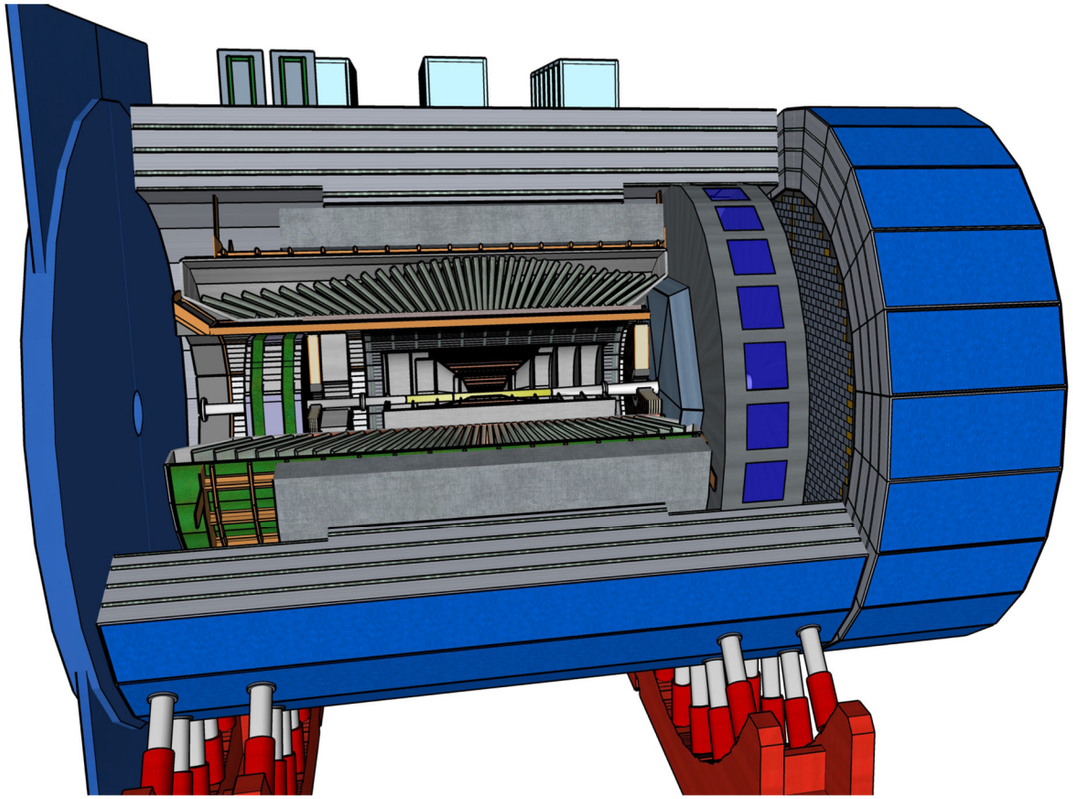
EIC Comprehensive Chromodynamics Experiment



Cost and Schedule

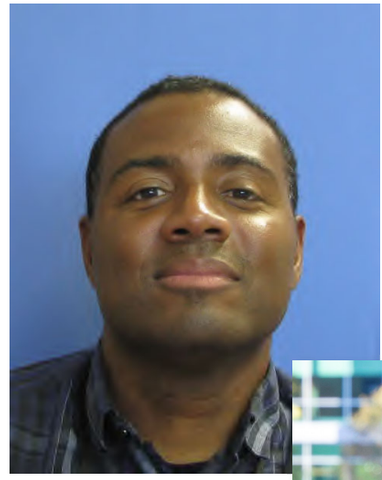
John Lajoie

Iowa State University

for the ECCE Consortium

ECCE Costing Team

- ECCE costing methodology:
  - Worked with experienced professionals to introduce principles of professional project management from the beginning
    - WBS in Primavera P6
    - Costing sheets exported to Excel
  - Consistent bottom-up approach to cost, schedule and risk across subsystems
- Substantial project management experience in ECCE:
  - Recent experience in sPHENIX MIE (BNL)
  - Extensive expertise at ORNL:
    - ALICE Upgrades, LEGEND-1000, NNSA ($6.5B) …
    - Project engineering experience (Joe Rasson)
- Extensive Internal Review:
  - Greg Capps, Director of ORNL Project Mgmt. Office
  - Marcel Demarteau, Physics Division Director



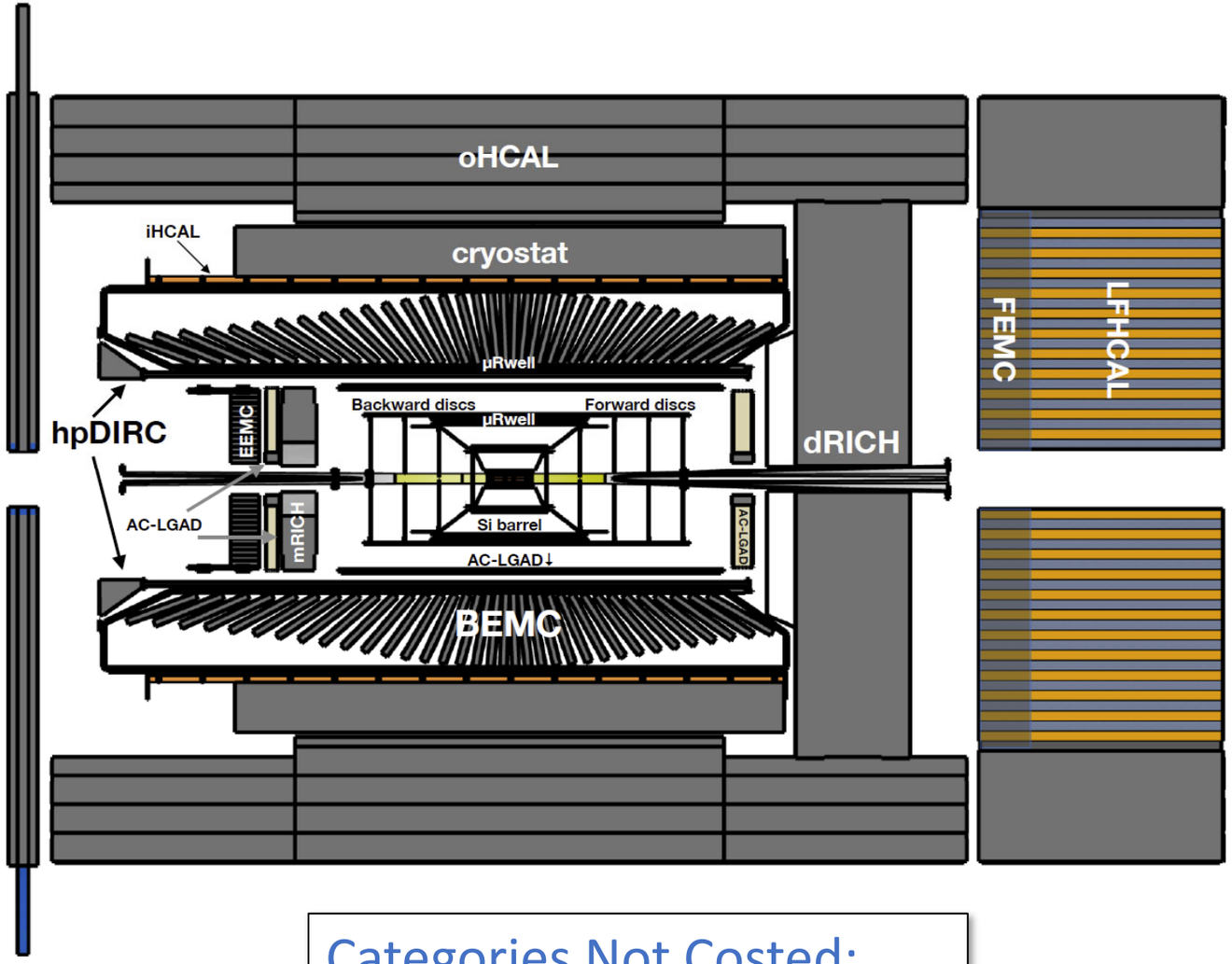
John Cunningham

Spencer Creekmore

Joseph Rasson

Costed Categories

- Tracking
  - Si Tracker and µRwell
- PID
  - mRICH, hpDIRC, dRICH, AC-LGAD TOF
- EM Calorimetry
  - EEMC, BEMC, FEMC
- Hadron Calorimetry
  - iHCAL, oHCAL (reuse), LFHCAL
- Magnet
  - BaBar solenoid reuse
- Electronics
  - Dividing line at photosensors
- DAQ/Computing
- Detector Infrastructure
  - Only reuse items, remainder not costed
- Auxiliary Detectors (not pictured)
- Luminosity Monitor (not pictured)



Categories Not Costed:

Detector Management*
Detector R&D* (evaluate)
Detector Infrastructure* (partial)
Pre-Ops and Commissioning

Costing Guidelines

- All costs calculated in fixed 2021 USD.
- Value of reuse items converted to 2021 USD using CPI
  - Most of the reuse comes from sPHENIX, where actual material and labor costs are available.
  - Corresponding on-project costs for refurbishment and modification are included.
- Labor categories and rates provided by the project
- No overhead or contingency was applied
- Detector subsystems include cost of their assembly and shipping to IP6
- Installation of subsystems are part of Detector Infrastructure (uncosted portion)

Cost in Primavera P6

ECCE DETAILED EIC DETECTOR COSTING BY WBS — 01-Dec-21 15:10

Activity ID	Activity Name	Funding Source	In-Kind Labor Hours	On-Project Labor Hours	Total Labor Hours	In-Kind Labor Cost	On-Project Labor Cost	Total Labor Cost	In-Kind Material Cost	On-Project Material Cost	Total Material Cost	Total In-Kind Cost	Total On-Project Cost	Budgeted Cost
Project: ECE06 Electron Ion Collider Project			180524.00	282537.86	463061.86	$13,873,213.14	$29,517,900.54	$43,391,113.68	$44,192,092.93	$82,872,465.76	$127,064,558.69	$58,065,306.07	$112,390,366.30	$170,455,672.37
WBS: ECE06.10 ECCE EIC Detector Project			180524.00	282537.86	463061.86	$13,873,213.14	$29,517,900.54	$43,391,113.68	$44,192,092.93	$82,872,465.76	$127,064,558.69	$58,065,306.07	$112,390,366.30	$170,455,672.37
WBS: ECE06.10.03 Tracking			54803.20	91868.80	146672.00	$4,414,637.99	$10,671,907.05	$15,086,545.04	$2,266,500.00	$9,485,500.00	$11,752,000.00	$6,681,137.99	$20,157,407.05	$26,838,545.04
WBS: ECE06.10.03.01 Tracking			54803.20	91868.80	146672.00	$4,414,637.99	$10,671,907.05	$15,086,545.04	$2,266,500.00	$9,485,500.00	$11,752,000.00	$6,681,137.99	$20,157,407.05	$26,838,545.04
WBS: ECE06.10.03.01.01 Inner Barrel Gas Tracking			2040.00	6880.00	8920.00	$101,102.00	$576,736.00	$677,838.00	$361,500.00	$939,000.00	$1,300,500.00	$462,602.00	$1,515,736.00	$1,978,338.00
WBS: ECE06.10.03.01.01.01 Design and Prototyping			400.00	3160.00	3560.00	$8,000.00	$300,645.20	$308,645.20	$1,500.00	$74,000.00	$75,500.00	$9,500.00	$374,645.20	$384,145.20
EIC19160	Prototype module design	Project	0.00	200.00	200.00	$0.00	$14,198.00	$14,198.00	$0.00	$0.00		$0.00	$14,198.00	$14,198.00
EIC19170	Prototype component purchase: uRwell foils	Project	0.00	0.00		$0.00	$0.00		$0.00	$14,000.00	$14,000.00	$0.00	$14,000.00	$14,000.00
EIC19170	Prototype component purchase: uRwell foils	Project	0.00	80.00	80.00	$0.00	$5,679.20	$5,679.20	$0.00	$0.00		$0.00	$5,679.20	$5,679.20
EIC19180	Prototype component purchase: detector frames	Project	0.00	0.00		$0.00	$0.00		$0.00	$5,000.00	$5,000.00	$0.00	$5,000.00	$5,000.00
EIC19180	Prototype component purchase: detector frames	Project	0.00	80.00	80.00	$0.00	$5,679.20	$5,679.20	$0.00	$0.00		$0.00	$5,679.20	$5,679.20
EIC19190	Prototype component purchase: other material	Project	0.00	0.00		$0.00	$0.00		$0.00	$5,000.00	$5,000.00	$0.00	$5,000.00	$5,000.00
EIC19190	Prototype component purchase: other material	Project	0.00	80.00	80.00	$0.00	$5,679.20	$5,679.20	$0.00	$0.00		$0.00	$5,679.20	$5,679.20
EIC19200	Prototype module assembly (Make 1)	Project	0.00	0.00		$0.00	$0.00		$0.00	$15,000.00	$15,000.00	$0.00	$15,000.00	$15,000.00
EIC19200	Prototype module assembly (Make 1)	Project	0.00	400.00	400.00	$0.00	$28,396.00	$28,396.00	$0.00	$0.00		$0.00	*$28,396.00*	*$28,396.00*
EIC19210	Prototype module assembly	Project	0.00	80.00	80.00	$0.00	$12,253.60	$12,253.60	$0.00	$0.00		$0.00		
EIC19220	Prototype module testing	In-Kind	0.00	0.00		$0.00	$0.00		$1,500.00	$0.00	$1,500.00	$1,500.00		
EIC19220	Prototype module testing	In-Kind	400.00	0.00	400.00	$8,000.00	$0.00	$8,000.00	$0.00	$0.00		$8,000.00		
EIC19230	Mechanical support structure design	Project	0.00	800.00	800.00	$0.00	$92,880.00	$92,880.00	$0.00	$0.00		$0.00		
EIC19235	Slow Controls	Project	0.00	120.00	120.00	$0.00	$8,518.80	$8,518.80	$0.00	$0.00		$0.00		
EIC19240	Support Structure Prototyping/Fabrication	Project	0.00	0.00		$0.00	$0.00		$0.00	$5,000.00	$5,000.00	$0.00		
EIC19240	Support Structure Prototyping/Fabrication	Project	0.00	400.00	400.00	$0.00	$28,396.00	$28,396.00	$0.00	$0.00		$0.00		
EIC19250	Mechanical support structure final design	Project	0.00	400.00	400.00	$0.00	$46,440.00	$46,440.00	$0.00	$0.00		$0.00		
EIC19260	Mechanical support structure fabrication and assembly	Project	0.00	0.00		$0.00	$0.00		$0.00	$30,000.00	$30,000.00	$0.00		
EIC19260	Mechanical support structure fabrication and assembly	Project	0.00	520.00	520.00	$0.00	$52,525.20	$52,525.20	$0.00	$0.00		$0.00		
WBS: ECE06.10.03.01.01.02 Procurements			240.00	400.00	640.00	$37,692.00	$28,396.00	$66,088.00	$360,000.00	$120,000.00	$480,000.00	$397,692.00	$1	
EIC19280	Rack, LV, HV, Crates, Cable Purchase Ready for Installation	Project	0.00	0.00		$0.00	$0.00		$0.00	$120,000.00	$120,000.00	$0.00	$1	
EIC19280	Rack, LV, HV, Crates, Cable Purchase Ready for Installation	Project	0.00	400.00	400.00	$0.00	$28,396.00	$28,396.00	$0.00	$0.00		$0.00		
EIC19290	Detector component purchase: uRwell foils	In-Kind	0.00	0.00		$0.00	$0.00		$210,000.00	$0.00	$210,000.00	$210,000.00		
EIC19300	Detector component purchase: detector frames	In-Kind	0.00	0.00		$0.00	$0.00		$75,000.00	$0.00	$75,000.00	$75,000.00		
EIC19310	Detector component purchase: other components	In-Kind	0.00	0.00		$0.00	$0.00		$75,000.00	$0.00	$75,000.00	$75,000.00		
EIC19320	Detector component purchase: uRwell foils (Make 1)	In-Kind	120.00	0.00	120.00	$18,846.00	$0.00	$18,846.00	$0.00	$0.00		$18,846.00		
EIC19330	Detector component purchase: detector frames	In-Kind	80.00	0.00	80.00	$12,564.00	$0.00	$12,564.00	$0.00	$0.00		$12,564.00		
EIC19340	Detector component purchase: other components	In-Kind	40.00	0.00	40.00	$6,282.00	$0.00	$6,282.00	$0.00	$0.00		$6,282.00		
WBS: ECE06.10.03.01.01.03 Integration, Installation and Testing			1400.00	3320.00	4720.00	$55,410.00	$247,694.80	$303,104.80	$0.00	$745,000.00	$745,000.00	$55,410.00	$992,694.80	$1,048,104.80
EIC19349	Detector assembly tooling	Project	0.00	0.00		$0.00	$0.00		$0.00	$25,000.00	$25,000.00	$0.00	$25,000.00	$25,000.00
EIC19349	Detector assembly tooling	Project	0.00	400.00	400.00	$0.00	$28,396.00	$28,396.00	$0.00	$0.00		$0.00	$28,396.00	$28,396.00
EIC19350	Detector assembly	Project	0.00	0.00		$0.00	$0.00		$0.00	$150,000.00	$150,000.00	$0.00	$150,000.00	$150,000.00
EIC19350	Detector assembly	Project	0.00	1200.00	1200.00	$0.00	$85,188.00	$85,188.00	$0.00	$0.00		$0.00	$85,188.00	$85,188.00
EIC19380	Electronics integration	Project	0.00	0.00		$0.00	$0.00		$0.00	$330,000.00	$330,000.00	$0.00	$330,000.00	$330,000.00
EIC19380	Electronics integration	Project	0.00	400.00	400.00	$0.00	$28,396.00	$28,396.00	$0.00	$0.00		$0.00	$28,396.00	$28,396.00
EIC19382	Electronics integration	In-Kind	400.00	0.00	400.00	$8,000.00	$0.00	$8,000.00	$0.00	$0.00		$8,000.00	$0.00	$8,000.00
EIC19390	Mechanical integration	Project	0.00	0.00		$0.00	$0.00		$0.00	$75,000.00	$75,000.00	$0.00	$75,000.00	$75,000.00
EIC19390	Mechanical integration	Project	0.00	400.00	400.00	$0.00	$28,396.00	$28,396.00	$0.00	$0.00		$0.00	$28,396.00	$28,396.00
EIC19400	Mechanical integration	Project	0.00	400.00	400.00	$0.00	$40,404.00	$40,404.00	$0.00	$0.00		$0.00	$40,404.00	$40,404.00
EIC19410	System testing and qualification	Project	0.00	0.00		$0.00	$0.00		$0.00	$150,000.00	$150,000.00	$0.00	$150,000.00	$150,000.00
EIC19410	System testing and qualification	Project	0.00	400.00	400.00	$0.00	$28,396.00	$28,396.00	$0.00	$0.00		$0.00	$28,396.00	$28,396.00
EIC19420	System testing and qualification	In-Kind	200.00	0.00	200.00	$31,410.00	$0.00	$31,410.00	$0.00	$0.00		$31,410.00	$0.00	$31,410.00
EIC19430	System testing and qualification	In-Kind	800.00	0.00	800.00	$16,000.00	$0.00	$16,000.00	$0.00	$0.00		$16,000.00	$0.00	$16,000.00
EIC19440	Transportation of Detectors	Project	0.00	0.00		$0.00	$0.00		$0.00	$15,000.00	$15,000.00	$0.00	$15,000.00	$15,000.00
EIC19440	Transportation of Detectors	Project	0.00	120.00	120.00	$0.00	$8,518.80	$8,518.80	$0.00	$0.00		$0.00	$8,518.80	$8,518.80
WBS: ECE06.10.03.01.02 Outer Barrel Gas Tracking			2640.00	8200.00	10840.00	$113,102.00	$696,740.40	$809,842.40	$364,500.00	$1,262,000.00	$1,626,500.00	$477,602.00	$1,958,740.40	$2,436,342.40

The ECCE project plan is a bottom-up estimate informed by subsystem experts.

