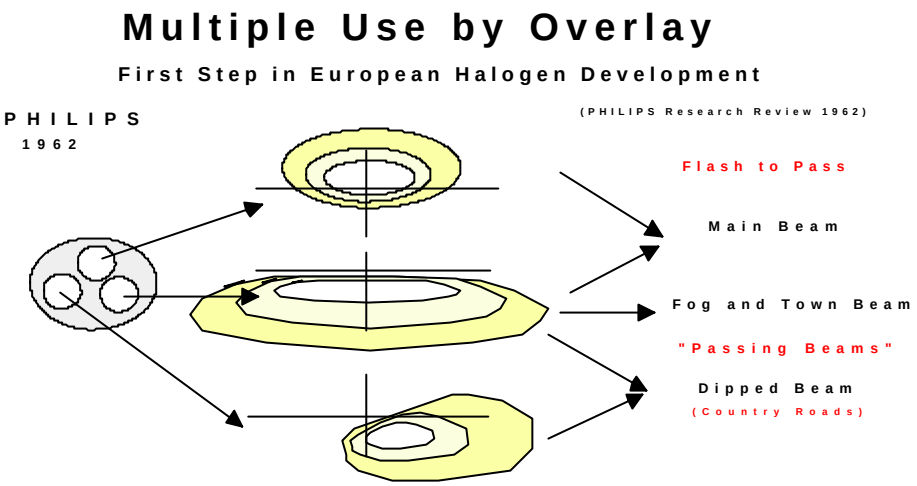
1. The AFS Project

- Project history and desirability of vehicle front lighting improvements

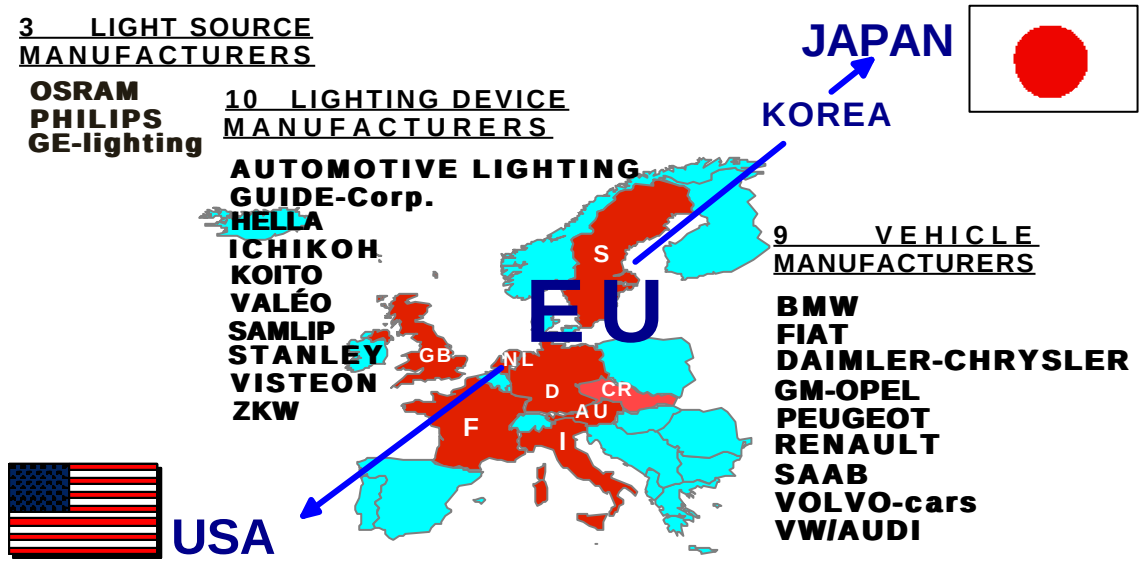
During the development within the Eureka project "VEDILIS" (Gas Discharge Light Sources) it became obvious that a single passing beam pattern can not provide an optimum lighting performance for all common road situations, particularly not in adverse weather conditions; it had to be a compromise. Already back in the 60th (see figure), attempts were made for adaptive beams, but the projects were stopped for missing technologies with respect to accuracies of light sources and reproduceability of mechanical levelling movements. However, headlamp levelling control was introduced in the 70th, be it by manual setting as a first step.



