IETF Forming a Working Group for Energy-Efficient Networking

Empowering Sustainability: Energy Efficiency and Circular Design in ICT

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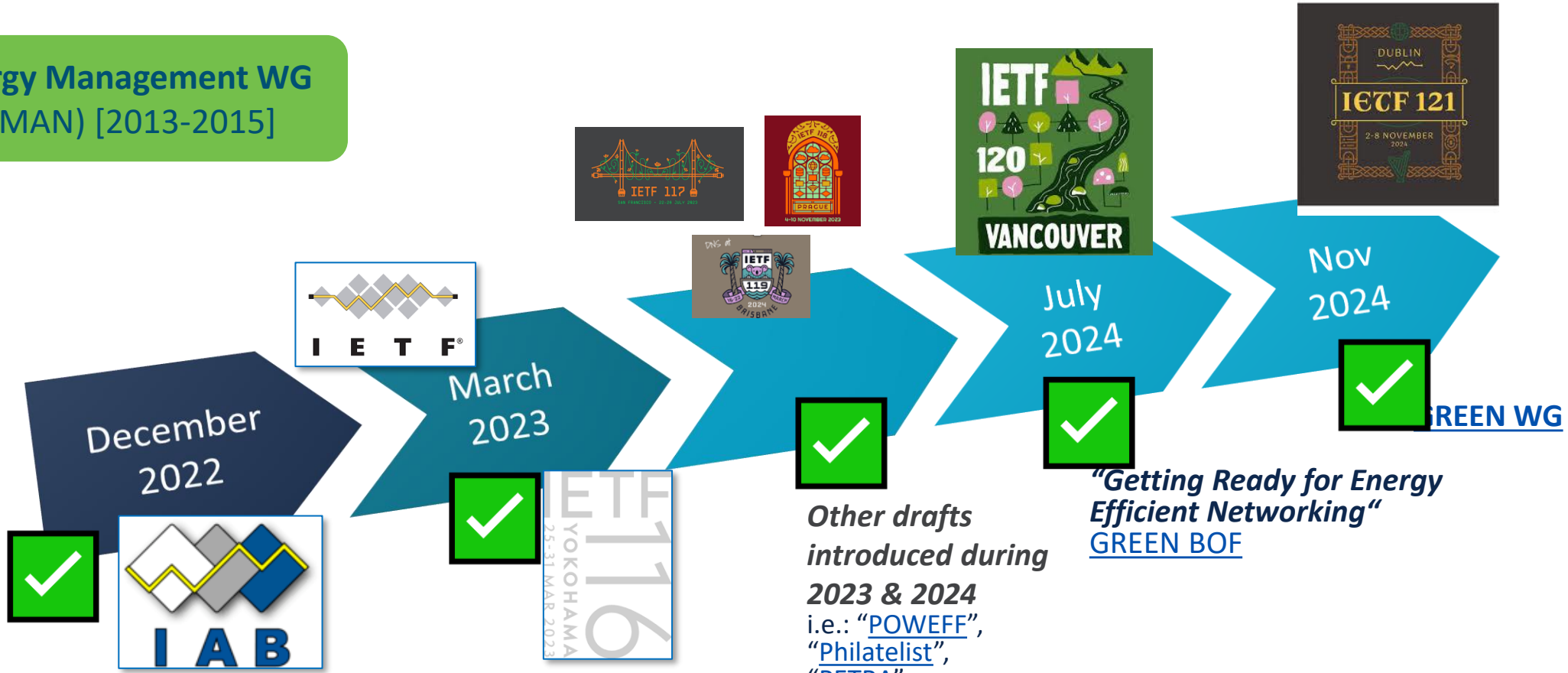
Dec 11th, 2024

Sustainability @IETF

Energy Management WG
(EMAN) [2013-2015]



Program "Environmental Impacts of Internet Technology (e-impact)"

"Sustainability Insights"
Draft

Other drafts introduced during 2023 & 2024
i.e.: "POWEFF", "Philatelist", "PETRA", ...

"Getting Ready for Energy Efficient Networking"
GREEN BOF

GREEN WG

Getting Ready for Energy-Efficient Networking (GREEN) Working Group in IETF

The group creation was approved by the IESG and held its first meeting in November 2024, in Dublin, during IETF 121.

The GREEN WG is chartered to explore use cases, derive requirements, and provide solutions for identifying and characterizing energy efficiency metrics, methods related to energy consumption of network devices, and optimizing energy efficiency across the network. The WG is committed to focus initially on the following deliverables:

- Informational document(s) that (1) defines common terminology and metric definitions, (2) categorizes various types of metrics and measurements at component, device, and network levels.
- Definitions of YANG data models at the component level, device level, and network level for energy-efficient network management including energy usage monitoring and energy consumption management.
- Informational document(s) that (1) defines a set of architectural components for managing energy-efficient networks and (2) describes incremental deployment considerations for new energy efficiency metrics monitoring and capability discovery, and management within a network domain.

The GREEN WG would welcome the opportunity of collaborating with related initiatives on benchmarking methodologies related to power management. As in all IETF WGs, participation is totally open, mainly via the WG list (green@ietf.org) that can be joined via https://mailman3.ietf.org/mailman3/lists/green.ietf.org/.

GREEN WG charter Documents(*)

1. Requirements
   * draft-stephan-green-ucs-and-reqs
2. Terminology
   * draft-bclp-green-terminology
   * draft-pignataro-green-enviro-sust-terminology
3. Metrics
   * draft-bogdanovic-green-energy-metrics
   * draft-cx-green-green-metrics
   * draft-opsawg-poweff
4. Models (Reporting and optimizations, different architectures)
   * draft-li-green-power
   * draft-cwbgp-green-energy-saving-management
   * draft-xiong-green-host-power-monitoring-yang
   * draft-petra-green-api
5. Framework
   * draft-lindblad-tlm-philatelist

