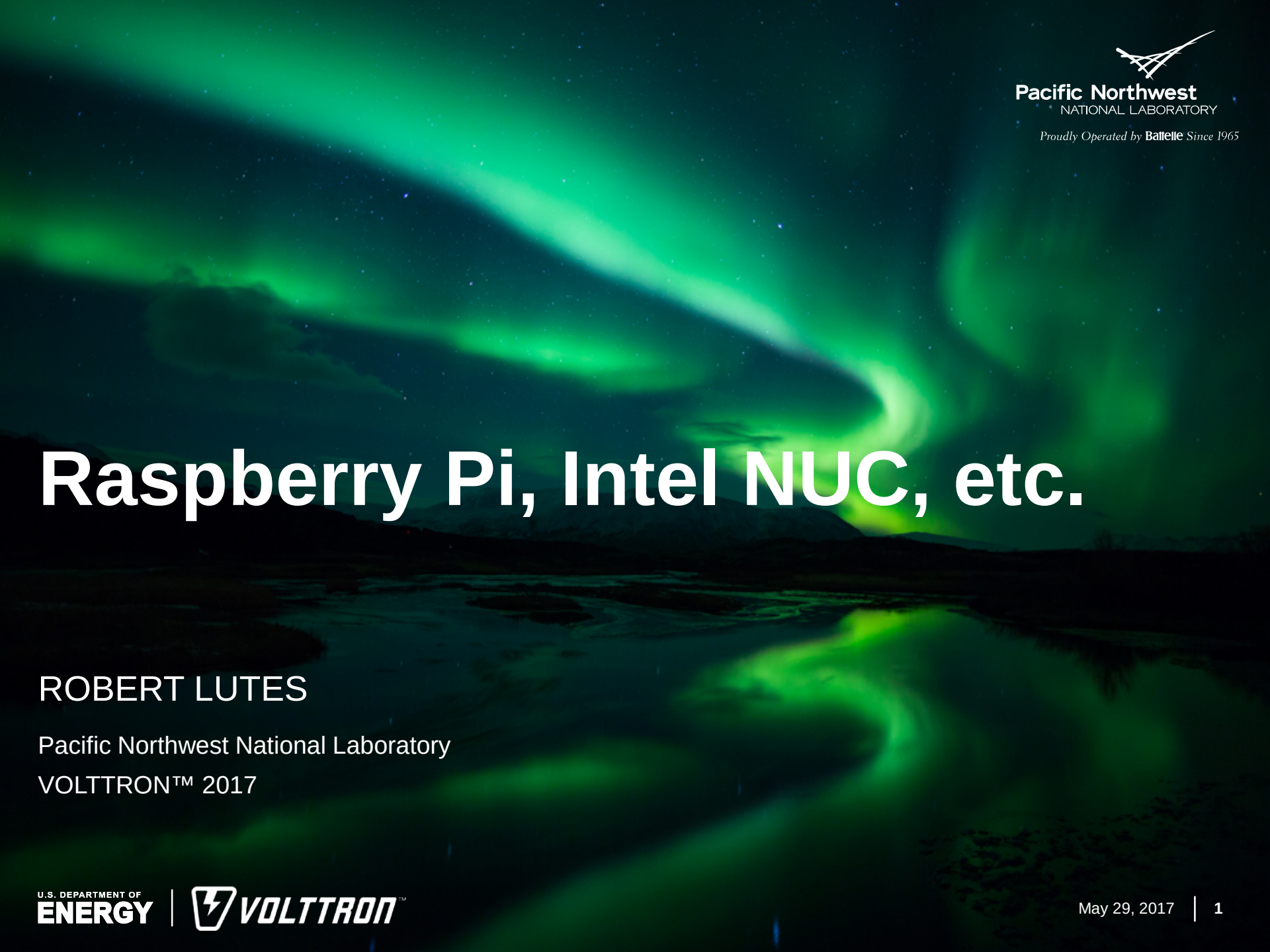

Pacific Northwest
NATIONAL LABORATORY
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Raspberry Pi, Intel NUC, etc.