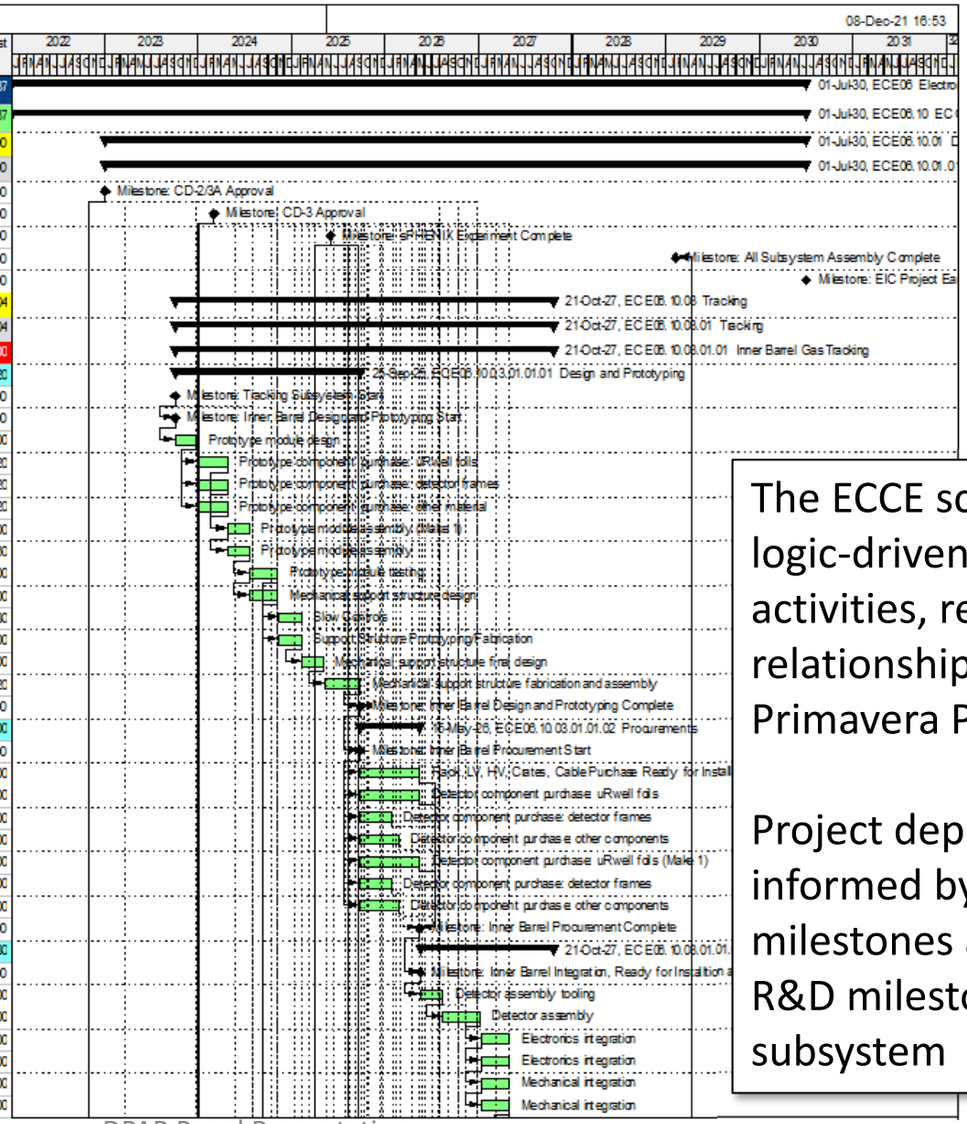
More than 1250 activities, more than 250 milestones.

Schedule in Primavera P6

ECCE Electron Ion Collider Project Notional Schedule

08-Dec-21 16:53

Activity ID	Activity Name	Start	Finish	Original Duration	Budgeted Total Cost
ECE06	Electron Ion Collider Project	04-Jan-22	01-Jul-30	2138	$170,455,672.37
ECE06.10	ECCE EIC Detector Project	04-Jan-22	01-Jul-30	2138	$170,455,672.37
ECE06.10.01	Detector Management	02-Jan-23	01-Jul-30	1887	$0.00
ECE06.10.01.01	Key Milestones	02-Jan-23	01-Jul-30	1887	$0.00
EIC13840	Milestone: CD-2/3A Approval		02-Jan-23*	0	$0.00
EIC13850	Milestone: CD-3 Approval		01-Mar-24*	0	$0.00
EIC13854	Milestone: sPHENIX Experiment Complete		02-Jun-25*	0	$0.00
EIC13862	Milestone: All Subsystem Assembly Complete		05-Feb-29	0	$0.00
EIC13868	Milestone: EIC Project Early CD-4A		01-Jul-30*	0	$0.00
ECE06.10.03	Tracking	02-Oct-23	21-Oct-27	1020	$26,838,545.04
ECE06.10.03.01	Tracking	02-Oct-23	21-Oct-27	1020	$26,838,545.04
ECE06.10.03.01.01	Inner Barrel Gas Tracking	02-Oct-23	21-Oct-27	1020	$1,978,338.00
ECE06.10.03.01.01.01	Design and Prototyping	02-Oct-23	25-Sep-25	500	$384,145.20
EIC18891	Milestone: Tracking Subsystem Start	02-Oct-23		0	$0.00
EIC19158	Milestone: Inner Barrel Design and Prototyping Start	02-Oct-23		0	$0.00
EIC19160	Prototype module design	02-Oct-23	27-Dec-23	60	$14,196.00
EIC19170	Prototype component purchase: uRwell foils	28-Dec-23	22-Apr-24	80	$19,679.20
EIC19180	Prototype component purchase: detector frames	28-Dec-23	22-Apr-24	80	$10,679.20
EIC19190	Prototype component purchase: other material	28-Dec-23	22-Apr-24	80	$10,679.20
EIC19200	Prototype module assembly (Make 1)	23-Apr-24	17-Jul-24	60	$43,395.00
EIC19210	Prototype module assembly	23-Apr-24	17-Jul-24	60	$12,253.60
EIC19220	Prototype module testing	18-Jul-24	08-Nov-24	80	$9,500.00
EIC19230	Mechanical support structure design	18-Jul-24	08-Nov-24	80	$9,280.80
EIC19235	Slow Controls	12-Nov-24	07-Feb-25	60	$8,518.80
EIC19240	Support Structure Prototyping/Fabrication	12-Nov-24	07-Feb-25	60	$33,395.00
EIC19250	Mechanical support structure final design	10-Feb-25	05-May-25	60	$46,440.00
EIC19260	Mechanical support structure fabrication and assembly	06-May-25	25-Sep-25	100	$82,525.20
EIC19450	Milestone: Inner Barrel Design and Prototyping Complete		25-Sep-25	0	$0.00
ECE06.10.03.01.01.02	Procurements	26-Sep-25	15-May-26	160	$546,088.00
EIC19278	Milestone: Inner Barrel Procurement Start	26-Sep-25		0	$0.00
EIC19280	Rack, LV, HV, Crates, Cable Purchase Ready for Installation	26-Sep-25	15-May-26	160	$148,396.00
EIC19290	Detector component purchase uRwell foils	26-Sep-25	15-May-26	160	$210,000.00
EIC19300	Detector component purchase detector frames	26-Sep-25	22-Jan-26	80	$75,000.00
EIC19310	Detector component purchase other components	26-Sep-25	20-Feb-26	100	$75,000.00
EIC19320	Detector component purchase uRwell foils (Make 1)	26-Sep-25	15-May-26	160	$18,845.00
EIC19330	Detector component purchase detector frames	26-Sep-25	22-Jan-26	80	$12,564.00
EIC19340	Detector component purchase other components	26-Sep-25	20-Feb-26	100	$6,282.00
EIC19460	Milestone: Inner Barrel Procurement Complete		15-May-26	0	$0.00
ECE06.10.03.01.01.03	Integration, Installation and Testing	18-May-26	21-Oct-27	360	$1,048,104.80
EIC19348	Milestone: Inner Barrel Integration, Ready for Installtion and Testing St	18-May-26		0	$0.00
EIC19349	Detector assembly tooling	18-May-26	11-Aug-26	60	$53,395.00
EIC19350	Detector assembly	12-Aug-26	06-Jan-27	100	$235,188.00
EIC19380	Electronics integration	07-Jan-27	30-Apr-27	80	$358,396.00
EIC19382	Electronics integration	07-Jan-27	30-Apr-27	80	$8,000.00
EIC19390	Mechanical integration	07-Jan-27	30-Apr-27	80	$103,396.00
EIC19400	Mechanical integration	07-Jan-27	30-Apr-27	80	$40,404.00

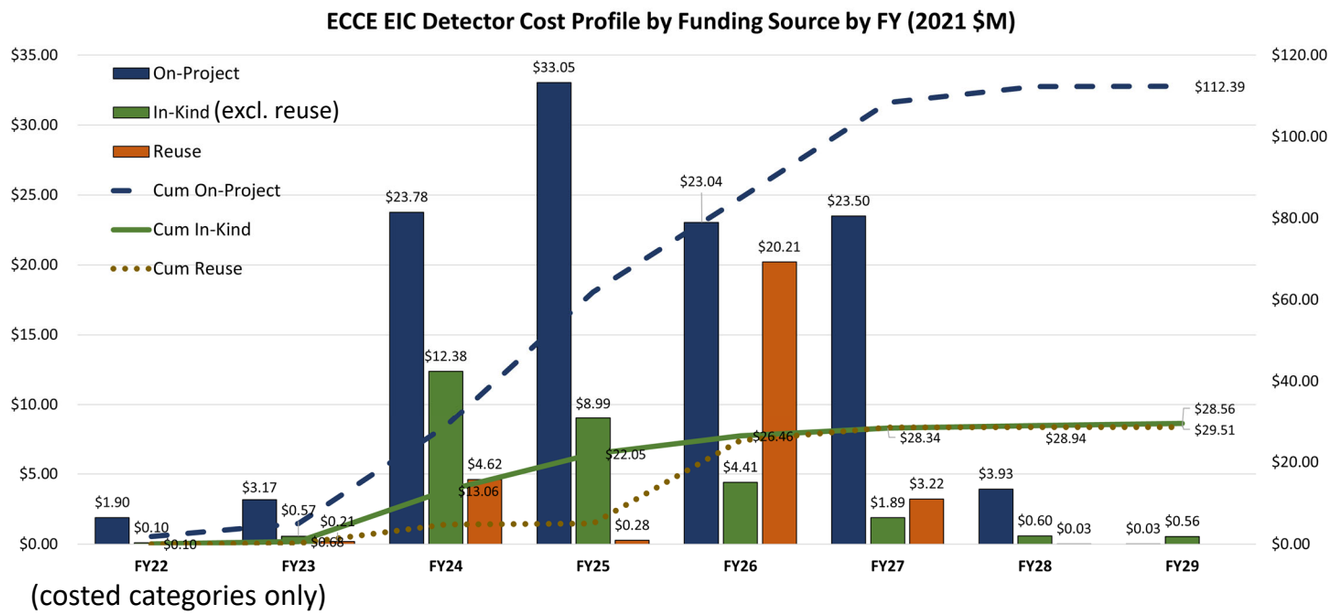


The ECCE schedule is entirely logic-driven based on the activities, resources, duration and relationships within the Primavera P6 project plan.

Project dependencies are informed by the EIC project CD milestones as well as the relevant R&D milestones for each detector subsystem

Cost Estimate and Profile

Category	In-Kind ($M)	On-Project ($M)	Total ($M)
Tracking	**6.7**	**20.2**	**26.8**
Inner Barrel μRwell	0.5	1.5	2.0
Outer Barrel μRwell	0.5	2.0	2.4
Si Tracker	5.7	16.7	22.4
Particle ID	**6.1**	**28.1**	**34.2**
hpDIRC	5.5	8.2	13.7
mRICH	0.1	3.0	3.1
dRICH	0.2	7.0	7.2
AC-LGAD TOF	0.3	9.9	10.1
EM Calorimetry	**7.4**	**21.0**	**28.4**
Barrel	1.5	15.1	16.6
Electron Endcap	3.7	5.2	8.8
Hadron Endcap	2.2	0.7	2.9
Hadronic Calorimetry	**10.0**	**13.3**	**23.3**
Barrel	10.0	3.5	13.5
Hadron Endcap	0.0	9.8	9.8
Magnet	**9.0**	**3.4**	**12.4**
BaBar Solenoid	9.0	0.9	9.9
Replacement Magnet Design	0.0	1.3	1.3
Valve Box	0.0	0.4	0.4
Cryo Line	0.0	0.8	0.8
Electronics	**2.7**	**18.9**	**21.6**
DAQ/Computing	**1.2**	**6.0**	**7.2**
Detector Infrastructure (reuse only)	**3.9**	**1.1**	**5.0**
Auxiliary Detectors	**10.3**	**0.4**	**10.8**
Roman Pots	0.0	0.4	0.4
Off-Momentum Detector	1.2	0.0	1.2
B0 Detector	1.1	0.0	1.1
ZDC	7.0	0.0	7.0
Low-Q^2 Tagger	1.1	0.0	1.1
Luminosity Monitor	**0.8**	**0.0**	**0.8**
Subtotal for Costed Categories (2021 USD)	**58.1**	**112.4**	**170.5**



(costed categories only)

Direct output of ECCE cost and schedule exercise.
Scheduled activities inform profile.
Reuse value taken when committed to ECCE.

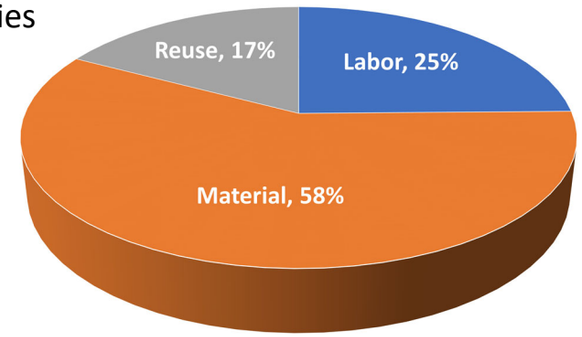
Subsystem cost (excl. magnet): $158.1M (2021 USD)

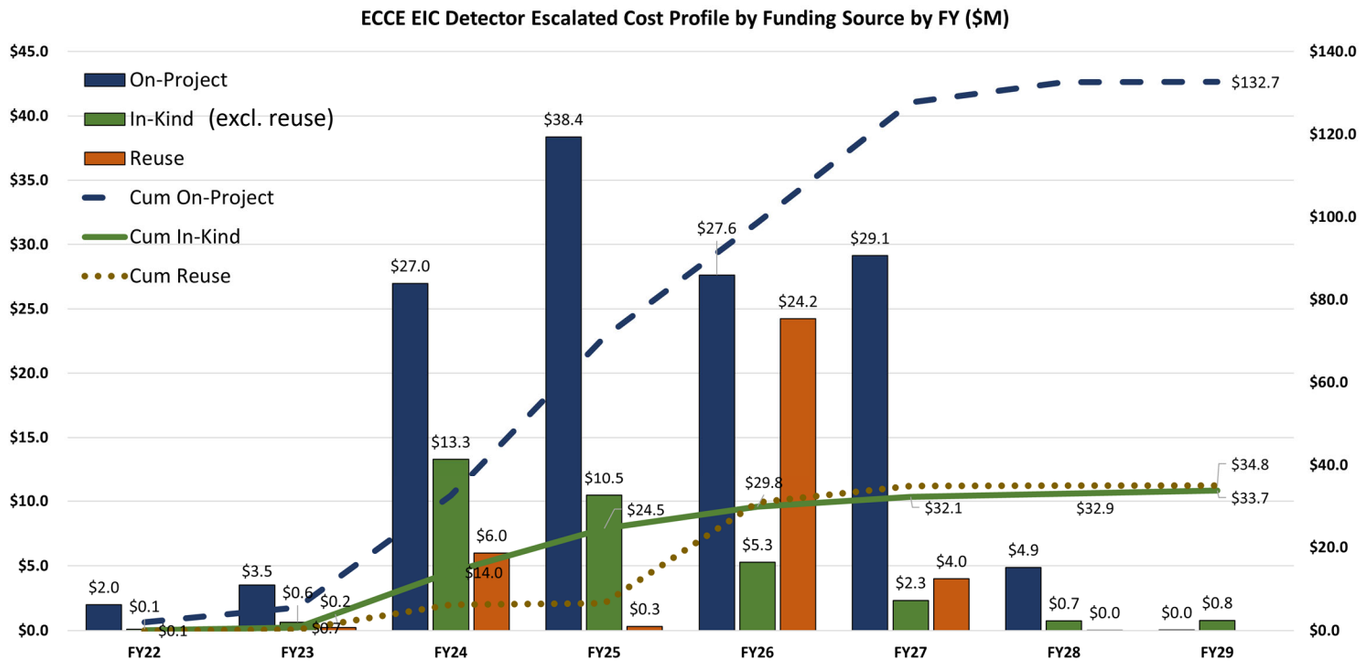
Total Cost with Escalation

Total for Costed Categories (2021 USD)	**170.5**
Costed Categories (Escalated 3.5%/yr)	**201.2**
Detector Management	7.4
Detector R&D	12.1
Detector Infrastructure (remainder not costed)	20.6
Pre-Ops and Commissioning	8.7
TOTAL	**250.0**

Cost escalation taken at 3.5%/year from project costing sheet template.

