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Demand Side Management

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IRRP
INTEGRATED RESOURCE AND RESILIENCE PLANS

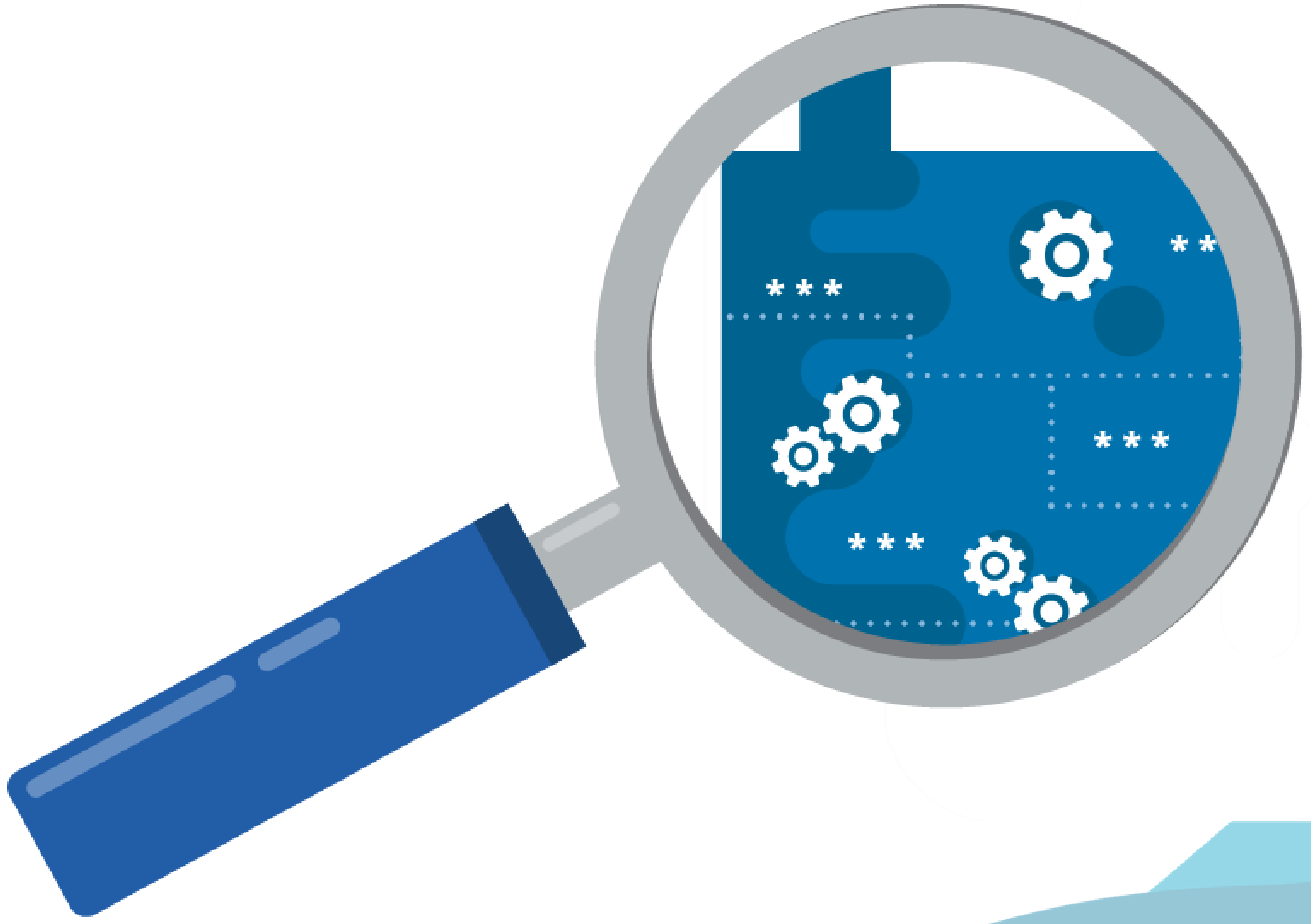
Presenters

Prof. Chandrabhan Sharma
Dept. Electrical and Computer
UWI, St. Augustine

Dr. Sanjay Bahadoorsingh
Dept. Electrical and Computer
UWI, St. Augustine

Overview

- Introduction
- Evolution of DSM Technology
- Challenges
- DSM – Global and Region
- Conclusions

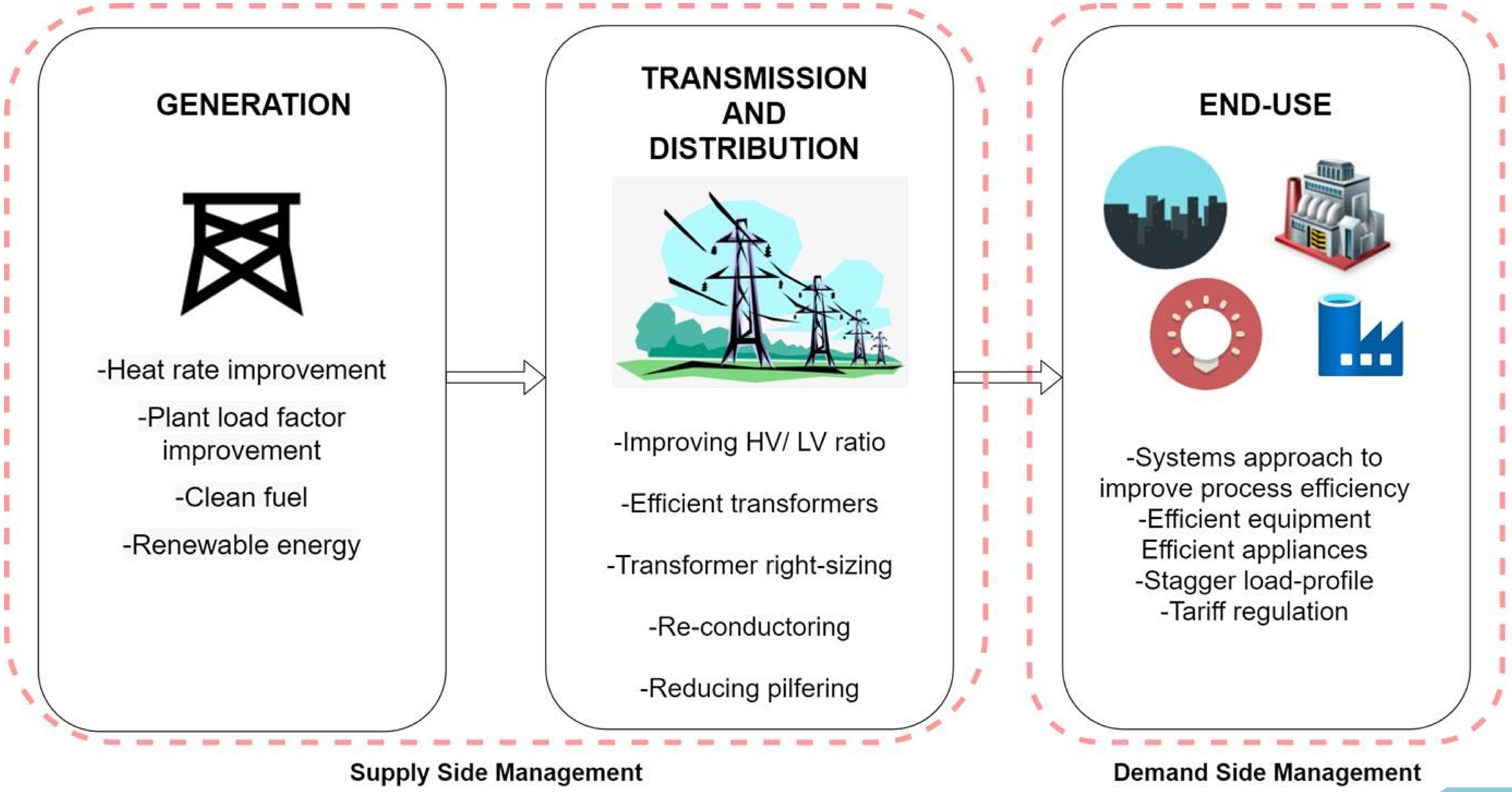


Introduction

Definition

Demand Side Management (DSM) refers to a group of actions/activities/programs to influence modification of the consumer’s demand for energy.

