Community Advisory Board

Investing in the Future of Science: 2020 Update

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Fermilab Infrastructure At-a-Glance

Physical Assets

6,800	acres (10 mi^2)
366	Buildings
2.4M	GSF
$2.21B	Replacement Plant Value
22,155	GSF in Leased Facilities
15-30	Bison

Electrical

2	345 kV substations
101	mi electric cable

Underground Utilities

27	mi fire prot & ICW
20	mi domestic water
16	mi sanitary
20	mi natural gas

Surface Infrastructure

300	ac surface water in cooling ponds
15	
36	mi roads
130	ac parking

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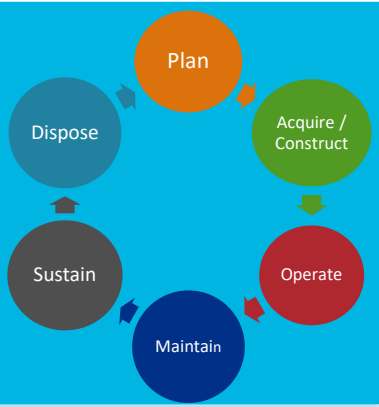
Fermilab Science Strategy *Aligned With the P5 Plan*

The ten-year goal of Fermilab's science strategy is a **world-leading neutrino science program** anchored by the **Long-Baseline Neutrino Facility** (LBNF) and **Deep Underground Neutrino Experiment** (DUNE), powered by megawatt beams from an upgraded and modernized accelerator complex made possible by the **Proton Improvement Plan II** (PIP-II).

Key Points



Fermilab's 10-year Science & Technology Plan is the basis of our Campus Strategy

Planning processes yield a prioritized list of campus projects which identifies the Lab's top S&T priorities

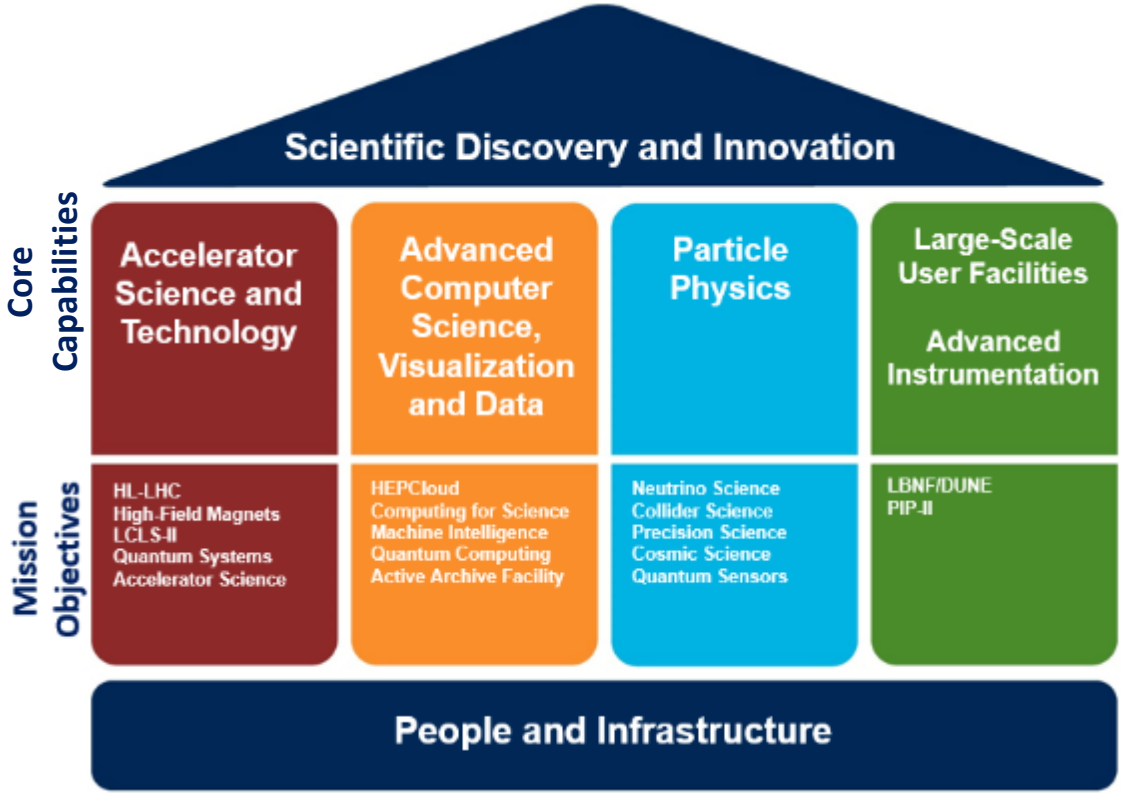
Executing construction onsite prepares the way for near-term S&T activities

