You have likely meant the case mentioned by **Pjdd**. He is right that this can be a source of confusion. What I have shown in my previous attachment investigates the **maximum transferred power with respect to R_{LOAD}**, i.e. when the **source is GIVEN** (V_0 and Z_I, or Z_S if you like). In other words both V_0 and Z_I are CONSTANT and we look for the load impedance meeting the condition of maximum power dissipated in load. In fact, the result also tells us what the maximum power that we can get out of such a (given) source is. Take also notice of the expression (10) in my previous pdf attachment – the max. load power equals:

$$P_{LOAD\_MAX} = \frac{V_0^2}{4R_I} = \frac{V_0^2}{4R_{LOAD}} = \frac{\left(\frac{V_0}{2}\right)^2}{R_{LOAD}}, \tag{1}$$

it is ¼ of the "*maximum power from that source ever*" (= V_0^2/R_I; but all that power is dissipated in the source internal resistance then; the source is shorted), and at the same time it is ½ of the total source power under the matching conditions: ½ is dissipated in R_I, the second one in R_{LOAD}. I have digressed a bit, so let's get back to our original topic... :-)

Now the task is different, say, "*reversed*": $\boldsymbol{R_{LOAD}}$ **is GIVEN** (CONSTANT) and we are looking for optimum of R_I at which the load power will reach its maximum. The expression (function) for P_{LOAD} is formally the same like before (expr. (3) in my previous attachment):

$$P_{LOAD} = R_{LOAD} \cdot I^2 = V_0^2 \cdot \frac{R_{LOAD}}{(R_I + R_{LOAD})^2} = \frac{V_0^2}{R_{LOAD}} \cdot \frac{1}{\left(1 + \frac{R_I}{R_{LOAD}}\right)^2}, \tag{2}$$

but the **independent variable is $\boldsymbol{R_I}$** now. This function reaches its mathematical minimum when R_I approaches +infinity (first derivative approaches zero, second derivative > 0) and it reaches its (improper) maximum (infinity) when R_I approaches $-R_{LOAD}$ (the function is discontinuous at that point). In reality the mentioned maximum is meaningless (R_I never can be zero, neither less than zero, of course). The meaningful maximum comes near (never can be reached) when R_I approaches zero from the right – it is obvious from the function itself. It means that the lower R_I is in comparison with R_{LOAD}, the higher the resulting load power. Let's have a look at the transfer efficiency (which is exactly 50% in case of matching impedances):

$$\eta = \frac{P_{LOAD}}{P_{SOURCE}} = \frac{R_{LOAD} \cdot I^2}{V_0 \cdot I} = \frac{R_{LOAD} \cdot I}{V_0} = \frac{R_{LOAD}}{R_{LOAD} + R_I} = \frac{1}{1 + \frac{R_I}{R_{LOAD}}} \tag{3}$$

Let's call $\frac{V_0^2}{R_{LOAD}}$ an ideal load power P_{LOAD_IDEAL} (as if R_I were 0), then we can write:

$$P_{LOAD} = P_{LOAD\_IDEAL} \cdot \eta^2 \tag{4}$$

The "better" the relation ($R_I \ll R_{LOAD}$) is met, the higher the efficiency (always $\eta < 1$) and at the same time the actual load power gets lower with respect to the maximum load power available from such a source (see the charts in Appendix):

$$\frac{P_{LOAD}}{P_{LOAD\_MAX}} = 4\eta^2 \frac{R_I}{R_{LOAD}} = \frac{4m}{(1+m)^2}, \quad \text{where } m = \frac{R_I}{R_{LOAD}} \tag{5}$$

Does it still seem that there is a contradiction in these two pieces of knowledge (I mean this and that in the previous pdf attachment)? There isn't any at all! If R_I decreases (load power increases), then the condition for max power transfer changes at the same time (new optimal R_{LOAD} equals the new, decreased R_I). Let's have a look at your example, **subbuindia**:

V_S (V_0) = 20V, R_{LOAD} = 3Ω

ad **A**) $R_I = 1\Omega$ => $P_{LOAD\_A} = 75W$; P_{LOAD_A} according to (2)

but if $R_{LOAD} = 1\Omega$ (= matching with R_I; instead of 3Ω),

then **($P_{LOAD\_A\_MAX}$ = 100W) > P_{LOAD_A} !** ; $P_{LOAD\_A\_MAX}$ according to (1)

ad **B**) $R_I = 2\Omega$ => $P_{LOAD\_B} = 48W$

but if $R_{LOAD} = 2\Omega$ (= matching with R_I; instead of 3Ω),

then **($P_{LOAD\_B\_MAX}$ = 50W) > P_{LOAD_B} !**

ad **C**) $R_I = 3\Omega$ => $P_{LOAD\_C} = 33\,\frac{1}{3}$ W ($=P_{LOAD\_C\_MAX}$)

