Challenges and opportunities in fluid power for agriculture machines

WIEFP2016 – 3rd Workshop on Innovative Engineering for Fluid Power

Eng. Leandro de Oliveira Santos
Eng. Murilo Oliveira

October 25th 2016

CNH Industrial

Overview

- 2nd largest agriculture equipment manufacturing in the World
- A member of FIAT GROUP
- 2 main brands:

Brazil Factories:

- Sorocaba / SP
- Curitiba / PR
- Piracicaba / SP

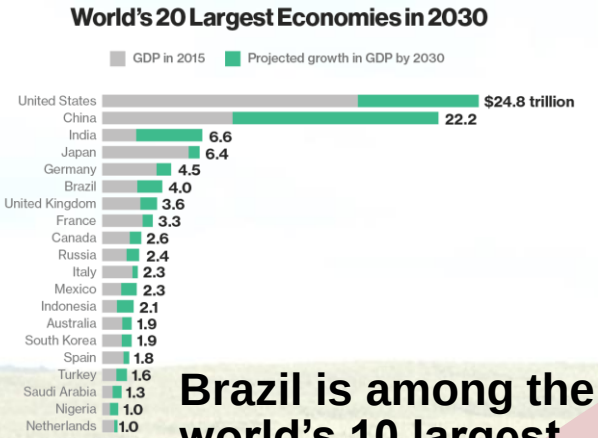
Disposition

Challenges and opportunities in fluid power for agriculture machines

- Brazilian agriculture scenario
- Challenges for this scenario
- How fluid power is embedded in Agriculture Machines
- **How to use fluid power to increase productivity**
- Trends of fluid power in agriculture machines

Brazilian agriculture scenario

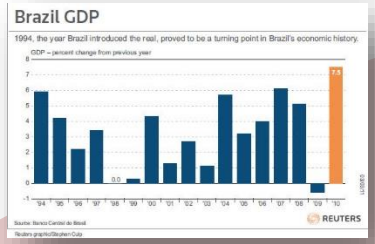
Facts & Statements



Source: U.S. Department of Agriculture

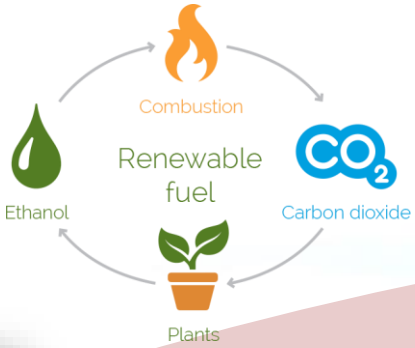
Brazil is among the world's 10 largest economies

- 5th highest population (now over 200 million) and the **5th largest surface area.**



Brazilian agriculture → growth for over 3 decades.

- **Total agricultural has doubled in volume** compared to its level in 1990

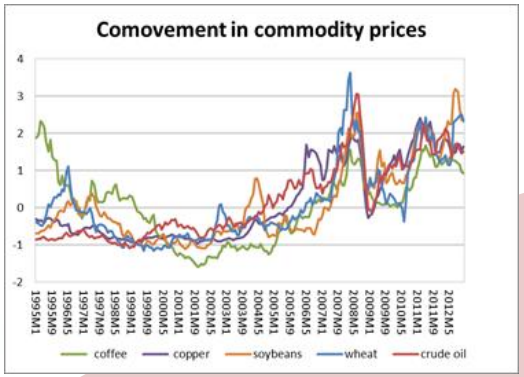


Agriculture in Brazil is an important contributor to the country's energy supply.

- sugarcane biomass (42%)
- firewood (20%)
- and other sources (10%).

Brazilian agriculture scenario

Facts & Statements



Agricultural frontier in the Centre-West and Northern regions.