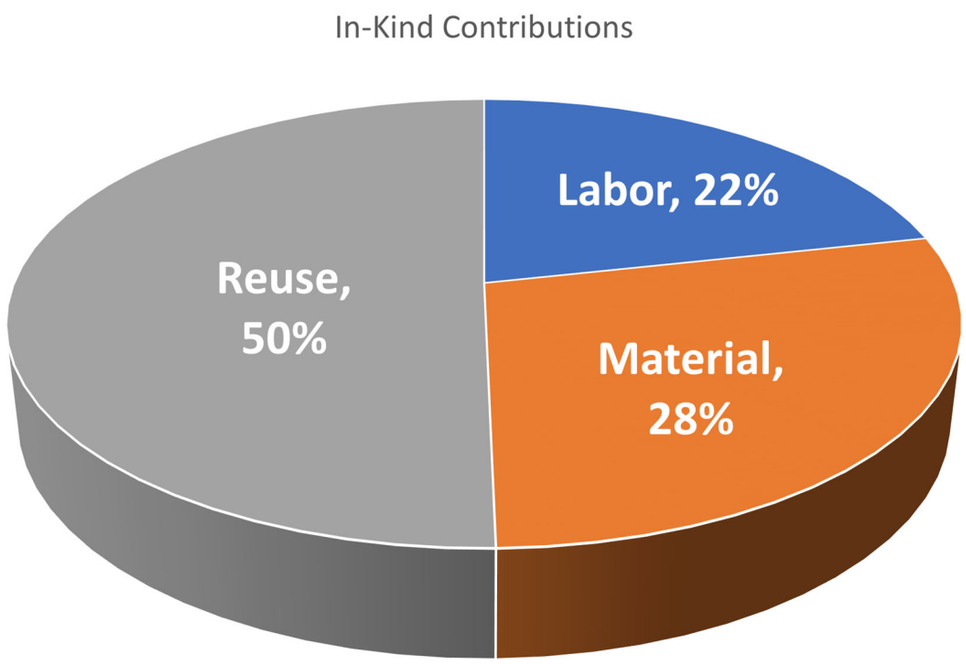
Breakdown for costed categories

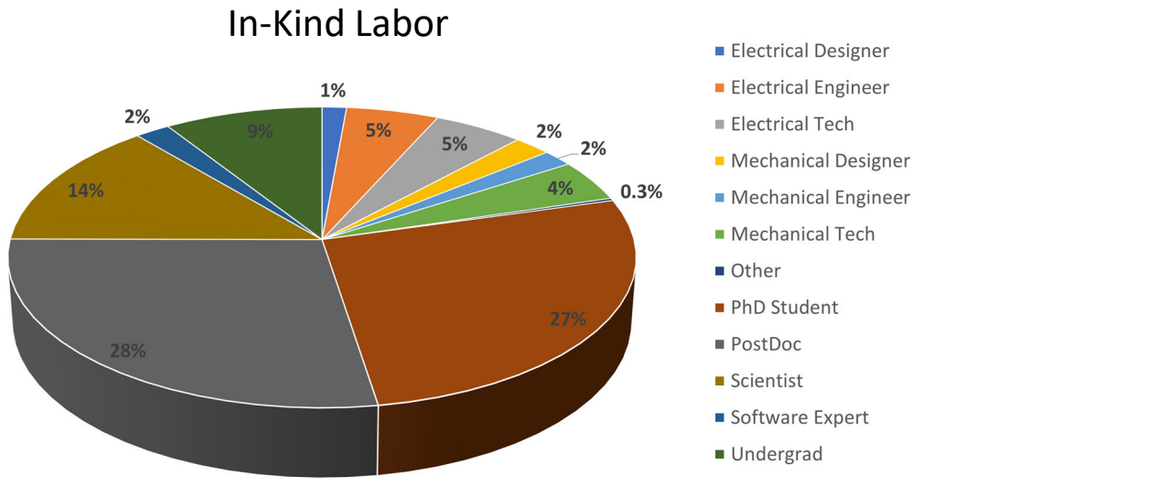




(costed categories only)

In-Kind Contributions





The in-kind labor contributions are well-supported by the ECCE consortium commitments.

In-Kind FTEs by Subsystem

Subsystem	Electrical Designer	Electrical Engineer	Electrical Tech	Mechanical Designer	Mechanical Engineer	Mechanical Tech	PhD Student	PostDoc	Other	Scientist	Undergrad	Software Expert	Total FTE's
ECE06.10.03 Tracking	0.0	0.9	2.6	0.0	0.6	2.4	8.0	11.6	0.0	5.1	0.0	0.0	**31.1**
ECE06.10.04 PID	0.0	0.0	0.0	0.9	0.0	0.3	6.2	0.2	0.0	1.8	1.3	0.0	**10.6**
ECE06.10.05 Electromagnetic Calorimetry	0.0	0.4	0.0	1.0	0.6	1.3	9.8	13.3	0.0	0.0	6.9	0.0	**33.2**
ECE06.10.08 Electronics	1.0	2.3	1.7	0.0	0.0	0.0	0.0	0.0	0.3	3.8	0.0	0.0	**9.0**
ECE06.10.09 DAQ/Computing	0.0	0.0	0.2	0.0	0.0	0.0	0.2	0.1	0.0	1.8	0.0	1.9	**4.2**
ECE06.10.11 Auxiliary Detectors	0.3	1.2	0.3	0.1	0.2	0.2	0.7	0.3	0.0	0.3	0.3	0.0	**4.0**
ECE06.10.14 Luminosity Monitor	0.0	0.1	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.4**
Totals	**1.3**	**4.9**	**4.8**	**2.0**	**1.7**	**4.1**	**24.9**	**25.6**	**0.3**	**12.8**	**8.5**	**1.9**	**92.6**

Equipment Reuse

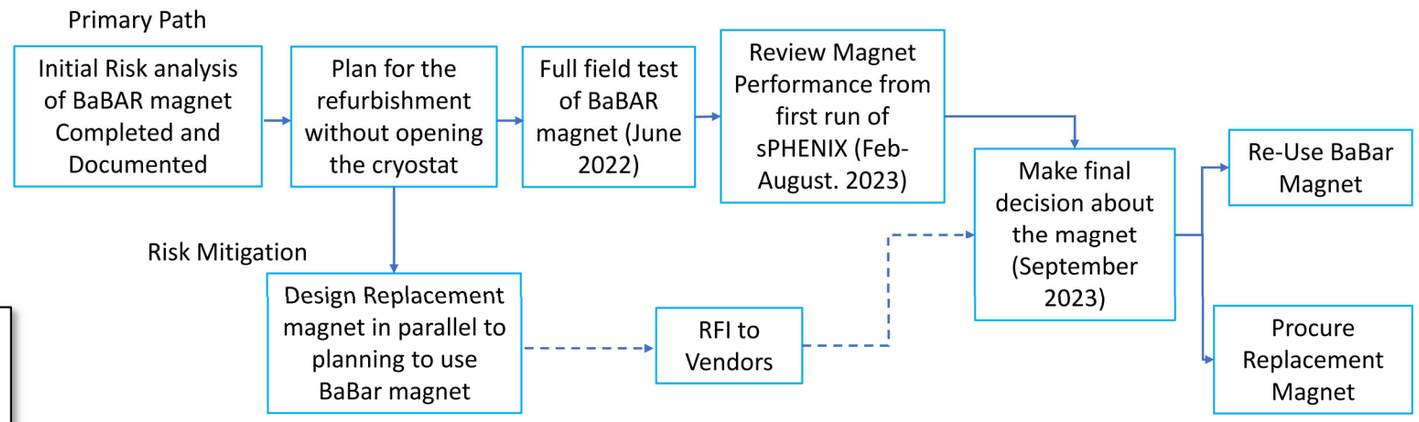
(2021 USD)

Equipment	Source	In-Kind Value ($M)	On-Project Costs ($M)
BaBar Solenoid	BNL	9.0	2.9
sPHENIX Experiment Pedestal, Backwards Flux Return	BNL	3.9	1.0
sPHENIX Outer Hadronic Calorimeter	BNL	10.0	3.5
PWO Crystals	JLab	0.7	0.0
BaBar DIRC quartz bars	SLAC	5.0	0.3
TOTAL		**28.6**	**7.7**

Project plan tabulates value of reuse as well as on-project expenses to refurbish and prepare for use in ECCE.

BaBar solenoid, sPHENIX oHCAL (partial) and cradle.

Magnet Reuse



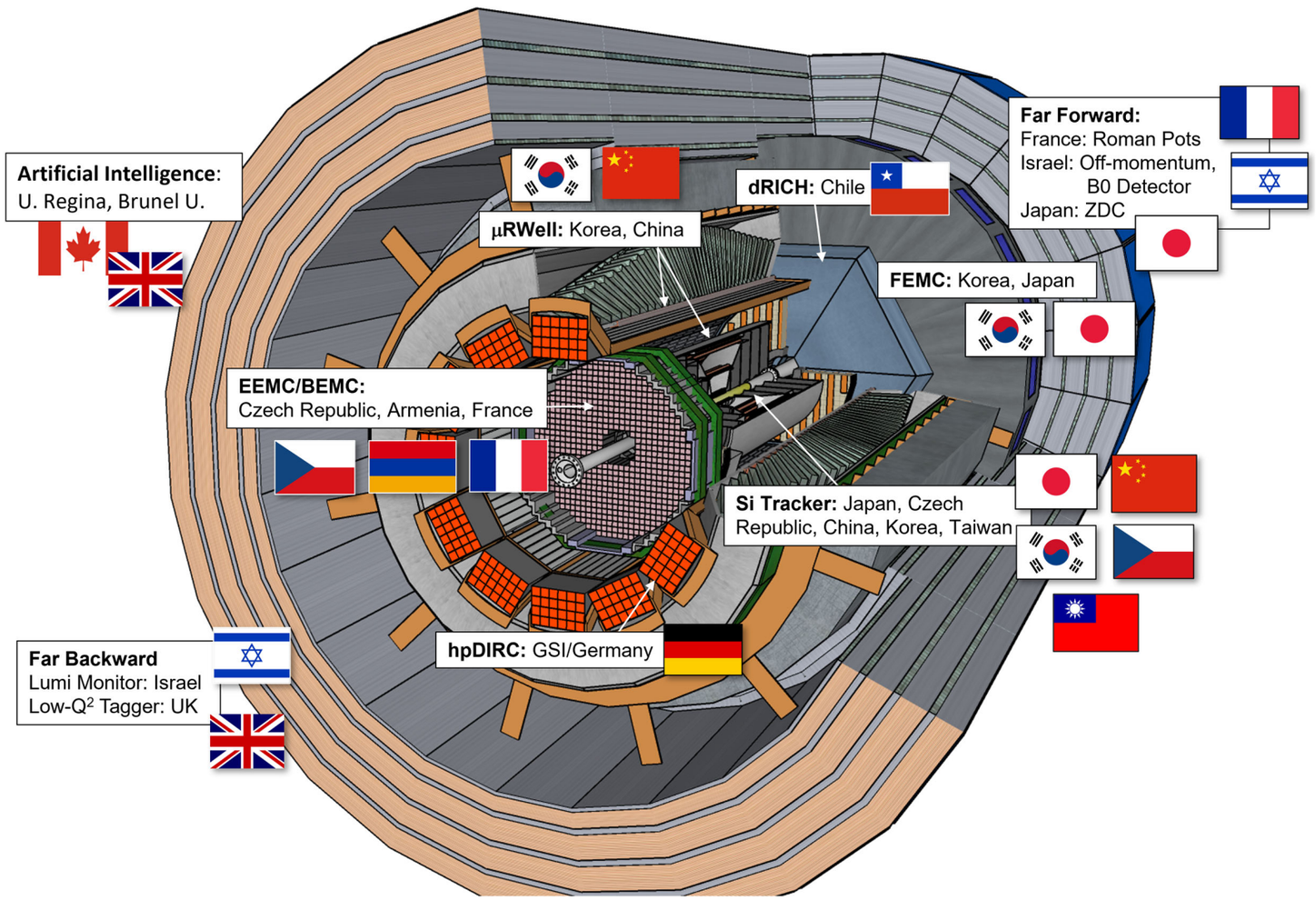
Cost and schedule for reuse of the BaBar solenoid tightly coupled with risk mitigation plan.

(2021 USD)

	Total Labor Cost	Total Material Cost	Budgeted Cost
WBS: ECE06.10.07 Magnet	**$2,621,147.20**	**$9,806,800.00**	**$12,427,947.20**
WBS: ECE06.10.07.01 Magnet Refurbishment Preparation and Relocation	$856,807.20	$9,086,800.00	$9,943,607.20
WBS: ECE06.10.07.02 Replacement Magnet Design	$1,280,974.00	$0.00	$1,280,974.00
WBS: ECE06.10.07.03 Valve Box Replacement, Procurement and Documentation	$173,694.00	$220,000.00	$393,694.00
WBS: ECE06.10.07.04 Cryocan and Cryo-Flex Line Design, Fabrication and Installation	$309,672.00	$500,000.00	$809,672.00

Starting replacement magnet design ahead of review of sPHENIX first run performance mitigates long manufacturing time (60 months) if risk is realized.

International In-Kind



(2021 USD)

Contribution	International Partners	In-Kind Value ($M)
FEMC Detector and Electronics	Korea, Japan	2.7
μRwell foils/boards	Korea, China	0.4
Si Tracker Module Assembly Sites (probe test, tooling, labor)	Korea, China, Taiwan	2.6
ZDC Detector and Electronics	Japan	7.0
Off-Momentum Detector B0 Spectrometer Luminosity Monitor	Israel	3.2
PWO Crystals (EEEMCal Consortium)	Czech. Republic (Charles U./Prague)	0.6
EEEMC Materials, Construction and Mechanical Design (EEEMCal Consortium)	Armenia, IN2P3/France	1.0
dRICH Mechanical Engineering	UTSFM (Chile)	0.2
Low-Q^2 Tagger	UK (Glasgow/York)	1.1
TOTAL		**18.8**

Letters of Intent available in supplementary material
https://www.ecce-eic.org/ecce-internal-notes
(password: ECCEprop)

Subsystem Completion

Last detector system (EEMC) is ready 17 months prior to early CD-4A date (1 July 2030).

Starting elements for detector construction (pedestal, magnet, oHCAL) ready more that two years prior to early CD-4A – staged assembly.

ECCE can be assembled, integrated and tested prior to EIC early CD-4A.

