
AWS
re:Invent
NOV. 28 – DEC. 2, 2022 | LAS VEGAS, NV

MFG205

Toyota and CFS speed up engineering and design with AWS

Nate O'Farrell

Head of IT Infrastructure
Commonwealth Fusion Systems

Phil Reuter

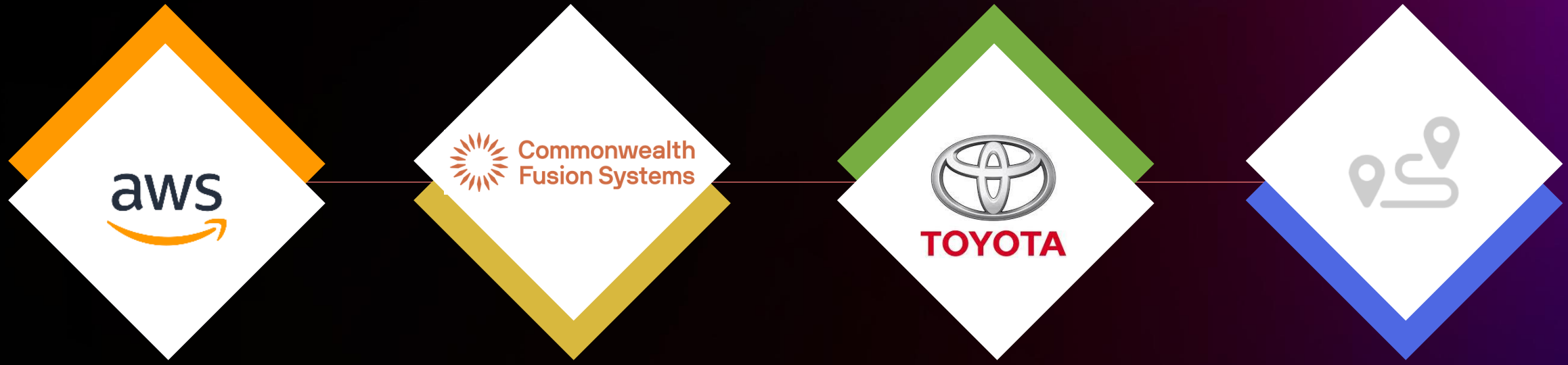
Senior Director,
Engineering Transformation
Toyota

Walker Stemple

Global Manager, Engineering and Design
AWS

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Agenda



Engineering and design at AWS

Walker Stemple
Global Manager, Engineering and Design

Commonwealth Fusion Systems (CFS)

Nate O'Farrell
Head of IT Infrastructure

Toyota

Phil Reuter
Senior Director, Engineering Transformation

Wrap-up and outlook

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The manufacturing data flywheel

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Product complexity



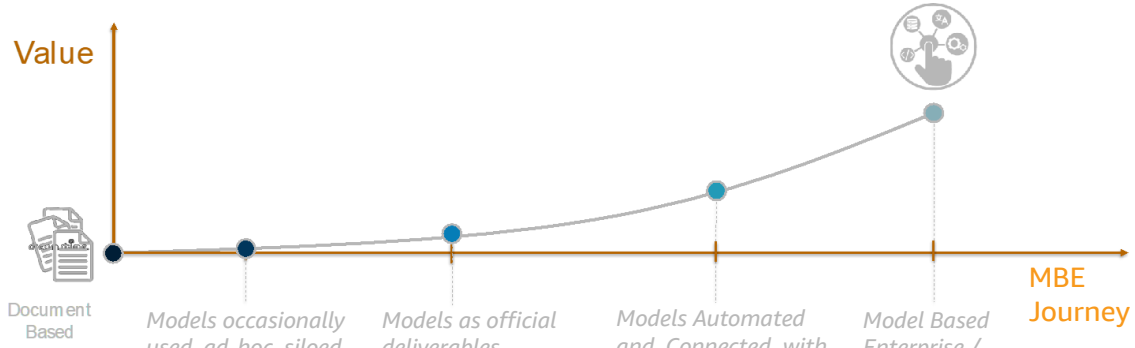
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Engineering modernization journey