- **increased productivity**

High prices for agricultural commodities

- **3.5% real GDP growth per year between 2005 and 2013.**

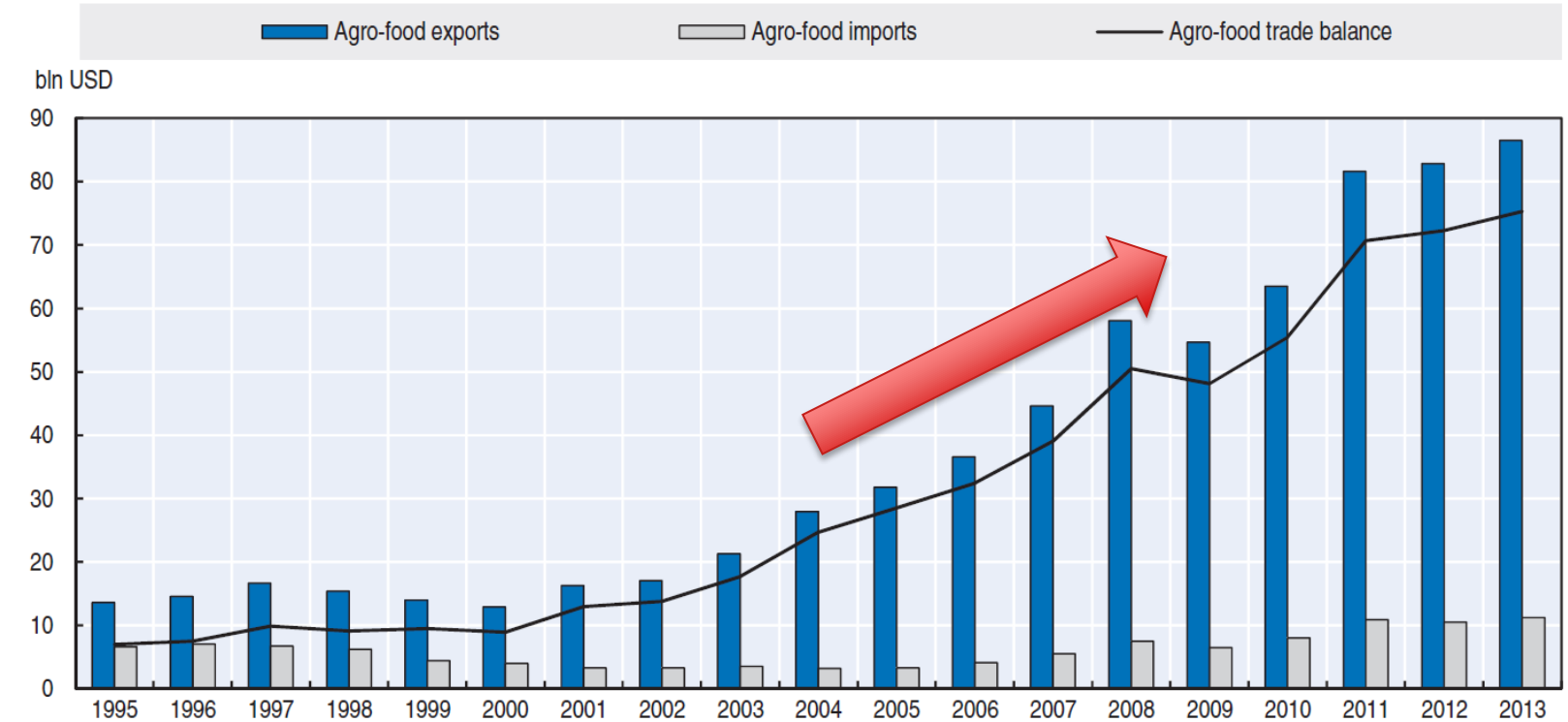
Growth remains hampered by structural weaknesses in the economy

- weak infrastructure
- high indirect tax system
- **low levels of education and skills.**