(*) https://datatracker.ietf.org/wg/green/documents/

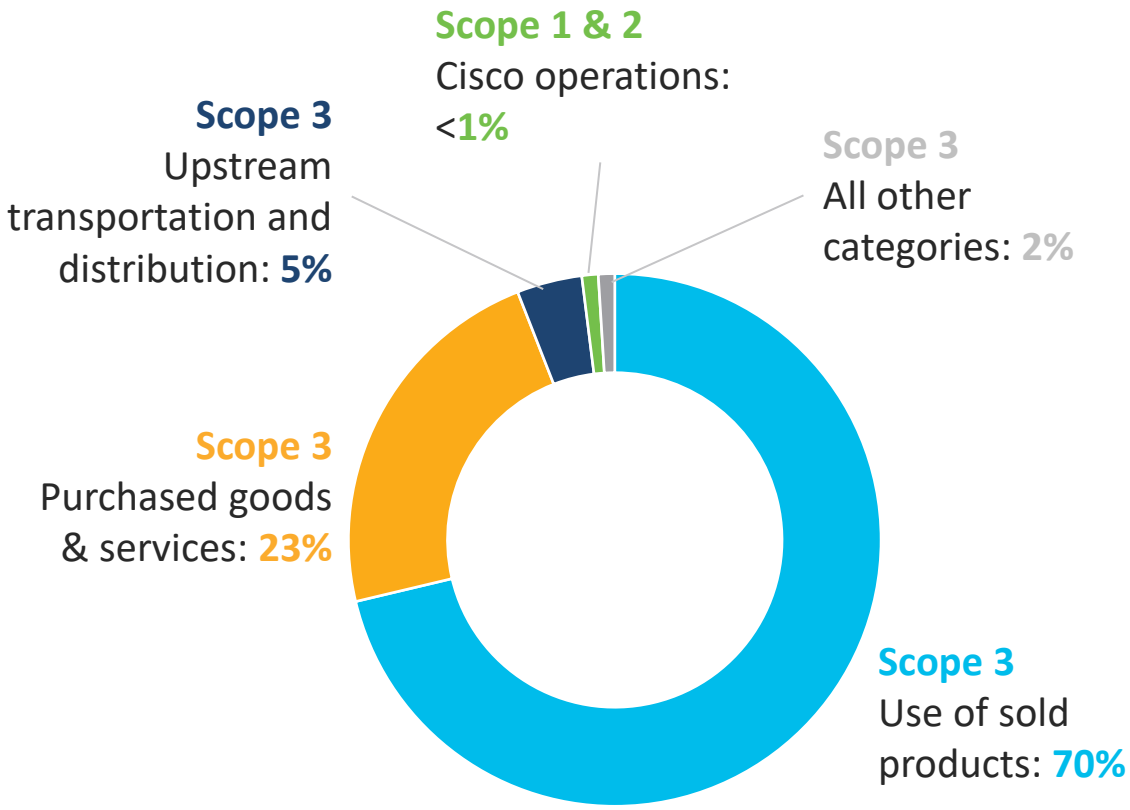
Cisco's Goal

Net zero GHG emissions across our value chain by 2040

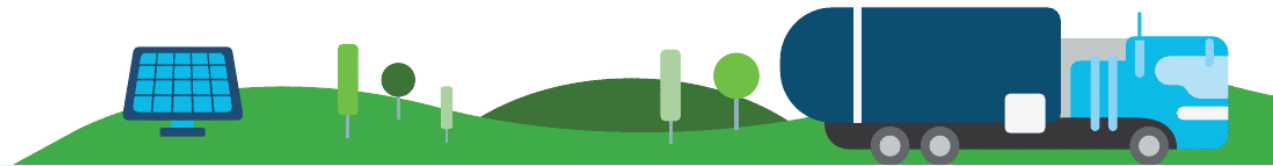
Our 2040 net-zero goals and near-term targets are approved by the Science Based Targets initiative (SBTi).

SCIENCE BASED TARGETS

DRIVING AMBITIOUS CORPORATE CLIMATE ACTION

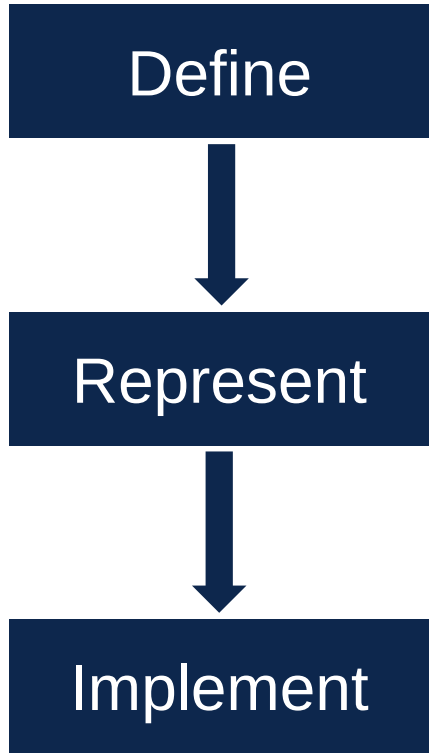


Source: Cisco's Fiscal Year 2023 ("FY 23") Scope 1, 2, and 3 GHG emissions



Metrics vs Data Models vs Implementation

- Metrics
  - What are the metrics that matter?
    for control loops, to assess and compare effectiveness
- Data Models
  - How do we represent and organize metrics
  - How to relate them to different entities
- Implementation
  - How do we implement software to provide actual data instances
  - May involve internal instrumentation on a device,
    but also measurements & supporting protocols



Observability vs Monitoring

Monitoring

Track Performance	Metrics	Reactive	Identify performance bottlenecks and resource leaks

