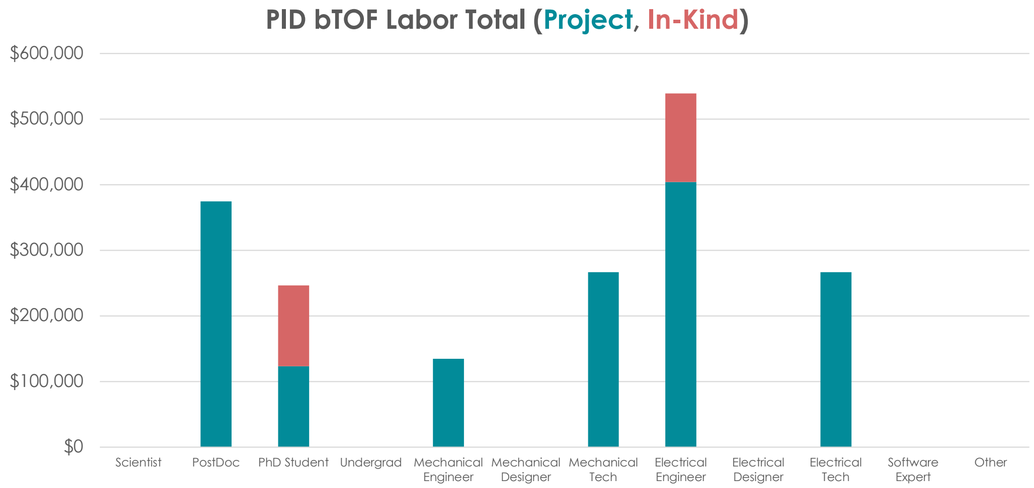


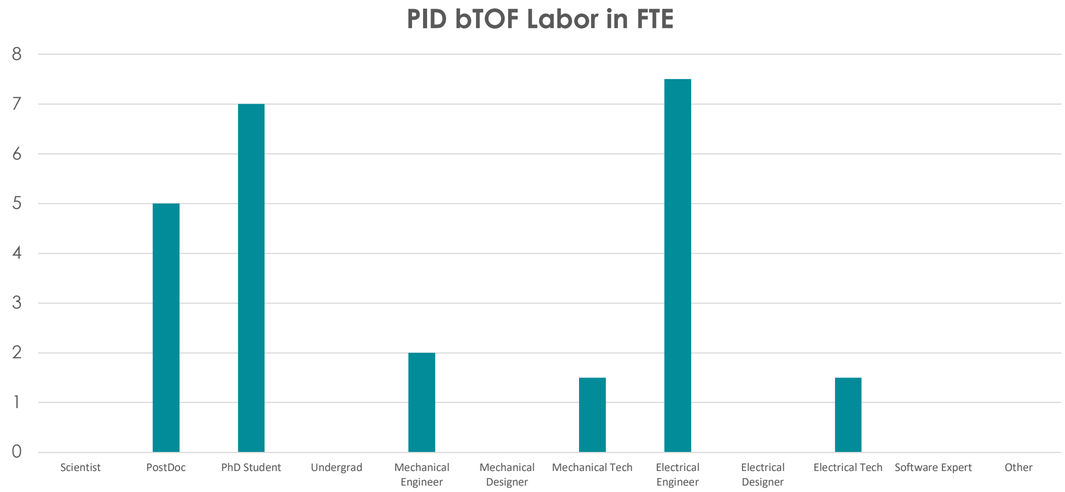
Costing - PID bTOF



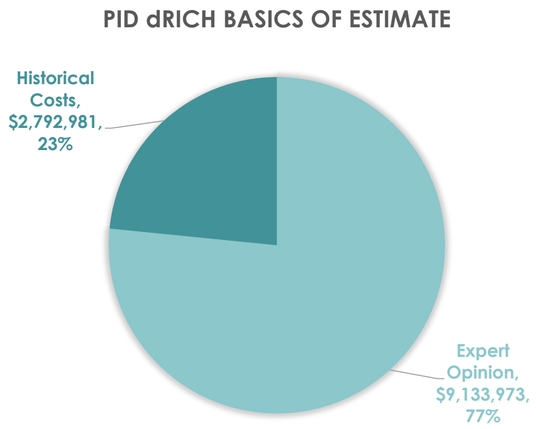


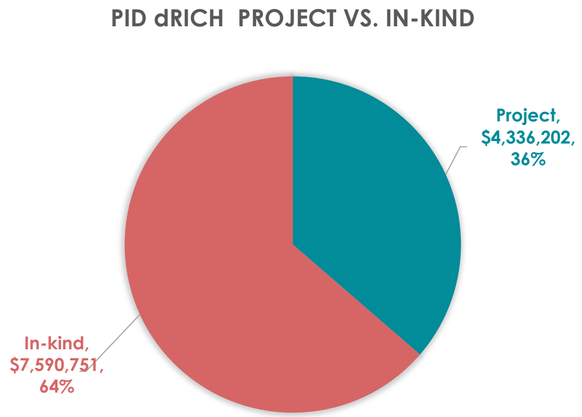


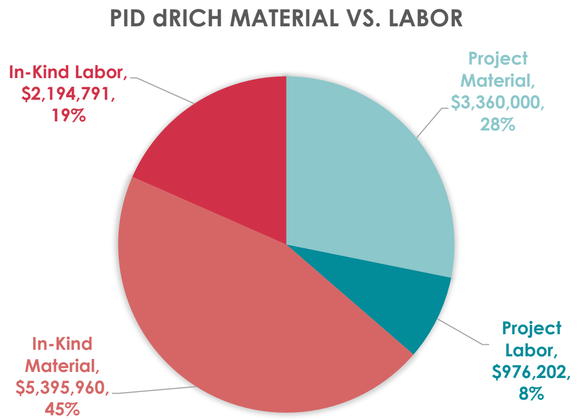


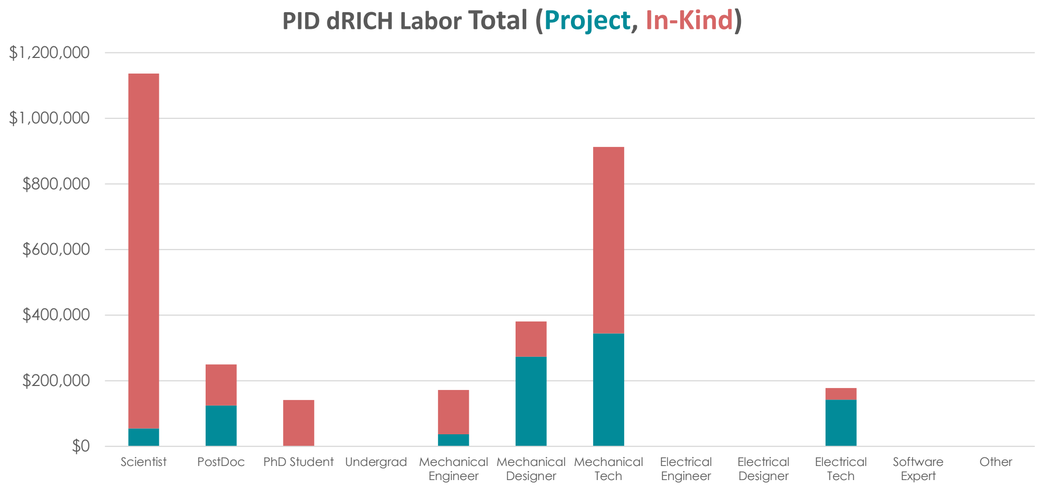


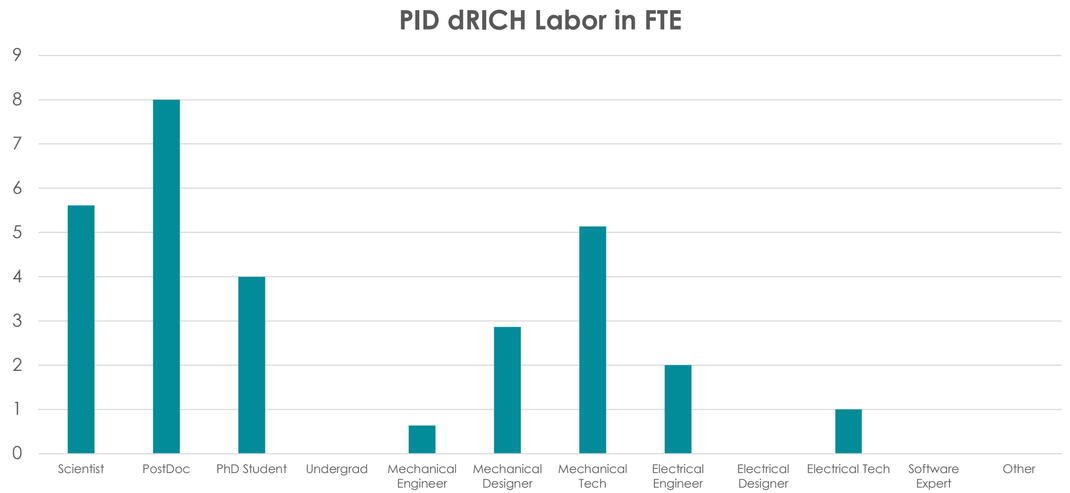
Costing - PID dRICH



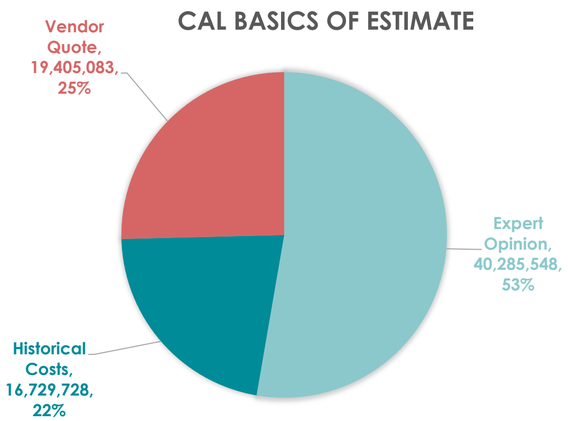


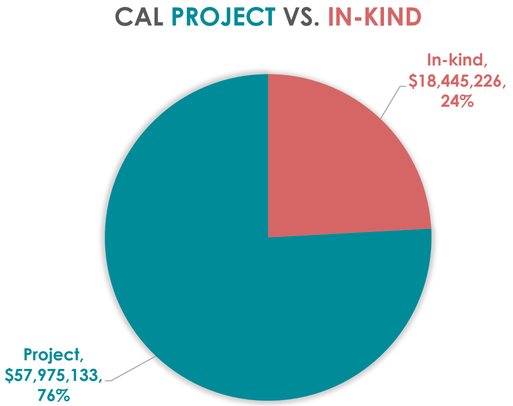


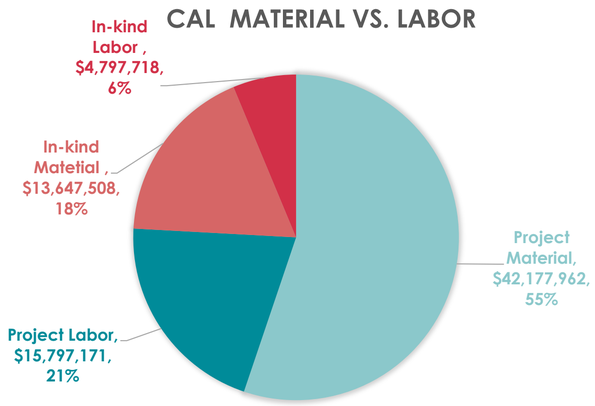


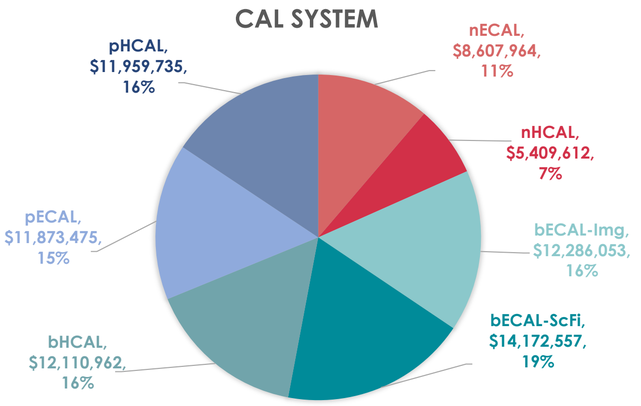


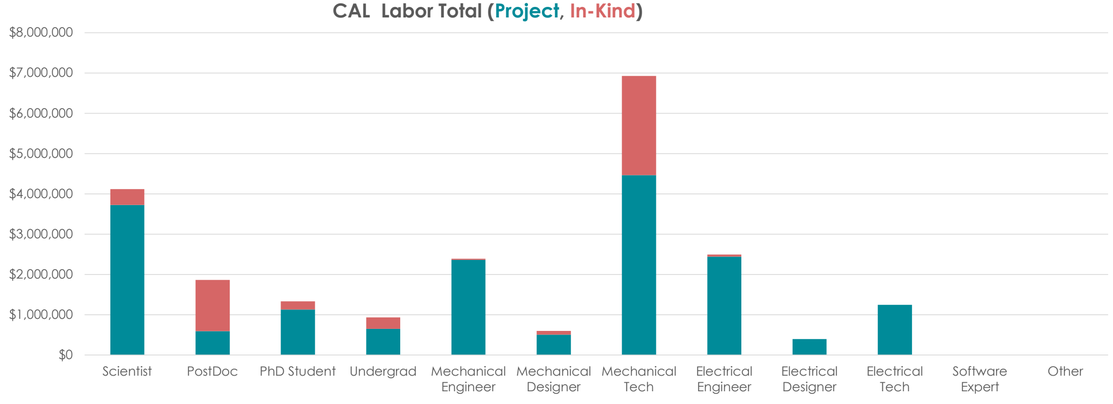
Costing - Calorimetry Overview

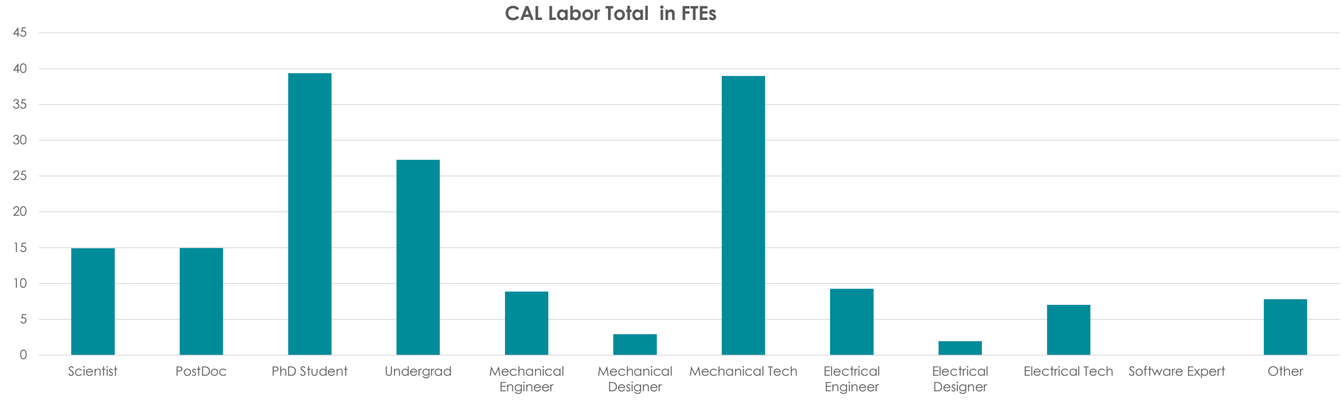




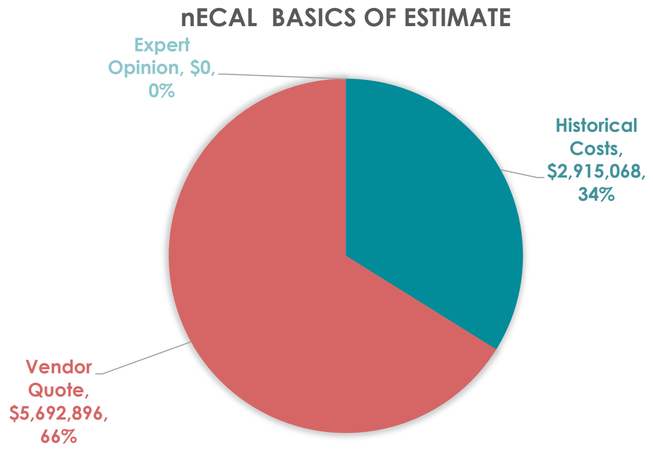


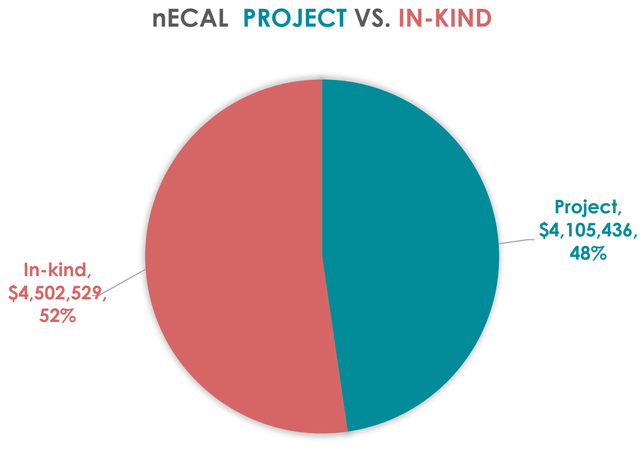