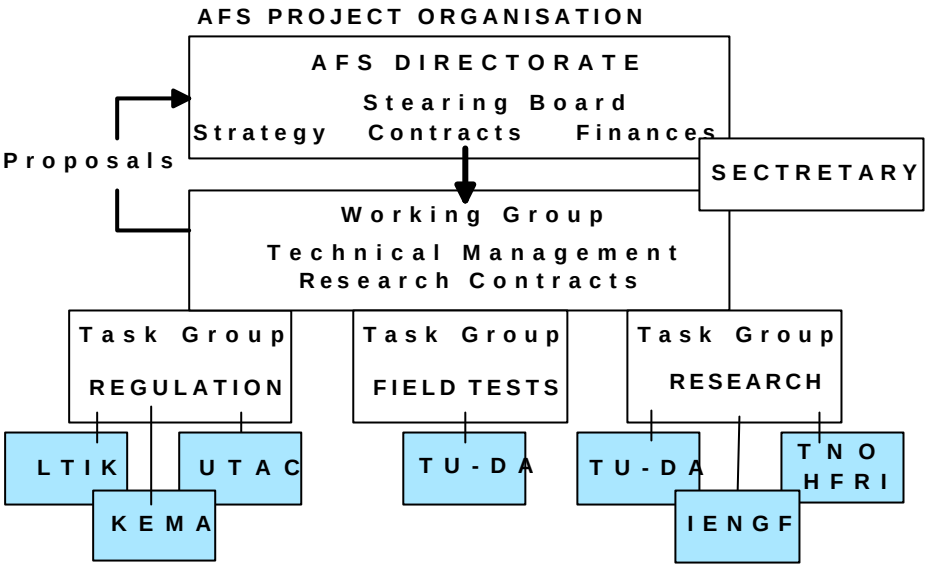
J.J. Balder, Iodine incandescent lamps, Philips Technical Review, Vol 23, No.8/9, 1961/2

In 1992, new technologies were available that would allow front lighting systems to adapt in lighting performance for different road and weather conditions. The partners of the VEDILIS project therefore decided to initiate a new EUREKA project "AFS" with the purpose to advance in the development of *adaptive front lighting systems* and overcome some major weaknesses of conventional passing beams.

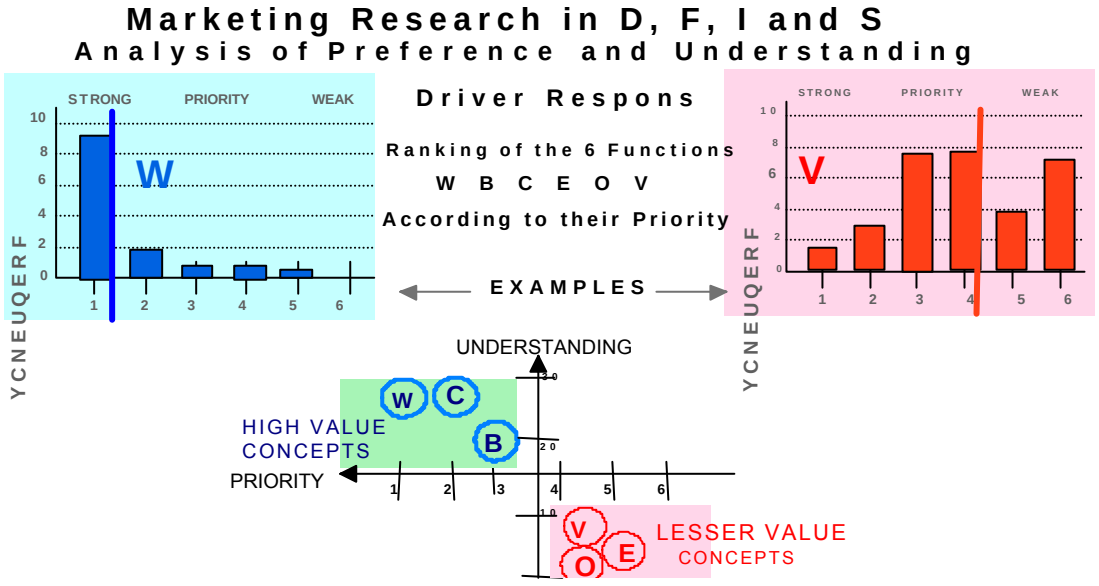
In May 1993 the Eureka project status was granted. A value analysis and feasibility study of shortcomings of conventional front lighting revealed possibilities to improve visibility and comfort for typically adverse conditions. The consortium in the project was build from light source manufacturers, headlamp manufacturers and car makers from over the world.



The project structure was set up and work could begin.



First a marketing study was made to investigate the drivers' complaints and their wishes. Enquired for the wishfulness and priority of different options, the drivers in all age groups, female and male, wearing and not wearing glasses understood easily their advantage with an improvement for wet road lighting (W), improved passing beams (C) and bend lighting (B). For the latter a cost increase such as being paid for front fog lamps or even ABS was judged acceptable. The special visual conditions on town roads with public lighting (V), on motorways (E) and for overhead signs (O) found less understanding and were, accordingly, judged of lesser value.