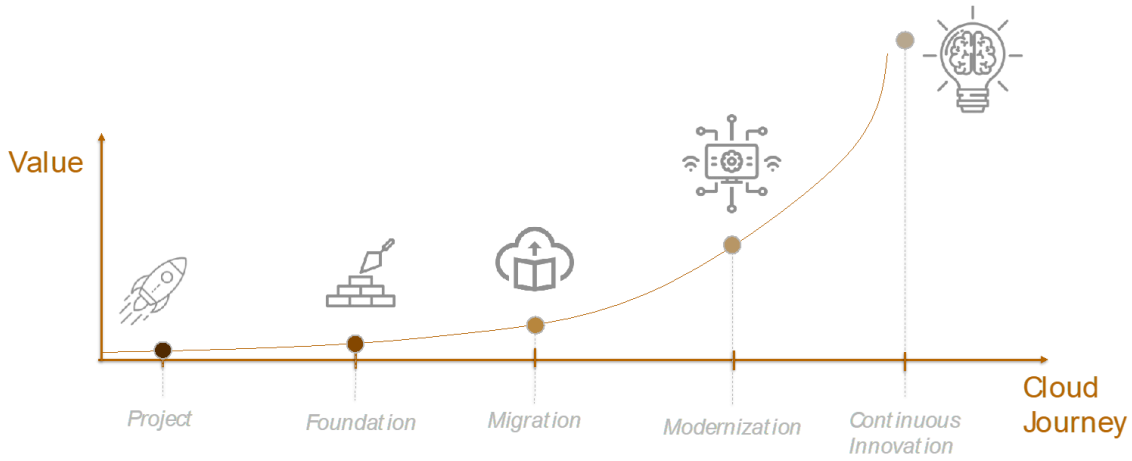
Digital engineering journey

Coherence

Cloud journey



Customer journey

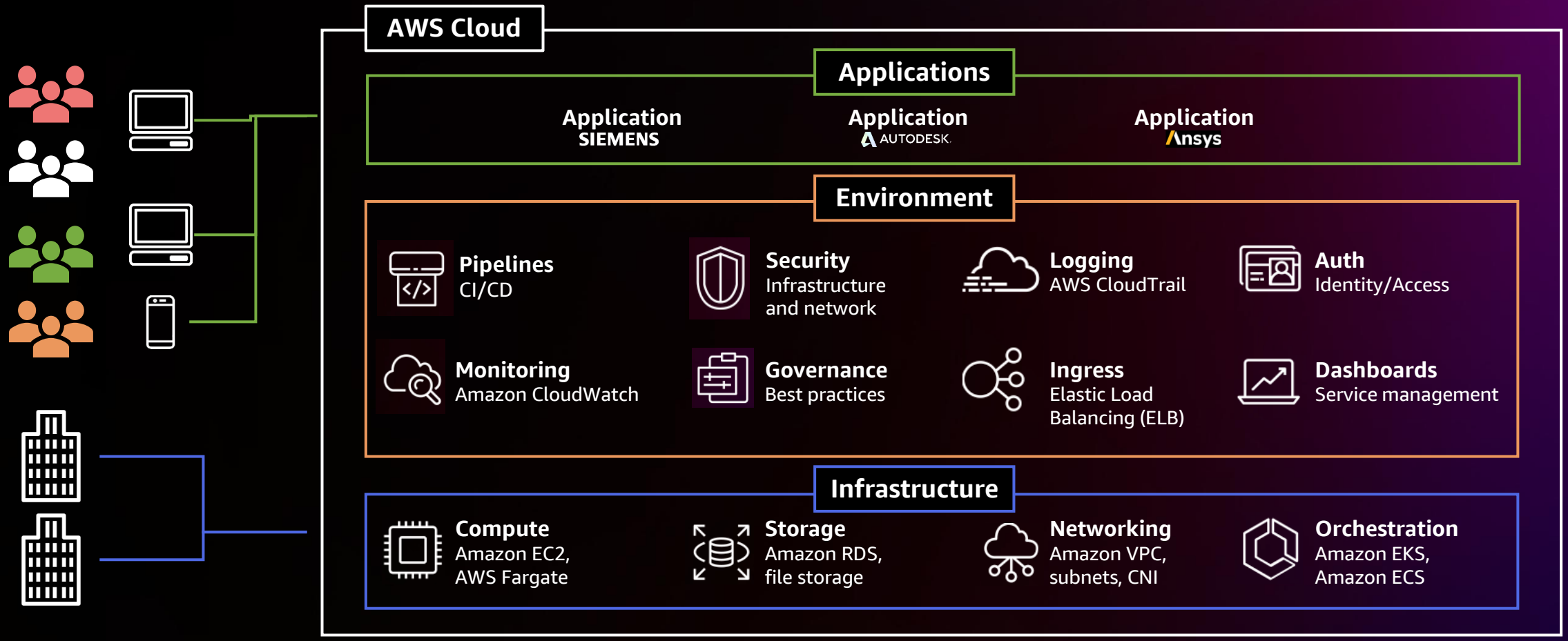


AWS Partner Network and tools

AWS Professional Services

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Open Industrial Data Architecture



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Engineering and design

AWS services (build)

- Amazon EC2
- AWS ParallelCluster
- NICE DCV
- Amazon EFS
- Amazon FSx
- Amazon AppStream

Use cases

- Computer-aided engineering
- Engineering Datalake
- Engineering VDI
- Product digital twin
- Semiconductor EDA

AWS solutions (build)

- Integrated Digital Engineering on AWS
- Scale-Out Computing on AWS
- EFS-to-EFS Backup

Sample AWS Partners (deploy)

AUTODESK. SIEMENS SYNOPSYS

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Commonwealth Fusion Systems (CFS)

Nate O’Farrell
Head of IT Infrastructure

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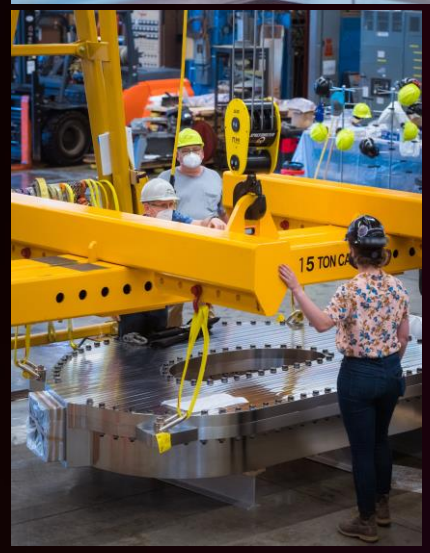
CFS is on a path to deliver commercial fusion energy

2018 Founded by and spun out of MIT

$2B+ Raised from a diverse group of investors

>350 Employees in a high-caliber, diverse team







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What and why?

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New clean energy source to combat climate change