WBS	Projected Completion	Months Prior to Early CD-4A
ECE06.10.03 Tracking	**Q1FY28**	**32.8**
ECE06.10.03.01.01 Inner Barrel Gas Tracking	Q1FY28	32.8
ECE06.10.03.01.02 Outer Barrel Gas Tracking	Q1FY27	45.4
ECE06.10.03.01.03 Si Tracker For Barrel and Endcaps	Q4FY27	32.8
ECE06.10.04 PID	**Q2FY28**	**27.5**
ECE06.10.04.01 Barrel PID	Q2FY28	29.8
ECE06.10.04.02 Electron Endcap PID	Q1FY28	30.8
ECE06.10.04.03 Hadron Endcap PID	Q2FY28	27.5
ECE06.10.05 Electromagnetic Calorimetry	**Q2FY29**	**17.0**
ECE06.10.05.01 Barrel Electromagnetic Calorimetry	Q4FY28	22.6
ECE06.10.05.02 Electron Endcap Electromagnetic Calorimetry	Q2FY29	17.0
ECE06.10.05.03 Hadron Endcap Electromagnetic Calorimetry	Q4FY27	34.5
ECE06.10.06 Hadronic Calorimetry	**Q2FY28**	**28.9**
ECE06.10.06.01 Barrel Hadronic Calorimetry	Q2FY28	28.9
ECE06.10.06.03 Hadron Endcap Hadronic Calorimetry	Q1FY28	33.1
ECE06.10.07 Magnet	**Q1FY28**	**31.9**
ECE06.10.08 Electronics	**Q2FY28**	**29.8**
ECE06.10.09 DAQ/Computing	**Q1FY28**	**30.9**
ECE06.10.10 Infrastructure	**Q3FY26**	**49.3**
ECE06.10.11 Auxiliary Detectors	**Q3FY28**	**24.6**
ECE06.10.11.01 Roman Pots	Q4FY26	45.7
ECE06.10.11.02 Off Momentum detectors (OMD)	Q3FY27	37.1
ECE06.10.11.03 B0 Detector	Q3FY26	51.6
ECE06.10.11.04 Zero Degree Calorimeter (ZDC)	Q3FY28	24.6
ECE06.10.11.05 Low Q2 Tagger	Q2FY26	52.0
ECE06.10.14 Luminosity Monitor	**Q2FY26**	**54.0**

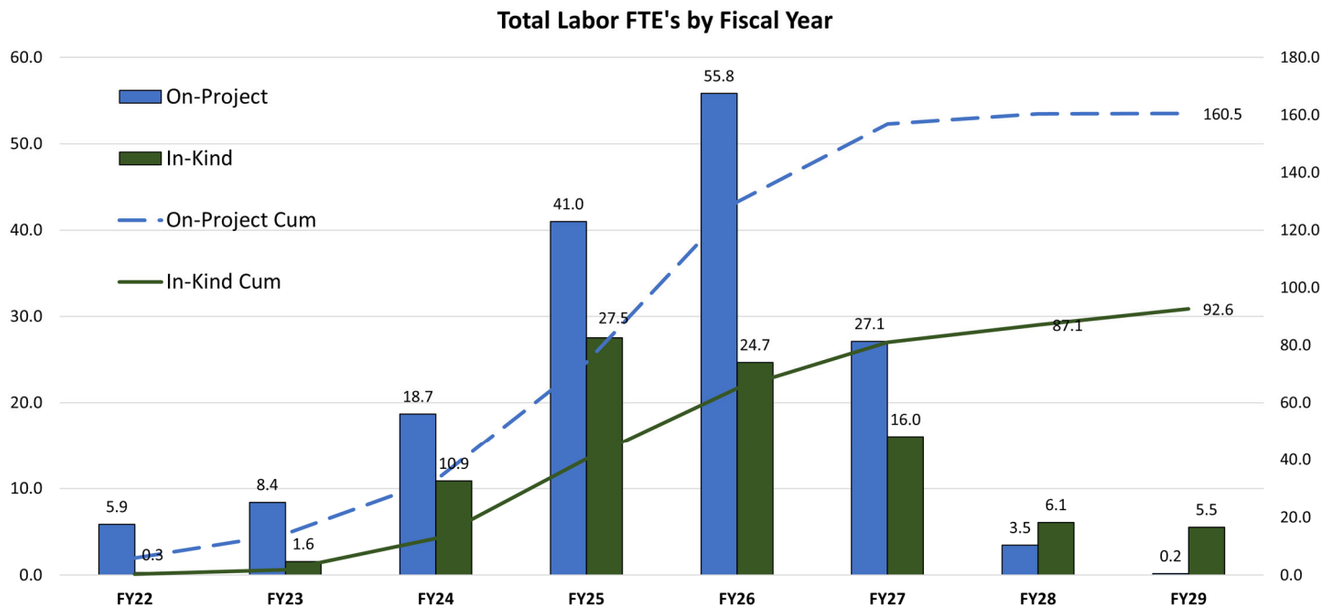
Long-Lead Procurements/FTE Profile

(2021 USD)

CD-3A Long-Lead Item:	Cost ($M)
Forward Hadronic Calorimetry Scintillating Tiles	2.7
Backward EMCal PWO Crystals	4.7
Barrel EMCal SciGlass	12.3
BaBar Solenoid Evaluation	0.5
Replacement Solenoid Design	1.3
TOTAL	**21.5**

Schedule informs need for CD-3A long-lead procurement items.

FTE Profile peaks at 55.8 on-project (FY26) and 27.5 in-kind (FY25)



Risks and Opportunities

ECCE EIC Detector Preliminary Project Risk Log

Risk ID	Detector Subsystem	Primary Risk Impact Category (Dropdown)	Risk Title	Description	Risk Trigger
EIC-DR01	ECE06.10.07 - Magnets	Technical	Strain gauges not working	Five strain gauges are not working and one shows unusually high readings and is ignored during tests.	If tie rods, disc springs have been overstressed, they could fail in the future.
EIC-DR02	ECE06.10.07 - Magnets	Technical	Potential hard touch between inner thermal shield and cold mass	There is some indication that both Ansaldo and SLAC struggled with making certain joints leak tight.	Additional thermal shorts occur increasing the heat load on the system. Additional leaks open up. There could have been some overstressing of components (e.g. welds between cooling tubes and the coil support tube) during the transport from SLAC to BNL although there are no outward signs of this at present.
EIC-DR03	ECE06.10.07 - Magnets	Technical	Internal leak in Valve box	Internal leak when cold: 10^{-6} to 10^{-7} torr-liters/sec level – presently being managed by pumping	Leak could get worse or other leaks could open up. There could have been some overstressing of components during the transport from
EIC-DR04	ECE06.10.07 - Magnets	Technical	Some sensors not reading properly	Strain gauges not working, temperature sensors on splices reading high, suspect.	
EIC-DR05	ECE06.10.07 - Magnets	Technical	PXIe data acquisition system may not be adequate	One recorded failure while at high current,	
EIC-DR06	ECE06.10.07 - Magnets	Technical	Magnet peformance after opening the magnet	Magnet performance might degrade after cutting open the magnet	
EIC-DR07	ECE06.10.05 - Electromagnetic Calorimetry	Technical	SciGlass R&D - Large Scale Glass	Validation of large-scale glass; part of ongoing project R&D	
EIC-DR08	ECE06.10.07 - Magnets	Technical	Reuse of Babar 1.5T magnet	Overall moderate risk. See 2020 Jlab Risk Assessment: https://indico.bnl.gov/event/10974/contributions/49222/	
EIC-DR09	ECE06.10.05 - Electromagnetic Calorimetry	Cost and Schedule	Loss of international vendor for scintillating tiles (Uniplast) - eCAL	International vendor is unable to fulfill order for geopolitical reasons	
EIC-DR10	ECE06.10.06 - Hadronic Calorimetry	Cost and Schedule	Loss of international vendor for scintillating tiles (Uniplast) - hCAL	International vendor is unable to fulfill order for geopolitical reasons	
EIC-DR11	ECE06.10.05 - Electromagnetic Calorimetry	Technical	SciGlass R&D - Groups	SciGlass R&D is performed by two major groups in the US and in Euro complete before CD-2	

- Detailed risk and opportunities log available
- Risks specific to detector technology choices will be discussed in next talk.

- Risks:
  - Magnet risks and mitigations
  - International vendors
  - Unanticipated design needs
  - Loss of key personnel
  - …
- Opportunities:
  - Reduction in sensors for hPDIRC
  - Large-area photosensor R&D
  - ITS3 yields better than anticipated
  - …

Additional Information

- Far more material was developed than can be presented in this talk.
  - WBS L4/L5 breakdowns
  - Detailed schedule
  - WBS Dictionary
  - R&D and Detector Management WBS Details
  - Basis of Planning documentation
  - Executive Narratives
  - BoE Documentation
  - Risk and Opportunities log
  - Project Spreadsheets (exported from Primavera P6)
  - …
- More details available in supplementary material
  https://www.ecce-eic.org/ecce-internal-notes
  (password: ECCEprop)

Summary

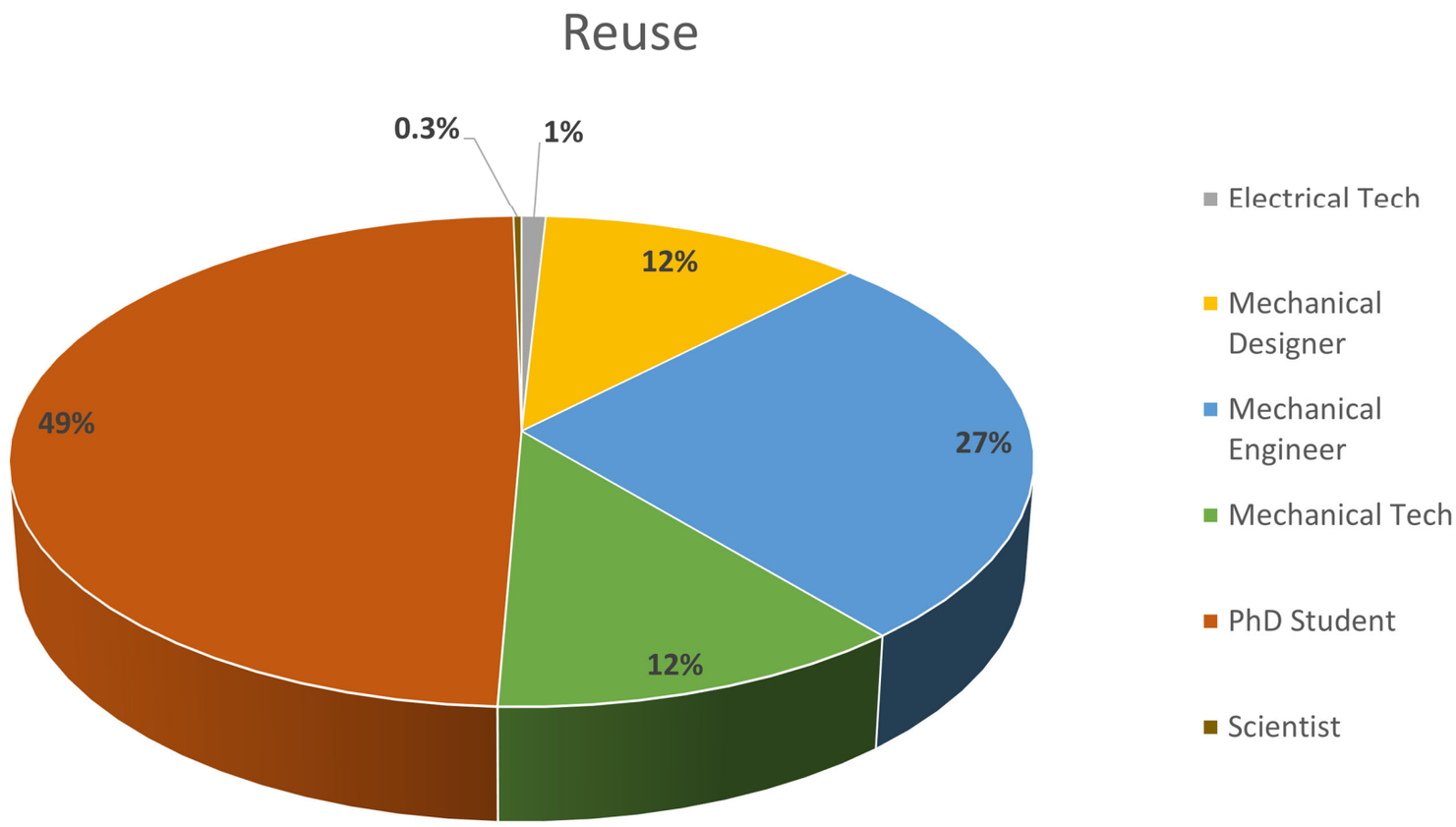
- The ECCE cost and schedule is bottom-up, logic-driven and implemented in Primavera P6
- The total cost of the ECCE detector is $250.0M in escalated USD
  - Includes $181.5M in on-project expenses
  - Includes $68.5M ($58.1M in 2021 USD) in-kind contributions
    - $21.5M ($18.8M in 2021 USD) in international contributions.
- Subsystem readiness consistent with ECCE completion by EIC early CD-4A (1 July 2030)

Total for Costed Categories (2021 USD)	**170.5**
Costed Categories (Escalated 3.5%/yr)	**201.2**
Detector Management	7.4
Detector R&D	12.1
Detector Infrastructure (remainder not costed)	20.6
Pre-Ops and Commissioning	8.7
TOTAL	**250.0**

BACKUP

Reuse Labor

Reuse labor is labor required to prepare/refurbish equipment for reuse.

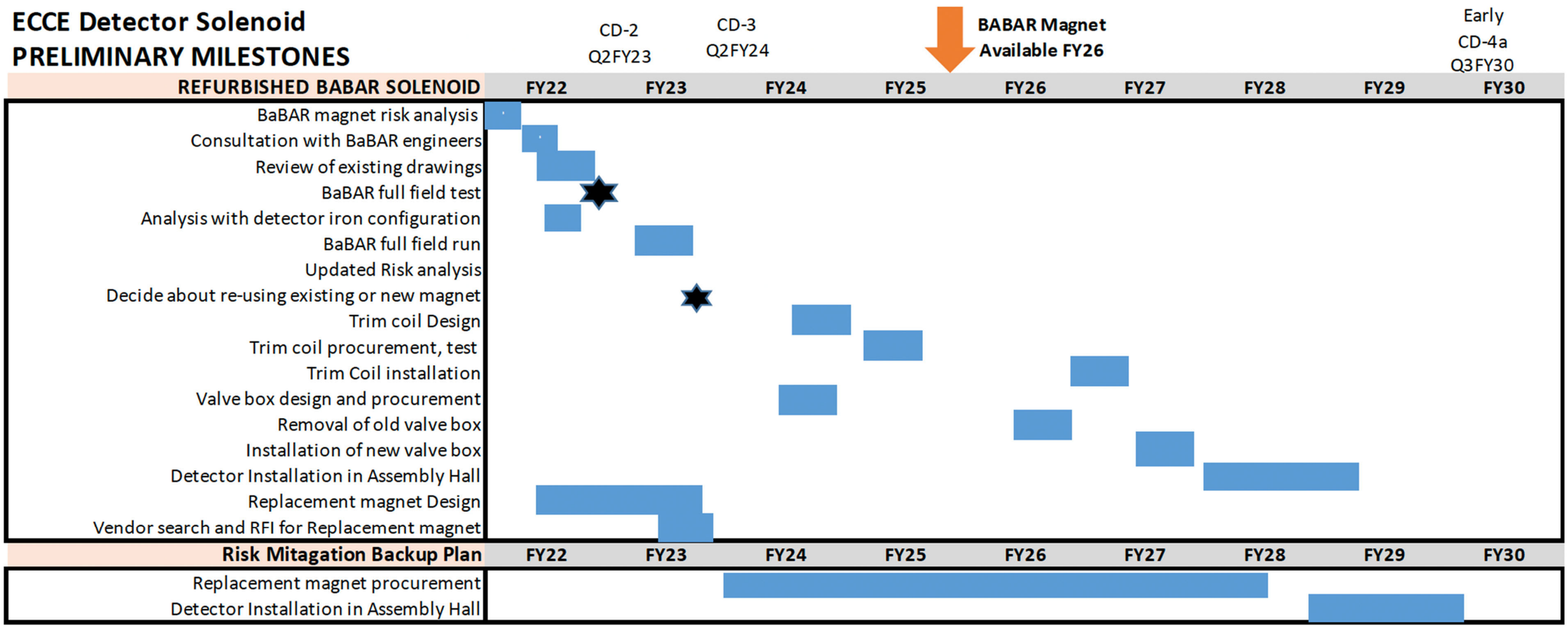


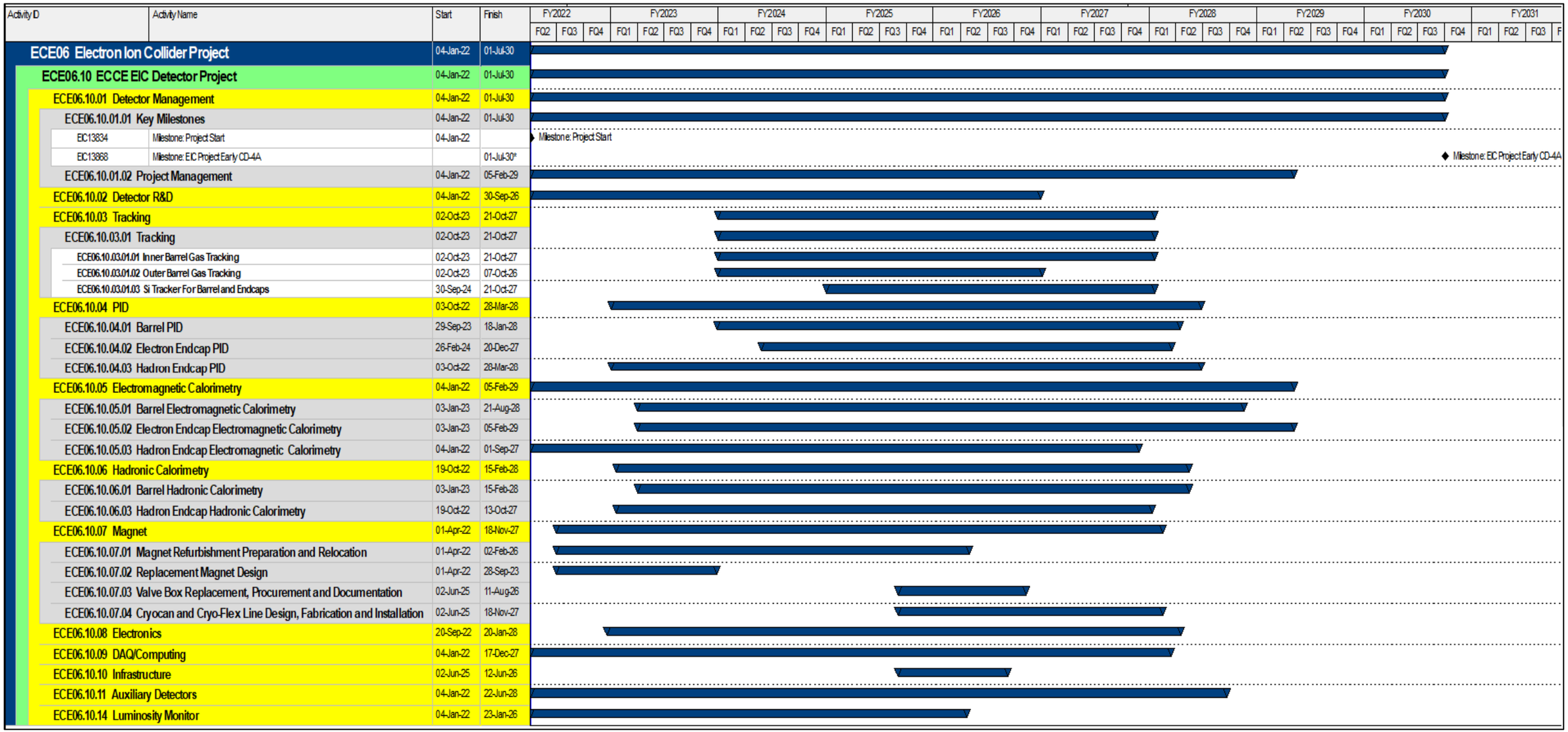
Project Cost by Resource

	Tracking	PID	Electromagnetic Calorimetry	Hadronic Calorimetry	Magnet	DAQ/Computing	Electronics	Infrastructure	Auxiliary Detectors	Luminosity Monitor
Reuse	$-	$5.0	$0.7	$10.0	$9.0	$-	$-	$3.9	$-	$-
Material	$11.8	$22.6	$24.2	$11.9	$0.8	$16.3	$1.8	$0.1	$9.9	$0.7
Labor	$15.1	$6.6	$3.5	$1.4	$2.6	$5.4	$5.4	$1.0	$0.9	$0.1