ROBERT LUTES

Pacific Northwest National Laboratory

VOLTTRON™ 2017

VOLTTRON™ Hardware

Intel NUC

- CPU/GPU are Intel architecture so wide software support
- Models range in capabilities but typically higher power and cost than ARM devices (e.g., Raspberry Pi):
  - N3050 Celeron Dual Core with 4GB DDR2 RAM to I7 Quad Core with 16 GB RAM
  - $200 - $600
- NUCs are suitable for all deployments but are significantly more expensive than alternatives like the Raspberry PI:
  - Use as a server (VC managing multiple VOLTTRON nodes)
  - large deployment is usually

Raspberry Pi 3

- SoC: Broadcom BCM2837 (roughly 50% faster than the Pi 2)
- CPU: 1.2 GHZ quad-core ARM Cortex A53 (ARMv8 Instruction Set)
- GPU: Broadcom VideoCore IV @ 400 MHz.
- Memory: 1 GB LPDDR2-900 SDRAM.
- USB ports: 4
- Network: 10/100 MBPS Ethernet, 802.11n Wireless LAN, Bluetooth 4.0.

Kits including 2.5 A power supply, enclosure, and micro SD card ~ $75 dollars

ODROID-XU4

- CPU: Samsung Exynos5422 Cortex™-A15 2Ghz and Cortex™-A7 Octa core
- GPU: Mali-T628 MP6(OpenGL ES 3.1/2.0/1.1 and OpenCL 1.2 Full profile)
- Storage: eMMC5.0 HS400 Flash Storage
- Memory: 2GB LPDDR3 RAM PoP stacked
- USB ports: 2 x USB 3.0 Host, 1 x USB 2.0 Host
- Network: Gigabit Ethernet (no wifi)

Kits including 4 A power supply, enclosure, and eMMC ~ $95 dollars

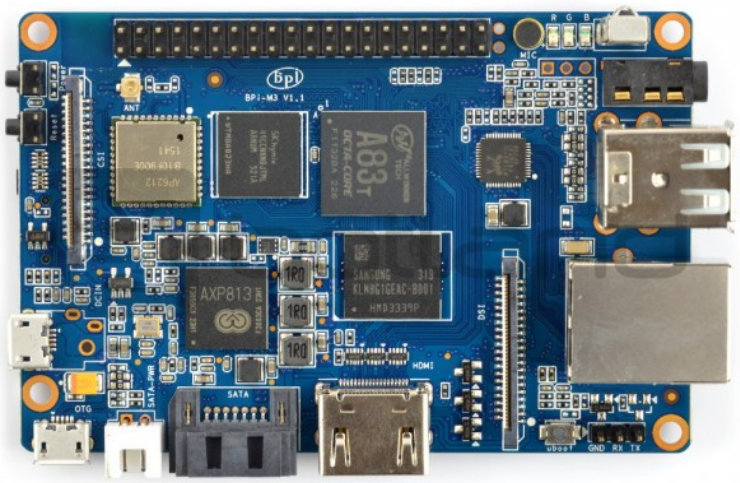
ODROID-C2

- SoC: Amlogic S905 SoC
- CPU: Amlogic ARM® Cortex®-A53(ARMv8) 1.5Ghz quad core CPUs
- GPU: Mali™-450 GPU (3 Pixel-processors + 2 Vertex shader processors)
- Storage: eMMC5.0 HS400 Flash Storage
- Memory: 2GB DDR3 SDRAM
- USB ports: USB 2.0 Host x 4
- Network: Gigabit Ethernet (no wifi)

