KOMATSU

P&H

JOY

MONTABERT

Agenda

Komatsu segmento UGHR

Underground Mining

Solution Portfolio

LHD Hybrid

Mining methods

- Komatsu became a full line equipment supplier in IN-PIT operation through the acquisition of KMC in 2017.

For Surface mining									For Underground mining					
Bulldozer	Motor grader	Dump truck	Hydraulic Excavator	Mechanical Wheel Loader	Elec. Wheel Loader	Rope Shovel	Drill	Dragline	Continuous Miner	Truck	Roof Support	Roadheader	Shearer	LHD
✓	✓	✓	✓	✓										
					✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Notes:

KOMATSU

KMC (JOYGLOBAL)

Komatsu Cummins Chile

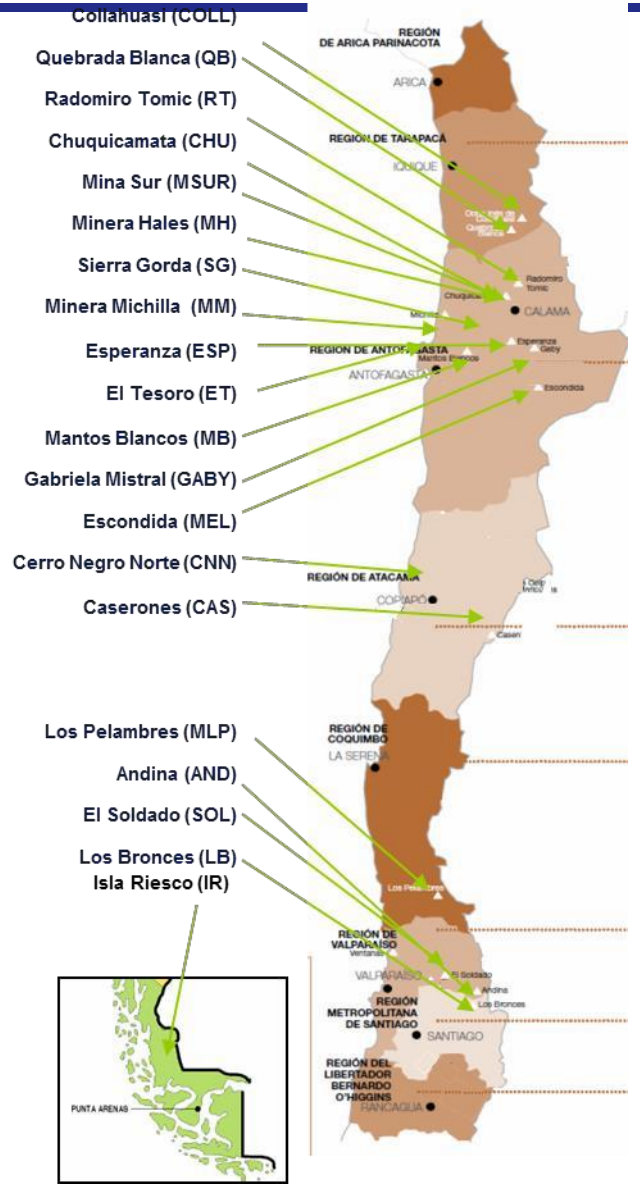
Komatsu Cummins Chile	
Ventas anuales	USD1,081 million
Número de trabajadores	5,029
Sucursales	38
Contratos mineros	18
Taller eléctrico para minería	2 (Antofagasta – Santiago)
Flota Komatsu Fleet bajo contrato de servicio	896
Inventario de repuestos	USD171 million
Pool de componentes de intercambio	USD120 million

Minería
(82% de las ventas)

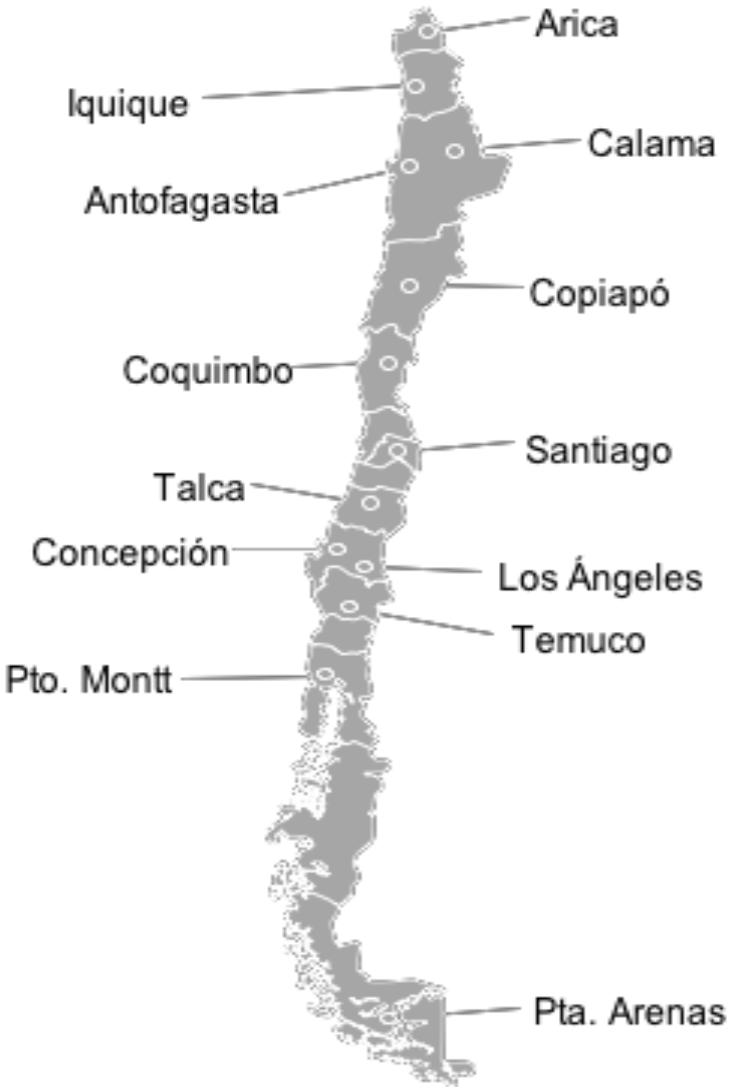
Construcción
(17% de las ventas)

Forestal
(0.6% de las ventas)

Otros
(0.4% de las ventas)



Komatsu Chile – Sucursales



18 Sucursales

KCH KCCA

- Venta de Equipos
- Venta de Repuestos
- Arriendo de Equipos
- Servicios de Reparación y Mantención
- Asistencia Técnica en terreno

Komatsu Chile – Centro de distribución Antofagasta

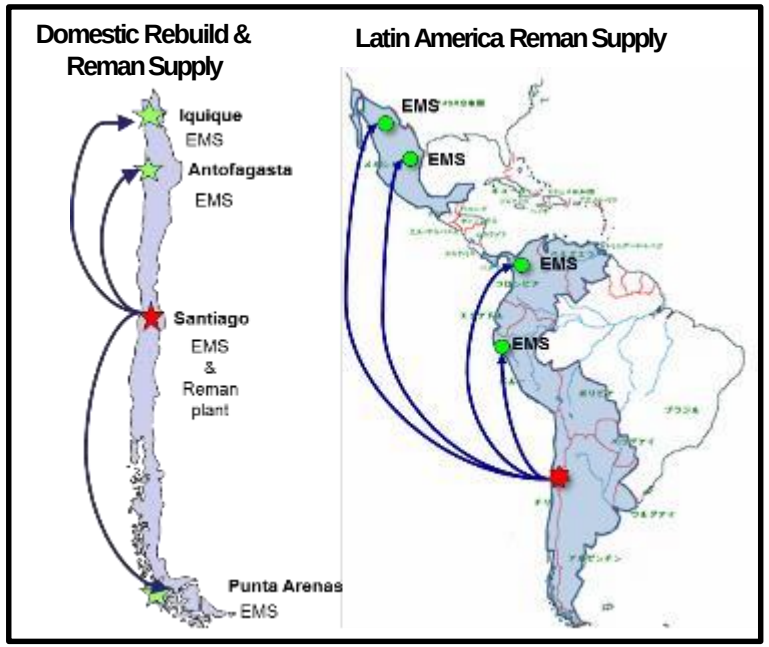
Superficie	:	56,000 m2
Bodegas	:	13,200 m2
Inventario	:	66 MMUS$
SKU	:	33,252
Sistema	:	WMS SAP
Mov.	:	600,000 units/month