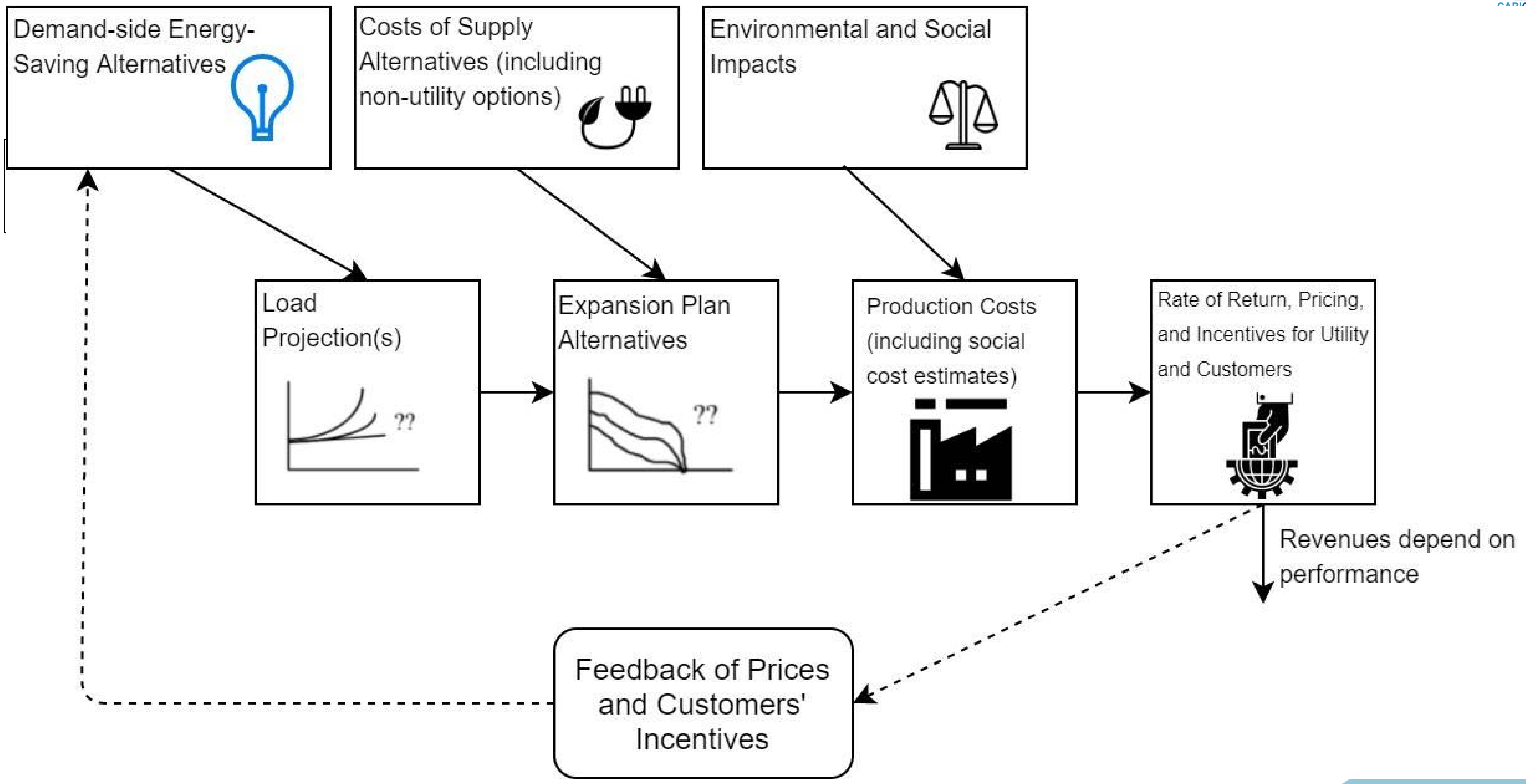
Supply Side Management vs DSM



Introductory Video

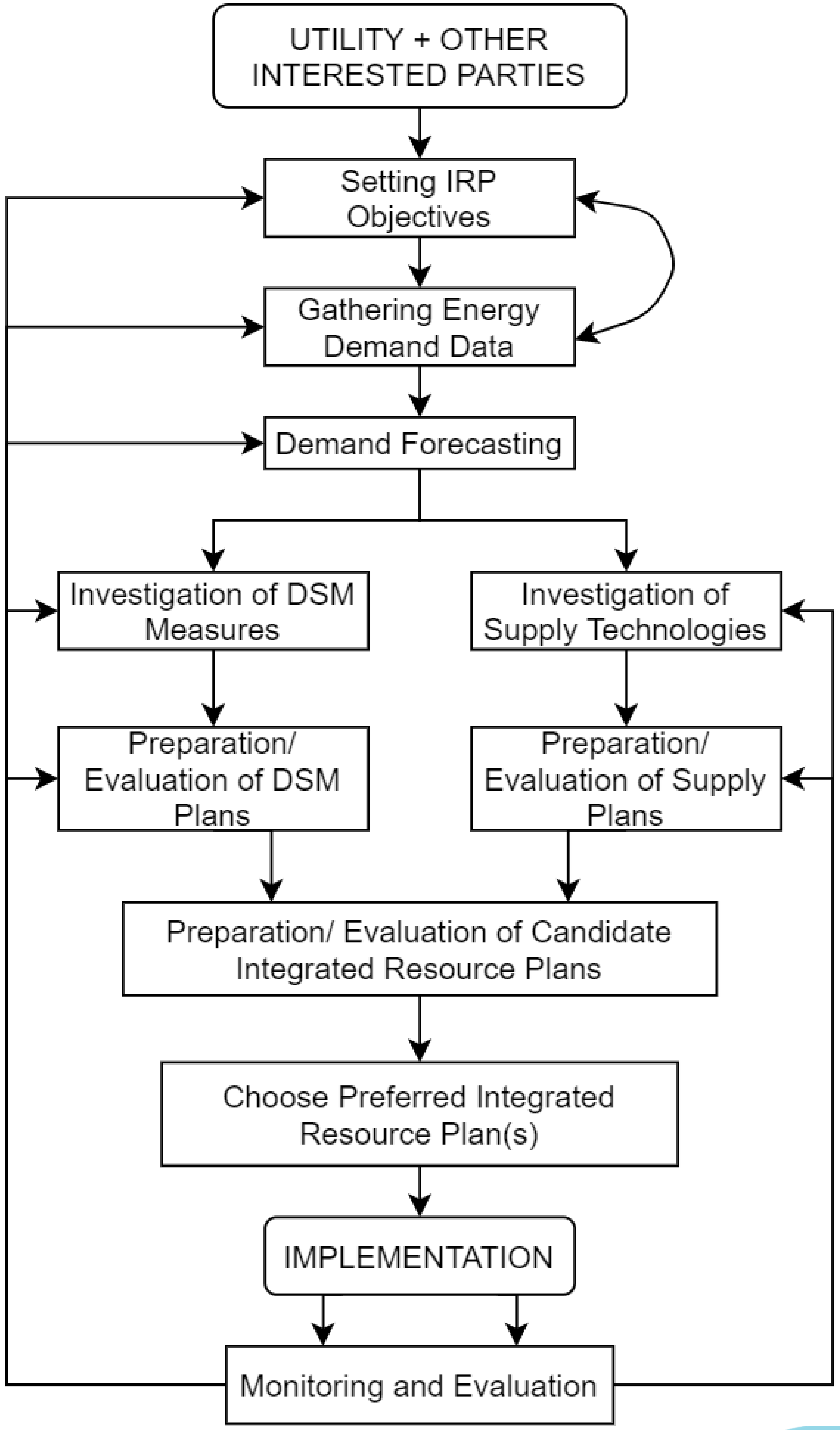
Demand Side Management: The role of Electricity Utilities in India’s low carbon development,TERI, 2018
http://www.youtube.com/watch?v=RgGAMLRUH0E

DSM in the IRRP Process



Adapted from UNEP Collaborating Centre on Energy and Environment

How DSM fits into the bigger picture?

