

THINK GREEN! Energy Efficient Cloud for HPC

THINK GREEN, GO GREEN !

What is Energy Efficient Cloud ?

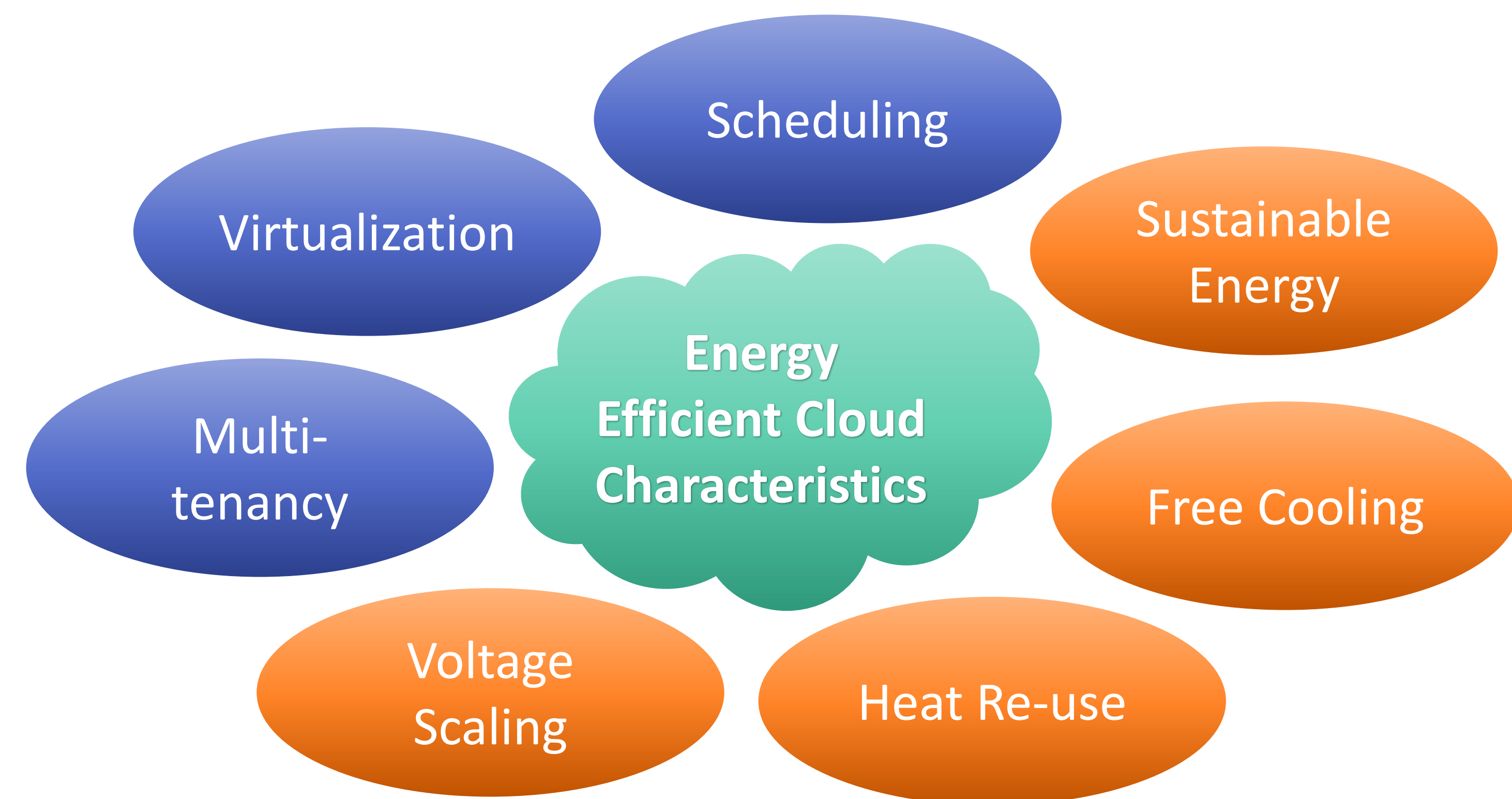
- ✓ Cloud infrastructure with emphasis on optimizing energy utilization.
- ✓ It is study and practice of designing, manufacturing and using digital devices in Cloud in a way that reduces energy consumption, thereby reducing impact on the environment.