Komatsu Chile – Training Center, KRCC

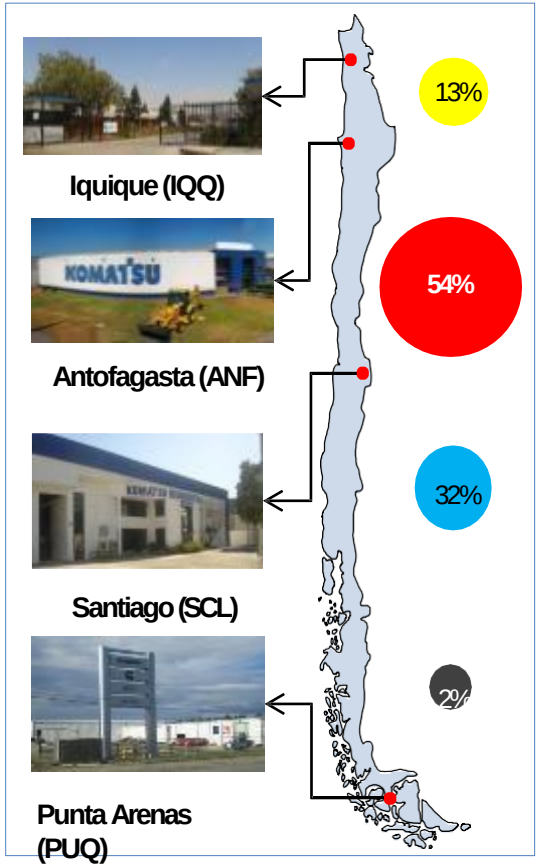
Instalaciones Lo Boza, Santiago

Komatsu Reman Center Chile (KRCC)

- Centro de reconstrucción y reparación de componentes eléctricos, hidráulicos y electrónicos.
- Planta principal de reparación de componentes para camiones eléctricos.
- Programas de certificación de talleres de electricidad y mecánica (EMS) de la región.

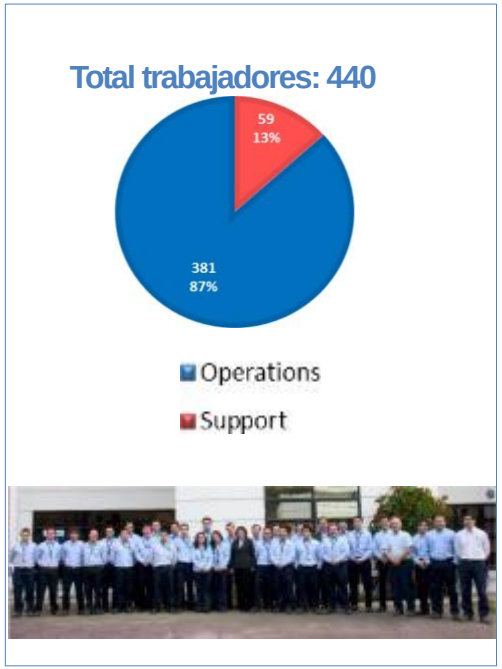


PLANTAS TRABAJADORES



PRODUCTOS

PERSONAS



Spare Parts & Components (New or Reman)

Commercial Parts & Components

Cummins

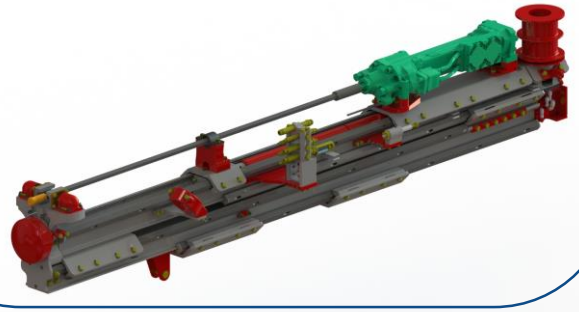
DANA

Reman

Key Parts & Components

MONTABERT

Timberock International



Komatsu Rental Fleet

KOMATSU ARRIENDA

UG Rental Fleet

LT-1051 (10 Tons)

Vein Runner II
Drift Runner SB 1

DT-3504 (31 Tons)
16TD (16 Tons)

Montabert HC 50
Montabert HC 109/110

Modelos de Equipos

LT-1051
(10 Tons)

LT-605
(7 Tons)

LT-4LD
(Usados)
(4 Tons)

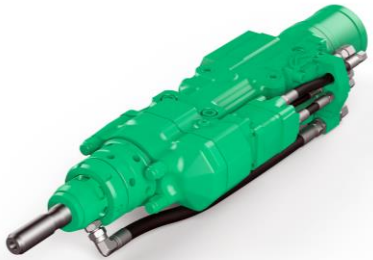
DT-3504
(32 Tons)

Jumbo DR 1SB

Jumbo VR II

Modelo de Equipos

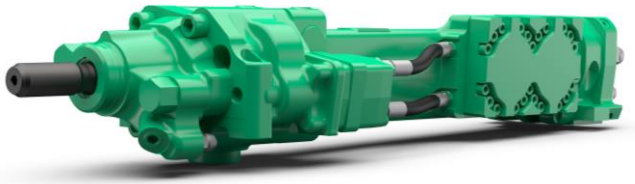
Jumbo DR 1SB



HC 50

HC 95

Jumbo VR II



HC 110

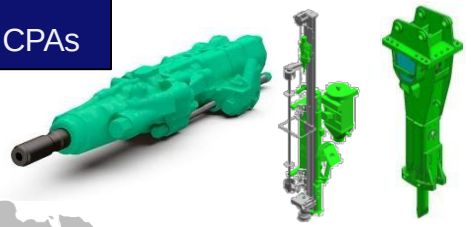
Komatsu – Soluciones

Hard Rock Product Organization

2017

Sudbury, Ontario Canada
Narrow Vein, Sudbury Products – Jumbo's, ITH Drills, LHDs, Trucks, Drifter Conversions, Shaft Equipment, Rotary Drill Tools – Raisebore, Blasthole

Lyon, France
Montabert Breakers, Rock Drills, CPAs



Longview, Texas USA
SR Hybrid Drive LHDs, Trucks

Franklin, PA
NPD, Engineering Systems

Tianjin, TAEA, China
Dynaminer Mfg Support

Moss Vale, Australia
DynaMiner, HRCM

Wadeville, South Africa
NPD – Engineering Design

Manufacturing, Technical Support Center

Engineering Center of Excellence

KOMATSU

KOMATSU

Loader & Truck Underground

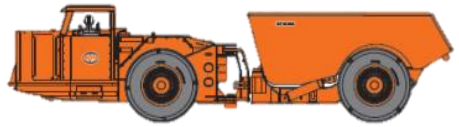
Current Loader Product Range

Joy Loader Models		Load Capacity	Bucket Volume	Tunnel Size
LT-270		2 722 kg 6,000 lbs	1,2 m^3 1.5 cu.yd.	2,5 x 2,5 m 8.0 x 8.0 ft
4LD		4 000kg 8,800 lbs	1,9 m^3 2.5 cu.yd.	3,0 x 3,0 m 10.0 x 10.0 ft
LT-650		6 591 kg 14,500 lbs	3,1 m^3 4.0 cu.yd.	3,5 x 3,5 m 11.5 x 11.5 ft
LT-1051		10 000 kg 22,000 lbs	4,6 m^3 6.0 cu.yd.	4,0 x 4,0 m 13.0 x 13.0 ft