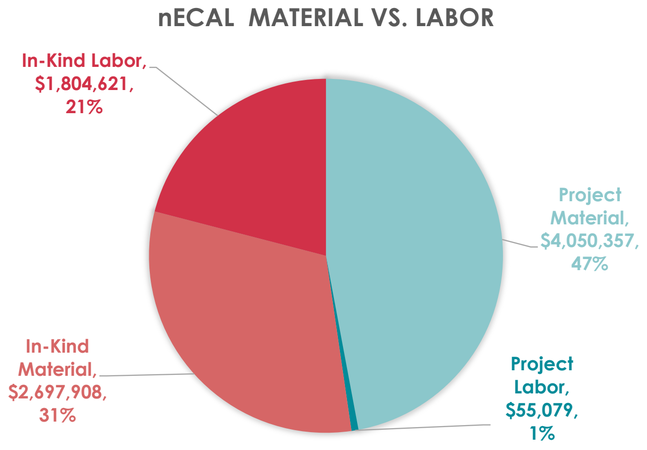


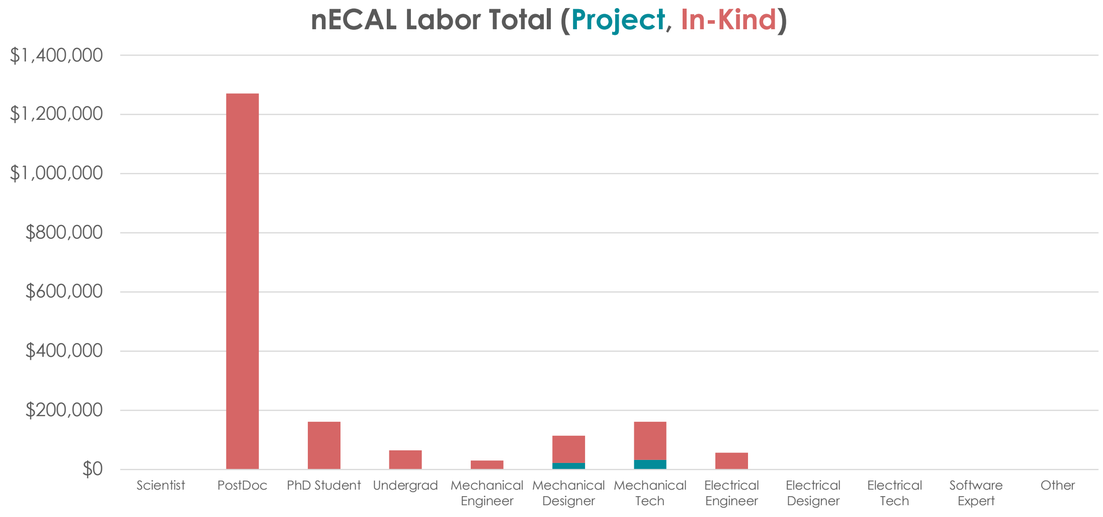


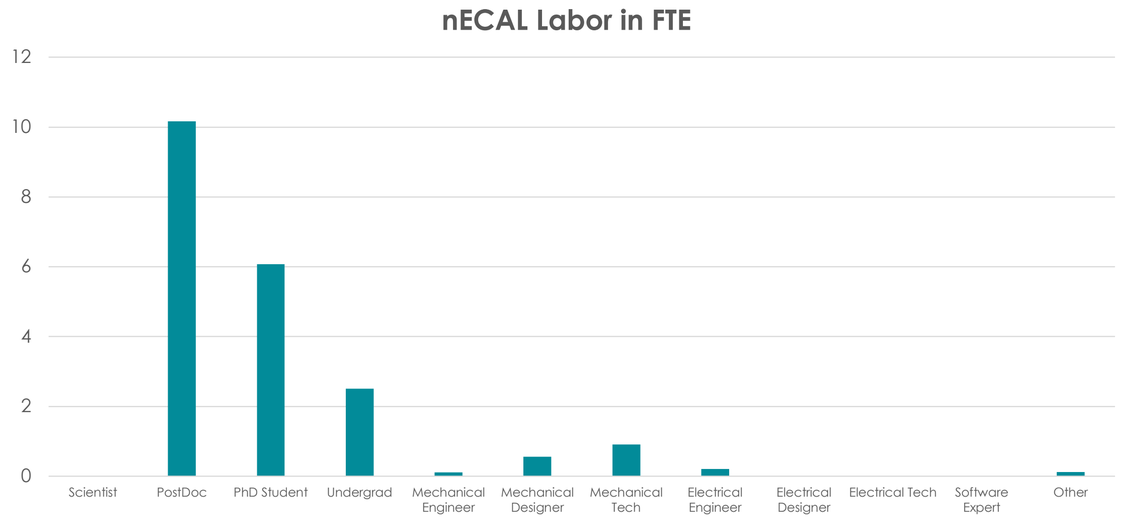
Costing - Calorimetry nECAL



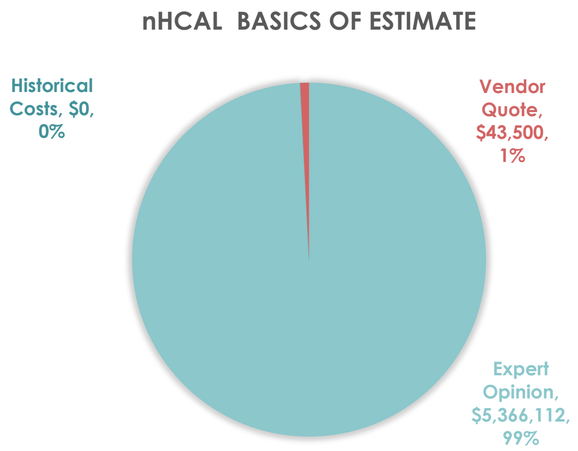


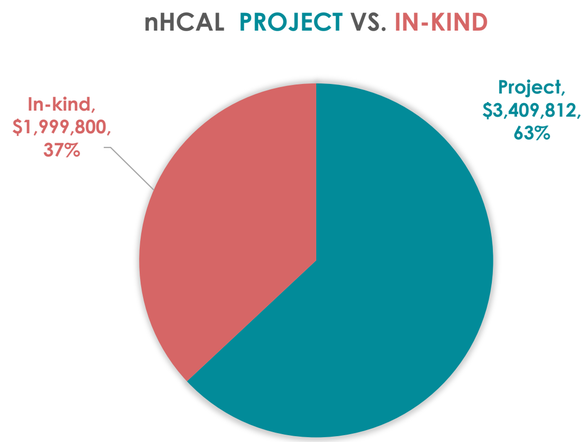


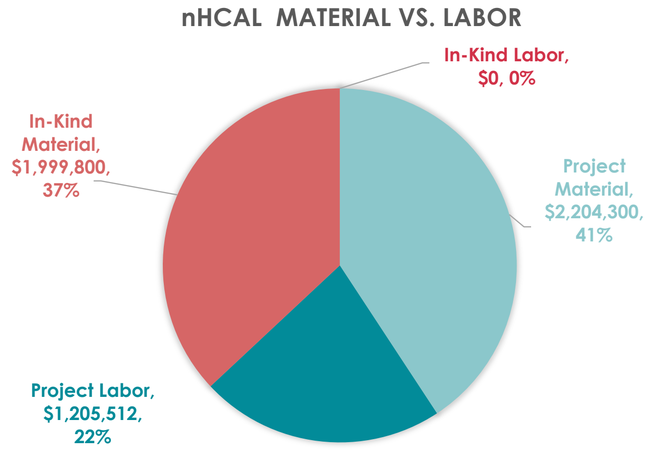


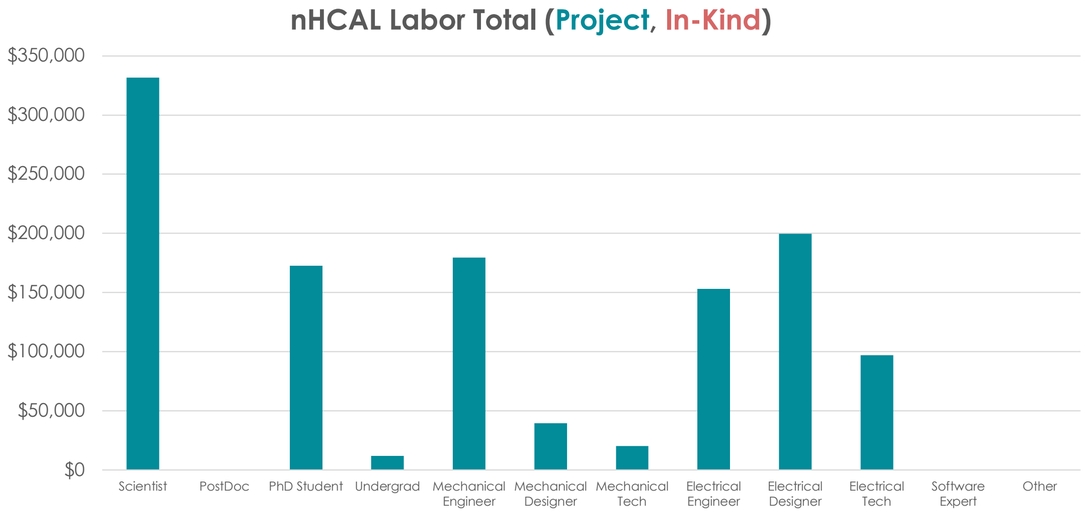


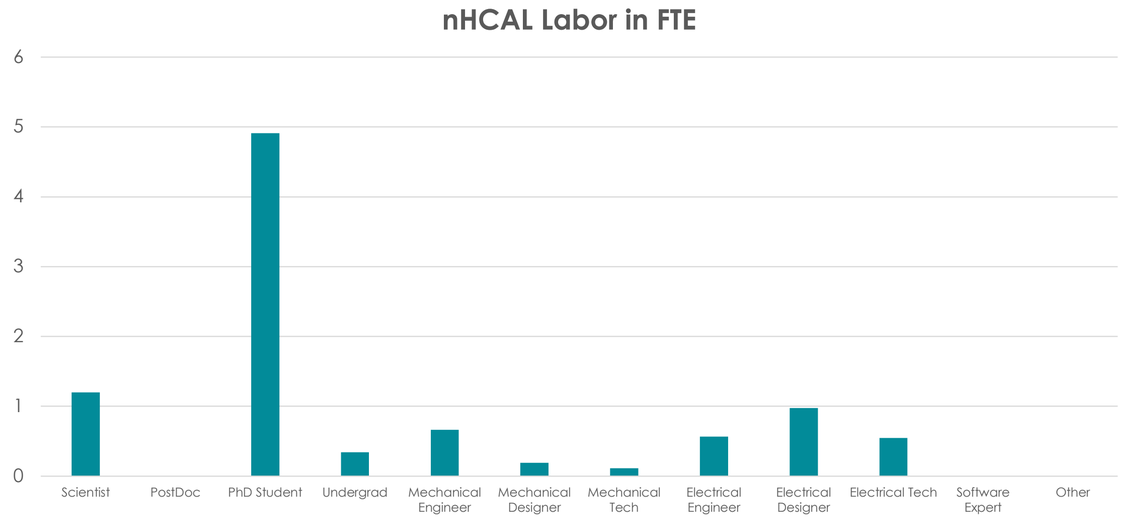
Costing - Calorimetry nHCAL



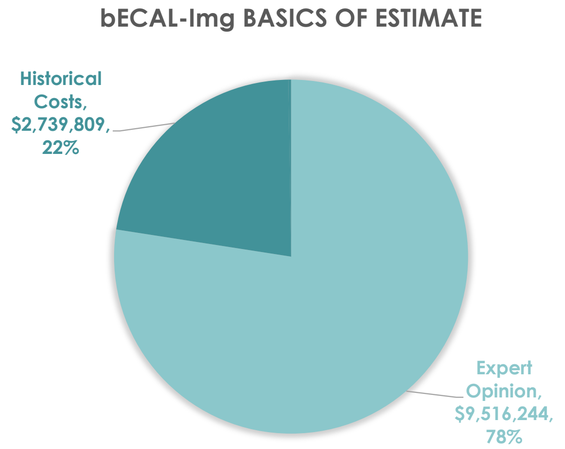


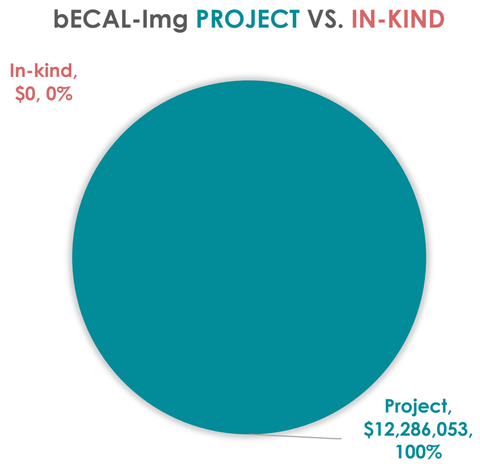


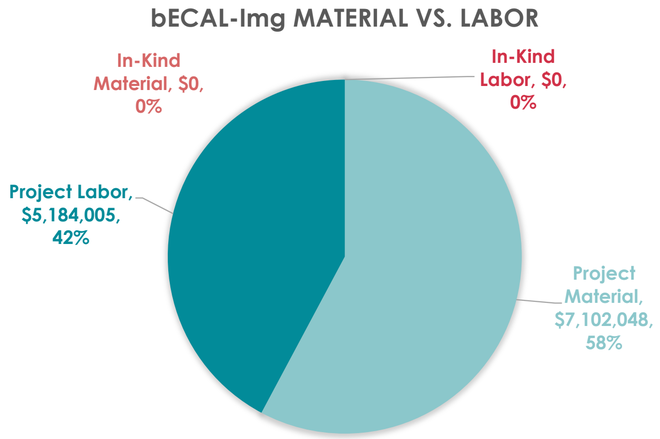


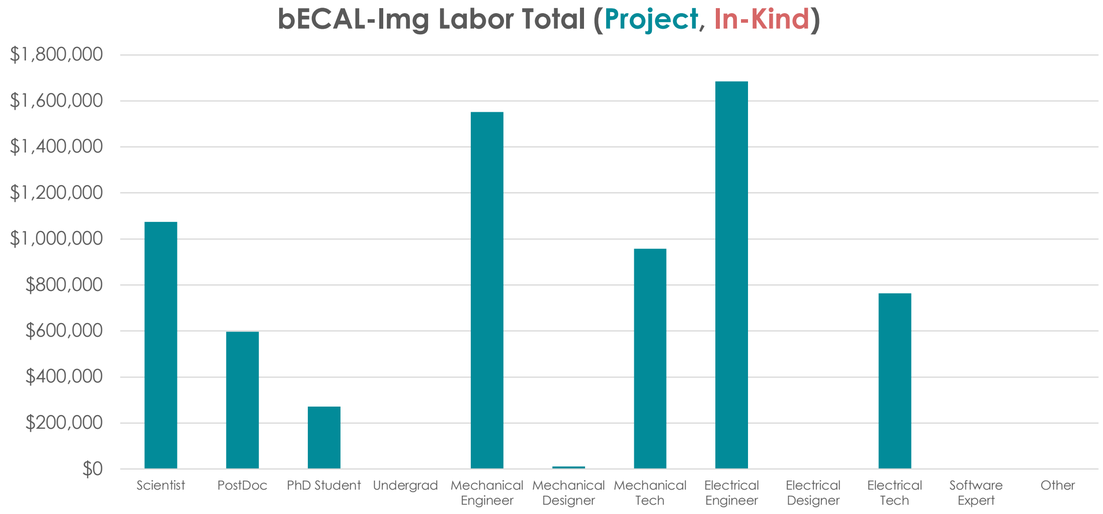


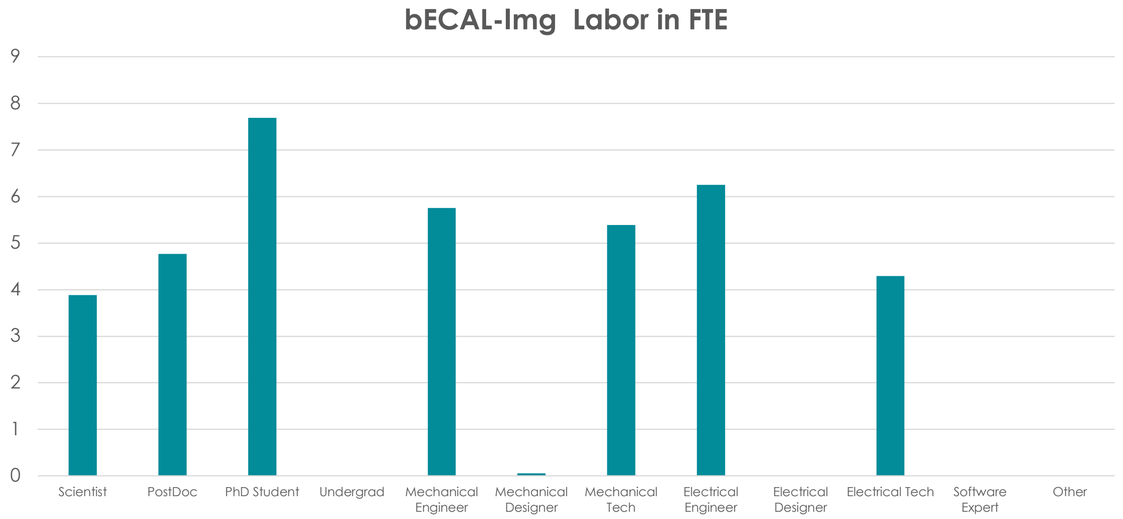
Costing - Calorimetry bECAL-Img



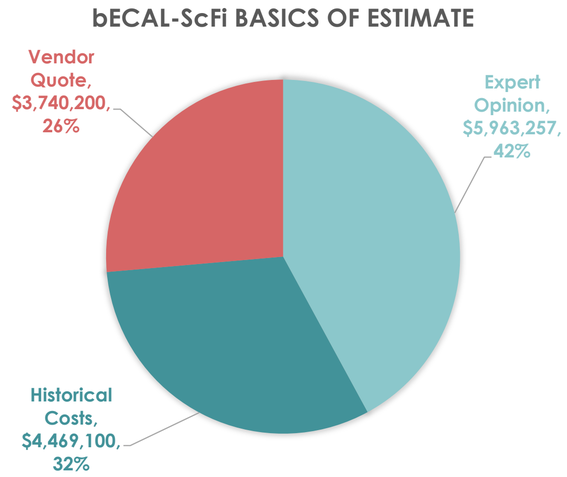


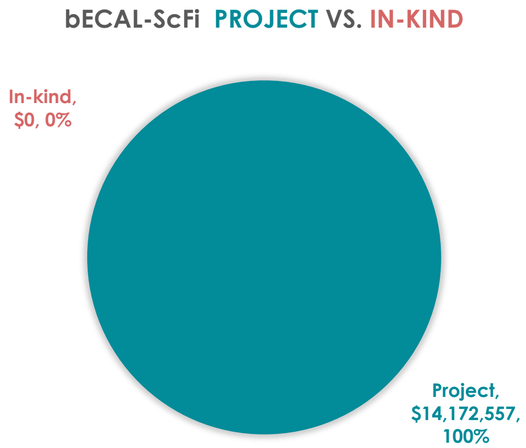