Brazilian agricutural scenario

Higher demand for food

Brazil's agro-food trade, 1995-2013

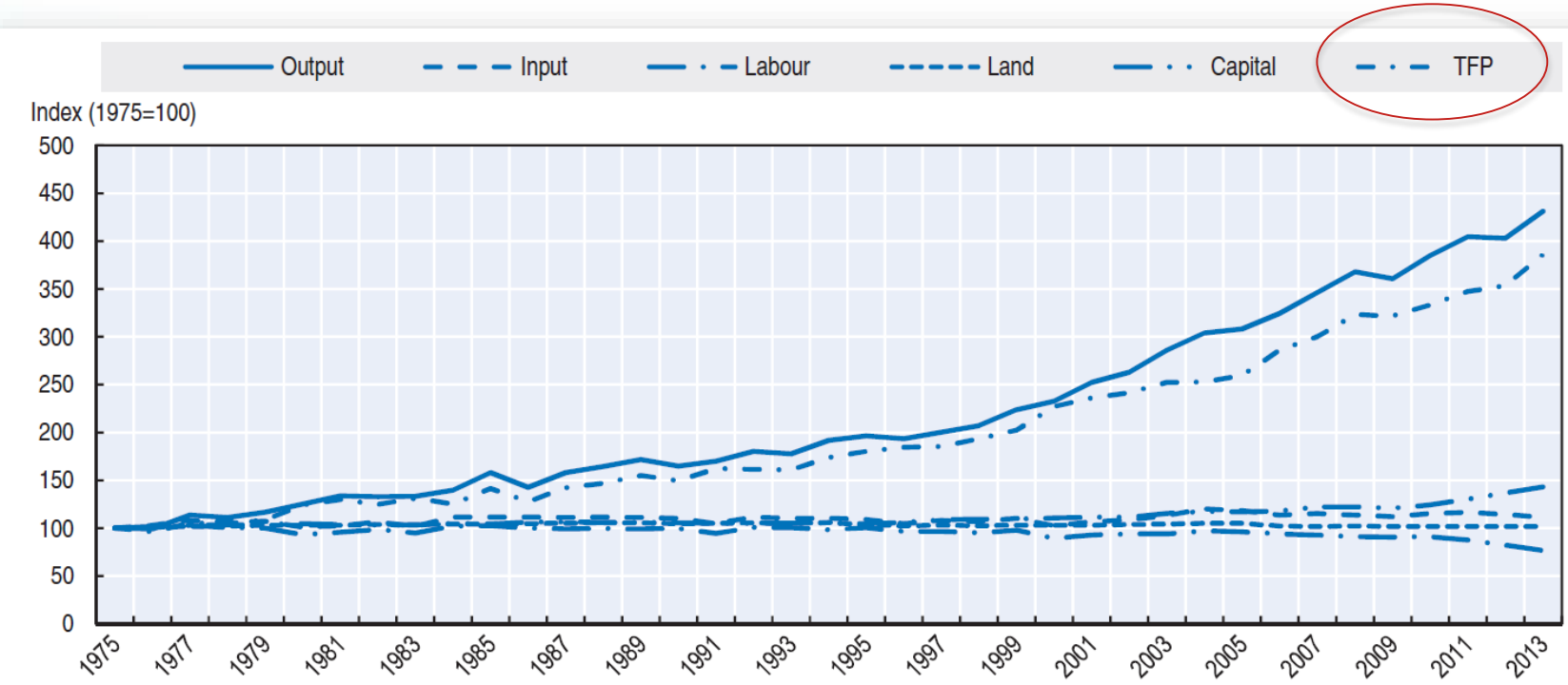


Source: UN Comtrade Database (2013).

Brazilian agricutural scenario

Higher demand for food

Trends in agricultural output and Total Factor Productivity in Brazil, 1975-2013



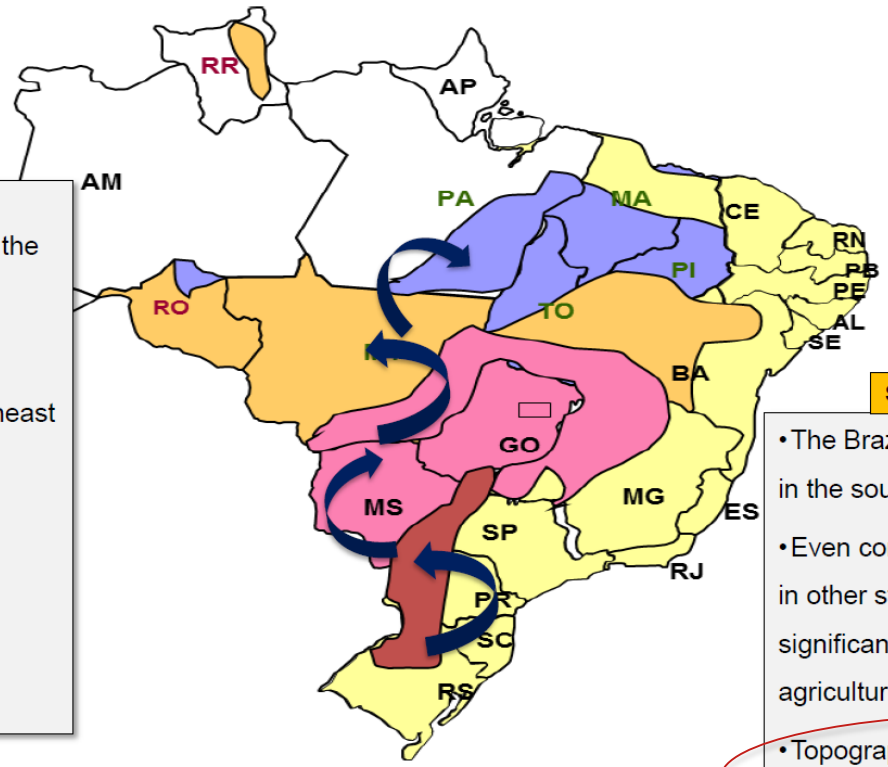
Source: Gasques et al. (2014).

Brazilian agricutural scenario

Harvest areas migration in Brazil

Brazilian Agriculture Evolution and Regional Profile

Brazil



Agriculture Migratory Flow

- 10/20's
- 00/10's
- 1990/00's
- 1980/90's
- 1970/80's

Midwest / Mapitoba

- New Agriculture frontier emerging with the migration of farmers from the south.
- Area expansion to some states of Northeast area, recently nominated "Mapitoba" represents the new wave of Brazilian agriculture.
- Basically plane topography.