Equipos LHD

Equipo	Capacidad de Carga Nominal	Volumen Balde	Alto x Ancho x Largo	Motor
LT-1051  *Cabina FOPS/ROPS	10 ton	Std 6,0 yd3 / 4,6 m3 Opt. 6,5 yd3 / 5,0 m3 Opt. 7,3 yd3 / 5,6 m3	9,75 x 2,75 x 2,45 m	Cummins QSL9 (280 hp)
18HD  *Cabina FOPS/ROPS	18 ton	Std. 12,0 yd3 / 9,2 m3 Opt. 13,1 yd3 / 10,0 m3 Opt. 14,7 yd3 / 11,2 m3	3,0 x 3,2 x 11,63 m	MTU Serie 1100 (375 hp)
22HD  *Cabina FOPS/ROPS	22 ton	Std. 14,6 yd3 / 11,2 m3 Opt. 12,2 yd3 / 16,0 m3 Opt. 18,0 yd3 / 13,8 m3	3,05 x 3,71 x 11,7 m	MTU Serie 1300 (429 hp)

Current Truck Product Range

Joy Truck Models		Load Capacity	Dump Box Volume	Tunnel Size
7TD		6,3 t 7 tons	3,3 m^3 4.3 cu.yd.	2,5 x 2,5 m 8.2 x 8.2 ft
16TD		16 t 17.6 tons	8,0 m^3 10.4 cu.yd.	3,2 x 3,2 m 10.5 x 10.5 ft
DT-3004		27,3 t 30 tons	15,9 m^3 20.0 cu.yd.	4,0 x 4,0 m 13.0 x 13.0 ft
DT-3504		31,8 t 35 tons	17,4 m^3 22.6 cu.yd.	4,3 x 4,3 m 14.0 x 14.0 ft

KOMATSU

Development & Production Underground Drill

Development Drills Current Product Range

Joy Global Models	Face Coverage	Drifter Size	Tram Tunnel Size (H x W)	Steel Length Size	Application
NV-1 	3m x 3m 10ft x 10ft	HC-20 HC-25 HC-50	3m x 2.5m 10ft x 8.2ft	1.8m - 6ft 2.4m - 8ft 3m - 10ft	Drilling Bolting
VR-II 	5.3mH x 5.6mW 17.6ft x 18.4ft	HC-25 HC-50 HC-109 HC-110	3m x 3m 10ft x 10ft	3m - 10ft 3.7m -12ft 4.3m -14ft	Drilling Bolting
DR-1MB 	6.3mH x 5.8mW 20.7ft x 19ft	HC-50 HC-109 HC-110	3.5m x 3.5m 11.5ft x 11.5ft	3.7m -12ft 4.3m -14ft 4.9m -16ft	Drilling Bolting
DR-2MB 	6.3mH x 8.5m 20.7ft x 27.7ft	HC-50 HC-109 HC-110	3.5m x 3.5m 11.5ft x 11.5ft	3.7m -12ft 4.3m -14ft 4.9m -16ft	Drilling Bolting