Observability

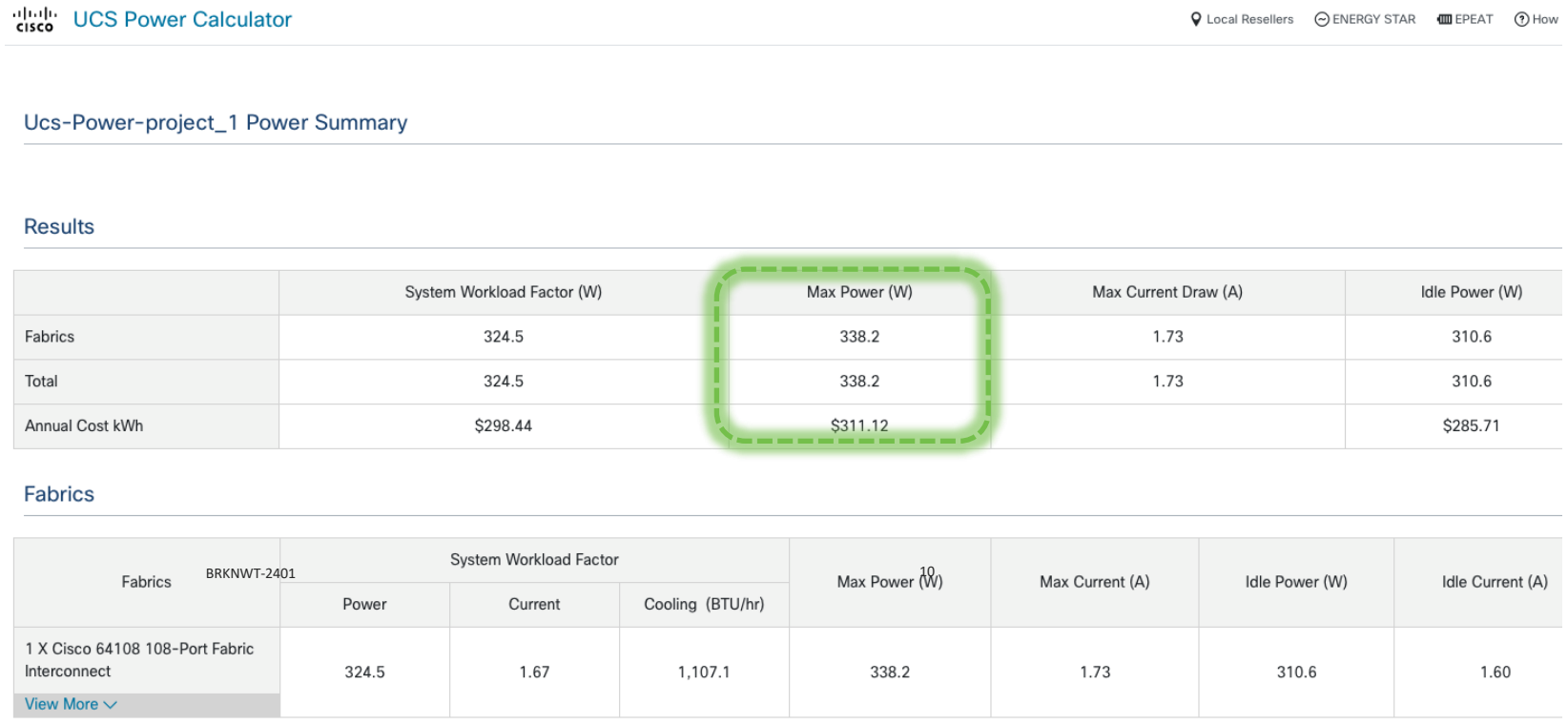
Understand the internal state of the system	Logs, Metrics and Traces	Proactive	Identify problems **BEFORE** they cause outages

Data Driven + Actionable

Estimated vs Measured

The “Estimated” energy consumption can be used for preliminary planning and setup.

Equally Important Metrics in the Context of **Planning** and Managing Usage



UCS Power Calculator

Local Resellers ENERGY STAR EPEAT How

Ucs-Power-project_1 Power Summary

Results

	System Workload Factor (W)	Max Power (W)	Max Current Draw (A)	Idle Power (W)
Fabrics	324.5	338.2	1.73	310.6
Total	324.5	338.2	1.73	310.6
Annual Cost kWh	$298.44	$311.12		$285.71

Fabrics

Fabrics	System Workload Factor			Max Power (W)	Max Current (A)	Idle Power (W)	Idle Current (A)
	Power	Current	Cooling (BTU/hr)				
1 X Cisco 64108 108-Port Fabric Interconnect	324.5	1.67	1,107.1	338.2	1.73	310.6	1.60
View More							

https://ucspowercalculator.cisco.com/finalResults
http://tools.cisco.com/cpc/launch.jsp

Estimated vs Measured

"Real-Time" measurements help in adjusting plans and making more accurate predictions for the future.

Equally Important Metrics in the Context of Planning and Managing Usage

```
9300-1#show environment all
Sensor List: Environmental Monitoring
 Sensor          Location        State           Reading          Range(min-max)
 PS1 Vout        1               GOOD            56313 mV         na
 PS1 Vin         1               GOOD            206500 mV        90 - 264
 PS1 CURin       1               GOOD            2000 mA          na
 PS1 Curout      1               GOOD            6250 mA          na
 PS1 POWin       1               GOOD            394000 mW        na
 PS1 POWout      1               GOOD            352000 mW        na
 PS1 FAN         1               GOOD            4864 rpm         na
```

Problem Statement

What are we measuring exactly?

- Metadata
- Accept diverse type of data: SNMP, CLI, JSON, ...
- New metrics that "sustainability" brings:

CO2eq: GHG Emissions, Carbon Intensity

Circularity: e-Waste management, transport, end of life, packaging, manufacturing...

From Optimization to ML/AI approach:

- Organized data in a way that improves current methods and protocols
- It requires a solid data baseline to produce the right insights

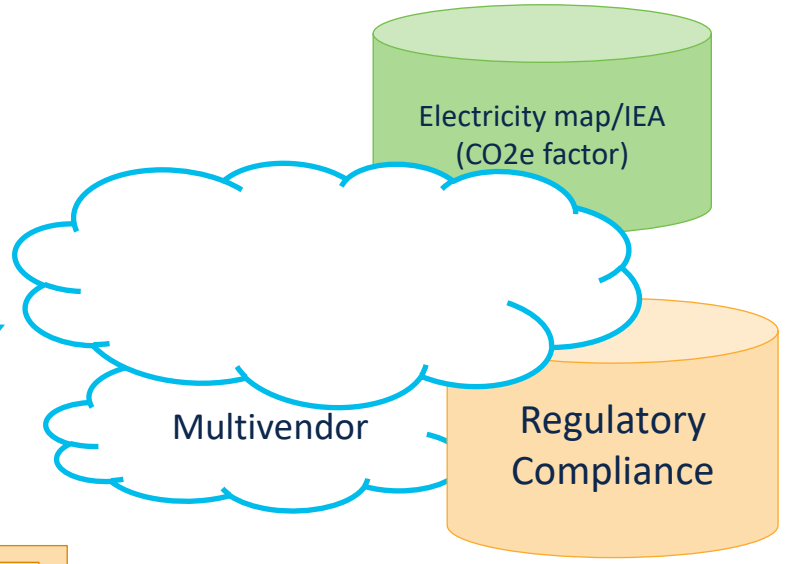
Energy Consumption through Telemetry Data

Metric

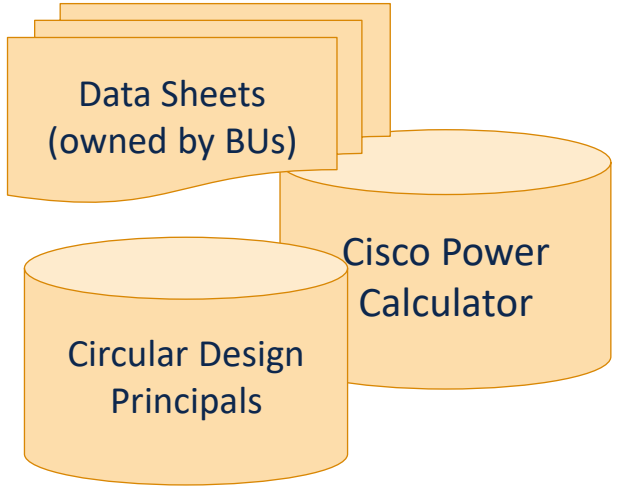
Characterized by Inconsistency and Best Effort

"Telemetry" is defined for most of the platforms in different forms:
Show commands, MIBs, YANG modules, ...
different transport mechanisms:
SNMP, RESTConf, NetConf, ...