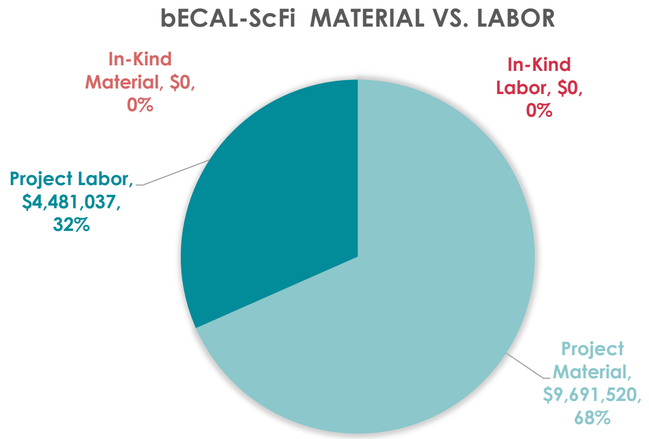


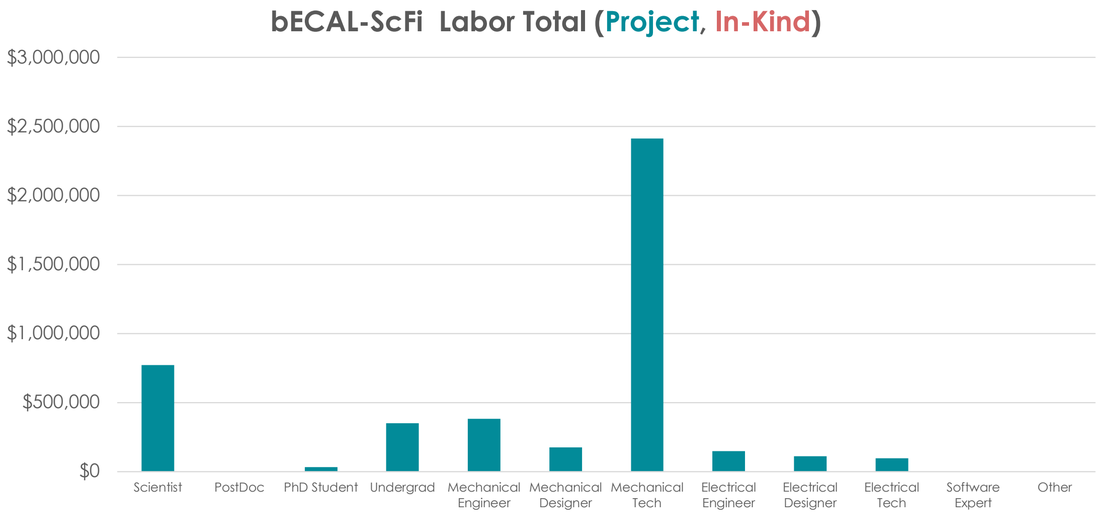


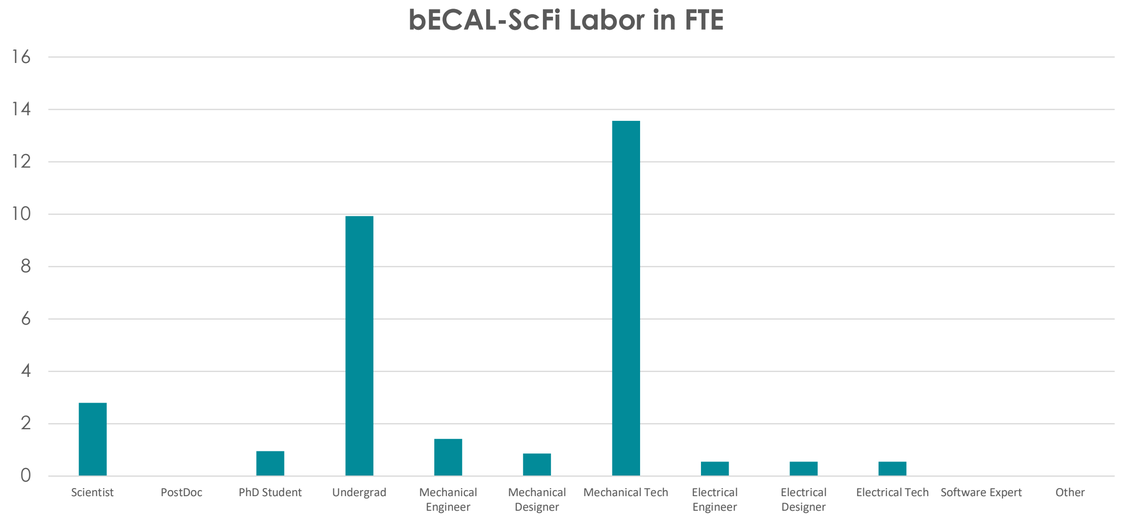
Costing - Calorimetry bECAL-ScFi



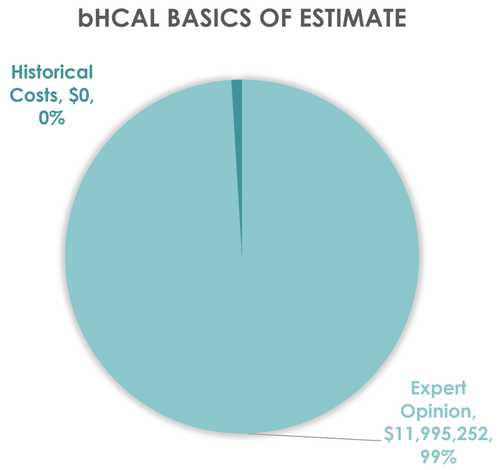


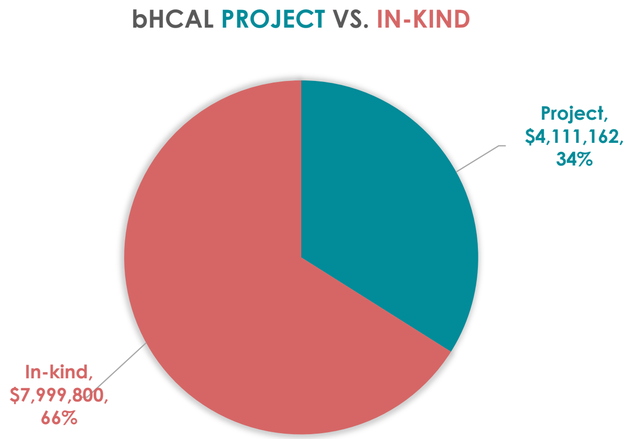


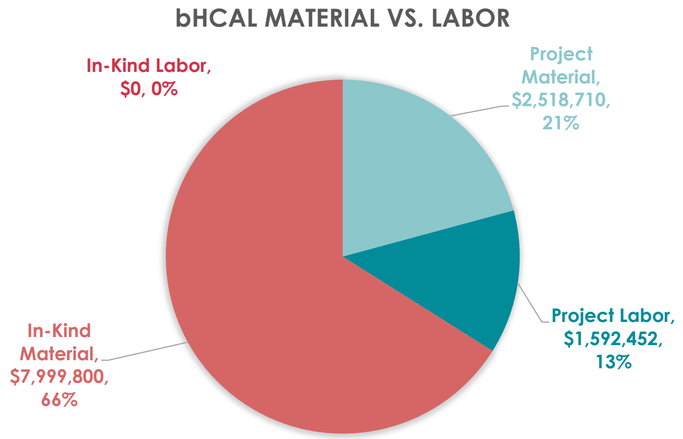


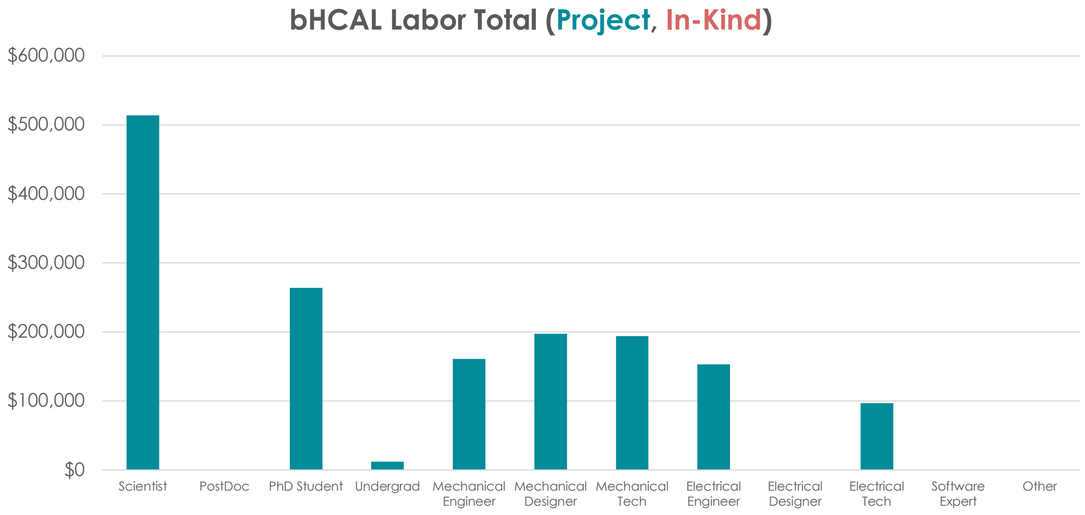


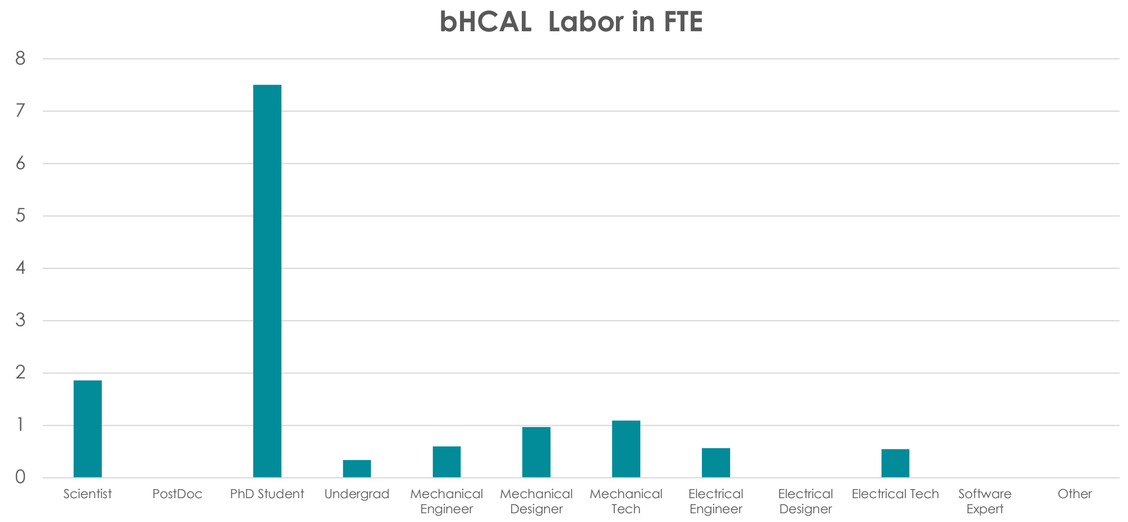
Costing - Calorimetry bHCAL



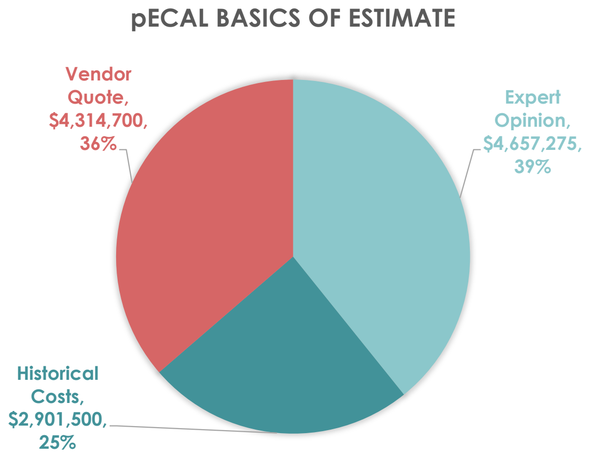


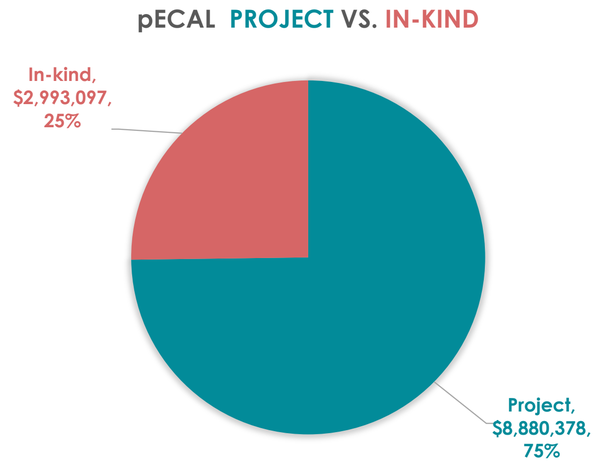


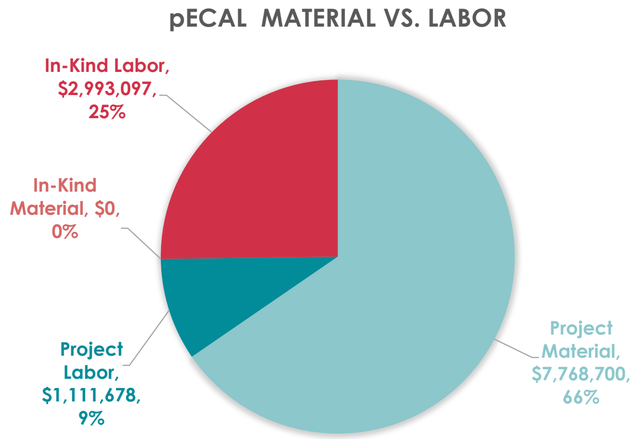


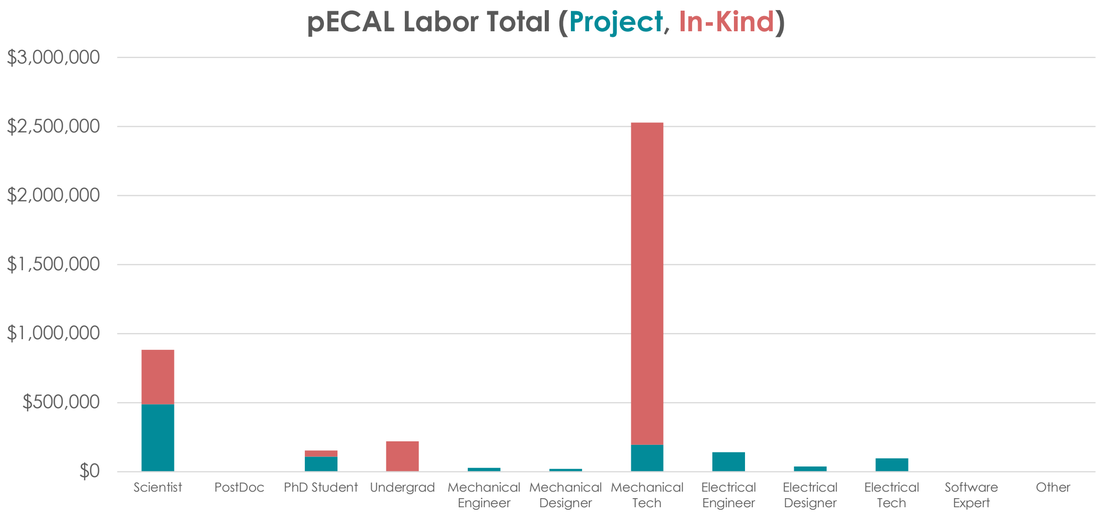


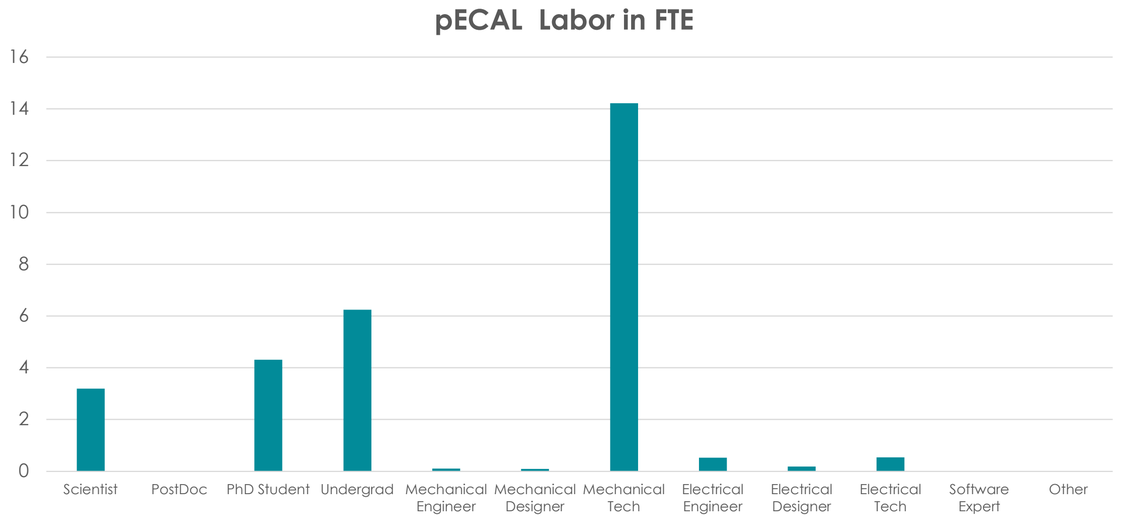
Costing - Calorimetry pECAL



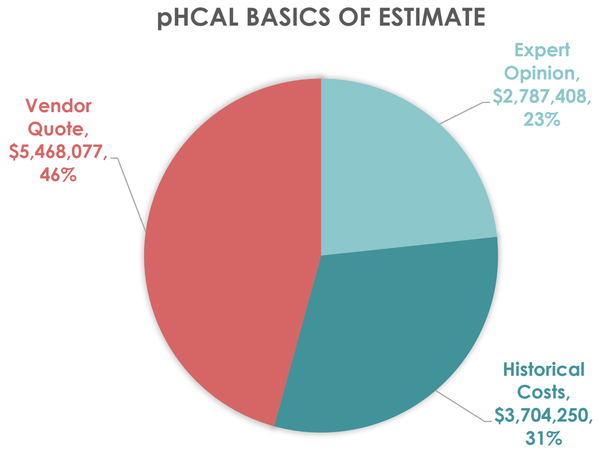


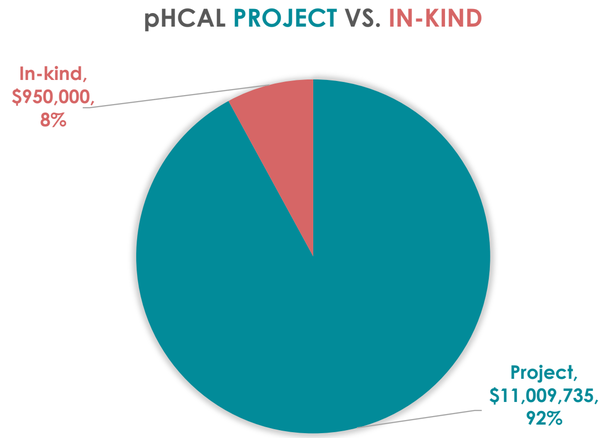