KOMATSU

Montabert Drifter & Timberock Feed

Komatsu Drilling Solution Conversion

Komatsu Drilling Solutions

Montabert Drifter Conversion

Montabert Drifter
& Feed Conversion

Fixed/
Telescopic Feed Conversion

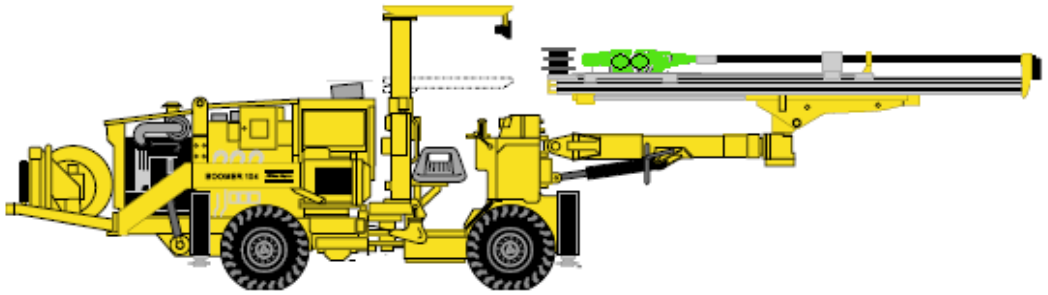
Bolter Conversion

SAME CAPABILITIES AND COMPATIBLE WITH ALL MAJOR AND MOST OTHER OEMS

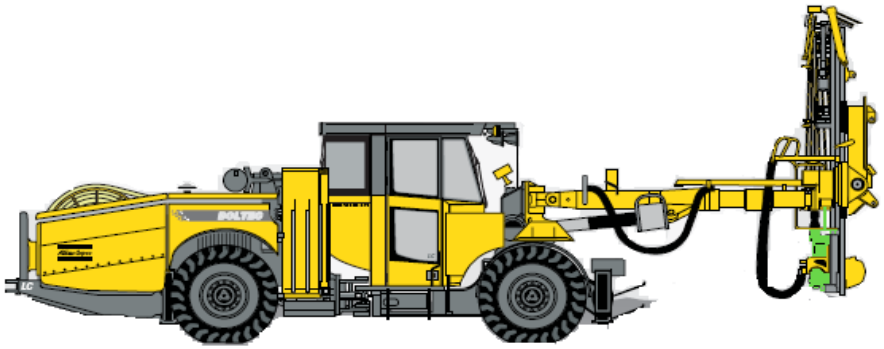
KOMATSU

Viable Montabert Conversions

Atlas Copco Jumbo



Atlas Copco Bolter



Sandvik Jumbo & Bolter

Same capabilities and compatible with all major and most other OEMs

Viable Komatsu Drilling Solution Conversions

Atlas Copco Jumbo

Atlas Copco Bolter

Sandvik Jumbo

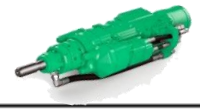
Sandvik Bolter

KOMATSU

Compatible Drill Models

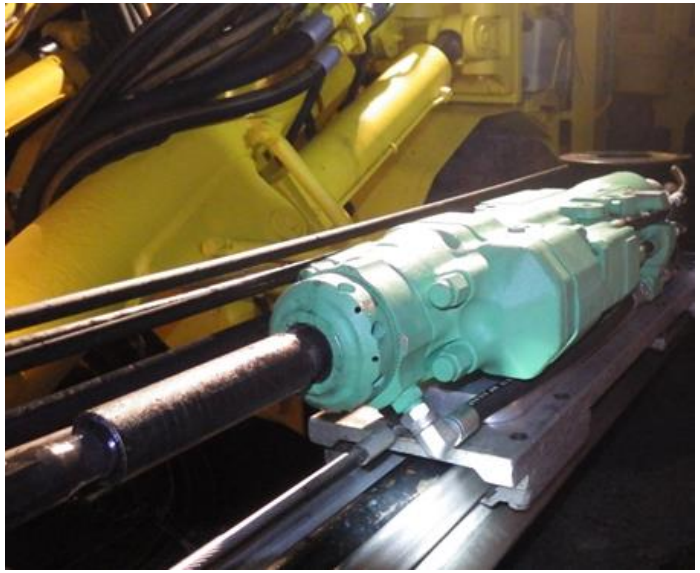
MONTABERT	HC20	HC25	HC50	HC109/HC110	HC110	HC112	HC170
Atlas Copco	COP1019DS-1 COP1019DS-2 COP1019 COP1022 COP1025 COP1028HB/HD COP1032LE	COP1032HD COP1032HB COP1036HB COP1132	COP1038HF COP1238K COP1238LE COP1238HF COP1240 COP1432 COP1432ED COP1435 COP1532	COP1038HD COP1038HB COP1038HL COP1238ME COP1238HE COP1238LP COP1338MEX COP1550 COP1638+ COP1638HD+ COP1640+ COP1640EX COP1838LE COP1838ME COP1838MEX COP1838+ COP1838HD+ COP1838MUX COP1850 COP1850EX COP1850CR	COP1838CR COP1838HE COP1838HE+ COP1838HUX 1840+ 1840EX COP1838HEX COP1840HE COP1840HEX COP1440 COP1838HF COP2150 COP2150EX COP2150CR COP3038	Cop3060MUX COP4050 COP4050EX COP4050ME COP4050MEX COP4050MUX	COP2540+ COP2540EX COP2550 COP2550EX COP2550UX COP2550CR COP2560
SANDVIK	HYDRASTAR 200 HLX1	HYDRASTAR 300 F/NV HYDRASTAR 300 L/LT HL 300 HL 300S HE 300 HE 322 HE 425 HE 428	HYDRASTAR 350 F/NV HYDRASTAR 350 L/LT HLR 438 HL 538 HL 500 HL 500S HL 510 RD314	HL 438T HL 600 HL 600S	HL 550SUPER HL 560SUPER HLX5T	HL700 HL700 S (LH) HL710 HL800 T HL844 HL844E HL850 HL850 S RD520 HL1500 HL1500 S (LH)	HL1000 HL1000 S (LH) RD525

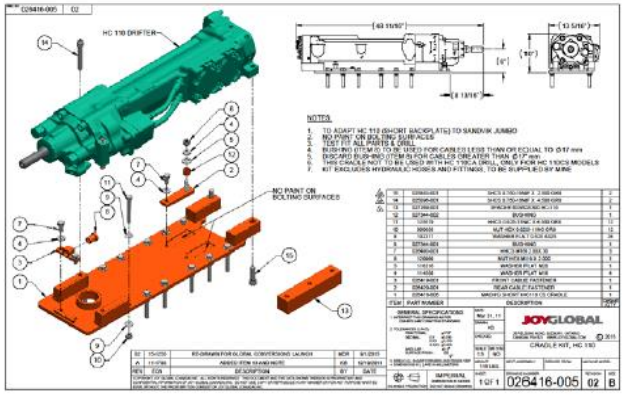
Montabert Drifters Available for Conversions

Model		Weight	Percussion power	Impact Rate	Percussion flow/pressure	Rotation flow/pressure	Application	Hole range
HC25		72 kg 158 lbs	8 kW	3,900 BPM	65 l/min 150 bar	30 – 48 l/min 175 bar	Light face drilling, bolting	38 – 64 mm 1” – 2”
HC28		103 kg 227 lbs	6 – 9.8 kW	3,200 BPM	68 l/min 160 bar	48 l/min 210 bar	Light face drilling, bolting	32 – 64 mm 1.25” – 2.5”
HC50		103 kg 227 lbs	14 kW	Up to 4,400 BPM	80 – 105 l/min 150 bar	25 – 52 l/min 150 bar	Face drilling, bolting	45-76 mm 1 3/4” - 3”
HC95		170kg 375 lbs	Up to 24 kW	Up to 3,800 BPM	90-120 l/min 160-200 bar	48-75 l/min 210 bar	Face drilling, long hole, bolting, scale	45-102 mm 1 3/4” - 4”
HC109		142 kg 313 lbs	Up to 19 kW	2,900 - 3,500 BPM	100-135 l/min 135 bar	30-60 l/min 150 bar	Face drilling, long hole, bolting, scale	45-102 mm 1 3/4” - 4”
HC110		200 kg 441 lbs	Up to 27 kW	4,620 BPM	90-170 l/min 165-225 bar	65-75 l/min 175 bar	Face drilling, long hole, tunneling, shaft drilling	51-89 mm 2” - 3 1/2”
HC112		248 kg 547 lbs	26 kW	2,740 BPM	170 l/min 180 bar	70-80 l/min 175 bar	Long hole	76-127 mm 3” - 5”

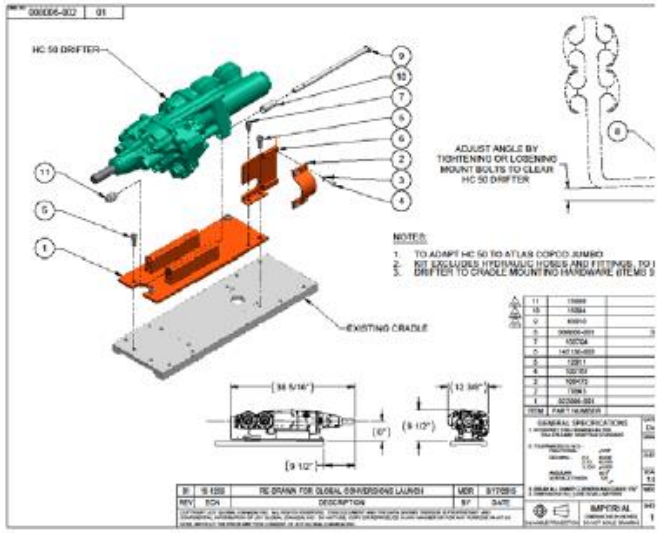
KOMATSU

Cradle for Conversion





- Re-buildable Cradles
- Multiple designs for different applications



Montabert Conversion

Annual Operating Cost Summary

	Otra Perforadora	HC110 CS
Annual Production (ft) (est.)	269,087	284,332
Total Annual Rebuild Cost ($)	$41,148	$12,012
Total Annual Shank Cost ($)	$7,650	$3,375
Total Annual Bit Cost ($)	$34,003	$20,346
Total Operating Cost	$82,801	**$35,733**
Total Annual Savings For One Drifter		**$47,068**
3 Year Savings		**$141,204**

Montabert HC110CS los costos de operación se reducen en 56.8%

Operación típica en Chile puede tener 1200 hr/año vs 750hr/año del estudio (Esto significa US$75,300 /año en ahorros por perforadora)

Komatsu Drilling Solution Conversion

Komatsu Drilling Solutions

Montabert Drifter Conversion

Montabert Drifter
& Feed Conversion

Fixed/
Telescopic Feed Conversion

Bolter Conversion

SAME CAPABILITIES
AND COMPATIBLE
WITH ALL MAJOR
AND MOST
OTHER OEMS

KOMATSU

Competitive Conversion Target

Fixed Feeds

Application	Length	Sandvik TF500	Sandvik TF5i	Epiroc 2000	Epiroc 6000	Epiroc 6800	(Joy)
Product(s): Dev. Jumbo	8"	✓		✓			✓
Tunnel: Narrow Vein	10"	✓		✓			✓
Function(s): Drill, Bolt	12"	✓		✓	✓		✓
Product(s): Dev., Shaft and Tunneling Jumbos	14"	✓	✓	✓	✓	✓	✓
Tunnel: Small to Medium	16"	✓	✓	✓	✓	✓	✓
Function(s): Drill	18"	✓	✓		✓	✓	✓
Product(s): Dev., Shaft and Tunneling Jumbos	20"		✓		✓	✓	✓
Tunnel: Large	21"		✓			✓	
Function(s): Drill	22"		✓				