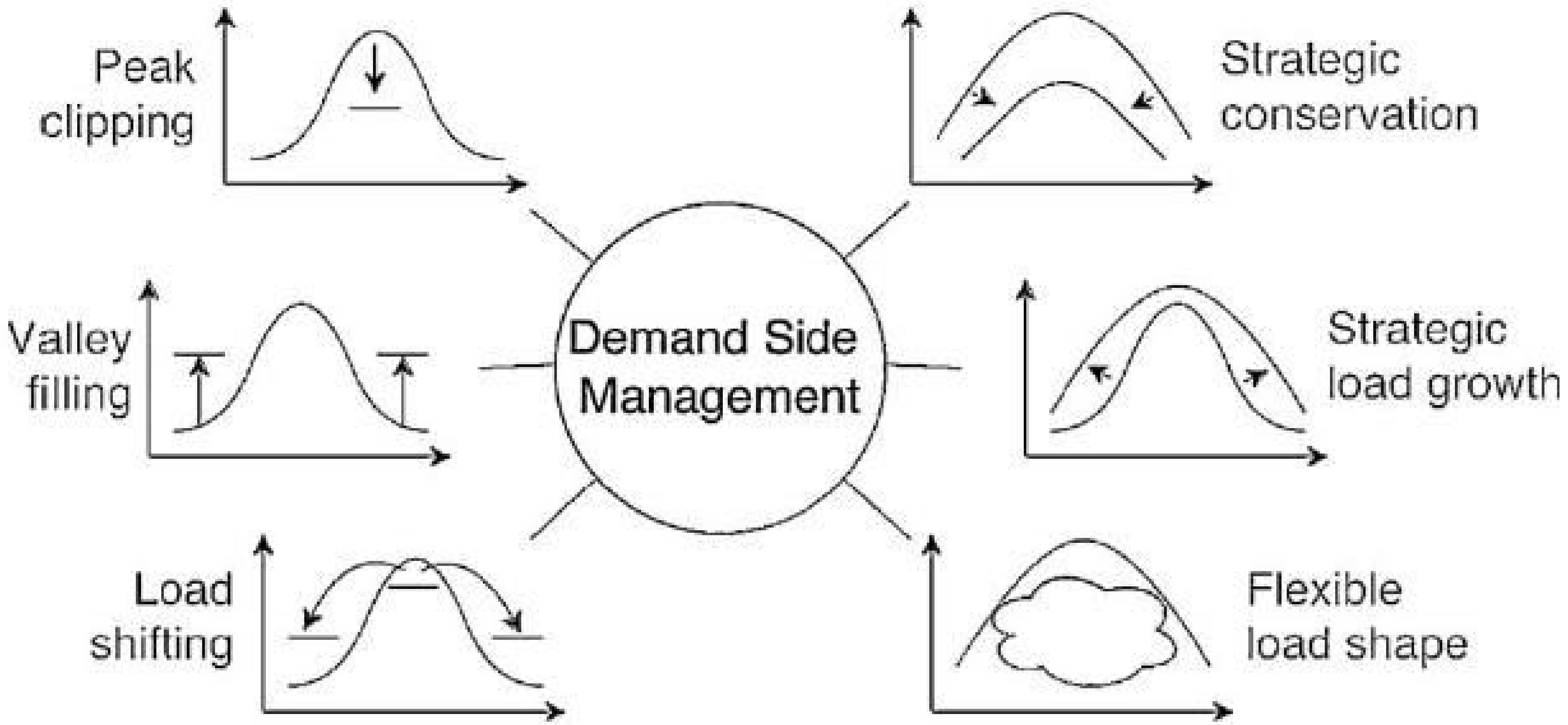


International Rivers 2013: An introduction to integrated resource planning

DSM Benefits

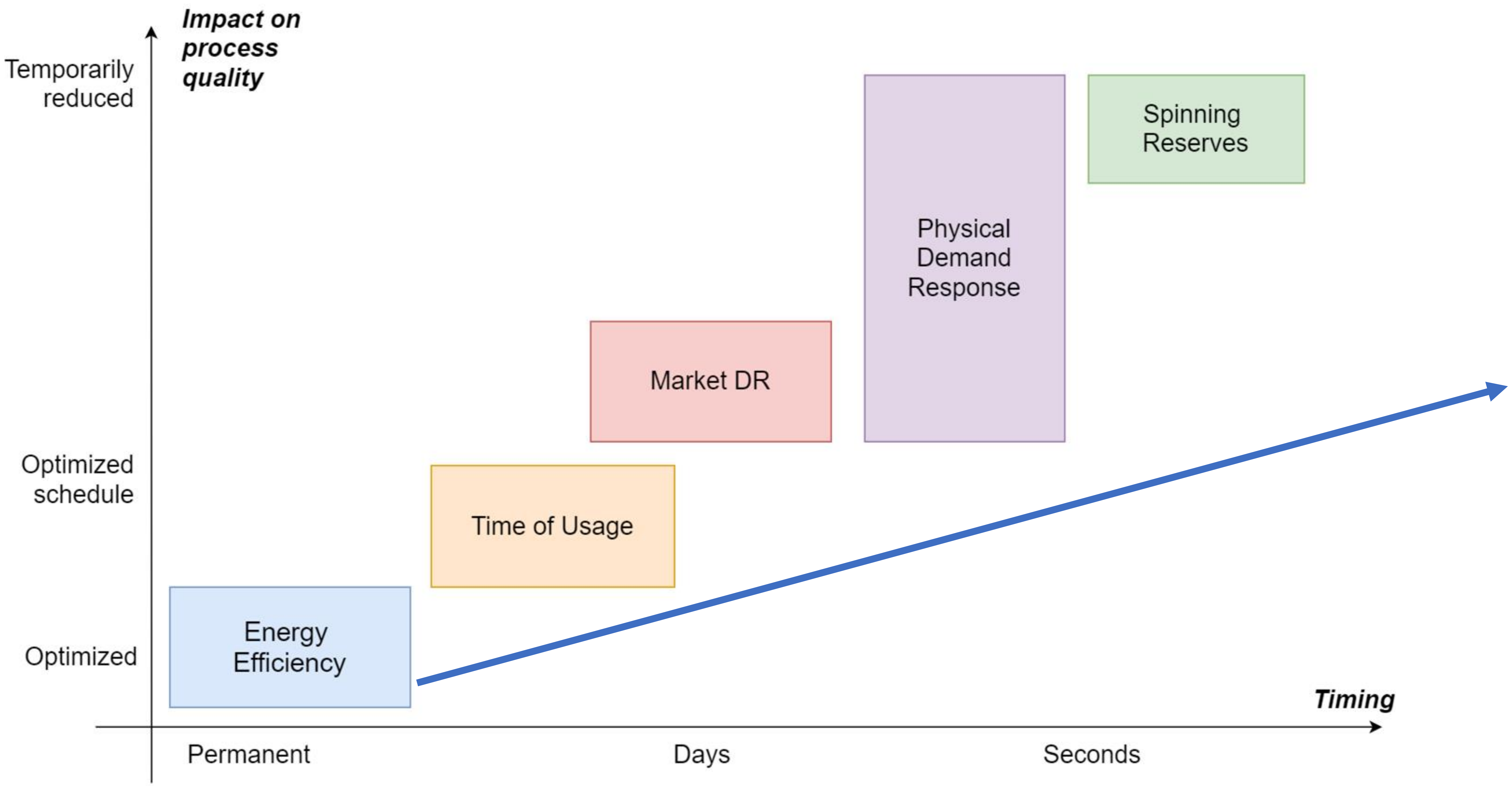
- Deferral of investments in generation and networks
- Reduction in technical losses
- Improvement in network reliability due to reduced load and associated outages
- Social benefits as consumers can improve their standard of living and more can afford service through efficient use of power
- Reduction of greenhouse gas emissions
- Promotion of renewable energy and sustainable energy development

DSM changes the Load Profile



Focus is on reducing area under graph. This means less energy is used in a given period