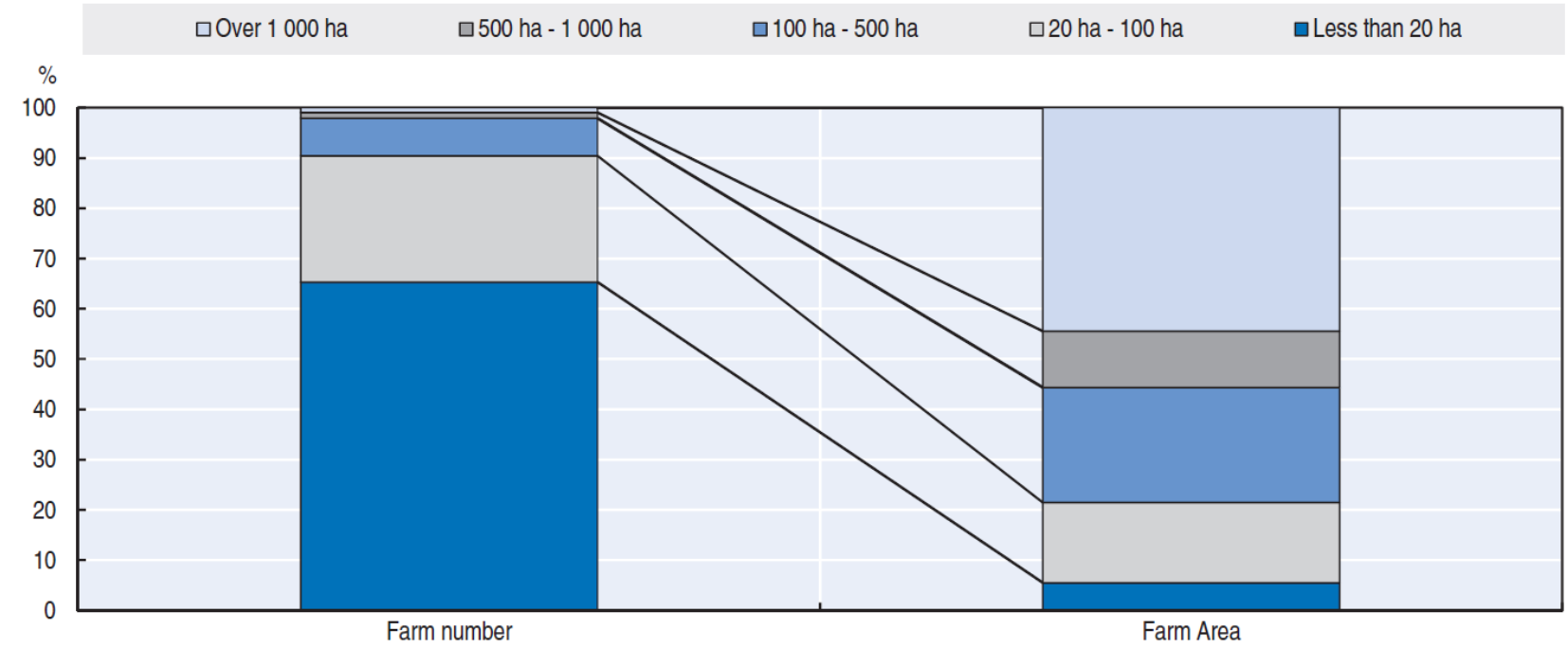
South/Southeast

- The Brazilian agriculture activities started in the south and southeast regions.
- Even considering new areas expansion in other states, the region still have a significant weight in the national agriculture.
- Topography basically marked by rough reliefs.

Brazilian agricutural scenario

Crop production areas

Brazil's Crop production areas



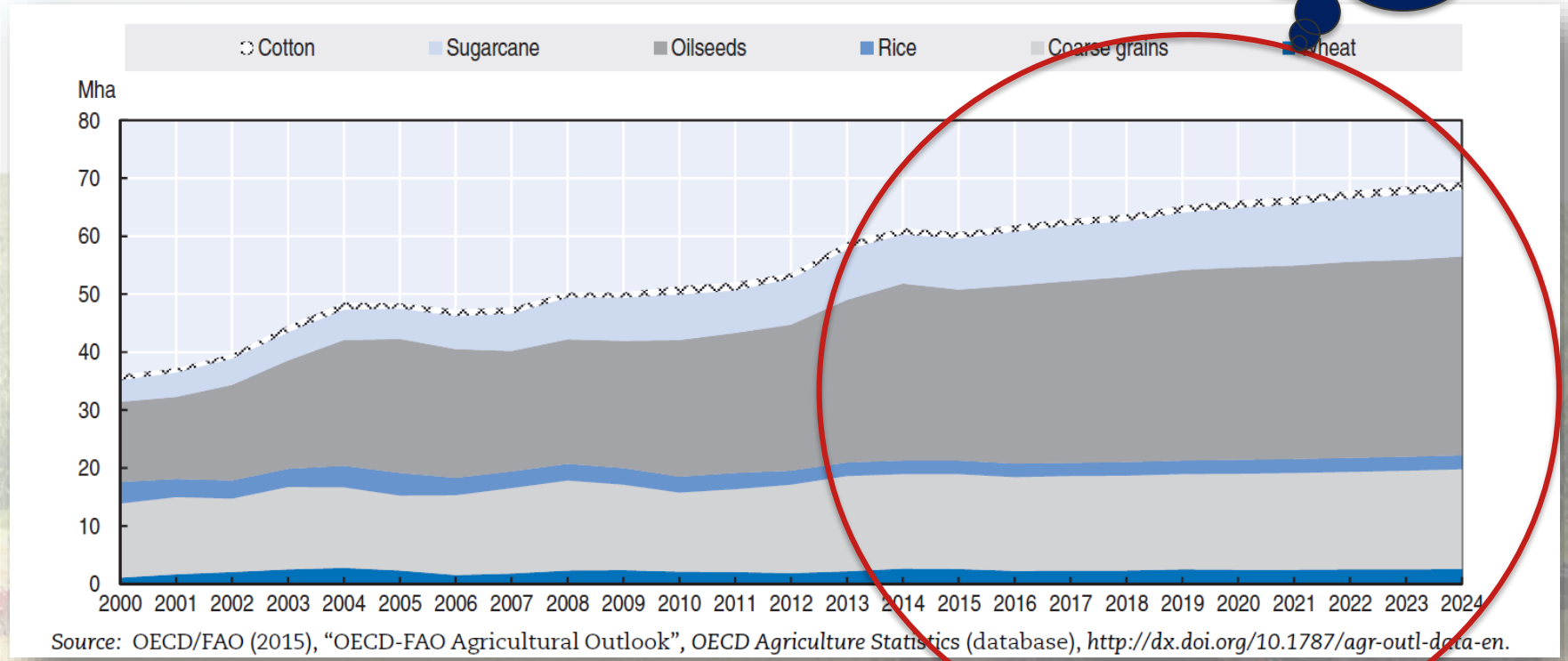
Source: IBGE (2006).