The Hill

Climate change is no longer a future problem

The Atlantic

California's wildfires are 500 percent larger due to climate change

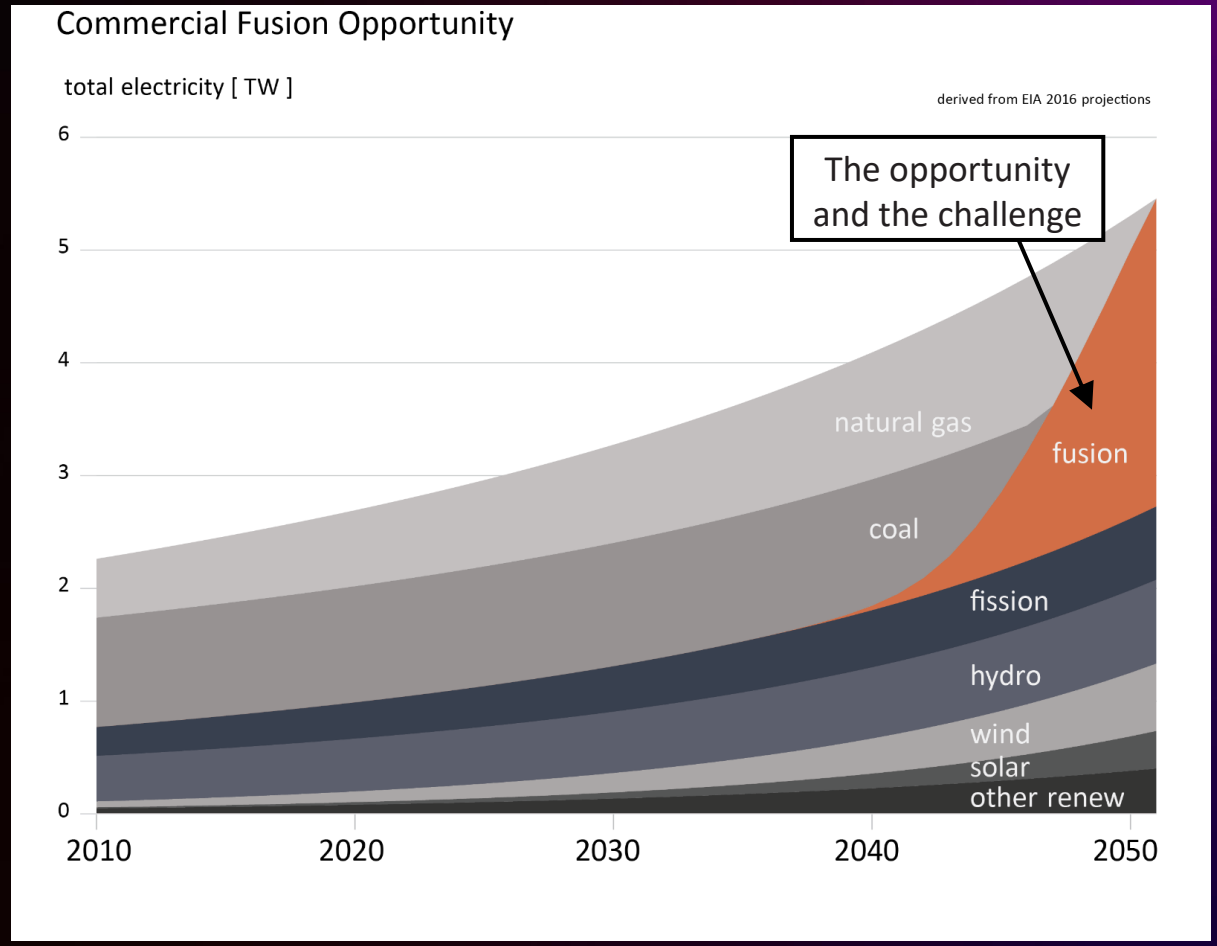
The Washington Post

After a blistering heat wave boosted by climate change, Europe just notched its hottest June on record

MIT Technology Review

Welcome to climate change

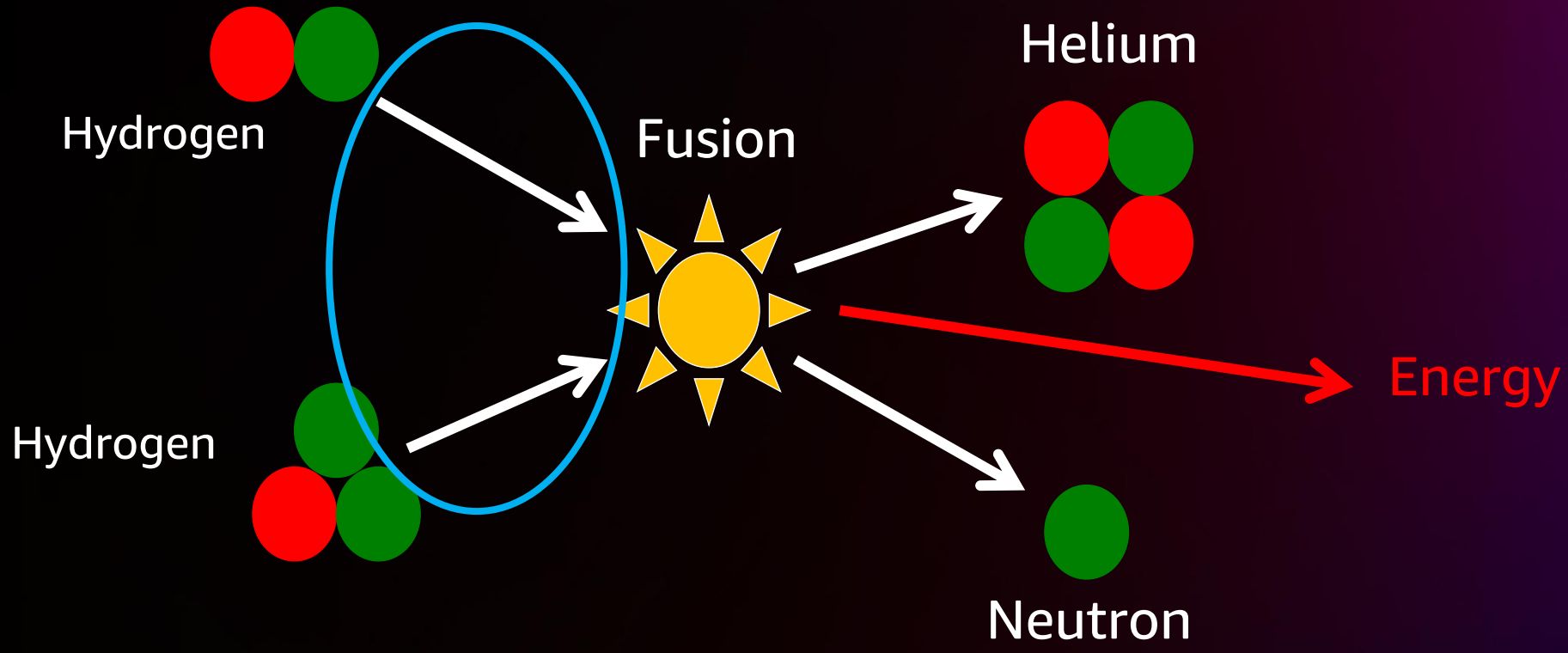
Cover for The Climate Issue



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What is fusion?



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Fusion benefits



Huge amount of energy potential



Inherently safe



Zero carbon



Economically competitive

Limitless, clean, fusion energy

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CFS timelines

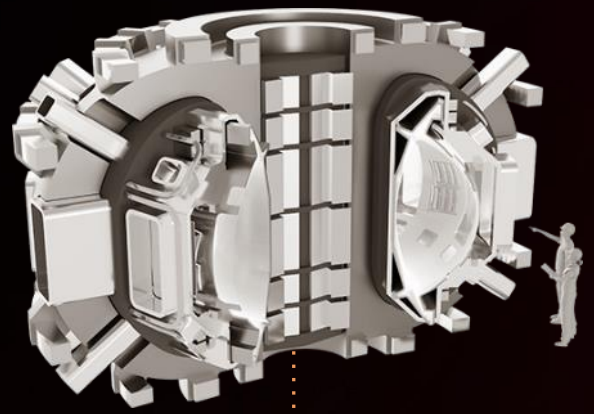
Completed:
Alcator C-Mod
Record-setting
tokamak