Categories of DSM



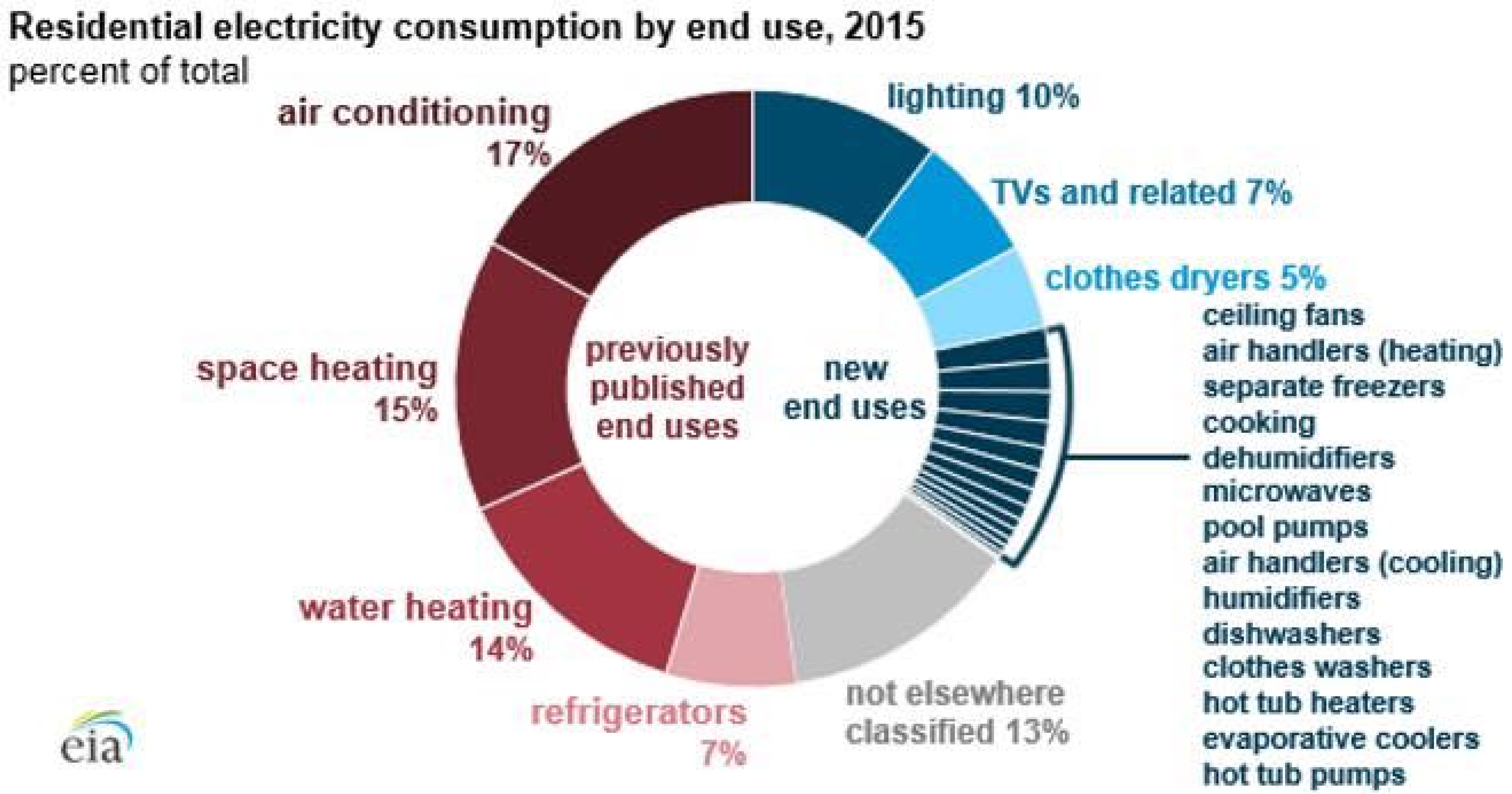
Most desired form of DSM.

Permanent solution that, while may be costly to implement at first, saves both money and power in the long-term.

Other measures can cause shifts in load profile, Energy Efficient measures can reduce emissions and energy usage

Adapted from Demand Side Management: Demand Response, Intelligent Energy Systems, and Smart Loads, Palensky, Dietrich, 2011.

Categories - Energy Efficient Investments



Fuel Switching
Power Factor Correction
Distributed Generation
Smart Grid

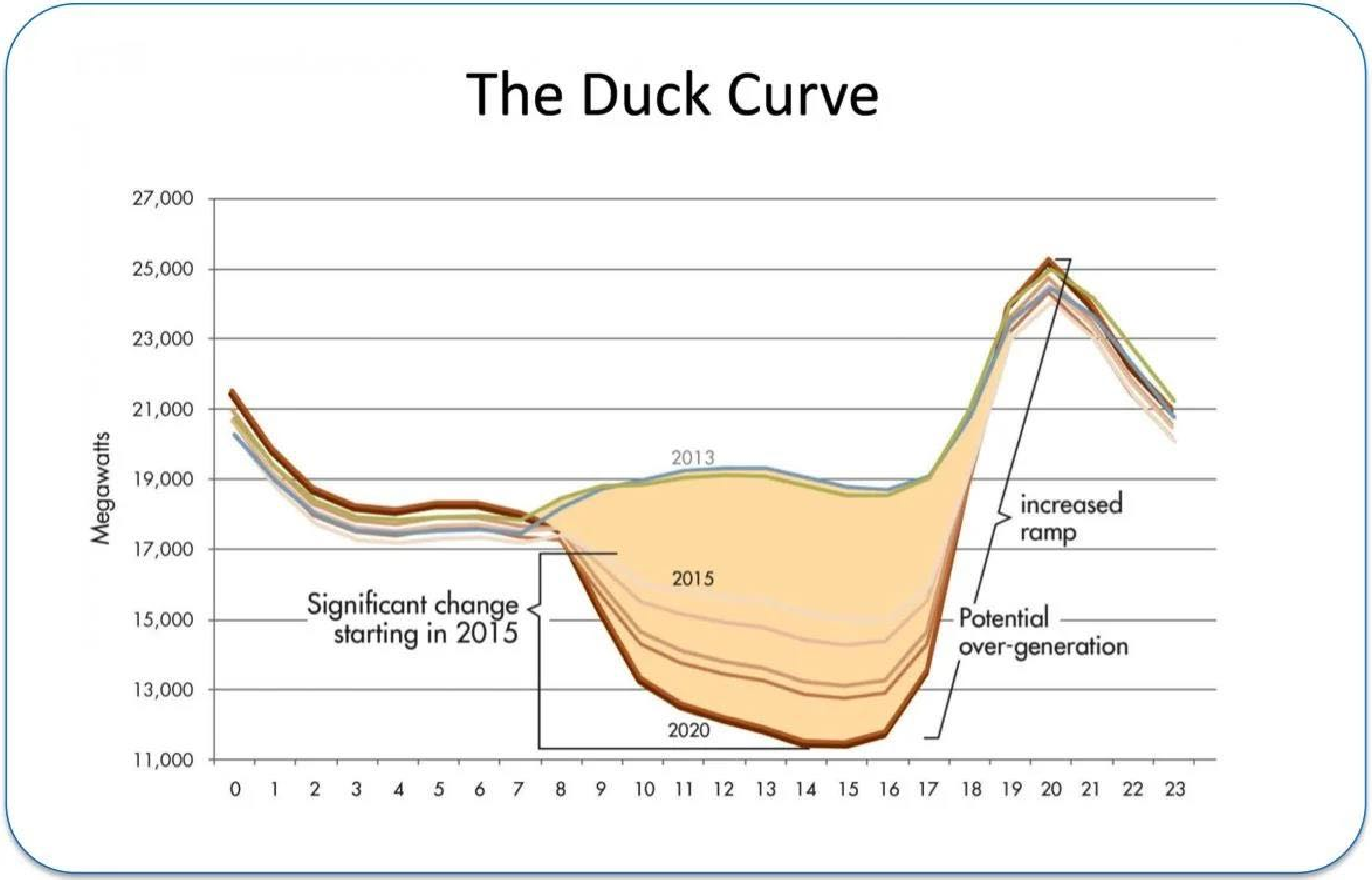
https://www.eia.gov/consumption/residential/

Categories - Time of Use

- This brackets electricity prices with the costs of generation for a specific time.
- Incentivizes customers to avoid usage in peak hours.
- It also provides incentive for transitioning to smart grid technology and energy efficient investment.
- Customers can plan electricity usage.