Business bring us to new needs for Telemetry

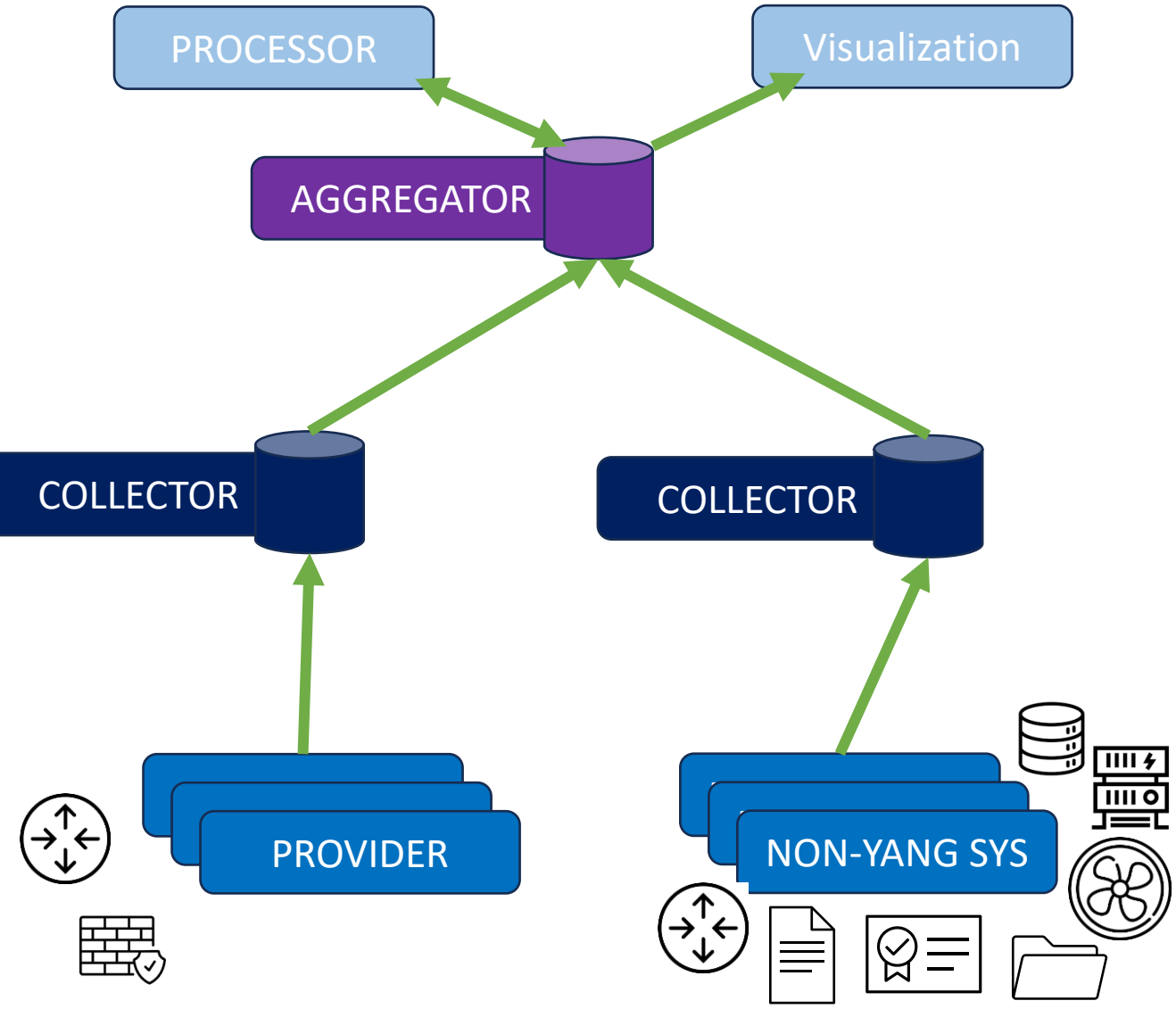



```
router#show energy-efficiency
   Input Power(watts):      1100
   Used Power(watts):       900
   CO2e(gr):                X
   Traffic(watts/packts):   X
   Energy Efficiency:       81%
```



Source:
https://app.electricitymaps.com/map
https://www.iea.org/

“Sustainability Insights” Framework



Data Normalization

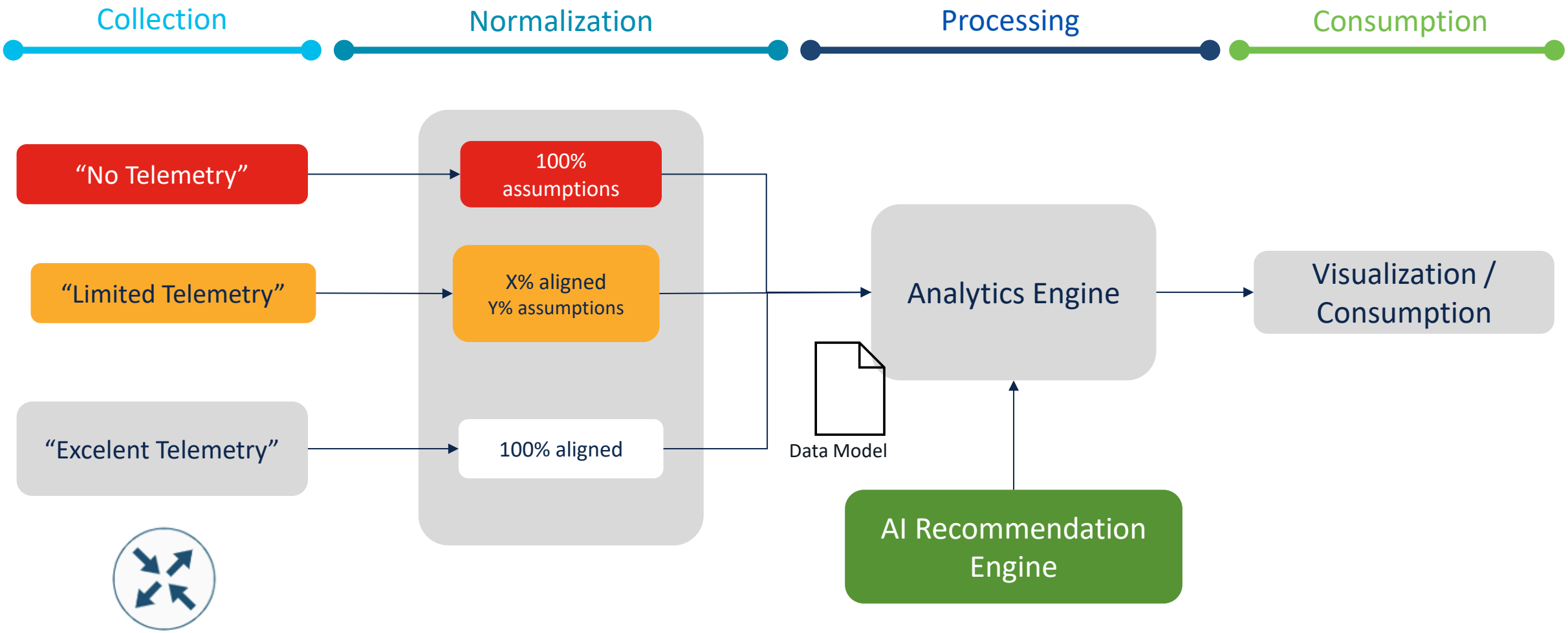
- Where? @Provider level?