Brazilian agricutural scenario

Trends for crop production

FUTURE

Trend in land used for crop production in Brazil



Source: OECD/FAO (2015), "OECD-FAO Agricultural Outlook", *OECD Agriculture Statistics* (database), *http://dx.doi.org/10.1787/agr-outl-data-en.*

Challenges of Agricultural Scenario

Small to Big farms

Lack of skilled operators at remote areas

- Electronics and Hydraulics requires proper training

Shorten harvesting window

- Harvest as quick as possible for second season planting
- Unstable weather conditions

Improve bottom line users profitability

Higher reliability on machines

- Easy to use equipment with quick maintenance

Challenges of Agricultural Scenario

What are the challenges for Brazil's Agriculture?

Higher demand for food

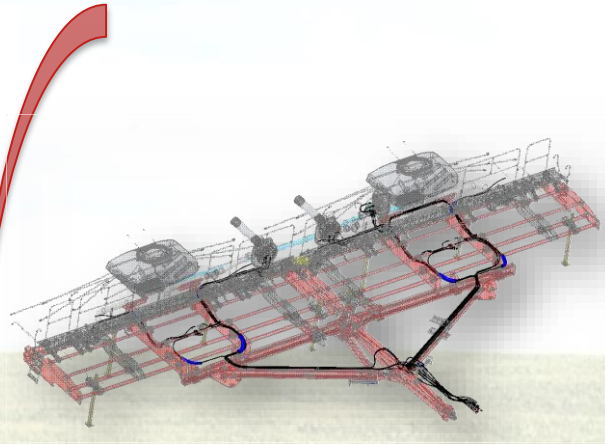
Opening of new planting areas are decreasing

How to increase productivity?

Fluid power in Agriculture Machines

Percentage of hydraulic control (among all functions)