Categories - Time of Use

- The Duck Curve allows a visualization for when time of use tariffs can be implemented in order to best save energy
- Supports the integration of renewable sources into the grid system.



https://youtu.be/KwA44fr7apw

www.greentechmedia.com/articles/read/can-water-kill-the-duck-curve

Categories - Demand Response

- Aim to smoothen out any dips or peaks in load profile through automatic consumer adjustment
- This involves the financial incentivization of the customer base by the utility
- Temporary measure
- Market or Physical or both!
- Interruptibility Contract
- Direct Load Control

http://project-respond.eu/demand-side-management-vs-demand-response/

Categories - Spinning Reserves

- Quickest form of DSM.
- Extra power capacity that becomes available.
- Should consumer demand changes, these generators provide this capacity respond immediately to balance the power system.

DSM – Challenges

Challenges of DSM

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- **Lack of ICT Infrastructure**

Technology (metering, control methods and communication) may be difficult to access, procure and implement

- **Lack of Understanding/ Education across consumer base**

Consumers must have a comprehensive understanding of the merits of DSM programs

Challenges of DSM

- Preference to traditional methods
- Additional system complexity
- Lack of incentives
- Actors and respective roles

DSM - Role of the Government

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- Standards for new buildings - implemented to ensure lighting, plugs and appliances all meet Energy Efficiency (EE) standards
- Incentives for EE and other DSM measures
    - Energy taxes
    - Grants or loans
    - Rebates
- Publicity and awareness campaigns
- Funding transition of government assets to EE assets

DSM - Role of Utility

- Tariff Design
- Technology Adoption
- Data collection

A Short Break

Before we switch presenters

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Evolution of DSM Technology

Evolution of DSM Technology

- ***Load control*** was the first DSM strategy, in the early 1950s
- In the 1960s, ***electronic load control***
- A key DSM strategy has always been ***innovative rates***. Employed prevalently since early 1980s
- ***Energy efficient investments*** is now common in most utility's DSM portfolio. EPRI study showed reduced consumption by 11-14%
- ***Demand response*** was first coined in 2007 by the US Energy Independence and Security Act

Evolution of DSM Technology

- ***Electrification*** describes the conversion of non-electric end-uses to electricity
- E.g. electric space/water heating in lieu of natural gas or fuel heating, or electric transportation instead of gasoline/diesel based transport
- The installation of electric devices in place of fossil-fuel devices has the potential to reduce emissions of gases such as CO_2 by 114-320 million per year in 2030

https://www.researchgate.net/publication/312423141_Evolving_practice_of_demand-side_management

Electrification

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Equipment type	Electricity demand in 20 years (GWh)[1,2,3]
Agricultural pumps	400–600
Aircraft gate electrification	80–120
Airport ground support equipment	200–900
Cargo handling equipment (cranes, yard trucks)	1000–2000
Harbor craft	900–1700
Industrial equipment (forklifts, transportation refrigeration units, sweepers)	6300–27000
Lawn and garden equipment	2900–11000
Ship shore side power	4400–6600
Switching locomotives	400–900
Recreational equipment (all-terrain vehicles, off-road motorcycles, golf carts, specialty carts)	1200–2400
Total	18000–53000

GELLINGS, C.W. Evolving practice of demand-side management. *J. Mod. Power Syst. Clean Energy* **5,** 1–9 (2017). https://doi.org/10.1007/s40565-016-0252-1

Evolution of DSM Technology

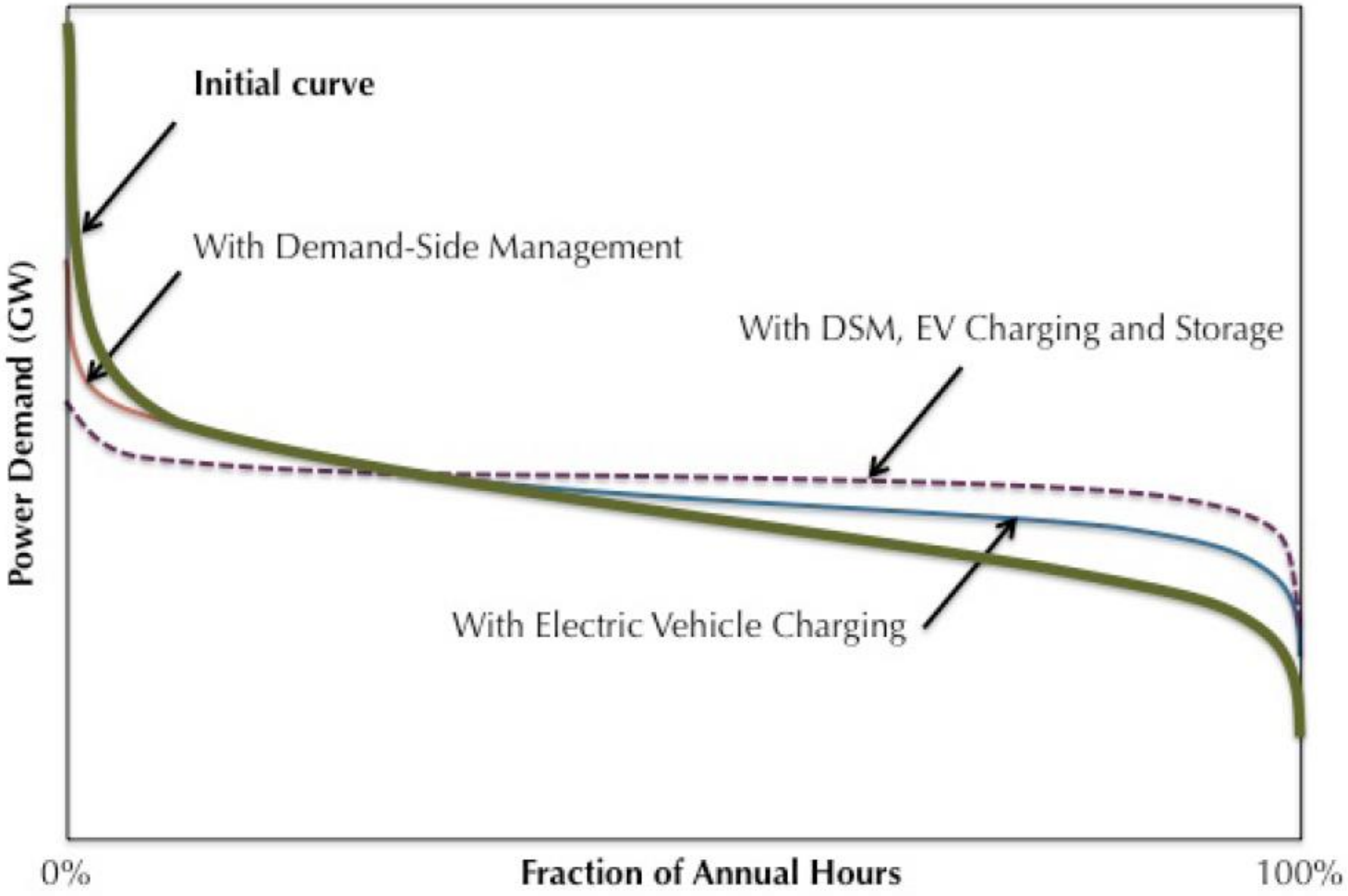
- One major electrification appliance is the **electric vehicle**
- The market share of EVs could approach 30% by 2030, meaning 9 million EVs on the road at this point
- A recent study by EPRI and the Natural Resources Defense Council (NRDC) estimates that by 2050, up to 53% of vehicle miles could be EV bourne- resulting in a 48-70% reduction in emissions