KOMATSU

Competitive Conversion Target

Telescopic Feeds

Application	Length	Sandvik TFX	Epiroc 2000	Epiroc 6000	Epiroc 6800	(Joy)
Product(s): Dev Jumbo, TBM **Tunnel:** Narrow Vein **Function(s):** Drill, Bolt	6/9"					
Product(s): Dev. Jumbo **Tunnel:** Small **Function(s):** Drill, Bolt	6/12"					
	8/12"					
Product(s): Dev. Jumbo **Tunnel:** Medium **Function(s):** Drill, Bolt	8/14"					
	10/16"					
	12/18"					

KOMATSU

18HD/22HD Hybrid Diesel LHD
Product Introduction

Emerson L. Tobar Arrué, Gerente Cuenta Comercial
October 18, 2019
Underground Hard Rock Mining

Pala Hibrida 18HD Komatsu

Potential Applications

Large tunnel profiles

- >5m x 5m
- >16.4ft x 16.4ft

Mining methods

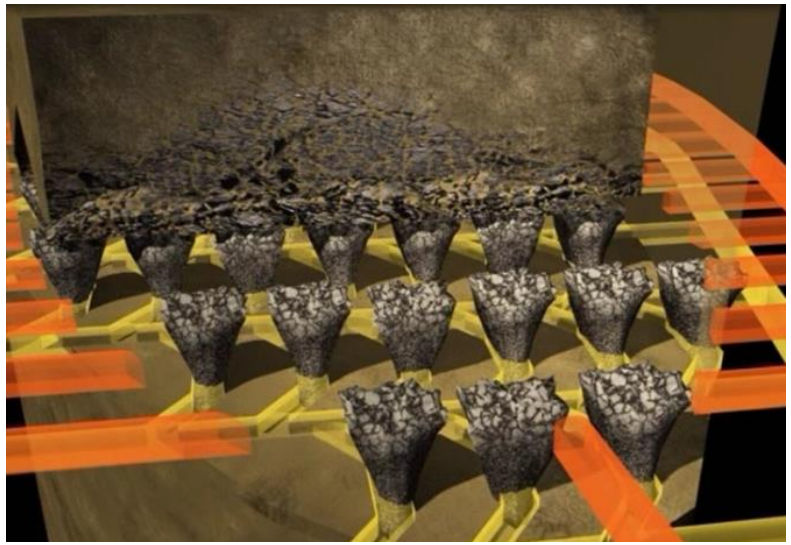
- Block/panel caving
- Sub level caving
- Various stoping methods

Commodities

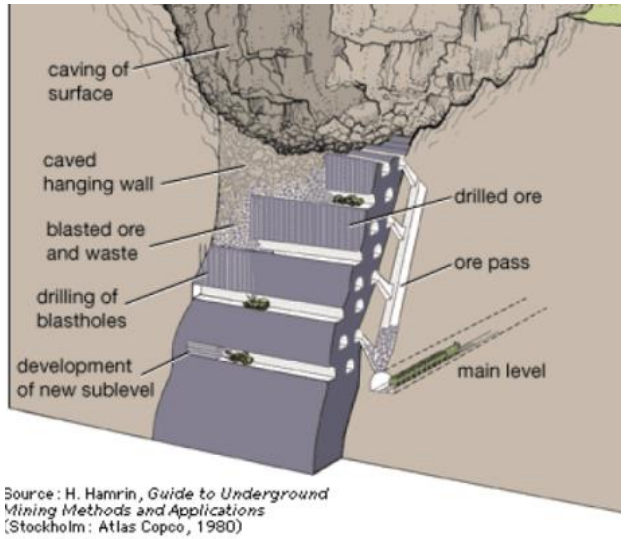
- Hard rock
  - Gold
  - Copper
  - Nickel
- Soft rock

Applications

- Load-Haul-Dump (LHD)
  - Moving ore or rock from one point to another
- Truck loading



Block Cave



Sub Level Cave

Productividad

Sistema de Propulsión Híbrida SR

- Captura y re-utiliza energía de frenado
  - Aceleración: Lider en su clase
  - Ciclo de carguío mas corto
  - Mayor eficiencia en uso de combustible

Diseño ultra pesado

- Menos fallas, mas tiempo útil

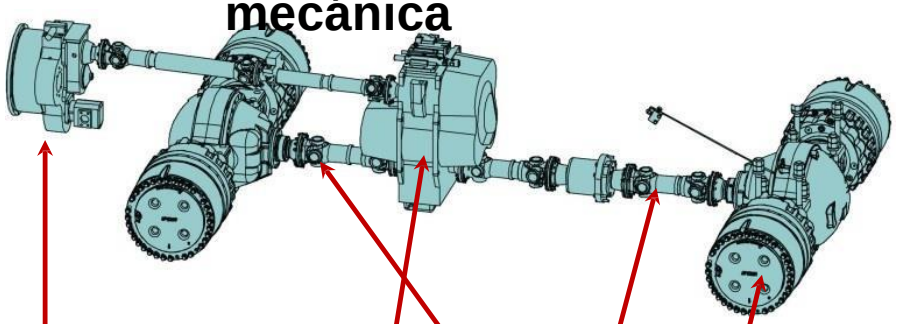
Diseño de balde

- Fácil de llenar, bajo desgaste

Controles de cabina fáciles de usar

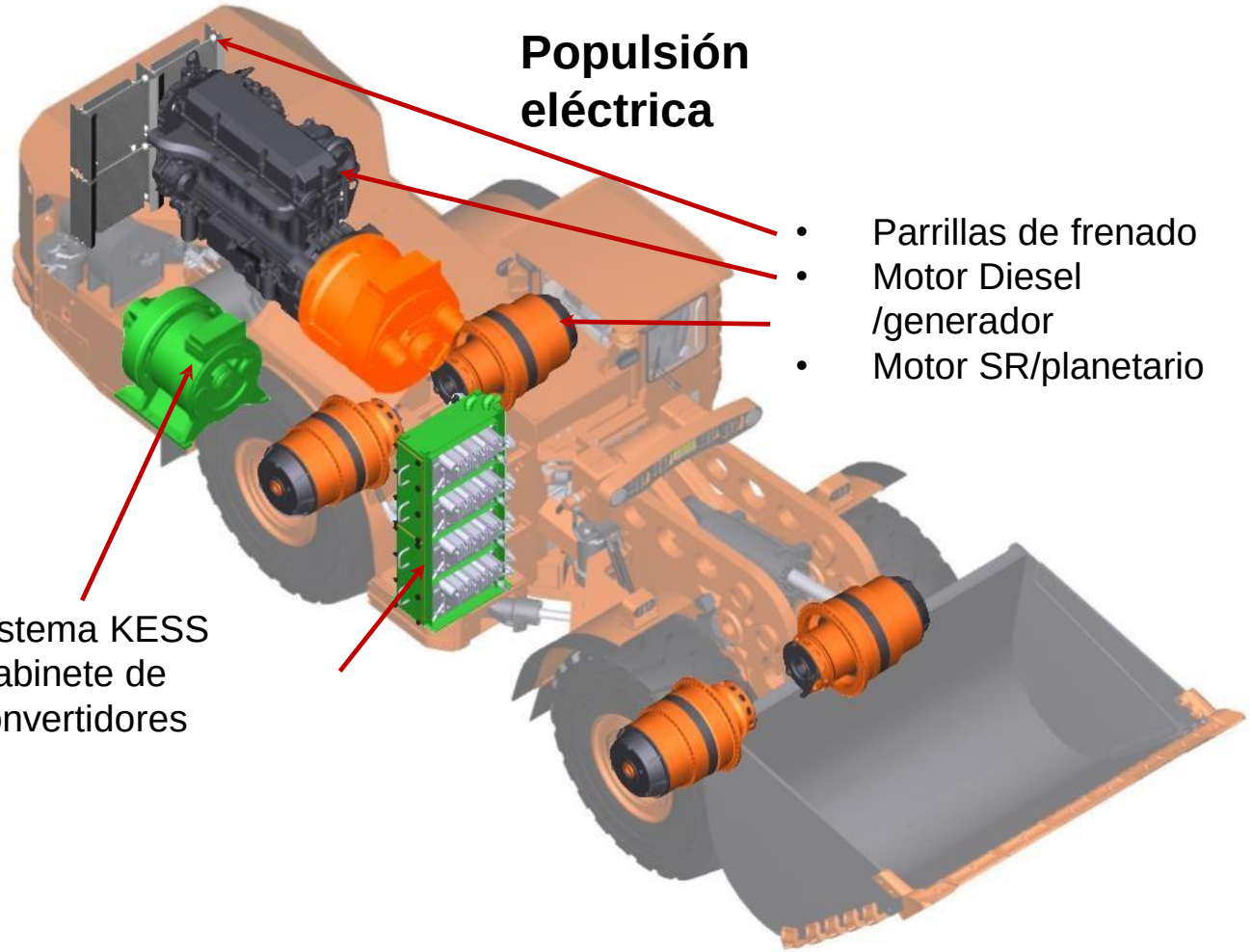
Diferencias claves –Sistema de propulsión híbrida SR

