

POWERING THE 21ST CENTURY

Presentation for the National Research Council
and
Alberta Innovates
April 10th 12:00 – 1:00PM
Webinar

TRENDING THEMES

Decentralisation

Watt Addiction

The Great Data Flood

War of Currents



CONSUMER OWNED



COMMUNITY OWNED



BUILDING INTEGRATION

DECENTRALISATION



ENERGY STORAGE



PLUG-IN DEVICES



RENEWABLES



GRID CHALLENGES

- Alberta - \$267 billion grid assets
- 26,000 km of transmission lines (\$117billion)
- >200,000 km of distribution lines (\$150 billion)
- Rural – 3 customers/km
- >50% bill is delivery charges



SUPERCAPACITORS



HOUSEHOLD DEVICES

WATT ADDICTION



BATTERIES



INDUSTRIAL ELECTRIFICATION





Transportation

Building
Automation

Information and
Communications
Technologies (ICT)

ELECTRIC VEHICLES

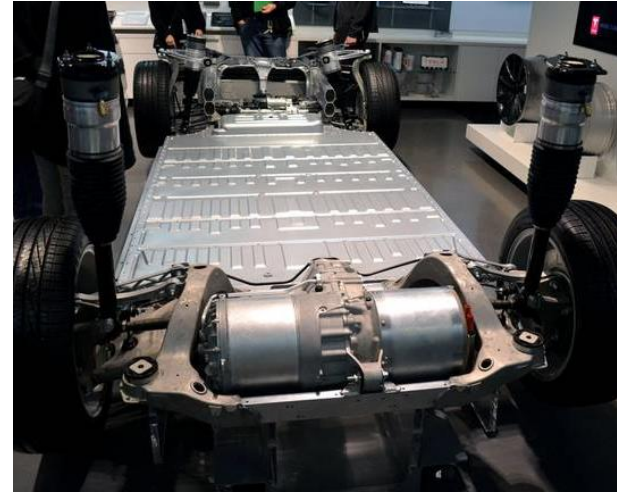
Country	Ban announced	Ban commences	Scope	Selectivity
 China	2017	2040 ^[4]	Gasoline and diesel	Production and new vehicle sales
 Costa Rica	2018	2021 ^[4]	Gasoline and diesel	New vehicle sales
 Denmark	2018	2030 ^[a] 2035 ^{[b][14]}	Gasoline and diesel	New vehicle sales
 France	2017	2040 ^[15]	Gasoline and diesel	New vehicle sales
 Germany	2016	2050 ^{[16][17]}	Combustion engine	New vehicle sales (cities can ban diesel)
 India	2017	2030 ^[18]	Gasoline and diesel	New vehicle sales
 Ireland	2018	2030 ^[19]	Gasoline and diesel	New vehicle sales
 Israel	2018	2030 ^[20]	Gasoline and diesel	New vehicle sales
 Japan	1996	Ongoing ^[4]	Incentives	New vehicle sales
 Netherlands	2017	2030 ^[21]	Emission vehicles	New vehicle sales
 Norway	2016	2025 ^[4]	Gasoline and diesel	New vehicle sales (buses are exempt) ^[22]
 Portugal	2010	Ongoing ^[4]	Incentives	New vehicle sales
 South Korea	2016	2020 ^[4]	Incentives	New vehicle sales
 Spain	2017	2040 ^[citation needed]	Non-electric	New vehicle sales
 Taiwan	2018	2040 ^[23]	Non-electric	New vehicle sales
 United Kingdom	2017	2040 - England, Wales, Northern Ireland ^[24] 2032 - Scotland ^[25]	Gasoline and diesel	New vehicle sales
 Sweden	2018	2030 ^[26]	Gasoline and diesel	New vehicle sales