Completed:
Demonstrate groundbreaking
HTS magnets

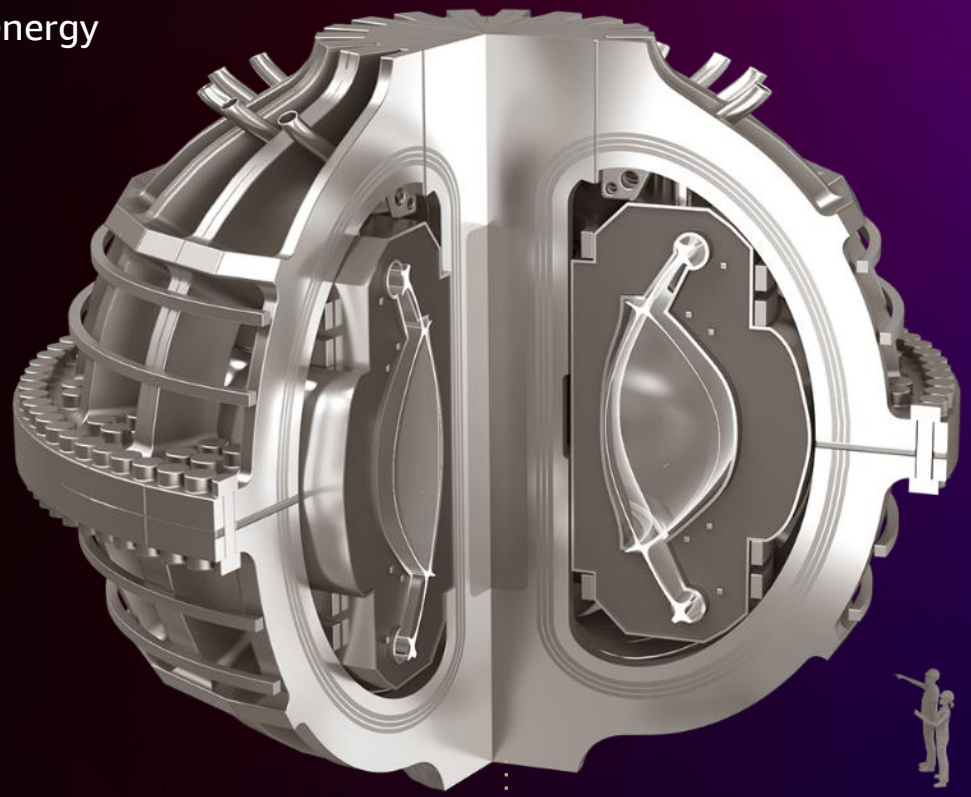


Construction underway for 2025 launch:
SPARC
Achieve net fusion energy



Commercially-relevant net fusion energy for the first time

Early 2030s:
ARC deployed
>200 MW



Carbon-free commercial power on the grid

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Construction of commercial fusion campus in Devens, MA



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Technical challenges

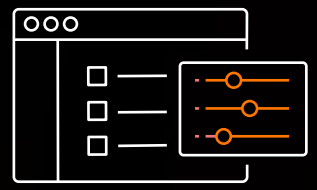
1. Large-scale simulations need to be completed to inform decision-making for manufacturing
2. End-user workstations are not powerful enough or fast enough to complete medium-scale simulations
3. Further impacted by hybrid employees with residential networks
4. Dynamic and frequent changes in requirements, scope, and priority require highly flexible advanced solutions



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Before AWS



Individual high-power workstations



Shared on-premises compute



Testing third-party SaaS HPC providers



Data storage limits

Not fast, not flexible

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Building usable, scalable compute

Distributed Linux compute

- AWS GovCloud (US)
- 150–200K cores/month consumption – over 1M total
- Average 2,500 cores/job
- Some jobs – 50K+ cores

eVDI

- High performance Windows and Linux VDI nodes using SOCA/IDEA
  - Hpc6a.48xlarge
  - G4dn
- Non-ephemeral storage using Amazon FSx for NetApp ONTAP

User experience is intrinsic to success

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Results: Distributed computing

Neutronics server

- 32 CPU
- OpenMP (32 tasks)
- Estimated computation 20-deg SDDR: **~56 days** (including manual file setups)

Amazon Web Services

- 160 nodes MCNP/17 nodes FISPACT, 15,360 cores
- OpenMP and MPI for MCNP
- Estimated computation 20-deg SDDR: **~3 days** (including manual file setups)

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Distributed computing with MPI