Populsión mecánica



- Convertidor de torque
- PTO/caja de transferencia
- Eje de propulsión
- Diferencial/mandos finales

Populsión eléctrica

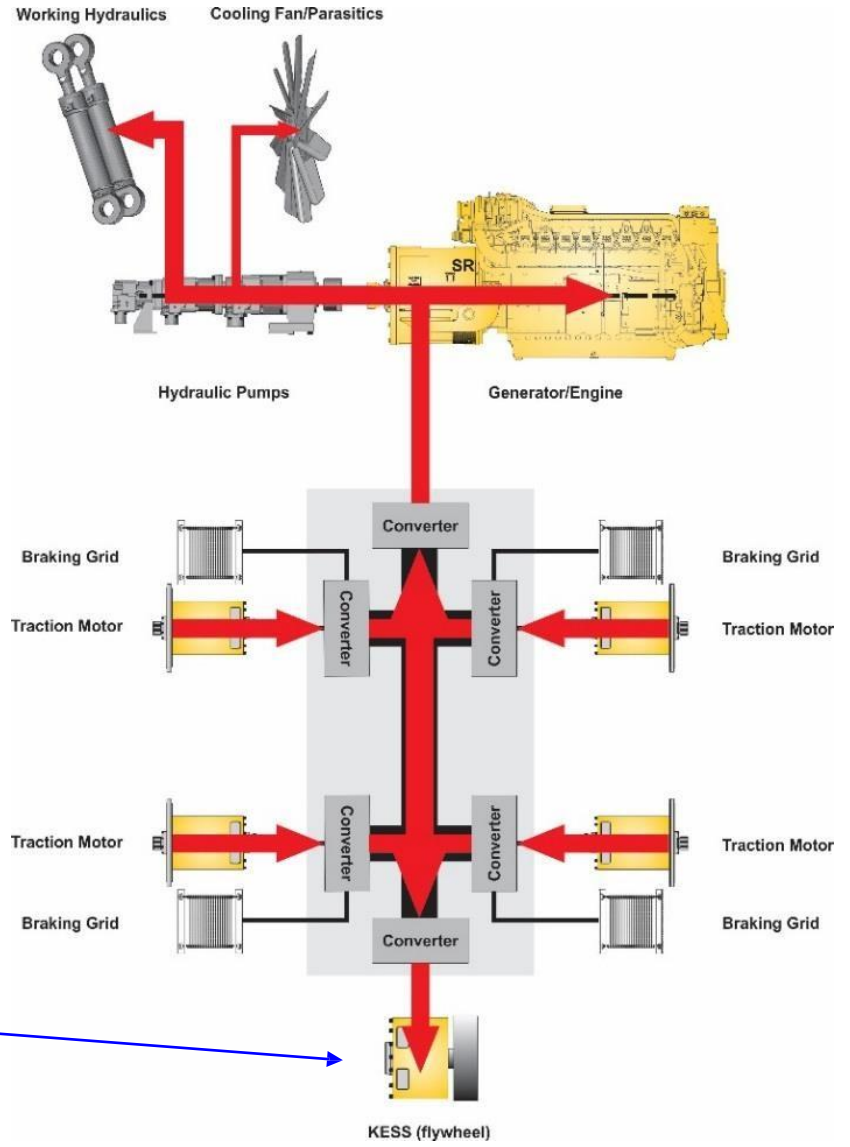


- Parrillas de frenado
- Motor Diesel /generador
- Motor SR/planetario

- Sistema KESS
- Gabinete de convertidores

Diferencias claves –Sistema de propulsión híbrida SR

Al frenar, en vez de usar frenos mecánicos como nuestra competencia los cuales generan calor, los motores SR montados en cada rueda convierten la energía de frenado a electricidad la cual se envía al Sistema KESS (Sistema de Almacenamiento de Energia Cinética).

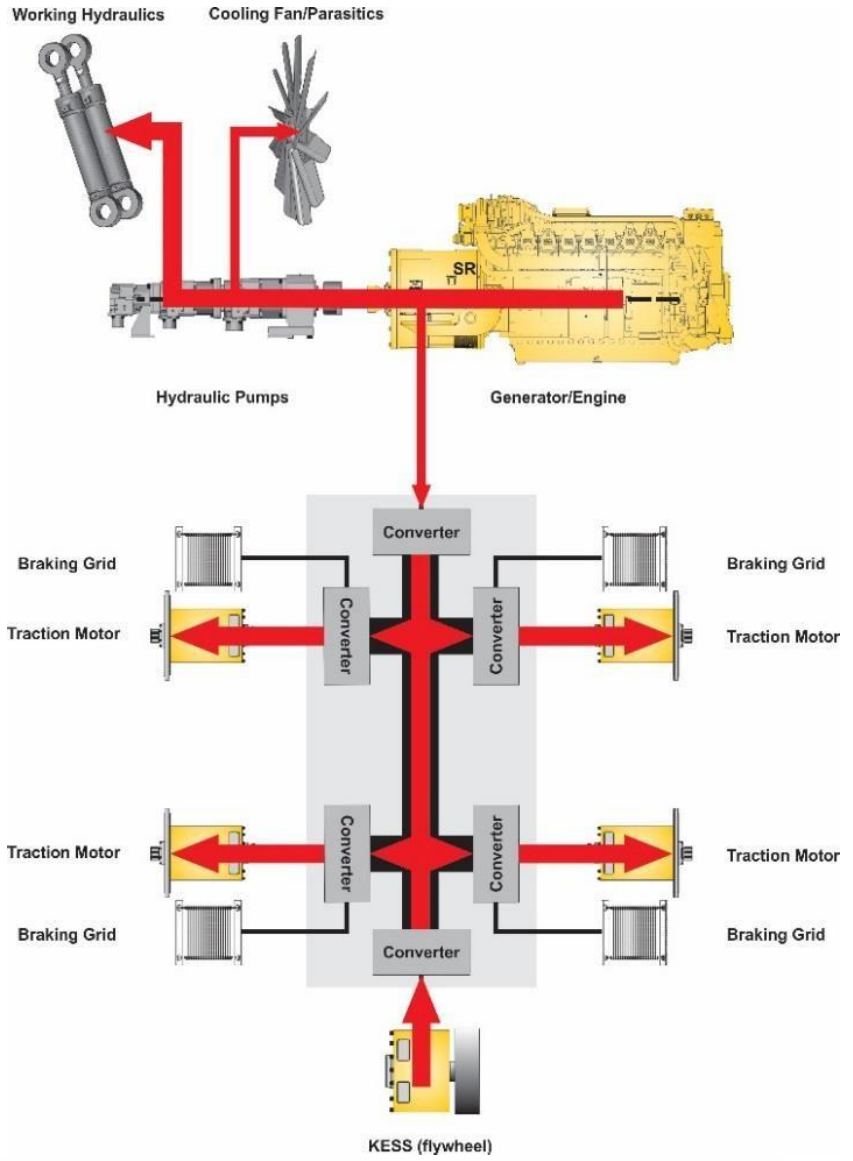


Sistema KESS

Ventajas del sistema de propulsion SR sobre propulsión mecánica

Cuando la pala acelera nuevamente se toma la energía del Sistema
KESS y se re-usa para ayudar a acelerar la máquina.