$\boldsymbol{P_{LOAD\_C} = P_{LOAD\_C\_MAX}}$ (because R_{LOAD} is matching with R_I),

if $R_{LOAD} \neq 3\Omega$, then P_{LOAD} will always be lower!

ad **D**) $R_I = 4\Omega$ => $P_{LOAD\_D} = 24\,\frac{24}{49}$ W

but if $R_{LOAD} = 4\Omega$ (= matching with R_I; instead of 3Ω),

then **($P_{LOAD\_D\_MAX}$ = 25W) > P_{LOAD_D} !**

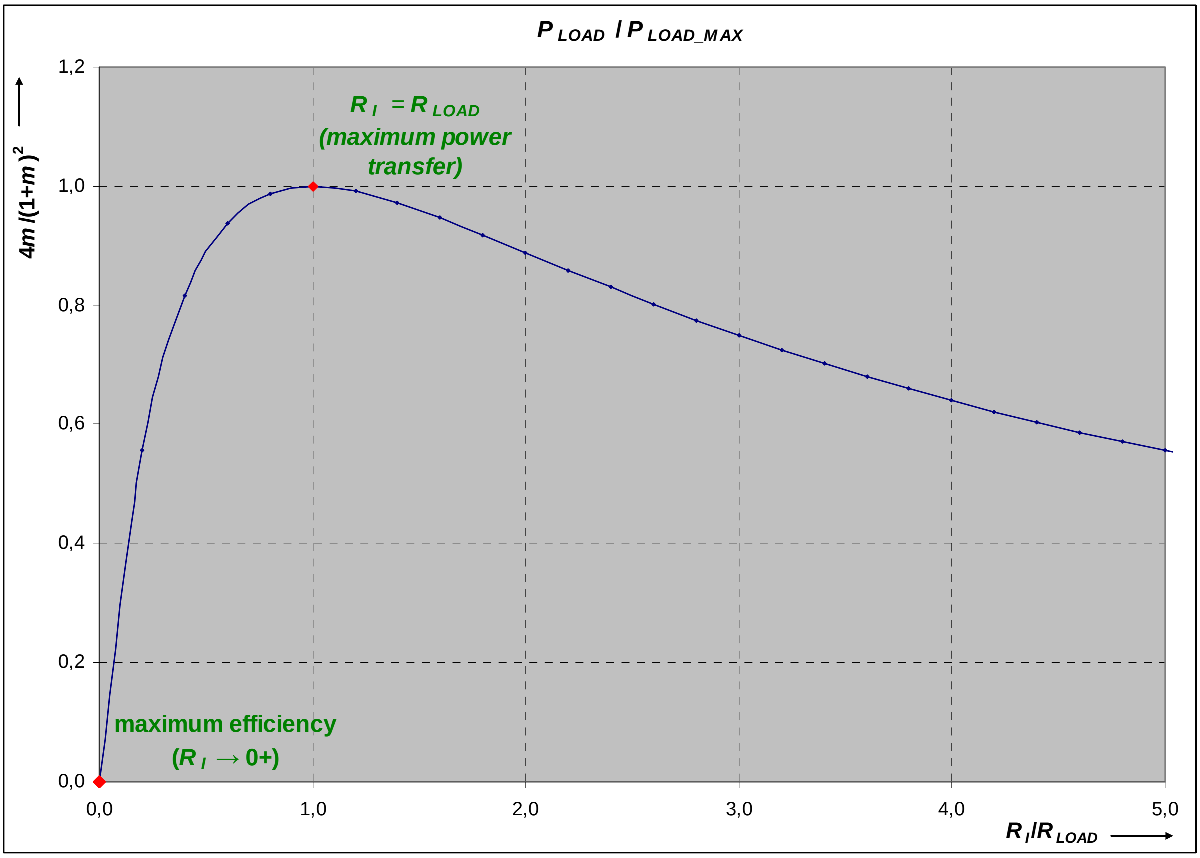
It can be seen that the load power (P_{LOAD_D} to P_{LOAD_A}) really increases with decreasing R_I (@ constant R_{LOAD}) but to each case A) to D) there exists a different optimal R_{LOAD} (= R_I) at which the load power is even higher (max) than that for given (constant) R_{LOAD} = 3Ω, except for the case C, where R_I already equals R_{LOAD}.

