

A NEW IDEA TO DISCOVER FOR WIND TURBINE TECHNOLOGY

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AT a glance

The Concept:

Take advantage of the inherent property of a planetary gearbox (something that has not been yet explored for wind turbines)

The goal:

reducing the cost of the electrical parts and controls in a modern wind turbine

How:

With some modifications in the structure and the way a wind turbine gearbox is employed it is possible to have two outputs: A smaller shaft with a variable speed output and a larger shaft with a constant speed. Accordingly, two generators are run by the same gearbox.

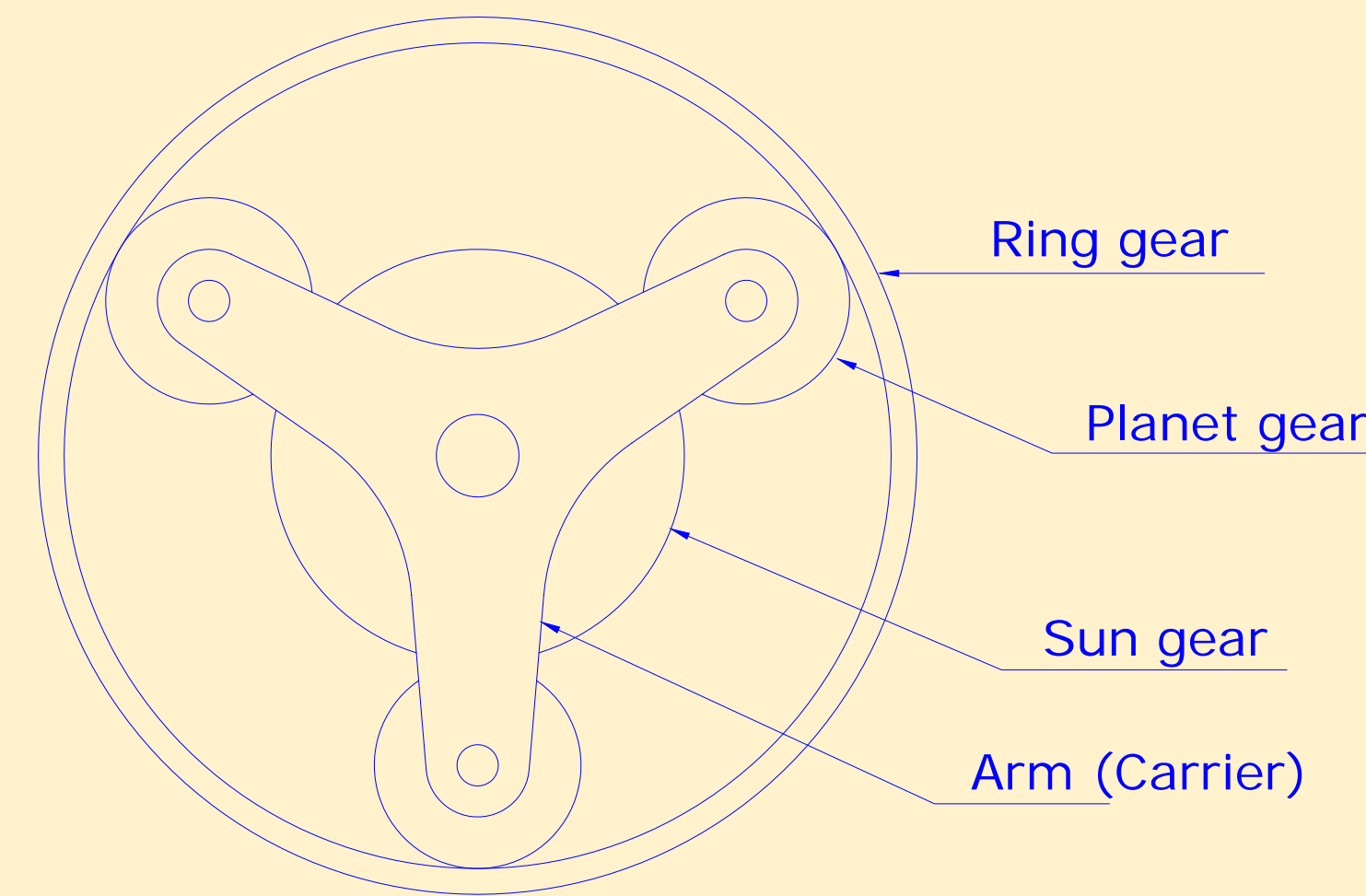
Advantages:

The main generator, taking a larger portion of the load, can be a cheaper machine. Only the smaller generator will be a DFIG or a synchronous generator, requiring converters.

In a planetary gear box either of the ring gear, sun gear or the carrier can be input or output