(2021 USD)

Replacement Solenoid Timeline





Activity ID	Activity Name	Start	Finish
ECE06	Electron Ion Collider Project	04-Jan-22	01-Jul-30
ECE06.10	ECCE EIC Detector Project	04-Jan-22	01-Jul-30
ECE06.10.01	Detector Management	04-Jan-22	01-Jul-30
ECE06.10.01.01	Key Milestones	04-Jan-22	01-Jul-30
EIC13834	Milestone: Project Start	04-Jan-22	
EIC13868	Milestone: EIC Project Early CD-4A		01-Jul-30*
ECE06.10.01.02	Project Management	04-Jan-22	05-Feb-29
ECE06.10.02	Detector R&D	04-Jan-22	30-Sep-26
ECE06.10.03	Tracking	02-Oct-23	21-Oct-27
ECE06.10.03.01	Tracking	02-Oct-23	21-Oct-27
ECE06.10.03.01.01	Inner Barrel Gas Tracking	02-Oct-23	21-Oct-27
ECE06.10.03.01.02	Outer Barrel Gas Tracking	02-Oct-23	07-Oct-26
ECE06.10.03.01.03	Si Tracker For Barrel and Endcaps	30-Sep-24	21-Oct-27
ECE06.10.04	PID	03-Oct-22	28-Mar-28
ECE06.10.04.01	Barrel PID	29-Sep-23	18-Jan-28
ECE06.10.04.02	Electron Endcap PID	26-Feb-24	20-Dec-27
ECE06.10.04.03	Hadron Endcap PID	03-Oct-22	28-Mar-28
ECE06.10.05	Electromagnetic Calorimetry	04-Jan-22	05-Feb-29
ECE06.10.05.01	Barrel Electromagnetic Calorimetry	03-Jan-23	21-Aug-28
ECE06.10.05.02	Electron Endcap Electromagnetic Calorimetry	03-Jan-23	05-Feb-29
ECE06.10.05.03	Hadron Endcap Electromagnetic Calorimetry	04-Jan-22	01-Sep-27
ECE06.10.06	Hadronic Calorimetry	19-Oct-22	15-Feb-28
ECE06.10.06.01	Barrel Hadronic Calorimetry	03-Jan-23	15-Feb-28
ECE06.10.06.03	Hadron Endcap Hadronic Calorimetry	19-Oct-22	13-Oct-27
ECE06.10.07	Magnet	01-Apr-22	18-Nov-27
ECE06.10.07.01	Magnet Refurbishment Preparation and Relocation	01-Apr-22	02-Feb-26
ECE06.10.07.02	Replacement Magnet Design	01-Apr-22	28-Sep-23
ECE06.10.07.03	Valve Box Replacement, Procurement and Documentation	02-Jun-25	11-Aug-26
ECE06.10.07.04	Cryocan and Cryo-Flex Line Design, Fabrication and Installation	02-Jun-25	18-Nov-27
ECE06.10.08	Electronics	20-Sep-22	20-Jan-28
ECE06.10.09	DAQ/Computing	04-Jan-22	17-Dec-27
ECE06.10.10	Infrastructure	02-Jun-25	12-Jun-26
ECE06.10.11	Auxiliary Detectors	04-Jan-22	22-Jun-28
ECE06.10.14	Luminosity Monitor	04-Jan-22	23-Jan-26

Detector Management

While a detailed breakdown for detector management was not requested, we costed this section independent from the project to ensure that we had sufficient support and oversight for the subsystem activities.

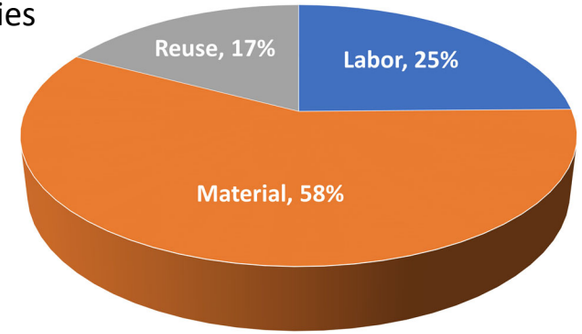
Hours and Cost by WBS - Detector Management ($M)					
WBS	Labor Hours	Total Labor Cost	Total Material Cost	Total On-Project Cost	Total Cost
WBS: ECE06.10 ECCE EIC Detector Project	**49990**	**$7.38**	**$0.47**	**$7.85**	**$7.85**
WBS: ECE06.10.01 Detector Management	**49990**	**$7.38**	**$0.47**	**$7.85**	**$7.85**
WBS: ECE06.10.01.02 Project Management	**49990**	**$7.38**	**$0.47**	**$7.85**	**$7.85**
WBS: ECE06.10.01.02.01 Project Engineering Management	**49190**	**$7.26**	**$0.47**	**$7.73**	**$7.73**
WBS: ECE06.10.01.02.01.01 Project Engineering	**12000**	$1.84	$0.11	$1.95	$1.95
WBS: ECE06.10.01.02.01.02 Subsystem Engineering Support and Travel	**25190**	$3.73	$0.36	$4.09	$4.09
06.10.03 - Tracking System Engineering Support	3500	$0.54	$0.00	$0.54	$0.54
06.10.03 - Tracking System Travel Cost	0	$0.00	$0.06	$0.06	$0.06
06.10.03 - Tracking System Travel Cost	0	$0.00	$0.06	$0.06	$0.06
06.10.04 - PID Subsystem Engineering Support	3640	$0.56	$0.00	$0.56	$0.56
06.10.04 - PID Subsystem Travel Cost	0	$0.00	$0.03	$0.03	$0.03
06.10.05 - Electromagnetic Calorimetry Subsystem Engineering Support	2730	$0.42	$0.00	$0.42	$0.42
06.10.05 - Electromagnetic Calorimetry Subsystem Travel Cost	0	$0.00	$0.02	$0.02	$0.02
06.10.05 - Electromagnetic Calorimetry Subsystem Travel Cost	0	$0.00	$0.02	$0.02	$0.02
06.10.06 - Hadronic Calorimetry Subsystem Engineering Support	2730	$0.42	$0.00	$0.42	$0.42
06.10.06 - Hadronic Calorimetry Subsystem Travel Cost	0	$0.00	$0.03	$0.03	$0.03
06.10.07 - Magnet Subsystem Engineering Support	2730	$0.42	$0.00	$0.42	$0.42
06.10.07 - Magnet Subsystem Travel Cost	0	$0.00	$0.03	$0.03	$0.03
06.10.08 - Electronics Subsystem Engineering Support	2080	$0.32	$0.00	$0.32	$0.32
06.10.08 - Electronics Subsystem Engineering Support	2080	$0.21	$0.00	$0.21	$0.21
06.10.08 - Electronics Subsystem Engineering Support	120	$0.01	$0.00	$0.01	$0.01
06.10.08 - Electronics Subsystem Engineering Support	40	$0.01	$0.00	$0.01	$0.01
06.10.08 - Electronics Subsystem Engineering Support	40	$0.00	$0.00	$0.00	$0.00
06.10.08 - Electronics Subsystem Engineering Support	40	$0.00	$0.00	$0.00	$0.00
06.10.08 - Electronics Subsystem Travel Cost	0	$0.00	$0.04	$0.04	$0.04
06.10.09 - DAQ/Computing Subsystem Engineering	1820	$0.32	$0.00	$0.32	$0.32
06.10.09 - DAQ/Computing Subsystem Travel	0	$0.00	$0.02	$0.02	$0.02
06.10.11 - Auxiliary Detectors Subsystem Engineering Support	1820	$0.28	$0.00	$0.28	$0.28
06.10.11 - Auxiliary Detectors Subsystem Engineering Support	910	$0.11	$0.00	$0.11	$0.11
06.10.11 - Auxiliary Detectors Subsystem Travel Cost	0	$0.00	$0.01	$0.01	$0.01
06.10.11 - Auxiliary Detectors Subsystem Travel Cost	0	$0.00	$0.02	$0.02	$0.02
06.10.14 - Luminosity Monitor Subsystem Engineering Support	460	$0.07	$0.00	$0.07	$0.07
06.10.14 - Luminosity Monitor Subsystem Engineering Support	450	$0.05	$0.00	$0.05	$0.05
06.10.14 - Luminosity Monitor Subsystem Travel Cost	0	$0.00	$0.01	$0.01	$0.01
06.10.14 - Luminosity Monitor Subsystem Travel Cost	0	$0.00	$0.02	$0.02	$0.02
WBS: ECE06.10.01.02.01.03 System/Integration Engineering	**12000**	$1.69	$0.00	$1.69	$1.69
System Integration and Engineering	8000	$1.23	$0.00	$1.23	$1.23
System Integration and Engineering	4000	$0.46	$0.00	$0.46	$0.46
WBS: ECE06.10.01.02.02 Safety and Quality Assurance Support	**800**	**$0.12**	**$0.00**	**$0.12**	**$0.12**
Safety and Quality Assurance Liason	800	$0.12	$0.00	$0.12	$0.12

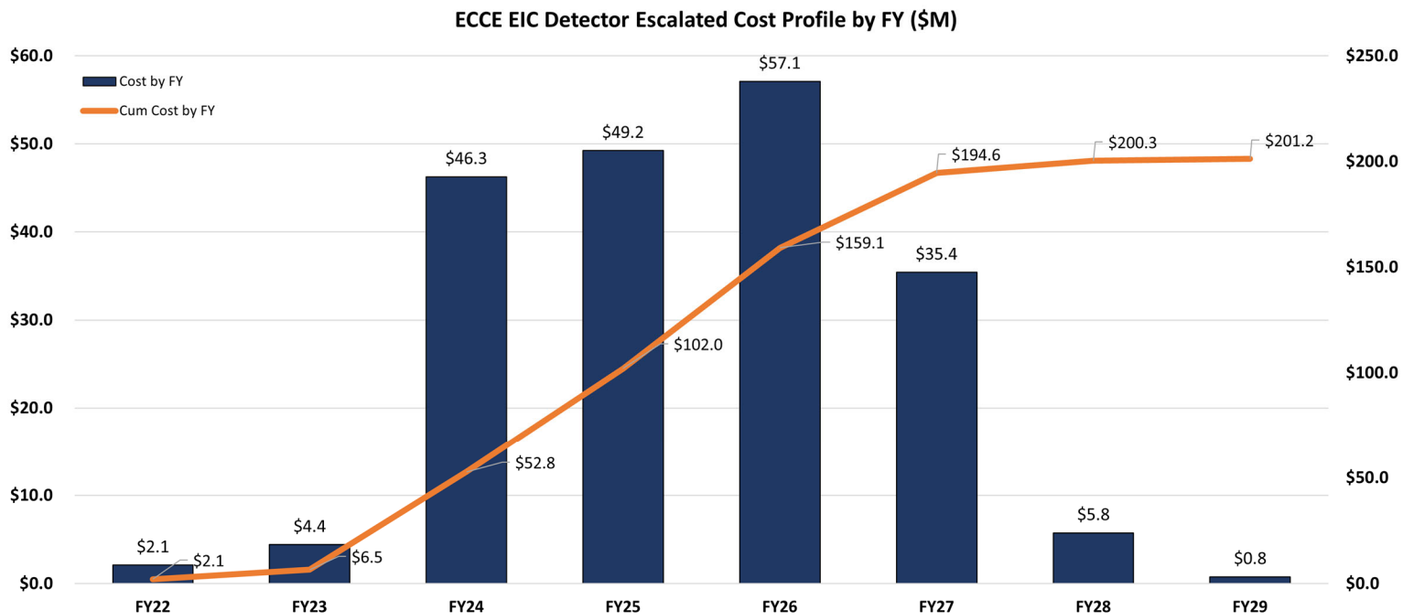
Total Cost with Escalation

Total for Costed Categories (2021 USD)	**170.5**
Costed Categories (Escalated 3.5%/yr)	**201.2**
Detector Management	7.4
Detector R&D	12.1
Detector Infrastructure (remainder not costed)	20.6
Pre-Ops and Commissioning	8.7
TOTAL	**250.0**

Cost escalation taken at 3.5%/year from project costing sheet template.

Breakdown for costed categories





(costed categories only)

ECCE Consortium Effort Level

Average yearly FTE effort level envisioned by ECCE member institutions:

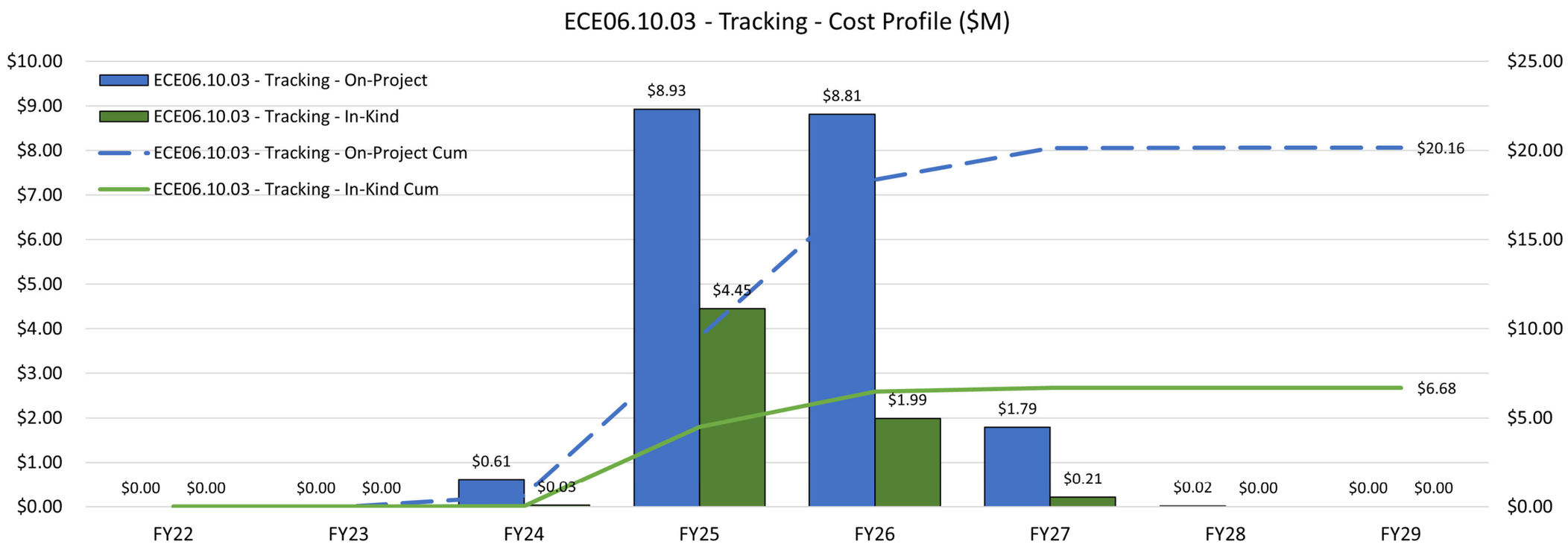
Envisioned average FTE effort level									
Prof.	Research Prof.	Staff Scientist	Postdoc	Grad.	Under-grad.	Engineer	Design	Tech.	Sum
14.6	3.35	15.2	27.85	44.7	25.45	9.35	4	10.2	154.7