Sustainment processes to reduce deferred maintenance by centralizing efforts to increase investment and the use of data analytics will improve the condition of campus infrastructure enabling the S&T plan

Disposition includes a long-term plan for excess facility repurposing or demolition; a 2019 "cold & dark" pilot clears informs our plan for achieving future S&T goals

Fermilab Core Capabilities, Foundational Infrastructure

Make the best use of lab core capabilities + people + infrastructure to strengthen the field of particle physics in the U.S. and host the world to advance scientific discovery and innovation



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10-Year Campus Strategy

10-Year Science & Technology Plan & Life Cycle Campus Management

- Be the International Hub for Neutrino Science
- Be the Frontier Laboratory for Particle Physics Discovery
- Be the World Leader in Accelerator Science and Technology
- Drive Innovation in Particle Detector Technologies
- Be at the Forefront of Large-scale Data Analytics
- Become a National Center for Quantum Science and Technology

Planning infrastructure to meet the S&T goals

Plan / Budget

Enabling S&T work thru new **construction** projects

Acquire / Construct

Operate

Improving infrastructure **operations** thru centralized facility management

Sustain – Maintain

Reducing deferred maintenance through improved **sustainment** processes

Sustain – Recapitalize

Demolition reduces risk & lifecycle costs

Dispose

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PLANNING

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Infrastructure Planning *Fermilab Campus Master Plan*

- Fermilab's plan to support DOE's science mission though the built environment
- Sets a vision for infrastructure initiatives

Support cutting-edge research

Enhance the campus experience

Reinforce community

Ensure the campus is welcoming to visitors & collaborators

Promote stewardship

Ensure integrative planning and design

Uphold the unique character of Fermilab

Fermilab Campus Infrastructure Planning

- Condition Assessment Surveys
- Regulatory Requirements
- New Mission Requirements
- Lab Initiatives
- Resilience, Energy Planning
- ESH Assessments

Risk-Based, Prioritized List of Laboratory Needs

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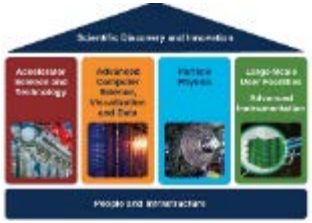
10-Year Campus Strategy

Planning – Projects Ready to Deliver



Target Systems Integration Building

Neutrino and Muon experiments including LBNF and future Mu2e-II, LBNF 2.4MW, and the booster target upgrade stations, will be crucially supported by TSIB which will double Fermilab's existing capacity to produce horns and targets.

Scope

29,600 sf addition to existing MI-8 service building to produce horns and targets

Cost

$17.9M

Schedule

Design to begin Q1 FY21

Construction to begin Q1 FY22


Proposed TSIB rendering


Horn assembly


AD Assembly Team

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10-Year Campus Strategy

Planning – Projects Ready to Deliver

Accelerator Controls Operations Research Network (ACORN)

ACORN supports the future of DOE/HEP research and enables transformational accelerator R&D by recapitalizing accelerator control and power supply systems and enabling data analytics for operations. ACORN R&D aims to evaluate feasibility of operating high-bandwidth / low-latency (mmWave) wireless technology in accelerator tunnels. Possible 5G technology applications include 5G antenna designs for tunnels and directed or autonomous 5G-enabled robots operating in tunnels and high radiation areas.

Scope

Modernize accelerator control and power supply systems

Cost

TBD, draft funding profile = $140M

Schedule

TBD, CD-0 potentially Q4FY20

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10-Year Campus Strategy

Planning – Projects Ready to Deliver

Center for Accelerator Science & Technology

CAST will exploit the world's highest power beams for neutrino science while performing R&D to extend the scientific reach of existing DOE/SC accelerator facilities. It provides a platform for integrating Fermilab Accelerator Complex operations with experiment operations (LBNF/DUNE, PIP-II) and future (Booster Replacement, Mu2e-II, HE-LHC) projects.

Scope

Facility addition providing modern laboratory space which centralizes state of the art accelerator science and technology research and development.

Cost

TBD, draft funding profile = $128M

Schedule

TBD, CD-0 potentially Q1FY22

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10-Year Campus Strategy

Planning – Projects Ready to Deliver

Wilson Hall Improvements Concrete Repairs, Windows, Utilities

Wilson Hall is Fermilab's research and engineering engine. The most cost effective solution is to recapitalize (rather than replace) and will enhance energy efficiency, enable flexible future missions, and retire operational risks. Data analytics and 5G applications include monitoring environmental conditions and mechanical and utility equipment.