15,360-core single job on 160 hpc6a.48xlarge

```
[root@ip-10-97-0-22 bin]# pbsnodes -SLaj
                                                    mem       ncpus     nmics     ngpus
vnode           state           njobs   run   susp      f/t       f/t       f/t       f/t   jobs
--------------- --------------- ------ ----- ------ ---------- ------- ------- ------- -------
ip-10-97-180-212 job-busy            1     1      0  370gb/370gb    0/96     0/0     0/0 2345
ip-10-97-152-174 job-busy            1     1      0  370gb/370gb    0/96     0/0     0/0 2345
ip-10-97-184-160 job-busy            1     1      0  370gb/370gb    0/96     0/0     0/0 2345
ip-10-97-181-171 job-busy            1     1      0  370gb/370gb    0/96     0/0     0/0 2345
ip-10-97-165-160 job-busy            1     1      0  370gb/370gb    0/96     0/0     0/0 2345
ip-10-97-135-46 job-busy             1     1      0  370gb/370gb    0/96     0/0     0/0 2345
ip-10-97-185-133 job-busy            1     1      0  370gb/370gb    0/96     0/0     0/0 2345
ip-10-97-164-59 job-busy             1     1      0  370gb/370gb    0/96     0/0     0/0 2345
ip-10-97-142-88 job-busy             1     1      0  370gb/370gb    0/96     0/0     0/0 2345
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ip-10-97-148-123 job-busy            1     1      0  370gb/370gb    0/96     0/0     0/0 2345
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ip-10-97-179-140 job-busy            1     1      0  370gb/370gb    0/96     0/0     0/0 2345
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ip-10-97-167-71 job-busy             1     1      0  370gb/370gb    0/96     0/0     0/0 2345
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ip-10-97-174-187 job-busy            1     1      0  370gb/370gb    0/96     0/0     0/0 2345
ip-10-97-142-104 job-busy            1     1      0  370gb/370gb    0/96     0/0     0/0 2345
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ip-10-97-170-61 job-busy             1     1      0  370gb/370gb    0/96     0/0     0/0 2345
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ip-10-97-162-28 job-busy             1     1      0  370gb/370gb    0/96     0/0     0/0 2345