I hope it's comprehensible enough.

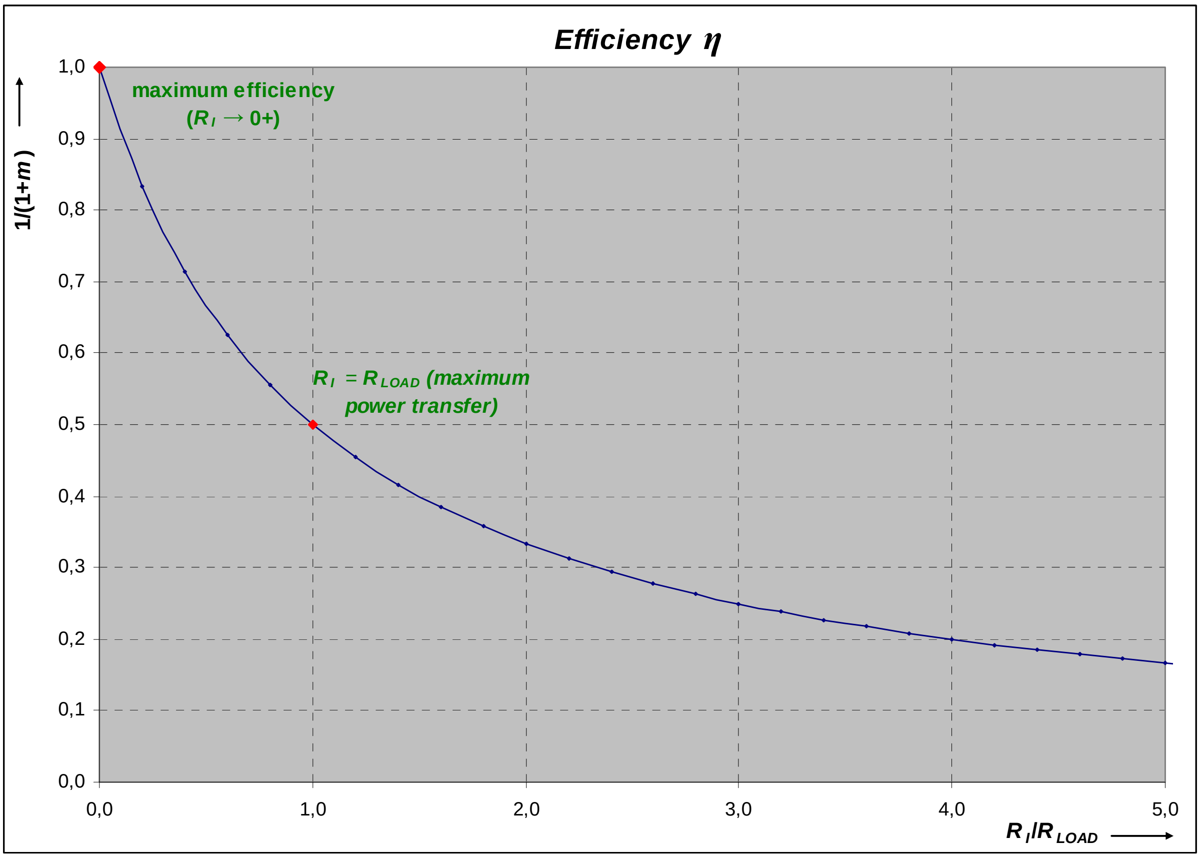
Best Regards,

Eric

Appendix



P LOAD / P LOAD_MAX
4m /(1+m)²
R I = R LOAD
(maximum power
transfer)
maximum efficiency
(R I → 0+)
1,2
1,0
0,8
0,6
0,4
0,2
0,0
0,0
1,0
2,0
3,0
4,0
5,0
R I/R LOAD



Efficiency η
1/(1+m)
maximum efficiency
(R I → 0+)
R I = R LOAD (maximum
power transfer)
1,0
0,9
0,8
0,7
0,6
0,5
0,4
0,3
0,2
0,1
0,0
0,0
1,0
2,0
3,0
4,0
5,0
R I/R LOAD