Kits including 2 A power supply, enclosure, and eMMC ~ $75 dollars

ODROID-C2

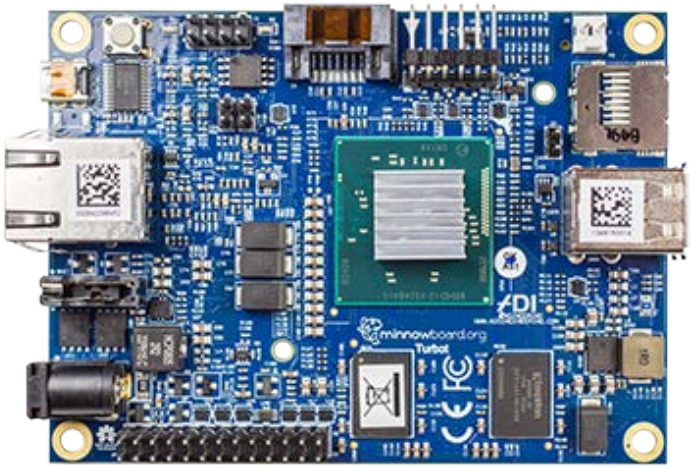
- CPU: A83T ARM Cortex-A7 octa-core
- GPU: PowerVR SGX544MP1· Comply with OpenGL ES 2.0, OpenCL 1.x
- Storage: MicroSD Card, SATA(up to 2TB USB-to-SATA; GL830), eMMC(8GB onboard)
- Memory: 2GB LPDDR3 (shared with GPU)
- USB ports: USB 2.0 Host x 2
- Network: 10/100/1000Mbps Ethernet (Realtek RTL8211E/D), 802.11 b/g/n (AP6212)



Including 2.5 A power supply, enclosure (using 8GB onboard eMMC) ~ $100

Intel MinnowBoard Turbot (Dual Core)

- CPU: Dual Core Intel Atom® Processor E3826 (2 x 1.46 GHz, 1MB cache)
- GPU: Intel HD Graphics
- Storage: 1x SATA2, 1x MicroSD
- Memory: 2GB DDR3L 1067MT/s, on board
- USB ports: 1x USB 2.0 host, 1x USB 3.0 host
- Network: 1x 1Gb Ethernet RJ45



Kits including 2 A power supply, enclosure, and NO SD card ~ $175 dollars

Quad core CPU board $225

BeagleBone (White)

- CPU: Single core AM3358 ARM Cortex-A8 720MHz
- Storage: 1x MicroSD
- Memory: 256MB DDR2
- USB ports: 1x USB 2.0 host
- Network: 10/100 MB, RJ45

Kits including power and SD card ~ $90dollars

Message Bus Driver Performance

Machine	Device Count/Point Count	Average Time to Scrape and Publish (seconds)	Standard Deviation (seconds)	Historian	Driver
Raspberry Pi 3	500/6	3.43	0.211	None	Simulated
ODROID-C2	500/6	3.32	0.147	None	Simulated
ODROID-XU4	500/6	1.88	0.022	None	Simulated
Banana Pi M8	500/6	3.44	0.068	None	Simulated
Intel Minnowboard Turbot	500/6	3.59	0.0637	None	Simulated
BeagleBone White	500/6	21.15	0.123	None	Simulated