Electric Power Research Institute (2015) Environmental assessment of a full electric transportation portfolio: executive summary https://www.epri.com/research/products/3002006881

DSM and EVs

- DSM and EVs aim to reduce emission of greenhouse gases
- New challenges implementing EV charging with DSM
- Prime opportunity for renewables to be introduced into the transport sector
- Massive reduction in air pollution, while also emerging as a source of storage for sources of renewable energy

Impact of DSM on the LDC



Flattening of the Load Duration Curve

Bryan Hannegan, California's Energy Future: Electricity from Renewable Energy and Fossil Fuels with Carbon Capture and Sequestration

DSM- Solutions

Enabling technologies

- Internet of things (Smart home)
- Behind-the-meter batteries
- Electric-vehicle smart charging
- Artificial intelligence and big data
- Renewable power-to-heat (residential)

Business models

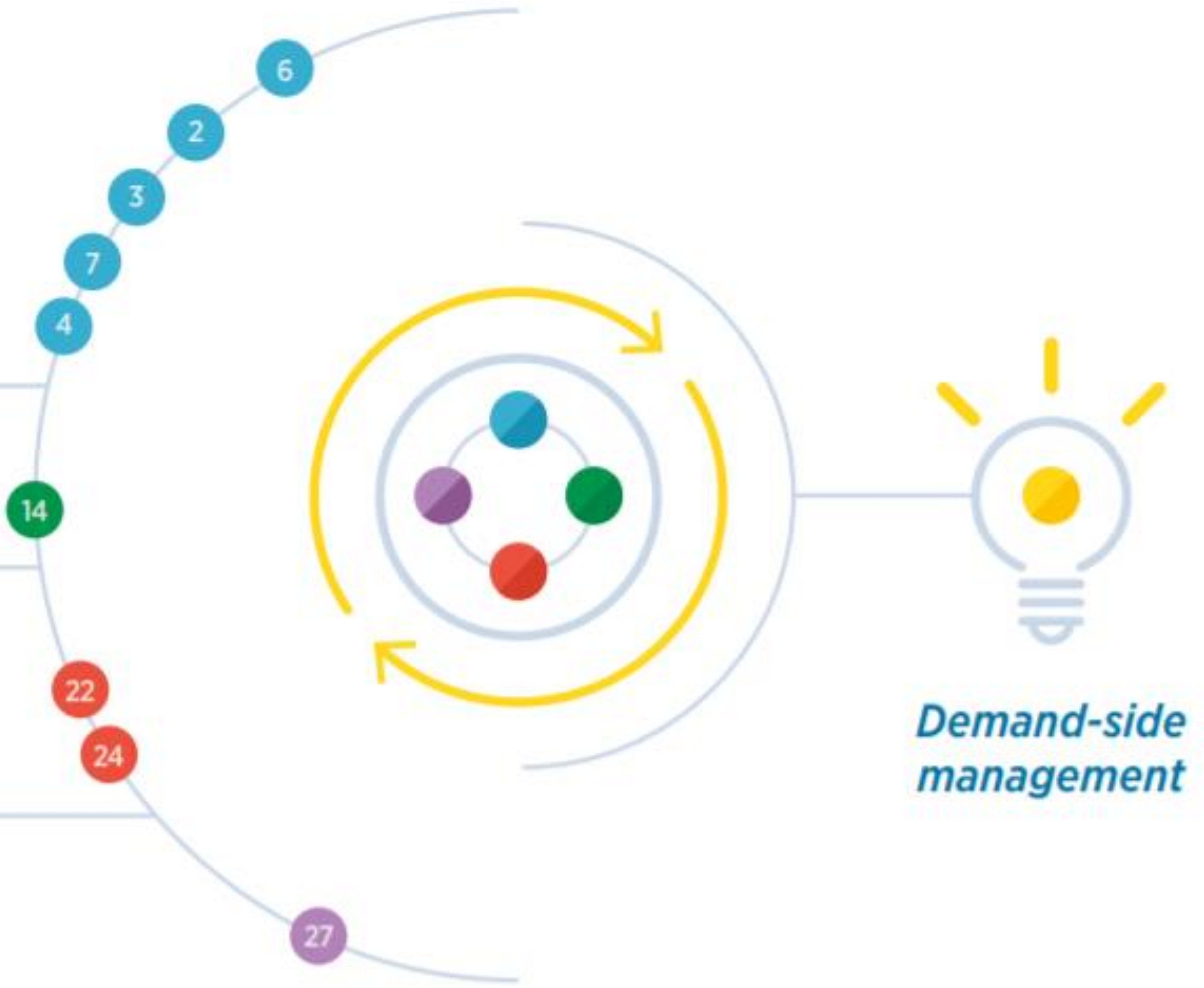
- Energy-as-a-service

Market design

- Time-of-use tariffs
- Net billing schemes

System operation

- Advanced forecasting of variable renewable power generation

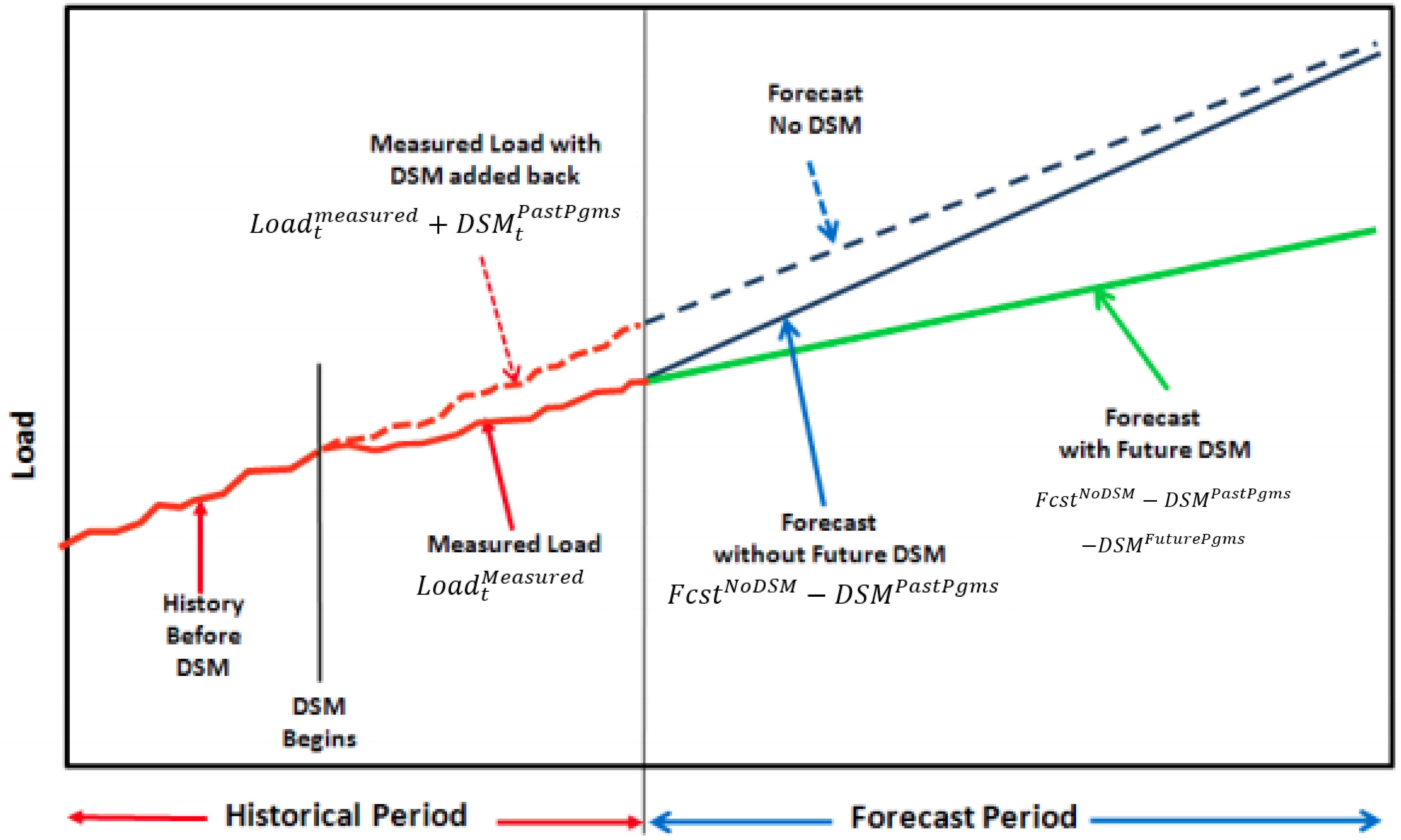


IRENA 2019: Innovation Landscape for a Renewable-Power Future

https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2019/Feb/IRENA_Innovation_Landscape_2019_report.pdf