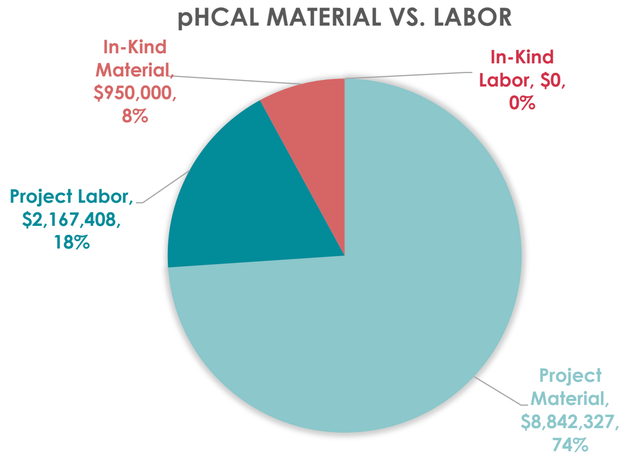


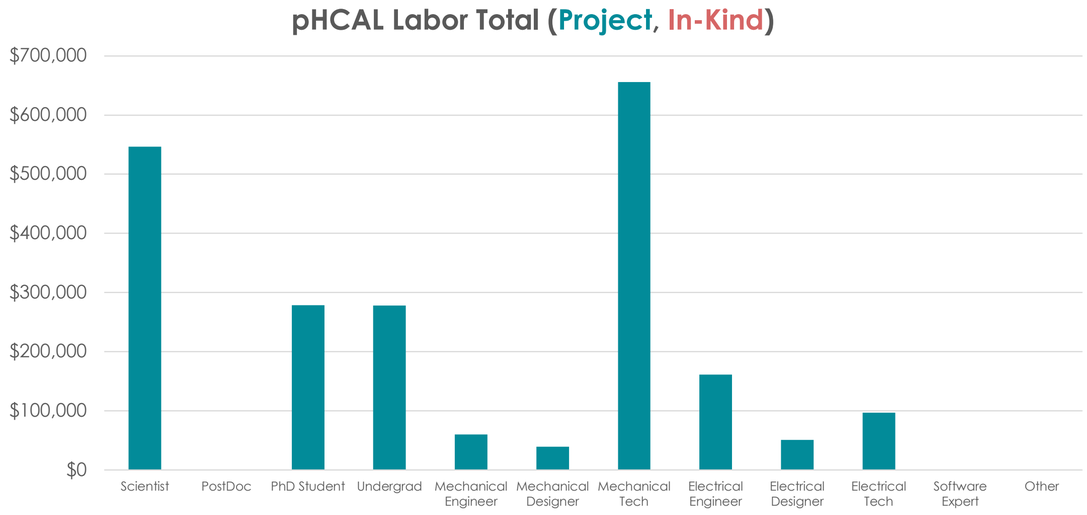


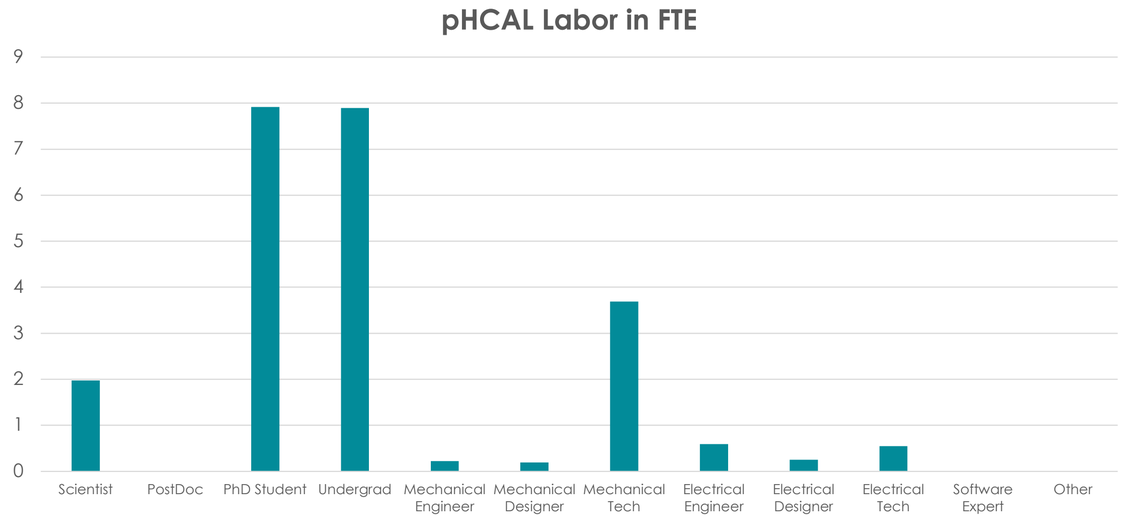
Costing - Calorimetry pHCAL



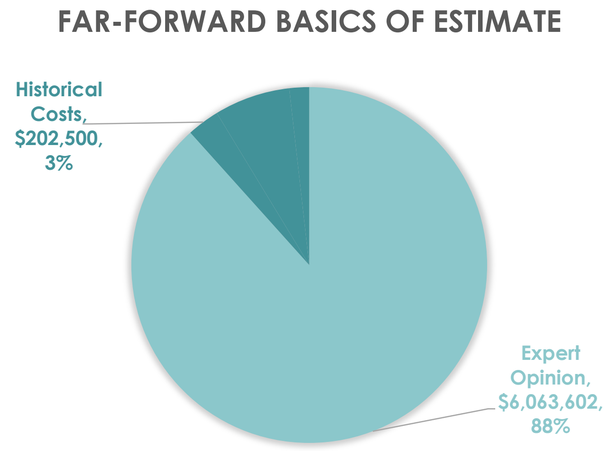


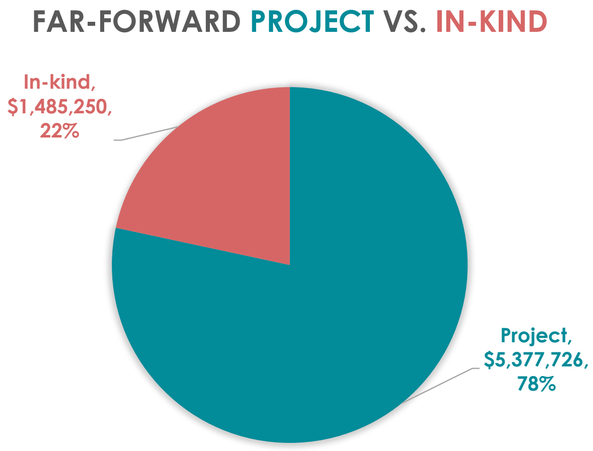


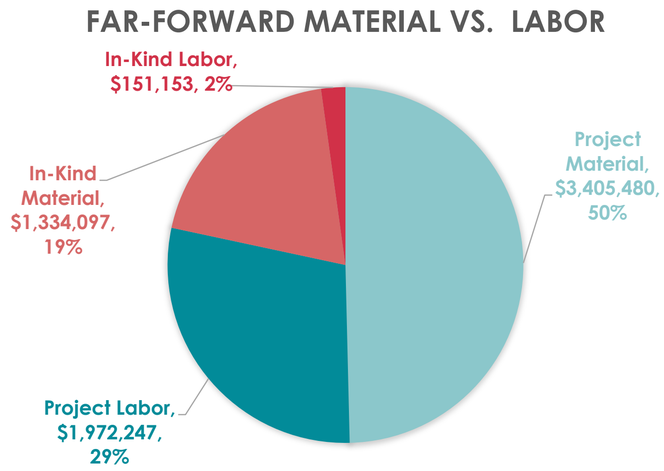


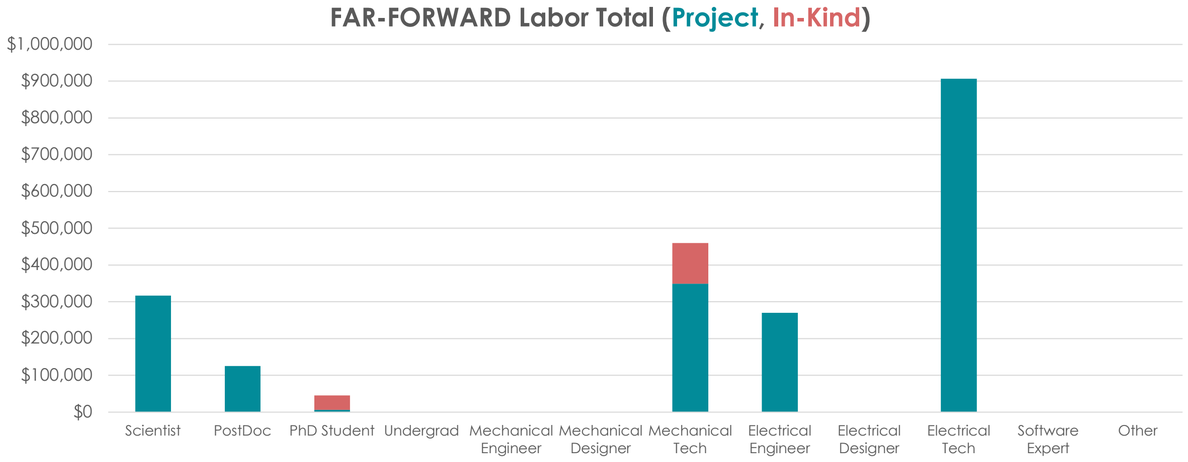


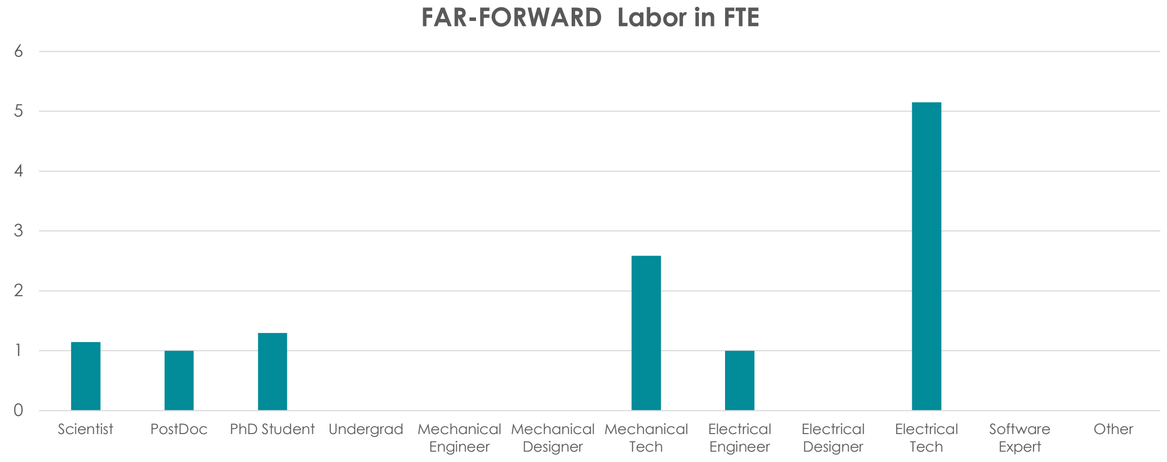
Costing - FarForward Overview



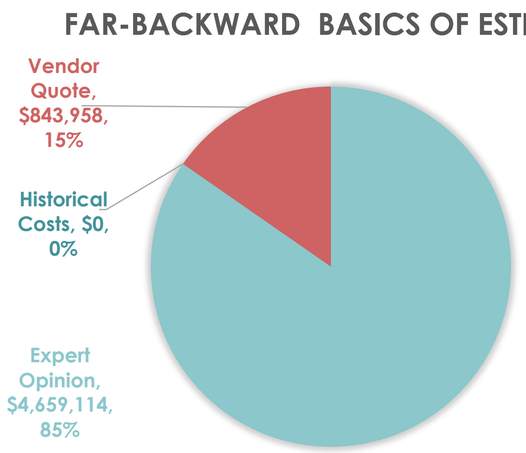


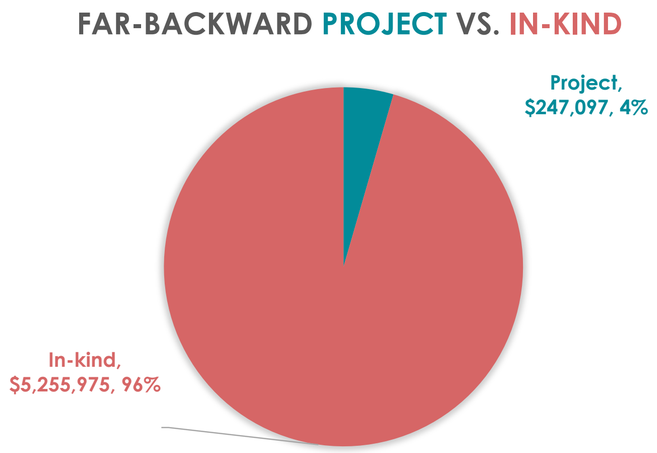


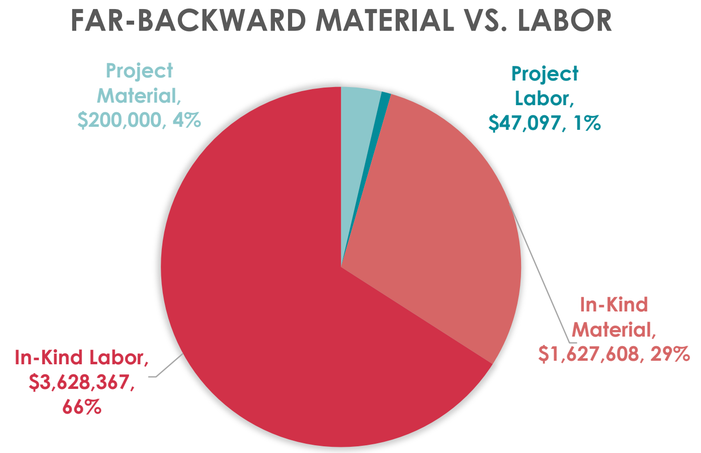


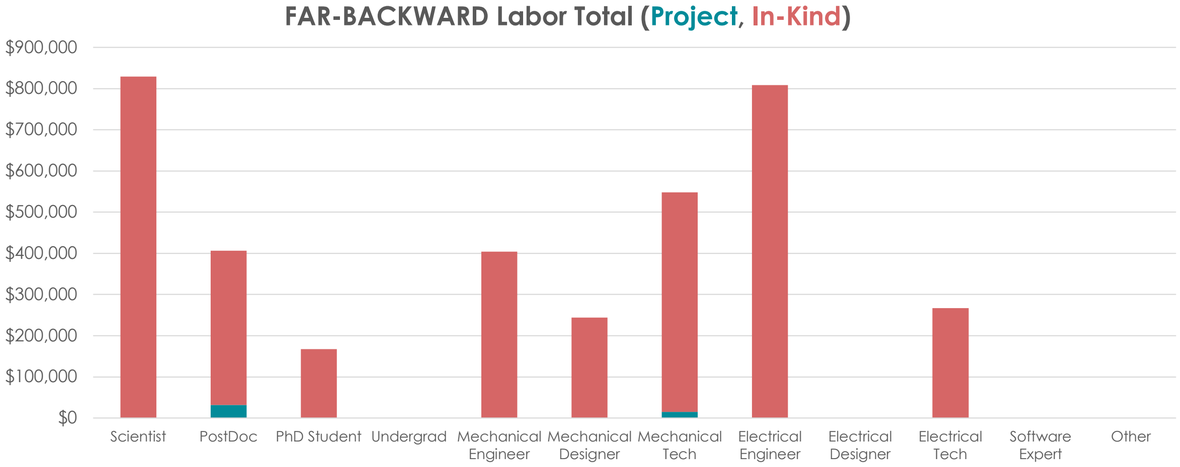


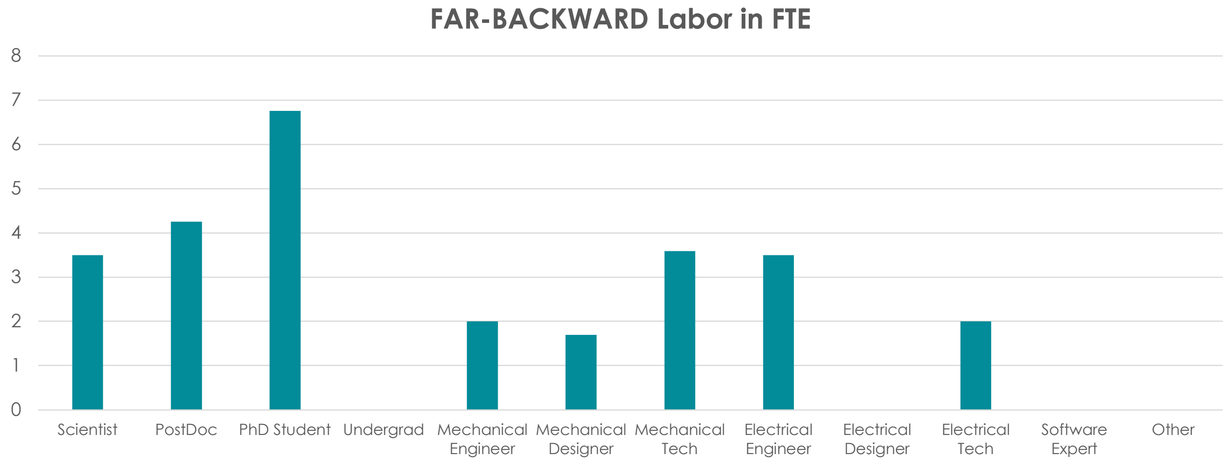
Costing - FarBackward Overview



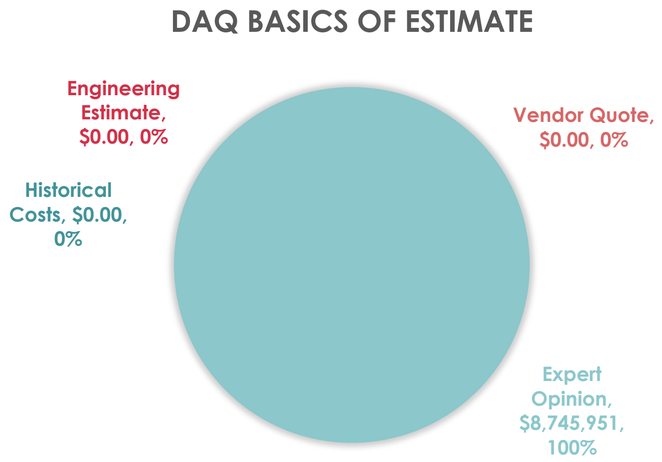


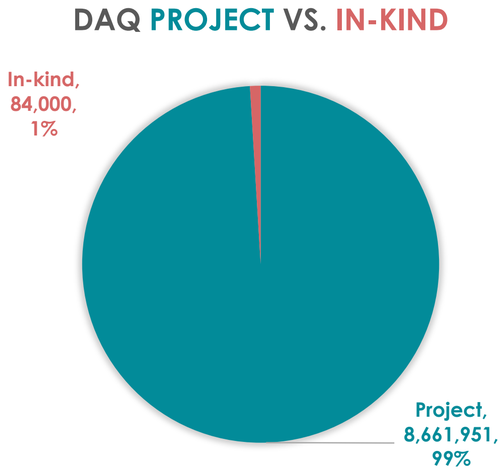