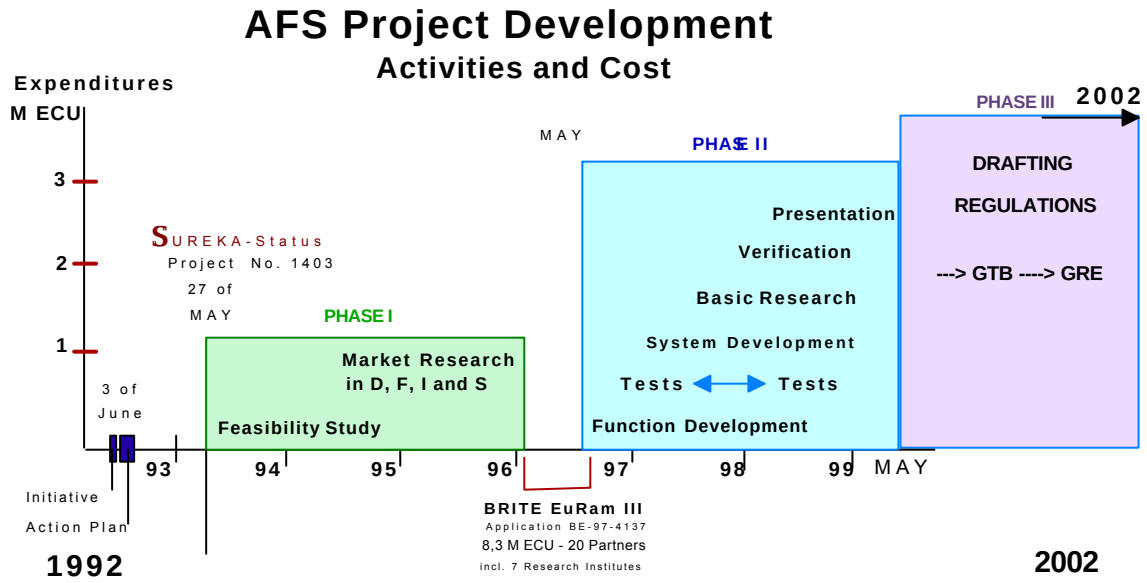


The results of the marketing study gave evidence to pursue the project and to allocate financial assets for the project. After more detail work in function development, the necessary research was specified and first prototype systems were made for field tests and to develop type approval procedures. The specified research included dynamic glare and the influence of shape, area and partition of the headlamps on glare as well as on vehicle appearance for other road users. Initially it was also planned to include road reflection research on dry and wet roads in different countries as well as statistical research on pedestrian reflection and on the statistical positions relative to the headlamps of targets such as road signs, pedestrians, rear view mirrors in the visual field.

The enormous cost involvement of such research and development (8 M €) was reason to apply for sponsorship within the framework of BRITE EuRam III - with 20 partners and 7 research institutes being involved. However, the application was denied and preference given to non automotive traffic projects. This was a loss of a year and urged to cut the research activities to a bearable budget. The research was dedicated to glare and appearance issues only and to the assistance of test houses in developing type approval procedures and the set up and evaluation of field tests.

The AFS systems were developed and designed to adapt the front lighting performance to particular environmental and traffic conditions. Such particularly differing conditions prevail on motorways, country and town roads and they prevail also in adverse weather such as fog, precipitation, wet roads and when driving on curved roads or cornering. For the special conditions in fog and cornering, special lamps are specified and regulated with adequate performances. They can be reciprocally incorporated in AFS systems. Their lighting performances, however, form no part of the AFS system requirements but of separate ECE Regulations.

The project targets (phase II) were finalised by May 1999. The results were presented and real scale test drives done at the Balocco test grounds by members of the participating industries and invited guests from national governments, GTB and GRE.



During phase III of the project, the experiences and investigations were transformed into draft regulations that were approved by GTB at their 92nd session at Kyoto in 2001 and transmitted to GRE as working document in January 2002.