DSM Influence

Adjust the load forecast by accounting for the amount and the continuing momentum of the historic DSM contained in the load forecast model



Itron white paper: **Incorporating DSM into the Load Forecast**

Commercially Available Applications

SAS Energy Forecasting: https://www.sas.com/en_us/software/energy-forecasting.html

ITRON https://www.itron.com/it/solutions/product-catalog/metrixidr-system-operations

LoadSeer http://willdan.com/ServiceBrochures/IA%20Flyer_LoadSEER_v5.pdf

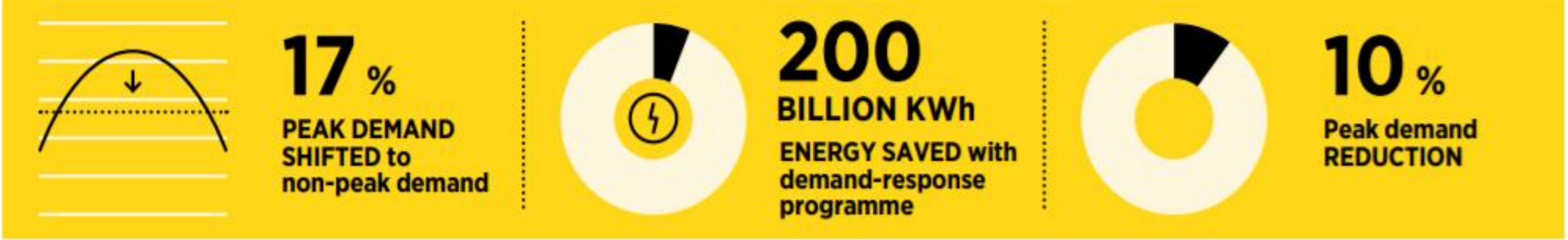
Etap https://etap.com/product/load-forecasting-software

EnFor https://enfor.dk/services/loadfor/

QuantRisk https://www.quantrisk.com/analytics-electricity-load-forecast.html

DSM – Global and Regional

DSM - Worldwide



Impact on demand reduction:

- **17% of the peak demand shifted to non-peak hours through time-of-use tariffs in Sweden.**

Electricity consumption during peak hours declined from 23% to 19% of total electricity demand in a pilot project that used price signals for demand response in Sweden; 17% of the peak demand was therefore shifted to non-peak hours (WEF, 2017).

- **5% of total electricity sales (around 200 billion kWh) was saved during a demand-response programme in the US in 2015.**

A 1% reduction in electricity sales for a utility means on average a 0.66% reduction in peak demand for that utility (Nadel, 2017) .

- **Utilities' peak demand could be reduced by 10% on average using demand response.**

The American Council for an Energy-Efficient Economy (ACEEE) has estimated that demand-response programmes can be used to reduce peak demand by 10% or more (Nadel, 2017).

- **A Google data centre using artificial intelligence experienced a 40% reduction in demand used in cooling.**

Google's DeepMind AI reduced the energy used for cooling at one of the company's data centres by 40% (a 15% overall reduction in power usage), using only historical data collected from censors and applying a machine-learning algorithm to predict the future temperature and pressure of the data centre and to optimise efficiency (Evans and Gao, 2016).

IRENA 2019: Innovation Landscape for a Renewable-Power Future
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DSM - Worldwide

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Impact on energy costs for consumers:

- **15% savings on utility bill with time-of-use tariffs for 350 households.**

Con Edison's Community Power pilot project would give 350 New York City Housing Authority households access to solar energy for a discounted price. The consumers managed to save 15% on their electricity bills, or around USD 80 (Con Edison, 2018).

- **Up to 40% savings on utility bill using artificial intelligence for demand management.**

BeeBryte, a France- and Singapore-based "software-as-a-service" (SaaS) company, provides cloud-based intelligence software that can monitor real-time load in large commercial and industrial facilities. Using artificial intelligence for weather forecast, occupancy, usage and energy price signals, the software can automatically switch loads such as HVAC systems to battery storage based on time-of-use charges and delivers up to 40% savings in utility bills (BeeBryte, n.d.).

IRENA 2019: Innovation Landscape for a Renewable-Power Future

https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2019/Feb/IRENA_Innovation_Landscape_2019_report.pdf

DSM in the Caribbean

- DSM must be introduced systematically and strategically.
- ***Financial incentivization*** is the key motivator.
- ***Education*** is critical in order to stimulate changes in ***behaviours*** towards energy conservation, and power generation's role in ***climate change.***
- Energy Efficient Investment is the ***most applicable form of DSM*** for the Caribbean region
- Combining this with ***financial incentivization*** leads to optimal implementation of DSM schemes

DSM in the Caribbean

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Energy Report Cards

https://www.ccreee.org/all-publications/

https://www.energy.gov/eere/island-energy-snapshots

Have a closer look!

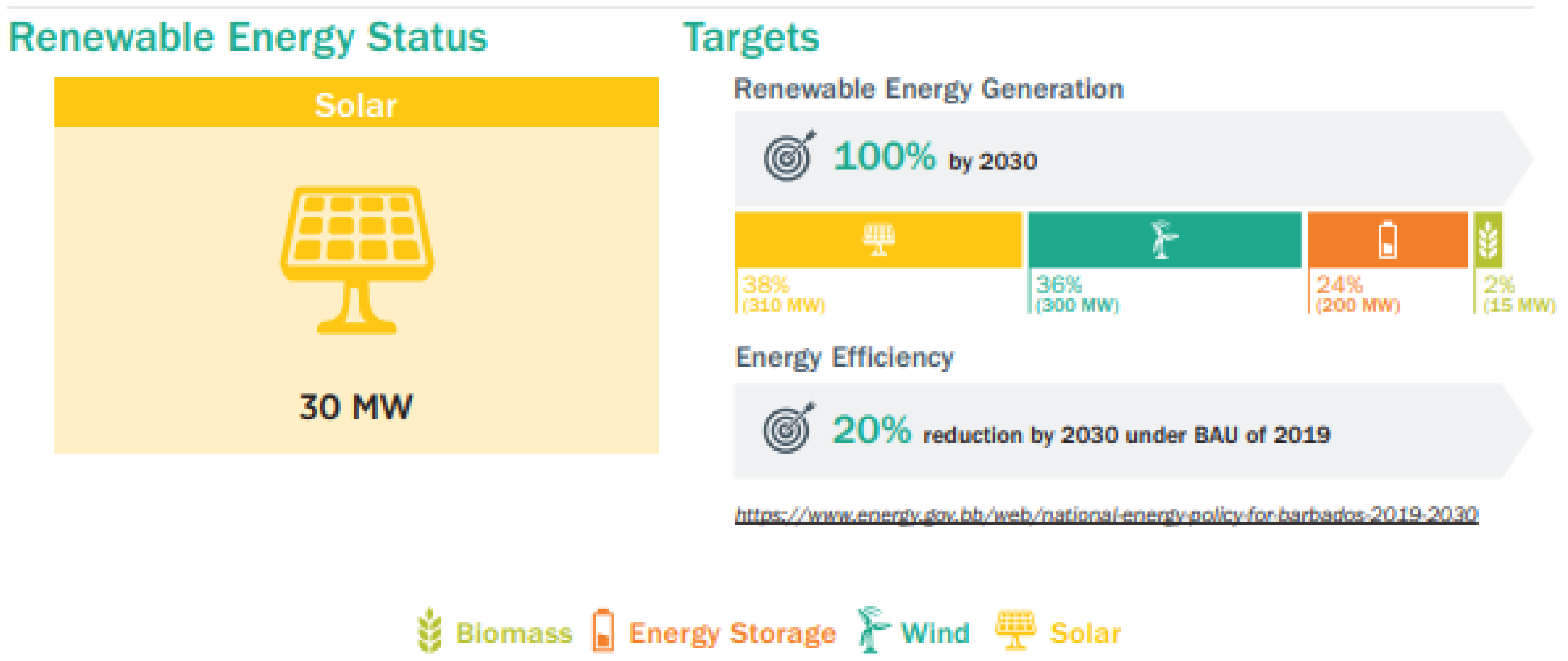
Population and Economy
Electricity Sector Overview
Renewable Energy Status
Existing Policy
Regulatory Framework
Targets
Energy Efficiency