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ip-10-97-133-187 job-busy            1     1      0  370gb/370gb    0/96     0/0     0/0 2345
ip-10-97-153-19 job-busy             1     1      0  370gb/370gb    0/96     0/0     0/0 2345
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ip-10-97-162-24 job-busy             1     1      0  370gb/370gb    0/96     0/0     0/0 2345
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ip-10-97-185-128 job-busy            1     1      0  370gb/370gb    0/96     0/0     0/0 2345
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ip-10-97-144-107 job-busy            1     1      0  370gb/370gb    0/96     0/0     0/0 2345
ip-10-97-167-34 job-busy             1     1      0  370gb/370gb    0/96     0/0     0/0 2345
ip-10-97-188-228 job-busy            1     1      0  370gb/370gb    0/96     0/0     0/0 2345
ip-10-97-152-86 job-busy             1     1      0  370gb/370gb    0/96     0/0     0/0 2345
ip-10-97-141-23 job-busy             1     1      0  370gb/370gb    0/96     0/0     0/0 2345
ip-10-97-155-150 job-busy            1     1      0  370gb/370gb    0/96     0/0     0/0 2345
ip-10-97-186-57 job-busy             1     1      0  370gb/370gb    0/96     0/0     0/0 2345
ip-10-97-171-169 job-busy            1     1      0  370gb/370gb    0/96     0/0     0/0 2345
ip-10-97-178-153 job-busy            1     1      0  370gb/370gb    0/96     0/0     0/0 2345
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ip-10-97-154-86 job-busy             1     1      0  370gb/370gb    0/96     0/0     0/0 2345
ip-10-97-158-192 job-busy            1     1      0  370gb/370gb    0/96     0/0     0/0 2345
ip-10-97-155-9  job-busy             1     1      0  370gb/370gb    0/96     0/0     0/0 2345
ip-10-97-135-121 job-busy            1     1      0  370gb/370gb    0/96     0/0     0/0 2345
ip-10-97-129-188 job-busy            1     1      0  370gb/370gb    0/96     0/0     0/0 2345
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ip-10-97-160-58 job-busy             1     1      0  370gb/370gb    0/96     0/0     0/0 2345
ip-10-97-168-65 job-busy             1     1      0  370gb/370gb    0/96     0/0     0/0 2345
ip-10-97-182-207 job-busy            1     1      0  370gb/370gb    0/96     0/0     0/0 2345