Scope

Repair and replacement of exterior concrete, windows, and building utilities, facility modernization, and other site needs

Cost

TBD, draft funding profile = $251M

Schedule

TBD, CD-0 potentially Q4FY21

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CONSTRUCTION

10-Year Campus Strategy

Execute Construction & Transition to Operations – Projects in Process

Utilities Improvement Project (UIP)

Fermilab's central utility systems are ideal candidates for the use of 5G sensors and data analytics to monitor & optimize equipment and system performance.

Scope

Recapitalize highest priority segments of 50-yr old site-wide utility system infrastructure experiences system failures daily/weekly – including electrical, domestic water, storm and sanitary, natural gas, ICW, fire protection, and chilled water systems.

Cost

TBD, draft funding profile = $314M

Schedule

TBD, CD-1 potentially Q3FY21

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10-Year Campus Strategy

Execute Construction & Transition to Operations – Projects in Process

Utilities Improvement Project (UIP)

This project will increase redundancy and resiliency of the infrastructure supporting operations. The scope and implementation of this project are scalable depending on project funding.

Central Utilities Building

- Recapitalize equipment that is beyond end-of-life
- Address structural issues to facility
- Increase capacity for future needs

Electrical Distribution

- Upgrade safety features and capacity at Kautz Road Substation
- Recapitalize the site's electrical distribution system

Linear Utilities

- Recapitalize the site's piping systems
- Increase data sensors and metering
- Address local municipalities' concerns

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10-Year Campus Strategy

Execute Construction & Transition to Operations – Projects in Process

Integrated Engineering and Research Center (IERC)

IERC will provide world-class modernized facilities to advance Fermilab's highest-priority projects, such as LBNF/DUNE & LHC upgrades, with new initiatives such as quantum information science.

Scope

An efficient building that will provide state-of-the-art laboratories, technical, and office space for particle physics-related R&D projects.

Cost

$86M

Schedule

CD-2/3 Aug 2020

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10-Year Campus Strategy

Execute Construction & Transition to Operations – Projects in Process

Proton Improvement Project (PIP-II)

The PIP-II particle accelerator will be the new heart of Fermilab, featuring a brand-new, 800-MeV, leading-edge superconducting linear accelerator. PIP-II will enable the most intense high-energy neutrino beam for the laboratory's flagship project—the Long Baseline Neutrino Facility and Deep Underground Neutrino Experiment (LBNF/DUNE).

Cost

$888M

Schedule

CD-2 FY21 Q1

PIP II Groundbreaking Ceremony


PIP II Rendering (Looking down from Wilson Hall)

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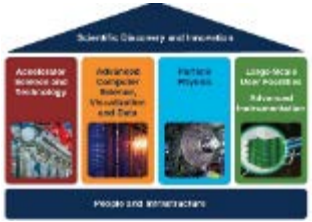
10-Year Campus Strategy

Execute Construction & Transition to Operations – Projects in Process



Long Baseline Neutrino Facility (LBNF) – Near Site

LBNF provides the enormous caverns and cryogenics infrastructure for the DUNE detector deep underground at Sanford Lab. This includes the excavation of 800,000 tons of rock. It will also build structures at Fermilab to send neutrinos through stone and earth to South Dakota — no tunnel needed.

Cost

$2,600M (near site + far site)

Schedule

CD-2/3b FY21 Q3

Site Prep will be complete at end of this year

Conventional Facilities construction to begin in 2023


Indian Creek Culvert Construction


Cooling Tower & Piping


Electrical & Communication Cable Ductbank Installation

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SUSTAINMENT

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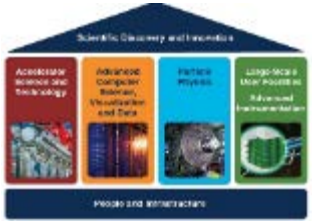
10-Year Campus Strategy

Sustainment – Optimizing Operations, Deferred Maintenance & CFM



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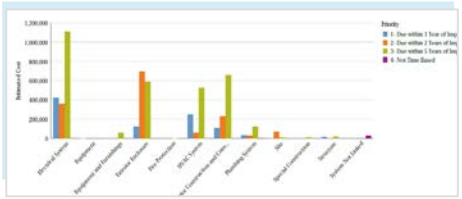
Optimizing Campus Operations

Fermilab is using capital planning software to leverage data analytics for developing FY21+ workplans and eventually predictive failure analysis.