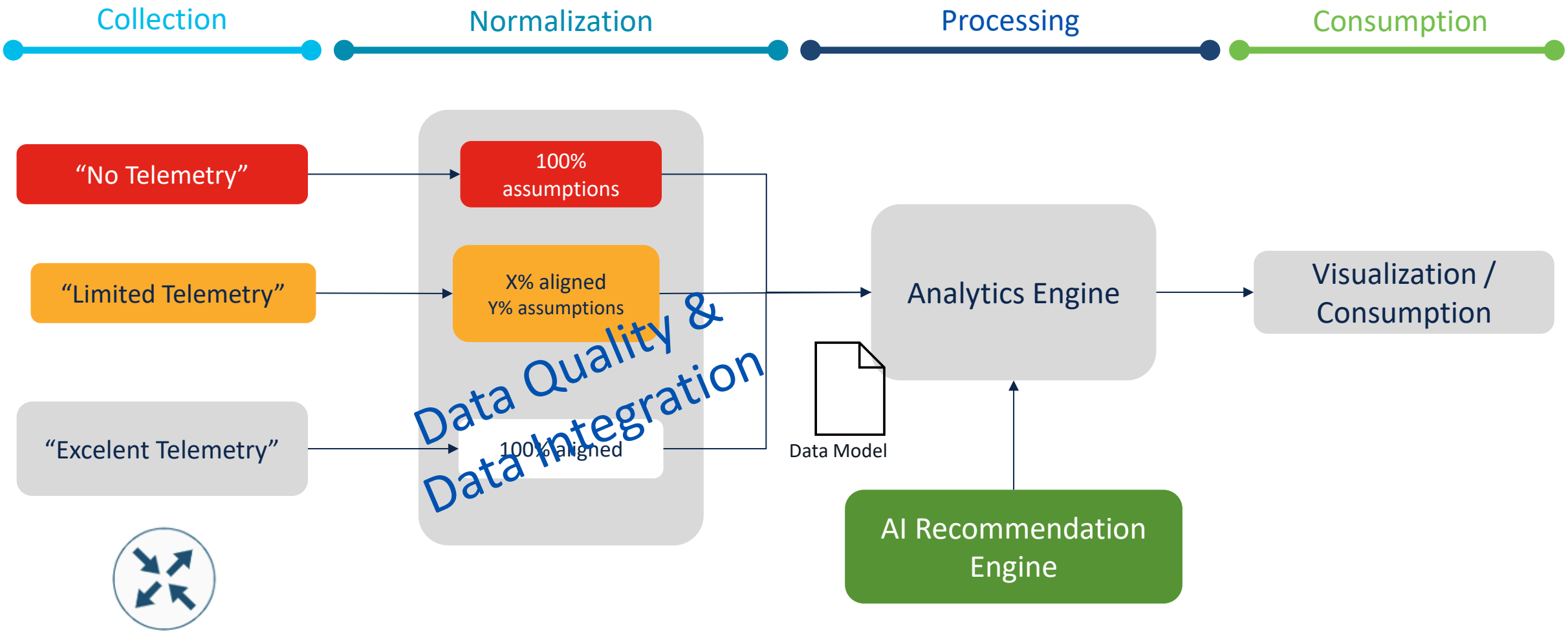
Circularity

- If automation, digitization, scale, optimization => YANG or any other language defining semantic is required

Optimization

- Reduce CO2eq emissions
- Reduce e-Waste
- Simulated vs Real metrics
- Cross Domain





Towards Structured Data, aka “parser” Function

```
JCOHOE-ASR1000#show inventory
NAME: "Chassis", DESCR: "Cisco ASR1001-HX Chassis"
PID: ASR1001-HX        , VID: V01  , SN: TKM20400035

NAME: "Power Supply Module 0", DESCR: "Cisco 750 Watt reverse-airflow AC power supply"
PID: ASR1KX-AC-750W-R  , VID: V01  , SN: ART203511ST

NAME: "Power Supply Module 1", DESCR: "Cisco 750 Watt reverse-airflow AC power supply"
PID: ASR1KX-AC-750W-R  , VID: V01  , SN: ART203511SN

NAME: "Fan Tray", DESCR: "Cisco ASR1001-HX Fan Tray"
PID: ASR1001HX-FAN     , VID:      , SN:

NAME: "module 0", DESCR: "Cisco ASR1001-HX Modular Interface Processor"
PID: ASR1001-HX        , VID:      , SN:

NAME: "SPA subslot 0/0", DESCR: "8-port Built-in Gigabit Ethernet Port Adapter"
PID: BUILT-IN-EPA-8x1G , VID: N/A  , SN: JAE12345678

NAME: "subslot 0/0 transceiver 0", DESCR: "GE T"
PID: ABCU-5710RZ-CS5   , VID: B2   , SN: AGM203344NN

NAME: "subslot 0/0 transceiver 1", DESCR: "GE T"
PID: GLC-TE            , VID: V03  , SN: AVC24110008

NAME: "SPA subslot 0/1", DESCR: "8-port 10G/1G multirate Ethernet Port Adapter"
PID: BUILT-IN-8X10G/1G , VID: N/A  , SN: JAE87654321

NAME: "module R0", DESCR: "Cisco ASR1001-HX Route Processor"
PID: ASR1001-HX        , VID: V01  , SN: JAE2045047E

NAME: "module F0", DESCR: "Cisco ASR1001-HX Embedded Services Processor"
PID: ASR1001-HX        , VID:      , SN:
```