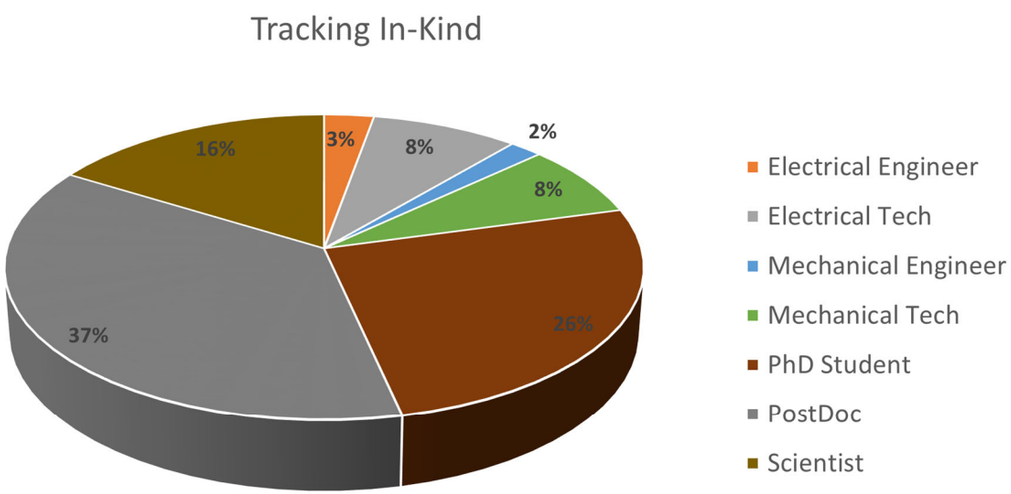
On-Project FTEs by Subsystem

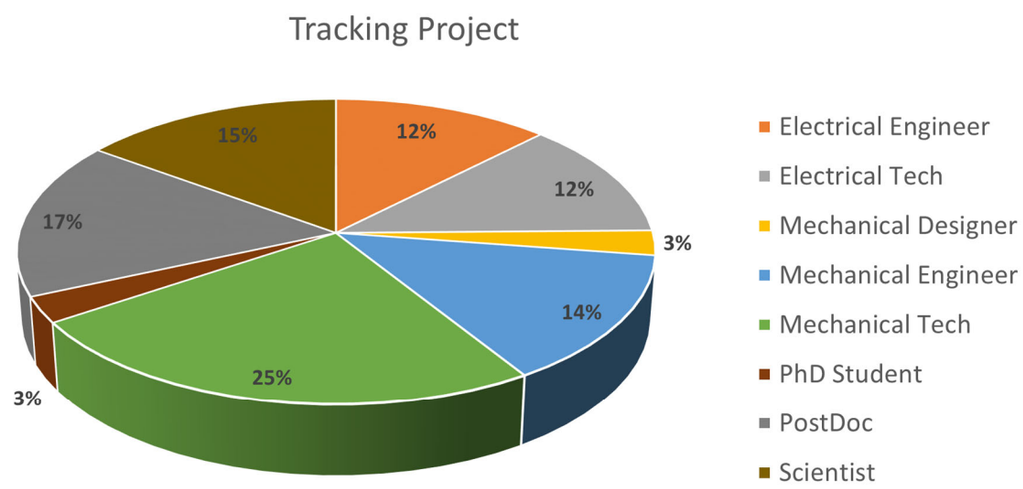
Subsystem	Electrical Designer	Electrical Engineer	Electrical Tech	Mechanical Designer	Mechanical Engineer	Mechanical Tech	PhD Student	PostDoc	Other	Scientist	Undergrad	Software Expert	Total FTE's
ECE06.10.03 - Tracking	0.0	6.5	6.4	1.4	7.2	12.8	1.4	8.7	0.0	7.8	0.0	0.0	**52.2**
ECE06.10.04 - PID	0.0	4.7	1.3	0.1	2.5	6.6	6.6	15.1	0.0	0.3	1.3	0.0	**38.4**
ECE06.10.05 - Electromagnetic Calorimetry	0.0	0.1	0.0	0.2	0.8	1.8	0.0	0.0	0.0	0.0	0.0	0.0	**2.9**
ECE06.10.06 - Hadronic Calorimetry	0.0	0.1	0.1	0.1	1.7	0.9	8.7	0.8	0.0	0.1	8.3	0.0	**20.9**
ECE06.10.07 - Magnet	0.0	1.4	0.0	0.8	2.0	2.4	0.0	0.0	0.0	4.1	0.0	0.0	**10.6**
ECE06.10.08 - Electronics	4.4	2.9	2.2	0.0	0.0	0.0	0.0	2.8	0.3	2.8	0.0	0.0	**15.4**
ECE06.10.09 - DAQ/Computing	0.0	0.2	0.2	0.0	0.0	0.0	0.1	0.2	0.1	6.9	0.0	7.0	**14.8**
ECE06.10.10 - Infrastructure	0.0	0.0	0.0	0.6	2.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	**4.6**
ECE06.10.11 - Auxiliary Detectors	0.1	0.1	0.0	0.0	0.2	0.3	0.1	0.0	0.0	0.0	0.0	0.0	**0.8**
ECE06.10.14 - Luminosity Monitor	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
Totals	**4.5**	**16.0**	**10.2**	**3.2**	**16.3**	**26.8**	**17.0**	**27.7**	**0.4**	**22.0**	**9.6**	**7.0**	**160.5**

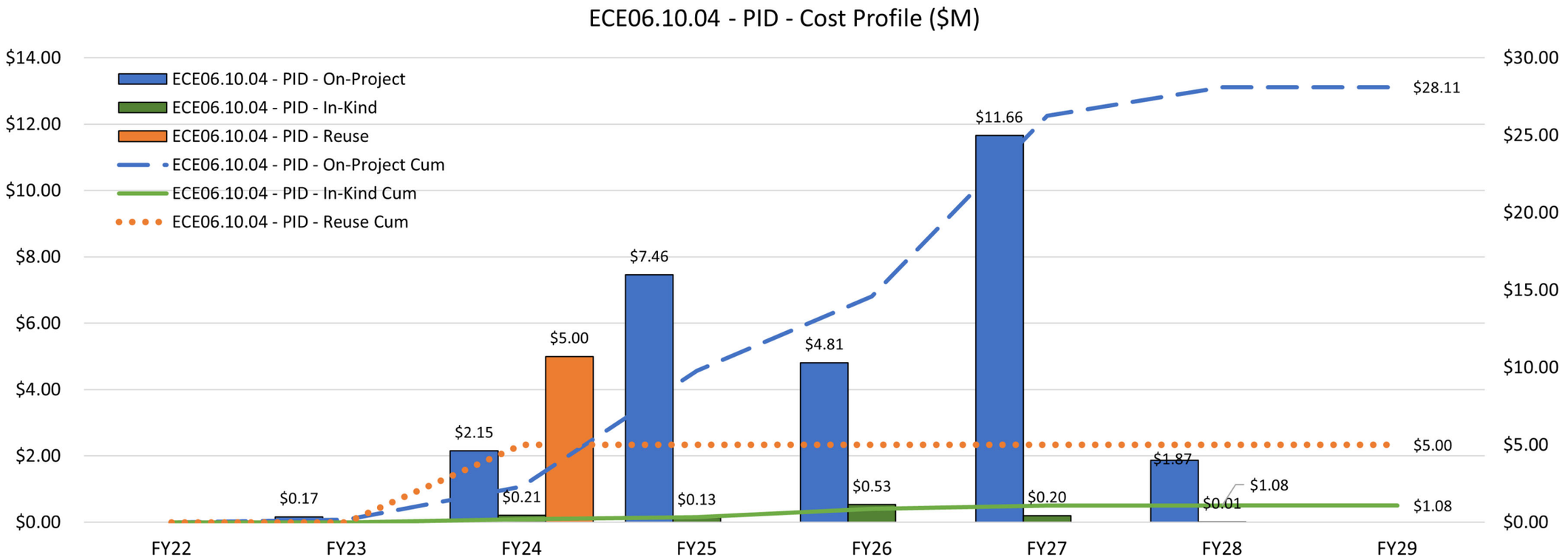
In-Kind FTEs by Subsystem

Subsystem	Electrical Designer	Electrical Engineer	Electrical Tech	Mechanical Designer	Mechanical Engineer	Mechanical Tech	PhD Student	PostDoc	Other	Scientist	Undergrad	Software Expert	Total FTE's
ECE06.10.03 Tracking	0.0	0.9	2.6	0.0	0.6	2.4	8.0	11.6	0.0	5.1	0.0	0.0	**31.1**
ECE06.10.04 PID	0.0	0.0	0.0	0.9	0.0	0.3	6.2	0.2	0.0	1.8	1.3	0.0	**10.6**
ECE06.10.05 Electromagnetic Calorimetry	0.0	0.4	0.0	1.0	0.6	1.3	9.8	13.3	0.0	0.0	6.9	0.0	**33.2**
ECE06.10.08 Electronics	1.0	2.3	1.7	0.0	0.0	0.0	0.0	0.0	0.3	3.8	0.0	0.0	**9.0**
ECE06.10.09 DAQ/Computing	0.0	0.0	0.2	0.0	0.0	0.0	0.2	0.1	0.0	1.8	0.0	1.9	**4.2**
ECE06.10.11 Auxiliary Detectors	0.3	1.2	0.3	0.1	0.2	0.2	0.7	0.3	0.0	0.3	0.3	0.0	**4.0**
ECE06.10.14 Luminosity Monitor	0.0	0.1	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.4**
Totals	**1.3**	**4.9**	**4.8**	**2.0**	**1.7**	**4.1**	**24.9**	**25.6**	**0.3**	**12.8**	**8.5**	**1.9**	**92.6**

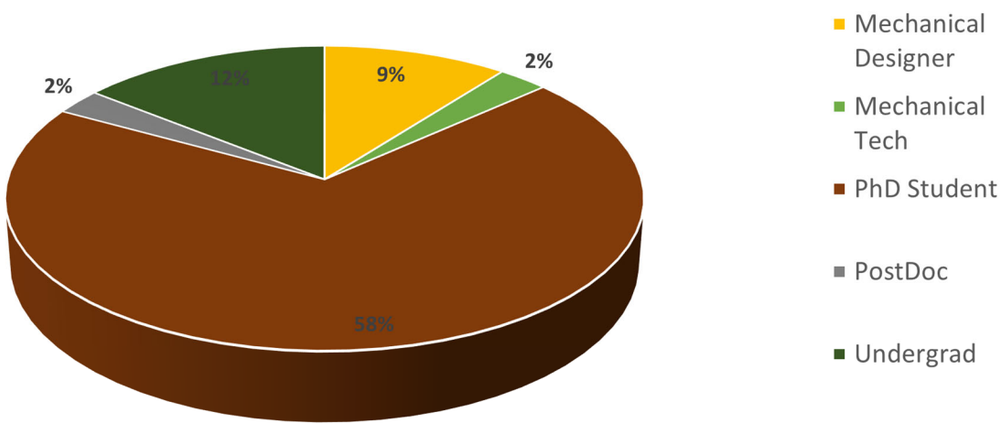

ECE06.10.03 - Tracking - Cost Profile ($M)
ECE06.10.03 - Tracking - On-Project
ECE06.10.03 - Tracking - In-Kind
ECE06.10.03 - Tracking - On-Project Cum
ECE06.10.03 - Tracking - In-Kind Cum
$10.00
$9.00
$8.00
$7.00
$6.00
$5.00
$4.00
$3.00
$2.00
$1.00
$0.00
$25.00
$20.00
$15.00
$10.00
$5.00
$0.00
$0.00 $0.00 $0.00 $0.00 $0.61 $0.03 $8.93 $4.45 $8.81 $1.99 $1.79 $0.21 $0.02 $0.00 $0.00 $0.00
$20.16
$6.68
FY22
FY23
FY24
FY25
FY26
FY27
FY28
FY29


Tracking In-Kind
3%
8%
2%
8%
26%
37%
16%
Electrical Engineer
Electrical Tech
Mechanical Engineer
Mechanical Tech
PhD Student
PostDoc
Scientist

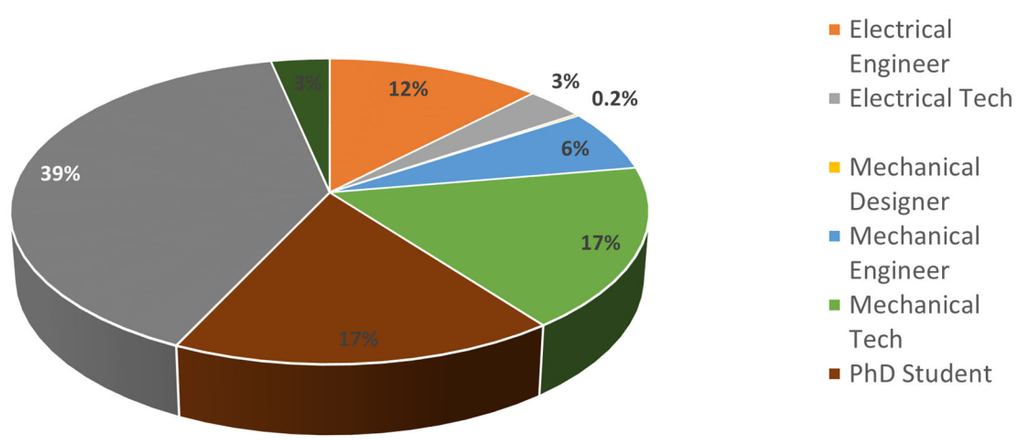

Tracking Project
12%
12%
3%
14%
25%
3%
17%
15%
Electrical Engineer
Electrical Tech
Mechanical Designer
Mechanical Engineer
Mechanical Tech
PhD Student
PostDoc
Scientist

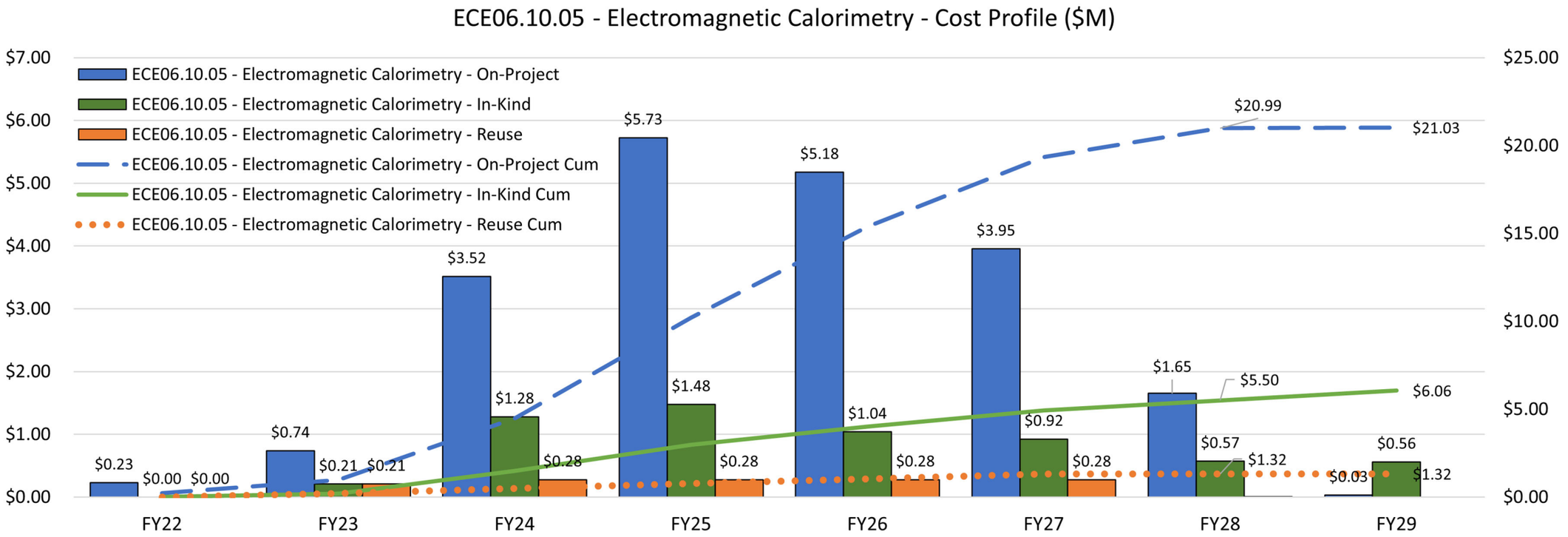

ECE06.10.04 - PID - Cost Profile ($M)
ECE06.10.04 - PID - On-Project
ECE06.10.04 - PID - In-Kind
ECE06.10.04 - PID - Reuse
ECE06.10.04 - PID - On-Project Cum
ECE06.10.04 - PID - In-Kind Cum
ECE06.10.04 - PID - Reuse Cum
$14.00
$12.00
$10.00
$8.00
$6.00
$4.00
$2.00
$0.00
$30.00
$25.00
$20.00
$15.00
$10.00
$5.00
$0.00
$0.17
$2.15
$0.21
$5.00
$7.46
$0.13
$4.81
$0.53
$11.66
$0.20
$1.87
$0.01
$1.08
$28.11
$5.00
$1.08
FY22
FY23
FY24
FY25
FY26
FY27
FY28
FY29