Message Bus, Driver, Historian Performance

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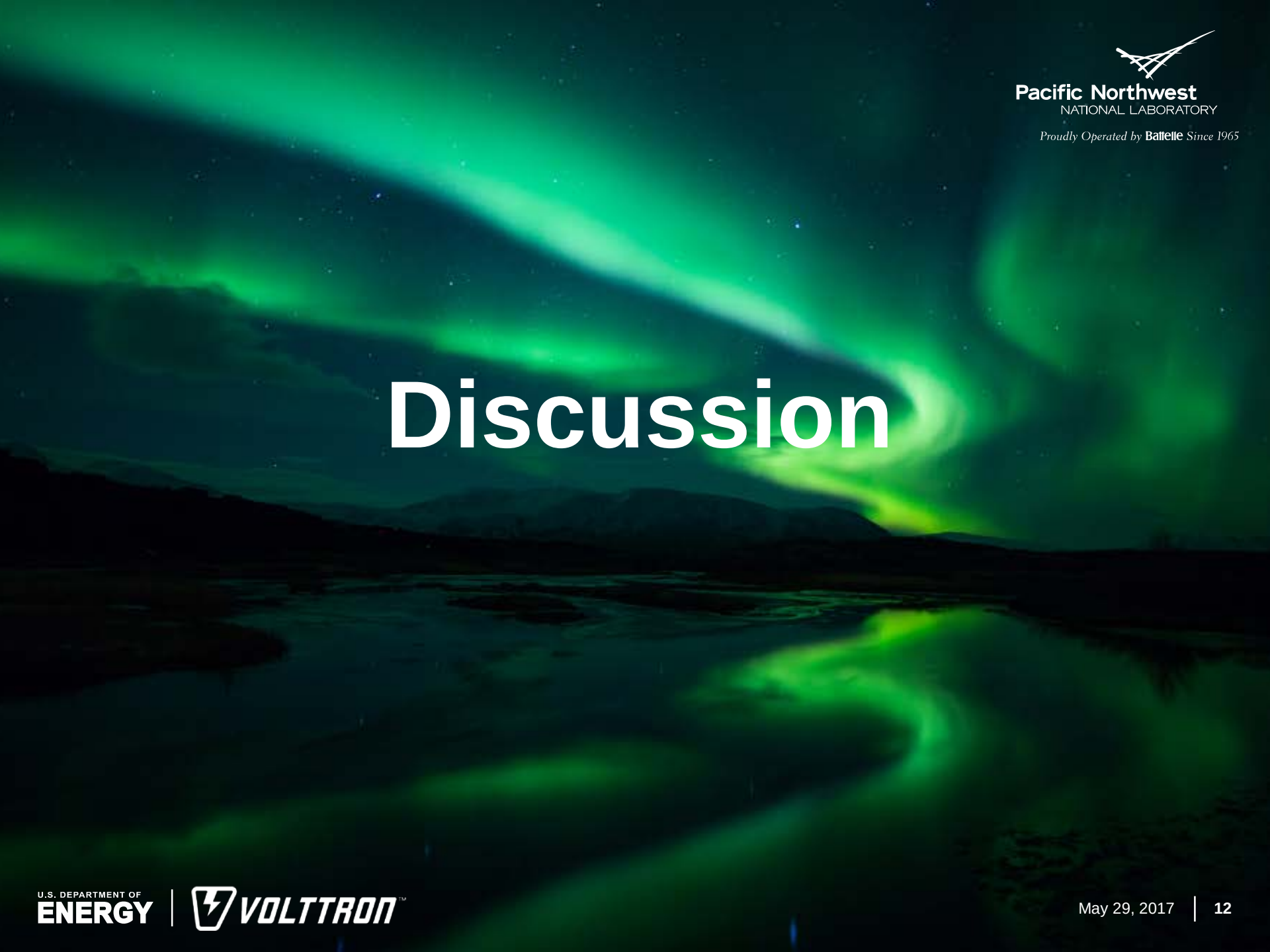
Machine	Device Count/Point Count	Average Time to Scrape and Publish	Standard Deviation	Historian	Driver
Raspberry Pi 3	500/6	5.67	0.188	NULL	Simulated
ODROID-C2	500/6	5.78	0.145	NULL	Simulated
ODROID-XU4	500/6	2.92	0.041	NULL	Simulated
Banana Pi M8	500/6	5.75	0.099	NULL	Simulated
Intel Minnowboard Turbot	500/6	6.03	0.301	NULL	Simulated
BeagleBoneWhite	500/6	26.34	0.468	NULL	Simulated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Discussion
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ENERGY
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