Fluid Power %



15-30%

15-40%

40-50%

40-60%

70-85%

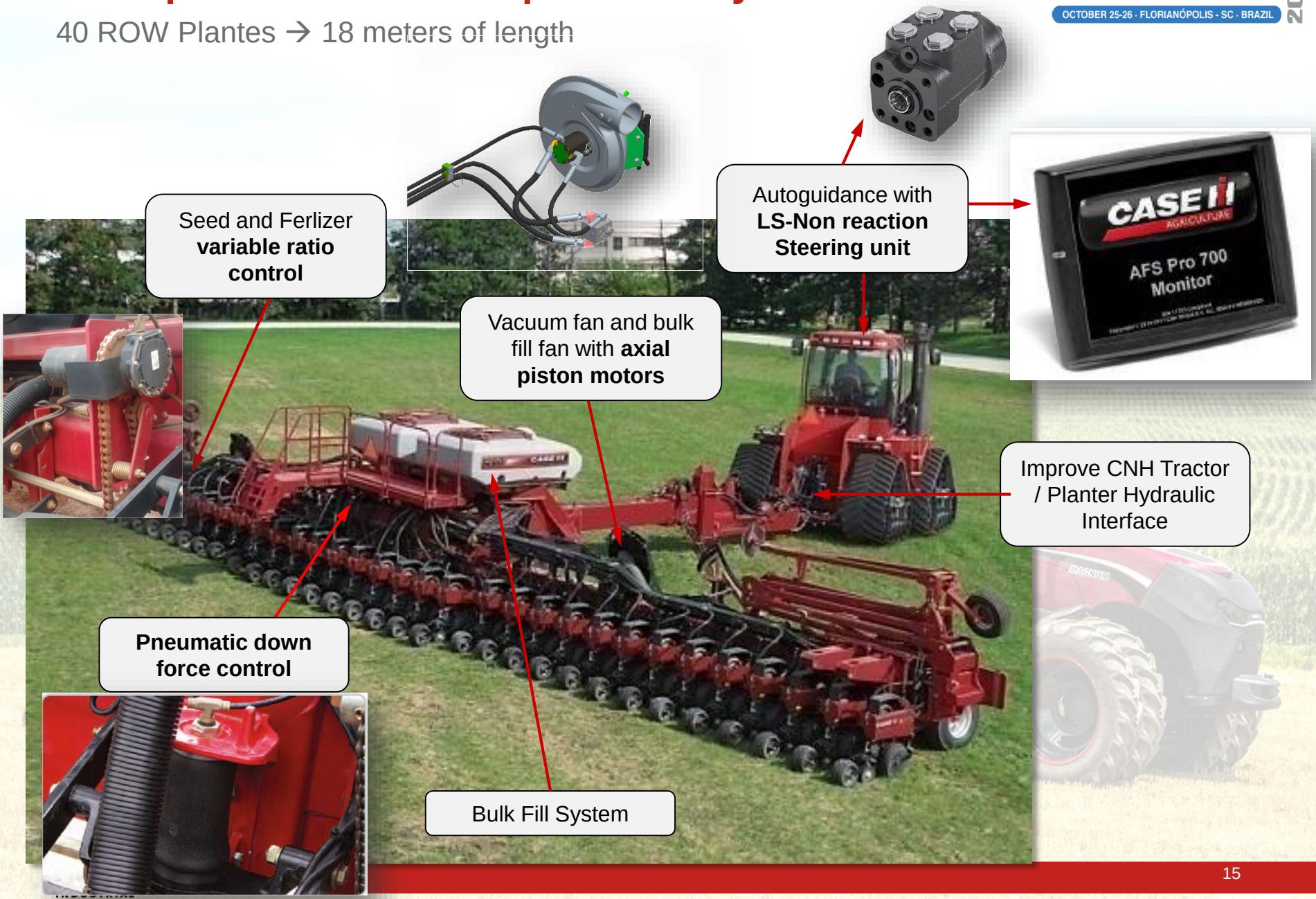
Fluid power in Agriculture Machines

Sugar cane Harvester

- **9** hydraulic pumps
- **1500** lpm flowing
- **285** kW consumed
- **28** hydraulic motors
- **2** hydrostatic motors
- **9** cylinders
- **312** hoses
- **9** control manifold
- Harvesting **700 to 800 tons of sugar cane** per machine per day!

Fluid power to increase productivity

40 ROW Plantes → 18 meters of length



Fluid power to increase productivity

Tractor x Planters integration → Larger Remote Valves

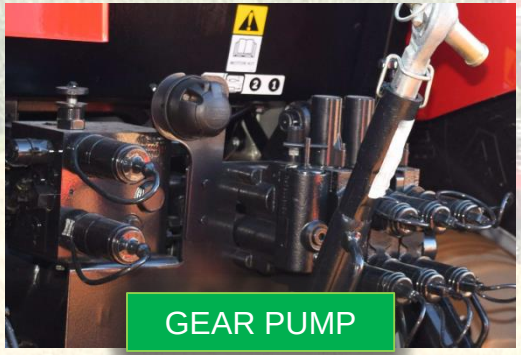
Q = 90 lpm

Q = 150 lpm

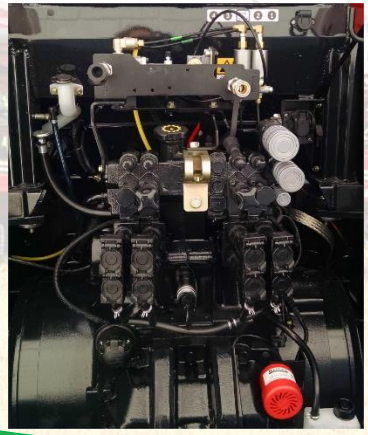
Q = 225 lpm

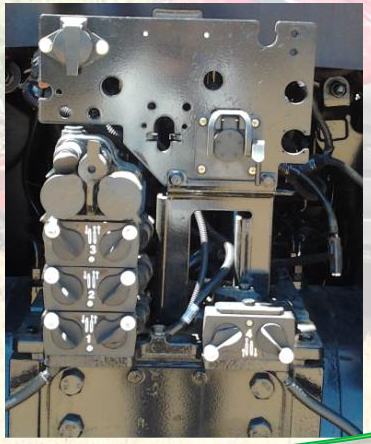
Q = 428 lpm

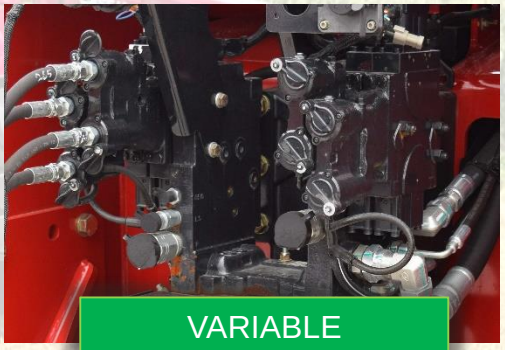
Future Q = ???