PID In-Kind

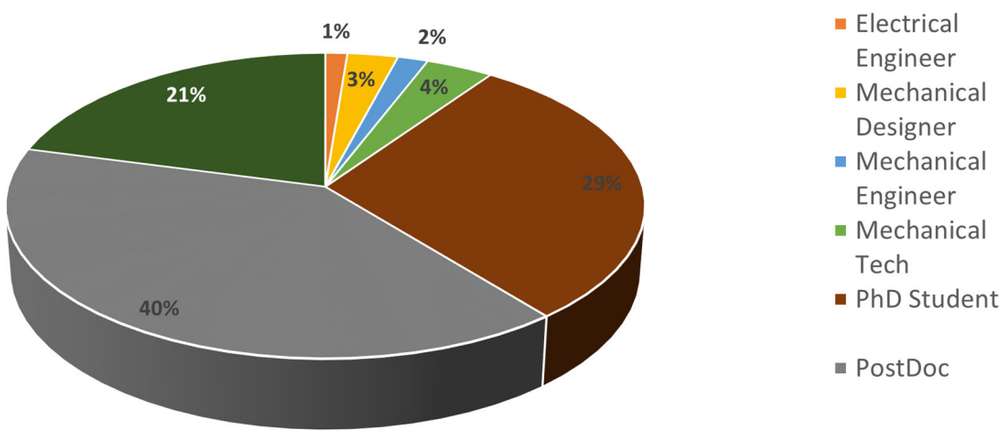


PID Project

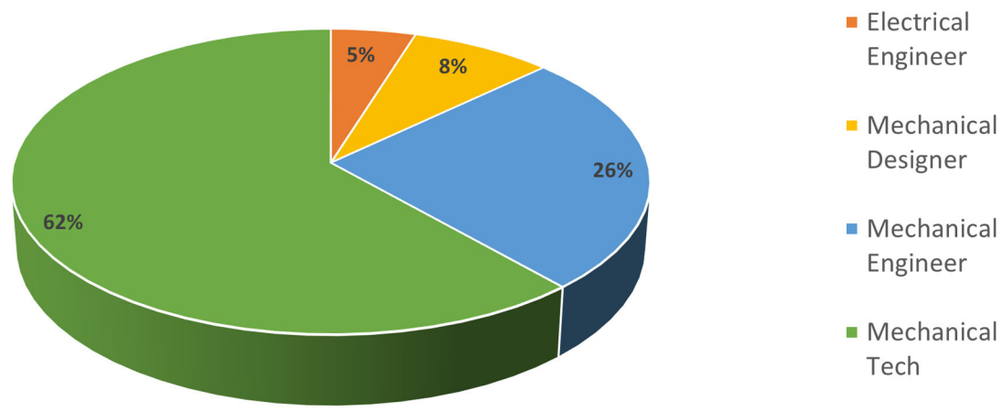


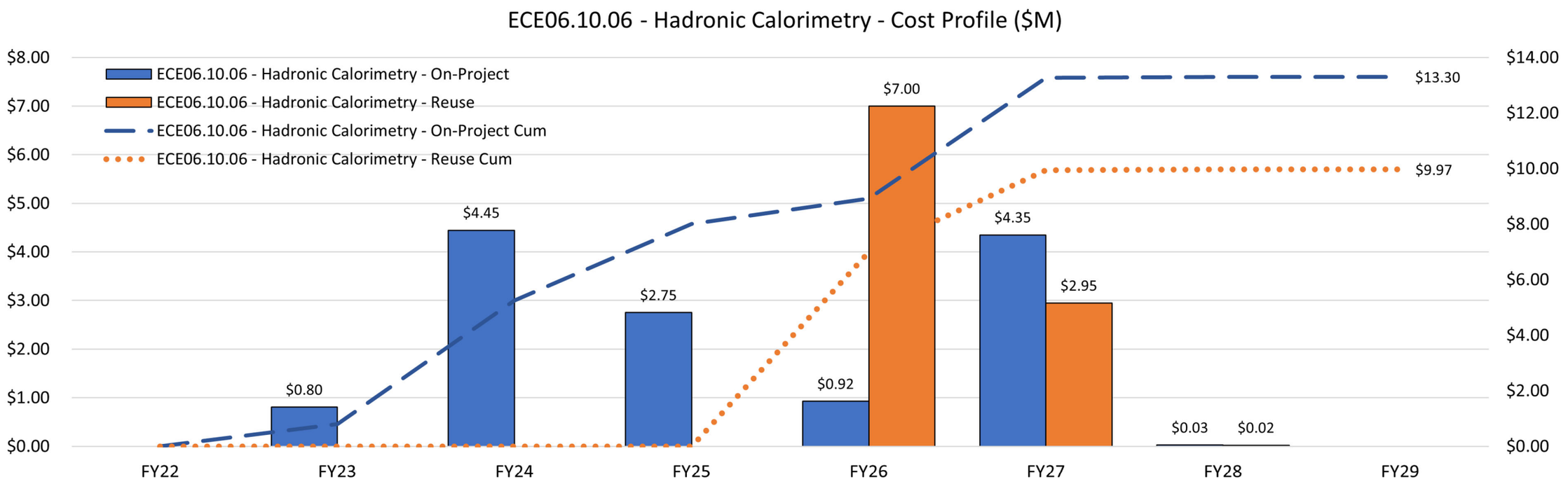

ECE06.10.05 - Electromagnetic Calorimetry - Cost Profile ($M)
ECE06.10.05 - Electromagnetic Calorimetry - On-Project
ECE06.10.05 - Electromagnetic Calorimetry - In-Kind
ECE06.10.05 - Electromagnetic Calorimetry - Reuse
ECE06.10.05 - Electromagnetic Calorimetry - On-Project Cum
ECE06.10.05 - Electromagnetic Calorimetry - In-Kind Cum
ECE06.10.05 - Electromagnetic Calorimetry - Reuse Cum
$7.00
$6.00
$5.00
$4.00
$3.00
$2.00
$1.00
$0.00
$25.00
$20.00
$15.00
$10.00
$5.00
$0.00
FY22
FY23
FY24
FY25
FY26
FY27
FY28
FY29
$0.23
$0.00
$0.00
$0.74
$0.21
$0.21
$3.52
$1.28
$0.28
$5.73
$1.48
$0.28
$5.18
$1.04
$0.28
$3.95
$0.92
$0.28
$1.65
$0.57
$1.32
$0.03
$0.56
$1.32
$5.50
$6.06
$20.99
$21.03

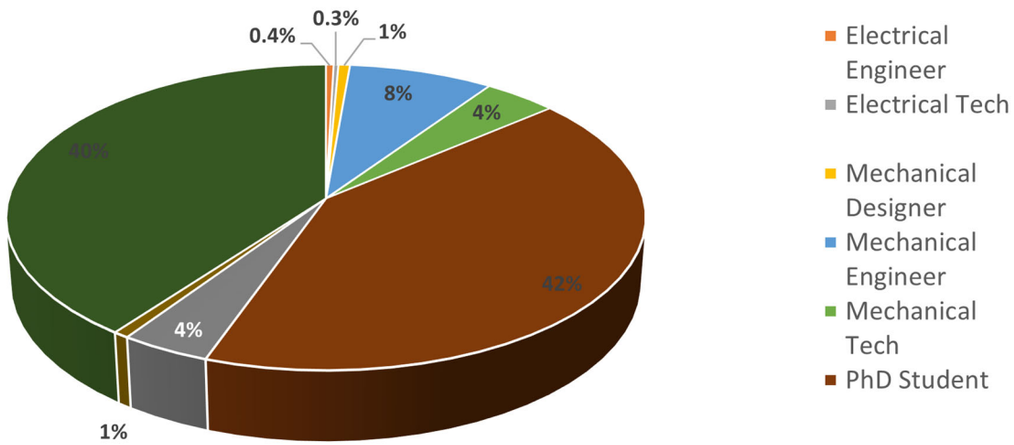
Electromagnetic Calorimetry In-Kind

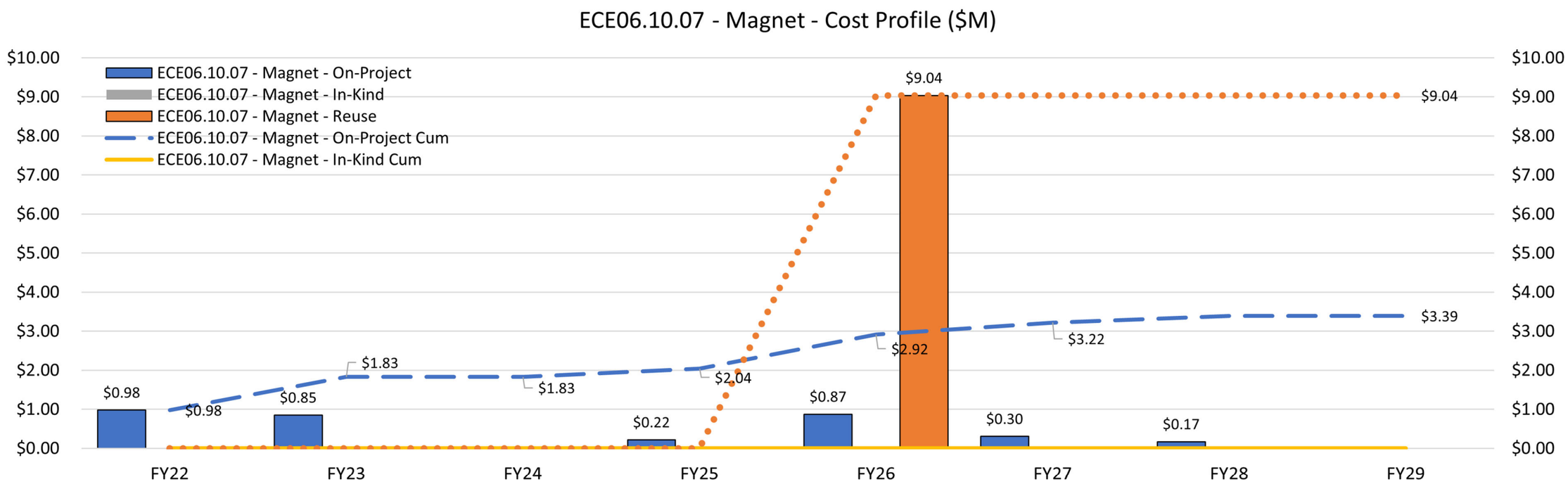


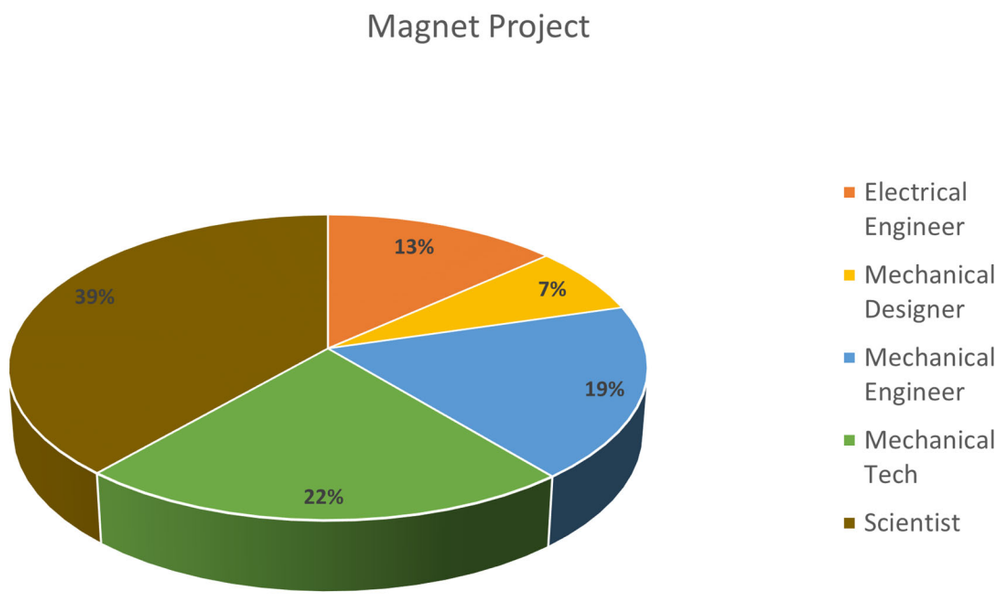
Electromagnetic Calorimetry Project

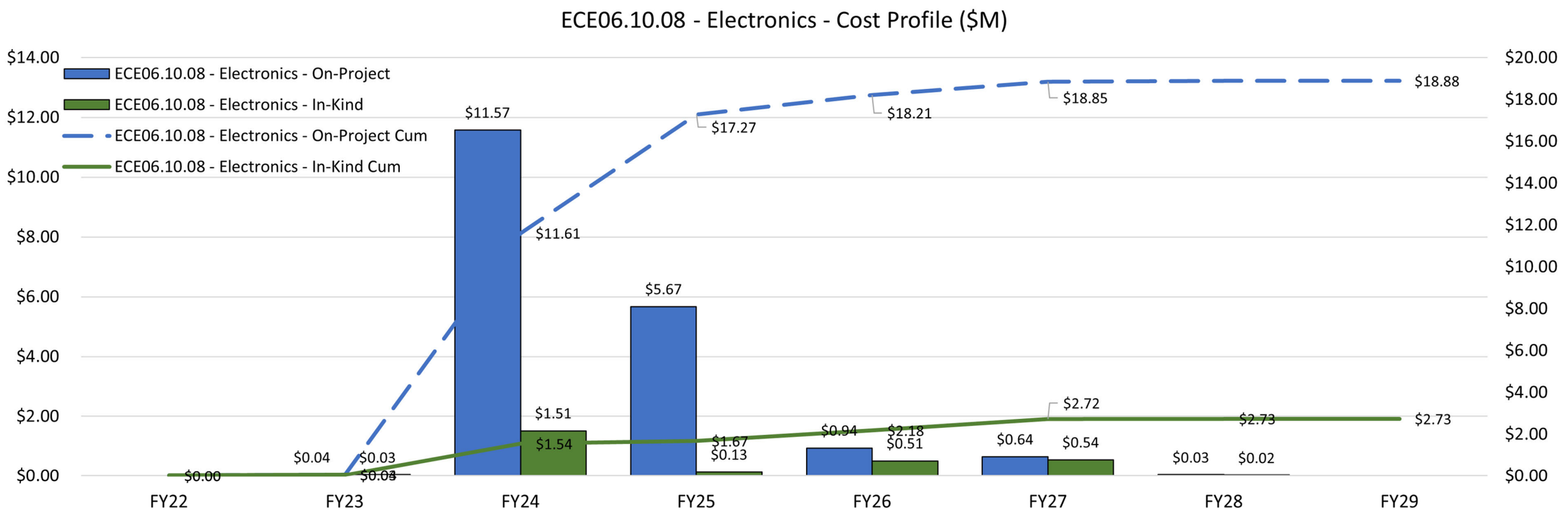



ECE06.10.06 - Hadronic Calorimetry - Cost Profile ($M)
ECE06.10.06 - Hadronic Calorimetry - On-Project
ECE06.10.06 - Hadronic Calorimetry - Reuse
ECE06.10.06 - Hadronic Calorimetry - On-Project Cum
ECE06.10.06 - Hadronic Calorimetry - Reuse Cum
$8.00
$7.00
$6.00
$5.00
$4.00
$3.00
$2.00
$1.00
$0.00
$14.00
$12.00
$10.00
$8.00
$6.00
$4.00
$2.00
$0.00
$0.80
$4.45
$2.75
$0.92
$7.00
$4.35
$2.95
$0.03
$0.02
$13.30
$9.97
FY22
FY23
FY24
FY25
FY26
FY27
FY28
FY29

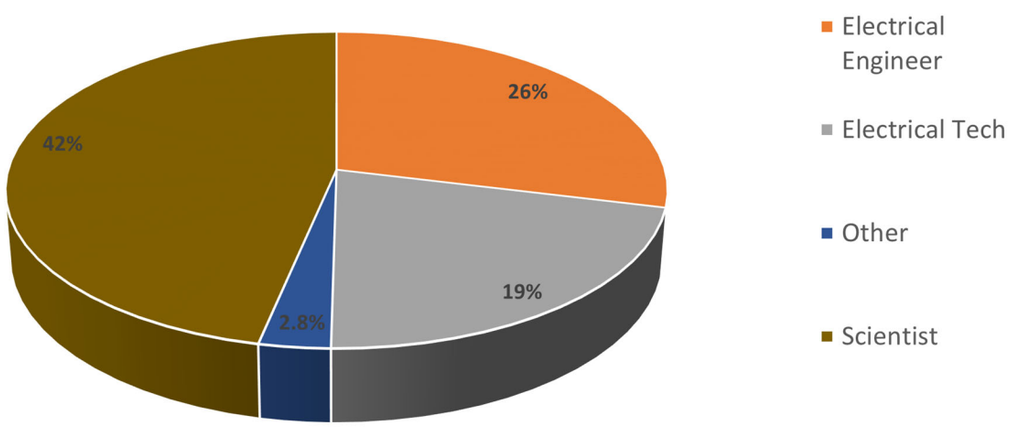

Hadronic Calorimetry Project
0.4%
0.3%
1%
8%
4%
40%
42%
4%
1%
Electrical Engineer
Electrical Tech
Mechanical Designer
Mechanical Engineer
Mechanical Tech
PhD Student


ECE06.10.07 - Magnet - Cost Profile ($M)
ECE06.10.07 - Magnet - On-Project
ECE06.10.07 - Magnet - In-Kind
ECE06.10.07 - Magnet - Reuse
ECE06.10.07 - Magnet - On-Project Cum
ECE06.10.07 - Magnet - In-Kind Cum
$10.00
$9.00
$8.00
$7.00
$6.00
$5.00
$4.00
$3.00
$2.00
$1.00
$0.00
FY22
FY23
FY24
FY25
FY26
FY27
FY28
FY29
$0.98
$0.85
$0.22
$0.87
$9.04
$0.30
$0.17
$0.98
$1.83
$1.83
$2.04
$2.92
$3.22
$3.39
$9.04

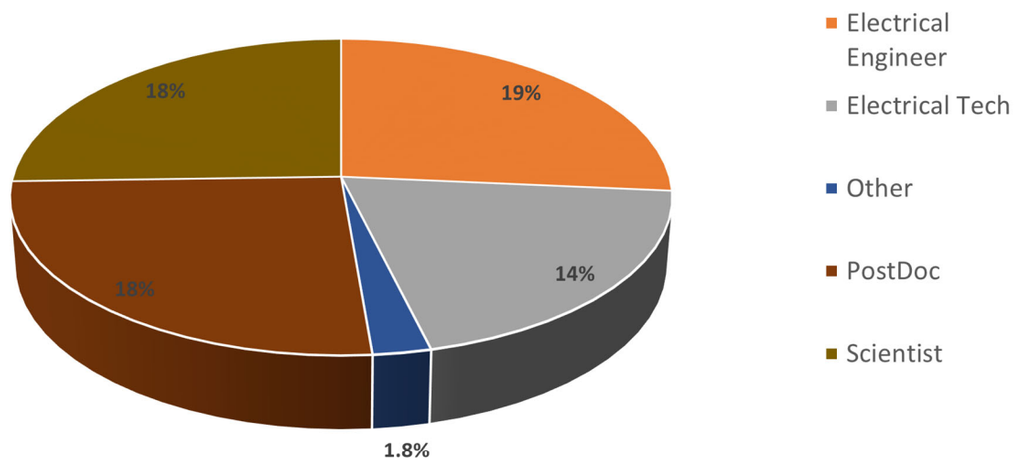

Magnet Project
13%
7%
19%
22%
39%
Electrical Engineer
Mechanical Designer
Mechanical Engineer
Mechanical Tech
Scientist