Structured Data example: Table format

```
JCOHOE-ASR1000#show location geo-location static
Geo location information
------------------------
Identifier  : host
Latitude    : 40.416775
Longitude   : 37.116775
------------------------
Identifier  : JCOHOE-ASR1000
------------------------
```

```
JCOHOE-ASR1000#show environment

Number of Critical alarms:  0
Number of Major alarms:     0
Number of Minor alarms:     0

 Slot        Sensor          Current State   Reading       Threshold(Minor,Major,Critical,Shutdown)
 ----------  --------------  --------------- ------------  ----------BRKNWT-2401----------
 P0          Vin             Normal          112   V AC    na
 P0          Iin             Normal          1     A       na
 P0          Vout            Normal          12    V DC    na
 P0          Iout            Normal          9     A       na
 P0          Temp1           Normal          43    Celsius (na ,na ,na ,na )(Celsius)
 P0          Temp2           Normal          51    Celsius (na ,na ,na ,na )(Celsius)
 P0          Temp3           Normal          50    Celsius (na ,na ,na ,na )(Celsius)
 P1          Vin             Normal          112   V AC    na
 P1          Iin             Normal          1     A       na
 P1          Vout            Normal          12    V DC    na
 P1          Iout            Normal          10    A       na
 P1          Temp1           Normal          43    Celsius (na ,na ,na ,na )(Celsius)
 P1          Temp2           Normal          55    Celsius (na ,na ,na ,na )(Celsius)
 P1          Temp3           Normal          54    Celsius (na ,na ,na ,na )(Celsius)
 R0          VRRX1: VX1      Normal          1006  mV      na
 R0          VRRX1: VX2      Normal          6867  mV      na
 R0          VRRX1: VX3      Normal          758   mV      na
 R0          VRRX1: VX4      Normal          1050  mV      na
 R0          VRRX1: VX5      Normal          816   mV      na
 R0          VRRX1: VP1      Normal          1794  mV      na
 R0          VRRX1: VP2      Normal          1517  mV      na
 R0          VRRX1: VP3      Normal          1505  mV      na
```

Structured, Unstructured & Semi-Structured Data Change Your Data Analytics Practice

Schema Definition	CLI	YANG - JSON
Serial Number	SN	serial-number
Geo Location	Geo Location information	install-location
Sensor Location	Slot	sensor-location

Structured Data (CLI based example)	
Serial Number	TKM20400035
Geo Location: Latitude	40.416775
Geo Location: Longitude	37.116775
Sensor Location*	P0

Schema Definition + Representation (Table/JSON)

Towards Structured Data, aka “parser” Function

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PID: ASR1001-HX        , VID:      , SN:
```

Structured Data

+

Mapping to YANG Data Model implemented in JSON

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 R0          VRRX1: VP2      Normal          1517  mV      na
 R0          VRRX1: VP3      Normal          1505  mV      na
```
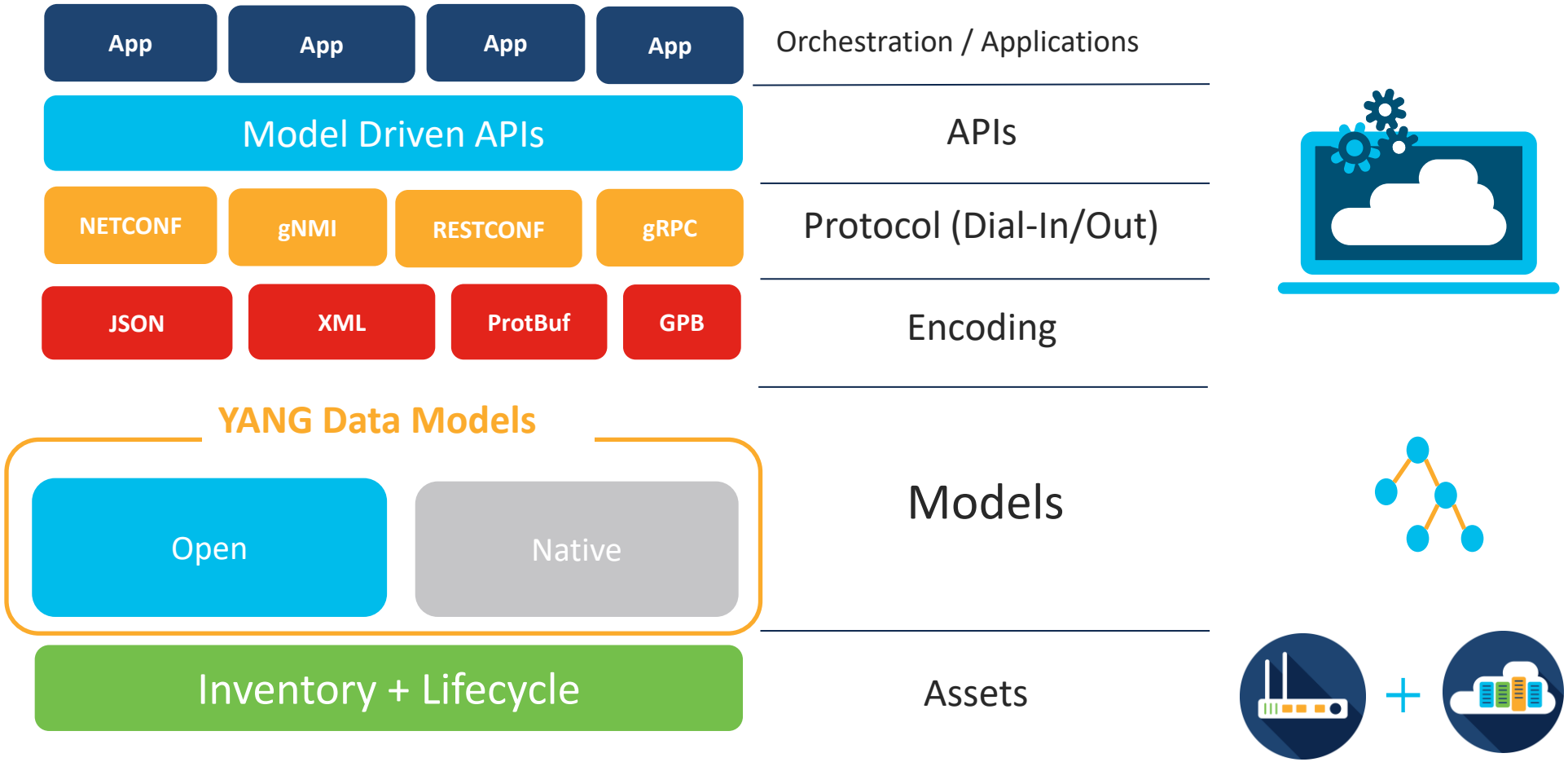



```
"ietf-lmo:lmos": {
"lmo": [
{
"lmo-class": "ietf-lmo-asset:asset",
"inst": [
{
"id": "ASR1001-HX",
"ietf-lmo-assets-inventory:vendor": "cisco",
"ietf-susi-power-static:power-static": {
}
},
{
"id": "JCOHOE-ASR1000",
"ietf-lmo-assets-inventory:description": "Cisco ASR1001-HX Chassis",
"ietf-lmo-assets-inventory:serial-number": "TKM20400035",
"ietf-lmo-assets-inventory:entity-name": "chassis",
"ietf-lmo-assets-inventory:install-location": {
"geo-location": {
"latitude": "40.416775",
"longitude": "37.116775"
}
},
"ietf-susi-power-environment:sensors": {
"sensor": [
{
"sensor-name": "Iin",
"sensor-location": "P0",
"sensor-state": "Normal",
"sensor-current-reading": "1",
"sensor-units": "amperes"
},
{
"sensor-name": "Vin",
"sensor-location": "P0",
"sensor-state": "Normal",
"sensor-current-reading": "108",
"sensor-units": "volts-ac"
}
]
},
```