Why is it recommended for Cloud HPC solutions ?

HPC products, services running heavy workloads in Cloud

consume high energy leading to

- ✓ Increasing carbon emissions and
- ✓ Could be costing a fortune.





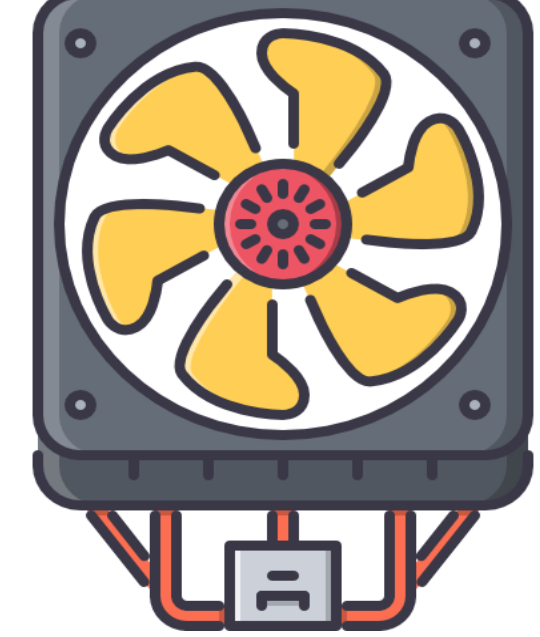

Advantages of Energy Efficient Cloud

- Cost-effective (pays over time)
- Reduced carbon emissions
- E-waste management
- Leads to centralization of information activities

Disadvantages of Energy Efficient Cloud

- High start-up cost
- Maintenance
- Adapting to frequent changes in technology may not be easy
- Not readily available at times

Approaches to Optimize Energy Utilization

Renewable Energy and Power Consumption <ul style="list-style-type: none"> ✓ Use renewable energy produced from natural resources such as wind, hydropower, or solar. ✓ Use of methods like Dynamic Voltage Scaling Frequency (DVFS) to reduce power consumption. 	Energy Efficient Processors and Storage <ul style="list-style-type: none"> ✓ Use of ENERGY STAR certified processors and storage equipment from vendors like IBM, Intel etc. ✓ Use of storage devices like RAID 5, SSDs, Tape storage when possible. 
Efficient Cooling system <ul style="list-style-type: none"> ✓ Tweaking cooling system in response to weather change. ✓ Use of efficient methods to reduce the waste generated by airflow. 	Server Virtualization and Scheduling Workloads <ul style="list-style-type: none"> ✓ Virtualization of servers to reduce footprint of physical servers. ✓ Workload across servers is allocated to a server as a function of their cost to operate. 
Monitoring/Metering <p>Tools to measure, monitor and reduce cloud carbon emissions. Open-source tools like Cloud Carbon Footprint can be used.</p>	

Case Study: UCAD Energy Efficient Data Centre Approach

University of Dakar (UCAD), Senegal followed several approaches

- Workload Diversification - Improved hardware utilization, to reduce power use.
- Usage of Solar PV Array -Integration of solar charge controller and batteries
- Usage of low power CPUs and servers.

Table showing 94 % less energy consumption with Energy Efficient Approaches

	Switch Gear	UPS	PDU	IT Gear	Zone AC	
Energy Efficient Data Centre	0.05	0.08	0.05	6	0.2	0.98 KW
Current Data Centre	0.1	0.5	0.9	9.8	4.5	15.7 KW

References:

- [1]. <https://ijesc.org/upload/7cdf6f6917828848f439dc14271e22a2.Advancing%20Towards%20a%20Better%20Future%20Green%20Cloud%20Computing.pdf>
- [2]. <https://www.ibm.com/ibm/environment/products/energystar.shtml>