a. ^ ban on ICE-only vehicles

b. ^ ban on all vehicles with gas emissions

ELECTRIC ADVANTAGES

BY 2030 EV CHEAPER THAN ICE



FROM BEING APPROXIMATELY 200,000 MILES TO BEING A 1,000,000 MILES

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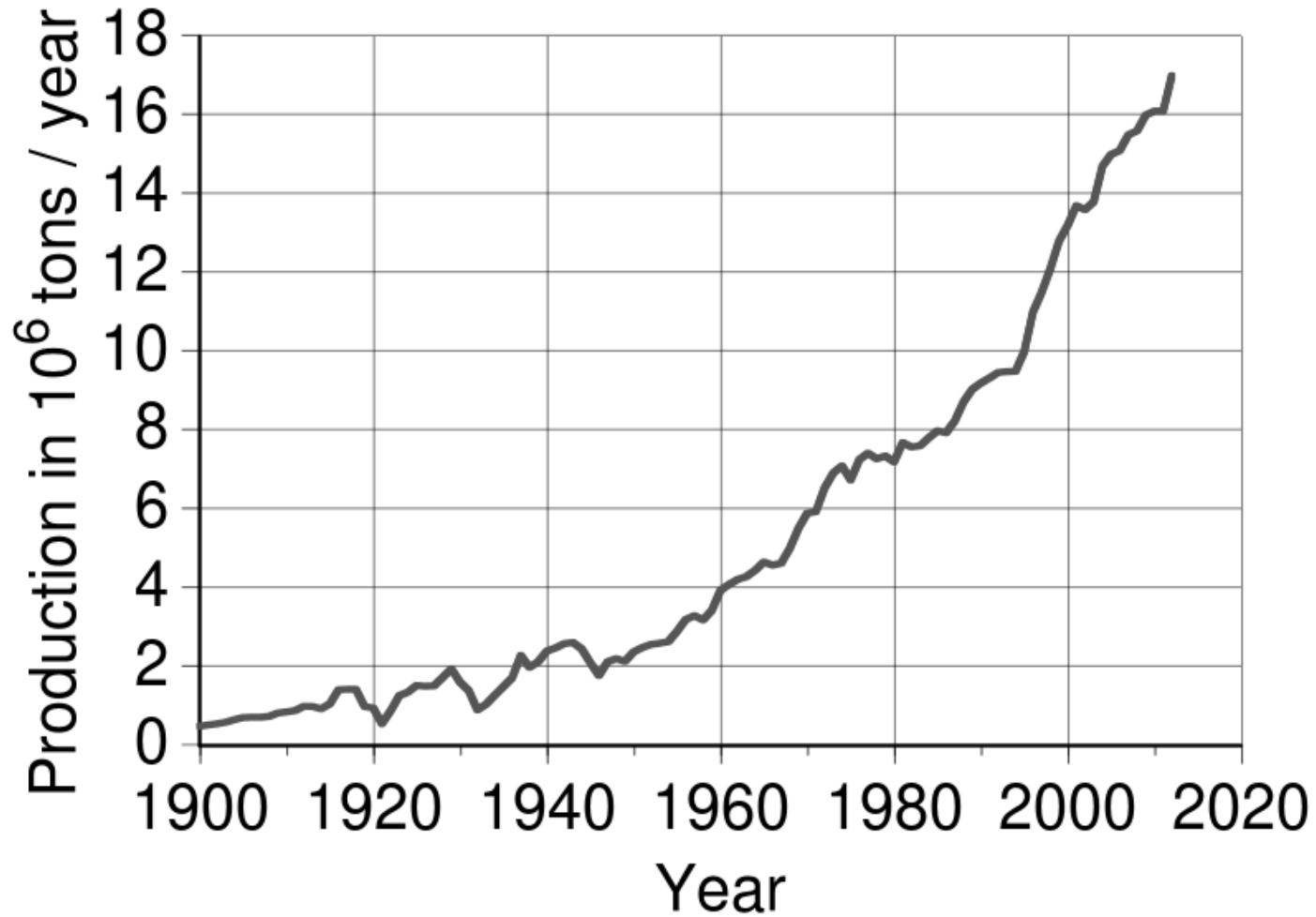
DRIVE UNITS THAT JUST NEVER WEAR OUT.



ELECTRIC IMPLICATIONS



COPPER'S STORY OF RECYCLABILITY



IMPLICATIONS OF BUILDING AUTOMATION



THE GREAT DATA FLOOD

INTERNET EXPLOSION

Internet traffic* is growing exponentially, and reached more than a zettabyte (ZB, 1×10^{21} bytes) in 2017.

1987
2 TB[†]

1997
60 PB

2007
50 EB

2017
1.1 ZB

*Traffic to and from data centres.

[†]TB, terabyte (10^{12} bytes); PB, petabyte (10^{15} bytes); EB, exabyte (10^{18} bytes).