Energy Sector Summary
Energy Sector Performance
Projects
Transportation
Training
Workforce
Climate Change

DSM | Barbados | Rooftop PV Cells

Rooftop PV Cells:

- Barbados has seen a significant increase in solar PV capacity since 2001
- In 2001, the capacity of solar PV was 37kW. In 2013 the capacity was 1700kW due to the ***Renewable Energy Rider*** program.
- As of June 2020 30MW of solar energy generation (ETI-Energy)
- Incentivized customers to generate power via renewable energy sources by crediting their accounts.



https://www.energy.gov/sites/default/files/2020/09/f79/ETI-Energy-Snapshot-Barbados_FY20.pdf

DSM | Barbados | Electric Vehicles

- As of 2019, Barbados has over 400 electric vehicles
- This is the highest EV count per capita in the region
- Numerous stations available for public charging
- A new fleet of 33 electric buses in 2020

https://www.megapower365.com/ev-barbados

https://ecpamericas.org/newsletters/electric-buses-hit-the-road-in-barbados/

DSM | Barbados | Solar Water Heating (SWH)

- > 50,000 SWH installations. Estimated to save 100,000 MWh of energy annually

https://www.smartenergybarbados.com/smart-products/solar-water-heaters/

DSM | Barbados | Tariffs

- Barbados Light and Power (BLP) offers a time of use tariff, reducing the cost of energy from $0.2190/kWh to $0.0620/kWh from peak to off-peak hours
- Barbados also offers both net metering and net billing services for residential solar installations. There is a distinction to be made:
  - Net metering involves the earning of credits for PV generation added to the grid
  - Net billing is a system where customers have their bill netted for the quantity of electricity generated versus the quantity used
- Barbados offers feed-in tariffs, where small-scale renewable producers are granted above-market prices for their contribution to the grid

https://www.smartenergybarbados.com/smart-products/solar-water-heaters/

DSM | Jamaica | EE Investments

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- In 2016 $30 million to promote electricity conservation by reducing electricity consumption, improving traffic flows in congested road corridors in the Kingston Metropolitan area
- In 2018 $765 million for improvements in the energy efficiency and energy conservation initiatives
- Aims to invest US$7.3B into its electricity sector by 2037. 20 year plan using more RE - 320MW of solar and wind power, 120MW of LNG, 74MW of hydro, waste to energy and/or biomass by 2025.

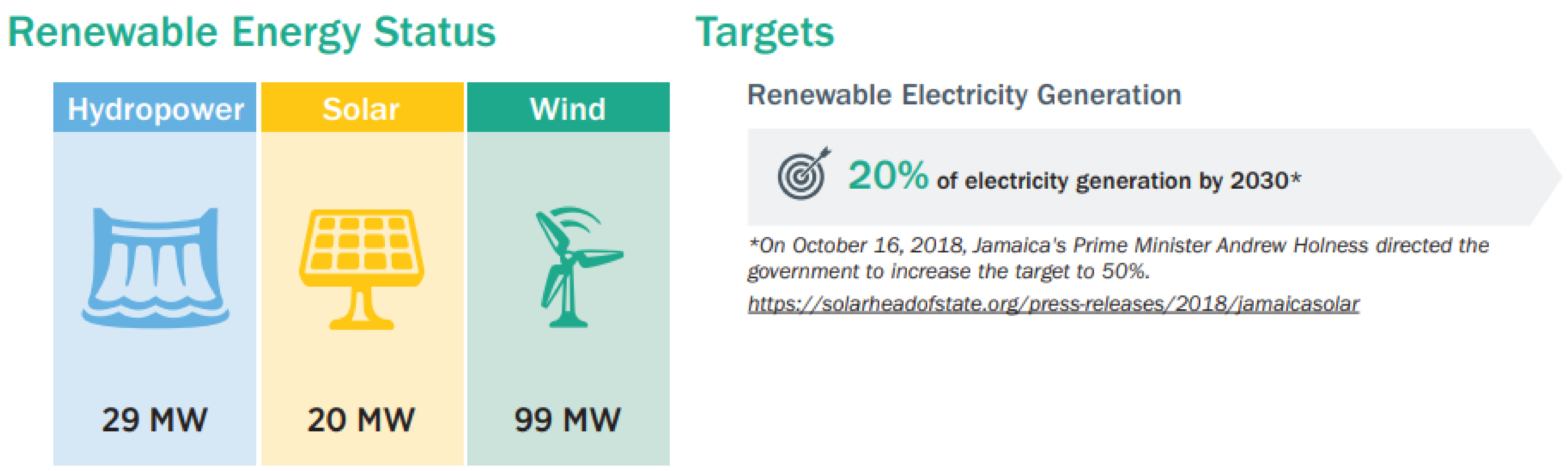
DSM | Jamaica | Time of Use Tariffs

Period	Day	Time	Rate ($/kWh)
On-Peak	Mon-Fri	6pm-10pm	15.76
Partial-Peak	Mon-Fri	6am-6pm; 6pm-10pm for weekends and public holidays	13.79
Off-Peak	Mon-Fri	10pm-6am; all hours except 6pm-10pm for weekends and public holidays	9.85

https://www.jpsco.com/2020-2021-rate-schedules/

DSM | Jamaica | Renewable Energy

- The JPSCo has also introduced Net Billing to allow personal RE (wind and solar PV) generators installed at the home to produce energy at home and gain the ability to avoid billing/ sell excess energy back to the grid
- Jamaica has installed 20MW of solar capacity, 99MW of wind power, and 30MW of hydroelectric power as of 2020 (ETI)



https://www.energy.gov/sites/default/files/2020/09/f79/ETI-Energy-Snapshot-Jamaica_FY20.pdf

https://www.energy.gov/sites/prod/files/2020/09/f79/ETI-Energy-Snapshot-Jamaica_FY20.pdf

DSM | Trinidad and Tobago

- Since 2017 25% rebate when their regular electricity bill is $300 TTD or lower <1000 kWh bimonthly.
- 100% tax credit on the cost of solar water heating as of January 2020
- 2020 LED Bulb program for residential customers

DSM | Guyana

- Various lighting and solar PV projects.
- The Guyana National Bureau of Standards (GNBS) is working closely with CARICOM's Regional Organisation for Standards and Quality (CROSQ) to develop standards for energy performance (minimum) for refrigerators, air conditioners and lighting
- Energy rating labelling of appliances.
- VAT and import duty exemptions

DSM | St Lucia

- While St Lucia is nearly completely reliant on fossil fuels for generation, a clean energy policy that has stemmed from the 1990s has allowed some degree of demand side management throughout the island
- Net metering and billing is offered by LUCELEC, the country’s utility
- Tax credit, reductions and exemptions have been offered on renewable energy assets such as solar water heaters (since 2001)

Conclusions

Concluding Remarks

- Demand Side Management techniques and programs aim to reduce consumption on the customer side of the electrical utility
- With well-documented success of these programs in countries such as the UK, USA, Canada, the Caribbean region could benefit from implementation of DSM techniques
- Promoting energy efficient investment in appliances and equipment is the most effective and permanent technique mentioned

Concluding Remarks

- Utilities should strive to financially incentivise consumers to carefully monitor demand patterns

- Consumers require education on the merits of energy conservation- this grassroots effort can be one of the most effective in DSM implementation

Thank You

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