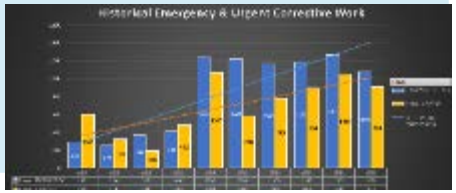


FY20 facility condition assessments are yielding baseline asset data and investment needs

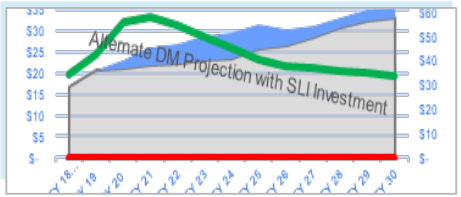
Installed 25 natural gas smart meters, an ICW monitoring system, and a smart acid leak detection system to grow data analytics capabilities

Reducing Deferred Maintenance

Increasing investments in lab maintenance to reach the DOE targeted rate, prioritizing investment in areas with highest risk-return benefit.



Analyzing work order metrics allows Fermilab investments to target critical maintenance needs



Projected SLI & HEP investments in infrastructure will significantly decrease deferred maintenance

Centralized Facility Management

Centralizing facility management to achieve facility consistency, process efficiency, economies of scale, and workforce development.

Centralizing facility management will yield a professionally trained workforce and consistent facility maintenance protocols.

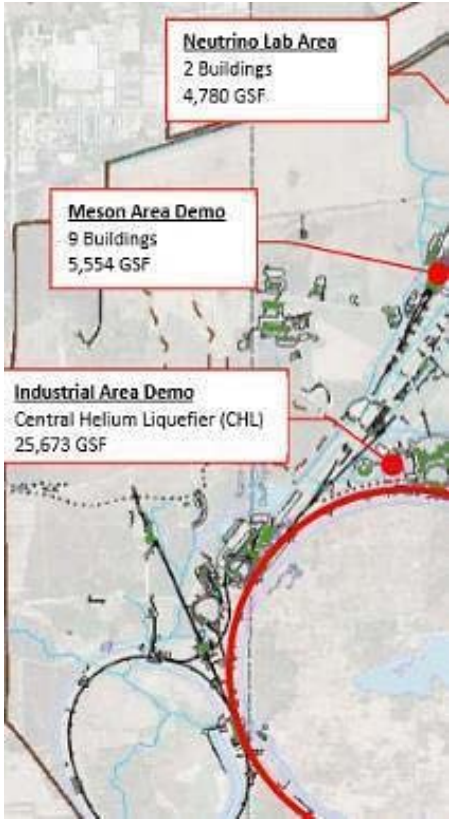
Under CFM, Facility Managers will collect standardized infrastructure condition information to prioritize end of life investments

10-Year Campus Strategy

Disposition - Excess Facilities

We have a plan and are making progress...

- Completed “Cold and Dark Pilot” in 2019 - is informing future disposal planning
- Included Sitewide Demolition Program in Top 20 Priorities List
- Funded Strategic Facility Assessment to identify top projects for demo (paused due to COVID).



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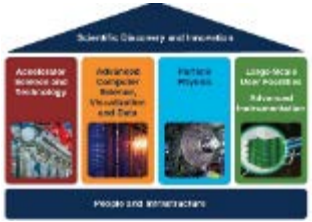
Data Analytics for Campus Operations



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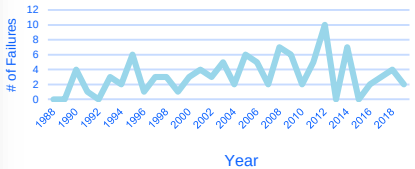
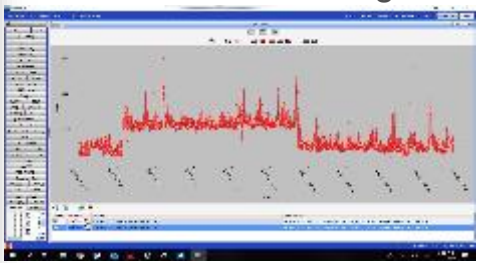
In Infrastructure, analytics are used to identify trends, patterns, and insights within facility data, and uses the information to improve visibility, make data-based decisions, and develop initiatives.

Better Fault Data



Performance Trending



In FY19, FNAL developed a Task Force to develop key metrics to analyze facility and infrastructure data (i.e., where do we need the data?)

In FY20, FNAL is investing in upgrading the site's metering & data collection

In FY21+, FNAL will continue to upgrade site's utility and infrastructure data gathering

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QUESTIONS?