©nature

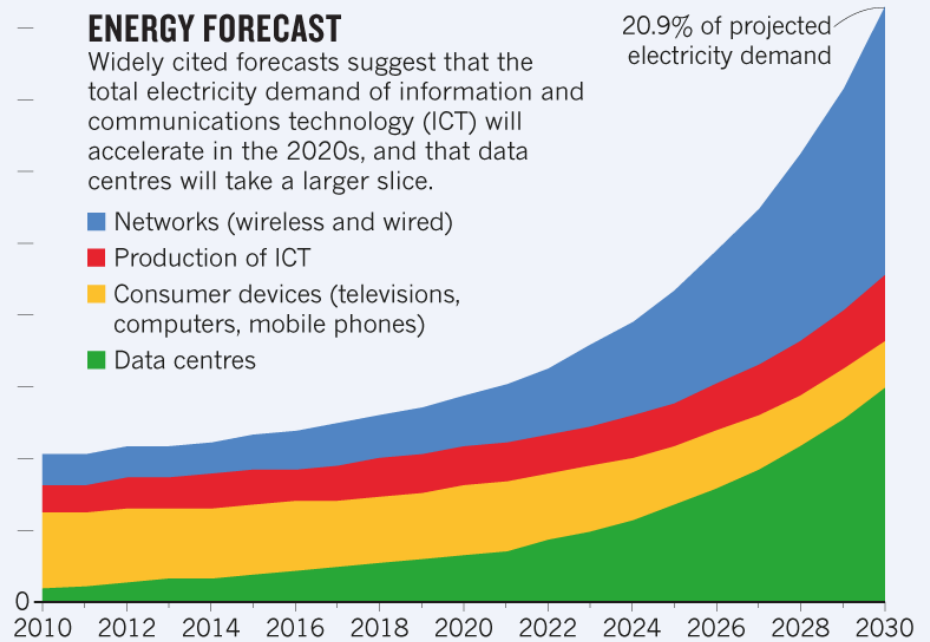
9,000 terawatt hours (TWh)

ENERGY FORECAST

Widely cited forecasts suggest that the total electricity demand of information and communications technology (ICT) will accelerate in the 2020s, and that data centres will take a larger slice.

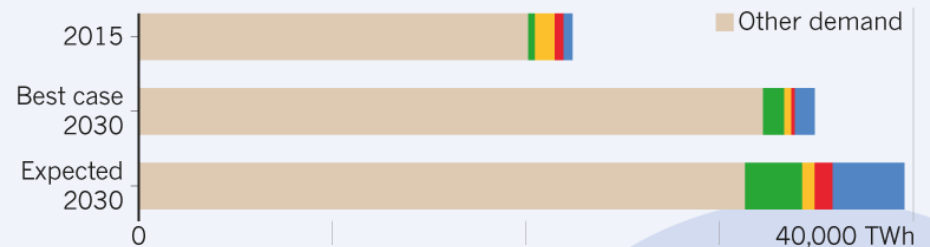
20.9% of projected electricity demand

- Networks (wireless and wired)
- Production of ICT
- Consumer devices (televisions, computers, mobile phones)
- Data centres



The chart above is an 'expected case' projection from Anders Andrae, a specialist in sustainable ICT. In his 'best case' scenario, ICT grows to only 8% of total electricity demand by 2030, rather than to 21%.

Global electricity demand



THE COMING FLOOD OF DATA IN AUTONOMOUS VEHICLES

RADAR
~10-100 KB
PER SECOND

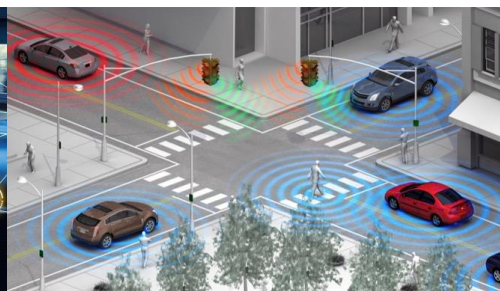
SONAR
~10-100 KB
PER SECOND

GPS
~50KB
PER SECOND

CAMERAS
~20-40 MB
PER SECOND

AUTONOMOUS VEHICLES
4,000 GB
PER DAY... EACH DAY

LIDAR
~10-70 MB
PER SECOND



DEC
Decentralised Energy Canada

DIGITAL TRANSFORMATION UNLOCKS \$1.3 TRILLION



Asset life cycle management

Technology solutions can enable real-time, remote-control or predictive maintenance to extend the life cycle or operating efficiency of the generation, transmission or distribution of assets and infrastructure.



Grid optimization and aggregation

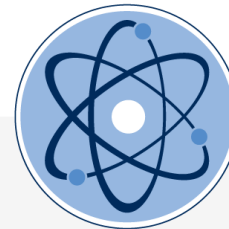
Grid optimization is possible through real-time load balancing, network controls and end-to-end connected markets, enabled by connected assets, machines, devices and advanced monitoring capability.

electricity sector



Integrated customer services

Innovative, digitally enabled products and services relating to energy generation and energy management are bundled into an integrated customer service.



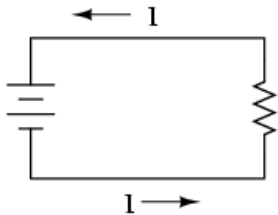
Beyond the electron

Hyper-personalized connected services beyond the electricity value chain that adapt to the consumer. Electricity moves from being a commodity to becoming an experience.

WAR OF CURRENTS



DIRECT CURRENT
(DC)





THE ROAD AHEAD

Complex systems take time to develop. Consider all options and all consequences.

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