ip-10-97-153-113 job-busy            1     1      0  370gb/370gb    0/96     0/0     0/0 2345
ip-10-97-136-78 job-busy             1     1      0  370gb/370gb    0/96     0/0     0/0 2345
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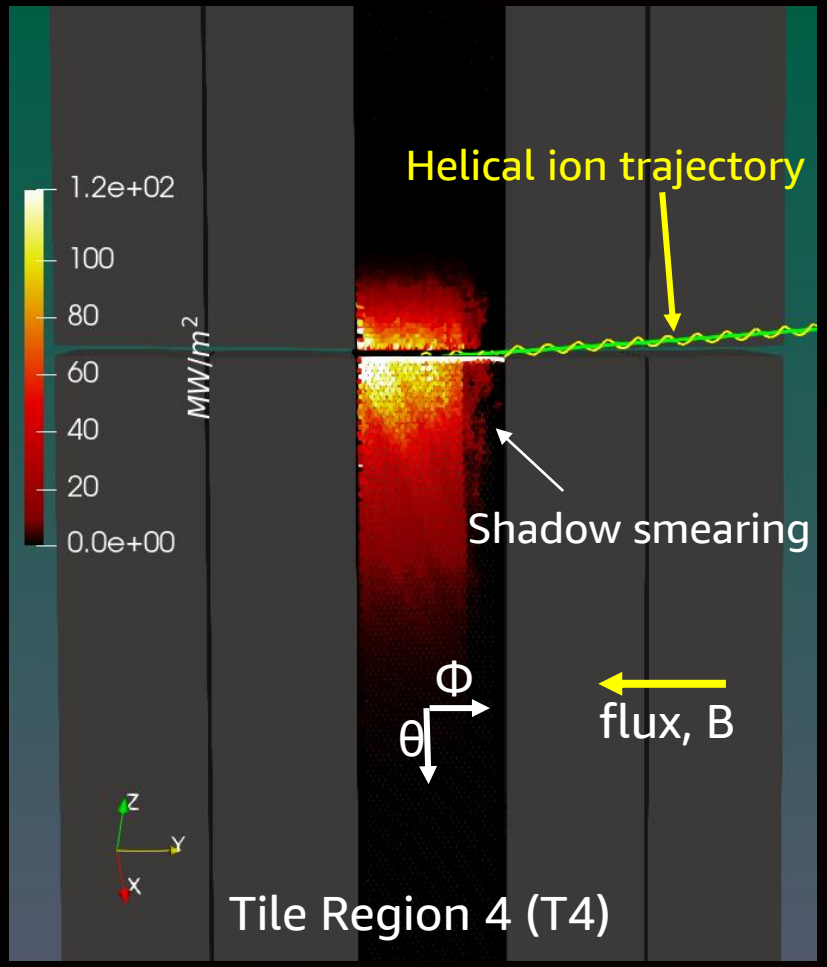
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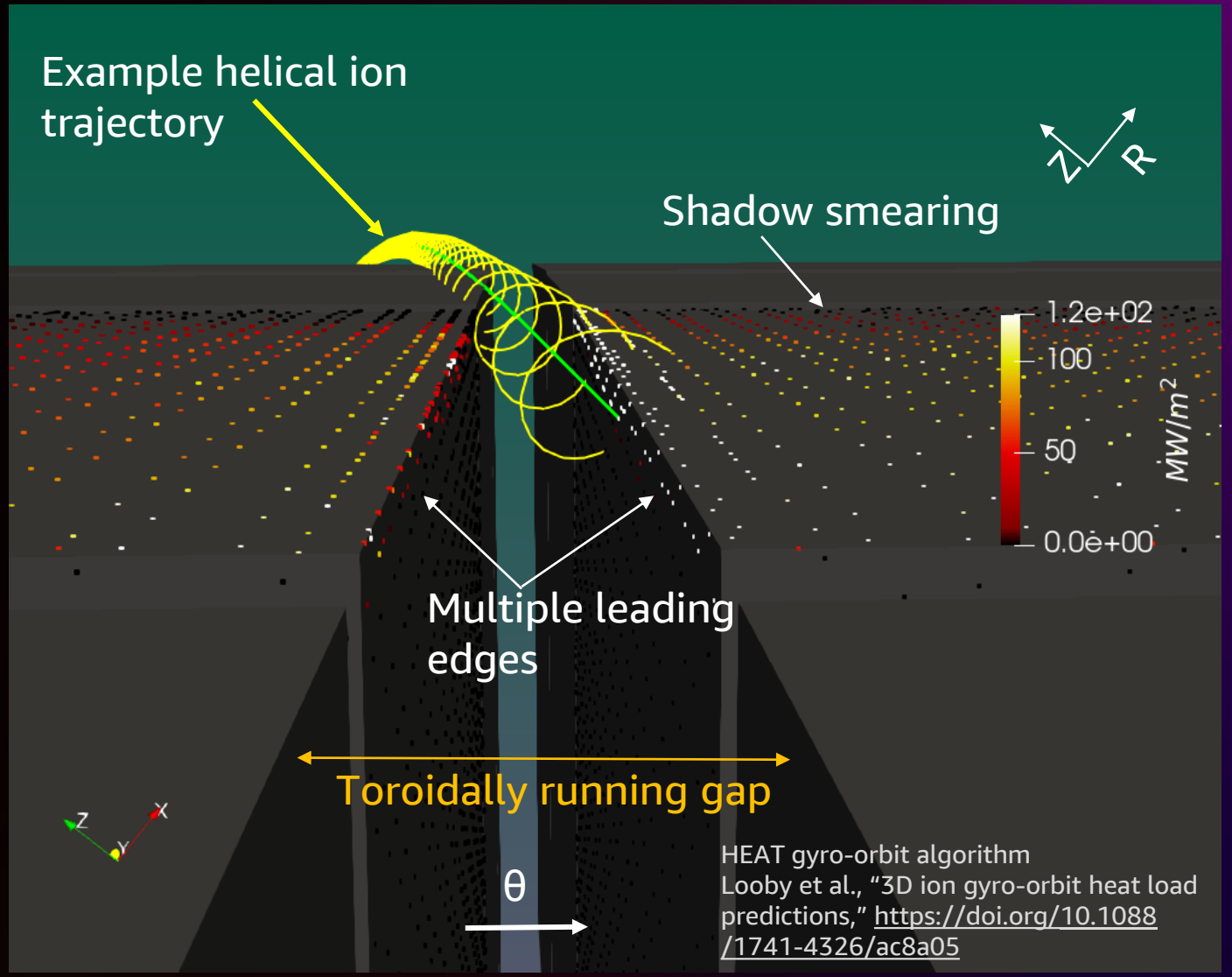
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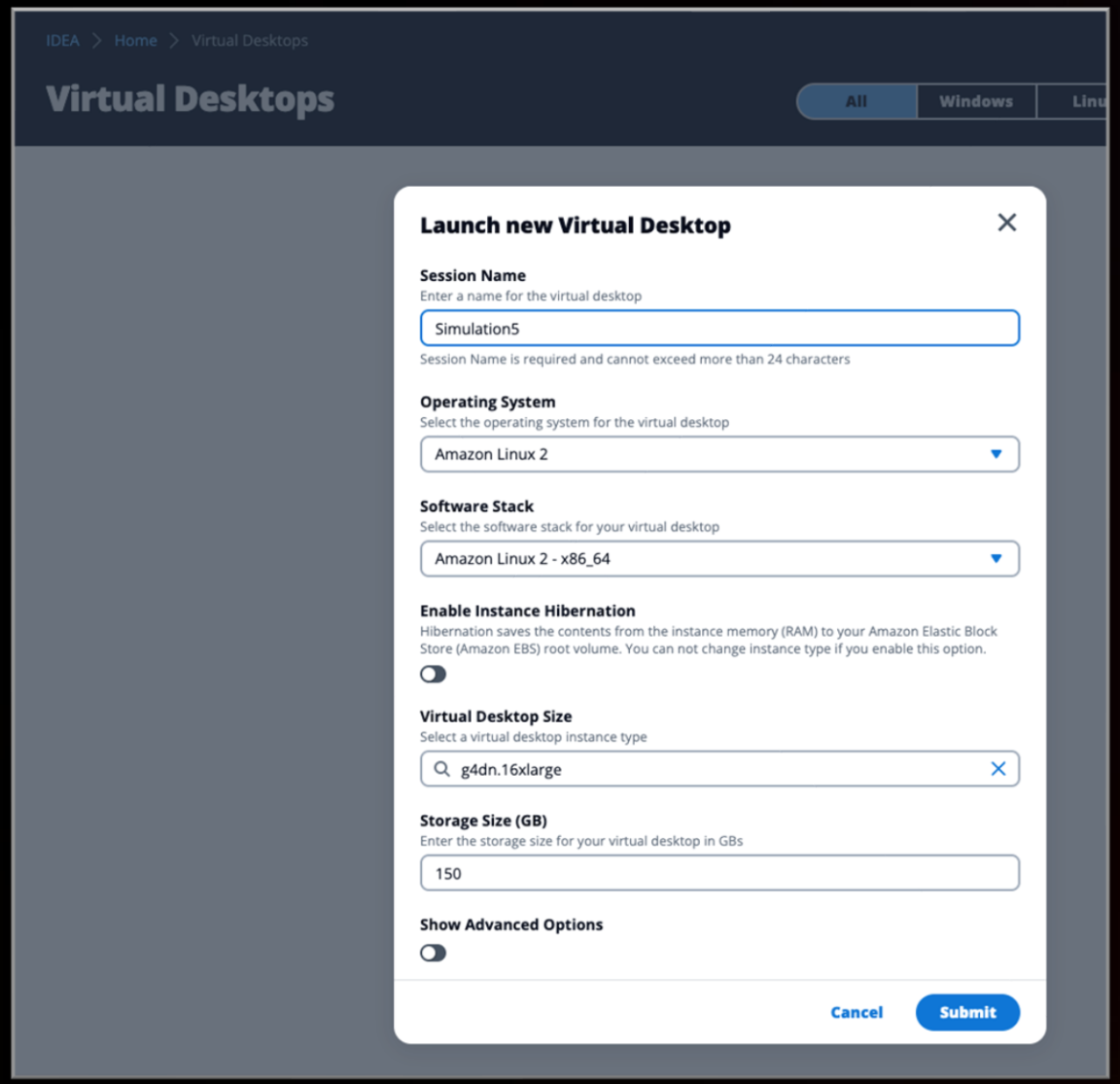
Accelerated particle tracing calculations: 32 days > 32 hours

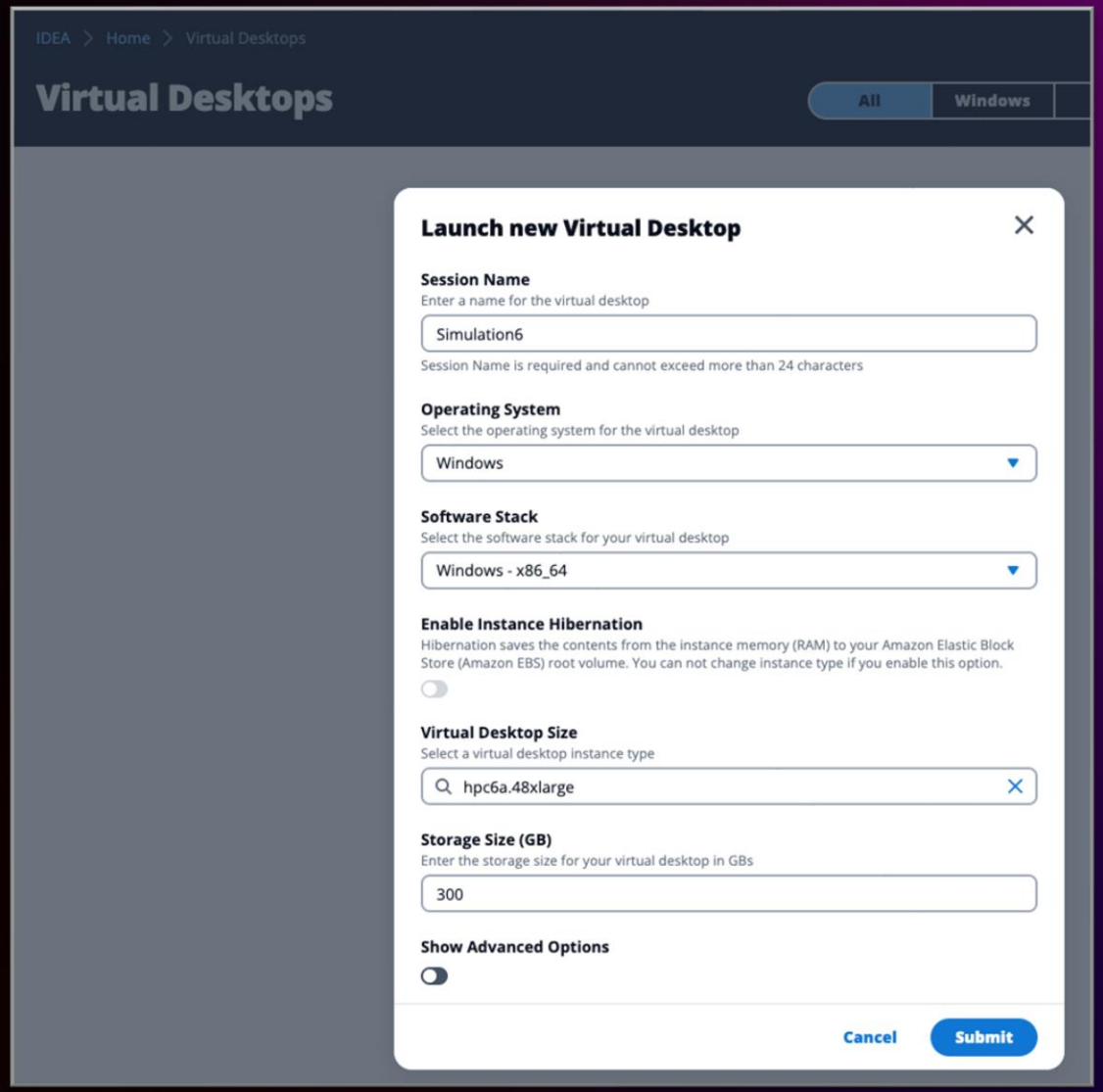




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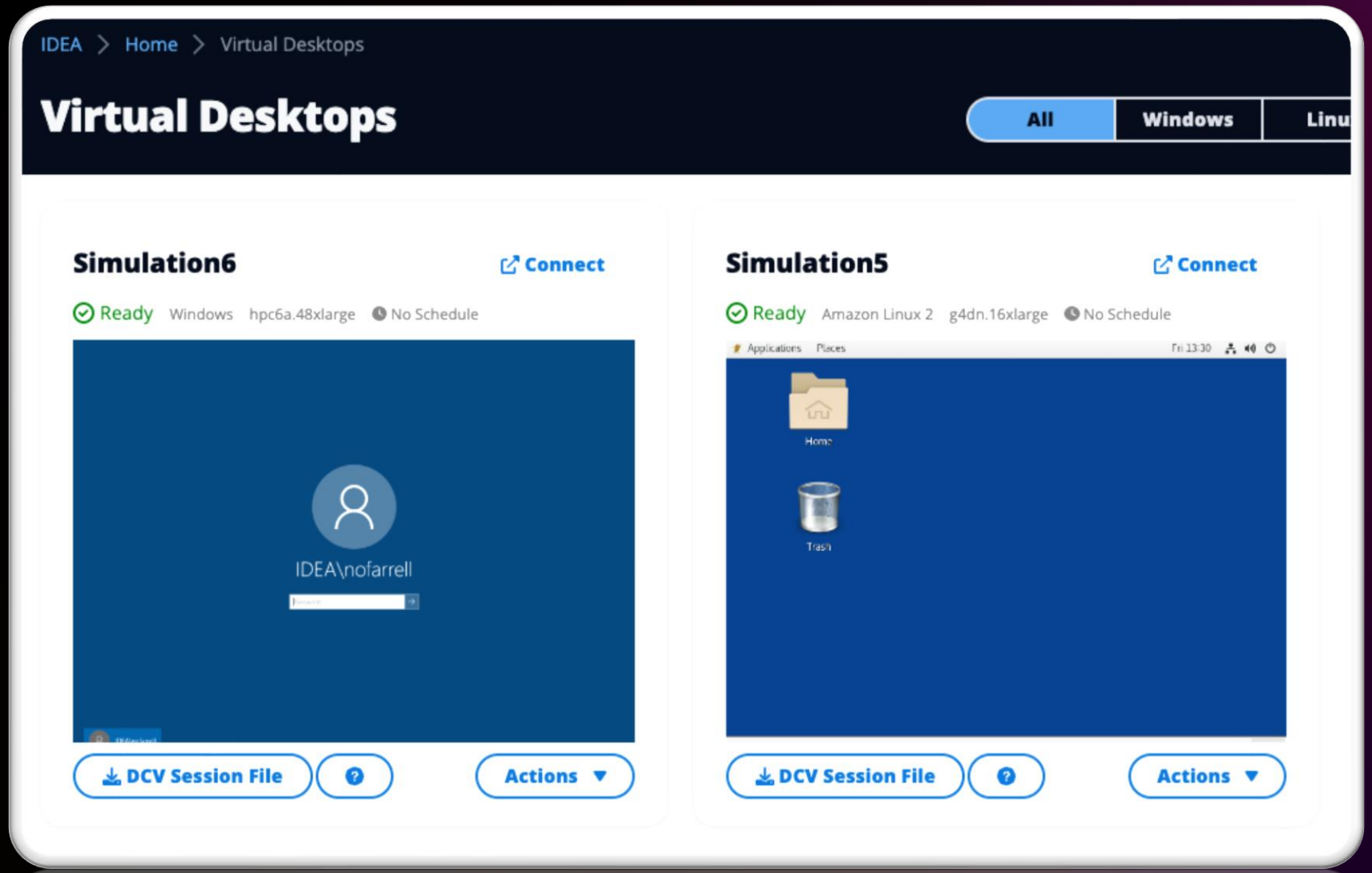
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What’s next

Build • Test • Learn

Bring limitless, green, fusion power to the grid

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“Using HPC to run incredibly complex simulations and to streamline our engineering and design processes has been imperative to achieving our goals and timelines for SPARC.”

Bob Mumgaard

CEO, Commonwealth Fusion Systems

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Toyota Motor North America

Phil Reuter
Senior Director, Engineering Transformation

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TOYOTA MOTOR NORTH AMERICA



Development



Production



Logistics



Sales and marketing



Quality

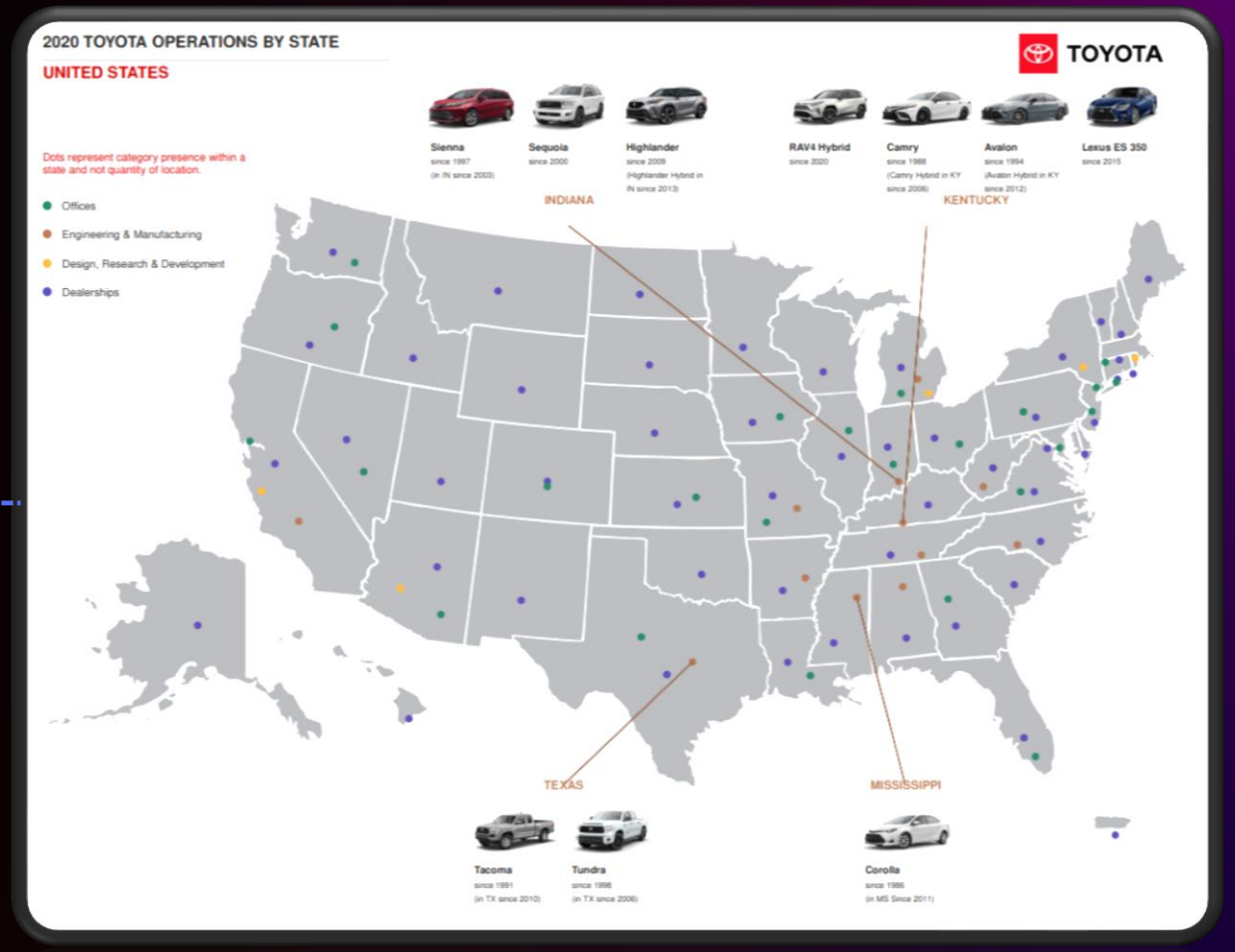
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Building a better vehicle design

Business need

Engineering can work together seamlessly regardless of their location



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Challenges moving to the cloud



Business challenges

- Resistant to new ways of working because what we have been doing works fine
- Changing the fundamental ways of working for over 20 years



IT challenges

- New ways of working within IT with an extension of the data center
- Paradigm shift with security mental model

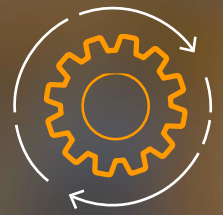
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Why change?



Enhance employee satisfaction



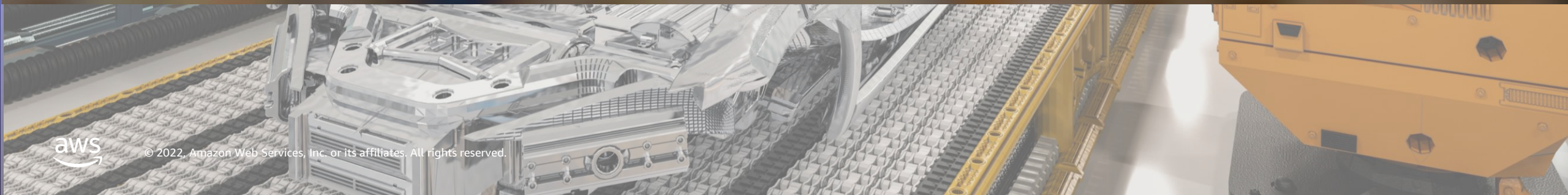
Drive continuous improvement