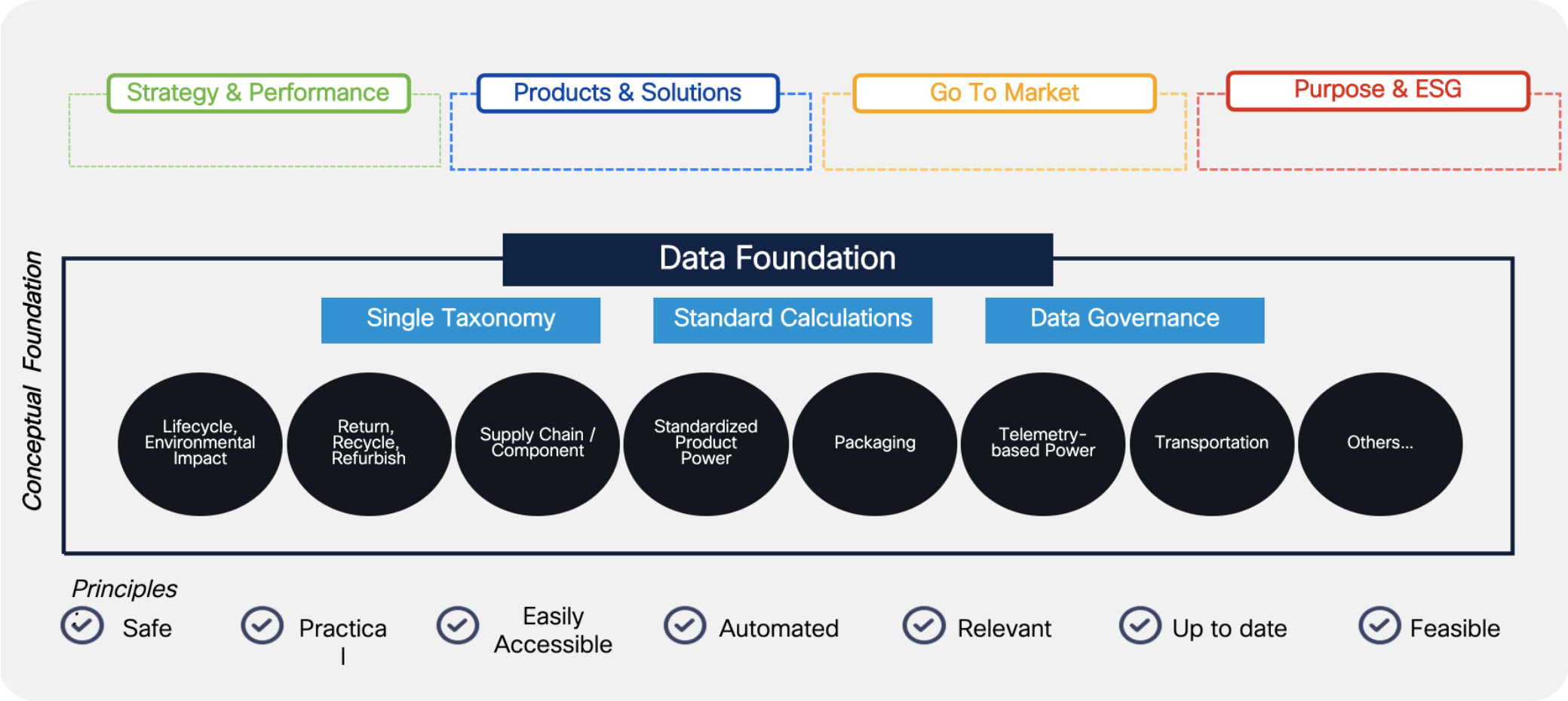
Data Model Driven Telemetry with YANG



YANG Data Models are the foundation of automation Structured, Well-Defined, Programmable Network API

Cisco Data Strategy

Sustainability Data Foundation (SDF)

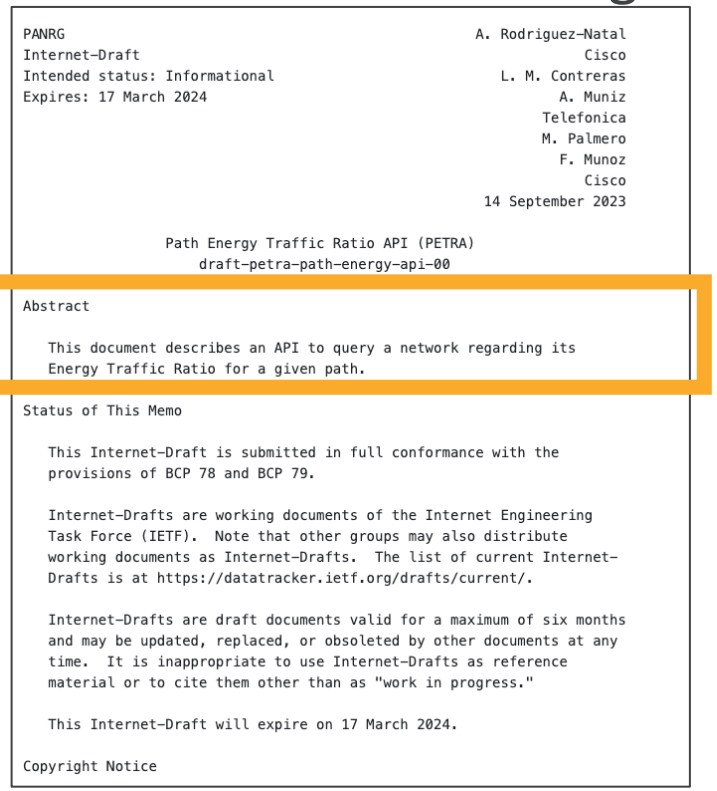


From Device to Service Level

- “Service Carbon Footprint”