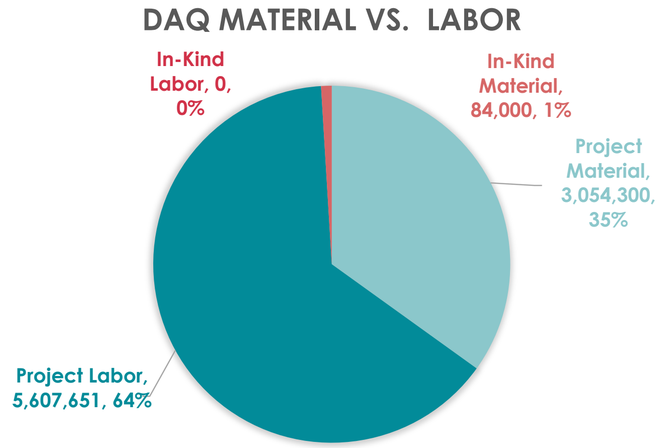


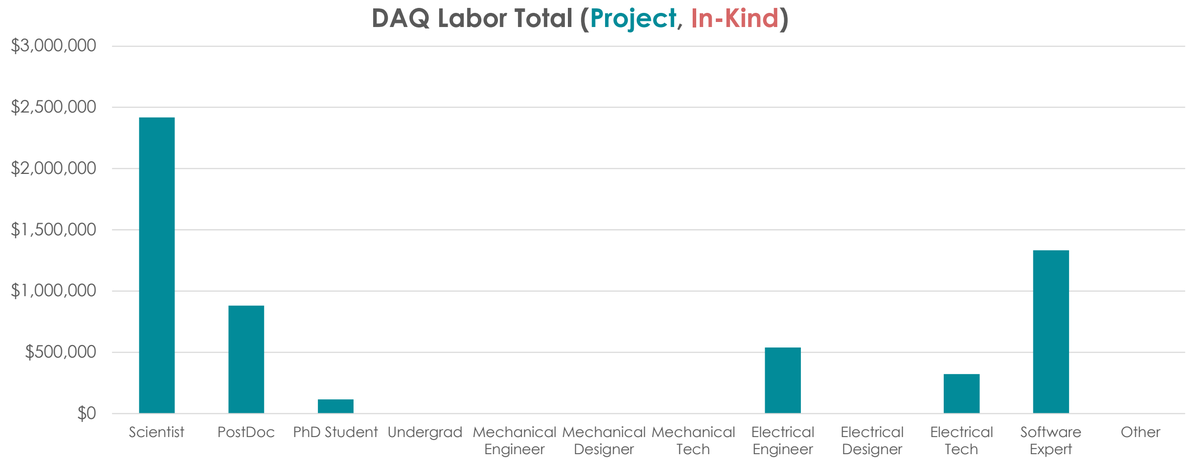


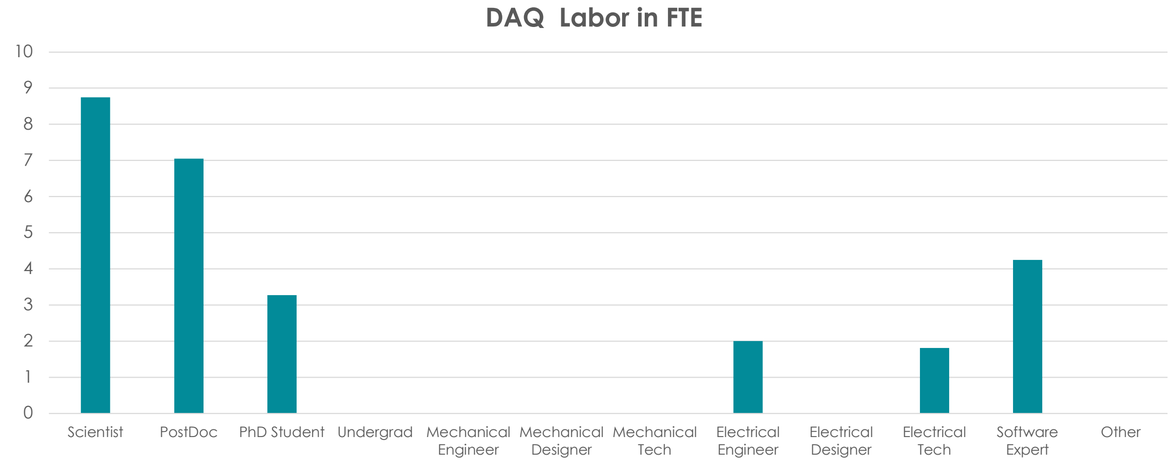
Costing - DAQ Overview











ATHENA DPAP Review Q&A

ATHENA

Question: How was escalation determined?

EIC Detector Proposal Advisory Panel Meeting, December 13-15, 2021

Question: How was escalation determined?

- Answer:
  - Link to individual costing EXCEL files: https://www.dropbox.com/sh/5411 3m8t4h3xcrd/AAAaJ2nKjdUaUKATmG8mhUWBa?dl=0
  - Column AC provides escalation for each costing item (Labor/Material) from 2021 costing using:
    - $FV_{\text{Escalation estimate}}$ - Future Value: Column AC
    - $PV_{\text{2021 costing}}$ - Present Value: Column AB
    - R - Growth rate: 3.5%