It is possible to have two outputs

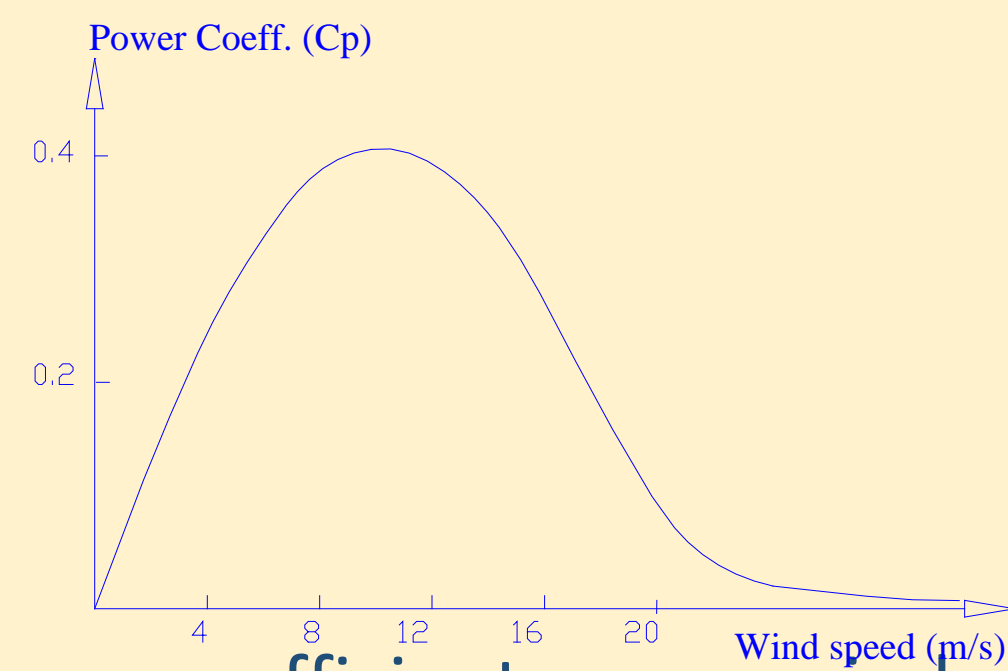
One output can be used to control the other



Example:

A 3MW turbine does not need to have a 3MW generator with all its converters rated accordingly. If 2MW is provided by a squirrel cage machine, then only 1 MW is through a costly generator.

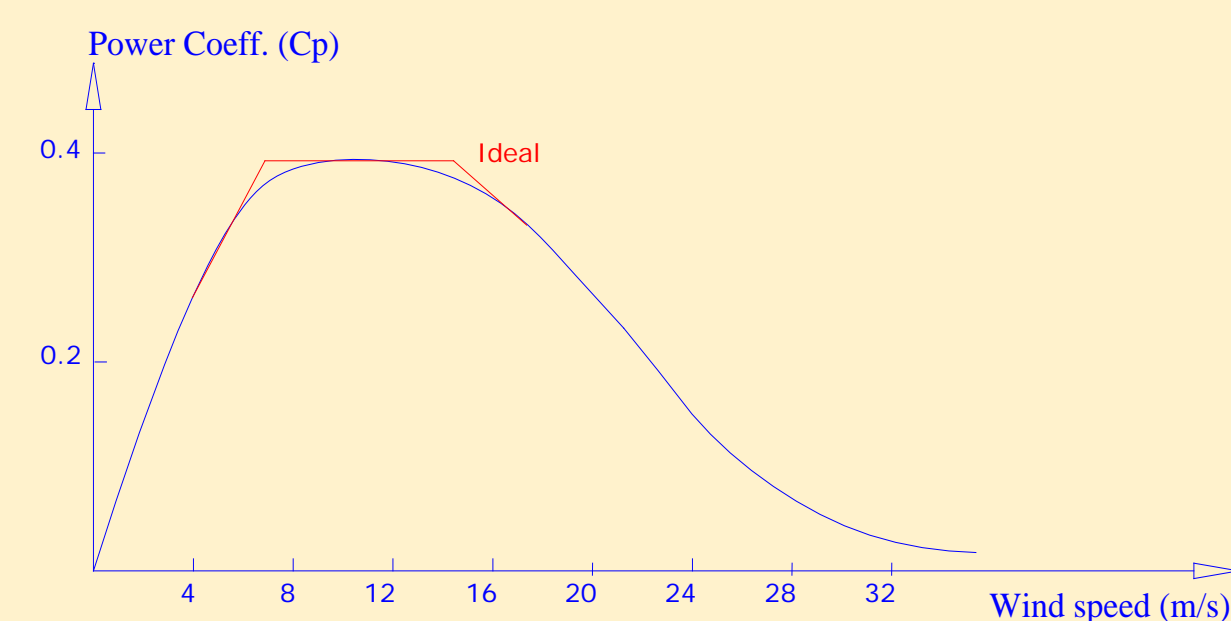
The Technology: Fixed Speed Turbine - Variable Speed Turbine



Power coefficient versus wind-speed curve for a fixed speed turbine

Fixed Speed Turbine

Simpler and less costly
But not efficient, because of wind speed variation



Power coefficient versus wind speed for a variable speed turbine

Variable Speed Turbine

Better performance, by adapting to wind speed,
But more costly, because of the generator and power electronics

New Concept:

Combines the advantages of variable speed turbine and the low cost of fixed speed turbine

Illustrative Calculations for a 3 MW Turbine

Total power (MW)	Input shaft rpm (10 times rotor rpm)	Controlled power (thru arm), kW	Power through main generator, kW	Main generator rpm (sun rpm)	Arm (carrier) rpm
3	190	1000	2000	1267	70.4
2.5	175	707	1793	1255	55
2	160	450	1550	1244	40
1.5	134	225	1275	1233	24
1	130	60	940	1222	9

Total power (MW)	Torque of sun gear shaft (Nm)	Torque on ring gear shaft (Nm)*	Wind speed (m/s)/mph
3	15,077	135,700	15.2/33.5
2.5	13,641	122,776	14.2/31.2
2	11,937	107,429	13.2/29
1.5	9,878	88,907	12/26.5
1	7,346	66,110	10.5/23

(* This value is based on the ring gear radius.