  Example: on a Cloud Service, “Carbon Footprint” per tenant

- “Decarbonization Level Agreement” as offering to customers



PANRG
Internet-Draft
Intended status: Informational
Expires: 17 March 2024

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Cisco

14 September 2023

Path Energy Traffic Ratio API (PETRA)
draft-petra-path-energy-api-00

Abstract

This document describes an API to query a network regarding its Energy Traffic Ratio for a given path.

Status of This Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

Internet-Drafts are working documents of the Internet Engineering Task Force (IETF). Note that other groups may also distribute working documents as Internet-Drafts. The list of current Internet-Drafts is at https://datatracker.ietf.org/drafts/current/.

Internet-Drafts are draft documents valid for a maximum of six months and may be updated, replaced, or obsoleted by other documents at any time. It is inappropriate to use Internet-Drafts as reference material or to cite them other than as "work in progress."

This Internet-Draft will expire on 17 March 2024.

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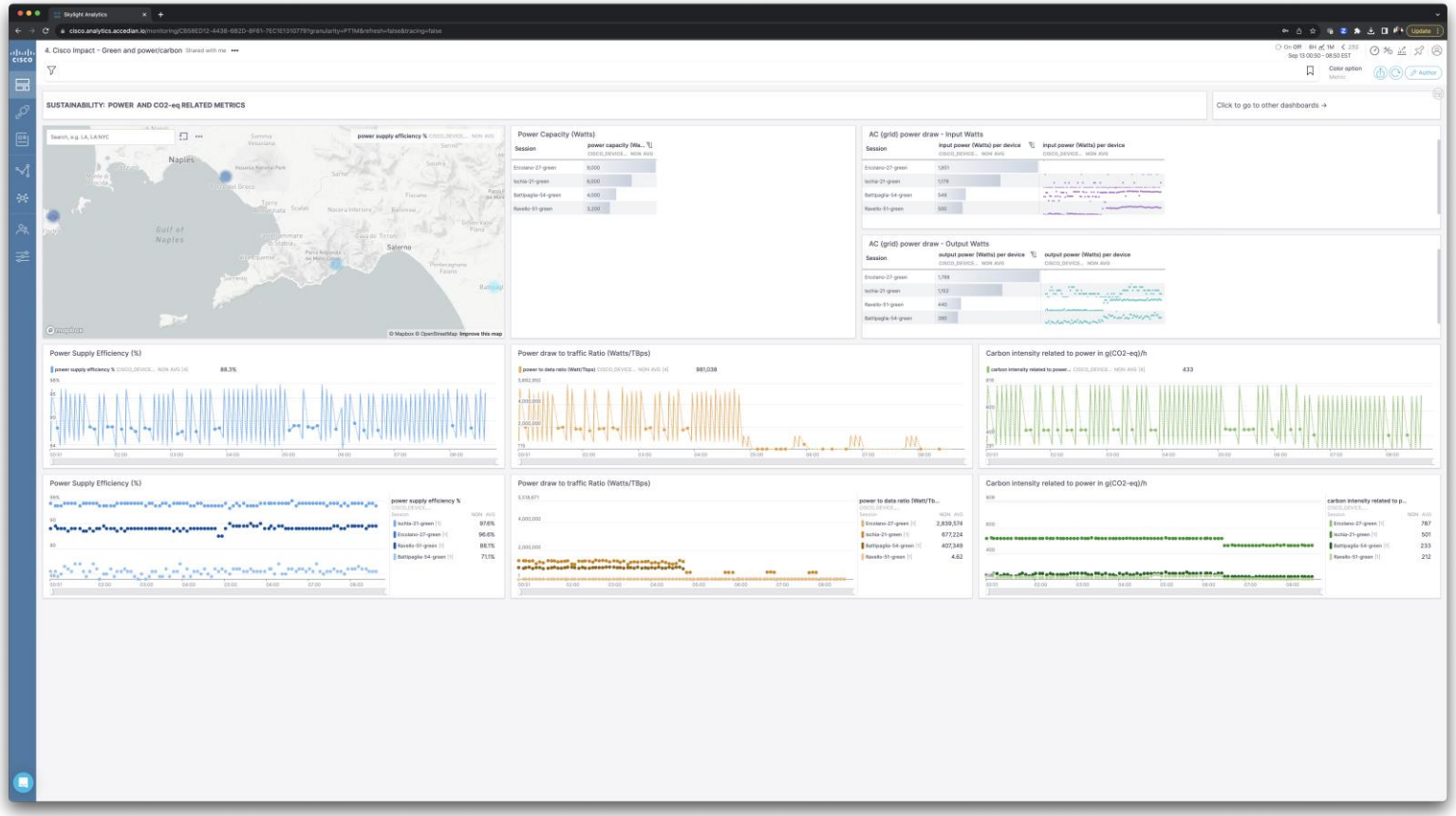
It needs Investment & Research

Green Path: End-to-End Service KPI Insights

Network Transport, from Planning to Carbon Optimized Routing

- Visibility of the power/carbon footprint of services over time
- Derive greater insights from the combination with other performance assurance metrics
- Make this information available to customers in an end-customer portal
- Take well-informed optimization decisions to reduce power consumption and lower OpEx of services



Conclusion & Next Steps

- Shared material that has been prepared for the GREEN WG forming.
- Shared GREEN WG charter.
- The relevance of the Operations and Best Usage of the networking components and devices.

- IETF reuses terminology already developed by ITU/ETSI.

Ask: Time to review our documents for new terminology and metrics that we need to develop and try to incorporate them in ITU/ETSI practices.

“The goal is to turn data into information, and information into insight.”

Carly Fiorina