    - T - Time period in years: Number of working years provided in column V

$$FV_{\text{Escalation estimate}} = PV_{\text{2021 costing}} \cdot (1 + R)^{T}$$

FV: Future Value

PV: Present Value

Compounding

  - Total escalated values are provided at the end of column AC!
  - Total escalated values are shown in the column on side 3!

Question: How was escalation determined?

- Answer: A comprehensive summary in US Dollars (USD) of the entire ATHENA costing, including sub-systems and global systems, is provided on Slide 4. Slide 5 provides a costing comparison by sub-system as a ranked stacked horizontal bar chart in 2021 USD. Excluding global systems and R\&D cost items, the total estimated ATHENA detector cost in 2021 USD amounts to $165,611,884, which is the sum of in-kind material of $30,290,473 (18.3%), project material of $76,184,402 (46.0%), in-kind labor of $19,138,720 (11.6%), and project labor of $39,998,289 (24.2%). We expect that the fraction of in-kind contributions will increase with the evolution of the ATHENA collaboration and detector project. The respective escalated cost figures for all ATHENA sub-systems are $205,769,626 (Variable escalation factor estimate), assuming a yearly growth rate of 3.5%, considering individual funding execution periods for each cost item.

Costing

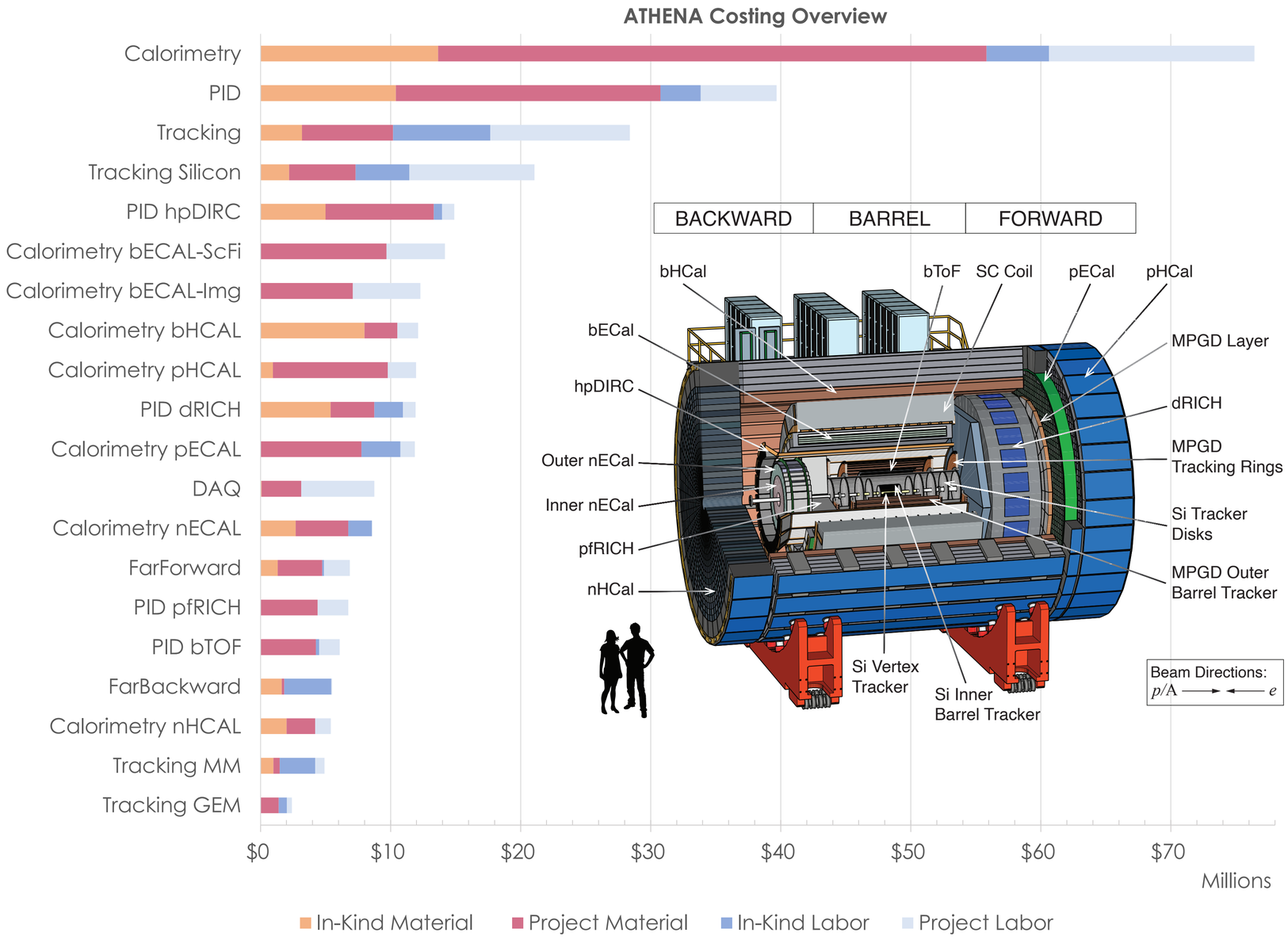
- Complete ATHENA costing table:
- Total for sub-system construction in 2021 USD: $166M
- Total for sub-system R&D in 2021 USD: $25M