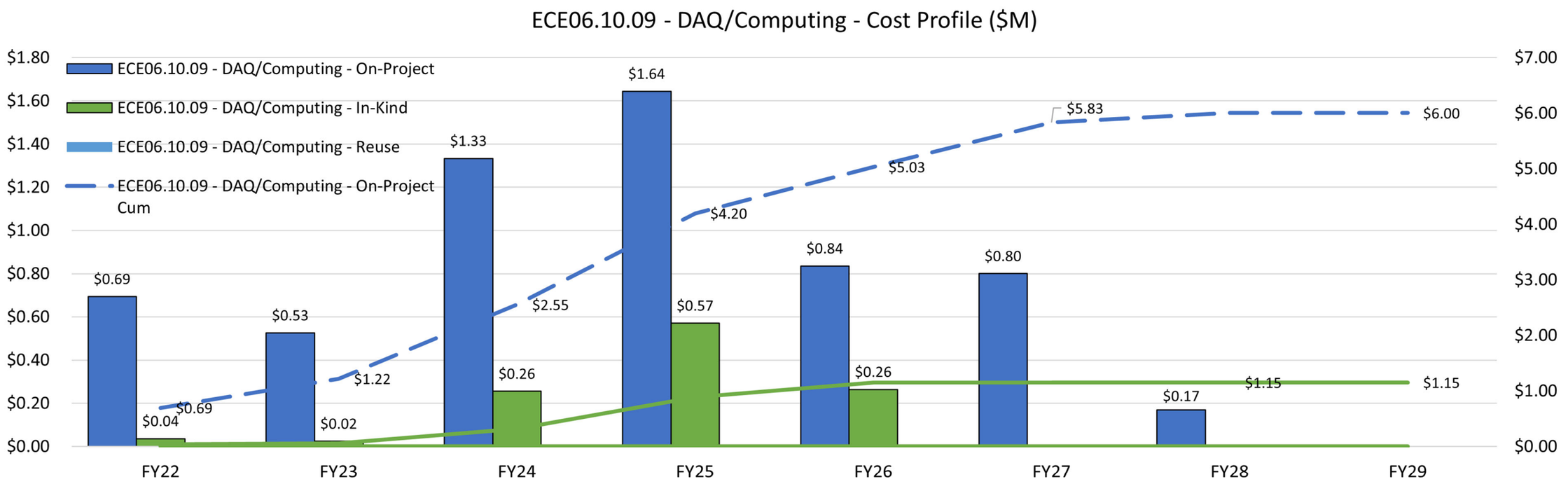

ECE06.10.08 - Electronics - Cost Profile ($M)
ECE06.10.08 - Electronics - On-Project
ECE06.10.08 - Electronics - In-Kind
ECE06.10.08 - Electronics - On-Project Cum
ECE06.10.08 - Electronics - In-Kind Cum
$14.00
$12.00
$10.00
$8.00
$6.00
$4.00
$2.00
$0.00
$20.00
$18.00
$16.00
$14.00
$12.00
$10.00
$8.00
$6.00
$4.00
$2.00
$0.00
FY22
FY23
FY24
FY25
FY26
FY27
FY28
FY29
$0.00
$0.04
$0.03
$0.03
$11.57
$11.61
$1.51
$1.54
$5.67
$17.27
$1.67
$0.13
$0.94
$18.21
$2.18
$0.51
$0.64
$18.85
$0.54
$2.72
$0.03
$2.73
$0.02
$2.73
$18.88

Electronics In-Kind

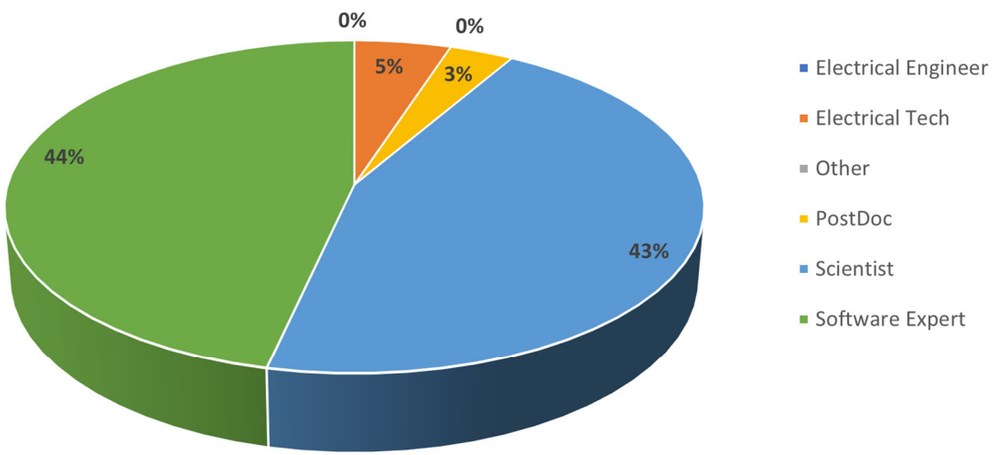


Electronics Project

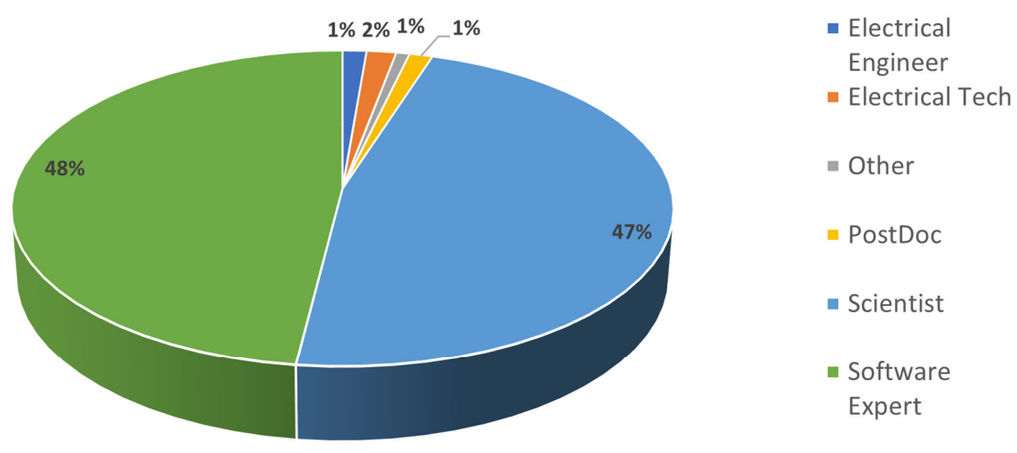


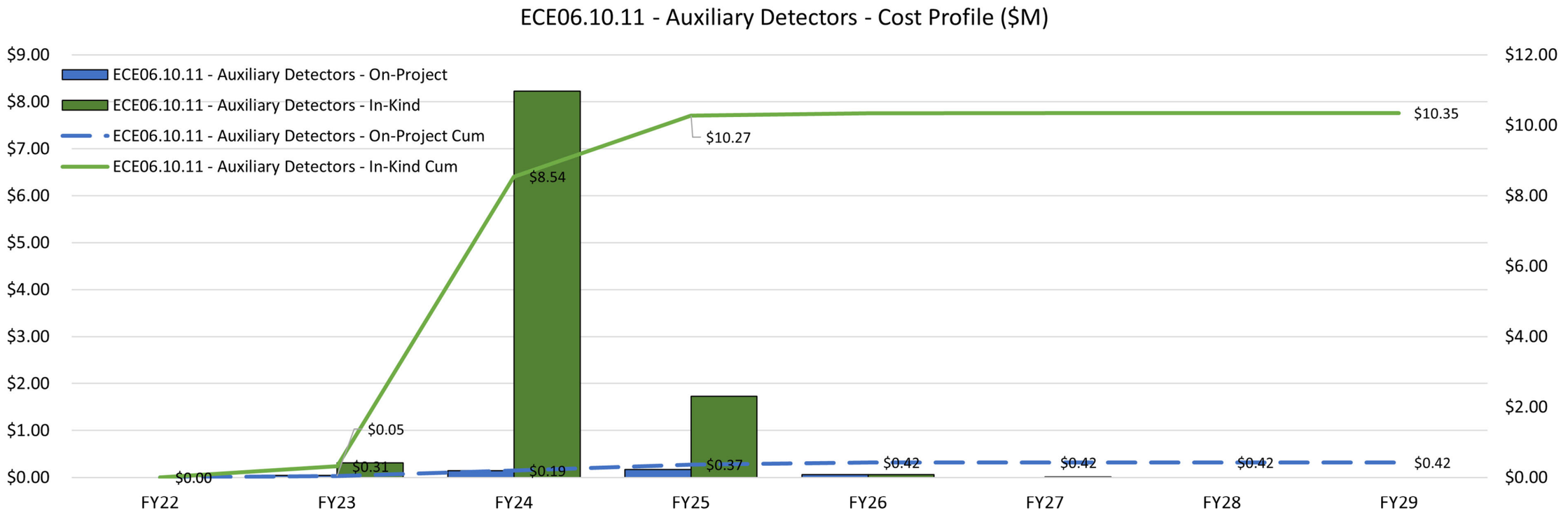

ECE06.10.09 - DAQ/Computing - Cost Profile ($M)
ECE06.10.09 - DAQ/Computing - On-Project
ECE06.10.09 - DAQ/Computing - In-Kind
ECE06.10.09 - DAQ/Computing - Reuse
ECE06.10.09 - DAQ/Computing - On-Project Cum
$1.80
$1.60
$1.40
$1.20
$1.00
$0.80
$0.60
$0.40
$0.20
$0.00
$7.00
$6.00
$5.00
$4.00
$3.00
$2.00
$1.00
$0.00
$0.69
$0.04
$0.53
$0.02
$1.33
$0.26
$1.64
$0.57
$0.84
$0.26
$0.80
$0.17
$1.15
$1.15
$0.69
$1.22
$2.55
$4.20
$5.03
$5.83
$6.00
FY22
FY23
FY24
FY25
FY26
FY27
FY28
FY29

DAQ/Computing In-Kind

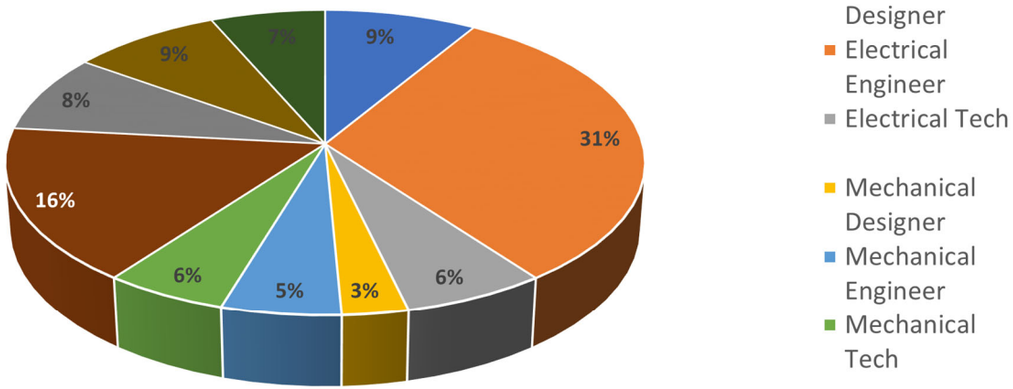


DAQ/Computing Project

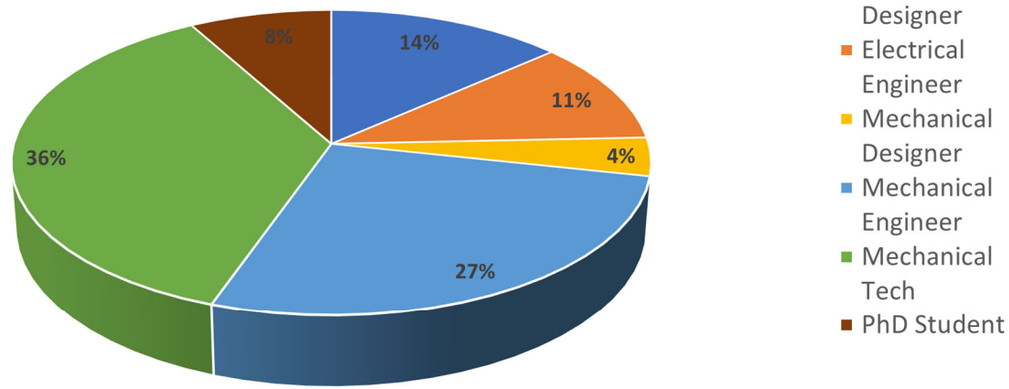


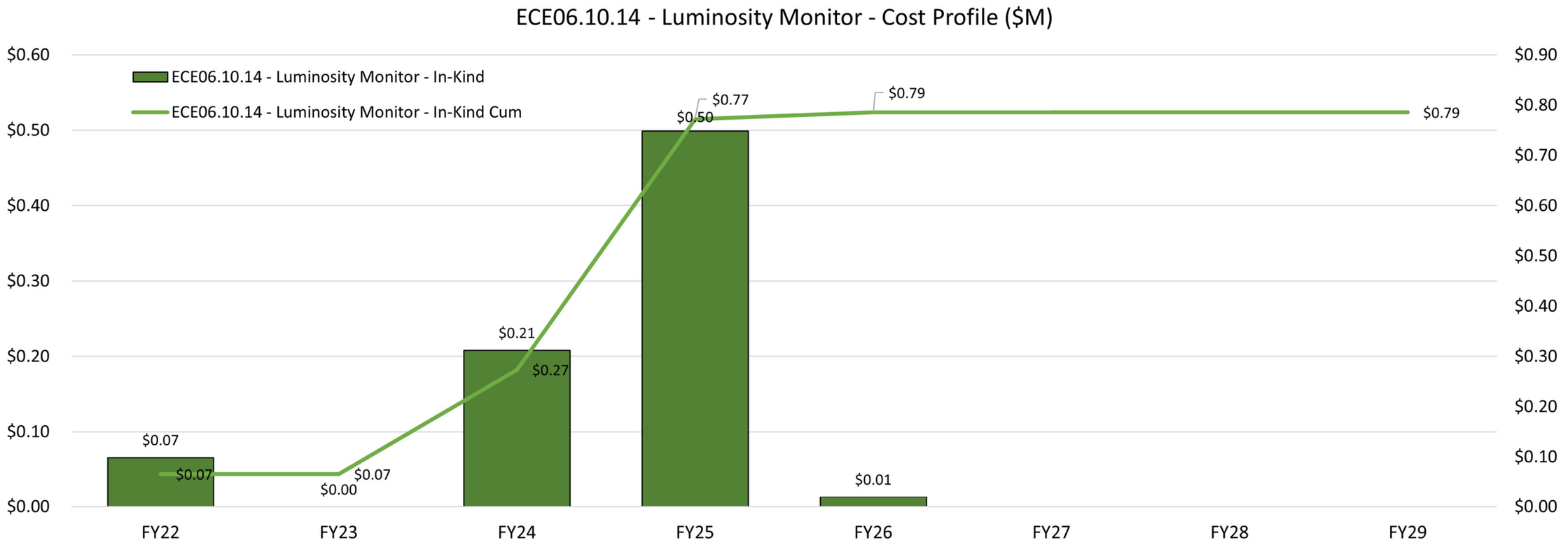

ECE06.10.11 - Auxiliary Detectors - Cost Profile ($M)
ECE06.10.11 - Auxiliary Detectors - On-Project
ECE06.10.11 - Auxiliary Detectors - In-Kind
ECE06.10.11 - Auxiliary Detectors - On-Project Cum
ECE06.10.11 - Auxiliary Detectors - In-Kind Cum
$9.00
$8.00
$7.00
$6.00
$5.00
$4.00
$3.00
$2.00
$1.00
$0.00
$12.00
$10.00
$8.00
$6.00
$4.00
$2.00
$0.00
$0.00
$0.05
$0.19
$0.42
$0.42
$0.42
$0.42
$0.31
$8.54
$0.37
$10.27
$10.35
FY22
FY23
FY24
FY25
FY26
FY27
FY28
FY29

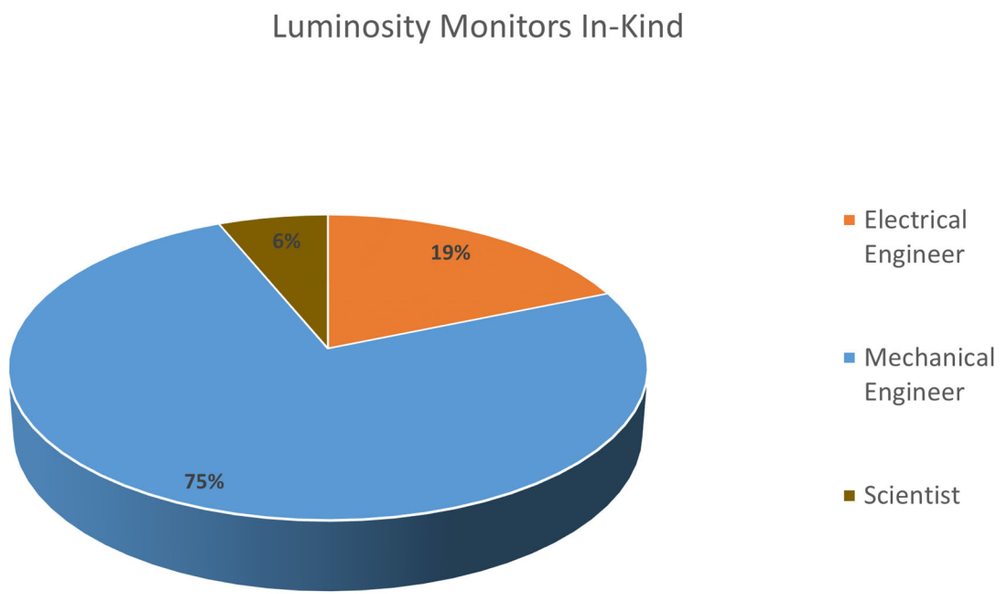
Auxiliary Detectors In-Kind



Auxiliary Detectors Project




ECE06.10.14 - Luminosity Monitor - Cost Profile ($M)
ECE06.10.14 - Luminosity Monitor - In-Kind
ECE06.10.14 - Luminosity Monitor - In-Kind Cum
$0.60
$0.50
$0.40
$0.30
$0.20
$0.10
$0.00
$0.90
$0.80
$0.70
$0.60
$0.50
$0.40
$0.30
$0.20
$0.10
$0.00
$0.07
$0.07
$0.00
$0.07
$0.21
$0.27
$0.50
$0.77
$0.01
$0.79
$0.79
FY22
FY23
FY24
FY25
FY26
FY27
FY28
FY29


Luminosity Monitors In-Kind
6%
19%
75%
Electrical Engineer
Mechanical Engineer
Scientist