Improve productivity & operational efficiency



Increase development velocity



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Solution

PATH TO FINDING AN AWS SOLUTION

- Ran a multi-month PoC to mimic production to test AWS technology
- Explored Amazon WorkSpaces and Amazon AppStream
- Used Integrated Digital Engineering on AWS solution to orchestrate NICE DCV

KPIs

HOW WE MEASURE SUCCESS

- **Time to open files**
- **Benchmarking engineering performance**
- **User experience**
- **Remote work capability**

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Proven results



Time to open files

5 min. – near data on premises

35–55 min. – remote to data on premises

3 min. – AWS Cloud



User experience

~150 hours of productivity gained per engineer with AWS solution

Improved employee satisfaction anticipated based on feedback



Engineering performance

On-premises benchmarking – 10.5 min.

AWS Cloud – 10 min.



Remote work capability

Users tested in the office and at home

Observed results were better than current remote access options to physical workstations

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Solutions for your engineering journey

Modernize your product and production design efforts using innovative cloud solutions





Quick start remote desktops

Using on-demand temporary or permanent engineering desktops **NICE DCV, Amazon Appstream 2.0, Amazon Workspaces**



Centralized experience for digital engineering

Utilize engineering collaboration with IDEs for your engineering tools; e.g., AWS open-source reference **Integrated Digital Engineering on AWS**



Innovate with AWS

Artifact store – smooth transition from document- to model-based approach

Serverless workflow automation – Automate human machine (hybrid) workflows

Include digital twins – AWS IoT TwinMaker

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For more information:

https://aws.amazon.com/industrial/engineering-design/

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Thank you!

Nate O'Farrell
nofarrell@cfs.energy

Phil Reuter
phil.reuter@toyota.com

Walker Stemple
wsstempl@amazon.com

https://cfs.energy
@cfs.energy
@CFS_Energy



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