Sub-system	Sub-system components	In-Kind Material	Project Material	Total Material	In-Kind Labor	Project Labor	Total Labor	Total: 2021	Total: Escalated (Sub-system)
Calorimetry	nECAL	$2,697,908	$4,050,357	$6,748,264	$1,804,621	$55,079	$1,859,700	$8,607,964	$10,438,168
	nHCAL	$1,999,800	$2,204,300	$4,204,100	$0	$1,205,512	$1,205,512	$5,409,612	$6,593,356
	bECAL-Img	$0	$7,102,048	$7,102,048	$0	$5,184,005	$5,184,005	$12,286,053	$14,185,197
	bECAL-ScFi	$0	$9,691,520	$9,691,520	$0	$4,481,037	$4,481,037	$14,172,557	$17,611,694
	bHCAL	$7,999,800	$2,518,710	$10,518,510	$0	$1,592,452	$1,592,452	$12,110,962	$14,999,623
	pECAL	$0	$7,768,700	$7,768,700	$2,993,097	$1,111,678	$4,104,775	$11,873,475	$14,831,909
	pHCAL	$950,000	$8,842,327	$9,792,327	$0	$2,167,408	$2,167,408	$11,959,735	$14,783,373
	Calorimetry Total	$13,647,508	$42,177,962	$55,825,470	$4,797,718	$15,797,171	$20,594,889	$76,420,359	$93,443,319
DAQ	DAQ	$84,000	$3,054,300	$3,138,300	$0	$5,607,651	$5,607,651	$8,745,951	$11,685,584
FarBackward	FarBackward	$1,627,608	$200,000	$1,827,608	$3,628,367	$47,097	$3,675,464	$5,503,072	$7,020,595
FarForward	FarForward	$1,334,097	$3,405,480	$4,739,577	$151,153	$1,972,247	$2,123,400	$6,862,977	$8,623,207
PID	pfRICH	$0	$4,399,900	$4,399,900	$0	$2,349,762	$2,349,762	$6,749,662	$8,712,913
	bTOF	$0	$4,263,600	$4,263,600	$257,990	$1,570,518	$1,828,508	$6,092,108	$7,826,676
	hpDIRC	$5,005,000	$8,327,000	$13,332,000	$640,916	$934,886	$1,575,802	$14,907,802	$16,938,918
	dRICH	$5,395,960	$3,360,000	$8,755,960	$2,194,791	$976,202	$3,170,993	$11,926,953	$15,509,226
	PID Total	$10,400,960	$20,350,500	$30,751,460	$3,093,697	$5,831,369	$8,925,066	$39,676,526	$48,987,734
Tracking	Tracking GEM	$0	$1,396,200	$1,396,200	$623,628	$387,346	$1,010,973	$2,407,173	$2,956,895
	Tracking MM	$1,000,000	$475,260	$1,475,260	$2,719,636	$731,526	$3,451,162	$4,926,422	$6,253,342
	Tracking Silicon	$2,196,300	$5,124,700	$7,321,000	$4,124,521	$9,623,883	$13,748,405	$21,069,405	$26,798,949
	Tracking Total	$3,196,300	$6,996,160	$10,192,460	$7,467,785	$10,742,755	$18,210,540	$28,403,000	$36,009,186
Grand Total	Total 2021	$30,290,473	$76,184,402	$106,474,875	$19,138,720	$39,998,289	$59,137,009	$165,611,884	$205,769,626
	(Fraction to Total 2021)	18.3%	46.0%	64.3%	11.6%	24.2%	35.7%	100.0%	
	Detector R&D							$25,339,863	$28,921,946
Global Systems	Detector Management								$7,400,000
	Magnet								$28,700,000
	Detector Infrastructure								$26,400,000
	Detector Pre Ops & Com.								$8,700,000
Grand Total	Total Escalated								$305,891,572

Costing

- ATHENA costing for sub-system construction in 2021 USD:
- Largest cost drivers:
  - Calorimetry
  - PID
  - Tracking
- Total for sub-system construction in 2021 USD: $166M

	In-Kind	Project	Total	
Material	$30M	$76M	$106M	64%
Labor	$19M	$40M	$59M	36%
Total	$49M	$116M	$166M	
	30%	70%		



ATHENA DPAP Review Q&A

ATHENA

Request: Separate electronics cost for each sub-system!

EIC Detector Proposal Advisory Panel Meeting, December 13-15, 2021

Question: Separate electronics cost for each sub-system!

- Answer:
  - Link to sub-system costing files: https://www.dropbox.com/sh/54113m8t4h3xcrd/AAAaJ2nKjdUaUKATmG8mhUWBa?dl=0
  - Electronics categories where extracted for each sub-system and provided in the costing file for each sub-system.
  - The total amount ($16M) is comparable to the CD1 estimates ($17M) provided in the Readme sheet for each costing file.
  - Slide 2 provides the Electronics costing table in 2021 USD.
  - Slide 3 provides the total sub-system costing table in 2021 USD.

Costing table: Electronics by sub-system in 2021 USD

Sub-system	Sub-system components	In-Kind Material	Project Material	Total Material	In-Kind Labor	Project Labor	Total Labor	Total: 2021
Calorimetry	nECAL	$0	$0	$0	$56,673	$0	$56,673	$56,673
	nHCAL	$0	$366,800	$366,800	$0	$260,813	$260,813	$627,613
	bECAL-Img	$0	$47,608	$47,608	$0	$1,211,595	$1,211,595	$1,259,203
	bECAL-ScFi	$0	$367,840	$367,840	$0	$260,013	$260,013	$627,853
	bHCAL	$0	$441,500	$441,500	$0	$260,813	$260,813	$702,313
	pECAL	$0	$938,700	$938,700	$0	$241,632	$241,632	$1,180,332
	pHCAL	$0	$754,960	$754,960	$0	$259,739	$259,739	$1,014,699
	Calorimetry Total	$0	$2,917,408	$2,917,408	$56,673	$2,494,604	$2,551,277	$5,468,685
DAQ	DAQ	$0	$0	$0	$0	$0	$0	$0
FarBackward	FarBackward	$489,600	$0	$489,600	$0	$0	$0	$489,600
FarForward	FarForward	$600,000	$792,000	$1,392,000	$10,000	$125,084	$135,084	$1,527,084
PID	pfRICH	$0	$1,471,488	$1,471,488	$0	$21,987	$21,987	$1,493,475
	bTOF	$0	$894,000	$894,000	$17,600	$152,390	$169,990	$1,063,990
	hpDIRC	$0	$898,000	$898,000	$316,502	$250,703	$567,205	$1,465,205
	dRICH	$1,904,400	$0	$1,904,400	$21,987	$0	$21,987	$1,926,387
	PID Total	$1,904,400	$3,263,488	$5,167,888	$356,089	$425,080	$781,169	$5,949,057
Tracking	Tracking GEM	$0	$135,089	$135,089	$118,829	$37,152	$155,981	$291,070
	Tracking MM	$162,683	$77,317	$240,000	$1,155,502	$114,216	$1,269,718	$1,509,718
	Tracking Silicon	$74,100	$172,900	$247,000	$105,315	$245,734	$351,049	$598,049
	Tracking Total	$236,783	$385,305	$622,089	$1,379,646	$397,102	$1,776,748	$2,398,836
Grand Total	Total	$3,230,783	$7,358,202	$10,588,985	$1,802,408	$3,441,870	$5,244,278	$15,833,263
	(Fraction to Total 2021)	20.4%	46.5%	66.9%	11.4%	21.7%	33.1%	100.0%

Costing table: Total by sub-system in 2021 USD

Sub-system	Sub-system components	In-Kind Material	Project Material	Total Material	In-Kind Labor	Project Labor	Total Labor	Total: 2021
Calorimetry	nECAL	$2,697,908	$4,050,357	$6,748,264	$1,804,621	$55,079	$1,859,700	$8,607,964
	nHCAL	$1,999,800	$2,204,300	$4,204,100	$0	$1,205,512	$1,205,512	$5,409,612
	bECAL-Img	$0	$7,102,048	$7,102,048	$0	$5,184,005	$5,184,005	$12,286,053
	bECAL-ScFi	$0	$9,691,520	$9,691,520	$0	$4,481,037	$4,481,037	$14,172,557
	bHCAL	$7,999,800	$2,518,710	$10,518,510	$0	$1,592,452	$1,592,452	$12,110,962
	pECAL	$0	$7,768,700	$7,768,700	$2,993,097	$1,111,678	$4,104,775	$11,873,475
	pHCAL	$950,000	$8,842,327	$9,792,327	$0	$2,167,408	$2,167,408	$11,959,735
	Calorimetry Total	$13,647,508	$42,177,962	$55,825,470	$4,797,718	$15,797,171	$20,594,889	$76,420,359
DAQ	DAQ	$84,000	$3,054,300	$3,138,300	$0	$5,607,651	$5,607,651	$8,745,951
FarBackward	FarBackward	$1,627,608	$200,000	$1,827,608	$3,628,367	$47,097	$3,675,464	$5,503,072
FarForward	FarForward	$1,334,097	$3,405,480	$4,739,577	$151,153	$1,972,247	$2,123,400	$6,862,977
PID	pfRICH	$0	$4,399,900	$4,399,900	$0	$2,349,762	$2,349,762	$6,749,662
	bTOF	$0	$4,263,600	$4,263,600	$257,990	$1,570,518	$1,828,508	$6,092,108
	hpDIRC	$5,005,000	$8,327,000	$13,332,000	$640,916	$934,886	$1,575,802	$14,907,802
	dRICH	$5,395,960	$3,360,000	$8,755,960	$2,194,791	$976,202	$3,170,993	$11,926,953
	PID Total	$10,400,960	$20,350,500	$30,751,460	$3,093,697	$5,831,369	$8,925,066	$39,676,526
Tracking	Tracking GEM	$0	$1,396,200	$1,396,200	$623,628	$387,346	$1,010,973	$2,407,173
	Tracking MM	$1,000,000	$475,260	$1,475,260	$2,719,636	$731,526	$3,451,162	$4,926,422
	Tracking Silicon	$2,196,300	$5,124,700	$7,321,000	$4,124,521	$9,623,883	$13,748,405	$21,069,405
	Tracking Total	$3,196,300	$6,996,160	$10,192,460	$7,467,785	$10,742,755	$18,210,540	$28,403,000
Grand Total	Total 2021	$30,290,473	$76,184,402	$106,474,875	$19,138,720	$39,998,289	$59,137,009	$165,611,884
	(Fraction to Total 2021)	18.3%	46.0%	64.3%	11.6%	24.2%	35.7%	100.0%