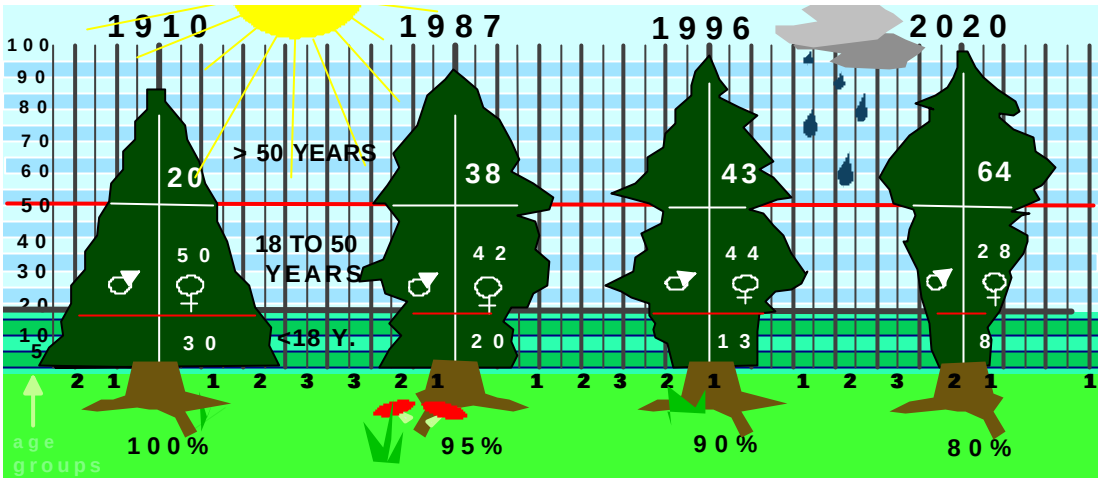
During the AFS phase II a special overhead sign lighting had also been developed and tested. During discussions in GTB it was omitted from the set of requirements since modern retroreflective traffic signs are adequately visible with spread light intensities of about 100 cd. Therefore no special lights were felt necessary.

This report summarises the research aspects that let to the requirements as specified in the draft documents for

1) a new AFS Regulation (TRANS/WP.29/GRE/2002/18 and 19) and
2) amendments for mounting and operating requirements of AFS systems in ECE Regulation No. 48 (TRANS/WP.29/GRE/2002/20).

glare sensitive and also have less visual acuity. The increasing number of complaints on glare and requests to the parliament to take action against glare, underline this. Thus glare and visibility under vehicle front lighting conditions form a key issue that needs a profound understanding in order to develop effective lighting improvements.

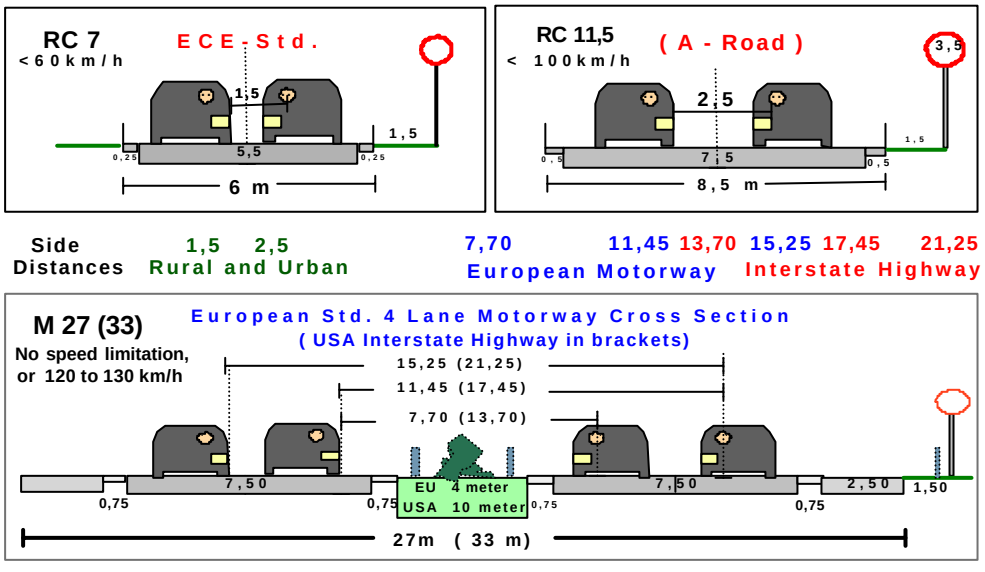
GERMANY'S LIFE TREE - EUROPE DEVELOPS SIMILARLY -



The AFS project was particularly set-up to address the needs of older drivers for improved vehicle front lighting that would compensate for their loss of acuity and take care of increased glare sensitivity due to eye cataract. In the following, therefore, the relationship of visibility and glare are addressed in more detail.

2.2 Influence of lateral distance of glare sources on glare

Country roads are dual carriageways where opposing traffic flows at rather short lateral distance that makes glare from headlamps and reflexes on wet roads a special item of concern. On motorways the lateral distance is much greater and reflex glare is shielded by the crash barriers. This reduces the glare effects for opposers considerably.



Since the lateral viewing angle under which the headlamps of opposing vehicles are seen has great influence on glare, the glare on motorways is much less than on dual carriage ways. For roads of 6 meter width (RC7) the ECE glare limitation in EB50 and for zone III was introduced in the 60th. The need of limiting glare on the rather small traffic roads had also been reason to develop shielded filament lamps "R2" in 1924 and similar halogen lamps "H4" in 1971. In the USA, at those times, most of the traffic flow concentrated already on highways