GEAR PUMP



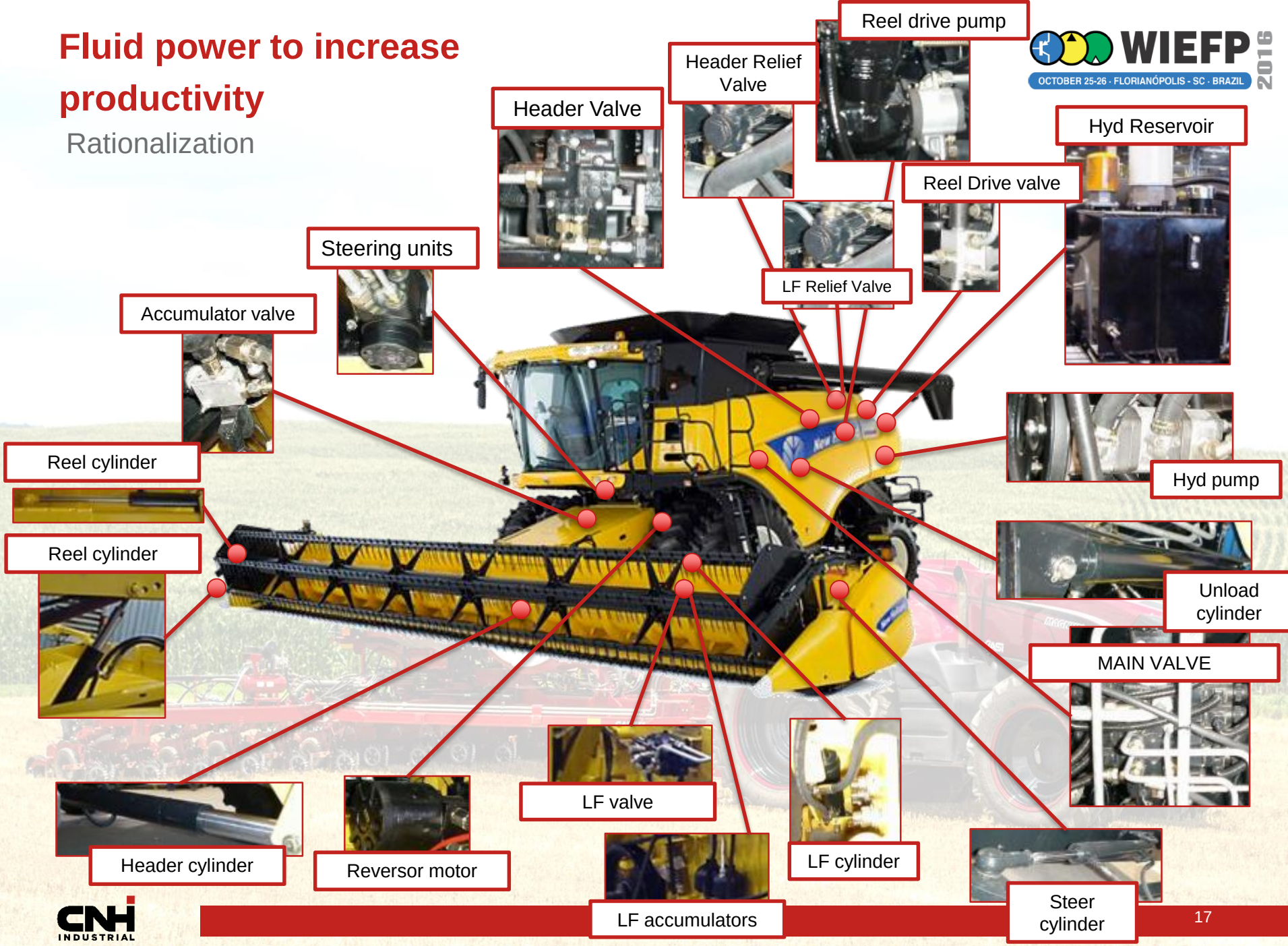




VARIABLE DISPLACEMENT PUMP

Fluid power to increase productivity

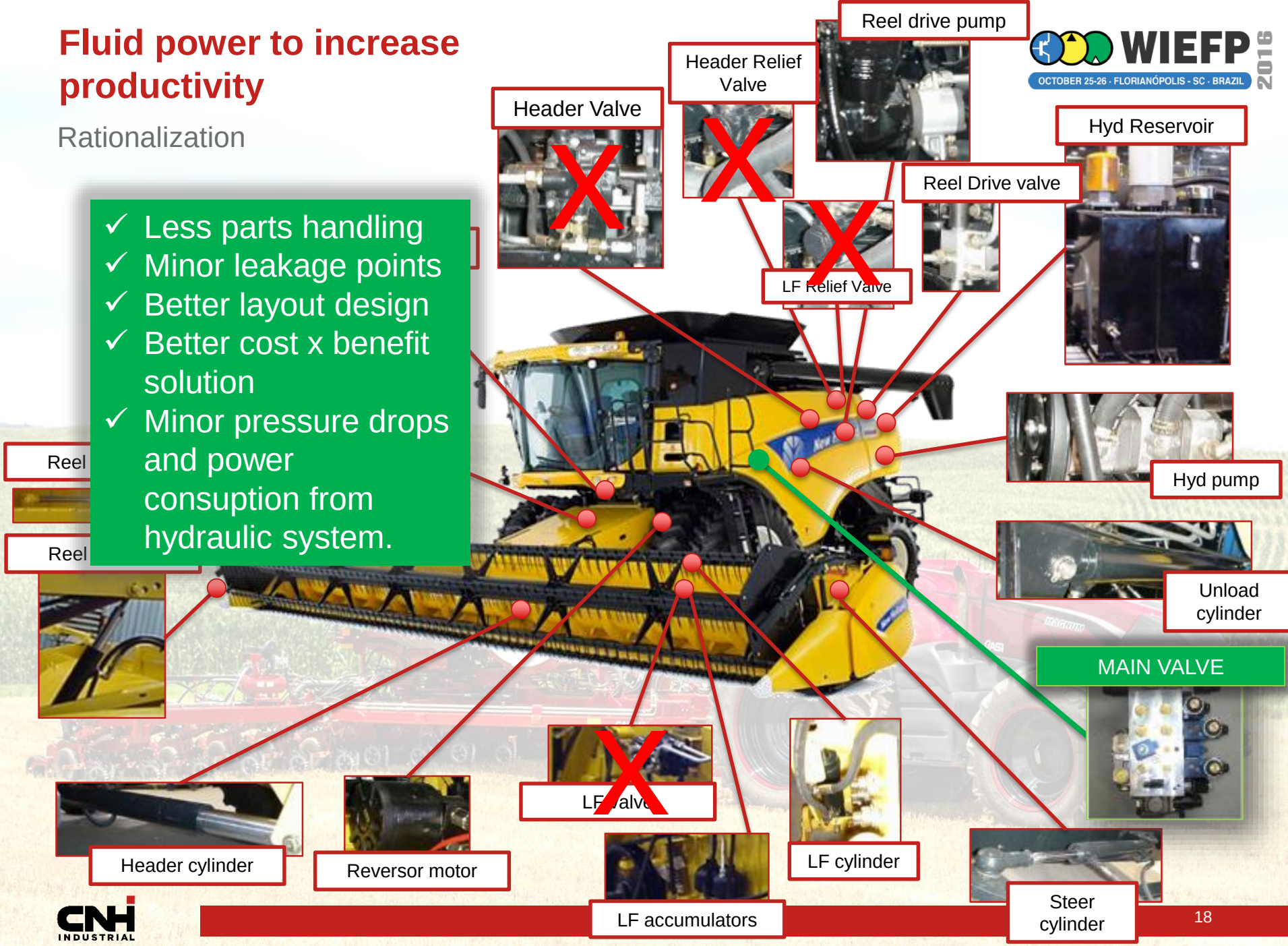
Rationalization



Fluid power to increase productivity

Rationalization

- ✓ Less parts handling
- ✓ Minor leakage points
- ✓ Better layout design
- ✓ Better cost x benefit solution
- ✓ Minor pressure drops and power consuption from hydraulic system.



Fluid power to increase productivity

New products to increase productivity

CVT Transmission

- ✓ Infinite gear ratios → perfect balance of power and efficiency
- ✓ The best gear ratio through varying conditions,
- ✓ **Improved fuel economy and more efficient performance.**

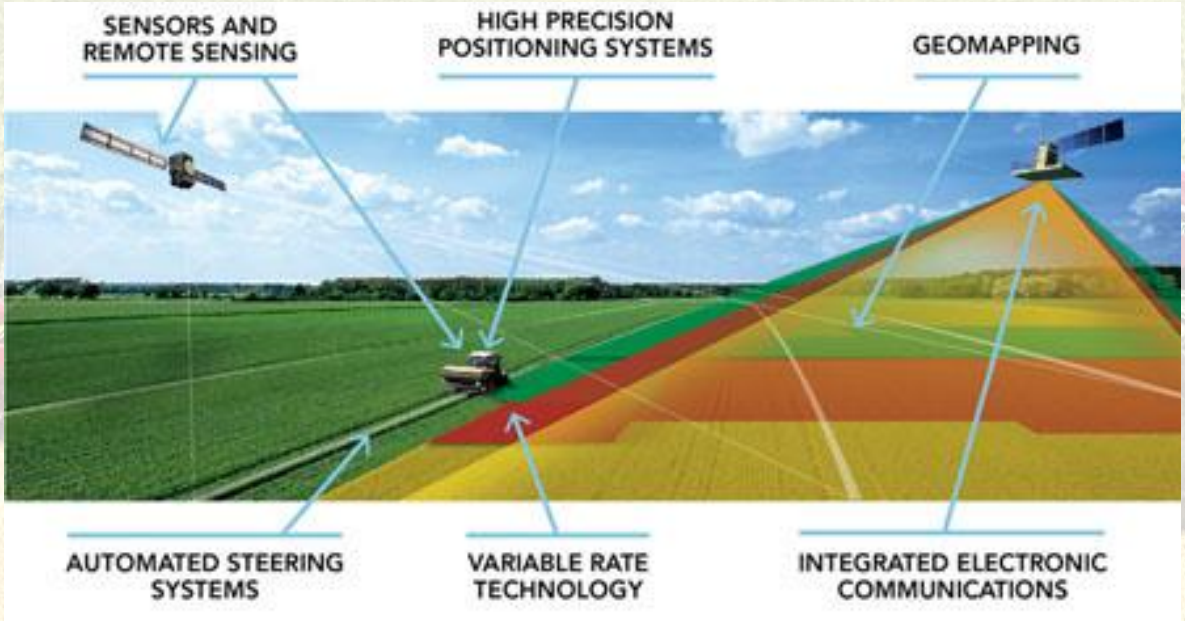
Front Axle Suspension

- ✓ Tires on the ground → crucial for stability and efficient performance
- ✓ **Better ride at higher speeds.**
- ✓ Avoid from bouncing and jarring in the cab

Fluid power to increase productivity

GPS & Precision Agriculture

- High demand of precision agriculture
  - Automated Steering systems
  - Sprayer overlapping, planter overlapping (variable rate control)
    - ✓ Individual nozzle control
  - Machinery fleet control and synchronization;



Trends of fluid power in agriculture

Components

Valves	**Manifolds**
Open Center	**Closed Center**
Manually operated	**Electronic operated**
Soneloid valves	**Proportional Control valves**
Medium flow	**High flow pumps and systems**
Manual operation	**Remote (pilot) operation**
Troubleshooting	**Telemetrics**


CASE IH
MAGNUM
CASE IH

THANK YOU!

Backup