Durante la aceleración, se potencian los 400 hp del motor Diesel con otros 550 hp derivados de la energía de frenado los cuales se hubiesen perdido como calor. Estos 950 hp de potencia le dan a la pala una rapidez espectacular al mismo tiempo que se ahorra combustible, hasta 30% en algunas aplicaciones.

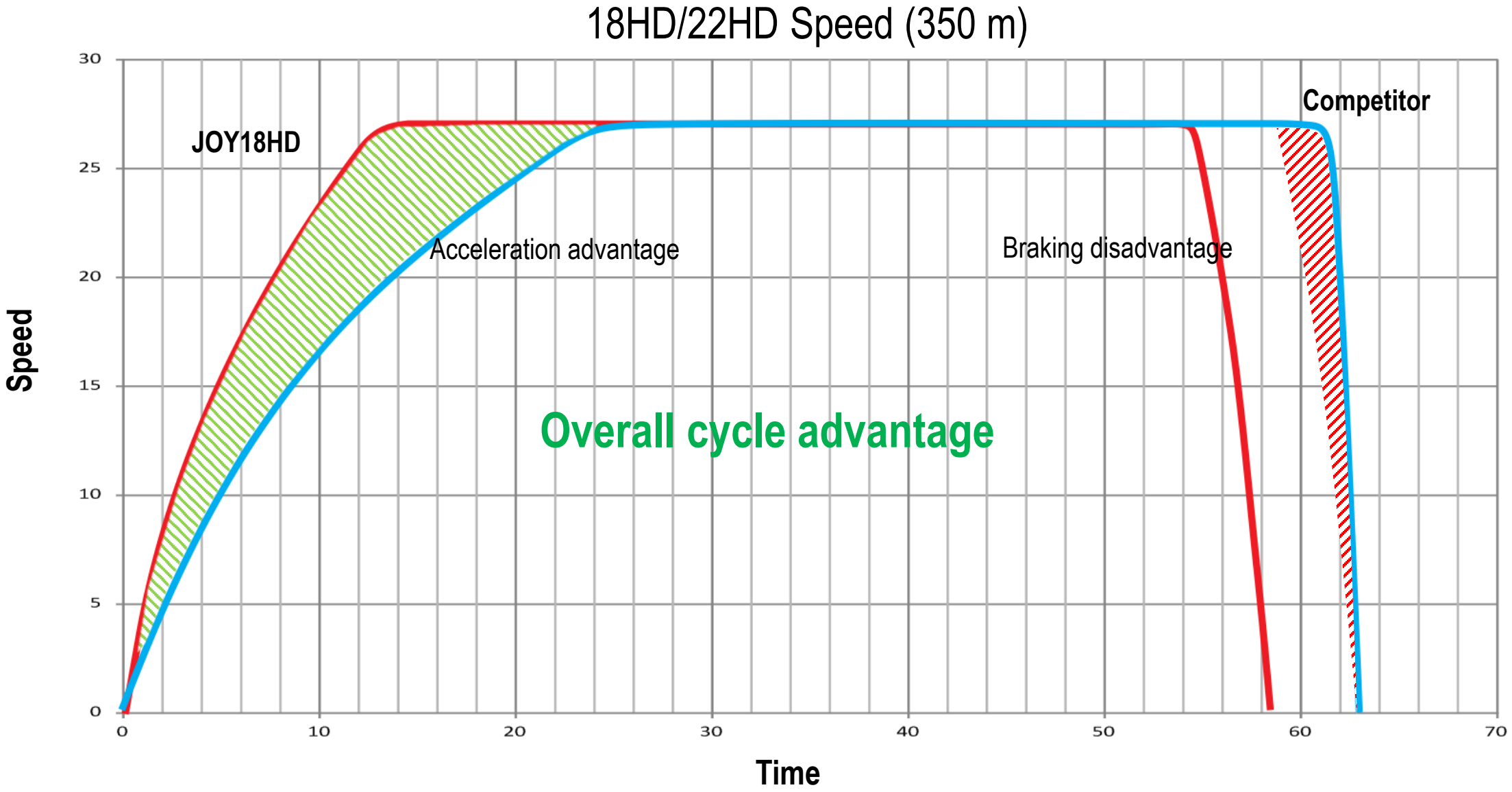


Ventajas del sistema de propulsion SR sobre propulsion mecánica

El **Sistema de propulsión híbrida SR** es también **muy eficiente al cargar material**. Al estolear, la pala mecánica esta usando toda su energía disponible para generar torque, El Sistema de propulsión híbrida SR crea el máximo empuje en las ruedas con solo un 10% de consumo de energia del motor Diesel, permitiendo que el otro 90% de energia restante sea usado por el Sistema hidraulico.

El calor generado por los frenos y el convertidos de torque en palas mecánicas debe ser disipado a traves de ventiladores y enfriadores. Los motores SR y sus paneles convertidores son enfriados con líquido refrigerante y no necesitan enfriadores auxiliares. Esto significa un costo menor del diseño, pocos hp perdidos en cargas parásitas y menos calor generado por la pala.

Speed Over Time Comparison



Hybrid LHD El Teniente

Overview

- Mine : El Teniente
- Start : **July 2019**
- Period : 12 Months
- Machine : LHD 18 T

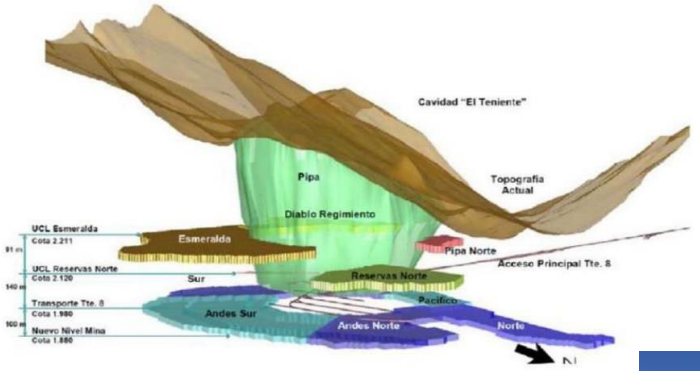


Imagen: Codelco El Teniente

Imagen: Codelco El Teniente

LHD Híbrido Modelo Joy 18HD - Características

Características operacionales:

- Equipo con motor Diesel y Eléctrico
- Capacidad de Levante:18 ton
- Volumen de Balde 13 yd3

Ergonomía y Salud Ocupacional:

- Reducción de Ruido para el operador
- Reducción de vibraciones de motor

LHD (Diesel) Competitors

Capacity (Operating envelope)	<2t LHD (2m x 2m)	2 – 3t LHD (2.3m x 2.3m)	3 – 4t LHD (2.5m x 2.5m)	5 – 7t LHD (3m x 3m)	8 – 12t LHD (3.5m x 3.5m)	13 – 15t LHD (4.5m x 4.5m)	16 – 18t LHD (5m x 5m)	>20t LHD (5.5m x 5.5m)
KOMATSU		**LT-270**	**4LD**	**LT-650**	**LT-1051**		**18HD**	**22HD**
Atlas Copco			ST-2D ST-2G	ST7	ST-1030	ST14	ST18	
SANDVIK	LH201	LH202	LH203 LH204	LH307	LH410	LH514	LH517	LH621
CAT				R1300G	R1600H	R1700G	R2900G	R3000H
GHH FAHRZEUGE			LF-5	LF-6	LF-10 LF-11H	LF-12H LF-14		
RDH		MM100 MM200	MM300	MM350 MM400	MM500D MM600D	MM800D	MM1000D MM1100D	
Aramine	L130D L150D							
PAUS	PFL8	PFL12	PFL18	PFL30	PFL45			
KGHM ZANAM		LKP-0301	LKP-0402 LKP-0405	LKP-0701	LKP-0806 LKP-0903		LKP-1601B	

OE Price vs TCO

JOY Op Cost makeup:

- Fuel: 38 litres/hour (prototype machine data)
- Maintenance parts & labour: US$80/hr. (very conservative modelling)

Competitor Op Cost makeup

- Fuel: 50 litres/hour (customer data)
- Maintenance parts & labour: US$140/hr. (customer data)

Does not include GET, tyres and accident damage

Leveraging Joy SR Hybrid Drive Technology

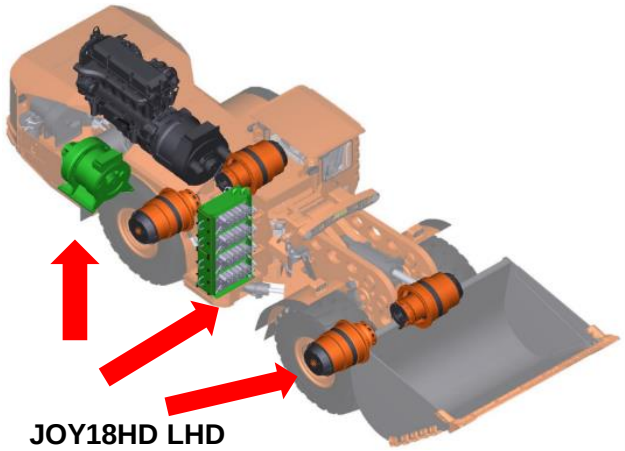
SR Hybrid drive – simple, powerful, robust, reliable & smart

Joy uniquely placed with a world class electric power system

Standard, configurable building blocks, all applications

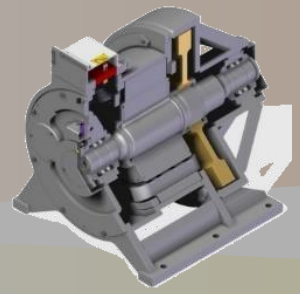
Build capability, competitive advantage

Adopt / adapt across products



JOY18HD LHD
The genesis of SR Hybrid Drive technology

SR wheel Unit
High speed, high torque, high power long life drive.

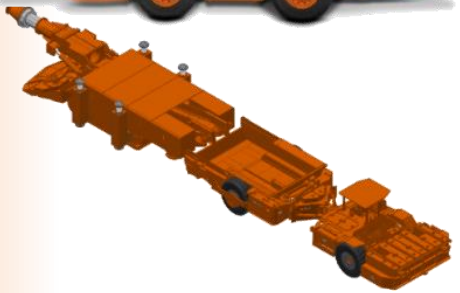


SR KESS Unit
SR motor flywheel to store energy
Superfast uptake and discharge
Extreme cycle life

UNDERGROUND

Next Gen SR cable-less shuttle car

Fast energy uptake
"*plug and charge*"
with mining machine



AFC / Conveyor SR Hybrid drive Joy system

SURFACE

Hybrid systems – n[illegible] gen surface loading tools

Proprietary technology across products reduces product cost, improved support and increases service capture

CAT the diesel engine company…Joy the electric driveline company…reducing impact to the environment

KOMATSU

18HD/22HD LHD / Surface Loader Comparison

Surface loader 2300 hp 270t weight 72t bucket capacity 21m long

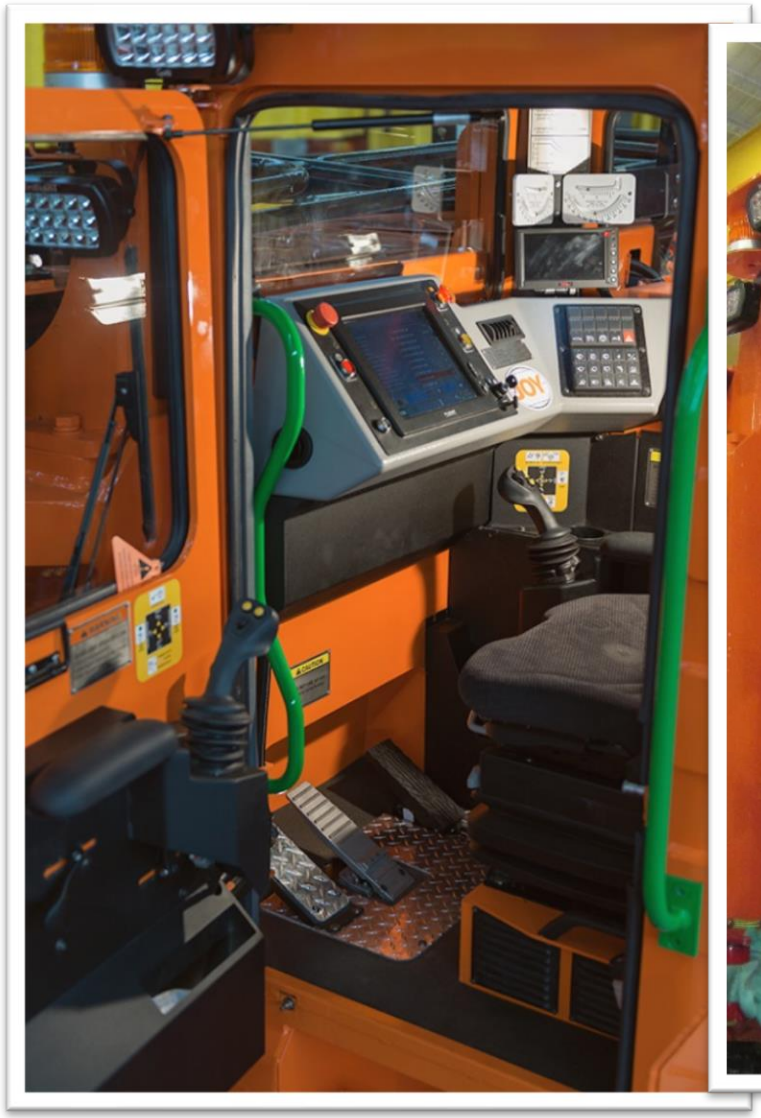
Underground LHD 400 hp 50t weight 18t bucket capacity 10m long

Same technology platform as surface loader – efficient mine duty electric driveline

Same design philosophy to deliver long life driveline. Same, proven, reliable “fly by wire” control system


Operator’s Cabin
JOY
PLANAR

Operator’s Cabin




Product Similarities

Komatsu Underground Hard Rock

Safety
Improve performance
Reduce operating costs

Visit mining.komatsu for more information.

Contact me emerson.tobar@mining.komatsu